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Michael R. Gross

David K. Vaughan

Marisue Pickering

Richard A. Hale

James F. Philip

See next page for additional authors

Authors

Michael R. Gross, David K. Vaughan, Marisue Pickering, Richard A. Hale, James F. Philip, Richard Jagels, and Detmar Schnitker

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EXPLORATIONS

A JOURNAL OF RESEARCH
AT THE UNIVERSITY OF MAINE

Cover: *Debouche*, a thermo-formed acrylic sculpture, by Deborah de Moulpied, Associate Professor of Art at the University of Maine, (from the collection of Barbara Heldt and Gerald Smith, Oxford, England); photograph by Dale and Nedra Van Volkinburg.

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IN 10,000 YEARS THE NEED FOR FOOD HASN'T CHANGED. TOOLS HAVE.

BIOTECHNOLOGY

by Michael R. Gross

Biotechnology, a new focus for science in the last half of this century, has been called *the new alchemy* based on the laws of nature. The lead-into-gold myth of the dark ages may actually be close to the reality of today's science which takes inefficient biological processes and turns them into extremely productive forces for man.

We survive by consuming the edible portions of plants and animals. Our homes and clothes are composed, at least in part, of biologically derived material. In the course of time, human ingenuity has gradually worked to improve these organisms, selecting the best and most useful from the wild, breeding the best with the best to create more desirable combinations of traits.

Scientists with the Maine Agricultural Experiment Station are working to take the happenstance out of plant and animal growth, beginning at the smallest possible point, inside the cell, and directing its progress to improve man's life on this planet. But it's taken over a century of research to get to this edge of a new scientific revolution.

Biotechnology is not new. The human animal has for centuries used what nature provided. Slowly humans began to study the systems which became known as biology and the linkages among some of the smallest units of matter in the science called chemistry, and they've now coined a word which expresses the manipulation of processes and procedures which have been evolving for thousands of years.

In the very early 1900s, English biologist Alexander Flemming found a mold had destroyed a bacteria he'd been growing, but he didn't know how such an event could take place. It wasn't until others began to progress seriously from his beginnings that the technology would be created to make the drug penicillin generally available during World War II.

Was that biotechnology? Most would agree that in its rudimentary form the creation of the drug was an act of biotech. The research takes years before it produces a tangible result, and in the case of biotechnology, there are many different meanings attached to the word.

The Office of Technology Assessment of the U.S. Department of Agriculture sees biotechnology as *any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants or animals, or to develop microorganisms for specific uses.*

The most rapid progress in what is now considered biotechnology began with the explosion of scientific knowledge that occurred late in World War II and has not stopped. In the laboratory, scientists began to look at the activity of microorganisms. With breakthroughs in equipment that would allow exploration deeper and deeper inside the cell, and advances in biochemistry that allowed the extraction of chemicals from the cell, scientists began to impose changes on the chemical processes. At first these were very simple, primarily based on the concept of fermentation of useful bacteria in *factories* that now produce such products as vinegar, vitamins, even the preservative and flavor enhancer monosodium glutamate.

But medicine was benefiting as well. The idea that some chemical process was at work as one organism, such as a fungus, killed off another, such as a bacterium, lead to the identification of antibiotics. Further development of

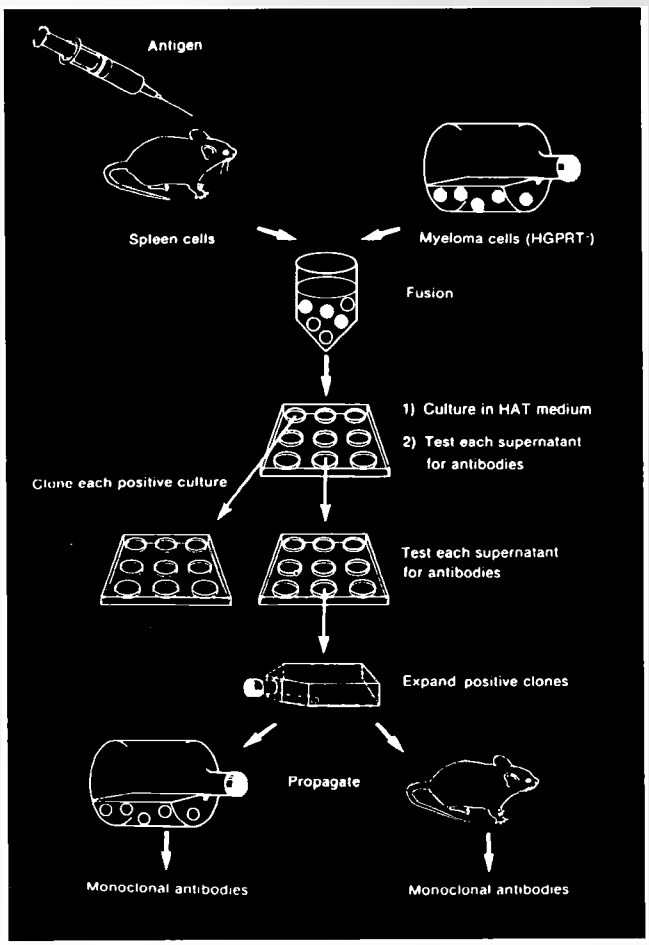
Michael R. Gross is Communication Specialist for the Maine Agricultural Experiment Station, and in that capacity, he works to explain the role Experiment Station scientists play improving food and fiber crops for Maine people. He is experienced in the communications field and works with University faculty, members of the media, and other communications professionals to make the public more aware of the significant work being done at Maine's Land-Grant institution.

laboratory techniques made it possible to mass-produce these antibiotics to help an animal's immune system fight off invading bacteria.

But what of an animal's ability to, by itself, fight off invading organisms? Cesar Milstein, Nobel Prize winning researcher, explains, *When a foreign substance, (an antigen), enters the body of a vertebrate animal or is injected into it, one aspect of the immune response is the secretion by plasma cells of antibodies: immunoglobin molecules with combining sites that recognize the shape of particular (points) on the surface of the foreign substance, or antigen, and bind to them. . . conventional antiserums (groups of chemicals in the blood which, together, fight off the antigen) contain mixtures of antibodies, and the mixtures vary from animal to animal*, he continues writing about the development of one of the most exciting new tools in biotechnology today, the monoclonal antibody.

These antiserums were *polyclonal* in that they were mixtures of many, many different cells, each secreting antibodies. If a way could be found to isolate each antibody producing cell, and clone it, a long-term source of the antibody could be created, and that antibody would be like no other. It would be *monoclonal*, from a single, specific cell.

The high quality and availability of fish disease identification in the microbiology laboratories at the University of Maine have prompted entrepreneurs to open commercial salmon and trout hatcheries in Maine. Here a technician removes kidney cells for disease analysis.



Producing monoclonal antibodies step by step.

The most dramatic change in this area of microbiology occurred when a laboratory technique was perfected that could manufacture pure antibodies, *monoclonal antibodies*, antibodies that would react to only one, or only one part of an invading organism.

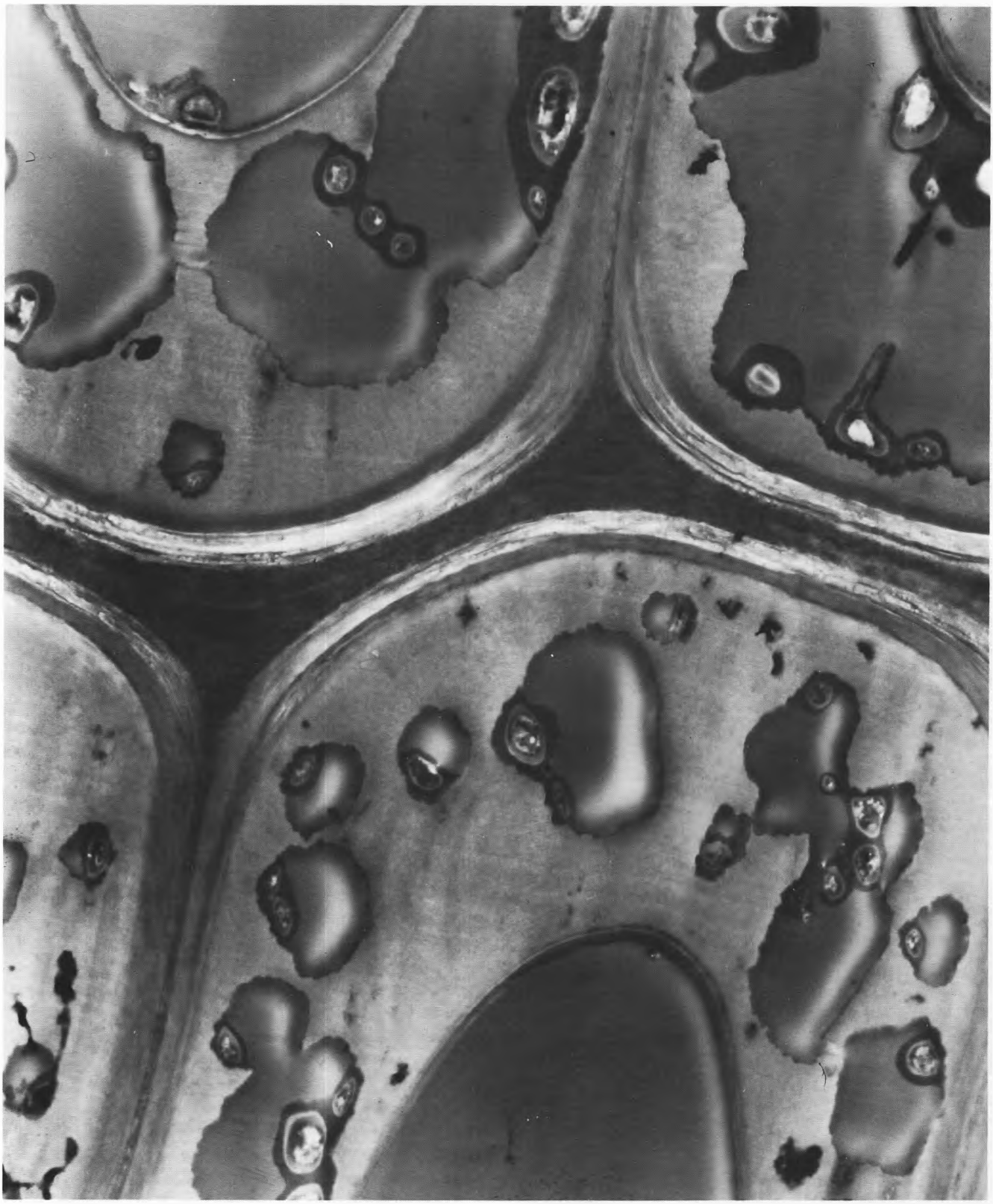
Bruce Nicholson, Chairman of Microbiology at the University of Maine explains: *The breakthrough came when scientists were able to isolate an antibody and identify exactly which part of an antigen it was fighting against. Once identified, this part of the antibody could be separated out, made monoclonal, and reproduced in large numbers for a variety of purposes.*

Nicholson's research has used the monoclonal antibody to identify quickly and accurately specific viruses in fish. His work, along with specialist Paul Reno's, is expected some day to allow the production of a diagnostic test which could tell aquaculturists which agents are infecting their stocks and make treatment simple and effective.

A monoclonal antibody is reproduced in large numbers by fusing the antibody producing cell with a tumor cell. The use of these special cells, hybridomas, in research isn't limited to animals and fish.

Using the same biotechnology, University of Maine scientists Barry S. Goodell, a wood scientist, and Jody Jellison, a forest biologist, hope to understand the chemical processes which deteriorate wood. Ultimately their research may produce a quick test to use when checking on how wooden structures have withstood exposure to the elements.

Structural wooden members, exposed to environmental conditions that promote the attack by decay fungi, may fail in service, often with serious consequence. In the United States, biodeterioration in homes alone causes at least two-billion dollars worth of damage each year, explains Goodell.



The cell walls of wood shown here are riddled with soft-rot decay fungi which secrete enzymes which in turn destroy the structural integrity of the wood. Maine scientists are working to develop monoclonal antibodies which will detect the presence of the fungi in time to stop the decay process.

According to Goodell, up to 70 percent of the strength in wood may be lost in early decay stages where micro- and macroscopic changes cannot be detected using current methods.

Understanding the wood decay process also has a flip side in that the enzymes which decay fungi use to destroy homes, utility poles, and other wood products could also be used for man's purposes in a beneficial way. One example is the breakdown of wood to produce pulp and paper products.

Work in Goodell's and Jellison's laboratory is now underway using monoclonal antibody technology to isolate some of the key wood decay enzymes that would work in this process and to develop methods to use these enzymes in a commercial process. Biologically *pulping* wood to produce paper and other products would be an environmentally cleaner and less expensive process than that currently in use, according to Goodell.

In a related, although separate project, research going on in Goodell's lab is expected to produce treatment methods that can be aimed exactly at the invading fungi and at trees which are extremely difficult to treat with preservative, including spruce. Industry is extremely interested in this research and its resulting impact on wood preservative treatment methods.

Central Maine Power Company imports hundreds of trees into Maine to be used as utility poles. If Goodell's work can identify the biodeterioration processes in a common Maine tree, spruce, and come up with an effective preservative method, those costly imports could be stopped and a tree common to this state utilized for utility poles.

The monoclonal antibody is just one aspect of biotechnology which uses or manipulates a process of nature. In this case it's one which deals with cellular processes.

In another area of biotech, microbes themselves are put to work for man. At its most simplistic level, fermentation is one example of this aspect of biotechnology.

Researcher John Singer would like to see microbes go to work cleaning up the environment. His study of Microbial Detoxification of Chlorinated Hydrocarbons may someday

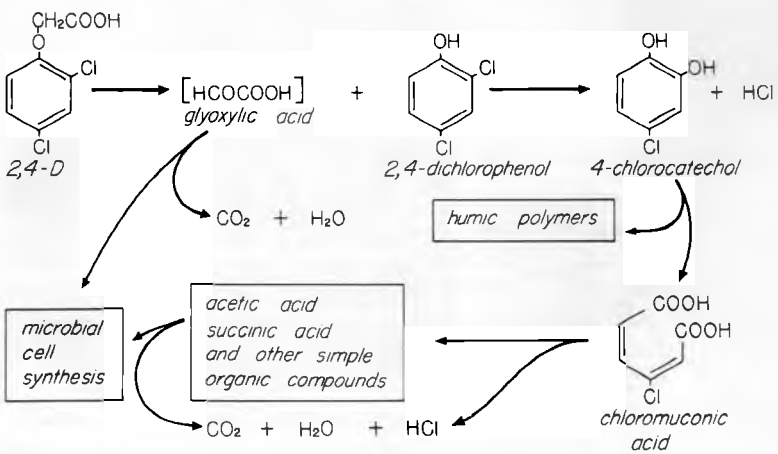
Microbe magic is commonly performed by Pseudomonas as they break down various hydrocarbons. The hero here is of the Putida variety, and while his photograph taken through an electron microscope makes him look like a peanut, he is actually very busy degrading the herbicide 2-4-D.

lead to soil treatments for land which has become tainted by some types of pesticides.

Already pesticides *2-4-5-D* and *2-4-5-T* have been reduced to harmless minerals by a biological agent which Singer believes can, in the future, be even more effectively genetically engineered to help tainted land.

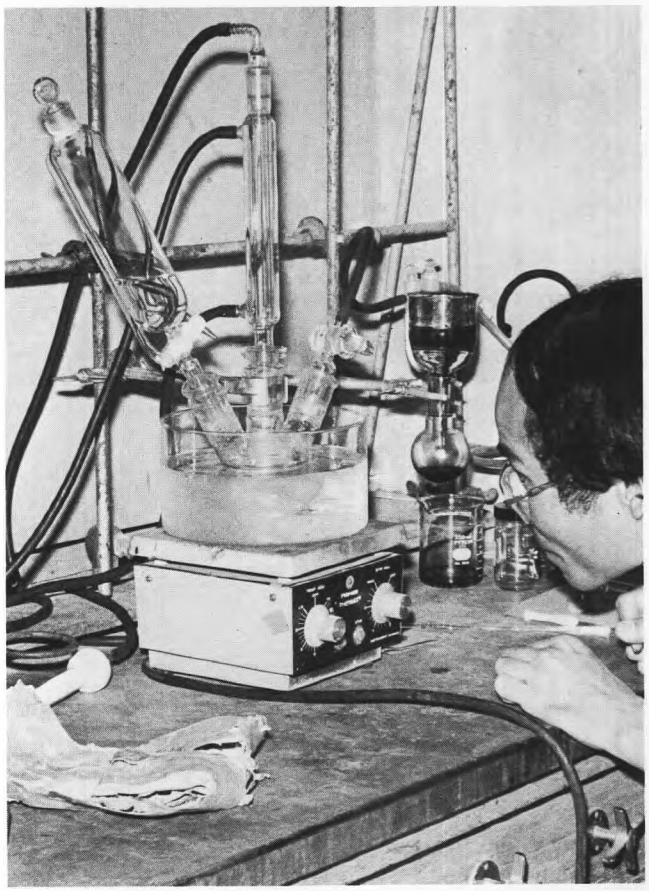
The concept of creating conditions in or on plants which would make them unappetizing to pests is being worked on by the UMaine team of researchers in Entomology, Botany, and Food Sciences. They, along with counterparts in Plant Pathology and Biochemistry, are part of a coordinated program of Integrated Pest Management which brings together all aspects of scientific study to effect a change in the way we deal with agricultural pests.

The concept of *Integrated Pest Management* with biological agents is at the core of Maine scientist Richard Storch's attack on the Colorado Potato Beetle. Storch is looking for a strain of *Bt*, a biological insecticide, which acts directly on the beetles, and at a plant fungus which wouldn't affect the potato



The results of the microbe magic are simple organic compounds as shown in this diagram of the chemical breakdown of the common herbicide 2-4-D.

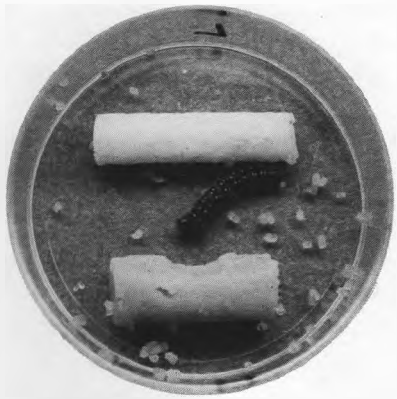
itself but would make the plant unsuitable for the potato beetle to feed on. Biological agents have been effectively used against insect infestations. *Bt* is a bacterium which can be made to affect only a specific insect and no other. It's credited with helping to stem the spruce budworm attack on Maine woods, and may be effective in ridding areas of pesky blackflies without damaging other organisms.



Common birchbark, of which there is an abundance in the State of Maine, has a newly discovered and exciting property: it contains an effective antifeedant. Maine scientists are analyzing and isolating the antifeedant component of the bark.

There are other naturally occurring agents which inhibit crop damage by insect pests. These are called *antifeedants*. The chemical components of birch bark and citrus seeds are under intense study as possible sources of natural pesticides by A. Randall Alford of the Department of Entomology and Michael Bentley of the Department of Chemistry of UMaine.

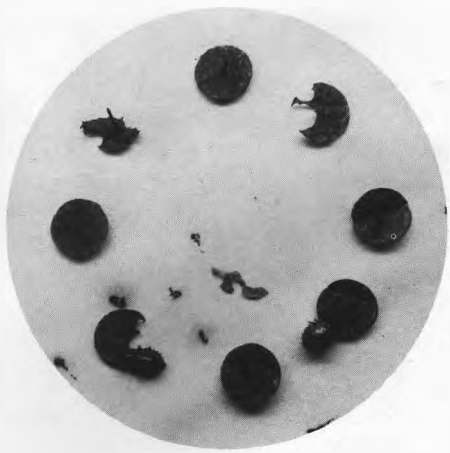
Some potato plants create their own barriers to pests and disease. Food scientists Al and Rod Bushway are investigating how potato plants produce *glycoalkoloids* which seem to protect the plants from the ravages of insect pests and may hinder the development of potato viruses. Insects and disease significantly reduce the yield of cultivated potato crops.



The spruce budworm in this petri dish has chosen to eat an untreated food source while avoiding the food option which contains an experimental chemical compound. Records are maintained documenting the amounts of each food source eaten by the budworm.

Some organisms need to be modified to be more useful to man. In case of the potato, it may be a change in its genes which will make the most difference.

Since the discovery in 1953 of DNA's complex structure, the double-helix shaped grouping of nucleotides that controls the organic functions of life, man has been working to manipulate that structure and create more useful plant and animal life.



Antifeedants are just what they sound like: substances which make a usual dietary component unpalatable. When the dietary component is a substance of importance to human consumption or utilization, and when the substance is competed for by insects, antifeedants can turn off insects' appetites and conserve the substance for human use. As shown in this photo of a petri dish and two Colorado potato beetles, when given a choice, the Colorado potato beetle larvae avoid leaf disks which have been treated with an antifeedant. The well-eaten disks are untreated controls.

In the case of the potato, Maine Plant Pathologist Stylianos Tavantzis believes a single gene in the DNA code of a wild potato gives that plant immunity to Potato Virus X. Once identified, if that gene were implanted in cultivated potato stock, its resistance to the virus could eliminate the need for chemical spraying to control the spread of the plant virus. Tavantzis is taking part of his research to West Germany this year as he assists colleagues at the Max-Planck-Institute in Koln.

Using this technique, the creation of recombinant DNA, UMaine Biochemist Robert Roxby hopes someday to manipulate the genes of cultivated potatoes so that tuber size, nutritional properties, density, resistance to pathogens and other properties of their tubers can be controlled.

Roxby and his associates are working to identify and characterize the genes of the potato plant so that they can understand each gene's function.

Once done, moving those genes around in the DNA code could result in plants that have potatoes shaped the way industry could use them most effectively. As an example, the french fry industry would prefer potatoes which are long and slender rather than round and fat. The cucumber shaped potato would be easily fed through french fry cutting machines. But that's only one possible application of this new biotechnology.

Genetic studies are underway in a number of areas as Maine scientists work to understand the reproductive processes of animals as well as plants.

One of the biggest mysteries is the metabolic change that takes place in trees as they mature. In most other plants, exact clones of those plants can be achieved through a process called tissue culturing. For mature trees, that process does not work, and researcher Michael Greenwood wants to know why, and more specifically, how it is affected by tree growth.

By looking at the genetics of conifer trees Greenwood, along with Biochemist Keith Hutchison, hope to discover what is controlling the maturation process.

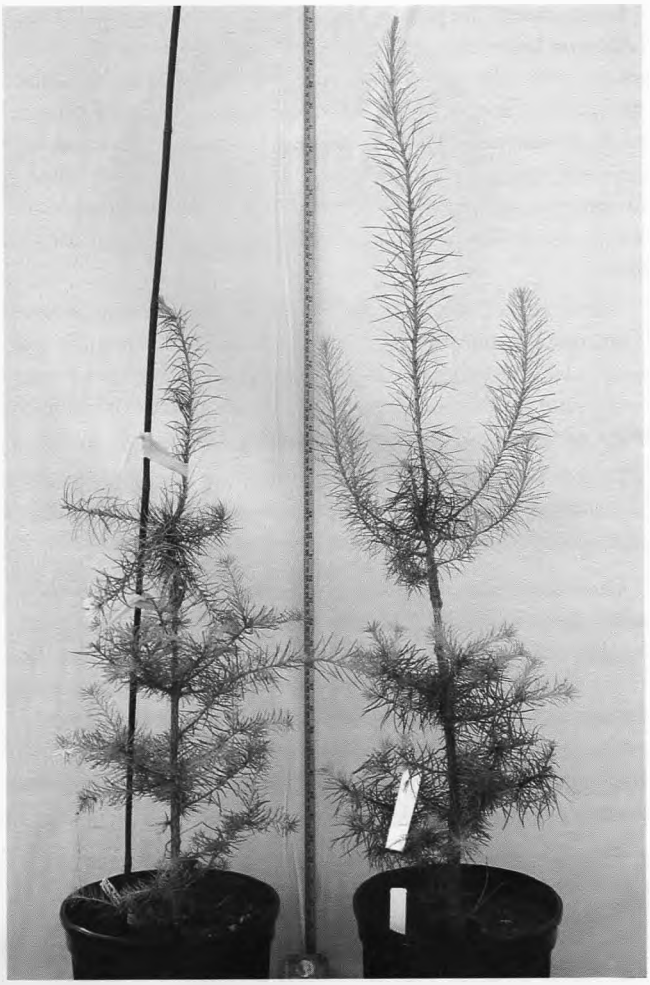
According to Michael Greenwood, understanding the metabolic and possible genetic changes that take place in the cell of mature conifer trees is the key to unlocking that cell for future manipulation.

We first want to be able to clone mature, selected, trees. At this point traditional breeding programs can graft from quick growing stock, but our inability to replicate a specific superior tree just by grafting has hampered the advancement of forest biology, he explains.

Through the recombinant DNA process, these *super trees* grown from single cells could be given the ability to resist disease or to grow in difficult environments. But that's assuming scientists can understand or bypass the mysteries of tree cell reproduction and maturation which appears unlike that of non-woody plants.

Laboratory harvest of seed culture is the initial step in mycoplasma antigen preparation, key to the development of a diagnostic test for chickens suspected of having mycoplasma gallisepticum or mycoplasma synoviae.

Expressive tuber genes are under constant experimentation in UMaine labs. Of high commercial interest and value to the french fry industry is the proximity to growing a cucumber-shaped potato which will make cutting and processing fast and simple.



Cloning mature, selected trees by tissue culturing poses an elusive problem: for some reason a metabolic change occurs via the genetic code as trees age. As this photo shows, the graft of the mature tree is poor, while the young tree graft is healthy and vigorous.

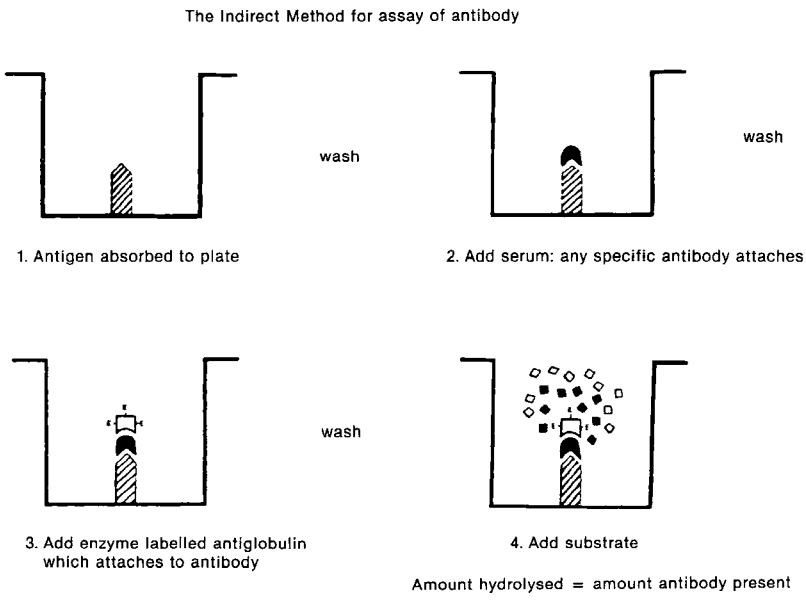
Such genetic engineering of trees is a long way off, but according to Philip Leder, a leading geneticist at the Harvard Medical School, *It is impossible for us to say with confidence that something reasonable cannot be done using this technology. In nearly all cases it's just a question of time and the financial commitments to support research.*

Using some of the new technology, University of Maine Poultry Pathologist Michael H. Opitz developed a diagnostic test for chickens suspected of being infected with two common diseases, *Mycoplasma gallisepticum* and *M. Synoviae.* This diagnostic test is now commercially available to the poultry industry.

All of this work, and there is more, centers around the Maine Agricultural Experiment Station's mission to conduct research that will benefit Maine and her people: so charged more than 100 years ago by Federal and State directive.

A direct benefit to Maine people is research by Food Scientist Rod Bushway which has made it possible to measure the amounts of alpha- and beta-carotene in fruits and vegetables. Beta-carotene has been shown to restrict the human body's ability to create cancer cells, and eating a significant amount of it may reduce one's risk of developing the disease. This results directly from the scientist's use of these new biotechnological tools in agriculture. In years past, as recently as 1970, these breakthroughs would not have been possible. Research was still conducted primarily through grafting of plants, traditional animal breeding techniques, and the search for more effective chemical control of insects.

As we approach the end of this century, the potential for the elimination of disease, the production of rapidly growing food and fiber crops with a natural resistance to pests and disease, the manipulation of reproductive biology to eliminate genetic defects, or tests for their existence much earlier in embryo development, becomes a greater and greater reality.



Schematic drawing of the test principle of the indirect ELISA: indirect method for assay of an antibody. The tests are used extensively in Opitz's research on chicken diseases.

This is not without consequences and concern. Careful study of all aspects of biotechnological research is underway at both Federal and State levels. Peer review is an ongoing practice at the Maine Agricultural Experiment Station in Orono, and guidelines are in place to control the extent to which researchers bring new organisms and processes into the environment.

These new tools in agriculture seem far away from the farm.

In the last century the scientist was out in the field, examining crops for indications of change. Today most are in the laboratory, but this is not to challenge the traditional role of farming.

Dr. Wallace C. Dunham, Director of the Maine Agricultural Experiment Station and Dean of the College of Life Sciences and Agriculture at the University of Maine, recently told a Canadian audience, *Every assessment of agricultural biotechnology should return to a system-wide view. Training molecular genetics rather than traditional plant breeders may speed the development of advanced breeding lines, but these crop strains cannot be perfected, tested, and delivered to the farmer without plant breeders. The new farming systems which we create with new biotechnologies must evolve from our existing system.*

That existing system has been under study since 1865 at the Maine Agricultural Experiment Station, and it looks ahead to a future that is being shaped by the new tools of biotechnology.

THE SEARCH FOR TOM SWIFT OR,
SOME REFLECTIONS ON ONE OF AMERICA'S BEST-KNOWN CULTURAL HEROES

by David K. Vaughan

Few people in America have not heard of Tom Swift, so it may seem an unlikely proposition to suggest that a good deal of valuable information could be gained in the process of searching for him. What, a skeptical reader might ask, brings about the need to look for Tom Swift? The travels of Tom Swift and of his successor, Tom Swift, Jr., have been chronicled only too well; books describing the numerous adventures of these two imaginary heroes of American culture have been found in abundance upon the shelves of bookstores every year since the first decade of this century. What information is lacking? How much more do we need to know? And why?

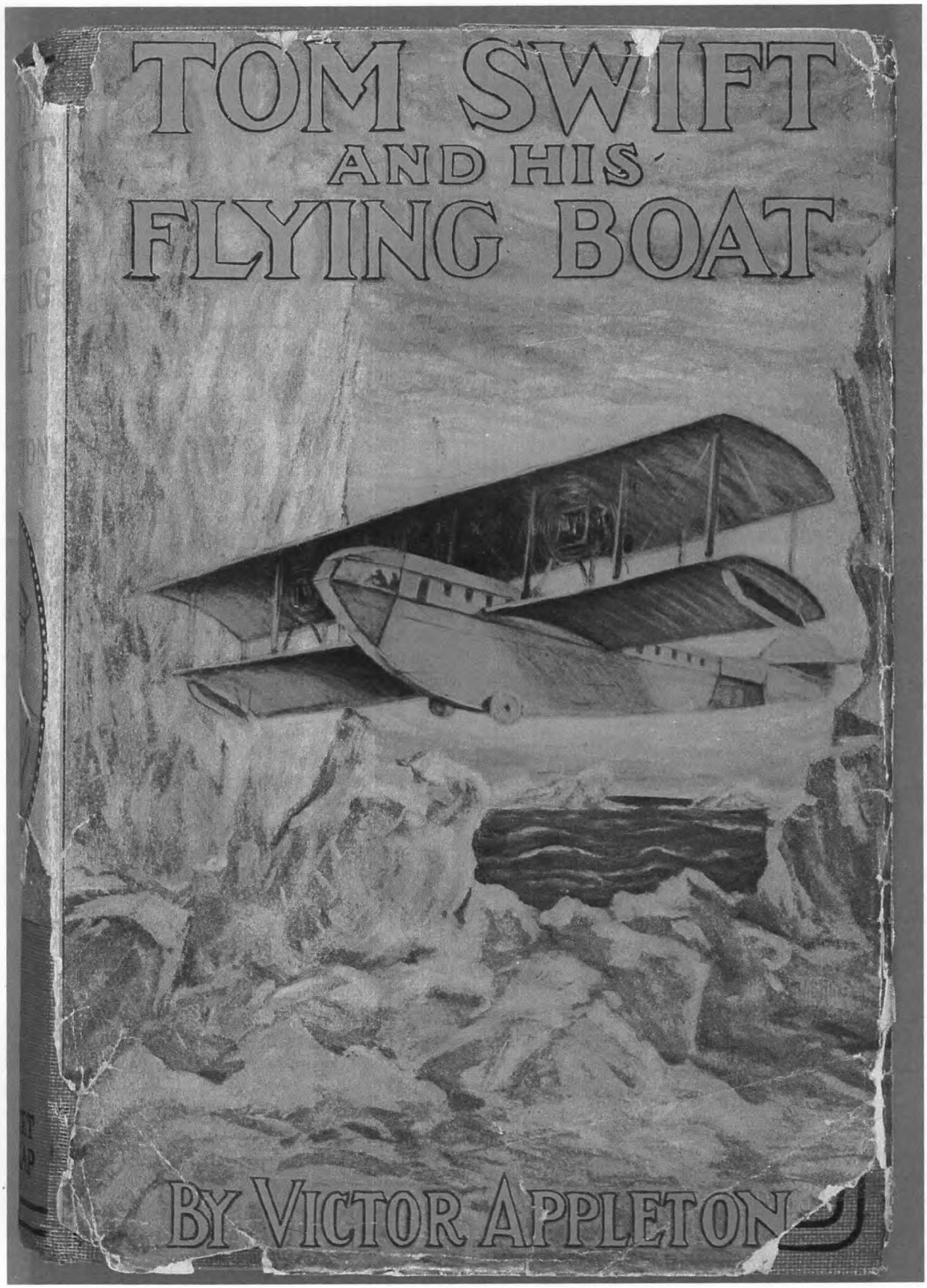
Well, no, as a matter of fact, Tom Swift is not really missing. He can be found pretty much where he has always been. Books describing his various adventures are on numerous bookshelves, and his experiences still live in the minds of thousands, perhaps millions, of readers. But while we might know what he has *done*, we know less about his impact upon our society. *The search for Tom Swift constitutes an attempt to understand the social and technological values contained in one of the most important of the many juvenile series books published in America in the last hundred years.* Tom Swift is only one of the better-known of the series book characters of this period; other well-known boys' book heroes include the Rover Boys, the Hardy Boys, Hal Keen, Rick Brant, the Motorboat Boys, Ted Scott, and Dave Dawson. Girls' book heroines include Nancy Drew, Judy Bolton, Cherry Ames, Vicki Barr, and the Outdoor Girls. Other popular series book figures include the Bobbsey Twins, the Lone Ranger, and the X Bar X Boys. And while every one of these series book characters become involved in mystery and adventure, these books can also tell us a good deal about American cultural and social values. *For all of these series books both mold and reflect the American perspective, and in attempting to discover the value systems that these books contain, we can gain a better understanding of the ideals and attitudes that these books interpreted and transmitted to succeeding generations.* Seen in this light, these books become much more than artifacts on the bookshelf; they become valuable expressions of the American experience.

But a number of obstacles hinder our exploration. First, there is the problem of availability of texts. Juvenile series books have seldom been considered as serious literature; it was an unusual library which allocated space and resources to series books. Series books were viewed with profound suspicion by most librarians and educators. As a result, those who wish to do research in this field today must find their own copies of these books, usually on back shelves of secondhand bookstores. This can be a time-consuming task and it can become an enjoyable one, even bordering on an addiction. But it can require the passage of a good deal of time before an entire set is assembled. Recently a number of university libraries have initiated steps to acquire series book collections to aid scholarly research; the university libraries at Minnesota and South Florida deserve mention in this regard. Once the problem of gathering the texts is solved, problems of authorship and publication history arise.

Literary researchers want to learn as much as possible about the authors, for it has often been shown that conditions affecting the author at the time a book was written can shed light on the themes and ideas found in the book. Once again, however, the Tom Swift books present a problem. Most readers probably remember that the author of the Tom Swift books was someone named Victor Appleton. However, there is no person named Victor Appleton; at least, no one by that name wrote the Tom Swift books, for Victor Appleton was a *house name* of the Edward Stratemeyer Syndicate.

Edward Stratemeyer was an industrious and inventive writer of juvenile series books in the last half of the nineteenth century and the first part of the twentieth century. He wrote hundreds of books in his lifetime, many of which were published with his real name listed as author. But he also published many books under pseudonyms so that he could continue writing books at a rapid rate and not have to worry over public concern about whether or not such a prodigious turnout would have an adverse effect on the quality of the style or the predictability of the plot. Some of Stratemeyer's pseudonyms were Arthur W. Winfield, Clarence Young, and Captain Ralph Bonehill.

David K. Vaughan, Assistant Professor of English at the University of Maine, received his Ph.D. from the University of Washington. His specialties include technical writing, literature and technology, and juvenile series books.


TOM SWIFT
AND HIS
FLYING BOAT
BY VICTOR APPLETON

But Stratemeyer soon realized that book production could be further increased in the burgeoning series book market of the early twentieth century if he introduced a series of house pseudonyms, *house names*, and contracted with individual writers, often unkindly referred to in the business as *hacks*, to produce series books on contract. Thus Stratemeyer developed a system in which individual writers were tasked to develop a series book according to the plot outlines supplied by the Stratemeyer Syndicate. The writers might write as few a two or as many as twenty books, depending on the interest of the writer and the success of the series. Some of the better-known writers who wrote for the Syndicate include the Canadian writer, Leslie McFarlane, who wrote most of the early Hardy Boys books, and all of the prolific Garis family, Howard, Lillian, Cleo and Roger. Howard Garis was the author of the popular Uncle Wiggily series. But we know these people wrote for the Syndicate largely because they came forward to tell us so. Other Syndicate writers have been much less forthcoming.

Many of the names of the authors of some of the other well-known series books are in fact also Stratemeyer *house names*. For example, Laura Lee Hope, the ostensible author of the Bobbsey Twins books, does not exist; most Bobbsey Twins books were written by the Garis family. Roy Rockwood, author of the Bomba series and other books, does not exist. Nor does Franklin W. Dixon, supposed author of the Hardy Boys and Ted Scott books. Nor does Carolyn Keene, whose name is found on the Nancy Drew books. To be sure, some authors were, and are, real people. Margaret Sutton, author of the Judy Bolton books, is still active in the field, as is Hal Goodwin, real author of the Rick Brant series (John Blaine was his pseudonym). Helen Wells, primary author of the Cherry Ames and Vicki Barr series, died suddenly last year. But until one sorts out true identities from false, the problem of authorship is a confusing issue.

To return to Tom Swift, Victor Appleton was not a real person (nor is Victor Appleton, Jr., author of the Tom Swift, Jr., series). There is a good deal of evidence to suggest that the original author of the Tom Swift series was Howard Garis. As Jack Dizer, perhaps the foremost Tom Swift expert in America, says, *It is common knowledge that Garis was actively involved with the Tom Swift series until Stratemeyer's death [in 1930]. How much of the writing was actually the work of Garis is not clear (Tom Swift & Company, 61).* We are not likely to discover the real authorship of the Tom Swift (and other series) volumes until such time as we can obtain access to the Stratemeyer Syndicate files, which in the past have been carefully guarded.

There were 38 titles in the original Tom Swift series. The first title, *Tom Swift and his Motor Cycle*, appeared in 1910; the last title in the series, *Tom Swift and his Planet Stone*, appeared in 1935. As was typical in a Stratemeyer series, a large number of books were published early in the life of the series. These books, known as *breeders*, were intended to generate reader interest in the books and to establish a ready-made audience for succeeding books. The first five Tom Swift titles appeared in 1910; five more appeared in 1911; four appeared in 1912. After 1912 one Tom Swift book appeared every year until 1935, when the series effectively ended. Two Big Little Tom Swift books were published in 1939 and 1941, but these are not normally considered part of the Tom Swift series. The Tom Swift, Jr., series did not begin until 1954.

The Swift household initially consisted of Tom, his widowed father, Barton Swift, an industrious and gifted inventor, and their housekeeper, Mrs. Baggert. According to the account given in *Tom Swift and his Motor Cycle*, the first book in the series, *Mr. Swift and his son lived in a handsome house on the outskirts of the village of Shopton, in New York State. The village was near a large body of water, which I shall call Lake Carlopa, and there Tom and his father used to spend many days boating, for Tom and the inventor were better chums than many boys are, and they were often seen together in a craft rowing about, or fishing.*

Later Tom is described as having a *natural love for machinery, and it hurt him almost as much to see a piece of fine apparatus abused as it did to see an animal mistreated.* Tom and his father share an interest in mechanical things and are continually working on new and unusual inventions. Tom graduated from the local school with honors, but instead of going on to college, decided to continue his education at home under the tutelage of his father. Tom's best friend is Ned Newton, who works for a bank in a nearby town. Tom also has a romantic interest, Mary Nestor, but inventions come before romance in Tom's view of the world, and as a result more than nineteen years pass before Tom and Mary are married (in *Tom Swift and the House on Wheels*, published in 1929).

Another series character is Mr. Wakefield Damon, an eccentric but enthusiastic elderly gentleman who often provides Tom with reasons for setting out on his adventures, and who often accompanies him on them. One of the stalwarts of the Swift group is an aging black man by the name of Eradicate Andrew Jackson Abraham Lincoln Sampson, or *Rad* for short. Readers today would object to the portrayal of Eradicate Sampson, for he is described as poor and uneducated, and speaks in the stereotypical slang of the period, referring to Tom as *Massa Tom*. But Eradicate is nobody's fool, and he is often instrumental in helping Tom out of some dangerous situations. The Swift household is eventually enlarged with the presence of Koku, a giant South American native, whom Tom rescues in the course of his adventures in the area of the Amazon River (*Tom Swift in Captivity*, 1912). Another lesser-known associate of the Swift enterprise is an aged engineer named Garret Jackson, who helps to maintain the various pieces of machinery that are necessary for producing components of the inventions with which the Swifts, father and son, are continually occupied.

Tom's first adventures occur in the immediate vicinity of the Swift residence in Shopton, and reveal Tom's ability to solve relatively small-scale mechanical problems and mysteries simultaneously. His initial mechanical im-

provements are limited to motorcycles and motorboats, for instance. But once he becomes involved in airships and airplanes, the scope of his adventures enlarges significantly, as he travels around the world to test his inventions, solve crimes, or aid his friends. The airship is introduced in the third book in the series, when Tom helps a balloonist named John Sharp perfect his airship, a controllable balloon with wings and motor. With this wonderful device Tom and his fellow travelers are able to visit more distant locations, like Pennsylvania and North Carolina. Soon, however, they are traveling to far-off Uruguay, Brazil, Russia, and the polar regions. As each year passes, Tom and his friends construct more sophisticated flying machines which enable them to undertake more challenging adventures. Usually their new flying machines reflect the latest technological developments of the period.

Just as Tom's inventions are linked to the latest technological developments, so are Tom's adventures linked to the latest scientific or political happenings. When airships are employed in the exploration of the polar areas, Tom and his friends head north in an airship (*Tom Swift in the Caves of Ice*, 1911). When America becomes involved in World War I, Tom turns his energies towards military activities (*Tom Swift and his War Tank*, 1918; *Tom Swift and his Air Scout*, 1919). Usually, however, Tom's interest is captured by the possibilities resulting from scientific and technological advances. For instance, at about the time the first moving pictures were developed, the following Tom Swift book appeared: *Tom Swift and his Wizard Camera; or The Perils of Moving Picture Taking* (1912). Then, when sound was added, this title was published: *Tom Swift and his Talking Pictures; or The Greatest Invention on Record* (1928).

Although it is not very clear just how Tom's more exotic inventions function, it is clear that Tom is a handy and resourceful person when it is necessary to fix things that are broken. The books regularly describe the appropriate methods for adjusting carburetors or spark plugs, and there are many accounts of how specific types of machines work or how energy or motion is transmitted. In addition to his mechanical abilities, Tom displays the traditional American values of honesty and hard work. Any reward that Tom receives is directly attributable to his personal efforts and technological know-how. The criminal activity with which he comes in contact is usually the work of envious competitors who are unhappy that they cannot match the inventive genius of Tom and his father. More often than not, these crimes consist of attempts to steal the plans of the latest inventions or efforts to sabotage whatever mode of conveyance Tom and his friends are using at the moment. Although Tom naturally prefers to use his mental capacities to solve his problems, he does not hesitate to resort to physical action, especially when he is confronted by his most frequent nemesis, Andy Foger, a spoiled and selfish youth of Tom's age.

In general, the Tom Swift books reflected the latest scientific and technical developments, of which there were many in the early years of the series. Edward Stratemeyer seems to have modeled Tom after a number of scientists and engineers of the day, including Alexander Graham Bell, Thomas Edison, and Glenn Curtiss, for each title typically heralded a recent invention and the subtitle indicated the activity in which it was involved in the story. Here, for instance, are two typical titles: *Tom Swift and his Electric Runabout; or, The Speediest Car on the Road* (1910); *Tom Swift and his Electric Locomotive; or, Two Miles a Minute on the Rails* (1922). Although no particular individual served as the exclusive model for Tom's adventures, one individual in particular deserves special recognition: the aviation pioneer, Glenn Curtiss. Curtiss was pretty clearly the model for the first three books and for at least three of the later books.

Jack Dizer has convincingly shown that Tom's origin is too much like that of Curtiss to be coincidental: like Curtiss, Tom came from central New York State; the lake near which Tom lives, Lake Carlopa, is too much like the lake near Curtiss' home, Lake Keuka; even the pronunciation is similar. And like Tom, Glenn Curtiss built a motorcycle, a motor boat, an airship, an air racer, a flying boat, and a house on wheels.

The Tom Swift books mark almost exactly the span of time in which American interest in technological development and scientific exploration was at its greatest.

These inventions are featured in three titles published in 1910, one in 1911 and the titles which appeared in 1923 and 1929. The events described in the third volume of the series, *Tom Swift and his Airship*, closely resemble events that occurred in Hammondsport in the summer of 1907, when Curtiss helped Captain Thomas Baldwin develop a powered, controllable airship. Baldwin is strikingly similar to balloonist John Sharp of *Tom Swift and his Airship*. The work of Curtiss undoubtedly caught the eye of Edward Stratemeyer because Curtiss' success story was exactly the kind of success story Stratemeyer liked to write about in his series books. But Curtiss was only one of a large number of industrious and successful inventors, scientists, and engineers who were working in America in the first three decades of the twentieth century.

The idea of the engineer or scientist serving as a model for a juvenile series was really a new idea in series books in the early 1900s. Previous series heroes were patterned after explorers, outdoorsmen, or commercially-successful individuals; the latter model could be found in any Horatio Alger novel. But it was not until a number of truly unusual technical and scientific achievements occurred that the notion of a boy inventor or boy engineer began to be developed. The development of electricity and the development of the gasoline engine led to the creation of the automobile, the airship, and the

aeroplane (as it was called in those days), and these machines made possible (at least in theory and in imagination) spectacularly rapid travel to parts of the globe little seen before. These technical achievements and these new means of transportation provided tremendously exicting possibilities in the minds of the public and in the plots of series story writers. It is interesting to note that Richard Byrd's flight over the North and South Poles in an aircraft in the 1920s generated as much, if not more, interest than the original treks by foot and dog sled several years earlier.

The Tom Swift books mark almost exactly the span of time in which American interest in technological development and scientific exploration was its greatest level. The commercial development of the airplane by the Wright Brothers in 1909 can serve as the starting point of this technological era, and the onset of World War II marks its end. The war of 1939-1945 serves as the end point to this era not because technological development declined, but because the onset of the war marked the beginning of the modern period, in which optimism in technological development and scientific discovery was replaced by increasing doubt about the value of those discoveries and developments, and fears over the uses to which those discoveries and developments would be put. *From 1909 to 1939 American faith in technology was at its highest level, and from 1910 to 1935 Tom Swift helped us to appreciate the impact and potential, if not the scientific truths, of that technology.*

It is interesting to note that the Stratemeyer Syndicate tried to revive Tom Swift from 1954 to 1971, in the person of Tom Swift, Jr., but the 33 books published during that eighteen year period never seemed to have the same impact on the minds of American youth that the original Tom Swift books had. Titles like *Tom Swift, Jr., and his Diving Seacopter*, or *Tom Swift, Jr., and his Triphibian Atomicar* show that the technology of Tom Swift, Jr., was the technology of the future, not of the present. Tom Swift, Jr., represented an escape into the future, not a celebration of the present.

Edward Stratemeyer might be surprised to learn that the series he initiated in 1910 would lead to these kinds of speculations and assessments. He might even argue that his works were being misinterpreted. But Tom Swift exists in his own right, regardless of Stratemeyer's intentions, and he speaks truths his originator may never have thought of. And *the more we can learn about Tom Swift and his fictional compatriots, the more truths we may be able to discover about the world that made us and the world we are making.*

FOR FURTHER READING: The most complete discussion of the Tom Swift books is found in John T. Dizer's *Tom Swift & Company* (McFarland, 1982). Three periodicals which are devoted to Tom Swift and other series are *Dime Novel Roundup*, Edward T. LeBlanc, editor, 87 School St., Fall River, MA 02720; *Yellowback Library*, Gil O'Gara, editor, 811 Boulder Ave., Des Moines, IA 50315; and *Mystery and Adventure Series Review*, Fred Woodworth, editor, P.O. Box 3488, Tucson, AZ 85722.

The Complete List of the Tom Swift books (all published by Grosset and Dunlap):

1. Tom Swift and his Motor Cycle (1910)
2. Tom Swift and his Motor Boat (1910)
3. Tom Swift and his Airship (1910)
4. Tom Swift and his Submarine Boat (1910)
5. Tom Swift and his Electric Runabout (1910)
6. Tom Swift and his Wireless Message (1911)
7. Tom Swift among the Diamond Makers (1911)
8. Tom Swift in the Caves of Ice (1911)
9. Tom Swift and his Sky Racer (1911)
10. Tom Swift and his Electric Rifle (1911)
11. Tom Swift in the City of Gold (1912)
12. Tom Swift and his Air Glider (1912)
13. Tom Swift in Captivity (1912)
14. Tom Swift and his Wizard Camera (1912)
15. Tom Swift and his Great Searchlight (1912)
16. Tom Swift and his Giant Cannon (1913)
17. Tom Swift and his Photo Telephone (1914)
18. Tom Swift and his Aerial Warship (1915)
19. Tom Swift and his Big Tunnel (1916)
20. Tom Swift in the Land of Wonders (1917)
21. Tom Swift and his War Tank (1918)
22. Tom Swift and his Air Scout (1919)
23. Tom Swift and his Undersea Search (1920)
24. Tom Swift among the Fire Fighters (1921)
25. Tom Swift and his Electric Locomotive (1922)
26. Tom Swift and his Flying Boat (1923)
27. Tom Swift and his Great Oil Gushers (1924)
28. Tom Swift and his Chest of Secrets (1925)
29. Tom Swift and his Airline Express (1926)
30. Tom Swift Circling the Globe (1927)
31. Tom Swift and his Talking Pictures (1928)
32. Tom Swift and his House on Wheels (1929)
33. Tom Swift and his Big Dirigible (1930)
34. Tom Swift and his Sky Train (1931)
35. Tom Swift and his Giant Magnet (1932)
36. Tom Swift and his Television Detector (1933)
37. Tom Swift and his Ocean Airport (1934)
38. Tom Swift and his Planet Stone (1935)

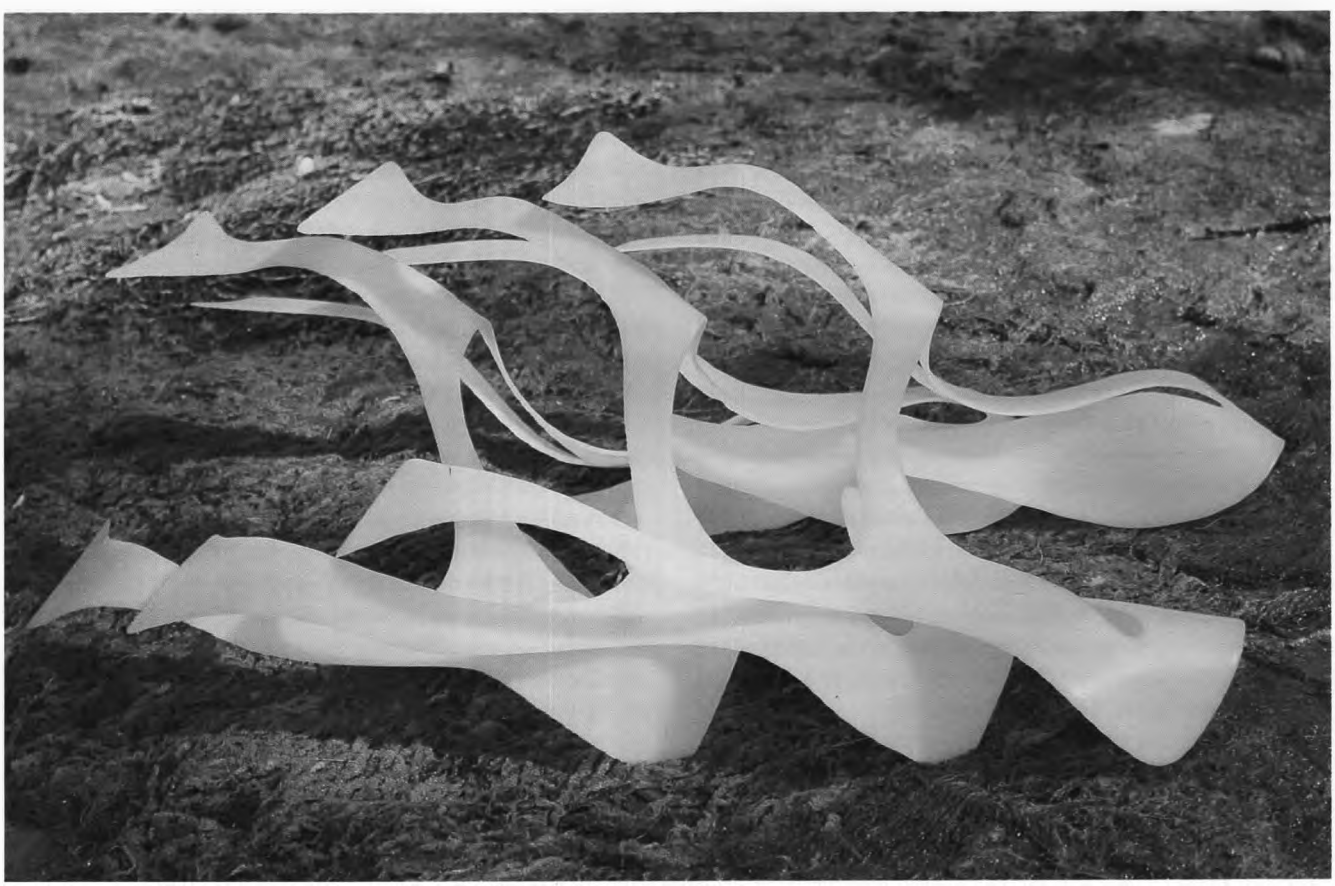
ENDO-EXO 1
SCULPTURE IN MOTION

Our cover artist for this issue of EXPLORATIONS is Deborah de Moulpied, Associate Professor of Art at the University of Maine. She earned her MFA and BFA degrees at Yale University School of Art and holds a Diploma with Distinction in Sculpture from the Boston Museum School of Fine Arts. Prior to coming to the University of Maine, she served as a Firm Associate with Architectural Graphics Associates, Inc., New Canaan, Connecticut, and Fort Lauderdale, Florida, and she taught at William Paterson College and The University of Bridgeport.

De Moulpied's work has been exhibited at the Museum of Modern Art, Galerie Chalette, NYC, Wadsworth Atheneum, Houston Museum, Yale University, American Academy and Institute of Arts and Letters, Whitney Museum, Aldrich Museum, Hirshhorn Museum, Rutgers University, Colby College Museum, Sculptors Guild, NYC, Imprimatur, St. Paul.

Some of the collections in which her work is found include those of the Museum of Modern Art, Gertrude A. Mellon, Chase Manhattan Bank, Colby College Museum, Joseph and Olga Hirshhorn, Drs. Jerome Sterling, Herbert Robbins, Lawrence Abt, Hirshhorn Museum and Sculpture Garden.

De Moulpied has also been involved in environmental design and public commissions including those at Miami International Airport, Niagra Falls International Convention Center, Baltimore Washington International Airport, Cleveland Hopkins Airport, and the Maine State Bureau of Public Improvements, Bangor Public Services Building.



COMMUNICATION IS NOT JUST SAYING WORDS; IT IS CREATING TRUE UNDERSTANDING

COMMUNICATION

by Marisue Pikering

By training and experience, I am a speech-language pathologist. This has meant providing assessment and therapeutic services for people with communication disorders and, at the university level, educating and training undergraduates and graduate students to do the same. Throughout both the *hands-on* clinical work and the preparation of students, one area constantly has surfaced as having particular import: the interpersonal communication within the helping relationship.

The profession of speech-language pathology and its parent discipline, Human Communication Disorders, has *not* been exemplary in probing aspects of interpersonal communication in its helping, clinical relationships. On the other hand, fields such as Counseling, Humanistic Psychology, and Speech Communication have been concerned with interpersonal communication in dyadic helping relationships and have made significant contributions to theory, research, and practice. A major focus in these and related fields has been on listening and talking to the communicative partner (client, patient, student, child, *etc.*) in ways that help the other person feel accepted or confirmed. Examples from several fields are illustrative of this focus.

Marisue Pickering is Associate Professor and Chair of the Department of Speech Communication at the University of Maine. Her bachelor's and master's degrees are in Speech-Language Pathology, and her doctorate, from Boston University, is in Humanistic and Behavioral Studies. Her research interests focus on interpersonal communication in helping relationships as well as on theoretical methodological concerns. Dr. Pickering's latest work is a coedited book, Supervision in Human Communication Disorders*: Perspectives on a Process, to be published Spring, 1987, by College-Hill Press, San Diego. The book contains two chapters by Dr. Pickering, one on interpersonal communication in supervisory relationships and one on epistomological issues in human communication disorders.*

Carl Rogers (1962), a well-known counselor and humanistic psychologist, has written extensively about trying to understand the counseling client's world and then communicating that understanding to the client. Rogers talked about understanding others from *their* perspectives, not from one's own. This implies a non-evaluative understanding and acceptance, within the counseling encounter, of what the other person is experiencing.

Thomas Gordon (1970), writing about parent-child communication, has stressed talking to children with the *language of acceptance* (p.29). Gordon suggested that genuine acceptance of an individual is a vital factor in producing a relationship in which the *other person can grow, develop. . .* (and) *become more productive and creative* (p.31). He noted that it is the *unacceptance* of children — with the concomitant evaluation, judgment, and criticism — that teaches them not to share their feelings and problems. It is unacceptance that *turns kids off* (p.32).

Thanatologist Elisabeth Kübler-Ross (1969) is another who is concerned with how individuals are listened to and talked with. From her work with individuals who are in the process of dying, she concluded that many patients *welcomed the possibility of talking with someone who cared* (p.262) and welcomed talking in a straightforward and accepting way about death and dying.

Interpersonal communication scholar William Wilmot (1979) also has discussed confirmation in interpersonal relationships. He identified three modes of response to an individual's social behaviors and roles: confirmation, rejection, or disconfirmation. Wilmot equated confirmation with acceptance of the other person's role, and rejection with a lack of acceptance. He suggested that disconfirmation meant negating the other person, acting as if that person did not exist, and failing to validate his/her existence.

A final exemplar of scholars who are concerned with acceptance and confirmation comes from nursing. In a collaborative work, communication scholars Paul Fritz, Charles

Russell, and Ethel Wilcox and nursing scholar Frieda Shirk (1984) discussed accepting the patient as a person. They also focused on accepting the content of the patient's talk. *Person acceptance* (p.72) suggests to these authors some type of identification with the patient. Content acceptance is a willingness to encourage the patient's discussions without rejecting his/her ideas.

Listening and talking to another in accepting ways may, on the surface, seem simple and easy to do. It isn't. Consider how many occasions in a day we respond to other people in ways that deny their feelings, criticize their judgments, demean their opinions, trivialize their experiences, and so forth. These same behaviors may occur during interactions in helping relationships. This has led me to investigate communicative behaviors in clinical situations in speech-language pathology, particularly those behaviors that reflect acceptance and confirmation of the client. One investigation (Pickering, 1982) used a descriptive-qualitative methodology to investigate the transactions in student-conducted therapy sessions in speech-language pathology. Analyses of transcripts and videotapes of therapy sessions revealed that the student-clinicians rarely responded to their clients' feelings in confirming or empathic ways. In the sessions that did appear to be the most accepting and confirming of the clients, the student-clinicians and clients jointly participated in activities, shared feelings with each other, had reciprocal eye contact, and touched one another.

In a related investigation, I focused on interpersonal communication between student-clinicians in speech-language pathology and their university supervisors during conferences designed to discuss the students' work with their clients (Pickering, 1984). Transcript analyses revealed that frequently supervisors failed to attend to a student's expressions of feelings, especially in regard to clients. Nevertheless, students frequently shared personal feelings and frustrations about themselves and their clients.

A major implication arises from these and other such studies: *If as a helping profession, speech-language pathology has assumptions and values concerning acceptance and confirmation of its students and clients (and it does), then its practitioners and academicians need to find ways to teach the interpersonal skills associated with those values.* Thus developing a model for teaching interpersonal communication within the field of Human Communication Disorders has represented a second dimension of scholarly endeavor. Much of this effort has been done collaboratively with Professor Dwayne VanRheenen, formerly of the University of Maine, now of Pepperdine University.

A major component of our work to date has been on the linkage of intent with specific interpersonal communication behaviors, particularly those empathic behaviors associated with accepting or confirming the other person (Pickering and VanRheenen, 1984, 1984-85). Our efforts to teach empathic skills have led to an identification of four intents or desires associated with empathy:

1. Desire to be other-directed, rather than to project one's own feelings and ideas onto the other.
2. Desire to be non-defensive, rather than to protect the self. When the self is being protected, it is difficult to focus on another person.
3. Desire to imagine the roles, perspectives, or experiences of the other, rather than assuming they are the same as one's own.
4. Desire to listen as a receiver, not as a critic, and desire to understand the other person rather than to achieve either agreement from or change in that person.

A second component has been to specify particular interpersonal skills that are associated with the other person's feeling accepted or confirmed. Such a set of empathic behaviors or skills is presented in Table 1.

This list is not exhaustive, nor does it offer standardized definitions of the skills. Numerous writers in other fields also discuss empathic and other helping skills. See, for example, Gordon (1970) and Marshall, Kurtz, and Associates (1982).

Presenting a construct's opposite seems to enhance learning the construct. Thus Table 2 identifies behaviors associated with the intent to listen as a critic, that is, with no desire to understand the other person's perspective. Like the first list, this set of behaviors is not exhaustive, nor are the examples the definitive ones.

The work that has been reviewed here concerns efforts to investigate and teach interpersonal communication in a somewhat limited context: the profession of speech-language pathology. From this base, other areas of concern having to do with communication and helping have emerged. (Appropriately enough, three of these areas represent the three foci of a land-grant institution: teaching, research, and public service.)

The first area has to do with teaching interpersonal communication to a broad spectrum of students interested in helping relationships and helping professions, for example, students from education, nursing, and social work, as well as speech-language pathology. A few years ago, the students in our advanced interpersonal course represented traditional helping fields as just noted. In the last two or three years, increased numbers of students have been concerned with communication in a variety of contexts that represent crucial areas of personal and societal concern. We now have students who want to probe communication involved with counseling rape victims and battered women, child abuse counseling, suicide prevention, family conflict, supervisor-supervisee dyadic interaction, and grief counseling. We have students who have a strong need *to help* people in difficult situations, to understand the complexities of their own family and intimate communication patterns, to resolve conflict more effectively than they were taught in their homes, and to learn the *language of acceptance.* Responding to their learning needs while simultaneously developing the theoretical and investigative

Table 1. Skills Associated with Empathy

Skills	Explanation
1. Attending, acknowledging	1. Providing verbal or non-verbal awareness of the other, for example, eye contact
2. Restating, paraphrasing	2. Responding to person's basic verbal message
3. Reflecting	3. Reflecting feelings, experiences, or content that has been heard or perceived through cues
4. Interpreting	4. Offering a tentative interpretation about the other's feelings, desires or meanings
5. Summarizing, synthesizing	5. Bringing together in some way feelings and experiences; providing a focus
6. Probing	6. Questioning in a supportive way that requests more information or that attempts to clear up confusions
7. Giving feedback	7. Sharing perceptions of the other's ideas or feelings; disclosing relevant personal information
8. Supporting	8. Showing warmth and caring in one's own individual way
9. Checking perceptions	9. Finding out if interpretations and perceptions are valid and accurate
10. Being quiet	10. Giving the other time to think as well as to talk

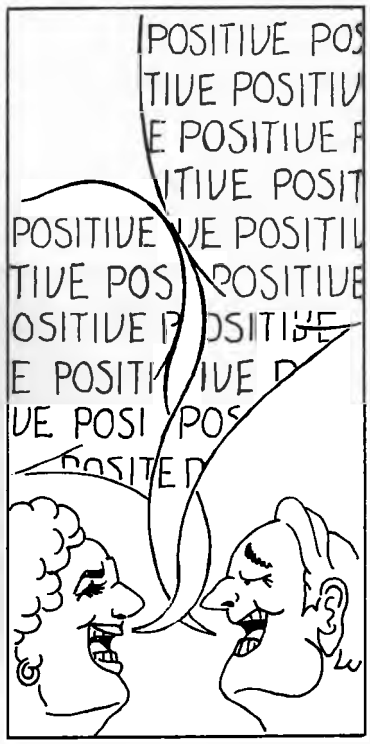


Table 2. Behaviors Associated with Listening as a Critic

Behavior	Example
1. Denying feelings, perceptions, experience	1. "There is no reason to be upset, you're not that bad."
2. Advising, insisting, imposing	2. "Well, I think you *should* go; it will be good for you."
3. Judging negatively, admonishing	3. "You shouldn't have done that."
4. Diagnosing or explaining the other's world to that person	4. "You only feel that way because you get uptight about grades."
5. Diverting, changing topic	5. "Here, look at these papers."
6. Giving false hope or inappropriate reassurance	6. "It'll be all right."
7. Making impersonal, stereotypic statements	7. "You're just a typical student."
8. Focusing inappropriately on one's self	8. "Why, that happened to me the other day. You know. . ."
9. Interrogating	9. "Why on earth did you do that?"
10. Trivializing	10. "Oh, that's a silly thing to worry about."

bases for heuristic applications is a major challenge to which a colleague, Associate Professor Kristin Langellier, and I have begun to respond. Our efforts have meant taking seriously the experiences of those people in the position of being *helped* and building theory on the basis of those experiences. In addition, we are finding it helpful to teach our students skills of qualitative interpretative data collection and analysis so as to achieve a rigorous understanding of the personal experiences of both the *helpers* and the *helpees*.

A second area of concern has to do with ways of investigating interpersonal communication. Traditional empirical-experimental methods have particular limitations for studying aspects of human communication. On the other hand, methodologies based in the *human sciences*, a tradition that dates back at least to the late 19th century, offer challenging approaches to knowing and understanding interpersonal communication, in part because this tradition acknowledges the inseparability of fact and value. The approaches to inquiry in the human sciences often are descriptive, interpretive, existential, or phenomenological. According to philosopher of science Donald Polkinghorne (1983), such approaches are *aimed at describing and clarifying the nature of experience which people live through* (p.239). Explicating the need for and illustrating the application of constructs from the human sciences to the study of Human Communication Disorders is a current endeavor (Pickering, in press). A particular application has to do with human linguistic and communicative expression, for example, the use of metaphor to express meaning within the helping relationships germane to my field.

A third area of current interest has to do with working with hospice volunteers to help them understand how to listen to and talk with dying patients and their families. Thus far, the behaviors identified in Table 1 appear to be important ones for showing acceptance and confirmation to hospice patients. In addition, it becomes important to learn to listen to all the other ways a patient communicates, for example, through the use of touch, gestures, tone of voice, body posture. The axiom *one cannot* **not** *communicate* (Watzlawick, Beavin, & Jackson, 1967, p. 48-51) is of particular relevance in this regard. Workshop interactions with hospice volunteers at St. Joseph Hospital, Bangor, Maine are a constant reminder of the dialectical relationship between theory and practice as well as of the need for a strong experiential base when working with a helping relationship.

Working within helping relationships leads invariably to a major concern with interpersonal communication. Furthermore, by their very nature, scholarly endeavors in interpersonal communication involve people and their daily experiences. This I find forever fascinating and worthwhile.

TALKING WITH A CLIENT

The following real life interaction (names have been changed) is representative of the kind of interaction a speech-language pathologist is confronted with regularly.

Kevin, a junior high boy, age 14, has been referred to the speech-language pathologist student-clinician for an assessment of an obvious lisp.

Kevin: *I don't wanta be here.*
Ms. Brown: *Oh, you want to have a good S; you don't want to lisp. I'm sure it bothers you.*
Kevin: *No.*
Ms. Brown: *Oh, but when you start dating it will. Besides, it really is important to work on it.*
Kevin: *Not to me.*

In this example, the *helper* (student-clinician) did not respond as someone whose intent was to understand the client's particular perspective (see Table 1). Rather, the student-clinician responded in ways that suggested efforts to deny Kevin's feelings and perspective, to impose her standards and perceptions on him, and even to tell him how he will feel in the future (see Table 2). Presumably some training in interpersonal communication would help this student-clinician examine her intent vis-à-vis this client as well as increase her repertoire of interpersonal communication skills.

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In the mid-1960s wood drying technology in the State of Maine could best be described as mediocre. With the development of University of Maine short courses and regional association programs, it very soon became known as the best in New England and then in the Northeast. Now it is often recognized as the best in the nation.

MAINE OUTREACH: TEACHING SUCCESS

by Richard A. Hale
and James F. Philp

Public service is an essential component of the tripartite mission of the University of Maine, and public service activities constantly occur along a continuum from the formal, organized efforts of divisions such as the Cooperative Extension Service and the Bureau of Public Administration to the individual efforts of faculty and professionals as they respond to informal inquiries made by phone, letter, and even casual visitors. Between the two extremes is a large group of service efforts composed of various faculty presenting short courses appropriate to their disciplines and aimed at particular audiences. These may be departmental efforts or efforts done in cooperation with one of the regular public service agencies. The sum total of all of these efforts combined has a tremendous impact on the economy of the State in the course of a year, as thousands of contacts are involved.

In 1967 the Forest Products Laboratory of the College of Forest Resources initiated a program in wood drying, with the aim of upgrading the knowledge and skills of dry kiln operators, yard managers, and general management in the drying of wood products. We chose this subject because we felt that it was a very broad area in the manufacture of wood products and crossed the lines of many processes. With a few exceptions, all wood is dried either before putting it into place, or after it is in place.

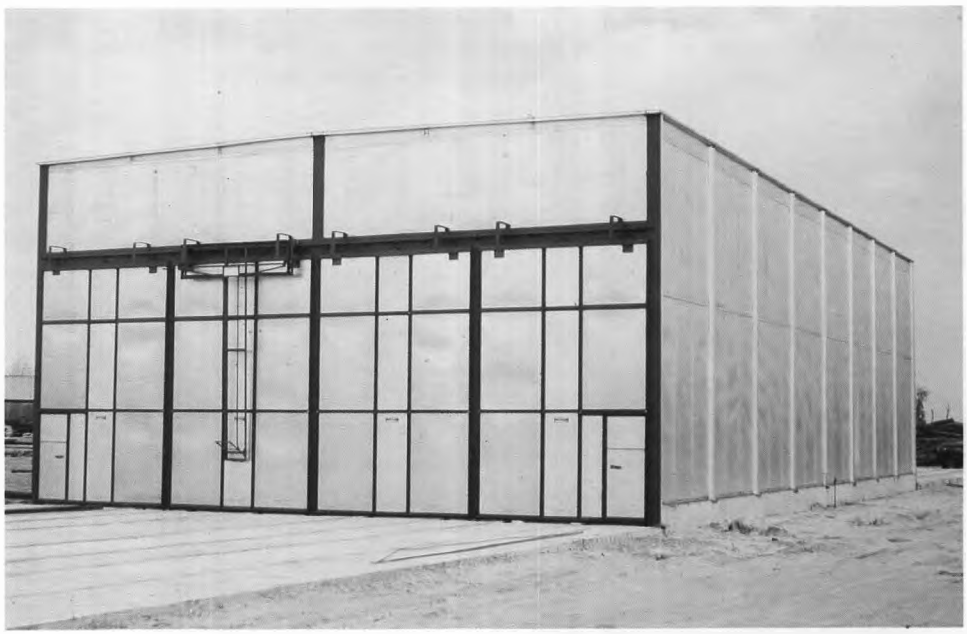
It is commonly acknowledged that up to 80 percent of the problems in processing wood are based on problems with moisture content. In many cases, green lumber has a water content well over 50 percent of its weight. This water must be removed in an orderly fashion to the condition that it will assume in use. For example, lumber for the manufacture of furniture must be dried to, or slightly below, the moisture content the furniture will assume in a typical, northern-heated, unhumidified house. Lumber for construction purposes does not have to be dried to such a low degree of moisture content.

The drying process is essentially one of exposing the wood to temperatures, relative humidity, and airflow which will remove the water without damaging the material in the process. This may be done in the open air or, more commonly, in a dry kiln chamber in which the lumber is exposed to air of a proper temperature and humidity which is blown across the layers of stacked material. The control of the process in a dry kiln is critical, as the energy costs are high and the penalty for drying too rapidly may be disastrous.

There are several philosophical approaches to the presentation of wood drying short courses; the most common one is a one-to-two-week course designed to train new operators in the field. We chose to use an approach of updating and retraining the kiln operators with a secondary purpose of orienting management to the detailed problems of managing drying operations. This we felt we could accomplish in

Richard A. Hale is Associate Professor of Wood Tecchnology in the College of Forest Resources at the University of Maine. He earned his B.S. degree at the University of Maine and his M.F. degree at Yale School of Forestry. His research interests focus on kiln-drying, electro-mechanical stress grading, production analysis, systems design, equipment design, residue utilization and wood fuel. His public service activities have included more than 19 years work with the wood drying short course and clinic described in this article as well as service with numerous industrial clinics.

James F. Philp is a Forest Products Specialist, Maine Cooperative Extension Service, Extension Educator and Faculty Associate in the College of Forest Resources at the University of Maine. He earned his B.S. and M.S. degrees at Pennsylvania State University and has served as General Manager of Dushore Wood Products, Inc.; as an instructor in Forest Marketing and Utilization for the Cooperative Extension Service, School of Forest Resources, Pennsylvania State University; as a Land Management Forester for the Union Camp Corporation, Virginia; as well as doing work for the United States Forest Service and research in forest inventory, land surveying and ecological biometrics.



A dry kiln: the structure within which lumber undergoes a series of carefully monitored processes to manage its moisture content. Fortunes are made and lost depending on the expertise and training of the professionals who manage the kilns.

Lumber is loaded into the kiln.

a three-day course. After the first course, it became apparent that we would be having some attendees who were not experienced kiln operators and needed some basic training. It was also apparent that some of the experienced operators needed added schooling in the basics, so we evolved a format of one day of basics and two days of applied subjects.

Who are our clientele? The major group is the dry kiln operators. They include people across a broad spectrum of age, experience and education. The majority are personnel who have a high school education and have been promoted from the yard or plant to the position of kiln operator or yard superintendent. There are some, however, who are college educated, occasionally with degrees in wood technology and sometimes degrees in other fields.

Drying is a combination of art and science, as the knowledge of absolutes in the field is limited, and wood is a widely variable material. The responsibilities are great, as for example, a load of two-inch high quality oak lumber may have a value of $50,000 when it is piled in the kiln for drying. Errors in operational procedure can result in the entire load becoming virtually worthless. Approximately 20 percent of our clientele are involved in management. These people have found the course to be valuable in that it helps them make better decisions in their processing operations, as well as understand better the needs and responsibilities of their kiln and yard personnel.

The body of relevant knowledge is so large that we generally establish a subject matter theme for a meeting. These are generally fairly broad as we must serve clientele who are drying many different types of wood products as well as different species. The first day, the day of the basics, is fairly well fixed in its subject matter. The themes for the second and third days are fairly broad and flexible to allow for the diversity we feel is necessary for the course. They may, for example, deal with economics, some particular type of operation, or maintenance. Whenever it is appropriate, we include at least one or two presentations reviewing basic information. This is an essential review for some of our participants and it assures that all involved have a common thorough understanding of the basics of drying. We encourage as much input from the industry in making up our program as is possible, and we have a policy of bringing in speakers from anywhere in the country as long as there is a sufficiently large number of people who are interested in their specialty.

Speakers for the day of basic review are traditionally from the College of Forest Resources and from among Cooperative Extension personnel. We are extremely fortunate in being able to call on sales personnel from one of the larger suppliers to help in the conduct of the course. These two people have a tremendous background both in terms of operating and in the breadth of their travel. Their experience and expertise add immeasurably to the success of the course. Whenever possible we try to include kiln operators as speakers as they bring a high degree of credibility and hands-on experience with their presentations. We quite often have had extension wood products specialists from other areas such as North Carolina, New Hampshire, Vermont, and Missouri, and we were fortunate at one time to obtain the services of the retired head of drying research from Weyerhaeuser Company in Tacoma, Washington.

Teaching techniques are important, as there are usually a number of attendees who are having their first experience with outside-of-plant courses. Questions from the floor are encouraged, and usually about a third of the time designated for the presentation is reserved for a question and answer period. Speakers are encouraged to use questioning techniques to draw out the participants and initiate discussions. The regular staff makes a point of trying to involve every student in some sort of a discussion or case study involving the operation of his company.

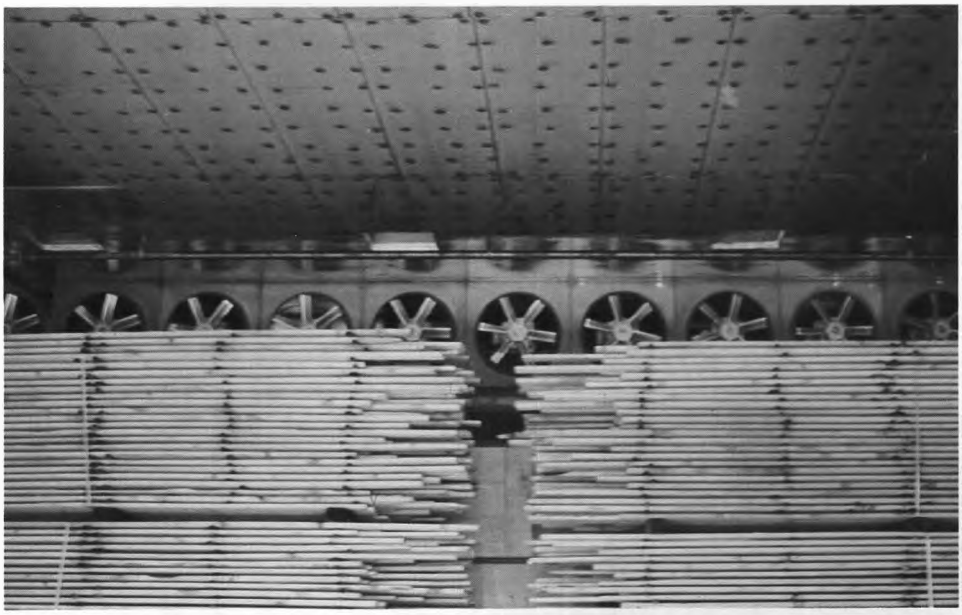
At the end of the first and second days, we tour a nearby plant which has a drying operation. We are particularly fortunate to be able on the first day to visit a plant with an outstanding precision drying system and a production system which starts with a rough log and carries the manufacturing process through to a semifinished product ready for assembly. Plant tours on the second day vary from year to year and include both hardwood and softwood drying operations. These tours allow for discussions of some of the principles covered during the lecture periods.

Evening sessions for both the first and second days of the course provide an opportunity to discuss subjects brought up during the day, and, even more often, subjects not covered in the course as well as individual problems. There will usually be someone, especially if it is their second or third year at the course, who will have a handful of charts and records to go over with one of the instructors. In addition to the evening sessions, on the second day we have a dinner at a local restaurant, a strictly informal affair which enables the attendees to become better acquainted with each other and with the staff.

The first course was held almost 20 years ago in Madison, Maine, at the Town Office. All subsequent courses, with the exception of one, have been held at the Cooperative Extension Office in Skowhegan. The initial reasoning for the location was its proximity to a number of plants having dry kilns, which would allow the operators to come in in the morning after having checked their units and allow them time to check their units after the sessions in the afternoon. Subsequent analyses have indicated that this choice still holds. For this and a number of other reasons we have remained in the Skowhegan area. The existence of a good classroom at the Extension Office plus the availability of a reasonably priced motel with a lobby which we can use for our meetings are also major factors. Other factors include the availability of nearby plants willing to let us tour their facilities, and the short distance from Bangor International Airport is a convenience to the attendees and speakers coming from out-of-state.

Publicity for the program is a perennial problem. We have established an extensive mailing list and have excellent coverage through the various forest products trade associations' newsletters. Having become accustomed to the course, the in-state companies expect it to be conducted annually, and they usually contact us if they have not received notification. A major problem is contacting new companies with no trade connections and home-crafters and businessmen who may be considering establishing a drying operation.

Based on comments from participants, we have found that the best publicity is by radio, followed by regional weekly newspapers. The course is sometimes viewed as a local event, and the larger daily newspapers consequently give it little coverage. Early in the history of the course, display advertisements were used in major daily newspapers in the southern and central parts of the state. As we found them ineffective, they were discontinued. We are currently working with UMaine professionals to solve the information dissemination problem.



Fans in the predrier circulate air to help in the moisture content control. Properly dried wood minimizes shrinkage and is a product ready for use in a number of predetermined situations. For example, the lumber destined for use as furniture must meet certain specifications so it will function properly in homes in particular climates, while wood for structures must meet different criteria. Only when the lumber is dried to clear and distinct requirements will it be useable in the appropriate market.

Throughout the time-consuming drying process, samples are carefully monitored and weighed to determine the effectiveness of the procedures.

The original course was organized by Hale and Extension Forester, Lewis Bissell. It was funded through the State Technical Services Program for the first two years. On cancellation of the state-sponsored program, we felt that we had established our course to the extent sufficient to justify running it on an unfunded basis with the attendees' fees covering the cost of the operation. Sponsorship for the first eight years continued as a joint operation of the Forest Products Laboratory and Cooperative Extension Service. Subsequently, the Forest Products Laboratory has taken over the operation with the Cooperative Extension Service serving as a cooperator, and the administrative details handled by the Conferences and Institutes Division of the University of Maine. Attendees vary somewhat with economic conditions, sometimes in a reverse mode. For example, when business is very good, companies cannot afford the time for their operators to attend meetings, and when business is very bad, companies see the advantage to training their operators to help in cost reduction.

During the twenty years of the course's operation, participants have totaled approximately 500 individuals from 180 different firms and agencies. Seventy to 80 percent of these attendees have been from companies within the state; however, we have had a number from Canada, primarily the Maritimes, and a number from other states in the Northeast. One company has sent 26 different individuals and a second company 12 different individuals. From both of these companies, we have worked with a very high percentage of their

management personnel, as well as their dry kiln operators and drying superintendents. A number of operators have attended several sessions, the record being 12 for one operator. These attendees are a valuable factor in our instruction as they generally come prepared with a number of questions which enhance the discussion period.

One factor we have found in the running of this course is that the operators become acquainted with each other and exchange an appreciable amount of information directly throughout the year instead of calling the staff at the Forest Products Laboratory or Cooperative Extension Service, personnel who, in many cases, would turn right around and call the appropriate kiln operator. One of the things that we have done at meetings is to provide everyone with an attendance list with the telephone numbers of participants included. Under the technology existing in the state at the time of the inception of the short courses, it is probable that a number of companies were losing 10 percent or more of their yield due to defects caused by improper drying. We know we have reduced this by a major factor. An extreme example that we found in one company, according to their kiln operator, was that they lost seven inches due to drying defects from each end of a 48-inch long stick. One of the kiln operators in the course took the operator to his own kiln and gave him a schedule which resulted in the loss of an inch and a half from each end of a 48-inch stick, a reasonably conservative loss.

Because of the intrinsic nature of the drying process, and its lack of visibility as a process compared with a machine process, it is probably the least understood by management of any of the production systems. In many cases, it appears to be the monster in back of the plant which everyone complains about, and yet seems to keep running even if requests for repair and maintenance are turned down. Increasing the awareness of management about the needs of proper drying from the standpoint of having materials reach the plant at the specified moisture content, and the needs inherent in the process in terms of time elements, power needs, and maintenance needs has long been a feature of our courses. From the beginning, we have had a number of management personnel attending the courses. Reaction has been positive and favorable in most cases.

One problem with a course with a mixture of operators and management is that the presence of management personnel will sometimes inhibit the operators' participation, particularly in the form of questions and answers. When we sense that this may be a problem, we talk with the kiln operator on an individual basis to determine if there is any way in which we can help him and his company. Over the years a number of operators have been promoted to management and continue to attend the course. This is particularly helpful in our discussion sessions.

There is a statement made frequently that there are so many problems in drying that no one in the industry can afford to keep any secrets. This is a true statement and maintains its validity all the way to the national level. Over the years this has resulted in the development of an extensive technology transfer system in wood drying. At a very early date, the U.S. Forest Products Laboratory in Madison, Wisconsin, ran short courses for dry kiln operators, with one of the early ones held in 1946 in Old Town, Maine. These have evolved into courses conducted by other universities and Extension agencies all over the country.

The second major feature of this technology transfer is the wood drying associations, of which there are currently 10 scattered over the country. In the Northeast, the New England Kiln Drying Association is the largest organization nationally and one which is providing excellent service to the industry over the northeastern area. These associations generally provide two meetings a year which are attended by regional plant and management personnel. The New England Association also provides four regional scholarships for students in wood products programs. Through the years a number of University of Maine students have been recipients of these substantial awards. The Forest Products Research Society provides a medium for the circulation of technical papers through their journal and also through the publication of informal wood drying notes which are circulated by the drying associations and provide a valuable teaching tool for our short courses. At present there is no apparent immediate need for a national organization to further coordinate the transfer of wood drying technology, but Hale chairs a meeting of wood drying association executives and interested personnel at the national meeting of the Forest Products Research Society.

Over the years we have evolved a format which meets the needs of industry and the public in helping industry provide a product which will achieve its designed goals. We want to emphasize that it is possible to carry out a program using the best nationally available instructors and yet stay within reasonable financial bounds. We feel that the body of knowledge involved in wood drying rests with the wood science and technology profession, and that is is entirely appropriate that we be involved with teaching at all levels in this subject including plant-level technical personnel. It is particularly gratifying, over the years, to see the progression of some of the participants in terms of technical knowledge and in terms of promotion to management level. Knowing our technology transfer courses have helped with this growth is personally and professionally rewarding.

THROUGH CLOUD AND FOG, HUNTING THE ELUSIVE pH

by Richard Jagels

During the fall and winter of 1983-84, after pondering whether an acid rain/red spruce decline problem existed in the Northeast, I began to formulate a possible field experiment. Until this point I had been vexed by the problem of establishing a suitable reference site within what appeared to be a region-wide problem.

Reports of red spruce decline were coming from mountainous regions where trees were frequently bathed in cloud mist, and this mist in the Adirondacks, Green and White Mountains of New York, Vermont and New Hampshire was quite acidic with pH values which averaged 3.5 to 3.7. Rain in the mountains was also acidic (generally averaging 4.1 to 4.3) but this was not greatly different from the rain for the Northeast in general. Several investigators, therefore, began to suggest that acidic fog or mist might be at least a contributing, if not primary, factor in initiating red spruce decline at high elevations.

The reference forest that I envisioned was coastal Maine, the site of the only United States maritime population of red spruce. I speculated that the coastal fog, in which these forests were regularly bathed, would be less acidic than fog at high elevations. This speculation was based on the following:

1) the supposition that the chemistry and pH of coastal fog was strongly influenced by local conditions, primarily the ocean, and
2) a research report which documented coastal fog collection in the late 1930's, at which time pH had been measured at selected sites from Massachusetts to Kent Island, New Brunswick. With the exception of Brooklyn, Maine, the pH values for these collections averaged near neutrality (pH 7.0). At Brooklyn the pH values averaged 4.7, but at that time I attributed this to a technical aberration.

Richard Jagels is Associate Professor of Forest Biology, with a cooperating appointment in Botany, at the University of Maine. His undergraduate and graduate training at SUNY-Syracuse were in wood anatomy and forest pathology, and his Ph.D. thesis in Botany at the University of Illinois involved an ultrastructural study of the photosynthetic system in a lower vascular plant. His research interests encompass structure-function relationships, at the cellular level, in plant systems as diverse as seagrasses and red spruce; the latter dominates his present interests.

Of course, near neutral pH values in the late 1930's might not be indicative of present day pH values, but the researchers had also measured pH of cloud fog on Mt. Washington and found average pH values of 4.5, which were not dramatically different from present day values.

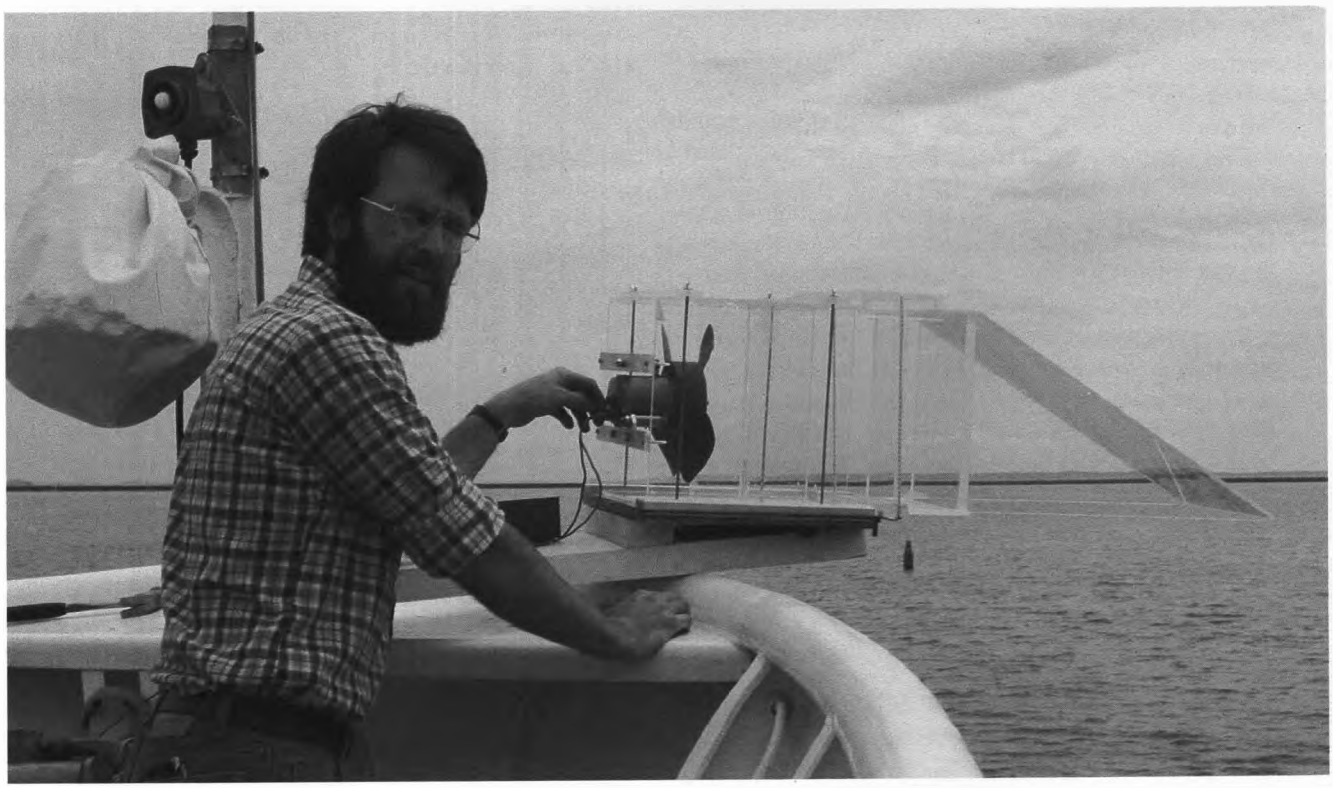
Armed with this meager background, supplemented by the thought that coastal spruce forests were inherently healthy (based on conversations with people reasonably knowledgeable about Maine coast island ecology), I approached the University of Maine's Land and Water Resources Center for funding through a block grant from the United States Department of the Interior. Because I had no meteorology background (being a botanist/wood anatomist), I coerced Dr. Geoffrey Gordon, Senior Research Associate, Institute for Quaternary Studies, to become a co-collaborator, and we enlisted the aid of the Geological Sciences Water Chemistry Laboratory (Dr. Stephen Norton and research associate Jeffrey S. Kahl) to handle the water chemistry data.

The next six months were spent trying to learn as much as possible about fog capture, designing and testing fog collector prototypes, and choosing appropriate collection sites. In January, 1985, Jobie Carlisle, a former University of Maine forestry student, joined our research team and began building our field fog, rain and forest canopy throughfall collectors (the latter to assess possible leaching of elements from the spruce canopy), and at the same time we began the arduous logistical tasks of establishing final field sites, finding and training collaborators to operate the sites, and transporting all of the equipment into the field to be ready to collect during the summer and fall of 1985.

We have been most fortunate in the high level of cooperation we have received from our field collaborators, Nadine McLeod on Sugarloaf Mountain (established as a reference for our coastal sites), Jim Porter and Ken Rich on Roque Island, Rosemary Mannix on Isle au Haut, several collaborators from the College of the Atlantic on Mount Desert Rock, and Dave Kane and Diane Zigner who were interns of the Nature Conservancy on Damariscove Island. Collecting fog is a very serendipitous activity so that dedicated full-time site collaborators were essential to the success of the project.

On mountaintops cloud fog can be collected with a *passive collector* because of the winds associated with the mists moving through. To avoid dilution with pure water vapor which

A fog collector facing southwest at Head Harbor on Isle au Haut.



Research Associate Jobie Carlisle testing a fog collector on the bow of a National Oceanic and Atmospheric Administration ship in Penobscot Bay.

can affect pH and quantitative chemical analysis, fog is collected by impaction rather than condensation. The most commonly used collectors in the Northeast utilize vertically arranged teflon strands as the impaction surface, with gravity acting to coalesce the droplets and draw them to a collecting trough which funnels the water into collection bottles. The fog water touches only teflon and linear polyethylene surfaces (all of which have been carefully acid washed and multiply rinsed) which minimizes chemical contamination.

At our coastal sites we needed to use an *active collector* because wind speeds are often very negligible during fog events. The fog is drawn past the teflon strands by a motorized fan, the speed of which is calibrated to maximize droplet impaction. Since the collectors were established at locations lacking electricity, the fan motors are operated by deep-cycle rechargeable 12-volt batteries.

The first indication that my initial premise, *that coastal fog would be less acidic than montane cloud fog*, might be incorrect came with our first few collections which had pH values in the low 3's. By the end of the season it was clear that coastal fog, on average, was as acidic as cloud fog at montane sites in New England. Average coastal fog pH, for all sites, was 3.77, while on Sugarloaf Mountain cloud fog pH averaged 3.78. Coastal Maine would *not*, therefore, serve as a useful, less-acidified reference site for high elevation populations of red spruce.

But not all coastal sites had equally acidic fog. Damariscove Island and Isle au Haut, our most southwesterly sites (see map), regularly had fog pH values in the low 3's and even occasionally as low as 2.9, while Mt. Desert Rock and Roque Island, which were farther downeast or out to sea, had average fog pH values near 4.0, and we never collected fog with pH values of less than 3.3 at these sites. This suggests a gradient of decreasing acidity along the coast of Southwest to Northeast. Such a gradient would be consistent with the ozone gradient observed along the coast, as measured for the past several years by the State Department of Environmental Protection: highest ozone levels near Cape Elizabeth and the lowest at Roque Bluffs.

Data from growth chamber studies have suggested that the threshold for plant injury from acidic mist occurs at pH levels between 3.0 and 3.5, depending on plant species, air temperature and other factors. It appeared from our fog collection, that we had two islands, Isle au Haut and Damariscove, which fell below this threshold and two islands, Roque Island and Mount Desert Rock, for which threshold pH levels were never quite reached or just barely reached.

Chemical analysis of the fogs revealed that on Sugarloaf Mountain most of the acidity was a result of sulphates, but on the coast, nitrates and nitrites (NOx) were involved as well as sulphates in producing acidity. As one might expect, the NOx contribution to acidity was greatest on Damariscove Is-

Visiting German scientists examine yellowed foliage on young red spruce at Isle au Haut.

land and Isle au Haut. This chemical data provides further documentation for a coastal fog acidity gradient which is linked with the ozone gradient, since NOx is an essential precursor for ozone formation.

Of our four coastal sites, only two have spruce forests, Isle au Haut and Roque Island. Throughout the summer, fall and winter of 1985-86 we examined these forests in some detail. It soon became clear that red spruce on Isle au Haut were dying from causes which were not readily explainable (insects, mistletoe and other pathogens were systematically eliminated).

In particular, spruce of all age classes growing on thin organic soils on granite outcroppings were particularly sensitive, especially in areas where episodic fog is most frequent. The visual symptoms observed included the yellowing of older needles, with the yellow coloration occurring on the upper surfaces, and the progressive death and shedding of older needles, while recently produced needles remained alive. The overall effect of this pattern of needle shedding was to produce a tree with a thin inner crown but live branch tips and a small live crown top. This tiny crown often remains viable even after most of the lower crown is dead. Previously set, latent buds often produced new shoots on dying branches, generally on the upper surface.

This set of symptoms closely resembles those observed in Europe, particularly in areas of Germany where ozone and acid mist have been suggested as possible causes for forest decline.

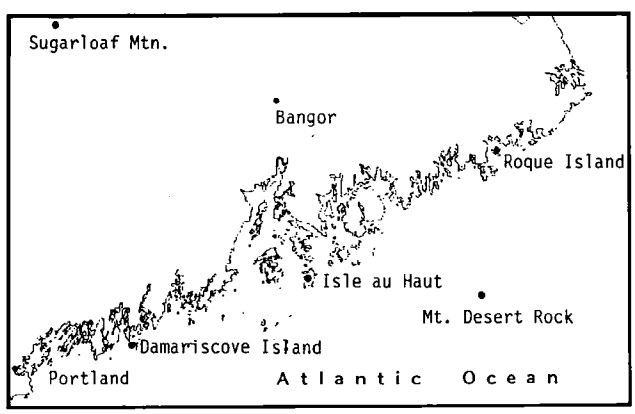
In general, the spruce on Roque Island do not show decline symptoms, or at most only very mild symptoms. As mentioned, the fog is less acidic on this island and ozone levels are also lower, but the soils on Roque Island are also slightly different from those on Isle au Haut: in general, they are deeper, although they also overlay granite.

The Germans who link acid mist and ozone to forest decline suggest that ozone can damage cuticles or cell membranes in the leaf, and acid mist will then leach out essential nutrients. For trees growing on magnesium-poor soils (thin soils on granite outcropping), the magnesium essential for photosynthesis cannot be replaced rapidly enough and the needles turn yellow (*chlorosis*). Because the yellowing is confined primarily to the upper, sun-exposed, side of the needles, the foliage still appears green when the trees are viewed from below. Thus, thinning of the foliage is often the first symptom noticed in declining trees. Although we have close analogies between our sick coastal red spruce and the spruce decline observed in Europe, considerably more study is needed before we can suggest actual causes for what we are observing.

We are presently continuing our fog collecting and are extending our research to include chemical analyses of spruce needles to test for nutrient deficiencies; fertilizing selected sites with dolomite lime (high in magnesium), or lime-urea combinations; examining needles microscopically for cellular damage; and analyzing extracted wood cores taken from spruce stems to assess growth rate and within-growth-ring cellular changes. We also plan to assess the lichen populations with other collaborators since some lichens are sensitive pollutant indicators.

Recently this study has taken an interesting historical turn. Robert Cunningham, who made some of the first fog collections on Kent Island, New Brunswick, in the late 1930's, visited our Isle au Haut site in late August and we discussed our respective methods of fog collecting. In 1983 and 1984 he repeated his fog collecting on Kent Island with exactly the same equipment he had used in 1938. Surprisingly, after 45 years, his pH values were nearly the same. Kent Island is only about 40 miles from Roque Island, so we are both very interested in determining why this great difference in fog pH exists. Next year we hope to place one of our collectors on Kent Island as we continue to delve into the vaguaries of coastal fog and its possible effects on the biology of coastal Maine.

The pH scale ranges from 1 to 14 with 7.0 being neutral and values above 7.0 being alkaline and those below 7.0 being acidic. The scale is logarithmic and, therefore, a change of one pH unit (*that is*, from 5.0 to 4.0) represents a hundred-fold change — in this example, a hundred-fold increase in acidity. Distilled water generally has a pH of around 5.6. In theory, this should be the pH of pure rain water, although this value varies somewhat based on dissolved carbon dioxide.



1985 Sites

OCEAN BASIN WITH A PAST

A CRYPTIC HISTORY: BREAKING THE CODE DISCERNING A FUTURE

by Detmar Schnitker

The Gulf of Maine means different things to different people: a source of serenity and recreation to some, a livelihood to others. Whatever their relationship to the Gulf of Maine, very few people ever contemplate that the body of water before or below them has a history and may not always have looked the same as it does today.

But if we dig through the memories from our science courses, we recall that not so very long ago a one to two mile thick ice sheet covered much of North America, shaping, among many other places, the landscape of the State of Maine. This ice sheet also ground across Nova Scotia, through the Gulf of Maine, and across Massachusetts. The edge of the massive ice sheet came to rest on Georges Banks and Cape Cod, and even ran on into the deep ocean where it broke off in pieces that floated off as icebergs. (See figure 1.) *There was no Gulf of Maine then, about 18,000 years ago.* How was the transition from *no Gulf to the present impressive Gulf of Maine* accomplished?

A record of the history of the Gulf of Maine exists. The muds that are slowly accumulating on the bottom of every ocean contain many witnesses and clues to the environments and life of the past. The layers upon layers of sand, silt and clay on the bottom are like the pages of a history book: one has only to retrieve them and learn how to read them. To that end we embarked on an expedition into the Gulf, using the Duke University research vessel *Eastward* under the sponsorship of the National Science Foundation.

Detmar Schnitker is Professor of Geology and Oceanography and a member of the Institute for Quaternary Studies at the University of Maine. He earned his Ph.D. from the University of Illinois, and before coming to Maine, he spent two years working for the French petroleum company, Elf-Aquitaine. He has been a participant and co-chief scientist on two legs of the scientific drilling vessel GLOMAR CHALLENGER, investigating the evolution of the North Atlantic. A micropaleontologist and paleoecologist, he applies his experience with present-day microfaunas to interpret the fossil faunas he finds in ocean-bottom cores. He is particularly interested in the history of the ocean's deep circulation and its interaction with climate and its possible role in the formation of global climate.

At first we spent several days crisscrossing the Gulf of Maine, looking for *good editions of the record book.* That was done by seismic profiling: we sent out periodic loud and sharp pings from the ships' bottom and recorded the echo from the ocean floor. The sound not only reflects from the ocean floor, but much of it penetrates into the sediment, to be bounced back from layers within it or from the bedrock below. (Figure 2 shows such a seismic record.) These profiles gave us a good picture of where strong bottom currents had left only bare rock, where sediments had accumulated, and how thick and complete these sediment layers were.

The next task was the retrieval of samples from the *record book.* A piston corer, which is essentially a long steel pipe with a piston inside it and about a ton of lead on top of it, was lowered over the side of the ship on a thick steel cable and allowed to punch into the bottom muds. (See figure 3.) In this fashion we collected seventeen cores from different places within the Gulf of Maine, some of them as much as sixty feet long. This ended the easy part of the study with its cramped quarters, diesel fumes and seasickness. The cores were brought home to the laboratory at the University of Maine's Darling Center in Walpole where the tedious part of the work commenced.

The cores, essentially just long strings of mud, were carefully split lengthwise to expose an undisturbed surface. Color photos were taken immediately because exposure to air and later drying quickly altered or wiped out the vivid colors that could be seen in freshly split cores. Every inch of core was then described in detail: color, color variations, the stiffness (strength) of the mud, layering or bedding structures, the presence of pebbles, of worm burrows and any shells of snails, clams, or brittle stars. Then the cores were sampled for the various analyses that we had planned: in ten centimeter intervals small pieces of core were cut out of the *working half of the core* (the other half remains untouched as the reference half), one sample each was taken for the analysis of water content and sediment grain size, calcareous microfossils (foraminifers), algae (diatoms), for pollen grains, and finally, for radiocarbon dating. When it was all over, we had taken well over a thousand samples. Now the grinding work began: we weighed and dried, we washed and weighed, we sieved and

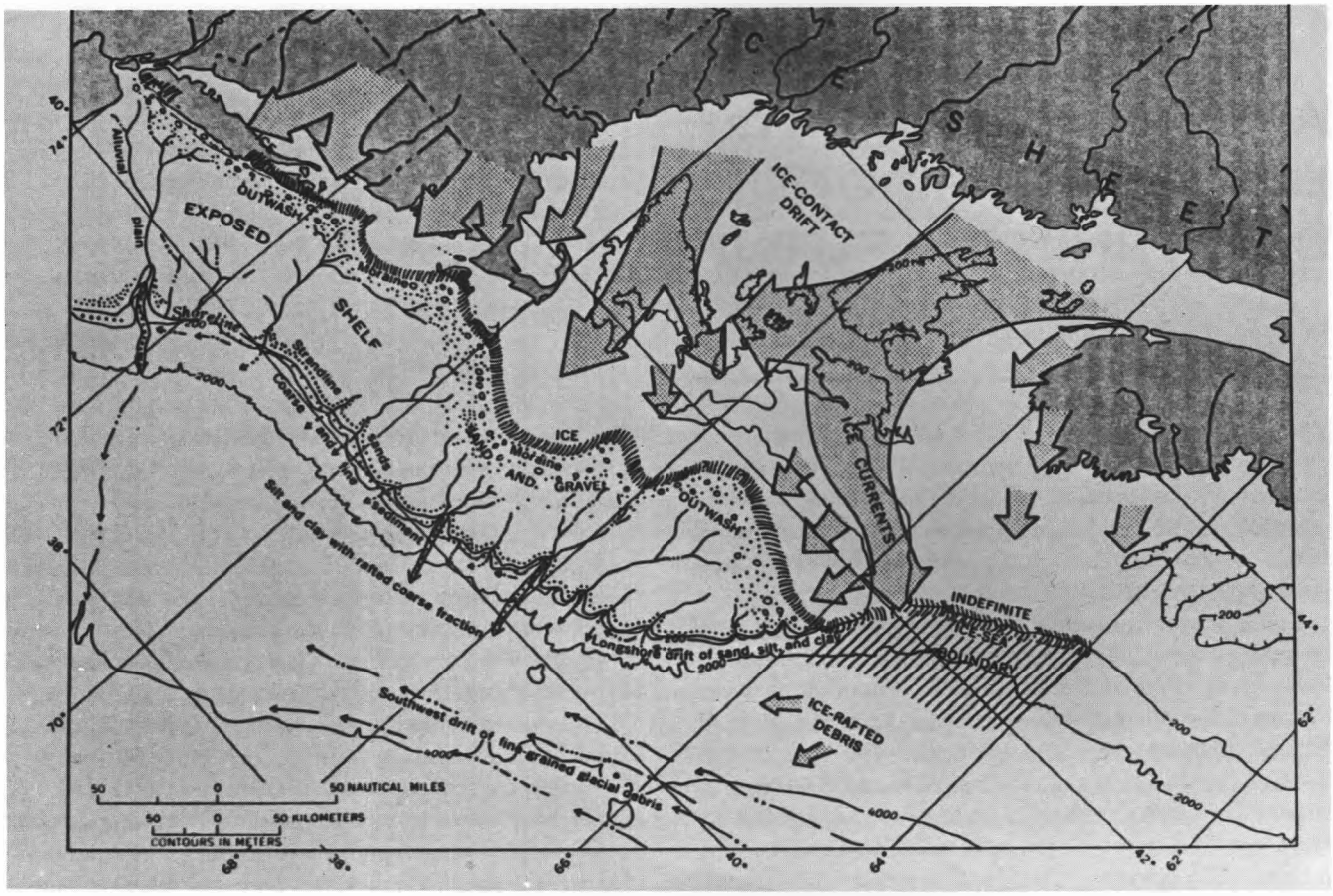


Figure 1: Maximum extent and flow directions of ice during the last Ice Age (from Schlee and Pratt, 1973).

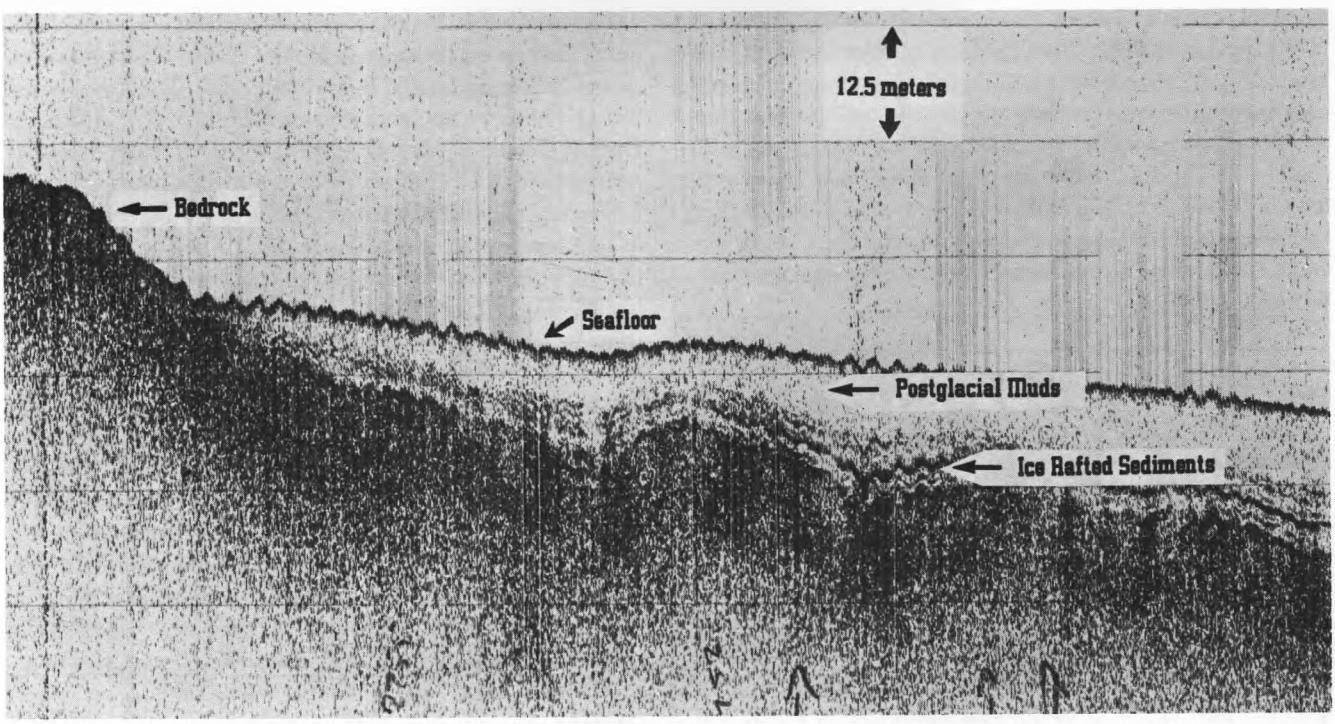


Figure 2: Seismic reflection record from the Wilkinson Basin showing the layering of different kinds of sediments.

Figure 3: All hands on the research vessel EASTWARD helped with a piston core retrieval made more challenging by high seas.

weighed, we dissolved and concentrated, we sieved and picked and sorted, we identified, classified and counted thousands of samples, tens of thousands of pollen grains, diatoms and foraminifers and ran the numbers through powerful computer analyses. Crucial samples were sent out to colleagues at other universities and laboratories for specialized analyses, such as radiocarbon dating, amino acid racemization dating, and oxygen isotope analysis. Not all of the results are in yet, but we can already tell a fairly clear tale of the happenings in the Gulf of Maine from the time of the last Ice Age to the present.

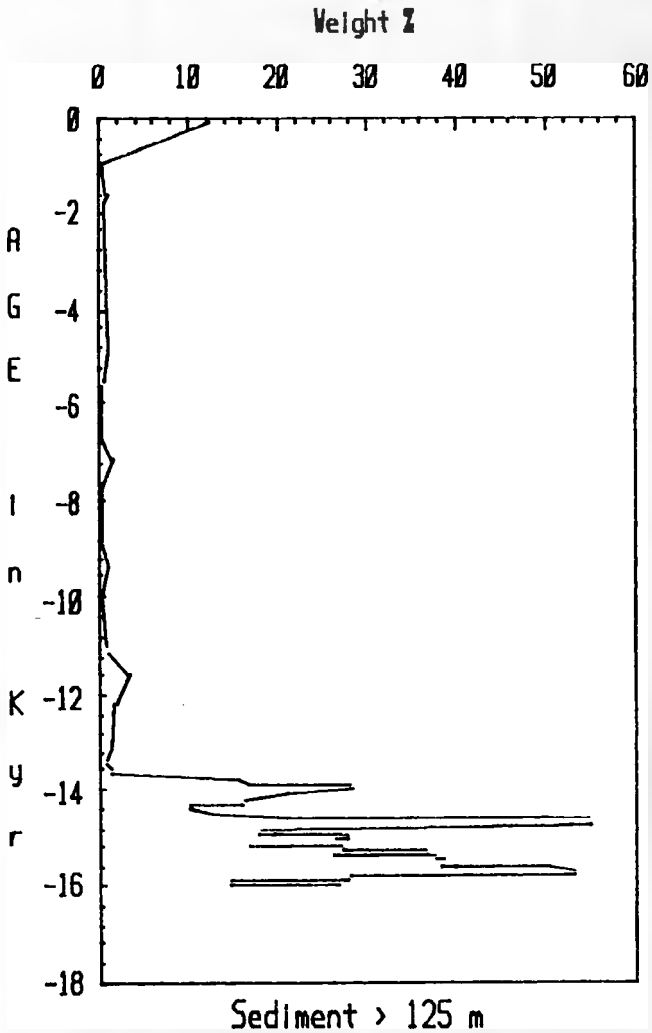


Figure 4: Distribution of coarse grained (ice rafted) sediments in core 2 from the Wilkinson Basin. Ice rafting began about 16,000 years ago and lasted until about 13,000 years ago. From 13,000 years ago until the present, only very fine-grained sediment accumulated.

Let's take the case of the sediments themselves. Way out in the deep basins of the Gulf of Maine, far away from the land and rivers, only the very finest silt and clay-sized materials can be floated in by the slow water currents. The sediments that accumulate there now are therefore very fine-grained muds, with only an occasional shell as coarse material. However, in the lower portion of most of our cores we found much very coarse material: pebbles, granules and sand. The only way such coarse material could have reached these sites is by ice transport: ice carries everything, from the biggest boulders to the finest rock-flour. Using a time scale that was provided by the radiocarbon and amino acid racemization dating, we can construct the sediment distribution curve shown in Figure 4: sedimentation began about 16,000 years ago with much very coarse material being brought in, but 2500 years later, shortly after 14,000 years before present, the influx of coarse material abruptly ceased. That represents the disappearance of ice from the Gulf of Maine, the end of the Ice Age there.

This twofold division of the character of sediments, coarse below, fine on top, can also be seen very clearly on the seismic profiles (figure 2): the coarse ice-rafted sediments are dark and layered, while the very watery and fine-grained postglacial sediments above return hardly any echo below the seafloor. They are said to be *seismically transparent*. Nearly everywhere in the Gulf of Maine, the layer of ice-rafted sediments is at least as thick, or thicker, than the layer of postglacial sediments, although it took only 2,500 years to deposit the former, and 13,500 years to deposit the latter. The ice brought in sediments almost ten times as fast as the weak currents can do it now.

All living organisms are exquisite indicators of their environments: they have very specific physical, chemical and biological limits beyond which they cannot exist. The remains of former life, *fossils*, can therefore give us an appreciation of former environmental conditions. Even soft-bodied organisms which decompose completely after death, such as worms, leave us a record of their activity: worm burrows can easily be recognized in our cores and are important testimony to the former presence and abundance of life.

Shells of clams and snails did occur throughout our cores, but were too scarce to give us a reliable picture of past living conditions. The shells of microscopically small organisms, on the other hand, are plentiful and very diverse, so that we relied on them to provide the bulk of the paleoenvironmental information. Diatoms are single cell algae that secrete a delicate firm shell out of silica which can be preserved with the sediment. Different species of diatoms occur in fresh, brackish and marine waters; some are planktonic, others live on the bottom. Foraminifers are akin to single-celled amoebas, but build a shell which can also be preserved within sediments. They occur only in brackish and marine waters, both as plankton and as benthic organisms.

All these biologic indicators demonstrate that the early deposits, those ice-rafted sediments laid down from 16,000 to 13,500 years before present, were well inhabited by marine organisms and that the water was relatively warm, well above freezing. Drawing upon experience from the Antarctic, where similar conditions exist right now, we can conclude that by

16,000 years ago, the ice sheet had thinned so much that sea water, penetrating along the bottom of the Northeast Channel was lifting the ice off the bottom, thus creating an ice shelf. Life was fairly abundant and diverse below the ice, supported by nutriments that came in with the inflow of water. The floating ice shelf may have been a hundred meters or more thick, keeping the waters below in the dark, conditions in which no algae could grow. Diatoms are absent from those sediments. In contact with the relatively warm sea water, the bottom of the ice melted rapidly so that the rocks and dirt included in the ice dropped to the bottom. Figure 5 is a stylized cross-sectional representation of this early marine phase of the Gulf of Maine.

When the ice shelf finally disappeared from the Gulf of Maine, the surface waters were exposed and cooled drastically, at least during the winter. The continental glaciers on the mainland were melting and sending their meltwater into the Gulf of Maine. Global sea level, however, was still far below its present level, so that Georges and Browns Banks were dry land. The Gulf was thus an almost landlocked basin. (Figure 6) All the microfossils from our cores indicate that its waters were cold and fairly brackish, containing only ⅔ the salt of normal seawater. But the waters were well mixed and fertile. This stage lasted only a very short time: by 12,000 years before present it was over. Figure 7 is a stylized cross-sectional representation of this meltwater phase of the Gulf of Maine.

The Gulf of Maine then was slowly invaded by many species from the deep offshore waters and from areas to the south of Cape Cod: relatively warm and very salty offshore waters had found entry. Global climate, and with it the climate of northeastern North America, became warmer than it is even today. Very little freshwater runoff entered the Gulf, but the rising sea level had flooded Georges and Browns Banks, so that the Gulf was well connected to the open ocean. This oceanic water was low in nutrients and remained well stratified, and as a consequence biological productivity was low. Although we did not find their remains in our cores, it is reasonable to assume that it was during this time that such southern species as swordfish and oyster became established here. These species played a significant role in the diet of the early Indians who settled along the coast of Maine. Figure 8 is a stylized cross-sectional representation of this oceanic warm phase of the Gulf of Maine.

About 5,000 years before present a single species of foraminifer started to become exceedingly abundant and to dominate the bottom faunas: *Bolivina subaenariensis*. This species, at the present time, is always found in areas where the overlying waters are highly productive and where the food input to the bottom is very high — it is an indicator of upwelling. Almost at the same time, the composition of the diatom flora became modern, that is, all the species that make up the modern-day diatom flora appeared in just about the same quantitative proportions. The waters had become slightly cooler, slightly less saline, and much richer in nutrients than they were before. The Gulf of Maine had almost started to resemble the modern Gulf of Maine.

The principal reason for the present-day high productivity of the Gulf of Maine is the very high tides which cause strong mixing of the water and thus bring nutrient-rich waters from the bottom to the surface, where they can be utilized by photosynthetic algae. The relatively sudden onset of the high productivity can therefore be taken as an indicator that the extraordinarily high tides had commenced.

The combined gravitational attraction of the moon and the sun force the ocean surface to bulge out once every 12 hours and 40 minutes. In the open ocean this bulge is less than a meter high, but when the water becomes confined, then it begins to pile up and to slosh like water in a bathtub or a washbasin. If the size of the basin is just right, so that the sloshing frequency corresponds to the tidal forcing frequency of 12 hours 40 minutes, then the basin is in resonance and extremely high tides are built up. That is what happened to the Gulf of Maine between 6 and 5 thousand years ago. Because sea level was lower and the land itself was higher, the early Gulf of Maine was smaller and shallower then, too small for the 12 hour 40 minute tides to resonate. But as sea level rose and the land subsided, the gradually enlarging Gulf slowly started to resonate, to slosh. These high tides stired up the waters, bringing cool, nutrient-rich bottom waters to the surface and thus changed the whole ecology of the Gulf of Maine. Mud flats became extensive and with them the soft-shell clam became abundant. Warm water oceanic fish, such as the swordfish, became rare, but cold water bottom feeders, such as cod and pollock, became more abundant. Such changes again were very significant to the Indians dwelling in the coastal zone, as has been recognized in archaeological research.* Figure 9 is a stylized cross-sectional representation of this fertile phase of the Gulf of Maine.

Continued subsidence slowly enlarged the Gulf of Maine, so that eventually it become too large for perfect tidal resonance and the tides diminished in their amplitude. This can be seen in a change in the microfaunal composition that took place nearly 2,000 years ago, when *Bolivina subaenariensis* was displaced as the dominant species by *Bulimina aculeata*, indicating a slight drop in productivity. From then on no further significant change in the composition of the fauna and the flora can be seen in our cores: the Gulf of Maine had reached its modern state.

While this initial survey of the Gulf of Maine and its history produced a good overview, much detail still needs to be pursued. We are hoping for the time when we can take a systematic inventory with more precise seismic profiling equipment and when new wider and longer cores and new analytical techniques yield more refined and detailed information on the temporal and spacial differences in past ecological conditions. This initial study was essentially a one principal investigator (and his students) effort; the new study would be truly interdisciplinary and would involve many of

the oceanographers of the University of Maine and perhaps some of our Canadian colleagues.

This review of the ecological history of the Gulf of Maine has some interesting ramifications concerning future human activities. Presently, our Canadian neighbors are studying the feasibility of a tidal power-generating plant in the Bay of Fundy. By cutting off a good sized embayment from the Gulf of Maine with a power dam, this project would effectively reduce the size of the Gulf of Maine and thereby bring its size closer to the tidal resonance point. Computer modelling already has shown that the power dam will increase the tidal range in many parts of the Gulf of Maine by a foot or more. Our paleoecological evidence suggests that construction of the dam will return the conditions that reigned perhaps 4,000 years ago by increasing the fertility of the Gulf of Maine waters and lowering their temperatures. Whether this is desirable depends upon viewpoint and perspective.

*See *The Gulf of Maine Littoral*, EXPLORATIONS, Vol. II, No. 2, January, 1986.

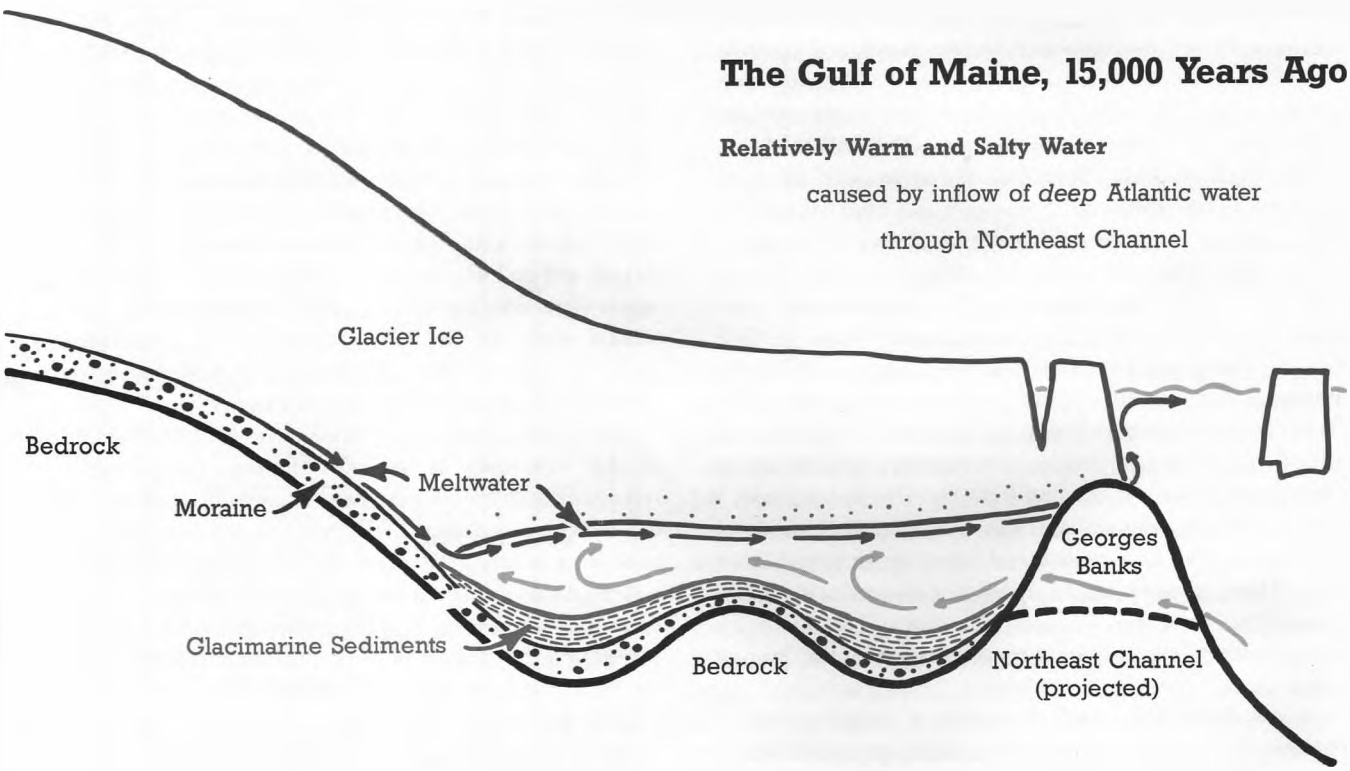


Figure 5: North-west to South-east section across the Gulf of Maine area as it would have appeared about 15,000 years ago. The ice began to thin and seawater found entry into the Gulf underneath the ice. Gravel, sand and mud melted out of the base of the glacial ice.

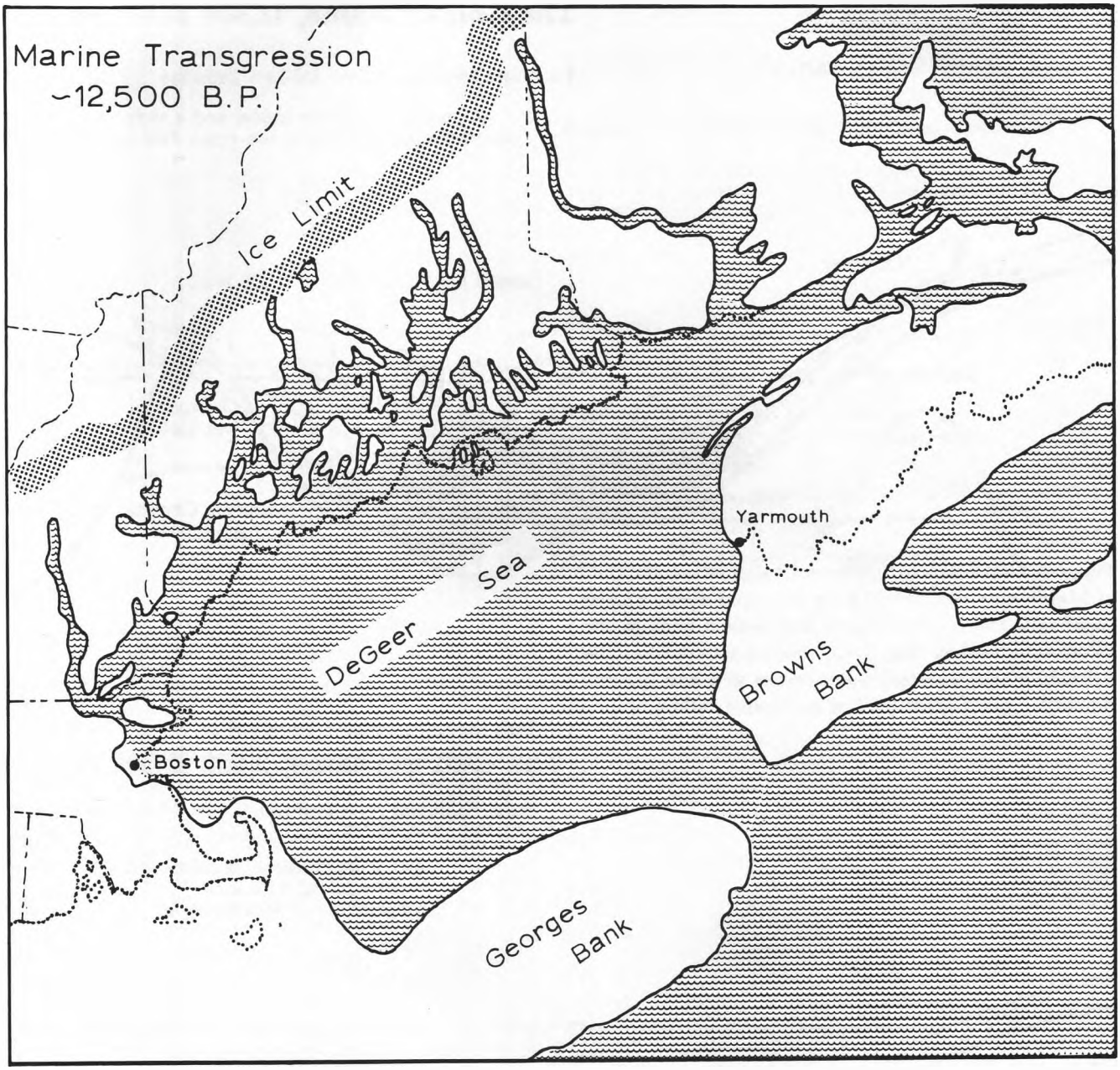


Figure 6: The nearly landlocked early Gulf of Maine shortly after the ice had disappeared 12,000 years ago (after Lougee, 1952).

The Gulf of Maine, 12,500 Years Ago

Cold and Brackish Water (20-24% Salinity)

caused by meltwater inflow and a very restricted connection to the open Atlantic

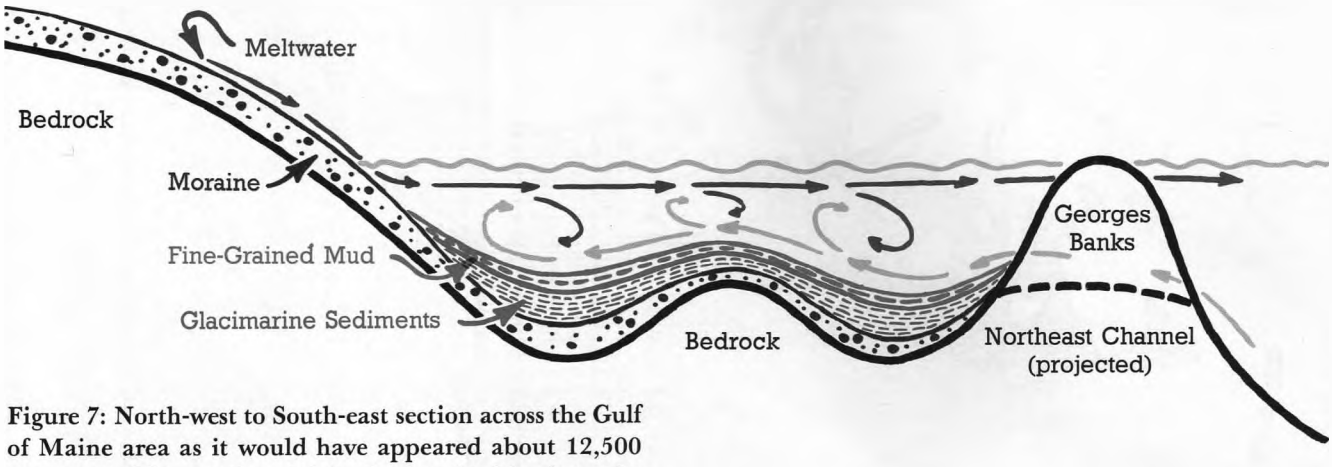


Figure 7: North-west to South-east section across the Gulf of Maine area as it would have appeared about 12,500 years ago. The continental ice had melted back to the interior of Maine. The Gulf was separated from the Atlantic by the emerged outer banks and had become brackish from a great deal of meltwater inflow.

The Gulf of Maine, 9,000 Years Ago

Warm and Salty Water

caused by climatic warming, little runoff from land, strong inflow of Atlantic water

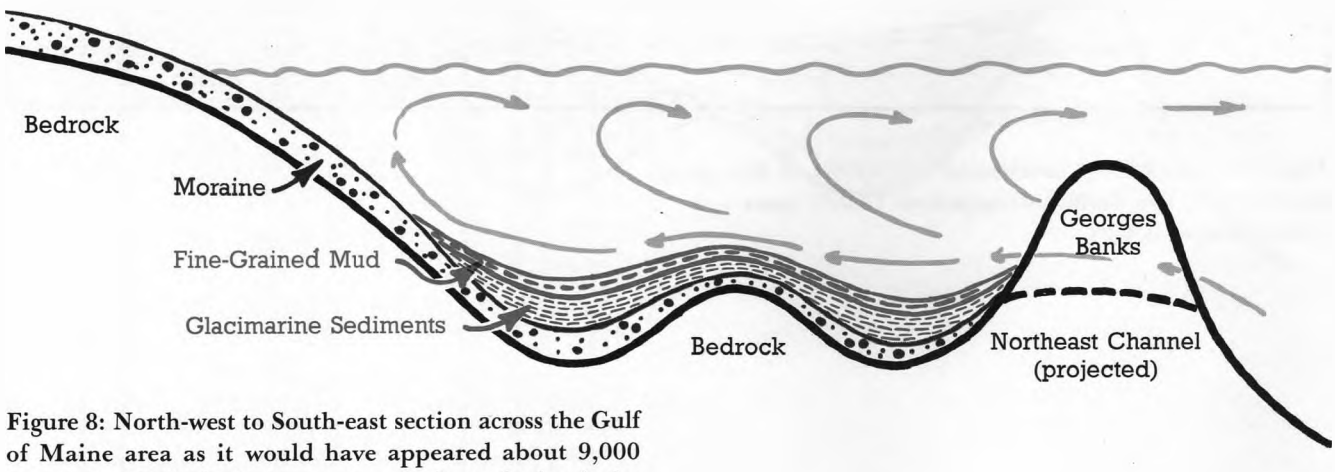


Figure 8: North-west to South-east section across the Gulf of Maine area as it would have appeared about 9,000 years ago. Little fresh water came in from the land, the Gulf was then well-connected to the open Atlantic, and its waters were warm and very saline.

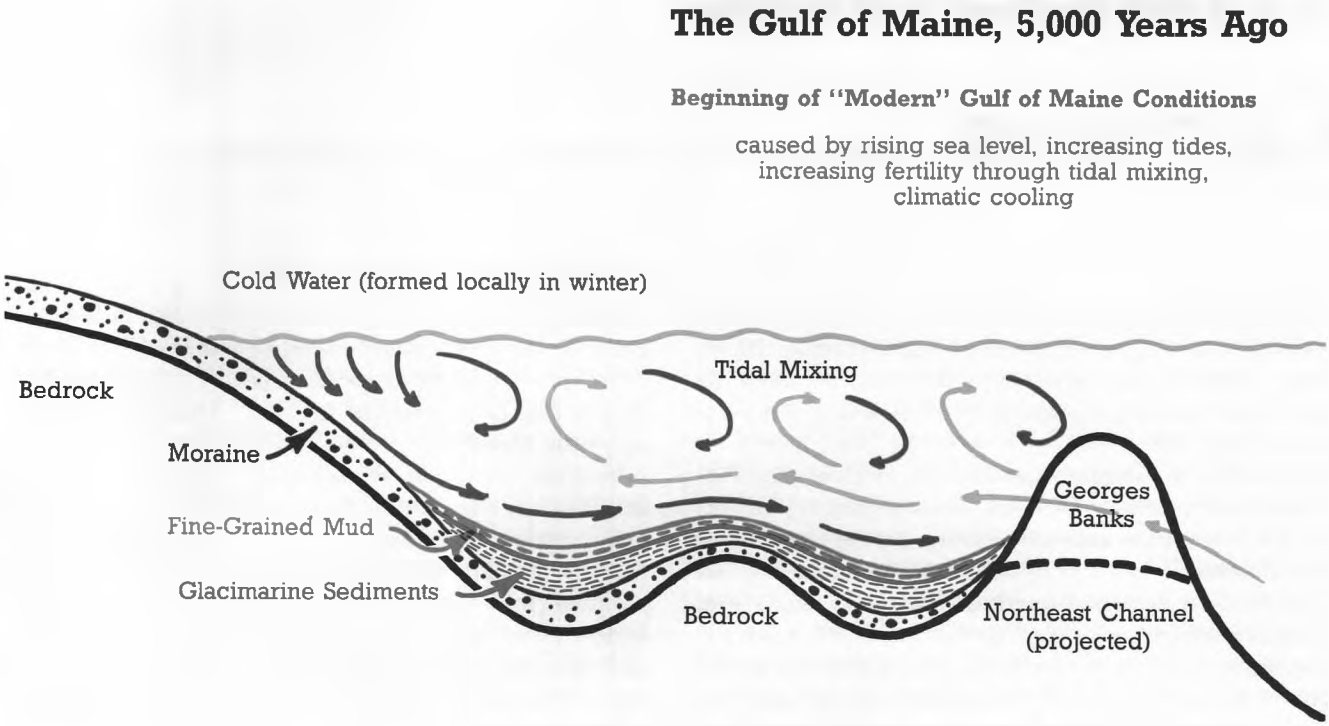


Figure 9: North-west to South-east section across the Gulf of Maine area as it would have appeared about 5,000 years ago. Subsiding land and rising sea level enlarged the Gulf so that it began to resonate with the lunar tides. Strong tidal mixing brought about the high fertility of the Gulf waters.

WE STAND CORRECTED

In Volume II, Number 2, of EXPLORATIONS, we reported two errors in "Nobody Told the Bumblebee He Couldn't Fly," by Herbert Hidu. In the section about polyploidy in shellfish, cytochalasin-treated groups which remained as diploids were treated identically to their triploid (not diploid as stated) siblings. Later in the article, a performance gain of 4 percent should have read a performance gain of 40 percent (from a single manipulation). We regret the errors.

DIALOGUE

LETTERS

To the Editor:

I have read with some interest Burton Hatlen's article entitled "Carroll Terrell and the Great American Poetry Wars" in the April issue of EXPLORATIONS. Terry is a gentleman and a scholar who is surely deserving of this loving tribute.

I presume to disagree, however, with much of what Professor Hatlen seems to be saying about poetry. It may well be that "there is an authentic *American populist poetry* in our century (which) has developed in opposition to a tradition of *American academic poetry*", but it is ludicrous to suggest that such unintelligible poets as Pound and Zukofsky belong to the former category. Professor Hatlen informs us—almost cheerfully — that none of Zukofsky's books has ever sold more than a few hundred copies. And Pound, whose *Cantos* require a monumental line-by-line scholarly *Companion* for explication, is ipso facto the quintessential academic poet. Other than English majors under duress, who reads Pound? Lobster fishermen? Mill-workers? Farmers?

Given the perennial popularity of such anti-poems as Joyce Kilmer's *Trees*, it is easy to be contemptous of American poetic public opinion. This may explain — but does not justify — the elitist attitude of those poets who cannot condescend to communicate and those critics who confuse opacity with profundity. Still, I believe that there is an authentic American populist poetry. It survives, for example, in the works of Witter Bynner, Emily Dickinson, Loren Eiseley, Robert Frost, and Edna St. Vincent Millay. It finds expression in the poems of Lawrence Ferlinghetti, Donald Hall, Mary Oliver, and Linda Pasten. And its ultimate survival lies not in the hands of Academia but in the hearts of the American people.

Phil Locke
Assoc. Prof. of Mathematics
University of Maine

To the Editor:

Thank you for offering me an opportunity to respond to Phil Locke's letter. And I'd also like to thank Phil himself, a mathematician who cares about poetry and music. People like Phil help to remind us what a liberal arts education is all about.

Yes, the poetry of Pound and Zukofsky *does* make demands on the reader. Any *new* poetry stretches our preconceptions about poetry, and about language itself. But when Phil calls the poetry of Pound and Zukofsky "unintelligible," I find myself remembering that in the early decades of the 19th century the poetry of Wordsworth and Keats was regularly denounced as unintelligible, and that the major works of Blake seemed impenetrable to readers for almost a century. These examples suggest that unintelligibility may sometimes lie in the eye of the beholder. "Artists," said Pound himself, "are the antennae of the race." As this metaphor suggests, major artists are likely to be a little *ahead* of the race as a whole, just as the caterpillar's antennae *precede* it on its journey, sensing out the territory ahead, and telling the creature where it is going. So I'm not particularly disturbed by the relatively small audience for Zukofsky's poetry. As for Pound—here the audience is, thanks in considerable measure to Terry, steadily growing. Yes, this audience is still largely an academic one. But as students learn to read Pound from their teachers, at least some of them are carrying this enthusiasm beyond the classroom. On this score, the case of William Carlos Williams seems to me especially pertinent. Thirty years ago, when I was an undergraduate, Williams had virtually no readers in or out of academia. But in the 1950s the academics began to take Williams seriously. (I was part of this process. In 1959 I wrote an M.A. thesis on Williams—one of the first.) And now, by the mid-1980's, Williams has become one of the few truly popular poets in this country. Williams is somewhat more accessible than Pound, simply because he takes as his subject a piece of northern New Jersey, rather than the whole of history. Yet Williams learned more from Pound than from anyone else, and his poetic method is similar to Pound's. Anyone who can learn to read Williams (and nowadays the students don't need to learn how to read Williams—they just know how) can learn to read Pound: and as time passes Pound's readership will, I am confident, continue to grow.

But in my article, I not only claimed that Pound and company are important poets, I also described them as representing a *populist* tradition in American poetry. Phil raises a significant objection here. In what sense can a poetry which lacks a large popular audience be populist? Here I need to make a distinction between popular and populist. TV shows like *Dynasty* are very popular cultural commodities. Yet their popularity doesn't make these shows populist. Indeed, quite the contrary, for the implicit message of these TV shows is that only the rich and powerful are worthy of our attention, and that the lives of ordinary human beings (unless they happen to work for rich people) are totally empty of meaning. That so many of the popular shows on TV carry such overtly anti-populist messages demonstrates that there is no necessary connection between popularity and a populist viewpoint. Of course, some popular works *are* populist in viewpoint: I'm thinking of the films of Stephen Spielberg and the novels of Stephen King, for example. But many works of art which are profoundly populist in viewpoint have never been very popular: the works of Tillie Olsen and Meridel Le Sueur, for example. Thus in labelling as "populist" the poetic tradition represented by poets like William Carlos Williams, George Oppen, Allen Ginsberg, etc., I was implying nothing one way or another about the popularity of these poets. Rather I was pointing to their insistence upon taking seriously the lives of ordinary human beings. That ordinary Americans aren't often reading George Oppen and are watching *Dynasty* instead seems to me very sad. But this fact shows, not that Oppen isn't a populist poet, but rather that the mass media have in significant measure deprived the American people of a culture that celebrates the values to which this country was once dedicated—*i.e.*, the values of democracy and equality—and have instead foisted upon our nation a culture which celebrates a purely selfish pursuit of power and pleasure.

The lists of poets which Phil includes in the last paragraph of his letter suggest his confusion over what is or is not populist. Indeed, I can't see much of anything that these poets have in common with one another, except that Phil likes them all. For example, Frost remains a popular poet and his work has some populist qualities, but Witter Bynner is neither popular nor a populist. And Phil lists Emily Dickinson, one of the two major American poets of the 19th century, while omitting Walt Whitman, the other such poet and surely the most consistently populist poet in all literature. So too, Phil includes Lawrence Ferlinghetti, an admirer and imitator of Whitman and Pound and Williams, and surely a part of the populist tradition. But Ferlinghetti jostles against Donald Hall, who likes to voice quasi-populist ideas, but whose sense of language and of poetic form is as Mandarin as they come. Ultimately, the point of my essay is that what poets think really doesn't matter much. What matters is *how they put the words on the page*—and on this score no two poets could be more antithetical than Ferlinghetti and Hall. It is Ferlinghetti's ear for the cadences of American Speech and his willingness to let his poems open out to follow the contours of the American human and natural landscape, not his interest in baseball, that makes him a populist poet. Conversely, it is Hall's mannered, quasi-British language and his neo-Audenesque cadences that make him an academic poet, even though he too is interested in baseball. I admire mathematicians because they seem to understand better than anyone else that it's not the answer that counts, it's how you get there. Well, Phil, the same is true of poetry. It's not what the poem says but *how* it says it that counts.

Obviously, I haven't changed my mind on these issues. But I hope this letter will help to clarify some of the assumptions that underlie my essay on Carroll Terrell. Thanks again to you and to Phil, and to the dozen or so other people who wrote in response to my essay.

Burton Hatlen
Professor of English
University of Maine

UPDATES FROM THE DISPATCH CASE

Paula A. Quatromoni, Research Assistant in the School of Human Development, was interviewed extensively by WNBC-TV, New York, for inclusion in a Nightly News segment on malnutrition and poverty in Maine and the United States. Triggered by inclusion of her research and field work in an article in EXPLORATIONS, the nationally televised series ran for several days and covered malnutrition from several states in addition to Maine. The highlighted project is one funded through a State grant from the Department of Human Services obtained by Associate Professor of Nutrition Richard A. Cook. Ms. Quatromoni's participation provided the basis for her thesis research for her recently completed University of Maine Master of Science degree in Human Nutrition. See "Malnutrition in Maine" in EXPLORATIONS, Volume II, Number 1, pp 14-16, and From the Dispatch Case, Update on Malnutrition in Maine, EXPLORATIONS, Volume II, Number 3, p 31.

MORE ON THE MAINE LOBSTER

It is illegal in Maine to land lobsters with a mutilated or notched right uropod (tail flipper). The voluntary v-notching of egged lobsters by fishermen enhances the reproductive capability of Maine lobsters. The marking of egged lobsters and subsequent protection of marked lobsters has been in practice since 1916 in the State of Maine. However, since 1982, no effort had been made to determine the contribution of v-notched lobsters to the fishery until the survey of trap contents conducted by the Maine Lobstermen's Association (MLA). Three years of MLA survey results indicate that v-notched lobsters may make a significant contribution to the fishery. Twenty-nine percent of trapped females and 68 percent of trapped egged lobsters were v-notched, while 59 percent of trapped lobsters were female. Since v-notched females must have been previously egged and hence are larger than landed females they should have higher fecundities and be proportionally more sexually mature. Using a modified eggs per recruit equation, it was predicted that the egg production of a v-notched female may be 15 times greater than that of a landed female. Therefore, it is necessary for only five percent of annual trapped lobsters to be v-notched in order to contribute an equivalent number of eggs as calculated for landed lobsters. These preliminary studies using data from the MLA surveys indicated the need to include v-notched lobsters in Maine fishery surveys and assessments.

Two assumptions used in this study must be validated to compare accurately the v-notched recruitment contribution with that of nonv-notched female lobsters. First, it was assumed that the size-frequency distribution of v-notched lobsters is similar to that of egged lobsters sampled in Maine waters. This appears to be reasonable since only egged lobsters are v-notched by lobstermen, but to date there has been no field sampling to determine sizes of v-notched lobsters. Furthermore, the Department of Marine Resources has v-notched and released an undetermined number of nonegged females, which could have the effect of lowering the mean size of v-notched lobsters in the coastal Maine population. Valuation of this assumption is important in that fecundity and the proportion of sexual maturity increase logistically with size.

Second, it was assumed that the MLA survey trap catch is representative of the population of legal-sized lobsters in Maine. Knowing the numbers of females commercially landed annually allows the determination of the number of v-notched lobsters trapped annually by direct proportion and hence, the estimation of annual egg production of v-notched lobsters. This assumption is probably invalid. Nonv-notched and nonegged lobsters are removed from the fishery after trapping which prevents redundancy in landing statistics. V-notched lobsters are returned to the sea after trapping, allowing the possibility of repetitive captures. The 29 percent value for proportion of trap caught females with v-notches determined from the MLA survey would represent a maximum value since it does not take into account repetitive captures.

The current project tests these two assumptions through an intensive sampling program. By incorporating the aid of responsible fishermen, data is being gathered on the size-frequency distribution and the amount of redundancy in trap-catch of v-notched lobsters. This has involved a series of trap samplings along the coast of Maine during the most active lobstering period of June to October, 1986.

For more information about University of Maine research and direction in the effort to conserve the Maine lobster, see "Diet Developments for the Maine Lobster", by Robert Bayer, in EXPLORATIONS, Volume II, Number 2, pp 39-42.

University of Maine
Office of the Vice President for Research
Orono, Maine 04469

A JOURNAL OF RESEARCH AT THE UNIVERSITY OF MAINE