## THE SEARCH LIGHT IN PHOTOGRAPHIC WORK.

BY FRANK C. PERKINS, BUFFALO, N. Y.

In photography, art printing, and many other similar kinds of work, it is necessary to work with surfaces illuminated as evenly and as brightly as possible. Such work is now being largely done abroad by means of projectors of the same general construction as the ordinary searchlight as to form, electric current used, and type of feeding mechanism employed, but the projectors are fitted with transverse dispersers, as indicated in the accompanying illustrations. Fig. 1 shows the method of using a projector for photographic purposes and the transverse disperser projector is noted in Fig. 2. This type of focusing arc light apparatus is constructed by the Elektricitäts-Aktien Gesellschaft, formerly known as Schuckert & Co., of Nurnberg, Germany, the celebrated searchlight electrical manufacturers.

The rays from the parabolic glass mirror, which are almost parallel, are first spread horizontally by means of an ordinary disperser of about 20 deg., with a cylindrical lens running vertically. Each lens distributes in an angle of 20 deg. the whole of the light falling upon it, causing a superposition of the images of all the lenses and effecting an equalization of the unevenness of the projector rays. In front of this a second lens is attached which distributes the light vertically on the same principle.

When adjusted at a maximum intensity and uniformity, the illuminated square has a width and height of 85 centimeters, with the disperser a distance of 2½ meters from the illuminated surface, the current being about 35 amperes at the focusing arc lamp. If the current is increased to 50 amperes and a somewhat larger disperser is used having a mirror of 600 millimeters in diameter instead of 450 millimeters as in the former case, the area of the illuminated square will be 88 by 88 centimeters. As the disperser is increased in distance from the illuminated surface to 3, 4 and 5 meters, the illuminated square is increased in size from 100 centimeters square to 158 centimeters square, with currents of from 35 to 50 amperes. The weight of these special projectors is from 175 kilogrammes to 290 kilogrammes, the former weight representing a disperser having a mirror 450 millimeters in diameter and the latter a disperser with a mirror 600 millimeters in diameter. Excellent results are obtained with this new apparatus, although the cost is somewhat higher than photo-engraving lamps, this class of apparatus being generally used in this country.

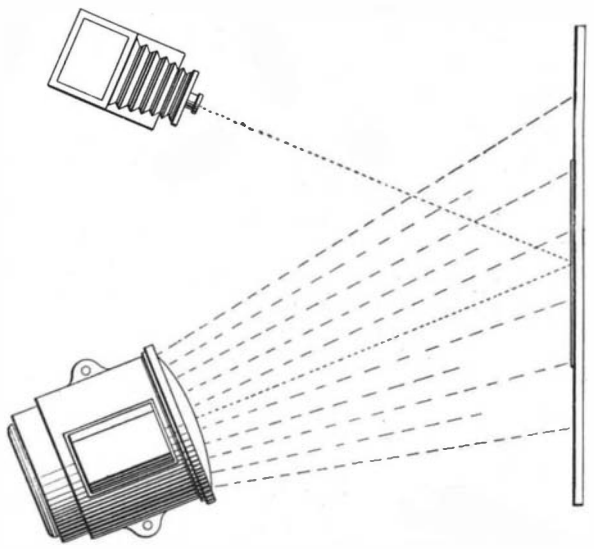


Fig. 1.—PLAN VIEW OF THE PROJECTOR IN OPERATION.

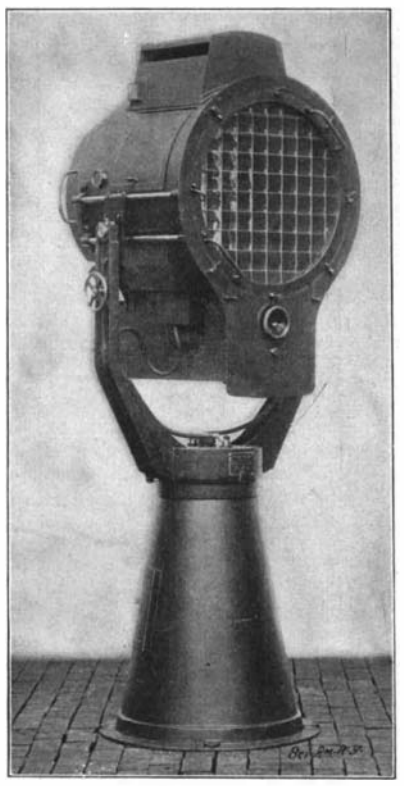


Fig. 2.—A TRANSVERSE DISPERSER PROJECTOR.

## THE ATBARA RIVER BRIDGE.

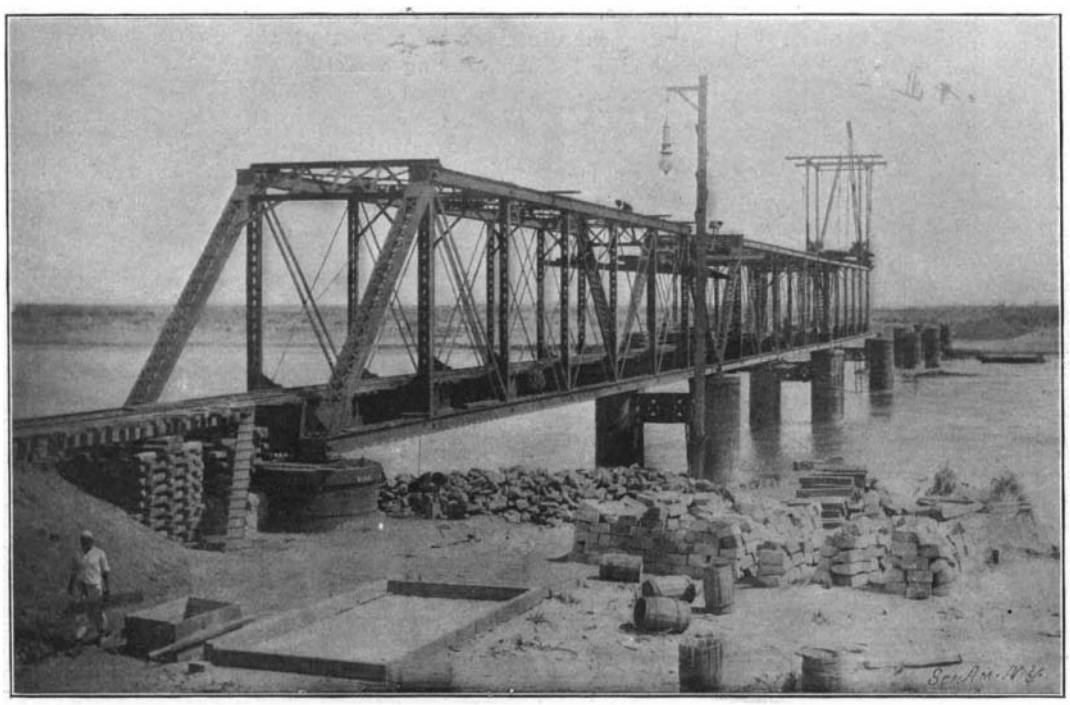
The world-wide attention attracted by the construction and erection of the Atbara Bridge in the Soudan was due to other causes than the magnitude of the work itself. The chief of these were, first, that the bridge was urgently required in connection with the British campaign in the Soudan; second, that the work was awarded to an American firm because of its promise of shorter delivery and lower price than could be obtained from English firms; third, because, although the contract time was very short, the work was completed well within the time.

The events which led up to the awarding of this contract to an American firm are to be found in the conditions and necessities of the campaign against the Dervishes by Kitchener, whose success was due mainly to the fact that he opened a line of railway communication as he went, and was able to concentrate his forces with full supplies, etc., right in the heart of the far-distant Soudan country. In order to continue his campaign against the Dervishes, the General found it necessary to complete a railway line as far south as Khartoum, and this involved bridging the Atbara River. The place selected for the bridge is 1,100 feet wide. During part of the year the river at the site is entirely dry, but during the summer months, beginning with the latter part of June, it is a raging torrent. The army engineers having constructed a railway some distance south of the Atbara, found it beyond their power to bridge the river itself; and the British Egyptian government, on making inquiries in England early in October, found that two years were required for the construction of the bridge, the reason given being that the shops were overcrowded with work. Second tenders were then asked of two American and five British firms, speedy delivery being laid down as the chief consideration. The lowest bid was that of the Maryland Steel Company, which offered to deliver the bridge material at Liverpool at the price of 2.55 cents per pound, within four months, the next offer being that of an English firm, Horsley, which offered to deliver the material at 2.89 cents in three and a quarter months. When the tenders reached Egypt in the latter part of December, 1898, it was found that since the bidders expected to use falsework in erecting the bridge, the work could not be prosecuted until after the summer floods, which would involve the loss of a year's time. Accordingly new bids were asked, based upon the condition that no falsework should be used, and the bridge should be built by overhang, from pier to pier. The Patent Shaft and Axle Company, the only British firm which responded to the final call, offered to do the work at 3.37 cents per pound, delivering the first span in Liverpool in sixty days and the rest in three weeks, while the best American bid, that of the Pencoyd Iron Works, offered to do the work at 2.5 cents per pound, the whole of the bridge to be delivered in New York in forty-two days. The bid of the last-named company, was, of course, accepted.

The Atbara structure is a single-track, narrow-gage railway bridge, composed of seven pin-connected through-spans, each 147 feet in length between centers of end pins. The width, center to center, of the trusses is 16 feet 2 inches, and the depth between chord centers is 21 feet 6 inches. The trusses, as will be seen from our illustrations, are of the ordinary Pratt type, with inclined end-posts and stiff, riveted bottom chords instead of eyebars which latter, for many years, were the prevailing practice in American bridges. The Pencoyd Iron Works, allowing two weeks for shipment to Liverpool, promised the delivery of the work in a third of the time required by the British firm, and at the same time asked a much lower price per pound for the steel. The bridge is carried upon steel cylinder piers, 8 feet 3 inches in diameter, covered by cast-iron pier-caps. The substructure was built by a Cairo firm, while the Pencoyd Iron Works designed and furnished the entire superstructure under a lump-sum contract, while they also furnished the pier-caps and the erection plant and tools under a special pound-price contract. The same company provided the extra erection force, a superintendent, two foremen and five riveters, riggers, etc. The bridge was designed to carry two engines, each weighing 181,000 pounds, followed by a uniform load of 2,240 pounds per foot. The material specified was open-hearth steel, ranging from 60,000 to 70,000 pounds ultimate strength. The plans, method of erection, etc., were worked out under the supervision of Messrs. C. C. Schneider, the Chief, and P. L. Wolfel, the Assistant Chief Engineer.

PORTAL VIEW OF THE COMPLETED BRIDGE.

The method of erection was as follows: One span was erected temporarily on shore to serve as a holdback anchorage for the first span over the river. The inshore end of this temporary span was loaded with 60,000 pounds of steel rails; a steel traveling derrick was erected on the top chords, and a temporary connection made between the two spans to take the tension in the top chords and the compression in the bottom chords. After the connection over the pier had been made the erection proceeded continuously across the river, while the overhang method, which is customary in the erection of cantilever bridges, was used. As soon as the span had been carried far enough out to enable the booms of the traveler to reach the next pier, the cast-iron pier-caps were set, and the span was completed and thus rendered self-sustaining.



Seven 147-foot spans; total weight of superstructure, 629 tons. Order received January 20; structure shipped March 7; erection completed August 19.

ATBARA BRIDGE IN THE SOUDAN, IN COURSE OF ERECTION.

The weight of the bridge is as follows: Superstructure, 1,258,300 pounds; temporary steel work and traveler, 121,000 pounds; cast-iron pier-caps, 129,600 pounds; duplicates and extras, 4,000, making a total of 1,512,900 pounds. The account of the construction of this bridge, given after its completion by Richard Khuen, in an article before the Engineers' Club of Philadelphia, gives a categorical statement showing the extreme rapidity with which this contract was carried through. The first inquiry was received January 7; on January 13 cantilever erection was specified; three days later the statement of the maximum loading of the bridge