

the longer distance suburban traffic. A somewhat similar policy is being followed by the South-Eastern and Chatham Railways. As regards the South-Eastern half of the combination, however, the method of working the trains between London Bridge and Charing Cross constitutes a serious handicap. Most of the trains proceeding to Charing Cross are sent into and out of Cannon-street, which is a terminal station, many tracks being, therefore, fouled in the double transit. This leads to numerous delays, which, if not specially serious to passengers making but occasional trips, are, when daily repeated, keenly resented by the outer-circle season-ticket holders, constituting the class the company is now particularly desirous of cultivating. The problem of maintaining a service to Cannon-street without causing delays to trains proceeding to and from Charing Cross is undoubtedly a very difficult one; but it is one which must be faced seriously, and solved satisfactorily, if the suburban traffic is to be properly developed, and carried on with the speed and punctuality which are so eminently desirable. The Brighton Line is also endeavouring to encourage the long-distance daily traveller, and this object was to a great degree responsible for the expensive enlargement of Victoria Station. The chairman, however, expressed the hope that the electrification of the South London line would attract back some of the passengers now carried by tram. The new service is to be opened between London Bridge and Victoria on October 1 next. The steam service, at present running, requires 36 minutes for the $\frac{3}{4}$ miles trip, which, in view of the relative infrequency of the service and the necessity of having to find his way to and from a station, offers little attraction to a possible passenger who has the option of proceeding by motor-bus or tram-car, which he can board or leave almost anywhere. With the new service the running time is to be cut down to 24 minutes, the number of stops being the same as before. The fact that the Lancashire and Yorkshire Railway Company are steadily increasing the range of their electric services, which are shortly to be further extended from Aintree to Maghull, is of hopeful augury in this regard. The Great Eastern Railway Company are at length attempting to stem the recession in the tide of travellers by reducing fares. The efficacy of this is perhaps doubtful, although Lord Claud Hamilton announces that its adoption has led to an arrest in the decline of the suburban passenger traffic. The large size of the trams does indeed go far to offset the advantage they have in the matter of accessibility, since, carrying 70 to 75 passengers, stops are necessarily too frequent to permit of a reasonable "commercial" speed, as it is called on the Continent. In this respect the omnibuses have an advantage, though their maximum speed between stops may be less. The Central London line is another company which has met competition by a reduction of fares. With the uniform fare of 2d., passengers, it was found, preferred to go by motor-omnibus for all distances of less than four tube stations, have, therefore, been introduced with the result of a large recovery in numbers, though with, as yet, no enhancement of receipts. The North London line is following the example set by the District Railway, and attracting passengers by inaugurating non-stop runs. The result of the management of this line by the North Western Railway has, so far, proved highly satisfactory, the rate of fall in the passenger traffic being less than half of what it was previously, while the doubling of the services between Broad-street and Willesden, backed by the inauguration of non-stop trains between Gospel Oak and Broad-street, should tap entirely new sources of revenue.

The enterprise of Sir George Gibbs in giving the lead in this direction has been insufficiently recognised. Before he took control of the District Railway, any suggestion of the practicability of such services would have been scouted by most experienced railway men, but the example set is now being followed, not only as stated on the North London line, but on the Metropolitan Railway, which is now running through services of this kind between Aylesbury, Uxbridge, Harrow, and the City. The automatic system of signalling is to be extended on this line as far as Neasden, as it has been proved to lead to greater punctuality in the operation of the trains.

In many respects the District Report is the most notable of any. Sir George Gibbs's patient perse-

verance and enterprising courage have now brought the undertaking into a position to pay nearly full dividends on all the guaranteed stock. The passengers carried numbered 32,900,000, an increase of 11.2 per cent. on the corresponding figure for 1908, and the gross receipts amounted to 254,000*l.*, which is a record in the history of the company. Receipts have gone up by 25,419*l.*, and expenses diminished by 67,531*l.* The Tubes also show improved returns, especially in the matter of interchange traffic. The Central London line have now secured their Act for an extension to Liverpool-street, which should prove highly profitable. On the other hand, the Bakerloo tube is abandoning the proposed extension to Paddington. To facilitate interchange between the Central London line and the Great Northern, Piccadilly, and Brompton tube, a subterranean travelling platform is to be constructed between the British Museum and the Holborn stations of the respective companies.

An interesting announcement made at the Great Western meeting was that relating to the acquisition of 12½ acres of land in Battersea, formerly occupied by the filter-beds of the Southwark and Vauxhall Water Company. The vendor is the Metropolitan Water Board, and the site, being nearly free from buildings, has been secured at a cost which does not preclude its use for a goods yard, access to which will be obtained over the West London Extension line. Further goods accommodation in the Metropolitan has long been needed by the Great Western Railway Company, but was commercially impossible in the neighbourhood of Paddington, where the price would, it is stated, have been three times that paid for the Battersea site.

THE SWEDISH STRIKE.

The number of men on strike, according to reports from the different district authorities last week, amounted to 285,762 hands. The actual number of workmen in industry, mining, commerce, traffic, &c., is stated to amount to about 480,000; further, there are the railway servants and about 800,000 rural labourers. The Socialists put the number of men on strike somewhat higher than the authorities, and it is probably about 300,000.

It may now, although the voting for or against the strike within the union of Swedish railway men has not been completed at the time of writing, be taken as certain that there will be no railway strike, the minorities in favour of strike, so far as the results the union show, being altogether insignificant. The union, however, only comprises one-half of Sweden's railway servants, who number about 40,000 men, so a strike would in any case only affect some 20,000 men; but as already stated there is no fear of this contingency. The same remark applies to the postal functionaries, who, according to orders from headquarters, must not join the strike, as the postal service is of equal importance to all parties.

The men employed in the service of keeping the towns clean may strike, at least, in Stockholm, having been strongly urged to do so by the other trade unions. The leaders say that the men are determined to persevere, and that literally no organised labourers have returned to work; on the other hand, it is certain that a number of factories have resumed work, in many cases, however, through the medium of unorganised and, may be, unskilled hands. So much is certain, that the great strike did not prove of such instantaneous and comprehensive effect as the men no doubt anticipated, and they are said to be impressed by the manner in which much work and many functions go on without them. To bring about this result people of all classes, men and women alike, have put their shoulders to the wheel.

An official statement has been published about the general strike. The deeper cause of the conflict, it is stated, must be looked for in the fact that the employers have arrived at the conclusion that only by inflicting a serious defeat upon the men will it be possible to overcome the men's attempts, in spite of the difficult financial position, to raise the wages by incessant minor conflicts. It is further pointed out that the country's three largest organisations of employers, for the purpose of making a large joint fight against the men possible, inserted a clause in the collective agreements with the men, which states that discontinuance of work may only take place subject to a certain notice. In the strikes within these organisations the men have exercised their right under the agreement, but within the many other

industries which have been affected by the strike, the collective agreements have generally rested upon the understanding, or clearly-defined, supposition that no discontinuance of work might take place within the duration of the agreement. The men's organisations, in obeying the central body's request to embark upon a general strike, have consequently in numerous cases acted in distinct violation of existing obligations. The violations of agreements connected with public services, which have entailed a real danger for the community, are especially regrettable. It is understood to be under consideration to convene the Swedish Parliament for an extraordinary session in October, in order to legislate upon the subject of workmen's agreements and kindred matters.

As far as can be seen at present, the strike is likely to become a somewhat protracted affair; the masters certainly intend, and will no doubt be able, to hold out, and the men, or, at least, their leaders, seem to be determined not to give in for a week or two to come at least, although things are likely to go very hard with them. So far, no disturbance of any moment has taken place. Attempts to bring about a solution of the conflict are said to be under consideration within Liberal political circles, but so far nothing definite has transpired. In the Stockholm harbour there are a number of steamers with coal unable to be discharged. Norwegian manufacturers of wood pulp and celluloid are receiving increased orders on account of the Swedish strike. The printers seem almost everywhere, as far as is hitherto known, determined to continue the strike, in spite of which the papers appear more and more regularly, though in some cases greatly reduced in size, but the printing, considering it is done by amateurs, is really excellent. The tram-car companies, or at least some of them, have given the men on strike notice of dismissal, and the hands at work in various harbours are daily increasing in number. The farm hands' strike is almost a complete failure. Most large industrial concerns, of course, are still closed. On the whole, the men, it must be admitted, show a brave front, although money must be getting very scarce with many of them. Some help to those most in need will now be forthcoming from their funds, and attempts to raise money in other countries—for instance, America—will now be made. The labour organisations in Denmark and one or two other countries have already sent comparatively handsome sums; but, of course, it is all utterly inadequate, and the men will now begin to feel the consequence of the strike in earnest.

According to what has transpired from several quarters it would seem that it was, to some extent at least, a matter of chance that the general strike took place in Sweden and not in Denmark or Norway. A general strike had to be tried in one of the Scandinavian countries, and the men have been singularly ill-advised to foster the conditions which brought it about in Sweden, where the masters are stronger than in either of the two other countries. Should this piece of information prove correct, and it has not been contradicted, it places the whole disastrous affair in a still less flattering light.

A PROPOSED ANALYTICAL MACHINE.

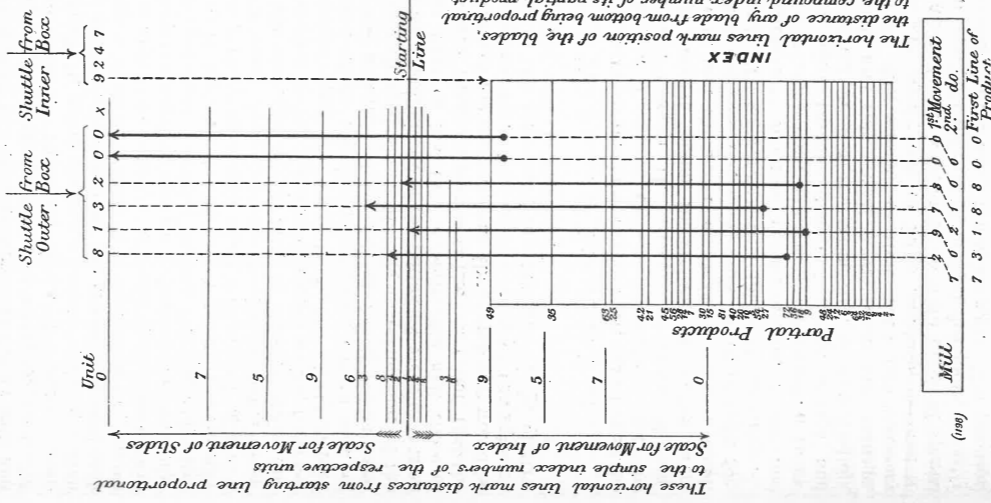
By name, at any rate, Babbage's famous analytical engine is known to all. It was intended to be a machine for the arithmetical solution of all problems in mathematical physics. Such solutions are generally, perhaps always, feasible, but in most cases when the computations have to be effected by direct human agency, they are so extremely tedious as to be practically, if not theoretically, impossible. Every operation in arithmetic can be reduced to addition, subtraction, multiplication, and division, and, indeed, the two latter operations can be regarded as mere extensions of the two former. The analytical engine was a machine by which these four operations could be performed in any desired sequence; moreover, a number of partial operations could be combined, and the final results automatically tabulated for any required values of the variable. As is well known, though many years' labour was spent on the machine, it was never even partially completed, Mr. Babbage's scheme being far too ambitious for a first effort. He wished, indeed, to tabulate values to 50 significant figures, thus enormously complicating the mechanism and augmenting the cost of the experiment. In a paper read not long ago before the Royal Dublin Society,

Mr. Percy E. Ludgate has revived again the idea of constructing such a machine. As proposed by him, the machine differs from that of Babbage in some fundamental details, though, as in its predecessor, Jacquard cards will be used to control the sequence of operations. Thus if, for instance, a number of values of the series

$$y = x - 2x^2 + 2x^3 - 2x^4 + 2x^5 - 2x^6 + 2x^7 - 2x^8 + 2x^9 - 2x^{10} + \dots$$

were required, the appropriate card would be placed in the machine, which would then, for different values of x , calculate each term of the series, add all the positive terms together, subtract from this sum all the negative, and print the result. For a different series a different card would be used.

In Babbage's engine it was proposed to effect multiplication by successive additions, and divisions by successive subtractions, just as is now done in the case of the ordinary arithmometer. Mr. Ludgate, in his engine, proposes to effect these operations on entirely different principles. Multiplication is effected by a series of index numbers analogous to logarithms.



The arrangement is shown diagrammatically in Fig. 1. Here the number 813,200 is to be multiplied by 9247. The arrow under 8 represents a slide, which to denote 8 is set at $\frac{1}{2}$ in. above the zero or starting line. The slide representing 1 lies on the starting line, whilst that representing 3 stands $\frac{1}{2}$ in. above this line, and that corresponding to the number two $\frac{1}{2}$ in. above. On the other hand, the slides representing zero are set 50 eighths above the starting line. The number of units above the starting line corresponding to each digit of the multiplicand are known as index numbers, and a complete table of these has been drawn up by Mr. Ludgate. All the slides aforementioned are mounted in a frame, and to multiply by 9 this frame is moved up over another frame divided with another series of index numbers. Thus, as shown, the distance between the lower frame and the starting line is such that the top of this lower frame lies on the index number corresponding to 9; that is, 14 eighths below the starting line. The lower end of the No. 8 slide, represented by the black circle, rests then, it will be seen, on a line marked "72," which is the product of 8 and 9. The digits 7 and 2 appear accordingly on the register below. Similarly, the tail of the No. 1 slide rests on the No. 9 line, that of the No. 3 slide on the No. 27 line, and that of the No. 2 slide on 18, corresponding to the partial products $9 \times 2 = 18$;

9×3 ; and 9×2 . The tails of the zero slides rest on no line in the lower frame, and hence zero is registered for these. All these partial products are registered in the mill below, as indicated. In a final operation these partial products are added together as indicated, giving 7,318,800. If now the frame is moved to the index number below the starting line marked "2," it will be found, on trial with a piece of tracing paper, that the tail of the No. 8 slide rests now on the line marked "16"—i.e., 8×2 . That of the No. 1 slide on the index-line marked "2," that of slide 3 on the line marked "15," and that of the No. 2 slide on the line marked "10." These partial products will then appear on the mill and be added together, giving the result of the multiplication of 813,200 by 2. The process is repeated for the remaining figures of the multiplier, and the whole added together so as to give the product of 813,200 \times 9247. Mr. Ludgate proposes to give such products to twenty significant figures, the time required being, he states, about 10 seconds.

To divide one number by another he proceeds in a different fashion. He notes that the expression $\frac{p}{q}$, where p and q are any two numbers, can always be expressed in the form—

$$\frac{p}{q} = \frac{A p}{1 + x}$$

where x is a small quantity, and A is the reciprocal of some number between 100 and 999.

The above expression can also obviously be written

$$\frac{p}{q} = A p (1 - x + x^2 - x^3 + x^4 - x^5 + \dots + \&c.),$$

the series being very rapidly convergent, the first eleven terms give the value of $\frac{1}{1+x}$ correct to at least twenty figures.

He proposes to perform division, therefore, by making the machine first calculate the value of this series, after which it will multiply $A p$ by the value thus found. As a maximum, he considers that this operation giving the result correct to twenty figures might require $1\frac{1}{2}$ minutes.

"SERIOUS AND WILFUL MISCONDUCT."

THE meaning of this phrase, which is used in the Workmen's Compensation Act, is of considerable interest to those affected by this piece of legislation. An employer can only escape liability for an accident "arising out of and in the course of the employment" if it be shown that the workman was guilty of serious and wilful misconduct which led to the accident. Even then, however, the employer may still be liable if death has supervened or if the injury has occasioned serious and permanent disablement to the workman.

What, then, is "serious and wilful misconduct?" By what standard is the conduct of a workman who has met with an accident to be judged? In the first place, it has been clearly laid down that the question whether there has been serious and wilful misconduct is one of fact. In a recent case, *George v. Glasgow Coal Company*, 1909, A.C. 123, the Lord Chancellor said: "It is not the province of the Court to lay down that the breach of a rule is *prima facie* evidence of serious and wilful misconduct. That is a question purely of fact to be determined by the arbitrator, who must decide it for himself, and ought not to be affected by artificial presumptions of fact."

While, therefore, it may be impossible to formulate any general rule, it is useful to consider some of the cases in which the Courts have considered the question of serious and wilful misconduct.

The point of view from which the question is to be approached is thus described in a well-known text-book: "If a workman does something which he ought not to do, or omits to do something which he ought to do, he may be guilty of negligence, and possibly of misconduct, but that, in itself, is not sufficient to disentitle him to compensation. The word "wilful" imports that the misconduct must be deliberate, and not a thoughtless act done on the spur of the moment. It is not the act itself, but the wrongful element in it, that must be wilful." ("Roberts on Employers' Liability," page 592). It has also been laid down that the misconduct which occasioned the accident must be serious in itself. The question whether it is serious does not

depend upon the consequences. To quote an illustration put by Lord James in the case above referred to, suppose a man who was told not to walk on the grass did so, and, slipping, broke his leg. In such a case the consequences would be serious, but the misconduct not so. One test may be applied, but it is not conclusive. It is whether the misconduct was such that it would have justified the workman's dismissal without notice.

In order that a workman may be deprived of his right to compensation, it must be shown not only that he was guilty of serious and wilful misconduct, but the injury he sustained must have been attributable thereto. In *Glasgow Coal Company v. Sneddon*, 7 F. 485, a miner, while riding with others through the tunnel of the mine, on the top of loaded hutches—a practice prohibited by the regulations—was killed by a stone which fell from the roof of the tunnel. There was no evidence that the fact of the men being on the hutches caused the fall of the stone. The sheriff decided in favour of the deceased's dependants on the ground that the injury to the deceased was not attributable to his misconduct, as there was no causal relation between his misconduct and the injury he had sustained. It was held that he had rightly so decided.

Many of the cases decided in relation to this matter arose as between colliery proprietors and colliers. We now propose to discuss some of the more interesting of these.

In *George v. Glasgow Coal Company, Limited*, (*supra*) the special rules of a mine imposed upon the miner working at the coal seam bottom of the mid-working the duty of keeping the gate which fenced the working from the shaft closed until the cage had been brought to the level of the working, and had come to a standstill, so that it might be safely entered from the working. The miner opened the gate before he had ascertained that the cage had been brought to the level of the working, and to a standstill. He then, assuming the cage was there, pushed a hutch forward, which fell down the shaft, and the miner fell also and was injured. In a claim under the Act it was found that the miner was guilty of serious and wilful misconduct. The House of Lords held that there was evidence to support this finding. Failure to profit by the warning of a fellow-workman may also justify a charge of serious and wilful misconduct. In *John v. Albion Coal Company*, 1902, 18 T.L.R. 27, a miner, while going along the main haulage line of a mine, on which there were manholes at intervals, was told by a fellow-workman who was in one of the manholes, that he also had better get in, as a "journey" of trams was not far off; but he declined to do so, and, after passing five other manholes, was overtaken by the trams and killed. It was held that there was evidence upon which the arbitrator could reasonably find, as he had done, that the deceased had been guilty of serious and wilful misconduct.

With this may be contrasted the case of *Rees v. Powell Duffryn Colliery Company*, 64 J.P. 164. In that case, a miner, who had been to the lamp-room to re-light his lamp, was obliged, in order to get back to his work, to walk along a way over which trams were being hauled by a rope. On reaching the way he was told that a journey of trams was approaching. He continued to go on, but was making for a manhole, when he was injured in consequence of the rope slipping. The arbitrator found that the man had been guilty of serious and wilful misconduct, but the Court held that there was no evidence to support the finding. Breach of rules has, of course, been the most fruitful source of accidents in respect of which the collier has been unable to claim compensation. So in *Daily v. Watson*, (2 F. 1044), where a miner, in contravention of the rules of the mine, used a naked light while carrying explosive cartridges, which he had omitted to enclose in a box, as he ought to have done, it was held by the Scotch Courts that he had been guilty of serious and wilful misconduct. Again, where in breach of a rule that props were to be set up at distances of no more than 6 ft., the applicant, notwithstanding that those who had been working before him had already mined a distance of 17 ft. without putting up any props, proceeded to mine for a further 3 ft.

The mere fact, however, that a miner is guilty of a breach of rules does not make him, as a matter of law, guilty of serious and wilful misconduct. In *Rumtoll v. Nummy Colliery Company* (80 L.T. 42) the applicant—a miner—had, in accordance with his orders, supported the roof of the place where