THE STEREOSCOPE.

IF, while standing perfectly still and steadily looking at an object, we close alternately first the right eye and then the left, we observe that the object appears to shift its position, and that it does not present the same aspect to both eyes. The right eye sees it under one angle, and the left eye sees it under another angle; and, when it is seen by both eyes together, those two different angles are no longer perceptible, and we see it only in one point of view. The fact is plain enough, and the experiment easy enough; the reader may try it without further trouble than the closing first of one eye and then of the other, and thus ascertain the accuracy of the statement. Properly to estimate the difference of the angle as seen by each eye, requires a little care and close observation. Arrange, for instance, a few things on your table, a book, a candlestick, a vase, any two or three objects in such proximity to each other as to form a group. Retire from them some distance, place your head firmly against the wall, close one eye—notice distinctly the exact angle of each of the objects on the table, and their relation to each other; then close the open eye, and open the closed eye, and compare the different angles which each object presents to your gaze. If this is done with care and attention, you will observe that the difference is such as, in fact, to form two distinct pictures.

Another illustration of this fact may be obtained by holding a thin book in such a manner that its back shall be exactly in front of the nose, and at a little distance from it. It will be observed, that by closing first one eye and then the other, the perspective view of the book differs according to the eye with which it is beheld. With the right eye, the right side of the book will be seen very much foreshortened; a corresponding view will be gained of the left side with the left eye, and the lengths of the different lines will be found to vary in the different views. On looking at either of these views singly, the only idea of solidity that can be acquired is that to which the mind is led by the association of such a view with the touch of the object it represents.

These two aspects of the same object admit of a very easy explanation. The right eye of the spectator looks at the object in one point of sight, the left eye looks at it in another point of sight, and the difference of the angle under which the object is seen by each eye answers to the distance which separates the one eye from the other.

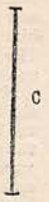
Leonardi da Vinci observed this phenomenon of vision, but did not apply it to any practical purpose. Many persons have noticed the same fact, but have not examined into its philosophy or application. To Professor Wheatstone we are indebted for a really useful, practical result of the observation of this interesting law of vision; he has examined into the principles of the phenomenon; he has traced the difference between the two objects seen by our two eyes; has shown how it is that the two objects are united when looked at by both eyes at the same time; how from the double angle, at which each object is necessarily seen, we derive our idea of solidity; and he has illustrated his theory, and fully established his principles, by one of the most interesting of philosophical instruments—namely, the stereoscope.

The stereoscope gives to a flat picture or photographic impression all the apparent solidity of the natural objects it is designed to represent. It no longer appears as a simple picture, but assumes all the roundness, distance, and effect of the object or objects from which it has been taken. The illusion is perfect. No artistic skill, however great, ever attained anything at all approaching it. There is nothing—if the size and colour of the stereoscopic picture bears out the illusion—by which we can distinguish it from Nature.

This curious effect is produced by a simple application of the laws of vision. We have two photographic pictures, at angles answering precisely to those under which the object or objects are beheld by the right and left eyes of the spectator. Each picture is taken at a different point of sight, but the perspective of both unites when looked at through the stereoscope, and conveys to the eyes—just as it would in nature—the impression, not of two, but of one object.

The principle upon which the stereoscope is constructed may be best understood by the accompanying illustrations.

Fig. 1 supposes the spectator observing a cube—the aspect under which it is seen conveys to his mind the impression of solidity. This arises from the complex aspect under which it is seen, that is, the union of the angles observed by the right and left eyes. Supposing the spectator closes the left eye, and regards the object with the right eye only, the perspective of the cube is that of Fig. 2; on closing the right eye and opening the left, the perspective of the cube changes to that of Fig. 3.



A glance at this double representation of this simple cube convinces us of a very perceptible difference between them. One presents the left face of the cube foreshortened, the right face being more fully exhibited; the other figure is the exact reverse of its neighbour. These two dissimilar images, taken by photography, or accurately copied, are, by the stereoscope, made to assume the appearance of

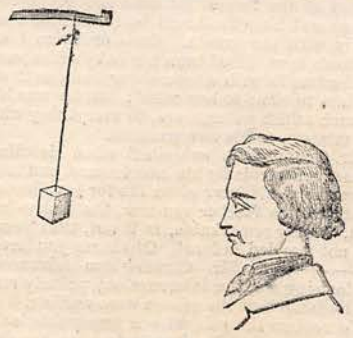


FIG. 1.

the solid cube. The two representations of the cube are so arranged as to fall on the corresponding part of the two eyes, in exactly the same manner as the two images formed by the solid object would have

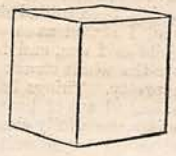


FIG. 2.

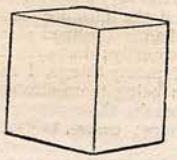


FIG. 3.

done; and hence the mind perceives not a single representation of the object, nor a confused union of the two, but a body projecting in relief, the exact counterpart of that from which the photographs or drawings have been taken.

What is the stereoscope? It is a simple philosophical instrument, essentially composed of two lenses—which increase the size of the object, and render it more distinct than it would be to the naked eye.

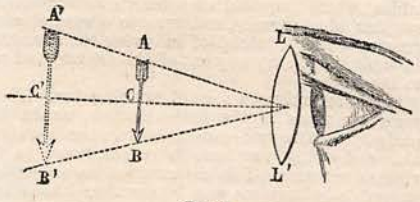
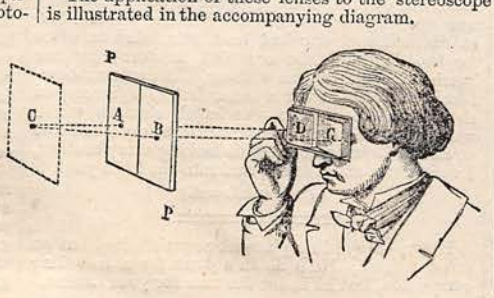
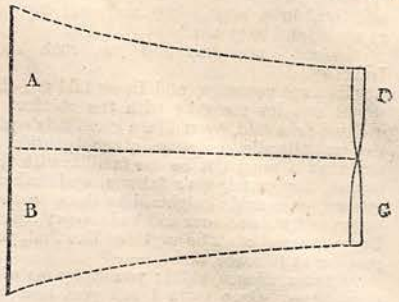


FIG. 4.

L L' is the section of the lens; A B is an object which appears to the eye at A' B'; the points A and B change their apparent position to A' and B', removing further from the axis C C', which is not effected by the lens.

The application of these lenses to the stereoscope is illustrated in the accompanying diagram.





The lenses are represented at C and D. On the framework P P are the two photographs or drawings of the same object at different angles—A and B. A is the impression corresponding to that of the right eye; B is the impression corresponding to that of the left eye; the perspectives of both impressions coincide at C, and form one distinct image, completing the illusion of a solid cube, or object, or objects in full relief.

(To be continued.)

MOROCCO.

(Concluded from page 221.)

TANGIER, anciently Tingis, the capital of Mauritania, successively occupied by Carthaginian, Roman, Goth, Saracen, and Portuguese, came into the possession of England in 1662, as part of the dowry of the Queen of Charles II., an infanta. The acquisition was highly valued; it was declared a free port, and large sums were thrown away upon it; a magnificent mole, 2,000 feet long, defended by triple batteries, having been built for a commerce that never came. A courtier spoke of it thus enthusiastically in dedicating a "Description of Africa" to the king:—"Your own bright star, none of the smallest magnitude, your metropolis, your royal city of Tangier, which, seated on the skirts of the Atlantic, keeps the keys both of the ocean and inland sea, whose unparalleled situation, temperature of air, and fertility of soil, may well make the story true, that an ancient emperor resolved to fix there his imperial seat, to be his terrestrial paradise, environing with brass a gold and silver city." Nevertheless, the pertinacious hostility of the Moors rendered a residence in this paradise so uneasy, that in 1684 the perplexed possessors destroyed the works and abandoned it.

As the special residence of foreign consular agents, the only official representatives of their respective governments in this barbaric land, Tangier is a busy place, and contains 10,000 inhabitants, of whom a fourth are Jews. The terraced buildings, the numerous mosques with slender white minarets, the stately consular residences, the massive battlements and towers of the citadel beyond, and the amphitheatrical disposition of the town on the margin of the Mediterranean, produce on a stranger an impression of magnificence which a closer intimacy shows to have been erroneous. The principal street, irregularly intersecting the town from east to west, contains the only fine buildings, the residences of the consuls. The remainder of the city is formed of a mass of squalid dwellings of a single storey, with no external openings but their low postern doors. Amid these hovels wind dark, tortuous, and filthy passages, accessible only on foot.

The Alcassaba, or citadel, which looks down upon the city from a hill, is an irregular mass of buildings, of various periods and orders of architecture, much dilapidated, and covering a large area. These are encircled by a lofty wall, the embrasures of which are empty. Faint traces of beauty may be distinguished on the arched gateways, in half-defaced arabesques. Passing through these, and traversing a court and a guard-room, the hall is attained wherein, seated on a mat, and enveloped in a white haik, the pasha administers a rude and speedy justice. The buildings within the citadel are occupied by the pasha and his attendants.

A market is held twice a-week without the city walls. To this resort country Arabs with dusky faces, tattered clothing, armed with knives, which they are too prompt to use; Moorish peasants, with fair, grave countenances, occasionally with the blue eyes and flaxen hair that betray their Germanic or Vandal descent, with flowing white garments, and long guns of rude construction; Moorish women,

The German Language

CLEARLY TAUGHT AND QUICKLY LEARNT.

LESSON XIII.

In German the adjective, like the noun and pronoun, changes according to the case. If you use the adjective without the definite article, you must give it the termination that would be requisite for the definite article, supposing you employed it. We give an example of this in the following declension :—

	SINGULAR.			PLURAL.
	Masc.	Fem.	Neut.	For all 3 Genders.
N.	gut-er	gut-e	gut-es	gut-e
G.	gut-es	gut-er	gut-es	gut-er
D.	gut-em	gut-er	gut-em	gut-en
A.	gut-en	gut-e	gut-es	gut-e

When the definite article goes before the adjective, its general termination is *en ;* but, as you will observe in the following, this remark does not hold good for all the cases :—

N.	der gut-e	die gut-e	das gut-e	die gut-en
G.	des gut-en	der gut-en	des gut-en	der gut-en
D.	dem gut-en	der gut-en	dem gut-en	den gut-en
A.	den gut-en	die gut-e	das gut-e	die gut-en

When the adjective is used with the indefinite article, or those pronouns that do not indicate the gender, it is thus declined :—

N.	ein gut-er	eine gut-e	ein gut-es
G.	eines gut-en	einer gut-en	eines gut-en
D.	einem gut-en	einer gut-en	einem gut-en
A.	einen gut-en	eine gut-e	ein gut-es

It will be some little time before you are able properly to apply these rules, but you shall have plenty of examples of the changes of the adjectives in the promised exercises.

We now furnish you with some short, but useful, sentences.

EASY DIALOGUE.

How do you do?	Wie befinden Sie ſich?
I am very well.	Ich befinde mich ſehr wohl.
Have you breakfasted?	Haben Sie gefrühſtückt?
No, not yet.	Nein, noch nicht.
Breakfast with us.	Frühſtücken Sie mit uns.
Breakfast is ready.	Das Frühſtück iſt fertig.
Shut the window.	Machen Sie das Fenſter zu.
Pray sit down.	Bitte, ſetzen Sie ſich.
Give me some bread.	Geben Sie mir Brod.
Bring me some coffee.	Bringen Sie mir Kaffee.
Send me some fish.	Senden Sie mir Fiſch.
Do you like tea?	Trinken Sie gern Thee?
Yes, I like it very much.	Ja, ich trinke ihn ſehr gern.
Give me a little more bread, if you please.	Geben Sie mir gefälligſt noch ein wenig Brod.
I thank you.	Ich danke Ihnen.
Ring the bell, if you please.	Klingeln Sie gefälligſt.
Bring me a fork.	Bringen Sie mir eine Gabel.
Will you have some meat?	Wollen Sie Fleiſch?
Cut me a piece of meat.	Schneiden Sie mir ein Stück Fleiſch.

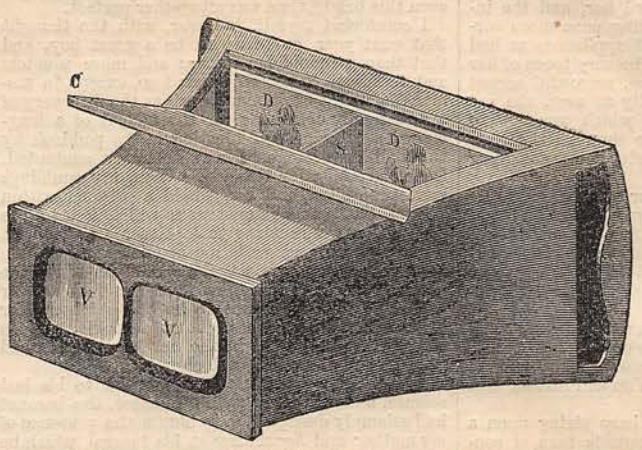
The politeness of our readers will suggest that "If you please" (in German, *gefälligst*) must follow a request; but it is not necessary that we should constantly repeat the word in these short dialogues.

"I thank you" is expressed by *Ich danke Ihnen ;* but *danke*, "thank you," may be used familiarly.

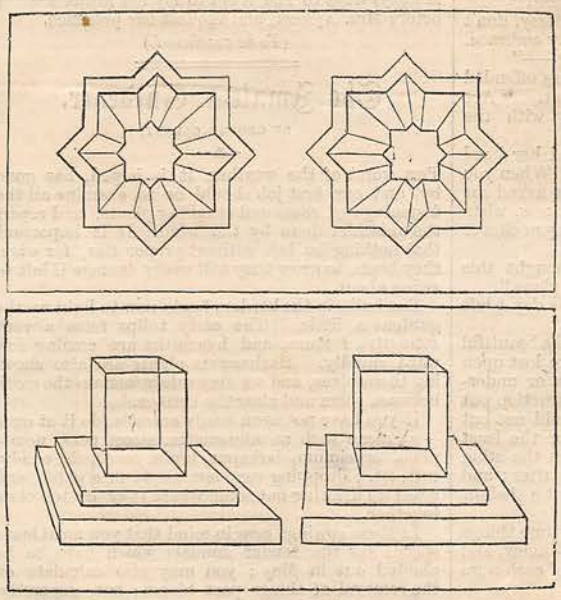
THE STEREOSCOPE.

(*Concluded from page* 236.)

The stereoscope is a very simple apparatus. It consists of a box blackened on the inside, at the top of which are inserted the lenses VV; opposite to these are placed the two photographs DD, which



are fully illuminated by the light which enters at the open flap or door. It is usual to have the bottom of the stereoscope formed of ground glass, which serves very well, especially when the photographs are transparent. The box of the stereoscope is also divided by a partition S, so as to form two compartments, into each of which one of the photographic impressions is introduced. The photographs introduced are always double—one being a representation of the object at the angle at which the left eye sees it, the other being a representation of the object at which the right eye sees it; of these we give examples.



These two figures are so arranged in the stereoscope that the two representations form exactly the same impression on the retinæ of the eye as would be found by observing the real objects, the result of which is that they appear the same—namely, as one distinct, solid image.

For stereoscopic purposes drawings of any object may be prepared, but very great care is required—as any fault, however slight in the perspective; any error, however small, as to the corresponding angle of one representation to the other, would completely destroy the effect. But that which it is most difficult for the pencil to accomplish, is obtained with perfect accuracy by the aid of photography. By the use of a stereoscopic camera the two impressions of the same object—at the necessary angle—are taken at once; and however elaborate may be the subject—all the delicate details, all the breadth of light and shadow, all the effects of perspective, are secured, and seen in the stereoscope. The stereoscopic camera, with its double lens, receives the impression of the objects presented to it, in precisely the same manner as those impressions are received on the retinæ of the human eye. Permanently secured by the agency of photography, these exact transcripts of Nature furnish an inexhaustible source of interest and amusement. We look at these pictures in the stereoscope, not as flat pictures, but as possessing all the solidity of the real objects which they so faithfully represent.

As our conviction of the solidity and projection in relief of bodies depend on the different angles under which it is seen by both eyes, how happens it that persons who see with only one eye, form correct notions of solid objects? And how happens it also that a person having the perfect use of both eyes, perceives no difference as to the solidity of the objects around him when he shuts one of them? To this Professor Wheatstone has replied, that to explain these apparent difficulties, it must be kept in mind that, although the simultaneous division of two dissimilar pictures suggests the relief of objects in the most vivid manner; yet there are other signs which suggest the same ideas to the mind, which, though more ambiguous than the former, become less liable to lead the judgment astray, in proportion to the extent of our previous experience.

The vividness of relief arising from the projection of two dissimilar pictures, one on each retina, becomes less and less as the object is seen at a greater distance before the eyes, and entirely ceases when it is so distant that the optic axes are parallel while regarding it. We see with both eyes all objects beyond this distance precisely as we see near objects with a single eye, for the pictures on the two retinæ are then exactly similar, and the mind appreciates no difference whether two identical pictures fall on corresponding parts of the two retinæ, or whether one eye is impressed with only one of these portions. Therefore a person with one eye sees all objects near and remote, as a person with two eyes sees only distant objects; the vivid effect arising from binocular vision of near objects, is not perceived by the former, who, to supply this deficiency, has recourse unconsciously to other means of acquiring accurate information. The motion of the head is the principal means employed.

It is not our object, in this place, to enter more at length into the subject of the construction or application of the stereoscope. That which we have described is but one form of the apparatus. There are some more complex, and others more simple; but they are all made on the same principle—namely, on the binocular process of vision.

The stereoscope in the first instance, as with most other new inventions, was issued at a price which almost confined its use to the wealthier classes. At present, however, stereoscopes of the best quality may be obtained for a sum within the reach of every one. A stereoscope on a new principle has just appeared, the price of which is half-a-crown, and which has the advantage of perfect portability, being no wider when folded up than the ordinary width of a slide, and in breadth not exceeding half an inch. The portability is obtained by means of an elastic hinge being applied to the division which supports the lenses, and which division is supported in use by means of a groove in the back of the instrument supporting the division, which when removed, the glasses sink to the bottom, the back folds over, and, by means of two elastic bands, is reduced to the size of a thin pocket volume. When opened it occupies the space of an ordinary stereoscope, and produces precisely the same effects. It is, however, more useful than the ordinary stereoscope,

VIEW OF NUREMBERG, BAVARIA.

as it can be applied to stereoscopic pictures bound in books, and is especially valuable for travelling purposes.

Many valuable articles on the subject of the stereoscope have appeared in the PHOTOGRAPHIC NEWS; and to such of our readers who desire to inquire further, we cannot do better than recommend a perusal of that journal.

NUREMBERG.

NUREMBERG is a famous old city of Bavaria, and, unlike many celebrated places, fully answers the expectations of the visitor. Its appearance from the window of the carriage, as we approach it from Augsburg or Bamberg, is highly picturesque; its feudal walls, and towers, and broad deep moat, the acutely-pointed gables of its houses, the graceful spires of its churches, its old castle—the former residence of the German emperors—all combine to make up a picture gratifying alike to the artist and the antiquary. Our satisfaction is not lessened when, having passed beneath one of its arched gates, we find ourselves in narrow streets of quaint houses that belong to a distant period; or when we discover the formidable ramparts to be converted into delightful promenades, and the deep broad ditch changed to a pleasant shadowy walk beneath the branches of fruit trees.

In all Germany there is not a city more thoroughly German than Nuremberg. It was founded in the ninth century, and in 938 became the first seat of the Germanic Diet. From that period to the beginning of the fifteenth century it had a resident governor, termed a *burggraf*, and the reigning Royal family of Prussia is lineally descended from these ancient rulers. About the year 1417, Nuremberg adopted a republican form of government. At the time of the Reformation, a Diet assembled at Nuremberg, and a treaty was signed, extending full toleration to those who professed the new faith. In 1805 the city was annexed to Bavaria by the Emperor Napoleon the First.

Nuremberg has a twofold claim on the visitor. It contains many noble buildings, and its manufacturing trade has caused it to be named the Continental Birmingham.

As to its buildings, there is the *Reichsveste*, or Imperial Castle, a building of very ancient date, with a picture gallery and a suite of rooms fitted up for the King of Bavaria's accommodation, when it pleases his Majesty to honour the town with his presence. Then there is the Town-hall, only 250 years old, but possessing, for the gratification of the curious visitor, sundry subterranean passages of a much older date, leading from the vaults beneath the hall to the town ditch. Then there are the churches—the Gothic edifice of St. Sebald; the fine old Church of St. Lawrence; the Church of St. Giles, and the Church of the Teutonic Knights. All these churches, especially the first two, contain many valuable works of art; and the Chapel of St. Maurice—a fine Gothic building—is used entirely as a picture gallery. Among the "lions" of the place, everything connected with the celebrated painter, Albert Durer, takes the lead. A society of artists occupy his house; his pictures embellish the town-hall, and in the churchyard of St. John his tomb is exhibited.

The trade of Nuremberg was at one period much more considerable than at present. Most of the curious toys which delight children all over the world, are manufactured in this old town. Its wooden clocks have also enjoyed a fair share of popularity—its toys and its clocks being exported in very large quantities. Optical and musical instruments, jewellery and lacquered wares, all sorts of oddities (in horn and ivory), all sorts of useful articles—such as woollens, linens, paper, parchment, &c.—are also manufactured at Nuremberg. The wire-drawing machine was there invented; there gun-locks were first made, and cannons were cast there in the middle of the fourteenth century. From time immemorial the people of Nuremberg have been employing their energies in the arts and manufactures with extraordinary diligence, rendering their old town one of the centres of trade, and making it, in times of disorder and civic discord, a haven of refuge for the fugitive; the good citizens, who were successful in trade, being no less successful in their assertion of independence. Although for many years past the importance of Nuremberg has been declining, there is every probability that the decline will be but temporary. New means of traffic open out fresh facilities for the extension of commerce; and the good citizens, no less industrious and enterprising than their fathers, will be sure to avail themselves of all such advantages.

Nuremberg has a population of about 50,000. It is divided into two parts by the river Pegnitz. The aspect of the old town is singularly interesting, and our artist has succeeded in producing a sketch—reproduced in the accompanying illustration—as remarkable for its fidelity as it is for its picturesque effect.