Controlling Power.

Sir John said that there was one feature of surpassing interest in the control of electric power that deserved particular mention. That was the equipment by means of which a whole great system could be controlled by the will of an individual operator. In a separate building, located in the immediate proximity of the switch gear of a power house, or of a switching station, were assembled the paraphernalia of "control." In the control room itself were situated the control panels with their associated bewildering array of automatic measuring and recording instruments, the control bench itself being studded with innumerable keys or plugs like those of some mammoth musical instrument, so that by the touch of delicate finger tips tens of thousands of horsepower can be manipulted with consummate ease. The opening and closing, by means of giant switches of circuits carrying high voltages and currents, was in itself an operation requiring considerable mechanical force. This force was provided by intermediate electrically operated mechanism, and that mechanism was actuated in the simplest manner, by merely depressing or raising the stops on the "keyboard" of the control bench. The control officer had ready to his hand and eye the numerous instruments for recording electric pressures, quantities, and performances throughout the whole system. He was "a modern, impassive Jove, distributing benignant thunderbolts." Absolute as was his rule, the controller himself and all that he did was under the unerring and relentless observation of numerous automatic recording instruments, which reproduced on tell-tale charts a faithful record of the manner in which the system has been operated throughout every moment of the day. The modern control equipment was in its entirety a beautiful manifestation of the ingenuity and insight of the human mind applied to the silent manipulation of stupendous forces.

Public Control Generation.

The lecturer then gave his audience a birdseye view of power generation as now developed, and dwelt upon its outstanding characteristics. He said that the most striking of the latter was the largely automatic character of the whole operation, and the consideration that its magnitude, at any moment of the day, was under the control, not of the power house staff or the control engineer, but of the consumers themselves. If the terminals of an electric circuit were not in contact, no current can "flow." It was only by "switching-on" that a transmission of energy could take place; and only then by the interposition, in the circuit, of an electricity consuming device, such as a lamp, a motor, or a heating unit. All, therefore, that the power house staff could do towards the generation of energy was to put and keep the generating machinery in motion. So long as the switches of the community served remained open, then so long would the transmission circuit remain inert, even though no further energy could be generated. The machinery would be running under "no load." When the consumers, in their collective demands for service, closed their switches, then energy would be generated at the power house automatically and without further intervention by the power house staff, and in quantity in exact accordance with the consuming power of the totality of the electrical devices which had been put into circuit by the consumers, at their own will. It was important for the public to realize that it was they alone, in their multifarious collective needs, and not the authority controlling the generating plant, who actually operated the system, and who determined from moment to moment the amount of energy which required to be generated. That was the very antithesis of the crude belief, so commonly held, that electricity was something in the nature of a commodity, which could be produced beforehand by the generating authority, and held available for distribution and sale, like so much merchandise. The truth was that it can be produced only at the precise moment that the user elected to demand it. When that was grasped, the miracle which had been wrought by the application of science came into clearer relief. It was a transmutation far more wonderful than any that was ever dreamed of by the mediaeval alchemist. A dross and uncleanly substance, such as coal, was transmuted, through several intermediate stages, into energy in a form which could be transmitted for hundreds of miles, and placed at their service for any purpose that they might desire, by the mere pressing of a button.

State Control Favoured.

There was a great diversity in the public demand for power. Difficult periods of the day and the year brought heavy demands, and other periods light requirements. Those, and many other considerations, necessitated the provision of spare or stand-by plant and appliances, not necessarily throughout the whole system, but certainly in respect of the more severely distressed units, such as the steam boilers and the turbo-generators. Those considerations furnished a cumulative and irresistible argument in favour of co-operation on the largest scale; and of the amalgamation of power supply undertakings, for the express purpose of effecting the electrical linking up of power houses; and also of a rigid standardization of voltage, phase and frequency, so as to permit of free interchange of electrical energy between the several systems. In that way alone could be achieve the desideratum than an electric supply super-system, covering large territories and serving a large population, might attain the highest practical economies of operation. So ambitious a project of co-operative effort was in most communities definitely beyond the financial resources of private enterprise. Few authorities, other than the State, could usually provide the finance or the legislative or administrative machinery necessary for the control of such a combination. The inference which he suggested was, that in no field of applied science could the principle of State control of a public utility be so effectively supported by technical and scientific considerations as in the matter of power development.

Sir John continued that the linking-up of power houses had already proceeded, upon a considerable scale, in the United States, and a beginning had been made with the application of the same principle in Great Britain. In the State of Victoria something had already been achieved on a modest scale in the same direction. Furthermore, during the last three years, a new and supremely important conception had taken possession of the minds of engineers in the United States. Stimulated by the success of the commercial operation of long-distance transmission lines, operating at the super-pressure of 220,000 volts, and exercised by the difficulties likely soon to confront the world in view of a practically stationary production of fuel in the face of a rapidly expanding demand for power, they had conceived a super-system of generation and distribution, designed to link into one vast network the entire energy producing and energy consuming loci of the whole of the United States. They could not but be impressed by the boldness and magnificence of such a conception, and by the faith of those engineers in their ability to deal with the incidental problems of the technique of transmission and with the perfection of the requisite regulating machinery.

Basic and Peak Stations.

When a plurality of power houses could be operated collectively, under a single control, for the service of an entire territory, an important question arose as to the respective roles which each generating station should be called upon to play in the general scheme. It was possible only to generalize upon that intgresting theme, because there were so many factors bearing upon the best solution that each case had to be minutely examined upon its merits. Broadly speaking, they might divide a group of power houses into basic stations and peak stations, the basic portion of the daily load having a high load factor, whereas the peak portions would have a low load factor. In order to illustrate this matter, Sir John referred to the Victorian State Electricity Scheme, where the principle enunciated was being applied. The great power house at Yallourn, now approaching completion, and the group of hydro-electric power houses in the Goulburn Valley, now under construction, would operate as basic stations, while the power house at Newport, which came into commercial operation about 12 months ago, would hereafter operate as a peak station. The basic stations would operate throughout the whole 24 hours under almost uniform load, whereas the peak station would operate only during about two hours each morning and each afternoon, in order to deal with the specially intensified demands which the community makes for electric services round about 9 a.m. and 5 p.m.

The coming decade would witness the application of those principles to an ever-increasing extent. Advanced countries like the United States and Great Britain were manifesting the gradual abolition of the isolated power house as such, and vast territories were being embraced in giant power supply schemes, composed of numerous generating stations, strategically disposed according to the available sources of power, all connected together by long-distance transmission systems, and all pouring their energy into a common reservoir, from which the entire population would be able to draw and to share in the benefits and economies of highly centralized methods. Paradoxically, that very centralization of energy production was likely to lead, very directly, to industrial decentralization. Present-day conditions in Australia, having regard particularly to the distribution of population, were not favourable to a very extensive application of the principles which had been discussed. The most favoured region for early development in those directions was undoubtedly the central portion of the State of Victoria. If, with Melbourne as a centre, a circle, having a riadus of, say, 150 miles, be drawn that circle would enclose a territory having practically throughout its whole area, a population density sufficient to justify the establishment within it of a super-scheme of linked power houses of the nature described. In several Australian States and in New Zealand a beginning had been made in the direction of emulating the American and Canadian examples of connecting the rural areas with centralized generating plants of major capacity. In connection with the extent to which capital expenditure upon a service of that nature was permissible, Sir John said that at the present ruling rates of interest, and with provision for depreciation and maintenance, 10 per cent. in all, the deduction was that in round figures a capital expenditure upon transmission and distribution plant (including the incidental substation electrical equipment), amounting to £10 per capita of the population to be served was permissible. The outstanding problem was that of improving the technical methods of transmission, particularly in the direction of reducing the capital investment. One complete change of practice had resulted in the introduction of the "constant pressure" alternating current system of transmission. The thoughts of physicists were now turning to the very recently invented "valves" and other devices, promising remarkable facilities for the conversion of electric energy from the alternating to the direct current form and vice versa. He asked was another readjustment in the practice of electric transmission impending? Would the near future witness a radical reconsideration of the design of our transmission systems, and the elimination of the influence of reactance and capacitance upon the economics of their difficult and complex transmission problems.

At present the investment of Australia in electrical transmission was relatively negligible, and therefore a fruitful field for research lay open for the realization of a beneficent advance before they were deeply committed by a more extended use of present methods.

Social Factors.

Density of population was a factor of paramount influence in determining the cost pehr capita of many public utilities, the lecturer resumed. The people in the southern dominions esteemed highly the social advantages of the relatively low density of the population in the urban communities, but those advantages increased the cost of every kind of community service. Such was the case, particularly, with electric service. The denser the population, therefore, the lighter would be the burden of cost per capita. That was the chief reason why the ultimate cost of the service to the residential consumer, in a relatively sparsely occupied area, such as the residantial suburbs of the Australasian capitals, was much greater than the cost of a similar service in the more congested industrial suburbs. It was significant of the beneficient influence of applied science that, in spite of the dartime upheaval of the world's economic conditions and the almost universil rise in prices, the cost of large-scale energy production had nowhere risen, but had on the contrary, exhibited a downward tendency. That had meant much for industry. It was, however, not only the favourable price, but also the vastly greater convenience and economy of operating machinery, by means of electric motors, that explained the rapid and widespread introduction of electricity into industrial life.

The factory owner had now the whole resources of the electric supply system to enable him to meet any occasional simultaneous demand by his machinery or processes. Those considerations had exercised a profound influence in the direction of an entire reorganization of manufacturing methods, to the great benefit particularly of the industrial classes. The use of electricity in industry had probably done, and was doing more to humanize the factory than any other agency of modern application. It was bringing to the worker many advantages of health and ease, removing noise, the smoke, the dirt, and the physical toil which dogged him in the past. The dignity of skilful and useful work, often hitherto obscured by the degradation of needless labour, was becoming better appreciated; the need in modern industry for a greater range of skill and training and for less reliance on mere physical effort, which followed in the train of electrically operated processes, was cutting across the lines which had separated class from class, and which had so long made strangers where friends should be, among men who were in reality, partners in production.

The application of electricity for purposes of traction greatly increased the speed and frequency of the transportation services. That consideration alone had produced a much increased freedom of selection by urban populations of their places of residence and of the places of their daily activities. In the home, the introduction of electric lighting, warming, water-heating, cooking, refrigerating, sweeping, washing, and ironing was reducing domestic labour, and increasing the standard of comfort. Most of all, it was into rural territories that the amenities of city life were steadily penetrating. Applications of electricity to farm operations and farm domestic life were rapidly spreading, as in dairying, in pumping, in agriculture, and in the driving of farm machinery in general. In that way, electricity might play an important role in the problems of decentralization, and particularly so when industries not greatly affected by transportation considerations, of which there were many, might have for their establishment a wide range of selection of provincial localities, provided that they were furnished with electric services.

Value of Scientists.

In conclusion, Sir John said he had to close his recital of the magnificent achievements of science in the field of power development. The results which he had attempted to describe had been obtained by rational research into the laws of Nature, and by the application of the knowledge so gained to the practical affairs of life. Mathematics, physical research in the realms of electricity and magnestism, chemistry, and metallurgy all had their place in the great achievements. The work had gone far, but they had arrived at no halting place. The future power development presented, as he had tried to show, far vaster problems than any that had been successfully solved. It was to the laboratory of the investigator and in that direction alone that they would have to look for the inspirations which would guide them on the path of future progress. The engineer was merely an exponent of applied science, but he was the first to acknowledge his debt to pure science and to the research worker. It was not always so. In many quarters, pure science was looked upon as merely academic, and of no immediate practical or commercial value. It might sometimes appear to be so; but history furnished overwhelmingly numerous examples of pure research having led straightway to practical results of the greatest value to mankind. To quote Huxley's aphorism, "What people call applied science is nothing but the application of pure science to particular classes of problems." If, therefore, the privilege which had come to him of addressing them and the Australasian public had enabled him to stimulate a just appreciation of the value of pure science; and a realization of the supreme importance of rendering the most generous support, both sympathetically and financially, to scientific organizations throughout their land, so as to utilize to the utmost the undoubted aptitude of their men and women for scientific labours, then he would feel that he had not misused his opportunity. (Applause.)

The lecture was followed by an interesting and instructive series of lantern slides.

GOVERNOR'S EULOGY.

The Governor (Sir Tom Bridges), in moving a vote of thanks to Sir John Monash, said the lecture was both masterly and illuminating. His previous acquaintance with Sir John Monash was when the latter was energetically pursuing his hobby, which fortunately for Australia and for the Empire, happened to be that of soldiering. The manner in which Sir John had marshalled his facts and deductions reminded him in their logic and clarity of his battle orders and instructions for the victorious onslaught of August 8, 1918, which had now passed into the classics of military literature. The importance of the subject which had been dealt with could not be exaggerated. Nations could hope to rebuild their prosperity only by increasing the world's production. As after the devastation of the Napoleonic wars the world recovered its wellbeing by the development of coalfields, steam power, and machinery, so to-day they must seek by discovery and invention to exploit fresh resources of power to meet the world's needs. Probably the greatest storehouse of such hidden wealth lay within the British dominions. A propitious augury of a new era was the world power conference at Wembley opened by the Prince of Wales in July. Thirty nations were represented there, and the deliberations of the conference on how best to harness the forces of nature for the common good would repay study. It was interesting to note that one delegate went so far as to contend that the wealth of nations might well be computed no longer in gold but in resources that could yield abundant, efficient, and economical power. Generally speaking as regarded science and invention, all had to feel that they stood on the bring of tremendous discoveries. The phantasies of to-day became the fact to-morrow. The mantle of romance that once clothed terrestial exploration had descended upon the realms of research in all branches of science, and on every hand there was the expectation of new secrets to be wrested from the heart of the universe. Many a scientist could say with Keats:—"Then felt I like some watcher of skies when a new planet swims into his ken." He would like to take that opportunity of extending a very cordial welcome to their visitors. He hoped their stay would be as pleasant to them as he was sure it would be in the direction of science, and of the exchange of knowledge. (Applause.)

The sentiment was supported by Sir George Murray, who said they had expected a lecture that evening of outstanding ability, and they had certainly got it.

Sir Edgeworth David moved a vote of thanks to the retiring President (Sir George Knibbs). The vote was seconded by the Lord Mayor (Mr. C. R. J. Glover) and carried with acclamation.