Recent tests have also been made with the Stirling boiler fitted at the Schwartzkopff works at Haydock, with the following results: Duration of test, eight hours; steam-pressure, 168 lb.; temperature of feed, 60° Fahr.; total fuel used, 5,264 lb.; total water evaporated, 397,230 lb.; water evaporated per pound fuel actual conditions, 7·54; water evaporated per pound of fuel from and at 212°, 9·12 lb. Gas-analysis average: CO_2, 12½ per cent.; CO, nil; O, 74; temperature, 420° Fahr. exit flue. Analysis of fuel: Moisture, 4·15 per cent.; volatile matter, 25·60 per cent.; fixed carbon, 53·75 per cent.; ash, 16·50 per cent.

The fuel used was the small screenings (Rushy Park seam) taken from slack as it passed over a ⅜ in. mesh screen, and was of the lowest calorific value. Its market price at the time of the test was 4s. per ton. At no time during the test was smoke observable at the chimney. The only indication that the chimney was in use could be traced from a very slight white vapour emitted from time to time.

*The Advantages and Disadvantages of Electricity as an Underground Motive Power.**

Steam-engines for haulage purposes were on their original adoption invariably fixed underground, and the motive power either generated in boilers at the surface and conducted through special pipe-ranges down the shaft to the engine, or the boilers were fixed underground in close proximity to where the steam was required. Either of the above systems produced a series of great disadvantages, which amounted in each case to a source of danger. For instance, the pipe-ranges in the shafts, being subjected to varying temperatures, were affected by unequal expansion and contraction, the result of which was fractured pipes or blown joints, which meant suspension of work until the evil was remedied. In course of time this was partly overcome by the introduction of expansion-joints at regular intervals in the range, though a serious loss occurred through condensation in transmission, which it may be noticed was continuous whether the engine was at work or standing. This gave rise to the introduction of underground steam-generating plant, which, needless to say, is at best bringing the attending dangers to the place where they are least desirable, as with their advent there sprung up a direct risk to underground fires, and in some cases disastrous explosions of firedamp, the nature of which is too well known to need any comment here.

Another and serious objection to the use of steam for doing work underground is the heat which it imparts to the strata, which in the ordinary shales of the coal-measures has a very deteriorating effect, making the roadways and other passages through which it is conducted very bad to keep, and consequently increasing the cost of this particular branch of labour and material. Independent of this there is also the difficulty of dealing with the exhaust steam, as in deep mines anything approaching perfect condensation would be impossible to obtain, while its efficient working-limit will probably be about one mile from the generating-point.

Hence with such objections attending the use of steam as an underground motive power it is only reasonable to expect that mining engineers, who were directly responsible for the safe and economic working of mines, should devote their time and attention to bring forth some suitable means of supplanting it. This was, in one course, to a certain extent obtained by the introduction of compressed air, to be used as a means of transmitting the work done on the steam-piston, through suitable pipe-ranges, to distant motors arranged for the purpose of hauling, pumping, machine coal-cutting, and rock-drilling.

The advantages of using compressed air for the above classes of work are that the temperature of the mine is unaffected, except about the exhaust, where it is below the normal. The air can be stored in fixed receivers and readily branched off to any point where it may be required, while after doing its work on the motor it may be employed for ventilating purposes. Compressed air has also a longer efficient range-limit than is the case with steam, as it is estimated that with carefully laid-out installations it may be used with advantage for a distance of three miles from the compressor.

The disadvantages attending the use of compressed air are the cost of providing and maintaining the compressing plant, and the low efficiency—probably not exceeding 25 per cent.—of the steam-pressure applied to the piston, this being due to cooling at the compressor and the friction set up in the pipe-range.

Another and very serious objection to the use of compressed air is the liability to ignition and explosion within the receiver adjoining the compressor. These have been of frequent occurrence, the most notable in our own country being at Ryhope in 1883, Carn Brea Mine in 1885, Newbattle Colliery in 1888, Wharncliffe Colliery in 1893, and Clifton Colliery in 1897; and, although I have no record of any of these being attended with loss of life, some idea of their effect upon the surrounding plant and other appliances coming within the line of their action may be obtained from the Ryhope case, which is in our own immediate neighbourhood, and consequently may be quoted with some degree of confidence. This explosion occurred at 10.40 p.m. on the 1st March, 1883, in which case the No. 1 receiver, fixed at the surface, was rent to pieces, and the report accompanied by a rush of flame, which attained a height of from 20 ft. to 30 ft., and though the flame rapidly diminished in volume it still continued to burn about the broken connection. Some surface damage was done, though the chief effect was confined to the shaft, where the brattice wall suffered severely, and at a depth of 762 ft. from the surface a segment of metal tubbing was blown ½ in. outwards from the pit. At a depth of 1,080 ft. several pipes were partially split open. From 1,200 ft. to 1,272 ft. the shaft was completely stripped of brattice, buntons, and other fittings. The pipes below this point were much damaged, and the No. 2 receiver, which was fixed at a depth of 1,500 ft. from the surface, was found at the shaft-bottom, while the effect of the explosion was felt at a distance of 1,000 yards from the shaft-bottom, at which point the top of an air-crossing was blown off and the ventilator for the time being partially damaged.

* A paper by Mr. W. Little, New Seaham Mining Students' Association, Durham, England.