

dounding dams generally. In each case there is the problem of assisting the fish (descending as well as ascending) over or round the dam, complicated by the fact that the top-water level of the reservoir varies according to meteorological and seasonal conditions.

An additional problem presented by, and peculiar to, the impounding of water for generating power, as distinct from supply, is the draw through the turbines. If there is adequate clearance between the blades, and the revolutions per minute do not exceed a certain—as yet not fully determined—maximum, small fish, such as smolts, can pass through, as they do at Tongland (and elsewhere) without hurt. It is probably better to let these small fish avail themselves of a quick exit from the reservoir by this, usually more readily found, route rather than compel them, by the interposition of closely interspaced gratings at the turbine intake, to seek it after probable delay through the fish pass intake. Screened, but by a grating with relatively wide interspaces, the turbine intake must be, however, to prevent the larger adults, spent and dropping downstream as

kelts, from getting involved in the turbines, with certainly fatal results—to the fish.

It might be supposed that what has been possible on the Dee at Tongland would be equally possible on the Columbia and Sacramento Rivers. The magnitude of the proposition on the latter rivers, however, removes it to a somewhat different category. On no single river system in Britain has it been nor is it likely to be, necessary to contemplate an overflow at any dam amounting to as much as 650,000 cu. ft. (as at the Grand Coulee on the Columbia River), or an annual catch of salmon exceeding 1,500,000 lb. (as is the case in regard to one commercial fishery alone at the mouth of the Sacramento River).

It requires no exceptionally acute imaginative faculty to realize that the problem in these Pacific coast rivers is on a scale which introduces a somewhat different standard of outlook and demands a special mode of treatment.

The fight of the fishery interests to prevent the extermination of these important and valuable fisheries will be watched with sympathetic interest.

THE INTERNAL COMBUSTION ENGINE

THE full text of the series of three Cantor Lectures of the Royal Society of Arts delivered by Prof. S. J. Davies under the title "Recent Developments in Internal Combustion Engines", is now available (*J. Roy. Soc. Arts*, Feb. 1941).

In his opening remarks Prof. Davies quoted the prophecy made by Sir Frederick Bramwell at the jubilee meeting of the British Association in 1881 with respect to the steam engine: "I very much doubt whether those who meet here fifty years hence will then speak of that motor except in the character of a curiosity to be found in a museum"; such was the overwhelming opinion he had formed regarding the internal combustion engine. While the steam engine, including the steam turbine, has found success in certain definite fields of application, as has its rival in others, it cannot be denied that the internal combustion engine has, due to its special advantages, opened up fields of application, not closed to but only remotely accessible by the steam engine. Of these the highest is that of aeronautics, in which the present-day performance of the engines in use is such as Bramwell could not have imagined.

The first of these three lectures was in the nature of a general survey, outlining the development of the various types of engine as regards combustion, materials and manufacture. It is only in the last twenty years or thereabouts that the processes of combustion in petrol engines have been elucidated. Such well-recognized phenomena as 'pinking' and 'knocking' were known to be of importance in practice, but only the vaguest ideas were prevalent regarding the conditions which give rise to them. Although finality has by no means been reached, the systematic investigations of Ricardo and others have given the engine designer a sound basis on which to work.

In the compression-ignition type of engine, the development of 'airless' injection has been the most important improvement in combustion processes, as the resulting simplification of the engine has extended its field of application and given an impetus to its

further improvement. Striking developments have also taken place in the materials used in their construction and in methods of manufacture, with great advantages in the reduction of weight relative to power.

The steadily increasing speeds at which internal combustion engines are now designed to operate has led to a virtual modification of the working cycle from the constant-pressure combustion proposed by Diesel to one approximating more closely to the constant-volume combustion of the petrol engine. In the petrol engine the direct injection of the fuel avoids the loss which otherwise occurs during the scavenging process in the two-stroke cycle and has opened up a wider field for this type. Prof. Davies expressed the view that the development of two-stroke petrol engines for aircraft appears to be within the range of practical possibility, and that, given success in this field, the extension of two-stroke working to all forms of petrol engines used in transport may be only a matter of time. Discussing the relative merits of carburation and fuel injection for aircraft engines, he gave it as his opinion that, if the two systems had started together forty years ago, fuel injection would have been in universal use to-day. The secret development work done by the Germans to make fuel injection satisfactory has enabled them to use it in all their fighter and bomber aircraft. Given a satisfactory arrangement of the controls, it offers the advantages of elimination of freezing, better distribution, low consumption at reduced brake mean pressures, lower hydraulic resistance in induction by the absence of choke and the possibility of two-stroke working.

An interesting comparison was made between the Rolls-Royce Merlin and a captured Daimler-Benz engine. Both develop practically the same power at take-off, but as the former is 27 litres against 33.9 of the German and their respective speeds are 3,000 and 2,400 r.p.m., the specific rating of the British engine is much higher. The Rolls-Royce has a two-

speed drive to its supercharger, while the Daimler-Benz has an infinitely variable hydraulic drive which permits of the speed and therefore the charge being suitably adjusted to altitude. Prof. Davies stressed the need for improved superchargers and scavenging pumps, as increased efficiency of these gives the advantages of reduced power required to drive them, lower cycle temperature with increase of charge density and of volumetric efficiency.

A type of engine of which little has been heard in Great Britain is the coal-dust engine, a point of some importance since British coals are more suitable for the purpose than those found in Germany, where development work has been done on this type. Diesel himself originally proposed such an engine but was unable to make it practicable. The Schichau Company of Elbing has carried out researches on a single-cylinder engine developing 160 h.p. at 200 r.p.m. Commercially, it has found the delivery of coal-dust ready for use direct from the mine in trucks to be most suitable, and the special removal of ash from the coal-dust to be uneconomical. Ignition temperatures vary from 300° C. for lignite to 600° C. for anthracite. The dust is used in the same fineness as for boilers, finer grinding being unnecessary as only 2 per cent in calorific value is lost to exhaust.

An auxiliary ante-chamber attached to the cylinder serves as a lock in free communication with the cylinder, and the fuel is admitted to the lock chamber by the fuel valve during the later part of the suction stroke, at the end of which the valve closes. During the instroke, compressed heated air is admitted and partial combustion occurs in the lock chamber as top dead-centre is reached. The resulting excess pressure in the chamber evacuates the contents into the cylinder during the expansion stroke. A continuous brake thermal efficiency of 25 per cent has been attained, but the main difficulties include wear of cylinder liner, wear, leakage and fracture of piston rings, pitting, erosion and sticking of the fuel-valve, and burning and erosion of the ante-chamber nozzles.

Concluding with some remarks on future developments, Prof. Davies pointed to the importance of research. For the last Schneider Trophy races the improvements in the aerodynamic properties of the aircraft and in the performance and reliability of the Rolls-Royce engine were obtained from comparatively modest outlays privately provided. Such an example shows the vast possibilities of well-directed research, and the reward of funds provided for the purpose.

FORTHCOMING EVENTS

Tuesday, April 22

INSTITUTION OF CIVIL ENGINEERS (Road Engineering Section) (at Great George Street, London, S.W.1), at 5 p.m.—Mr. Arthur John Hamblin Clayton: "Road Traffic Calculations".

Wednesday, April 23

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. T. Neville George: "The Development of the Towy and Upper Usk Drainage Pattern".

Friday, April 25

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, London, S.W.1), at 2 p.m.—Mr. G. E. Windeler: "Mechanical Mishaps".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at the Mining Institute, Newcastle-upon-Tyne), at 6.45 p.m.—Prof. J. F. Baker, and Mr. J. W. Roderick: "Plastic Theory: its Application to Design".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

GRADUATE TEACHER QUALIFIED IN ELECTRICAL ENGINEERING in the Blackburn Municipal Technical College—The Director of Education, Education Offices, Library Street, Blackburn (April 23).

CHIEF EDUCATION OFFICER to the Darlington County Borough Education Committee—The Chief Education Officer, Education Office, Darlington (April 28).

WOMAN GRADUATE LECTURER IN EDUCATION at the Bingley Training College—The Education Officer, County Hall, Wakefield, Yorks. (May 2).

ASSISTANT TO THE DIRECTOR OF EDUCATION with special reference to ELEMENTARY AND SECONDARY EDUCATION—The Director of Education, Education Offices, Leopold Street, Sheffield 1 (May 3).

CIVIL ENGINEERING ASSISTANT to THE TEES VALLEY WATER BOARD—The Engineer and Manager, Water Board Offices, Corporation Road, Middlesbrough (May 5).

RESEARCH OFFICER IN THE MENTAL DISEASE RESEARCH DEPARTMENT—The Secretary, The University, Edmund Street, Birmingham 3 (May 16).

READER IN PHARMACOLOGY—The Secretary, The University, Edmund Street, Birmingham 3 (June 1).

ASSISTANT ENGINEER FOR THE SUDAN GOVERNMENT RAILWAYS—The Controller, Sudan Government London Office, Oxford Hotel, 261 Clifton Drive South, Lytham St. Annes, Lancs. (quoting 'Assistant Engineer').

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 46, Section A, No. 9: Boolean Algebra and Probability Theory. By T. S. Broderick and E. Schrödinger. Pp. 103-112. 1s. Vol. 46, Section A, No. 10: Matrices of the Finite Period. By Olga Taussky and John Todd. Pp. 113-122. 1s. Vol. 46, Section A, No. 11: The Region of Bright Nebulosity in the Coal Sack. By E. M. Lindsay. Pp. 123-128+2 plates. 1s. Vol. 46, Section B, No. 6: Note of the Cytology of Human Uterine Glands in the Gravid Phase. By J. Brontë Gatenby and Olive E. Aykroyd. Pp. 97-100+plate 7. 1s. Vol. 46, Section B, No. 7: The Effects of Ultracentrifuging Human Oocytes. By Olive E. Aykroyd. Pp. 101-108+plates 8-10. 1s. Vol. 46, Section B, Nos. 8, 9: Description of Six New Species of Bassine Ichneumonflies, with Notes of some Others; A New Species of *Blacus* (Hymenoptera: Braconidae), with some Notes of other Species of the Genus. By A. W. Steffox. Pp. 109-124. 1s. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 113

Proceedings of the Royal Society of Edinburgh. Section B (Biology). Vol. 61, Part 1, No. 1: The Oesophagus of the Stenoglossan Prosobranchs. By Alastair Graham. Pp. 24. (Edinburgh and London: Oliver and Boyd.) 2s. 193

Other Countries

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ended June 30, 1940. (Publication 3600.) Pp. ix+115. (Washington, D.C.: Government Printing Office.) 25 cents. 113

Fisheries Research Board of Canada. Bulletin No. 59: The Chemistry and Technology of Marine Animal Oils, with Particular Reference to those of Canada. Edited by H. N. Brocklesby. Pp. 442. (Toronto: Fisheries Research Board of Canada, Toronto University.) Paper, 2.95 dollars; cloth, 3.80 dollars. 113

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 34: Some Practical Results of Sugarcane Research in India. Pp. 41. (Delhi: Manager of Publications.) 1.8 rupees; 2s. 3d. 133

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 135: Investigations on the Storage of Jonathan Apples grown in Victoria. By Dr. S. A. Trout, G. B. Tindale and Dr. F. E. Huelin. Pp. 96+4 plates. (Melbourne: Government Printer.) 143

Annals of the Carnegie Museum. Vol. 28, Art. 11: An Archaeological Collection from the Belcher Islands in Hudson Bay. By Diamond Jenness. Pp. 189-206+plates 14-22. (Pittsburgh, Pa.: Carnegie Museum.) 143

Field Museum of Natural History. Zoological Series, Vol. 24, No. 18: Reptiles and Amphibians from Central Arabia. By Karl P. Schmidt. Pp. 161-166. 10 cents. Zoological Series, Vol. 24, No. 17: Malacological Notes, 2: A New Marine Prosobranch Snail from the Yucatan Coast. By Fritz Haas. Pp. 167-174+1 plate. 30 cents. Zoological Series, Vol. 24, No. 18: New Termitophilous Diptera from the Neotropics. By Charles H. SeEVERS. Pp. 175-194. 15 cents. (Chicago: Field Museum of Natural History.) 193