RNA tumor viruses show action at a distance

Most cancer-causing retroviruses cause tumors in one of two ways: They carry a tumor-inducing "oncogene" into the cell they infect, or they insert their genetic message into the host cell DNA near genes that then become abnormally activated and make the cell malignant. But two retroviruses, human T-cell lymphotropic viruses (HTLV) types I and II, can turn a cell malignant regardless of where they set down, and they don't appear to carry a conventional oncogene.

William A. Haseltine and his colleagues at Harvard Medical School in Boston and the National Cancer Institute (NCI) in Bethesda, Md., report in the July 27 SCIENCE that they've discovered a gene regulation system in HTLV I and II never before seen in retroviruses. They say it could explain how these HTLVs cause cancer and other diseases. (Retroviruses contain RNA, and not DNA, as their genetic material.)

Three subtypes of HTLV are known: Types I and II cause leukemias and lymphomas of T cells, a white blood cell that orchestrates the body's cell-mediated defense against invaders. Type III is thought to cause AIDS (Acquired Immune Deficiency Syndrome) (SN: 5/28/84, p. 260).

Haseltine believes HTLV I and II make use of a mechanism for controlling genes called "*trans*-activitation," in which a viral gene makes a protein that affects the expression of other, perhaps distant genes. In HTLV-infected cells, where the system has been seen in action, the suspect protein is known to increase viral replication and may also activate cellular genes that control the infected T cell's growth, thereby turning it cancerous, Haseltine's group hypothesizes.

A comparison of the nucleotide sequences of HTLV I and II turned up a 1,000-base segment that is nearly identical in the two viruses and which the researchers believe is the gene that encodes this activity-boosting protein. Flossie Wong-Staal at NCI says there is now evidence for a similar sequence in the AIDS agent HTLV III, and Haseltine says that bovine leukemia virus "has the same setup. All of those together," he says, "add up to a nice picture."

A precedent for this RNA virus system occurs in certain DNA tumor viruses that make a protein which activates some of their own genes and at the same time switches on some genes in the cells they infect. While the suspected *trans*-acting protein seen in HTLV-infected cells hasn't yet been shown to activate genes known to control cell reproduction, the infection does switch on two T-cell genes of unknown function, Wong-Staal says.

The protein thought to be the culprit — it's the right size and is found only in HTLV-infected cells — is "not difficult to purify," says Wong-Staal, "but to make it in large enough amounts for study is a problem," she notes. At least three laboratories are trying to coax genetically engineered cells to produce the protein in quantity.

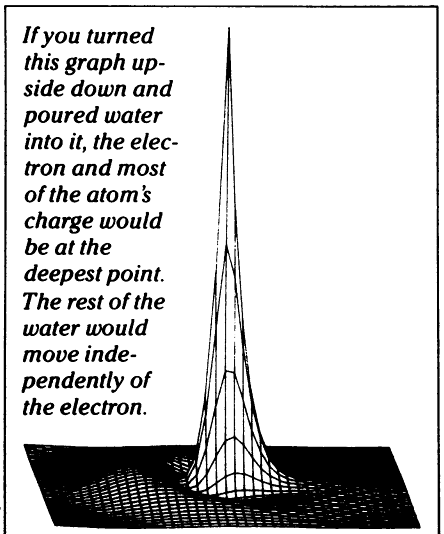
Among the researcher's immediate goals is to discover whether the *trans*-acting protein binds directly with the genes it influences and what its target sequences are. If HTLV does cause cancer, and perhaps AIDS, by the *trans*-activation system, therapies that exploit this mechanism might be devised. One idea is to genetically engineer a gene that codes for a poison in such a way that when it's put into cells, it is switched on only by HTLV's *trans*-acting protein, and thus would only kill cells in which HTLV was present and active, Haseltine says.

— *G. Morse*

First portrayal of hydrogen birth

A North Carolina physicist has produced the first portrait of a hydrogen atom at its moment of birth, data which should shed light on details of other atom collisions, such as those occurring during thermonuclear fusion.

"It's a complete picture of the hydrogen atom. We not only know where the electron is, but also how it moves, how the charge actually flows," says John S. Risley, of North Carolina State University in Raleigh. "It doesn't look like you normally think of an atom. The hydrogen atom is not symmetric, but the electron is slightly lagging behind the proton. We're not sure why it does that," says Risley, who presented his findings last week at the International Conference on Atomic Physics in Seattle.



If you turned this graph upside down and poured water into it, the electron and most of the atom's charge would be at the deepest point. The rest of the water would move independently of the electron.

Risley

The recipe for creating hydrogen atoms (the most abundant and simplest element, consisting of one positively charged proton and a negatively charged electron) in a collision chamber seems straightforward enough. Helium atoms are bombarded with protons, which snatch up and bind a helium electron. But details of the well-known process, such as hows and whys of electron transfer, are unclear, Risley says.

To look at hydrogen formation, Risley monitored the light known as Balmer alpha radiation from the collision chamber. First he applied electric fields to the collision area itself (disturbing and changing the light emitted by hydrogen), and then he measured light emitted from the atomic collisions from different directions, and fed this data into a computer programmed with atomic structure theories. The motion of an electron around a proton produces a "cloud" of negative charge, normally thought of as symmetric in hydrogen atoms. But Risley finds that the cloud, where the electron most likely is, lags behind the proton, possibly because helium is trying to regain its electron. He adds, however, that some of the cloud remains around the proton.

—*A. Rowand*

Old-time diamonds: Dating in the rough

When diamond dealers advertise that "a diamond is forever," they probably aren't thinking about a diamond's age. But the phrase almost fits new estimates that show natural diamonds may be at least 3 billion years old. This puts diamonds in the company of the oldest earth materials still in their original form.

"Our consistent results ... provide strong age and chemical constraints on an ultimate origin of diamonds in old, enriched mantle," report Stephen H. Richardson, formerly of the Massachusetts Institute of Technology and now with the University of Paris, and colleagues in South Africa and Scotland. Their study appears in the July 19 NATURE.

For years, controversy has surrounded the origin of diamonds. One theory suggests that diamonds crystallized from the magma that cooled to form the volcanic rock (kimberlite) in which they are now found. Most kimberlites are less than 200 million years old. On the other hand, molten rock could have serendipitously picked up a random sample of diamonds, originally scattered deep within the earth's upper mantle where they were formed, and then carried them to the surface. Such diamonds would be more than 3 billion years old.

The dating scheme used by Richardson

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