Acquired Immune Deficiency Syndrome Abroad

The new immune deficiency disease is now found in several countries: links to Central Africa and Haiti may provide clues to its origin

Epidemiologists have been tracking the spread of acquired immune deficiency syndrome (AIDS) in the hope of identifying the still elusive cause of this devastating disease. Participants at a recent meeting* presented data showing that AIDS, which was originally discovered in this country, is now widespread. It is found in Europe and in Canada, although not in the epidemic proportions seen here where there have been about 2700 cases and more than 1100 deaths. The disease is also present in Central Africa and in Haiti where the incidence is relatively high.

As of October of this year, 268 cases of AIDS had been reported in Europe, according to figures compiled by the World Health Organization and the Danish Cancer Society. The clinical symptoms closely resemble those observed in the United States. The patients suffer severe immunological deficiencies, leaving them prey to opportunistic infections and a hitherto rare form of cancer called Kaposi's sarcoma.

But, notes Jean Brunet of the French Ministry of Health, "There is an important difference between the American and European cases. One-quarter of the [European] cases were diagnosed in African patients." Eighteen of the 100 AIDS patients in France have links to Central Africa.

In addition, of the 40 cases in Belgium, "all are related in some way to Central Africa," according to Jan Desmyter of the Catholic University of Leuven (Louvain). They had either lived in the area themselves or had a sexual partner who had lived there. Zaire, the largest and most populous country in the region, has contributed the most cases.

The link to Central Africa is interesting because of what it may reveal about the origins of AIDS. The disease is thought to be a new one, at least in the United States where it was identified only in 1981. Where it originated is a big question because the answer may help epidemiologists identify the cause, which is generally, although not universally, thought to be an infectious agent, probably a virus.

Studies of AIDS in Central Africa are just beginning and the full extent of the problem there is unclear. "There are certainly cases in Africa," says Thomas Quinn of the National Institute of Allergy and Infectious Diseases, who recently returned from Zaire, "but it is premature to say how many cases there are. How long the disease has been there and the extent to which it has spread are questions we are working on now."

It is not yet known whether AIDS existed in Central Africa before it turned up here, but Kaposi's sarcoma has been occurring there for many years. AIDS patients, most of whom are young or middle-aged men in the United States, get an unusually virulent form of this cancer, which primarily affects the upper part of the body and frequently spreads to the lymph nodes and internal organs. They usually die within 2 to 3 years.

> "There are certainly cases in Africa, but it is premature to say how many."

The more classical form of the sarcoma, which was originally described in the late 1800's by Moritz Kaposi, affects primarily elderly men of Mediterranean origin. This type occurs on the legs, does not spread rapidly to other organs, and responds well to treatment. In addition, the patients' immune responses remain more or less normal, in contrast to the marked immune suppression seen in AIDS patients.

Both the virulent and milder forms of Kaposi's sarcoma occur in Central Africa, Quinn says. The virulent cancer usually affects children and young adults but older individuals also develop this form occasionally. "These cases look very similar clinically to their counterparts with AIDS," Quinn says. "The question remains, is this virulent form AIDS?" The team with which Quinn is working has not yet completed the immunological studies needed to determine whether the patients have AIDS-like immunological deficiencies.

They are also interested in possible associations between viruses and the Central African patients. The current leading candidate for the cause of AIDS is human T-cell leukemia virus, although the case for this agent is in no way ironclad (*Science*, 20 May, p. 806). In addition, cytomegalovirus has been linked to Kaposi's sarcoma. However, it seems unlikely that this virus, which has been around much longer than AIDS, causes the disease unless a new mutated strain has arisen.

In the United States, the most common means by which AIDS spreads is sexual intercourse among homosexuals. The largest group of AIDS patients, more than 70 percent of the total, consists of homosexual and bisexual males who have had very large numbers of sex partners, a life-style that virtually guarantees the dissemination of infectious diseases. In Africa, AIDS does not appear to spread by homosexual contact, according to Quinn. Moreover, Desmyter says that 40 percent of the patients seen in Belgium are women.

Heterosexual sex may be a more likely form of transmission in the African patients. In the United States, women who lived with bisexual men or drug addicts, the second largest group of AIDS patients here, have contracted the disease. AIDS is transmitted among drug addicts by contaminated needles, a possible mode of transmission in Africa, too.

The third largest group of AIDS patients in the United States consists of Haitian immigrants. In Haiti itself, a country with a population of about 6 million, some 150 to 175 cases have now been identified, according to Jean-Michel Guerin of the Groupe de Recherches sur les Maladies Immunitaire en Haiti, in Port-au-Prince.

AIDS began turning up in Haiti at about the same time that the disease was identified here. Because that country is a favorite vacation spot for U.S. homosexuals, there have been suggestions that the disease may have originated in Haiti and been brought back to New York by returning homosexuals, a suggestion about which Haitian officials are understandably sensitive. There is at present no conclusive evidence for that theory,

*Conference on Acquired Immune Deficiency Syndrome, which was sponsored by the New York Academy of Sciences and held in New York City on 14 to 17 November.

and the disease might have moved in the opposite direction. AIDS is not found in rural Haiti, Guerin notes. "It appears to us that the disease is an urban disease in a population that is in contact with tourists." The extent and nature of possible contacts between Haitians and Central Africans are currently unknown.

Haitian officials are also sensitive about suggestions that Haitians constitute a separate risk group simply because they are Haitians. Transmission among them is likely to occur by the standard routes, sexual contact and contaminated needles or blood products, Guerin says. The male patients, who constitute about 70 percent of the total in Haiti, rarely admit to homosexual practices, but these cannot be ruled out. "Homosexuality is a taboo subject in Haiti, and it is hard to get the information," Guerin explains.

A great many questions about AIDS, including the big one concerning the nature of the causative agent, remain unanswered. Nevertheless, the epidemiological studies are providing some interesting leads. As Quinn puts it, "The work in Zaire may give us some important clues about the course and spread of AIDS throughout the world." —JEAN L. MARX

Factoring Gets Easier

Mathematicians are exploiting computer designs to factor large numbers in times that, as recently as 1 year ago, seemed inconceivable

Each fall for the past 15 years, a group of mathematicians has met in Winnipeg to discuss progress in factoring large numbers. They know which numbers are particularly hard to factor and they even have a "Ten Most Wanted List" of difficult numbers, as well as a longer list of numbers that they have simply designated "Wanted." The wanted and most wanted numbers, says Gus Simmons of Sandia National Laboratories in Albuquerque, New Mexico, are not just long numbers. They are numbers whose factors would be important to engineers, who use them to construct shift registers; to mathematicians, who use them in such algebraic topics as field theory; and to cryptographers, who use them in the design of codes. And they are numbers that are known to be inordinately difficult to factor.

Last year, the mathematicians decided that they had reached a point of diminishing returns. They could use powerful computers to factor 50-digit numbers, but 50 digits seemed to be the limit of computational feasibility. They had on their wanted and most wanted lists numbers of 60 digits or more. Reluctantly, they decided to go to press with a paper that is jokingly said to have taken 50 years to write because two of the contributors, Derek and Emma Lehmer of the University of California at Berkeley, worked on the project that long. The American Mathematical Society (AMS), which had sponsored the search for factors of these large numbers, agreed to publish what was then known and close off the project.

Recently, however, the whole factoring picture has changed. Mathematicians are polishing off 50-digit numbers in roughly an hour and are finding that 70-digit numbers, which they would have expected to take about 100 times as long as 50-digit ones to factor on a computer, are easily within reach. "In 1982, you could have collected money from anyone in that crowd if you bet that 60-digit numbers would be factored in the next year," says Simmons. "They had all worked on factoring for 12 to 15 years and they knew how difficult it was."

Factoring has long been of interest to mathematicians, but it recently has become something of a hot research topic because the ability to factor large numbers is related to the security of a newly developed cryptography system. The system, called RSA after the last initials of its inventors, uses large numbers that are the product of two primes as the heart of its algorithm. Anyone who can factor those numbers can break the code. When the RSA code was first proposed about 6 years ago, its inventors suggested using 80-digit composite numbers. Now they suggest using numbers of at least 200 digits which, for the time being, seem invulnerable.

> "A few years ago, an interest in factoring was the hallmark of a proven eccentric."

John Brillhart of the University of Arizona, who is one of the old-time factorers, says he is somewhat disconcerted by the current interest in factoring. "A few years ago, an interest in factoring was the hallmark of a proven eccentric. Now it suddenly relates not only to the transfer of funds between banks but also to the national security. There's a certain amount of irony in this," he says.

The problem of factoring has fascinated mathematicians since the time of the ancient Greeks. But it is only comparatively recently that people have made progress. The beginning of the modern era of factoring was in the 1920's when the French mathematician Maurice Kraitchik developed some ideas that are now being implemented on large computers. Kraitchik's ideas, however, were not formulated in a particularly logical way. Yet Kraitchik made mathematicians realize that it might be possible to find clever ways to factor large numbers.

At about the same time that Kraitchik was developing his factoring methods, Derek and Richard Lehmer of the University of California at Berkeley began building mechanical devices to test for primes and to factor. In this precomputer era the Lehmers were able to factor 20-digit numbers, an extraordinary accomplishment since, for each additional three digits of a number, it seems that the factoring time is doubled.

About 15 years ago, the AMS decided to sponsor mathematicians in their search for the factors of large numbers. The idea was to make a table of all the known factors of numbers of the form $a^n \pm 1$, where a is a small whole number and n is a large number. These numbers have always been of enormous importance in number theory and algebra and are also used by engineers to generate random numbers.

The AMS table was to be called the Cunningham Project Table, in memory of a British colonel named A. J. Cunningham, who, around the turn of the century, compiled a table of factors of numbers of this sort. The reason for the AMS interest in the project was that, with the advent of large computers, mathematicians began to be able to fac-