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CONTENTS.

	PAGE
The Works of Messrs. David Brown and Sons (Huddersfield), Limited (*Illus.*)	559
Literature – Gaseous Combustion at High Pressures. The Principles of Metallurgy. Worked Examples in Electrical Technology. Die Deutschen Gewindetoleranzen	561
The Re-Girdering of the Lower Sone Bridge; East Indian State Railway (*Illus.*)	562
The Properties of Permalloy C. (*Illus.*)	567
The Late Mr. M. E. Unwin	568
Italian Flotilla Leader "Nicoloso da Recco"	568
Diagrams of Three Months' Fluctuations in the Prices of Metals	568
Labour Notes	569
Governor Gear for High-Speed Reciprocating Steam Engine (*Illus.*)	570
The Purification of Bauxite	571
Letters to the Editor.– Boiler Peak Loads Creaking in Passenger Ships	571
Engineering Training and Education	572
Tender	572
Books Received	572
Notes from Cleveland and the Northern Counties	572
Notes from South Yorkshire	572
Notes from the South-West	573
Notes from the North	573
Notices of Meetings	573
The Treaty of Naval Limitation	575
The Tranmere Bay Boiler Explosion	577
Mineral Dust in Factories	577
Notes	578
The Institution of Mechanical Engineers	579
A Skyscraper Survey	581
The Iron and Steel Institute	582
2-8-2 Type Tank Locomotive, London, Midland and Scottish Railway (*Illus.*)	582
Launches and Trial Trips	582
Normalising and Box-Annealing of Sheets (*Illus.*)	583
Airship Mooring-Strain-Indicator (*Illus.*)	584
The Distribution of Steam in Large Factories (*Illus.*)	585
Portable Rail-Sawing Machine (*Illus.*)	588
Developments in Fuel Economy at Skinningrove (*Illus*)	588
The Northern Coke Research Committee	590
Catalogues	590

Four One-Page Plates – THE WORKS OF MESSRS. DAVID BROWN AND SONS (HUDDERSFIELD), LIMITED. THE RE-GIRDERING OF THE LOWER SONE BRIDGE; EAST INDIAN STATE RAILWAY.

ENGINEERING

FRIDAY, MAY 2, 1930.

VOL. CXXIX. No. 3355.

THE TREATY OF NAVAL LIMITATION.

IT would not be difficult to criticise both the general principles and the details of the Naval Treaty between this country, the United States and Japan, which has just been signed, but it is evident that it would be fruitless to do so. Public opinion has endorsed the Treaty, notwithstanding its obvious weaknesses ; the opposition Press has not attacked it ; the Parliamentary opposition shows no inclination to contest its ratification by Parliament ; and nobody who has any knowledge of English public life can doubt the implications of this friendly reception. It may safely be assumed that the Treaty will be made operative, and that such criticism as is directed against it will be disregarded in the country and ignored by Parliament. In the circumstances, it is best to steer midway between insipid applause and criticism to which nobody is inclined to listen, and to review the practical consequences of the Treaty dispassionately and calmly.

The first and most important of all these consequences is that the Admiralty must devise, and the Government approve of, a building programme which will maintain the Fleet at the strength provided for by the Treaty ; for it can hardly be supposed that the Government intend to follow a policy of reducing the Fleet by deterioration and by treaty at one and the same time. We propose, therefore, to examine what replacements will be necessary during the six years in which the Treaty will be operative. As these replacements will have to be made in each of the classes of vessel catalogued in Article 16, we may deal with each in turn.

The Treaty allows Great Britain 146,800 tons of cruisers with guns of more than 6·1-in. calibre, so long as the total number of units does not exceed 15 : the actual position is as follows : Eleven 10,000-ton cruisers are actually built and in service, and to these must be added the four ships of the Effingham class, which mount 7·5-in. guns, and are therefore included in the category. The combined tonnage of these vessels is 146,800 the exact figure in the Treaty- but as the two Norfolks (20,000 tons), and the York and Exeter (16,800 tons) are nearing completion, it is evident that we have an excess of these ships, which will not be completely eliminated by putting the Effingham and Frobisher out of service, as provided for in Article 18. It would be useless to anticipate what measures the Admiralty will propose for reducing our heavy cruiser fleet to the figures provided for in the Treaty. Subsection 2 of Article 16 allows each signatory to dispose of excess tonnage "gradually," and the Government will presumably explain how this article will be put into operation when they announce their programme.

The Treaty allows us 192,200 tons of cruisers with guns of 6·1-in., or less, and we actually possess only 177,685. There is thus an actual shortage of rather over 14,000 tons ; but this is a small matter compared with the prospective shortage, which can most easily be described by a tabular statement.

Year.	Cruisers completing service	Tonnage.
1931	Dartmouth	4,860
1932	None	—
1933	None	—
1934	2 Birmingham	10,240
	3 Carolines	11,685
1935	3 Cambrians	11,760
1936	Brisbane	5,120
	3 Cambrians	11,760
	2 Centaurs	8,240
Total No. of units	16	Total tonnage 63,668

The actual and prospective shortages in these light cruisers amounts in all to about 18 units, and to nearly 78,000 tons. At the present moment the designs and tonnage of the vessels which are to replace these 6-in. gun cruisers are matters of the merest conjecture. Since the Washington Treaty was signed, the Admiralty have built nothing but heavy 10,000 ton vessels ; it was only in 1930, after the failure of the Geneva conference, that designs were prepared for vessels which were somewhere laconically described as "under 7,000 tons." A somewhat intricate strategical question will dominate the programme for replacing these 6-in. gun cruisers. It has frequently been said that they are required for defending sea-borne commerce. This is rather vague language, which requires explanation. If the attack which these new cruisers will have to parry is attack by surface vessels, then they will be engaged on such work as was performed by the old "County" cruisers during the war. The principal duty will be to patrol those focal areas which raiders are bound to visit sooner or later. As cruiser design has never corresponded exactly to the strategical duties which cruisers have to perform, it is not possible to say what design would be most suitable to a focal point cruiser. Most probably, however, the Admiralty's traditional love of speed and guns will influence the design, and if the new cruisers are built solely for work on the defence routes they will displace about 7,000 tons and carry from 10-in. to 12·6-in. guns. If it is decided to build this class of vessel in replacement of the Cambrians, Centaurs and Carolines, which are falling out of date so fast, then eleven new units will make good the total shortage of 78,000 tons, and we may expect the Admiralty to announce that at least two new keels will be laid down yearly.

This estimate is, however, made upon the assumption that the Admiralty contemplate defending trade only against surface attack. The assumption is rather a big one. The Naval Staffs of every nation in the world know that British commerce can only be effectively attacked by submarines operating without restriction, and presumably the civilian governments, whom the Naval Staffs advise, are well aware of it also. As our weakness is so generally known, it is most hazardous to imagine that the

settle, can see none in prospect, and are confident that if they arise they will be settled before they have provoked dangerous national passions, they are quite entitled to regard these good and friendly relations as the equivalent of a certain amount of protective military force. Now the outstanding fact in Anglo-French relations during the last ten years is that the vituperations of some part of the French Press against Great Britain, has not embittered the relations between the two Governments. From this it is safe to assume that if peaceful relations between the two countries are ever endangered, the disturbing influence will more probably be a question of high politics than an outburst of popular indignation at some incident which excites the antagonism of the two nations. In other words, the provocation will come from above rather than from below.

To proclaim *urbi et orbi* that the French building programme "affected the requirements of our national security" would be a very serious matter. Any British Government, whatever its political complexion might be, would hesitate to announce that France and Great Britain are naval rivals; any French Government would be willing to reconsider a policy which was provoking the British Government to take so serious a step. The probability is, therefore, that there will be some slight readjustments in the French programme; that the British Government will be satisfied; and that British public opinion will not be alarmed by the presence of a powerful French force on the southern side of the Channel, so long as the relations between the two countries continue on their present footing. A deterioration in those relations is, in fact, more likely to put Article 21 of the Treaty into operation than an increase in French naval strength, which the British public may not have expected, but to which they may well become accustomed.

THE TRANMERE BAY BOILER EXPLOSION.

THE report of the Commissioners appointed under the Boiler Explosion Acts of 1882 and 1890, to investigate the cause of the boiler explosion which occurred at the Tranmere Bay Works of Messrs. Cammell Laird and Company, Limited, on April 11, 1929, has recently been published, and demands some notice.

Stated briefly, the boiler which exploded was of the Stirling type, and the failure was obviously due to the wastage of the plating of one of the lower drums. The end of this drum was enclosed by brickwork, which, owing to the conditions of the site, below ground and between two docks, was liable to damp. The boiler was built about 1905. Till 1914 it was inspected by Messrs. Cammell Laird themselves, but at that date the responsibility under the Factory Act was transferred to the Manchester Steam Users' Association. It appears that the boiler was re-tubed and tested hydraulically in 1916, and was again re-tubed in 1928. The last certificate was given on December 17, 1928, and a further one was ready for issue at the time of the explosion based on an examination made about a fortnight before the boiler failed. It is to be noted that, in connection with this last examination, on April 2, the inspector suggested that "while he did not see any special need for stripping" the brickwork, he recommended that this should be done, as the boiler was getting old and the brickwork was damp.

The Commissioners' report places the blame for the occurrence on the Manchester Steam Users' Association, together with Dr. Petrie, its Chief Engineer, and Mr. Ogden, of his office. The latter was responsible for passing the inspector's report, referred to above, without instituting further action, but it will be noted that the wording is not such as necessarily to imply the need of immediate proceedings. The report, as set out, constitutes a somewhat serious indictment against the individuals named and the Association, but it is possible, as has been known to happen in such cases, that, had the inquiry been in really technical hands, other facts would have been given weight which would go to show some of the remarks specially selected for criticism, in a rather different aspect. We have not, of course, the benefit of the evidence in full, and we do not know how it was led, or whether carrying one or another part a little further, or a somewhat different handling of witnesses, might or might not have put a very different complexion on some of the points. We are, however, well aware that such inquiries, conducted after the legal manner, have not infrequently in the past arrived at conclusions which have greatly reduced the value of the investigation from the practical viewpoint.

One cannot help feeling that the case has been put in the worst light possible. We have very frequently referred to the excellent work of the Manchester Steam Users' Association, whose former chief engineer has made many valuable contributions to engineering knowledge. The accident in question is the first, we understand, in the 75 years' history of the Association, and it seems to us quite illogical for this reason to place so much blame personally upon the shoulders of Dr. Telford Petrie, who only took charge as chief engineer six months or so before the event under discussion. This is all the more so when we note that the Commissioners believe that the corrosion started soon after the erection of the boiler in 1905, and that for some time the boiler had been working in a dangerous state.

It is quite unlikely that if corrosion had thus been proceeding slowly for a long period, it should have been latterly so accelerated as to develop to a dangerous state only, or mainly, during Dr. Petrie's short term of office. Further, few large businesses nowadays expect a chief to concern himself with details of every part of his work. With the size to which organisations now extend, any such process is unworkable in most industries, and we do not imagine that boiler inspection is any exception. In order that work may proceed in any business, a certain amount of authority has to be delegated, and, for the chiefs to have time to give to the exercise of control and the direction of policy, it is essential that some balance be struck in these matters. While, therefore, we do not argue that the Association is free from blame, the personal responsibility of a relatively new chief engineer strikes us as in quite another light than that which has been put upon it in this report.

With regard to general conditions, it is to be inferred from the report that though Messrs. Cammell Laird tested this boiler after re-tubing in 1916, it was not so tested after the process had been repeated in 1928. This point is not brought out by the Commissioners, nor is any suggestion made by them that the brickwork might very well have been cleared at that time for a complete inspection. The Commissioners relieve the owners of all blame, as may be technically their due, under the terms of the insurance, but, with their intimate knowledge of the installation, it seems curious, since they are deemed competent and responsible, that it did not strike someone at the works that an hydraulic test after the second re-tubing might have been advisable, or that the brickwork, being liable to damp, was likely to encourage exterior corrosion. There is no evidence, in fact, that this occurred to anyone until the fact was noted in the inspector's report of 1928. In their own interests, it may reasonably be supposed, that, if conditions were so obviously unsuitable as the Commissioners state, the owners might have been expected to draw the special attention of the Association to the opportunity which re-tubing in 1928 gave, for the removal of any necessary brickwork, &c. Taken as a whole, the facts brought out by the inquiry suggest that certain features have been construed by the Commissioners in the worst sense, and that points which are clear enough to them with their present full knowledge, and on which they have expressed themselves very decidedly, were not so either to the owners, even when they inspected the boiler themselves, or to the insurance company or its agents subsequently.

So far as the Association is concerned, it enjoys too high a reputation for us to be convinced by such a report that it is not competent to choose suitable officials for its staff, and the Commissioners' criticisms will probably be assessed at a reasonable figure in competent circles.

MINERAL DUST IN FACTORIES.

The inconvenience of dust in industry varies greatly with the nature of the work that is being carried on, and of the material from which the dust is made. Any form of dust, for instance, is pestilent in the manufacture of photographic plates, and any form of abrasive dust is bad for machinery. This much knowledge is of old standing, but it is only in comparatively recent years that particular knowledge has begun to be acquired about the effect of a dusty atmosphere on those who work in it. For some time past it has been established that the inhalation of dust may cause not only diseases of the lungs and of the bronchial passages, but also local alterations of their tissues, the most important of which is the formation of fibrous tissue in the place of the air cells, whereby often the patient becomes much more susceptible to phthisis. In each of the industries in which such results of the inhalation of dust have been traced more particularly, the dust by which the injury was produced was some form of free crystalline silica, while some other forms of industrial dust could not produce similar effects. Of late, however, evidence has appeared that the dust formed in the treatment of asbestos produces effects which are generally similar to those arising from the silica-laden dust. The fibrous formations are not precisely the same, and they appear to develop more rapidly, though adding less to the patient's susceptibility to phthisis. After careful enquiries, in fact, asbestosis has been added to silicosis as an occupational disease arising from working in dusty surroundings, and in a report just issued by the Home Office on *Effects of Asbestos Dust on the Lungs, and Dust Suppression in the Asbestos Industry* (H.M. Stationery Office, price 1*s.* 3*d.* net), Dr. E. R. A. Merewether, M.D., and Mr. C. W. Price, respectively medical and engineering Inspectors of Factories, describe the results of an extensive investigation carried out during the year 1928 and 1929.

While the effect of the report is not such as to cause panic, and in Dr. Merewether's opinion the outlook for preventive measures is such that in 10 years or so their energetic application should produce a great reduction in the incidence of the disease, the results recorded seem to leave no doubt that, as Sir Gerald Bellhouse observes in submitting the report, the disease itself is serious, and the necessity for suppressing the dust from which it arises has only recently been appreciated. Its seriousness is the greater for the reason that has prevented it from attracting notice till recently. Although asbestos has been known and worked since the time of the ancients, yet it is only in the last 40 years or so that it has been worked commercially to an appreciable extent, and it is less than 30 years since the great expansion of the industry began. Even now it is not a large industry. Apart from the considerable number of workers exposed to the influence of mixed dust, of which asbestos forms only a part and often only a minor part, it is estimated that the number of persons in this country who are exposed in their daily work to the inhalation of asbestos dust is not more than about 2,200. This in itself is a number large enough to indicate the necessity of taking precautions against exposing such workers to any serious occupational disease, and it has also to be borne in mind that this number has been reached by a process of rapid growth in the industry, which is likely to go considerably further. In the motor, electrical, engineering and building industries the uses and applicability of asbestos are being increasingly recognised, and its value and convenience as an ingredient of heat-insulating covering seems likely to cause an enhanced demand for it with the increasing attention that is now being paid to the insulation of plant in the interest of fuel economy. There seems reason, therefore, to believe that the industry is likely to undergo much further development, partly perhaps in the methods and plant applied in its technical processes, and partly also in the enlargement and sometimes the rehousing of its existing plant. The time is, therefore, opportune for considering what measures are necessary to enable this valuable industry to be carried on without adding to the number of those who suffer from occupational diseases.

The suppression of dust has already been recognised as the indispensable means of solving problems of health and sometimes of efficiency in many industries. In the manufacture of asbestos it is attended with a peculiar difficulty, arising from the nature of the material. Asbestos is a term applied to a variety of minerals, which mostly differ from each other in their physical properties to such an extent that for some purposes it is necessary that they should be blended. Not only for this reason, but also because the fibres of which all kinds of asbestos minerals are composed owe some part of their technical value to their fineness and flexibility. These fibres have to be separated out before manufacture, and their structure is such that they seem able to divide longitudinally to an indefinite extent, and thus when broken to produce dust of extraordinary fineness. The observations included in the report show, for instance, that a majority of particles of asbestos dust floating in the air are not larger than a five-hundredth of a millimeter, and many are as small as a two-thousandth. It is said, therefore, that respirators, apart from their discomfort and the difficulty in inducing workers to wear them for any length of time, are unable to arrest the finest particles of dust, and at best can only be regarded as a second line of defence. Reliance has accordingly to be placed on arrangements for dealing with the dust at a greater distance from the worker, and the recommendations with which the report concludes show that the processes both of the direct treatment of the material and of the use of ventilation for controlling the dust are in many respects similar to those found in other industries. The chief measure hitherto adopted is the application of efficient localised exhaust ventilation at dust-producing points. Though it is described as the most generally applicable, it has not been applied as yet to hand-work, and only to some machines and appliances. In others the nature of the process and machinery presents special difficulties. The substitution of enclosed mechanical methods for hand conveyors and for dusty handwork generally is desirable wherever it can be applied, which at present does not seem to be as often as could be wished. The effective enclosure of dust-producing machines and plant, and the substitution of wet methods for dry, are also measures which it is considered might be adopted to a greater extent than they are. Apart from the elimination or modification of certain machines, which at present produce much uncontrollable dust, the utmost possible abandonment of settling chambers in manufacturing processes, the separation of dust-producing processes from others, so as to limit the number of workers exposed to them, and the wide spacing of dust-producing machines so as to reduce the concentration of dust in the air of the workroom as a whole, are among the other measures recommended. Many of these precautions are linked up with the efficiency of the general exhaust ventilation, and some of them, such as damping floors and benches, cannot yield their full benefit unless they are supplemented by efficient cleaning of the workshop.

Though the problems that are intended to be solved by measures such as these are not new, but occur repeatedly in a great variety of industries, they present themselves even in the asbestos industry in many different circumstances. This may have something to do with the fact that general exhaust ventilation does not seem to be as effective as might have been expected. The intervention of the Factory Department of the Home Office along the lines on which its work seems usually to be conducted ought to be of considerable assistance to the efforts of the industry to put its factories in order in this important respect. The report gives many examples of energetic measures taken by individual firms, experimentally and otherwise, to obtain a satisfactory solution, and in this, as in other industries, the Department appears to be working on the assumption that manufacturers are themselves no less anxious to have their works as healthy and as safe as they can be made than the Department is to see that they are so. This assumption is undoubtedly correct in regard to the great majority of the most enlightened and successful firms, and it seems likely that co-operation between the Department and such firms would yield results not to be obtained from inspectors who present themselves, like policemen and tax gatherers, for the purpose of forcing manufacturers to do what they do not think is necessary or desirable. It seems reasonable to hope that the improvement which this co-operation should effect would in itself go a long way to induce the example of the firms who took part in it to be followed by others, and would reduce the probably small number of instances in which it might be considered necessary to apply the much less satisfactory method of compulsion. By its constitution and functions the Factory Department of the Home Office is in an exceptionally good position to be of use in such co-operation. Each industry knows its own difficulties, and probably knows them better than they are known to factory inspectors. Of the difficulties of other industries, on the other hand, it has far less precise knowledge, and conceivably the experience of practically all industries which is centralised in the Factory Department might be of value in applying the methods that have been found successful in one industry to an unsolved difficulty of another. In the present report, for example, it appears that little or no use has been made of vacuum cleaning methods for the cleaning of works, machinery and sacks. It is pointed out, however, that in other classes of work, such, for example, as electric cable factories, portable vacuum sets are constantly used with great advantage. How this collective experience might be mobilised on occasion for use when it was required without overburdening factory inspectors by invoking it needlessly, might perhaps be a matter of some difficulty. It seems, however, to deserve consideration, if, indeed, it has not already received it.

NOTES.

MEMORIAL TO MATTHEW MURRAY.

THE labour of love, which was undertaken to provide a fitting memorial to Matthew Murray, who has been justly called "The Father of Leeds Engineering," has now been successfully completed. The efforts of those responsible have resulted in the distribution of over 2,700 copies of the Matthew Murray book, which was reviewed in ENGINEERING on February 22, 1929, to the libraries of Leeds and of the principal cities of Great Britain, as well as to most of the leading engineering institutions. A special gift by Lord Brotherton also enabled 900 copies of this book to be presented to scholars of the higher forms of the secondary schools in Leeds, who were invited to write essays on the pioneer, with which it dealt, and prizes were awarded for the result. In addition, many copies have been purchased by engineering firms, and a satisfactory number have been sold through booksellers. Further, a bronze plaque, which was described in ENGINEERING of May 17, 1929, has been erected on the site of the works of Messrs. Fenton, Murray and Wood, in Water-lane, Holbeck, large framed photographs of which plaque have been presented to the Institutions of Civil and Mechanical Engineers, the National Union of Railwaymen, the Engineering Department of Leeds University, the Leeds Technical College, and to several museums abroad. "Matthew Murray" prizes to the amount of 5*l.* are being awarded at the end of this session to day and evening students in mechanical engineering at the Leeds Technical College and at the Junior Technical School, Holbeck, and will be continued from year to year, as funds allow. Arrangements are being made for replicas of the models of the Murray locomotive, and the Blenkinsop rack rail now in the Science Museum, London, to be made for the Museum of Peaceful Arts, New York, and probably also for the Leeds Museum, while replicas of the rail have already been supplied to four other museums. That so much has been done in a manner, which Murray himself would have approved, is largely owing to the energy of the chairman and general honorary secretary of the Fund, Mr. E. Kilburn Scott, to whom the thanks of all those, who desire that the memory of pioneers in engineering should be fittingly honoured, are due.

THE JUNIOR INSTITUTION OF ENGINEERS.

The typical "Junior" atmosphere pervaded the dinner presided over by Sir Ernest Moir on Friday last. At these functions, as is known, it is not the custom to adhere quite so rigidly to the formality which is supposed generally to add dignity to occasions of the kind, though, on the other hand, the body has customs of its own by which it sets great store. The toast of the evening was "The Great Adventurers of Engineering," proposed by Mr. B. E. Dunbar Kilburn, and replied to by the President. Mr. Dunbar Kilburn recalled how many of the early adventurers in engineering had worked out their ideas without public encouragement. He thought that in their President they had a worthy successor to the long list who had held office before Sir Ernest Moir. Sir Ernest had had to act as a pioneer in many directions during his career, as had now been to some extent put on record in the address he gave some time ago before the Institution. Sir Ernest Moir, replying, admitted that he had had to play the part of adventurer. He had, he said, also been driven to do things himself which, if he had been only a little bolder, he would have deputed to others. He was fortunate in having been able to combine his adventures with not a little profit. The engineer was greatly indebted to other sciences, and the medical work which had rendered many of their schemes possible was as much pioneering as anything. Lord Cowdray was a great adventurer. There were pioneers in finance, and all needed to go forward together. The toast of "The Institution" was proposed by Major A. M. Kerr, of the Imperial War Museum, and replied to by Mr. Stanley Dunlop, Chairman of the Institution, who spoke of its members Empire-building abroad. With Sir Ernest Moir presiding, Mr. F. Palmer, Sir Brodie Henderson and Sir H. G. Lyons present as guests, the reflection of the Institution upon work abroad is evident. In fact, many of the elders present felt that by their attendance they were benefitting themselves as much as enjoying hospitality as guests, living over again some of the incidents of their earlier work and imbibing during the evening some of the spirit which keeps the Institution and its members young in spite of advancing years.

LAMINATED ARCH DAMS WITH FORKED ABUTMENTS.

In a paper published under the above title in the Proceedings of the American Society of Civil Engineers, Dr. F. A. Noetzli suggests a new type of arched dam, the main distinguishing feature of which is that the arch is built up of separate rings somewhat in the same way as were the brick overbridges of Brunel, though the successive rings are much thicker and are of concrete instead of brick. Thus constructed the dam is much less stiff in the vertical plane than a monolithic dam of equal total thickness. By this artifice the serious bending stresses in the vertical plane are much diminished, as also the stresses due to temperature changes and to shrinkage. In the central plane the arch profile leans downstream, so that a plumb line dropped from the downstream face of the crest would fall clear of the bottom by several feet. In this way the maximum radius of the arch is materially lessened. The abutments constitute another special feature of the new dam. They are forked in plan, and made sufficiently long to reduce very considerably the maximum span of the arch at crest level. In the concluding section of his paper Dr. Noetzli describes a remarkable dam now under construction in France, on the Dordogne River at Marège. In this case, in order to avoid the heavy secondary stresses associated with a thick arch, there is a succession of five arch dams, some 60 ft. to 70 ft. apart. Of these the crest of the highest is 229·6 ft. above bed level. It has a uniform thickness of 3·94 ft. About 60 ft. downstream of this arch dam is another, 183·7 ft. high and 4·43 ft. thick. The space between the two is kept filled with water, so that the effective head on the upper dam is only 45·9 ft. Below the second dam is a third, 137·8 ft. high and 4·32 ft. thick. This is followed by a fourth, 91·6 ft. high and 4·43 ft. The last of the series is 45·93 ft. and 3·94 ft. thick. Automatic arrangements are provided to ensure that the interspaces between each successive pair of dams is kept full of water. Before the plans for this dam were finally passed tests were made on a model, to a scale of $\frac{1}{100}$, which was loaded with mercury.