AIDS Transmission and Insects

According to William Booth's article (News & Comment, 24 July, p. 355), scientists have ruled out the normal insect vector route, gut to salivary gland to victim, for AIDS. They also note that 100 femtoliters of infected blood clinging to a mosquito's proboscis, if her meal is interrupted, will pose no threat of infection to anyone later bitten. But this overlooks the most obvious means by which a mosquito (or other bloodsucking insect) can transmit AIDS. The blood in her gut, if she is swatted while completing her meal, will surely contain more than enough viral particles to infect. If the itchy spot is immediately scratched, a normal reaction, the standard method of transmission is present: virus-containing body fluid on damaged epithelium. Indeed, scratching the site may prove unnecessary. The minute puncture of the bite may be sufficient to provide entry to the virus.

There are morals in this. First, look beyond the usual categories of biological and mechanical vectors. Second, when visiting an area where there is a high rate of AIDS infection, always apply insect repellent and never swat a feeding mosquito.

DAVID F. SIEMENS, JR.
*2703 East Kenwood Street,
Mesa, AZ 85203-2340*

Detection of Molecule Spectra

A review article on interstellar molecular clouds by John Bally published in *Science* last year (11 Apr. 1986, p. 185) said, "Little was known about the composition and physical conditions of these opaque objects [the interstellar clouds] until the late 1960s, when the development of sensitive radio receivers and the application of new technology in radioastronomy led to the accidental discovery of radio frequency spectral emission lines of several molecules, such as OH, H_2O, NH_3, and H_2CO, in interstellar space." This proposed history is strikingly astray.

Actually, there has been a long interest in the possibility of detecting molecular spectra in interstellar space, although this was limited to a few individuals (*1*). In 1955, in a discussion at the Fourth International Astronomical Union Symposium, the possibility was pointed out of detection of a number of molecules in astronomical sources, including the free radicals OH, CH, SiH, as well as NH_3, H_2O, and CO (*2*). The first substantial search for a microwave line of OH was made by Barrett and Lilley in 1957 (*3*), but failed primarily because the frequency of OH was not well enough known. A general discussion by Barrett of microwave lines of astronomical interest followed in 1958 (*4*). The OH ground-state frequency was then carefully measured by Ehrenstein *et al.* in 1959 (*5*) with the comment, "One of the molecules whose presence in interstellar space may be detectable by means of its radio-frequency spectrum is the OH radical. Attempts at observing it with radio telescopes have been unsuccessful thus far. To make future searches more fruitful, frequencies of the appropriate absorption line were measured in the laboratory. . . ." In 1963, Barrett, joined by Weinreb and others, took up the search again for OH at its measured frequency and detected it (*6*). Such a history can hardly be represented as "accidental" discovery. Furthermore, while Weinreb *et al.* used a new correlation technique in the second search for OH, this did not produce any marked gain in sensitivity over what had been current microwave practice for some time at wavelengths near 18 centimeters, where this OH frequency lies.

In late 1967, in a collaboration between the physics department and the radio astronomy laboratory the University of California, Berkeley, a receiver was built for the region near 1.25-cm wavelength appropriate to attempt the detection of ammonia, which had previously been suggested. At the time not all astronomers expected such molecules to be found; there was as yet no clear evidence that clouds would be dense enough or that many molecules could form (*7*). An application by Snyder and Buhl for antenna time at the National Radio Astronomy Observatory (NRAO) to search for H_2O was, for example, turned down on advice from expert reviewers at about this time. However, the search at Berkeley proceeded. It resulted in the discovery of ammonia (*8*) and immediately thereafter of water (*9*). The antennas and receiving equipment used were types that were more or less available and could have been used before that. Thus, the failure to detect these molecules earlier and the gap of 5 years between discovery of OH and more complex molecules occurred primarily because no one had looked carefully, and neither accident nor brand-new technology played significant roles. Discovery of NH_3 and H_2O immediately encouraged Zuckerman and Palmer to combine with Snyder and Buhl to search for H_2CO, which was detected with an NRAO antenna and receiver (*10*), again of types that had been available for some time. These discoveries allowed immediate estimates of molecular temperatures and demonstrated cloud densities substantially higher than had generally been expected. They also prompted the subsequent search for and detection of what is now a list of about 75 molecular species.

Detection of molecular lines in the millimeter range, of which CO has probably been the most important, has much more directly depended on development of new receivers and antennas and hence on new technology than those at longer wavelengths, and perhaps this is what the author of the *Science* article had in mind. The general point needs to be made and emphasized, however, that support by national agencies of large equipment developments and generally accepted lines of research must always be balanced by thoughtful support of individuals, sometimes working in not-so-popular directions. As in this case, it is not just support of popular and expensive equipment developments that open up new fields; the less expensive but persistent interests of individual scientists are sometimes more effective.

ALAN H. BARRETT
*Massachusetts Institute of Technology,
Cambridge, MA 02139*
LEWIS E. SNYDER
*University of Illinois,
Urbana, IL 61801*
CHARLES E. TOWNES
*University of California,
Berkeley, CA 94720*
W. JACK WELCH
*University of California,
Berkeley, CA 94720*

REFERENCES AND NOTES

1. I. S. Shklovsky, *Astr. Zhur. S.S.S.R.* **26**, 10 (1949); *Dokl. Akad. Nauk S.S.S.R.* **92**, 25 (1953); C. H. Townes, *J. Geophys. Res.* **59**, 191 (1954); ——— and A. L. Schawlow, *Microwave Spectroscopy* (McGraw-Hill, New York, 1955), p. 148; I. S. Shklovsky, *Cosmic Radio Waves* (Harvard Univ. Press, Cambridge, MA, 1960), p. 264.
2. C. H. Townes, in *Fourth International Astronomical Union Symposium, Manchester, England, 1955*, H. C. Van de Hulst, Ed. (Cambridge Univ. Press, Cambridge, England, 1957), pp. 92–103.
3. A. H. Barrett and A. E. Lilley, *Astr. J.* **62**, 4 (1957).
4. A. H. Barrett, *Proc. IRE* **46**, 250 (1958).
5. G. Ehrenstein, C. H. Townes, M. J. Stevenson, *Phys. Rev. Lett.* **3**, 40 (1959).
6. S. Weinreb, A. H. Barrett, M. L. Meeks, J. C. Henry, *Nature (London)* **200**, 829 (1963).
7. See, for example, G. B. Field and E. J. Chaisson, *The Invisible Universe* (Birkhäuser, Boston, MA, 1985), p. 25.
8. A. C. Cheung, D. M. Rank, C. H. Townes, D. C. Thornton, W. J. Welch, *Phys. Rev. Lett.* **21**, 1701 (1968).
9. A. C. Cheung, D. M. Rank, C. H. Townes, W. J. Welch, *Nature (London)* **221**, 917 (1969).
10. L. E. Snyder, D. Buhl, B. Zuckerman, P. Palmer *Phys. Rev. Lett.* **22**, 679 (1969).

Response: The letter from Barrett *et al.* represents a valuable contribution that clarifies the origins and early history of the study