FROM THE SPECIAL COURSE AT THE AGRICULTURAL UNIVERSITY AT WAGENINGEN, HOLLAND,

ON THE THEORY AND PRACTICE OF SIGHT

BY

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LESSON TO A BLIND PERSON TO GIVE HIM A FIRST IDEA OF PERSPECTIVE

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1) See for part 1, these „Mededeelingen", Vol. XVI, 1919.

PREFACE

The idea of the present pamphlet was suggested to me, while studying blindness and the blind, and to this I came, on account of questions, often asked by my numerous auditors, during the demonstrations, following my course *On the Theory and Practice of Sight;* a few objects for the use of the blind always forming part of these demonstrations. To meet the wants of my audience I even gave this year a special course on blindness, followed by an exposition of some two hundred objects in my possession, connected with this defect.

It is often considered as almost hopeless to give the blind a fair idea of perspective. In accordance with this opinion the large majority of the thousands of pictures published for the blind in England — the only country I know of that edits them on a large scale — are diagrams.

However it appears to me very possible to treat to the blind the principal matter in a rather simple way, as I hope will ensue from the present pamphlet; I may add that I tried my method, with *entire* success in not more than a couple of hours, on a blind boy of 15 years. Now it is true that this boy is a very clever person; but what succeeds in so short a time with a good intellect, will probably secure success in a longer time with less fortuned capacities.

LESSON TO A BLIND PERSON, TO GIVE HIM A FIRST IDEA OF PERSPECTIVE

3 Plates [1])

I intend to give you an idea how sighted persons represent on paper things, that are at different distances from them, the result being, that if another sighted person looks at the drawing, he instantly catches the meaning, although, beforehand, he knows nothing of what is represented.

Let us be careful *not* to hurry; never allow me to pass on, before you have thoroughly understood what has gone before.

1. First of all you should remember, that sighted persons see with their eyes, by means of something that emanates, more or less, from all clear and illumined or selfradiant objects, something that is called light. In the same manner as from a fire emanates warmth — as you can feel with the whole of your body — so light may emanate from objects. But light is only perceived by special organs, by the eyes.

2. Normal eyes, for a large part, are pellucid, as it is called; this means, that light may pass on there, without being stopped, without being intercepted. Sois also a portion of the outer membrane, through which light enters, which then passes on, until it reaches the hind-part of the eye-ball, that merely consists of a layer of nerve-endings, able to „feel" the light that reaches them.

3. The layer of nerve-endings — the so-called *retina* — through the light reaching it, receives valuable information concerning the objects from which the light emanated. This is a consequence of the fact that *images* are formed. And the way, in which these appear, is the same, as when they arise through the aid of *lenses*, of which I will show you one: it is made of glass and both surfaces are regularly curved. The lens you feel now, is thicker in the middle than towards the border; often the reverse is the case. In some spectacles you may notice the same thing, but then the difference between the middle and the margin sometimes is so small, that it can't be perceived by touch.

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[1]) By preference the lesson is to be given orally, and by a teacher who understands the matter well, in order that he may answer correctly any questions.

Plate 1 and 2 represent on about a half of the magnitude both sides of a board, which I had made for this lesson; its figures are chiefly made with small nails and can be easily perceived by touch.

4. Let us suppose that in figure 1 the groove represents a section (a diagram) of such a lens [1]), and that *ab* is a clear and illumined object in arrow-form. The light which emanates from the latter always follows straight lines.

Now see what curious result the lens produces! I represent it in the figure, but only by two specimen-rays: all the light emanating from one point of the object (as from the top *a* of the arrow, f.i.), by the lens is deviated in such a way, that after having crossed it, it again meets in one point, in *c*, the *image-point*. This holding good for all the light emanating from the object, as far as it crosses the lens, we get a constellation of image-points, each copying fairly the corresponding *object-point*. If, f.i., from *a* emanates intense light, in distinction of the feeble light emanating from another point, say *b*, then the corresponding images will respectively also be clear and faint. And not only this, but the relative positions of the image-points will also remind those of the object-points, though, as here is the case, the image may be inverted, and though also the image-points may be much closer together or further away than the object-points, the whole image in the first case being *diminished*, and in the latter *magnified*. The dimension of the image, however, depends upon circumstances we need not consider any further.

In quite the same way on the retina of the eye images of objects placed before the organ of sight may be produced [2]).

5. Now let *ab* in fig. 2 again represent an object in arrow-form. Suppose the groove in circle-form represents on enlarged scale the cross-section of the eye of a seeing person — the eye, very nearly has the shape of a sphere — the pellucid outer part of it is supposed to be turned to the object. Light — as we said

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[1]) Perhaps you may notice the curious effect, that when the shadowy parts in the figure of the groove are turned towards the source of light, especially towards the window, it really appears to be a groove; but when those parts are turned away from the light the effect is inverted, and what in reality is a groove appears raised. See for this interesting but very comprehensible effect: Part I of the communications concerning my *Special Course on the Theory and Practice of Sight*, in these „Mededeelingen", 1919, under no. 6.

[2]) The blind student should not imagine that, on the board, each prominent point in an object has one of the prominent points in the image as the corresponding imagepoint. This is only the case for the border-points of the object, for the images of the latter are als oborder-points. But the other prominent points in the object and in its image are not meant to point out such a correspondence; they only serve to indicate, in a tactile manner, where the object and its image are to be found. Consequently the prominent points in object and in image could be taken equidistant, although the dimensions of these two are not alike.

before [1]) — as far as it is gathered by the eye, may therefore form on the retina a small but a very distinct image of the arrow [2]).

To learn better where this image will appear, we may use advantageously — as is shown in physics — the *optic centre* of the eye, which in our case on the board is indicated by a somewhat more prominent point (where the rays are crossing [3])). This centre has a very interesting property. To construct the image-point on the retina of an object-point, placed at a convenient distance before the eye, I need only draw a straight line from the latter point to this optic centre, and to produce this line. Where it meets the retina, the point wanted is found. Therefore the dimension of the whole image is got by constructing the images of the border-points; all the other image-points lying intermediate.

6. The foregoing regards the construction of images, but gives no information about what one represents to oneself, as a result of that image; in other words, it gives no idea about the so-called: *mental presentation* [4]).

When we receive by one of our senses, f.i. by touch, the impress of any object, we represent to ourselves something as the cause of the impress; in the same way, if we hear the music which comes from a piano, we certainly represent to ourselves the instrument somewhere in our neighbourhood.

Sound gives a localisation of our mental presentation which is somewhat vague; a great deal more vague at least, than that, which sighted people receive by their eyes, as we will see now.

7. When a point of the retina is excited, the observer represents to himself, through the psychical act just referred to, in a quite determined direction, and outward of the body, a corresponding light-point. That direction is the same as the construction-line we used for getting the image on the retina, and is called the *line of sight*. In the same way the complex of

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[1]) See § 3 and § 4.

[2]) Perhaps the possibility will now also be seen of causing a change in the faculty of an eye to form images on its retina. If something in the eye is amiss in this respect, the effect may often be corrected by adding a lens (spectacle-glass) to the eye.

[3]) These somewhat more prominent points, here and in other cases, are not so very easily recognised as such in our *figures* of the board. On the board itself, however, *especially by binocular vision*, they are immediately discerned, and also by touch, of course, they are directly distinguished.

[4]) This term, translation of the German „Vorstellung", has for the first time been used by TYNDALL as far as I know of (See his *Address, delivered before the British Association, assembled at Belfast*, London, LONGMANS, GREEN & Co., 1874 p. 28; see also page 15 and 16).

image-points on the retina gives rise to the representation of the whole object, of the whole arrow in our case, also somewhere outside the eye.

8. This, however, leaves one very important thing unsettled.

Let us suppose a sighted person is looking at the face of another. How is it that, in his mental presentation he sees a head, and not in the correct directions indicated in the foregoing [1]), but at quite false distances, the parts of it? f.i. one eye at 5 feet, another at 3, one ear at 10, a nose at 20, etc.

9. The principal reason for his seeing the correct thing (there are also other reasons, not treated here) lies in the long experience he has obtained, concerning surrounding objects, in the use of his eyes, and in the interpretation of images.

You must not think that a person who has a couple of good eyes, from this mere fact alone would be able to see well, that is: to understand the images he receives.

Just as *you* had to learn to see by touch, so the ordinary person has to learn the use of his eyes. Moreover, also for the seeing person, touch remains the original and principal thing. By touch the young child realises the position of the different parts f.i. in the head of its mother, and only very gradually it learns, what retinal images coincide with certain actual positions of things or parts of them in space. So the child will manage to know, when it gets annew the image of a head, that it has to represent to itself a thing experienced number of times before, and corresponding to a definite kind of idea, which has been gradually formed in its mind by all the former observations. Therefore it does not see the disjointed parts of a head at largely differing distances, but the real head.

That *this* is the manner we learn to see, is chiefly known by cases in which a person, in advanced age, by an operation, for the first time acquired the use of his eyes, which for the rest are perfectly sound. We might expect that then he would be thrown in an extasy by the new world that all of a sudden was revealed to him. On the contrary, however, it only confuses him, for he does not in the least understand his retinal images.

10. Experience, of course, is also of much importance as to the distance at which object-points are seen, and as to the dimensions of objects.

The retinal image-points do not suffer any change, when the object-points, though coming nearer or going farther off, remain on the same lines of sight.

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[1]) See § 7 and § 5.

Consequently a retinal image of a head might give rise to the representation of a head as big as it is in reality, but also to a smaller head at a shorter distance, or to a bigger one that is farther off.

But this is also regulated by experience, in the first place at least.

Because we have gained experience of heads of quite determined dimensions, when we receive anew a retinal image of what evidently is a head, we place it in our imagination at such a distance, that its dimensions correspond with that of a real head.

11. Let the circle in the right part of fig. 3, Plate 2, again represent (on the board in natural scale) the diagram of an eye of a person, whom we will call P, in an upright position. The thin rod (bit of brass wire) beneath the eye, indicates part of the vertical, passing through this eye. The pellucid part of the eye is of course to be found, where you see in the figure the light entering [1]).

To be sure that you represent to yourself the figure well, take an upright position, and hold the board in such a way that the copper wire is parallel to your vertical, and that the surface of the board, when extended, would give with one of our eyes a cross-section, as the diagram on the board.

Now you may take the board again in ordinary position.

Suppose the centre of the pellucid part of the eye of P is exactly in a horizontal plane, represented on the board by a dotted line, parallel to the long sides of the board. I further suppose P is looking at the centre of the eye of another person (Q), of exactly the same height and facing him. This centre of the eye of Q is represented by the somewhat bigger and somewhat more prominent mark at a; also the top of the head of Q is indicated, at b.

Let us construct the retinal image of the head-top of Q in the eye of P. You see it in the lowest of the three points, somewhat more prominent on the retina. Now let us suppose Q is receding to the left. The retinal image of the centre of Q's eye has remained in the same place of P's eye. But the retinal image of the head top is now represented by the middle of the three (more prominent) points on the retina.

In fig. 4, part of fig. 3 is represented on a scale, about 3

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[1]) The piece of cord, represented on the board, is referred to later on; till then it is to be ignored; when this lesson is given orally, the cord is only affixed, as represented in the figure, in a subsequent part of the lesson (see § 12).

times larger, so that you may feel the lines of sight, the optic centre and the image points more easily than in fig. 3.

You see of course immediately that if we had also constructed the retinal images in P, of base-points of the head of Q in his two positions, we would have found two points above the horizontal retinal-point.

Therefore we arrive at the very important result:

The nearer a thing is, the larger will be the retinal image.

12. And now let us suppose that not real objects give the retinal images, but drawings, held somewhere in front of P, vertical to the plane of the board, say at such a distance that the cord of fig. 3 may represent the intersection of both planes [1]).

You see of course that the same retinal images as we constructed already, will be produced, if in the drawing the object-points were found at places represented by the knots in the cord: the knot, corresponding to the nearer head-top, being placed higher than the knot corresponding to the head-top farther away. Therefore:

The greater the distance of the object, a drawing is to represent, the smaller must be the corresponding figure.

13. Since you have seen that an object, going farther away, gives smaller retinal images, you will also understand that, when the object is receding to a larger distance, it will be less distinguishable in the retinal image. For even if the same number of details existed in that image, yet, for each of them, not the same number of nerve-endings would be available for its study. More details than one might even fall on the same ending, and then of course it would have become wholly impossible to distinguish them. This result is the same as when you read by touch. If the points are too close together, they cannot be felt separately.

14. Now it will be easy to put into practice what we have learnt; let us take for this purpose the balloon-drawing f.i. (Plate 3 [2])).

The nearest balloon is represented by the largest figure, and the farther the balloons are away, the smaller become the figures that represent them. Accordingly in the farthest you notice

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[1]) When using the board the cord is not affixed in the figured position until now.

[2]) Reproduction — by kind permission of the Editor — on a reduced scale, of Plate 12 in: *A Picture-Book for the Blind; Embossed, Printed and Published by the National Institute for the Blind*, 224-6-8 Great Portland Street, London W. 1. — This picture is also to be found in „*Comrades*", March 1918.

no detail at all, the whole being reduced to one single point. But, the nearer they get, the greater is the number of details represented.

15. By often examining drawings, you will gradually become more expert, till at last you will catch the *perspective* [1]), as it is called, irresistably and immediately.

In a similar way your sighted brethren in their first youth have learnt the use of their eyes. *But not before having practised very much they attained the readiness and sureness they possess later in life;* their not remembering this, is only a consequence of the fact, that they have already learnt to see and also to understand images, at so very low an age [2]).

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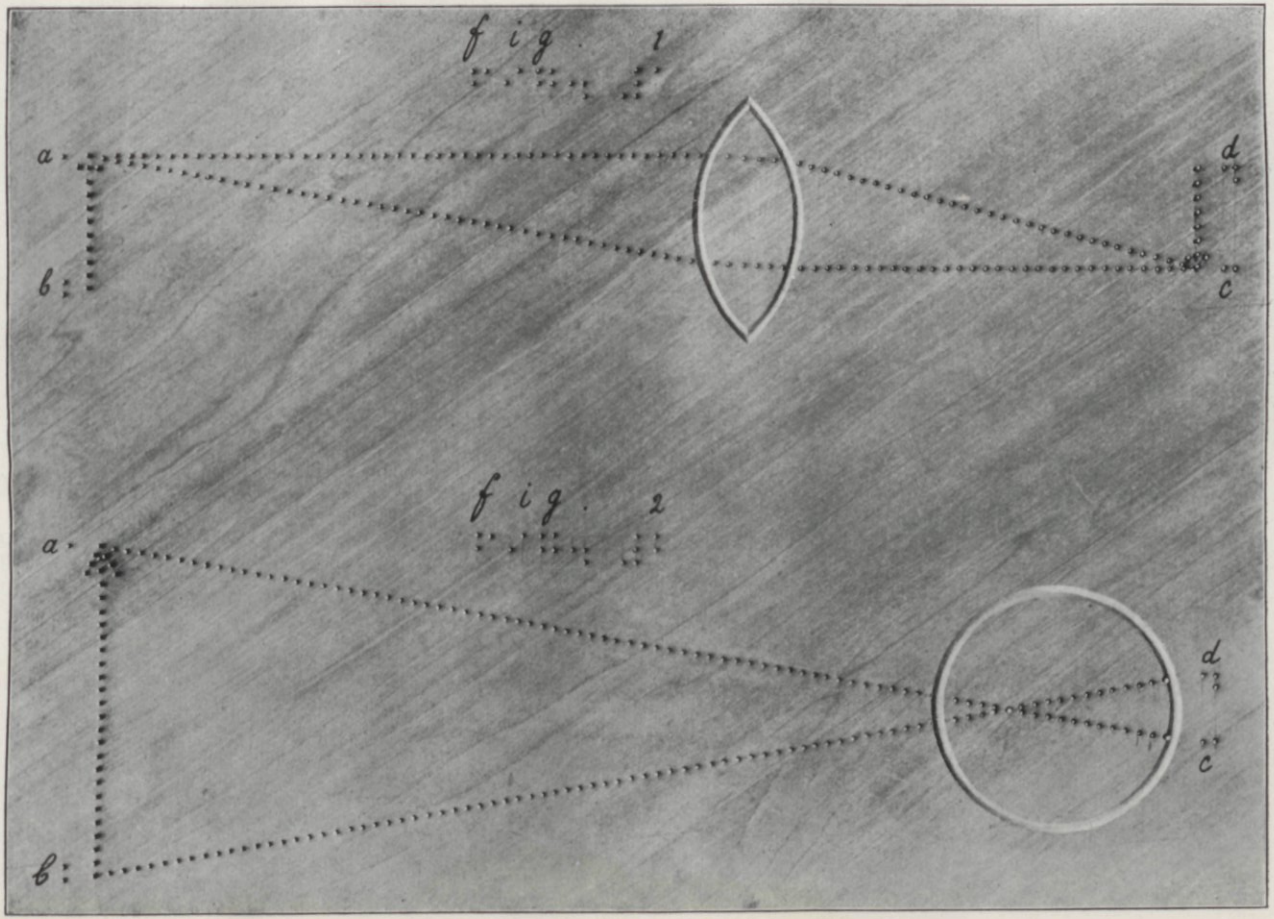
[1]) This term (from *per* and *spicere*) means the manner in which we have to look through a collection of objects or their parts, represented on a drawing, and therefore the distances and the dimensions we have to give them in our mental presentation.

[2]) A few of the most interesting cases, that uncivilised people, not accustomed to the seeing of pictures, so often fail to understand them, might be well in place here. See f.i., Lord AVEBURY (Sir JOHN LUBBOCK) *The Origin of Civilisation and the primitive Condition of Man, mental and social Condition of Savages*, 7th ed., London, LONGMANS, GREEN and Co., 1912, p. 33—35, and also Prof. Dr. FRITZ SCHULTZE, *Psychologie der Naturvölker*, Leipzig, VEIT & Comp., 1900, p. 106; this latter for the striking fact, communicated by a photographer, concerning peasants taking with them the wrong picture.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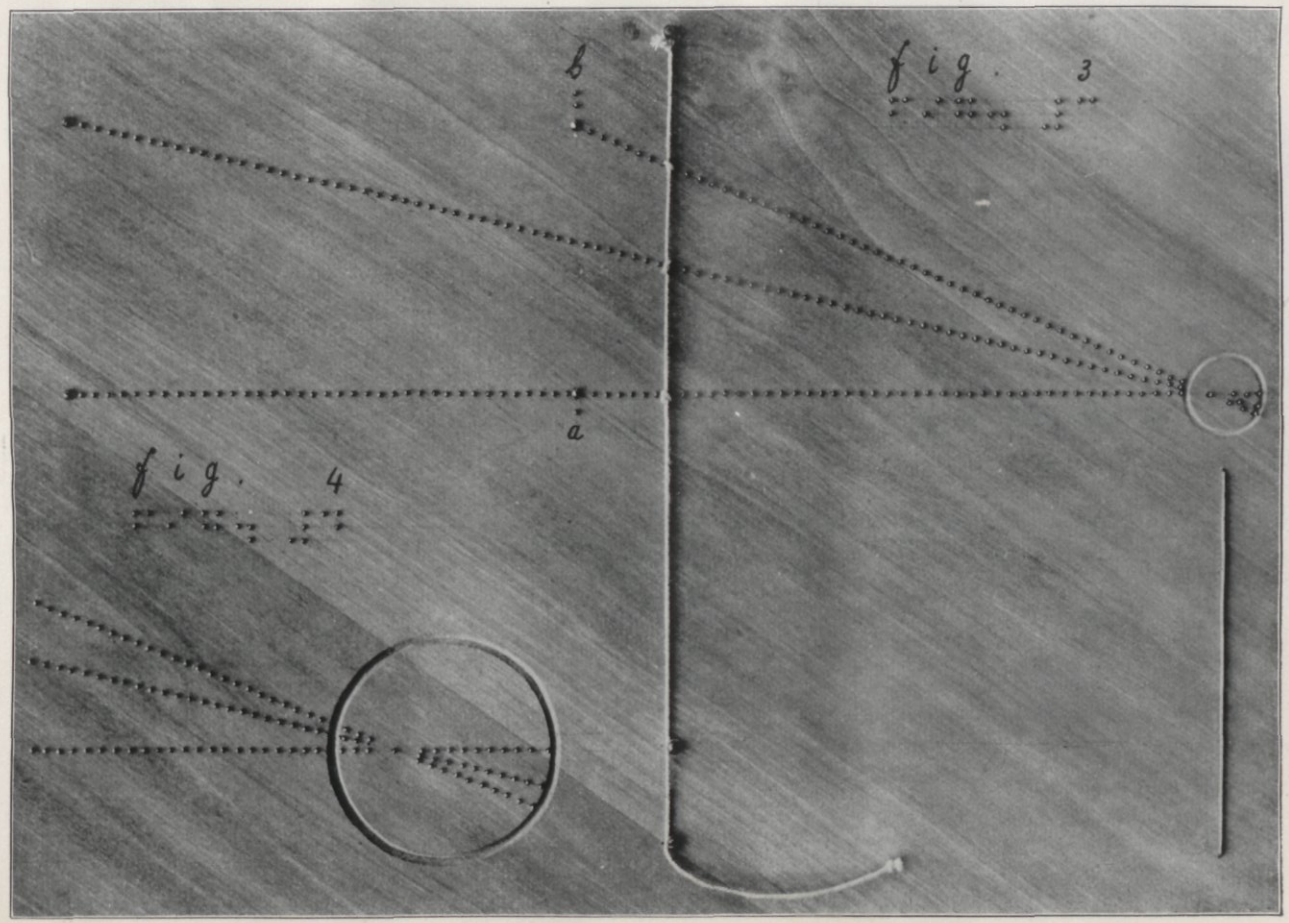
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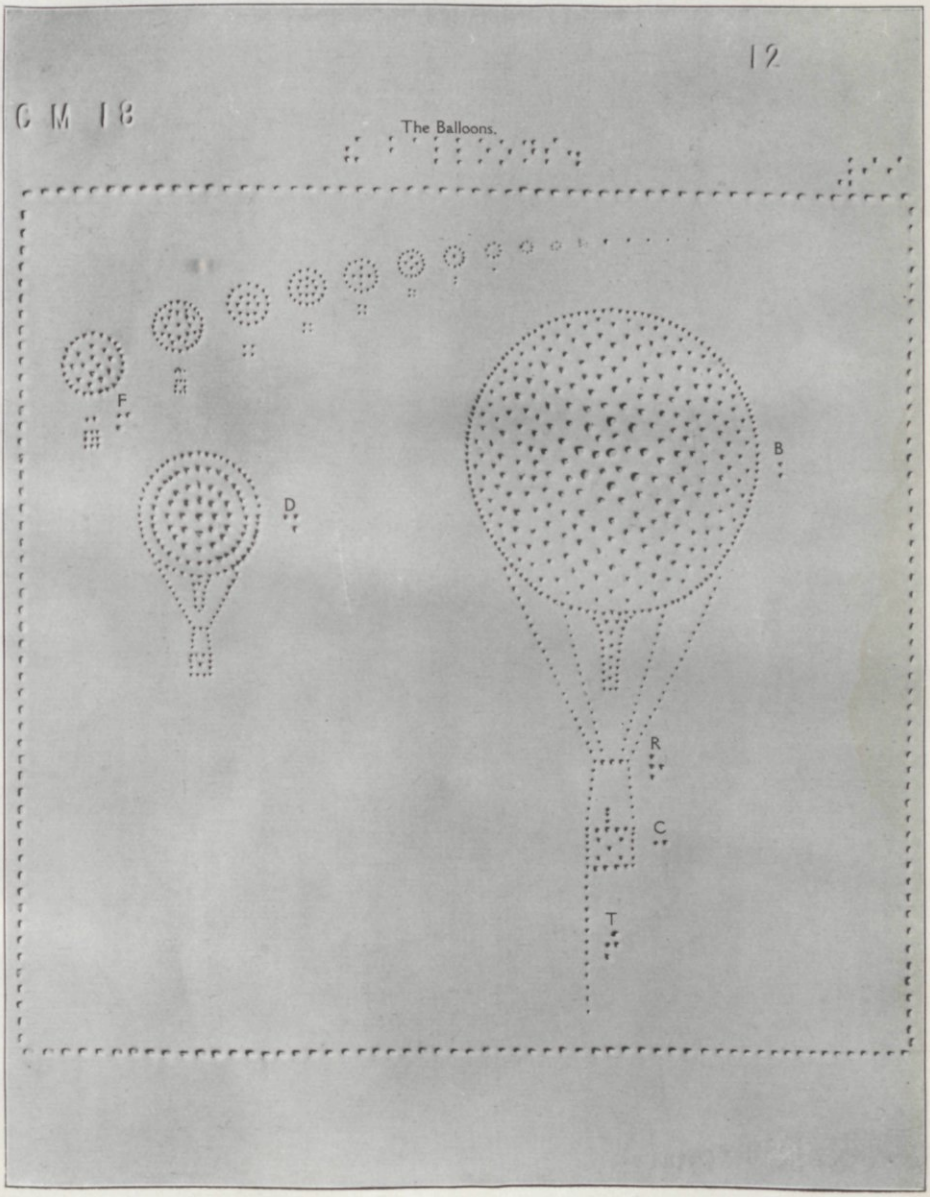
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