Where the power is utilized for the supply of some industrial centre this is undoubtedly true, but if the idea were to be generally adopted, it would cut out an enormous aggregate of potential power, more particularly in tropical and semi-tropical countries. The possibility of utilizing flood supplies for seasonal operations in connection with mining, agriculture, and forestry, or for the production of nitrates in such cases, would appear to be worthy of close consideration.

In any case, the possibilities of a given scheme can only be determined after a prolonged hydrographical and meteorological investigation of the site and surroundings. To be of real value such an investigation should extend Rainfall records, though over a long series of years. forming the basis of any such investigation, are only of partial assistance in dealing with water-power questions. The actual run-off from the catchment area is the all important factor, and the ratio of run-off to rainfall varies with the physical characteristics of the area, the vegetation, and the climate, so that rainfall gaugings cannot be substituted for the more laborious and costly collection of continuous records of river levels, combined with frequent gaugings of flow. It must be emphasized that each scheme of development requires independent investigations to determine completely the local conditions governing the flow from the area intended to be utilized.

Much can be done to ascertain the approximate possibilities of a potential scheme before deciding to incur the heavy cost of a detailed survey by—

(1) Installation and continuous recording of river gauges on all likely channels.

(2) Installation and recording of rainfall gauges at suitable places.

(3) Observation of river discharges for a series of gauge readings.

If a reasonably long record of rainfall exists, the determination of the run-off for a few years will serve to give a relation between precipitation and run-off which can be carried back as far as the rainfall records go. The initiation of operations (1)—(3) costs little, and no time is lost in collecting the more important data.

While this is true, it should be borne in mind-

(1) That to be of reliable value from a commercial point of view the hydrometric studies must give a continuous record for a number of years, and show not only the minimum low water flow, but also the maximum flood conditions that have to be met in designing the head works

(2) That the investigation of suitable rivers should include contour plans of the sites, profiles along the entire power reach of the river, and along the banks; also studies of lakes or lochs for storage, where they exist, and of the possibility of inter-connecting two or more such lakes to feed one large project. These studies should be in sufficient detail to allow of preparing preliminary plans and estimating capital and operating costs, in order to demonstrate the capacity available and the commercial feasibility of development.

(3) That to develop the most obvious power site on a river without full investigation of the whole power reach of the river may not secure, and may make it impossible to secure, the maximum advantageous use of the river by the development of two or more sites.

(4) That to secure the maximum possible use of a river the investigations should therefore be made by the government rather than by private interests.

(5) Especially is this the case where storage may be developed, in order that the maximum possible storage may be secured, and that the water may be equitably distributed to, and the cost of the works equally borne by, the various interests benefited. Proper storage may greatly improve flood conditions and enhance the value of land as well as increase the power available.

(6) That, without complete surveys the capacity of a river cannot be accurately judged. The pondage created by the dam will in many cases more than take care of the daily peak load, thus increasing the power available beyond that due to the minimum low water flow, and this may be still further increased by storage at the head waters. The power capacity of a river may sometimes be increased by such means by 100 or 150 per cent. or more.

State of Investigation Throughout the Empire

At the present time the only parts of the Empire in which any systematic attempt has been made to collect and tabulate the necessary data are Canada and New Zealand, and to a smaller extent Tasmania, New South Wales and South Africa. In Canada a large amount of excellent work has been done, during the past decade, by the Dominion Water-Power Branch of the Department of the Interior. By detailed surveys of the more important and accessible rivers, and by an extended series of river gaugings and of rainfall records, extending in most cases over a number of years, the Department has obtained information regarding a large proportion of the powers which are promising for development in the near future, and its methods might well be adopted as a model for the rest of the Empire. In New Zealand also considerable information is available, and in South Africa, New South Wales and Tasmania a beginning has been made on a comparatively small scale. But for the remainder of the Empire there is an entire lack of data on which to form a reliable estimate of the hydraulic resources.

It is a matter of urgent importance that the preparation of the necessary hydrographic and meteorological data should be undertaken at the earliest possible date in the remaining Dominions and Dependencies of the Empire.

In this connection an adequate rainfall map is of great value and importance, and where, as is the case, for example, for the greater part of the British Isles, data for such a map are available, its preparation would appear to be most advisable.

The following pages indicate very generally the waterpower possibilities of the Empire, as presented by the information so far available to the committee.

Great Britain and Ireland

Much information relative to the water-powers of the British Isles is given in a paper read before the Society of Arts in January, 1918, by Mr. Alexander Newlands, M.Inst.C.E., a member of the committee.

Scotland, and especially the Scottish Highlands, offer greater water-power possibilities than any other part of Great Britain. Over a considerable extent of its area the rainfall exceeds 60 ins. per annum, and this area is studded with natural lochs, which form excellent storage reservoirs at considerable elevation. Moreover, no part of this area, which is some 12,000 square miles in extent, is more than 20 miles from some arm of the sea or from the Caledonian Canal.

Mr. Newlands, assuming that 28 ins. of the total rainfall is available for power, calculates from an examination of the various powers having natural loch storage, that a total of some 235,000 continuous h.p. is available. He claims, however, that this is a very conservative estimate, and says that each drainage area is a problem in itself and must be investigated as such. Mr. W. Vaux (Continued on page 301.)