Letters

Human Trials of Malaria Vaccine

John Walsh's recent article "Human trials begin for malaria vaccine" (News & Comment, 13 Mar., p. 1319) contains the speculative statement that "such a vaccine [referring to sporozoites] would protect tourists and military personnel against infection. . . ." This statement must be based on the unproved assumption that in a malaria-endemic area, protection conferred by a synthetic peptide or a recombinant sporozoite vaccine would be of short duration and could not be boosted by exposure to the parasite through infected mosquito bites. Recombinant and synthetic peptide sporozoite vaccines are now undergoing their first clinical trials, and the vaccinated volunteers have not yet been challenged, that is, exposed to infected mosquito bites. Therefore, any statement regarding the duration and effectiveness of the protection conferred by the vaccine is conjectural and premature.

The only other malaria vaccine trials were performed in 1975 with an unusual type of vaccination, namely, repeated exposure to the bite of relatively large numbers of infected irradiated mosquitoes (*1*). Unlike the volunteers in the current trials, those volunteers were exposed to intact inactivated nonreplicating sporozoites, without administration of an adjuvant. Under those conditions protection was complete in some individuals and lasted from 3 to 6 months. The bite of infected mosquitoes at the time of challenge had a clear booster effect enhancing antibody titers and prolonging protection. Also, the repeated exposure to infective mosquito bites of people living in malaria-endemic areas leads to antisporozoite antibodies that increase with age (*2*). Mice immunized by the repeated administration of irradiated sporozoites develop complete protection that lasts 3 to 4 months, but the protection can be prolonged for the lifetime of these animals if they are occasionally exposed to the bite of infected mosquitoes.

The experimental data on vaccination of laboratory animals with synthetic peptides or recombinant polypeptides (*3*) are still too limited to permit prediction of the outcome of the human trials under similar conditions.

In any case, if protection should be short-lived, it would still benefit migrant workers, road construction crews, gold miners, and others, namely, the people from countries that have regions of malaria endemicity. It might be well to remember that the people living in malaria-endemic areas are the main target for malaria vaccine development and application and that acceptance of a future malaria vaccine can only be harmed by statements assigning its usefulness only to tourists and military personnel.

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REFERENCES

1. D. F. Clyde, V. C. McCarthy, R. M. Miller, W. E. Woodward, *Am. J. Trop. Med. Hyg.* **24**, 397 (1975).
2. E. H. Nardin, R. S. Nussenzweig, I. A. McGregor, J. Bryan, *Science* **206**, 597 (1979).
3. F. Zavala *et al.*, *ibid.* **228**, 1436 (1985).

Impending Energy Crisis?

Robert L. Hirsch (Articles, 20 Mar., p. 1467) summarizes very well in engrossing detail the declining status of the U.S. oil industry. However, his table 3 shows 100 to 200 billion barrels of oil (BBO) still remaining as U.S. oil resources. This table gives an unduly optimistic and misleading picture of the probable U.S. energy future.

The public constantly confuses two technical petroleum terms: reserves (discovered recoverable oil) and resources (theoretical oil yet to be found). The particular term being used depends greatly on whose funds are involved (*1*). Economists and the general public commonly view crude oil as a huge theoretical resource, akin to gold dissolved in sea water. But operating petroleum geologists and engineers must convert any resources into reserves that can be sold in the open market (*2*). This is much more restrictive. Private oil companies are in business to make money, not to find oil. If it costs more in energy to produce new energy, then production will not be continued for long by any corporation working with its own funds. Government agencies (spending taxpayers' money) cannot find oil any more easily than private companies can where no fields exist.

The recent U.S. oil-finding record is dismal. In 1977 through 1985, only 2 BBO were found in new U.S. and Alaskan fields, in spite of the greatest U.S. well-drilling effort ever (while contemporaneous U.S. production totaled 27 BBO, and consumption was 55 BBO) (*3*). Looking for new big U.S. oil fields is now about as effective as buffalo hunting (*4*). This is alarming when the total volume of oil used for U.S. transportation alone (for which there is no economic substitute) is 107% of our domestic crude oil production (*5*).

Global oil-finding rates are also bad news. The "giant" oil fields (each containing over 0.5 BBO recoverable oil), which are the largest targets and easiest to locate, now number only 320 worldwide (1% of known fields) but contain 75% of the world's crude oil. Discovery of new oil in such giants peaked at 125 BBO during the period from 1961 through 1965, when the total global production was 50 BBO. Since then, the amount of new oil discovered in giant fields has dropped steadily to only 10 BBO during 1981 through 1985. In this 5-year period, global production exceeded 100 BBO.

The first and second oil price shocks occurred in 1973 and 1979. The third and permanent global oil shock will be caused, as Hirsch predicts, by Organization of Petroleum Exporting Countries (OPEC) price increases within the next decade—just as soon as the non-OPEC giant fields start their inevitable decline (*6*). Meantime, the world's population continues to soar.

We should be reminded that foreign peoples develop their oil for themselves—not for us—and we have no inherent right to burn up their wealth for our convenience. Sixty-two percent of the world's oil reserves are in the Moslem nations surrounding the Persian Gulf, and there is no love lost between Arab oil exporters and other countries. The globe has only three oil-producing "superpowers," the United States, the U.S.S.R., and Saudi Arabia. U.S. oil production peaked in 1970 [as predicted by M. King Hubbert in 1956 (*7*)] and that of the U.S.S.R. in 1983. What will happen when U.S. and Soviet generals suddenly realize that their geologists cannot deliver the vast oil supplies forecast as resources? We can only hope that the United States and the U.S.S.R. will then cooperate in a plan whereby future oil from the Persian Gulf area will be shared peacefully by all nations. The alternative will be World War III.

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REFERENCES

1. L. F. Ivanhoe, *Stud. Geol.* (No. 21) (1986).
2. C. D. Masters, "Global oil assessments and the search for non-OPEC oil" (U.S. Geological Survey, Open File Report 86-373, Reston, VA, 1986).
3. *U.S. Crude Oil, Natural Gas, and Natural Gas Liquid Reserves, 1985 Annual Report* [DOE/EIA-0216 (85), Department of Energy, Washington, DC, 1986], p. 6, table 1; *Annual Energy Review 1985* [DOE/EIA-0384 (85), Department of Energy, Washington, DC, 1986], p. 101, table 45.
4. L. F. Ivanhoe, *Am. Assoc. Pet. Geol. Explor.* **6**, 38 (November 1985).
5. *Energy Security* (DOE/S-0057, Department of Energy, Washington, DC, 1987), pp. 48, 101, and 209.
6. L. F. Ivanhoe, *Am. Assoc. Pet. Geol. Bull.*, in press, (preprint of paper to be given at AAPG National Convention, Los Angeles, 9 June 1987).
7. M. K. Hubbert, *Drilling and Production Practice* (American Petroleum Institute, New York, 1956), pp. 7–25.