When we come to examine the whole spectrum of ether waves, we pass up from the electrical into shorter waves which possess heating qualities. We pass on to shorter waves still light; we pass beyond these into waves which are still shorter, ultra violet; we pass on further, and we come where—perhaps to the X-ray, for the latest ideas in regard to these X-rays are that they are very short waves of ether. We can prove in a wonderful way that the heat waves are similar to light in that they may be reflected, refracted and polarized.

Now the problem of heat transmission by radiation is the most difficult. We know the least about it. A great deal has been done recently in unearthing the laws of radiation from black bodies. And we have in applying our knowledge of radiation to problems, first of all to make a calculation of what it would be if the object were a black body. Then we must make estimates. Every kind of surface depending on its roughness and its temperature will send out or absorb different kinds of waves. In general, the higher temperature of the body the more of the light waves, or shorter waves are sent out and the fewer of the longer waves. The lower the temperature the fewer of the shorter waves will be sent out and the more of the long. Finally we get bodies which are not luminous at all, and then if we take bodies still colder, we find that they emit longer and longer rays the colder they become. Now the difficulty in applying the laws of radiation to practical engineering problems is that we do not know enough about surface conditions or radiation from cold bodies.

Bodies differ a great deal in their power of absorbing rays. Some bodies transmit heat waves; some do not. We have, for example, in colored glasses, very beautiful illustrations of how some bodies transmit light waves and some do not. Some of the rays are absorbed and some can go through. Tyndall has shown us that for heat rays water and ice are very opaque, and he has pointed out that of the longer rays which are emitted from an object heated one hundred degrees above its surroundings, the surroundings being the ordinary temperature of the room, these would be entirely stopped by a mass of water or a mass of ice. Ice is a little more opaque to heat rays than water. From the heat rays that are pro-duced from an Argand burner only II per cent. penetrate a small thickness of water. The penetrating rays, however, manage to pass through further and thicker layers of water. The filtering process is very complete, but the rays which penetrate pass on through the water unabsorbed.

This property of selective absorption, which is shown by many substances, is shown particularly for water, and it has only recently been proved experimentally that a large absorption band exists in the case of water for the longer heat rays. An absorption band is a band in the spectrum where the rays have been removed. Now to make the explanation clear, consider some examples. It is an exceedingly important point that I wish to bring out, and one which is to determine whether the long heat rays can penetrate water. Now first of all consider the spectrum. If we can study the light rays in regard to their absorption in bodies, then we can apply our knowledge to heat rays. We find that each vapor or gas has its characteristic spectrum. A good illustration is afforded in the absorption spectrum of iodine or bromine vapor. The light transmitted through the vapor when refracted through a prism shows dark bands together with characteristic colors. These dark bands show where the light at that particular wave has been filtered out and been absorbed in passing through the vapor.

(To be continued.)

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## DEVELOPMENT AT NIAGARA.

Since the general report of progress made in the Canadian Engineer last year on the power developments at Niagara Falls on the Canadian side, much work has been accomplished on the three great works.

At the Ontario Power Co.'s works little or nothing could be done on the forebay during the winter, but work on the penstock, power house, distribution station and tunnel was carried on all winter, and about 1,000 men are now employed by the company and its contractors. The foundations for

the intake piers have been laid, and the forms for the piers, which will be made of reinforced concrete, are being put in. The forebays are being cleaned, and preparations are made to let the water in this month. The type of gate adopted is the "Stoney" gate, made of steel, by Ransomes & Rapier, London, Eng. The gate is now in position. The big steel conduit has been concreted over, and is now being covered with earth to a depth varying from four to twelve feet. The distributing station is being put up, and excavations for the spill weir are being made. The spill weir tunnel is also being driven. The first of the penstocks is in place, and tested, and the first unit of 30,000 h.p. is practically ready, while the second is in course of erection. The power house, which is of concrete, will have temporary ends put in to enclose the units as they are installed. The cable conductors from the power house to the distributing station on the hill are now being laid. It is stated that the first power from these works, which will be ready for transmission about August next, will be used on the United States side, and that Albright & Hays, of Buffalo, who are financially interested, are said to be arranging with a corporation in New York State to take this power.

The Electrical Development Co., of Ontario, has several hundred men at work. The overflow dam, 700 feet long, and with a maximum thickness of 33 feet 3 inches at the base, is now completed. This will have a granite coping to resist the ice. The outer line of ice boom arches is finished. It is built of concrete, the portion of the masonry arches below a line two feet lower than low water mark being of cut stone. Work is being pushed on the head walls and head gates, which will be finished this summer. The excavations for the wheelpit are done, and the masonry lining of the pit is progressing rapidly, twothirds being already built. The excavation for the tail-race tunnel is completed, and the masonry lining for this is also well advanced. Preparations are well on for the building of the power house, the foundation walls for which are already being laid. The erection of the power house will go on as fast as the foundation walls can be laid up. The opening at the end of the tail-race tunnel under the Falls was made last season, and has been in constant use since for the disposal of material, without any of the trouble that was feared by some, so that this feature may be taken as an accomplished fact. The transformer station, located on the hill, outside the park limits, is well advanced, the erection of the steel work being now in progress. The electrical machinery and some of the hydraulic machinery will soon begin to come. The structural steel and cast iron piping is made by the Canada Foundry Co. It is probable that the first unit of 12,500 h.p. will be ready to transmit current to the industries of the vicinity and to Toronto next autumn.

The Canadian Niagara Power Co. is drawing to the close of construction work for the operation of the units it has in present contemplation. The power house has already a finished appearance, the granolithic floors being laid, and all will be in shape by next month. Three wheels of 10,000 h.p. each are now erected and in working order. One of them is already connected up to the United States side of the river for use in case of an accident to the big power works there with which the Canadian company is financially associated. Two more wheels are being installed, and will be completed during the summer. The power house is heated by natural gas from Welland county, supplied at twenty cents per thousand. The false dam was taken away, and all the forebay finished in March last. The standpipe, 116 feet high and 30 feet diameter, is now finished, and water can be pumped to it either by water power or electricity. The machinery so far installed has stood the tests perfectly. The 60,000 volt switches are nearly finished, and the low-tension bus bar compartment is completed. The transformers are all in place in their building, which was finished last year. Only a few minor details of this building remain to be done, and these will be finished this month. The contract has been let for the second section of the wheelpit, and the excavation is now down 120 feet out of a total of 150 feet. This will be finished in about nine months, and will contain six units of 10,000 h.p. each.