

ENGINEERING.

ENGINEERING DEVELOPMENTS IN THE PORT OF DUBLIN.

THE port of Dublin deals annually with more than 4,000 vessels, with a total net registered tonnage of over three millions, of which about 1,000 vessels are engaged in overseas trade. About two and a half million tons of goods are imported annually and 380,000 tons are exported. Dublin is an estuarine port, situated at the mouth of the River Liffey. The depth on the bar is now $3\frac{1}{2}$ fathoms and

Dredging of the berths, river, and bar is carried out by the dredgers of the port authority—the Dublin Port and Docks Board; the quantity dredged annually amounts to approximately 1,000,000 tons. The Board now operate four dredgers and a fleet of dumb and steam hopper barges. The principal dredgers are the Sandpiper and Deepworker. The Sandpiper, a twin-screw suction dredger with a hopper capacity of 1,200 tons, so designed that the vessel can either dump at sea or pump out her own hopper for reclaiming purposes, was built in 1904 by Messrs. L. Smit and

For dredging the channel and deepwater berths, the Deepworker, a bucket dredger, not self-propelled, is used. The Deepworker was built in 1920 by Lobnitz and Company, of Renfrew, and has a length of 170 ft., a beam of 31 ft., and a moulded depth of 14 ft. 3 in. This dredger has a ladder 108 ft. long and can dredge to a depth of 52 ft. 6 in., the maximum output (assuming full buckets) being 1,600 tons per hour. The dredger has a three-crank compound engine of 350 h.p. For general maintenance dredging in the other berths, two grab hopper dredgers are used.



FIG. 1. GENERAL VIEW OF PORT.

deepening operations are in progress. The port is relatively free from fogs and the entrance is easy, being practically a straight run from the bar to the upper quays, a distance of some six miles. The entire port provides safe shelter under all weather conditions, and all berths are free from swell or range of tides. The total length of quays in the port now amounts to 18,500 ft., of which 2,300 ft. has a depth of 30 ft. or more below low water, ordinary spring tides. A general view of the port is given in Fig. 1, herewith.

Zoon, of Kinderdijk, Holland. She is 222 ft. long by 34 ft. beam and $16\frac{1}{2}$ ft. moulded depth, and has two triple-expansion engines of 100 indicated horsepower each, capable of emptying the hopper in $2\frac{1}{2}$ hours, or propelling the vessel at a speed of 9 knots. The Sandpiper is used to a considerable extent on the bar, and much of the spoil so obtained has been used, as it still is, for reclamation. The whole of the area to the east of the East Wall road has been reclaimed, either by dredging or refuse dumping, during the past 50 years.

In 1949, a contract was let to the Westminster Dredging Company, Limited, for the dredging and pumping ashore of 600,000 cubic m. of spoil. The object of this work was mainly to provide suitable fill for the Electricity Supply Board's new station at Ringsend and a portion of the Ocean Pier, which is still under construction. The dredging was, as far as possible, done in the navigable channel, so that it resulted also in useful deepening of the waterway. Fig. 2, on the next page, shows this work in progress at the Ocean Pier.

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FIG. 2. RECLAMATION WORK BEHIND OCEAN PIER.

Five lighthouses come under the jurisdiction of the port authority; four of these lighthouses are completely automatic in operation. The change to automatic working was made on the first lighthouse some 27 years ago. In 1924, the automatic control of navigation lights by sun valves and time clocks was not uncommon, but no apparatus for the automatic control of fog signals was commercially available. The port authority developed their own method of controlling the fog signals by means of a beam of light and a photo-electric cell; when fog interrupts the beam of light, a relay, controlled by the photo-electric cell, closes and starts the fog signal. This, it may be remarked, was one of the earliest applications of the photo-electric cell to automatic control.

The port is equipped with 46 four-ton level-luffing portal electric cranes, of which 26 have been supplied recently and erected by Sir William Arrol and Company, Limited. They operate on 500 volts direct current, supplied by the port authority's sub-station, which converts the Electricity Supply Board's alternating-current supply to direct current. These cranes have lifting speeds varying from 125 ft. to 300 ft. per minute, a luffing speed of 150 ft. per minute, and a slewing speed of $1\frac{1}{2}$ revolutions per minute. Regenerative braking is provided on the hoist motion. In addition, the port is equipped with a hammer-head 100-ton electric crane, and one 6-ton and two 2-ton level-luffing electric cranes. The port authority have on order seven more 4-ton cranes, three 6-ton, and two 10-ton.

The silos and the grain-handling equipment in the Port of Dublin are owned and operated by private firms. The Merchants' Warehousing Company, Limited, own the grain discharging equipment on Alexandra Quay, which covers a total length of quay of 1,000 ft. Two belt conveyors, each of 150 tons per hour capacity, housed in a gantry, cover this length of quay. Two travelling pneumatic towers, each equipped with two telescopic pipes, discharge the grain vessels, and feed on to the band conveyors; this plant is illustrated in Figs. 3 and 4, herewith. As Alexandra Quay is used for cargoes other than grain, the travelling towers are arranged so that they can be traversed not only up and down the quay, but also back from the quay, so as to have it free for the operation of the general cargo cranes. The pumps providing the

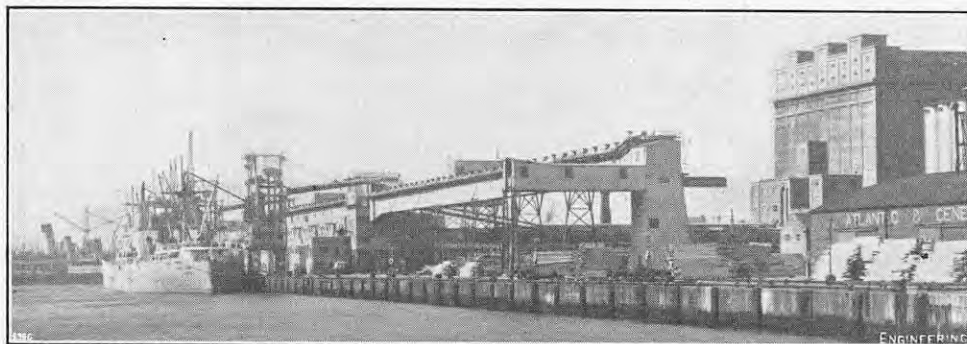


FIG. 3. GRAIN-DISCHARGING EQUIPMENT.

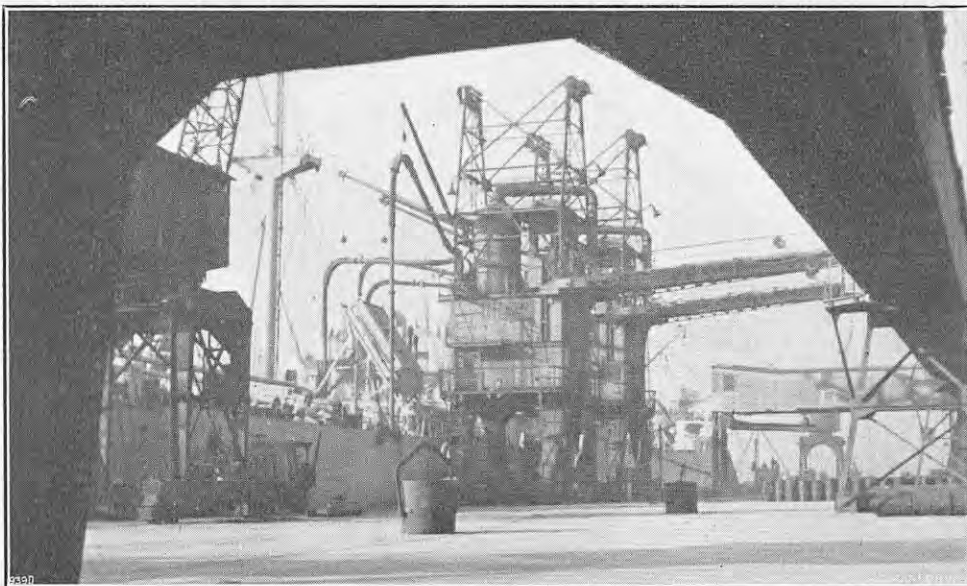


FIG. 4. GRAIN TOWERS ON ALEXANDRA QUAY.

suction for the grain-discharging plant are situated in the silo, which is sited some 270 ft. back from the quay face. Twin pipe lines, with connections at about 10 ft. intervals, run along the top of the gantries housing the band conveyors. Cross conveyors take the grain from the quayside bands to the silos, where it is weighed, etc. The Merchants' Warehousing Company's total silo capacity is 37,000 tons.

The Dublin Port Milling Company also operate a silo of 2,000 tons capacity, mainly in connection with native wheat. This silo is equipped with three Miag dryers of 5 tons per hour capacity. A new 16,000-ton silo is being built adjacent to the Port Milling Company's existing silo, to be seen in Fig. 5, opposite; it is of the Miag steel tank type. All silos in the port area are connected by conveyors and thus can operate in conjunction with the existing quay-

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FIG. 5. ALEXANDRA QUAY AND BASIN.

side plant. Provision has been made for the future discharge of grain ships at the Ocean Pier and the conveying of the grain to the silos by means of a tunnel conveyor.

A new four-floor reinforced-concrete warehouse, 480 ft. by 140 ft. wide, has been constructed recently by the Port and Docks Board. It is founded on 1,256 Franki piles, and is somewhat unusual in that glass blocks have been used almost exclusively for lights. The building is divided into 20 separate compartments, and is equipped with ten 30-cwt. goods lifts and five continuous package elevators. This work was put out to contract, the foundation work being carried out by the Irish Piling and Construction Company, Limited, and the superstructure by R. Costain and Sons (Liverpool), Limited.

The Port Board are carrying out, or have recently completed, quay-wall construction in five places, namely, at the Custom House Quay, for the new Ocean Pier, the Eastern and Western oil jetties, and at the wharf connected with the Electricity Supply Board's Ringsend power station. In the case of the Custom House Quay reconstruction, the work is being carried out on more or less orthodox lines, a mass concrete wall being built behind a steel sheet pile cofferdam. A depth of 17 ft. below low water, ordinary spring tides, is being made available at this quay.

For the other works mentioned, reinforced-concrete caissons, of the type now generally referred to as the "Mulberry," are used. This form of construction was first adopted by the Dublin Port Board in 1921 for Alexandra Quay, and the same method, with minor modifications, is still in use. The caissons are 50 ft. long by 30 ft. wide, divided into eight compartments by diaphragm walls, and are built to a height of about 9 ft. 6 in. on a slipway before launching. While they are floating, the height of the caissons is built up in

lifts in the ordinary way to the full height of 42 ft. to 45 ft. The caissons are sunk into a trench excavated to at least 2 ft. 6 in. below the ultimate dredged level of the berth. The trench is excavated in three stages; by bucket dredger in the first instance, then rough levelling by grab, and finally hand trimming by men working in a diving bell. The diving bell employed, with its float, was built in 1864 to the design of Dr. Bindon Stoney, for use in connection with the placing of 350-ton concrete blocks formerly used for quay wall construction at Dublin. The diving bell measures 20 ft. by 20 ft. at the bottom of the chamber, and 16 ft. by 16 ft. at the top, the height being 6 ft. 6 in. A 3-ft. diameter access shaft with air lock allows men to enter and leave the bell when working in depths of water of up to 38 ft. The chamber is built up of cast-iron sections and the access shaft is of wrought-iron plate.

One of the first caissons made suffered an accident because the design did not allow for internal water pressure; bad weather caused the water level in a founded caisson to rise higher inside than out, with the result that the wall burst outwards. Further accidents of this nature were guarded against by the fitting of flap valves. Apparently, similar accidents occurred with some of the "Mulberry" units used in connection with the French invasion.

When the caissons were first adopted, the front compartments were filled with 1:15 concrete to the full height and the back to a height of 15 ft. only, the remaining height being filled with gravel. Latterly, gravel fill, with the top 10 ft. of the front compartment only concreted, has been adopted. Formerly, the gravel fill was placed by grab, but latterly a considerable saving in cost has been made by using the dredger Sandpiper to pump gravel spoil directly into the compartments.

The space between the caissons used for quay-wall construction is closed by steel sheet piles. For

the eastern oil jetty, a single row of caissons is used, and for the western jetty, two rows, set with a space of 13 ft. between units and 10 ft. between the two rows. A reinforced deck covers the top of the caissons and on this the superstructure is built. The Ocean Pier and the oil berths are designed for a depth of water of 35 ft. below L.W.O.S.T.; at the Ringsend power station, the depth is 32 ft. 0 in. All quay construction is carried out by the Port Board departmentally.

(To be continued.)

LITERATURE.

Some Aspects of Fluid Flow.

Published for the Institute of Physics by Edward Arnold and Company, 41, Maddox-street, London, W.1. [Price 50s. net.]

A CONFERENCE organised by the Institute of Physics was held at Ashorne Hill, near Leamington Spa, from October 25 to 28, 1950, with the general objective of surveying the problems raised by the behaviour of moving fluids, more especially in those industries and technical processes where fluid motion is an incidental rather than a primary factor and where, in consequence, the great volume of scientific knowledge in hydrodynamics and aerodynamics, accumulated during the past 50 years, is only belatedly and gradually coming to be applied. The importance with which fluid dynamics is now rightly regarded is evident, alike from the large number of applied scientists who took part in the conference, and from the variety of subjects and the high quality of the papers presented for consideration. These 15 papers, illustrated and indexed, together with summarised reports of the discussions and a statement of the outstanding conclusions

THE CENTRAL VALLEY PROJECT, CALIFORNIA.

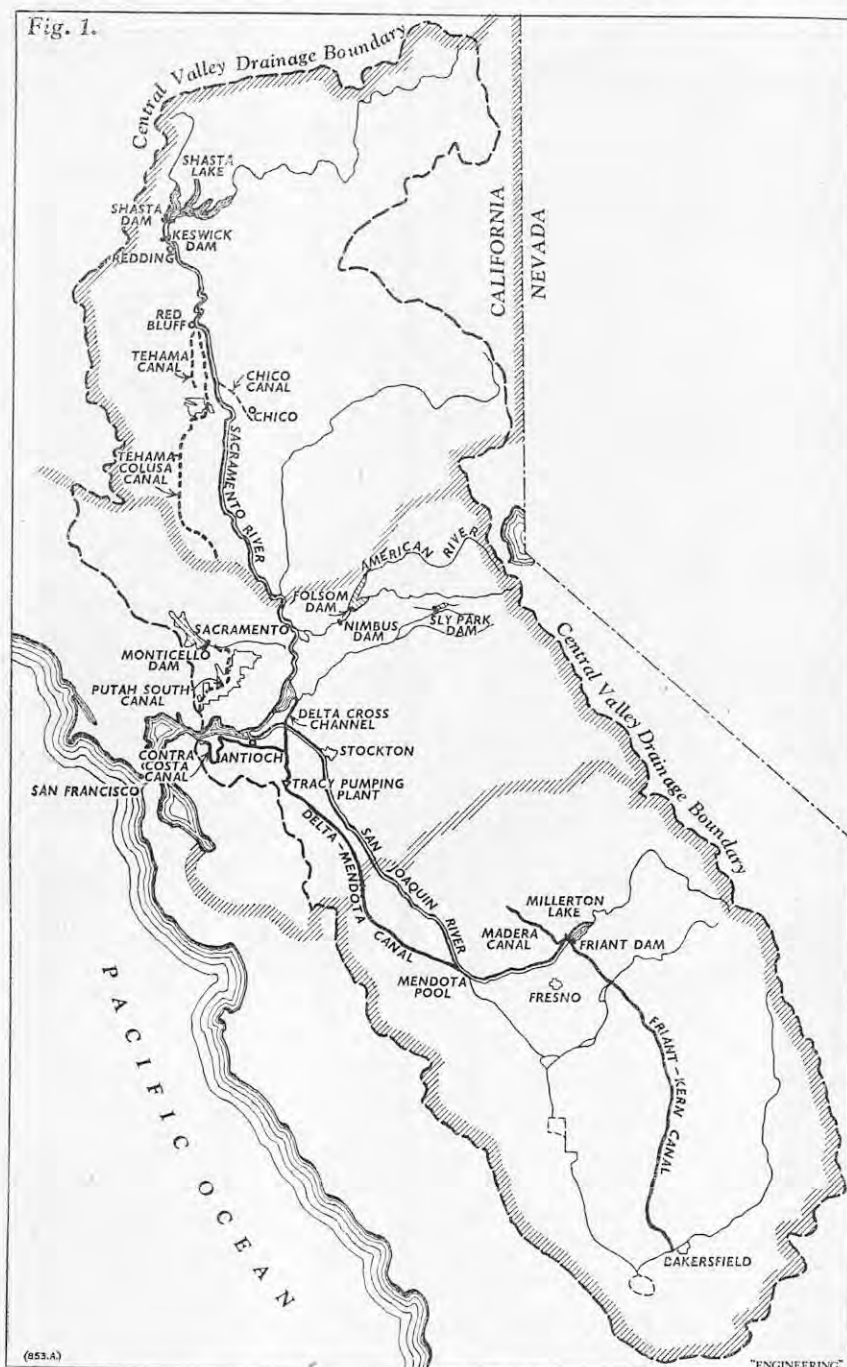


FIG. 2. TYPICAL GROUND-WATER IRRIGATION IN THE SAN JOAQUIN VALLEY.

THE CENTRAL VALLEY PROJECT, CALIFORNIA.

As indicated in an article dealing with reclamation projects in the western part of the United States, which appeared in our issue of June 27, 1952, on page 818, the scheme covering the Central Valley in California is one of the most ambitious and extensive. A general description of the main features of the project appeared in our columns nearly ten years ago. Since that time, much progress has been made and many constructional works described at that time as planned or in progress are now completed. The whole project covers such a large area that individual items may be situated at great distances apart and when completed may at first be only of local importance. The basis of the project, however, is that the valley shall be treated as a whole. Some items in the overall programme have been in operation since 1940, but the initial phase of the integrated scheme was inaugurated only in July, 1951, when a public celebration was held to mark the supply to the southern part of the valley of water controlled by the Shasta Dam in the north.

The Central Valley comprises two basins, that of the Sacramento River in the north and the San Joaquin River in the south. The combined basin extends nearly 500 miles in a northwest-southeast direction and averages about 120 miles in width. It includes more than one-third of California. The basin is entirely surrounded by mountains except for a narrow gap on its western edge through which the combined Sacramento and San Joaquin Rivers flow to the Pacific Ocean through San Francisco

reached, are here collected in a book for which both the Institute and its publishers may take credit.

In respect of subject matter, the papers fall into four main groups, the first of which comprises surveys of industrial problems involving particular aspects of fluid motion. Processes involving turbulent mixing of fluids and the flow of fluids combined with solid matter in particulate form serve aptly to introduce the general subject, since they are inherent in a very wide range of industries. Two other papers in this group, concerned with flow patterns and hydromechanics, emphasise the fundamental interactions between moving fluids and their constraining boundaries, and are helpful in introducing the second major group, where attention is directed to the theoretical, as well as the experimental, study of compressible fluids moving at high speeds, the atomisation of liquids, and flow through porous media or beds of granular materials.

Since one purpose implicit in the conference was to promote research into industrial problems of fluid motion, a major group of papers was devoted to reviews of experimental techniques for observing, measuring and recording fluid flow under controlled or plant conditions. The peculiar difficulties of such work at high temperatures accounts for a paper in this group dealing especially with fluid flow in

relation to the manufacture of steel, followed by an excellent account of a technique in which radon and a gold-leaf electroscope have been used for tracing gas flow in hot systems. In the final group of papers, applications of the knowledge and experimental methods illustrated earlier in the conference are exemplified by studies of the design of ejectors, the motion of particles in fluids, the resistance through beds of solid material, and the excitation of turbulence on ship models.

This last paper was one of several which emphasised the merits of reduced-scale models for experimental studies of fluid motion. Notwithstanding the difficulties of achieving valid similarity and interpreting the results, small-scale work offers an attractive line of approach from basic physics to improved industrial design and practice, and was accordingly recognised in the concluding statement appended to the *Proceedings*. Even more important, however, is the inference that fluid-flow physics is well worth active development. Probably the most valuable outcome of the conference has been to confirm the beneficial results of using physics more and more widely in all sorts of technologies, and this collection of papers will stimulate as well as instruct scientific workers throughout a corresponding range of industries.

CENTRAL VALLEY IRRIGATION PROJECT, CALIFORNIA.

(For Description, see Page 1.)



FIG. 2. SHASTA DAM AND LAKE, ON THE SACRAMENTO RIVER.



FIG. 3. TYPICAL INTENSIVE CULTIVATION IN THE SACRAMENTO—SAN JOAQUIN DELTA AREA.

Bay. The valley floor is a gently sloping, practically unbroken alluvial plain, which comprises nearly one-third of the basin area. It is about 400 miles long and averages about 45 miles in width. The surrounding two-thirds of the basin is mountainous. To the east of the main valley is the Sierra Nevada, which rises gradually from the valley floor to the peaks of the divide, several of which are more than 14,000 ft. in elevation. The Coast Range, to the west of the main valley, is less rugged and lower in altitude, its crest being generally less than 4,000 ft. in elevation, except at the northern end. The Coast Range separates the interior Central Valley from the Pacific Ocean.

Population, agriculture and industry are principally concentrated on the main valley floor, but the surrounding mountains play an important part in the valley development; the heavier precipitation in the mountains provides the main source of the water supply essential for successful development. The mountain regions have, in addition, considerable areas of land suitable for crop production and grazing, and are rich in minerals, forests, hydro-electric power sites and recreational areas. The Central Valley Project is a comprehensive plan for the full conservation, control and use of the water resources of the basin. The main water-control features of the scheme are shown in the accompanying map, Fig. 1, opposite. Much of the project is now in service. The post-war or initial phase of the programme includes works to serve the pressing needs of the Central Valley up to the year 1960, but the project envisages many more works for the maximum expansion of water use; the construction of additional works under the comprehensive plan may well be extended up to the end of the present century or later.

More than 75 years ago, it was foreseen that the growth and wealth of California depended on an irrigated-farm economy, and that the vast extent of dry lands and the disparity of rainfall and water distribution would ultimately require a corrective programme of great scope and cost. One of the first men to put forward a plan was Colonel Robert B. Marshall, chief geographer for the United States Geological Survey. In 1891, when he first toured this inland basin, Marshall conceived a great system of dams, canals and other works. His plans were made public in 1919, and were placed before the California legislature in 1921. There followed the State Water Plan of 1931, forerunner of the Central Valley Project. After the people of California had approved the plan, Federal assistance was sought and, in September, 1935, President Roosevelt allocated funds for the project under the Emergency Relief Act. Construction began on October 19, 1937, under the direction of Mr. Walker R. Young, later Chief Engineer for the Bureau of Reclamation.

PURPOSES OF THE PROJECT.

The main purpose of the Central Valley Project is an equalisation of the basin's water resources between the well-watered northern area and the water-deficient southern two-thirds of the valley, providing for the irrigation of more than one million acres of fertile farm lands. Two-thirds of the basin's water supply originates in the Sacramento River watershed, while only one-third of the irrigable land lies in that valley; conversely, two-thirds of the basin's irrigable land lies in the San Joaquin Valley, while only one-third of the water supply originates in that area. Other objectives, all by-products of water storage and conservation, include the release of water from Shasta Lake to improve navigation on the Sacramento River; stopping and storing peak-flood flows on the Sacramento, American and San Joaquin Rivers; generation of hydro-electric power at Shasta, Keswick and Folsom dams; the supply of water to municipalities and industries; a steady flow of water to the low-lying delta to repel the salt water of San Francisco Bay; conservation of fish and wild life; and recreational opportunities on and near the newly-created lakes of the project.

Since two-thirds of the water supply to the valley comes down the Sacramento River, the Shasta Dam, controlling the flow of that river and forming Shasta Lake, may be looked upon as the key structure of the whole scheme. A general view of the dam

and lake, with 14,141 ft. Mount Shasta in the right background, is given in Fig. 3, on Plate I. A detailed description of the dam has already appeared in these columns,* and it will not be dealt with here. Its position at the head of the valley is shown in Fig. 1. The Keswick Dam, eight miles downstream from the Shasta Dam, is a much smaller structure; it forms an afterbay reservoir below Shasta. Further control of the lower reaches of the Sacramento River will be provided by the Folsom Dam, now under construction on the American River, which joins the Sacramento River at Sacramento.

These works enable peak winter floods to be controlled, low summer flows increased, hydro-electric power to be generated, navigation on the Sacramento improved, and salt water prevented from intruding into the delta channels. Surplus waters are diverted to the Delta Cross Channel, supplied to the Tracy pumping plant and lifted 200 ft. into the Delta-Mendota Canal, to flow another 120 miles south to Mendota Pool on the San Joaquin River west of Fresno. At this point the imported northern supply replaces the irrigation duty formerly performed by the San Joaquin River. By this exchange San Joaquin waters can be retained behind Friant Dam and diverted still farther south—largely into the 153-mile Friant-Kern Canal for irrigation of the critically water-deficient areas along the east side of the San Joaquin Valley as far down as Bakersfield. As part of this mass movement of water from north to south, other water supplies are provided, as needed, along the Sacramento River; in Contra Costa County from the 48-mile Contra Costa Canal, which joins the Delta Cross Channel; along the lower west side of the San Joaquin Valley, from the Delta-Mendota Canal; and in Madera County from the 37-mile Madera Canal which connects from Friant Dam. Power developed by the project is used to drive the pumping installation at Tracy and in cities and farms throughout the area. Revenues from power supplies and from irrigation and municipal water supplies largely meet the construction costs of the project.

It is estimated that the initial phase of the Central Valley Project, which covers the works now, or soon to be, in operation, will cost approximately 400,000,000 dols., of which 87 per cent. will be repaid through the sale of water and power developed by the project over a sixty-year period. Sale of power is expected to repay 45 per cent. and sale of water 42 per cent. of the total cost; the remaining 13 per cent. is charged to non-reimbursable items such as flood control and navigation. When all authorised works of the Central Valley Project are completed, it is estimated they will have cost 622,800,000 dols.

CLIMATE AND RUN-OFF.

The climate of the Central Valley is characterised by rainy winters and dry summers. Rainfall on the main valley floor is relatively light, decreasing from an annual average of 23 in. at Red Bluff in the north to 6 in. at Bakersfield in the south. Eighty-five per cent. of the precipitation occurs from November to April. The almost complete absence of rainfall during the summer makes irrigation imperative for production of most agricultural crops. The average frost-free period in the valley exceeds 7½ months and the remaining winter months are mild, with an average of less than 15 days per year with minimum temperatures below 32 degrees. The moderate winter climate permits production of citrus fruits, the less hardy deciduous fruits, and other specialised crops which require mild winters and long growing seasons. The mountains surrounding the main valley floor receive much greater precipitation and have a more severe winter climate. In the Sierra Nevada, the average annual precipitation varies from about 80 in. east of Chico in the northern part of the basin to 35 in. in the southern Sierras. At the higher elevations in the mountains, precipitation occurs largely as snow. Rainfall on the Coast Range is much less than on the Sierra Nevada. Run-off from the mountain areas is the principal source of the water supply so essential for successful development of the main valley floor.

Run-off follows the trend of precipitation, but only in a general way. Over nine-tenths of the total run-off comes from the Sierra Nevada, and less than one-tenth from the Coast Range. Winter rainfall on the Coast Range and on the foothills of the Sierra Nevada causes immediate run-off, practically all of which occurs from December to April, a period of little irrigation demand. Snow storage in the high Sierras delays the major portion of the run-off from that area until April, May and June. One-half of the normal annual run-off into the valley occurs during these three months. The average annual run-off is 33,000,000 acre-feet, but individual years have varied from one-fourth to twice the average amount. Large reservoirs are therefore necessary to regulate seasonal and year-to-year variations in run-off.

Agriculture, based principally on irrigation, is the basic activity in the Central Valley. One-fourth of the people in the basin live on farms. A large part of the remaining three-fourths derive their living as a direct result of the irrigated agriculture. In 1939, the 59,000 farms in the Central Valley produced crops and livestock products valued at more than 220,000,000 dollars. In 1950, crop values in the seven San Joaquin Valley counties were 972,000,000 dollars. Over 90 per cent. of the gross farm income of the basin is from irrigated crops. A view of a cultivated district in the Sacramento-San Joaquin delta area is given in Fig. 4, on Plate I. Other economic activities depend in large measure on the basic agricultural production of the basin, such as processing agricultural crops. Important manufacturing industries include printing and publishing, wood and wood products, iron and steel products and oil refining. Petroleum, natural gas and gold are the principal mineral products. Lumbering in the pine region of the Sierra Nevada is an industry of considerable importance and there is also a commercial catch of salmon spawned in Central Valley streams.

Before the initiation of the integrated project, much progress had been made in the use of the water resources, largely through the efforts of private enterprise and local community organisations; the principal use was for irrigation. Existing irrigation works include thousands of wells which tap underground reservoirs, typified by the installation shown in Fig. 2, opposite, thousands of miles of canals and laterals to distribute water by pumping or gravity diversion from the main streams of the valley, and hundreds of reservoirs, both large and small, for water regulation. These facilities in 1943 delivered water to 3½ million acres of land. In addition, there are municipal water supply systems, dependent on direct stream diversion or ground-water pumping, for all the important towns and cities in the basin. The more notable municipal developments are those of the East Bay district and of the city of San Francisco, both of which have constructed large storage reservoirs in the Sierra Nevada and long aqueducts across the San Joaquin Valley and the Coast Range to import water from the Central Valley basin into the San Francisco Bay area.

(To be continued.)

REMOVAL OF RESTRICTIONS ON USED JUTE BAGS.—The Minister of Materials has issued the Control of Textile Bags (Revocation) Order, 1952 (S.I. 1952, No. 1155), as a result of which all restrictions on the use of used jute bags are removed.

THE ARC WELDING OF ALUMINIUM ALLOYS.—Considerable progress has been made in the development of electrodes for the arc welding of aluminium alloys for a variety of applications, including shipbuilding, structural work and general engineering. The latest aluminium-5 per cent. silicon electrode made by Murex Welding Processes, Ltd., Waltham Cross, Hertfordshire, produces welds having a very high tensile strength, the minimum claimed being 10.5 tons per square inch. This type of electrode has been approved by the Ministry of Supply for the welding of military bridging equipment and it has many special features. The electrode is said to be smooth running and simple to use, and, being of the extruded type, it has the advantages of uniformity of coating and welding properties. The slag is easy to remove and while the electrode is primarily designed for welding in the down-hand position, it can be used, if required in any other position.

* ENGINEERING, vol. 157, page 1, et seq. (1944).

ATOMISATION OF FUEL SPRAYS.*

By PROFESSOR E. GIFFEN.

HERBERT AKROYD STUART was the inventor of the compression-ignition engine with direct spraying of liquid fuel into the combustion chamber. In one of his engines he injected the fuel near the end of the compression stroke, as in the latest types of compression-ignition engine, but, to his disappointment, this engine was not developed commercially. Instead, the better-known Hornsby-Akroyd engine employed injection of the fuel into the hot combustion chamber during the suction stroke, so that evaporation could take place before the end of the compression stroke. This was regarded by the engine manufacturers as more reliable in principle, and it is difficult to say now whether it would have been possible to develop a successful and practicable system for high-pressure fuel injection with the knowledge and facilities available at the time. As we know, the Diesel engine met that difficulty by using blast air for injection of the liquid fuel, and it was not until about 20 years later that the real development work on "airless" injection began.

Since that time a great deal of effort has been devoted to the investigation of the phenomena associated with the breaking up of a fuel charge into the finely-divided spray required for satisfactory combustion in an engine. Other applications have also been found for liquid-fuel sprays, as, for example, oil-fired boilers, petrol-injection in spark-ignition engines, and, what is the most important recent development, the gas turbine. With these newer applications many of the operating conditions, such as injection pressure and air density, are not the same as in the compression-ignition engine, and so there is still a need to continue the investigation, and to enlarge its scope.

So much work has already been done, and so much detailed information has been obtained, that it might be expected that the fundamentals of the subject would now be well understood. However, this is not so; most of the results obtained by the many workers in this field are applicable only within the range of experimental conditions under which they were obtained. The basic mechanism of the disintegration of a jet of liquid is understood in a general way, but so many variables are involved that the influence of each is difficult to estimate.

A liquid jet discharged from an orifice at low velocity is under the influence of gravity and surface-tension forces, the resistance offered by the air being negligible. At a very low velocity individual drops form slowly at the orifice under the action of gravity. When the velocity is increased, the liquid is discharged as a compact continuous jet which, under the action of surface tension forces and internal disturbances in the flow, may collapse if its length is greater than its circumference, dividing subsequently into small drops. At higher velocities the turbulence in the flow becomes more important, the radial velocity components tending to cause a widening of the liquid jet and its eventual disruption. The air-resistance forces also become important as the jet velocity is increased, the variation in air pressure on the surface of the jet tending to accentuate any surface irregularities and therefore to hasten the disintegration process. This breaking up of the jet is resisted by surface tension and viscosity forces in the liquid, and the extent to which a jet is sub-divided, or atomised, depends on the relative magnitudes of the turbulence in the flow and the air-resistance forces on the one hand, and the surface-tension and viscosity forces on the other. At high jet velocities, such as are used in practical applications of fuel sprays, the disintegration begins directly at the orifice, when it becomes very difficult to observe the actual mechanism of disruption.

Fig. 1 (from Simons, 1946)[†] shows a kerosine spray from a swirl atomiser. Here the injection

ATOMISATION OF FUEL SPRAYS.

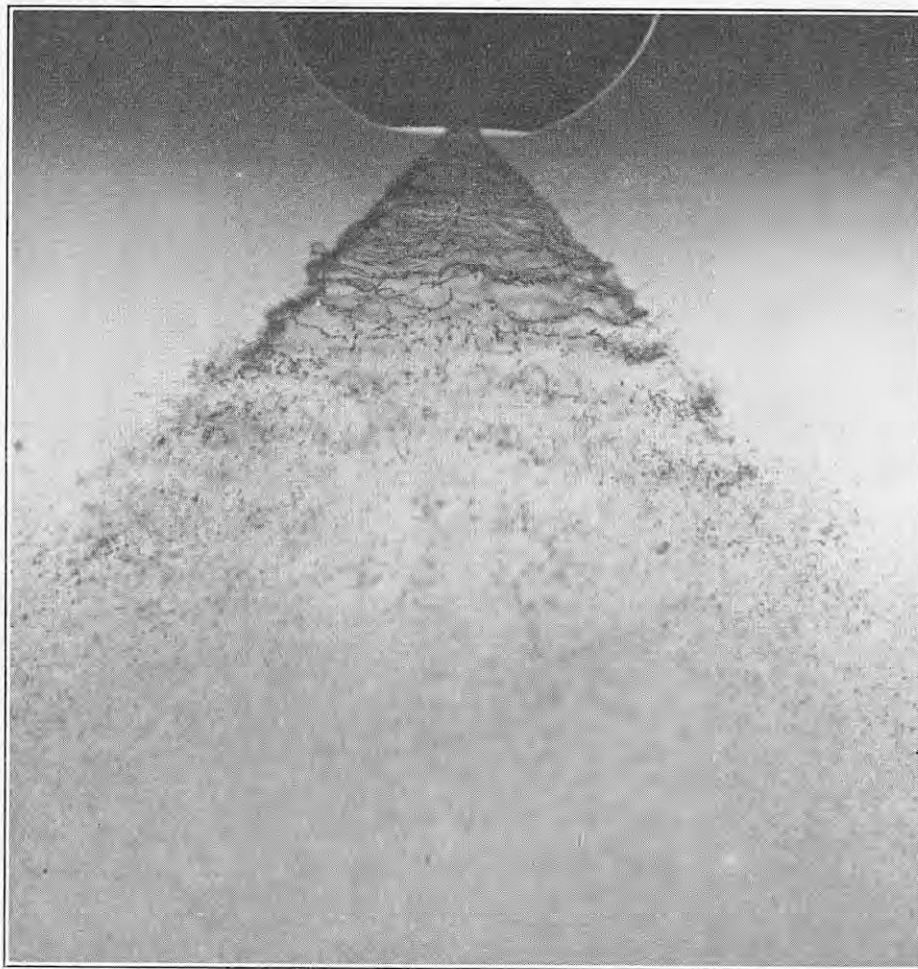


FIG. 1. KEROSENE SPRAY FROM SWIRL ATOMISER.

pressure (and hence the jet velocity) is not sufficient to cause atomisation to begin at the orifice, and the illustration shows some of the stages in the development of such a spray. Of special importance are the "ligaments" of liquid, here seen transverse to the axial direction of the spray. The conical sheet of liquid leaving the orifice becomes thinner with increasing radius until it finally disintegrates into these ligaments, which then break up into small droplets. In practical applications the jet velocity is so high that the intervening stage of a conical sheet of liquid cannot be discerned, and droplets are formed immediately on leaving the orifice. Whether ligaments are then an intermediate product in this type of spray is not known.

The droplets formed at the atomiser orifice do not necessarily remain intact during the subsequent motion of the spray through the air. Two opposing influences are at work; collisions of small droplets may lead to their combining to form larger droplets, and the resistance of the air may cause large droplets to be sub-divided. This latter effect is well shown in Fig. 2,* opposite (from Lane and Edwards, 1949). In these experiments single droplets of uniform size were allowed to fall into a vertical tube of transparent material down which a stream of air was drawn at a known velocity. Flash photographs were taken at different distances down the tube, and these photographs, of different droplets, were assembled as in Fig. 2 to show the sequence of events for any one droplet. For a given size of droplet it was found that splitting did not occur unless the air velocity exceeded a certain value. For the conditions of Fig. 2 the diameter of the droplets was 0.102 in. and the minimum air velocity for disruption was about 75 ft. per second. It is seen from Fig. 2 that the droplet is first flattened to form a circular ring with a thin membrane in the centre. This membrane is then blown out into a hollow bag which bursts and produces a shower of

fine droplets. The pictures show successive stages in the formation of the hollow bag and its disintegration, which proceeds as a wave travelling back towards the thicker rim. When the wave strikes the rim the latter throws off small droplets and then itself breaks into larger droplets.

It was mentioned above that disintegration of a liquid jet is promoted by turbulence in the flow of the liquid from the orifice and by air resistance, and is opposed by the viscosity and surface-tension forces of the liquid. It would appear, therefore, that the atomisation of a spray will be affected by the design of the atomiser, the discharge velocity, the viscosity and surface tension of the liquid, and by the density and viscosity of the air into which the spray is discharged. It is not possible in one lecture to deal with the effects of all these variables, or to study all the characteristics of a fuel spray that are important in practice, and I have decided, therefore, to restrict the scope of the lecture to some aspects of the problem on which experimental work has been proceeding for the last few years at Queen Mary College, University of London, with the financial support of the Motor Industry Research Association. This work has been concerned mainly with the measurement of atomisation and the effects of some important variables on the atomisation of low-pressure sprays.

Different methods have been used by different investigators to determine the atomisation of a spray. For the most complete information about the droplet size, it is necessary to measure and count large numbers of droplets, and as this is a very laborious task, efforts have been directed towards the development of simpler methods. At present, the more usual methods are based on (a) allowing a representative sample of the droplets to fall on glass slides, coated with a suitable substance in which the droplets make impressions, which are then counted and measured; (b) spraying a liquid, such as molten wax, which has approximately the same physical properties as the actual liquid before spraying, but which solidifies when

* Akroyd Stuart Memorial Lecture. Delivered at Nottingham University on Friday, February 29, 1952. Abridged.

[†] "Photographs of Sprays from Pressure Jets," Aero. Res. Council, Rep. and Memor. No. 2343, Sept., 1946.

* Figs. 1 and 2 are reproduced from Crown copyright photograph

ATOMISATION OF FUEL SPRAYS.

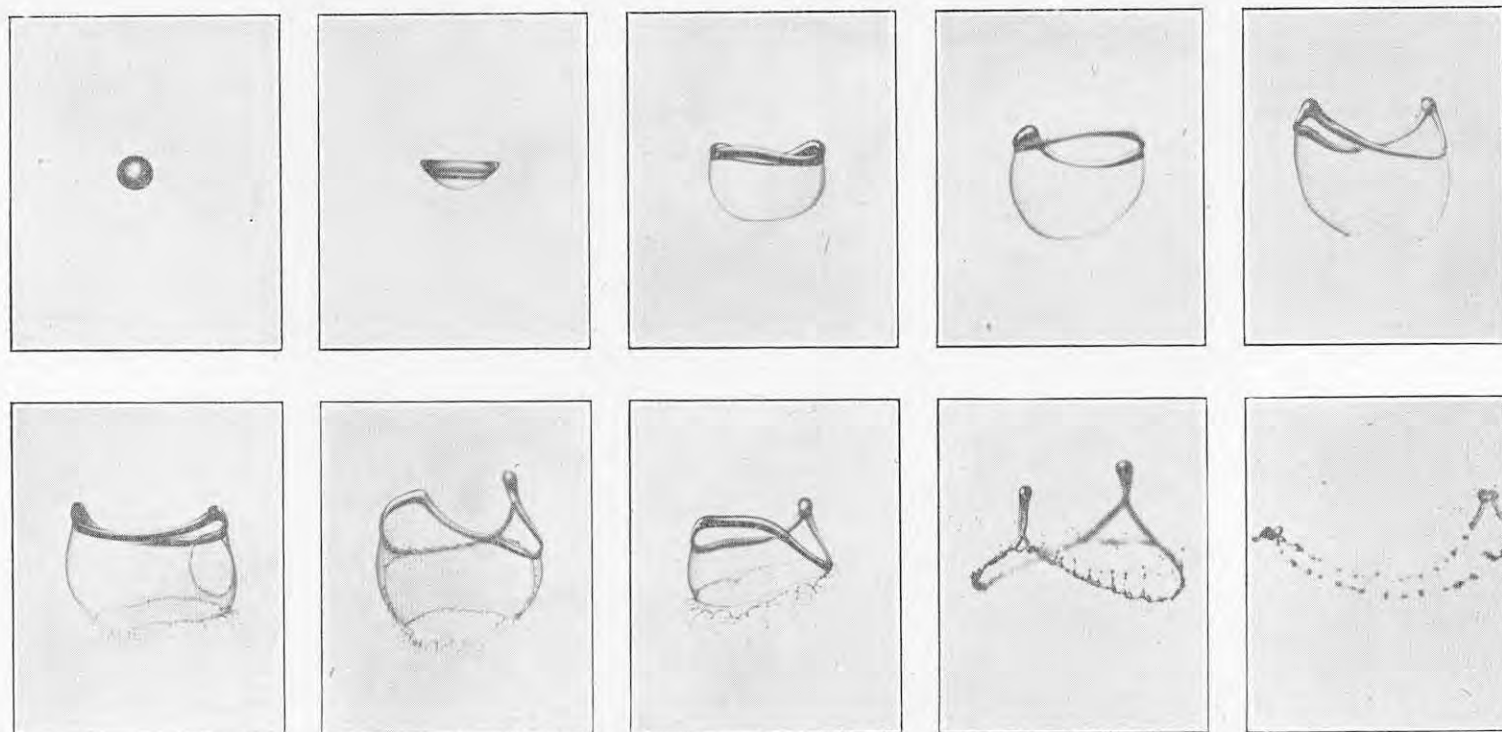
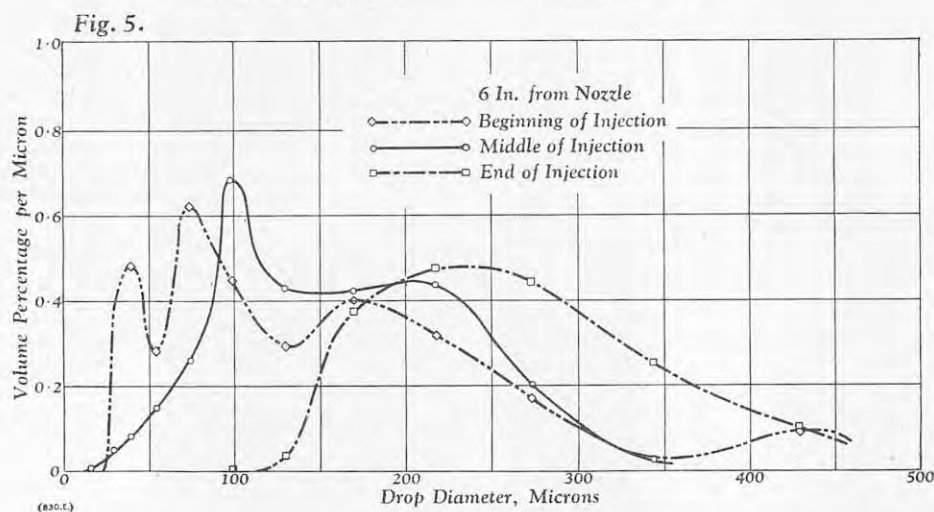
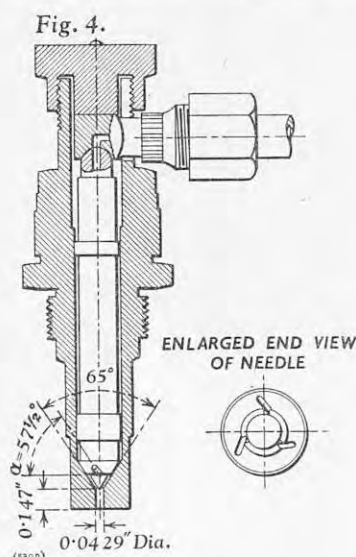
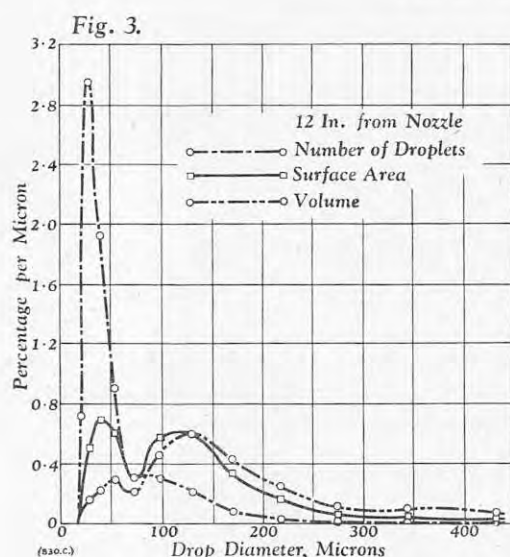


FIG. 2. BREAK-UP OF DROP OF WATER IN STREAM OF AIR.



the spray is discharged into the atmosphere—a sample of the wax spheres may then be separated into size groups by sieving, and it is only for the smallest spheres, which pass the finest sieve, that counting and measuring are required; (c) photographing sections of the spray by flash photography and using the photographs to count and measure the droplets in the field of view, and also to find

their velocities. Each method has its own advantages and disadvantages, but all three give the numbers of droplets in different size groups in the spray sample, and hence in the whole spray. This information may then be used to plot a size-frequency curve for the spray and to calculate the mean droplet size and a non-uniformity factor.

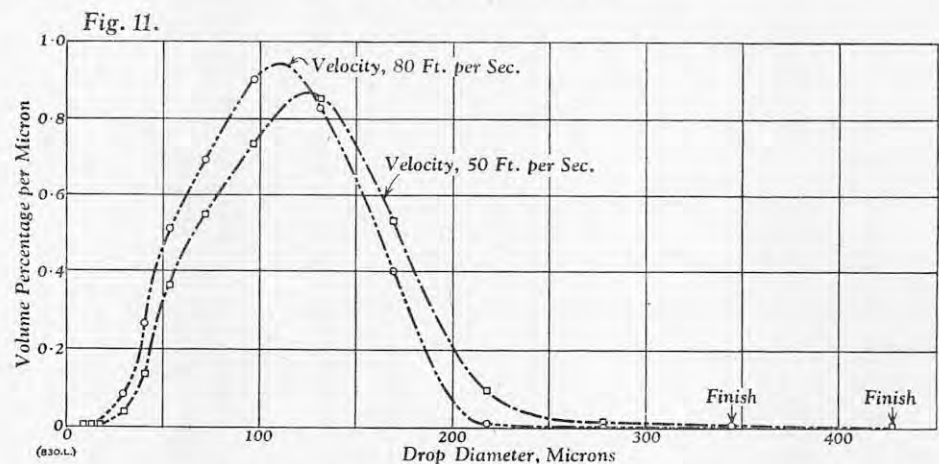
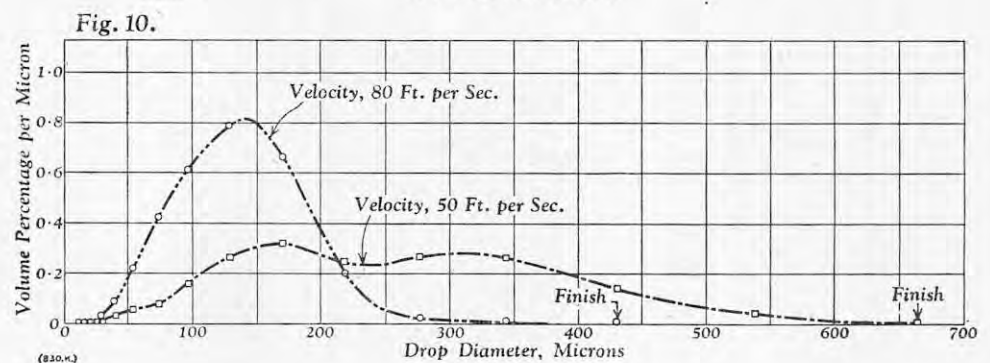
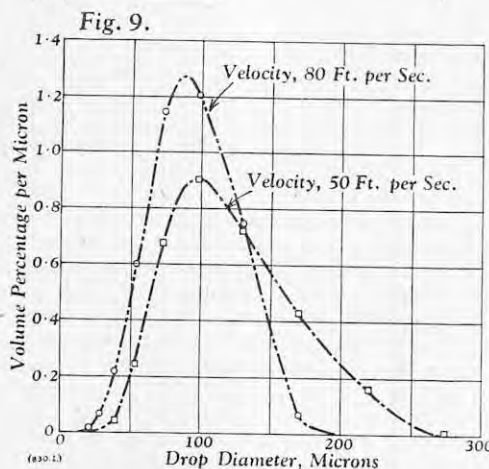
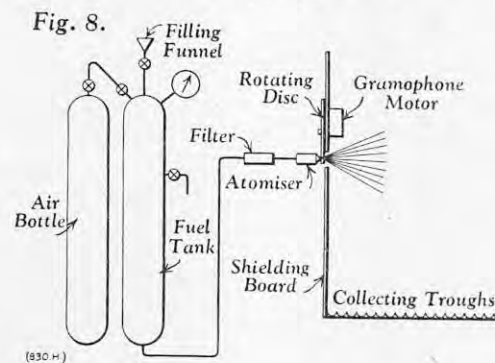
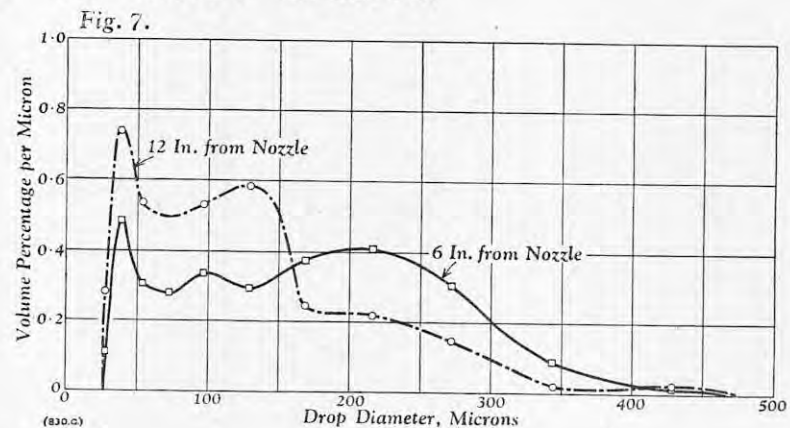
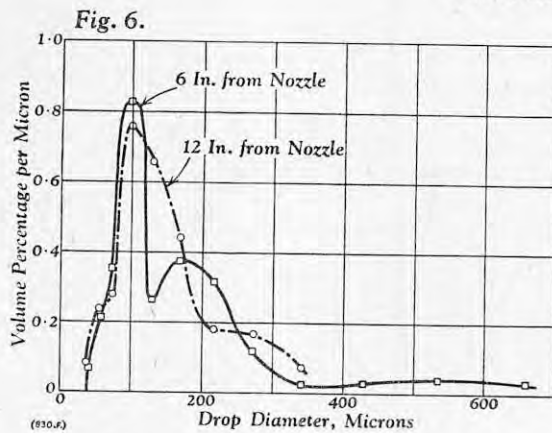
The method used at Queen Mary College is the

first of the three mentioned above. Glass microscope slides are coated with magnesium oxide, by holding them over a burning magnesium ribbon, and spray droplets impinging on this coating leave impressions which are easily measured under the microscope. The impressions are not exactly the same size as the droplets, but it is possible to obtain a relationship between the two by a separate experiment. To obtain a representative sample the coated slides are suitably disposed in the path of the spray, which is allowed to impinge on them for only a short time, in order to avoid collecting too many droplets and introducing errors caused by overlapping of the impressions. The time of exposure of the slides may be controlled by a rotating disc in front of the atomiser, with a slot of the required width, and by using a shutter to allow only one injection to impinge on the slides.

This method of measurement has advantages for the investigation of intermittent sprays, such as are used for reciprocating engines. In such a spray the injection pressure varies during the injection; and consequently the discharge velocity, and hence the fineness of atomisation, changes during the period of injection. The rotating disc is driven by an extension of the injection-pump shaft, so that the small slot may be set at any required angular position relative to the beginning of injection; a number of samples taken at different stages of the injection are then measured and counted, and the results show how the atomisation varies during this period.

Fig. 3 shows the kind of size-frequency curve obtained by the above procedure. This refers to a sample collected over 5 deg. angular rotation of the pump shaft at the middle of the injection period. The spray in this case was produced by a swirl atomiser, of a type used for petrol injection, with a period of injection of 50 deg.; the pump speed was 500 r.p.m., and the injection pressure was low compared with the values used in compression-ignition engines, giving a mean discharge velocity of about 42 ft. per second during the sampling interval. The liquid was safety fuel, with a kinematic viscosity of 1.8 centistokes at 20 deg. C. The three curves in Fig. 3 show the percentage of the number of droplets, the surface area, and the volume, corresponding to the various size groups to which the droplets were assigned during counting. Each point plotted on the diagram represents the percentage for a size group divided by the width of the group in microns. Thus the area under the curve gives the percentage of the number, surface

ATOMISATION OF FUEL SPRAYS.



or volume of droplets over any chosen section of the size range. It will be seen that the droplet diameter varied from 20 to 430 microns, and that the greatest number of droplets occurred at a group diameter of 30 microns, while the maximum volume was found at about 130 microns.

When the number of droplets in each size group is known, a mean droplet size may be calculated. The usual basis of calculation gives the diameter of droplet that would apply to a spray of constant droplet size, and having the same volume and same surface area as the droplets (of different sizes) in the actual spray. This is called the Sauter Mean Diameter for the spray. If n is the number of droplets in a size group of mean diameter d in the spray sample, the Sauter mean diameter d_m is given by $d_m = \frac{\sum nd^3}{\sum nd^2}$. The range of droplet size in a spray, and the variation from the S.M.D., can only be clearly indicated by a size-frequency curve, but a general indication of the degree of non-uniformity is given by the ratio $\frac{\sum n}{n_m}$, where $\sum n$ is the total number of droplets in a spray sample, and n_m is the number of droplets the spray would contain if the droplets were all the same size, equal to the S.M.D. A completely homogeneous spray has a non-uniformity factor of unity; in any other spray $\sum n$ is greater than n_m , and the factor is greater than unity.

Table I gives the results of experiments made under comparable conditions, with variations in such quantities as (a) the portion of the injection period over which the sample was taken, with con-

TABLE I.—Atomisation Tests on Intermittent Sprays.

Expt. No.	Distance From Atomiser, In.	Portion of Injection Period.	Discharge Velocity, Ft. Per Sec.	S.M.D. Microns.	Non-uniformity Factor.
1	6	Beginning	41.2	133	2.20
2	6	Middle	43.0	130	3.58
3	6	End	12.5	248	1.25
4	6	Middle	50.5	133	2.34
5	12	Middle	50.5	117	1.81
6	6	Middle	68.3	121	2.96
7	12	Middle	68.3	93	2.17

stant pump speed; (b) the distance from the atomiser to the point at which the droplets impinged on the slides; and (c) the discharge velocity. The atomiser was of the open-swirl type, Fig. 4, on page 7, the swirl being generated by helical grooves in the conical end of the atomiser stem. The helix angle was $57\frac{1}{2}$ deg. and the grooves were 0.032 in. wide and 0.020 in. deep. The atomisation given by this type of atomiser is not generally as good as is obtainable from later types, but this would not affect the relative values, showing the influence of changes in the operating conditions. The pump speed was 250 r.p.m., and the liquid was safety fuel.

In experiments 1, 2 and 3 the sample was taken during 5 deg. rotation of the pump shaft, (1) near the beginning, (2) at the middle, and (3) near the end of the injection period, which extended over

51 deg. of pump-shaft rotation. The atomiser was of the "open" type, for which a large decrease in discharge velocity before the end of injection is a typical characteristic. Table I shows the mean discharge velocities during the three stages of injection as being 41.2, 43.0 and 12.5 ft. per second, the corresponding values of Sauter mean diameter being 133, 130 and 248 microns, respectively. Besides showing the effect of variation in discharge velocity on atomisation, these results indicate the way in which the atomisation of an intermittent spray changes during the period of injection, and emphasise in the present instance the disadvantage of the "open"-type atomiser in giving a much coarser spray at the end of the injection. Droplet size frequency curves for experiments 1, 2 and 3 are given in Fig. 5, on page 7. It is interesting to note that the size of the biggest droplets is about the same in experiments 1 and 3 at 430 microns, as compared with about 350 microns in experiment 2. The outstanding difference in the three curves is the much smaller volume of droplets below 100 microns in experiment 3; this is a direct result of the lower discharge velocity, and also explains the lower value of the non-uniformity factor.

Experiments 4 and 5 were made at the same atomiser conditions, but with the collecting slides at different distances (6 in. and 12 in.) from the atomiser. Experiments 6 and 7 were similar to experiments 4 and 5, but at a higher discharge velocity. An interesting and important result of these experiments is the reduction in S.M.D. in each case with increasing distance from the atomiser.

With a discharge velocity of 50.5 ft. per second (experiments 4 and 5) the droplet mean size decreased from 133 microns at 6 in. to 117 microns at 12 in., and with a discharge velocity of 68.3 ft. per second the corresponding figures were 121 and 93 microns. The droplet size-frequency curves for experiments 4 to 7 are shown in Figs. 6 and 7, opposite. The important point to notice in each diagram is the marked reduction in the volume of large droplets in the sample at 12 in. from the atomiser as compared with the sample taken at 6 in., and the increase in smaller droplets. It is seen that the change in atomisation, as shown by the values of S.M.D. in Table I, is caused by the disruption of large droplets by air resistance; and, as would be expected, the improvement in atomisation between 6 in. and 12 in. from the atomiser is greater at the higher velocity in experiments 6 and 7 than in experiments 4 and 5. These results show the part played by air resistance in causing disintegration of the larger droplets in the spray.

In order to reduce the time required for counting and measuring the large number of droplets in a sample of the spray, a somewhat different method of assessing atomisation has been used in some tests with continuous sprays. It was based on the observation that, with a spray directed horizontally, and falling on slides placed on a horizontal table below the spray axis, although the mean size of the droplets varied with the distance from the atomiser, first increasing and then decreasing, the mean droplet size remained more or less constant on a line perpendicular to the spray axis. This observation does not necessarily apply to all atomisers but its accuracy was checked for those atomisers for which the method was subsequently used. In the method as now used, a small amount of blue dye is

$\sqrt{(A^2 + T^2)}$ where A is the average value of the axial velocity of the liquid leaving the orifice, and T is the average value of the tangential velocity. For any injection pressure the average axial velocity may be determined from a knowledge of the coefficient of discharge and the effective cross-sectional area of the orifice (area of orifice — area of air core in centre of orifice); and the average tangential velocity may be derived from this axial velocity and the cone angle of the spray ($\frac{T}{A} = \tan \frac{\alpha}{2}$ where α is the cone angle).

Three liquids were used in the experiments, in order to cover a range of viscosity and surface tension. The first, safety fuel, has physical properties between those of petrol and kerosine; the second, a light lubricating oil, has a greater viscosity than the safety fuel but nearly the same surface tension; and the third, water, has approximately the same viscosity as safety fuel but a much higher surface tension. For each liquid two different discharge velocities were used, 50 ft. and 80 ft. per second. For each liquid separate experiments were made to find the injection pressure required to give each value of the resultant discharge velocity. Table II shows the physical properties of the liquids and the values of injection pressure used in the atomisation tests. It also gives the results of the tests in terms of S.M.D. and non-uniformity factor.

Drop size-frequency curves for the three liquids are shown in Figs. 9, 10 and 11, opposite, and these, with the numerical values in Table II, bring out the effects of discharge velocity, viscosity and surface tension on the atomisation of the sprays. The difference between each pair of curves in these figures shows the effect of a change in discharge velocity. An increase in velocity in each case

Table II shows that the increase in surface tension appears to cause a slight reduction in S.M.D. at the lower value of discharge velocity, and a slight increase at the higher velocity.

The 15-fold increase in viscosity from the first liquid to the second is small compared with the range of viscosity between the lightest and heaviest liquid fuels, and the three-fold increase in surface tension from safety fuel to water is much greater than the range of surface tension in liquid fuels. It can be concluded from these results, therefore, that the variations in surface tension that can occur from one liquid fuel to another have no appreciable effect on atomisation, whereas the changes that are possible in the viscosity of the fuel have a major influence on the atomisation of the spray. It would be wrong, however, to say that surface tension has little effect on atomisation compared with viscosity; the ranges of these variables in the experiments were 15:1 and 3:1. If it were possible to test liquids with a range of surface tension of 15:1, it might be found, for example, that the effect on the size of the largest droplets would be just as great as the effect of viscosity. For the liquid fuels in general use, however, the generalisation is true that viscosity is very important and surface tension relatively unimportant.

An interesting point about the curves in Figs. 9 to 11, and indeed in all the other size-frequency curves, is that there was no appreciable change in the size of the smallest droplets in the spray. It might be expected that a change in discharge velocity or in viscosity would change the size of the smallest droplets as well as of the largest, but this does not occur; instead, the minimum size of droplet seems to be approximately the same under practically all conditions, with this swirl atomiser. Even when the pressure was increased to about 750 lb. per square inch no drops smaller than 8 to 10 microns could be detected. If smaller droplets had been present they could easily have been seen, as were smaller droplets of condensed water vapour.

One of the important requirements of the fuel spray for a reciprocating engine is that the engine should start readily from cold, even at sub-zero temperatures. Although it might be expected that the effect of fuel temperature on atomisation would depend only on the change in viscosity, it was thought desirable to make a test to see if any other influences were at work. Two liquids were used: one, safety fuel, had a viscosity of 3.0 centistokes at -8 deg. F.; the other was a mixture of safety fuel and a refrigerator lubricating oil, in such proportions that the mixture had the same viscosity at atmospheric temperature (70 deg. F.). Atomisation tests were made with the two liquids, one at atmospheric temperature and the other in a cold room at -8 deg. F. The pump was motor-driven, giving an intermittent spray from the atomiser shown in Fig. 4, and the apparatus for cutting off a sample from the middle of the spray was that already described for experiments 1 to 7. The atomisation was measured by the method described for experiments 8 to 15. Experiments were made with each liquid at three different settings of the pump. Although each pair of tests should have been at the same discharge velocity, direct measurements of the discharge showed consistently higher values for the low-temperature experiments. No explanation was found for this, except possibly an inadvertent rise in pump speed at the low temperature. The values of Sauter mean diameter for the six experiments are shown in Table III, below.

TABLE III.—Effect of Temperature on Spray Atomisation.

Experiment No.	Pump Setting.	Temperature, deg. F.	Discharge Velocity, Ft. Per Sec.	S.M.D. Microns.
14	I	73	54	128
15		- 8	60	160
16	II	75	63	118
17		- 8	68	141
18	III	72	66	95
19		- 8	76	132

TABLE II.—ATOMISATION TESTS WITH SWIRL ATOMISER CONTINUOUS SPRAYS.

Experiment No.	Liquid	Kinematic Viscosity at 20 deg. C., Centistokes.	Surface Tension at 20 deg. C., Dynes Per Cm.	Specific Gravity.	Resultant Discharge Velocity, Ft. Per Sec.	Injection Pressure, Lb. Per Sq. In.	S.M.D. Microns.	Non-Uniformity Factor.
8	Safety Fuel	1.80	23.9	0.77	50	49	109	1.53
9					80	144	86	1.56
10	Light lub. oil	32.0	32.0	0.86	50	50	200	3.19
11					80	152	112	1.91
12	Water	1.01	73.0	1.00	50	71	100	1.88
13					80	191	90	2.23

added to the spray liquid and the spray is discharged horizontally, as shown in Fig. 8, over a tray containing a series of troughs, each 1 in. wide, arranged side by side and transverse to the spray. A slotted disc, driven by a gramophone motor, rotates in the path of the continuous spray, in order to reduce the penetration of the sample to a distance suitable for collection in the troughs, and a shutter is provided to control the time during which the spray impinges on the slotted disc. The experiment is carried out in two parts. First the troughs are partly filled with undyed liquid, and the dyed test liquid is sprayed into the air, the droplets falling into the troughs; the volume of spray in each trough is then found by measuring the colour density of a sample of the mixture. The second part consists in spraying again under the same conditions, the droplets falling on a row of slides coated with magnesium oxide, placed on top of the tray and below the spray axis. The proportions of droplets in different size groups for each trough are then found by measuring and counting the droplets on a narrow strip of each slide. From this information, and the volume of spray in each trough, the number of droplets in each size group is found for each trough, and hence for the whole spray. As with the previous method, the results may be shown as droplet size-frequency curves, in terms of droplet number, surface area, or volume, and may also be expressed in terms of the Sauter mean diameter and a non-uniformity factor.

Using this latter method, experiments were made with a swirl atomiser to study the effects of changes in discharge velocity, and in the viscosity and surface tension of the liquid on the atomisation of the spray. In a swirl atomiser the average value of the resultant discharge velocity is given by

reduces the maximum drop size and increases the proportion of smaller droplets. The effect of an increase in discharge velocity is most marked in Fig. 10, where the higher viscosity of the liquid results in a coarser spray, as compared with the other liquids, at the lower discharge velocity. This observation is in agreement with the general rule that a change in one of the variables affecting atomisation has a proportionately greater effect the poorer the atomisation.

If we compare Figs. 9 and 10, we see the result of an increase in viscosity. Not only is the Sauter mean diameter increased (Table II), but the general shape of the frequency curve is quite changed, especially at the lower discharge velocity. The most significant feature of the curves is the very considerable increase in the size of the largest droplets. Since the time required for the evaporation and combustion of a droplet in a combustion chamber depends on the droplet size, it follows that in many combustion chambers an increase in the size of the largest droplets has a quite disproportionate effect on combustion efficiency, carbon deposition, smoky exhaust, etc. In such cases the ill-effects of changing to a more viscous fuel are more the result of the increase in the size of the biggest droplets than the increase in the Sauter mean diameter. The increase in the range of droplet size in Fig. 10 leads to the higher values of the non-uniformity factor shown in Table II for the more viscous liquid. The effect of the change in surface tension was not nearly so great as the effect of the change in viscosity. On comparing Figs. 9 and 11, it is seen that the curves for water show an increase in the size of the biggest droplets compared with safety fuel, but the number of these large droplets is not great and the value of Sauter mean diameter is not greatly affected.

EXHIBITS AT THE ROYAL AGRICULTURAL SHOW, NEWTON ABBOT.



FIG. 1. CROP DRYER; ALPEMA AGRICULTURAL MACHINERY DEVELOPMENT COMPANY, LIMITED.



FIG. 2. PORTABLE AIR-HEATER; ALPEMA AGRICULTURAL MACHINERY DEVELOPMENT COMPANY, LIMITED.

It will be seen that in each pair of experiments at the same pump setting the S.M.D. was markedly higher at the lower temperature. The higher discharge velocity in the low-temperature test at each pump setting would normally give a lower value of the S.M.D., and it follows that if the velocity had been the same in each pair of experiments, the difference in the values of S.M.D. for each pump setting would have been even greater than in Table III. Since the two liquids had the same viscosity at the conditions of the test, and since also the surface tension was approximately the same, and the density and viscosity of the air into which the spray was discharged, there is no apparent reason for the higher values of S.M.D. at the lower temperature (evaporation of the safety fuel at -8 deg. F. would have been negligible). It can only be suggested that the change in temperature caused some dimensional change in the atomiser which affected the atomisation of the spray. Whatever the cause, the interesting result of this series of experiments is that, when an engine is being started at low temperature, the atomisation of the spray may be significantly worse than would be expected from the increase in viscosity of the liquid. Thus, for applications where cold starting is important, the atomisation of the spray at low temperature may deserve special investigation.

In conclusion, I should mention that Dr. A. Murazew, Dr. B. S. Massey and Mr. J. A. Murrell have been responsible for the detailed work at Queen Mary College described above. Further particulars of this work will be found in the three following reports of the Motor Industry Research Association: No. 1948/4 and 5, and No. 1951/4.

THE ROYAL AGRICULTURAL SHOW AT NEWTON ABBOT.

THE Royal Agricultural Society's annual Show, which opened at Newton Abbot on Tuesday, July 1, and closes this evening, is the fourth to be held in Devonshire, the last visit being paid to that county 62 years ago. This is the first time, however, that the Show has been held at Newton Abbot, former Shows in Devonshire having been at Exeter in 1850, and at Plymouth in 1865 and 1890. At the 1850 Royal Show there were over 1,000 implement exhibits and 613 head of livestock, Devon cattle, as was to be expected, having been much in evidence. In those days, the railways were anxious to demonstrate their potentialities for the carriage of livestock and a subsequent Council meeting of the Royal Agricultural Society reported that "the principal railway companies, with their usual liberality, conveyed the livestock free along their respective lines. . . ." In 1865, when the Royal Show was first held at Plymouth, the number of livestock entries had risen to 934 and the implements on show to 4,000. Despite gloomy prognostications to the contrary, the Show proved extremely popular, over 88,000 visitors attending, a figure which had only been exceeded on three

previous occasions. When the Show returned to Plymouth in 1890, livestock entries totalled 1,764 and the implement entries 4,143. Ninety-five machines were entered for the Society's Silver Medal, but only three were awarded, namely, for a butter-making machine, a disintegrator and a horse rake.

This year, the Show is being held on a 117-acre site at Stover Park, a thickly-wooded area surrounded by hills, the showground, as a consequence, having a most attractive setting. Unfortunately, the widespread occurrence of foot-and-mouth disease has forced the organisers to cancel the cloven-hoofed sections of the livestock classes. The possibility of allowing exhibitors from Devon and Cornwall, two of the counties at present free from outbreaks, to enter animals was examined, but it was agreed that it would not be advisable or practicable to hold such a restricted Show, as visitors from infected areas might pass on the disease. The Society, therefore, arranged for the space thus made available to be used for alternative features, including tractor-driving competitions, a display of machinery made in Devon, demonstrations of tractor-mounted implements, a display of old implements, and a parade of veteran tractors.

Approximately 30 manufacturers in Devon combined to provide a comprehensive display of the county's post-war engineering achievements, particularly as applied to agriculture and forestry. Some of the machinery is to be seen in the machinery ring and the remainder is shown working under practical conditions. The display includes a joinery workshop in operation and a transportable log band-saw. The latter machine is tractor-drawn and operated, and is being shown at work in a copse situated in the centre of the showground. The display of old implements and tools has been arranged by the museum of English Rural Life, formed at Reading University to preserve material connected with the history of the English countryside. Parades of veteran tractors are being held in the machinery ring and, though some are 40 years old, they are all travelling under their own power. Other additional features include a supplementary flower show, which includes those entries which could not be accepted for the main flower show, and displays in the grand ring by a contingent of Royal Marines from Plymouth. Some of the extra space made available has been used for additional commercial exhibits. The British Electrical Development Association and the South-West Electricity Board, for example, have arranged an additional documentary display which includes photographs, dioramas and models illustrating the many uses for electricity on the farm and in the farmhouse.

The foregoing, of course, are additional to what might be termed the main part of the Show, which, in general, follows fairly closely the pattern of its predecessors, the many different exhibits, displays, etc., covering practically all aspects of agriculture. As in previous years, the Ministry of Agriculture, the Milk Marketing Board and other interested bodies have co-operated by contributing exhibits to

the educational section. This year the main theme of the Ministry of Agriculture's exhibit is the production of more meat and milk from home-grown feeding stuffs. The indoor section includes an exhibit on three ways of increasing beef production, featuring the value of South Devons for producing meat as well as quality milk and pure-bred North Devons for the production of meat. Other exhibits in this section deal with the feeding of stock from home-grown foods, calf diseases, prevention of infestation by grain weevils in stored grain and a survey of agricultural planning in Devonshire. Outdoor plots show how to obtain increased production from permanent grass by: ploughing and re-seeding to long-term leys; ploughing and cropping for home consumption; and improving the surface of unploughable grassland. There are also demonstrations of ditching, tile-laying, gate-making, concrete mixing and implement repairing.

Originally, the Milk Marketing Board intended showing calves of local breeds, produced by artificial insemination, but this scheme had to be cancelled, and the main exhibit is a complete milking parlour of a design recommended by the Board. Other exhibits on the Board's stand deal with their cattle-breeding service and the value of milk recording. The Rural Industries Bureau are displaying products ranging from complete farm vehicles and implements to pottery, baskets and small boats, the exhibits having been chosen to show the individuality and quality of the rural craftsmen's work. The competitive entries in the forestry exhibition include farm gates, hunting gates, tree guards, fencing and articles made from thinnings. There is also a non-competitive section which is displaying specimens of timber and varieties of trees and shrubs. The Gas Council's exhibit shows the uses to which gas may be put on the farm with emphasis on such applications as grass drying and heating water for the dairy. Other bodies represented at the Show include the Animal Health Trust, the British Sugar Corporation, the Accredited Poultry Breeders Federation, the National Coal Board, the Soil Association, the British Wool Marketing Board and the British Beekeepers' Association. There is, in fact, something to interest almost everybody, and, in its efforts to overcome the limitations imposed by foot-and-mouth disease the Society has arranged what is possibly the most interesting Royal Show ever held.

British agricultural engineers have been pre-eminent for a number of years in the development of mechanical aids for farming and have played a leading part in placing this country's agriculture among the most highly mechanised in the world. The Royal Agricultural Society has long recognised the value of mechanisation as applied to farming and since the first Royal Show, held 113 years ago, has awarded medals for outstanding exhibits in the machinery section; an award, it may be added, highly coveted by those in the industry. That the Society continues to place emphasis on this side of agriculture is, perhaps, indicated by the fact that at this year's show nearly half of the showground is occupied by stands show-

EXHIBITS AT THE ROYAL AGRICULTURAL SHOW.

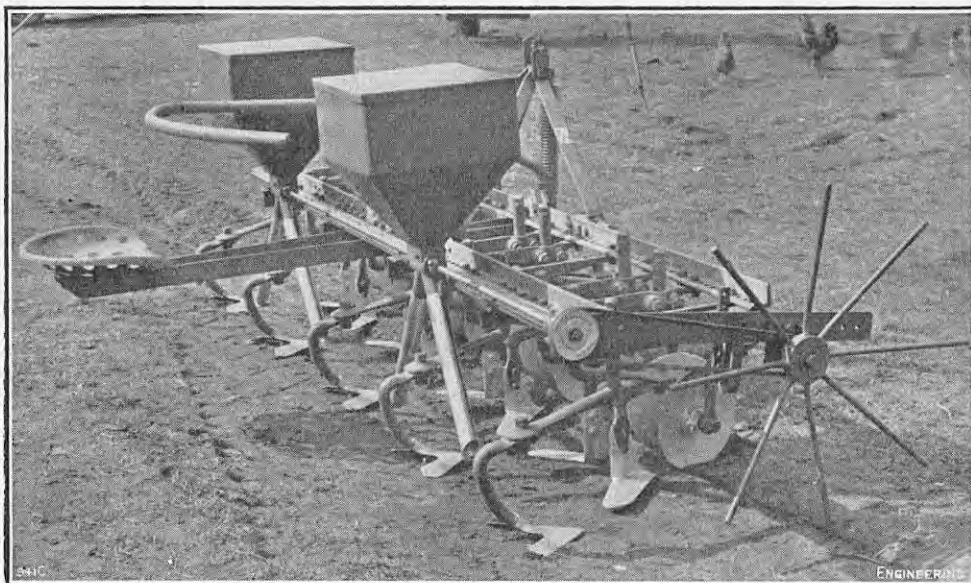


FIG. 3. FERTILISER DISTRIBUTOR; ALPEMA AGRICULTURAL DEVELOPMENT COMPANY, LIMITED.



FIG. 4. BALE ELEVATOR; ALPEMA AGRICULTURAL DEVELOPMENT COMPANY, LIMITED.



FIG. 5. INDEPENDENT GANG STEERAGE HOE; HARRY FERGUSON, LIMITED.

ing mainly mechanical equipment. Actually, 60 acres is taken up by 570 stands, those with shedding occupying a total frontage of nearly 11,000 ft. and those on open spaces covering an area of approximately 500,000 sq. ft. Nine machines, including three deferred from the 1951 Show, have been accepted for final judging for the Society's Silver Medal for new implements: these medals are awarded to those machines that fulfil a purpose of value to agriculture, for which no machine hitherto has existed or, if the purpose is not new, which embodies some new principle of operation. The machines entered include an animal-spraying tunnel, a ditcher, a silage and green-crop combine, a pea cutter and swather, and a steerage hoe.

The machinery and implements on view cover practically every aspect of agriculture, ranging from diminutive single-wheel horticultural tractors to large track-laying machines capable of hauling the heaviest multi-furrow ploughs. There are, however, no startling new developments, most of the equipment shown being of well-proved design. Considerable interest is being taken in the various grass-drying machines and, judging from reports, there would appear to be little doubt that increasing use will be made of these machines in the near future. Actually, they were first introduced some years before the second World War, but it was not until farmers were faced with the post-war shortage of feeding stuffs, particularly concentrates, that their use became popular. Drying of grass in itself, of course, does not imbue the crop with any special qualities, but young fresh grass is much richer in protein, carbohydrates, vitamins and carotene than the matured crop as cut for hay and, if it is properly dried, these qualities are preserved; the resulting product, as a consequence, is much richer than hay prepared in the traditional manner. Furthermore, it is often possible for four, or even five, cuts to be taken from a single field in a year, thus enabling the farmer to increase considerably his stock of winter feed. It seems fairly certain that the future will see grass dryers used in increasing numbers and in view, therefore, of their growing importance, it may not be inappropriate to commence our review of the exhibits in the machinery yard by referring to a machine of this type.

TRANSPORTABLE GRASS DRYER.

A good example is afforded by the "T.L." crop dryer illustrated in Fig. 1, opposite. This machine is being shown by the Alpema Agricultural Machinery Development Company, Limited, Redhill Aerodrome, Surrey, and has been designed to meet the requirements of farmers with up to 250 acres. It is of comparatively light weight and is provided with road wheels so that it can be towed to any part of the farm and used at the most convenient point. The crop is dried between two concentric drums, an outer stationary drum and an inner rotating drum, the latter being fitted with spring-loaded tines. The machine is loaded through doors arranged along the top of the outer drum and, when dry, the crop is discharged through similar doors fitted along the bottom of the drum. Hot air from the burner is drawn through a duct arranged along the axis of the rotating drum by a fan which delivers into another duct located along the bottom of the fixed drum, perforated plates which form an integral part of the outer drum permitting the air to pass into the annular chamber containing the grass. After it has passed through the grass, the moisture-laden air leaves the top of the drum through a further series of perforated plates and enters a duct which directs it through filter trays back to the burner, a proportion of the saturated air being bled away to atmosphere and the remainder recirculated with the fresh intake to prevent scorching.

The burner, which is designed to operate either with vaporising oil or gas oil, is similar to those employed in aircraft gas turbines and was designed in the first instance by Tiltman Langley Laboratories, Limited, for use in a thermal de-icing system for aircraft. It is an efficient unit and is capable of liberating up to 1,250,000 B.Th.U.s when burning gas or vaporising oil at the rate of approximately eight gallons an hour. The operating temperature

is easily controlled by varying the amount of fuel supplied to the burner and a thermostat is installed which limits the temperature to a maximum of 300 deg. F. It is, therefore, perfectly safe to leave the machine once it has been loaded and set in operation; as a consequence, it can be operated by one man, who can cut and collect the next load while the previous load is being dried. The average capacity of the dryer is 3 cwt. of dried material per hour, but this figure will vary, of course, according to the moisture content of the crop. Fuel consumption varies similarly, but the average figure of fuel consumed per ton of dried material is 60 gallons. The rotating drum is driven through a simple ratchet mechanism, the ratio of which is arranged to give approximately one revolution of the drum per minute. The power requirement for full capacity is 10 h.p., this figure including that required to operate the fan and the fuel pump. Normally, the machine is driven from the belt-pulley power take-off of a standard tractor, but a self-contained engine mounted on the chassis of the unit can be used if required. The dryer embodies a hot-air "take-off" for grain drying and can be supplied with special equipment for this purpose. The overall length of the machine, as illustrated, is 23 ft. with the drawbar stowed, the height 9 ft. and the width 7 ft. 6 in.

The burner used on the "T.L." crop dryer is also employed in the portable air heater illustrated in Fig. 2, on page 10. This machine has been developed to meet the need for a portable grain dryer, but can also be used for other duties, such as heating greenhouses, defrosting orchards, etc. It is capable of a heat output of 200,000 B.Th.U.'s per hour at a maximum operating temperature of 400 deg. F. and the fan will deliver 5,000 cub. ft. of heated air per minute at pressures up to 2 in. water gauge. It is driven by an air-cooled Coventry-Victor petrol engine, which, as will be seen from the illustration, is carried on an extension of the chassis. The complete unit is mounted on two wheels fitted with pneumatic tyres and can easily be moved by hand. It is 8 ft. long, 3 ft. wide and 5 ft. high, and the weight is 10 cwt.

FERTILISER-PLACING DRILL.

The Alpema Agricultural Machinery Development Company are also showing a fertiliser-placing drill, and a sack and bale elevator. The fertiliser-placing drill, which is known as the "Econolizer," is illustrated in Fig. 3, on page 11. It has been designed to fit most four-row hoes, and in the illustration is shown installed on a Ferguson steering hoe. It consists of two hoppers, which are fitted to the frame of the hoe and provided with tubes which lead the fertiliser down to the rows of plants; consequently, the fertiliser is placed directly on the ground close to the roots of the plants and is not dissipated by the wind. The operating mechanism of the "Econolizer" is similar to that employed on seed drills, a land-wheel formed from a series of spokes being attached to the side of the hoe and arranged to drive a cross-shaft by means of an endless V-belt. The cross-shaft passes through the two hoppers and is fitted with cups which pick up the fertiliser from the hoppers and deposit it in the chutes, the mechanism being arranged so that the rate of feeding can be varied from a few pounds to 10 cwt. an acre. The hoppers are of welded-steel construction and, after being treated with an anti-corrosive preparation, are painted with a rust-resistant paint. The chutes are made from aluminium and are thus capable of being bent to suit particular applications. The "Econolizer" can also be fitted to other implements, such as cultivators, and potato ridgers and planters; or it can be used for applying insecticidal dusts, etc., to rows of plants, the chutes enabling the dusts to be deposited with accuracy along the rows.

SACK AND BALE ELEVATOR.

The elevator, which is illustrated in Fig. 4, on page 11, has been designed to handle loaded sacks, bales of straw and hay, and root crops. It is driven by a 1½-h.p. Petter engine which can be operated on petrol or tractor vaporising oil. The transmission incorporates a clutch so that the elevator can be brought to a standstill without stopping the engine.

The power from the engine is transmitted first to a cross-shaft through a flat belt and then by a roller chain to the bottom shaft of the single elevator chain, a single chain being used for this purpose to avoid side loads and thus reduce wear. The trough in which the chain runs is made from two folded sections welded together to form a U. It is supported by two telescopic tubes which can be adjusted to give delivery heights of between 7 ft. and 12 ft., the tubes being disposed so that the weight of the elevator and the load is transferred directly to the axle for the roadwheels. The trough is counterbalanced by a strong coil spring arranged inside the chassis, thus making it possible for one man to alter the height of discharge. To enable heavy loads to be elevated, two retractable legs are fitted to an extension of the chassis; one of these can be seen in Fig. 4, where it is shown in the retracted position. The chassis is built up from steel plate welded to form box sections and, in plan view, is in the form of a Y. The wheels are fitted with pneumatic tyres and the axle is placed as near the centre of balance as practicable to facilitate man-handling of the unit. For loading beet and other root crops, tines are fitted to the elevator and a hopper is provided at the base of the trough.

STEERAGE HOE.

At last year's Show, Messrs. Harry Ferguson, Limited, Coventry, introduced three new tractors and ten new implements; it was hardly to be expected, therefore, that they would be showing much in the way of new equipment this year. Nevertheless, the exhibits on their stand include an entirely new type of gang steering hoe, which employs hydraulic means to ensure that each gang of hoes penetrates the ground to a uniform depth. There are five gangs, or sets, of hoes, and each set is connected to the tool bar by a parallel linkage which is balanced in all positions by a tension spring and a cam, designed so that ground reaction is the only controlling force on the hoes. Constant overall implement depth is still maintained by means of the standard Ferguson automatic depth control fitted to the tractor, but each hoe is also free to adjust itself to ground undulations along the row of plants on which it is working. This is accomplished by arranging for the movement of each gang to be imparted to a hydraulic cylinder, there being individual cylinders to each gang. All cylinders are interconnected and, in addition, are connected to a further hydraulic cylinder and piston assembly, so arranged that any thrust developed acts against the tractor control spring. When any local variation in ground contour forces a gang to rise, therefore, the hydraulic system applies a proportionate thrust against the tractor control spring, thereby causing the implement to be raised as a whole. The fluid displaced by the rising gang, however, flows equally into the other gang cylinders, producing a downward movement on each gang so that, although the complete implement is raised to accommodate the increased thrust on one gang, the others automatically are lowered to maintain constant depth of cultivation. In practice, therefore, each set of hoes follows the ground contour as a separate unit. The implement retains all conventional steering-hoe features, such as ability to alter row width, depth of hoes, discs, etc. The company are continuing to produce their standard gang steering hoe, which does not incorporate hydraulic control, for use where a high degree of sensitivity is not essential.

(To be continued.)

SHACKLETON MARK 2 ANTI-SUBMARINE AIRCRAFT.—The prototype Mark 2 Shackleton anti-submarine aircraft, constructed by A. V. Roe & Co., Ltd., Green-gate, Middleton, Manchester, has recently made its maiden flight. It is more powerfully armed than the Mark 1 version, and has two 20-mm. guns in the nose. The single fixed tailwheel has been replaced by twin retractable wheels, and the rear fuselage has been faired. The radar scanner has been transferred from its former position under the nose to a retractable housing aft of the bonnet doors. The Shackleton Mark 2 is fitted with four 2,450-h.p. Rolls-Royce Griffon engines. The wing span is 120 ft., the overall length is 87 ft. 4 in., and the height is 16 ft. 9 in. A crew of ten is carried.

FATIGUE-TESTING LABORATORY.

ON Monday, June 23, a fatigue-testing laboratory, which has been built for the British Welding Research Association at Abington, near Cambridge, was formally opened by the Lord President of the Council, Lord Woolton. The Association has devoted much attention to problems of fatigue in metals and structures, since failure by fatigue is particularly to be guarded against in a welded structure, but its earlier work in this field had to be carried out as economically as possible, and this led to the adoption of resonance testing. This method is of limited value, however, since only equal tensile and compressive stresses can be generated and their magnitude depends on the design of the part under test. It is, therefore, difficult to assess the relative merits of different types of construction, for example, welded and riveted joints. It was this consideration, in the main, that led the Association to finance the construction of the new laboratory.

The building has a floor area of 5,000 sq. ft., and provides office, as well as laboratory, accommodation. The architect was Mr. G. Coles, F.R.I.B.A., and the consulting structural engineers were Messrs. W. S. Atkins and Partners, 158, Victoria-street, London, S.W.1. The Association wished the laboratory to have a welded-steel framework and to be a practical realisation of the work on the plastic design of building frames which has been carried out by the Association in conjunction with Professor J. F. Baker, O.B.E., M.I.C.E., of Cambridge University. This type of construction was, therefore, adopted.

It was assumed that the maximum strength and stiffness would be obtained if the structure were welded into a single framework. This was, in fact, done. There are no bolts or rivets whatever in the frame. Furthermore, every part of the structure, including even the roof guttering, was designed to carry an appreciable load, so that as much weight as possible might be saved. Except in certain special instances, as, for example, the gantry rails, reliance was placed on structural redundancies and on plastic deformation of the structural elements to provide the requisite margin of safety against collapse. The framework, shown under construction in Fig. 1, on page 16, consists of six pitched-roof portal frames spaced 24 ft. apart. These are surmounted by I-section purlins at 4 ft. intervals. Gantry girders carry a 5-ton travelling crane at approximately 21 ft. 6 in. above the lower floor level. The building being on a sloping site, it was necessary to make the floor in two parts, one 3 ft. below the other. To stabilise the brick walls and secure the transference of wind forces to the framework, reinforced-concrete wind-beams were included, which also form sills and lintels for the windows. The weight of the wall, however, is not taken by the steelwork but by ground beams resting on foundation blocks. To facilitate the welding of the structure, the latter was first bolted lightly together, jigs being employed to give stability with the minimum number of bolts.

The purlins were not only welded into continuous lengths, but were previously cambered. In this way, the steel was well loaded, although a limitation was imposed by the comparative inflexibility of the asbestos cement cladding which forms the roof. It has been estimated that, compared with an equivalent cantilever-column and roof-truss construction, the design adopted has effected a saving in weight of 45 per cent., and is 24 per cent. less heavy than a comparable welded design having bolted side connections.

The principal item of equipment in the laboratory, which is illustrated in Fig. 2, is a Losenhausen fatigue-testing machine which can apply pulsating loads of up to 100 tons in compression or tension, the maximum range of load being also 100 tons. Thus, for example, the load applied to the specimen may vary between 25 tons compression and 75 tons tension, or from zero to 100 tons tension. The machine illustrated in Fig. 3 is also capable of applying static loads up to 200 tons in tension or compression, and can be used for tensile, compression, buckling and bending tests.

THE "OLYMPUS" TURBOJET ENGINE.

BRISTOL AEROPLANE CO., LTD., BRISTOL.

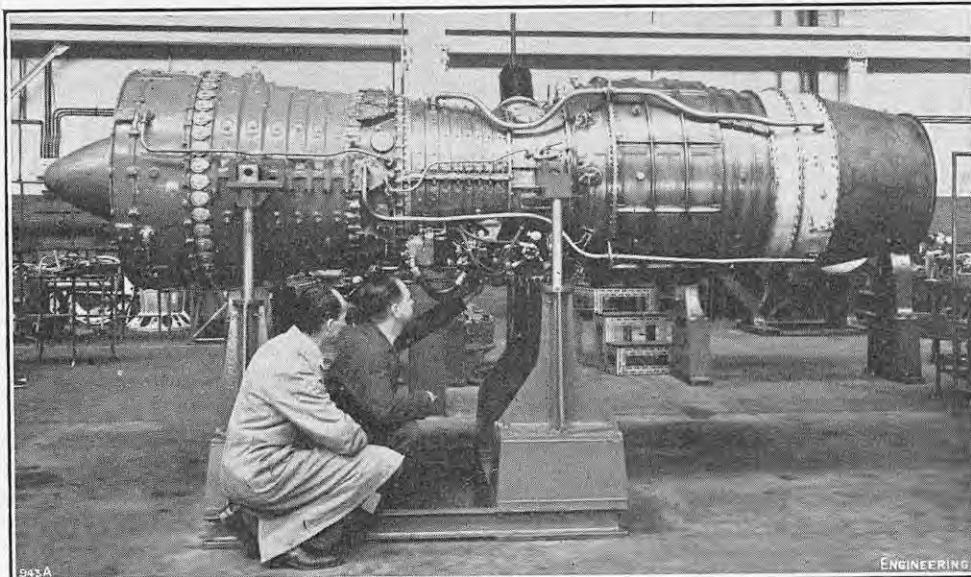


FIG. 1.

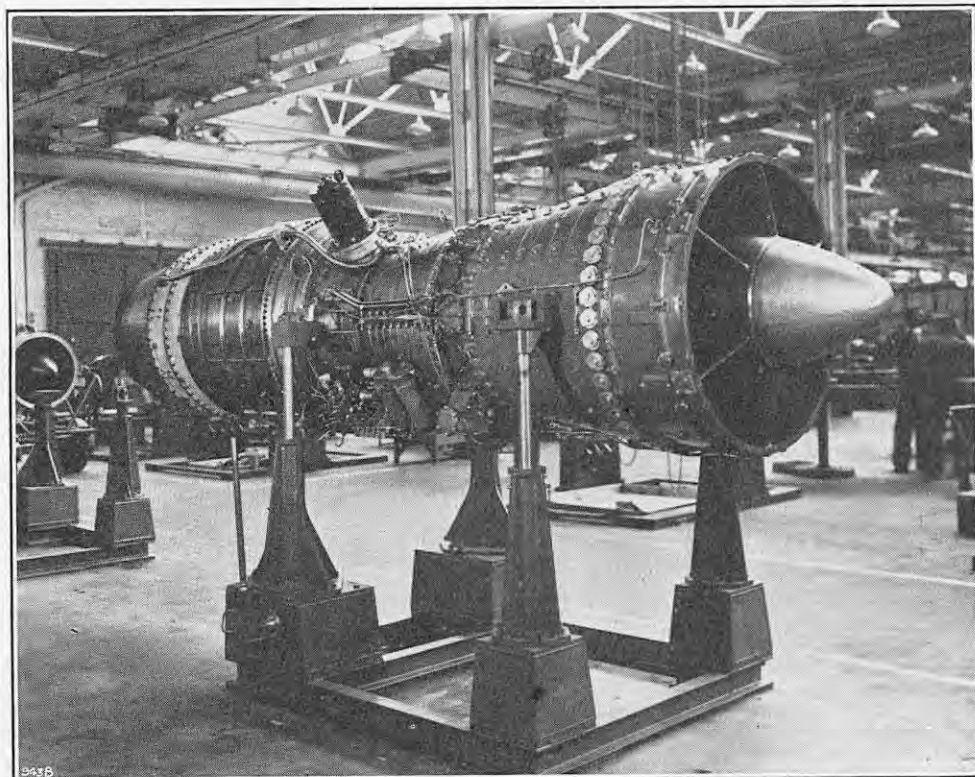


FIG. 2.

There are other machines of this type in Britain, but none with a greater loading capacity, or able to take so large a test-specimen. Under axial loading, test-pieces in the form of flat or round bars of any diameter or thickness up to $2\frac{3}{4}$ in., and of up to 6 ft. in clear length between the supports, can be accommodated. The lower, and stationary, head of the machine includes a bending table by means of which tests may be made on specimens up to 6 ft. 6 in. in span and 18 in. in width.

The machine is hydraulically operated. For dynamic tests, a separate pumping unit is employed to generate pulsating pressures which are transmitted to a tensioning cylinder in the straining head. A compression cylinder, also in the straining head, is connected to a large oil vessel which acts as a counter-spring and is maintained at a steady pre-selected load, the range of load on the test-piece being determined by opposing the forces in the two cylinders. If, for example, the machine is required to test a specimen between the limits of 5 tons compression and 50 tons tension, the fluctuating force

in the tensioning cylinder may be set to vary between 10 and 65 tons, and a steady force of 15 tons applied to the compression cylinder. The machine has four speeds for dynamic testing, namely, 200, 300, 400 and 600 cycles per minute.

The mode of supporting the machine is of interest and is illustrated in Fig. 4. Since the machine weighs only some 20 tons, some difficulty might be expected in isolating the vibrations of its moving parts from the foundations of the building. One way of achieving the desired result in such cases is to support the system containing the vibrating elements on a spring mounting which has a much lower natural frequency of oscillation than the source. In the case of some Losenhausen machines used on the Continent, it has been customary to mount the machine together with its pumps and reservoir vessels on a large concrete block weighing from 200 to 300 tons, and to support the latter on an arrangement of springs or equivalent resilient supports. At Abington, however, a much simpler and cheaper solution of the problem has been

adopted, which has been used elsewhere with success by the British Admiralty. The machine is mounted on a series of flat strips of high-tensile steel which form vertical struts loaded slightly beyond their fundamental Euler critical load. Owing to the finite displacement of the struts their curvature is not negligible, and, in their displaced position, they are stable, although their stiffness is small. They act, therefore, as springs having, in this case, a natural frequency of about 50 cycles per minute, which is sufficiently low to achieve the desired result of almost perfect insulation of the vibration from the foundations at a fraction of the cost of the heavy mountings mentioned above.

In addition to the Losenhausen machine, the laboratory contains four resonance test-rigs and a 50-ton universal Denison testing machine. Other equipment includes a double-ended slow-speed fatigue-testing machine of 100 tons capacity, which is a copy of one designed and used by Professor W. M. Wilson of Illinois University.

THE "OLYMPUS" TURBOJET ENGINE.

ALTHOUGH it has been known for over a year that the Bristol Aeroplane Company, Limited (Engine Division), Filton, Bristol, have been developing an economical and powerful aircraft jet engine, known as the Olympus, security regulations have prevented the publication of any information on the performance and construction of the engine. Certain details have now been released, and it has been revealed that, with a static thrust of 9,750 lb. and a specific fuel consumption of 0.766 lb. per pound of thrust per hour, the Olympus represents a considerable advance in comparison with any other jet engine for which official performance figures have been given. The Olympus, a compound axial-flow engine, is illustrated in Figs. 1 and 2, herewith. It weighs 3,520 lb. and is 124 in. long from the intake flange to the exhaust flange, with a diameter of 40 in. It is slightly less in overall dimensions than the less powerful Rolls-Royce Avon and Armstrong Siddeley Sapphire engines.

The Olympus has been designed for high-speed long-range applications, where the primary design requirements are low fuel consumption, long life, and a low frontal area to enable the engines to be installed completely within the wings; a practice which, it is considered generally in the United Kingdom, is essential in order to obtain the near-sonic speeds expected of present-day long-range aircraft. The outstandingly low fuel consumption has been made possible by the use of a high compression ratio, the actual value of which has not been published. In order to obtain a high pressure ratio at the design condition, while retaining easy starting and efficient operation at low speeds, free from vibration resulting from stalled blades, the Olympus has two independent turbo-driven compressors, mounted on co-axial shafts. The aerodynamic design of the forward low-speed compressor, which acts as a supercharger to the rear high-speed compressor, is such that the rotational speeds of the two compressors are matched at the design condition. Under static conditions, however, the low-pressure compressor rotates at a lower speed than the high-pressure compressor. The two-shaft compound system is, naturally, more complex mechanically than a conventional single-compressor jet engine, and the low specific weight of the Olympus, 0.36 lb. per pound of thrust, is therefore particularly noteworthy. The present engines are fitted with ten combustion chambers, enclosed in an annular casing.

At a recent demonstration of the Olympus by the Bristol company on two engines on the test beds, the almost instantaneous response of the thrust meter to rapid movements of the throttle control was a notable feature. A considerable amount of ground-test experience has been accumulated and flight trials will commence shortly with an English Electric Canberra aircraft fitted with two Olympus engines. It should be mentioned that the performance figures quoted apply to one of the earlier marks of the engine; it is still undergoing development and may be expected, in the near future, to surpass the published figures.

NOTES FROM THE INDUSTRIAL CENTRES.

SCOTLAND.

TERMINAL BUILDINGS AT RENTFREW AIRPORT.—The hope that work would begin this year on the construction of new terminal buildings at Renfrew Airport has been expressed by Sir Patrick Dollan, chairman of the Scottish Advisory Council for Civil Aviation. The new terminal, he added, would embody modern principles of design and construction, and would represent a great advance on the present buildings, which are simply converted hangars. The work, which was first discussed in 1946, is estimated to cost more than 400,000/.

RAILWAY GOODS YARDS IN SCOTLAND.—That Parliamentary permission had been given to lay down a large marshalling yard at Thornton, Fife, to cost at least 2,000,000/., was mentioned by Mr. T. F. Cameron, Chief Regional Officer of British Railways in Scotland, on June 21, when, at St. Andrews, he addressed the convention of the Railway Students' Association. Work is to begin in October. He added that a large addition to the existing yard at Alloa was likely to be made in the near future, and that powers were also being sought to put down a new yard at Niddrie, Edinburgh, which would cost about 2,000,000/.

SCHOLARSHIPS TO VISIT ENGINEERING WORKS.—To enable pupils of Robert Gordon's College, Aberdeen, during the summer vacation, to visit engineering works in England in the administration of which he takes a part, Sir Alexander Roger, a former pupil, is to provide two scholarships. It is stated that, if they prove to be appreciated, Sir Alexander will make arrangements for the visits to be continued in the future.

INVENTION AWARD TO INVERNESS ENGINEERS.—The payment of 2,000/ to Resistance Welders, Ltd., Inverness, in respect of their claim for welding equipment for airscrew hubs during the war of 1939-45, has been recommended by the Royal Commission on Awards to Inventors. The award is on account of the design of the machine which the firm developed after it had been found impossible to obtain suitable machines from the United States.

GLASGOW PROFESSOR VISITS AMERICA.—Professor A. T. Price, who occupies the chair of mathematics at the Royal Technical College, Glasgow, has accepted an invitation to visit the Department of Terrestrial Magnetism and Atmospheric Electricity at Washington, it was announced on June 19 at a meeting of the College Governors. His visit will extend to six or seven weeks during June and July, and he will discuss some of the theoretical results he has obtained concerning various terrestrial magnetic phenomena and a number of new research projects. He will also visit a number of other research institutions in America.

EXTENSION OF HARBOUR AT MAIDENS.—Ayr County Council yesterday received information that the Treasury are willing to make a grant of about 33,500/ towards the cost of a scheme to extend the harbour at the village of Maidens. Local fishermen have raised 5,700/ towards the cost, which has been estimated at about 50,000/.

CLEVELAND AND THE NORTHERN COUNTIES.

TYNE EXPORTS AND IMPORTS.—Coal and coke shipments from the Tyne continue to increase, although they are still well below the pre-war figures. In May, 829,168 tons left the port, an increase of 41,378 tons on May of last year. For the first five months of the year, shipments were 4,058,230 tons, an increase of 13.3 per cent. on the corresponding period of 1951, but 24.4 per cent. less than the figures for 1938. Exports of general merchandise for the first four months of the year totalled 123,999 tons against 128,029 tons for January-April, 1951, and 84,293 tons in the corresponding period of 1938. The chief exports were 11,265 tons of machinery, 21,494 tons of oil-fuel cargo, 26,014 tons of sulphate of ammonia and 18,582 tons of tar and pitch. Imports for the first four months of 1952 amounted to 819,046 tons, against 746,501 tons in January-April last year, and 735,594 tons in the first four months of 1938. The chief imports were 104,546 tons of grain, 199,292 tons of iron ore and 221,998 tons of oil fuel and other oils. Imports of pit props were 23,144 tons against 6,806 tons in January-April, last year, and imports of iron and steel scrap 11,328 tons in January to April, 1952, against 3,510 tons in January to April, 1951.

CONCRETE FOR COLLIERY-ROADWAY LINING.—The National Coal Board are to experiment with the use of concrete blocks for lining underground roadways, in place of the customary steel and brickwork. At Horden Colliery, Co. Durham, a workshop has been erected and skilled men have been brought from the Ruhr coalfield, Germany, to demonstrate the manufacture of the blocks and their installation underground. At present it is proposed to line only small sections of the roadways but, if the idea is successful, the system will be extended. It is stated that this method of lining underground roads has been used successfully in German mines for 30 years.

SHAFT SINKING AT RISING SUN COLLIERY.—The Northern (Northumberland and Cumberland) Division of the National Coal Board are to carry out developments at the Rising Sun Colliery, Wallsend, designed to increase output from 1,800 to 3,000 tons a day and the number employed from 1,450 to 2,160 men and boys. The work will include the sinking of a shaft 1,350 ft. deep and 22 ft. in diameter. This work will begin, it is expected, about the end of this year and will be completed within two years. It is believed that there are 70,000,000 tons of workable coal in the vicinity of the Rising Sun Colliery.

RAILWAY CONNECTIONS AT BLYTH COLLIERIES.—Work has been completed on the construction of a railway about 2,000 yards long, connecting the Bates and Isabella Pits, Blyth, Northumberland. The railway has cost about 80,000/ and the work has also involved the construction of two bridges. The scheme is part of a development plan for the Isabella, Bates and Crofton Mill pits which will increase output at the three collieries to 5,000 tons a day.

OPENINGS FOR ELECTRICIANS ON NORTH-EAST COAST.—A shortage of electricians is reported by shipyards on the North-East Coast. Mr. W. Scott, area secretary of the Electrical Trades Union has received an inquiry from one yard alone for 100 men, and the Ministry of Labour has applications for a similar number. It is believed that work could be found for at least 300 electricians, and firms are seeking them in other areas, notably in the South of England. Recently one firm obtained 150 electricians from outside areas.

DEEP-WATER QUAY AT JARROW.—Plans have been approved by Jarrow Corporation and the Tyne Improvement Commission for a deep-water quay in Curlew-road, Jarrow, for the Mercantile Dry Dock Co., Ltd. The quay will be 550 ft. long and enclose the existing old timber piles and projecting jetties about 130 ft. eastward of the company's No. 1 dry dock. The quay will be 32 ft. wide and constructed of reinforced concrete, fringed by Larsen sheet piling. The engineers are R. T. James & Partners, Newcastle-on-Tyne.

LANCASHIRE AND SOUTH YORKSHIRE.

STEEL ALLOCATION CHANGES.—Steel users welcome the suggested changes in the method of allocating steel which would take into consideration the needs of those industries making products having a high conversion value in relation to the cost of the raw steel consumed. The effect of annual holidays upon steel production has precluded the possibility of maintaining allocations for the third quarter at the level of second-quarter allocations. Imports of steel, however, are improving the supply position; a shipment of 4,334 tons of steel from America was expeditiously handled by Hull dockers on three days of last week.

EFFECTS OF STEEL SHORTAGES.—Mr. T. G. Jameson, chairman and managing director of Hardypick, Ltd., makers of mining tools and machinery, states that there are signs of a falling off in business. Orders are being lost through delay in delivery due to inadequate supplies of steel. Sheffield makers of hacksaw and bandsaw blades have tried ineffectually to obtain increased allocations of steel to enable them to deal with orders on hand. They complain that, while production is thus hampered, imports of foreign hacksaw and bandsaw blades are being permitted.

TRADE BARRIERS.—Sheffield's dwindling trade with Turkey in cutlery will probably be extinguished by the revocation of a 1945 decree, by Turkey, which means that the duty on certain cutlery will rise by 17 per cent., and on most other cutlery by 15 per cent. Furthermore, Greece has added unfinished and semi-finished iron and steel castings to the existing tariff lists. On the other hand, there are to be duty-free imports of steel shafting, sheets, hoops and piping into New Zealand during the second half of the present year.

HIGHER MUNICIPAL COSTS.—Two committees of Sheffield City Council have had to ask for supplementary

votes totalling more than 20,000/ in the present year owing to recent wages awards. The transport committee were authorised to spend 224,000/ on purchasing 56 new omnibuses, but have had to seek permission to spend 2,800/ in excess of that amount because tenders were higher than was expected.

THE MIDLANDS.

BIRMINGHAM TRAMS.—July 5 is the last day for the operation of the tramway system on the south-west side of Birmingham. The system, which connects the city centre with three populous suburbs, has a total route length of about 12½ miles. Almost all the track is double, and on one route a large part of it is in a reserved strip in the centre of a dual carriageway. The vehicles are all of the double-bogie double-deck enclosed type. The tram service is being replaced by Diesel-driven 'buses, 114 of which will be used in place of 120 trams. Abandonment of these routes will leave Birmingham with only three tram services in use. These are on the north-east side of the city, and all are due for replacement by 'buses next year.

REMOVAL OF FACTORY.—George Clancy, Ltd., West Bromwich, have removed their machine shop to a new site at Belle Vale, Halesowen, Worcestershire. The firm have had a foundry at Belle Vale for some years, and the removal of the machine shop has enabled them to centralise the whole of their production on one site.

COAL SURPLUS AT SMALL MINES.—The North Staffordshire Small Mine Owners' Federation have asked for Government assistance in disposing of the coal which they say they cannot sell. About 400 men are employed in the 35 small mines in the area, and the output is about 4,000 tons a week. Most of the output has been absorbed by salt works, potteries, and electricity undertakings. The pottery industry, in particular, has felt the effect of decreased export trade, and its coal requirements have fallen in consequence. The coal produced by the small mines is allocated by the National Coal Board, and cannot be sold freely. The mine owners have asked for consideration to be given to the possibility of exporting the coal, if a market cannot be found for it locally.

FURTHER INDUSTRIAL SAFETY COURSES.—The Birmingham and District Safety Group (secretary, Mr. G. M. Hopps, Bakelite, Ltd., Redfern-road, Birmingham, 11) are sponsoring another series of safety courses at Birmingham University. Groups of engineering employees will attend lectures and demonstrations on industrial safety. Power presses and guards are being lent by manufacturers for the purpose. Courses for both Birmingham and Coventry employees will be held, and so much interest has been aroused in other parts of the country that it has been found necessary to have a special course for applicants from farther afield.

APPLICATION FOR COURT ORDER TO BORE FOR COAL.—The National Coal Board applied to Wolverhampton Corporation in October, 1951, for permission to sink a borehole at Penn, near Wolverhampton, but the application was rejected. The Board have now applied to the High Court of Justice, Chancery Division, for an Order giving them the right to bore for coal at a specified point at Penn. The Board state that they wish to ascertain whether the workings of the existing Baggeridge Colliery can be continued in a northerly direction.

STEEL RE-ROLLERS' CENTENARY.—The West Bromwich firm of J. B. and S. Lees Ltd., producers of steel strip, celebrated their centenary last month. In the first 50 years or so of their existence, the firm produced wrought iron, and later changed to steel re-rolling. The business has been in the hands of the Lees family since it was founded.

SOUTH-WEST ENGLAND AND SOUTH WALES.

ANTHRACITE DEVELOPMENT SCHEME NEAR LLANELLY.—A hint that work would begin soon on the National Coal Board's 9,000,000/ anthracite development scheme at Cynheidre, near Llanelli, was made by Mr. Gomer Evans, Labour Director of the Divisional Board. He said that the Board would soon be giving out contracts for the sinking of two shafts to the lowest measures in the Gwendraeth Valley at the colliery.

SOUTH WALES PORTS TRADE STATISTICS.—In the four weeks ended June 15, the South Wales group of ports handled their largest trade for 12 years. At 1,855,747 tons, it was the highest recorded since June, 1940. The development of the oil trade at Swansea

has played the principal part in the improvement. So far this year, Swansea has handled 3,921,353 tons of oil, passing in and out, which was 1,115,704 tons more than in the corresponding period of last year. Coal and coke exports to foreign destinations, in the present year, have risen to 1,605,451 tons from the figure of 1,176,188 tons in the corresponding period last year.

LLANGYFELACH TIN-PLATE PLANT PROJECT.—An early announcement is expected from the Ministry of Supply confirming that the site at Llangyfelach, originally intended for the tin-plate mills now operating at Trostre, near Llanelli, has been chosen for a second tin-plate mill for South Wales, under the 1946 plan. The proposed works are estimated to cost more than 11,000,000*l.* and will eventually produce annually some 40,000 tons of tin-plate. More than 250,000*l.* was spent, up to 1948, in preparing the Llangyfelach site before the scheme was transferred to Llanelli, for which, at the time, a stronger case was made out in respect of employment needs.

LAUNCHES AND TRIAL TRIPS.

M.S. "EBRO."—Single-screw cargo vessel, carrying twelve passengers, built and engined by Harland and Wolff, Ltd., Govan, Glasgow, for the Royal Mail Lines, Ltd., London, E.C.3. Main dimensions: 415 ft. between perpendiculars by 58 ft. 6 in. by 38 ft. 4 in. to shelter deck; gross tonnage, 5,500. Harland-B. and W. six-cylinder single-acting two-stroke Diesel engine. Trial trip, June 10, 11 and 12.

M.S. "MERCHANT KNIGHT."—Single-screw oil tanker, built by Sir James Laing & Sons, Ltd., Sunderland, for Lykiardopulo & Co., Ltd., London, E.C.3. Main dimensions: 475 ft. between perpendiculars by 67 ft. 4½ in. by 37 ft. 4 in.; deadweight capacity, about 15,300 tons on a draught of 29 ft. Hawthorn-Doxford four-cylinder opposed-piston oil engine, constructed by R. and W. Hawthorn, Leslie & Co., Ltd., Newcastle-upon-Tyne, and installed by William Doxford & Sons, Ltd., Sunderland. Service speed, 12½ knots. Launch, June 11.

M.S. "SINGULARITY."—Single-screw cargo vessel, built by the Goole Shipbuilding and Repairing Co., Ltd., Goole, for F. T. Everard & Sons, Ltd., London, E.C.3. Main dimensions: 225 ft. by 37 ft. 10 in. by 16 ft.; deadweight capacity, 1,815 tons on a draught of about 15 ft. 8 in. Four-cylinder Diesel engine developing 800 b.h.p. at 250 r.p.m., constructed by the Newbury Diesel Co., Ltd., Newbury, Berkshire. Speed, about 10½ knots. Trial trip, June 12.

M.S. "OBUSI."—Single-screw cargo vessel, with accommodation for twelve passengers, built and engined by Harland and Wolff, Ltd., Belfast, for Elder Dempster Lines, Ltd., Liverpool. Second vessel of a series of three. Main dimensions: 415 ft. between perpendiculars by 60 ft. by 34 ft. to shelter deck; gross tonnage, about 5,600. Harland-B. and W. five-cylinder two-stroke single-acting opposed-piston Diesel engine. Launch, June 24.

M.S. "CORBRAE."—Single-screw collier, built by the Burntisland Shipbuilding Co., Ltd., Burntisland, Fife, or Wm. Cory and Son, Ltd., London, E.C.3. Main dimensions: 258 ft. between perpendiculars by 39 ft. 3 in. by 18 ft. 11 in.; deadweight capacity, 2,700 tons on a draught of about 17 ft. 5 in. Polar eight-cylinder Diesel engine, developing 1,050 b.h.p., constructed by British Polar Engines, Ltd., Glasgow. Speed, 11 knots. Launch, June 25.

M.S. "CLAN MACINNES."—Single-screw cargo liner, with accommodation for twelve first-class passengers, built by the Greenock Dockyard Co., Ltd., Greenock, for the Clan Line Steamers, Ltd., London, E.C.3. One of a series of vessels for these owners. Main dimensions: 438 ft. between perpendiculars by 60 ft. 6 in. by 37 ft. 9 in. to upper deck; deadweight capacity, 9,000 tons on a mean draught of about 26 ft.; gross tonnage, 6,588. Brown-Doxford six-cylinder opposed-piston heavy-oil engine, developing 6,000 b.h.p. at 108 r.p.m. in service, constructed and installed by John Brown and Co., Ltd., Clydebank. Service speed, 15 knots. Trial trip, July 1 and 2.

SPECIAL OXY-ACETYLENE WELDING RODS.—Suffolk Iron Foundry (1920) Ltd., Sifbronze Works, Stowmarket, have extended the range of their oxy-acetylene welding rods by the addition of two new rods. The first of these, Sifonite No. 18 hard-surfacing rod, is a special cast hard alloy, developed to eliminate wear caused by heat, corrosion and abrasion, and is available in three sizes, namely, ⅜ in., ½ in. and ¾ in. in diameter. The second is a bronze rod containing 22 per cent. of nickel, which has been produced for use in stainless-steel fittings. It is stated to provide an extremely good colour match. This material is available from stock in rods of ⅜ in. and ½ in. diameter.

BRITISH STANDARD SPECIFICATIONS.

THE following publications of engineering interest have been issued by the British Standards Institution. Copies are available from the Sales Department of the Institution, 24, Victoria-street, London, S.W.1, at the price quoted at the end of each paragraph.

Screw-Thread Gauge Tolerances.—First issued in 1940 as a war-emergency specification, a revision of B.S. No. 919 has now been published. The specification furnishes tolerances for gauges for Unified screw threads and makes recommendations for a new approach to gauging practice based on the principle of having a general "Go" gauge with its tolerance zone inside the work limits, in place of the former "workshop" and "inspection" gauges. Provision is also made for a reference "go" gauge which is intended for use by manufacturers and inspectors as a control on the performance of their general gauges. Tolerances are specified for screw gauges and setting plugs for screw threads in the regular series, such as the B.S. Whitworth, B.S. Fine, B.S. Pipe (parallel threads), UNC, UNF, B.A., Metric, and B.S. Conduit. General requirements are given for all types of gauges used for checking external and internal threads and for setting plugs for screwing and thread calliper gauges. [Price 5s., postage included.]

Methods of Sampling Ferrous Materials for Analysis.—A newly-issued specification, B.S. No. 1837: Part 1, covering methods for the sampling of ferrous metals and metallurgical materials for analysis, is intended for use in conjunction with B.S. No. 1121, which deals with methods for the analysis of iron and steel. In section 1 of B.S. No. 1837 are set out general requirements. Section 2 deals with liquid iron and liquid steel, while section 3 covers the sampling of pig, cast and wrought iron. In section 4, consideration is given to the sampling of steel in the form of ingots, castings, blooms, billets, slabs, heavy sections, plates, light sections, bars, rods, wire, sheet, strip and tubes. The methods given are those which have been found most satisfactory in practice. [Price 2s. 6d., postage included.]

Shear Bolts and Nuts for Aircraft.—Two new specifications in the series of materials for aircraft have now been published. These, Nos. A.57 and A.58, are issued as one single publication, and relate to shear bolts (A.57) and shear nuts (A.58) for aircraft. The specification is concerned with the material and manufacture, dimensions, finish, and method of identification and marking of close-tolerance hexagonal-headed shear bolts, and slotted and thin hexagonal nuts made of high-tensile steel. [Price 3s., postage included.]

Bell and Call Systems.—The Council for Codes of Practice for Buildings Construction and Engineering Services, Lambeth Bridge House, London, S.E.1, have issued, in final form, Code No. 327.401, relating to bell and call systems. It forms part of a series dealing with telecommunication services in the group of codes on electrical installations in and about buildings. The Code deals with the installation, in private dwellings, hotels, schools, factories and other buildings, of bell and indicator call systems, including time bells, burglar alarms and watchmen's supervisory services. Advice is given on the necessary consultation at the planning stage and on the choice of materials, appliances and components. Recommendations follow regarding the various types of systems, methods of wiring and power supply, and concerning the provision of the necessary structural accommodation for the equipment and wiring. Sections on inspection and testing, and on maintenance, are included. In an appendix are given details of some special types of cable. [Price 3s., postage included.]

Impulse Clock and Timing Systems.—The Council for Codes of Practice have issued another code forming part of the series dealing with telecommunication services. This, C.P. No. 327.403, deals with the design and installation of impulse-controlled clock and timing systems for various types of premises and provides for visual or audible time-indication, means of time recording, or any desired combination of these facilities. As is the case with the Code on Bell and Call Systems, advice is given on consultation at the planning stage and on the choice of materials, appliances and components. Recommendations are also given regarding the design of various types of systems, methods of wiring and power supply, and the necessary structural alterations. The code ends with clauses on inspection, testing and maintenance. [Price 3s., postage included.]

BRITISH SUBMARINE FOR FRENCH NAVY.—Subject to completion of sea trials, H.M. submarine Sportsman is to be transferred to the French Navy on Tuesday, July 8, and will be renamed Sibylle. She will be received on behalf of the French Navy by the French naval attaché in London, Rear-Admiral R. E. M. Blanchard, at Fort Blockhouse, Gosport.

PERSONAL.

AIR COMMODORE SIR FRANK WHITTLE, K.B.E., C.B., M.A., F.R.S., has been awarded the gold Albert Medal of the Royal Society of Arts for 1952, "for the development of the continuous-combustion gas turbine and jet propulsion."

SIR EDWARD APPLETON, G.B.E., K.C.B., D.Sc., F.R.S., Principal of Edinburgh University, has been awarded the Emblem of Honour of the Norwegian Polytechnic Society.

SIR ANTHONY BOWLBY, a director of Guest Keen and Nettlefolds (Midland) Ltd., and **MR. A. B. WARING**, chairman and managing director of Joseph Lucas Ltd., have been elected vice-presidents of the Institute of Industrial Supervisors.

MR. H. H. MONTGOMERIE, C.B., O.B.E., former Under Secretary, Ministry of Works, is joining the board of Mackay Industrial Equipment Ltd., Faggs-road, Feltham, Middlesex, in an advisory and consultative capacity.

MR. H. E. WRIGHT retired from the position of general manager of the Steel, Peech and Tozer Branch of the United Steel Companies Ltd., 17, Westbourne-road, Sheffield 10, on June 30. He will continue to serve, however, in a consultative capacity. His successor as general manager is **MR. ANDREW JOLLIE**, hitherto general works manager. **MR. G. E. D. HALAHAN**, formerly chief labour superintendent, succeeds Mr. Jollie as general works manager.

MR. H. BURROUGHS, F.R.Ae.S., has been elected President of the Society of British Aircraft Constructors for 1952-53, **MR. J. J. PARKES** has been elected vice-president and **MR. W. T. GILL**, deputy-president. **SIR FREDERICK HANDLEY PAGE, C.B.E.**, has been re-elected honorary treasurer.

MR. T. F. TURTON, M.B.E., certifying officer, Eastern Area, Ministry of Transport, has been appointed chairman of the Eastern Group of the Institute of Road Transport Engineers, 69, Victoria-street, Westminster, London, S.W.1, for 1952-53. **MR. P. M. BAKER**, district engineer, Birmingham and Coventry district, Road Haulage Executive, has been reappointed chairman of the Midland Centre for 1952-53.

MR. R. H. JAMES has set up a private practice as a production consultant on building and civil-engineering work. He will be in partnership with **MR. T. E. CROWLEY, B.Sc.**, and the firm is operating under the title of R. H. James and Partners, at 7, Hobart-place, London, S.W.1. (Telephone: SLOane 9860.)

MR. H. C. DRAYTON has joined the board of Mitchell Cotts & Co. Ltd., Winchester House, Old Broad-street, London, E.C.2, and has been appointed chairman in succession to the late **MR. LEONARD ALDRIDGE**. **MR. A. A. LOUGH** has been appointed deputy chairman.

MR. A. E. H. BOAZ has been appointed manager of the Falmouth Depot of the Marconi International Marine Communication Co., Ltd., Chelmsford, Essex, in succession to the late **MR. C. J. A. GILL**.

MR. O. W. J. FARMER, deputy manager of the Mazda lamp and lighting advertising department, British Thomson-Houston Co. Ltd., Crown House, Aldwych, London, W.C.2, is succeeding **MR. H. E. GOODY** as manager, when, as stated on page 799 of our issue of June 20, Mr. Goody retires on July 31.

MR. W. YOUNG, formerly foundry sales manager of the Clyde Alloy Steel Co. Ltd., Motherwell, has joined the staff of Foundry Services Ltd., Long Acre, Nechells, Birmingham, 7, as a technical representative in the Scottish area.

THE RADIO COMMUNICATION AND ELECTRONIC ENGINEERING ASSOCIATION, of which the secretary is **MR. S. NEILL CHRISTIE**, has moved from 59, Russell-square, to larger premises at 11, Green-street, London, W.1. (Telephone: MAYfair 7874-5.)

THE NORTH BRITISH LOCOMOTIVE CO. LTD., Springburn, Glasgow, have acquired a controlling interest in **HENRY PELS & CO. LTD.**, makers of light machine tools, London, N.W.1. **MR. T. A. CROWE**, chief managing director of the North British Locomotive Co., has been made chairman of Henry Pels & Co.

FOSTER TRANSFORMERS AND SWITCHGEAR LTD., South Wimbledon, London, S.W.19, a subsidiary company of Lancashire Dynamo Holdings Ltd., are to be known in future as **FOSTER TRANSFORMERS LTD.**

The activities of the **PHILCO TECHREP CONSULTANTS**, hitherto conducted from 93, Regent-street, London, W.1, will now be carried on from c/o Philco (Overseas) Ltd., Lion House, Richmond, Surrey. (Telephone: RICHmond 5661.)

SMALL AND PARKES LTD., Hendham Vale Works, Manchester, 9, have opened a new depot for "Don" brake and clutch linings, at 50, Old Market-street (Jacob-street entrance), Bristol. (Telephone: 27214.)

BRITISH INSULATED CABLES LTD. announce that their London branch stores have been removed to 10-14, White Lion-street, Islington, N.1. (Telephone: TERminus 8696-7.) The branch office remains at 21, Bloomsbury-street, W.C.1.

FATIGUE-TESTING LABORATORY FOR WELDING RESEARCH.

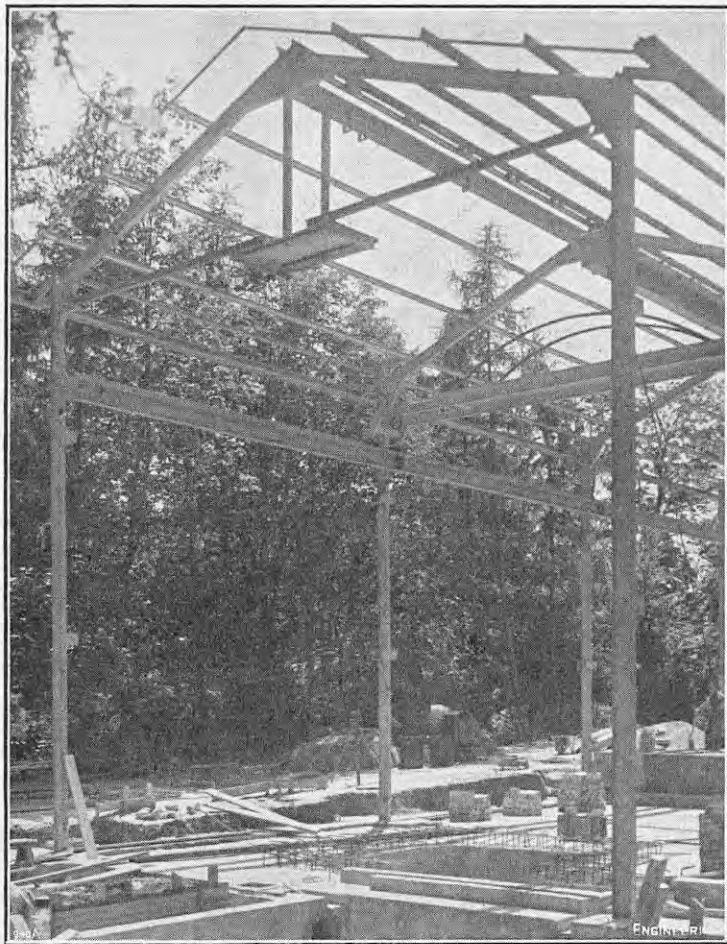
(For Description, see Page 12.)

FIG. 1. FRAMEWORK OF BUILDING UNDER CONSTRUCTION.

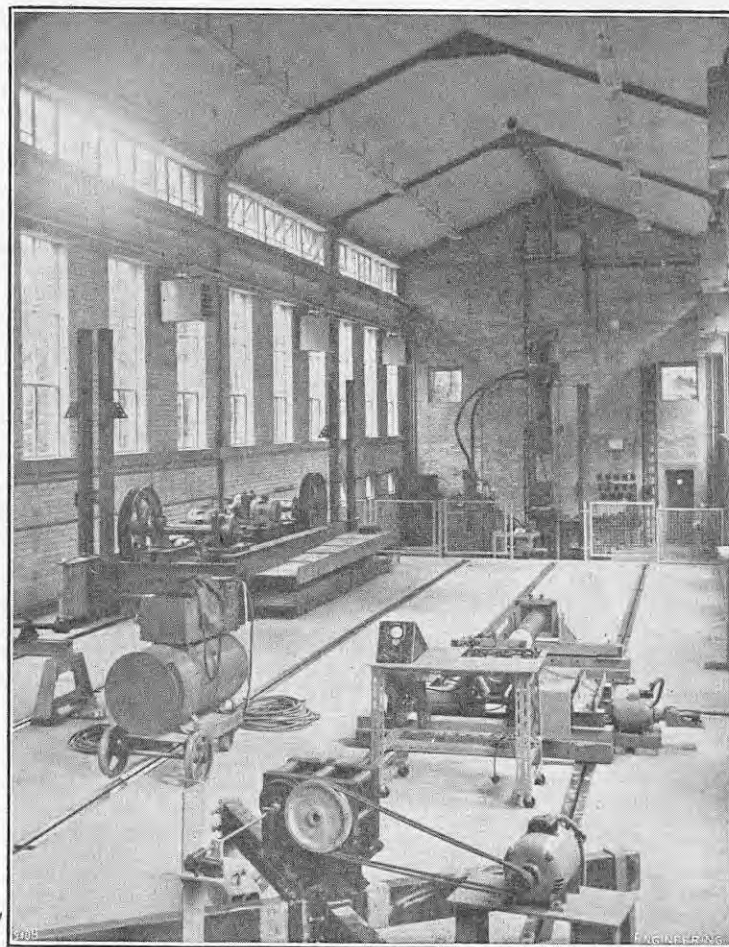


FIG. 2. INTERIOR OF LABORATORY.

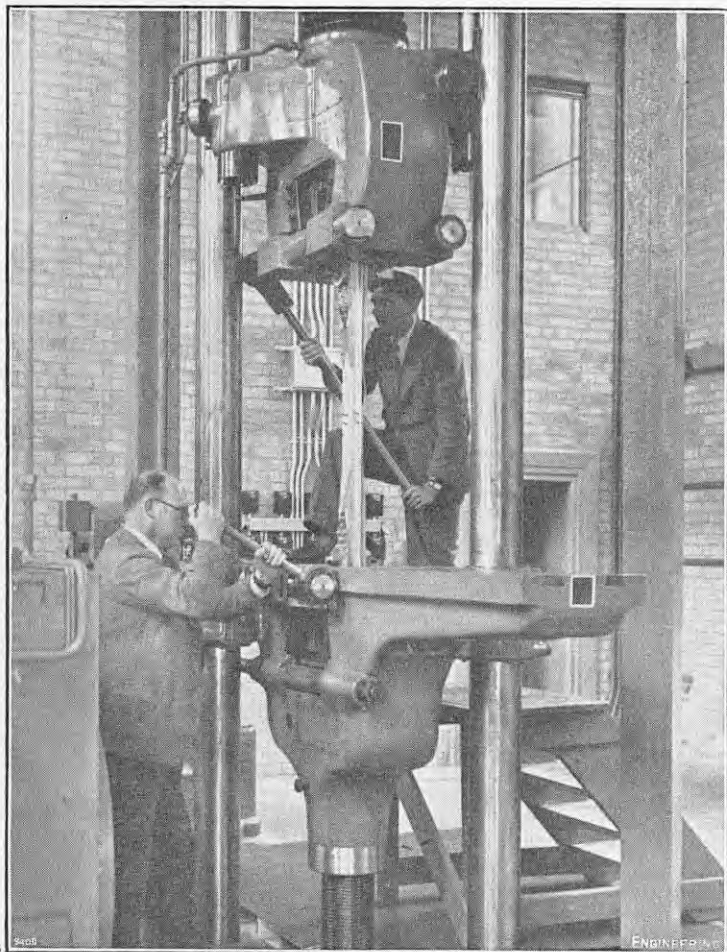


FIG. 3. LOSENHAUSEN FATIGUE-TESTING MACHINE.

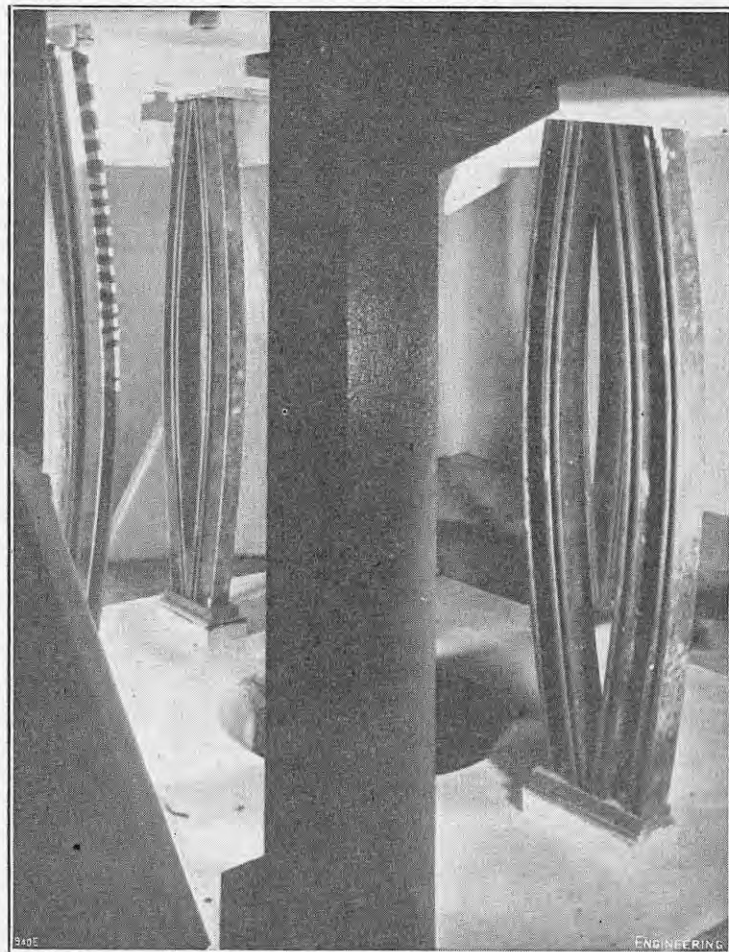


FIG. 4. SUPPORTS FOR LOSENHAUSEN MACHINE.

ENGINEERING

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LONDON, W.C.2.

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For Canada	£5 5 0

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ADVERTISEMENT RATES.

Terms for displayed advertisements on the green art paper wrapper, on the inside black and white pages and in the buff art paper two-colour supplement, as well as for insets, can be obtained on application to the Manager. The pages are 12 in. deep and 9 in. wide, divisible into four columns 2½ in. wide. Serial advertisements will be inserted with all practicable regularity, but absolute regularity cannot be guaranteed.

The charge for advertisements classified under the headings of "Appointments Open," "Situations Wanted," "Tenders," etc., is 10s. for the first four lines or under, and 2s. 6d. per line up to one inch. The line averages six words and when an advertisement measures an inch or more, the charge is 30s. per inch. If use is made of a box number the extra charge is 1s. per insertion, with the exception of advertisements appearing under "Situations Wanted." Series discounts for all classified advertisements can be obtained at the following rates:—5 per cent. for six; 12½ per cent. for thirteen; 25 per cent. for twenty-six; and 33½ per cent. for fifty-two insertions.

TIME FOR RECEIPT OF ADVERTISEMENTS.

Classified advertisements intended for insertion in the current week's issue must be received not later than first post Wednesday.

"Copy" instructions and alterations to standing advertisements for display announcements must be received at least 10 days previous to the date of publication, otherwise it may be impossible to submit proofs for approval.

The Proprietors will not hold themselves responsible for advertisers' blocks left in their possession for more than two years.

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PLATE.

Plate I.—CENTRAL VALLEY IRRIGATION
PROJECT, CALIFORNIA.

ENGINEERING

FRIDAY, JULY 4, 1952.

VOL. 174.

No. 4510.

IRON AND STEEL
PRODUCTION IN BRITAIN
AND THE UNITED STATES.

DURING the past few years, we have commented in these columns on a number of the reports of teams from this country who have examined the processes of United States industry under the auspices of the Anglo-American Council on Productivity, but we do not recall one that has impressed us quite so deeply as that of the team, representing the British iron and steel industry, who, in 1951, toured the principal heavy steel works of the United States.* Like all the other productivity teams, they found in America not only a significantly greater output per man than is usual in this country, but also a totally different mental attitude towards labour-saving devices, a highly developed sense of the urgency of better productivity, and a marked individual interest of the employee in the commercial success of his firm. What particularly distinguishes the report, however, is the breadth of its economic outlook, the mass of factual data that it contains, and its clear presentation of the influence of circumstances on the size, form, activities and welfare of the industry—or group of related industries—that it covers. Many of these factors, or their British equivalents, will have a direct bearing on the new five-year plan for the expansion of the steel industry in this country, some details of which were announced on Monday of this week, so that it is well that the team should have developed the clear appreciation of essentials that the report reveals.

Before passing to the main conclusions set out in the report, it may be recorded that, in 1945, the British iron and steel industry formulated what is

*Productivity Team Report: Iron and Steel. Anglo-American Council on Productivity, U.K. Section, 21, Tothill Street, London, S.W.1. [Price 5s., including postage].

now described as its First Development Plan, which was to have been accomplished in five years, but was extended subsequently to seven, and which, originally estimated to cost 120l. millions and, later, 185l. millions, eventually cost 260l. millions. Its fruition has raised the annual British production of pig iron from 8 to 10½ million tons and ingot steel production from 13 million to 16 million tons. The new plan, now in process of preparation by the British Iron and Steel Federation, is a continuation of the initial plan and is designed to increase the production of pig iron to 15 million tons and of steel to 20 million tons a year. It is expected to cost some 300l. millions by 1957 and will involve the scrapping and replacement of plant representing an annual output of at least a million tons a year. A basic feature is an increased dependence on supplies of imported ore, for which purpose steps are being actively taken to develop new sources of supply, notably in North Africa, and to improve, concurrently with the projected plant developments, the supplies of suitable coking coal. The possibilities of doing this are now being examined by the National Coal Board, the increase aimed at being 7 million tons of coal a year. To some extent, the new plan may be said to be already in process of fulfilment, as 15 ore-carrying ships, of special design to facilitate rapid loading and discharging, are now on order and the construction of some of them is well advanced.

Of the world output of steel (some 185 million long tons in 1950), the American production and the British production of 86½ and 16·3 million tons, respectively, together represented rather more than half; but, the respective populations of the two countries being 152 millions and 50 millions, it is seen at once that the American production is appreciably higher *per capita*. The American consumption of steel is higher still, for the United States industry exports only about 5 per cent. of its output, compared with a British exported proportion of about 20 per cent. Moreover, the rate of peace-time shipbuilding in the United States is low by comparison with the output of the British shipbuilding industry, which is one of the largest consumers of British steel. Another important point of difference is that, in the United States, 25 per cent. of the employed population is engaged in agriculture and only 20 per cent. in industry, whereas in Britain the respective proportions are 5 per cent. and 36 per cent. It may be noted, too, that 90 per cent. of the United States steel output comes from a comparatively small area, mainly on the shores of the Great Lakes, while the British production is more widely distributed within the country. The bearing of transport costs on steel production is very different, therefore, in the two countries, though this is balanced to some extent by the much greater distances over which, in America, the steel has to be transported to the domestic user.

Everything considered, however, the American steel industry enjoys many material advantages that the British industry does not; some of these are natural advantages—for instance, the higher iron content of the ore consumed, cheaper and better coking coal in relatively abundant quantity, and the availability of rich supplies of cheap oil and natural gas. Other advantages are artificial and result from the larger scale of operations; notably, the facts that the ranges of product sizes are less and that the producer has to meet less rigid specifications of finish and tolerances on size than in Britain on some of the largest product classifications, and can afford to take definite steps, by price increases and otherwise, to discourage any tendency of consumers to demand small quantities of special kinds and sizes of steel.

In addition to these advantages, the American steelmaker has benefited by Government financial

assistance, granted on a liberal scale during the war to encourage expansion of the industry. American firms are allowed to write off the capital cost of plant and buildings more rapidly than is permitted to British firms; and, knowing that replacement is thus facilitated, they can and do work their plant more intensively. In part, no doubt, this can be attributed to the "productivity-mindedness" of American labour. Certainly, as the report points out, after making allowances for the purer ore, the better coke, the plentiful oil and natural gas, and the greater size of American units of plant, American steelworkers are able to get 10 to 20 per cent. more out of each unit than is customary in this country. In some directions they have to pay more to get it—for example, the coke consumption in blast furnaces is higher, on the average, than in Britain, and in open-hearth furnaces the roof life is shorter; but they accept these extra charges as being worth while, and counteract them to an appreciable extent by using mechanical aids more generally and by reducing the periods when the plant is out of production for maintenance purposes.

A feature of particular interest is that, in spite of the very considerable advantages enjoyed by the American steel industry, steel is still produced at a lower cost in Britain than anywhere else with the exception of Australia. The capital developments already undertaken in this country, combined with the greater use of oil as fuel and the introduction of the continuous working week, have led to an increase of 25 per cent. in the output per man of finished steel, and there is good reason to believe that this could be further improved upon by continuous modernisation and a more effective use of the plant; though the comment is made that "there is no case for a blind following of American operating practice." One reason for the high efficiency of present British steelmaking is the vigorous and extensive prosecution of co-operative research, which is carried on in the British industry on a larger scale, in proportion, than in America. In the United States, however, a great deal of research applicable to the steel industry is carried on by the Bureau of Mines, the Bureau of Standards and other Government agencies, and many university laboratories and commercial research institutes also receive Government grants for metallurgical investigations.

The report recommends that, in planning the future development of the British steel industry, new blast-furnaces should be designed with a minimum hearth diameter of 25 ft. for imported ore and 27 ft. for home-produced ore on basic iron; and open-hearth furnaces also should be increased in size—to 150 tons per tapping for cold-metal furnaces, 225 tons for fixed hot-metal furnaces, and 350 tons for hot-metal tilting furnaces. The layout of existing secondary mills should be modified in relation to the primary mills so that the latter can be loaded nearer to their full capacity, or, if this cannot be done, additional finishing stands should be provided. New primary mills (preferably to be either slabbing or blooming mills) should have a minimum annual capacity of 750,000 to 1,000,000 tons. Development and re-equipment should be concentrated in the works most suitably situated for expansion—which seems fairly obvious common-sense; and British Railways should be invited to consider the possible provision of larger wagons and more powerful locomotives to handle steelworks traffic. It is added that "a long-term programme of British shipbuilding and port development is required" and that greater use should be made of road transport inside steelworks and for short-haul distribution of products. Room for improvement is seen, also, in the size distribution and bulk density of British coke, and in the fuel-consumption rates of British soaking pits and reheating furnaces.

ELECTRICAL RESEARCH.

THE outstanding feature of the fourth British Electrical Power Convention, held at Bournemouth recently, was the stress laid on research. As will be seen from our report, which is commenced on page 29 of this issue, seven papers were devoted to this subject, while at a further meeting a paper on "High-Performance Dielectrics" naturally intruded into the same field. This mass of material could only be presented in abstract; and even so the time allocated in a crowded programme rendered the discussion quite inadequate in volume. It is therefore to be hoped that the different communications, which cover such subjects as research in the electricity supply, manufacturing, cable and lamp-making industries, as well as a consideration of co-operative investigation, will be carefully studied. They provide a great deal of information about what has been, and is being, done even if there is rather less about what it is proposed to do. It may perhaps be added that this perusal will require a certain amount of effort and the exercise of the reader's powers of selection, for, in some cases, the authors have thought it necessary to deal at great length with the history of their subject; and in others there is a tendency to stress unduly the value of research, which is an example of preaching to the converted that seems superfluous at the present time.

The admitted value of research is, however, greater or less, depending upon the way in which it is organised and hardly less upon the methods adopted to apply the results obtained to the production of more efficient and cheaper equipment. In his opening survey of the subject, Sir Arthur Fleming listed the five types of research organisation which operate in this country. These include the universities and technical colleges, which carry out fundamental research; the research associations, which conduct investigations and make the results directly available to their members, and perforce also to others to some extent; the research and development departments of the large manufacturers; and the somewhat similar departments of such operating concerns as the Post Office and the British Electricity Authority. All these phases of research are closely inter-related and, although they are also to some extent competitive, the fact that co-operative research has made greater advances in this than in any other country indicates that much of the work benefits the industry as a whole. Dr. Whitehead, it is true, would like to see further progress towards co-operation in the form of greater financial support of the Electrical Research Association, although he admits that the total amount now being spent by the British electrical industry on research is as great as can be readily justified.

On the other hand, Mr. P. V. Hunter, in his presidential address, expressed some doubt whether every need was being met; and called attention to the requirements of the small manufacturing establishments, such as still makes a surprisingly large contribution to the country's industrial effort. He therefore favoured the setting up of special research establishments, which would accept work on a cost basis from clients who, in turn, would have the exclusive use of the results obtained. Something of the sort, of course, already exists in this country in the form of the Association of Short-Circuit Testing Authorities, although the President probably had in mind an organisation which would enjoy greater freedom from the influence of the larger manufacturers than that useful body. Although it is highly desirable that the smaller firms should be encouraged, many will have doubts whether the best way of doing this is to increase the number of organisations already existing, and, if it is, whether the form of organisation suggested

is that best suited for the purpose. It is probable that a good deal more will be heard of this proposal; but, for our own part, we should prefer a movement towards greater consolidation, a movement which would have advantages not only from the technical but also from the economic point of view.

A study of the papers read at the Convention inevitably raises the question as to the use that is being made of the results obtained in the various research laboratories. The criticism is often made that "production" in research is painfully slow and that much of the work bears little or no relationship to practical requirements. Although there may be some justification for both these charges, especially the first, it must be remembered that an efficient two-way traffic exists. An example of this is that the conclusion reached some years ago by the Central Electricity Board to use a voltage higher than 132 kV on the main transmission system of the country led to the erection of an experimental 275-kV line. Useful information regarding corona loss and radio noise under various weather conditions has been obtained on this line; and will be applied in the construction of the actual system which is now under way. Another is the problem of transformer noise, which is likely to become more insistent as time goes on. A survey of the noise levels of transformers of various sizes has therefore been made, as well as an investigation into the attenuation of this noise with distance and the effect of erecting screening walls or of complete enclosure. This study has also been completed, and the sound level at a dwelling house can now be estimated in a particular case. It is to be hoped that this useful form of co-operation will be continued and extended.

Nevertheless, Mr. E. B. Wedmore was quite right to emphasise the need for adopting means of ensuring that the discoveries of research are quickly applied in production, and Mr. D. P. Sayers was on equally firm ground in stressing that much had still to be done in the way of economic and technical improvements in present engineering techniques. He pointed out that while the normal load current of the circuit-breakers described by Dr. Wilkinson was about 1,000 amperes, they had to be designed to rupture fault currents of ten times that value. Some electronic mechanism which would prevent the building up of such currents, so that the energy to be dealt with at the instant of rupture would be quite small, was therefore needed. This suggestion should provide a stimulus to research workers in this particular field and should direct attention to the useful investigations on circuit-breaker design that are being carried out elsewhere.

An analysis of the research work that is being done in the various branches of the British electrical industry, as disclosed in these papers, indicates, in fact, that a very large number of investigations are being carried out; and that in many cases the results are being usefully employed in manufacture. A quantitative relationship between these results and their application, however, is not available, and in any case would be hard to establish, although it is on such a relationship that the value of research as a whole must be ultimately assessed. There may be a great deal to be said in favour of knowledge for its own sake, but in this case the standpoint must be more utilitarian. It may also be asked whether the net is not being spread too widely and whether it would not be better, from more than one point of view, to concentrate on matters the practical value of which can be most easily foreseen. Again, although co-operation exists, there are many arguments why it should be closer, in order that both time and money may be most efficiently employed. Readers must not, therefore, be tempted into complacency or the authors to regard themselves as being the only spreaders of the true gospel.

NOTES.

THE END OF LONDON'S TRAMWAYS.

At 11.57 p.m. to-morrow, Saturday, July 5, the last London tramcar will leave Woolwich for the depot at New Cross, where it will arrive about half an hour later. Six services only remain to be abandoned in this final stage of a conversion to 'bus operation which was decided upon in 1933, namely, Nos. 36 and 38, between Abbey Wood and Victoria Embankment, No. 40, from Plumstead to Victoria Embankment, and Nos. 44, 46 and 72, between Beresford-square, Woolwich, and Eltham Green, the City and Victoria Embankment, respectively; and only 162 tramcars are still in use, out of a total which was about 3,000 in the heyday of the system. The history of tramways in London goes back 91 years, to March, 1861, when George Francis Train began his horse-drawn service along Bayswater-road between the Marble Arch and Porchester-terrace, following his pioneer tramway venture in Birkenhead in the previous year. Train started two other services in London, one along Victoria-street, Westminster, and the other from the Surrey end of Westminster Bridge to Kennington; but all three had only a short life, because the rails, which were laid on the surface of the roads, caused annoyance to other road users, especially the drivers of hansom cabs. London was then left without trams until 1870, when services were begun by separate companies between Westminster Bridge and Kennington, between Greenwich and Vauxhall, and along Whitechapel, Mile End-road and Bow-road. Between 1870 and 1876, following the passing of the Tramways Act in the former year, 61 miles of new routes were opened—all, of course, served by horse-drawn cars; but none of them entered the City, and the West End also declined to permit their introduction. The first trams to Croydon ran in 1876, to Bermondsey in 1880, and to the northern suburbs in the following year. Efforts to develop mechanical traction began in 1871, when Loftus Perkins introduced a "steam tram-horse." John Grantham also constructed a steam tram; compressed-air tractors were tried in 1877; and in 1883 a battery-operated electric tram was tested, though for one day only. The first regular electric-tram service, with current supplied from a power station, was instituted by the London United Tramways Company in April, 1901, and two years later the London County Council's electrified system began operation. It was extended rapidly and had a total length of 144½ route miles by 1915, when the last L.C.C. horse tram service, down Tower Bridge-road, was withdrawn. In all, London had 700 miles of tramway track, which had cost 10,000,000% to lay; a cost due largely to the adoption of the conduit system in the central area, in the interest of amenity. No new trams were built after 1932, but there were still 2,600, and 327 route-miles of track, when, in 1933, the London Passenger Transport Board took over the assets and services of the 17 tramway undertakings then operating.

THE INSTITUTION OF METALLURGISTS.

The eighth annual general meeting of the Institution of Metallurgists was held at 4, Grosvenor-gardens, London, S.W.1, on June 26, with Dr. C. J. Smithells, M.C., occupying the chair. The first matter on the agenda, after the minutes of the previous meeting had been dealt with, was the report of Council which was presented by Dr. Smithells. The report showed that, from January 1 to December 31, 1951, the number of members had increased by 191, representing 79 per cent. of the applications for membership received during the year. On December 31 last, the total membership was 2,316. The Institution's examinations had been held from August 27 to September 3, 1951, in London, Birmingham, Glasgow, Corby and Bristol. In addition, two candidates had been examined in South Africa and six in India. There had been 59 candidates for the Associateship, of whom 25 had been successful, and 84 for the licentiateship, of whom only 16 had satisfied the examiners. In accordance with the by-laws of the Institution, Dr. J. W. Jenkin would retire from the Council at the present

meeting and he had also signified his desire to be relieved of the chairmanship of the Examinations Board, which he had held with distinction since the inception of the Institution. Dr. Edwin Gregory had accepted the Council's invitation to succeed Dr. Jenkin. The honorary treasurer's report indicated that the income for the calendar year 1951 was 5,214%, and the expenditure 4,943%, thus showing an excess of income over expenditure for the year of over 270%. Turning to the election of officers, Dr. Smithells announced that Mr. L. W. Derry had been elected to represent the associates and Messrs. J. Arnott and R. S. Brown and Drs. L. Northcott and E. G. West to represent the fellows on the Council; that Mr. G. L. Bailey, C.B.E., had been re-elected honorary treasurer; that Drs. N. P. Allen and E. Gregory had been elected vice-presidents, and that Professor H. O'Neill had been elected President. In inviting the latter to take the chair, Dr. Smithells recalled the main stages of his career, stating that after graduating in Sheffield, Dr. O'Neill had been lecturer in metallurgy in the University of Manchester from 1921 until 1934, chief metallurgist to the London Midland and Scottish Railway Company, at Derby, from 1934 until 1947, and since 1947, Professor of Metallurgy at the University College of Swansea. After a vote of thanks to the retiring President had been carried with acclamation, Professor O'Neill delivered his presidential address on some of the "Cultural and Professional Aspects of Metallurgical Training," which we hope to reprint in an early issue.

THE SUPPLY OF ELECTRIC WIRES AND CABLES.

A long report on "The Supply of Insulated Electric Wires and Cables" has been prepared by the Monopolies and Restrictive Practices Commission and was published by H.M. Stationery Office on Tuesday, July 1, at the price of 5s. net. It traces in detail the history of the Cable Makers Association and the Covered Conductors Association since 1899, when severe price cutting was reducing quality; and describes how these bodies and various sub-associations have fixed common prices; shared business in agreed proportions based on sales over previous periods; and in some cases have allocated orders and pooled profits. Turning to what may be called the other side of the picture, it is noted that standards of quality have been laid down by these Associations, that output is subjected to regular performance tests, and that new products must be submitted for approval before they are sold. It is further agreed that, although the production of first quality cable is by no means confined to members of the Cable Makers Association (who, with the Covered Conductors Association, account for three-quarters of the whole supply), that body has played a predominant part in establishing the reputation of the industry. Moreover, no recent evidence can be found of any general policy of restricting productive capacity, although there are certain restrictions on imports. Patent policy has been liberal and there is no evidence that members of the Association have abused their power to exercise control over supplies of copper to independent manufacturers. Nevertheless, it is recommended that there should be some modification of the existing price-fixing policy and that the arrangements with very large buyers (such as the British Electricity Authority and the Post Office) for the purchase of mains, telephone and submarine cables, should be continued and supplemented. Prices to small consumers of these commodities should bear a reasonable relationship to those charged to large ones. The common price system for other cables should be brought to an end, but, to obviate any reduction in quality as the result of extreme price cutting, the Association should be allowed to fix minimum prices. All "quota" and "allocation" arrangements should cease and exclusive dealing arrangements, aggregated quantity rebates and association rebates should also be ended. It would not therefore appear that any great scandal has been uncovered or that any reasonable change will greatly affect the situation.

ALUMINIUM DEVELOPMENT ASSOCIATION.

Although, so far, there has been no large-scale application of aluminium to ship structures in this

country, some 2,000 tons of the metal and its alloys have been incorporated in the upper works of the American transatlantic liner United States, and details of these were given in our description of the vessel on page 809 of our issue of June 27. The Aluminium Development Association, 33, Grosvenor-street, London, W.1, through its Marine Sub-Committee, has always fostered and encouraged the adoption of aluminium alloys on shipboard, and, in this connection, maintains close relationships with the Ministry of Transport, Lloyd's Register of Shipping, the British Shipbuilding Research Association and other organisations concerned with shipping, as well as with many individual shipbuilders and shipowners. It is stated in the newly-issued report of the Aluminium Development Association for the year ended December 31, 1951, that experimental work on a scale model superstructure at King's College, Newcastle-upon-Tyne, is being carried forward and that the eventual aim of this work is to provide a basis for the design of superstructures for all types of vessels up to the largest. The Association is also interested in the use of aluminium in railway rolling stock, and work with the Ulster Transport Authority has continued during the year. A scheme for an integral Diesel-engined railcar has been completed, from which it appears that some 2½ tons weight could be saved by the use of aluminium compared with steel, although figures for an existing car of comparable performance were not available. Other schemes put forward concern aluminium-alloy floor panels for new standard coaching stock on British Railways and tubular-type luggage racks, cast brackets and such equipment as semaphore signal arms. Advice has been tendered on bascule bridges in this country and in Holland, and memoranda, specifications and codes of practice have been prepared by the Building Sub-Committee of the Association. Considerable interest has been taken in light-alloy roof supports for collieries, and, on the electrical-engineering side, the existing interest in aluminium for conductors and components has been maintained, while other fields are being actively explored.

POLLUTION OF SEA WATER BY OIL.

According to a statement issued by Lord Runciman, President of the Chamber of Shipping of the United Kingdom, the continued pollution of sea water by oil has led the shipping industry to set up a special committee, under the chairmanship of Sir Colin Anderson, to consider as a matter of urgency the best practical measures to be taken to deal with this problem. The statement recalls that British shipowners have been concerned for some time now at the extent and seriousness of the pollution of the coasts and coastal waters by oil. So far as the United Kingdom is concerned, the problem first arose in 1918, and in 1922, after consultations between the various bodies interested, the Oil in Navigable Waters Act was passed, which prohibited the discharge of oil or oily waste within the territorial waters of Great Britain and Northern Ireland. Two years later, the industry set up a joint committee to inquire into sea-water pollution. The report of this committee was studied by the then International Shipping Conference and, as a result, the shipowners of the constituent countries were recommended to issue instructions that all possible precautions should be taken to prevent any cause for complaint. In 1926, a conference was held in Washington; at this, a draft convention was drawn up which provided for the establishment of zones extending not more than 50 miles, and in exceptional circumstances, 150 miles, from the coast, within which the discharge of oil was to be prohibited. Unfortunately, the convention was not ratified; nevertheless, British shipowners and others of the International Shipping Conference instructed their masters not to discharge oil or oily waste within 50 miles of any coast. British shipowners, therefore, have always co-operated in taking all practical steps to mitigate the nuisance, but, as Lord Runciman points out, the problem is essentially an international one and must, in the end, be dealt with on international lines. The setting up of the new committee, he adds, is a further indication of the desire of British shipowners to assist in solving this problem.

to the strain gauges. The slipring frame carries two ground and hard chromium-plated tracks on which run the bearings of the brush cage.

The brush cage, *g*, which is also fabricated, is supported on the slipring frame by six ball bearings, *h*, the outer races of which act as wheels running in the ground track in the frame. These bearings are packed with grease and sealed by the manufacturers. It is important that this grease, which is the only lubricant required in the slipring unit, should have a high melting point so that in service it does not soften and spread over the sliprings and brushes. The brush-holders, *i*, Fig. 2, are machined from laminated plastic insulating material and are screwed into the cage. There are three paralleled connecting brushes of soft carbon, $\frac{1}{4}$ in. square in section, to each ring.

The requirements for a slipring and brush are that their contact potential and resistance should be small and constant over a wide range of rubbing speeds, and that the "noise" induced by them in any amplifying system should be negligible. Silver

able noise results from the use of brushes made of carbon containing divided silver, probably due to the particles of silver welding to the rings.

A cover, *k*, protects the brushes and locates a Ferodo-lined brake. The brushes may be inspected and the slipring cleaned when the cover is removed. The brake is anchored to a convenient support and prevents the brush cage from rotating. It may be removed, and the cage allowed to rotate freely with the slipring frame, when the torque meter is not in use, thereby reducing wear on the sliding surfaces. All steel components of the slipring unit are treated with a corrosion-resistant finish. The slipring unit is placed over the strain gauges on the shaft, and protects them from mechanical damage. The gauge chamber, *m*, so formed, is sealed by an "O" ring under each end, but additional sealing is required to protect the gauges over long periods of time.

The strain gauges used in the measurement of shear strain consist of approximately 25 in. of Nichrome wire, 0.001 in. in diameter, which is wound into a flat grid 1 in. long and 0.3 in. wide, and bonded between two pieces of paper. They are cemented in pairs to the shaft on each end of a diameter, and at an angle of 45 deg. to its axis. The arrangement is shown in Fig. 6, herewith, where the curved surface of the shaft has been developed and presented in the plane of the paper. When the shaft is twisted, one gauge of each pair will be extended (gauges 2 and 4, for instance) and will increase in resistance, and the other gauges (1 and 3) will be contracted and their resistances will decrease. The gauges are connected to form the four arms of a Wheatstone network, as shown in Fig. 7.

(To be continued.)

FOURTH INDUSTRIAL PHYSICS CONFERENCE, GLASGOW.

A CONFERENCE on industrial applications of physics, the fourth of its kind to be arranged by the Institute of Physics, 47, Belgrave-square, London, S.W.1, was held at the Royal Technical College, Glasgow, last week. The Society's main objective in this instance was to bring to the attention of industrial executives, engineers and scientists recent developments in the applications of physics in industry, and, the meeting-place being Clydeside, special prominence was given to engineering and shipbuilding. Transport and technical education were also among the subjects discussed. The lecture programme occupied the three days from June 25 to 27, and an exhibition of scientific instruments, apparatus and books, also held within the Royal Technical College, was open from June 24 to 28. There were, besides, a number of visits to research laboratories and industrial plants.

The conference was formally opened by Lord Bilsland, President of the Scottish Council, and Sir Andrew McCance, deputy chairman of Colvilles, Limited, delivered the opening lecture. Sir Andrew, who chose as his subject "Physics in the Service of Metallurgy," reviewed the history of the latter, tracing its origin to the publication, in 1555, of a treatise in Latin, entitled *De Re Metallica*, by one Agricola, a physician of Freiburg in Saxony.

It was not until the middle of the 19th century, however, said Sir Andrew, that metallurgy developed from an art into an observational science. The initial steps in the process were taken by Sorby, a geologist of Sheffield, who was the first to employ the microscope in the study of metal structures. Although Sorby's discoveries were published, they aroused more interest abroad than in his native city, and stimulated, in particular, the Frenchman, Floris Osmond, who had spent ten years of his life at Le Creusot. It was Osmond who discovered allotropy in the course of his investigations of the hardening of steel. In his researches, he was aided by the thermocouple, the potentialities of which had been suggested by Becquerel as early as 1826 and reiterated later by Le Chatelier, who proposed the use of platinum and rhodium as the elements, a combination which was still supreme in the metallurgical field. Means for the exact determination

of temperature had done much to advance the science of metallurgy.

An accurate method of determining temperatures within the working range of open-hearth furnaces had long been desirable. Ever since such furnaces were constructed for melting steel, it had been customary for the temperature to be estimated by the melter, who judged its value from the appearance of the refractory lining, and it had been proved that a skilled workman could assess a temperature of 1,580 deg. C. correctly to within ± 15 deg. C. by visual observation alone. By means of pyrometers, however, which Sir Andrew described, the temperature of a bath of molten steel could be found accurately in 10 to 15 seconds, but the outstanding qualities of these instruments were matched by high maintenance costs. The latter consideration had led to the development of radiation pyrometers, although these were not so suitable for determining the temperature of a liquid. Their field of usefulness lay in the automatic control of furnace temperature and operation. Control of this kind was beset by problems of time lag in combustion and heat transmission, but the day of the fully automatic steel-melting furnace seemed within sight. Automatic metallurgical control might also be possible by injecting radio-active carbon into the molten metal and then making an instantaneous chemical analysis by means of instruments located outside the furnace. Radio-active tracers had also been used to measure gas velocities and the rate of erosion of refractories.

Sir Andrew then referred to methods of analysis in metallurgy, saying that a striking change within recent years was the growth of physical, as opposed to wet chemical, methods. At the present time, spectroscopic analysis was widely employed, a development due largely to the work of Twyman. Recently, spectroscopic methods had been extended to the analysis of slags and refractory materials, and their success foreshadowed an era of even more precise slag control in steelmaking. Spectrographic methods were particularly useful when elements of high atomic weight were present, and enabled the percentages of such constituents to be determined with considerable accuracy. Much attention had been given to the design of an instrument which would give direct readings, and there was one such on the market capable of determining, within a few seconds, and displaying on instrument dials, correctly to within one per cent. in each case, the percentages of 11 elements present in a steel. Spectrographic methods, however, were not very suitable for the analysis of gases or when the elements present were of low atomic weight, but attempts had been made to use the mass-spectrometer for this purpose, and it seemed likely to be only a matter of time before this technique was perfected.

Sir Andrew then reviewed other analytical methods applicable to steel, mentioning that which depended on magnetic induction and which was used for determining the quantity of carbon present. This method was very accurate for carbon percentages between 0.25 and 1, and was also very rapid. X-rays had also been applied to determine lattice structure, and both X-rays and gamma-rays were used for inspecting castings and welds. Much pioneering work in this field had been done by Dr. V. E. Pullin, at Woolwich Arsenal, and, as a result, high-pressure boiler drums, which were formerly hollow-forged in large and costly hydraulic presses, could now be fabricated satisfactorily with the aid of electric welding. By using two-million volt X-ray equipment, steel six or seven inches thick could be examined radiographically, a short exposure sufficing to give a satisfactory photographic negative. High-pressure valves, pipes and turbine casings could also be inspected by such means. More recently, radio-active isotopes, produced at Harwell, had been employed to detect faults in metal parts. The advantage of this method of examination was that several capsules containing the isotope could be placed simultaneously along one face of a welded joint and a photographic film attached to the other, the record could be obtained overnight.

X-rays, said Sir Andrew, could also be used to measure the thickness of metal sheets and to control the thickness of sheet as it was rolled. With the aid of two X-ray tubes, working on alternate

Fig. 6.

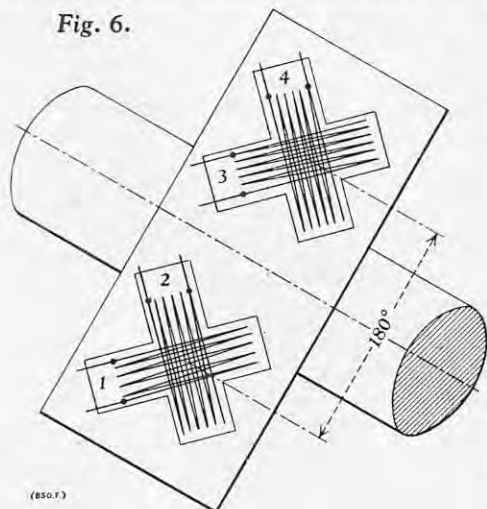
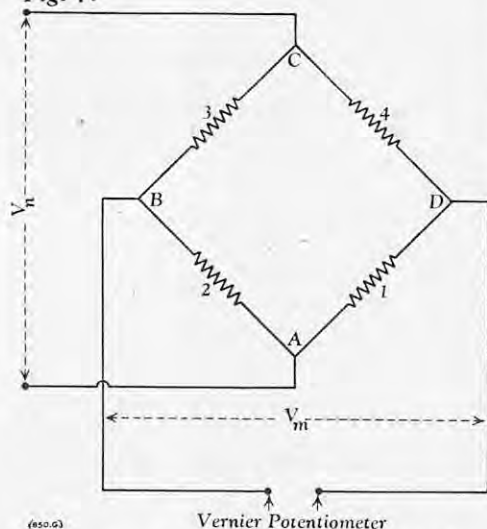


Fig. 7.



was chosen for the sliprings because of its high conductivity and easily removable oxide, and carbon brushes were used for their anti-frictional properties. The contact potential of carbon on silver is greater than that of many other combinations recommended for this purpose in the literature, but, since the terminals of the strain-gauge network are not connected through thermionic valves or condensers, the contact potential will not affect the measurements, provided that all the rubbing contacts are at the same temperature. Where the sliprings and collectors are both metallic there is usually a rubbing speed beyond which the temperature of the contacts will increase rapidly and will substantially affect the torque measurements. The low frictional resistance of the carbon brushes prevents this localised heating, and it has been found that the noise imparted to the amplifier by a silver-carbon combination is low. These results have been confirmed by B. M. Horton,* who reports that consider-

* *Rev. Sci. Instr.*, vol. 20, page 930 (1949).

half-waves of a single exciting source and positioned so that one beam was directed through the sheet being rolled and the other through a standard sheet, variations in thickness of as little as 0.0002 in. could be detected with the aid of a photo-multiplier.

Continuing with a discussion of the detection of flaws in metal, Sir Andrew referred to the magnetic method of detecting surface-cracks. This depended on the concentration of magnetic flux which occurred at a small air-gap, the existence of which was revealed by allowing an oil, containing fine iron filings in suspension, to flow over the surface. It was particularly useful when a magnetic field could be produced easily, as, for instance, in the case of a bar, by passing an electric current through the material, but it was not so suitable for castings of irregular shape. In such cases, fluorescent liquids, which penetrated into the cracks, could be used. After removal of the excess liquid, the cracks showed up clearly in ultra-violet light.

Ultrasonic methods, said Sir Andrew, were now widely employed to detect internal flaws, and were particularly useful for examining plates, since the depth of the flaw could be determined easily with the aid of the reflection which was also obtained from the lower surface of the plate. The method had its limitations, however. The size of flaw detectable depended on the wavelength of the incident wave train which, for a given frequency, varied directly as the velocity of sound in the material. For example, the minimum size of flaw which could be detected in steel was greater than that in magnesium. A reduction in the wavelength by increase of the frequency ultimately resulted in excessive attenuation combined with dispersion and diffuse reflection, and a final limitation on wavelength was imposed by the grain size in the material. It could be shown that, for a spherical discontinuity, the amplitude of the scattered wave was proportional to the volume divided by the square of the wavelength, so that, for detecting small flaws, the frequency should be high.

Finally, Sir Andrew referred to current physical theories about the solid state. Ultrasonic methods of determining the elastic constants of metals and of single crystals had shown that materials differed greatly from the ideal solid postulated in theory. The fundamental work of Cauchy on polarisation and dispersion in an elastic medium, undertaken in connection with studies of the nature of light, which had been envisaged as a longitudinal vibration in such a medium, had been of great value to engineers, as Cauchy had formulated the equations which determined the life history of any set of initial displacements in such a medium. The skill of the metallurgist in growing large single crystals of pure metals, combined with the skill of the physicist in measuring elastic constants along crystallographic axes, had made possible the determination of the characteristic coefficients of Cauchy's strain analysis. As a result, the relation which should exist between these coefficients, were the material truly isotropic and the forces between atoms truly central forces, and that determined experimentally could be compared. The results showed that there were few, if any, ideal solids, although certain salts, such as the chlorides and bromides of alkali metals were nearly so.

A question arose as to how much of the difference was due to lack of perfection in the crystals. The occurrence of crystalline dislocations had been suggested by Sir Geoffrey Taylor, and Sir Laurence Bragg had shown that they could be produced. Further information on the mechanical behaviour of metals had been obtained from recent studies of wave-damping. According to Clerk Maxwell's theory, damping depended on the frequency but not on the amplitude of the disturbance, but Zener, who had tested this theory, had found largely the opposite result. Damping could be caused by phase lag between stress and strain, by thermal, atomic and magnetic diffusion, by grain boundaries, or by the occurrence of a duplex structure or inhomogeneity. The consequences of phase lag and diffusion from thermal and magnetic effects could be calculated and the conclusions agreed well with the experimental results, while the effects of atomic diffusion were well illustrated by the behaviour of carbon and nitrogen in iron.

(To be continued.)

SUMMER MEETING OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE summer meeting of the Institution of Electrical Engineers was held in Dublin from Tuesday, June 24 to Saturday, June 28. Rather over 200 members and ladies attended, including the President (Sir John Hacking) and the Chairman (Mr. B. O'Mongain), the honorary secretary (Mr. J. D. Ferguson) and other representatives of the Irish Branch. The programme included the inspection of a number of places of engineering interest in Dublin itself, as well as visits to the the Clonast peat bog, the peat-fired power stations at Portlannington and Allenwood and the water-power station at Poulaphuca on the River Liffey. A number of social gatherings also took place and much credit is due both to the officials of the Irish Branch and to Mr. R. C. Chapman of the headquarters staff of the Institution for the smooth conduct of the proceedings.

FINGLAS 110-kV TRANSFORMER STATION.

The proceedings opened with an informal reunion and smoking concert at the Metropole Ball Room, O'Connell-street, Dublin, on Tuesday evening, while on the following morning a number of alternative visits were paid. These included an inspection of the 110-kV transformer station of the Electricity Supply Board at Finglas to the north of Dublin, which has been erected to supplement the similar station at Inchicore, on the south of the city, owing to the extensions of the network. The equipment at present consists of one 30-MVA, 110/38/10-kV transformer, but another similar unit will shortly be commissioned. Both transformers will be fitted with built-in radiators and will be cooled by automatically-controlled fans. An on-load tapping range of 27.8 to 48.5 kV in 20 steps is provided and are-suppression coils with ratings of 7,000 and 4,600 kVA are installed. The high-tension switchgear is operated by compressed air and is remotely controlled from a control room. It consists of nine 110-kV and 11 38-kV air-blast circuit-breakers with rupturing capacities of 2,000 and 1,200 MVA, respectively. On those controlling the 110-kV circuits, the conventional air-break switch in series with the arcing contacts has been omitted, while in the "off" position, the arcing contacts are held open by compressed air. There is no mechanical coupling between the three phases. All this switchgear is installed out of doors on reinforced-concrete pedestals and is protected from direct lightning strokes by rods on the terminal masts. The 110-kV isolators are arranged "in line" and are fully interlocked to prevent incorrect operation. Combined current and voltage transformers are installed on the 110-kV lines.

MANUFACTURE OF SMALL TRANSFORMERS.

A visit was also paid to the works of the Aberdare Electric Company, Limited, where an inspection was made of the equipment which is being manufactured for rural electrification schemes. This includes single-phase pole-mounting transformers with capacities of 3, 5 and 15 kVA, although designs for 30-kVA and 50-kVA units are in course of preparation. These transformers have been specially designed for rural distribution work and have very low core losses and excitation currents. They are also capable of dealing with severe overloads. Other manufactures include steel-cored aluminium, steel-cored copper, galvanised steel, copper and aluminium conductors in small sizes, as well as equipment for supplying low-voltage lighting circuits at 12, 24 or 50 volts. The transformers provided for this purpose are rated at 100, 200 and 500 volt-amperes, as well as at 1 and 2 kVA and are suitable for use both indoors and out of doors.

A third party visited the workshops of Aer Lingus at the Dublin Airport, where they had an opportunity of seeing the operations in the control tower.

BREWERY POWER PLANT.

On Wednesday afternoon a visit was paid to the brewery of Messrs. A. Guinness, Son and Company, Limited, where special attention was directed to the

new power station, although interest was also taken in the old plant (including a very early Parsons turbine set and a Ferranti switchboard), which is now scheduled for removal. The steam-raising plant in the new power station consists of five water-tube boilers, each of which has an economical output of 32,500 lb. of steam per hour at a pressure of 265 lb. per square inch and a temperature of 560 deg. F. Three of these units are equipped with travelling-grate stokers for coal firing and with burners for oil firing, while the other two are fitted with oil burners only. The fuel supply and draught are controlled by a single wheel. These boilers supply steam to three 1,000-kW units, each of which comprises a turbine, reduction gearing, alternator and exciter. The turbines run at 6,000 r.p.m. and exhaust steam at pressures of 90 lb. and 20 lb. per square inch for process purposes. The speed of the 1,430-kVA alternators is 1,500 r.p.m. and they generate three-phase current at 3.3 kV and 50 cycles. Their output is controlled from a 15-panel metal-clad type switchboard carrying air-break circuit-breakers. Eight circuit-breakers controlling the feeders are also mounted on the same board. Some of the output of the alternators is stepped down to 400 volts in two 500-kVA transformers.

A further feature of engineering interest in the brewery is the new refrigerating plant. This consists of six electrically-driven compressors, three of which have a capacity of 2,791,000 B.Th.U. per hour when evaporating at 35 deg. F. and condensing at 85 deg. F. The capacity of the other three is 1,472,000 B.Th.U. per hour under the same conditions. The motors driving these compressors and the pumps used in connection with them are controlled by metal-clad air-break switchgear, the circuit-breakers of which act as starters for the compressor motors when energised automatically from a central control board. This board is fitted with apparatus which enables the circulating pumps and other auxiliaries for each compressor to be started in sequence. It is also provided with a mimic diagram which enables any combination of plant to be pre-selected and controlled. Other plant in this portion of the brewery comprises four evaporators of the interlaced Baudelot type, two of which work on chilled water and two on brine.

Visits were also paid to the Post Office telephone exchange and the load dispatching station of the Electricity Supply Board, while in the evening those present at the meeting attended the annual conversation and dance of the Irish Branch of the Institution.

PEAT FOR ELECTRICAL GENERATION.

On Thursday, June 26, a whole-day excursion was made to the Clonast peat bog of Bord na Mona (the Irish Turf Board) and was followed by inspections of the peat-fired power stations at Portlannington and Allenwood. The Clonast bog covers an area of about 4,000 acres and has an estimated annual output of 120,000 tons of peat. Supplies should be obtainable for at least 25 years. Machine winning is extensively employed, the bog being first drained by digging main drainage trenches at about 825 ft. centres which lead to outfalls. These main trenches are then excavated to a depth of about 3 ft., after which cuts of not more than 1 ft. are made. Ample time is allowed between successive cuts to allow for seepage; otherwise the walls and floors of the drains might "heave." The final depth depends upon the fall and may be from 10 ft. to 13 ft., or the full depth of the bog. Cross drains are also cut at 300 ft. intervals, the sides of which are tumbled inwards to provide a covered channel. This work is carried out by special tractors.

When the moisture content of the peat has fallen to about 90 per cent., the surface is stripped and levelled mechanically and the voids over the cross drains are filled to provide a smooth surface on which the cutting machines can run. These machines are of the German "bagger" type and are electrically operated from overhead lines at 3.3 kV. They are capable of dealing with about 350 cub. ft. of raw peat per hour and work parallel to the main drainage trenches, the sides of which form the initial cutting face. The extruded peat is then passed through a macerator on to a spreader,

NEW PHYSICS AND ENGINEERING LABORATORIES, KING'S COLLEGE, LONDON.

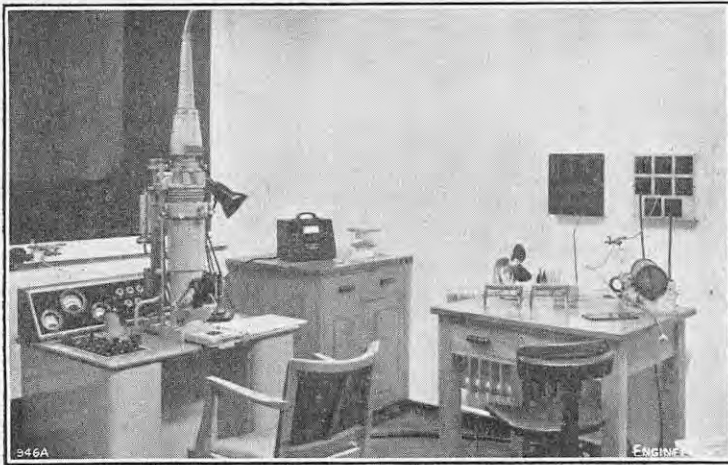


FIG. 1. ELECTRON MICROSCOPE.

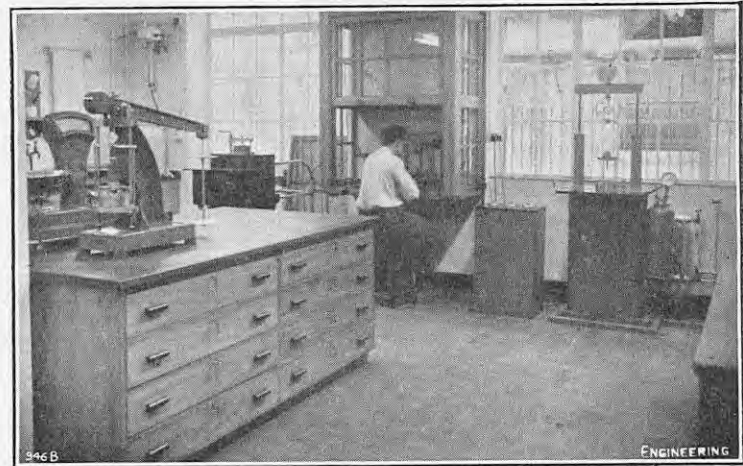


FIG. 2. SOIL MECHANICS LABORATORY.

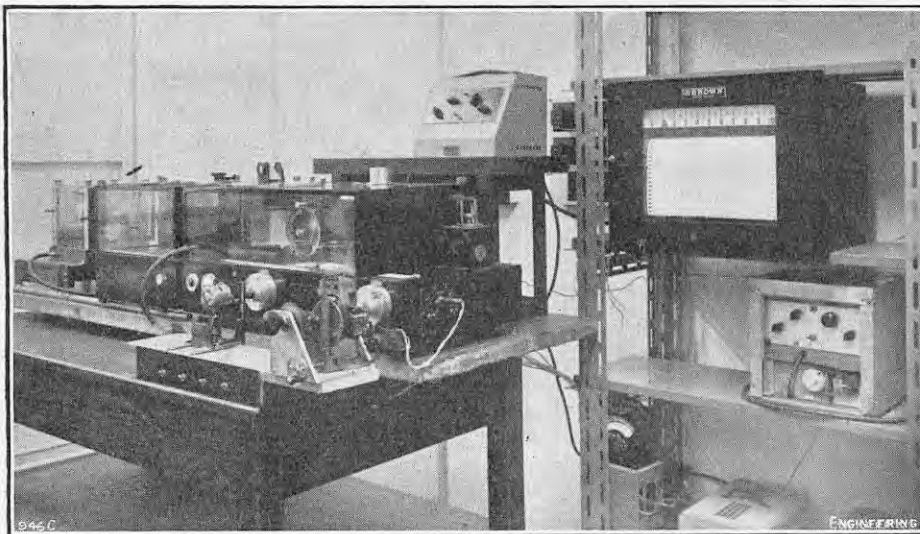


FIG. 3. EQUIPMENT FOR INFRA-RED MICROSCOPY.



FIG. 4. LABORATORY FOR ELECTRICAL MEASUREMENTS AND TELECOMMUNICATIONS.

NEW LABORATORIES AT
KING'S COLLEGE,
UNIVERSITY OF LONDON.

IN a brief ceremony on Friday, June 27, Lord Cherwell of Oxford, F.R.S., Paymaster-General in Her Majesty's Government and Professor of Experimental Philosophy in the University of Oxford, formally opened the new physics and engineering laboratories that have been constructed at King's College, University of London, during the past three years. They were designed by the late Mr. J. G. B. Stanton (who died in 1951) and form a two-storey building below the surface of the quadrangle through which the College is entered from the Strand, in a range of vaults which suffered considerable bomb-damage during the recent war. In these vaults, in 1836, Professor Sir Charles Wheatstone, of "Wheatstone bridge" fame, made some of his early experiments after obtaining the permission of the College Council to lay down "a series of iron and copper wires . . . for the purpose of trying some experiments in electricity on account and at the expense of the Royal Society."

Initially, the subjects of natural and experimental philosophy (including astronomy) were taught in the same faculty, the first professor being the Rev. Henry Moseley, who was appointed in January, 1831. Experimental philosophy was separated from natural philosophy in 1834, when Wheatstone was appointed. He occupied the chair until his death in 1875. After various changes in the scope and title of the two professorships, James Clerk Maxwell became Professor of Natural Philosophy in 1860; but he resigned five years later, being followed by W. Grylls Adams, who held office for 40 years. Subsequent occupants of the chair of physics have been H. A. Wilson, F.R.S. (1905-09), C. G. Barkla, F.R.S. (1909-14), Sir Owen Richardson, F.R.S. (1914-22), Sir Edward Appleton, F.R.S. (1922-34), Sir Charles Ellis, F.R.S. (1935-46), and the present holder, Professor J. T. Randall, F.R.S.

The faculty of engineering at King's College, though a few years junior to that of physics, is of a respectable antiquity; it is, in fact, the oldest University engineering school in Great Britain and Ireland, the first professor (William Hosking) having been appointed on July 10, 1840, a few weeks before Lewis Gordon became the first Regius Professor of Civil Engineering and Mechanics in the University of Glasgow. At first, architecture was included in the curriculum, and later, metallurgy, both of which are now separate courses of study; to-day, undergraduate study covers civil, mechanical and electrical engineering, all of which are continued in post-graduate work, together with chemical engineering. It may be mentioned that the King's College Engineering Society, which was founded in 1847, is the third oldest engineering society of any kind in this country and is junior by only six days to the Institution of Mechanical Engineers.

which deposits the sods on the bog. When the moisture content of the sods has fallen to 70 per cent. a condition which is generally reached two or three weeks after cutting, they are built into tripods or "footings" by hand. After the peat has been another three weeks to two months in these footings, the moisture content has fallen to 40 or 50 per cent. and the sods are then loaded by hand on to portable chain-plate conveyors, which deposit them in heaps at the sides of the spreading ground. They are next built into ricks 6 ft. to 10 ft. wide and of the same height, whence they are loaded into wagons. Finally, when the moisture content has decreased to from 30 per cent. to 40 per cent., the peat is placed in other ricks, where it is stored during the winter.

The Portarlinton power station, a description of which has already been given in *ENGINEERING*,* was designed to use the full output of the machine-cut turf produced on the Clonast bog. The Allenwood station is operated on peat obtained from a bog at Timahoe.

On Friday, June 27, a whole-day tour was made to Glendalough, Co. Wicklow, in the course of which the Poulaphuca water-power station was inspected. This station also has been described in *ENGINEERING*†; it is one of three plants situated on the River Liffey.

* Vol. 171, page 389 (1951).

† Vol. 173, page 772 (1952).

The new physics laboratories are entirely devoted to research and are supplementary to the teaching laboratories, which were considerably extended under Sir Edward Appleton. They provide accommodation for the study of theoretical physics, for research on nuclear radiations and the solid state, infra-red and ultra-violet spectroscopy, and for an extensive range of subjects under the general heading of biophysics. In the field of theoretical physics, the work may be divided broadly into wave mechanics and statistical mechanics, the first being concerned principally with problems associated with the chemical bond and the second with electrolytes. Other subjects studied are crystal structure, chemical reactivity, the electronic structure of cancer-producing chemicals, the theory of metals, ferromagnetism, and electron scattering.

Atmospherics research is another branch of study which will be centred in the new laboratories, and deals with the wave-form of the transient changes in the earth's electric field due to thundercloud discharges, and with the frequency-spectrum analysis of these disturbances. Multitube cathode-ray atmospheric wave-form recorders and radio spectrometers are installed on the roof of the College and are linked by a G.P.O. line with the Meteorological Office network of radio direction-finders for locating the source of atmospherics.

In electronics research, the group concerned are mainly occupied in the processing of information with the aid of their two high-speed electronic-analogue computing instruments, and in the application of computing techniques to the analysis of biophysical information. Closely associated with the biophysics group, also, is that engaged on infra-red and ultra-violet spectroscopy.

The accommodation allocated to engineering subjects in the new laboratories has enabled proper provision to be made for a number of relatively recent additions to the range of subjects which now come under the general heading of engineering; for example, soil mechanics and concrete technology, the study of vibrations as they apply to mechanical engineering, and developments in electronics and in automatic control. Moreover, it is now possible to assemble together the various departmental collections of books to form an engineering library, and to provide additional drawing-office accommodation. The eight rooms allotted to the Faculty of Engineering comprise four on the upper floor and four on the lower floor of the new block, these being, respectively, a light-current laboratory, standards room, the library and the drawing office, and a workshop, heavy-current laboratory, soil-mechanics laboratory, and machines and structures laboratory.

At the opening ceremony on June 27, the chair was taken by the Principal of the College, Sir William Halliday, M.A., who was supported by the Dean (the Rev. Canon E. S. Abbott, M.A.) and by Professor J. T. Randall, F.R.S., Wheatstone Professor of Physics, and by Professor S. J. Davies, D.Sc.(Eng.), M.I.Mech.E., the present holder of the chair of mechanical engineering. The Principal introduced Lord Cherwell, who, in his address, expressed the view that the engineering laboratories were possibly even more important than those devoted to physics, because increased exports were vital to the interests of the nation and the only way to increase exports ("short of working longer hours," he added) was to improve productivity, which was a matter for engineers. He hoped that, in due course, Britain would possess a research centre analogous to the Massachusetts Institute of Technology, but there would still be a real need for the university laboratories. The nation stood in great need of more technologists and engineers and he hoped that there would soon be a great outflow of both from the new laboratories. Lord Cherwell then declared the laboratories open.

Professor Randall, in proposing a vote of thanks to Lord Cherwell—which was carried by acclamation—observed that the King's College engineering laboratories were considerably older than those of the University of Oxford, which Lord Cherwell represented, and had a record of which the College was very proud. Professor Davies, in seconding the vote of thanks, said that it was often asserted that the nation needed more technologists who were also educated in the humanities; in King's College, however, the humanities were well looked after.

LABOUR NOTES.

WHAT is probably the largest single wage claim in the history of the trade-union movement in this country was presented to the Engineering and Allied Employers' National Federation, in London, on June 26, by the Confederation of Shipbuilding and Engineering Unions, on behalf of male manual employees in the engineering industry. Prior to the meeting of representatives of the two organisations, the executive council of the Confederation met separately to decide the exact sum which should be claimed and which previously had been referred to euphemistically only as a "substantial amount." The council agreed to request an increase of 40s. a week for all adult male manual employees in the industry, and, by way of emphasis, it was asked that the addition should operate as from last Friday, June 27. Proportionate increases for youths would follow automatically. A separate claim for a "substantial increase" for women and girls employed on manual work in the industry is due to be presented to the employers' Federation on July 17.

These claims, if granted in full, and if, as is usual, engineering employers outside the Federation raised the wages of their employees by corresponding amounts, would affect well over 2,250,000 men, women and juveniles in the industry and would add some 250 million pounds to its annual wage bill. The cost of such a concession to firms belonging to the Federation alone would, it is estimated, amount to not less than 100 million pounds. When presenting the case to the employers at the meeting on June 26, the Confederation spokesmen, led by Mr. Jack Tanner, the President of the Amalgamated Engineering Union, appear to have relied mainly on the advances which have occurred in the cost of living, on higher production in the industry, and on the increased profits which, they affirmed, the industry is making. According to a statement issued after the meeting, the Federation representatives undertook to give careful consideration to the Confederation's claim and to arrange for a further joint meeting at a mutually-convenient date in the near future. The Confederation asked that the reply from the employers should be delivered before its annual conference, which has been arranged to take place during the second week in August.

On the following day, June 27, representatives of the Confederation presented a parallel claim, to the Shipbuilding Employers' Federation, for increased wages for men and juveniles employed in manual occupations in the shipbuilding and ship-repairing industries. There was, however, no mention of 40s. a week. The Confederation asked, instead, only for a "substantial increase" for the shipyard employees. In this connection, it was not without interest that, while the case for the engineers was presented by Mr. Jack Tanner, whose union had passed a resolution in favour of a demand for an increase of 40s. a week being requested, the union side, in the case of the shipyard employees, was led by Mr. E. J. Hill, the general secretary of the United Society Boilermakers and Iron and Steel Shipbuilders. Mr. Hill was among the Confederation's representatives when the engineers' claim was delivered, and Mr. Tanner was among the officials who supported Mr. Hill when he presented the claim for the shipyard employees.

There had been some divergence of views among the unions concerned in the engineering claim as to the wisdom of requesting so large an increase as 40s. a week. Some of the unions belonging to the Confederation, of which there are at present 38, put forward alternative suggestions, among them being a claim for 30s. a week, and a claim for an increase of 6d. an hour. Other affiliated unions would have preferred that the claim should have been for a "substantial amount" only, without mentioning a specific figure. So far as the claim on behalf of shipyard employees is concerned, there appears to have been a feeling in some sections of the unions concerned that profits in the shipbuilding and ship-repairing industries have not reached such heights as to justify a claim for an all-round

increase of 40s. a week. After receiving the Confederation's claim on June 27, the Shipbuilding Employers' Federation promised to give it prompt attention and to present its reply at a subsequent meeting.

Another heavy wage claim, submitted on June 26, was on behalf of employees in the coal-mining industry. At a meeting in London of the joint national negotiating committee for the coal-mining industry, comprising representatives of the National Coal Board and officials of the National Union of Mineworkers, Mr. Arthur Horner, the general secretary of the N.U.M., asked for an increase of 5s. a shift all round, with corresponding increases on the minimum rates for underground and surface work, and proportionate increases for juveniles. Mr. Ebby Edwards, for many years secretary of the former Mineworkers' Federation of Great Britain and now labour relations member of the National Coal Board, presided.

The union's case in support of the wage claim was presented by Mr. Horner and is understood to have been based on advances in the cost of living and the effects of the recent Budget. The joint committee then adjourned and it is anticipated that a meeting between representatives of the N.U.M. and the full Board will be held in the very near future, but probably not before the annual conference of the union, which is due to commence on Monday next. As miners working five shifts in one week are paid for six, an increase of 5s. a shift is equivalent to a rise in pay of 30s. a week and it is computed that a wage concession of that dimension would increase the coal-industry's wage bill by between 40 and 50 million pounds per annum. Some 700,000 mining employees are affected by the claim.

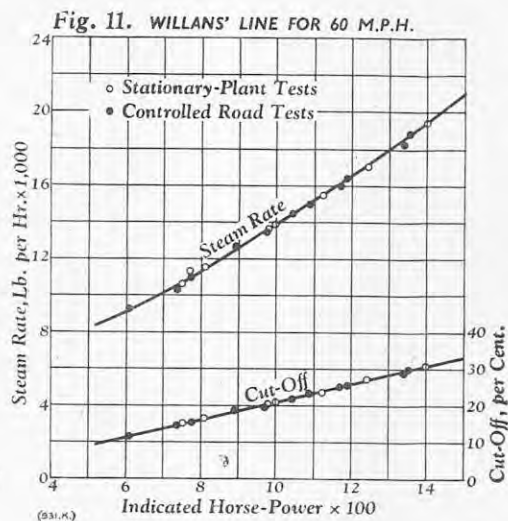
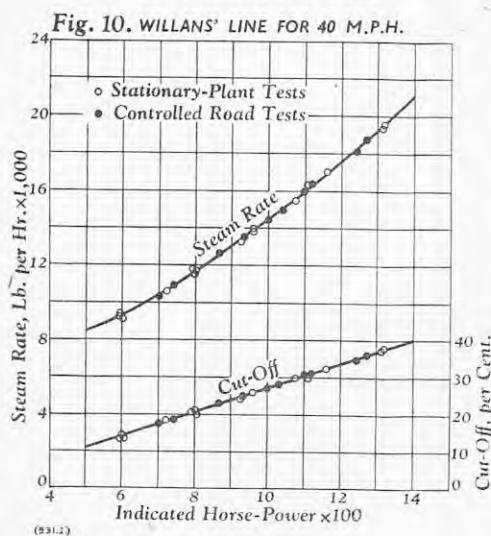
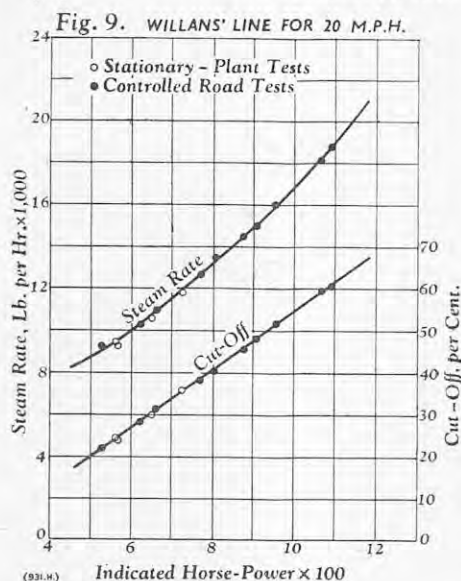
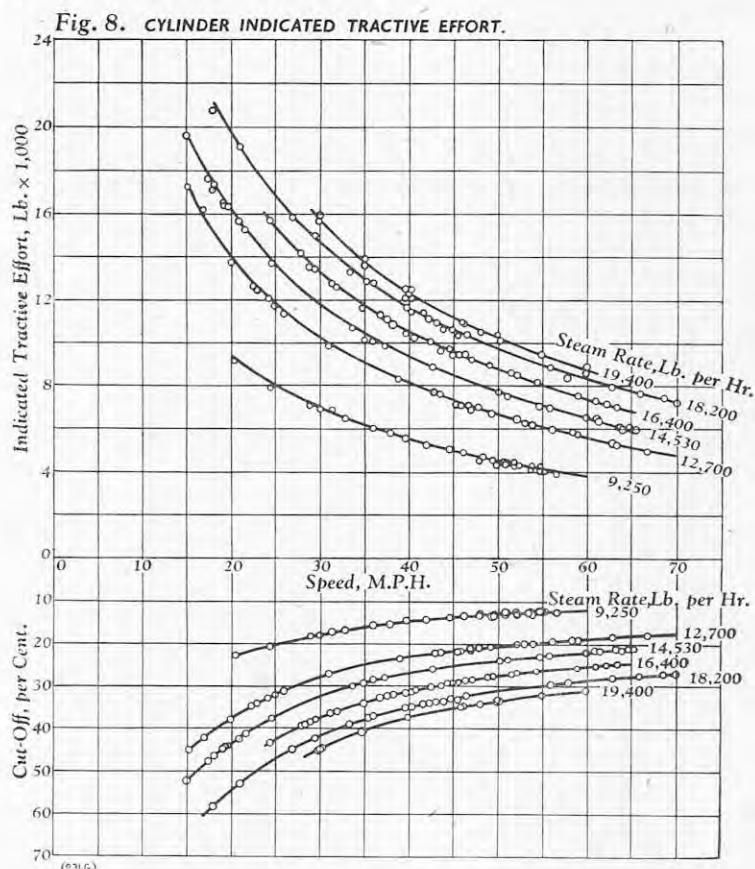
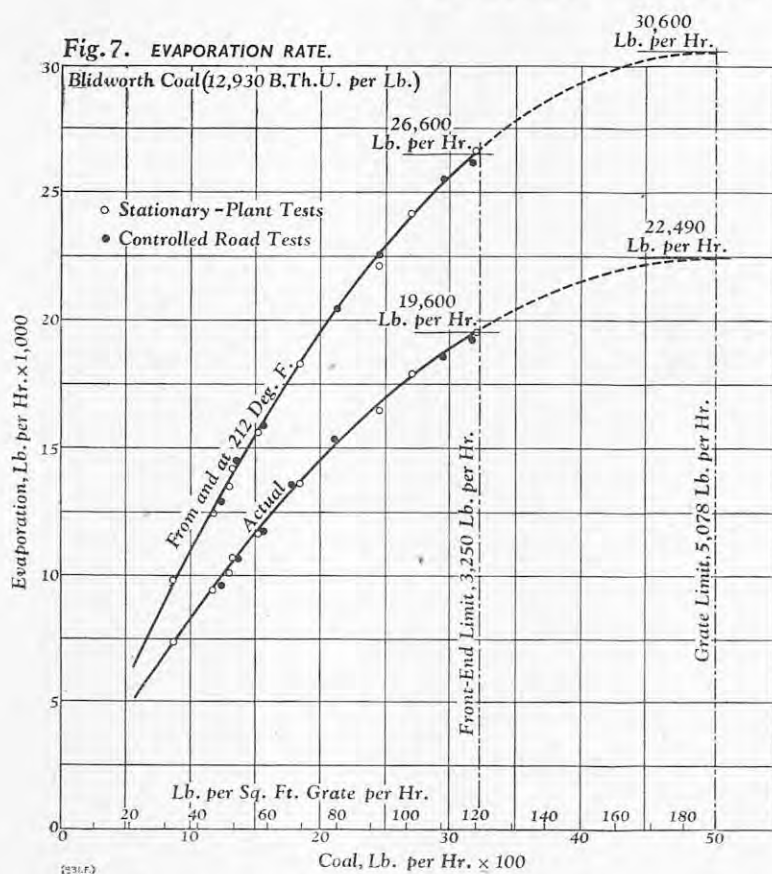
Dissatisfaction at the alleged lack of progress in connection with negotiations on their claim for an increase in their wages, continues to be shown by overmen and shotfirers in the North Eastern Division. At a meeting in Barnsley, on June 26, the executive committee of the Yorkshire branch of the National Association of Colliery Overmen, Deputies and Shotfirers approved of instructions being given to the members of the Association that they should adhere to the five-day week agreement. It was stated subsequently that this decision was a form of protest against the "slowness" of the National Coal Board in meeting the Association's wage demands. Strict compliance with the agreement by the six thousand members of the Association would result in a substantial reduction of coal production and in a loss of earnings to other sections of mining employees.

Arbitration has now been arranged for the closed-shop dispute between Durham County Council and the joint emergency committee of the professions. It was announced in London on Monday last that the Minister of Labour and National Service, Sir Walter Monckton, Q.C., had appointed Sir John Forster, Q.C., President of the Industrial Court, to be chairman, and Professor D. T. Jack and Mr. J. W. Bowen as members, of the board of arbitration which has been set up to inquire into the dispute. Professor Jack is the chairman of a number of wage councils and has acted on many occasions as an arbitrator in industrial disputes. He is Professor of Economics at Durham University. Mr. Bowen is a former chairman of the London County Council.

Some 400,000 workpeople in the United Kingdom received increases in their weekly full-time rates of wages during May. These increases amounted to a total of 132,000l. a week net, according to the *Ministry of Labour Gazette* for June. The principal increases affected workpeople employed in unlicensed places of refreshment, retail meat distribution and brickmaking in England and Wales, but persons in a wide variety of other employments were also among those who benefited, and these included juveniles engaged in the shipbuilding and ship-repairing industry. During the first five months of this year, 4,509,500 workpeople received increases in their weekly wage rates, amounting, in all, to over 1,795,900l. net.

In use, an indicator on one of the manometers is fixed at a predetermined pressure. Cut-off by the driver and speed at the control table are together altered in such a way that the meniscus of the mercury in the manometer is maintained at the

LOCOMOTIVE TESTING AT SWINDON.



level of the fixed pointer. It is usually arranged that alterations in speed take place in steps of about 5 miles an hour. At each step, indicator cards are taken by high-speed indicators, care being taken that the reading of pressure shown by the manometer is exactly opposite the fixed mark when this is done. During the progress of the test, the summations of increment plots of coal and water consumption are made, as already described. Fair straight lines can invariably be drawn through the points thus plotted and it is the slopes of these lines and not the pressure indicators which determine the coal rates and the steam rates for the test. Actually, Fig. 4 refers to a variable-speed test, not a constant-speed test. The law for the meter, which varies with each arrangement, is always found from the initial tests, but this is used only for estimating.

The principal boiler relationships are clearly defined by these methods, as typified by Fig. 6, on page 25, of boiler efficiency, and by Fig. 7, above, of evaporation. The variable-speed system of testing also shows that the combustion-steam-air cycle of the boiler is not affected by engine working (except in the case of some two-cylinder engines when disturbing forces destroy the fire-bed at high speed). Fig. 8, on this page, shows cylinder, or indicated,

tractive effort, which is proportional to mean effective pressure, plotted against speed for six variable-speed tests of a series, with plots of observed cut-offs, from which it will be seen that there is no difficulty in representing the results by fair curves. The coal rates which correspond to the steam rates are those shown in Fig. 7.

The next step in defining the complete characteristic is an interesting one. Taking a number of ordinates of speed on Fig. 8, values of indicated horse-power are calculated from the curves of tractive effort and are plotted against the corresponding steam rates in diagrams, of which Figs. 9, 10 and 11 are typical. Cut-offs are also plotted against indicated horse-power in these diagrams. Through the points thus obtained on each diagram, fair curves can be drawn; the steam rate-indicated horse-power curves are recognisable as Willans' lines for governing by variation in cut-off (Willans's straight-line relationships for throttle governing are also produced for partial-regulator working). These diagrams illustrate the importance of knowing the steam rate when taking indicator cards.

From diagrams such as Figs. 9, 10 and 11, indicated horse-power values and cut-offs are read for a number of steam rates, and from these the diagram of indicated horse-power characteristics, Fig. 12, opposite, is constructed. This form of diagram was

first produced at Swindon. About 1,000 indicator cards are used in the construction, each one having been related directly to steam and coal rate, without adjustment. It is a key diagram, from which many useful relationships may be worked out; one of the most interesting of these is the cylinder thermal efficiency, as shown in Fig. 13.

In this outline of testing methods, reference has only been made to the direct measurements. Assessment of heat absorption is, of course, made indirectly from gas and coal analyses and gas temperatures; Fig. 3, obviously, could only have been prepared with the help of the indirect measurements. Such measurements, together with draught measurements at various points in the boiler, play an important part in the control of conditions during a test.

CONTROLLED ROAD TESTING.

The operating characteristics of the locomotive cannot be finalised from the stationary-plant tests, since the dynamometer of a testing plant cannot account for the aerodynamic and frictional losses always associated with the movement of vehicles over the permanent way. To obtain the operating characteristics, a method known as the controlled road-testing system has been evolved from the variable-speed testing system employed at the Swindon testing plant. It consists of running the

LOCOMOTIVE TESTING AT SWINDON.

Fig. 12. INDICATED HORSE-POWER CHARACTERISTICS.

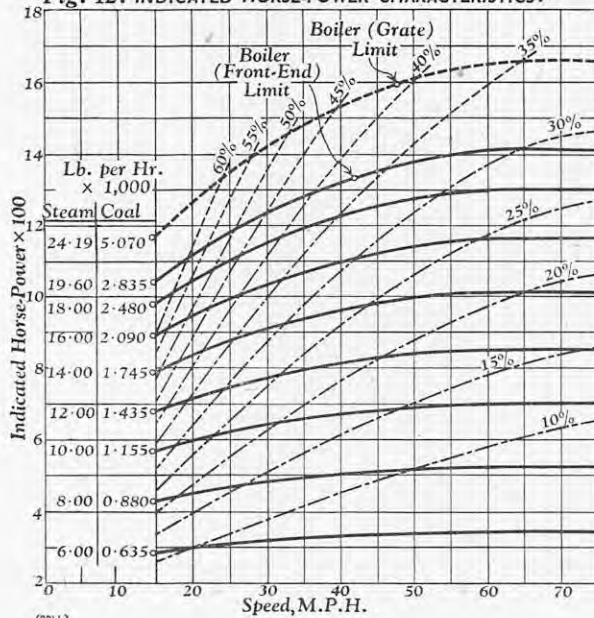


Fig. 13. CYLINDER THERMAL EFFICIENCY.

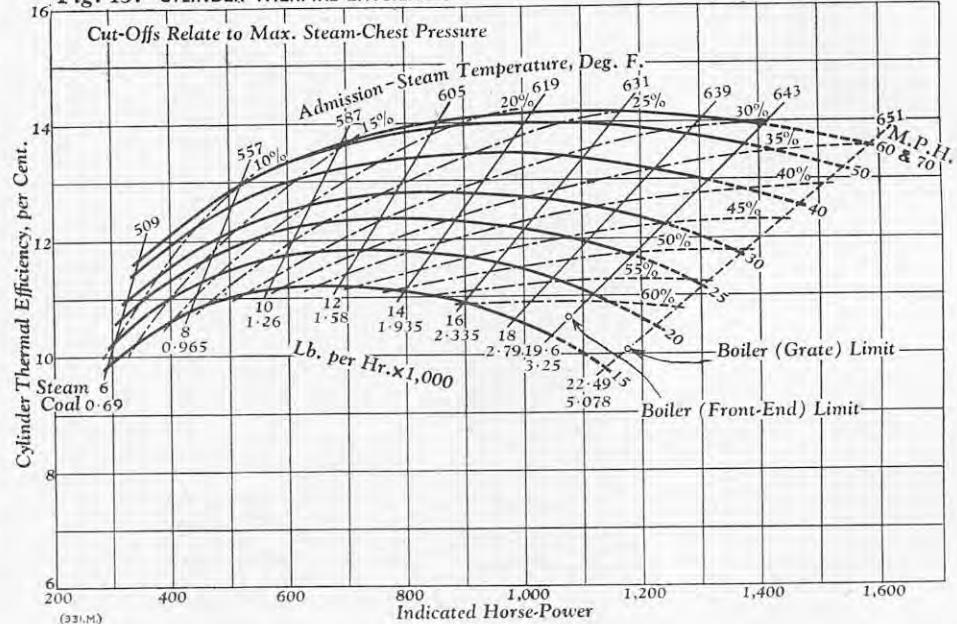


Fig. 14. ROAD TEST AT CONSTANT EVAPORATION.

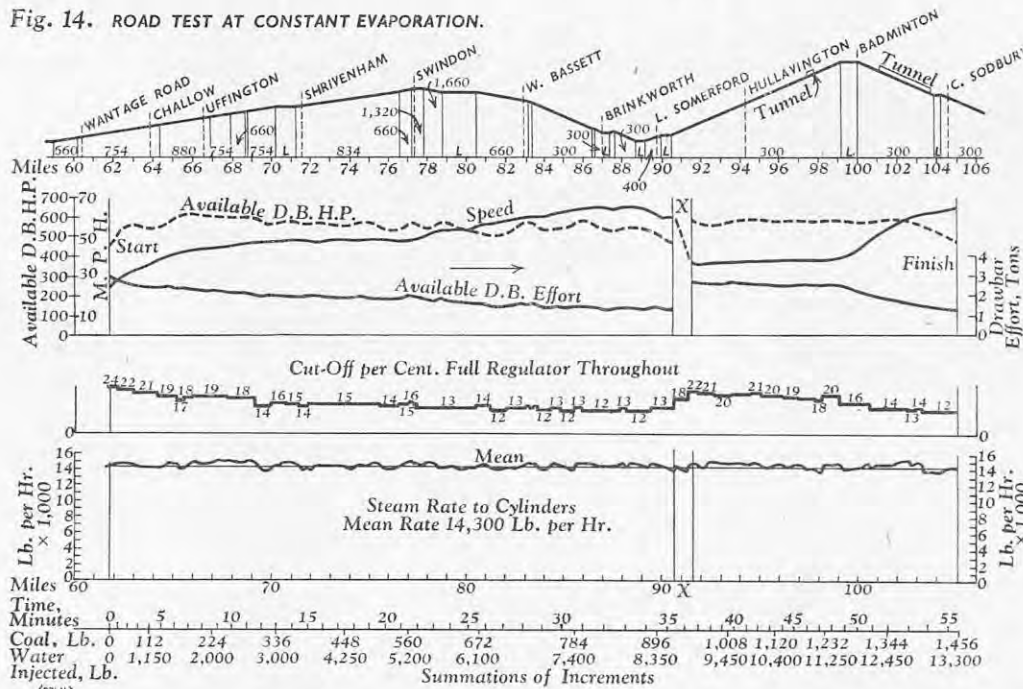
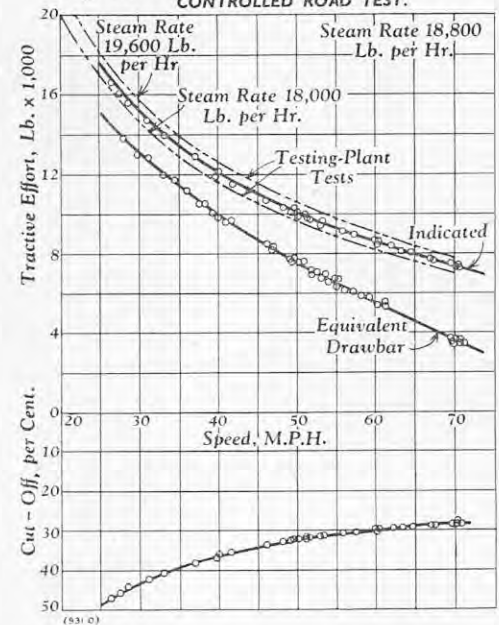


Fig. 15. TRACTIVE EFFORT ON CONTROLLED ROAD TEST.



locomotive with normal loads at constant rates of evaporation and combustion, to which the power at the drawbar, as measured by a dynamometer car (which is the vehicle next behind the locomotive) is referred.

Control over the rate of steam demand (and therefore over the rate of evaporation) is obtained by adaptation of the flow indicator, in conjunction with the summation of increments method of control over the rate of combustion, as already described. Control is entirely in the hands of the driver, who, with full or partial regulator opening, as may be previously decided, adjusts the cut-off so that, whatever the speed, the flow indication of his manometer is kept against a pre-set mark. This is under constant surveillance from the dynamometer car, where another manometer is carried.

The fireman takes coal from a partitioned-off part of the shovelling plate of the tender, into which coal increments are tipped as required from previously-weighed bags. An observer in the cab signals this operation to the car, where the time is noted and the feedwater injected up to that moment is read from a water meter. Overflow from the injectors is led to a self-discharging tank, which automatically signals the discharge of a known amount to the dynamometer car. The slopes of the straight lines, which must be drawn through the points plotted on the summations of increments graph on all valid tests, establishes the values of

the mean rates by direct measurement. A constant water level must also be maintained, as on the stationary-plant tests. Indicator cards are taken during the tests, care being observed to take cards only when the manometer level is opposite the pre-set mark; a manometer is fitted in the indicating shelter for this purpose. The running of one of these tests is shown diagrammatically in Fig. 14.

This set of diagrams provides an example of a test at constant evaporation under conditions giving approximately the most economical coal consumption. The test was carried out on May 31, 1951, using the Western Region dynamometer car. The calorific value of the Markham coal, as fired, was 14,470 B.Th.U. per pound, and only the live-steam injector was used. The load consisted of 15 coaches, weighing 459 tons. The steam demand was 14,300 lb. per hour, the coal rate 1,560 lb. per hour (or 57.6 lb. per square foot of grate area per hour), the mean admission-steam temperature 580 deg. F., the mean feedwater temperature 54 deg. F., and the boiler efficiency 81.3 per cent. The regulator was kept fully open throughout; the cut-off is shown in the diagram. Over the length of track marked XX in the diagram the brake had to be applied owing to a temporary permanent-way speed restriction.

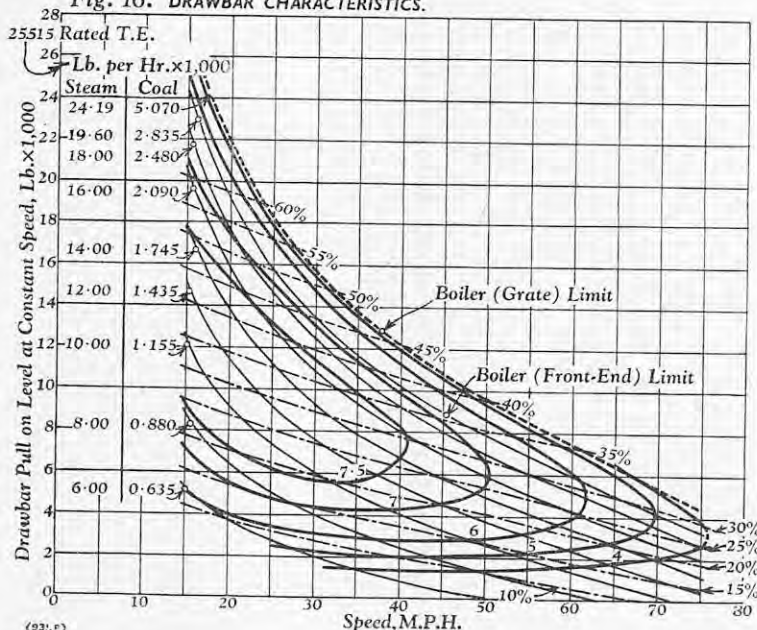
Fig. 15 shows the results of power measurements on one of these tests. It will be noted from the

figure that, in respect to steam rate and speed, the indicated horse-power obtained on the road test agrees very closely with that obtained on the stationary-plant trials. Reference back to Figs. 6 and 7 will show that boiler relationships obtained on the road tests also agree with those obtained on the stationary-plant trials. The lower effort line of Fig. 15 gives the equivalent drawbar effort measured during the road test by the dynamometer of the car. The vertical difference between the indicated and drawbar effort lines represents, of course, the locomotive resistance. A few controlled road tests at various rates of evaporation easily cover the operational range of the locomotive and make possible the production of the drawbar characteristics of the locomotive as shown in Fig. 16, on page 28, in which the contour lines indicate constant thermal efficiency per cent., and the cut-offs shown relate to maximum steam-chest pressure. Bedwas coal with a calorific value of 13,970 B.Th.U. per pound was used. Locomotive resistance shows some variation with wind force and direction. In producing the final characteristics, it is the practice to standardise resistance for a wind velocity of 10 m.p.h.

The contours of efficiency clearly indicate that there is a tractive-effort line for the most efficient performance of the locomotive; further examination, however, will show that there is a wide margin on each side of this line, within which there is no significant difference in efficiency. Observational

LOCOMOTIVE TESTING AT SWINDON.

Fig. 16. DRAWBAR CHARACTERISTICS.



trials on normal services often follow the testing-plant tests and controlled road tests. These yield, on analysis, valuable information in respect of the efficient use of fuel and of the use of the most efficient operating range of the particular locomotive class.

Although this outline has been confined to the testing of steam locomotives, the Western Region dynamometer car is fully equipped for the testing of gas-turbine and Diesel locomotives on the controlled road-testing system. A drawbar-effort characteristic of a Diesel-electric locomotive, obtained from trials on a revenue-earning service, is reproduced in Fig. 17, herewith.

ANNUALS AND REFERENCE BOOKS.

Lexicon of Terms Used in Connexion with International Civil Aviation. English-French-Spanish.

International Civil Aviation Organisation, International Aviation Building, 1080, University-street, Montreal, Canada. [Price 1 dol.]; and H.M. Stationery Office, York House, Kingsway, London, W.C.2. [Price 6s. 10d.]

ALTHOUGH primarily for use in connection with the work of the International Civil Aviation Organisation, this volume, prepared by the secretariat of the Organisation, will be useful to a much wider circle because of the list of selected abbreviations and notations for units and parameters contained in one of its appendixes, which provides a valuable guide to many of the alphabetical mysteries that are encountered so frequently in aviation literature. The main body of the book comprises a vocabulary of some 2,500 entries, in English, with their French and Spanish equivalents. Definitions of some of the entries are also given in English. In addition to aeronautical terminology it covers certain aspects of aeronautical cartography, communications, and meteorology. It is intended, in the future, to produce French and Spanish editions. In the foreword it is stated that the present edition, which is incomplete and, to some extent, tentative, "should be regarded as a nucleus, to be gradually expanded into a comprehensive aeronautical vocabulary in the three languages of the Organisation."

English-French Vocabulary of Aeronautical Terms.

Prepared by M. CHALMETTE. Bunhill Publications, Limited, 12, Bloomsbury-square, London, W.C.1. [Price 4s.]

AN inexpensive and well-arranged French-English vocabulary of modern aeronautical terms, which are not always to be found in the more comprehensive technical dictionaries, would be a useful addition to the aircraft engineer's bookshelves. Unfortunately, the manner in which the volume under review has been presented has placed serious limits on its usefulness to British users, most of whom probably require such reference books for the purpose of understanding articles published in the French technical Press, or French aeronautical trade publications. The present vocabulary, which is based on British Standard 185-

1950, *Glossary of Aeronautical Terms*, is arranged under ten classified headings—Aeronautics (general), general motion of aircraft, structures, aerodynamics, heavier-than-air aircraft, rotorcraft, lighter-than-air aircraft, power plant, propellers and auxiliary services. Within these classified headings, the English words are arranged alphabetically, which is likely to be more helpful to the French than to the British reader. The classified arrangement, also, is less convenient than a purely alphabetical list. The proportions of the space assigned to the various sections are not well balanced; of the 36 pages of the book, six are devoted to lighter-than-air aircraft, and less than two to the auxiliary services which contribute so much to the modern aircraft.

Water Engineer's Handbook, 1952.

The Colliery Guardian Company, Limited, 30 and 31, Fumival-street, London, E.C.4. [Price 18s., including postage.]

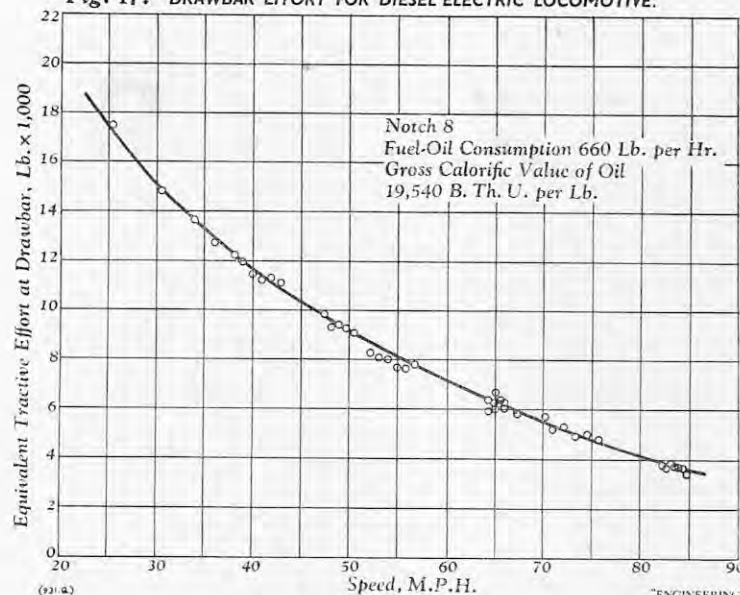
THIS useful reference book, now in its 20th year of publication, comprises as its main features a directory of all the water undertakings in the British Isles (more than 1,900 in all), listing the chief officers, the sources and limits of supply, the character of the water and details of treatment, capital expenditure, etc.; and statistics of the populations and areas served, the consumptions, storage capacities, length of mains, and rateable values. A further section lists the water supply authorities in terms of the hardness of the water supplied to consumers. There are also lists of the water undertakings' managers, consulting engineers, etc., particulars of the various River Boards and Catchment Boards, and of the Government departments concerned with water supply. We would suggest that, in future issues, the inclusion of some particulars of the pumping plant operated by the various undertakings—steam engines, Diesel-driven or electrically-driven pumps—would be appreciated by many users of the *Handbook*.

Ship and Boat Builder Annual Review, 1952.

John Trundell (Publishers), Limited, Temple Chambers, Temple-avenue, London, E.C.4. [Price 30s.]

A NEW reference book must be expected to pass through a transitional format before its appearance and arrangement become more or less established by the experience of publishers and users; which may be the reason why the volume under review bears on the cover the title quoted above, and, on the title page, that of *Ship & Boat Builder Year Book, 1952*. The various lists and indexes, directories, relevant British Standards, etc., appear as before, and are supplemented by a number of special articles, some on rather unusual subjects—for example, that of Mr. R. P. Woods, of the Timber Development Association, on "Searching for Substitute Timbers." A review of "The State of the Industry" is contributed by Mr. A. E. K. Rodgman, President of the Ship and Boat Builders' National Federation; and Mr. R. V. B. Blackman, A.M.Inst.N.A., the editor of *Jane's Fighting Ships*, is the author of an informative survey of the increasing use that is being made by the British and United States navies of small high-speed craft for minesweeping and other coast-defence duties.

Fig. 17. DRAWBAR EFFORT FOR DIESEL-ELECTRIC LOCOMOTIVE.



CONTRACTS.

During May the British Electricity Authority placed contracts for equipment for power stations, transforming stations and transmission lines, amounting, in the aggregate, to 4,781,403l. The principal contracts include two 180,000 lb. per hour boilers for Woolwich power station, with JOHN THOMPSON WATER TUBE BOILERS LTD.; coal-handling plant, coal cranes and ash and dust handling plant for Marchwood power station, near Southampton, the first item with JOHN THOMPSON (WOLVERHAMPTON) LTD., the cranes with STOTHERT AND PITT LTD., and the third item with BABCOCK AND WILCOX LTD.; two 540,000 lb. per hour boilers for Tilbury power station, with JOHN THOMPSON WATER TUBE BOILERS LTD.; six boiler-feed pumps for Castle Donnington power station, near Derby, with MATHER AND PLATT LTD.; two electrostatic precipitators for Drakelow power station, Burton-on-Trent, with the STURTEVANT ENGINEERING CO. LTD.; 132-kV 2,500-MVA switchgear for Carmarthen Bay power station, Burry Port, with FERGUSON, PAILIN LTD.; circulating water pumps for Stella South power station, near Newcastle-upon-Tyne, with GWYNNE'S PUMPS LTD.; three 150,000 lb. per hour boilers for Blackburn power station, with SIMON-CARVES LTD.; 66-kV, 11-kV, and auxiliary cables from Fulham to Wandsworth and from Norroy-road to Roehampton, with BRITISH INSULATED CABLES LTD.; 132-kV overhead line material from Nursling to Velmore, Hampshire, with W. T. HENLEY'S TELEGRAPH WORKS CO. LTD.; and 3,500-MVA 132-kV switchgear for Slough (New Denham) substation, with A. REYROLLE & CO., LTD.

THE SOUTH DURHAM STEEL AND IRON CO. LTD., has received an order for large-diameter steel pipe from the Basrah Petroleum Co., an associate of the Iraq Petroleum Co. The contract is for the manufacture of 80 miles of 24-in. pipe, weighing 17,000 tons, at a cost of over 900,000l. The pipe is to be laid next year from the Zubair oilfields in Southern Iraq, which came into production in December, 1951, to the port of Fao, near Basrah, on the Persian Gulf.

HARLAND & WOLFF LTD., are to supply to the Middlesex County Council a gas-turbine air-compressor plant of approximately 1,000 h.p., at an inclusive cost of 39,900l. The turbine which is to be designed to operate on methane gas obtained from the digestion of sludge and also on dual fuel (oil and methane), will be installed at the Mogden Works, Isleworth, of the Council's West Middlesex main-drainage undertaking. The air compressor will be of the two-shaft open-cycle type, delivering 25,000 cub. ft. of free air per minute at a pressure of 7½ lb. per square inch, for the operation of the aeration tanks of the activated-sludge plant.

FURNESS SHIPBUILDING CO., LTD., Haverton Hill-on-Tees, are to build two tankers, each of 24,000 tons deadweight carrying capacity, for Progressive Investments Ltd.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION CO. LTD., Chelmsford, Essex, have received an order for the provision and installation of marine radio and navigational-aid equipment for the 7,850-ton bauxite and oil-carrying vessel now under construction at the shipyard of the BURNISLAND SHIPBUILDING CO., LTD., for Saguenay Terminals, Ltd., Montreal, Canada.

MOBILE LOADING PLATFORM.

LANSING-BAGNALL, LIMITED, BASINGSTOKE.



MOBILE LOADING PLATFORM.

THE accompanying illustration shows a mobile loading platform designed to expedite the transfer of goods between road vehicles and railway wagons by power pallet trucks, recently introduced by Messrs. Lansing-Bagnall, Limited, Kingsclere-road, Basingstoke, Hampshire. The platform consists of a four-wheel trailer, provided with a tow bar, and carrying two platforms hinged together. Each platform can be raised or lowered by a crank handle operating a screw jack and a linkage system. The platform at the rail-wagon end is 6 ft. square, and remains horizontal throughout its range of vertical movement, from 3 ft. 9½ in. to 5 ft. 3½ in. above the ground level. The other platform, which pivots about the hinge, is 10 ft. long and 6 ft. wide, and at the road-vehicle end, has a range of vertical movement from 3 ft. 1 in. to 4 ft., so that it forms an inclined ramp. At the rail-wagon end are three hinged flaps, which can be used as bridge plates when the platform is in use. A single hinged bridge plate is provided at the road-vehicle end.

In operation, the trailer is placed so that the horizontal platform is in line with the doorway of the railway wagon. The height of the platform is adjusted and one of the hinged flaps is lowered to form a bridge plate. The parking brake is then applied. The other two hinged flaps at the wagon end form safety guards. The road vehicle is backed up to the ramp, the height of the latter is adjusted and its bridge plate is lowered. The loads can then be transferred directly between the road vehicle and the rail wagon by a power-operated pallet truck. The loading platform can also be used for unloading railway wagons in goods yards without the necessity for shunting the wagons up to a platform, and for conveniently transferring loads from long distance vehicles to local delivery lorries.

ELECTRONICS COURSE AT HARWELL.—Applications are invited by the Atomic Energy Research Establishment, Harwell, from physicists and electronic engineers holding a degree, or equivalent qualification, who wish to attend a specialised course on the design, use, and maintenance of electronic instruments used in nuclear physics, radio-chemistry, and in work with radio-isotopes. The course to be held at the Isotope School, Harwell, from Monday, July 14, to Friday, July 18, and will comprise lectures and practical work concerned with counters, direct-current and pulse amplifiers, coincidence units, scalars and ratemeters. The lecturers and demonstrators will be specialists from the Atomic Energy Research Establishment. The Isotope School is outside the security fence and the subjects will be entirely unclassified. The fee for the course is 12l. 12s. Living accommodation, at Buckland House, near Faringdon, one of the senior staff hostels of the Establishment, together with transport, and morning and evening meals, will be provided at a charge of 7 guineas. Application forms for the course may be obtained from the Electronics Division of the Establishment, Harwell, near Didcot, Berkshire.

BRITISH ELECTRICAL POWER CONVENTION.

THE fourth British Electrical Power Convention was held at Bournemouth from Monday, June 16, to Wednesday, June 18, under the presidency of Mr. P. V. Hunter. Compared with former meetings, the time occupied by the Convention was reduced to two and a half days. Nevertheless, 12 papers, in addition to the presidential address, were considered, of which seven dealt with the influence of research on various branches of the industry. The attendance was well up to the standard of previous years. The first meeting was held in the Town Hall on Monday morning when a civic welcome to the Convention was given by the Mayor, Alderman H. A. Benwell.

PRESIDENTIAL ADDRESS.

The President then delivered an address in which he took the basic organisation of the industry as his main theme. There were, he said, some 55,000 separate manufacturing establishments in this country, of which, it was surprising to find, no less than 50,000 employed less than 250 persons. What was more remarkable was that there appeared to be no tendency for the proportion of such smaller establishments to shrink. This was due largely to the friendly relationship which existed between the owner-managers and their workpeople. This relationship was a vital factor in industry, for the progressive widening of the gap between management and workpeople, which derived from great size and complexity of organisation, was to a large extent responsible for the indifference and apathy so apparent to-day.

Many managements, including those of the nationalised industries, were reluctant to foster the interest of workers in their business because they feared invasion by trade unions of their own sphere of activity. This fear was groundless, since the true mission of the unions was to urge maximum production on the management and to induce the latter to give the proper share of the proceeds to the workers. Probably the goodwill and interest of the workers in an organisation would result in between 10 per cent. and 30 per cent. more output than that of an indifferent team. Unfortunately, the Inland Revenue heavily penalised the rewards of such extra output; he thought that earnings above the standard weekly rate should be free of tax.

Productivity teams had visited America to see whether there was anything in that country's practices which, if adopted, would help us to overcome our difficulties. Any idea that American techniques could be transferred to this country on a large scale was visionary. Greater availability of electric power was one factor and the much larger home market was another. It was often suggested that American manufacturers were more research-conscious than those in this country. This was partly the result of the economic conditions in the United States. In Great Britain the members of a

manufacturing trade association were officially encouraged to inform one another of their technical improvements. This undoubtedly blunted the edge of competition between them in research. Moreover, while with us co-operative research was common, there was no corresponding arrangement in the United States. On the other hand, there were in America research organisations which would accept contracts on a cost basis from individual manufacturers for specified researches; he felt strongly that this type of activity would meet the needs of industry in this country to an increasing extent.

THE HEATING LOAD.

At a meeting held on Monday afternoon, a paper on "The Cooking, Water Heating and Comfort Heating Loads of an Integrated Electricity Supply System" was presented by Mr. R. Y. Sanders. He said that between 1920 and 1950, the consumption of electricity for domestic purposes had risen from 300 million to 15,000 million kWh per annum, while the load factor of the domestic load had increased from 12.5 per cent. to 32 per cent. Between 1939 and 1946, the percentage of consumers using comfort heaters had doubled. Close analysis, however, showed that most of these heaters were used in a manner generally acceptable to the supply authorities. In fact, the majority were employed to provide short-time intermittent heating, an application which conserved the national fuel resources and improved the load factor of the supply system.

The contribution of domestic comfort heating to the peak load on a winter's morning of average severity was probably only some 4,500 MW. This had to be compared with a total installed capacity of 50,000 MW, 15,000 MW of which was accounted for by electric fires. Even in extremely cold weather, the contribution did not exceed about 5,000 MW. If this morning heat load could be eliminated, the load factor would be much improved, while its impact would be much reduced if display and shop window lighting were freed and the system, therefore, reverted to an afternoon peak.

Discussing the price policy of the industry, the author said that simplification and standardisation of methods of charge were required by the 1947 Act. For domestic consumers this had meant a conventional two-part tariff or a variable-block tariff with the floor area or number of rooms determining the fixed part of the tariff or the basic units. Such tariffs had attracted criticism from outside the industry because the fixed charge was not related to the consumers' peak demand on the system and because the low follow-on rate was alleged to be an encouragement to extravagant use. Theorists, however, failed to recognise that tariffs offered by a public service had to be a compromise between the cost of supply, the cost of actually recovering these costs and the preference of the consumer as to the method by which the costs of supply should be collected from him. Critics, who contended that the small consumer should be charged on a basis of his contribution to the system peak, forgot the cost of metering and the relatively slight relationship between the costs of supply and the contribution of the individual consumer to the system demand. They also forgot that tariffs had to influence future demand as well as to cover present costs. Diversity, too, was completely ignored. When the low running charge component of tariffs was attacked, the increase in industrial running charges was contrasted with the relatively stable domestic charge. The great improvement in the load factor of the domestic load and the corresponding decrease in the industrial load factor were, however, forgotten.

In conclusion, it was claimed that the development of the cooking, water-heating and comfort-heating loads had improved the characteristics of the load on the system as a whole, had enabled industrial supplies to be given more cheaply than would otherwise be the case and had conserved national fuel resources.

DOMESTIC WATER HEATING AND COOKING.

The second paper to be presented was on "Domestic Electric Water Heating," and was read by Mr. C. H. Smith. In this, the author surveyed the numerous applications of electricity to domestic

water heating and described in detail much of the apparatus available for this purpose and its operating characteristics. It was claimed that the electric water heater, when properly applied, was the best of all current-using devices in terms of electricity consumed in relation to incidence on peak load. In a third paper, Mr. J. A. Fraser dealt with "Electric Cooking and its Advantages." These advantages were convenience and cleanliness; the fact that there were no products of combustion; the ease with which both automatic and hand controls could be fitted; and the convenience of indicator lamps. The author produced evidence to show that Gas Board officials realised the advantages of electric cooking. Yet the cooking load was being lost and a firm official reply was, therefore, necessary to the many irresponsible statements that had been made by gas and solid fuel interests.

ELECTRIC HEATING REQUIREMENTS.

In the fourth paper on "Electricity in Domestic Heating," Mr. R. Berry examined the heating requirements of the average home, in an attempt to determine a method of meeting them which would ensure the best use of the national fuel resources, with due regard to other factors affecting the national economy. After drawing a distinction between continuous and intermittent heating, he suggested that there were four main factors to be taken into consideration in heating the home: air temperature, radiation, air change and humidity. He discussed the first point at some length and said it had been suggested that the ideal to be aimed at was an air temperature of about 55 deg. F., with a high rate of air change and sufficient radiation to prevent chilling.

Background heating was required in this country for about five months in the year and details were given of the appliances available to provide this. The dual problem of domestic heating and coal conservation was illustrated in a series of tables in which figures for the fuel consumed, working efficiency, coal economy, efficiency and running cost of a number of appliances for different periods and rates of heating were set out. These tables showed how the use of electricity for heating became more advantageous as the length of the period was shortened or the heat input to the room was reduced. For any one period of six hours in a 24-hour cycle, electric heating compared favourably with any solid-fuel appliance, while for longer periods it had the advantage of being less liable to incorrect adjustment and operation. As a heating plan for the average home, the author recommended a solid-fuel boiler to take the main winter water-heating load and to supply radiators. There should be a solid-fuel fire in the living room and an electric radiant heater should be available. An electric convector was best for the dining room, while radiant fires were ideal for the bedrooms.

DISCUSSION.

In the course of a joint discussion on these four papers, Dame Caroline Haslett said that the days of easy development on the domestic side had gone and the electricity supply industry had now to produce facts and figures and to carry out research if it was to answer its critics. Without the diversity provided by the domestic load, the industry could not provide cheap electricity.

Mr. A. C. Hazel pointed out that there was a tendency on the part of the fuel-producing industries to dictate to the public, who should be free to decide what they wanted. He criticised the different rates of purchase tax on gas, electric and paraffin radiators and asked who decided what the tax on a particular form of fuel should be. One of the great advantages of electrical appliances was their safety, and this should be emphasised. The electrical industry should press for the proper insulation of houses, as this would promote the use of electricity for heating.

Mr. O. W. Humphreys welcomed the papers as a belated defence of the use of electricity for domestic purposes, but was disturbed by the figures for gas efficiency given by the Egerton Committee. The gas industry was entitled to claim credit for the whole of the heat content of the products yielded by carbonisation, but for present purposes they were concerned with the proportion of the heat

in the coal which was used for the heating of houses. What was required for this purpose was simply the ratio of the heat content of the coal to that of the gas and coke which it yielded. That was about 55 per cent. The average heating service in British homes could be provided better by electricity than by any other single method.

Mr. J. I. Bernard said that 12 kWh of electricity would give the same cooking service as one therm of gas. The gas industry claimed to get 75 therms of gas and 10 cwt. of coke by carbonising one ton of coal, so that allowing 1½ lb. of coal burnt at the power station per kilowatt-hour, it meant that 10½ cwt. of coal burnt at the power station would give the same service as a ton of coal carbonised at the gasworks, which were left with 10 cwt. of coke to dispose of.

Mr. J. S. Warren emphasised the point that electricity was more efficient for short-period and intermittent heating than other methods and that electric fires and heaters, when properly used, made far less contribution to the peak than was supposed. Miss M. V. Griffith agreed with the author that such methods as floor heating were of value because of their inherent storage. She was surprised that no speaker had mentioned the heat pump, which transformed electric heating from a low capital cost high running cost method to one of high capital cost and low running cost. This at once brought electricity into the picture for base-load space and water heating. By attending to the heat insulation of a house 0.5 watt per cubic foot would be sufficient for background heating.

Mr. J. F. Field pointed out that one great virtue of gas was that it could be stored. It was possible to make gas and electricity simultaneously and their integration seemed to be indicated. At the moment, the British Electricity Authority bought 37 million tons of coal a year and threw away the heat equivalent of 25 million tons in heating up rivers and cooling towers. As long as it did this it would be in a vulnerable position.

Summing up, Mr. C. T. Melling said that the supply industry must safeguard its cooking, water-heating and comfort-heating loads, otherwise consumers would be subjected to considerable rises in charges. Moreover, in the near future, there would be a great increase in the industrial load which must be balanced by an improvement in the domestic load. It would be false economy to condemn the people who would occupy the new houses to use old-fashioned methods. The present-day electric cooker consumed no more coal than the modern gas cooker and much less than the old black gas cooker, of which some six million were still in use. There were also nearly ten million old-fashioned coal fires, which were much less economical than an electric fire.

In the evening, a reception was held at the Pavilion by the Mayor and Mayoress of Bournemouth.

HIGH-PERFORMANCE DIELECTRICS.

On Tuesday morning, June 17, a meeting was held in the Pavilion, at which a lecture on "High Performance Dielectrics, with Special Reference to Power Factor Correction Capacitors" was delivered by Dr. R. S. Vincent. After a brief historical introduction in the course of which the work of Cavendish, Volta, Faraday and Clerk Maxwell was reviewed, the lecturer turned to the modern theory of dielectrics, which were simply stated as being substances which would store electric energy reversibly by a physical mechanism. When a dielectric held a charge it became polarised, the polarisation being electronic, molecular or atomic. In the case of a material, such as plain mineral oil, the polarisation was mainly electronic. The molecules of such liquids were described as non-polar; that is they were electrically symmetrical until an electric field was applied. Molecular polarisation occurred where a molecule had permanent electrical asymmetry with the result that the molecule was an electrical dipole. Chlorinated diphenyl was a well-known example. The upper frequency limit for this kind of polarisation might be of the order of power frequency. Atomic polarisation, which was due to the displacement of single charged atoms or ions in the molecule, could be very large. It was this that gave the phenomenal high permittivity properties to such ceramic dielectrics as barium titanate.

The principal requirement of a dielectric for a power-factor correction capacitor was that it should store energy as efficiently as possible at the power-supply frequency and at the particular voltage needed. Efficiency was here used in a very wide sense and included such factors as capacitor life, volume, weight and thermal loss of energy, all of which contributed to both the initial and running costs. Just where the balance lay between these factors, which might be mutually opposed, depended upon the requirements of the particular application and the properties of the available dielectric materials. In the face of this complex situation it was desirable to decide upon the magnitude of the charge storage and the working voltage and then to design the most economic capacitor from the materials available. For quite a small unit capacitor, with a rating of 11 kVA and 230 volts, the area of the dielectric was several hundred square feet and this sheet must be cut up into small areas or rolled from long strips. Many dielectrics were excluded from consideration because they could not be obtained in thin enough sheets, especially in large areas, and for this reason impregnated paper had until recently been without a rival. The design of two types of capacitor using this material was then considered at some length.

New dielectrics, continued the lecturer, were now gradually becoming available, among them being the polar liquid impregnants, such as chlorinated diphenyl. Fibrous inorganic sheet materials might be used with these substances, though most of them were too low in density to contribute the required electric strength. Listing these new dielectrics in terms of their intrinsic power rating—permittivity multiplied by the square of the working stress and a factor to give volt-amperes per centimetre cube—it appeared that high density paper had a value of 1.6 with oil impregnant and 2.4 with a chlorinated impregnant. A barium/lead zirconate gave 17. It was important to realise that since impregnated paper consisted of 50 to 80 per cent. by volume of cellulose, it was of little value to develop an impregnant with a permittivity much higher than six. Even a very high permittivity material would not increase the dielectric constant above twelve.

Polystyrene film seemed very promising though there were many manufacturing difficulties associated with the winding operation. Chlorinated diphenyl had a rather doubtful history and some serious operational drawbacks. Ceramic-plate capacitors perhaps showed the greatest possibilities, although at present their dielectric loss was too high and a greater electric strength was needed.

RESEARCH IN THE ELECTRICAL INDUSTRY.

The meeting on Tuesday afternoon, June 17, was also held in the Pavilion and was devoted to the consideration of seven papers on various aspects of research in the electrical industry. The first of these was by Sir Arthur Fleming and was presented in his absence by Mr. J. T. Kendall, who pointed out that every field of service found an application in the electrical industry. Conversely, research carried out in the electrical industry found applications in every other field. The types of research organisation operating in the electrical industry might be divided into the fundamental work carried out at the universities and technical colleges; the activities of the research and development departments of large manufacturing concerns and the research associations; and the work of operating concerns, such as the Post Office, and the British Electricity Authority. All these phases of research were closely interrelated, and the co-operative attitude existing avoided the duplication of scientific man-power.

The cumulative effect of continuous research might be illustrated by mentioning that the best thermal efficiency of steam turbines had risen from 16.9 per cent. in 1922 to 26.76 per cent. in 1948, while the weight of a turbo-alternator had been reduced from 12.5 lb. per kilovolt-ampere in 1914 to 4.5 lb. per kilovolt-ampere at the present time. The use of nuclear energy, whatever its ultimate economic value might be, presented problems which were entirely new to classical engineering and illustrated the manner in which a new development arising from research immediately gave rise to a

series of other researches, the results of which might in time form the starting point of further investigations. This rapid evolution of research in an industry of ever-widening scientific interests placed a heavy premium on trained personnel—those able to conduct research and those who were required to use the new knowledge which research provided. These two personnel problems constituted one of the major limitations to obtaining new knowledge and ensuring its effective use.

CO-OPERATIVE RESEARCH.

The next paper, on "Co-Operative Research in the Electrical Industry," was read by Dr. S. Whitehead, who said that the Electrical Research Association was one of the earliest research associations to be formed after the end of the 1914-18 war and was to-day one of the largest. It might well be asked, seeing that private research in the electrical industry was among the greatest in volume in the world, whether research associations were needed. The answer was two-fold. In other bodies, co-operative research was ancillary to other primary objects and industrial research was expensive. Accordingly, the industry supported not only the Electrical Research Association, but to a lesser degree other associations with fringe interests.

The author then dealt with the development of the Electrical Research Association at some length and described in detail a number of researches, notably those on switchgear, surge protection, dielectrics and wind power. The prominent feature of the Association was that it brought manufacturers and users together, communication interference being an outstanding example of this co-operation. Among the items of what might be called speculative research, mention might be made of the small-scale study being carried out into the direct conversion of electro-chemical energy into electrical energy. Another example was an investigation into methods of current measurement which would overcome the difficulties of insulating current transformers for very high voltages.

THE ELECTRICITY SUPPLY INDUSTRY.

A survey of "Research in the Electricity Supply Industry" was given in a paper presented by Dr. J. S. Forrest, who said that activities in this field might be classified into research carried out by the British Electricity Authority and by the Area Boards; co-operative research under the aegis of a research association or in conjunction with manufacturers or other users; and external research carried out for the Authority by some other organisation, such as a university. Much of the work was concerned with operational problems and might be termed "user" research, but this often led to research of a more fundamental nature. The Authority had its own laboratories at Leatherhead, Croydon, and Grove-road, London, as well as divisional laboratories associated with generating stations throughout the country. Croydon was concerned with the performance of high-voltage insulators and of cooling towers, while Grove Road had recently been established to provide experimental facilities for work on external deposits and internal corrosion in boilers. Trials were being arranged to obtain operating experience with advanced steam and gas-turbine cycles. Other possible sources of electrical energy, such as fuel cells and wind power, were being investigated. Research was also being carried out on transmission at voltages of 275 kV and above, the development of new types of insulators and the prevention of corrosion of overhead-line conductors and underground-cable sheaths. Among the many other subjects upon which work was proceeding mention was made of nuclear energy. It was doubtful whether a sufficiently large effort was being made to develop power from this source; better progress might be possible as the result of a joint attack on the problem by a body representing the electrical-plant manufacturers, the supply industry and the Atomic Energy Research Establishment.

MANUFACTURING RESEARCH.

The fourth paper in the series on research was by Dr. K. J. R. Wilkinson, entitled "The Nature of Research in the Electrical Manufacturing Industry." The author said that electrical products ranged widely over the field of physics and involved

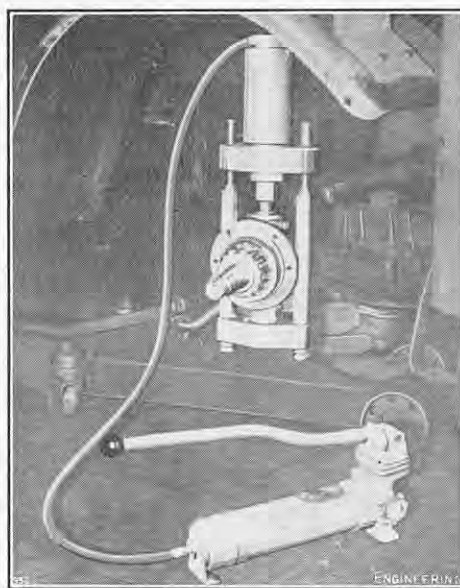
two interests of particular importance: the continuing evolution of the products themselves and the use of new materials which these products might embody. Research in the electrical industry was sometimes equivalent to a cross-fertilisation of ideas; developments already known to one branch of engineering, physics, chemistry or metallurgy required translation to a new engineering field. Research had much in common with the inventive outlook and faith in the eventual emergence of a successful result was necessary. Besides faith, the engineer engaged in research needed a critical habit of reasoning and an able experimental flair. Problems were seldom presented in a straightforward way and, in practice, the first inquiry had to be into the general nature of the questions presented for resolution. When the form of the problem had been perceived, the research worker had to embark on a process of learning some new piece of reasoning and thus to become a self-taught specialist.

Scientific ability, although insufficient in itself, was a very important requirement of the research worker and much was being done in the electrical manufacturing industry to encourage the development of this quality by courses in advanced engineering. The aims of research were not always predictable, but the general trend of successful work could be seen as gains either to the understanding of a new field of interest, to the ability to measure some elusive effect or as achieving some new engineering device.

(To be continued.)

THE "STAFFA" KING-PIN REMOVER.

THE accompanying illustration shows a heavy-duty hydraulic tool designed by Messrs. Chamberlain Industries, Limited, Staffa Works, Leyton, London, E.10, for removing and replacing the king pins used in the steering gear of motor road vehicles. It is known as the Staffa king-pin remover and will fit the axles of most of the road-transport vehicles at present in service. The tool consists of a manually-operated hydraulic pump, connected by a 7-ft. length of flexible hose to a single-acting spring-return hydraulic ram. Under a hydraulic pressure of



5,500 lb. per square inch, the ram exerts a force of 12 tons. The cylinder of the hydraulic ram is screwed into a press frame comprising rigid cross members, of 2-in. steel plate, and hexagonal tie rods having long threaded upper ends to allow a wide range of adjustment of the depth of the frame. The tie rods pass through the lower cross member and are secured by nuts. The centre of the lower yoke is drilled with a 2-in. hole to permit the passage of the king pin as it is forced out of its bush by the action of the hydraulic ram. Pusher pins, with an effective length of 6½ in., are available in diameters of ¾ in., 7⁄8 in. and 1 in.

The tool can also be used for re-fitting king pins.

For this purpose, a spigoted plate is inserted in the hole of the lower plate and the pin rests on the plate for lining up. During re-fitting, the ram remains stationary on top of the axle and the application of hydraulic pressure causes the cylinder to move backwards, drawing the press frame upwards and driving the king pin smoothly into the bush.

FRANCO-BRITISH JOINT TELEVISION PROGRAMMES.

As a result of the experiments made a few weeks ago into the possibility of transmitting television programmes from Paris to London, a further programme has been arranged and will be carried out from Tuesday, July 8, to Monday, July 14. During these tests television signals from outside broadcasting points in France will be transmitted to a receiving point at the Eiffel Tower by a radio link. For this purpose, three units, manufactured by La Compagnie des Compteurs and operating at 9,000 megacycles, will be used. The programmes will be broadcast to French viewers in the Paris region by two transmitters of the Radiodiffusion et Télévision Françaises, one operating on the 819-line and the other on the 441-line system. A converter developed by Radio Industrie will be used to change the 819-line picture to 441 lines.

The 819-line vision signals will be transmitted over the experimental radio link of Radiodiffusion et Télévision Françaises to Lille, a distance of 136 miles. This link, on which there are intermediate stations at Villers-Cotterets (44 miles north-east of Paris) and at Sully-Saillissel (50 miles from Villers-Cotterets and 42 miles from Lille) operates on a frequency of about 900 megacycles and was manufactured by the Compagnie Française Thomson-Houston. It is being used to supply programmes to the Lille television station until the permanent radio link, which is now being installed by the French Post Office, is ready. At Lille, the programmes will be broadcast for the benefit of viewers in that area.

The transmissions from Lille will be at about 180 megacycles, and will be picked up at Cassel by a special receiver manufactured by Société Desmet, as well as by a temporary radio link operating at 9,000 megacycles, which was supplied by La Compagnie des Compteurs. The received signals will then be fed into a converter, which has been developed by the British Broadcasting Corporation for transferring pictures from the French standard of 819 lines to the British standard of 405 lines. From Cassel, these signals will be transmitted by radio link at about 7,000 megacycles by equipment manufactured by Marconi's Wireless Telegraph Company, Limited, Chelmsford, to Apleton, a distance of 18 miles, and thence to Swingate, near Dover, a distance of 40 miles, at about 4,500 megacycles by equipment supplied by Electrical and Musical Industries, Limited, Hayes, Middlesex. The latter firm have also constructed the radio link from Swingate to Wrotham, a distance of 49 miles, while the corresponding link from Wrotham to London, a distance of 23 miles, was supplied by Standard Telephones and Cables, Limited, London, the operating frequency in all cases being 4,500 megacycles.

Technical responsibility for the camera equipment and for picking up the programmes in Paris will be in the hands of Radiodiffusion et Télévision Française. Four different types of camera: Image-Orthicon, manufactured by Messrs. Pye, Limited, Cambridge, and Radio Industrie; Photicon, manufactured by the Compagnie Française Thomson-Houston; and Image-Ionoscope, manufactured by Radio Industrie, will be used.

INDUSTRIAL APPLICATIONS OF ZINC.—The recent ninth issue of the *Zinc Bulletin*, published three or four times a year by the Zinc Development Association, Lincoln House, Turl-street, Oxford, is mainly devoted to various types of zinc coating. It contains articles on hot-dip galvanised steel pylons, zinc-sprayed hydro-electric pipelines and seagoing ships, and an Australian pipeline protected by a zinc-rich paint. Other articles give particulars of die castings, the properties and uses of zinc oxide, and the construction of door and porch hoods in rolled zinc sheet.

NOTES ON NEW BOOKS.

The Rhymney Railway.

By D. S. BARRIE. Oakwood Press, Tanglewood, South Godstone, Surrey. [Price 6s. 6d. net.]

THIS small book is the second in a series projected by Mr. Barrie to deal with the railways of South Wales, which was rather seriously interrupted by the war of 1939-45; the first, on the Taff Vale Railway, which has since appeared in a second edition, was reviewed in our columns (vol. 148, page 438) in the latter part of 1939. With 51 route miles of line, the Rhymney Railway was rather less than half the length of the Taff Vale Railway, but it was a singularly prosperous undertaking and at one time carried a coal traffic of more than 5,000,000 tons a year. The company was incorporated in 1854 and in its early years indulged in the usual crop of legal disputes and agreements with neighbouring lines; but it possessed at various times directors and executives of unusual ability, notably Cornelius Lundie, who was both traffic manager and engineer, and C. T. Hurry Riches, who was locomotive superintendent from 1906 onwards and who eventually was absorbed, with the Rhymney Railway, into the Great Western Railway's system in 1923. A complete list of the company's locomotives is included as an appendix, and another gives the new numbers allotted to those which were taken over by the Great Western Railway.

Patternmaking.

By L. L. COX. Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, London, W.C.2. [Price 12s. 6d. net.]

BOOKS about engineering handicrafts have never been so plentiful as those about engineering sciences, yet the sciences cannot be applied without the handicrafts. There is usually room, therefore, for a practical text-book which will help to turn the abstract into the concrete, though some doubt must remain whether any handicraft can be taught in print. Mr. Cox claims to do no more than to give the apprentice patternmaker "some idea of the interesting work he may eventually be called upon to perform." This he does clearly enough, with the aid of numerous line illustrations, well designed to bring out the salient points, and of twelve half-tone plates. These certainly portray current practice in pattern-shop machine tools, but it is a little to be regretted, perhaps, that eleven of them relate to the products of the same firm, albeit one that is long established and highly regarded. We think it a mistake, too, to omit almost all mention of the patternmaker's hand tools and their uses on the ground that "their application . . . can be more thoroughly demonstrated in the workshops than in a text-book"; that is true, of course, but the same could be said with equal truth of the whole craft of patternmaking.

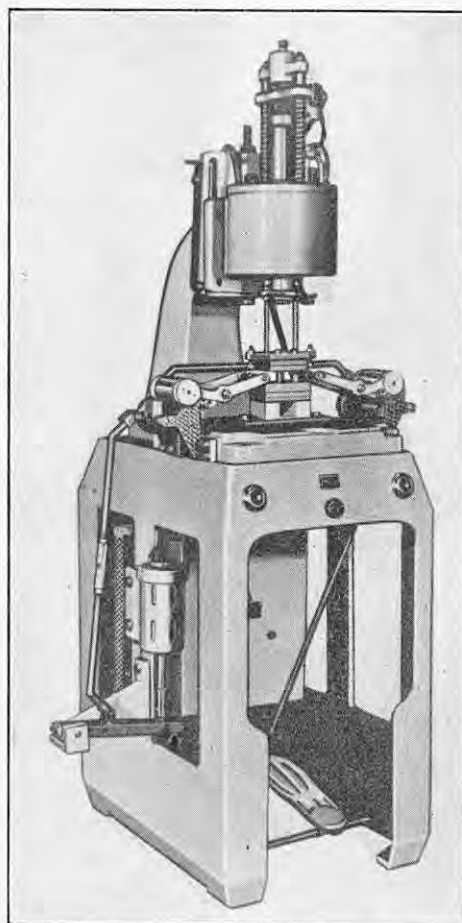
How the Civil Service Works.

By BOSWORTH MONCK. Phoenix House, Limited, 38, William IV-street, Charing Cross, London, W.C.2. [Price 25s. net.]

MR. MONCK, a former temporary civil servant in the Ministry of Aircraft Production, the Ministry of Production and the War Cabinet secretariat, was chairman of the group which prepared the Fabian Society's report on *Reform of the Higher Civil Service*. He writes, therefore, with considerable knowledge of his subject, his method of treatment being, first, to describe the general organisation of the Civil Service and the finance and processes of government, and then to devote roughly half of the book to "What Government Departments Do," dealing with some 25 departments in turn. The result is a survey that should interest equally those who maintain that more and more Government regulation of the ordinary citizen is advantageous and those who contend that there is already far too much. These opposing views are never likely to be reconciled, but it is at least desirable that the arguments for and against them should be based on facts. Mr. Monck provides ample ammunition for both parties. It should also give pause to those who too lightly suggest the formation of new Ministries.

ELECTROMAGNETIC PRESSES.

A RANGE of electromagnetically-operated presses, with maximum load capacities ranging from 550 lb. to 11,000 lb., manufactured by Elmeg Elektromechanik G.m.b.H., Germany, are now available in the United Kingdom. The British agents are Messrs. Newton, Lansdowne and Company, Limited, Brook House, 2, Torrington-place, London, W.C.1. The Elmeg press comprises a coil which, when energised for a short period, exerts a strong magnetic force on a core forming the press ram, thereby accelerating it to a high speed on its downward stroke. The impact energy can be regulated by varying the field current by a rheostat. At the end of each power stroke the current is automatically cut off. In the smallest press of the range, the ram is returned by a magnet, but in the five other machines the return stroke of the ram is effected by springs. Certain of the presses are fitted with



adjustable power heads, and in all models a fine adjustment of the stroke is provided. The two smallest presses, with maximum loads of 550 lb. and 1,650 lb., respectively, are of the single-stroke type, and are operated by a hand or foot switch. They are designed to work from a 220-volt alternating-current supply. The 550-lb. press is also available for direct-current operation. All the larger presses operate on direct current, but are supplied with a unit embodying a rectifier and suitable relays for use with an alternating-current supply. The larger presses are provided with control gear permitting either single-stroke working, under the control of the operator, or automatic continuous operation to be selected. All the machines are available either as complete presses, with supporting column and slotted work table or as separate power heads, complete with switchgear and control rheostats, for installing in multiple-head or special-purpose machines.

The example shown in the accompanying illustration is a fully-automatic press, intended for stamping and similar duties, having a load capacity ranging from 1,320 lb. to 4,400 lb., and an impact energy ranging from 35 in.-lb. to 218 in.-lb. It has been fitted with an automatic stock feed and indexing table. The maximum speed of continuous opera-

tion at full load is 1 stroke per second, and the corresponding power consumption is 250 watts. The ram has a stroke of 4.3 in. The power head is adjustable over a vertical range of 3.9 in.; in its lowest position it is 9.25 in. above the table. The bore of the ram, in which the upper tool is fixed, is 0.78 in. in diameter and 1.77 in. deep, and can be supplied with a screw thread if desired. The automatic feed gear, driven by a $\frac{1}{4}$ -h.p. motor, will handle material up to 2.4 in. wide, and provides a length of feed up to 3.2 in.

The manufacturers claim that these machines have a low current consumption, are lighter than hydraulic or pneumatic presses designed for equivalent duties, and do not require foundations. Since the ram, which is the only moving part, moves freely in the press, the risk of overloading the machine is small, and maintenance is simple. If desired, guards interlocking with any of the controls can easily be fitted.

TRADE PUBLICATIONS.

Air-Blast Circuit-Breakers.—Details of their 165-kV and 66-kV air-blast circuit-breakers are given in two leaflets received from the English Electric Co., Ltd., Kingsway, London, W.C.2.

Lubricants.—Details of industrial lubricants and a guide to their selection for a wide variety of uses are contained in a booklet published by the Ragsoline Oil Co., Ltd., Ibex House, Minories, London, E.C.3.

Diesel Generating Sets.—Three illustrated brochures giving details of alternators and complete Diesel-electric generating sets of various powers have been issued by Houchin, Ltd., Garford Works, Garford-street, London, E.14.

Electrical Accessories.—An illustrated catalogue recently published by M.K. Electric, Ltd., Wakefield-street, Edmonton, London, N.18, gives details of ranges of switches, plugs and sockets, adapters, fuse boxes and other electrical accessories of their manufacture.

Electrical-Resistance Alloys.—Two leaflets, one giving details of alloys suitable for wire-wound resistances, etc., which have the same electrical properties as Constantan, and the other of Manganin, have reached us from Isabellen-Hütte, Heusler K.-G., 16, Dillenburg, Germany.

Laboratory Equipment.—Catalogue 16B-S, recently published by Griffin and Tatlock, Ltd., Kemble-street, Kingsway, London, W.C.2, gives details of a wide range of specialised instruments and equipment for use in laboratories.

Mine Signalling System.—Details of mine signalling system, Type 48, for endless-rope, man-riding haulage systems are given in a leaflet published by the Automatic Telephone and Electric Co., Ltd., Strowger House, Arundel-street, London, W.C.2.

Sound Amplification and Distribution.—Details of radio and gramophone units, amplifiers, microphones and associated equipment for sound reproduction and distribution are given in an illustrated brochure published by Communication Systems, Ltd., Strowger House, Arundel-street, London, W.C.2.

Hoisting Blocks.—George W. King Ltd., Hitchin, Hertfordshire, have issued two illustrated leaflets giving particulars of hoisting blocks of recent introduction. One of these describes the Bantam 11 hand-chain block, which lifts a $\frac{1}{2}$ -ton load and weighs 29 lb., and the other relates to a sack hoist, with a capacity of 250 lb. This is driven by a $\frac{1}{4}$ -h.p. electric motor, has a hoisting speed of 75 ft. per minute and is available with single or twin hooks.

Holding Tools for Welders.—Donald Ross and Partners, Limited, 1 to 3, Arlington-road, London, N.W.1, have sent us a catalogue (No. 185A) of "holding tools and positioners" for the use of welders. These appliances, marketed under the general name of "Twiner," are designed primarily to be used in conjunction, the holding tools (vices, clamps, etc.) being used to secure the work to the positioner, which can be adjusted to turn or tilt it to the most convenient position.

Trucks and Assembly Trays.—We have received three illustrated leaflets from James Hustler & Sons, Ltd., White Lund, Morecambe, Lancashire. One of them depicts their range of Rase-Motte trucks, with a useful load capacity of 1 ton to 1 $\frac{1}{2}$ tons, 12 cwt., and 4 cwt., respectively, which incorporates loading winches and retractable front undercarriages, enabling the load to be taken up on the truck by one operator without external handling equipment. The other leaflets show, respectively, assembly trays and fixed and portable benches, and an engine overhaul standard parcel truck.