of chemical warfare. It is tacitly permitting the very, very critical possibility that in the hands of foreign countries it will be used the way it was used by the United States in Vietnam.

One cannot exclude the significant possibility that the example of the United States in Vietnam will be mimicked. I view the whole thing with horror.

Overshadowing the possible South American sale, as well as even the forthcoming EPA decision on domestic uses, is Agent Orange's prior history in Vietnam. Moseman warned in an interview, "Don't forget Vietnam. Never forget that. It's the overriding issue that clouds this thing. Anything that has to do with it is suspect." The State Department spokesman said the same thing, but in State's departmentese: "The political and psychological concerns associated with its use in Vietnam are very real."

Harrington, who is hopeful for an agreement with the Air Force, ultimately, was asked whether he felt sensitive about the fact that the herbicide was used in Vietnam. Citing his personal experience as a platoon leader in World War II who "used to clear out the woods after the tanks," Harrington said he thought the herbicide had been used in Vietnam to "save American lives." He cited the reaction of a South American government official who was asked whether he felt the Vietnam connection was a drawback and retorted: "What do you mean war materials? . . . The only thing we're fighting is the brush."

—DEBORAH SHAPLEY

Immunology: Two Immune Systems Capture Attention

There are fashions in science, just as there are in other areas of human endeavor, and fields of science move in and out of fashion in cycles, coming into style whenever the number of potentially answerable questions is high. Today, immunology is one of those fields which is very much in vogue.

Interest in immunology, among the public as well as scientists, has grown remarkably during the last decade. The enthusiasm for human organ transplantation that peaked in the late 1960's certainly gave a new urgency to the questions of immunological rejection that accompany transplantation.

Scientists' enthusiasm for immunological research was also enhanced by basic discoveries about the design of the immune system, which opened the door to an enormous number of experimental approaches to problems in immunity. At the same time, it became increasingly clear that manipulation of the immune system as a workable way of treating a considerable number of human diseases was within reach.

To the extent that funding levels say anything meaningful about what is going on scientifically in any given field, the steady increase in support that immunological research has received from the National Institutes of Health (NIH) is telling. In 1964, NIH (including each of the institutes that spent money in the area) supported primary research grants in immunology to the tune of $13.076 million. Last year, NIH paid for almost $47 million worth of research in immunology. The figures for 1972 can be broken down as follows: research grants, $29.683 million; contracts, $10.391 million; intramural research, $6.822 million. (According to an NIH spokesman, there are no available figures for contract or intramural research in 1964, "probably because there was none, or very little.")

Immunologists may not be overburdened with money, but, from a purely historical standpoint, they are getting richer.

In the beginning—back in 1798, when Edward Jenner discovered those milkmaids who were immune to smallpox —immunology was a field for those whose primary concerns were with infectious diseases, allergies, and questions about how antibodies are made. For a long time, certainly throughout the first half of the 20th century, immunological research continued to be focused on such problems.

Many immunologists who explored the chemical basis of antibody-antigen interactions and the molecular basis of antibody structure were convinced that, in order to understand how antibodies (or immunoglobulins) work, they would have to know precisely what immunoglobulins look like, just as molecular biologists had to know what DNA looked like before they could begin to understand the gene. And considerable progress has been made in this direction. (Last year, Gerald Edelman of Rockefeller University and Rodney Porter of Oxford shared the Nobel Prize for their work in elucidating the molecular structure of immunoglobulins.)

But strictly speaking, the investigators who did so much to put immunology on firm ground scientifically were not immunologists at all. They were chemists or molecular biologists, and their colleagues thought of them that way.

In fact, this still is true. A look at the departmental affiliations of the participants in any recent meeting on immunology shows that immunologists come in all sorts of disguises. Lots of them are pediatricians. Many are geneticists. Others come from departments of microbiology, pathology, radiology, biochemistry, and cellular physiology.

The situation is revealing. On the one hand, it points out the tremendous heterogeneity of immunology as a discipline, reflecting the broad range of the immune system itself. On the other, it shows that immunology even now has not achieved full stature within the biomedical community. Many universities have "sections" on immunology. Very few have full departments. These may come.

Among the most productive studies in contemporary research in immunology are those on the immunodeficiency diseases, in which part or all of an individual's immune system is defective.

To convey something of the direction and rapidity of movement in this field, the News and Comment section—in something of a departure from its usual content—is running two articles on immunology. The first summarizes much of the current knowledge on the nature of the immune system. The second will look at some attempts to use the immune system as a therapeutic tool.

The immune system is astounding in its versatility and complexity. It defends us from the assaults of microbes. It protects us from cancer. By deploying cells that keep the body under constant immune surveillance, it recognizes as foreign the malignant cells that some immunologists think turn up in each of us more often than we know. Normally, those malignant cells are then efficiently destroyed.

The immune system appears to be quite impartial in its dealings with foreign things and rejects whatever it recognizes as nonself, including transplanted organs that carry foreign antigens on their surfaces.

There is speculation that the immune system also plays a role in keeping people young or, more accurately, that it may play a part in the aging process. Certainly, the strength of the immune system declines with age. Whether diminished immune vigor causes the body to grow old or whether some still incomprehensible process of aging saps the energy of the immune system is a matter of conjecture, but the two phenomena do seem to be associated. Here again, cancer and immunity are combined. Generally, cancer is a disease of old age. When it occurs in the young, immune deficiency usually occurs too.

Current advances in immunology reemphasize the versatility and complexity of the immune system. As things stand now, new information about the anatomical structure of the system is being generated with almost disconcerting frequency. That in itself makes the challenge of assembling a coherent picture of immune function a formidable one.

Many of the new details of immune anatomy are emerging from studies of patients whose immune systems do not work normally. Immunodeficiency diseases provide what Robert Good likes to call the "experiments of nature" from which functions of the nondeficient immune system can be deduced. Such natural experiments are more common than has been presumed. Less than a decade ago, there were only half a dozen or so recognized forms of immunological deficiency in scarely more than 100 patients all over the world. Today, with a new recognition of numerous subtle forms of immunodeficiency, there are indications that diseases which are, at least in part, related to an immune deficiency of some sort are not rare at all.

The subtle distinctions that are being observed between one form of immune deficiency and another often are related to the type of cell that is missing or malfunctioning in a patient. Refinements in the art of telling one kind of immune cell from another have brought this to light. Sophisticated techniques for distinguishing cell types are also revealing interrelationships among the cells of the immune system.

The latest triumphs—and failures—of both basic and clinical research in immunology were presented and debated from dawn until midnight for 4½ days recently at the Second International Workshop on the Primary Immunodeficiency Diseases in Man, held in St. Petersburg, Florida. Robert A. Good, new director of the Sloan-Kettering Institute for Cancer Research in New York, organized the gathering which was sponsored by the National Foundation–March of Dimes. About 80 researchers were invited. Good also was the man behind the first such specialized workshop which was held on Sanibel Island off the Florida coast in 1967.

According to what has only recently become the central dogma of immunology, the immune system is divided into two parts. The discovery of its binary nature, made only 7 years ago, was the center of attention at the Sanibel conference. The two compartments of the immune system held center stage in St. Petersburg as well. In the interim, as one participant put it, "We've come a long, long way," but added, "The trouble is, we're not really sure yet where we've come."

Immunoglobulins and the antibodies they produce are part of what is now known as the B lymphocyte or humoral system of immunity—so called because its cells circulate in the body's fluids, primarily in blood. These cells are the ones which, through a series of steps, control immunoglobulin production. The B cell system appears to be designed to handle a variety of infectious organisms including pneumococci, certain influenza bacilli, streptococci, and meningococci. Investigators are discovering that at least some of the five major classes of immunogloblins—IgG, IgM, IgA, IgD, and IgE—have subclasses. The various immunoglobulins can be distinguished by specific differences in the configuration of molecules on their surfaces and these variations in molecular structure account for their versatility in reacting with a wide range of molecules and for the selectivity with which they do it. The human immune system can specifically respond to and react with an estimated 1 million different antigens, running the gamut from microbes to foreign tissues.

Companion to the B cell system is the comparatively newly discovered T cell system, so called because it works through lymphocytes that are dependent on the thymus gland for their differentiation. These are the agents of cellular immunity, which resist infections by fungi, acid-fast bacilli, and viruses. T cells are also the sentinels of immune surveillance against cancer and the mediators of graft rejection. Compared to the cells of the B system, they are a more sedentary lot and are seldom found in great numbers in circulating blood.

B and T Cells Sorted Out

Immunologists believe that some of the greatest recent advances in their craft have come from their ability to sort out the B and T cell systems in animals and man. As recently as 3 years ago, it was difficult to distinguish B and T cells (morphologically, both classes of lymphocytes look alike) and their quantitation was tricky. Now that obstacle is at least partially removed. The molecular basis of T cell function and the details of B and T cell cooperation remain critical and unsolved problems, however.

On the cells of the B system, surface immunoglobulins almost certainly are the receptor molecules which first react to the presence of a foreign antigen. The specific antibodies they then secrete attack the antigen in the ensuing immune reaction. The situation is less clear with regard to T cells. Many investigators think that T cells, like B cells, have specific immunoglobulins on their surfaces (although there are probably fewer of them) and that they may be the receptor molecules that account for T cell specificity. One hypothesis states that it is an immunoglobulin on the surface of the T cell, called simply IgX, which confers specificity. But there are other thoughts on the matter. It is possible, for instance, that immunoglobulins will turn out to have nothing to do with T cell specificity. Specificity may depend upon some completely different mechanism, such as those that operate in conferring specificity of action on enzymes.

Investigators feel certain that studies of children with immunodeficiency diseases will help resolve these matters. This, in turn, they believe, will help them do something more for their patients than they are able to do now. Primary immunodeficiency diseases are inherited and frequently show up in children within the first few months of life. In some cases, a child is born without a B cell system and therefore

lacks the capacity for making antibodies. Others may lack the T cell system. Some are deficient in both. Unless fairly heroic measures are taken—such as transplantation of bone marrow or thymus—these children usually die young. Other forms of immunodeficiency, now being discovered with increasing frequency, vary in their severity. Applying techniques for telling B and T lymphocytes and their subclasses apart, investigators are discovering persons deficient in one class of immunoglobulin but not others.

The chicken played a leading role in the discovery that the immune system comes in two parts. It began with work by Bruce Glick, who is now at Mississippi State University but at the time was at Ohio State University. Glick was removing an organ called the bursa of Fabricius from chicks to test the assumption that it plays a role in sexual development. (In chickens, the bursa is a lymphoid organ located at the posterior end of the gastrointestinal tract.)

One day a friend of Glick's asked if he could borrow some of his chickens for use in a class in which he was going to demonstrate features of antibody production. Glick obligingly donated some of his bursectomized birds, which, it turned out, produced antibody very, very poorly. In 1956, Glick therefore reported that bursectomized chickens are deficient in making antibody if, in fact, they can do so at all. His data were published in *Poultry Science* after *Science* turned his paper down on what were then probably the perfectly reasonable grounds that it was not of general interest. Glick's report languished in the world of poultry physiology for several years until Good heard about it from an associate.

Meanwhile, Noel Warner and his colleagues in Melbourne, Australia, also had been studying chickens. They put forth the idea that the immune system is dissociated, controlled in part by the bursa and in part by the thymus. Good, who until last January had spent his entire professional life at the University of Minnesota, and a younger colleague, Max Cooper, picked up Warner's idea. Cooper, now at the University of Alabama at Birmingham, recounts that, in a series of experiments, they surgically removed either the thymus or the bursa from young chicks and discovered that each organ is responsible for the production of a distinct line of cells; hence, T cells and B cells. "The idea of a two-compartment system seemed pretty clear," Cooper recalls, "because in the chick, we could take the immune system apart selectively and then put it back together by replacing the cells we had taken out."

Although the results of these experiments were quite convincing, observations of a similar schism in patients clinched it. Says Cooper, "Once we knew what to look for, we could find it in our patients, and then things fell into place."

And so it was learned that T cells pass through the thymus, where they differentiate and mature into competent lymphocytes. The B cells will mature into immunoglobulin-producing plasma cells.

Briefing

Health Appointees: Edwards, Sinatra; Maybe Cooper

After sitting vacant for more than 3 months, the office of the Assistant Secretary for Health in the Department of Health, Education, and Welfare (HEW) may soon be filled. On 13 March, the White House got around to announcing that the President has nominated Charles C. Edwards, commissioner of the Food and Drug Administration for the post.

Edwards, and everyone else in Washington who was interested, has known for weeks that he was slated to take charge of the health bureaucracy, but some greater bureaucracy apparently held up the official announcement.

Another presidential appointment of interest in the health field also came to light recently. Nixon has named Vice President Agnew's good friend Frank Sinatra to fill a vacancy on the advisory council of the National Heart and Lung Institute (NHLI). He will serve as one of five lay members of the council, which is also composed of 17 prominent physicians and scientists.

Sinatra's appointment apparently was made in December but was not generally known about until he sent a letter of acceptance to NHLI director Theodore Cooper just before the meeting of the council earlier this month. According to Cooper, who says he understands that Sinatra has been involved in health matters and philanthropic causes in the past, the NHLI played no role in the appointment. Sinatra was not present at the 3-day March meeting of the council.

Although the National Institutes of Health (NIH) has always operated with advisory councils, the heart council and the advisory board of the National Cancer Institute are particularly prominent and important bodies these days because of their role in setting policy for research programs of unparalleled magnitude in biomedical science. Their function is to establish priorities for the expenditure of the hundreds of millions of dollars that are being funneled into the heart and cancer programs. Naturally, members devote a considerable amount of time to discussions about what is going on in research—about what the choices are—as they move toward policy decisions.

The advisory boards are high-powered bodies whose members are presumably chosen for their expertise in science, business, or matters of public interest. All members are appointed by the President.

A spokesman for Sinatra declined to comment on the singer's interest in the heart program or on his plans for attending future meetings of the council unless questions were submitted in writing.

A third appointment of considerable interest to the biomedical community is one that has yet to be made, and that is the directorship of the NIH. The top job at NIH has been vacant ever since the President fired Robert Marston in early December.

Although it is risky to speculate on such things, several people in the upper reaches of government believe that White House recruiters are leaning toward the idea of choosing someone from inside NIH for the position. If that is true, Cooper is likely to be the man they will pick.

Cooper has not been approached formally about heading NIH, but he has had some conversations with the brass that amount to interviews. Most significantly, he was asked to fly down to Florida a few weeks ago to talk with Nixon's close personal friend Elmer Bobst, who is chairman of the Warner-Lambert Pharmaceutical Company and a member of the cancer advisory board. Cooper apparently passed that test satisfactorily because, since then, he has seen HEW Secretary Caspar Weinberger and discussed "things" in general. But so far, nobody has offered him the job.—B.J.C.

Today, everyone agress that the bursa is instrumental in B cell differentiation in chickens. There is, however, virtually no agreement about the situation in man—human beings have no bursa. Some investigators, Cooper among them, believe that man does have an equivalent organ. Acknowledging that he has only circumstantial evidence and that "my opinion on this score is definitely biased," Cooper postulates that Peyer's patches, arranged in discrete locations along the gut and the appendix, are the bursa equivalent in man. Apparently not many investigators are working to verify that idea, however. Among other experimental problems, according to Cooper, is the fact that surgical removal of these patches in animals is technically difficult, takes hours, and is tedious. He calls it "the sort of thing only a fanatic would pursue."

While other immunologists have not necessarily dismissed the idea of a bursa equivalent in man, many seem content to focus on bone marrow as the source of the B cell system. (Marrow stem cells, which have the potential for making various types of cells—including red blood cells—are also the source of T cells before they journey to the thymus.) The question of a bursa equivalent is a treacherous one. There could be an equivalent organ in man. On the other hand, B cell differentiation could depend upon some aspect of the microchemical environment of marrow which is not understood.

Although much remains to be learned, there is general agreement that recent data have accurately defined the outline of the development of the immune system. Immunologists now agree that cells originating in the yolk sac of the embryo embark on a journey which results in their development into mature hematopoietic (blood-making) cells. During fetal life, these cells are thought to enter fetal blood and travel to the liver where they apparently reside during much of embryonic development. In both the yolk sac and the fetal liver, one can find cells that are precursors of the lymphoid apparatus, which will ultimately produce the two systems of immunity.

The technical skills that immunologists have only recently developed enable them to draw such conclusions about the construction of the immune system. In the analysis of B cells and their products, refinements in immunofluorescence techniques and the ability to selectively tag antibodies have meant that it is possible to separate IgG from IgM (and so on), to tell the subclasses of IgG apart, and to look at the life cycle of immature B cells as well as at the interactions of various immunoglobulins with each other.

In addition, it has become apparent that certain stimuli elicit a response from B cells but not from T cells. Various types of antiserums, for example, stimulate a reaction from B cells. Endotoxins (poisons derived from bacteria) are also selective B cell stimulants, whereas an extract of the pokeweed plant, whose roots and berries are poisonous, stimulates both B and T cells to react against it.

Using these techniques, investigators are gathering information about the life of the B cell which is providing insights into the basic structure of the system and the nature of B cell deficiency diseases.

Alexander Lawton, L. Y. F. Wu, and Cooper reported studies suggesting that B cell differentiation is discontinuous and that, beyond a certain stage, B cells mature only after stimulation by an antigen. In the human fetus, they said, normal adult percentages of B cells are present long before more than trace amounts of immunoglobulins they produce are detectable in the blood. Immunoglobulin levels rise later, leading Cooper to surmise that "B cells seem to be generated independent of antigen stimulation but the production and secretion of circulating antibodies is an antigen-driven stage." Further studies of patients with immunodeficiency diseases confirm this assumption. Individuals may, for instance, have a perfectly normal number of B lymphocytes but an abnormal lack of one or all types of immunoglobulin, indicating that their defect exists in the cell mechanisms which control the maturation of B cells.

Maxime Seligmann of the University of Paris aroused everybody's interest with a report on B cells in cancer. Using immunoglobulins bound to the cell surface as markers by which to identify specific immune cell types, he and his associates studied more than 130 patients by direct immunofluorescence. They found that, in various immune disorders, including cancer, only the type or class of B cell was out of control. For instance, in a majority of patients with chronic lymphatic leukemia, the proliferating cells all carried IgM on their surfaces. In some cases, the lymphocytes bore some other immunoglobulin on the surface but, generally, in each case it appeared that only a single immunoglobulin class was involved. (In a few cases, it was a population of T cells, rather than B cells, that was proliferating uncontrollably.) Thus, Seligmann tentatively concludes that chronic lymphatic leukemia may be a disease in which the control mechanisms for a single cell population go awry and that, therefore, it is not a disorder of lymphocytes in general. It is conceivable that this finding could contribute to the development of a test for early diagnosis. It is also possible that better forms of therapy will emerge if scientists can learn how to suppress the proliferation of cell populations selectively.

Until recently, it has been easier to identify B cells than T cells. But the difficulties of T cell identification may be eased by a new and relatively simple test. It seems that T cells bind in vitro to sheep red cells in a characteristic rosette formation. B cells apparently do not. David Kiszkiss who is from the University of Minnesota—as were many of the conference participants—was among those reporting on human rosette-forming cells. Kiszkiss presented data showing that antiserums to human immunoglobulins do not inhibit rosette formation in vitro. If immunoglobulins derived from B cells were the cells involved in this reaction, there would be inhibition. Similarly, lymphocytes known to possess high levels of immunoglobulins on their surface fail to form rosettes—another indication that rosette formation is a T cell response.

The response of a population of lymphocytes to the mitotic agent, phytohemagglutinin (PHA), is another way of spotting T cells. Phytohemagglutinin—a kidney-bean extract—has been used since 1960 to stimulate lymphocytes to divide and proliferate in vitro. A couple of years ago, investigators found evidence that PHA selectively stimulates T cells, and they have used PHA as a T-cell marker ever since.

Now, however, the selectivity of the PHA stimulus is being called into question by B. Phillips and Ivan Roitt of Middlesex Hospital Medical School, London, who reported in the 21 February issue of *Nature New Biology* that B cells may also respond to PHA. If they are right, it means the loss of a distinguishing marker but provides one more bit of evidence of similarities between the two cell populations.

The more immunologists learn about the two-compartment immune system, the more they see that its two compartments overlap. Richard Hong of the University of Wisconsin put it plainly: "After 6 years of telling ourselves that the thymus has little to do with immu-

(Continued on page 89)

(Continued from page 48)

noglobulins and that the T cell system has little to do with the B system, we're changing the party line. There seems to be no doubt that there are interactions in many instances and, most significantly, that they are important in regulating patterns of immune response." Investigators say the data are accumulating rapidly on this score. Hong cited some examples, suggesting that the thymus may be important in regulating the production of IgE, an immunoglobulin associated with inflammatory reactions and respiratory problems. It may also be critical to the control of IgA, an immunoglobulin whose deficiency has been correlated with a variety of diseases ranging from disorders of the gastrointestinal and respiratory tracts to autoimmunity to cancer. Evidence that IgA levels are low in nude mice, an inbred strain that has no thymus, and in neonatally thymectomized rabbits "points to a greater dependency of the IgA system upon the thymus than we thought," Hong said.

IgA deficiency appears to be unexpectedly common in the human population. There are estimates that it occurs, with varying degrees of severity, in 1 of 600 persons. That brings it into the range of fairly common birth defects such as mongolism. In many cases, IgA-deficient individuals actually do have IgA-bearing cells in perfectly normal numbers. The problem is that those cells do not secrete fully developed IgA immunoglobulins. Recent studies have shown, however, that, in vitro, these IgA-bearing lymphocytes can be triggered into full IgA production and secretion by stimulation by pokeweed extract. This finding has excited immunologists, who are hoping to find a way to trigger such a reaction in patients. Says Cooper, "It raises the hope that future research will uncover ways to treat this presently untreatable deficiency."

All of this basic work in immunology has had a significant and fairly immediate impact on clinical immunology. And, in turn, studies of patients with primary immunodeficiency disease have contributed to these basic advances. In immunology, perhaps more than in many other areas of biomedical science, human disease constitutes a model system that clearly elucidates basic phenomena. Next week, the current status of therapy for persons with severe immunodeficiency diseases will be examined.—BARBARA J. CULLITON

Personnel Placement

POSITIONS WANTED

Biochemist–Cell Biologist, Ph.D.; 10 years' experience nucleic acids, protein synthesis, hormones, membranes, radiation. Competent in tissue culture, cancer research. Publications. Seeks permanent research/teaching or research position. Prefers department with strong emphasis on cancer research. Box 194, SCIENCE.

Biophysicist, Ph.D. physics 1971, 2 years' research in neurophysiology as NIMH postdoctoral trainee, Brain Research Institute, UCLA. Experience in electrophysiology, optics, spectroscopy, electronics, and computers. Desires teaching and/or research position. Box 195, SCIENCE. X

Cell Biologist, Ph.D., woman, established research scientist and innovative university teacher with broad interests in genetics and physiology of cells, social aspects of science; some administrative experience. Seeks nontemporary position compatible with female person who will exhibit high degree of intelligence, autonomy, and creativity on job. Will consider nonacademic positions. Box 170, SCIENCE. X

Chemist/Biochemist. Ph.D., 4 years' postdoctoral. Desires opportunity to continue productive research program in chemistry, biochemistry, and antiviral properties (interferon) of synthetic polynucleotides at university or research institute. Teaching experience at university level. Available August 1973. Box 196, SCIENCE. X

Ph.D. Cytology, Electron Microscopy, Tumor Research, 12 years' experience university, government, excellent teacher, desires senior level challenging position. Box 174, SCIENCE. 4/6, 13

Dedicated, Energetic Biologist, 37, Ph.D. (1965, genetics). Postdoctoral (human genetics); 10 years' university, 5 years' other professional experience. Special interests: genetic counseling, innovative teaching, curriculum planning. Desires position in department seeking to develop meaningful alternatives to depersonalized mass undergraduate education. 2266 Lake Circle, Jackson, Mississippi 39211. 4/20

Developmental Biologist: Postdoctoral experience in embryo and tissue culture, tumor virus. Publications. Seeking research, teaching. Box 197, SCIENCE. X

Ecologist of Fishes, Ph.D., more than 30 papers, freshwater, estuarine, and open ocean. Administrative experience at program level. Research oriented, but holds position on university staff. Seeks teaching/research, but will accept administrative responsibilities. Box 198, SCIENCE. X

Enzymologist, Ph.D. 1970, 4 years of college teaching experience; thesis area: hydrolytic enzyme mechanisms. Postdoctoral area: nucleotide synthesis. Five publications, seeks academic position beginning fall 1973. Box 199, SCIENCE. X

Geneticist, recent Ph.D., Canadian citizen, trained in botany, biochemistry, and genetics, with teaching and research experience. Seeks teaching or teaching/research position, preferably in Canada. Box 178, SCIENCE. X

Geologist, Ph.D., emphasis volcanology, igneous petrogenesis, geochemical cycles in relation to human survival. B.A. in scientific philosophy, 15 years of secondary to university teaching. Interest in instruction/research opportunities of potential social significance, especially interdisciplinary, innovative approaches. Box 140, SCIENCE. X

Immunochemist-Immunologist-Biochemist: Ph.D. (Immunochemistry); M.S. (Microbiology); B.S. (Chemistry). Has had more than 10 years' research experience with publications. Antigen isolation and purification; antigen-antibody interactions and assays (including radioimmunoassays); various immune responses and immunochemical techniques; also interest in pharmacoimmunology. Seeks position in applied basic research or research-teaching. Box 200, SCIENCE. X

POSITIONS WANTED

Immunologist, D.V.M., Ph.D., seeks position in university or research institution. Broad interdisciplinary background, including research in foreign animal diseases and cancer immunology. Some teaching experience. Major research interests: cell-mediated immunity in viral and protozoal diseases, immunopathology, and cancer immunology. Box 201, SCIENCE. X

M.D., Ph.D. research team have discovered reliable method for detecting minor brain damage in experimental animals. Desire two positions in collaboration with neurosurgeon(s), neurologist(s) for purpose of team R & D of human test procedure. Box 182, SCIENCE. 4/6

Neurobiologist, M.D. with long experience and publications on experimental clinical neurology. Strong background in electron microscopy, immunofluorescence of neurotransmitters in neuroendocrinology, autonomic systems, psychoactive drugs. Desires academic research-oriented position. Prefers South-East. Box 185, SCIENCE. 4/6

Ph.D. with Teaching Background in Genetics, Embryology, Behavior, Molecular Biology, and Statistics seeks challenging administrative position (teaching or research). Strong interdisciplinary interests. Administrative training and experience. Broad background in medical research. Many publications, grants, and graduate students. Box 202, SCIENCE. 4/13

Plant Ecophysiologist, Ph.D. 1972. Desires position in environmental management and/or research, academic, or nonacademic employment; currently undertaking research in municipal and animal waste recycling for private firm. Box 203, SCIENCE. X

Plant Physiologist, Ph.D. 1969, 3 years' teaching experience in plant physiology, botany, and forest biology. Seeks teaching/research position at western location. Publications in reproductive and photosynthetic physiology. Box 204, SCIENCE. X

Reproductive Biologist, Ph.D., 37 years old. Research program currently funded and transferable. Teaching experience in endocrine anatomy and physiology, human gross anatomy and microanatomy. Seeks energetic, straightforward, research/teaching environment. Available 1 July 1973. Box 205, SCIENCE. 4/13

Science Editor, senior level. Experienced in all aspects of editing, rewriting, printing. Medicine, chemistry specialist. Box 206, SCIENCE. 4/13

Wise Old Hand. Nationally known writer, editor, professor, gap-bridger in health communications seeks to relocate in action-oriented institution or program that values wide experience. Author of seven books, 250-plus professional journal and popular magazine articles interpreting health professionals' behavior in research, education, patient care, community services; consultant, contributor in commission studies, task force reports; recognized expert in conceptualizing problems, objectives; experienced in program planning, administration. Box 207, SCIENCE. X

POSITIONS OPEN

HUNTER COLLEGE, ENVIRONMENTAL HEALTH SCIENCE PROGRAM seeks **ASSISTANT PROFESSOR** for graduate and undergraduate teaching. Doctorate required with experience in one or more areas of environmental health including health physics. City University of New York salary scale and benefits. An equal opportunity employer. Résumé to: **Dr. George Kupchik, Program Director, Environmental Health Science, Institute of Health Sciences, 105 East 106 St., New York, N.Y. 10029.**

ASSISTANT PROFESSOR OF GENETICS

A 1–academic year visiting appointment beginning September 1973. Duties will include an upper division course in general genetics and participation in an introductory genetics course for nonscience students. Send curriculum vitae and references to **Dr. Eugene Gasiorkiewicz, Chairman, Division of Science, The University of Wisconsin–Parkside, Kenosha, Wisconsin 53140.** The University is an equal opportunity institution.

ASSOCIATE PROFESSOR

Position available in the Department of Microbiology, University of Michigan Medical School. Candidate must have Ph.D. and 1 year of postdoctoral training, or equivalents. Position is for immunologist to conduct independent research in basic immunology and to participate in teaching programs. Code #200J. Send résumé with reprints of most significant publications to **Box 208, SCIENCE.** A Nondiscriminatory Affirmative Action Employer.