to the employees, it is clear that by the same measure of decrease the price of commodities might have been diminished. It seems to us to be a fundamental condition of profit-sharing—looked at economically, and not altruistically—that it should lead directly to greater workshop efficiency, and if it does not do so, then the simpler system of payment by results—through piecework or the premium plans—which does unquestionably improve shop efficiency, is preferable. Under the Clarke, Nickolls and Coombs' system the profits above a fixed amount are returned in one form or another to the workpeople ; under the Taylor, Taylor and Hobson system the profits over a certain amount will be invested in the company, and only the dividends will be paid to the workers. The latter plan has the merit that the money will remain in the business, and can be devoted to its extension and development. Is has been very carefully worked out, and has many attractive features. We shall watch its progress with interest.

* * * * *

Engineers in Business.

IN an address which he delivered early in December to the Midland Section of the Junior Institution of Engineers, Professor F. W. Burstall alluded, with a touch of regret, to the fact that the engineer, despite his technical skill, is deemed "incapable of the management of a large organisation, and that when it comes to matters of public policy and the government of large technical industries, such as mines and railways, the person put in supreme command is either a business man or a lawyer." Professor Burstall is certainly not unaware that there are several notable exceptions to the practice of which he spoke, but in a general way he was undoubtedly right in his facts. Whether or not it is a matter for regret that engineers are not entrusted with the management of great organisations is quite another question. Business is one thing and engineering another, and on the whole we are disposed to think that the less the engineer has to do with business the better engineer he will be. There is, we suggest, not the least reason to suppose that education in science and technology fits a man for the management of affairs, and it seems not much more reasonable to ask that engineers should be appointed heads and directors of great organisations than it would be to give positions of technical responsibility to lawyers and business men. Professor Burstall recognises that engineering is based on science, but he does not, perhaps, see quite so clearly that business has also its science, and demands just as close a specialised education as that given to engineers. The classical example of Boulton and Watt remains, as it will always remain, the ideal combination ; on the one hand a business man with a keen sympathy for science, and on the other hand an engineer with a keen sympathy for business. It does, of course, not infrequently happen that a man who starts life as an engineer finds himself drawn into the meshes of business, and gives up a great deal of his technical work, but whenever that happens the world is the loser, for it is probable that the technical ability which originally displayed itself would have developed further had it not been diverted and obstructed by non-technical affairs. We all know that for years past the technical managers of great engineering works have found their time increasingly engaged by labour problems—a form of business of a very serious kind. Can anyone doubt that such is an undesirable state of affairs ? Far better would it be to appoint a business man, or even a lawyer, to attend to all these matters than to keep the engineer away from the study of the subjects in his proper province.

* * * * *

The Woman Engineer.

THE position of women in engineering and other professions and trades is one of those matters that will settle itself. If they are better than men, they will get work, and if they are not they won't, and that, as our American friends would say, is "all there is to it." That is the final position which will be reached when equilibrium has been attained. Speaking as mere males, it does not alarm us a great deal. Nature has not fitted women for engineering, and though here and there one may break away from the normal, just as we may find now and then a great woman novelist or a tolerable woman artist, so a few times in a century women may reach eminence in engineering. When we say engineering, we mean engineering, and we do *not* mean the mere mechanical handicraft which has been so facilitated by a succession of inventions that, except in a few occupations—rapidly disappearing—where muscular strength or physical endurance is required, anyone can become an expert in a few weeks. It is astonishing that women should desire to engage in such work, but the sex was always, and will always be, incomprehensible. We are sorry to see from the first number of a little quarterly published by the Women's Engineering Society, and called the *Woman Engineer*, that mechanical craftsmanship and engineering are confused, though we admit that the bad example was set by the male sex. But it is unfortunate that just at a time when engineers are endeavouring to effect some distinction between the mechanic and the scientifically trained engineer anything should be done to support or perpetuate the misuse of the word "engineer." If women desire to remain in the craft of engineering they must be content to call themselves women-mechanics, women-machinists, women-fitters, and so on. With the example of the ill that has resulted from the confusion amongst men engineers, they will be ill-advised if they do not take the earliest opportunity of making a clear distinction between those who are able to earn a decent income by a training extending over a few weeks or months and those others, on a higher plane, who, after years of study and considerable expenditure of their fathers' money, manage with difficulty to make both ends meet, and only in exceptional cases have the pleasure of seeing them lap over.

The Miner and the State.

IN view of the miners' movement for nationalisation a brief account of past legislation affecting miners and mining may not be amiss, and a note of warning regarding the future may not be inopportune.

Until the middle of the last century the miner's lot was probably worse than that of any other worker in this country. Hard labour, long hours, great danger, low wages, and little freedom were the chief features of the miner's life. Appliances were primitive, lights were bad, drainage and ventilation shocking. Women worked in the pits, and they and their little children were harnessed like horses and drew the tubs of coal from the workings to the shafts. Mining was, indeed, a black occupation. Some of the commonest rights and liberties enjoyed by other workers were denied the miners for generations.

Although miners were specially mentioned in several Acts of Parliament between 1736 and 1831, it was not until 1842 that anything was done for their benefit. Prior to 1842 what legislation there was relating to miners was mainly for the purpose of controlling and punishing these men. But in that year a new epoch was ushered in. We got the first Coal Mines Regulation Act for the benefit of labour. This measure prohibited the employment of women below ground and the employment of boys under ten years of age ; provided for inspection ; ordered that winding engines should not be controlled by persons under fifteen ; and that wages should not be paid in public-houses.

In 1850, in 1855, and in 1860 important Amendment Acts were passed. They provided that no boy under twelve be employed below ground unless he could read and write, or was allowed to attend school two half days per week ; that engines should not be controlled by persons under eighteen ; that shafts be lined, cased, and fenced ; that ventilation and drainage be attended to ; and directed the adoption of several other safeguards. In 1862 an Act was passed for the provision of duplicate shafts or outlets, as the result of a terrible shaft accident at Hartley.

In 1872 another important Mines Act was carried. The chief clauses prohibited the employment of all boys under twelve ; regulated the employment of women and girls above ground ; provided that all mines be under the control of certificated managers ; imposed the imprisonment penalty upon owner, agent, or manager for neglect likely to cause danger ; and enacted various other safeguards. In 1881 and 1886 further amendments were effected.

Then in 1887 we got an Act to "amend and consolidate" former Acts. It provided for all the material safeguards enacted previously and laid down some fresh ones. The age of winding enginemen was brought up to twenty-two ; provision was made for better timbering, ventilating, draining, and lighting ; for ambulance appliances ; and many smaller matters. In 1896 a few more safeguards were provided for, and in 1897 miners were included in the first Workmen's Compensation Act. In 1900 the age of boys was brought up to thirteen. In 1903 amendments relating to inspection were carried. In 1905 additional rules relating to explosives and to weighing were introduced. In 1908 the famous Eight Hours Act was carried. In 1912 we got the Minimum Wage Act.

What has been the result of all this legislation ? Between the Act of 1842 and the Act (Eight Hours) of 1908 there was a huge increase of safety. The first really reliable figures were those for the 'fifties. In the ten-year period ending 1855 the average number of deaths from mining accidents worked out at a rate equal to one death for every 250 persons employed—that was annually. In the ten-year period ending 1905 the average was only equal to one in every 770. In other words, the mines were more than three times as safe at the beginning of the twentieth century as in the middle of the nineteenth. To put it another way, such a degree of safety had been attained a few years ago that the miner could count upon working 770 years before meeting with a fatal accident, were such longevity possible. That was a remarkable record. Mining became so safe, relatively, that the occupation of the merchant marine sailor was five times more dangerous, and the occupation of the deep-sea fisherman was ten times more dangerous, measured by fatal accidents, than that of the coal miner. Almost similar comparisons hold good to-day. It is very wide of the mark to describe mining as the most dangerous trade.

But to credit all that improvement in mining to legislation would be wrong. A safety device was never invented by an Act of Parliament. The silent engineer has done far more than the noisy politician. The growth of science and its application to industry has done much more than all the laws and regulations. Law has been necessary to bring the worst employer up to the standard set by the best one, and to enforce the general adoption of the safety device. However, the fact remains that through a variety of factors the occupation of the miner is less than one-third as dangerous as it was a couple of generations back. There was a vast improvement down to the operation of the Eight Hours Act.

The Eight Hours Act was the first step in the wrong direction. This measure was strongly recommended on the ground that it would further increase safety. It had the opposite effect. Until 1909, when that measure became operative, the decline in the accident death-rate was persistent. In spite of the huge number of miners employed, the deaths averaged only four per working day. But in the first three years under the Eight Hours Act the number was six per day. From a steady 1000 to 1200 deaths a year the number jumped up to from 1500 to 1800. The new law, by imposing uniformity upon all districts, mines, and men, regardless of varying conditions, upset the industry and the men. Much night work was introduced. The men were less alert. Repair work was scamped. There was a tendency to rush. There was no time for the pits to cool where the three-shift system was introduced. A big series of explosions and an alarming increase of smaller accidents followed immediately upon the introduction of the Eight Hours Law. What will be the result of a six-hour day if it is enforced ?

Now a word about the cost of all this legislation. Prior to the Eight Hours and Minimum Wage Acts legislation had, according to evidence given before Royal Commissions, added not less than 2s. per ton to the cost of coal production. That was apart from actual wage advances—it was the increased cost in respect of increased safety. The nation, through its Parliament, did more for the miners than for any other class. And the miners returned the compliment by cutting down their output. In spite of a vast improvement in appliances, tools, machinery, lights, ventilation, and drainage—to say nothing of much higher wages—the output of coal per unit of labour went down and continues to go down. There is no other industry with such a black record of reduced production concurrent with better health and safety, better machinery and wages. Less than forty years ago the output of coal was equal to 310 tons per man employed at the mines. Even under the shockingly bad conditions of seventy years ago it was about 270 tons per capita. To-day the rate is barely 200 tons a year, or four tons per week per man.

One more point. If the nation nationalises the mines to please the miners, will the miners consent to be nationalised ? At present the miners work and play when they like, through their organisations they dictate their own hours and wages, and very effectively control the whole of the labour side of the industry. If the mines are taken over by the State will the miners consent to submit to the discipline that applies to ordinary State servants ?

NON-FERROUS MATERIALS.

THE following particulars of the stocks—exclusive of old metal and scrap—in this country in possession of the Minister of Munitions on January 1st, 1920, have been published :—

	Tons.
Copper	10,095
Spelter, G.O.B.	10,318
Spelter, refined	9,754
Aluminium	7,084
Soft pig lead	54,975
Nickel	1,650
Antimony regulus	2,775

It is announced that a proportion of the above stocks is already sold to the trade for forward delivery.

BOOKS RECEIVED.

Steel Works Analysis. By J. O. Arnold, F.R.S., and T. Ibbotson. Fourth edition. London : Sir Isaac Pitman and Son, Limited, 1, Amen Corner, E.C. 4. Price 12s. 6d. net.

Regulations for the Electrical Equipment of Ships. The Institution of Electrical Engineers. London : E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1. Prices 3s. 6d. net and 2s. 6d. net.

Private Companies : Their Utilities and the Exemptions they Enjoy. By H. W. Jordan. Ninth edition. London : Jordan and Sons, Limited, 116–117, Chancery-lane, W.C. 2. Price 1s. 4d. post free.

Bradford Chamber of Commerce Year-book, 1919. First issue. Edited and compiled by P. Anderson. Derby : Published for the Chamber by Bemrose Publicity Company, Limited, 25, Midland-place.

A Treatise on Electro-chemistry. Edited by Bertram Blount, F.I.C. : *The Manufacture of Chemicals by Electrolysis.* By Arthur J. Hale. London : Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 6s. net.