It is not within the scope of this paper to deal with the cause of these explosions, but it may be here stated that the theory is a very feasible one, and the conditions necessary to produce them are frequently present, especially about a coal-mine. Consequently we may at once conclude that compressed air is not the simple, though rather costly, agent it is generally given out to be.

Another source of power which is very readily obtained in most mines is that due to a head of water, giving rise to what is commonly termed hydraulic pressure. This is easily transformed to do useful work on machines for hauling, pumping, rock-drilling, and, if needs be, machine coal-cutting; and though it gives a high efficiency—about 70 per cent. of the pressure employed—the repumping of the waste water greatly reduces this, and involves the application of much heavier pumping plant than what in its absence would be really needed. So that, except in cases where free drainage can be obtained, hydraulic pressure does not commend itself for use as a motive power in mines where economy with safety is becoming a very important necessity.

There is yet another, though at present a much-neglected, system of transmitting power to do work underground—viz., the telo-dynamic or wire-rope system, which, when carefully laid out to run at high speeds under comparatively small strains, has been known to give off 60 per cent. of useful work at a distance of 3,000 yards from the generator. The loss of power due to friction and other causes in a carefully proportioned above-ground transmission has been proved to be only $2\frac{1}{2}$ per cent., with an additional $\frac{3}{4}$ per cent. for each 1,000 yards added. This, it must be acknowledged, is very satisfactory, especially when its distance-limit of application is equal to that of compressed air and much beyond that of steam. It need scarcely be noticed that it would be impossible to obtain such efficient results in underground installations owing to the irregularity of the roads, which would demand the use of guiding-sheaves at the various curves, so common even in the best-laid-out mines. Nevertheless, there is no doubt but that from 30 to 40 per cent. useful effect would be gained under any ordinary condition likely to be met with underground. The only disadvantage to this system of transmitting power is the necessity of having extra ropes running in the shaft, which it may be noticed is rather an objectionable feature, especially in winding-shafts.

After having carefully considered the advantages and disadvantages of each of the foregoing systems we find that each one involves a certain amount of risk which it is almost impossible to overcome, and also that the efficient limit distance is only about three miles, which is much below what will be required in the future when the still deeper-lying coal-seams have to be won and worked; and, finally, that in the very best of the available installation the efficiency at the distance-limit may not exceed 30 per cent. of the original power applied to the generating-piston. There are other causes that are sure to arise in the deeper workings, such as increased temperature, which will tend to reduce the produce per man employed, while the great thickness of overlying strata will demand modified systems of working that will insure a uniform subsidence throughout the whole area worked. This, then, seems to suggest a general adoption of straight-faced long-wall, with machine coal-cutters employed throughout. Therefore we may look forward to a more extensive employment of machinery in mines, and the duty of each and every man who is in any way interested in mining is to endeavour to find some safe and economic means of transmitting the power necessary to give motion to these machines.

The solution to this problem seems to depend upon electricity, a force which forms the basis of the latest applied science, and is a source of energy that may be readily transformed into useful work at almost unlimited distances from its generator; it may also be split up into any number of branches, each capable of doing work at any point where it may be required. Another and very important advantage in favour of its use is the many and varied classes of work to which it may be applied. For instance, in most modern mines electricity is used for signalling on engine planes and in winding-shafts. It is also used for speaking purposes, as in the telephone—a simple instrument, which renders talking-communication possible between all points in connection; while in mines where safety lamps are used it is now considered the only means of firing shots. Again, electricity is at present being largely employed to do the heavier work of lighting, hauling, pumping, machine coal-cutting and rock-drilling, and in some few cases for winding and the driving of ventilating machinery. Consequently, in electricity we have a force that is capable of supplying all our requirements. This prevents the employment of mixed plants, which is anything but a desirable feature where the distribution of power is concerned, and should be avoided in cases where extreme danger was likely to arise from its general adoption.

Electricity for signalling or speaking purposes only demands the use of very feeble currents, usually produced by chemical action set up by causing the liquid chloride of ammonium to act upon two distinct metallic substances, usually copper and zinc, in connection with each other by a suitable wire circuit, or by substituting carbon for copper, which is done in the Leclanche cell, commonly used for this purpose in mines, and the extent through which the electric energy may be felt depending upon the length of the connecting circuit.

Shot-firing is usually done by means of a small magneto electric battery or miniature dynamo, in which case the feeble currents from the electrically excited magnets pass along the cable to the highly sensitive detonating material enclosed in the copper tube, commonly termed the detonator. Sufficient resistance is set up in the detonating material to cause a spark to pass in the high-tension arrangement, or to heat a very fine strip of platinum in the low tension, either of which is sufficient to detonate the matter and explode the charge.

As the object of this paper is to deal with currents of sufficient power to do heavy mechanical work, it is not my intention here to give more than a passing reference to those branches whose action depends upon the feeble currents set up by chemical action. Consequently, for purposes requiring large quantities of electrical energy, mechanical appliances, commonly termed dynamos, are used to generate the electricity, and are driven by some convenient power, such as a head of water or a steam-engine, the first being the most economical if naturally supplied in sufficient