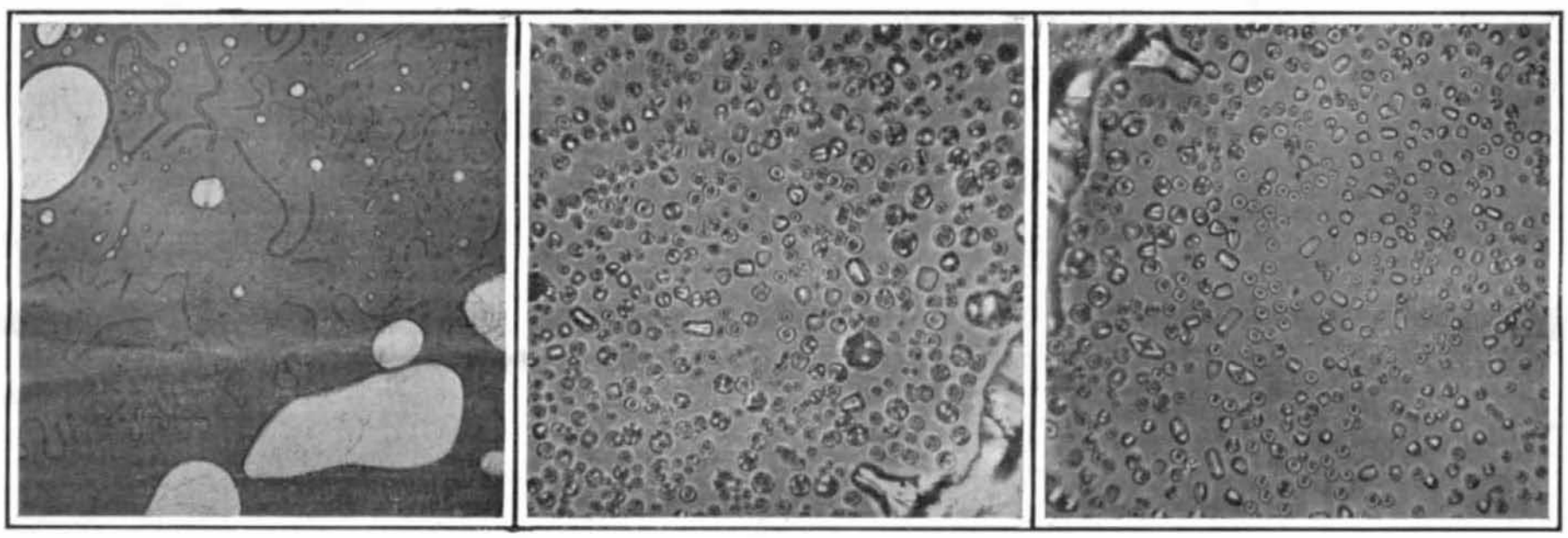
### SOFT CRYSTALS SHOWING APPARENT LIFE.

BY DR. ALFRED GRADENWITZ.

The present tendency of physical science is rather toward evidencing a continuity between provinces that were formerly entirely separated from each other than to establishing new boundaries corresponding to new categories. The impossibility of establishing a definite boundary between solid and liquid states has been evidenced in the course of the last few years by the work of Prof. O. Lehmann, of Karlsruhe, Germany, whose researches on liquid crystals deserve the highest interest, the more so as the soft crystallinic forms produced and investigated by this physicist show some striking analogies with the world of living beings, thus constituting another link in the chain of recent researches on the boundary between living and apparently dead matter, to which attention has been drawn especially by Butler Burke's recent investigations. As a complement to these researches on one hand and to Prof. Leduc's work on the other (of which the writer has published an account in a recent issue of the SCIENTIFIC AMERICAN) the following observations may be of interest.

An organic substance called para-azoxy-cinnamic-acid-ethyl-ether, obtained in the "fleeting" crystallinic state between 139 deg. and 248 deg. C., is one of the most remarkable substances susceptible of assuming this condition. In fact, the phenomena observed under the microscope seemingly show a perfect analogy with the phenomena of living beings, so that partisans of the ancient theory of spontaneous generation might avail themselves thereof in establishing the basis of their theory. While modern science abhors premature conclusions, so far from discarding such phenomena as are incompatible with present laws, it should most thoroughly and without any prejudice examine any facts brought to its notice.



Long Crystals Squirming Like Serpents. Creeping Crystals. Fleeting Crystals at Rest as Seen by Polarized Light.

SOFT CRYSTALS SHOWING APPARENT LIFE.

In the present case its task will be to investigate how far the forces working in the living organism agree with the forces of lifeless nature. A striking difference in the behavior of these two classes, as so far observed, has been that while the growth of living beings takes place in virtue of internal absorption ("intussusception"), and while by the copulation of two individuals into a single one, or the subdivision of one individual into two or more, an increase or decrease in their size is produced, the crystals so far known would grow only in virtue of the gradual adding together of molecules. Now the substance referred to in the beginning just shows the same phenomena as were so far attributed solely to living matter, and in addition exhibits some most striking motional phenomena, that are quite analogous to those of micro-organisms. So far from considering these soft crystals as living beings, Prof. Lehmann suggests that they fill up a gap in our knowledge of molecular effects, the forces acting in the case of both classes being possibly identical.

When heating a small amount of the substance above mentioned, after moistening it with some monobromine-naphthaline as solvent until only a few particles of the jelly are left, and cooling to about 200 deg. C., some short, square columns with rounded edges and angles will, under the microscope, be found to be separated, showing in some cases the shape of pyramids. The lower the temperature, the less will be their tenacity, possibly owing to their absorbing some of the solvent in a way analogous to other crystals, dyeing stuffs, etc. While being colorless when inspected in a longitudinal direction, they show a yellow and sometimes a reddish-yellow tint on being viewed transversely.

Whenever two individuals come in contact with each other, they are seen immediately to combine like two oil drops, especially in case their position is a corresponding one. In the event, however, of their being placed in opposition, the summit and base of the pyramids coinciding, twin crystals will be produced, showing at the juncture, owing to the refraction of light, a cross on a gray rhomb.

While crystals of an oily consistency are produced as the temperature continues dropping, they are no more able to withstand the pressure of surface tension (increased owing to the decrease in temperature, and which acts like an elastic membrane encompassing the whole) so as to be compressed to spheres, the crystalline structure of which is only manifested by their special refraction. If any one of these spheres is turned over, it is found not to be absolutely round, but to show a flattening or funnel-shaped depression at some point, from the middle of which a dark straight line leads to the centrum of the sphere. If the latter be so placed that the depression is situated either on the top or underneath, everything being symmetrical round the center, it will show a set of concentric circles; this is what is called the "first main position." If on the other hand the depression be situated sideways, the dark stroke will be seen leading from the center to the periphery; this is what Prof. Lehmann terms the "second main position." If now two drops combine in the first position, one drop with only one core or center and one depression will be obtained, and the same in the second main position if the positions be corresponding ones. If, however, the depressions be placed in opposition, both will be maintained in the resulting drop. If finally two individuals strike each other at their depressions, a twin form will be produced, the spheres being combined without flowing together into a single one. Such twin structures may also be produced spontaneously, an extension growing out of the depression of a drop gradually taking the size of an equivalent sphere. This shows a perfect analogy with the springing up of a bud, as observed in the case of micro-organisms, this bud being thrown off after some time, and continuing its existence as an independent individual of the same species as the original. A perfect analogue to the ordinary phenomenon of subdivision as observed in the case of the smallest organisms is likewise noted, the drop in the first main position being frequently drawn out to a bacterium-shaped small rod, this being suddenly divided into two pieces. Before this separation a sort of partition wall is observed at the dividing point, as ascertained by a strange light refraction due to the twin position of the molecules.

So far from being at rest, the drops are susceptible of rotating around their axis. The miniature rods frequently show phenomena of motion analogous to those of the diatoms, being a slow creeping both forward and backward, while passing through what seem to be obstacles to the motion. The small rods in some cases suddenly take the shape of long serpents, bending incessantly with great energy, and even moving from their ordinary position and performing what seems to be a peristaltic motion. The growth of these serpents, which is evidently intensified by cooling, actually forms an analogy to growth by internal absorption (intussusception) in the case of living organisms. Though the separation of substance occurs at the surface of the serpent, its thickness remains perfectly constant, there being only an alternation of its length. Any molecules joining the structure are evidently drawn immediately into the interior, dispersing the existing molecules. Sometimes such a serpent will expand with extraordinary speed, covering the whole field of vision of the microscope, while sometimes disappearing before the eyes of the observer. If the latter succeed in studying the various phases of the phenomenon, he will see the serpent to be instantly contracted to a sphere, thrown away by the force of contraction.

Similar phenomena are observed in the case of the ordinary rods. These will in fact bend into a ring, while a contraction to a sphere occurs as soon as the ends meet. A similar effect is observed in the case of the contact of two rods, while a combination of rods to twins and threefold structures is observed in some cases. Serpents will sometimes spring up from the depression of drops in the second main position, or else a given serpent will give rise to the production of a thinner one, or else its thickness will gradually decrease during growth, resulting in a structure analogous to a germ filament, showing a similar oscillatory motion of the tail.

Rods and serpentine structures are frequently observed in the case of the separation of a bud connecting the latter to the mother individual as well as in the case of a subdivision. The addition of foreign substances may result in some kind of poisoning, the phenomena of motion being slackened or the morphogenetic force vanishing, or else some disfiguration being produced. Even the absorbing force of the glass may result in disturbances, the drops being attracted by it. A multitude of remarkable structures is formed even in normal conditions, a serpent being, e. g., suddenly separated into a chain of droplets, or else into a miniature rod showing expansions which are gradually converted into a drop.

### Wormholes in Wood.

Wood felled and worked up is frequently subject to wormholing. The sapwood is much more attacked than the perfect wood, and it has to be cut off when we wish to produce durable work; whence a pretty considerable loss. Mons. Emile Mer noticed that the species attacked are those whose sapwood contains the most starch; on the other hand, analysis revealed to him that the dust from the wormholes no longer contained starch. The insect, therefore, introduced itself into the wood in order to nourish itself at the expense of this material. Now, starch is produced by the leaves under the influence of the light; there go branches to the trunk and to the roots through the *liber* or inner part of the bark. Removing a ring of bark intercepts the descent. The starch newly elaborated accumulates above the ring; that which existed in the inferior region is soon absorbed and transformed by the cells of the wood, whose food it constitutes. Hence an annulation of a few centimeters' length at the top of the trunk, three or four months before the felling, is sufficient to eliminate the starch from the trunk. The best season for operating is the spring; the trees can then be felled in October. It is essential not to allow any shoot to develop below the excoriated part.—L'Illustration.

It is said that tantalum has great possibilities when used for tool making, its toughness and hardness rivaling the diamond. Von Bolton made a laboratory experiment recently, when a sheet 0.04 inch was hammered from the first piece produced of the pure metal, and all attempts to drill a hole through it were found to be futile. Finally a diamond drill was employed, and after continuous work for seventy hours at a speed of 5,000 revolutions per minute, about one-fourth of the task had been completed, while the drill was so badly worn as to necessitate a discontinuance of the test. Tantalum is entirely non-magnetic, has a specific gravity varying from 14 to 17, and fuses at about 2,300 deg. C. (4,172 deg. F.). In the form of a wire it has a tensile strength of about 128,000 pounds per square inch.—Mechanical World.