LETTERS TO THE EDITORS

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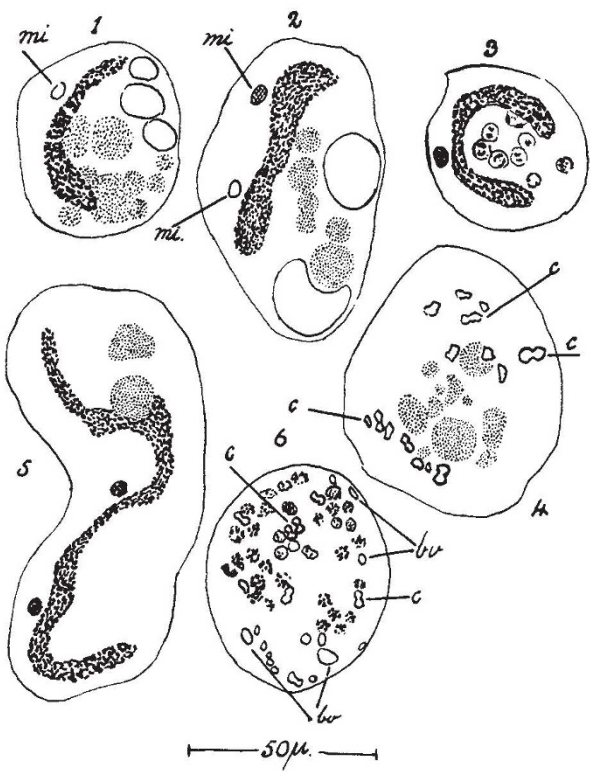
IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Virus Inclusions, Blastogenic Agents and Ciliates

THERE was reported in these columns[1] the production of abnormal Paramecia by 3 : 4-benzpyrene, and the information that these abnormal cells, by reproduction, gave rise, in the absence of the agent and indefinitely, to abnormal races showing widely varying polymorphism, like the cells of tumours.

Since then, similar races of abnormal Paramecia and other Ciliates have been produced by suitable exposure to the following blastogenic agents : cyclic hydrocarbons, gamma and ultra-violet radiations, heat, cold and hypertonic dextrose.



NOS. 1, 2 AND 5 ARE SPECIMENS FROM THE INFECTED CULTURE STAINED BY FEULGEN'S METHOD ; THE NUMBER OF PARTICLES PER UNIT AREA IS APPROXIMATELY CORRECT ; IN NO. 1 THE MICRO-NUCLEUS (*mi*) IS UNSTAINED ; IN NO. 2, WHICH IS A DOUBLE, ONE IS UNSTAINED AND THE OTHER FAINTLY STAINED ; NO. 5 IS A DOUBLE MONSTER ; NO. 3 IS A NORMAL WELL-FED ORGANISM STAINED FEULGEN ; NO. 4 IS AN INFECTED CELL STAINED GRAM AFTER FORMALIN VAPOUR FIXATION, IT SHOWS INCLUSION BODIES AND DUMBELL CRYSTALS (*c*) ; NO. 6 IS A NORMAL STAINED INTRA VITAM WITH CRESYL BLUE, IT SHOWS FOOD VACUOLES, CRYSTALS AND BLUE VACUOLES (*bv*).

The possibility that a virus might be playing a part has been kept in mind ; nothing suspicious was noted until a few weeks ago. In a culture of Aspidisca sp. subjected to 40° C. for one minute, abnormals were sought for ; they occur for 24–48 hours after such an exposure. None was found, as is often the case, since they are always of rare occurrence. In the culture, six days later, I was astonished to see many abnormals, far more numerous than ever seen before. Some were picked out and stained by Feulgen's method ; they showed in the cytoplasm, collections of minute stained particles, similar to virus inclusions (see accompanying figure).

These inclusions are easily distinguished from food vacuoles containing bacterial debris shown in Nos. 3 and 6. It may be mentioned that organisms fed on Gram positive Staphylococci do not show Gram positive cocci in the food vacuoles : they become Gram negative. The inclusions appear to lie free in the cytoplasm and not within a vacuole. They have never before been found in Aspidisca, either in normals or in abnormals produced by blastogenic agents.

The infected culture was sub-cultured to many well slides, under conditions known to favour abundant growth. Instead of reproducing, they ceased to divide and gradually died out, all being dead on the twenty-second day. Many attempts to infect normals and cells subjected to blastogenic agents were unsuccessful.

Two other facts are worth recording. Accompanying the presence of abnormals in the infected culture, were seen all the signs of increased cytoplasmic viscosity which has invariably been observed preceding the production of abnormals by blastogenic agents. There is, therefore, a similarity in the reaction of the cells to virus and to blastogenic agent. I also noted that in many cases, the micro-nuclei failed to be stained by Feulgen, see Nos. 1 and 2 ; perhaps the supply of nucleic acid to the micro-nuclei is interfered with, being all grabbed by the virus ; in these specimens one also sees unstained bands, see No. 1, in the macro-nucleus as though it, too, was deprived of nucleic acid.

I would be very grateful for any information on virus or virus-like inclusions in the Protozoa.

J. C. MOTTRAM.

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[1] NATURE, **145**, 184 (1940).