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

o proclaim *urbi et orbi* that the French building ramme "affected the requirements of our nal security" would be a very serious matter. British Government, whatever its political plexion might be, would hesitate to announce France and Great Britain are naval rivals; French Government would be willing to sider a policy which was provoking the ish Government to take so serious a step. probability is, therefore, that there will be light readjustments in the French programme; he British Government will be satisfied; and British public opinion will not be alarmed e presence of a powerful French force on uthern side of the Channel, so long as the ns between the two countries continue on present footing. A deterioration in those as is, in fact, more likely to put Article 21 Treaty into operation than an increase in naval strength, which the British public t have expected, but to which they may come accustomed.

TRANMERE BAY BOILER EXPLOSION.

eport of the Commissioners appointed under ler Explosion Acts of 1882 and 1890, to ate the cause of the boiler explosion which l at the Tranmere Bay Works of Messrs. Laird and Company, Limited, on April 11, as recently been published, and demands tice.

briefly, the boiler which exploded was of ling type, and the failure was obviously he wastage of the plating of one of the ums. The end of this drum was enclosed work, which, owing to the conditions 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

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

[illegible] British Government [illegible] will be satisfied [illegible] that British public opinion will not be alarmed [illegible] 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 [illegible] likely to put article 24 of the Treaty in 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 [illegible]. Till 1914 it was inspected by Messrs. Cammell Laird themselves, but at that time 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 [illegible] for stripping the brickwork, he recommended that this should be done as the boiler was getting [illegible] 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 [illegible] [illegible] ve, without [illegible] but it will [illegible] stated that the warning is not such as necessarily [illegible] the need [illegible] to prevent [illegible]. The [illegible] constitutes [illegible] judgment [illegible] the individuals named and the Association [illegible] as has been seen [illegible] happen in such cases, that, had the inquiry [illegible]

[illegible] that been [illegible] for a long [illegible] should have been [illegible] so [illegible] to devotion to [illegible] state [illegible] mainly during Dr. Petrie's [illegible] Further, [illegible] nowadays [illegible] a chief [illegible] with details of every part of his work. With the size to which organisations now extend, [illegible] process is [illegible] in most industries, and [illegible] 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 [illegible] 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 [illegible] not competent to choose [illegible] staff, and the Commissioners [illegible]

[illegible] rapidly [illegible] to the patient's susceptibility [illegible] asbestos, has been added to [illegible] occupational disease arising from working in dusty surroundings. 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 1s. 3d. 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 [illegible] 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 [illegible] of asbestos dust is not more than about 2,000. This in itself is a number large enough to [illegible] the necessity of taking precautions against exposing such workers to [illegible] 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 [illegible]. In the motor, electrical, engineering and building industries the uses and [illegible] of asbestos are being increasingly recognised [illegible] value and convenience as an ingredient of heat-insulating covering seems likely to [illegible] demand for it with the increasing attention that is now being paid to the [illegible] of fuel economy. [illegible] the [illegible] that the industry [illegible] further development [illegible] methods and plant [illegible] processes and partly also in the [illegible] the rehousing of [illegible] therefore opportune for considering what measures are necessary to [illegible]

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 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 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, 91·8 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.

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 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.

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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.

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