ment is made between two mirrors A and B at a fixed distance apart. In a gravitational field the world-lines of A and B will not be parallel. Light leaves A at right angles and travels in a geodesic to B. It returns starting at right angles to B and the return geodesic cuts A at A', which in general will not coincide with the starting point. The difference in time which is due to the curvature of space will be taken as a measure (inverse) of the velocity of light. Cannot the velocity of light be expressed in terms of the Riemann-Christoffel tensor? In formulæ (1) c is usually identified with the velocity of light, but AA will have to adjust the value of it if his acceleration of gravity changes and the latter is a function of the curvature of space.

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Intracellular Bodies in Plant Virus Diseases.

IT has been known since 1903, when Iwanowski's paper on tobacco mosaic appeared, that virus disease in plants is frequently accompanied by the appearance within the cells of abnormal inclusions bearing some resemblance to amœbæ. These inclusions, or 'X-bodies', are well-defined masses of granular or finely reticulate material not unlike protoplasm, typically rounded or roughly spherical in shape, though often elongated, and usually containing in their substance vacuoles, which vary in number from one to as many as ten or eleven. The resemblance to amœbæ is heightened by the not infrequent appearance of lateral projections suggesting pseudopodia, and the occurrence of bodies constricted in such a fashion as to suggest fission has led several observers to believe that these X-bodies are in fact living organisms or plasmodial colonies of organisms, which represent some stage in the life-history of the virus parasite.

Some fresh light has been thrown on the formation and nature of these bodies by a study of them as they occur in *Solanum nodiflorum*, when infected with the yellow or aucuba mosaic of tomato. In this plant the hairs stand out stiffly from the leaves and lend themselves to examination in the living state, under quite high magnification, without further treatment than mounting the leaf in water or other suitable medium. The bodies in the cells of infected hairs are unusually conspicuous, and ordinarily occur uncomplicated by the other abnormal structures, for example, striate material, crystal plates, etc., which are usual in the cells of mosaic tobacco, tomato or other plants, although a long crystalline spike is frequently seen lengthways in the cell. They can be readily seen in cells of other type than the hair cells, for example, in epidermal or palisade cells of the leaf, but in these situations some operative interference is necessary to show them clearly.

It was noticed by one of us (F. M. L. S.) that in the early stages of infection there appear in the streaming cytoplasm of the hair cells small particles, which are carried along in the stream and tend to aggregate together to the formation of larger masses; and it has been found possible to follow in the individual living cell the formation of the X-body from its early beginnings to its completion. A young plant is inoculated and, when the first signs of the disease appear, a suitable leaf is detached, and under the microscope the hairs projecting from its margin examined seriatim. The leaf is then placed with its petiole in water or nutrient solution, and examined again from time to time at short intervals; the appearance and development of the X-bodies can be watched in selected individual hairs for many days.

At the first examination, no bodies may be visible in any hairs. In a few hours tiny particles appear in the cytoplasmic strands and are carried round the cell in the stream. As time goes on, these particles increase in size, and at the anastomoses of the strands tend to hesitate or halt for a longer or shorter time before they move on, their further progress being facilitated by modification of the strands and by alteration in shape of the plastic particles themselves. With still further increase of size, the halts become longer: they may last for a couple of hours or more. At such a halt another particle may join the stationary one, and when the movement is resumed the two may again separate or they may go on together as one mass. By successive increments large masses are eventually formed which are readily recognisable as X-bodies. There may be several such masses in a single cell, which continue to move independently of one another, or they may coalesce to form one or more larger masses.

These composite masses may remain permanently in union, and, when they do, they seem to fuse together, as it were, into a more homogeneous whole, in which vacuolation can be observed; even in quite small masses vacuolation is sometimes observable. Sometimes, however, a composite mass may again separate, even after long contact, into its constituent parts which resume their independent movement. When this occurs, figures are seen which look quite like a process of fission; but it is not a case of division in the sense of multiplication, since the separate portions may again unite. Similarly, when a smaller mass breaks away from, or joins up with, a larger mass, appearances may be presented which simulate pseudopodia, and have been so interpreted. In leaves which have been infected for several weeks, breaking down of the bodies is comparatively common.

This mode of formation accounts for many of the appearances which have led to the belief that X-bodies are living creatures, for example, the pseudopodia, the fission-figures, the occurrence of several bodies in one cell (which has been attributed to division of a parent body). It also explains the great tendency of X-bodies to be associated in position with the nucleus, since it is round the nucleus that the protoplasmic strands cross and anastomose most freely, and it is in such situations that aggregation tends to occur. Of the nature of the small particles themselves it is too early to say anything definite. They give the impression of being foci where the protoplasm has condensed or solidified, and are of no fixed shape. There is no sign of autonomous movement and nothing to suggest that either they or the complete body is living, in the sense of being an independent organism or parasite.

The possibility that they are cytoplasmic condensations is strengthened by the fact that X-bodies are protein in nature. They give the usual protein reactions, such as Millon, Raspail, biuret, and various aldehyde tests; they are soluble in acid and alkali of sufficient strength, insoluble on boiling and in alcohol. They have a distinct tendency to crystallise out, especially in old leaves, and the crystals have all the characters of protein crystals, such as are seen in aleurone grains, including the tendency to take semi-crystalline forms with faces and angles on only part of their surface. In polarised light these crystals do not appear, nor does the uncrystallised body, though sometimes one or two small doubly-refracting crystals may be seen lying on the surface of the body or embedded in its substance.

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