X RAY AND RADIUM PROTECTION COMMITTEE.

A PRELIMINARY REPORT.

THE X Ray and Radium Protection Committee, representing the various radiological and other scientific bodies with their headquarters in the metropolis, after deliberating for some weeks, has issued a preliminary and admittedly tentative report. The document states present knowledge in regard to equipment, ventilation, and working conditions of X ray and radium departments, and undoubtedly there is a constant demand for guidance, both from individuals and institutions, upon such points.

The preliminary part of its work, the Committee states, will lead up to more extensive objects, entailing research, and offers of personal or other assistance are invited by the Committee and should be sent to the hon. secretaries, from whom the preliminary document may be had on application.

PRELIMINARY REPORT.

Introduction.

The danger of over-exposure to X rays and radium can be avoided by the provision of efficient protection and suitable working conditions. The known effects on the operator to be guarded against are: (1) Visible injuries to the superficial tissues which may result in permanent damage. (2) Derangements of internal organs and changes in the blood. These are especially important, as their early manifestation is often unrecognised.

General Recommendations.

It is the duty of those in charge of X ray and radium departments to ensure efficient protection and suitable working conditions for the personnel. The following precautions are recommended: (1) Not more than seven working hours a day. (2) Sundays and two half-days off duty each week, to be spent as much as possible out of doors. (3) An annual holiday of one month or two separate fortnights. Sisters and nurses, employed as whole-time workers in X ray and radium departments, should not be called upon for any other hospital service.

Protective Measures.

It cannot be insisted upon too strongly that a primary precaution in all X ray work is to surround the X ray bulb itself as completely as possible with adequate protective material, except for an aperture as small as possible for the work in hand.

The protective measures recommended are dealt with under the following sections: (I.) X rays for diagnostic purposes. (II.) X rays for superficial therapy. (III.) X rays for deep therapy. (IV.) X rays for industrial and research purposes. (V.) Electrical precautions in X ray departments. (VI.) Ventilation of X ray departments. (VII.) Radium therapy.

It must be clearly understood that the protective measures recommended for these various purposes are not necessarily interchangeable; for instance, to use for deep therapy the measures intended for superficial therapy would probably subject the worker to serious injury.

(I.) X Rays for Diagnostic Purposes.

1. *Screen examinations.*—(*a*) The X ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 2 mm. of lead. The material of the diaphragm to be equivalent to not less than 2 mm. of lead. (*b*) The fluorescent screen to be fitted with lead glass equivalent to not less than 1 mm. of lead, and to be large enough to cover the area irradiated when the diaphragm is opened to its widest. Practical difficulties militate at present against the recommendation of a greater degree of protection. (*c*) A travelling protective screen, of material equivalent to not less than 2 mm. of lead, should be employed between the operator and the X ray box. (*d*) Protective gloves to be of lead rubber (or the like) equivalent to not less than ½ mm. of lead and to be lined with leather or other suitable material. (As practical difficulties militate at present against the recommendation of a greater degree of protection, all manipulations during screen examination should be reduced to a minimum.) (*e*) A minimum output of radiation should be used, with the bulb as far from the screen as is consistent with the efficiency of the work in hand. Screen work to be as expeditious as possible.

2. *Radiographic examinations* (*"overhead" equipment*).—(*a*) The X ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 2 mm. of lead. (*b*) The operator to stand behind a protective screen of material equivalent to not less than 2 mm. of lead

(II.) X Rays for Superficial Therapy.

It is difficult to define the line of demarcation between superficial and deep therapy. For this reason it is recommended that, in the reorganisation of existing, or the equipment of new, X ray departments, small cubicles should not be adopted, but that the precautionary measures suggested for deep therapy should be followed. The definition of superficial therapy is considered to cover sets of apparatus giving a maximum of 100,000 volts (15 cm. spark-gap between points; 5 cm. spark-gap between spheres of diameter 5 cm.).

Cubicle System.

Where the cubicle system is already in existence it is recommended that: (1) The cubicle should be well lighted and ventilated, preferably provided with an exhaust electric fan in an outside wall or ventilation shaft. The controls of the X ray apparatus to be outside the cubicle. (2) The walls of the cubicle to be of material equivalent to not less than 2 mm. of lead. Windows to be of lead glass of equivalent thickness. (3) The X ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 2 mm. of lead.

(III.) X Rays for Deep Therapy.

This section refers to sets of apparatus giving voltages above 100,000. (1) Small cubicles are not recommended. (2) A large, lofty, well ventilated and lighted room to be provided. (3) The X ray bulb to be enclosed as completely as possible with protective material equivalent to not less than 3 mm. of lead. (4) A separate enclosure to be provided for the operator, situated as far as possible from the X ray bulb. All controls to be within this enclosure, the walls and windows of which to be of material equivalent to not less than 3 mm. of lead.

(IV.) X Rays for Industrial and Research Purposes.

The preceding recommendations for voltages above and below 100,000 will probably apply to the majority of conditions under which X rays are used for industrial and research purposes.

(V.) Electrical Precautions in X Ray Departments.

The following recommendations are made: (1) Wooden, cork, or rubber floors should be provided; existing concrete floors should be covered with one of the above materials. (2) Stout metal tubes or rods should, wherever possible, be used instead of wires for conductors. Thickly insulated wire is preferable to bare wire. Slack or looped wires are to be avoided. (3) All metal parts of the apparatus and room to be efficiently earthed. (4) All main and supply switches should be very distinctly indicated. Wherever possible double-pole switches should be used in preference to single-pole. Fuses no heavier than necessary for the purpose in hand should be used. Unemployed leads to the high tension generator should not be permitted.

(VI.) Ventilation of X Ray Departments.

(1) It is strongly recommended that the X ray department should not be below the ground level. (2) The importance of adequate ventilation in both operating and dark rooms is supreme. Artificial ventilation is recommended in most cases. With very high potentials coronal discharges are difficult to avoid and these produce ozone and nitrous fumes, both of which are prejudicial to the operator. Dark rooms should be capable of being readily opened up to sunshine and fresh air when not in use. The walls and ceilings of dark rooms are best painted some more cheerful hue than black.

(VII.) Radium Therapy.

The following protective measures are recommended for the handling of quantities of radium up to one gramme: (1) In order to avoid injury to the fingers the radium, whether in the form of applicators of radium salt or of emanation tubes, should always be manipulated with forceps or similar instruments, and it should be carried from place to place in long-handled boxes lined on all sides with 1 cm. of lead. (2) In order to avoid the penetrating rays of radium all manipulations should be carried out as rapidly as possible, and the operator should not remain in the vicinity of radium for longer than is necessary. The radium when not in use should be stored in an enclosure, the wall thickness of which should be equivalent to not less than 8 cm. of lead. (3) The handling of emanation should, as far as possible, be carried out during its relatively inactive state. In manipulations where emanation is likely to come into direct contact with the fingers thin rubber gloves should be worn. The escape of emanation should be very carefully guarded against, and the room in which it is prepared should be provided with an exhaust electric fan.

Existing Facilities for Ensuring Safety of Operators.

The governing bodies of many institutions where radiological work is carried on may wish to have further guarantees of the general safety of the conditions under which their

personnel work. (1) Although the Committee believe that an adequate degree of safety would result if the recommendations now put forward were acted upon, they would point out that this is entirely dependent upon the loyal coöperation of the personnel in following the precautionary measures outlined for the benefit. (2) The Committee would also point out that the National Physical Laboratory, Teddington, is prepared to carry out exact measurements upon X ray protective materials and to arrange for periodic inspection of existing installations on the lines of the present recommendations. (3) Further, in view of the varying susceptibilities of workers to radiation, the Committee recommend that wherever possible periodic tests—e.g., every three months—be made upon the blood of the personnel, so that any changes which occur may be recognised at an early stage. In the present state of our knowledge it is difficult to decide when small variations from the normal blood-count become significant.

The Committee is constituted as follows:—

Chairman: Sir Humphry Rolleston, K.C.B. Members: Sir Archibald Reid, K.B.E., C.M.G., St. Thomas's Hospital; Dr. Robert Knox, King's College Hospital; Dr. G. Harrison Orton, St. Mary's Hospital; Dr. S. Gilbert Scott, London Hospital; Dr. J. C. Mottram, pathologist, Radium Institute; Dr. G. W. C. Kaye, O.B.E., National Physical Laboratory; Mr. Cuthbert Andrews. Hon. Secretaries: Dr. Stanley Melville, St. George's Hospital; Prof. S. Russ, the Middlesex Hospital. Address: care of Royal Society of Medicine, 1, Wimpole-street, W. 1.

THE CAVENDISH LECTURE.

Dr. Christopher Addison delivered the Cavendish Lecture before the West London Medico-Chirurgical Society in the Council Chamber of the Kensington Town Hall, London, on June 17th. Dr. F. J. McCann, who presided, said that it had been given to few men in the course of a single lifetime to rise to eminence in two professions. Dr. Addison after being a distinguished teacher of anatomy had become an important Minister of the Crown, and had filled the posts of President of the Local Government Board, Minister of Munitions, Minister of Reconstruction, and Minister of Health with conspicuous ability.

The Part of the State in the Prevention of Disease.

During the last century, said Dr. Addison, the country had become an industrial, as distinct from an agricultural, nation, and in the past the short-sighted policy had been adopted of practising the doctrine of individual effort and the survival of the fittest in its most unthinking form. Whatever that system might mean to the individual it was not "good business" to run up habitations anyhow, on any spare spot of ground, to bring young children into factory life, to have factories and industries so organised that they were prejudicial to the lives of those engaged in them. Our statute books were crammed with expedients adopted from time to time in the endeavour to prevent the effects of this kind of scramble. Among the legacies bequeathed to us by this condition of things it would be interesting to know what our slums had cost in Poor-law expenditure, in provision of sanatoriums and convalescent homes, in amelioration of physical disabilities, and in industrial inefficiency and unemployment resulting from those disabilities. The sum might even challenge comparison with our war debt. The best available knowledge and professional advice were needed to undo the evils of the past, but there was an opponent to be reckoned with in the shape of a certain type of latter-day economist who would readily spend millions on armaments, but would question every item spent on a system of preventive services.

The Need for Preventive Medicine.

Knowledge was naturally always in advance of its application. The average medical practitioner did what he could in the cause of preventive medicine by advising his patients, but most of his time was spent in attending to the sick and bringing them back to health. There was, however, a serious deficiency in regard to the teaching of preventive medicine in our present scheme of medical education. When an attempt was made to deal with causes which might affect in bulk avoidable disabilities, difficulties arose which were beyond the bound of individual effort, and to deal adequately with these causes public education was needed. Voluntary aid was most useful, as the report of Lord Cave's Committee had shown, in regard to hospitals, but the action of public bodies, with the power of the State behind them was also required. A State medical service was no panacea, and it was certain that large categories of the work to be undertaken in the combat against disease and disablement could only be dealt with by civil or lay authorities. Dr. Addison then described in some detail the various municipal bodies who shared in the administration of health matters, and referred to the waste and muddle that resulted from incoördination of the work of these bodies. In 1919 the public funds expended on direct health service and in payments to those who were sick amounted in England and Wales alone to nearly £46,000,000. At a time of national stringency and when the disastrous records of the war, with its multitude of men classified as unfit, were still fresh in our minds, it behoved all men of patriotic goodwill to examine the mass of sickness indicated by this expenditure, to inquire to what extent it was preventable, and to frame the measure of policy accordingly. We were now at the commencement of a new period of revelation and inquiry, and, though our information was as yet scanty and imperfect, the importance of acquiring it was being clearly appreciated both generally and in industry. An examination of the ailments for which insured persons sought medical advice in 1916 showed that, excluding influenza, tuberculosis, pneumonia, malignant and other defined diseases, nearly 1 in 3 of the people required medical attention because of colds, nasal and bronchial catarrh, and digestive disorders. Here was presented an opportunity for common-sense instruction and for further research of well-nigh incalculable value. The difficulty was to devise ways and means of disseminating reliable information. It was of little use to give advice upon which the majority of the people could not act, and it was necessary to guard against the reactions which followed on advice which proved to be unavailing. There were many voluntary organisations which were exceedingly helpful though difficulties were presented by their multiplicity. Beyond these medical research on sound lines must be encouraged, for it was one of the most economical and rewarding directions of effort open to the community. Over and over again during the war, at the Ministry of Munitions and in the armies, it was found that small expenditure upon research under the superintendence of the Medical Research Committee produced saving which not only repaid the expenditure incurred, but more than paid the whole cost of all the Committee's efforts for a whole year, and in some cases for the whole time of its existence since 1912. There was also need for improvement in the home and in domestic habits and conditions. The medical schools might with great advantage pay more attention to instruction in the beginnings of disease and to the importance of those so-called minor ailments which were among the most disabling in so far as the mass of the community was concerned.

Summary of the Present Situation.

In concluding his lecture Dr. Addison said that well-considered effort was required in at least five directions: the spread of useful information and instruction, steady progress in the provision of better home conditions, encouragement of research and inquiry—not only into the more strictly scientific aspects of medical problems but extending beyond this into the field of employment and industrial conditions—improvement of facilities for early diagnosis and treatment, and a better organisation and direction of agencies charged with responsibility in health matters. At a time of national and world impoverishment we were confronted with a mass of physical disablement, much of which was realised, even with the knowledge