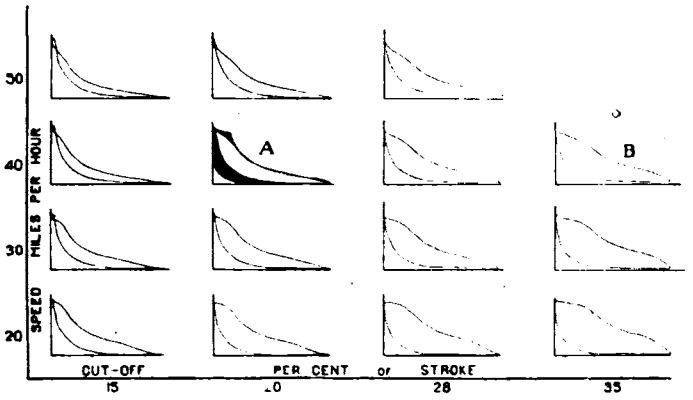
those who would improve valve gears have to work, it must be admitted that it is not large. Results have already been quoted which prove that the locomotive with all its wire drawing, gives a horse power on less than 24 lbs. of steam per hour. This is near the minimum. From this performance of a simple locomotive having normal valve gear with its narrow port openings and wire drawing effects, we may turn to the Corliss engine, the action of which is generally accepted by all improvers of locomotive valve gears as a standard of perfection. Such an engine, with its large port opening, its prompt movement of the valves, can in fact be relied upon to give as good a performance as engines having any other type of valve gear operating under similar conditions of speed and pressure. Corliss engines having cylinders which are comparable in size with those of locomotives and which when under a similar range of pressure are, however, not common, and hence, it is not easy to command data for the proposed comparison. Generally simple Corliss engines work under a lower pressure than locomotives. The best performance of which I have been able to find record of a simple Corliss engine exhausting into the atmosphere is that of an 18 x 48 Harris-Corliss engine, for which the steam consumption was 23.9 lbs. per hour. The steam pressure supplied this engine was only 96 lbs. by a gauge. On the basis given the engine should, when supplied with steam at 180 lbs., which is the pressure



under which the locomotive data were obtained, require less than 23 lbs. of steam per horse-power per hour. Straining the facts applying to the two classes of engines as widely apart as a knowledge of existing data will possibly permit, we may assume that a Corliss engine, if given the advantages of the high steam pressure and high piston speed common in locomotive service may give a horse-power hour, or approximately 8 per cent. less on the consumption and 2 lbs. less of steam than the locomotive. This, then, is the margin upon which those who seek to improve the locomotive valve gear must expect to work. While it is well worth attention, it cannot revolutionize practice.

I am aware that this statement is in conflict with the experiences of many men who, having been interested in special gear, have found them to be 10, 20 and even 30 per cent. more efficient than the link motion they have displaced. A careful examination of such cases, however, will not fail to disclose the fact that the normal gear, which is made the basis of comparison, was either poorly designed, or in poor condition, and hence the results are misleading. Obviously, where two systems are involved, comparison should be based upon the best type which can be selected of each.

Valve Setting.—While somewhat apart from the purpose of my discussion, I cannot refrain from making brief reference to the matter of valve setting, for which the engraving furnishes a most admirable text. Experience both upon the testing plant and upon the road has shown that in setting valves care should be taken to avoid excessive lead at running cut-offs. Whenever the setting is such as to give a loop in the top of the card such as that which appears in the cards of the left hand column, it is safe to conclude that there is too much lead. Its reduction will increase the economy with which the engine will work at the cut-off in question. Experience also has shown that it is profitable so to reduce the lead as to avoid the loop at running cut-offs, even though there is negative lead for the longer valve travels. An examination of the cards is of interest in this connection. The cards at 15 per cent. cut-off already referred to, present too much lead, but the cut-off in question is really shorter than that at which any locomotive should be operated, and if it be assumed that these cards represent conditions which, is not impracticable, are undesirable, which is the fact, the next column of cards at 20 per cent. cut-off may be accepted as those of shortest cut-off. Here the loop has disappeared and the form of these cards may be accepted as that which attends a satisfactory degree of efficiency. With the valves thus set, it is interesting to note that at the longest cut-off of the series, namely, that of 35 per cent. stroke the lead is insufficient to sharpen the initial corner of the card, which, upon the diagram appears rounded. This, however, should create no concern, since the cards which are here presented, were obtained under conditions which have been proven to be highly efficient.—*From a paper read before the Southern and Southwestern Railway Club.*

PAPER AND PAINT FOR STEEL WORK.

An interesting experiment in the use of paraffin paper and paint to protect steel work has been going on for some time at the Jersey City station of the Pennsylvania Railroad. At the recent meeting of the American Society for Testing Materials Mr. L. H. Barker presented interesting details of this investigation. The steel work was first carefully cleaned by wire brushes and a certain kind of tacky paint was applied. The paper was then tightly pressed upon the painted surface with slightly lapping joints. Over the paper the second coat of paint may be immediately applied without waiting for the inside coat to dry. A great saving is effected by this method by necessitating but one scaffolding. The experiments have extended over three years, and are considered of too short duration to determine the value of the paper as a protection for iron and steel. They have, however, shown very satisfactory results thus far. Mr. Barker believes that the experiments prove the fact that in the case of smoke and gases corrosion begins from beneath the paint, and not from in front by the disintegration of the paint. The paper apparently prevents the access of water to the metal, and Dr. Dudley's careful experiments have shown that all paints seem to be pervious to moisture. After two years and three months exposure to smoke and gases the paper and the first adhesive coat were intact, and in places where the paper was removed for examination the adhesive coat was not yet dry, and the surface of the steel was the same as when first painted.

STEAM TURBINES IN MARINE SERVICE.—Mr. William Gray, in a paper before the Institution of Naval Architects (England), records interesting results of trials of the Midland Railway turbine steamers as compared with exactly similar ships driven by reciprocating engines. For a speed of 19.5 knots the turbine steamer saved 9.4 per cent. of coal, and at other trials the same turbine steamer saved 8.5 per cent. of coal over other vessels with reciprocating engines at a speed of 19.3 knots. Mr. Gray says: "Speaking generally, therefore, the performance of the turbine steamers, specially the 'Manxman,' have been greatly superior to those of the steamers fitted with reciprocating engines." Mr. Gray believes that the only real inferiority of the turbine vessels, which lies in the difficulty of manœuvring in narrow channels, can be overcome by increasing the backing power by making the reversing turbines more powerful. He shows the difference in the weight of machinery to be about 6 per cent. in favor of the turbines, and the difference in initial cost of the turbines as compared with the reciprocating engines 1½ per cent. of the total cost of hull and machinery.