When to these demands are added those of India, Australia and Africa, it is evident that the fertilizer demand of the Empire will in itself call for an enormous supply of energy.

Apart from these requirements, which are admittedly for the future, electric power has a wide and practically unlimited field as a motive power conveniently and economically adaptable to any class of service. In the heating and welding of metals as a part of the process of manufacture, electricity by its control, speed, and concentration or distribution, has many advantages over coal or gas.

Electric Railroads

Electric railroads have not as yet attained more than inter-urban and terminal use. The electrification of trunk lines, which demands the supply of cheap electric power at frequent intervals along the route, and involves a very large capital outlay, has not as yet become commercially attractive, but the future possibilities in this respect are enormous.

Necessity for State Control

The considerations already outlined would indicate that the conservation and utilization of the water-power resources of the Empire is likely to be one of the most important problems in our political economy.

The solution of this problem involves many complex questions of law, of administration, and of engineering and economic investigation, if the public interest is to be best served by the development.

In view of the immensity of the interests involved, it is urged that nothing short of statutory control of these developments is desirable. The exact method of control is not for the committee to suggest. So far as is possible private enterprise should be encouraged, but under conditions which would prevent the perpetual rights being lost to the community.

In this connection it is worthy of note that Canada and New Zealand have state control over the majority of their water-powers, and that in all provinces in India there are Canal Acts which expressly lay down that government is entitled to use and control for public purposes the water of all rivers and streams flowing in natural channels. In the case of Australia, each state has enacted lengthy legislation in relation to water conservation, but no special clauses appear in respect of developable water-power. It is also suggestive that the Administration in Washington is at present taking steps to control the development of water-powers on all public lands and navigable streams in the United States; that, in spite of the revolution in Russia, the Provisional Government has recently appointed a water-power committee, with absolute control over the development of all water-power schemes in the Empire exceeding 300 h.p.; and that the Austrian Government has, during the past session, introduced a bill for the promotion of hydro-electrical development, giving the state the right to acquire any undertaking after the expiration of 25 years, and at the end of any subsequent period of five years.

It should be recognized, however, that while it is essential that the State should have the right of ultimate purchase, the period of such purchase should not be unduly short or the terms too onerous. It will be remembered that such legislation had the effect of severely handicapping the electric power and lighting industry in the early days of its development.

Cost of Hydraulic Power

It must be realized that the cheapness or dearness of energy is purely relative, and hydraulic powers which are not at present able to compete economically with steam, may in the not distant future be able to do so.

Even now in favorable localities, the cost of electric power generated from hydraulic installations compares favorably with that of steam or oil power.

The cost of such power is made up mainly of charges against capital, interest, depreciation, sinking fund charges, taxes and insurance, which are usually much greater than water charges and costs of operation, maintenance and supplies. These capital charges vary widely with the local circumstances and physical characteristics of the site. Where the available head is great and the storage reservoir is provided by some natural lake, they may be comparatively small. Where, on the other hand, extensive works are required to bring the water to the power house, and where the transmission line is long, the overall cost of power may be largely in excess of that generated by a steam plant.

An examination of some 120 European installations shows that for large installations of upwards of 10,000 e.h.p., the minimum cost of the hydraulic works is £8.4 per h.p. installed, and the maximum, £79.6 per h.p. For the majority of the installations the cost lies between £25 and £45. The cost of the electrical generators, switch boards, etc., and transmission lines, also varies greatly, ranging from £1.25 to £28.4 per h.p., while the cost of the turbines ranges from £4 to £8 per h.p. The working costs vary between £1.3 and £6.8 per e.h.p. year, with an average value of £3. From these figures it appears that on the average, making an allowance of 15 per cent. for interest and depreciation, the cost per e.h.p. per annum is in the neighborhood of £10.5.

In many installations, however, the cost is very much less than this. The Ontario Power Company, for example, is able to supply power to the Hydro-Electric Commission of Ontario at £1.8 per e.h.p. per annum. It is estimated that many of the large powers in Canada can be developed at a total cost, including all generating machinery and transmission lines, ranging from £12 to £20 per e.h.p., in which case the cost per h.p. per annum should not exceed £2 to £3.

Necessity for Preliminary Investigations

In spite of the great importance of water-powers, many of the potential powers in existence must of necessity prove economically useless, either on account of their great distance from centres of industry, the lack of transport facilities, or from the fact that the storage necessary to give a continuous or fairly continuous supply would be too costly. Of many potential powers it can be said without further investigation that for the present this is, and for a long period to come will be, the case. Of others the reverse is true, and it is evident that the scheme will amply repay development. But in the majority of cases the extent to which a scheme is capable of economic development can only be determined after a careful examination of the catchment area and of the site of the proposed works; after a careful and prolonged investigation of the rainfall and run-off records; and, especially in an undeveloped country, after an investigation of the mineral and forestal or agricultural possibilities of the surrounding region.

It has usually been understood that the usefulness of a water supply depends on the possibility of maintaining its uniformity over the whole period of the year, and that the maximum useful power is strictly limited by the minimum power which, by the aid of any suggested storage system, will be available towards the end of the longest probable period of drought.