

*Exp. 2.*—Set up as for experiment 1, except that the 50-cp. lamp is not used. In this case, when the 100-cp. lamp is switched off, the outer rings appear first and the central disc last.

*Exp. 3.*—On a piece of very dark grey paper (or a well-used blackboard) about 36 in. square fasten a piece of black velvet about 9 in. square. Reduce the light in the room so that the velvet can only just be distinguished from a distance of about 2 ft. Gaze steadily at the centre of the velvet, and after about four seconds the outer edges of the paper will appear to darken. This darkness will slowly progress until the paper and velvet appear to be enveloped in an absolutely black curtain. It is interesting to note that in each of these experiments the slightest movement of the eyes or eyelids is sufficient to restore normal conditions. So far as I am able to ascertain, these three experiments have not previously been recorded. They appear to indicate that the retina depends for its action upon sensitisation from the periphery inwards; also that this sensitisation is dependent upon light falling upon the periphery.

*Exp. 4.*—Take an oculist's ordinary test-type and hang it on the wall of the room fitted with the three lamps previously described. Choosing a T in the 6/18 line, gaze at it steadily from a distance of about 12 in. After a few seconds the white paper immediately surrounding the letter appears to increase in brightness. At this point have the 100-cp. lamp switched off. This brightness will now increase and spread towards the terminals of the letter. At the same time the brightness takes a slightly blue tinge until, in the words of a friend who tried the experiment, "the letter appears to float in a Bunsen flame."

I should be glad if some of your readers will repeat these experiments, or if they have been recorded elsewhere give the reference. HERBERT S. RYLAND.

9 Vere Street, W., July 2.

#### Photosynthesis and Stomatal Aperture.

In your issue of August 10, 1911, you were good enough to publish a brief description of my "Stomatograph" (Proc. Roy. Soc., B., vol. lxxxv., p. 33). I there pointed out that the stomatal aperture in Egyptian cotton plants under field conditions during June reaches its maximum at about 9 a.m., and that this maximum aperture is maintained for only a few hours at most, closure ensuing as the result of the severe water-strain on the root-system. Thus the stomata may be almost completely closed by noon, or even earlier.

It was highly probable that this closure would be found to provide a limiting factor on photo-synthesis by restricting the inward diffusion of carbon dioxide. It has, moreover, been noted by Thoday (Proc. Roy. Soc., B., 82) that such limitation may probably account for the low values obtained by some workers, and possibly for the fact, pointed out by Blackman, that the theoretical possibilities of carbon-dioxide assimilation have never even been approached. Since the stomata in Egyptian cotton plants are gaping wide, under intense illumination, and at high temperatures, for an hour or two in the morning, there was a further expectation that record values might be obtained. Both these expectations have been fulfilled.

The error from asymmetry of the leaves is high. Using the Sachs-Thoday stamping method, the P.E. on twenty identical pairs, each 15 cm.<sup>2</sup> in area, worked out at  $\pm 4$  per cent. of the mean dry-weight. The dry-weight of a square decimetre of these stamped areas is about 0.7 grams, so that with ten pairs of such areas we still have a P.E. of 9 mg.

In the effort to avoid this error I carried the number of pairs as high as 73 in a single experiment, which covered 1.6 hours, centred on 9.43 a.m., and gave an increase in dry-weight—without correction for translocation, if any—of 22.8 mg. per square decimetre per hour, with a P.E. of 3 mg. The mean shade temperature was about 28° C. only.

Results of greater interest were obtained by series of hourly determinations, which in two cases were successfully carried from 8 and 7 a.m. to 6 p.m. Ten pairs, each 15 cm.<sup>2</sup> in area, were employed in the first set, and twenty, each 10 cm.<sup>2</sup> in area, in the second set. The results are as follows:—

|     |          |       |       |       |          |       |       |
|-----|----------|-------|-------|-------|----------|-------|-------|
|     | 7-8 a.m. | 8-9   | 9-10  | 10-11 | 11-12    | 12-1  | 1-2   |
| (1) | +12.4    | +22.3 | +26.8 | +20.7 | +7.3     | -6.8  | +8.3  |
| (2) | —        | +23.7 | +39.9 | +29.7 | +13.4    | +25.9 | +21.5 |
|     |          |       |       |       |          |       |       |
|     |          | 2-3   | 3-4   | 4-5   | 5-6 p.m. |       |       |
| (1) | +17.6    | -5.7  | +29.7 | +1.3  |          |       |       |
| (2) | -3.3     | -28.2 | -5.8  | -7.6  |          |       |       |

It will be noticed that in the first set the sustained rate from 8 to 11 a.m. works out at 23 mg. (P.E. 5 mg.), while in the second it amounts to 25.7 mg. (P.E. 2½ mg.) from 8 a.m. to 2 p.m. It seems quite certain that values of 25 mg. per square decimetre per hour are attained by cotton plants in Egypt; these values are 25 per cent. higher than have formerly been recorded, with known probable error.

Turning to the effect of stomatal closure, it is quite clear that assimilation is very greatly reduced, if not inhibited entirely during the afternoon, by this closure. The data quoted above do not plot out to a smooth curve, partly on account of the high asymmetry of the leaf, and partly from the idiosyncrasies of individual plants, although the latter error was reduced in the second series by using twenty different plants, instead of three or four, for each hourly group.

Comparing these curves, such as they are, with the records from stomatograph and thermograph, we find that assimilation seems to be limited by temperature until about 9 a.m., and then by stomatal aperture for the rest of the day. Even when the stomata are widest, the intake of carbon dioxide is not sufficient to follow the temperature up to its maximum of 35° to 42° C.; during the afternoon the plant is starving.

W. LAWRENCE BALLS.

Gezira House, Cairo, July 3.

#### Curie's Constant in the Ferromagnetic State.

In reference to my brief letter on this subject appearing on July 18, I should like to say that while the relative values of Curie's constants for iron and nickel agree with those of the analogous constants in the ferromagnetic state, the absolute values in the two states are connected by a factor of the order of 10<sup>6</sup>, and the constants are only independent of the temperature each for its own state.

July 29.

J. R. ASHWORTH.

#### Elliptic Functions.

I VENTURE to appeal for information as to tables of elliptic functions of the second kind, those by which the lengths of elliptic arcs are evaluated. The best tables accessible to me are those in Dale's very useful book, "Five-figure Mathematical Tables," and these are too brief for my purpose.

I have failed to obtain Legendre's original tables. But surely these have been reprinted, either in full, or in a shape more detailed than that I have mentioned. Possibly there may be a French or a German edition, failing an English one. I shall be grateful for any definite information.

Hyde Park, Leeds, July 27.

C. T. WHITMELL.