Mr. Chas. Cochrane read a paper which was a sequel to one read by the same author at the Leeds meeting of the Institution, and dealt with Blast Furnace working, with special reference to the analysis of the escaping gases. It was laid down at the outset that economy of fuel in blast-furnaces is governed by three conditions (1) the temperature of the blast, (2) that of the escaping gases; (3) the quantity of carbon which can be maintained in the condition, once attained, of carbonic acid, instead of being re-transformed into carbonic oxide by absorption of carbon in the fuel. On the first two of these heads there is, of course, nothing new to be said, but they were illustrated by elaborate and valuable tables, giving, in units of fuel (C burnt to Co), (a) the heat carried in by blast of a given weight and temperature, (b) the heat carried out by escaping gases of given weight and temperature. The third is dwelt on at some length, and tables are given, showing for any given consumption of C per ton of pig, the ratio of CO_2 to CO in the escaping gases, first when all the CO_2, once formed, is retained in that condition; and afterwards when ¼ cwt, 1 cwt., 1½ cwt., etc., are afterwards reconverted into CO, or, as the author terms it, when a transfer of ¼ cwt., 1 cwt., etc., of C has taken place. From this is deduced the conclusion that the mere knowledge of the ratio of CO_2 to CO in the escaping gases, as given by analysis, is useless to indicate what is really going on in the furnace, because the same ratio may appertain to any different conditions, according to the amount of the transfer which has taken place, from CO_2 back to CO. If, however, the consumption of carbon per ton of pig iron has been at the same time ascertained, then we are at once able to refer the case to its proper position, and the knowledge of the ratio between the two cases enables us at once to see what amount of transfer has been going on, and what prospect there is of effecting an improvement. It was further pointed out that the main causes of this injurious re-conversion of CO_2 into CO were (1) the fact that the limestone, used as flux, contains a proportion of CO_2, which can only be evolved at a red heat, and therefore in contact with red-hot coke, which immediately gives up some of its B to the evolved gases, (2) the fact that the ore, especially in the larger pieces, does not get completely de-oxidised until it reaches the red-hot region, where the CO ascending in the furnace first unites with the oxygen in the ore to form CO_2, and then absorbs another equivalent of C from the coke, so returning again to the condition of CO. It is therefore suggested that both these sources of evil might be removed if (1) the limestone were calcined before entering the furnace, so as to have already parted with its oxygen, (2) the ironstone were broken up into pieces small enough to insure their decomposition in the higher parts of the furnace. Another means of accomplishing the latter result was to increase still further, if necessary, the height of furnaces. A sanguine estimate was made of the economy that would attend the application of these two devices, which it was expected might reach over 3 cwt. of coke per ton of pig-iron made.

The value to ironmasters of the elaborate tables annexed to the paper, and of the mode in which the problem of blast-furnace economy is presented, cannot but be very great, but grave doubts were expressed in the discussion, by Mr I. Lowthian Bell, F.R.S., whether the practical results would answer the author's expectations. As regards the use of calcined limestone, in particular, it was stated that it had already been tried, without effecting any economy, at least in large furnaces, the suggested reason being that the calcined lime, as soon as charged, re-absorbed CO_2 from the escaping gases, and that although heat was no doubt disengaged in the process, yet this was too near the throat of the furnace to have any serious effect. Moreover it is to be remembered that the previous calcining of the limestone must itself require fuel, the amount of which must be deducted from any apparent gain due to the absence of CO_2 in the line within the furnace.

Engineers' Club of Philadelphia, Jan. 20th, 1883.—Mr. Henry G. Morris in the chair. Mr. Wm. E. Lockwood presented a full description of the Shaw Locomotive, profusely illustrated by magic lantern, working model, etc., etc.

The Shaw Locomotive may be classed as a 37-ton soft-coal passenger engine, with two cylinders on each side, each 10½ x 24 inches; the two working in combination, being equivalent to one cylinder 14.85 x 24 inches, two cross-heads; two piston-rods; two connecting and parallel rods on each side.

Her drivers are 5 feet 9 inches; weight of engine, 67,000 pounds; coal and water, when in use, 73,000 pounds. Total, 74,300 pounds. Weight of tender, 26,000 pounds, water, 15,000 pounds, coal, 6500 pounds. Total, 47,500 pounds. Total combined, ready for use, 121,800 pounds, or 60.45 tons.

The improvement in Engines claimed in the Shaw Locomotive are

First.—No counter-balanced drivers, ergo, no hammer-blows and no nosing around.

Second.—A single movement of valve with duplex action.

Third.—Steam is the motor of balance as applied to the reciprocating parts.

Mr. Wilfred Lewis exhibited a machine for the graphical determination of centre of gravity and moment of inertia of plane areas. The figure to be calculated is drawn to a suitable scale and placed in the machine, where the outline is followed by a tracing point in order to produce, upon another piece of paper, a figure whose area shall be proportional to the statical moment of the given figure about an assumed axis. If now the second figure be followed by the tracing point and a third figure be drawn, its area will be proportional to the moment of inertia, and from the areas thus drawn can be found, by simple arithmetical processes, the centre of gravity and moment of inertia.

The machine is intended for application to such figures as cannot readily be solved by the usual methods, such as decks beams, steel rails, and castings, with round corners, large fillets and curved sides which can only be approximately solved by long and tedious integrations. A planimeter is used to measure the areas and it is thought that by this graphical method, more accurate results can be obtained with less work and without so much probability of error in the operations. The machine can also be made use of to determine the contents of any solid of revolution or its radius of gyration

Engineers' Club of Philadelphia, Feb. 3rd.—Henry C. Morris in the chair. Mr. W. S. Auchincloss exhibited and described his latest forms of Averaging Machine, which consists of an endless platform, the grooves of which represent days or distances. The various weights, representing quantities or values, are placed in these grooves and the endless platform rotated until a balance of the weights is secured, when the exact answer may be read from the accompanying scale and, by then continuing the rotation, the weights fall upon an inclined plane, reach their respective compartments in front, and are again ready for immediate use. The machine is of special interest to the engineering profession in its application to the engines, boilers and coal-bunkers in steamers, the determination of pulleys, speed of shafting and average haul of material. Mr. J. J. de Kinder described the United States Metallic Packing for piston rods, valve stems, pump rods, and throttles—exhibiting sections and model; also model with packing it is intended to supersede. The metallic packing consists of eight composition blocks, held in a brass ring, on which are horns holding the springs which regulate the pressure of the block on the rod. It is said to preserve a steam tight joint without appreciable friction or binding. The vibration of the rod is provided for by a ball joint on one end and spring follower on the other, which contrivance is said to give the packing free play and preserve its tightness, notwithstanding a vibration of the rod.

The Institution of Civil Engineers.—At the Ordinary Meeting on the 30th of January, Mr. Brunlees, President, in the chair, the Paper read was on "Mild Steel for the Fireboxes of Locomotive Engines in the United States of America," by Mr. John Fernie, M. Inst. C.E.

It was stated in the Paper that the use of mild steel for the fireboxes of locomotive engines was now general in the United States. Although large numbers of the outer shells of the boilers were still made of iron plates, this was simply to effect a saving of expense, and many railroad companies had the boilers wholly of steel Iron plates were first used as a substitute for copper, owing to the rapidity with which the anthracite coal wore away the soft copper When sound the iron plates gave better results, but the weldings were frequently unsound; they were apt to blister, and the plates were subject to crack near the fire-bars. Steel fireboxes, the plates being a nearly pure compound of iron and carbon, were used for the Pennsylvania Railroad engines eleven years ago. Since then, excellent steel for this purpose had been made by the Siemens-Martin open-hearth process in many places in the United States. The mode of manufacture of this steel was briefly described, as it differed from English practice. The specification for boiler and firebox steel last given out by the Pennsylvania Railroad Company was quoted. The Author next proceeded to state that in the cities of the United States, all steam-boilers of stationary engines were placed under municipal regulations, whereby a proper registration and inspection were instituted at a small cost to the user. In Philadelphia about 4,000 boilers were tested once a year, and a licence was given by the Inspector to use the boiler for one year at the pressure it was considered fit to sustain. The formulas, under which the calculations were made, were stated, and the tests employed. The highest test was when a boiler-plate, from which a portion was cut off lengthwise, showed a ductility of 20 per cent. upon a measured length of twelve thicknesses of the plate, and when cold would bend to 180° over a diameter equal to two thicknesses of the plate, or when cut crosswise would bend cold to 90° over a diameter equal to five thicknesses of the plate. In every steam-vessel navigating the lakes, rivers and seas of the United States, and sailing under its flag, a complete system of inspection during manufacture, and an examination of boilers when made, was maintained by the Government, and all boiler-plates had to be branded with the maker's name, and with the tensile strength of the plate per square inch. Makers of boiler-plates were pecuniarily liable for any failure of the material if it occurred at a lower strain than that with which it was branded. Officers for examining and testing the materials and work done were appointed, and the question seemed to be much better understood and practised in the United States than in England. With respect to locomotive engines, which were in one city one day, and in another on the next, and which might constantly be moved out of one State into another, there could be no Municipal or Government control, but there was a healthy public opinion on the subject, and heavy damages would be obtained against any company whose boilers exploded from neglect, or from the use of bad material. In America, it was stated, railroad engineers were not hampered by Government control. There was no necessity to urge railway companies to adopt improvements. Inventions were quickly examined, tested and rejected or adopted. Hence the march of improvement was more rapid than in Great Britain. The Author then proceeded to describe, first, the English type of locomotive firebox, and afterwards the various new forms of American fireboxes. In the former the strains set up by the greater expansion of the inner box over the outer, from the higher temperature, were aggravated from the material being of copper, which expanded more than iron under equal increments of temperature. Greater stress was thrown upon the stays, and by the use of copper and brass tubes a galvanic action was established in locomotive-boilers, which speedily destroyed the iron plates. The Author illustrated the American type by two examples of boilers and fireboxes in use on the Pennsylvania Railroad, and he pointed out in how far they approached the conditions of what he held to be a perfect firebox of the old and well-known form. The requirements for a firebox of this kind were, that the plates forming the outer and inner boxes should be of similar metal, that as the metal of the inner box must always expand more than the outer, it should be thin enough to bend or spring between the spaces where it was held by the round stays, that to compensate for the extra expansion, the heavy roof-beam stays should be done away with, that there should be a number of water tubes through the body of the firebox, that the fire-bars should also be water-tubes, that the areas of the firebox and grate should be large, and that the materials of construction should be cheap and easily obtainable. The Author demonstrated that in these respects the American was far in advance of the English type of locomotive-boiler. With regard to cost he showed that as steel fireboxes were only half the weight of copper ones, and as the price per ton of the former metal was about one-third of the latter, the actual cost of steel fireboxes was from one-fifth to one-sixth the price of copper ones, although the cost of workmanship would be a little more in working steel.