## REVIEWS.

### Lake's System of Canal Steam Navigation.

It is a somewhat strange coincidence that whilst reviewing a proposition for a Ship Canal on this side of the Atlantic, of 20 feet depth of water, (See March No. of Canadian Journal,) to supersede a river depth of 8 feet, our notice should be attracted to a system patented in England and proposing to apply steam power to the economic and efficient use of shallow Boat Canals, whereby they shall be enabled to compete in cheapness of transit with Railways. The patentee Mr. John Lake, C. E., has selected half a mile on the Grand Junction Canal, whereon practically to illustrate his system; and the length we are told includes unusual Engineering difficulties, must therefore be considered as affording a severe test. It comprises at "its northern extremity, an extremely sharp curve, and about the middle a rise by a Lock of 7½ feet, approached by another curve though of larger radius—beyond this again and on the higher level, it is continued in a straight and then in a curved direction." The lock above referred to is double, and through one of the Chambers the ordinary traffic of the Canal still flows. The gates of the other have been removed, and their functions superseded by an inclined plane constructed on the principles laid down in Mr. Lakes specification. As the work of the level portions of the experimental line was sufficiently great to admit of two boats abreast, the old and new system were worked simultaneously, and the comparison was accordingly direct and palpable.

The substance of Mr. Lakes invention (as stated in The London Mechanic's Magazine) admits of being concisely stated, from its extreme simplicity, and we purpose to give a succinct account of it in this place, that the results already accomplished by it may be fully appreciated. First, the permanent way of the works in every level section of the canal consists of a double line of light iron rails, supported at the uniform height of about 18 inches above the usual high-water mark, upon parallel walings, or beams of wood, to which they are attached by countersunk screws. The walings follow the course of the canal and rest upon rows of piles driven into the bed of the canal, about 15 feet apart. Within the trackway thus formed a number of canal boats with square ends are brought together, and coupled rather closely, so as to constitute a train. Immediately in front of them is another boat, which contains the engine by which motion is to be communicated to the train. The piston-rods of the engine are directed upon cranks in a transverse shaft, which carry the driving-wheels, by the reaction of which upon the rails the whole train is set in motion. In order to produce the requisite tractive force, the driving-shaft is pressed downwards to the rails by a pair of levers, through which it passes freely, and which lie in the direction of the rails. The after ends of these levers are attached strongly to fixed points in the engine-boat, while their other ends are united by a transverse beam of iron, which can be raised or depressed by means of a powerful screw and lever. When the transverse beam is depressed, the driving-shaft and its wheels are pressed down upon the rails, and the engine being set in motion, the entire train of boats is drawn along. On level canals, or those without locks, the arrangements described are all that would be necessary in actual practice; but to raise the train from one level to another, an inclined plane of extreme simplicity and perfect efficiency has been proposed by the inventor, which at once does away with the loss of time, water, and enormous expenditure incidental to the present system of locking. This incline is, in fact, a double one. The walings ascend upon the heads of piles gradually increasing in height, and strongly framed together in both directions. As the engine would be utterly powerless to draw its train up even a moderately inclined surface, with a smooth rail, a strong rack-work is fixed upon it, which is continued beyond the summit of the incline for about the length of a train. The driving-shaft of the engine is provided with suitable pinions to geer into these racks; and the continuation of the latter will obviously enable the engine to draw the last boat of the train to the higher level. It is obvious that, by this arrangement, any amount of required fulcrum may be obtained. A line of large rollers or drums, mounted in plumer-blocks about 10 feet apart, which it is proposed to reduce to 5 feet, is fixed upon an inner and lower incline, and over these the bottoms of the boats pass, strips of stout iron being attached to them, to diminish the friction and to protect the botoms, which are also strengthened otherwise. These rollers are continued under water in the upper and lower "pounds" of the canal, so that a support for the boats is provided the moment that the racks and pinions become engaged, and they are deprived of their natural support in the water.

The complete efficiency of this remarkably simple and ingenious mode of working a train of canal boats was amply demonstrated in the trials we witnessed at Grove, though neither in point of power nor in precision of detail is the mechanism at present to be regarded as a fair illustration of it. A small 10-horse engine, with its boiler and fuel, and subsidaiary apparatus, was fitted in the leading boat, to which a train of twelve other boats were attached. These were merely old canal boats, with their sharp ends cut off square, to diminish the resistance in the water, and then cut into two smaller ones, which were laden with blocks of granite and bricks to the extent of about 100 tons. At first the engine-boat was at the foot of the incline, and Mr. Lake ordered the train to be backed, or driven northwards along the level and smooth rails. A turn or two of the large screw sufficed to produce a good bite between the driving-wheels and the rails, and the moment the engine was set in motion the train started, and proceeded with the greatest ease of motion through the water—no eddies resulting from it, nor any undulatory effects that would be detrimental to the banks. The train threaded its way, without difficulty, through the sharp curve at the northern end of the piece, the walings guiding it continuously and gently in its assigned course. In these curves, the only preliminary precaution to be observed is, to give a little divergency at the walings to the point of maximum curvature, and then to contract them gradually for the remainder of the curve, until their normal gage is attained at the next straight piece. In going round a curve thus formed, a train of ordinary length will move freely, without risk of being jammed between the walings. In this trial, the readiness with which a train can be backed, even through a sharp curve, was clearly proved.

The engine was now reversed, and the train drawn forward in the usual manner. Its speed was here considerably above four miles per hour, and was then lessened, to show the control which the engine-driver had over it; and the levers were released until the wheels slipped upon the rails, and the train proceeded with the momentum it had acquired to the foot of the incline. There eight of the boats were detached; as the small engine at present in use is not of sufficient power to draw up more than a gross load of about fifty tons. The levers were again screwed down, and the engine set in motion, upon which the pinions geered into the racks, and the engine-boat rose gradually out of the water, commencing its ascent of the incline. As it continued to ascend, it rolled smoothly over the rollers below, and was followed by the four boats attached to it; all of which were landed, without the delay of a moment, in the upper pound of the canal. From this point the train proceeded along the remainder of its course in the upper level of the canal, and being brought back again to the incline was allowed to descend it. The descent was accomplished with perfect ease, and the absence of all danger. All that the engineer had to do now, was to admit the steam into the cylinder on the other side of the piston, so as to render it effective in checking the motion, which would otherwise give to the mass a destructive momentum. Thus, the same engine which propels the train of boats along the level portions of the canal, by the arrangements here adopted, is also available for elevating from one level to another; a feat never before accomplished—or shown only in detail—except by means of stationary power.

The advantages of this arrangement over the present canal system scarcely require to be pointed out. Any rational alteration in the extremely inartificial and unphilosophical application of power we now witness on our canals, cannot fail to be productive of advantage; but it is evident, too, that the train system must be the basis of every approximation to economical working. Past experience, and, indeed, the remonstrances of common sense, declare against the adoption of paddle-wheels, or screw propellers, either in a train of canal baots, or in single ones: as the confined nature of the channel prevents the access of new water to the moving surfaces, and little better than a churning action is the result. We are therefore driven to substitute for the extremely imperfect reaction against canal water, that against fixed and rigid objects in the vicinity of the boats. This being so, it appears to us that Mr. Lake's system of canal steam navigation embraces all the requirements of the case, and has combined in itself all the favorable circumstances that can be brought to its aid. Having given evidence of its efficiency, a few comparisons will prove its great economy.

First, as regards construction—premising here that existing canals can be altered without any stoppage of the navigation, and the locks and other works, if it should be deemed desirable, may be left freely open for the present clumsy method of hauling. A line of level railway can be laid down on this principle at a prime cost of £1200 to £1500 per mile, according as the wood employed is oak, fir, or beech. An inclined plane of average length would cost £1000, which would be an economical substitution for the expensive works of a lock. A flight of locks might be replaced by a sufficiently long incline; and thus, upon the whole, places where locks must otherwise be constructed would become the cheapest portion of the entire work, as the inclines might be built upon land with but little excavation. The outlay incurred by laying down the works for an up and a down line of rails, would be far more than returned in a short time by the saving that would arise in the maintenance of the canal. Besides dispensing with the locks themselves, the heavy expense of lockage-water would