Research Board is represented by its director, Dr. H. T. Calvert, and its secretary, Dr. A. Parker, on this Committee, so that there is active co-operation in this important matter.

An immense amount of detailed work is dealt with each year by Dr. A. Key, the research chemist to the Liquor Effluents Committee. Besides possible modifications in gas works practice which have been previously indicated, the annual report of this Committee deals in great detail with the effects of spent liquor on one hand and crude or ammoniacal liquor on the other, when mixed with sewage in various proportions, and the resulting mixed liquors dealt with by standard methods of biological oxidation, such as the activated sludge process or filtration through bacteria beds. Broadly, it may be said that the former process is more sensitive than the latter, that the average proportion of gas liquor to sewage in a town varies from 0·3 to 0·5 per cent by volume, that if the waste liquor is discharged at a level rate to the public sewers no serious difficulty arises at a well-designed sewage purification plant so long as spent liquor only is discharged. On the other hand, crude or ammoniacal liquor from gas works introduces difficulties which are not associated with spent liquor; and as the Institution of Gas Engineers is pursuing quite promising investigations on the recovery of the ammonia from crude liquor, it is very desirable from every point of view that these efforts shall be successful.

The Water Pollution Research Board continues its detailed investigations on activated sludge in relation to its action on various types of sewage, and also on various materials such as sugars—fructose, maltose, glucose, etc., amino acids, fatty acids, fats, suspensions of proteins, and so on. Certain experiments were carried out showing that physical factors play an independent part in the action of the activated sludge process, etc.

The investigations which the Board has carried out on the River Tees, and the present survey which is being made on the estuary of the River Mersey, are of fascinating interest, and are providing not only a mass of information of scientific character, but also material facts affecting a wide range of interests, nautical, fishing, manufacturing, sanitary, etc. One fact elucidated seems to illustrate the complexity of the problems arising, when it is stated that on comparing the relatively unpolluted Lough Foyle with the heavily polluted Mersey: "Samples of the mud from the Lough contained larger proportions of organic matter than the samples from the bank near Stanlow in the Mersey".

F. R. O'SHAUGHNESSY.

Mechanism of the Human Body

ODDLY enough, engineers have always enjoyed a thrill when shown the working mechanism of any bodily organ; the beating of an isolated heart taken from a tortoise, for example, arranged to circulate a suitable saline fluid, usually commands more admiration from an engineer than from a physiologist. It is not surprising, therefore, that the Institution of Mechanical Engineers should have invited a physiologist to deliver the Thomas Hawksley Lecture on November 29, and to present some of the more mechanical and physico-chemical processes taking place in the human body. Their selection, happily, fell upon Prof. A. V. Hill, Foulerton research professor of the Royal Society and a distinguished biophysicist.

The human body, as a whole, has often been likened to an internal combustion engine, for both ultimately depend on the transformation of chemical potential energy into heat and mechanical energy, and so the human body is as dependent on adequate food supply as is the engine on fuel. Dealing with the preservation and transport of food on sound engineering and biological lines, Prof. Hill stated that this is not enough, "for food must be supplied as well, and we are fools, if, on any moral, social, or political theory, we wilfully allow our population to remain below the level of health which science and engineering can provide". After dealing with problems common to physiology and engineering affecting deep diving, high flying, work at high temperatures and so on, he carried his hearers into the more intimate consideration of the processes occurring in two highly specialised tissues, muscle for the development of mechanical power, and nerve for high-speed conduction.

Prof. Hill described, with the authority of the leading experimenter in this branch, how the measurement of heat production in the various phases of muscle contraction have elucidated the energy transformations occurring; but he stated that "we need to know much more about the physical chemistry and the molecular structure of muscle before we can even begin to guess at the mechanism by which chemical energy is transformed directly into tension energy and mechanical work". Experiments on the mechanical efficiency of muscles give results dependent on the manner in which the muscles are employed: the mechanical efficiency in pedalling a bicycle, or in rowing a boat with sliding seat, under good conditions and not too fast, is about twenty per cent—perhaps twenty-five per cent as a maximum. Under most conditions, it is less, but it must be remembered that the accompanying heat dissipation serves the necessary purpose of maintaining body temperature. The power developed by a vigorous man in a steady condition of exercise may be as much as $\frac{3}{5}$ horse-power, while for maximum efforts of only a few seconds $1\frac{1}{2}$ horse-power may be attained.

During the consideration of the processes occurring in nerve, Prof. Hill dwelt on the difficult problem represented by the excitatory process in nerve. The application of radio-engineering to the problem has been productive in studying both electric excitation and the transmission of nerve impulses. When an electric current passes through a nerve from anode to cathode, a physico-chemical change occurs at the cathode which, if big enough, results in excitation. As soon as the current is broken, this cathode potential begins to disappear exponentially with time, proportionately to $e^{-t/k}$, where k is a time-constant

characteristic of the nerve. The quicker the reactions of a nerve the smaller will be the value of k; for human motor or sensory nerve, k is about 250 microseconds. Electrical studies of the excitation process and action potential, which is a constant accompaniment of a nerve impulse, are beginning to shed new light on the initiation of the nerve impulse, and physiologists with the aid of other engineering devices are looking forward to the solution of this problem, which they hope will turn out to be on a simple physico-chemical basis.

Science News a Century Ago

The Siamese Twins

LONDON MEDICAL GAZETTE, January 16, 1836, said: "This inseparable pair are now at Paris. M. Geoffroy de St. Hilaire congratulated the savans of the Academy of Sciences on the circumstance. Six years ago, he says, he applied in vain to the French Government to allow this 'teratological curiosity' to enter France. It may now be examined at leisure; and will be found deserving of attention, not only from the singular mode in which the individuals are united, but as presenting a specimen of a race of men little known to Europeans. M. Coste has visited these singular strangers, and raised rather a curious question about them, namely, at what epoch of intra-uterine life their union took place. He has satisfied himself that it occurred during the last days of the first month of pregnancy".

Darwin's Observations in New South Wales

THE beginning of 1836 found the *Beagle* on passage from New Zealand to Australia, and on January 12 the ship anchored in Sydney Cove, whence she sailed on January 30 to Tasmania. Darwin took the opportunity of making an excursion to Bathurst, 120 miles inland, where he arrived on January 20 after a four days' ride. In the course of his journey he passed parties of convicts working in chains, under the charge of sentries, and groups of aborigines whose skill with the spear he admired. He ascended the Blue Mountains, made notes on the vegetation and geology of the district, went kangaroo hunting and had the good fortune to see several of "the famous Ornithorhynchus paradoxus".

The rapid prosperity and future prospects of the colony puzzled Darwin. The country was unfit for canals, pasturage was thin and agriculture on account of the drought could never succeed on an extended scale. "I formerly imagined", he wrote, "that Australia would rise to be as grand and powerful a country as North America, but now it appears to me that such future grandeur is rather problematical". He was deeply interested in the state of society and the condition of the convicts, and though he admitted he had few opportunities of studying the latter, speaking of the use of Australia as a penal settlement, he said, "On the whole, as a place of punishment, the object is scarcely gained; as a real system of reform it has failed, as perhaps would every other place; but as a means of making men outwardly honest—of converting vagabonds, most useless in one hemisphere, into active citizens of another, and thus giving birth to a new and splendid country—a grand centre of civilization—it has succeeded to a degree perhaps unparalleled in history".

Death of Antoine-François de Férussac

ON January 21, 1836, the French soldier and naturalist, Antoine-François de Férussac, died at the age of forty-nine years. The son of Jean-Baptiste-Louis de Férussac (1745–1815), a colonel who had fought in the Revolutionary wars and had devoted his leisure to zoology, de Férussac was born at Lauzerte (Tarn-et-Garonne) on December 30, 1786. While undergoing military training in Paris, he attended the lectures of Cuvier, Lamarck and Latreille, and at the age of twenty read a paper on Crustacea to the Paris Academy of Sciences which was printed in the *Annales du Muséum*. His corps being sent to Germany, he took part in the battles of Jena and Austerlitz, and afterwards served in Silesia and Spain, returning home severely wounded. Though some years later he served in the National Guard, he was always devoted to the study of natural history, writing many papers and in 1819 completed and published his father's "Histoire naturelle, générale et particulière des mollusques terrestres et fluviatiles". In 1823 he founded the *Bulletin universal des sciences et de l'industrie*, which, in spite of Government assistance, he was only able to carry on for a few years.

Magazine of Popular Science

AN advertisement in *The Times* of January 23, 1836, said, " 'The Magazine of Popular Science, and Journal of the Useful Arts', will be published on the 1st of February, and continued monthly, price 1*s.* 6*d.*, edited under the direction of the Society for the Illustration and Encouragement of Practical Science, at the Adelaide-street Gallery, London. . . ."

The Railways of England and Wales

IN its issue of January 23, 1836, the *Athenæum* gave a review of the principal railways in England and Wales under the three headings: (1) those completed and in operation; (2) those not yet completed, but in progress of formation; and (3) those existing only in prospectuses and engineers' surveys. Altogether, about thirty railways were included in the review, which was accompanied by a map drawn by James Arrowsmith. After dealing with the railways themselves, the writer of the article said, "Having thus hastily noticed the principal railway schemes lately brought forward, a few observations in conclusion may not be misplaced. The magnitude of the sums already risked in this new class of speculation indicates a degree of private wealth and enterprise, such as no time or country but ours, we believe, has ever exhibited. . . . Little attention has yet been given to calculate the effects which must result from the establishment throughout the kingdom of great lines of intercourse traversed at a speed of twenty miles in the hour. It is a subject deserving the attention of all such as are studious of social and economic philosophy. The experiment is quite unprecedented and its effects will not be easy to estimate". The writer was not very sanguine regarding the immediate prosperity of some of the projects, but remarked: "There is also one consoling circumstance on the very extremity of railway speculation: the vast sums it is destined to swallow up will, at least, be consumed for the advantage of some one at *home*, and not sunk in the shafts and mountains of a foreign territory".