city, noted for its strong Faculty of Applied Science, and not less is the city celebrated for its fine Technical High School, wherein industries and industrial processes are made to serve the highest educational purposes for its three thousand day students. At night the school is attended by six thousand apprentices in the various trades the equipment covers. In short, Canada, in proportion to its population, is well provided with institutions of university rank, and in the near future she will have educational facilities second to no other country in the world. Prof. Barker is also not less loud in his praise of the educational activities and institutions of the States, especially of the Massachusetts Institute of Technology, in many respects one of the finest institutions in the world, wherein nothing is spared to make the courses good and experimental and research work so efficient that it cannot be left out of the industrial sequence, with the result that the institution is simply flooded with students who are inspired with the possibilities of discovery. He speaks highly of the provision for textile training and education, and especially of the fine school at Lowell (Fig. 2), which represents for the textile industries what the Institute of Technology of Boston represents for mining and engineering. The report is full of apt observation upon educational and industrial aims and methods.

Sunshine in the United States.[1]

THE United States *Monthly Weather Review* for January, 1920, contains a discussion on "Sunshine in the United States" by Mr. J. B. Kincer, Meteorologist attached to the Weather Bureau, Washington, from observations mostly for the twenty years from 1895 to 1914.

Data are given showing the actual amount of sunshine in hours and tenths and the percentage of the possible amount, both methods having their special advantages. Charts and diagrams show the mean solar time of sunrise and sunset, and the average length of day, sunrise to sunset. The seasonal and annual distributions of sunshine are given in percentages of the possible amount, and a table shows for each month and for the year the percentage of possible amount of sunshine for all stations where records are made.

Some dissatisfaction is expressed at the records of the automatic instruments available, as they in no way indicate the different degrees of sunshine intensity—an anomaly shared by all other countries. In describing three forms of sunshine recorders in use, the Campbell-Stokes, the Jordan, and the electrical thermometric recorder, which is said now to be in general use by the Weather Bureau, the *Review* states: "The Campbell-Stokes burning recorder, consisting of a lens or burning-glass which scorches, during bright sunshine, a trace on a strip of cardboard placed at the proper focal distance and adjusted by clockwork to revolve with the sun"; this description seems open to objection, as the card is stationary, and the sun revolving impinges its image on the card bearing the time-scale.

Distribution of sunshine with geographical position is well treated. For the year as a whole the least amount of sunshine occurs along the North Pacific coast, where it is only 40 per cent. of the daylight hours. The maximum amount in the United States occurs in the south-west; in the Lower Colorado River valley the duration of sunshine is 90 per cent. of the total number of hours from sunrise to sunset. July is the month of maximum amount in nearly one-half of the country, including all the northern districts.

Data are given showing the average annual percentage of days clear, partly cloudy, and cloudy. Dealing with diurnal variations in sunshine, it is stated that the amount is least during the early morning hours, with a secondary minimum in the late afternoon. The greatest amount occurs near midday.

Prof. R. de C. Ward, of the Harvard University, contributed an article to the U.S. *Monthly Weather Review* for November, 1919, bearing the title "Bibliographic Note on Sunshine in the United States." Foreseeing the issue of a series of new sunshine charts for the United States, a brief account is given of previous sunshine charts issued.

Reference is made to work done by van Bebber in 1896 and by Gläser in 1912, and it is mentioned that "the available material was confessedly very inadequate." In charts prepared by Prof. A. J. Henry in 1898 the percentages of sunshine were obtained by subtracting the mean annual cloudiness from 100, and a map of normal annual sunshine compiled from observations at the Weather Bureau stations from 1871 to 1908 inclusive seems to have been obtained in the same way. The system seems open to serious objection, and is far less satisfactory than using the records of the automatic sunshine instrument.

C. H.

1 From U.S. Monthly Weather Review, January, 1920, vol. xlviii., pp. 12–17 and charts i–iv; November, 1919, vol. xlvii., pp. 794–95.

The Peat Resources of Ireland.

THE Fuel Research Board has issued as a Special Report (No. 2) a lecture on the above subject delivered by Prof. P. F. Purcell before the Royal Dublin Society last year. The importance of using the lower grade fuels has been greatly enhanced by the enormous rise in the price of our higher grade staple fuel, coal; and Sir George Beilby, in his introductory remarks to the Report, ascribes the revival of interest in peat as a fuel not only to the general scarcity of fuel, but also to the great and apparently permanent increase in the cost of coal.

The peat resources of Ireland are of paramount interest in that country, where the bogs cover one-seventh of the area, and Prof. Purcell estimates that the peat reserves in these bogs are more than ten times those of the *proved* coal reserves of that country. The estimated "anhydrous peat" is 3,700,000,000 tons, equivalent to 5,000,000,000 tons of average air-dried peat. Sixty-two per cent. of the farmsteads are entirely dependent upon peat fuel, and it is estimated that the annual consumption is between 6,000,000 and 8,000,000 tons.

The problem of the utilisation of peat is, as is well known, one of the economical removal of excess water, the average content of which is about 90 per cent. The effect of water is, perhaps, best emphasised when it is stated that "with 89 per cent. present, the 11 per cent. of dry peat will just be sufficient to evaporate the 89 per cent. of water." In the natural process of air-drying peat, difficulties of a practical and economic nature are met with; thus the drying season is only from five to six months. In winter, water freezing in the blocks causes their breaking down, and the whole year's supply has to be won in the limited dry season of the year. "It thus happens that a great number of hands are required for a portion of the year, and few for the remainder," and these considerations furnish a very strong incentive to the invention of economical methods of artificial drying.

In Prof. Purcell's opinion, in spite of the many methods which have been tried for the removal of excess water and improvements in mechanical and industrial operations, the air-drying of peat by natural means is the only recognised commercially successful method in use to-day. Reduction of the water-content from 90 to 70 per cent. by pressure alone on the raw peat is considered by the author to be the maximum, and he does not consider that drying by artificial heat becomes a practical proposition until this 70 per cent. content is reached, "and even then it is a very doubtful financial proposition."

For use under boilers the water should be reduced to 30–35 per cent.; for gas producers it is stated that several leading manufacturers claim successful working with 60–70 per cent., but Prof. Purcell considers that the possibility of using peat with as high a moisture-content as 60 per cent. is doubtful, and quotes the Canadian authority, Haakel, in support. "If it were permissible [to use such wet peat] it would render the industry less dependent on the weather, extend the peat-winning season, and simplify the whole problem."

Prof. Purcell considers that a clear case for the extended development of the peat deposits exists from an agricultural point of view, for the reclamation of land by removal of the bog and drainage must add to the food-producing capacities of a country. But labour costs are no small difficulty, for, as Sir George Beilby points out in his introduction, the development of a bog with 20 ft. of good peat is in some respects analogous to the proposal to develop a coalfield of similar area containing a single seam of only 15 in. thickness. It is true that the peat bog entails only surface working, but the whole depth has to be worked and 10 tons of raw material excavated and handled for 1 ton of dry peat. J. S. S. B.

Past and Present Sewage Systems.

TWO Chadwick public lectures recently delivered at Colchester by Mr. A. J. Martin dealt with the nature and treatment of sewage. Since the very earliest days there have been codes of sanitary laws, but all kinds of readjustments had to be made as soon as men began to congregate in large cities. These crowded conditions seem to be met most satisfactorily by the water-carriage system, by which the clean water supplied to a town returns ultimately to the sewers charged with all manner of pollution. When sewers were first laid the sewage was discharged straight into the rivers. The results were, of course, disastrous, and successive Royal Commissions were set up to find a remedy. The whole problem of sewage purification was obscure, and very little progress was made for a whole generation. Great hopes were centred in sewage farms as a method of disposing of the sewage, and the various local authorities hoped at the same time to reap a profit from the cheap manuring of the land. Sewage farms, however, rarely pay in a humid climate such as ours, for the land cannot deal with the huge amounts of water brought down from the sewers. Many other methods were tried, but in all of them the investigators failed to recognise the existence of the tiny scavengers which Nature provides to deal with our waste products.

The modern method of sewage purification was evolved after Pasteur's discovery of the bacteria which induce fermentation, and after the work of Warington and of Winogradsky on the nitrifying bacteria in the soil. The purification is carried out in two stages. The first stage is treatment in the "septic tank," through which the sewage passes extremely slowly. The solids sink to the bottom, where they are attacked by anaerobic organisms flourishing there, and ultimately either liquefied or turned into gas. The second stage of the process consists in the oxidation of the dissolved polluting matter. This matter has to be brought into contact with a large supply of atmospheric oxygen in the presence of certain small organisms which are able to oxidise the organic materials. This contact may be effected in the soil, in a specially constructed filter, or in a large volume of water. When soil forms the contact bed, purification is brought about either by "filtration," when the sewage percolates downwards through the soil, or by "broad irrigation," when the sewage merely passes over the soil surface. The method chosen depends on the openness or otherwise of the soil and subsoil. When suitable land is not available, artificial filters are made of broken clinker, destructor slag, etc. These materials provide a home for the nitrifying bacteria. The sewage is allowed to trickle slowly through, and with a good filter a purification of 80–90 per cent. is effected. When purification is allowed to take place in water, the volume of the water into which the sewage flows needs to be about five hundred times greater than the volume of the sewage.

Engineers had just settled down to the septic tank and trickling filter as the standard method for sewage purification when the "activated sludge" process was introduced by Drs. Fowler and Ardern. In this process the whole purification is completed in a tank provided with particles of activated sludge to serve as homes for the nitrifying bacteria. The sludge (*i.e.* solid deposit from the sewage) is activated by being submitted to currents of air for several days. It is then placed in the tank with the sewage, and air forced through for some hours until purification is effected. The drawback of this method is the great bulk of the resultant sludge, and the problem now is to find an economical way of disposing of the sludge so that the plant-food which is contained in sewage shall not be wasted.

Experimental Cottage Building.

IN view of the present housing difficulties, considerable interest has been centred in the results of the experiments in cottage building which have been carried out on the Ministry of Agriculture's Farm Settlement at Amesbury. These results are published in the Weekly Services for May 15 and 22, where we also learn that on Wednesdays for two or three months competent guides have been available to show visitors the experiments actually in progress. The present scheme includes thirty-two cottages, sixteen of which are for comparison purposes, and are built of brick on normal lines of construction, while the other sixteen are more directly experimental. Each cottage consists of parlour, living-room, scullery, bath-wash-house, larder, fuel store, etc., on the ground floor, with three bedrooms on the upper floor. Experiments in building in chalk include a cottage with cavity walls built of blocks made of chalk and cement, one with walls of chalk and cement rammed between shuttering, one with walls of chalk alone (chalk pisé), and one with walls of chalk and straw (chalk cob) built without shuttering. There is also one cottage of monolithic reinforced concrete and two concrete-block cottages with hollow walls. These two cottages are being erected under contract by two proprietary firms; for all the other experimental cottages direct labour is employed. The experiment also includes a pair of timber-framed cottages faced with