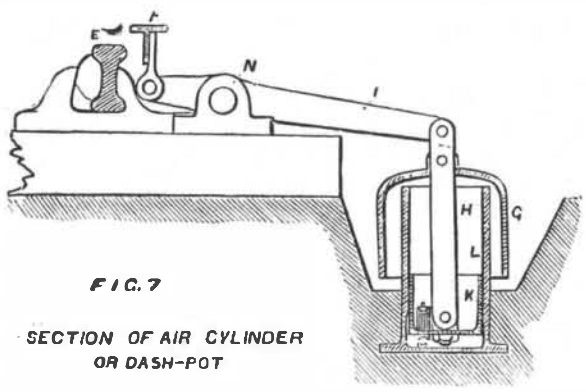
IMPROVED AUTOMATIC SIGNAL APPARATUS.

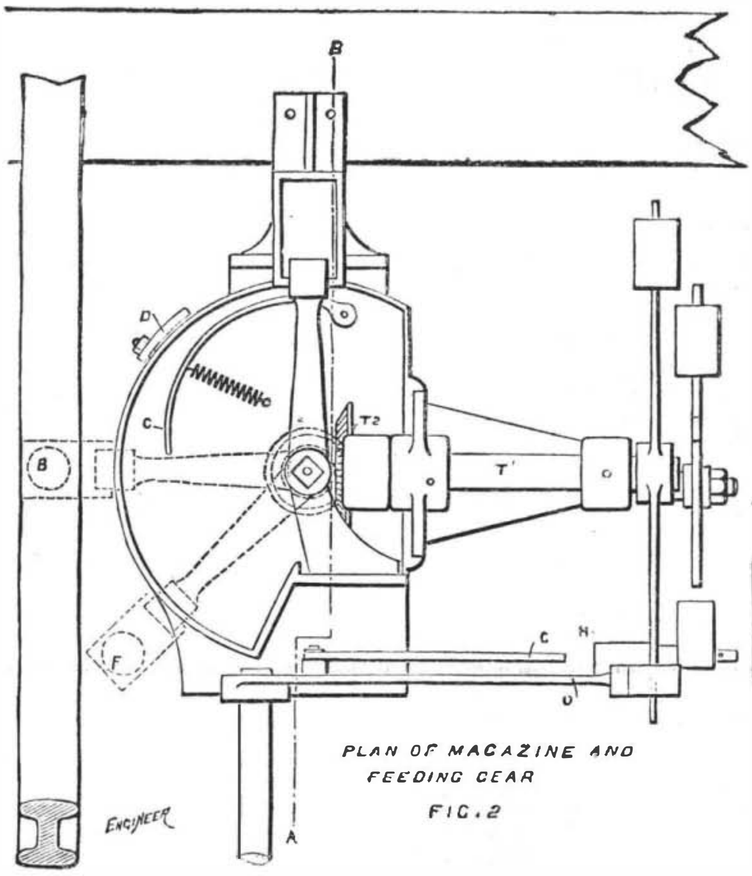
In England at this season of the year all the railway companies are more or less troubled with fogs, and the question of the best methods of dealing with the immense traffic near the large centers of population requires very careful consideration. The *Engineer*, London, to which we are indebted for these illustrations and the following particulars, says: The system now generally employed is that of placing men at short distances apart alongside the various tracks, and the duty of these fogmen is to place detonators upon the rails. In order to increase the certainty of the signaling, it is usual to place two detonators at a distance of some ten yards apart, so that in case one should fail to explode it is practically certain that the other will give the required signal. In many cases detonators are left on the rails even after the fog has cleared off, and some of the men are not averse to the work, seeing that while employed on it they obtain about three times their usual pay. In both cases there is, of course, unnecessary expense.

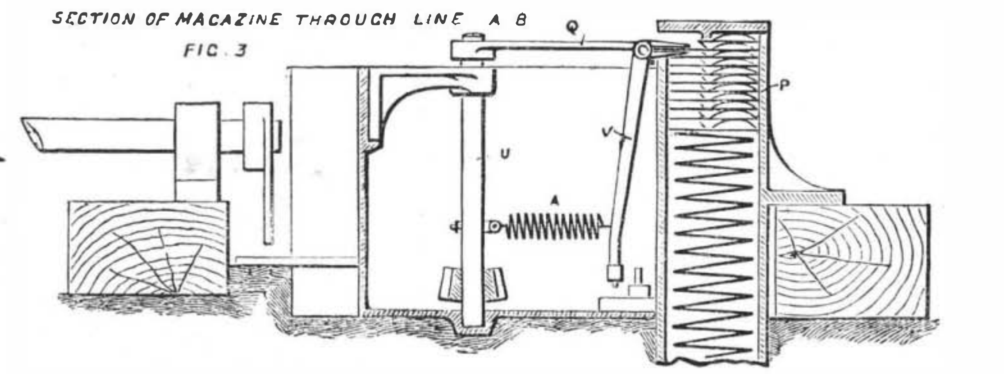
On some lines pits are dug in the six-foot way, and the men are stationed in them and provided with open fires. This system, however, is a fruitful cause of rheumatism, brought on by the damp rising from the ground and the impossibility for movement on the part of the men. The work of fogmen is not entirely without danger from the explosion of the detonators, as there have been many cases where portions of the cases have injured the sight of the man employed. In order to obviate these difficulties, and to render the work of fog signaling more certain, while requiring the attention of fewer men, many inventors have brought out apparatus. Some of these mechanisms have been, however, too elaborate, and when subjected to the frequent shocks on the main lines have failed to work properly, while in other cases the apparatus has been too expensive.

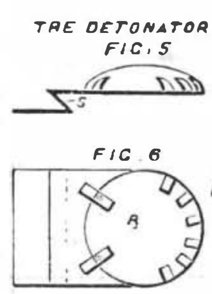


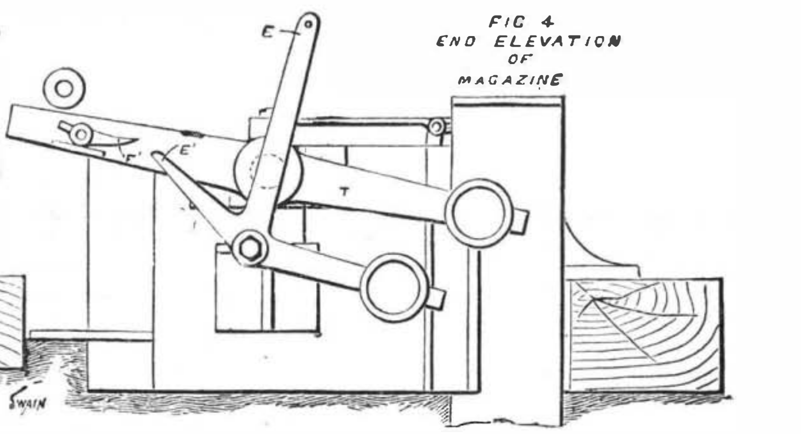
We were recently invited to witness the working of a new apparatus invented by Mr. J. F. Dixon, of Huddersfield. On arriving at Holbeck, near Leeds, we found that a complete set of the apparatus had been fixed at a distance of about 200 yards from the station upon the main line, and the party was here joined by the inventor, who, along with Mr. Evans, explained the working of the apparatus. By the kindness of Mr. Ellis, of the Great Northern Railway, a locomotive had been provided, which was run backward and forward over the detonators to exhibit the action of the apparatus.

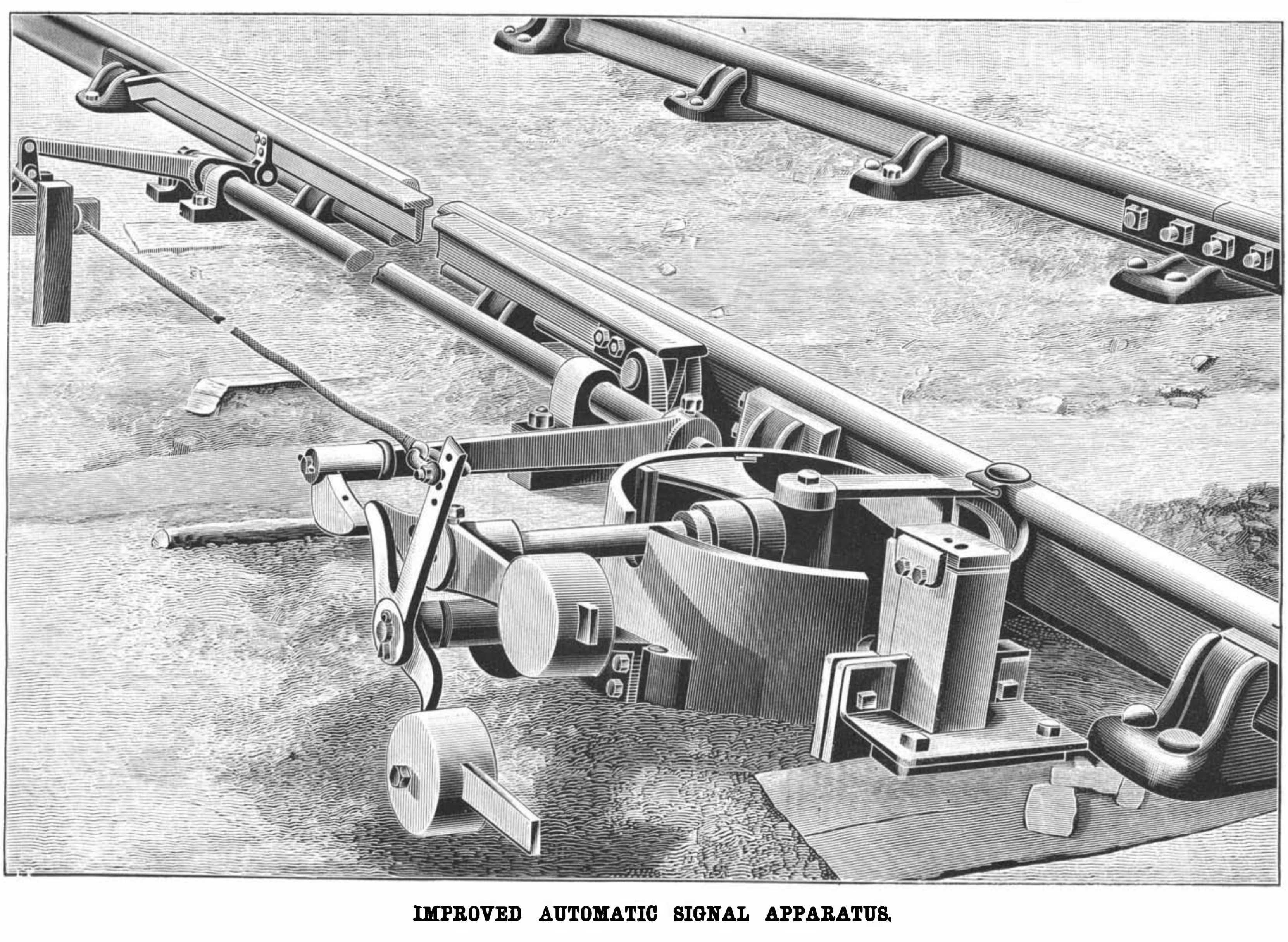
Fig. 1 is reproduced from a photograph, and shows the general arrangement of the mechanism outside the rail. It will be seen that the space occupied is not great; and that no obstruction is caused. Figs. 2 to 7 show the apparatus in detail. Referring to Fig. 7, E is the rail, and close alongside it is placed an inclined bar, F. This bar is pivoted at one end upon a sleeper,











IMPROVED AUTOMATIC SIGNAL APPARATUS.

and the top of the tee-bar is at the same level as the top of the rail, while the other end is about 1½ in. higher than the top of the rail, and is therefore subject to depression as soon as a train passes over it. The depression of this bar actuates the whole apparatus. The arrangement really consists of two entirely separate parts—(*a*) the tee-bar and its controlling dashpot, (*b*) the detonator magazine and feeding apparatus. These two parts are not rigidly connected in any way, so that the jars to which the bar is necessarily subjected are not transmitted to the more delicate mechanism of the feeding apparatus. Fig. 7 is a section through the dashpot, and shows clearly its connection with the tee-bar. As soon as bar, F, is depressed, it lifts the link, H, by means of the lever, J, and causes the piston, K, to rise in the air vessel, L; this piston rises freely, owing to the opening of the valve, M. The cover, G, is attached to the lifting link, H, and is used merely to keep dirt out of the dashpot. At the same time the rocking shaft, N, is partially rotated and the lever, O, is raised. The train may now be supposed to have passed over the tee-bar; the lever, O, which is counterweighted, and the weight of the piston in the dashpot now cause the piston, K, to descend slowly in the cylinder, L. Two vertical grooves are cut inside the cylinder, L, which allow the piston to descend rapidly at the end of its stroke by permitting air to escape from underneath it. The valve, M, should of course allow no air to pass it. It is thus obvious that the speed at which a train may pass over the bar has no effect upon the action of this part of the apparatus, as it is entirely controlled by the dashpot. In fine weather the whole apparatus is put out of gear by wedging up the lever, O, on the dashpot side of the rocking shaft, and so permanently depressing the tee-bar to the level of the top of the rail.

We now pass to the magazine and feeding mechanism. Fig. 3 shows the magazine, P, most clearly. It consists of a cast iron box of rectangular cross section, provided with a light spring of the jack-in-the-box type, which continually presses upward the detonators piled upon it; the detonator is therefore always kept at the proper height to be seized by the forceps, Q. The detonators are formed as shown in Figs. 5 and 6, where R is the detonator proper, held by clips formed from the thin tinned plate, S. Supposing the tee-bar, F, to be pressed down by a passing train, or to be permanently held down as described by wedging the lever, O, then the counterweighted lever, T, Fig. 4, descends and partially revolves the spindle, T', Fig. 2, upon which is keyed a quadrant, T², gearing with a bevel wheel keyed upon the vertical shaft, U, Fig. 4. Upon the shaft, U, is keyed the forceps, Q, so that a descent of the tee-bar causes the forceps to rotate until opposite the magazine. The loose limb of the forceps is controlled by the spring, *a*, and the method of opening and closing the jaws of the forceps is very ingenious. Let us suppose that a detonator has been held upon the rail at B, Fig. 2, then a passing train would explode it, and, depressing the tee-bar, would allow the forceps to swing toward the magazine. In doing so the lower limb, V, which is provided with a small roller, would pass externally along the curved blade, *c*, and the jaws would be gradually opened until the catch, *d*, released the spent detonator, which then would fall to the ground; the jaws of the forceps, remaining wide open, would come opposite the detonator in the magazine, and at that instant the lever would reach the end of the curved blades, *c*, and would be smartly drawn back by the spring, A, so closing the jaws of the forceps upon the detonator. We may suppose that this series of movements has occupied two seconds; the forceps will remain opposite the magazine until the tee-bar again rises, which may take half a minute, or any shorter or longer interval desired, according to the fit of the plunger in the dashpot.

As soon as the tee-bar rises, the lever, O, falls, and the forceps moves round and places the new detonator on the rail. The curved blade, *c*, allows the limb, V, to press it out of the way, and then returns to its previous position. We have now described the action of the mechanism when detonators are required, and it must be clearly understood that in the normal condition a detonator is always on the rail, just as in the normal condition the signal is at danger. If the apparatus is placed out of use, the forceps remain opposite the magazine the whole time. As the signal given by the detonator must agree with that given by the signal arm, there must be a connection between the two, and this is effected by attaching the end, *e*, of the bell-crank lever, Fig. 4, to the lever which works the semaphore signal. If now the semaphore be pulled over to the "off" position, the bell crank lever descends, and its end, *e'*, catches the cam, *f'*, and causes the lever, T, to be partially rotated. This action is not very obvious in Fig. 4, as the lever, T, is supposed to be at its highest position, and the forceps to be just taking a new detonator out of the magazine; but in the normal position, with a detonator on the rail, the lever, T, is horizontal, and the end, *e'*, comes into gear with *f'*, owing to the fact of the center, upon which the bell crank lever turns, being out of plumb with the axis of the lever, T. By the descent of *f'* the quadrant and bevel wheels and vertical shaft, U, are actuated to the opposite direction to that previously described, and the detonator is swung off the rail from position, *b*, to position, *f*, where it remains so long as the signal is at "all right," and is, therefore, not exploded. The semaphore can thus be worked at any time, irrespective of whether a train is on the bar or not.

Another case which may be supposed is that of a train upon the bar, during which time the signalman might place the signal at danger before the train was clear. The return of the bell crank might cause another detonator to be placed upon the rail when it is not needed. This action has been foreseen, and a locking gear arranged. Referring to Fig. 2, a narrow bar, G, may be seen, which is actuated by the signal lever. This bar, G, comes over the piece, H, which is rigidly connected with the lever, T, and locks the apparatus so long as a train is on the bar. As soon as the train passes over, however, this lock is freed, and the apparatus is free to work. We may add that the magazine will hold fifty detonators, and it can be filled very easily. A small hole is provided in the cover, and by pressing down the spring by means of a short rod, the new detonators can be inserted one by one. The apparatus can be made so as to place two or three detonators upon the rail. That at Holbeck places two detonators on the rail at a distance of ten yards apart; this needs merely a duplication of the magazine and feeding mechanism. Only one dashpot and inclined bar are needed.

How to Make Plaster Casts of Objects of Natural History.

At a recent meeting of the Manchester Microscopical Society, Professor Boyd Dawkins, F.R.S., exhibited a number of casts in plaster of Paris of various objects of natural history, and explained the process by which any one can make them for himself. The material of the mould is artistic modeling wax, which is a composition akin to that which is used by dentists. And as it becomes soft and plastic by the application of heat, though in a cold state it is perfectly rigid, it may be applied to the most delicate object without injury. As it takes the most minute markings and striations of the original to which it is applied, the microscopic structure of the surface is faithfully reproduced in the cast. The method is briefly this:

1. Cover the object to be cast with a thin powder of steatite or French chalk, which prevents the adhesion of the wax.

2. After the wax has become soft, either from immersion in warm water or from exposure to the direct heat of the fire, apply it to the original, being careful to press it into the little cavities. Then carefully cut off the edges of the wax all round, if the under-cutting of the object necessitates the mould being in two or more pieces, and let the wax cool with the object in it, until it be sufficiently hard to bear the repetition of the operation on the uncovered portion of the object. The steatite prevents the one piece of the mould sticking to the other. The original ought to be taken out of the mould before the latter becomes perfectly cold and rigid, as in that case it is very difficult to extract.

3. Then pour in plaster of Paris, after having wetted the moulds to prevent bubbles of air lurking in the small interstices, and if the mould be in two pieces, it is generally convenient to fill them with plaster separately before putting them together.

4 Then dry the plaster casts either wholly or partially.

5. Paint the casts in water colors, which *must* be fainter than those of the original, because the next process adds to their intensity. The delicate shades of color in the original will be marked in the cast by the different quantities of the same color which are taken up by the different textures of the cast.

6. After drying the cast steep it in hard paraffin. The ordinary paraffin candles, which can be obtained from any grocer, will serve the purpose.

7. Cool, and polish the cast by hand with steatite.

The result of this process is far better than that obtained by any other. The whole operation is very simple, and promises to afford a means of comparison of natural history specimens in different countries which has long been felt to be a scientific need. Casts of type specimens may be multiplied to any extent at a small cost of time and money, and are as good as the original for purposes of comparison, and almost as hard as any fossil.

Professor Boyd Dawkins has employed it for copying flint implements, fossils, and bones and teeth which can scarcely be distinguished from the originals.

Notes on Wheat.

From field experiments carried on at the Agricultural Experiment Station, Purdue University, Indiana, reported in *Bulletin* 45, extending over ten years, it appears that none of the varieties of wheat tried have any tendency to deteriorate or "run out," provided proper care is exercised. No wheat proved to be "rust-proof," but early wheats were generally less injured by rust than later kinds. Eight pecks of seed per acre gave the best returns at the station, the average yield for nine years being 30·35 bushels per acre. The best results came from sowings made not later than September 20. The value of crop rotation in maintaining yields of grain has been strongly emphasized, for a comparison of rotating crops with constant grain cropping for seven years showed an average gain of 5·7 bushels per acre in favor of the former. Another important result obtained was that wheat may be harvested at any time from the dough stage to the dead-ripe condition, without appreciably affecting the weight or yield of the grain. A comparison of forms of nitrogen as fertilizers for wheat indicated that sulphate of ammonia is better than nitrate of soda or dried blood.

Oxygen for Enriching Gas.

At a late meeting of the Southern District Association of Gas Engineers and Managers, Dr. L. T. Thorne gave an account of further experiments with the new process for enriching coal gas by means of oxy-oil gas. Dr. Thorne has been enabled to carry out an exhaustive series of tests at Huddersfield, where the process is now in actual operation. His conclusions are summarized as follows:

1. The addition of oxygen to oil gas, preferably while the latter is still hot, not only increases the illuminating value of the oil gas when employed directly as illuminant, but also when it is used for purposes of enrichment.

2. Oxy-oil gas is a highly permanent gas, and when used as an enricher of coal gas actually increases the stability of that gas.

3. Enrichment of coal gas by oxy-oil gas would cost about one-third of a penny per candle per thousand cubic feet.

Dr. Thorne concludes by expressing the opinion that the experimental results place oxy-oil gas at the head of the enriching processes yet known, and fully justify the favorable view of the process which was expressed in an earlier communication. With regard to the actual working of the Huddersfield plant, we learn from *London*, the organ of the London County Council, of November 30, that the Huddersfield Corporation have now used the new gas continuously for over two months, and have obtained a steady white flame, affording a better light, while enabling a saving to be effected at the rate of £10,700 per annum. They are now using 36,000 cubic feet of the new gas per day for enriching the ordinary product. They have been in the habit of enriching their ordinary gas, which is of about 16 candle power, to the extent of four additional candles, by means of cannel coal. The cost per candle at Huddersfield, using Yorkshire cannel, has been about three-halfpence per cubic foot. With the new plant of the oxy-oil process the actual working cost is at present less than a halfpenny per candle per thousand cubic feet, and will eventually be still less by thirty per cent or more, as crude petroleum is rapidly becoming cheaper. Moreover, the coke produced from cannel coal is so useless that the Huddersfield Corporation have been unable to dispose of it, even to give it away. Under the new process they find no difficulty in selling all the coke they can produce for seven shillings and sixpence per ton. The saving due to enrichment amounts to £7,700 per annum, and the gain from sale of coke to £3,000, results which will have the practical effect of reducing the price of gas to the consumers at Huddersfield by at least threepence per thousand cubic feet, while supplying them with a more cheerful light, which is stable even in winter.—*Nature.*

Chemical Changes Effected by Mechanical Force.

In a recent article in the *American Journal of Science*, M. Carey Lea gives an interesting account of some of his experiments in which the salts of various substances were subjected to great pressure. For this purpose he used a powerful screw vise.

As it was intended to keep the substances which were to be subjected to pressure from any contact that might affect them, they were folded up in platinum foil, and this was set in a V-shaped piece of soft sheet copper. The portion of material which received the pressure was about one-half inch long by one-fourth wide; it consequently had an area of about one-eighth of a square inch. This limited surface received a pressure in the proportion of over a million pounds to the square inch, or about seventy thousand atmospheres. These, of course, are calculated pressures, subject to deduction for friction. The amount lost in this way cannot be determined, but is known to be considerable.

Certain salts of silver, iron, potassium, platinum, mercury, when subjected to pressure were visibly affected, the color being changed. The author says:

"We are justified in concluding that many of the salts of easily reducible metals, especially of silver, mercury, and platinum, undergo reduction by pressure. Such reactions are endothermic, and it therefore follows that mechanical force can bring about reactions which require expenditure of energy, which energy is supplied by mechanical force precisely in the same way that light, heat, and electricity supply energy in the endothermic changes which they bring about."