It appears that some arrangement whereby power companies supplying large cities could have recourse to observations of daylight illumination, especially during the thunderstorm season, would be of decided benefit to them, for the falling off of this illumination would afford an index as to the proper time to prepare to supply additional current.

This sketch is sufficient to indicate the character of the important work being done by Dr. Kimball and to suggest some of the industrial benefits to be derived from the study of daylight under various types of cloudy and smoky sky.

C. LE ROY MEISINGER

WASHINGTON, D. C.

ON STEREOTROPISM AS A CAUSE OF CELL DEGENERATION AND DEATH, AND ON MEANS TO PROLONG THE LIFE OF CELLS

IN former investigations we have shown [1, 2] that amoebocytes of Limulus have the tendency to move and to spread out in contact with solid bodies. We thus found another instance of a reaction which is common to many kinds of cells and which we observed and analyzed in 1897 and subsequent years and which we designated as stereotropism of tissue cells [3].

We further found that the blood cells of Limulus, as a result of this stereotropic response and the concomitant spreading out of their protoplasm along the surface of the solid body, underwent degenerative changes; they lost their granules, became hyaline and gradually motionless and then died. There was some indication that this spreading out of the cells was accompanied by a taking up of fluid from the surrounding medium and that this led to processes of solution which initiated the retrogressive changes. [1, 2, 4]

In order to prolong the life of these cells it was therefore necessary to retard this exaggerated stereotropic response which led to a spreading out of the cell in contact with the solid body. We found previously that this can be done not only by keeping the cells at a lower temperature, which retards other activities as well as the stereotropic reactions and is therefore not specific, but in a specific manner by enabling the cells to rest on a surface previously covered with a thin film of paraffine or vaseline. [4] In contact with such a surface the spreading out of the cells is considerably retarded and the life of the cells and the duration of their amoeboid movement is prolonged. In carrying out these experiments, we make use of the experimental cell fibrin (amoebocyte) tissue, a small piece of which we place on the prepared surface and surround with the desired kind of fluid.

Last summer at the Woods Hole Marine Biological Laboratory we continued these experiments with the cooperation of Mr. K. C. Blanchard [5] and found an additional method of preventing the extension of the cells and thus to prolong their life and activities. This can be accomplished by making the medium into which the cells enter from the piece of tissue very slightly acid, an observation which agrees with our previous finding according to which the cells perish in a neutral solution of isotonic sodium chloride, but are preserved in such solutions after addition of a very small amount of either acid of alkali.[2]

In our recent experiments we found that in such slightly acid media the cells leave the tissue in dense masses and continue to move for a considerable period of time; they are preserved, their spreading out is much retarded and their motor activity in consequence much prolonged. In alkali the cells are likewise preserved for some time, but they begin to spread out and become dissolved much earlier than in acid.

It is possible to grade the effect of acid upon the cells. If the acid used is too strong and

1 Leo Loeb, *Journal Medical Research*, 1902, II 145. *Virchow's Archiv.* 1903, Vol. 173, 35.

2 Leo Loeb, *Folia Haematologica* 1907, IV 313. *Pflüger's Archiv.* 1910 Vol. 131, 465.

3 Leo Loeb, *Archiv. f. Entwickelungsmech.* 1898 VI 297. *Anatomical Record* 1912, VI 109.

4 Leo Loeb, *Washington University Studies* 1920 VIII 3. *American Journ. Physiol.* 1921, Vol. 56 140.

5 These experiments will be more fully described by the writer and Mr. K. C. Blanchard elsewhere.

consequently the consistency of the cell too great, their motility is diminished. If it is used in too weak a concentration, the spreading out and solution processes are not sufficiently delayed. In an intermediate concentration of the acid, the consistency is such that the migration of the cells out of the piece is readily possible and at the same time the cells are preserved and the stereotropic reaction is retarded. But ultimately the cells begin to spread out and now retrogressive changes set in even in these favorable media. However, it may be possible to keep the cells active for six days or longer even at room temperature, at which under ordinary conditions the cells spread out and become hyaline on the first or second day.

In this case we recognize thus as the principal cause of cell death an extreme degree of reactivity of the cells in contact with solid surfaces. There is good reason for assuming that this reaction leads to an increased permeability of the surface of the cell which reaches a degree which is injurious and is thus responsible for the subsequent degenerative processes.

Conditions which prevent this extreme stereotropic reaction tend therefore to prolong the life of the cells. Acid acts in this way apparently by increasing the consistency of the cells, at least of its outer layer.

As we have shown elsewhere [4] there exists a striking analogy between the behavior of the amoebocytes and ordinary tissue cells. Through agglutination the amoebocytes produce sheets of a tissue-like material. After an incision in such a tissue cells migrate from the cut edge into the defect, in a way similar to tissue cells adjoining a wound. In both cases two factors determine the direction of migration: (a) The stereotropic reaction, (b) a tendency towards centrifugal movement.

During the process of movement the amoebocytes spread out and thus produce structures totally unlike the original amoebocytes, but closely resembling various tissues. A similar change from agglutinated round cells to cells spreading out in contact with a solid or viscous substratum underlies the embryonic tissue formation. Under the influence of mechanical factors a system of fibrillation can be produced in this experimental amoebocyte tissue which indicates the direction in which the mechanical factors act. In an analogous way we know that certain mechanical effects determine the fibrillation in certain higher tissues. In both cases the tissue formation leads to the production of an elastic tension under which the tissues are held, which latter retract after an incision had been made. The processes of tissue formation had led to the production of potential energy stored in the tissues.

The transformations which we observe in the amoebocytes in the case of tissue formation are, as far as our evidence shows at present, due mainly to two factors: (a) changes in consistency primarily in the outer layer of the cells; this depends in all probability upon a taking up of fluid from the surrounding medium and a different distribution of fluid within the cell, and (b) an increased permeability of the outer layer of the cell. These changes may lead to degenerative processes in the cell.

In some respects the differentiation and specialization of tissue cells in higher organisms has likewise the aspect of retrogressive changes; it may diminish the power of resistance of these differentiating cells. This suggests very strongly that changes of a similar character, although perhaps quantitatively weaker, may take place in the higher tissue cells during the process of tissue formation.

LEO LOEB
DEPARTMENT OF COMPARATIVE PATHOLOGY,
WASHINGTON UNIVERSITY

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF CHEMISTRY OF MEDICINAL PRODUCTS
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Arsphenamine and neoarsphenamine: GEORGE W. RAIZISS, JOSEPH GAVRON AND M. FALKOV. Arsphenamine and neoarsphenamine are indispensable in the treatment of spirochaetic infections. The elimination of the alarming symptoms or "reactions" attendant upon the use of these drugs is a problem of increasing importance. These have been attributed to chemical impurities which the authors have tried to identify. Incidentally, samples, of unusually high chemotherapeutic indices have been obtained. Methyl alco-