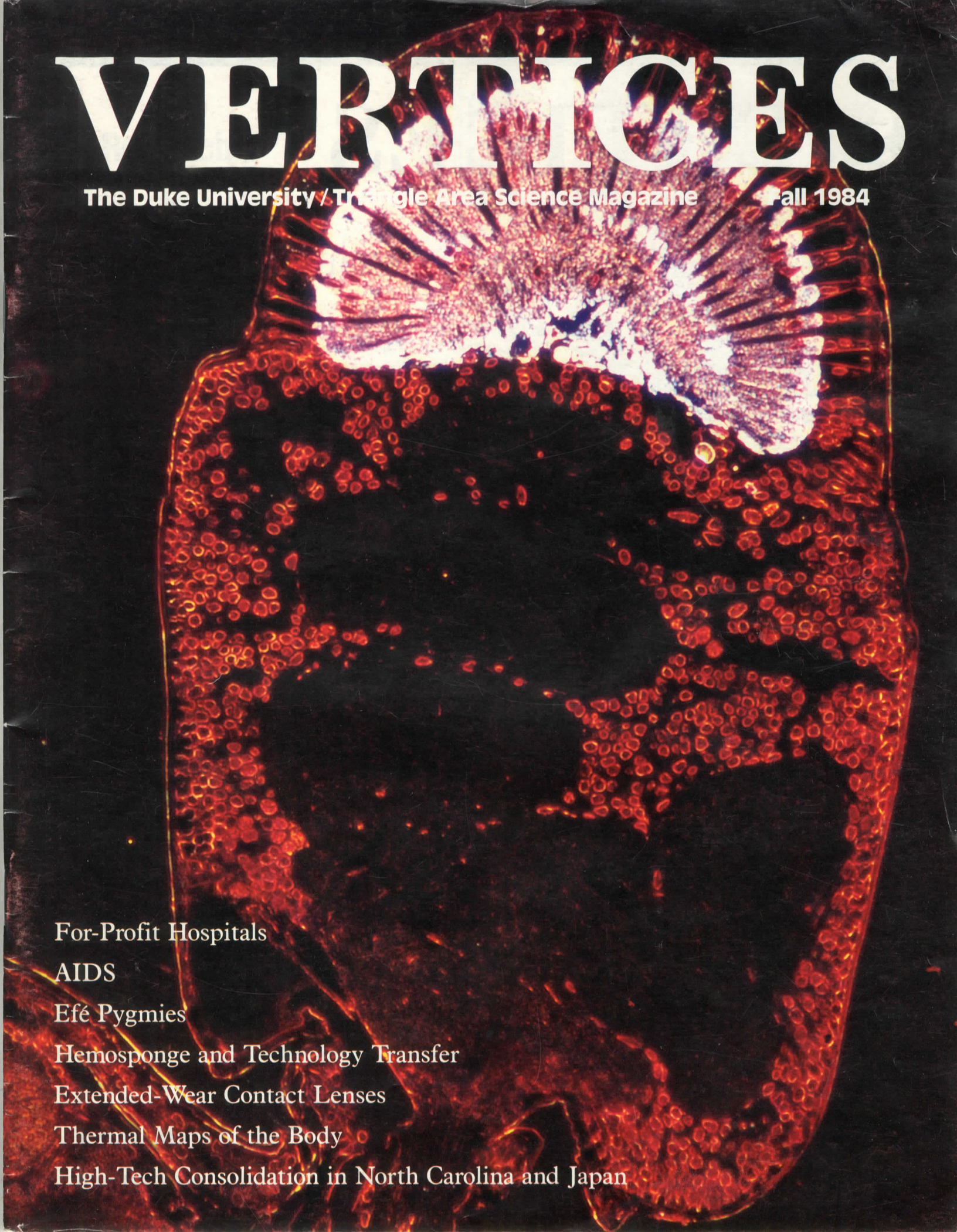
VERTICES

The Duke University / Triangle Area Science Magazine Fall 1984



For-Profit Hospitals

AIDS

Efé Pygmies

Hemosponge and Technology Transfer

Extended-Wear Contact Lenses

Thermal Maps of the Body

High-Tech Consolidation in North Carolina and Japan

VERTICES

Executive Editor
R. Steven White

Managing Editor
Ray Zwycewicz

Senior Editors
Steve Bickston, Terry Habacker, Hyder Jinnah

Associate Editors
John Owen, Steve Rottman
Murray Abramson

Advertising Manager
Lisa McHam

Financial Managers
Omar Atassi, Melanie Grove

Contributors
Anne Allen, Ted Alyea, Jeff Baer, John de Beixedon, Sharon Brackelmanns, Wendy Koppel, Charlie LeVay, Ruth Lininger, Stuart Meyers, Katie Pitkin, Tom Romary, Bill Sandy, Kristina Sigmon, Pamela Stevenson

Artists
Tom Tung, Murray Stanton

Typesetting
Universal Printing,
Chapel Hill, North Carolina

Printing
Carter Composition Corporation,
Richmond, Virginia

VERTICES is a semi-annual student publication designed to give its readers insights into current scientific topics and issues. The opinions expressed in *VERTICES* are those of the authors, and the authors are responsible for the content. This magazine is not an official publication of Duke University.

The editors of *VERTICES* encourage submission of articles of scientific interest. Manuscripts must be typewritten and double-spaced, and along with a bibliography, any photographs, grpahics, or suggestions for such, sent to *VERTICES, Office of Student Activities, Bryan Center, Duke University, Durham, North Carolina, 27706.* All submissions are subject to editorial review.

VERTICES is distributed within the Duke community and the Research Triangle Park free of charge. Mailed copies may be obtained for $5 each.

from the editor

North Carolina's past claims to fame (or infamy, depending on your point of view) have been cigarettes and Jesse Helms. Most New Jersey student immigrants have seen the RDU airport terminal, I-95 and the campus that they call home for four years before returning to the civilized northeast. Through their eyes I have seen the rest of North Carolina as a haven for Bible-toting Southern Baptist farming families perfectly content to progress into the 1920's.

While these northeasterners blinked, though, the reality that fostered such a view of North Carolina was partially replaced. The snowball that North Carolina governor Luther Hodges started rolling in 1956 has gained quite a bit in size. Now, down the road from Antioch Baptist Church you'll find Mitsubishi Semiconductor America. Nestled in forested seclusion are IBM, Burroughs Wellcome and other corporate and research giants. State leaders are getting what they asked for, big research bucks for North Carolina.

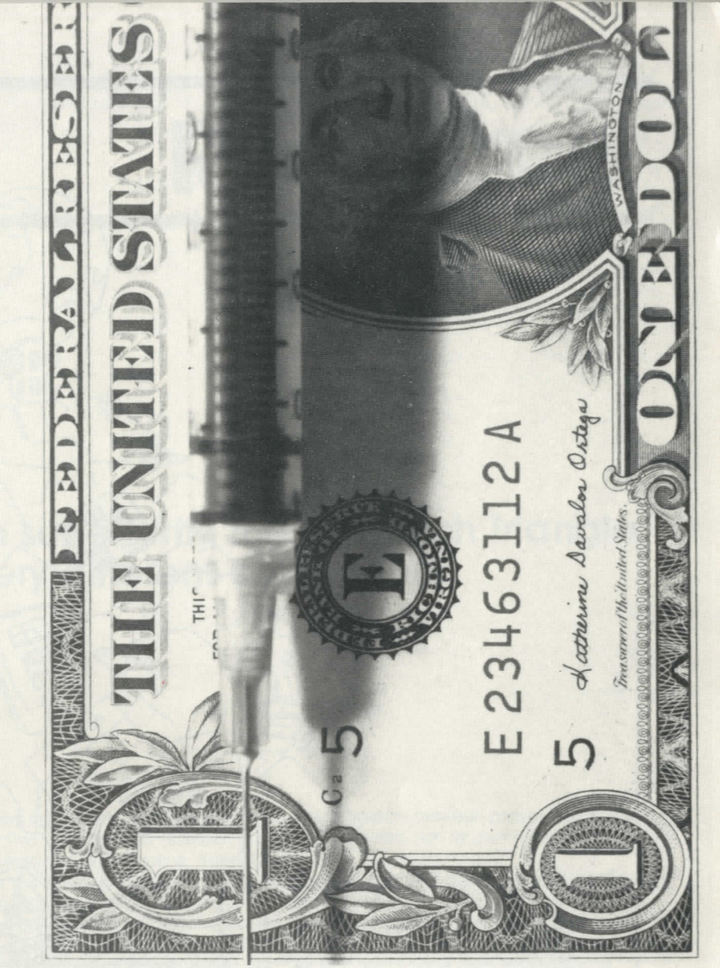
You have in your hands the first issue of *VERTICES*, quite a natural creature to have evolved in the Triangle's forests. Surrounded on all sides by-much lauded research facilities, some of us Duke students wondered what these facilities were being lauded for. We found that some science majors had an urge to write something besides lab reports. With some pre-business undergraduates looking for a legitimate space-holder for their resumes, the two components necessary for a magazine staff were already present at Duke.

Duke students who took valuable time out from their classes and parties are responsible for *VERTICES*. The writers are individuals who have a feel for how science is affecting our lives and our world. The business managers have entered into a project that will yield tangible results. This first issue of *VERTICES* is the fruit of their combined efforts.

I thank all of the people here at Duke, in the Triangle area and in the rest of the nation who have been primary sources of information. I thank Dean Friedl and Dean Griffith for their financial and moral support, as well as the Bassett Committee for funding this first issue of *Vertices*. They and our advertisers took a great leap of faith by funding a new publication, but they should not be disappointed.

This is *VERTICES*. I hope you enjoy it.

R. Steven White



Cover

The cover shows a horizontal section through the eyestalk of a juvenile grass shrimp. The medial dark masses are ganglia concerned with processing visual information. Cell nuclei of neurons surround axons and dendrites extending from cell bodies. The compound eye itself is composed of a semicircular white and pink material which screens and reflects light and surrounds rhabdoms. Rhabdoms, functionally analogous to rods and cones in the vertebrate eye, are masses of microvilli filled with rhodopsin which is responsible for photoreception. Photograph by John Douglass.

Research

In the race for high-tech superiority, the Research Triangle Park and Tsukuba are very different contenders.

Bill Sandy

In the international high-tech race, efficiency, innovation and productivity are essential for competing. Bringing together researchers in various scientific disciplines, with easy access to each other, is fast becoming the strategy that many countries are adopting. Both public and private investors are backing the development of research complexes to foster scientific ferment and compete in the world of scientific endeavor.

Two examples of this idea that have been put into practice are the Research Triangle Park of North Carolina and Tsukuba outside Tokyo, Japan. Though their goals of advancing high-tech and basic science research are the same, however, their approaches to achieving these goals are quite different. While Tsukuba strives for efficiency by coordination, the Research Triangle Park strives for efficiency by competition.

In order to understand this difference, it is necessary to see just how each institution of organized research came into being. Two different societies came to find similar solutions to their problems with the construction of Tsukuba and the Research Triangle Park. Each arose as the solution to specific problems, although problems that were dissimilar in most respects.

North Carolina has had an excellent reputation for providing exceptional higher education facilities for its population. However, many of the graduates from these institutions left the state; superbly educated minds trained in the state were being lost to more attractive business and research opportunities outside North Carolina. Keeping this pool in the state would require providing the stimulus of high-tech, medical, engineering and basic science research jobs. If a park could be created where major research organizations would locate their facilities, the state would gain incentive for graduates to work in North Carolina, as well as valuable income from the organizations' revenues and the prestige of possessing a research park that would be on the cutting edge of scientific innovation.

Since the Stanford Industrial Park was established in 1951 in Palo Alto, California, more than fifty research communities have been founded in the United States. Although many of these have since closed, the Research Triangle Park is still the largest and without question one of the most successful.

In 1956 North Carolina governor Luther Hodges persuaded the administrations of Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill, as well as several local businessmen to cooperate in financing an institute that could persuade private industry to operate out of such a park. They agreed and established the Research Triangle Foundation.

While the Park does contain facilities for government organizations, it is not a federal project; most research is done with private profit impetus. As such, there is little sharing of information between groups. Each must be concerned with its own profits and contracts.

Such seclusion would not exist in Tsukuba. Freely given help and exchange of ideas or breakthroughs would lead to the enhanced productivity for which the Japanese ruling body, the Diet, is striving.

The coordinating body for Tsukuba consists of the various ministries of the Diet. Each institute is under the directorship of one of the ministries, such as the Ministry of Education, the Ministry of Agriculture and Forestry, the Ministry of International Trade and Industry (MITI), or the Ministry of Health and Welfare. Public Funding supports research directed toward solving problems of the public sector.

In contrast, the Research Triangle Park is privately organized, funded and supervised. The Research Triangle Foundation, staffed by five full-time employees, is a nonprofit group responsible for soliciting research organizations. They study a company and determine whether its requirements may correspond to what the Park offers. The foundation is also responsible for executing ordinances and making sure that companies adhere to strict and effective land use regulations. For instance, a research organization may build on only 15 percent of the land they purchase; the rest must remain open or wooded.

The Research Triangle Institute, on the other hand, was established as a corporation in 1958 by Duke, N.C.S.U. and U.N.C.

Tsukuba is much more than a collection of sterile research facilities and university classrooms.

It is also a non-profit organization, but its 900 employees conduct research which is financed by contracts with federal or local governments and private industry. In all, the Park is comprised of 31 established laboratories, corporations, and institutes of study. Nineteen of these are privately owned and administered, six are federally funded, and six were established by either state, local, or university groups.

Much of the work being done involves environmental studies. Five organizations, both federal and private, conduct research dealing with forestry, environmental services, or environmental science. Included in this is the largest facility of the U.S. Environmental Protection Agency and a center for the National Institute of Environmental Health Sciences.

The concept of a research city for Japan was first proposed in 1963. It emerged from plans to build several communities around Tokyo that would help relieve the problems of over-population in the city by drawing people into outlying areas that would still be convenient to Tokyo. The former Minister of Construction and the former Vice-president of the Science and Technology Agency are both credited with the idea of populating one of these communities with scientists and engineers and devoting it to science.

Japan has the international reputation of being an eclectic nation, extremely adept at incorporating and improving the technologies and industrial methods of foreign nations. But they have been confronted with the question of whether they can be the originators of innovation in industry or science and not merely the perfectors.

At present Japan has as many engineers as the United States, but only one-half the United States' population. However, Japan has only one-tenth the number of research scientists as the United States, a fact that the Japanese feel they need to alter. In the forty years since the end of World War II, Japan has recovered itself from total economic dependency on the West to an industrial power. The Japanese Gross National Product is second only to that of the United States.

As in the West, such growth brought with it pollution, urban overcrowding and disorganized growth of cities. Reforms were needed in civic planning, land use and resource consumption. Tokyo, with one of the densest population centers in Japan, seemed to be a logical area to begin such reforms. The consolidation of efforts for population redistribution, effective land use and urban planning with the need to stimulate indigenous scientific innovation seemed possible via the new government project that would be located at Tsukuba.

Tsukuba and the Research Triangle Park, although each is striving to generate breakthroughs in technology and exploit those breakthroughs for practical purposes, are proceeding in very dissimilar manners. This stems from the fact that each is led and funded by different organizations with differing goals. The Japanese Diet has appropriated over $5 billion dollars in public funding to Tsukuba in order to stimulate and enhance the efforts of the country to lead the world in technology, medicine and education.

Physically, the embodiment of the Japanese research community is strikingly different from that of the Research Triangle Park. Tsukuba is a true "science city." It is much more than a collection of sterile research facilities and university classrooms. It is a community devoted to its workers who are themselves devoted to research and discovery. Tsukuba includes a university, over 43 government research buildings, living quarters for thousands of employees, and all the trappings of a large community. An annual spending of $600 million dollars has been approved, and 19 more research centers like Tsukuba have been approved by the Diet.

The original population of Tsukuba was 80,000. An influx of over 70,000 service personnel, technicians, government staff, and businessmen were expected to deal with the needs of the community, as well as 10,000 students, 6,000 scientists and professors, and 30,000 additional family members of scientists. As of January 1983 the population had reached 137,000, well on the way to the government expectations of 200,000 persons within several years.

Private investments pay for 70 percent of the new housing requirements of Tsukuba, as well as for local businesses that locate there and for services required by the community. The government pays for such access facilities as roads and phones and also for utilities for the university.

In contrast to the city atmosphere of Tsukuba, the philosophy used in the development of the Research Triangle Park is that research should be far removed from the dimensions of a city or residential area. Although a 100-acre Park Plaza does exist to house essential services, a hotel and a conference center, no other businesses and absolutely no residential housing is permitted on the Park's acreage. The Foundation feels that it is essential to maintain a relaxed, spacious atmosphere to keep the Park attractive to research companies.

Japan is now preparing to display Tsukuba's accomplishments to the world. Tsukuba Expo '85 is scheduled to begin a six month exposition in March 1985 with the theme "Dwellings and Surroundings—Science and Technology for Man at Home." It is their first chance to showcase internationally the successes of their experiment and to show domestically that the project has justified the effort, the cost and the concept itself.

(For more information, write to The Research Triangle Foundation, Box 12255, Research Triangle Park, N.C. 27709.*)*

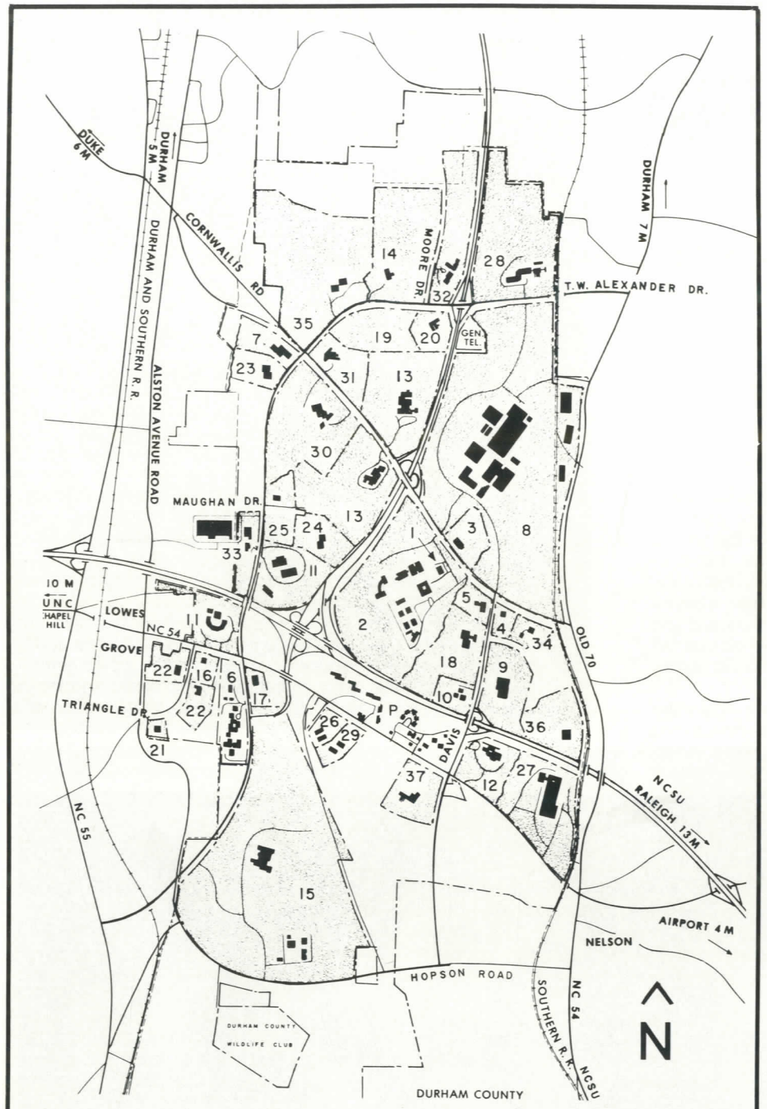
Education

教育

The Research Triangle Park works in close affiliation with Duke University, the University of North Carolina and North Carolina State University, as well as with six other area universities. The relationship is mutually beneficial in that each can take advantage of the others' resources in equipment, manpower and research talent. The universities provide companies with students as research assistants, in addition to research hardware and library facilities. Park institutes also employ professors as consultants. In return some 400 to 500 employees of Research Triangle Park institutions act as adjunct, part-time professors for the universities. In addition, the Park makes the universities much more attractive to prospective students who are interested in engineering, environmental, or other scientific research careers.

The university at Tsukuba is a rare emulation of the American university system by the Japanese. Tsukubadai, as the new national university is called, is an experiment in higher education sponsored by the Ministry of Education. It is structured in a manner familiar to Americans, but it represents a significant divergence from established Japanese national universities. The administrative managers have been given greater power over the university's functions. Five vice-presidents with responsibility for education, research, medical affairs, student affairs and administration have been established under the president on the university's administrative board. It is the first time that a relatively independent policy board will run a national university.

Enrollment will differ from that of other universities in that 20 percent of the student body will be selected on the basis of high school achievement and activities as opposed to entrance examination scores. Improved research facilities for graduate and undergraduate students have been provided. There is considerably more flexibility in undergraduate studies because of a system using what are known as "clusters," or fields of academic concentration. Clusters are interdisciplinary and include basic sciences, engineering and management, international relations, physical education, fine arts and medicine. The entire university structure is designed to allow for much greater academic freedom for faculty, students and administrators than is normally the rule for Japanese universities.



The Research Triangle Park area

1—Research Triangle Foundation of N.C., 2—Research Triangle Inst., 3—Monsanto Triangle Park Development Center, 4—U.S. Forestry Sciences Laboratory, 5—American Assoc. of Textile Chemists and Colorists, 6—N.C. Science and Technology Research Center, Triangle University Computation Center, 7—Nat. Inst. of Environmental Health Sciences, 8—Troxler Electronic Laboratories, 9—IBM, 10—Hercules, Inc., 11—Nat. Center for Health Statistics, 12—Environmental Protection Agency, 13— Becton, Dickinson and Co., 14—Burroughs-Wellcome, 15— U.N.C. R.T.P. Office, 16—Nat. Inst. of Envrionmental Health Sciences, 17—Family Health International, 18—U.S. Army Research Center, 19—Chemical Industry Inst. of Toxicology, 20 Triangle Universities Center for Advanced Studies, 21—Nat. Humanities Center, 22—Airco, Inc., 23—Northrop Services, Inc., 24—Data General Corp., 25—J.E. Sirrine Co., 26—Instrument Society of America, 27—Environmental Engineering/Progress Center, 28—Digital Switching Division, Northern Telecom, 29—Union Carbide Corp., 30—Mead Compuchem/Progress Center, 31—General Electric Microelectronics Center, 32—Microelectronics Center of N.C., 33—Glaxo, Inc., P—Park Plaza

Hemosponge

The hemosponge will benefit divers and blood recipients.

Steven White

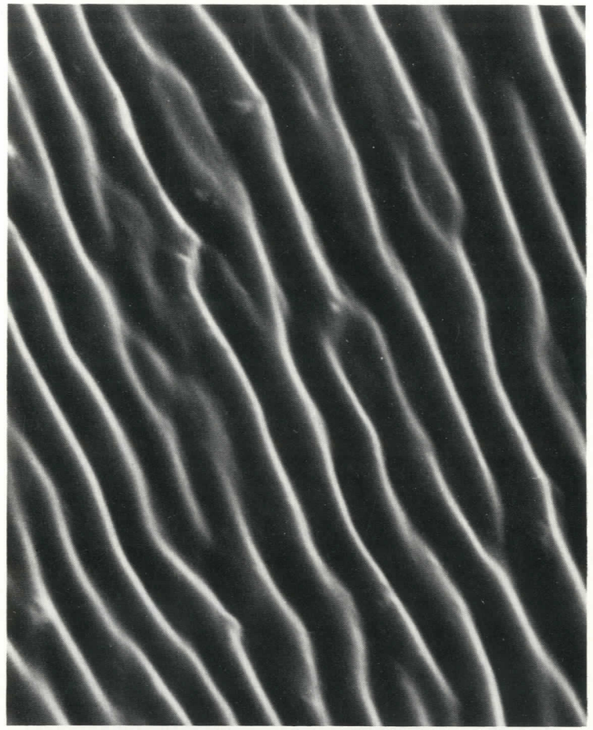
In the fabled American way Dr. Joseph Bonaventura's Saturday afternoon tinkering has resulted in a patent and over $1.3 million in royalties and research contracts for Duke. By trying to discover how some fish can fill their swim bladders, a component of their adjustable buoyancy system, Drs. Joseph and Celia Bonaventura have produced the hemosponge, a device by which oxygen dissolved in water can be extracted and turned into gaseous form. By mimicking the method that fish use to fill their swim bladders, the hemosponge could revolutionize artificial breathing apparatus.

While humans breathe air, fish "breathe" water. This water contains dissolved gas molecules, such as carbon dioxide and oxygen, which pass through a fish's gills, CO_2 outward and O_2 inward. At the gill membrane/water interface a protein, such as hemoglobin, in the fish's red blood cells releases CO_2 and picks up O_2. These cells transport oxygen to the fish's body tissues, exchange the O_2 for CO_2, and then return to the gills, always with the gas molecules dissolved in a liquid. When the fish needs to increase its buoyancy, O_2 is shunted to the swim bladder and "unloaded" in gaseous form.

A device imitating this swim bladder system could provide enough oxygen to sustain humans. A unit that could extract O_2 from seawater and release it into breathable, gaseous form would replace the tanks on scuba divers' backs and make living in underwater habitats more practical than it has been, something reminiscent of *20,000 Leagues under the Sea*.

First, though, the Bonaventuras had to figure out how to hold the hemoglobin molecules gingerly in place without interfering

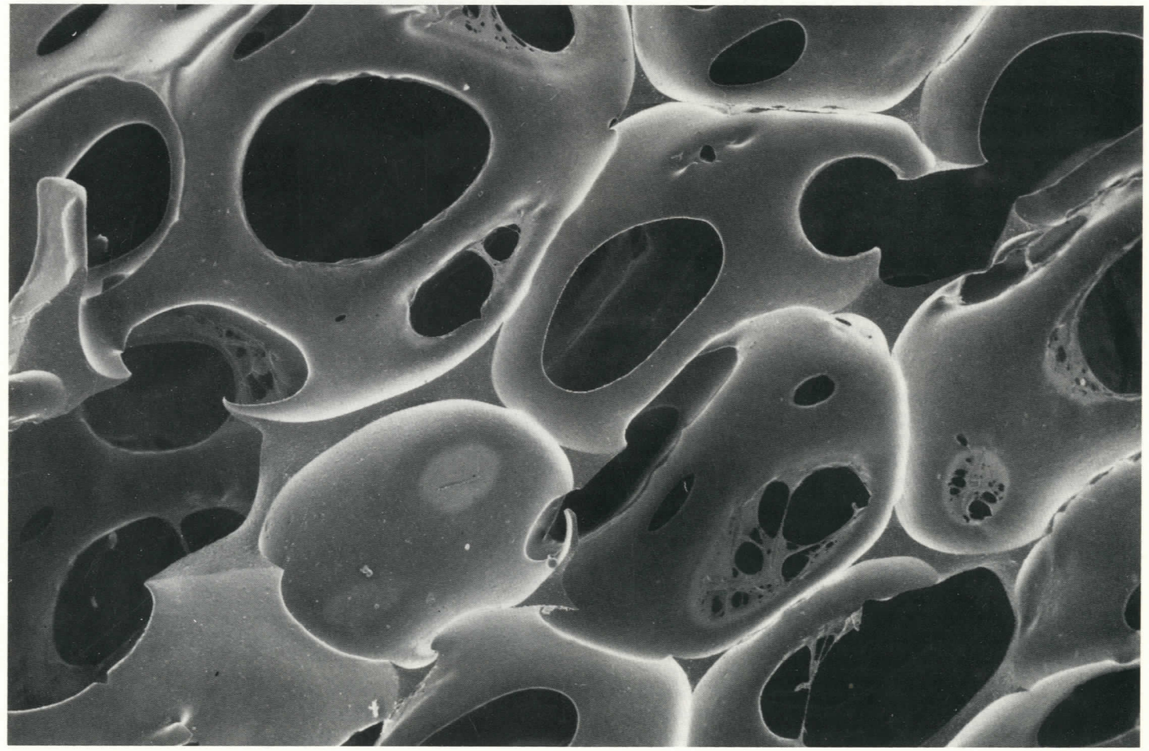
Drs. Joseph and Celia Bonaventura with samples of the hemosponge.



A

This 40X scanning micrograph (**A**) shows the reticulated nature of the polyurethane matrix in which hemoglobin is incorporated. The 4,000X micrograph (**B**) details the rippled surface of the walls of the matrix of **A**. Hemoglobin is held within the walls.

B



Duke, along with a growing number of universities, is finding out that letting the cat out of the bag can be a profitable enterprise.

with the shape changes necessary for oxygen binding and release.

A commercial plastic called Hypol™ only polymerizes, or solidifies, when in contact with water, when it turns into a sponge-like material. The Bonaventuras made the vital connection when they mixed a shot of hemoglobin from Joseph Bonaventura's blood with a shot of Hypol®, added water, and the first hemosponge, complete with oxygen binding and releasing properties, was created. Joseph Bonaventura still carries a piece of this original, made in 1976, in his pocket.

In this first crude tinkering and subsequent more sophisticated procedures, the Bonaventuras succeeded in entrapping hemoglobin and several other types of molecules onto surfaces of Hypol®. Most importantly, these molecules retained their biological properties. For example, hemoglobin and other oxygen carriers could still bind and release oxygen, and enzymes could still trigger reactions.

The molecules are mixed with the liquid form of the polymer, then water is mixed in. Depending on the mixing procedure and proportions, the resulting sponge can be dense or light and airy and made into pellet-shaped particles or manipulable chunks.

The Bonaventuras' patent includes nine claims dealing with different variations on this theme, and Aquanautics, Inc. has bought the rights to the claims which deal with removal of oxygen from water. At Duke's Marine Lab in Beaufort, North Carolina, the Bonaventuras are directing research supported by Aquanautics for the practical application of the hemosponge to oxygen-extraction equipment. Under a two year program the Biosponge laboratory, located at the marine lab, will try to produce a prototype scuba unit using the hemosponge. A commercial product, however, is not anticipated for at least four years.

Other claims in the patent include using the hemosponge particles as a blood substitute. Sponge particles small enough to flow easily through the circulatory system could act as a temporary replacement for lost red blood cells. Like the red blood cells, these hemoglobin-on-gel particles could bind with oxygen in the lungs, deliver the O_2 to tissue cells, pick up CO_2 from the cells, then return to the lungs to release the CO_2 and begin the cycle again.

The hemosponge is a result of scientific investigation whose further development is made possible through a carefully engineered "technology transfer." Duke, along with a growing number of universities, is finding that technology transfer, or letting the cat out of the bag, can be a profitable enterprise.

Before the 1979 adoption of a uniform policy concerning inventions and patents coming out of Duke, a Duke researcher with a patentable idea had to rely on his own resources and connections to patent his idea and find financial supporters to further its development. If he did patent the idea and find financial support, sticky questions arose concerning the university's share of the rewards. If a patent were sold, there were no guidelines delineating the reseacher's personal share, his laboratory's share, or the university's share.

Duke standardized the procedures dealing with patents in its *Policy on Inventions, Patents and Technology Transfer*. This policy establishes a pivotal Patent Administrator who acts as a middleman to researchers with ideas and corporations with money.

Carl Wooton, named to this post in late 1979, coordinates the financial agreements between companies and university-associated inventors, with an average of one potentially patentable invention going through his office per week. He contacts or is contacted by researchers with patentable ideas, helps them receive patent rights, and runs through a list of 5,000 or so companies which he knows from personal contact or from a bibliography of corporate listings. Eventually, if all goes well, the patent is approved and a company agrees to purchase it and often to support continued research at the university. It was Wooton who brought the Bonaventuras and Aquanautics together.

Tap Pryor, Director of Aquanautics' Biosponge Laboratory, exhibits a prototype of a prototype of a breathing apparatus using the hemosponge.

The gulf of time between the patent approval and financial agreement may be several months or several years, involving offers and counter-offers. "There is no set formula for what we do here," says Wooton. "Every agreement is different." This involves great flexibility, considering that Wooton has carried nearly 40 patents to inventor-university-industry contracts, ranging from a new plastic to the NIRO-scope (near-infrared oxygen scope) which determines the abundance of oxygen in the brain.

Considering the $1.2 million in research contracts and royalties which Wooton has secured for the university and faculty since 1979, the $100,000 yearly operating budget of the Office of Patent Administration can be called a sound investment. The Bonaventuras' agreement will bring in an additional $1.35 million over the next several years.

After nine months of haggling, Aquanautics and the Bonaventuras reached a two-fold agreement. First, Aquanautics will pay one million dollars for the patent rights, which will be divided between the Bonaventuras, the Bonaventuras laboratory, the Duke Marine Biomedical Center, and Duke's general fund. Second, the Bonaventuras received a $350,000 research contract for a two year period.

This research contract will support extensive basic developmental research in the area of oxygen-carrying molecule characteristics. The results from this basic research will be used to help develop the hemosponge. Ideally, at the end of a two year program at the marine lab, the Bonaventuras will have established the size and energetics necessary for a prototype scuba unit.

In trying to do this they will enter the grey area between basic and applied research. Understandably, conflicts sometimes arise between basic research, ideally a scholarly pursuit of knowledge, and applied research, often a financially-oriented prusuit of a product or process. Wooton is quick to claim that Duke "doesn't want straight development (of an invention) into a commercial product. We're between commercial and basic research." Indeed, the funding from the Bonaventuras' agreement is directed towards basic research into changes in protein functioning. The research into the effects of limiting the ability of the protein to undergo its usual conformational changes, for example, directly relates to the immobilization of hemoglobin in the hemosponge. Dr. Celia Bonaventura explains, "In this case, basic and applied research are complementary— there is no realistic dividing line."

Thermal maps

Stuart Meyers

Thermography is a graphic thermometer of the body, or a thermal map, and even with the sophistocated technology and equipment of today, no one would disparage the value of the simple oral thermometer. This graphic thermometer measures the surface distribution of infrared (heat) radiation from the body. Its properties have been known since the early nineteenth century; however, its medical applications have only been promulgated within the last few decades. Themography is used to detect and diagnose breast cancer, nerve root irritation, disk disease, the extent of arthritic inflammation, vascular dysfunction, and thrombophlebitis, among other physical disorders. It can detect soft tissue injury, infection, inflammation and pain, for diagnosis, research and legal purposes. "Tender spots" can be studied objectively for the first time.

The unique diagnostic and documentative value recently uncovered has also broadened the use of thermography into areas like sports injuries, pre-employment screening for back disorders and high-risk backs, and insurance claims. Thermographic findings can now be used as evidence in United States courts. Because of its pictorial nature, the results can be easily explained to the layman, such as a judge or juror.

Growth in the diversity, value, and application of thermography owes, in part, to new technology and the general nature of the examinations. Two techniques are currently in use. Electronic, or non-contact, thermography consists of scanning mirrors which reflect the infrared radiation onto an infrared-electronic transducer. The IR pattern in then displayed on a black and white or color screen from which it can be photographed.

Contact thermography is a more recently developed method originally introduced for the study of breast cancer, but it is spreading steadily into many other areas. This technique uses liquid crystals embedded in flexible, transparent, elastomeric sheaths. The crystals are cholesterol derivatives which show strong optical molecular rotary power and selectively reflect polarized light in a narrow region of wavelengths. When these crystals undergo a temperature change, their molecular arrangement is altered, and a specific color/temperature response occurs.

It is this response to temperature which is utilized in color thermography. The liquid crystal sheets are mounted on inflatable boxes which, when inflated, readily contour to virtually any part of the body. A Polaroid photograph is taken for a permanent record.

Flexi-Therm liquid crystal thermography has demonstrated accurate and reliable color responses to temperature changes. There is good correlation between electronic and contact thermography, and since contact thermography is significantly less expensive, there is a greater opportunity for more physicians to use thermography. Also, in addition to providing a rich, high contrast color pattern, the entire Flexi-Therm apparatus is mobile and can be easily utilized in various locations.

A great advantage of both electronic and contact thermography is that they are non-invasive, totally painless, and harmless. No radiation is involved.

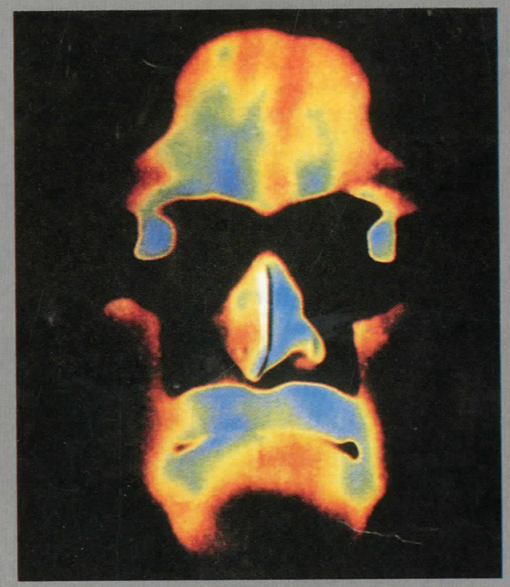
The rotation of molecules of cholesterol derivatives create a thermal map which can signal physiological abnormalities.

Temperature change and symmetry are the two basic criteria for the individual interpretation of the thermograms. Since the heat pattern of the left half of the body is essentially the same as that of the right, a normal thermogram will exhibit a symmetrical temperature distribution between corresponding parts of the body, as in the hands and feet. If there is a basic asymmetry, represented by a color/temperature difference of at least 0.3°C, it must be explained by the physician. The thermogram does not say what is wrong, but an asymmetrical heat distribution represents an abnormality. The physician must then correlate his thermographic findings with a patient's history, clinical examination, laboratory tests, and other findings, to make a final diagnosis.

For example, a routine thermogram is performed on the hands of an asymptomatic patient, and a distinct asymmetry exists. The thermogram appears positive; however, ten years ago that patient suffered a major cut which severed a nerve and reduced blood flow in the exact area where a cold spot appears on the thermogram. Thus, the patient's history correlates with the thermographic results. Previous surgery, a broken hand or leg, or peripheral nerve damage can produce a significant degree of change in a thermogram. This is just one example which shows the importance of establishing routine, regular thermographic examinations for certain parts of the body. In this way, a baseline can be established for each patient, and early detection of a disorder, from pain to cancer, can be observed and documented by deviations from this baseline.

If a thermogram is evaluated as abnormal, it is critical for reliability that the examination be repeated at least once, ten to fifteen minutes after initial pictures have been taken. A consistent abnormality that is demonstrated over a 45 minute period is sufficient evidence of organic damage. And those findings will be present on another day, assuming no change in status.

Experiments which create abnormal thermograms through the use of hot packs, rubs, creams, pinching, slapping, and the like show that they neither add nor subtract



Liquid crystals can detect physiological abnormalities.

from the basic underlying infrared pattern, but do obscure it. After 45 minutes of cooling, the thermogram will return to its pre-experimental appearance, whether normal or abnormal. If the heat does not totally dissipate within this period of time, there will still be a distinct change in the temperature pattern.

Thermography is a highly sensitive diagnostic tool, sensitive to 0.1°C in clinical conditions; however, it is entirely non-specific. Thus, it is complementary to, not competitive with, other diagnostic tests, such as the x-ray, myelogram, EMG, and CAT-scan. Thermography can and often does detect what another test cannot; it detects not anatomic abnormalities, as would an x-ray, but rather physiological abnormalities. The thermogram is a picture of physiology, and as such cannot differentiate between a herniated disc, for instance, or muscle spasm, or chronic scarring of a nerve root in the same area. Thermography is analogous to an oral thermometer in that it can no more diagnose a specific disease any more effectively than the thermometer can reveal the cause of an elevated temperature.

What thermography gives up in specificity it more than makes up for in sensitivity, often providing an overall accuracy greater than other anatomical tests. With such high sensitivity it has become very useful in differentiating psychogenic pain from pain caused by nerve injury or dystrophy, among other things. Given an abnormal thermogram many possibilities can exist, but the purpose of the exam is to see if the abnormality can be related to a specific problem and/or anatomic distribution.

Clinical investigations in the U.S. and overseas are currently studying Flexi-Therm liquid crystal thermography in many areas. These studies should soon be of paramount importance in clinical applications. It took 150 years from the development of the thermometer before its climical use in hospitals, but from all indications it won't take that long to apply the liquid crystal thermal map to daily patient use.

Duke University Photographic Department

Laying the cornerstone of Duke's West Campus Union building, 5 June 1928.

Duke's Primate Center has the only captive *Propithecus* lemur colony in the world.

Duke University Photographic Department

Efé Pygmies

A culture is regaining a foothold on survival

Article by John de Beixedon

Photographs by Jean-Pierre Hallet

Zaire is a nation in turmoil. Her people starve while her politicians live in a continual state of luxury. For example, Zaire's president, Mobutu Sese Seko, has amassed a personal fortune of $4 billion primarily through embezzlement. Foreigh corporations are allowed to rape Zaire's forests. Thousands die from epidemics annually. Most children remain malnourished. Tribal wars rage. To even the most optimistic observer, Zaire appears to be a nation heading towards collapse.

Yet, admidst the surrounding corruption and calamity, the Zairian Efé Pygmies are making the world's most amazing comeback. Once at the brink of extinction and after centuries of oppression, this hearty people has both survived and flourished. By adapting agricultural techniques, the Pygmies have fed their children, preserved their culture and maintained their pride and dignity. At present, the Pygmies possess over ten tons of drought resistant winged bean seeds. The foodstuffs produced from these seeds alone could ultimately feed the starving millions of Zaire. Yet, the path to the Pygmies' present success has been a long and trying one.

Three hundred years ago, the Pygmy population of the Central African region was approximately 2 million. At that time, the area was invaded by Bantu and Sudanese tribes from the north. These conquerers became overlords of the smaller, pacifistic Pygmies, who were then kept in a state of feudal servitude.

Over the last several centuries, the primordial forest of the Pygmies has been all but destroyed by plantation developers and greedy loggers. Since each member of the nomadic Pygmy society required two square miles of virgin forest for hunting and gathering, the destruction of the forest was costly. As the Pygmies say: "When the forest dies, the children of the forest die." In fact, by 1933 only 33,000 Pygmies remained.

The sickness-free world of the forest was destroyed by several other "gifts" of civilization— cholera, dysentary and tuberculosis. Lacking immunities to these diseases, the Pygmies were ravaged by epidemics which left them numbering a mere 3,800 in 1974.

In response to the loss of land for hunting and gathering, during the 1950's the Colonial Belgian government attempted to help the Pygmies develop agrarian techniques. But they were unsuccessful in transforming the hunter-gatherer lifestyle of the Pygmies to one dominated by agriculture. The light-skinned Pygmies were unaccustomed to the harshness of the direct tropical sun, and they suffered from heat stroke and heat prostration. Also, after the non-aggressive Pygmies left their forest home, many were kidnapped or killed by the taller neighboring tribes. Diseases, too, killed many of the Pygmies who left the security of the forest. In addition, due to their mental and spiritual attachment to their forest homes, even the best Pygmy workers would abandon agricultural project which were usually located far from these homes. The Pygmies need their ancestral forest spiritually, mentally and physically, and for any project to successfully alter any aspect of the Pygmy lifestyle, it must be responsive to the Pygmies' traditional needs and cultural adaptations.

In the late 1950's Jean-Pierre Hallet, a Belgian sociologist and agronomist who spent most of the first seven years of his life living with the Pygmies, initiated the first successful program for preventing the extinction of the Pygmies. Hallet began this program by living with the Pygmies for 18 months in order to gain a full knowledge and appreciation of their way of life. Though the Pygmies are often wary of foreigners, who tend to carry guns, diseases, and chainsaws, the Efé were immediately impressed by Hallet's desire to help rather than exploit them. In fact, within only two days they had fully accepted him as one of their own, even forgiving the 6 foot, 5 inch Hallet the fact that he was "so ridiculously tall."

On June 26, 1957, Hallet obtained for his adopted people a "Declaration of Emancipation" from their Bantu overlords, who had held the Pygmies in feudal serfdom for centuries. After this official emancipation of the Pygmies, Hallet taught the Pygmies simple farming methods, including crop rotation and use of improved selected breeds of crops. These farming techniques allowed the Pygmies both to cope with the increasing destruction of their forest home and to compete on an economic level with neighboring Bantu tribes. Hallet also developed small plantations for the Pygmies under the protective cover of the forest canopy, alleviating the problems of sun stroke and heat prostration. In addition, throughout this process of agricultural adaptation, Hallet make certain that the Efé maintained their close ties to their forest home.

In the early 1960's, during the post-independence civil wars of Zaire, Hallet fled the Congo. The new government of Zaire was composed of members of the same tribes who had formerly oppressed and enslaved the Pygmies. Consequently, the Pygmies became victims of new harassments, such as having to pay income tax, being drafted into the Zairian army and suffering from an enforced loss of cultural identity. Hundreds of Pygmies were kidnapped and killed, but

these crimes went uncontested by government officials, whose policy was that the Pygmies were "inferior." Many Pygmies tried to escape these oppressions by retreating to the swampy, uninhabited areas of the Ituri, where living conditions were extremely difficult. Finally, by the early 1970's, tourists began arriving with Western diseases. As a result, a series of epidemics reduced the Pygmy population by 25 percent each year.

In 1974, with the extinction of the Pygmies becoming increasingly likely, Hallet founded the Pygmy Fund, a publicly supported organization dedicated to preserving the Pygmies and their culture. The first action the Pygmy Fund took was to innoculate the Pygmies against disease. Agricultural self-help programs were initiated, introducing large scale cultivation of cassava, banana trees, peanuts and rice within the shaded security of the Pygmies' ancestral forest. Efforts to improve the sanitation of the semi-permanent Pygmy camps were made, and an accurate census was undertaken to determine the precise number of Efé still surviving.

The Pygmies whole-heartedly embraced these new programs in an effort to insure their permanent survival, and within a year their population had stabilized at 3,800 persons.

Since the aim of the Pygmy Fund is to preserve the traditional Efé culture and lifestyle, a system of agricultural rotation was established to allow the Pygmies to alternate between tending crops and hunting and gathering. By utilizing this system of rotation, the Pygmies were allowed both to maintain their traditional lifestyle and to produce enough food to supplement the meager food supplies left within the forest.

Since the Pygmy elders insist on being the last to eat, so as to keep the children well fed, many Pygmy elderly had formerly died of starvation in an effort to keep their young healthy. Yet, during the four years after the creation of the Pygmy Fund, as food became more plentiful because of cultivation, the elders ceased to starve to death. As a result, the Efé population grew to nearly 4,000 by 1979, while the average lifespan of the Pygmies increased dramatically. Also, the distribution of more than 1,000 tools (hoes, bill-hooks, machettes), the acquisition of 650 acres for Pygmy use, and the development of a high yield soya hybrid aided in the successs of the self-help agricultural program.

By 1980 the Pygmies had become relatively prosperous. Their population had reached 4,192 and their infant mortality rate had decreased to a level lower than that of neighboring tribes. In addition, 725 more acres of land had been obtained for cultivation. Even the Zairian zoning commissioner seemed pleased by the Pygmies' progress, as he guaranteed that a 500 meter radius around each Pygmy camp would be reserved for Efé use alone.

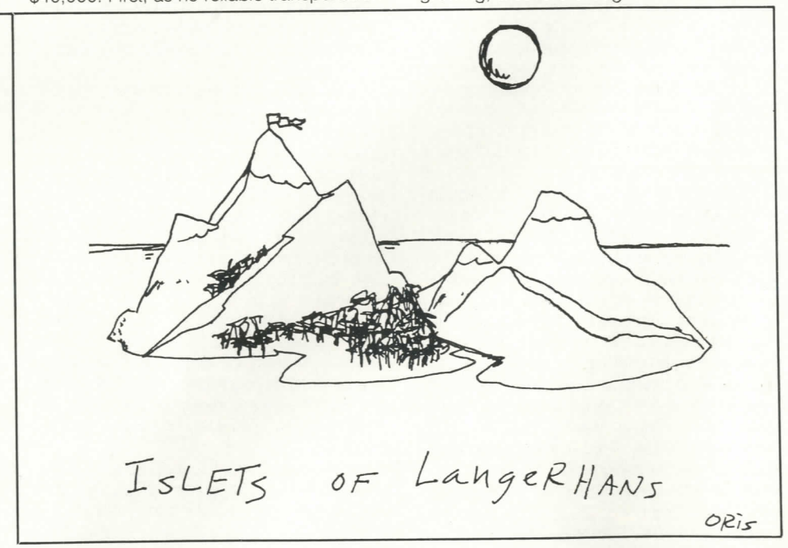
Due to this apparent prosperity, neighboring tribes began asking for aid from the Pygmy Fund, and as a result, the Pygmy Fund self-help program was extended to 400 Sua tribesmen. Yet, often when Pygmies would travel to more distant villages to trade, they would be verbally abused and ridiculed because of their primitive look. The Pygmy Fund then began offering efficient Pygmy farmers bonuses, which included bowls, salt, knives and Western-style clothing. Pygmies wear their native attire normally, but when faced with the prospect of a journey to a hostile village, they don shorts and shirts to escape ridicule.

Before 1981 the Pygmy Fund's expenditures were a mere $25,000 per year. But in 1981, expenditures totalled an unexpected $40,000. First, as no reliable transportation was available for the annual distribution of tools and seeds, the Pygmy Fund was forced to purchase a new Range Rover for $23,000.

Second, the Pygmy population was ravaged by a cholera epidemic. By the time Hallet heard of the epidemic, 60 Efe had already perished from *Vibrio cholerae* intoxication. He immediately purchased $15,000 in medications, and vaccinated over 2,000 of the Pygmies. In addition, he administered polyelectrolyte and fluid rehydration therapy to 932 people, and also administered antimicrobial drugs to 650 of the most severe cases. Incredibly, the Pygmy population suffered no additional fatalities.

Though the 1981 mission of the Pygmy Fund was marred by high costs and the potentially disastrous cholera epidemic, a sense of encouragement pervaded the Pygmy camps. The Pygmies had survived hundreds of years of oppression and they were not about to let one unpleasant incident ruin the mood created by their recent successes. "You can not stop the birds of sadness from flying over your head, but you can prevent them from nesting in your hair," say the Pygmy elders. With characteristic determination, the Efé decided to begin cultivation of the winged bean, a highly productive plant which Hallet introduced (see inset).

The introduction of the winged bean proved to be successful, and by 1982 the Pygmy population had surpassed 4,300. At this point, the Pygmy Fund introduced the winged bean on a mass scale in a project overseen by Hallet and the Pygmy Fund's Zairian general manager, Zikale Baku. Twenty-two varieties of these beans were planted on a 7.5 acre plot and also at 30 sites throughout the Ituri Forest. Although 380,000 plants at the 7.5 acre site began growing, a severe drought in 1982 caused



five out of 6 pods to fail. Those that did survive, however, produced drought-resistant seeds. The winged beans planted within the perpetually wet forest grew as well as expected.

The Pygmies relied on the all time high annual budget of $50,000 in 1982. However, as a result of the Pygmy Fund's ambitious projects, the Pygmies should be self-sufficient by 1986. With their newly acquired ability to produce seeds for the next year's planting and the likelihood of producing a tradeable food surplus, the Pygmies will be able to acquire the tools needed to continue farming.

At the present, the Pygmy Fund is continuing its large scale cultivation of the winged bean. Consequently, the Pygmies possess more available vegetable foodstuffs than ever before. Due to its success at feeding the Efé population, the Pygmy Fund created an independently run branch known as the International Research Center for Food Crops Improvement in Central Africa, dedicated to leading practical action towards ending starvation in the Third World.

Unfortunately, within a year and a half of its creation, this organization became so entangled in Zairian red-tape as to become completely useless. In addition, in January of 1984 the Zairian government sold the land where the Pygmies were carrying out their large scale winged bean cultivation. The Pygmies were reimbursed neither by the Zairian government nor by SOZADE, the Israeli corporation which pruchased this illegally confiscated land.

Still, three months after confiscating the most valuable land cultivated by the Pygmies, the Zairian zoning commissioner stated that the federal government had acted improperly. The commissioner created three new laws in order to protect the Pygmies from further abuses and to acknowledge the importance of the winged bean. Specifically, these laws state that the present property of the Pygmies will remain untouched, that all tools given to the Pygmies may not be stolen or bought by other natives, and that all farmers in the zone of Beni must grow at least a certain minimum amount of winged beans annually. Even the Zairian government now appears to realize the importance of the agricultural projects of the Pygmies.

Though the Pygmies have shifted from a completely hunter-gatherer lifestyle to one notable for its agricultural pursuits, the essential character of the Efé people has not changed. The Efé still live communally in the remainder of their ancestral forest, children are still loved extravagantly, food is never wasted, and elders are still respected. Though the techniques that they utilize for the acquisition of food have changed markedly, the traditional culture of the Efé Pygmies remains intact.

Although the Pygmies have worked hard for a certain amount of prosperity, they often find themselves subject to conflicting or corrupt government practices. Still, the Pygmies continue to work towards a future of freedom and peace, for as the elders say, "Do not drink your sweat, there is water ahead."

(to page 33)

(Tax-deductible donations to help the Pygmies reach self-sufficiency may be sent to The Pygmy Fund, P.O. Box 277, Malibu, CA, 90265.*)*

The wonderful winged bean

The winged bean (*Psophocarpus tetrogonolobus*) is a perennial climbing legume native to Papua New Guinea and Southeast Asia. Every part of this plant is edible and its nutrient content ranks among the highest ever recorded in tropical plants. The amino acid composition is even better than that of the soybean. Also, the combination of high protein to prevent anemia and carbohydrates to provide energy, along with the high levels of minerals, vitamins, and amino acids, make the winged bean a most attractive plant.

The winged bean possesses six different sources of food products: pods, seeds, leaves, tubers, shoots and flowers. The pods are a chewy delicasy and are especially rich in minerals and vitamins. The seeds are the most nutritious part of the winged bean, and contain up to 42 percent protein and up to 20 percent edible oils, and nearly all the essential amino acids. They possess a high level of digestibility and a high level of tocopherols, such as vitamin E, which greatly improve the utilization of vitamin A in the human body. Assuming an average of only 35 percent protein, each plant can produce 8 ounces of pure protein from seeds only. The leaves are very rich in vitamin A and tryptophan, which could compensate for tryptophan-deficient diets based on corn. The tubers are 20 percent protein compared to the 2 percent protein of normal potatoes. These tubers are rich in carbohydrates, and would be a very beneficial replacement for the protein-deficient manioc, sweet potato, yam and plantain crops which are grown as staples by many peoples living in the tropics. The shoots taste much like asparagus and possess the same nutritional value as the leaves. The flowers, when fried, look and taste like mushrooms, a Pygmy delicacy. Like the seeds and the tubers, the flowers are very rich in protein.

In 1981, the first year in which the Pygmies cultivated the winged bean, a mean yield of 6,223 kg of seeds per hectare (5,522 lbs. per acre) was obtained. Previously, the highest yield recorded for a winged bean strain was 5000 kg per hectare. During this initial cultivation, each ounce of seeds planted produced in excess of 9 lbs of seeds harvested. Additionally, the winged bean appears to be free from insect predation, virus infestation and fungal diseases.

Dividends from illness

The new profit incentive in hospital care

Ted Alyea

A growing number of hospitals in America are following IBM, General Motors, and McDonald's into the world of big business. The business of for-profit hospital management has mushroomed over the last 15 years, and corporations now have controlling interest in many health care facilities, from small community hospitals to large, metropolitan, university hospitals. The economic ramifications and moral implications of this growth have been the subjects of intense debate from all sides— the public, the medical community, insurance companies and government.

The rise of for-profit hospitals began in the early 1960's when the Hospital Corporation of America (HCA), located in Nashville, Tennessee, acquired control of five local hospitals. Today, 38 for-profit management corporations own approximately 1,100 hospitals in the United States. The five largest companies— HCA, HAI, Humana, AMI and NME— own two-thirds of these hospitals. HCA, the largest of these, controls about 200 hospitals, and after acquiring HAI controls a total of 345 hospitals.

When hospitals that are leased, managed, or owned are included in the number which these corporations control, the percentage of hospitals climbs to 34 percent of all non-federal hospitals. Some projections indicate that in the near future, one-half of all hospitals will be controlled by for-profit management corporations.

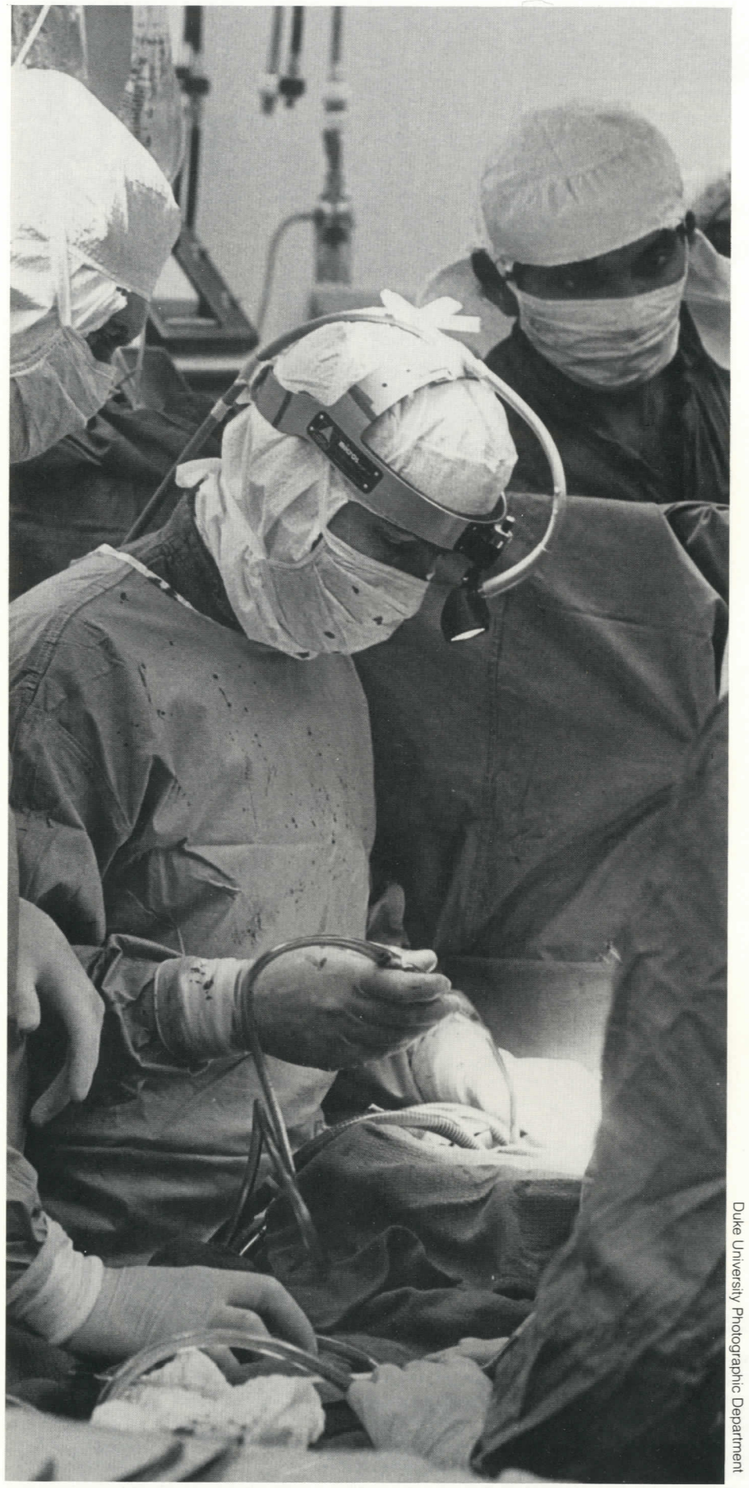
Of the for-profit hospitals, 58 percent are located in California, Florida, Texas, Tennessee and New York, with a substantial number located in rural areas. Large cities and academic hospitals, though, are not immune; both Cook County in Chicago and the University of Louisville hospital in Louisville are being rented by management corporations.

Simple management economics explain this rapid expansion. Management companies have access to capital for expansion of services and facilities, the ability to buy supplies in mass quantities, and have a mone-

When you have the only chess board in town, people play by your rules.

tary incentive to provide health care services at prices lower than their competitors. When combined with increased management efficiency, these result, the corporations contend, is less expensive care.

The companies also note that unprofitable community hospitals are a tax burden, and by corporate acquisition of the hospital, the community will be relieved of this burden. At the same time, the community will gain a tax-paying corporation which provides the same or improved health care as the public hospital. They also benefit by the national recruitment capabilities of these corporations. Small hospitals are restricted in their ability to recruit top physicians, while a corporation with its large financial resources can attract physicians to areas of



Duke University Photographic Department

With these advantages, why is criticism of the growing number of these hospitals increasing? Many contend that these corporations do not provide better care at lower prices, and that in a majority of cases hospitalization costs increase under the management corporations. Other concerns center on the loss of local control of the hospital and the economic drain on a community by a distant corporate headquarters. Also, many question the morality of corporate share-holders reaping dividends from a patient's illness.

Studies conducted in several states reveal that hospital prices are not lowered by the arrival of for-profit hospitals; in many cases, health care prices were actually greater by up to 25 percent. A 1981 study comparing hospital chains to non-profit hospitals in California, Florida and Texas found that charges per admission were 17 percent higher in the for-profit hospitals. Higher costs for ancillary services, including laboratory tests, radiological procedures, and supplies, were cited as reasons for the higher average cost.

How many people would not seek health care for the simple reason that they know a group of individuals is profiting from their hospital visit?

The Florida Hospital Cost Containment Board conducted a similar study comparing all Florida hospitals, and found patient care costs to be 15 percent higher in for-profit hospitals. Another study in California found 24 percent higher charges.

Two researchers who investigated the for-profit hospital systems in California attribute the increased cost per admission to more tests and supplies and at higher prices. Dr. Relman, a vocal opponent of for-profit hospitals, points out that "unless one makes the unlikely assumption that the patients admitted to the investor-owned chain hospitals were sicker than those admitted to similar-sized voluntary hospitals or that the medical outcomes were better, it seems probable that the increased number of tests and procedures per admission in the chain hospitals represented a heavier discretionary use of services rather than a response to greater medical need or a reflection of better treatment."

Comparisons of patient care costs contradict the chain hospital operators' claims of greater financial efficiency. Relman points out that "claims of greater efficiency for investor-owned chains cannot be substantiated from their record. Despite their centralized management, the investor-owned chain hospitals have not reduced their operating expenses below those of

In the near future, one-half of all hospitals may be controlled by for-profit management corporations.

comparable not-for-profit hospitals."

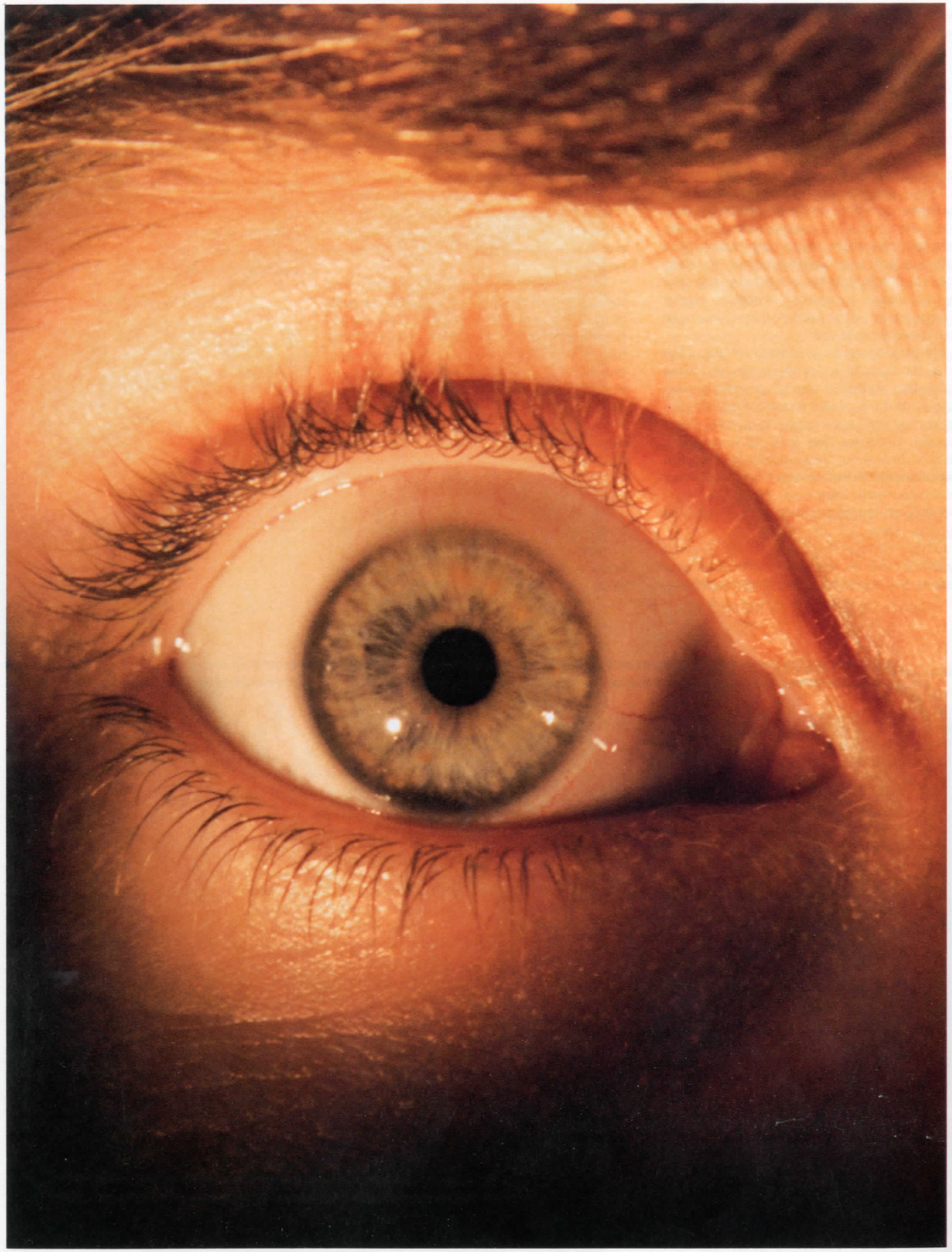
These studies are themselves criticized by those who note that many for-profit hospitals are located in rural areas where the cost of laboratory tests and radiological services are unavoidably higher. In addition, rural hospitals have a greater possibility of low bed occupancy, therefore higher charges per patient are required to make the hospital profitable.

Many observers are concerned about the rural location of for-profit hospitals. Most agree that access to capital, greater buying power, and the ability to attract health professionals are advantages to a rural community. However, the lack of competing health services in these areas means that the hospitals have less incentive to minimize health care cost. When you have the only chess board in town, people play by your rules.

Others ciritcize the control that for-profit systems have on the total health care system in a rural community. Many corporations have area residents on the local hospital governing board; still, a final decision concerning the care provided to a community may be made 500 miles away by people who know little about the community's needs.

The entrance on a for-profit hospital into a rural community will likely cause several immediate problems. The authoritarian control that the corporation can exert could hurt a community's economic growth and divide the established health care system in the community, possibly resulting in reduced health care. Also, in rural communities where traditions are very strong, how many people would not seek health care for the simple reason that they know a group of individuals is profiting from their hospital visit?

For-profit hospital systems are growing at a rapid pace, and the system offers several unique advantages which most non-profit hospitals cannot provide. The for-profit systems, however, are by no means flawless. Communities and individuals must weigh carefully the advantages and disadvantages of the introduction of this form of hospital management. The decisions made today will affect the lives and health of many generations in the future.



Contacts

The biophysics of extended-wear lenses

Steven White

Until recently, a "four-eyes" was easy to spot in a crowd. He had wire or plastic wrapped around two discoid pieces of glass or plastic, hanging onto his ears and usually gradually slipping down his nose. Such contraptions, spectacles, were the standard correction for vision defficiencies, such as near and farsightedness.

Some forty years ago, however, this standard correction was challenged by the development of contact lenses, originally small pieces of ground glass, miniaturized versions of glass lenses, made to fit directly onto the eye. These crude versions of contact lenses were soon replaced by safer hard plastic lenses, the hard contact lenses of today.

Pliable plastic polymers, supple enough to be more comfortable on the eye than hard lenses yet rigid enough to maintain necessary refractory properties, represent a major development in contact lens evolution. These soft lenses are composed of a plastic polymer matrix, as hydroxyethyl methacrylate (HEMA), with water molecules normally filling in the spaces inside the matrix, giving them the name "hydrogels." The matrix structure is analogous to a pile of springs connected to each other, with water filling in the spaces between the HEMA "springs."

The unique properties of water allow soft lenses to maintain their shape. Because of the water molecules' polar nature (they have both a negative and a positive side), the water molecules are attracted to the negatively charged regions of the polymer. Specifically, the positive ends of the water molecules are attracted to the negatively charged carboxyl groups along the polymer chain. These carboxyl groups are only exposed in the matrix spaces, where the polymer molecules are not connected to each other. The bulk of the water molecules causes the lens to swell to its normal shape.

The outer layer of cells of the cornea, the epithelium, does not receive oxygen from blood vessels, but relies on oxygen from the air around the eye. Hard contact lenses greatly reduce the concentration of air, and subsequently oxygen, available to this outer layer of cells. This reduction in oxygen results in a time limit, or maximum wearing time, for hard contact lenses to cover the eye, usually no more that twelve hours. Some hard contacts have three tiny holes drilled through them to increase oxygen availability to the epithelium and increase cellular comfort and wearing time.

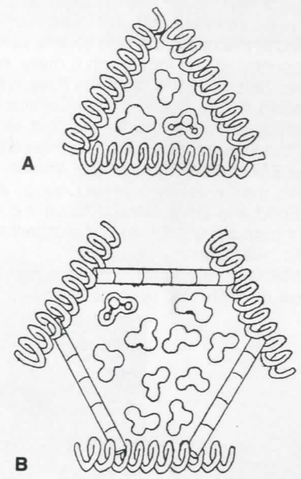
Their ability to hold water molecules, though, gives soft lenses the cellular comfort and wearing time not available from most hard contact lenses. The zig-zagging pathway of adjacent water molecules from one side of the lens to the other provides a route through which oxygen molecules can diffuse. Oxygen from the air diffuses through this waterway to the epithelial cells.

The drawback of both hard and soft lenses is well understood by anyone who has fallen asleep for more than two or three hours while wearing these contacts. What the optometrist will call lens grip and dehydration is more aptly described as eyefulls of dry sand. The lenses are not bathed with tears, the region between the eye and lens becomes dehydrated, the lens may slightly shrink, and the lens painfully grips the cornea. Patience and wetting solutions can eventually solve the problem.

While awake, the concentration of oxygen in the air is great enough to supply the corneal epithelium adequately with oxygen through the lens. However, while asleep, the concentration of oxygen behind the eyelid is only one-third of the atmospheric concentration, less oxygen is available to diffuse through the lenses, and the corneal epithelium essentially suffocates, along with the lens possibly shrinking due to dehydration.

Either of two developments could solve this problem. First, increase the oxygen concentration under the eyelid during sleep. Second, make it easier for the oxygen available during sleep to diffuse through the contact lens.

Extended-wear lenses, a progression from soft contact lenses, facilitate oxygen diffusion through the lenses by simply containing more water and therefore more water pathways for oxygen molecules to take (to page 37)



The springs represent the HEMA polymer molecules and the rods depict a cross-linking polymer. Water molecules are found in the spaces between the polymers. Regular soft contact lenses have no cross-linking polymer (**A**). The greater separation of HEMA molecules in extended-wear lenses (**B**) creates larger and more water pathways which facilitate oxygen diffusion through the lens.

AIDS

Isolation is the first step towards prevention

Ruth Lininger

The Public Health Service has received reports of more than 4,000 cases of AIDS (acquired immune deficiency syndrome) and more than 1,700 deaths since the first diagnosed patient in May of 1981. The incidence of the disease seems to be doubling every six months, and if it continues to spread at this rate in the next several years, the country will be faced with a major epidemic. Since 1981, $75 million have been allocated by the Public Health Service for the study of AIDS, and for the next fiscal year the President has requested an additional $54 million. The National Institute of Health, the Center for Disease Control, and the Food and Drug Administration are the major institutions involved in this urgent scientific investigation.

AIDS is a very serious disease with an overall mortality rate approaching 100 percent. Nearly 40 percent of the patients have died within less than a year after the onset of the disease, and those with the disease longer than two years have a mortality rate of 90 percent. Essentially no one with the full manifestation of the syndrome has recovered. Although as yet there is no cure for AIDS, the agent responsible for the syndrome is now known. It is a variant of the human cancer virus, human T-cell leukemia/lymphoma virus, or HTLV III, and was discovered by Dr. Robert Gallo, Jr., and his research team at the National Cancer Institute, as reported in a series of four articles in the May 4 issue of *Science*. Montagnier's research group in Paris had simultaneously discovered a lymphadenopathy-associated virus, or LAV, which may prove to be the same virus as HTLV III.

This breakthrough has enabled several steps to be taken towards the immediate control of AIDS. A blood test to detect the virus has already been developed and is currently being patented. By the end of the year the test will be available nationwide, allowing blood banks to screen donar blood for the virus, preventing transmission of the disease to hemophiliacs and other transfusion recipients. This test also enables the diagnosis of suspected or at-risk AIDS or pre-AIDS (having lymphadenopathy, or a disorder of the lymph glands) patients so that they can be treated earlier, before the disease has progressed too far.

A vaccine against the HTLV III virus and AIDS is being developed and should be available for testing in three years, estimate Dr. Gallo and Assistant Secretary of Health Dr. Edward Brandt. For those patients who already have AIDS, at present they can only be helped by being treated for the symptoms they manifest. Ultimately, scientists hope to find a way to treat the disease itself, but further and more complete research on the virus and its behavior will be needed before a prospective cure can be realized.

AIDS renders the victim virtually helpless against overwhelming infection by invasive microorganisms and viruses and several rare forms of cancer considered harmless to the healthy person.

According to the Public Health Service, almost 90 percent of AIDS cases can be placed in specific groups: 71 percent are homosexual or bisexual men, 17 percent are intravenous drug abusers, and 1 percent are hemophiliacs. The rest of the cases include Haitians, persons engaged in heterosexual contact with a person with AIDS or an AIDS-related complex, persons receiving blood products, and infants of mothers with the disease or at risk for it.

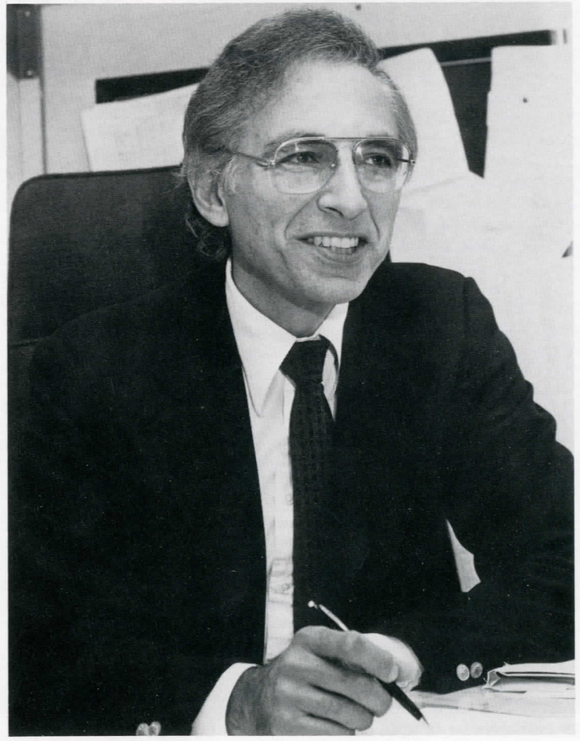
The disease itself is not considered highly infectious. The AIDS virus, which is now known to be carried in the blood and certain secretions such as semen, is primarlily transmitted through sexual contact or through contact with the blood of someone who has AIDS, as might occur by drug abusers sharing the same needle. AIDS does not spread through normal, everyday contact; surface secretions such as saliva, sweat and tears are not believed to transmit the virus. The precautions taken in treating an AIDS patient are like those taken for someone with the hepatitus B virus. As yet there have been no AIDS cases reported among health-care workers who have treated AIDS patients, and there have been no cases of AIDS being transmitted from a female to a male through sexual contact. But the disease is till new, though, and the incubation period may run anywhere from six months to four or five years.

The first AIDS patient was a 31-year old male admitted to a California medical center in January of 1981. He suffered from an unusual infection, candidiasis, and soon after developed a rare type of pneumonia caused by the organism *Pneumocystis cariini*, from which he subsequently died. Later, other young male patients in the Los Angeles area unexplainedly contracted this rare type of pneumonia and other unusual opportunistic infections. When at the New York University Medical Center several young homosexual men were admitted with unusual opportunistic infections and an aggressive form of Kaposi's sarcoma, a cancer of the cells of blood vessel walls before only seen in older Jewish or Italian men, doctors began to suspect an outbreak of a new disease.

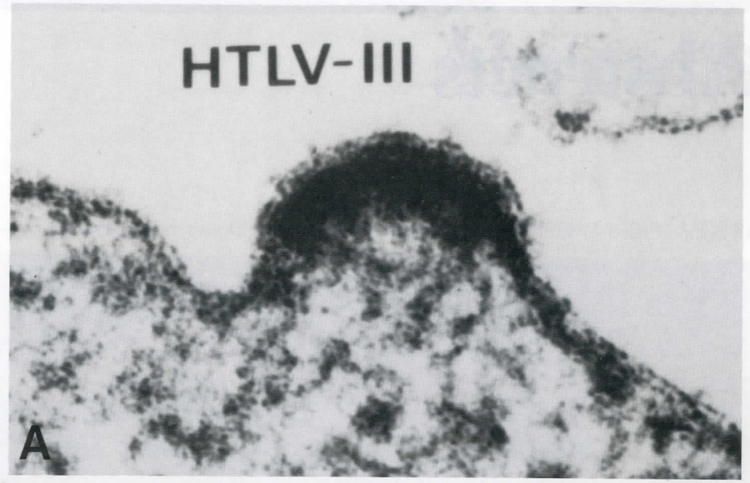
Although these types of diseases had previously been seen in cancer patients with a lowered immune response or in patients receiving immuno-suppressive drugs for organ transplants, the occurence of these diseases in formerly healthy young males was very odd. Soon it was discovered that both of these types of patients suffered from a severe deficiency in their cell-mediated immunity. How the disease was transmitted was not known, but it was obvious that most of the patients were either male homosexuals or IV drug abusers, implying that the agent was probably contagious and of viral origin.

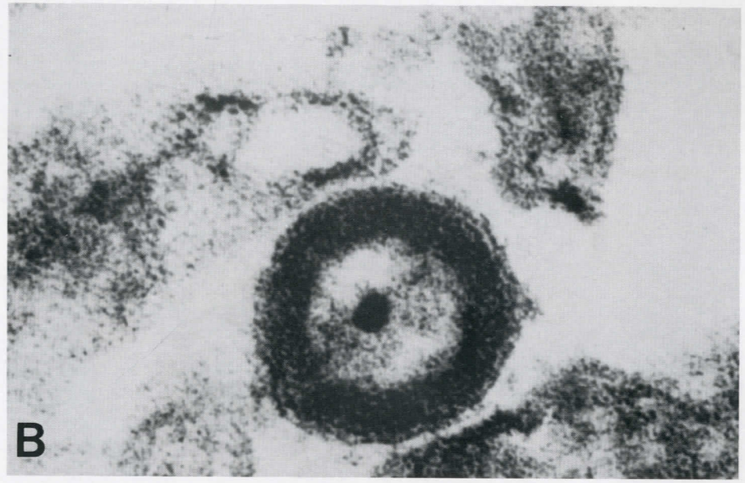
Before the discovery of the HTLV III virus, a patient with AIDS was defined as someone under 60 years of age who has either Kaposi's sarcoma or an atypical opportunistic infection with no other reason for an immune deficiancy. Now, diagnosis will also

(to page 34)



Dr. Robert C. Gallo and his research team at the National Cancer Institute successfully isolated the HTLV III virus cells responsible for AIDS.





Transmission electron micrographs of a thin-sectioned T-lymphocyte infected with the HTLV III virus. Virus particles are budding from the cell membrane in **A**. *Free particles have separated from the membrane in* **B** *and are shown sectioned in a different plane in* **C**. The dense cylindrical core is characteristic of the HTLV III virus.

Abstracts

An octopus used in learning and memory experiments at Duke's marine laboratory.

Learning

When presented with the task of discriminating tactilly and visually between two objects, the octopus is quite adept at learning a specific response and remembering it upon further testing. Using reinforcement techniques, they can easily be trained to distinguish rough from smooth or black from white. For example, if the animal accepts a rough, white ball presented on a string, it is rewarded with a shrimp. However, if it takes a smooth, white ball, it is given an electric shock. Eventually, the octopus learns to associate the rough or smooth character of the ball with the positive or negative stimulus.

During the 1983 fall semester at the Duke University Marine Laboratory, Jon Michels and I, under the direction of Dr. J.Z. Young and Dr. J.D. Robertson, conducted experiments testing the animals' abilities to perform simple and reverse preference discriminations and to retain this information. In addition, suggested correlations between tactile and visual learning and memory via second order conditioning and between abnormally high levels of lead and mental capacity were investigated.

The results obtained in these experiments show that the octopus is quite capable of learning and remembering simple and complex discriminations. In fact, an extraordinary example of the animals' capacity for memory was observed when a previously-trained animal disappeared for a week, returned, and upon testing showed a perfect score. The experiments also showed that the octopus does not seem to be capable of second order conditioning, in which the learned response to a stimulus of one sensory type (vision) is linked to a stimulus of a second sensory type (tactile). This suggests that there is probably not a transfer from visual to tactile memory. Finally, the research into the effects of lead on learning and memory were inconclusive, despite showing trends that abnormally high lead levels inhibit mental capacity.

Anne Allen

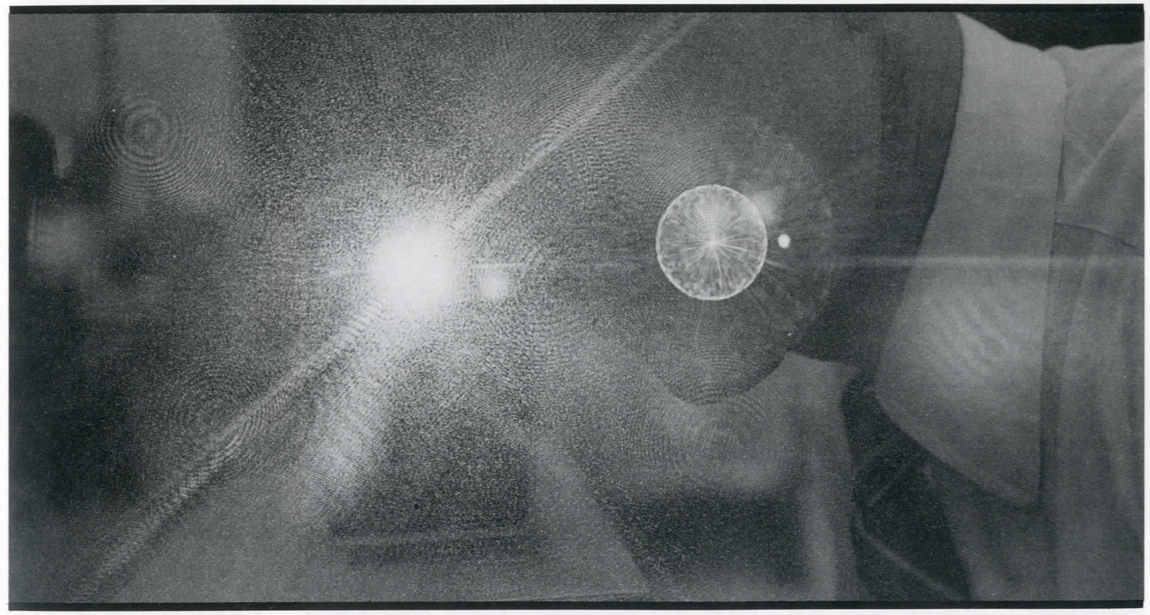
Abstracts

NMR

The product of the communications portion of this project is a software package entitled **APPLE NMR**. It is written in Apple Pascal for the Apple II computer and allows interactive control of a remote IBM NR-80 Fourier Transform Nuclear Magnetic Resonance spectrometer. **APPLE NMR** provides full use of the NMR spectrometer from a comparatively inexpensive microcomputer station, via telephone lines. Samples are delivered to the instrument location where an operator mounts them and relinquishes control of the spectrometer to the microcomputer station. The remote researcher can adjust parameters, acquire spectral data, view, plot, and save the spectrum— all without the necessity of a trip.

In a typical session, the user accesses the **APPLE NMR** program and dials up the NR-80 on the telephone. A high-pitched carrier signal indicates that a connection is made. Guided by the **APPLE NMR** menu format, the user enters a "chat" mode. Messages #re exchanged with the NR-80 operator by simply typing them in on the Apple keyboard and reading them off the screen. The user takes control of the NR-80, sets parameters, and takes a spectrum just as if he were sitting at the instrument itself. The user then receives the spectral data and displays it on the Apple monitor. He can shift the spectrum right or left and change the vertical or horizontal scaling as desired. The user then can obtain a hard copy of the final spectrum or save it on a disk.

Pamela Stevenson



Predation

In ponds without fish, the role of the gape-limited predator is often filled by salamanders. Thus, the study of the feeding habits of newts is integral to understanding how aquatic prey populations are regulated. This experiment was designed to study predation by *Notophthalmus viridescens dorsalis*, the broken-striped newt, on microcrustacea both in artificial lab conditions and in a natural pond. Particularly, it considered whether *Notophthalmus* feeds selectively or opportunistically. In addition, feeding differences and potential intraspecific competition for resources between larval and adult forms were analyzed.

The first part of the experiment consisted of an analysis of adult and larval food preferences, as measured in the laboratory. Then, comparisons were made between newt stomach contents and the actual water composition of a pond in the Sandhills of North Carolina, which is heavily populated by *Notophthalamus*.

It was demonstrated that *Notophthalmus* is a size-selective predator, choosing the largest accessible prey. Prey characteristics, such as velocity of escape from attack, can influence whether *Notophthalmus* actually gets the largest species. Other factors, such as eye size and pigmentation of prey, could affect size perception by the newts. Evidence suggested that adult and larval newts exhibit the same size-selective predation. However, the data were inadequate to demonstrate competition between the two aquatic life stages.

Kristina Sigmon

Abstracts

Malnourishment

In Costa Rica, protein-calorie malnutrition (**PCM**) is a significant contributor to the infant mortality rate. Though the severity of the problem lessened during the 1970's, there were still 22.1 out of every 1000 infant deaths directly attributable to **PCM** in 1979.

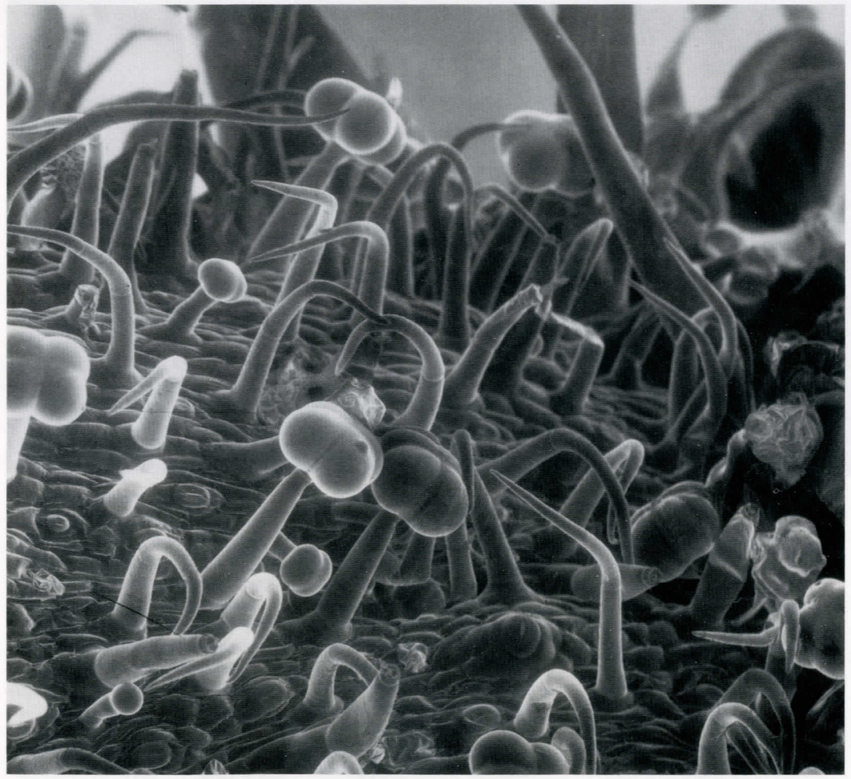
The cellular and biochemical changes that accompany **PCM** have been studied and include alteration of cellular division and migration; decrease in the content of cerebral lipids; decrease in the enzymatically catalyzed synthesis of myelin (an insulating coating around nerve cells); and a change in the distribution and quality of amino acids. Because these alterations are particularly significant for the growth of the central nervous system, and because the vital period for cerebral growth occurs between the thirtieth week of gestation and the end of the second year of life, the timing of **PCM** in a child's development is closely related to the level of psychomotor retardation observed.

To most effectively study **PCM**, it is necessary to investigate the role of environment and biological factors in infant malnutrition and their relation to psychomotor development. Infants less than two years old were identified at the Costa Rican Institute of Investigation and Teaching in Nutrition and Health (**INCIENSA**) and a descriptive study made on their psychomotor development and family situations. The children were evaluated using the *Curricular Guide for the Stimulation of the Integrated Development of the Child Under Six Years*. It was found that 91.7 percent of the children were retarded in the area of language ability. In each of the remaining areas of psychomotor development, including fine motor skills, heavy motor skills, cognitive development, and the ability to adjust to a new environment, 75 percent were retarded.

Interviews were conducted with the parents of each child, usually the mother, to investigate the socio-economic factors involved. Questions dealt with the parents themselves (age, employment, income, etc.), the family (structure, number of children, etc.), the home (sanitation, number of rooms, etc.), the health history of the child, and the number and types of toys available to the child.

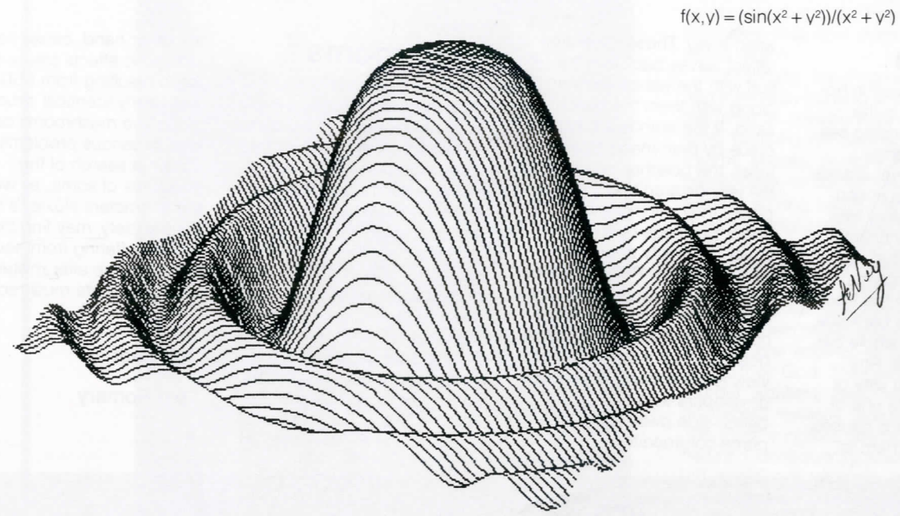
The data obtained showed a relationship between the socio-economic level of the family, the age of the mother, the amount of social contact of the child, and the level of psychomotor retardation. It was also found that the typical victim of infant **PCM** came from a large family, was not breast fed, had an unwed mother, and was under one year of age.

Katie Pitkin



A scanning electron micrograph of a tomatoe leat.

Abstracts



Scent-sitivity

Pheremones are chemical substances emitted by insects and mammals which communicate unlearned, reflexive behaviors. For example, pheremones exchanged between male and female mice will cause a male to court a female but aggress toward another male. In our experiment, we attempted to demonstrate the role of experience in the signal values of pheremones.

The experiment consisted of two phases, the first being the "acquisition phase" in which we sought to associate a neutral odor with increased or decreased aggression. One group of adult, male mice was exposed to stimulus males painted with the neutral odor as well as unpainted stimulus females. A second group was exposed to unpainted males and painted females. The experimental procedure involved introducing the male and female stimulus animals into the subjects' home cages for five minutes and three minutes, respectively, with a one minute inter-trial interval. Trials were divided into a series of ten second blocks, and any aggression occuring within a block was recorded.

In the "testing phase" we set out to determine whether or not an association between the neutral odor and aggressive behavior had been established. Two groups of prepubertal males, one painted with the odor and one unpainted, were introduced into the subjects' cages in such a way that each subject was exposed to both groups of stimulus animals. Aggression was recorded in a manner identical to that in the acquisition phase. In order to determine the persistence of the association, the testing procedure was carried out three times, twice in succession directly following acquisition and again, two weeks later.

We predicted that in the presence of the painted prepubertal males, the first group (exposed to painted adult males and unpainted females) would exhibit an increase in aggression as compared to an intermediate baseline level against unpainted prepubertals. Conversely, the second group (exposed to unpainted adult males and painted females) should show a generally decreased level of aggression toward the painted prepubertal males. Test one, which immediately followed the acquisition phase, graphically supported our prediction and provided statistically significant values of aggression. Test two showed a steady extinction of the acquired associations, and test three further confirmed that such associations learned through experience are short-lived. Thus, mice are capable of adjusting and readjusting their response to an environmental stimulus, given proper experience.

Sharon Brackelmanns
Wendy Koppel

Synopsis

Erosion

Many seaside vacation homes are ending up in the ocean, victims of a rising sea level and quick-fix engineering, as the barrier islands on which they are built continue on their migratory trek. Both beach and continental shelf studies show that high seas and powerful storms transport sand from the front of the islands to the backside, slowly pushing the whole barrier island over itself. Any structure, such as a jetty or seawall, built to hold one of these islands in place causes the beach around them to wash away. These structures reflect waves back into the surf,with the waves carrying along with them the beach's sand. If the islands are kept in place by man-made structures, the beaches erode. If the islands aren't kept in place, they will move out from under buildings built on them. Duke University deep-sea geologist Orrin Pilkey believes that the only solution is to concede to nature and move the cottages and resorts off of the beaches. Not surprisingly, this view is not popular among the developers who have found beach-side dwellings to be prime commodities.

'Shrooms

Soma, the heavily-used drug in Aldous Huxley's *Brave New World*, exists in nature as a Basidiomycete fungus. This class includes such toxic geni as the *Amanita* and *Psilocyte* mushrooms. While both of these mushroom types are similarly classified taxonomically, their effects on human beings when eaten differ drastically. The *Amanita* produce amino acids which bind to RNA molecules in liver cells. These amino acid toxins can cause death, sometimes after just one bite of the mushroom. The toxins of *P. mexicana*, on the other hand, cause hallucinogenic effects similar to those resulting from LSD use. The nearly identical structures of the two mushrooms can lead to serious problems. Those in search of the pleasures of soma, as were the characters Huxley's fictitious society, may find themselves suffering from acute liver damage after mistakenly eating *Amanita* mushrooms.

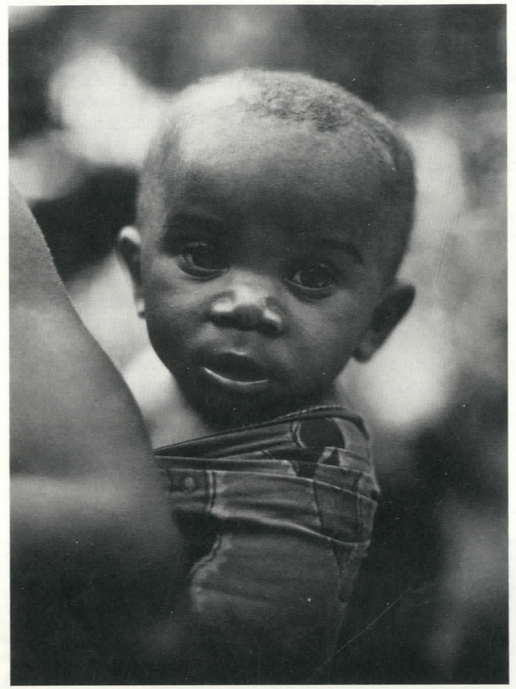
Jeff Baer

Tom Romary

John Fisher

Erosion along the Charlestown, Rhode Island coastline.

The people



(from page 19)

The Efe Pygmies of Zaire are Central Africa's oldest known surviving people. A full-grown male Pygmy will reach a height of four and one-half feet and a weight of about 85 lbs. Though their bodies are small, their brains and organs are proportionally larger than those of the average European. Large, widespread eyes, an abundance of body hair, and a variety of skin and hair coloring characterize these people. Overall, though, the complexion of the Pygmies is noticeably lighter than that of the Bantu and Sudanese tribesmen that now dominate the Central Africa region.

Traditionally, the Pygmies are nomadic and survive by hunting and gathering. They live in small communities of about 60 persons. Befitting the communal nature of the Pygmy society, hunters bring all of their game back to camp where it is divided equally among camp members. The Pygmies are strictly monogamous and the concept of divorce is completely unknown. Also, the decision of whom a Pygmy will marry is left to the individual.

The Pygmies are an intensely religious people. Their beliefs regulate their relationships to one another, to their forest home, and to their God. Their moral code is strict; murder, adultery, blasphemy, sorcery and disrespect towards elders are forbidden. The Pygmy culture stresses harmony with nature. Consequently, wasting food, polluting water, setting traps, cutting tall trees, and the needless killing of animals are prohibited. Since the Pygmies practice the lifestyle which they espouse, their society essentially lacks war, murder, rape, crime and greed.

VERTICES

The Duke University / Triangle Area Science Magazine

The existence of AIDS brings up the question of whether a loss of natural immunity allows cancer to occur.

(from page 27)
include seropositivity for the virus.

Dr. Robert Gallo, Chief of the Laboratory for Tumor Cell Biology in the National Cancer Institute's Division of Cancer Treatment and scientific director of the AIDS task force, together with his research team isolated viruses from the helper T-cells of more than 50 patients with AIDS or pre-AIDS. They found that more than 90 percent of the AIDS and pre-AIDS patients who were tested had high levels of the virus, indicating infection. The healthy people who were not in a high risk category had either low levels or no indication at all of antibody to the virus.

The breakthrough by Gallo's team was described in four articles in the May 4 issue if *Science*. They describe 1) the ability to isolate the HTLV III virus from infected individuals, 2) the development of a way to grow large amounts of the virus in T-cells in the laboratory, 3) biochemical and immunological characterization of viral proteins and genes, and 4) the detection of viral antibodies in blood samples from infected individuals.

Gallo's lab, collaborating with other clinicians and scientists from various centers of research, including Duke, isolated the viruses by first finding human T-lymphocytes that grew well in cell culture and were easily infected by the virus. Once it was possible to grow the virus, then the viral proteins, such as from the viral envelope, could be isolated and studied and used to test blood samples for the presence of HTLV III antibody. The effectiveness of the antibody in preventing infection by the HTLV III virus will determine whether a vaccine will be useful.

The HTLV III virus of AIDS is a retrovirus which suppresses cellular immunity by interacting with the OKT4 receptor-bearing helper T-cell, conberting the helper phenotype to a suppressor phenotype. This causes an increase in the suppressor T-cell population, and therefore a response of immune suppression.

"There is no absolute, defined way to treat the underlying disease process yet. What is treated is the patient's symptoms," said Dr. John Perfect of Duke's AIDS clinic. Drugs that are used to treat Kaposi's sarcoma are the natural immune products alpha and gamma interferon and interleukin 2, as well as other anti-cancer agents. To treat other infections, standard antibiotics are administered, but at much higher doses than those prescribed for normal patients. Patients have varying responses to treatment, suggesting some genetic as well as environmental factors are involved in determining who contracts the disease.

The nature of AIDS brings up the question of whether it is the loss of natural immunity which allows cancer to occur. With a disabled T-cell population, cancer viruses can establish and proliferate. Viruses such as EBV (Epstein Barr virus) infect B-lymphocytes causing their unchecked multiplication and result in the development of lymphomaa, and CMV (cytomegalo virus) is associated with Kaposi's sarcoma and causes cancerous endothelial cell growth. Also, under a deficient immune surveillance system, any transformed cancer cells stationed in the body but formerly held in check would be released and allowed to multiply wildly.

A relevant question is whether AIDS victims who have Kaposi's sarcoma or lymphoma have a greater likelihood of having cancer in other organs. As tragic as AIDS is for the patient, it does provide a model for investigating the effect of a depleted cellular immunity on the body.

AIDS has had an impact on many aspects of society. It has prompted many psychosocial controversies, especially over the issues of sexual preferences and practices. As Secretary of Health Margaret Heckler said, "This awesome medical problem was 'a disease with two names.' One was 'AIDS.' The other was 'Fear.'" Public education and recent understanding have greatly diminished the prevalence of fear, but much still needs to be learned before AIDS can be conquered. Further research in both the basic and applied sciences will be necessary to elucidate the etiology of the virus and solve the problem of effective diagnosis, treatment and prevention.

Photographs graciously provided by Dr. Gallo and his associates at the National Cancer Institute, the National Institute of Health.

AIDS

Duke's AIDS clinic opened in the spring of 1983 to serve the growing number of people in the area worried about having AIDS. The clinic, which received patient referrals from all over the state, offers a variety of services, providing information, treatment, and medical follow-ups as needed.

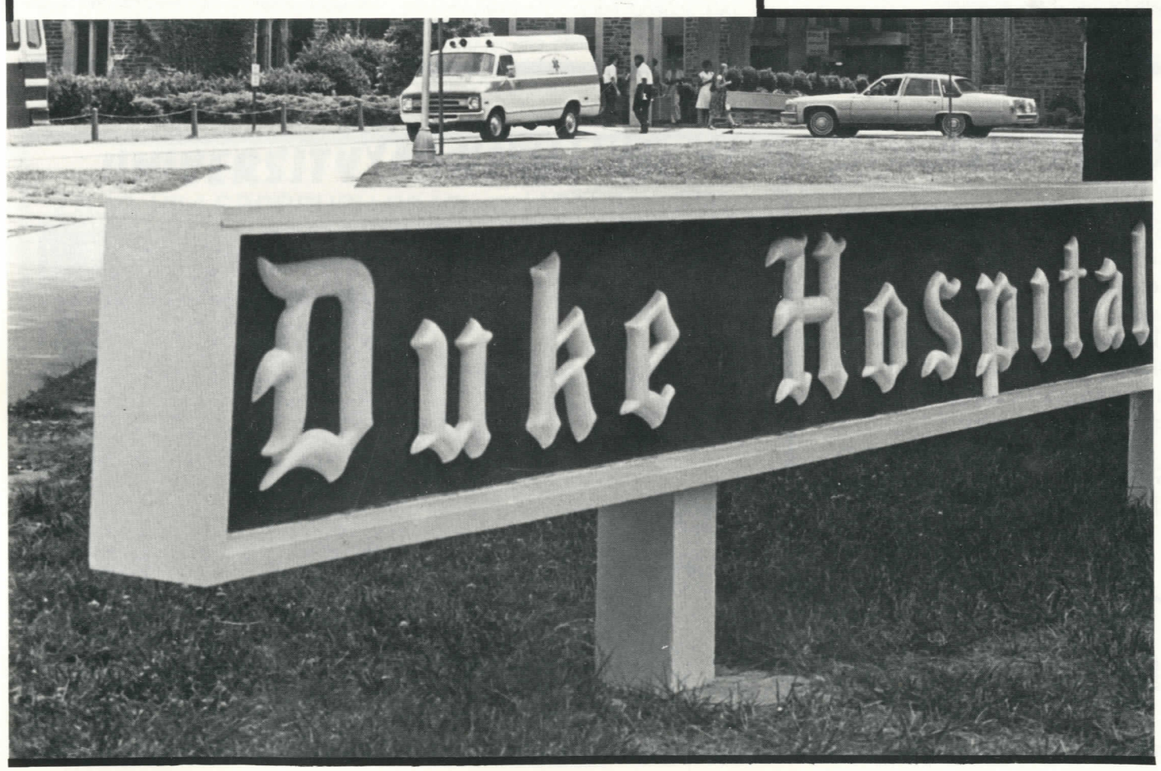
The clinic is held on Tuesdays, and when private patients who either have AIDS or and AIDS-related complex, or fear they are at high risk for developing AIDS can see one of the three attending physicians. A variety of patients with a variety of problems have been treated, but only about 20 of the many patients seen so far have actually been diagnosed as having AIDS.

Prior to the opening of the clinic, AIDS patients were treated in the Division of Infectious Disease, headed by Dr. David T. Durack. Durack, who became director of the AIDS clinic, has had an active interest in AIDS since 1981 when it was first diagnosed in the United States. He wrote one of the first articles discussing AIDS, published as an editorial in the December, 1981 issue of the *New England Journal of Medicine*.

Duke tries to keep abreast of the latest research and treatments discovered at other institutions. Doctors in the AIDS clinic are themselves also personally involved in researching better treatments of the infections associated with AIDS. Dr. John Perfect, for example, is involved in research relevant to antifungal therapy.

The clinic is not free; there is no governmental support for the treatment of AIDS at Duke. Secretary for the clinic, Olive Sherman, said that although the aptient must pay for the services, the expenditure is usually covered by insurance.

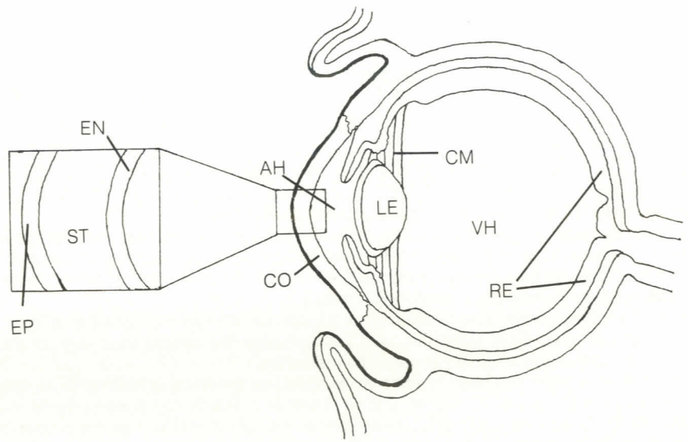
While no grant support has been specifically allocated for the study of AIDS at Duke, the research of Dukes Dr. Barton F. Haynes and Dr. Thomas J. Palker has contributed to the discovery by Dr. Gallo's team at the National Cancer Institute of HTLV III as the probable agent causing AIDS. There are also many other interested doctors who have invested their time in understanding AIDS, such as Dr. Dani Bolognesi and Dr. Joseph Vogel, professor of pathology at Duke, who has contributed an article in a recent volume on AIDS based on the 1983 AIDS symposium at the New York University Medical Center.



Optia

Before reaching the light and color-sensitive cells of the retina, light passes through the cornea, aqueous humor, lens, vitreous humor, and nerve fibers of the eye. The lens serves to refract light rays so that inside the eye, ideally on the retinal surface, the rays meet at a focus. The thickness of the lens is controlled by ciliary muscles so that both nearby and faraway objects can be brought into focus; the closer the object, the thicker and more curved the lens must be in order to refract the light rays to a focus on the retina.

Nearsightedness, the inability to bring distant objects into focus, results when the focus of the light rays falls in front of the retina; the lens is too thick and/or too curved and over-refracts the light rays. Concave lenses, whether spectacles or contact lenses, compensate for the eye's over-refraction, producing "normal" vision. Conversely, farsightedness results when the focus is behind the retina. The lens under-refracts, and convex lenses compensate for the under-refraction.



(AH, aqueous humor; CM, ciliary muscle; CO, cornea; EN, corneal endothelium; EP, corneal epithelium; LE, lens; RE, retina; ST, corneal stroma; VH, vitreous humor)

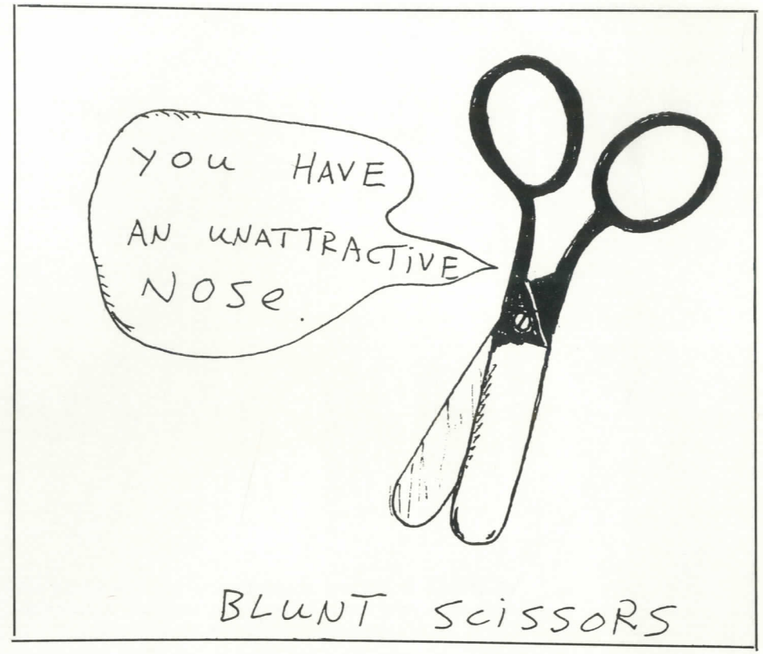
(from page 25)

from one side of the lens to the other. These lenses are usually made of a co-polymer, combining HEMA from regular soft lenses with some other polymer.

Whereas the HEMA molecules are connected to each other in conventional soft lenses, HEMA molecular chains in extended-wear lenses are joined through crosslinking with a second polymer. Because of the increased separation of the HEMA chains by the crosslinker, the space available for water molecules is increased. For this reason, the extended-wear lenses contain 70-80 percent water, as opposed to regular soft lenses with 30-40 percent. This additional water allows enough oxygen to diffuse through the lenses to the corneal epithelium to allow the wearer to sleep with the lenses in place. Ideally, the extended-wear lenses need to be removed only to be cleaned, from bi-weekly to bi-monthly.

The potentially most dangerous aspect of extended-wear lenses stems from their most valued attribute, that of staying on the eye for long periods of time. Warmth, oxygen, and protein food create prime conditions for bacterial growth behind the lenses.

Due to their respective water contents, extended-wear lenses are structurally weaker than regular soft lenses and are less resilient to being cleaned. While soft lenses usually last two years, the extended-wear lenses may only last 8 to 12 months. Dr. Peter Holyk, who has conducted clinical trials of Permalens[R] extended-wear lenses at the McPherson Hospital (Durham, NC), predicts "The marketing is moving to throw-away lenses. Instead of occassionally taking the lenses out to clean them, after one or two months of wearing them you would simply throw away the old pair and put in new ones."



Although the contact lenses are only a temporary panacea, not permanently correcting the problem of over- or under-refraction, the alternative surgical methods are still in the experimental stages. Since our society seems to shun the four-eyes image, and more and more compatable lenses are evolving, contact lenses will probably continue to enhance sight for a growing percentage of the population.

From the shadows of the ivory towers

VERTICES is entirely student–produced. If you're pleased with what we do, please show your support. Send your tax-deductible contribution to *VERTICES, The Office of Student Activities, Duke University, Durham, North Carolina 27706.*

Supporter $15

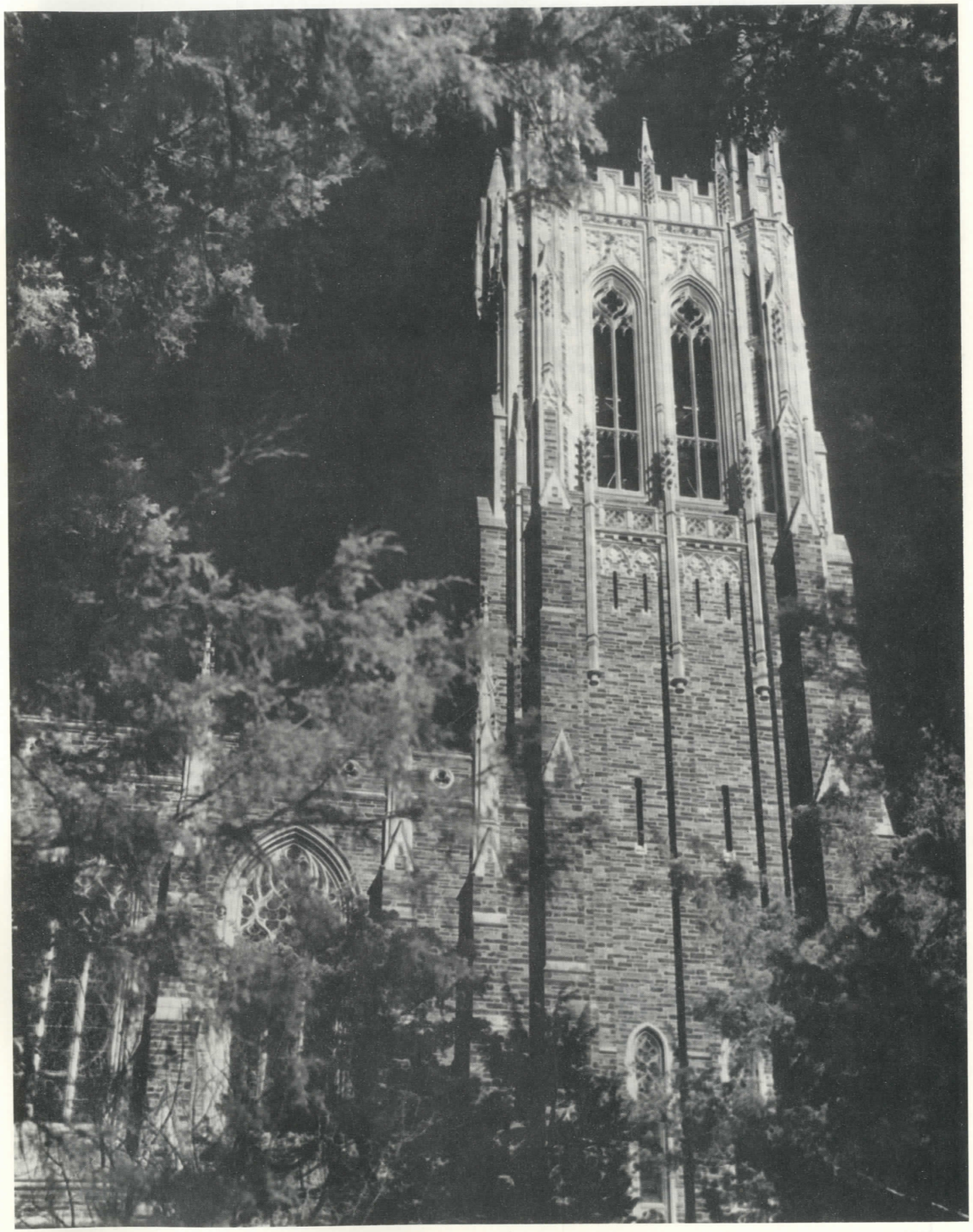
Charter Member $50

Sponsor $25

Other _____

VERTICES

The Duke University/Triangle Science Magazine



Infra-red photograph of the Duke Chapel at night.

The nightmare of automating a small business has just ended.

Say goodby **to endless hours of installation.** The Profit Center is faster to install than even the most basic of accounting programs, and it actually includes worksheets for easy conversion from manual systems.

No more **documentation that reads like ancient Tibetan.** The Profit Center's simple and sensible documentation is being hailed as the "most easy to use" of any accounting software. It even explains accounting procedures as it answers your questions about computing.

Gone **are gruelling days of "learning" the system.** The Profit Center speaks a language the most inexperienced computer user understands: English. And, because all our modules are fully integrated, once you learn how to operate one program, you can operate them all.

Farewell **to wasted hours of entering data.** The Profit Center lets you share common data with only a few keystrokes! Plus, you can start with a floppy disk system and move to hard disk with *no* conversions or delays. From 1 to 10,000 employees, from zero to a billion dollars per transaction, The Profit Center is designed to help even the smallest business think big.

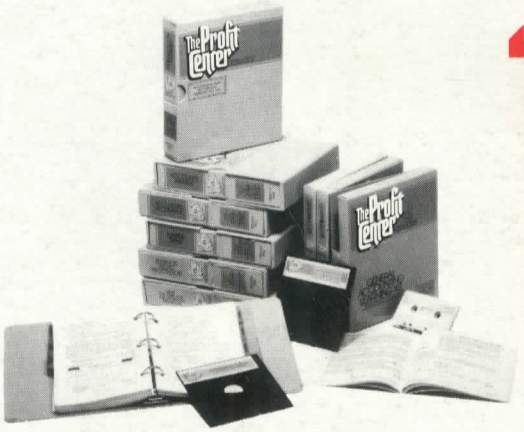
Good riddance **to systems that demand pre-printed forms or specific printers.** The Profit Center allows you to conduct business as usual, only faster and more efficiently. You can customize checks to look just like the ones you wrote by hand. And you can have your choice of *any* printer!

Adios **to software publishers with unlisted numbers.** The Profit Center guarantees you support for as long as you need it* with special toll-free numbers manned by both software *and* accounting specialists. And The Profit Center is the *only* Accounting Software that's backed by over 70 years of accounting publishing expertise.

And no more irate CPAs!
The Profit Center was designed, reviewed, and tested by accountants together to make their job easier... your business more organized.

Ask your computer salesperson to help you compare The Profit Center to *any* other Accounting Software. *No* other accounting system gives you *all* these features in *one* general accounting package!

- Provides 30-60-90 day aging for accounts receivable-customers.
- Custom formats and prints checks and statements to employees, vendors, and customers.
- Automatically calculates FICA and FIT.
- Generates more than 20 financial management reports.
- Through comprehensive audit trails, traces *any* transaction back to its original statement and operator.
- Immediate posting after transaction for up-to-date financial statements.
- Extensive on-line help.
- Only *one* program disk needed.



The Profit Center

Now available:
MASTER MENU
GENERAL ACCOUNTING
ACCOUNTS RECEIVABLE
ACCOUNTS PAYABLE
BUSINESS WORD PROCESSOR
NEAT: The Time and Information Manager

*Free for 90 days, extended warranty available thereafter.

Available for the IBM PC, XT, and Compatibles, TI Professional computer and Wang PC.

For pre-purchase technical information (from Orchid Software) call 512-328-1130

THE NEW STANDARD IN ACCOUNTING SOFTWARE FROM PRENTICE-HALL

COME FOR A *FREE* DEMONSTRATION AT DUKE UNIVERSITY BOOKSTORE.
Weds., October 3rd, 10-12, 1-3, or 6-8, and Thursday, October 4th, 10-12 or 1-3.
Duke University Bookstore, Bryan Center, Science Drive, Durham, North Carolina 27706.
Telephone: 919-684-6793.