[For the Scientific American.]

Photographs and Stereoscopic Angles.—The True Theory.

The scientific world have justly awarded to Prof. Wheatstone the honor of discovering that two distinct pictures of nature, taken from different points of view, may be made to coincide as one, and appear like a model, or solid in perfect relief. For this purpose Wheatstone arranged an instrument using reflectors, and named it the "Stereoscope," from two Greek words, which mean "seeing solids." Another instrument was constructed with an arrangement of lenses by Brewster. The perfect human vision of the two eyes is stereoscopic, and with a little careful practice two pictures, 6 by 8 inches in size, may be seen stereoscopically without either reflectors or lenses. The fact of the apparently solid combination having been established, it was not difficult to comprehend that daguerreotypes and other photographs might be readily made to answer the purpose admirably. Thus we see how the question must arise at once as to the points of sight from which to make the two pictures, or, in other words, an inquiry for the correct stereoscopic angles. An article of eighteen pages in the *North British Review* for May, 1852, gave very elaborate algebraic calculations for varying the angles according to the distance of the points of sight from the objects to be pictured. The space between the eyes, or two and a half inches, was to be the distance of eighteen inches from the object; and twelve feet from the object, the space between the points was to be eighteen inches. Sir David Brewster read a paper before the British Association for the Advancement of Science, and illustrated his theory by experiments, attempting to prove that the distortion universally noticed in the stereoscopic picture was caused by using lenses larger than the lens of the eye, and this theory was very generally embraced. In March, 1852, Messrs. Southworth and Hawes, of Boston, Mass., simultaneously discovered in their course of experimenting that the directions of Wheatstone were not correct as to the points of sight, that instead of these being on a horizontal line, the two points should be at an angle of 45 deg. with the horizon; that is, as far as one point is carried from the other to the right or left horizontally, so much must it be raised or lowered perpendicularly, and that the average space between the eyes is as near the proper distance for each movement as under the various circumstances can be attained. The pictures thus taken combine perfectly, without distortion, and appear to an artist's eye correct in drawing, and in perfect proportion. As there have been so many theories advanced, it is not to be presumed that a new one will be embraced without a clear philosophical demonstration of its principles.

1. Binocular Vision.—There is delineated upon the retina of each eye different images of the same objects, because the eyes occupy different points of sight. The slightest change in position varies the images upon the retina, and the universal joint of the neck; and our means of locomotion permit us, in judging of sizes, distances, and proportions, to realize very many different views of objects much quicker than we can express our judgment by language. In a fixed position, with the eyes on a horizontal line, we do not see objects in nature as they are, or in other words, the assumption that "the human eyes are only placed two and one half inches apart, and see solid objects in their proper solidity and relief" is incorrect and untrue, either in fact or in theory. With the two eyes on a horizontal line, all horizontal lines of objects towards which we direct our vision, whether near or distant, appear on the same plane. We see nothing over or under one line with one eye that is not seen with the other. We could, therefore, draw on one canvas all the horizontal lines seen with both eyes. Not so the perpendicular lines. With the right eye we should see lines beyond and around the nearer ones not seen with the left; and so with the left eye we should see lines around and behind not seen with the right. We could not draw the perpendicular lines, seen with both eyes, on one canvas, or in one picture. The perpendicular lines would have their own planes, and each would be different and in perspective. For example, suppose a cylinder supported horizontally by two columns; take a stand directly opposite, at equal distances from each column; the cylinder will appear, on its upper and under outline, to touch what lies in the background, whilst the columns will come forward to their proper places. Nothing will appear to one eye behind the cylinder that does not appear to the other, but each eye will see behind the columns in the background something not seen by the other eye. It is not a fact, then, that the human eyes see objects in nature as they are from two points on a horizontal line. Let us suppose, instead of the left human eye occupying the present horizontal relation which it does to the right eye, that it had been placed first as far over its present position as it is removed from the right horizontally, we should then, in one fixed position, have seen around on right and under objects with the right eye, and as far around on the left, and over objects with the left eye. We should see over horizontal lines or under as much as we see to the the right or left of perpendicular ones. Each horizontal line would be in the same picture plane with its own perpendicular. Each eye would require its own canvas to picture what it sees, both horizontally and perpendicularly. As, however, our eyes are placed in the best position, considering their various relations and uses, we are given the universal joint of the neck, and powers of locomotion, so as to change them into the particular positions which our various duties may dictate. We feel, on reflection, that the common phrase "unless my eyes deceive me," is neither inappropriate nor improper.

2. Stereoscopic Pictures.—A picture may represent nature as seen with one eye in a fixed position; but until Wheatstone arranged the stereoscope it required a model of nature—the actual sculptured forms of things—to represent what we see with two eyes, or to represent solidity. Wheatstone taught us that two pictures might be so arranged as to appear solid and statue-like, showing relief, not by lights and shadows, but by difference of outline, by combining them into one apparent image, the same as the images on each retina combine to show us nature itself. But it was seen at once that the pictures made and arranged according to Wheatstones' theory were out of proportion and out of drawing; that whilst they were wonderful as curiosities they were also wonderful monstrosities. In *this fact*, Brewster and others were not mistaken; and had they not erred in assuming that "objects seen correctly with the eyes when pictured, and the images again reproduced upon the retina from the pictures, instead of showing nature, were distorted and disproportioned," they would doubtless have finished the solution of the problem of the stereoscope so well commenced.

Having shown that the human eyes in one fixed position do not see solid objects correctly, it follows, of course, that an exact reproduction of the same images upon the retina will produce again the same imperfections. As it is not known how to combine more than two images in the stereoscope, and whilst viewing them we cannot change the outlines by inclining the head to the right or left, or changing place, we ask, "From what two points of sight, in any case, shall pictures be made and arranged to represent nature without any distortion or disproportion?" The true stereoscopic angles are always upon a line at an angle of 45° with the horizon, and about three inches and six-tenths apart. This is for the average space between the eyes, allowed to be two and one-half inches. It makes no difference which way the angle is drawn, as it regards the relative proportions of the picture or its correctness. Having selected one point of view, there are four other points from which a correct stereoscopic combination may be made. These four points are the four angles of a square, whose sides are five inches, two sides horizontal and two perpendicular; the first position being the interesting point of two lines drawn diagonally from opposite angles. This is correct for any distance beyond the focus of the ordinary vision. For objects very far off, or for microscopic objects, an allowance must be made, so as not to exceed that distance which will permit the two pictures to combine easily without troubling the vision or appearing double.

We come now to the only difficult question in connection with this subject. Do the lines of objects in nature in the same plane as the two points of sight taken at an angle of 45° with the horizon, and arranged in the stereoscope, show proper relief and assume their places, or do they appear to touch the background? The answer is, they appear in precisely the same relief as their own horizontals and perpendiculars, and appear true to nature.

Explanation.—Nature is solidity, and the stereoscope represents it as solid. Nature has her horizon or water level; the horizontal supports or balances, the perpendicular. In whatever position we place our eyes, or however we may view nature, we are conscious of the horizontal and the perpendicular; we measure every other line or angle from the horizontal to the perpendicular. Every intermediate line must have its own horizontal and perpendicular, and these are its support. The horizontal and perpendicular lines supporting one another being each to its own position in nature and in the stereoscope. Thus a brace at an angle of 45° must have its support from its perpendicular post, and though viewed in a stereoscopic representation, will assume its proper place, whether the post or beam to which it attaches is in the view or not. It bears the same relation to its supports as though they were pictured in the view. These are principles upon which the value and perfection of stereoscopic pictures depend, and they are as unchangeable as any problem in geometry. This theory, and the peculiar manner of taking the pictures is our own by discovery, and covered by letters patent in the United States and England.

Albert S. Southworth.

Boston, 1855.

The Blow Fly.

Messrs. Editors—I noticed, some time ago, in a number of the Scientific American, an article on the "blow-fly," stating that the eggs were hatched after a deposit. This is not the case with the blow-fly, or screw-fly (so called here,) so well known and dreaded by Texas stock raisers. It belongs properly to the order *diptera*, div. *muscidæ*, and the eggs are hatched the body of the female, the maggots being brought forth alive. I have frequently noticed this. Their appearance is much the same as the woods-fly (*hippobasca*,) but more distinctly marked. B. C. C.

Texas.

Overshot and Turbine Water Wheels.

Messrs. Editors—It would be well if some of our hydraulic engineers would get up the very best turbine wheel possible; and do the same with an overshot wheel; have each favorably situated, give each the same amount of water, couple them together, and see which will run the other back. It will not do to talk about a turbine being superior to a favorably situated overshot; if they will try the experiment they will find the turbine running backwards. The argument I shall not enter upon.

J. H. J.

[This would be an expensive experiment, and it is not likely that it will be tried very soon, at least with large wheels. But surely the brake is a good test for both kinds of wheels; it is as fair for one as the other.

Ancient Indian Mortars.

The Placerville (California) *American* says, that in almost every locality in the mining districts are found, at all depths from the surface, and generally upon the bedrock, these ancient mortars, relics of an ancient race. We say this because the present race do not use them of the form we find them. The only means used by the present race for rendering their acorns and seeds to flour, is by the use of pestle-shaped stones, in their primitive unworked form, upon the surface of rocks, or in circular cavities, worn sometimes to the depth of a foot by the repeated use of the pestle or pounder; while the mortar of olden time is a boulder, nearly round, and from six to sixteen inches in diameter, a little flattened at the bottom, with a cavity from half to three-fourths its depth from the top, and of a material entirely different from all adjacent rocks. The pestles, too, almost always found with these mortars, show much work to have been bestowed upon their formation. How came these ancient relics so deep beneath the present surface of the ground, sometimes fifty feet? Seldom if ever found in the bed of rivers, but often in tunneling the hills, where strata of lava and conglomerate rocks lie many feet thick above the earth in which they are imbedded. California presents a wide and almost untrodden field, not only for the geologist, but the antiquarian, because so new, and its physical formation so peculiar.

Bronze.

The analysis of a few pieces of bronze, of undoubted antiquity—namely, a helmet with an inscription (found at Delphi, and now in the British Museum,) some nails from the treasury of Atreus, at Mycenæ, an ancient Corinthian coin, and a portion of a breast-plate or cuirass, of exquisite workmanship (also in the British Museum,) affords about 87 to 88 parts copper to about 12 to 13 tin, per cent. The experiments of Klaproth and others give nearly the same results as to ingredients; the quantities sometimes slightly differ. Lead is contained in some specimens, as has been shown. Zinc, and the nature of it, was not known to the ancients. In an antique sword, found many years ago in France, the proportions in 100 parts were 87-47 copper, 12-53 tin, with a small portion of lead, not worth noticing.

Bell metal is a compound of 80 parts copper to 20 parts of tin. The Indian gong, so much celebrated for the richness of its tones, contains copper and tin in the above proportions. The proportion of tin in bell metal varies, however, from one-third to one-fifth of the weight of copper, according to the sound required, the size of the bell, and the impulse to be given.—M. de Arcet, of France, has discovered that bell metal formed in the proportion of 78 parts copper, united with 22 of tin, is indeed nearly as brittle as glass, when cast in a thin plate or gong. Yet if it be heated to a cherry red, and plunged into cold water, being held between two plates of iron, that the plate may not bend, it becomes malleable. Thus he manufactures gongs, cymbals, and tantums out of this compound.

Coal in Turkey.

At Heraclea, a distance of twelve hours sailing from Constantinople, there is an abundance of good coal, but owing to the supineness of the Turks, it has not been made available until the past year. An English company has made a contract with the Turkish government, and has to pay about two and a half dollars as a rent upon every tun raised. It is calculated that 60,000 tuns will be raised this year, a fine market for its sale being the supply of the steamships in the Black Sea.

The First Time Keeper Made Out of Clay.

M. Raby writes, from Paris, that this great industrial achievement was deposited at the Exhibition on August 22, and that it was inspected by the Queen and Prince Albert with amazement and admiration. The following is an extract from his letter:—"My famous pocket chronometer, made out of the precious aluminium, has been placed in the Panorama, alongside of the bars of the same metal; it keeps time very correctly. All the works, plates, cogs, and wheels, are made of aluminium; and I really believe it is much better for purposes of this kind than the other metals generally employed. It is much lighter, does not require so much power to conduct the wheels, and, therefore, with a heavy balance, will obtain a better result of regularity. It is very hard and smooth when hammered, and the friction will be reduced to almost nothing."—[London Mining Journal.

Varieties of Speed.

The velocity of a ship is from 8 to 18 miles an hour; of a race-horse, 29 to 33 miles; of a bird, 50 to 60 miles; of the clouds in a violent hurricane, 80 to 110 miles; of sound, 823 miles; of a cannon ball (as found by experiment,) from 600 to 1000 miles; of the earth round the sun, 68,000 miles—more than 100 times quicker than a cannon ball; of Mercury, 104,000 miles; of light, about 8,000,000 miles, passing from the sun to the earth in about 8 minutes, or about a million times swifter than a cannon ball.

The old custom of lighting up the mills of Lowell, and continuing the work until seven and a half o'clock in the evening, is discontinued for the present season. Work now ceases at half-past six o'clock, thus giving the operatives the use of long evenings.

[Good.