the calculations these were disregarded entirely, as there exists a probability, however remote, of their being swept out by the ice during some spring freshet. Some small protection is afforded them by extending the abutment walls of the race a small distance toward the creek. The final design consisted of two twenty-four-inch I-beams, with six inch by three-eighth inch bands, eighteen inches centre to centre, bent so as to fit over and riveted to the upper flange of the beams and with the lower portion rounded to the half section of the outside of the pipe. Every three feet of their length the I-beams are fastened together by two and one-half inch by two and one-half inch by three-eighth inch angles riveted to their top flanges.

While it is expected that the joints will be tight and the pipe non-porous, an additional safeguard was provided in the bending to the shape of the pipe of sheets of No. 12 gauge black iron 48 x 72 inches in size and placing the same directly upon the iron bands, and then fitting the pipe closely into the bent sheets. All the steel work was painted a uniform color.

The piers, although small, presented some constructive difficulties which were annoying. The water was about five feet deep with quite a strong current flowing, while there was not sufficient space in which to build water-tight coffer dams. The box molds were built of 2 x 8-inch tongued and grooved North Carolina pine pieces with their lower edges bevelled and driven hard on the rock bottom in an effort to make a tight joint and to exclude as much water as possible, without any success in that line. Under these conditions good concrete work was secured by the men standing in the water within the forms, taking the concrete in buckets, driving under the surface, and emptying the buckets on the bottom or on the material already deposited, so as to prevent the separations of the mixture into its component parts. Sufficient ramming was secured by the tramping around of the men. This was carried on in successive layers until the water surface was reached, above which the concrete was deposited from barrows in the usual way and rammed.

The steel work was placed easily by employing rollers on each pier. In laying the pipe at this point both the tripod and the A-frame had to be discarded, for the only available footing was the top flanges of the two 24-inch I-beams spaced four feet centre to centre. In their stead were employed two cross frames fifteen feet apart supporting an 8 x 8-inch horizontal hoisting timber from which hung the chain block. The frames were identical in design and consisted on each side of an upright 6 x 8-inch timber braced by two inclined strips of the same size, their lower ends being nailed to pieces of 2 x 6-inch securely bolted to the I-beams, the upper ends of the posts being fastened together and braced by a cap of 6 x 8-inch timber upon which the hoisting timber rested.

The only other point of interest lies in the general outline of the inverted siphon, which deviated somewhat from the usual design, its profile bearing a striking resemblance to the edge of a saw. The regular grade of the 30-inch pipe was stopped about one hundred feet back from the up-stream bank, where a vertical drop of ten and one-half feet was provided into a grit chamber, fifteen feet in length, divided into two compartments. From this a double line of 30-inch pipe leads on an up-grade of 2 per cent. for 85 feet to the edge of the water, ending in a manhole with a single 30-inch outlet. It is expected that any sediment contained in the sewage, which would deposit in the pipe, will do so at this section on account of the lessened velocity due to the up-grade and the additional area from the double pipe. This can be readily cleaned by closing one pipe and is easy of access both at times of high and low water. From here the profile was governed by topographical conditions and the character of the excavation and consists of a down-grade of 4 per cent. for 250 feet under the creek bottom and a final leg on an up-grade of 6 per cent. This last being of the larger size of 36-inch pipe. Considerations of economy dictated this course, a saving being effected in pipe on account of not running a double line for the whole distance; a saving in excavation, for it is in solid granite; but mainly a saving in time, advantage being taken of a short dry season to do the work, which if prolonged to a time of high water would have necessitated an expensive coffer dam.

DRAFTS IN STEAM BOILER PRACTICE.

A preliminary bulletin on "The Significance of Drafts in Steam-Boiler Pactice" is soon to be issued by the Technologic Branch of the United States Geological Survey. The authors of the bulletin, Walter T. Ray and Henry Kreisinger, in carrying out the particular work assigned to them in the general plan for the conservation of the fuel resources of the country have this to say in their bulletin:—

"The experiments so far made seem to indicate that it is possible to double or treble the capacity of a plant without making any radical changes in the furnaces and boilers. These increases require about double and treble the quantities of air to be put through the fuel beds and boilers. It also seems probable that rebaffling the boilers will often permit the capacity to be doubled or trebled, while still getting more steam than formerly per pound of coal for uses outside the boiler room.

"These experiments were undertaken with the object of clarifying ideas concerning the passage of air through fuel beds and boilers. Measured weights of air were passed through two beds of lead shot, in series, one of which remained always the same and represented a boiler; the other being varied as to size of shot and depth of bed, and representing a fuel bed. Careful observations were made of the weight of air passing through the beds per minute. All data were plotted in many charts, so as to permit the study of them from several points of view. A number of laws were deduced bearing on the relative amounts of power required to force air through fuel beds of various thicknesses, composed of various sizes of coal, and through boilers of various lengths and areas of gas passages.

"An important part of the discussion relates to an increase in the capacity of boilers by increasing the amounts of power which must be applied to pressure and exhausting fans in order to force several times as much air through the fuel beds and boilers.

"It may be possible, as a result of these investigations, to raise the rate of working the boiler heating surface to three or even four times its present value. Such an increase would undoubtedly mean new designs of grates, stokers, furnaces, and boilers, especially fitted for high rates of working. Fan equipments designed to supply three or four times as much air under several times the pressure would be provided with more efficient engines, which is an additional factor favoring high-capacity working.

"It must be borne in mind, as stated above, that the results are tentative. It will cost money to force gases at high speeds through fuel beds and boilers, and there will soon be pressing need of such quantitative data as will enable the largest possible part of the energy imparted by the fans to be advantageously utilized.

"The attempt must not be made to put more air through existing boilers by running the fans a great deal faster, because the power consumed will increase far faster than the above calculations estimate. New fans and engines must usually be installed of sufficiently larger size to supply the larger quantities of air at as high an efficiency, if not higher.

"As has already been suggested, one way of reducing the work required from the fan in the case of doubling the capacity of the boiler is to increase the grate surface, so as to avoid a high increase of pressure drop through the fuel bed, increasing materially only the pressure drop through the boiler proper. A low pressure drop through the fuel bed would also insure better combustion of the fine particles of coal which would be carried out of the stack unburned if high gas velocities through the fuel bed were employed, the high velocities being obtained by high pressure drops. This last method is being successfully used by H. G. Stott and W. S. Findley, of the Interborough Rapid Transit Company, New York City. They have recently installed an extra Roney stoker under the rear end of each of several Babcock & Wilcox boilers, with the result that the amount of steam produced was nearly doubled, the combined efficiency of the boiler and furnace dropping only about 3 per cent. A complete description of the outfits and the results is given in a paper read by Walter S. Findley, Jr., before the American