procating parts, the steam ports and valve travel, and the arrangement of the exhaust. Radical changes are probably unnecessary, but decided modifications must be made to adapt the average locomotive for fast runs.

It is well understood what will have to be done with the reciprocating parts, and a great improvement is noticeable in the most recent designs. The pistons are now made of less than one-half their former weight, and of cast steel or wrought iron. The reduction in the crosshead is not as great but a further reduction is at hand. The main rods, which largelv affect the counterbalancing, have been reduced one-half in several instances. The parallel rods, which do not affect the accuracy of the counterbalancing, and hence produce no detrimental effect on the track when counterbalanced, have been supposed to be one of the limitations of speed, but the rapid introduction of solid ends and "I" sections, as well as the use of an extremely fine grade of steel having a high tensile strength and great ductility, have so improved the strength, and at the same time decreased the strain by reason of a decrease in weight, that the limit of safety in increasing speed, as determined by side rods, has been raised considerably. If 60 miles an hour was a safe speed with the parallel rods of five years ago, then 90 miles an hour is a safe speed with the most improved form and kind of rod. The reciprocating parts of our best engines to-day, when perfectly balanced, have less detrimental effect upon the roadbed than the best single driver engines. Hence, so far as counterbalancing is concerned, we may consider that the best locomotive designs in this country are such as to remove the limit of speed to a point above the highest practicable speed with permanent way as it is.

The other two necessary changes in design to adapt the present locomotives to high speed have not received the attention they should have. It is only now that we can say that any efforts which promise success have been made to determine what is the proper form of an exhaust pipe and smokestack to give the least back pressure in the cylinders. The Master Mechanics' Association committee reported this year a few general facts which will assist in a solution of the problem; but we expect the most conclusive results from the experimental work being carried on by two railroad companies with old engines jacked up in the shop, on which a large variety of exhaust apparatus will be tried. Within another year one will probably know how to construct a locomotive blast apparatus so as to give approximately the least back pressure to the cylinders.

It is the mean effective pressure on the piston at high speeds that must be increased before we can hope to haul heavy trains at a higher rate of speed than is now common. This average pressure on the pistons is to be increased by decreasing the back pressure, as just shown, and further by so increasing the opening of the steam ports at short cut-offs, and prolonging the period of exhaust, that the wire drawing at admission and the loss by compression shall be materially reduced. There are those who have proposed, and will continue to propose, radical changes in the valve motion, such as a substitution of a new gear in place of the Stephenson link. While in a general way this is to be encouraged, yet the most advisable and desirable thing to do is to improve the plain "D" valve and the Stephenson link as much as it can be improved before we give it up. This gear we know all about in service. It is reliable and positive, and gives little or no trouble. There is no substitute yet proposed which does not promise trouble from the start when operated at high speed. As we have before shown in the *Railroad Gazette*, there are ways of increasing the port opening at short cut-offs and prolonging the period of exhaust which are perfectly practicable, and are being used with good success on several roads, notably the Reading, where the high speed was made which has called forth these comments. The engine which made this fast time had the following dimensions of ports, outside lap, and valve travel: cylinders, 18½ inches in diameter by 22 inches stroke; steam ports, 1¼ inches by 16¾ inches; exhaust ports, 16¾ by 3¼ inches; travel of valve, 7 inches; outside lap, 1½ inches; inside lap, zero; diameter of drivers, 68½ inches; weight on drivers, 64,400 pounds; weight on truck, 31,800 pounds: total weight, 96,200 pounds.

Undoubtedly, the area of port opening was much more than common with this engine at short cut-offs, and was 25 or 30 per cent greater than with the ordinary engines used on express trains. The indicator cards which we have seen from this class of locomotives have the least compression and the best admission line of any that have been put before us. The engines were built in 1886, and have been operated since that time with perfect success with these foregoing dimensions of valve and valve travel. Hence the feasibility of the arrangement is proved beyond question.—*Railroad Gazette.*

A patented process for obtaining cellulose and oxalic acid from the vegetable fibers contained in wood, which is the invention of M. Liefchutz, consists in reacting on wood with dilute nitric acid, in the presence of sulphuric acid, separating the intermediate product from the acid liquor, which contains in solution the oxalic acid formed, and subjecting the intermediate product to a further treatment to remove the remaining incrusting matters from the cellulose. As to the acid liquor, it is set aside and subsequently treated in a process for recovering the oxalic acid. The oxalic acid dissolved in the weak nitric acid can be obtained direct in the crystalline form, by repeatedly using the separated acid liquors for the treatment of fresh wood.—*Bull. Fab. Papier.*

THE CONVEYANCE OF DISPATCHES BY BEES.

Let not our readers think of a hoax on reading the title of this article. It is a question entirely of asking a new service of the bee—that insect so useful in the country; and it is desired, neither more or less, to obtain, after it has contributed to increase the national wealth in time of peace, its aid in the common defence when the country shall be threatened. But, what! it will be said, you do not think seriously of replacing the carrier pigeon, which travels im-