to the manufacture of large types only, such as are now made of wood, and to the making of small plates containing short notices or advertisements for newspapers. The advantages of the celluloid types and plates consist in their lightness, which saves storage and postage, and in their durability and cheapness. The types resist the action of acids and do not affect the colors of the inks used on them. This makes it possible to use the same type for many colors, which is a great advantage in printing-offices where wood type is used.

The Radiometer in Measuring Light.

THE radiometer bulb, with its white and blackened vanes, is a familiar object in the windows of opticians, but, while it has been the means of making important experiments in physics, it does not appear to have proved of much value in the arts. It has been suggested recently that it can be used as a photometer in testing the power of different lights. The radiometer bulb is placed in a square metallic box having openings opposite the bulb on opposite sides, and closed with glass. The box is filled with water that is raised, by means of a lamp, or other appliance, to a temperature about one hundred degrees higher than the heat that may be given by the two lights to be examined. The beam of light from the candle, or other standard, is then allowed to fall on the vanes of the radiometer through one of the openings in the box. The light to be tested is allowed to fall on the vanes, through the opening on the opposite side. If the two lights are of equal power, the action of the lights on the vanes will balance, and the vanes will stand with one face toward one light and the other toward the other. If the power of the lights is unequal, the stronger light will displace the vanes or cause them to revolve. To measure the photometric power of the light to be tested, it must be moved farther away or nearer to the bulb till the balance is set up. The distance of the lights from the bulb will then give the value of the light, as in any of the photometers now in use. The observation of the action of the vanes is studied through the openings on the opposite sides of the case in which the radiometer is placed.

Hydraulic Dispatch.

A NOVEL form of dispatch-tube for transmitting letters and packages under rivers or harbors has been made the subject of experiment. The plan is the same as in the dispatch-tubes already in use in cities, where light carriers containing letters are blown or drawn through metal pipes by a powerful current of air, except that water is used instead of air. The tube is of thin lead, bound with wire on the outside to give it strength, and covered with tarred hemp to resist the action of the water. The pipe is simply laid on the bottom of the river, the shore ends being placed in a trench for safety. To obtain power, a reservoir is placed at each end of the pipe at a sufficient height to insure a good head of water. The reservoir is connected, by a pipe of equal diameter with the tube, with the top of a box at the shore end. The tube enters the lower side of this box, and there are valves at the end of each pipe, and a water-tight door at the side of the box. The carrier consists of a wire cylinder covered with rubber and closed by a water-tight cap. The messages are placed in the carrier and it is put in the box with others, and the door is closed. The valves are opened and the water, under the pressure from the reservoir, sweeps or floats the train of carriers through the tube at a speed corresponding with the pressure. At the receiving end the water is discharged through a branch pipe into an open box or sieve, through which the water escapes, while the carriers are caught. The transmitting and receiving apparatus are the same at each end of the tube, and by reversing the current, messages may be sent either way. The chief advantage of such a hydraulic system of transmission will probably be found in the greater distance to which the carriers can be sent. As they float in this tube, there will be less friction than in pneumatic tubes, while leakage in the tube will be of less consequence. The commercial value of the system will depend on the relative cost of pumping air or pumping water through such a dispatch-tube.

Recent Progress in the Application of Electricity to Railroads.

THE experiments that were begun some time ago in this country, in the use of electricity on railroads, have been renewed recently upon a greatly enlarged scale. A new narrow-gauge railroad has been laid down on precisely the same conditions in regard to grade and curvature as would be found on ordinary railroads in the United States. A new locomotor with one car, of the ordinary single-horse pattern used on street railways, has been provided, and it is proposed to run the motor and the car continuously under all weathers for a year, in order thoroughly to test the system under every condition of the weather and the seasons.

The direct motive power is a stationary steam-engine located at the top of a hill, about a thousand meters from the nearest point of the railroad. Three dynamo machines are driven by belting from the engine, and these give the current for operating the road. These machines may be used in one of two ways. They may be joined to the wire to give a current that will cause the locomotor to move at a high rate of speed, or with power at a slower rate. If the current from one dynamo is sent into the next, and so on, in series, the current made available for work gives speed. If the current from each machine is sent direct to the wire, the combined currents give intensity or power. At the time the road was examined they were arranged in this way, as the track was new and a trifle rough. From the central station where the dynamo machines are placed, the wires are laid under-ground to the road. The insulation is secured by inclosing the wires in a wooden box filled with an insulating compound, poured in the box and over the wires while liquid. The track consists of square wooden ties and a light rail, laid in the usual manner. To secure insulation, the ends of each tie are painted with an insulating liquid that, when dry and hard, makes a good non-conductor. In placing the ties on the road-bed, care is taken to leave the ends of the ties exposed, so that the rail will not touch the ground between them. The rails are also painted with or dipped in the insulating compound up to the lower side of the tread. This gives the rails the appearance of being painted black at the sides and bottom. The sides of each rail at the ends are also filed or brightened so as to leave a clean surface, and when they are in place on the track, short bars of copper are laid from rail to rail across the joint. Each bar bears against this bright or bare spot on the rail, and is securely held in this position by the fish-plates. A little solder is also applied, to insure good electrical connection from rail to rail through these copper bars. To assist the insulation, there is also a small piece of insulating material placed on the tie under the rail. On this is also laid another insulator wherever the heads of the spikes rest on the rail. With such a track the loss of electricity by escape into the ground, per mile of track, is found to be very small. The cables from the central station are connected directly with the track, one to each rail, and at a point near one end of the road. This is, however, not a matter of much consequence, as the central station may be at the middle of the road or at either end, while the cable may be carried under a river or across a hill or valley.

The motor consists essentially of a single dynamo machine, of precisely the same pattern as those used to furnish the current. It is laid down horizontally with the armature at the forward end over the driving-wheel. The motor is supported on four wheels, one pair forward being the drivers, while a trailing pair is placed behind under the cab. There are no trucks, as the motor is supported on a rigid frame-work. As the whole machine is small, the wheel-base is about the same as in the horse-car, and it will pass ordinary curves with ease. Motors of a larger size, and carrying two or more dynamo machines, would be arranged differently, perhaps, with two driving-wheels and one trailing truck. The armature of the magnet is secured to a horizontal shaft at the front of the motor, and from this shaft is a belt to a counter-shaft at the rear under the cab. The counter-shaft carries a friction clutch, controlled by a hand-lever in the cab. From the counter-shaft is taken another belt to the axle of the driving-wheel, and over this belt is a belt-tightener, controlled by a hand-screw in the cab. The four wheels are made of iron, in two parts, with a backing of wood, somewhat after the manner of paper car-wheels. The wood serves as an insulator, and prevents the current that flows from the track into the wheels from taking a short circuit through the axles from rail to rail. On each wheel are fastened brass arms, arranged to support a round brass disk opposite the center of the wheel, but not touching it. On this disk rest copper brushes, supported by a brass rod, that communicates with an insulated wire that connects with the magnet. The current from one rail passes through the tread of the wheels on that side, then through the brass arms to the copper brush, and thence by the wire to the magnet. In like manner the current returns to the rail on the other side. In this way, the motor becomes a bridge or short circuit on the rail that is continually changing its position while in motion. This is precisely the same as in those electric block signals (already described in this department) where the current is made to pass from rail to rail through the first or last axle of a train moving in the block. In such signal systems, the moving train is merely an electric shunt or switch, and it receives no direct benefit from the current. In this motor the current passing through the apparatus does useful work in moving the train. All the switches for sending the current through the magnet in either direction, or for stopping, starting, and reversing the machine, are placed in the cab, and the whole work of control consists in moving these simple hand-levers, in moving the friction-clutch lever and the belt-tightener. There is also a hand brake.

At the time the road was inspected, the motor pushed the car containing several people, and dragged behind a small flat-car loaded with gravel and carrying two men. The motor was controlled by one engineer and one assistant. In starting, the switch was turned to admit the current to the magnet. The armature, turning idly before, began to revolve swiftly, and in a few seconds was moving at a high speed with a slight whirring sound. On applying the friction clutch, the motor started ahead easily, and in silence. On applying the belt-tightener a good speed was at once attained, and the train ran swiftly over the road for more than a mile without stopping. On taking off the flat-car load, the return trip was made at good speed, and apparently without effort. No attempt was made to display the highest speed possible, but enough was done to show that the motor could be handled with the greatest ease, and with entire precision. When used alone, the motor ran backward and forward, stopped, and started as readily as any locomotive, and without noise, dust, or smoke. While this road has been built for experimental purposes, enough has already been done to prove that it is a practical success. Such a road and motor will, no doubt, prove of great value wherever ordinary locomotives are objectionable, as in mines, tunnels, and city elevated roads. Short spurs or feeders to regular railroads, particularly where water-power is available, could be built on this system to advantage, and there seems no reason why it may not prove of great value. In point of simplicity and directness of means to ends, the motor and its road appear to be superior to the electrical railways already in use.

Improved Chain-Pump.

THE chain-pumps, so extensively used in some parts of the country, always had the defect of great wastefulness, both in time and power. The metal buttons used for buckets in the chain tube were too small, and allowed the water to run back too freely. An improved rubber bucket, in the form of an inverted cup, has been introduced, that appears to remedy the defects of this otherwise useful form of pump. The buckets fit the tube closely, and prevent the water from falling back.