Replication Cycle of the Blue–Green Algal Virus LPP-I

The infection of the blue-green alga *Plectonema boryanum* by a virus was first recorded by Safferman and Morris¹, and we have described methods of culture for the alga and the virus and also the mode of infection of the cell²,³.

Fig. 1. Section through part of a cell of *Plectonema boryanum* 16 h after infection. Note the fully formed virus particles. (× 62,000.)
The virus has a long "tail" by which it attaches itself to the cell wall; the DNA is then apparently injected into the cell after the manner of some bacteriophages. This communication deals with what happens after the injection of the DNA, and describes the replication cycle of the virus as far as this can be elucidated by electron microscopy.

A section through an algal cell 16 h after infection shows masses of the fully formed and nearly spherical virus particles (Fig. 1). A similar section through a cell 1 h or less after infection shows numbers of particles with an elongated profile instead of the virus (Fig. 2). At higher magnification these are seen to be helices (Figs. 3 and 4) in which the diameter of the coil is approximately 180 Å and that of the threads composing the coil about 20 Å. The number of loops in the helix has not been definitely ascertained, but there seem to be three. (One of the loops in Fig. 4D (arrow) suggests a second helical

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Fig. 2. Similar section to Fig. 1 but 1 h after infection. Note the elongated helices and also the developing helices between the photosynthetic lamellae (arrows); some empty spaces from which helices have migrated can be seen. The encircled helices in Fig. 2 are shown enlarged in Fig. 4, A, B and D. (×64,020.)
formation.) Still earlier in the process of infection, numerous small particles are visible between the photosynthetic lamellae of the cell and appear to be helices in process of formation (Fig. 2); at this stage many fine threads can also be seen in the nucleoplasm.

We tentatively suggest that the replication cycle of the virus consists of the following sequence of events. After injection of the DNA into the cell, viral DNA is formed in the nucleoplasm whence it migrates to the photosynthetic lamellae where the helices can be seen in the course of formation (Fig. 2, arrows). The next step seems to be the movement of the helices into the virogenic stroma; in Fig. 2 can be seen some empty spaces from which helices have migrated, as well as one or two helices still in situ. At a later stage all the helices seem to have moved into the virogenic stroma, leaving only empty spaces. In the virogenic stroma further changes take place: the helix becomes enclosed in its protein coat and condenses into a nearly spherical particle. In sections of particles at this stage of formation the loops of the helix are still visible (Fig. 4A, B and D).
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