

to reach honours standard. Mr. Abraham Flexner also has recently criticised the intellectual standards of British and American universities. The question accordingly arises whether the standard of intellectual selection should be maintained or even raised, or whether a wider conception of the function of a university should be entertained. Prof. Greenwood stressed the new factor of increasing leisure, and referred to the serious dangers to political freedom arising from an uneducated democracy to which the Bishop of Winchester has recently directed attention. The value of education from the hedonistic point of view has been insufficiently emphasised; while the ideal of Newman and Pattison cannot be realised in a great city, an even nobler ideal might be entertained. "In a great city what one loses in intimacy may be compensated by a gain of continuity. I think of the *universitas* of a *studium generale* in London as not restricted to the enrolled teachers and matriculated students, but as comprising the *universitas* of men and women to whom study and research can bring happiness and recreation."

#### The Electron in Industry

A RESEARCH and Development Lecture, arranged by the Royal Institution and the British Science Guild, was given by Mr. Clifford C. Paterson, director of the Research Laboratories of the General Electric Company, Wembley, on November 21, at the Royal Institution. After the work of J. J. Thomson, electricity could be thought of in terms of the individual electron, its habits and affinities. One of the two main reasons for the practical usefulness of electricity is its ease of control. The other is its transportability. It is in the direction of the control of electricity that the free electron has of late given the engineer new and extraordinary powers. The secret of the revolution is that electricity can now be freed from conductors. A stream of free electrons, whether in a vacuum or a gas, can be manipulated with such facility that the electricity can be increased or decreased at the rate of millions of times a second, or alternatively as slowly as desired, and no limit is set to the amount of energy which can be so controlled. It was the object of the first part of the lecture to explain and to demonstrate why these extremely rapid actions of the electrons are wanted. So much of what the eye sees and the ear hears consists, if analysed, of extremely rapid happenings. The eye and the ear are unconscious of these high-speed fluctuations and vibrations although sensitive to them. In order that these very rapid oscillations and variations may be faithfully reproduced and transmitted it is necessary to make exact electrical copies of them. This is done by suitably controlling a stream of free electrons.

THE two principal electron liberator devices discussed by Mr. Paterson were the thermionic valve and the photoelectric cell. To illustrate the potentialities of these, he demonstrated experimentally how the mechanical movements of a needle on a gramophone record can be converted into electrical pulses; then impressed on to the current in a luminous

discharge lamp and changed to light pulses; the beam of light carrying exactly equivalent modulations can be passed across a room and reconverted by a photocell into electrical pulses. These again can be amplified and, by a loud speaker, reconverted into sound waves in the air. The free electron is also being used in new ways in the art of electric lighting. The many coloured luminous discharge tubes used for display purposes in the streets have led the way to more brilliant and more efficient light sources. Some of these give much more light for the electricity consumed than existing filament lamps. The effects are the result of high-speed encounters between free electrons and the gas atoms in the tubes, at speeds up to six million miles an hour. Electricity which is liberated from the metals, which in the older engineering restrained it, is having industrial applications of the highest importance.

#### Fuel Research

FUEL research was discussed by Sir Harry McGowan, who succeeds Sir William Larke as president of the Institute of Fuel, in his presidential address on November 12. Experience, he said, has taught him the vital connexion between research of all varieties and commercial and financial prosperity, whether it is applied to the improvement of present methods of working an existing process, to the production of an entirely new commodity as an alternative or substitute for one now in use, to the safety of those who labour in industry, or to an examination of the demands of the consumer. Research in one industry cannot ignore the results of research in others, for all economic facts are intimately connected, and a change in any part of the economic structure inevitably induces changes in other parts. Our national fuel asset is coal, and our original industrial monopoly was based upon the introduction of steam power and the development of railways. Development, though world-wide, has not, however, been uniform; it has a ragged front, and new knowledge is continually changing relative national positions. Sir Harry McGowan referred to the domestic use of raw coal, which is still preferred to smokeless semi-coke by the ladies who command the household and value a cheerful flame above the more economical and healthy use of coal. More propaganda and technical research are needed to bring home to the public what coal can do in the home. Sir Harry mentioned that whole suburbs of cities in France are heated by a high-pressure hot water ring main based on coal, and that an astonishing economy in fuel has been achieved. On the other hand, the industrial users of coal base their demands on specific requirements as to effective heat value. Sorting and grading are usual, and much better coal than was previously thought obtainable has been brought on the market.

POWDERED coal, continued Sir Harry McGowan in his presidential address, is comparatively a new-comer into the power field. It speedily affords a high temperature, permitting rapid adjustment to varying load (such as a sudden demand for electricity