## ON STEREOSCOPIC PHOTOGRAPHY.*

By A. STROH.

IT is a matter of surprise and regret that so beautiful an invention as the stereoscope by Sir Charles Wheatstone, and its later modification by Sir David Brewster, should have shared the fate of other novelties, and should have been (at least as a popular instrument) a nine days' wonder. Probably the stereoscope will never become popular again—unless, perhaps, some new departure is made in it.

What is, however, more surprising is that amateurs do not more frequently avail themselves of the means at their command, through the stereoscope, of giving certain charms to their productions which they could not obtain in any other way—such as the effect of relief and solidity of the objects represented, as well as depth of scene.

I have heard it said that the reason why stereoscopic photography is not practiced more often is that it gives too much trouble, and requires more time than the amateur can generally bestow upon it. If this be the only disadvantage, then I think I can show that in order to produce a good stereoscopic slide no more trouble nor time need be expended than in making a half plate or quarter plate picture, if the proper means be at hand.

There is, however, one other obstacle, and that is that at the present time there are but few stereoscopic cameras in the market, and perhaps none at all of the detective class. But there can also be no doubt that makers of photographic apparatus will soon produce cameras and other necessaries, if they find that there is a demand for such articles.

*The Camera.*—The simplest way of obtaining a stereoscopic camera is by taking out the rising front of an ordinary half plate camera, and replacing it by a front with two lenses. The only other arrangement necessary is a partition inside the camera, which divides it into two compartments, and which can be made of thin wood, cardboard, or other suitable material.

Much can be done with such a camera, but since we are now moving in the right direction by using detective cameras for instantaneous work, a stereoscopic detective camera is what is really wanted.

In order to make a camera of the last named description, many conditions have to be fulfilled, and on this account, together with the fact that many of the parts have to be in duplicate, such a camera must necessarily be more or less complicated.

Having felt a strong desire to possess a camera of this class, and not being able to procure it in any other way, I have constructed one myself, a description of which I trust may be interesting to the members of the club.

This camera (Fig. 1) consists externally of a square box without any projections excepting a leather strap to serve as a handle. Its dimensions are 9 in. by 8 in. by 6¾ in. The back consists of a slide, which is drawn out when plates have to be changed. The plates themselves are in tin carriers, eight of which are contained in a compartment provided for them in the upper part of the box. The plates I use are the usual stereoscopic size—viz., 6¾ in. by 3¼ in. Each plate after being exposed is drawn down with its carrier into a lower compartment by a button or knob, which is concealed in the bottom of the box.

This shifting arrangement for the plates will be readily understood by those who are acquainted with the working of Samuel's patent back, for it is in fact nothing more or less. Instead of trusting, however, to the tin carriers for the exact position of the plate which is to be exposed, two brass supports are provided at the sides of the compartment, against which the face of the plate itself rests. In addition to these there are four movable supports touching the face of the plate in the four corners. These are attached to levers, which can be moved simultaneously by a cam in connection with an index concealed in the side of the box. The latter ar-

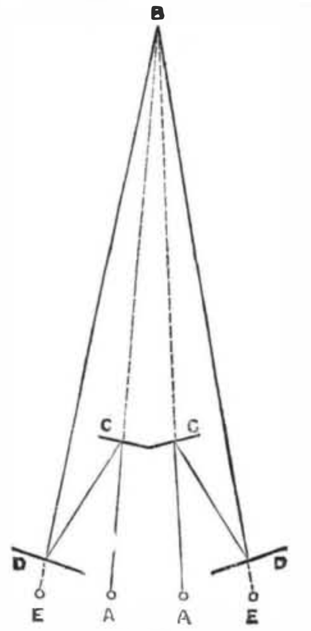


FIG. 7.

rangement is used for focusing. It has the effect of pushing the plates further away from the lenses, the extent of movement being controlled by the cam and index named.

Suspended by hinges in front of the box is a flap, which has to do duty in three ways. When closed, it protects the lenses from mechanical injury, and also keeps the light from them, while the shutter is being reset for exposure. When open, it forms a screen against top light. It is also in immediate connection with the catch or trigger of the instantaneous shutter, which it releases as soon as it is opened sufficiently.

The shutter works between this flap and the lenses, and consists of a thin leather screen or curtain, with two holes corresponding with the lenses, through which the exposure is made. The upper extremity of this leather shutter is fastened to a light revolving cylinder, mounted just above the lenses. The latter contains a spring, which can be wound up to a more or less degree by an index lever at the side of the box. (See Fig. 2.)

The action of this shutter is identical with that of an ordinary spring roller window blind. When it is being set for action, it is drawn down by a piece of catgut, which passes through the bottom of the box, and has a little knob at its end. There is a separate little spring barrel for the catgut, which winds it back into the box when released, while the shutter is prevented from being rewound on its barrel or cylinder by a catch, which can only be released by lifting the flap as above described. The time of exposure can be varied by this shutter from one-twentieth to a sixtieth of a second, according to the tension given to the spring in the cylinder.

Immediately behind the shutter are the lenses, which are a pair of Dallmeyer's rapid rectilinears, having an equivalent focus of 4 in. The distance between their axes is 3 in. They are mounted on a rising front, which can be moved up and down by an Archimedean screw, the end of which passes through the bottom of the box and carries an index.

The stops are all in one brass slide passing through both lens tubes, which are slotted to receive it. There are eight apertures in the slide, four for each lens. A spring catch is provided for locking the slide in four positions, in each of which two corresponding apertures are concentric with the lens tubes. The value of the apertures is $\frac{F}{7}$, $\frac{F}{10}$, $\frac{F}{14}$, and $\frac{F}{20}$. The stops are shifted by an index in the bottom of the box; attached to this index is a pinion, which, by means of a rack and a lever, communicates its movements to the brass slide.

The only other arrangement to be described is one which enables the operator to make time exposures. For this purpose a catch is provided in the same recess, which contains the index for the regulation of instantaneous exposures, which will lock the shutter when the two holes in it are opposite the lenses. The exposure is then made by lifting the flap to the full extent, in which position it will remain by itself during the exposure. It being necessary in such cases to place the camera on a stand, a brass socket is provided in the bottom of the box for a screw.

It will be seen by the above description that the box, or camera, contains all the elements necessary for taking any variety of subjects in or out of doors.

It may also be mentioned that the whole of the internal mechanism is attached to a light framework, which will slide out of the box when required, after simply opening the back. There are no bellows nor any other arrangement for reducing the size of the camera when not in use.

It will also be noticed that care has been taken to construct this camera in such a manner that all the most essential adjustments are controlled from below. This is a most convenient arrangement, as the levers and indexes are out of sight, and yet always ready for action. Even the operator does not want to see them, for his sense of touch suffices to work them. The indexes for focusing and altering the time of exposure are necessarily in the sides of the box; but they are not often required, and are, therefore, hidden by thin sliding covers.

With this camera, as with any other detective camera, an object or view has to be taken without seeing it first on a ground glass screen. Therefore, it is convenient to have a little view meter, which will help the operator to take up his position at the right distance from the object he is about to take. All that is necessary for this purpose is a little tube about 1 in. in diameter and ¾ in. long, with a thin plate fixed to one end, in which is a hole about ¾ in. square. When the open end of the tube is placed closely against the operator's eye, he can see through the square hole at the other end of the tube how much of the subject is included in his picture. He will also fix in his mind the center of the

* Read at the Camera Club April 5,—*Engineering.*

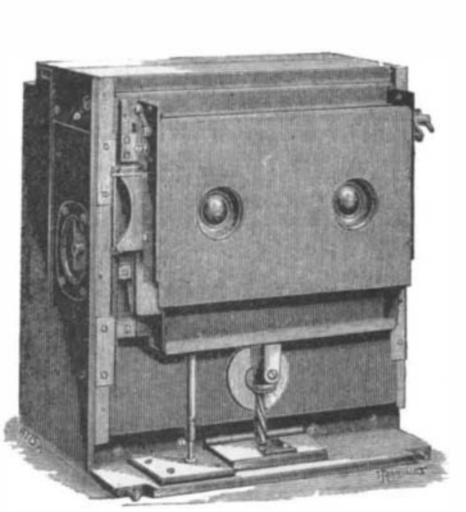

FIG. 1.

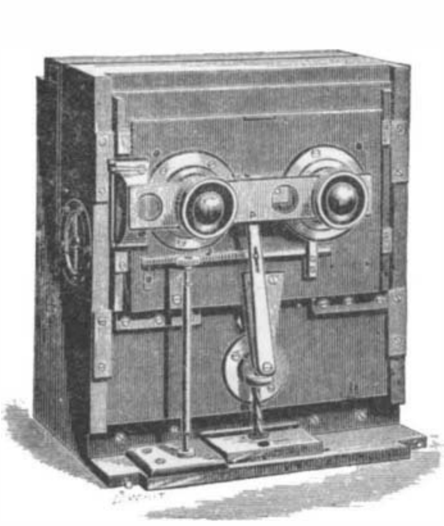

FIG. 2.

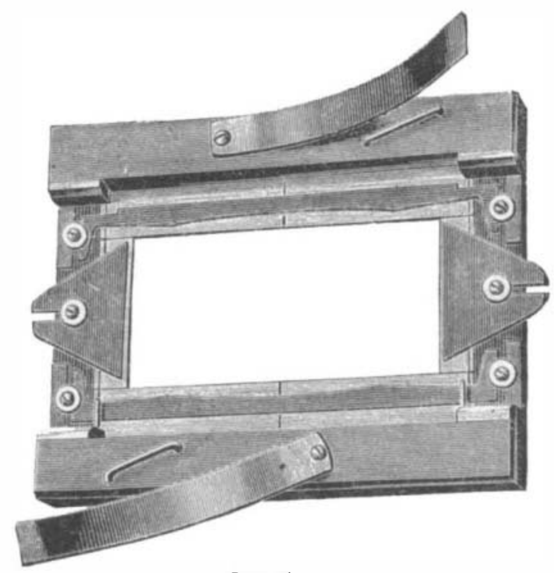

FIG. 4.

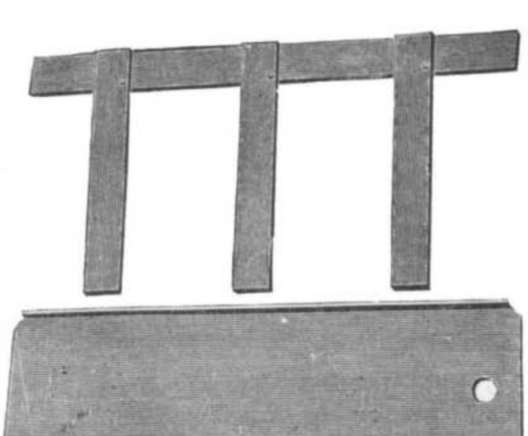

FIG. 3.

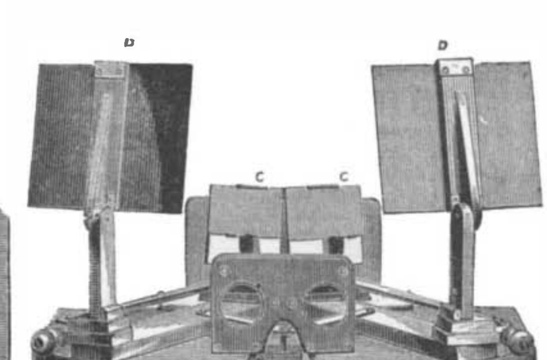


FIG. 6.

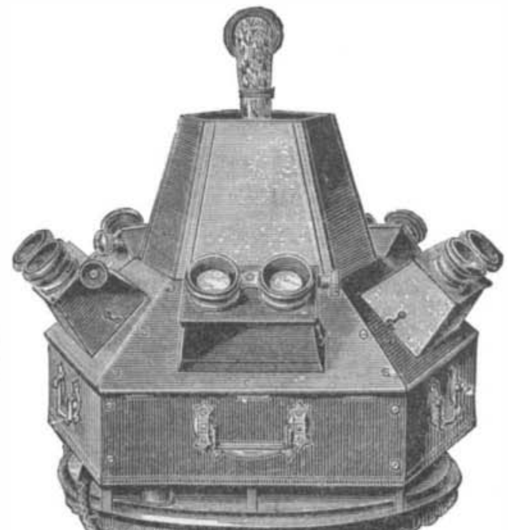

FIG. 5.

STEREOSCOPIC PHOTOGRAPHY.

picture against which he has to direct his camera, and he will also see, by imagining a horizontal line through his picture at the same level where he stands, whether it is advisable for the front carrying the lenses to be raised or lowered. He makes the necessary change; the shutter and stops are supposed to have been set already; and all that remains to be done is to direct the box toward the central spot in the intended picture, lift the flap until he hears the shutter act, and the exposure is made. He then pulls the button or knob for changing the plates, resets the shutter, and all is ready for another exposure.

The focusing arrangement is not often required; it is, however, useful in cases where one wishes to take a near object or group. For this purpose it answers very well to ascertain how many paces are required to walk from the object to the spot from which the photograph is to be taken, and to set the focusing index to that number, the scale being divided for the purpose.

*Printing.*—In printing from a stereoscopic negative, two important conditions have to be considered. In the first place, it must be borne in mind that, through the well known course of things, the two pictures on the negative are reversed—that is to say, the right hand side of the view is on the left in each picture, and *vice versa.* A print from a stereoscopic negative has therefore to be divided in the middle, and reversed in mounting. The second condition is that care should be taken to mount the two pictures in such a manner that the mean distance between the same object in each of the two pictures be not more than 2⅝ in. If they are too far apart, most persons fail to combine the two pictures in the stereoscope, and therefore they cannot see the stereoscopic effect.

It is true that stereoscopes vary, and so do observers' eyes, and the distance between them; it is, therefore, impossible to make stereoscopic slides to suit everybody's sight. A happy medium has therefore to be adopted, and the condition given above I believe to be that medium.

A well known method of printing from a stereoscopic negative is to cut the sensitized paper double the length of one print, and fold the two ends back, so as to meet at the middle of the strip; then print both sides while the paper remains folded. The strip may hereafter be unfolded and cut through the middle, whereby two stereoscopic prints will be the result, each of which may be mounted in one piece.

However ingenious this method may be, it has its disadvantages, and can only be carried out when the two pictures on a negative are perfectly upright. But, when working with a detective camera, on account of the difficulty of holding it in a perfectly vertical position, the resulting pictures are seldom quite upright, which is a matter of indifference, provided one has the means of making them upright afterward.

For this reason, I have adopted the plan of cutting the negative in two halves, and afterward fixing them, reversed of course, in a printing frame constructed for the purpose. The advantage of this plan is that when the two halves of the negative are once properly adjusted in the printing frame, any number of prints can be taken from them without further adjustment in mounting or otherwise.

For the purpose of cutting the negative I have contrived a very simple tool. It consists of a thin board, a trifle larger than a negative, and what may be called a triple T square. (See Fig. 3.)

The negative is placed face downward on the board with a white paper between, and the T square over it. It is then necessary to shift the negative so that the vertical outlines of building, or other objects in it, are parallel with the blades of the T square. Three cuts are then made with a diamond along the three blades, the middle cut dividing the negative exactly between the two pictures.

It will be seen that by the adoption of this device, besides the two pictures being made upright, the distance between the similar objects in a finished print is determined by the distances between the three blades of the T square. If, therefore, the latter be once properly adjusted, any number of negatives from the same camera may be divided without paying further attention to adjustment.

The printing frame, in which the two halves of the negative have now to be placed, is an ordinary half plate frame with a few additions.

The first of these is a piece of thin plate glass for a support fitting the frame. Over this is laid a mask of thin cardboard, also fitting the frame accurately, having a rectangular opening of 5¾ in. by 2⅝ in. (These dimensions may have to be varied slightly for negatives taken in different cameras.) Next to the mask are four adjustable slides, as shown in Fig. 4, for the purpose of holding the two halves of the negative in position. These slides are made of sheet zinc, and must be less in thickness than the glass of the negatives.

*Transparencies.*—We now come to the most pleasing part of stereoscopic photography, which is the production of transparencies. These can be made with the aid of a stereoscopic copying camera, the advantage of this method being that the negative can be preserved as a whole, for the inversion of the two pictures is corrected by the second inversion which takes place in the copying camera.

A copying arrangement of this kind is, however, an expensive item. It is, moreover, much more convenient to obtain transparencies by contact printing. The printing frame above described is admirably suited for the purpose.

It must be borne in mind that a transparency made by contact printing has to be viewed with the film side toward the observer, otherwise it will be seen reversed. A thin glass must be put over it for protection, and in a transparency thus made it is impossible to apply the usual ground glass at the back without adding a third glass, which would be objectionable.

A transparency without ground glass, as just described, when viewed in a stereoscope, also without ground glass, while the same is held over a sheet of white paper, is, however, all that can be desired for effect, and is the cheapest and simplest form of transparency.

At the same time, it is not always convenient to hold the stereoscope over a white paper, and in that case the coarse ground glass in the stereoscope, and the fine ground glass at the back of the transparency, are necessary for the diffusion of light.

Transparencies of the latter description can be obtained by proceeding as described; but instead of using plates of the usual make, to have special plates prepared of ground glass with the film on the polished side.

The transfer papers lately introduced, such as Eastman's transferrotype, make also very good stereoscopic transparencies. The paper in this case is printed by contact, and after development squeezed on to a glass on which the film remains after the removal of the paper support.

Looking at the film side of such a transparency, the picture is reversed, and in order to see it like its original it has to be turned round so that the film is at the back of the glass. This is, however, precisely what is wanted for a stereoscopic transparency, for all that remains to be done is to put a plain or ground glass behind it according to taste.

*Multiple Stereoscope.*—I have now to say a few words respecting the best way of showing a collection of stereoscopic transparencies to a number of persons. Any one possessing a large number of transparencies arranges them, naturally, in a certain order, in which he desires to show them. Or it may be for the purpose of easily finding any particular one or other. He can certainly have several stereoscopes, and hand them round with pictures, but the consequence of such a plan is that the latter will not be returned to him in the same order as given out, and his collection will be subjected to confusion.

Bearing in mind this inconvenience, and also the fact that all attempts to enable a number of persons to view the same stereoscopic picture simultaneously have failed, I have constructed what may be called a multiple stereoscope, which I find exceedingly convenient for exhibiting transparencies. (See Fig. 5.)

It consists of a light five-sided box, with five stereoscopes arranged around it. It could, of course, be constructed for any number.

One of the sides of the box opens on hinges, and gives access to the interior, where there is a framework capable of revolving on a central pivot. This framework is so constructed that five transparencies can be placed on it, so that each of the latter is viewed through one of the five stereoscopes. The framework surrounds a white disk, against which the stereoscopes are directed, and which is illuminated by a lamp suspended in the center. This disk revolves with the framework, and is provided with five notches, into which engages a spring lever, locking it in five positions where the transparencies or pictures are opposite the stereoscopes.

The change of pictures takes place through the side of the box which opens, and after each change the spring lever is withdrawn, while the disk is advanced one-fifth of a revolution, so that each picture has to travel round from one stereoscope to the other.

When constructing this instrument, I soon found, however, that it was extremely unpleasant and even painful to the eyes to look in one of the stereoscopes while the change of pictures took place. I had, therefore, to provide all the lenses with shutters, which close automatically during each advance of the inner framework.

*Binocular Perspective.*—Without exactly entering upon the theoretical field of binocular vision, I have to say a few words respecting it, in order that we may recognize the best conditions for the production of stereoscopic pictures.

If we look at an object with both eyes, the line of sight of one eye forms an angle with that of the other, and the one eye necessarily receives an image of that object slightly different from that seen by the other eye. Upon this angle of vision, as it is called, or, in other words, upon the difference of the images received by the two eyes, mainly depends our estimation of depth of solid objects, as well as distance between objects in the direction of the line of sight.

The nearer we are to an object, the greater is the angle of convergence of the lines of sight, and the better are we able to judge of the depth and solidity of such an object. But as the distance between the observer and the object increases, this angle diminishes until the lines of sight become almost parallel. The image in one eye is then practically identical with that in the other, and under these circumstances we no longer see what is called binocular perspective.

It is for this reason that distant scenery seldom makes a good subject for the stereoscope; the two pictures in such a case being so nearly alike that we fail to obtain thereby stereoscopic relief, or perspective. We should, therefore, choose subjects at not too great a distance for stereoscopic pictures, or, if we take distant views, care should be taken to have a foreground, without which our picture will look flat and uninteresting.

In order to obtain the effect of binocular perspective in the stereoscope, as we see it when we look at natural objects, we have to consider two distinct factors. These are the focal length of the lenses of the camera, and the distance between them.

Taking the latter condition first, a glance will tell us that we cannot do better than adopt for the separation of our lenses the same distance which separates our two eyes, which is, on an average, 2½ in. There are, however, reasons for making the distance between the lenses somewhat greater, since the pictures cannot be larger than 2½ in. if the lenses are only that distance apart. Pictures somewhat larger can be obtained by increasing the distance between the lenses, the necessary consequence, however, being distortion in the shape of exaggerated perspective.

If not carried too far, this exaggeration of perspective is permissible, and is almost necessary, for many persons cannot appreciate binocular perspective in the stereoscope at all unless it is exaggerated, and very few persons indeed can detect a moderate exaggeration of perspective.

Our power of correctly estimating distances in the direction of the line of sight by binocular vision is an acquired faculty, the extent of separation of our eyes being arbitrary, and we should be able to do it as correctly if our eyes were further apart from each other.

If it were possible for the distance between the eyes to be suddenly augmented, we should for some time see everything in exaggerated perspective, until we should gradually associate again in the mind the true dimensions of things with their images, as seen by our eyes. If, then, the distance between our eyes were suddenly restored to its former condition, we should see for a time everything in flattened or diminished perspective, until we again became used to the altered state of things.

In order to verify this fact experimentally, I have constructed an instrument which proves it in a striking manner. A A (Figs. 6 and 7) represents the two eyes of an observer looking in the direction of an object, B. The view is intercepted by reflectors. and the image of B can only be seen by the double reflection from the reflectors C C and D D. The result of this arrangement is the same as if the two eyes were looking from the points E E, and, therefore, a much larger angle of vision is obtained.

The instrument is so constructed that the distance between the reflectors, D D, can be varied up to about 12 in., so that an observer has thereby the means of gradually increasing his angle of vision. Any one looking through this instrument at another person's face, for instance, at about 4 ft. distance, will see the face become more and more elongated in the direction of the line of sight, as the reflectors are more and more separated from each other.

If, after gazing intently for a minute or two at this exaggerated perspective of the face, the observer suddenly looks over the instrument at the face direct, the contrary effect is produced, and for a short time the face appears perfectly flat, and without any perspective.

From what is said above, it appears that it is by no means necessary to adopt the distance between our eyes accurately for the extent of separation of our lenses in constructing a stereoscopic camera, although we must be guided to some degree by that distance. But there is nothing to guide us, so far as I know, in determining what should be the focus of our lenses, except trial or experience; and I should expect to find considerable diversity of opinion on this point. All I do is to give my own experience.

I have experimented with lenses varying in focus from 2½ in. to 10 in., and have come to the conclusion that lenses with an equivalent focus of 5 in. and a distance of 2¾ in. between their axes are about the best proportions when exaggerated perspective is not desired. For a moderate exaggeration, however, the distance between the lenses may be increased to 3 in., and their focal length may also be reduced to 4 in.

Lenses with too long a focus have the disadvantage of taking very little subject in the limited field of a stereoscopic slide; they have, moreover, the effect of diminishing perspective; while lenses with too short a focus certainly include more subject, but not without the consequent disadvantage of over-exaggerating the perspective. It is true that the disadvantages of too long a focus may be compensated by a much greater distance between the lenses; but in that case, the relation between binocular and geometrical perspective is no longer such as we are accustomed to. The result, therefore, must be more or less unnatural.

Volumes might be written on this subject; but I trust what I have said may prove useful to those who are thinking of taking up stereoscopic photography, and if by bringing this subject before the Camera Club I have stimulated, even to a small degree, a revival of this beautiful and fascinating branch of photography, my object will have been attained.

## CRYOLITE MINING.

I TALKED with two old-time sea captains the other day. One of these hardy navigators was a tall, full-faced, well built, benevolent looking man, Captain Louchlan McKay. In command of the Sovereign of the Seas, one of the famous old clippers that once made Americans proud of their merchant marine, Captain McKay left New York for San Francisco in August, 1851; the freight money amounted to $85,000—a very large sum to-day; a barrel of flour in San Francisco in those days of gold fever sold for about $45. Off Valparaiso, in a storm, Captain McKay's ship was dismasted but rigged up again and reached her destination in 102 days, which was a quick passage. Discharging her cargo, the gallant clipper sailed for Honolulu and loaded with oil for New York, and made the extraordinary time of 82 days.

For 10,000 miles she sailed without tacking or wearing, and in ten consecutive days she made 3,300 miles. But the days of the noble old clippers are gone, and I went to see this veteran of the sea about the ships that trade with Greenland. His are the only vessels that go regularly to the far-off land of Kane. They go out in ballast, for although Greenland imports wheat, brandy, coffee, sugar, tobacco and fire wood, it is not from this country. They bring back a mineral termed cryolite, which they obtain at a port called Ivigtut, on the southwest coast of Greenland. It is a bleak country, even in the short summer, during two months of which, June and July, the sun is always above the horizon. Mosses, stunted shrubs, dwarfish trees and huckleberry bushes are about the only vegetation, and the bare mountains in the grip of the great glaciers and the generally dead and desolate aspect of the country make it appear as strange and unreal as that gray corpse of a world the moon.

Cryolite looks like ice, and hence the name signifies icestone. It is all taken to Philadelphia, and is used in manufacturing soda, alum, lye, porcelain piano keys, door knobs, clock dials, and other articles. The seven barks in the trade each carry about 800 tons of this mineral and make fourteen voyages in a year. Last year they brought 8,400 tons to this country. Those at Ivigtut are the only known mines in the world. Specimens of this mineral have been found in the Ural Mountains and on Pike's Peak, but no other actual mines but those in Greenland are known. It takes 20 days to go to Ivigtut, and 30 to return. The Danish government owns the mines, and they are worked by a company that pays a royalty to that government.

The vessels in this trade are built unusually strong in order to withstand the rigors of that frozen region; they have steel plates on the bow, iron on the stem or forward part of the vessel, double planks on the sides, and are filled in with timbers, and yet three years ago one of the staunch barks was lost in the ice, and one that reached the open sea was never afterward heard from. The danger is not so much from icebergs as from the great blocks of floating ice or "floe ice." For eight months of the year, or in the winter season, it is a continuous night, and navigation is especially dangerous. During the four summer months of the year vegetation makes rapid progress, but it is of a dwarf-