Raike wonders whether this prohibits him from collaborating on research in any of the technical fields on which his invention draws.

A patent cannot be issued until after the secrecy order on an invention is lifted—a procedure which further muddles the issue of the inventor's rights. According to Patent Office officials, the government can proceed to manufacture a device while it is covered by a secrecy order, and to use it, and can reimburse the inventor for any use made of it during that time. However, the law does not appear to obligate the government to tell the inventor in the first place that his invention is being used. In discussing this point, one official explained: "Suppose the inventor were a Russian?"

(The remark, intended seriously, nonetheless recalls the old joke about how sad it is that so many fine American products are patented to a single great Russian inventor—Reg U.S. Patoff.)

The Seattle group is also concerned that, as a result of the way the secrecy laws are implemented in practice, outside commercial inventors like themselves may be put at an unfair disadvantage to defense contractors. Many defense industries, such as Motorola Communications and Electronics Inc., are bringing out communications privacy devices for the commercial market, and apparently have experienced no serious patent problems. In fact, a patent department spokesman for Motorola, Victor Myer, told *Science* that one recent offering, the Digital Voice Protection system (which encrypts digital voice transmissions and is compact enough to fit into a walkie-talkie), is being marketed now even though patents on parts of the equipment are still pending.

"Why is theirs being permitted to go forward when ours is not?" asks inventor Raike. He says that the Seattle group's device would sell for dramatically less than the $2600 to $6000 Motorola is asking for its system.

Most secrecy orders are issued on classified patent applications filed by government defense contractors. According to Patent Office officials, in the vast majority of cases, the author of the invention is the employee of a defense contractor, and has forfeited his chance to make his hurt feelings known. "They've already made their deal, and so we never hear from them."

And because they hold security clearances, defense contractors have less difficulty finding out the justification for a secrecy order as well as the government's plans for use.

But the Seattle group says it is bogged down on the matter of getting a meeting with NSA representatives to learn of the justification for the order and any plans for government use. Says one: "They haven't been willing to meet with us on the West Coast. But they say that of course, if we're willing to come East, at our own expense, they'll meet with us. Then they turn around and won't assure us we will learn anything substantive at such a meeting."

Because they have other defense business, the defense contractors are in a position to negotiate the fate of the secrecy order as part of their ongoing government business. A retired government attorney, who worked with secrecy orders during his 27-year career, says that often companies find that secrecy orders help their plans for commercial introduction of a new invention. "The government can be the only user until the year in which it might be timely in which to introduce the invention commercially," he says. At that time, the patent can be issued and the clock starts running on the company's 17-year entitlement to royalties from the invention's use. The attorney gave as an example the Norden bombsight, which was under secrecy in the 1940's, while it enabled American precision bombing during World War II. It was not released commercially until later, when it became used in commercial aviation.

One explanation for the peculiarities of the secrecy order laws may lie in their history. They have been passed in wartime or times of national emergency—when foreign espionage rather than inventors' rights have seemed to be uppermost in the lawmakers' minds. The laws have then drifted on in force in peacetime, without any new rewriting to better serve peacetime conditions. The first such law was passed in World War I, in 1917, and, although technically emergency legislation, it was neither repealed nor updated until 1941, at the outbreak of World War II. This law remained in force after 1945 and was most recently updated in 1952, at the time of the Korea crisis and the McCarthy era concerns about foreign infiltration of the United States. Indeed, the legislative report accompanying the rewrite of the 1952 law shows more concern with industrial espionage among company employees on loan to the government, stalking the corridors of the Patent Office looking for competitors' secrets, than with the rights of the individual inventor who filed the application.

Finally, the secrecy order received by the Seattle group raises questions about the future of communications privacy technology—a field which is rapidly developing thanks to new developments in cryptography, a new range of devices made possible by the adoption of digital voice communications (the Motorola device takes advantage of this), and by spread spectrum technology (of which the Seattle work is an offshoot).

The inventors regard their device as a specific application of an entirely new branch of this growing field, and are uncertain whether to proceed with other applications in the light of the secrecy order. A defense department spokesman familiar with the Nicolai application said he did not know of any policy regarding the entire field, but said that decisions to classify certain applications were being made on an ad hoc basis.

—DEBORAH SHAPLEY

RECENT DEATHS

Benjamin Alexander, 68; head, Coagulation Laboratory, The New York Blood Center; 13 February.

Edward G. Begle, 63; professor of mathematics and education, Stanford University; 2 March.

Charles H. Best, 79; former head, physiology department, University of Toronto; 31 March.

James C. Braddock, 65; professor emeritus of zoology, Michigan State University; 21 March.

Ian Campbell, 78; former California State Geologist; 11 February.

Donald P. Costello, 68; professor emeritus of zoology, University of North Carolina, Chapel Hill; 6 February.

Clara Deasy, 62; associate professor of chemistry, College of Mount St. Joseph; 12 February.

Helmuth Etzold, 68; professor of electrical engineering, University of Rhode Island; 15 March.

Thomas H. Goodding, 87; professor emeritus of agronomy, University of Nebraska; 6 February.

C. Sherman Grove, Jr., 72; professor emeritus of chemical engineering, Syracuse University; 8 February.

Hardin B. Jones, 64; professor of medical physics, University of California, Berkeley; 16 February.

Russell M. Kerchner, 78; former head, electrical engineering department, Kansas State University; 26 March.

John E. Kouba, 65; adjunct professor of biology, College of Mount St. Vincent; 27 March.

Elizabeth McCoy, 75; professor emeri-

tus of bacteriology, University of Wisconsin; 24 March.

Max Miller, 67; professor of medicine, Case Western Reserve University; 25 March.

James H. Potter, 65; professor of mechanical engineering, Stevens Institute of Technology; 15 March.

Leo Schubert, 62; professor of chemistry, American University; 21 June.

Henry A. Schuette, 92; professor emeritus of chemistry, University of Wisconsin, Madison; 4 February.

Louis B. Slichter, 81; professor emeritus of geophysics, University of California, Los Angeles; 25 March.

Aaron S. Strauss, 38; professor of mathematics, University of Maryland, College Park; 13 April.

Edmund B. Thomas, 67; former professor of chemistry, John Carroll University; 15 March.

Otto T. Walter, 85; professor emeritus of biology, Macalester College; 6 June.

L. David Walthousen, 44; research associate for nuclear engineering, Rensselaer Polytechnic Institute; 18 May.

John L. West, 66; professor of veterinary medicine, Kansas State University; 18 April.

Hugh M. Wilson, 75; professor emeritus of radiology, Washington University School of Medicine; 21 April.

RESEARCH NEWS

Polypeptide Hormones: What Are They Doing in Cells?

Polypeptide hormones, such as insulin, prolactin, and growth hormone, are large charged molecules—not at all the kinds of molecules that can slip through a cell's membrane and enter the cell. For a number of years, researchers attributed all of the effects of these hormones to changes that occur inside the cell when the hormones bind to specific receptors on the cell surface.

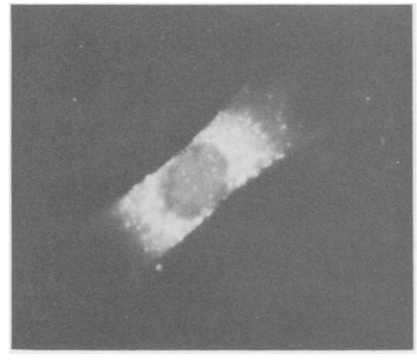
Recently, however, investigators discovered that many of these hormones do in fact enter cells, although exactly how they get in is still open to question. Seeing a whole class of new problems, researchers are jumping in to study how and why these hormones enter cells. One investigator goes so far as to say that "The internalization of polypeptide hormones is now the hottest topic in cell biology."

As so often occurs in science, the earliest reports that polypeptide hormones enter cells were largely ignored. In the 1950's, two groups of investigators published evidence that insulin enters cells, but endocrinologists persisted in believing that insulin remains on the cell surface. Twenty years later, a few scientists noticed that insulin and other polypeptide hormones may enter cells, yet even then some of these reports were greeted with skepticism.

Now opinions have changed. Once investigators accepted the fact that it was possible for polypeptide hormones to enter cells, it was easy to show that they did so. Hormones reported to enter cells include insulin, prolactin, parathyroid hormone, growth hormone, gonadotropins, and the hormone-like "growth factors" such as nerve growth factor and epidermal growth factor.

The methods used to show that hormones may enter cells can be roughly classified as morphological and biochemical. With the morphological methods, researchers look directly at cells and labeled hormones. For example, they may attach ferritin, which is an electron-dense molecule, to hormone molecules. Then they expose cells to the labeled hormone, fix the cells, and examine them with an electron microscope. With the biochemical methods, researchers look for indirect evidence that the hormones have entered cells. For example, they may show that at a certain time after cells have been exposed to hormones the hormones can no longer be removed from the cell surfaces. If the hormones are also absent from the medium, the assumption is that they have entered the cells or at least have been enfolded by the cell membrane.

Since the various morphological and biochemical methods have different advantages and different limitations, Ronald Kahn of the National Institute of Arthritis, Metabolism, and Digestive Diseases (NIAMDD) comments, "What is surprising is that, more or less, these different techniques seem to agree."



Fluorescently labeled α_2-macroglobulin inside mouse cells. [Source: Mark Willingham and Ira Pastan; courtesy *Cell*, vol. 13, March 1978, copyright MIT; MIT Press]

Agreement that the hormones enter cells does not extend to agreement on where the hormones go when they get inside. Researchers may be getting different results in part because their techniques are not always comparable. These differences of opinion on where the hormones go have led to differences of opinion on why the hormones enter cells.

One possible effect of polypeptide hormones entering cells may be to exert long-term effects on cellular growth and metabolism. This hypothesis is especially favored by several investigators studying insulin, a hormone whose long-term effects are poorly understood.

Insulin is the most extensively studied of the polypeptide hormones. Researchers first began to study insulin 50 years ago, yet surprisingly little is known about how it acts on cells. The hormone has short-term effects, such as changing the transport properties of the cell membrane, and long-term effects, such as changing the patterns of cell growth and protein synthesis. The short-term effects occur within minutes after insulin binds to a cell. The long-term effects occur hours later.

Many of the short-term effects of insulin seem due to the binding of insulin to its receptors on the cell surface. The long-term effects, on the other hand, have been more difficult to explain. A number of investigators speculate that the long-term effects of insulin, and possibly of other polypeptide hormones, arise when the hormones bind to specific receptors on intracellular structures.

One advocate of this hypothesis is Ira Goldfine of the Veterans Administration Hospital in San Francisco. Goldfine, A. L. Jones, and their associates report that intracellular structures, such as the nuclear membrane and the endoplasmic

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