there is no proof that this was the earliest fitting. According to BION, it was DE LA HIRE who first suggested the ruling of lines with a diamond on glass. In 1748 Tobias MEYER ruled the lines on glass with ink; but it was G.F. BRANDER, between 1764 and 1773, who first succeeded in making diamond rulings. Ruling on glass was introduced into England by General SABINE in 1822, a glass diaphragm of this nature being fitted in a transit instrument.

A PROJECTOR FOR TRANSFERRING DETAIL FROM ODD-SCALE PHOTOGRAPHIC COMPILATIONS TO HYDROGRAPHIC SHEETS.

by

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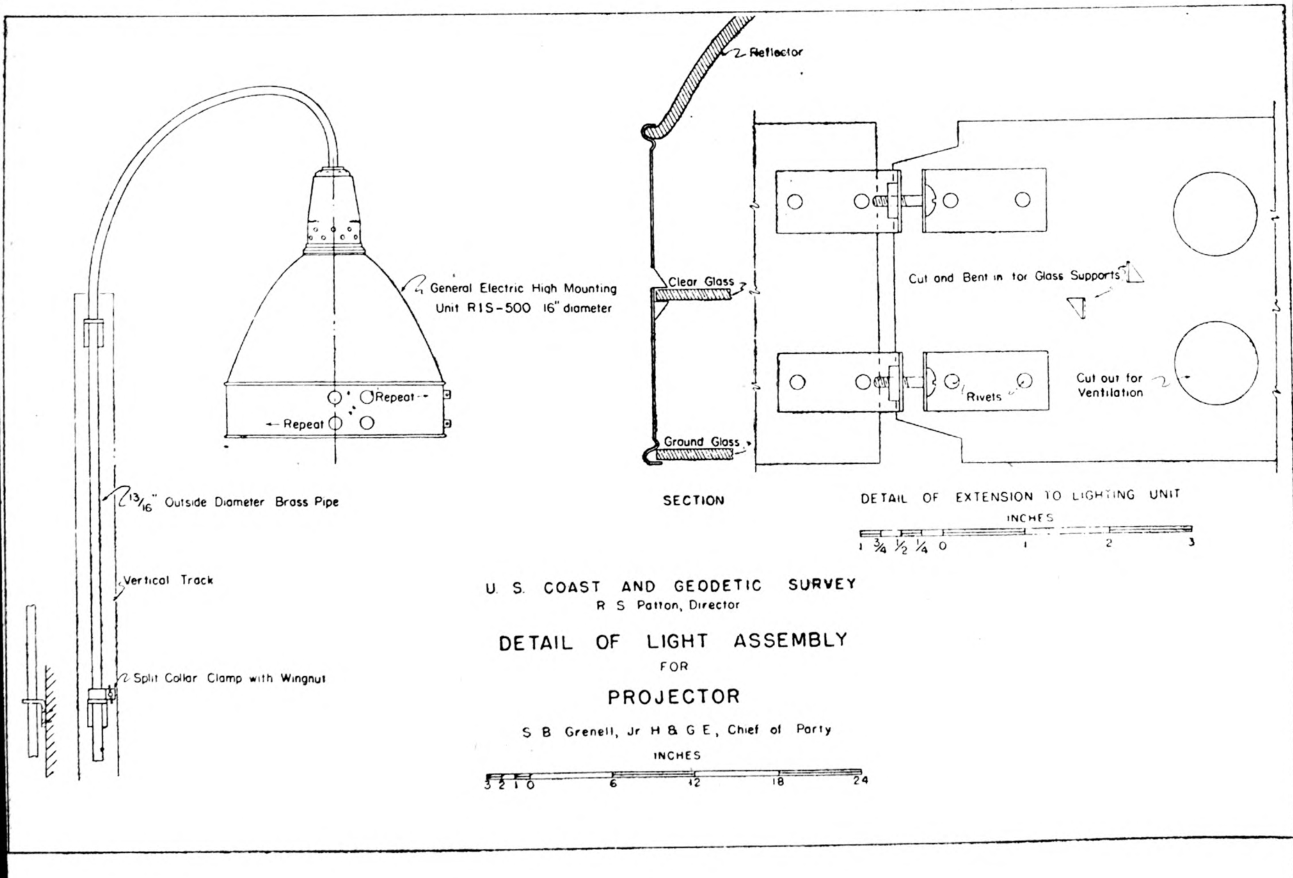
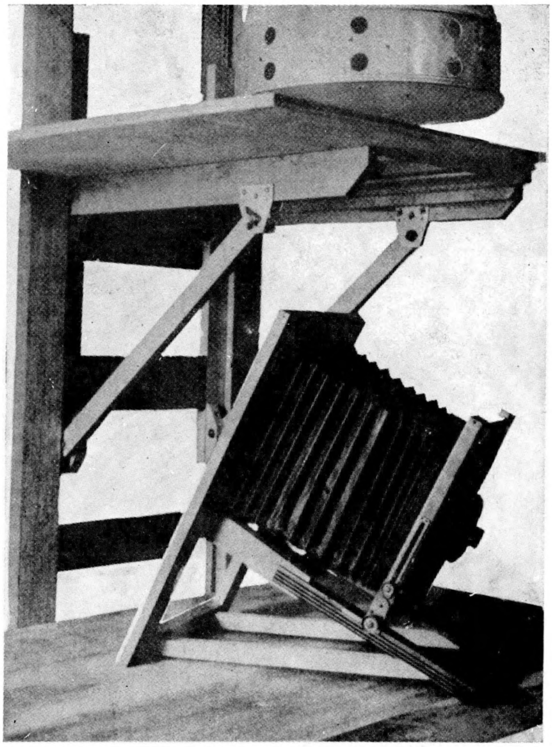
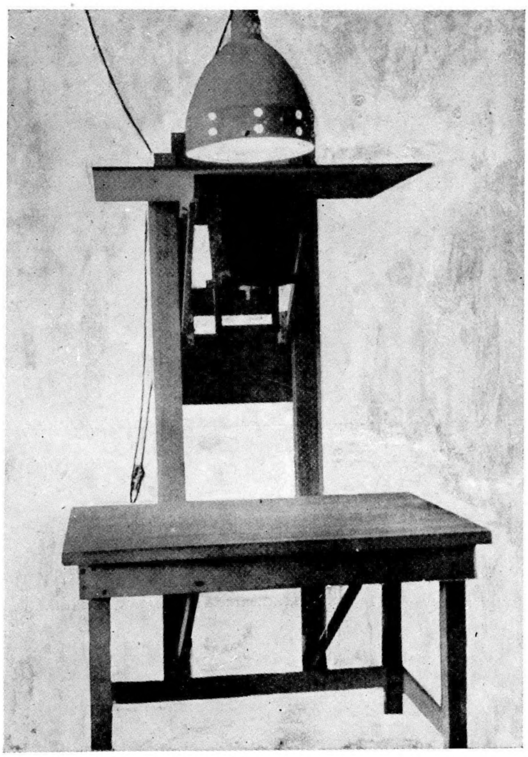
The air-photo project, sheets for which were compiled at Savannah, Georgia, by a field party of the U. S. Coast and Geodetic Survey, covered a strip of coastline approximately fifteen miles wide extending from the vicinity of Beaufort, South Carolina to the St. Johns Rivers, Florida. The entire project covered an area of 3051 square statute miles embracing 5414 statute miles of shoreline. At approximately the same time that photo compilation was begun, five separate combined operations parties took the field within the project area. These field parties had immediate need for the shoreline for hydrographic sheets, so the photo compilations were rushed through with shoreline only; the other detail being left to be added at a later date.







Except for a narrow strip of single lens photographs along the Inside Route, which were enlarged to true 1:10,000 scale, the photographs varied from the standard scales by 6 to 9 per cent. This made it impossible to transfer the detail to true scale hydrographic sheets by the usual tracing paper method. The next procedure was to forward the compilations to the Washington office as soon as the shoreline was completely traced in order that true scale photostats could be made. This procedure was very unsatisfactory for several reasons. The Chart Division was so rushed under the expanded program that they were unable to make the required photostats immediately thus holding up work on the compilations and hydrographic sheets where the shoreline was required. Also, the photostats, when received, were frequently so badly distorted that a great deal of adjustment was required in making the transfer tracings for the hydrographic sheets. This system had a further disadvantage in that it was necessary to go over each line three times in transferring from the photostat to the hydrographic sheet thus losing considerable fine detail in the process. A further difficulty arose in making comparisons in the field between detail rodded in on the aluminium mounted control sheets and the compilations. This comparison should be made, where possible, at the time the compilation is being traced, thus avoiding a great deal of difficult erasing at a later date.

After studying the problem for some time, it was decided that a type of enlarging and reducing projector similar to a photographic enlarging machine could be designed to meet the requirements. Various crude experiments were made with cardboard boxes fitted with an ordinary magnifying glass as a lens. It was immediately apparent that the principle was sound but that an accurate lens would be required. A great deal of credit for the development of this projector should be given to Mr. T. R. Cooper, who was employed at that time as a draftsman on the party. Mr. Cooper had considerable amateur photographic experience and owned a small 5"×7" enlarging machine which he brought down to the office and with which further experiments were made.

Authority to construct the projector was obtained and a suitable lens was furnished by the Washington office. A second-hand camera bellows and track was purchased from a local photographer and the main projector assembly designed to fit the camera frame and lens. A lens with a different focal length would require a change in the design of the vertical track.

The lens used in the design is a double lens assembly Bausch and Lomb Optical Co., Protar, Series VII, Focus 13-3/4" and 18-7/8". The camera bellows and track assembly are Eastman View Camera 2-D, 8"×10". The lighting unit is a General Electric 16" High Mounting Unit No R1 S-500. The pipe support and ventilated extension to the reflector were made locally. Bids for the wood work on the projector were received from local planing mills and the projector built under the supervision of the writer. The reflector extension is constructed from a strip of aluminium rolled at the edges to clamp at the top on the beaded edge of the reflector and to hold a sheet of ground glass at the bottom. V-shaped notches were cut in a double line along the center of the extension strip and the "tabs" bent in to form supports for a sheet of clear glass which acts as a screen to reduce the amount of heat reflected. A double row of 1" holes — above and below the glass screen — furnish ventilation and cut down the amount of heat reflected to the board. A 150 watt bulb will give ample illumination with a minimum amount of heat. A larger bulb may be used if the compilation is not left under the reflector too long.

The cost of the projector exclusive of the lens is as follows:

Second Hand Camera	$	25.00
Fabrication and Assembly of Projector	$	40.00
Reflector Unit	$	10.00
Reflector Extension Assembly	$	10.00
Reflector Support Assembly	$	5.00

The entire structure has been designed so that it may be dismantled and crated for shipment. This is an important factor since the projector will be used primarily in field offices which are shifted frequently. When the projector was tested out it was found to have an enlarging and reducing ratio of approximately 1 to 3 ½ which can be extended to 1 to 4 + by sliding the movable board above the top of the vertical track.

In transferring shoreline to hydrographic sheets the compilation is placed on the upper or movable board and the hydrographic sheet placed on the table. The scale is adjusted by a combination movement of board and lens until the projections match and the image is sharp. The shoreline can then be traced directly on the hydrographic sheet with no intermediate process. This can be done in a fraction of the time required to prepare tracings from photostats ; the cost of photostatic reproduction is eliminated, and the errors due to photostat distortion and repeated tracing are avoided. The principal advantage, however, is in the saving in time both to the hydrographer and compiler, in that the work is done as required in the field, and no time is lost on plotting or compilation while waiting for sheets to be returned to the field.

The projector was designed primarily for the transfer of shoreline but it was soon found to have other uses of only slightly less importance. All detail inked on the aluminium mounted control sheets can be quickly and accurately checked against the compilations by the method outlined above. Another important use is in the comparison of junctions between compilations of different scale. This process heretofore required tedious use of the proportional dividers which process at best was often inadequate where junction detail was intricate. Comparison with charted detail can be made in the same manner by projecting the compiled shoreline onto large scale charts of the section. This is very useful in checking structures along waterfront areas.

In several instances it was found that the paper of the hydrographic sheet had distorted. This distortion was generally greater in the direction of the long axis of the sheet thus "warping" the projection. This could be compensated for by "warping" the projected image of the compilation which is done by tilting the lens slightly or by shifting the lens in a horizontal plane or by both, thus making it unnecessary to adjust the sheet frequently while tracing an area.

Along the South Atlantic Coast the field topographer frequently finds areas in which it is exceptionally difficult or even impossible to carry planetable surveys for hydrographic control. This may be due to lack of precise control, unstable marsh land areas where set-ups are difficult or restricted ground visibility. Several such areas were found in Georgia, the most extensive being the Altamaha River above Darien. This river winds for a distance of 21 miles through a dense cypress swamp where planetable control is impossible, so Lieutenant C. A. EGNER, who was in charge of the hydrographic party, tried the following experiment.

The building party took aerial photographs of the area with them to the field, and spotted the hydrographic signals on these prints as they were built. The signal points were then carefully transferred to the mounted office prints and plotted on the compilation with colored ink by holding the surrounding radial points. This method assured a more accurate signal location than could be secured by spotting the signals on the compiled shoreline. The signals and shoreline were then projected directly on the boat and smooth sheets, and the colored hydrographic signals removed from the compilation. The field prints on which the signals were spotted were retained by the hydrographic party and forwarded with the hydrographic sheets in lieu of topographic control sheets. This system proved to be satisfactory and was used several times on the Georgia project and is being used at this time by Lieutenant J. A. BOND in the Pungo River area in North Carolina.

DEEP SEA ELECTRIC BOMBS.

by

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In order to carry out the experiments between the ships *Pioneer* and *Guide* to determine the velocity and ray paths of sound waves in deep sea water, it was necessary to perfect a bomb that would withstand the enormous pressure encountered at a depth of 1000 fathoms, as the original intention was to fire bombs at varying depths, with 1000 fathoms as the maximum. There was no available literature on the subject, and inquiries of the powder manufacturers showed that so far as they knew, the field was a new one. They were very much interested, however, to see how the standard detonators would work at such depths, for at 1000 fathoms the pressure is approximately 2700 pounds per square inch.