extremely important subject of popular education in science. Such a centre would be continually receiving and digesting reports of scientific progress throughout the world, and producing data suitable for elaboration by the journalist, the radio speaker, the film producer and the organizer of exhibitions. It would be a projection on a world scale of agencies such as the successful American Science News Service. It might ultimately be very suitably associated with the International Science Co-operation Service.

Allied also is the proposal of the British Association's Committee on Post-War University Education that some kind of world council of universities should be set up, sponsored perhaps by the Association of Professors and Lecturers of Allied Countries in Great Britain, and the Conference of Allied Ministers of Education⁸.

In quite another sphere, the changing face of the modern world has necessitated proposals for the reform of the British Foreign Service⁹. Attachés and counsellors trained in economics are expected to play a greater part in embassies after the War than hitherto. The question has often been raised whether men with a scientific training should not also be included on embassy staffs. It was debated in Parliament in July 1943¹⁰ and the proposal strongly recommended by Lord Samuel. In the course of the discussion great emphasis was laid on the Government's post-war plan for science, including arrangements for consultation and co-operation with the Dominions and the other United Nations.

Lastly, with regard specifically to West and East, Sir Henry Dale, in his message to the President of the Indian Science Congress Association¹¹, said: "There is a general desire among men of science in Britain for more intimate collaboration with those in India who are working for the advancement of knowledge in the same fields of research". Similarly, Minister Chu Chia-Hua, president of Academia Sinica, thanking the foreign secretary of the Royal Society, Sir Henry Tizard, for the gift of a facsimile of the Charter Book, wrote: "We believe it is our task to help to evolve and carry into practice some guiding principles of rational education for the world as a whole. Our first step in that direction must be to encourage and start widespread intellectual cross-fertilization. The Sino-British Science Co-operation Office has already done much in that direction in this country, and we hope that it may form part one day, in the not too far distant future, of an Office of World Science Co-operation. Compared with the Royal Society, the Academia Sinica is young, and not only in age; but as an organization of intellectual pursuit, we pledge to contribute our 'widow's mite' to the general wealth and strength that will some day bring about the supremacy of the intellect and reason". This interest on the part of the Chinese in the establishment of international organization appears again in the summary of proposals issued by the Commission for the Study of Post-war World Peace, of the Chinese People's Foreign Relations Association¹². The summary stresses the importance of "international cultural and social co-operation". It is suggested that a cultural co-operation committee be established to undertake the work of changing the mentality of the people of the aggressor nations, and of strengthening cultural contacts. As regards social co-operation, the International Labour Office should extend its activities, including the improvement of social welfare and public health administration.

Proposals

For the purpose of discussion, the following concrete proposals emerge from the arguments of this memorandum. It is proposed:

(1) That an International Science Co-operation Service should be set up by the United Nations at the conclusion of the War under the aegis of whatever supreme international organization is devised, parallel with the International Labour Office, the International (Permanent) Commission on Food and Agriculture, and other similar bodies.

(2) That the functions of the International Science Co-operation Service should be (a) the promotion of scientific co-operation in all its aspects, (b) the collection and dissemination of scientific information, (c) the furtherance of schemes of collaboration in research, (d) the facilitation of the movement of scientific men across national boundaries, (e) the provision of advice on scientific matters to government and diplomatic personnel of individual States when desired, (f) the provision of scientific assistance to all other international organizations.

(3) That the International Science Co-operation Service be supported by funds, which relatively to those required for other purposes would, of course, be small, subscribed by the Governments of the United Nations on some agreed income-tax basis.

(4) That the International Science Co-operation Service should have permanent representatives in all countries or regions, with diplomatic or 'League-official' status, and guaranteed Governmental facilities for communication and transportation.

(5) That the International Science Co-operation Service should have permanent headquarters in some centre to be later decided on; but that apart from a central and peripheral permanent secretariat, a considerable proportion of the total number of its officials should be working scientists of every nationality serving on a temporary leave-of-absence basis, that is, seconded from governmental, academic and possibly industrial, laboratories; in order to ensure that the organization shall always preserve the true atmosphere and understanding of research.

¹ *Nature*, 153, 63 (1944).

² *Nature*, 152, 365 (1943).

³ *Indian Information* (May 1, 1944).

⁴ *Nature*, 152, 29 (1943).

⁵ *Nature*, 152, 67 (1943).

⁶ *Nature*, 152, 309 (1943).

⁷ *Advancement of Science* (British Association), 2, No. 8, 290 (1943).

⁸ *The Times* (April 3, 1944).

⁹ *Indian Statesman* (February 1, 1943). *Nature*, 153, 91 (1944).

¹⁰ *Nature*, 152, 129 (1943).

¹¹ *Nature*, 153, 63 (1943).

¹² *Chungking Daily News* (July 5, 1944).

WATER SUPPLY AND HEALTH

IN his Chadwick Lecture, delivered on October 3, on the "Treatment of Water in Peace and War", Lord Amulree gave a history of water supply, discussed its effect on the health of the community and described the various processes of purification which are applied to a water supply in order to render it epidemiologically safe and acceptable to the consumer, and the special precautions that have been taken during the War to protect it against war hazards.

Lord Amulree began by pointing out that water is one of the necessities of life, and stressed the

importance of ensuring its freedom from harmful impurities.

So long ago as 1832, during a cholera epidemic in Glasgow, the idea arose that the infection might have been carried by water. In this case Gorbals Parish furnished comparatively few cases of cholera, whereas in the rest of the city the epidemic was very severe. As Gorbals was provided with a soft water and the rest of Glasgow with a very hard one, the suggestion was made that the comparative freedom from cases in the Gorbals area was due to the soft water. Although this was by no means a full explanation, it was an important step forward in the epidemiology of cholera.

Next came the remarkable work of Dr. John Snow in connexion with epidemics of cholera in London in 1853 and 1854. At that time London was supplied by seven companies with water taken from the Thames and Lee and in many cases not filtered. One area was supplied by two companies, the Southwark and Vauxhall Water Company and the Lambeth Water Company, and by painstaking investigation Snow showed that whereas in the houses supplied by the Southwark and Vauxhall Water Company there were 286 deaths from cholera between July 8 and August 5, in those supplied by the Lambeth Water Company there were only 14 deaths. The former company derived its water from the Thames at Battersea, where contamination from London sewage was very heavy, whereas the Lambeth Company had, the previous year, moved its intake up to Ditton, which was free from such contamination. This convinced Snow that there was some connexion between the relative purity of the Lambeth Water Company's water and the low mortality from cholera of its consumers; but it was not until the following year, when another outbreak of cholera occurred in the neighbourhood of Broad Street, Golden Square, that he was able to provide definite proof that cholera was a water-borne disease. He found that nearly all the cases had drunk water from a pump in Broad Street, and at the end of the first week he persuaded the authorities to remove the handle of the pump so that it could not be used. As this was followed by a remarkable decrease in the number of cases of cholera, his proof was complete.

The observations of Snow have been amply confirmed since the discovery that bacteria were the causes of many diseases including cholera; but the interest lies in the fact that he reached the right conclusion by observation and deduction without any laboratory aid.

Typhoid fever is another of the great water-borne diseases. Prior to 1871, it was not differentiated in the Registrar General's returns from other diseases such as typhus and fevers of unknown origin, so that a true comparison cannot be made with what occurred in the first part of the nineteenth century; but these returns show a steady decline in the death-rate from typhoid fever from the five-year period 1871-75, when it was 374 per million living, to 4 in the last recorded period in 1936-40. "This," said Lord Amulree, "is a very remarkable and gratifying fall and must to a very large extent be attributed to a consciousness of the importance of water supplies to the public health of the country."

From what has been said, it is obvious that the most satisfactory kind of water supply is one that does not require any treatment and is drawn from an unpolluted source. Unfortunately, in a small and overcrowded island like Great Britain, it is difficult

to find sufficient uncontaminated sources to supply the whole country, and many sources which in the past may have been quite wholesome have, by changing conditions, become liable to pollution.

Lord Amulree gave a warning that too much reliance should not be placed on bacteriological examination of the water, but that results obtained should be checked and used as a guide in investigating the possible sources of pollution. A word of warning was also given about the meaning of an unsatisfactory bacteriological analysis. Such a report does not necessarily mean that the whole of the consumers are immediately to be plunged into a large and serious epidemic. The presence of *Bact. coli* in the water means that the supply is liable to pollution, and that it is therefore possible that dangerous pathogenic organisms may at any moment gain access to the supply. Immediate steps should be taken to discover and remove or exclude the source of pollution, and at the same time special forms of treatment such as chlorination should be applied.

Unfortunately, a large number of water supplies in Great Britain come from rivers or other surface supplies. Rivers and streams are quite properly used in many places for the discharge of sewage effluents, and it must be remembered that no sewage treatment is aimed at making the effluent sterile, or even approaching a sterile condition, and for this reason treatment becomes necessary before the water is safe to be given to the consumers.

Proper treatment for water is complex and difficult, and requires supervision by expert staff who have laboratory facilities at their disposal. There are three stages of purification: storage, filtration and sterilization. In the early part of the twentieth century, Sir Alexander Houston, director of water examination at the Metropolitan Water Board, showed that polluted water is capable, to a very large degree, of purifying itself, if it be stored for long enough. Filtration may be done by slow or rapid sand filters. Sand filters act in two ways, by physical straining and by the biological destruction of the bacteria in the water by the saprophytic organisms in the 'skin' of the filter bed. Slow sand filters are worked at a rate of one to three million gallons per acre per day. Rapid filters work at much higher rates, and it is usual to add some chemical coagulant such as alumina to the water before filtration. Sterilization consists of adding chlorine or some other bactericide such as ozone to the water. Chlorine was first used as a sterilizer for a piped supply at Maidstone in 1897, following a serious outbreak of typhoid fever. It was extensively used by the armies in the field during the War of 1914-18 and has been widely employed since then, both in Great Britain and America, for treating water.

Like all measures which in modern times are hailed as panaceas, the treatment of water by chlorination has very definite limits. There is, for example, the danger of imparting an unpleasant taste to the water by an excess of chlorine, and there is also the fact that chlorine is only fully effective when applied to water which is free from any appreciable quantity of suspended organic matter. The adjustment of the dose to the varying condition of the water requires skilled supervision and laboratory control; it is a significant fact that of the water-borne outbreaks of typhoid fever which have occurred in recent years, most have taken place in areas where the water supply was supposed to have been treated with

chlorine. During the War, instructions were given to all water undertakings in Great Britain to chlorinate the water under their care. Lord Amulree said that this was done as a protection against sabotage by enemy agents, and has led to the erroneous idea that so long as a certain amount of chlorine is put into the water, the water is automatically safe for consumption and that very little or no care need be paid to other forms of treatment or to care of the source. This easy and fatal attitude of mind is one which it is going to be very difficult to eradicate. The fact that chlorination should be under skilled and intelligent supervision, with laboratory control, makes the process difficult to provide for in small rural supplies; hence it becomes more and more important for them to acquire a source free from pollution and to take steps to keep it so.

Some waters are corrosive to lead, and require treatment to protect the consumers from lead poisoning. This is due to the acidity of the water, and is usually corrected by the addition of lime.

Much discussion has taken place during the last hundred years on the relative merits of hard and soft water, and it has been contended that the use of a soft water not only results in a saving of soap but also that food cooked in soft water is more wholesome and more palatable, and that there is a saving in the wear and tear of garments washed in soft water. There are two processes used for water softening. One is based on the process evolved by Prof. Clark, and consists of adding lime to the water and precipitating the calcium bicarbonate as calcium carbonate. The other is called the base-exchange or zeolite method. When hard water is passed through a bed of natural zeolite or artificial base-exchange material, the sodium ions of the zeolite pass into the water and are replaced by the calcium and magnesium ions of the water which combine with the zeolite. By this means a completely softened water is obtained, and when the water issuing from the apparatus is no longer soft the material is regenerated by passing sodium chloride through it and thus reversing the exchange. In particular cases treatment has to be given for the removal of iron, which imparts an unpleasant taste to the water and stains clothing in the laundry. The treatment consists of aeration and sedimentation or filtration. Algae which interfere with filtration and sometimes give rise to obnoxious tastes in the water may be controlled by treatment with copper sulphate or by coagulation.

Lord Amulree pointed out that the War has brought many new difficulties to water undertakings. In the first place, there was the establishment of camps and training grounds for troops, which led to the possibility of contamination of gathering grounds as well as the necessity for providing largely increased supplies of water. A further danger was the possibility of sabotage or the dropping of chemical or bacterial poisons into reservoirs from enemy aircraft. So far as is known, no attempt to poison water supplies has been made by the enemy.

The bombing of towns brought another danger, when water mains were broken in the same street as sewers. Owing to the great care that has been taken to isolate all sections of damaged mains and to sterilize them with chlorine after they have been repaired and before being put back to service, this danger has been successfully overcome.

DENISON B. BYLES.

PROSPECTS OF CIVIL AVIATION

ON November 4 the Royal Aeronautical Society held at the Institution of Mechanical Engineers a discussion on civil aviation, and I agreed to preside. The time was appropriate in that a British Empire technical conference on the subject had just been held at Ottawa and one was going on on international aviation at Chicago. True, there is this difference in that, whereas agreement was required at the conferences, disagreement was required at the Royal Aeronautical Society's meeting in order to get real discussion.

The conduct of a meeting of this kind is always difficult: technicians are retiring, shy people as a rule, with the result that if you wait for someone to get up, it looks as if the meeting is slow, while if you call on people it appears to be pre-arranged and not spontaneous.

The canvas is very large that contains the picture of civil aviation, and it was certainly not our province to discuss any portion of it that brought in political prejudices or differences. How training or the economics of civil air transport comes within the ambit of a purely scientific society is not very clear, except on the basis that there is no one else to deal with it. I do not know whether a Saturday is a good day for such a gathering, starting at 10.30 a.m. and continuing until 6 p.m., but such was the demand to attend that tickets for admission were hard to come by and the place was full.

Brigadier-General Critchley, the director-general of British Overseas Airways Corporation, opened the discussion, speaking on training for civil purposes. He showed that much thought has been given to the subject. A pilot's career starts at twenty, for example; he must go anywhere until he is thirty-five, after which he can choose his route by virtue of his domestic ties until he is forty-five, when he comes off flying; but meanwhile he is to have training in administrative work, to see if he would be suitable for further employment in that line. It was interesting to note that one aircraft should average 3,000 hours a year and requires three crews to fly it. Accidents have been shown throughout the world to be at least 85 per cent pilot's errors.

Training for the R.A.F. and civil flying were said to be very different, a point disputed by Air Marshal Longmore as to engineers aboard. Altogether, chosen instrument or not, the personnel training of British Overseas Airways looked good, and General Critchley certainly impressed the meeting.

Major Thornton, a shipping director of Holts, an amateur flyer, a member of the Air Registration Board and a most treasured member of my Committee on Civil Aviation, dealt with the economics of flying, and startled everyone by saying he was surprised at being asked to speak on such a theme as the two subjects had never met! Coming from one who has dealt all his life with the running of tramp ships, his was a most enjoyable and instructive talk. He discussed frequency versus big machines, and showed a preference for frequency; but no one pointed out that the tiresome route London-New York non-stop compels at present a big machine on technical grounds. Major Thornton poured scorn, very rightly, on the aeroplane as a rival to ordinary freight carriers, but said it would create a new type of freight which is only of value if carried from place to place quickly.

Dr. Roxbee Cox pleaded for non-commercial routes