

Letter to the Editor

Virus Terminology and the Viroid: A Rebuttal

T. O. Diener

Plant Virology Laboratory, Plant Protection Institute, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland 20705.

In his Letter to the Editor (10), McKinney acknowledges the significance of recent discoveries made with the potato spindle tuber (PSTV) and citrus exocortis (CEV) agents, but takes issue with certain aspects of terminology.

Before commenting on these issues, I wish to point out two errors in McKinney's brief summary of recent developments relating to these agents. His statement, that after Raymer & O'Brien's (13) work, PSTV "became available for intensive study by biochemical means," is incorrect. Only now, after 10 years of intensive work, has PSTV been obtained essentially pure and in sufficient quantity for biochemical study (4, 7). His statement that Diener & Raymer (6) worked with purified preparations is similarly erroneous. All experiments described in the quoted publication were made with crude extracts from infected leaves or with crude nucleic-acid preparations derived therefrom.

I agree with McKinney that the term *self-replication* is ambiguous. My objection to the term, however, differs from McKinney's. His statement that "complete replication of TMV still requires contributions from its host" is a truism that applies equally to all pathogenic microorganisms, whose multiplication, as well as that of viruses, depends on building blocks supplied by their hosts.

What distinguishes viruses from microorganisms is the fact that the former, in addition, depend on certain biosynthetic capabilities of their hosts to produce virus-specific constituents. This fact, however, is such a basic, well known, and securely established tenet of virology that misinterpretation of *self-replication* in McKinney's sense is most unlikely to occur.

Contrary to McKinney's statement, *self* is not redundant in Montagnier's (11) usage, since *self-replication* evidently stands for DNA-independent RNA replication. For a time, I followed Montagnier's terminology (3). Several other meanings could, however, be ascribed to the term (such as, for example, helper-virus-independent replication) and, in this sense, *self-replication* is ambiguous. I have since abandoned the term in favor of more specific ones (5).

Although McKinney does not seem to question the need for a new term to designate PSTV and similar agents, he objects to the use of *viroid*, because, in his judgment, this term still serves a useful function in Altenburg's (1) connotation.

In defending Altenburg's *viroid*, however, McKinney takes undue liberty with the term. According to Altenburg, *viroids* are hypothetical, ultramicroscopic organisms that are useful symbionts,

occur universally within cells of larger organisms, and are capable, by mutation, of giving rise to viruses (1). It is difficult to see how "harmless nucleic acids involved in the evolution of disease-inducing nucleic acids" could be accommodated within Altenburg's concept of *viroid*. *Harmless* certainly is not *useful*, and nucleic acids clearly are not organisms.

In thus drastically altering Altenburg's definition of *viroid*, McKinney admits that, in modern terms, Altenburg's original *viroid* and *viroid* theory are not useful concepts. This conclusion is strengthened by the fact that none of the references cited to show a "rekindling of interest in an old subject" (2, 12, 14) mention Altenburg's *viroid* or *viroid* theory, and also by the fact that the term (in Altenburg's connotation) is absent from the subject indexes of Biological Abstracts for the years 1951 to 1972.

One may argue that Altenburg, nevertheless, preempted the term, and that its use in a different connotation is inadmissible. If so, one must bear in mind that Altenburg did not coin the term, but only redefined it from its earlier meaning; namely, "any prophylactic vaccine" (17) or "any biological specific used in immunization" (9).

I submit that the term, either in its earlier or in Altenburg's connotation, is obsolete, and that redefinition of *viroid* to encompass nucleic-acid species with properties similar to those of PSTV is appropriate and serves a useful function.

Finally, McKinney's reasoning that "the PSTV and the CEV may be regarded as the most primitive or the most degenerate plant viruses known" is fallacious, in that it omits another equally likely possibility; namely, that these pathogenic RNA's are unrelated to viruses.

Investigators active in this area of research have pointed out this possibility (3, 8, 15, 16), but McKinney takes a more narrow view and insists that the agents must be viruses. Undoubtedly, at an earlier time, such reasoning would have opposed as well the concept of (filterable) *viruses*; and the newly discovered pathogens would have been regarded simply as the most primitive or the most degenerate bacteria known. Needless to say, such a narrow view not only would have been shortsighted and erroneous, but would have tended to delay progress in the new discipline of virology.

LITERATURE CITED

1. ALTENBURG, E. 1946. The "viroid" theory in relation to plasmagenes, viruses, cancer and plastids. *Am. Natur.* 80:559-567.

2. COHEN, S. S. 1970. Are/were mitochondria and chloroplasts microorganisms? *Am. Sci.* 58:281-289.
3. DIENER, T. O. 1971. Potato spindle tuber "virus." IV. A replicating, low molecular weight RNA. *Virology* 45:411-428.
4. DIENER, T. O. 1972. Potato spindle tuber viroid. VIII. Correlation of infectivity with a UV-absorbing component and thermal denaturation properties of the RNA. *Virology* 50:606-609.
5. DIENER, T. O. 1972. Viroids. *Adv. Virus Res.* 17:295-313.
6. DIENER, T. O., & W. B. RAYMER. 1967. Potato spindle tuber virus: A plant virus with properties of a free nucleic acid. *Science* 158:378-381.
7. DIENER, T. O., & D. R. SMITH. 1973. Potato spindle tuber viroid. IX. Molecular weight determination by gel electrophoresis of formylated RNA. *Virology* 53:359-365.
8. DIENER, T. O., D. R. SMITH, & M. J. O'BRIEN. 1972. Potato spindle tuber viroid. VII. Susceptibility of several solanaceous plant species to infection with low molecular-weight RNA. *Virology* 48:844-846.
9. DORLAND'S ILLUSTRATED MEDICAL DICTIONARY. 1965. 24th edition. W. B. Saunders Company, Philadelphia, Pa. 1725 p.
10. MC KINNEY, H. H. 1973. Comments on virus terminology and the "viroid." *Phytopathology* 63:438.
11. MONTAGNIER, L. 1968. The replication of viral RNA. *Symp. Soc. Gen. Microbiol.* 18:125-148.
12. RAVEN, P. H. 1970. A multiple origin for plastids and mitochondria. *Science* 169:641-646.
13. RAYMER, W. B., & M. J. O'BRIEN. 1962. Transmission of potato spindle tuber virus to tomato. *Am. Potato J.* 39:401-408.
14. SAGER, R. 1972. Cytoplasmic genes and organelles. Academic Press, New York. 405 p.
15. SÄNGER, H. L. 1972. An infectious and replicating RNA of low molecular weight: the agent of the exocortis disease of citrus. *Adv. Biosci.* 8:103-116.
16. SEMANCIK, J. S., & L. G. WEATHERS. 1972. Pathogenic 10 S RNA from exocortis disease recovered from tomato bunchy-top plants similar to potato spindle tuber virus infection. *Virology* 49:622-625.
17. STEDMAN'S MEDICAL DICTIONARY. 1961. 20th edition. Williams & Wilkins Company, Baltimore, Md. 1680 p.