posure in microphotographic work, as in all other work with the sensitive plate, depends entirely upon the quantity and quality of the light obtainable. The amount of exposure to give must be judged by the operator, using the appearance of the image on the ground glass as a guide. From thirty to forty-five seconds would be about the right exposure on a bright day with the sun unclouded, using a fast plate. All the light that reaches the plate must come through the microscope objective. To prevent any light getting in between the microscope and the camera lens, the space, no matter how small, must be covered with a piece of black cloth. If the light is very bright better results will be obtained by using a ray-screen. A piece of yellow isinglass hung in front of the microscope will answer the purpose as well as an expensive ray-filter.

First attempts are rarely successful in any undertaking, and microphotography is not an exception to the rule. A few plates must necessarily be wasted and much of the photographer's patience will undoubtedly be lost, but the goal is worth the game. With a little of the "stick-to-it" quality even the very beginner will be successful in microphotography.

UNIFORMITY OF ORGANIC AND INORGANIC BODIES.

BY DR. ALFRED GRADENWITZ.

The present tendencies of scientific investigation are to prove the existence of a continuity, not only between the various branches of the same science, but even between ranges of knowledge which formerly were regarded as widely distant from and entirely foreign to each other. Physico-chemical laws have thus been shown to control the activity of the world of organized beings as they do that of inorganic bodies. There remains, however, the much-discussed problem of the origin of life, and this leaves an unsurmountable gap between organized and inorganic matter. Burke's recent experiments have been interpreted by many as being nothing short of a creation of life from lifeless inorganic matter, though the experimenter himself seems to be far from drawing so bold a conclusion from his interesting results. Nor is the writer inclined to think that the partisans of that theory are right, or that the mystery of life will ever be explained away by physical laws. Very interesting is the work of a French scientist, Prof. Leduc, of Nantes, who has been successful in elucidating the mechanism of the formation of cells and in demonstrating the striking analogies existing between cellular and crystallized bodies.

The main factor operative in the formation of all cellular bodies, both inorganic and organic, has been shown by Leduc to be the phenomenon of *diffusion*, which according to him follows a law quite analogous to the law of Ohm.

Leduc's fundamental experiment is as follows:

A ten per cent solution of gelatine is spread in a uniform layer on a glass plate, and after it has become solidified, drops of various solutions forming a precipitate with one another are distributed symmetrically over its surface. Potassium ferrocyanide and copper sulphate or iron sulphate may be used, and these solutions, on diffusing in the gelatine, are precipitated as they come in contact with one another. Now, these precipitates are found to constitute geometrical figures of perfect regularity, strikingly demonstrating the uniformity of diffusion. (See Fig. 1.) The shape of these figures can be varied indefinitely according to the kind, number, and position of the drops and the color of the solutions and precipitates. Contrary to the opinions of previous investigators, it was found that the diffusion goes on more rapidly if the solution is less concentrated. Even the slightest influences, e. g., acidifying or alkalinizing the solution, are shown greatly to alter the resistance to diffusion. The rate seems to be proportional, the remaining factors being the same, to the molecular concentration of the diffusing substances. The shape drawn by the precipitate on the gelatine accordingly depends on the ratio of the molecular concentration or the osmotic tensions. If these are equal, for instance, the forms are rectilinear. From the above facts is inferred a physical explanation for a large number of biological phenomena, which have so far remained mysterious.

Diffusion, as above said, occurs according to a law analogous to the law of Ohm, the intensity corresponding to the rate of diffusion, and the potential difference to the difference of osmotic pressure, the only divergence being the variability of the resistance according to the diffusing substances. Organic membranes are of different permeability to diffusing substances, thus giving rise to the phenomenon of osmosis. Now, the above experiments show that colloids behave, from the point of view of diffusion, in exactly the same manner as membranes.

On repeating the fundamental experiment referred to above, Prof. Leduc succeeded in producing artificial cells (see Fig. 2) of polygonal shape, quite analogous outwardly to natural cells, and in which a cytoplasma and a core could be distinguished. In each cell during its formation, and in fact as long as there is any difference of concentration in the gelatine, lively molecular movements are apparent, consisting as in live cells of a double current, the dissolved substance going from the center to the periphery, and the water from the periphery to the center. This molecular activity, *being the life of the artificial cell*, can be kept up by maintaining in the neighborhood of the latter a convenient medium and by feeding the cell, i. e., reconstituting any losses of concentration.

Three stages may be distinguished in the life of an artificial cell, the first stage being that of organization, when the drop constituting the core forms the cell in connection with the gelatine, giving rise to the production of a cytoplasma and a surrounding membrane. The second stage is the period during which the osmotic pressure tends to equalize the concentration between the various parts of the cell and the medium in which this is placed. The third stage, being that of decay, corresponds to the diminution in the double molecular current due to a diminution in the difference of concentration. As soon as the equality of concentration is established, the active existence of this cell will have come to an end, the cell being now lifeless and conserving only its outward form. These cells are influenced just as are live cells, with respect to their organization and evolution, by moisture, dryness, acidity, alkalinity, or the addition of various substances to either the gelatine or the drop constituting the core.

All the phenomena of diffusion are accounted for on the theory of *field of force of diffusion* suggested by Leduc. If a drop of any aqueous solution be inclosed within a mass of distilled water, the dissolved molecules will be carried away by diffusion in all directions, being replaced by the water, which moves in an inverse direction. The drop thus really is the focus of a field of force, the directions followed by the moving molecules being what may be properly called the *lines of force* of this field.

In connection with the above experiment, the osmotic pressure is stronger in the drop of solution than it is in the pure water; the center of this drop is what is called a *positive pole of diffusion*, while if the conditions are reversed, this is called a *negative pole of diffusion*. Prof. Leduc shows the striking analogies that exist between fields of force of diffusion and magnetic or electric fields by photographing the spectra of such fields. An example is shown in Fig. 4.

A field of force of diffusion exhibits the same behavior as a field of magnetic force, where ether currents, as it were, carry along the iron filings, as the water carries along the globules of the blood or powder particles used as pigment. The phenomena of attraction or repulsion according to polarity also demonstrate this analogy.

Polygonal figures can be obtained by a number of poles of diffusion, giving rise to a cellular structure. The cells thus produced are much more sensitive than those having solid membranes, and respond to any outward influence. (Figs. 5 and 6.)

Diffusion then is the force controlling the phenomena of *crystallization*. If a crystal be formed in a solution, the dissolved molecules will travel toward its core, replacing the water which is carried away; this is what Leduc calls a *field of force of crystallization*. By causing fields of force of crystallization and diffusion to interfere with each other, Leduc has been able to reproduce and to photograph all fern-like and other forms as observed in crystallization. (See Figs. 7 and 8.) The polygonal figures and fern-shaped formations observed on metals, such as antimony, are obviously of the same origin; they are also found to be illustrative of the various forms assumed by the most primitive organisms.

Fig. 9 shows the result of introducing into an artificial cell a very small soluble crystal, with the production of a species of fertilization analogous to this action in a live cell.

The theory of these fields of force in liquids permits a great number of phenomena which had so far been mysterious to be explained on a physical basis, e. g., amœboidan motions, Brownian motions, agglutination, as well as the orientation called tactism and tropism. The hypothesis that live cells have been formed by a similar process, and that the problems of morphology and morphogeny are susceptible of a solution by experimental methods, seems to be warranted by the results of the above experiments.

If a crystallizing substance be added to a colloidal solution, there are obtained in the place of amorphous, homogeneous bodies, regular forms which, while differing from those of crystals, are highly interesting as evidencing the mechanism of crystallization. These forms are obviously due to the presence of the forces of crystallization during the solidifying process. The constant morphogenical action here exerted appears to play an extensive part in nature, as vegetable and animal tissues result from the solidification of mixed solutions of colloids and crystalloids.

In Fig. 10 is illustrated a field of crystallization, as obtained by spreading out on a glass plate a solution consisting of a mixture of a crystallizing substance (viz., sodium chloride) and a colloid. It has been suggested that these fields of crystallization be utilized to characterize the various substances. As will be seen, the field in question strikingly shows two axes of crystallization, with perpendicular lines rising on both sides. The diagonals of the crystal coincide with the axes of crystallization, and all of the four sides forming the projections of the four side faces of the crystal bear prisms constituting another crystal deplaced through 45 deg. with regard to the core. The axes of crystallization of the latter are perpendicular to the four side faces.

Something About Spanish Olives.

The olive industry in Spain is increasing in importance within late years, mainly owing to the efforts which have been made to use improved processes, so as to compete successfully with the Italian industry. One of the leading branches of the olive trade is the preparation of green olives. This is carried out on a large scale at Barcelona. There is a large internal consumption of the olives and besides, the annual exports now reach 7,000 tons. The olives are put up in bottles or kegs. To carry out the pickling process, the olives are well sorted, as only those which show no faults can be kept. They are then placed for several days in cold water, which is renewed frequently. Then they are placed in a brine bath, which consists of a salt and soda solution, and are covered with the liquid. In some cases different aromatic substances are added to the bath so as to give a special flavor to the olives. Ripe or nearly ripe olives are but little in demand and are not consumed to a large extent. As to the extraction of olive oil this has been carried out heretofore by a primitive process. Each small cultivator extracted his own oil by a press which he hired, generally making payment in oil or farm products. The olives were ground up in a horse-mill before pressing. The ground olives were then put in a lever press, using boiling water for the extraction. The presses are of heavy build, but the process is a slow one and the olives need to be stored on hand for some time. They are thus likely to ferment and give an inferior quality of oil. It is estimated that there are some 3,000 or 4,000 of such primitive oil-presses in use in Spain at the present time. The pomace which remained was formerly used for fodder or as combustible, but now it is generally sold and more oil is taken from it by an improved process. Some of the large producers saw the necessity of working on a greater scale and commenced to introduce large cylinder presses and grinding mills, which gave an increase in the quantity as well as the quality of the oil. The use of these machines is now becoming general in the large factories. As to the remainder of the olive oil process, the oil is placed after extraction in large earthenware jars or tin tanks and is then filtered. In some cases the air is kept from the oil by means of a layer of alcohol which is placed on the surface. The inferior grades of oil are used in soap manufacture.

Official Meteorological Summary, New York, N. Y., October, 1905.

Atmospheric pressure: Mean, 30.11; highest, 30.57; lowest, 29.51. Temperature: Highest, 80; date, 9th; lowest, 37; date, 27th; mean of warmest day, 70; date, 5th; coldest day, 44; date, 27th; mean of maximum for the month, 63.5; mean of minimum, 50.3; absolute mean, 56.9; normal, 55.5; average daily excess compared with mean of 35 years, +1.4. Warmest mean temperature for October, 61, in 1900. Coldest mean, 50, in 1876. Absolute max. and min. for this month for 35 years, 88, and 31. Average daily deficiency since January 1, —0.1. Precipitation: 2.67; greatest in 24 hours, 1.60; date, 19th and 20th; average of this month for 35 years, 3.68; deficiency, —1.01; excess since January 1, +1.41. Greatest precipitation, 11.55, in 1903; least, 0.58, in 1879. Wind: Prevailing direction, west; total movement, 8,605 miles; average hourly velocity, 11.6; max. velocity, 48 miles per hour. Weather: Clear days, 15; partly cloudy, 10; cloudy, 6. Frost: Light, 22d and 23d; heavy, 27th, 30th, and 31st.

The Current Supplement.

The current SUPPLEMENT, No. 1558, opens with a well-illustrated article by Frank C. Perkins describing the Crewe Railway Signal. The theory of coherer action is fully described. "How to Build a Small Alternating-Current Dynamo Without Castings" is the title of a most instructive article by N. Monroe Hopkins. Full working drawings accompany the article. Dr. O. N. Witt contributes one of his simply-worded and interesting articles on chemical solubility. The discussion of old age and its causes is concluded. Mr. A. R. Hinks writes on the Milky Way and the Clouds of Magellan. A great many kinds of figs are found in commerce. The complicated biological relations which connect these various figs, and the curious process by which the fruit is developed, are described in an article published in the current SUPPLEMENT. One of the most interesting papers read before the British Association was that by Francis Darwin on the perception of the force of gravity by plants. The first installment of this paper is published in the SUPPLEMENT.