spectrum. It is positive in the green and negative at the two ends. The zero points are near 477 $\mu\mu$ and 640 $\mu\mu$. The form of the curve, also, indicates a minimum in the ultra-violet. (Fig. 5, ○ points).

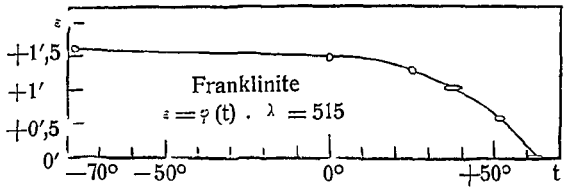

Fig. 6.

The rotation decreases very slowly from — 78° to 0°. It then falls off rapidly, vanishing between 60° and 65°. (Fig. 6). In agreement with this WOLOGDIN found 61° for the transition temperature.

Physiology. — "*On the* TYNDALL-*phenomenon in gelatin-solutions.*" By L. ARISZ. (Communicated by Prof. H. ZWAARDEMAKER).

(Communicated in the meeting of June 28, 1913).

In watching the TYNDALL-phenomenon in a 1% gelatin-solution Prof. ZWAARDEMAKER observed a greater intensity of the diffused light after the change from sol to gel than before the gelatification.

This prompted me to investigate the TYNDALL-phenomenon more closely.

For a determination of the intensity of the light a method was adopted that has been suggested by HARTMANN [1]). My mode of procedure was the following: A series of photographs were taken of the TYNDALL-phenomenon at right angles to the incident pencil and the intensity was calculated every time from the grade of blackness of the picture. This estimation was based on the principle, that when a number of plates, as uniform as possible, are exposed under precisely the same conditions of time, temperature, development and further treatment, the density of the negative will depend only on the intensity of the light.

Different portions of a plate being successively exposed at various known distances to the same constant light-source for an equal space of time, afford a suitable scale of various grades of blackness. For

[1]) Zs. f. Instrum. **19**. 97. 1899.

a measurement of the intensity of the light we have only to compare the density of the image of the TYNDALL-cone with this scale.

A small NERNST-lamp I found to work very well as a light-source; by means of some lenses its light was focussed to a well-defined pencil, which was sent through a closed glass cuvette with smooth walls and filled with the solution to be examined. In order to regulate the temperature the cuvette was placed on a thermostat, a cover of asbestos preventing as much as possible the influence of the temperature of the surroundings. The cover was removed only while the pictures were being taken. This arrangement as well as the photographic apparatus was unaltered during the whole series of exposures, so as to yield perfectly comparable results.

In order to obviate any deteriorating influence of an occasional inconstancy of the NERNST-lamp or of some error in our procedure, an exposure was made together with the TYNDALL-phenomenon on the same plate, of a surface, lighted directly by the lamp. The density of this comparison surface must be the same on the various plates of a series in order to draw conclusions from the differences in the pictures of the TYNDALL-cones [1]).

After some preliminary experimentation with an aqueous gelatin-solution, demonstrating that a fall of the temperature causes a considerable rise of the intensity, I invariably used solutions of gelatin in glycerin, because a previous investigation of some other properties, especially the viscosity, had proved how their condition is influenced by the temperature. An advantage of these solutions is that, in closed vessels, they keep very long without any alteration attributable to evaporation or to micro-organisms. For the solution I used commercial glycerin containing about 30% of water and gelatin, which had been washed long enough, to remove the salts and had then been dried again. After careful filtration the solution was put in the cuvette. Then it still contained a large number of air-bubbles, which could be removed in vacuo at 70°.

In all gelatin-solutions that were examined, the incident pencil generated a beautiful cone. In diluted solutions nearly the same intensity is observed over its whole length; in more concentrated solutions (10 %) the intensity diminishes rapidly but evenly, as the

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[1]) For the pictures I used the very sensitive plates of Lumière ("étiquette violette"). Time exposure 30 sec. Development with oxalate of iron after EDER for 2 minutes. Fixation in a hyposulphite solution. Development with oxalate of iron is preferable since it yields perfectly black tints, whereas organic developers often act upon the tone of the image.

pencil penetrates farther into the solution. The colour of the diffused light is white and, as in all other cases, the light, emerging perpendicularly on the incident pencil, is highly polarized.

In experimenting upon the TYNDALL-phenomenon I was guided by the knowledge of the changes in gelatin-solutions, obtained in studying the viscosity in the selfsame solutions. Before long I intend to discuss this point at length. With a view to elucidate the experiments reported in this paper, it is necessary to preface them with a short survey of my experience just now alluded to.

The properties of a gelatin-solution, whether this be a sol or a gel, are, in a condition of equilibrium, completely determined by the concentration, the temperature and the pressure. Most often, however, the solution worked with is not in equilibrium. Therefore, even under constant outward circumstances alterations are to be noted in the solution, which bring it nearer to the equilibrium. This approximation occurs rapidly at 60° or at a higher temperature, when the equilibrium is established in a few minutes. Lower temperatures slacken this process. At 40° it takes some days even; at 20° an equilibrium cannot be noted even after three weeks and at 0° the progress of the process is imperceptible.

In order to find the value of a variable in the equilibrium at a given concentration, temperature and pressure, I took the equilibrium to be the limit of all the changes that occur in the solution. Therefore, the preceding treatment was conducted in such a way, that when the desired temperature was reached, the value of the variable was either too high or too low, so that while the temperature remained the same, it was respectively reduced and augmented. By prolonging the experiment we can get as near to the equilibrium as we like.

Now it appeared that the intensity of the TYNDALL-cone evinced changes similar to those described here. We publish an experiment in which the phenomenon was faint soon after the required temperature was reached and was gradually intensified; a 2% gelatin-glycerin solution, after being heated for five minutes to 70°, was at once cooled in cold water. As soon as the room-temperature was reached pictures were taken at regular intervals of an hour. The images obtained, showed that the intensity of the light had increased continuously. In the meantime another change had taken place in the solution, viz. the viscosity had increased slowly and after 2 hrs the solution had been solidified; even then, however, the intensity was increasing; this was proved by an exposure made after 12 hours.

We give a summary of our results in the following table [1]).

2% gelatin-glycerin solution cooled to 16° after heating to 70°

Readings after	0 hr	1 hr	2 hrs	3 hrs	12 hrs
Consistence	fluid	viscous	nearly solid	solid	solid
Intensity	0,25	1	1,4	1,4	2,8

The conversion from sol to gel is not sudden.

In another experiment the initial intensity of the TYNDALL-phenomenon at the temperature of the experiment was greater than when the solution reached the equilibrium, determined by this temperature, so that, as the test proceeds a reduction of the intensity is to be looked for. The experiment was performed with a 1% solution that had been kept at room-temperature for some time and had subsequently been warmed to 50°. *At this temperature the solution was fluid always.* At intervals of 24 hrs three determinations were made, demonstrating a slow and slight diminution of the intensity of the light.

1% gelatin-glycerin after 10 days at 16°—18°, warmed to 25°.

Readings after :	1 day	2 days	3 days
Consistence :	fl.	fl.	fl.
Intensity :	5,6	4	4

After heating to 70° the intensity was rapidly reduced to 0,5 and then remained constant. Experiments such as these can be repeated at will on the selfsame liquid. The results will ever be the same. They are in keeping with the above survey, so that we are justified in concluding that the intensity of the TYNDALL-phenomenon always approximates its equilibrium value and that in that state it is a function of the temperature.

Hereafter we were eager to know, whether the changes of the TYNDALL-cone occur only when the solution passes from sol to gel or whether they are not dependent on this conversion. To ascertain this a series of experiments were carried out with a 1% solution, that had been heated beforehand to 70°. They were continued for 12 days, in which time the viscosity was highly increased, but a conversion to gel was out of the question. At first an exposure was made every 24 hrs, later on every 2×24 hrs. It appeared that after 12 days no equilibrium had been established; from the 1st to the 8th exposure (on the 12th day) a set of negatives was obtained,

[1]) The values recorded apply to the most intense portions of the cone. They are calculated from ratios for which the unit was arbitrary.

illustrating a growing intensity of the TYNDALL-phenomenon; the rate of the growth, however, was gradually reduced.

1% gelatin-solution cooled to 16°—18° after heating to 70°.

Readings after:	0 d.	1 d.	2 d.	4 d.	6 d.	7 d.	9 d.	11 d.
consistence:	fl.							
Intensity:	1	2	2	2,5	4	4	5,6	5,6

We are in a position to record also another experiment carried out at 20° with a 2% solution and started a few hours after the solidification of the solution. For four days the changes were noted. Here also an alteration took place, which was most marked in the first 12 hours and then became less conspicuous.

2% gelatin-solution cooled to 20° after heating to 70°.

Readings after:	0 d.	1/2 d.	1 d.	1½ d.	2 d.	3 d.
consistence:	solid					
Intensity:	1,4	4	5,6	5,6	5,6	(4)[1]

The last two experiments yielded two series of plates that were very much alike inter se. It is impossible to determine whether they had been taken from a sol or from a gel. The TYNDALL-cone does not enable us to tell the one from the other any more than the naked eye does.

The changes in the 1% and the 2% solutions are not so conspicuous at high temperatures as at the temperature of the above experiments. At 40° no change could be made out, and if we compare the intensities at 40° and at 70°, the difference seems to be nihil. We take it therefore, that beyond 30° the temperature has only little, if any, influence on the intensity and that the increase commences only below 30°.

Additional experiments were made with 5% and 10% solutions. As for the latter we can but say, that changes presumably did occur at various temperatures, but that they could not be clearly demonstrated by our method of working [2]).

The 5% solutions yield results similar to those of the 1% and the 2% solutions. Here also different values of the intensity of the light correspond to the various temperatures; changes only appear at lower temperatures. Contrary to the 1% solution, an obvious difference is to be noted in the 5% sol. between the intensity at 40° and 70°, as shown in the following table:

[1]) In this exposure the comparison surface was not equal to that of the other plates of the series.

[2]) The rapid reduction of the intensity of the diffused light as the pencil penetrates farther into the solution, renders it difficult to determine the differences in the absolute intensity.

Readings at:	70°	40°	50° (after 12 hrs)	19°	19° (after 12 hrs)
Consistence:	fl.	fl.	fl.	solid	solid
Intensity:	1,4	2,8	4		8

To sum up the above, we have first of all to call attention to the fact, that we have observed a change in the intensity of the TYNDALL-phenomenon in a gelatin-solution at a constant temperature. It occurs in the sol- as well as in the gel-condition and seems to proceed according to a fixed rule. This changing process sometimes lasts several days, the solution approximating an equilibrium, determined by the temperature.

The influence of the temperature on solutions of various concentration is not the same. In a 1% solution it is not, or hardly, noticeable beyond 40°; very great, however, below 30°; in a 5% solution the intensity increases rapidly even at 40°.

This does not seem to be attributable to the change from sol to gel. Still, there is most likely some connection, since the change of the TYNDALL-cone always becomes more distinct below a temperature about 10° higher than that at which the gelatification can be considered to have been established.

Physiology. — *"Experiments on the atonical muscle."* By Prof. J. W. LANGELAAN. (Communicated by Prof. H. ZWAARDEMAKER).

(This communication will not be published in these Proceedings).

Chemistry. — *"On the formation of an aldehyde from s. divinylglycol."* By P. MULLER. (Communicated by Prof. P. VAN ROMBURGH).

(This communication will not be published in these Proceedings).

ERRATUM.

Proceedings of March 22 and April 25, 1913.

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p. 1256 l. 1 from the bottom, and p. 1257 l. 1 from the top { for: of the sequence / read: of each partial sequence of the sequence

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read: $b_i \overset{i}{<} u \overset{i}{<} c_i$ $(b_i \overset{i}{<} c_i)$.

(October 24, 1913).