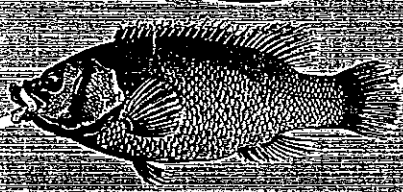
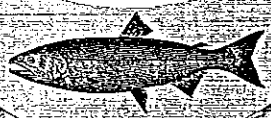
Wesleyan

The Wesleyan University Alumnus

Earth and Environment





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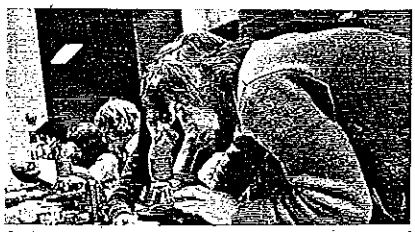


A Change in Environment

The earth moves and so does one department.

by Alphonsus J. Mitchell

Live like the reed, bend with the wind." So says a Japanese proverb much in favor with ecologists. As counsel for survival in the natural world, it has the ring of wisdom. In the highly contrived world of the University, it sounds less lovely but is no less valuable as a principle of survival.

Where better to find such a principle illustrated than in the department of Earth and Environmental Sciences, which had over 450 students enrolled in its courses last year and counts a healthy 45 majors among its current students? The department not only survives but it flourishes on the same hard ground where a small Geology Department struggled to hold its place not too many years ago.

Obviously this is a department which has ridden the winds of change very nicely, the main current having been the ecology movement which directed the attention of many young people to the condition of their living environment. But bear in mind that the E&ES program is not a haven for easy riders. The department offers two distinct majors, one in Earth Science – the remodeled Geology major – and one in Environmental Science, which demands a minimum of 17 science courses, the stiffest requirement for any major in the university. A mild curiosity about the environment might get a student into such a program but can hardly sustain him or her without some serious commitment.

Clearly there are some other factors involved in the E&ES success of recent years. Among them are:

- The faculty's willingness to change directions.
- A cleverly implemented program that makes the most of minimal resources.
- Powerful teaching, particularly on the introductory level.
- The appeal of a program that allows students to study scientifically rocks and beaches, streams and mountains, things in their natural state.
- A high degree of sociability among students and teachers.
- Luck.

Not all of these things could be said to have flowered from the reform of the department in 1973. In fact, it was not the reform nor the ecology movement which triggered its successful surge but another big wind which almost blew the department away five years earlier.

* * *

Geology has been taught at Wesleyan since 1833, but the department consisted of one man for most of that time. Jelle de Boer, who has taught at Wesleyan since 1964, is only the fifth full professor in the long history of the department. The fourth was Joe Webb Peoples, who taught for 40 years before retiring in 1975. Over the course of four decades, Peoples' persuasive Tennessee drawl was successful in cajoling the administration to allow a small build-up of the department against a lot of odds.

For the fact was that the Geology Department never had many majors. As Peoples points out, nobody ever came to Wesleyan declaring himself as a prospective Geology major. If they became interested in the subject, that happened after they arrived.

In the early 60's when the department had expanded to three members, a student interested in becoming a professional geologist could work very closely with some top scientists. In addition to Peoples, who was an editor of an important international journal on economic geology and has a legendary world-wide acquaintance, there was James Balsley, who was well known in the field for developing the basic techniques for airborne geophysical surveys. Balsley had served with the U.S. Geological Survey for 22 years before coming to Wesleyan in 1962. He returned to the USGS in 1971 as Assistant Director in charge of its vast environmental program. Besides the two senior faculty, there was a succession of bright young geologists. Among these was de Boer, a geophysicist from the University of Utrecht in the Netherlands, who came as a post-doctoral fellow. When he arrived he was already into important research on plate tectonics, the theory that continents ride on huge crustal plates and very slowly change positions in relation to one another. The general acceptance of this theory in the late 60's was a revolution in geology and changed the direction of much research and teaching.

Part of the faculty's time was committed to a small graduate program. Wesleyan accepted as graduates able students who had become interested in geology late in their undergraduate careers and had insufficient background to get into a standard graduate program. The faculty also took on foreign students, mainly from Korea, Taiwan and the Phillipines, who might have language problems and would be lost in a big university. Wesleyan could do a good job with these students because the faculty could give the time to help them make up deficiencies.

Nevertheless, the undergraduate majors did not materialize. In the years between 1962–63 and 1969–70, while the department added a fourth member, Gregory Horne, the number of majors (counting both juniors and seniors) was 3, 4, 4, 3, 2, 2, 2, 2. On analyses that showed the commitment of resources per student by department,

Geology always looked high and vulnerable.

The department's anchor in the undergraduate program was Introductory Geology, the famous "Rocks for Jocks." All undergraduates were required to take one lab science course to fulfill the distribution requirements. For many, Intro Geology was the least distasteful way of checking off the requirement.

In 1968–69, the anchor blew away. The faculty voted to abolish course-distribution requirements in favor of a guideline system. Language departments and physical education suffered grave first-year declines but no department was stripped so bare as Geology. In the first year after requirements were dropped, only three students registered for Introductory Geology.

"Actually, that course was not fun to teach," says Horne, now an associate professor and chairman of the department. "Most of the students didn't want to be in it."

Earlier the trustees had expressed concern about the low enrollments in the department and one board member had suggested that a course in oceanography might capture some interest. Horne, then the junior faculty member and the one best qualified to teach such a course, recalls feeling indignant about the idea ("We're a Geology Department, not an Oceanography Department!")

Two years later the department was living like the reed, offering half a dozen introductory courses and finding new ways to interest students. Horne taught oceanography.

"Our enrollments shot up," says Horne. "We enjoyed the fact that these courses were fun to teach. It changed our whole attitude toward teaching lower level courses. We put a lot into them."

The total course enrollments in the department quadrupled in three years and the number of majors rose modestly so that they at least exceeded the number of faculty in the department.

In the spring of 1973, shortly after President Colin Campbell had made his first grim speech to the community about the severe strains on Wesleyan's finances, the idea for the reform of the Geology Department was hatched in discussion between Horne and Assistant Professor James Gutmann. The thought was to broaden the scope of geology from the study of solid rocks to include the study of the atmosphere, hydrosphere (ground water and oceans) and biosphere. Environmental science was seen as strongly rooted in earth science but taking in all the systems of air, land, water, energy and life that surround man.

Gutmann and Horne wrote the proposal and brought it to de Boer and Peoples who endorsed it. The plan called for the addition of a fifth and eventually a sixth faculty member and cooperation from the Biology and Chemistry Departments which would be handling some of the requirements for the E&ES majors.

"Colin had mentioned in his speech something about innovation and how he hoped it would continue. But at the time, it looked as if everybody would be lucky to keep what they had," says Peoples. "We were astonished at Colin's reaction when we first met with him. There was genuine enthusiasm for the idea. We were delighted but surprised.

"But something like this was happening all over the country in our field. There were two or three factors involved: a major breakthrough in theory and understanding, for which plate tectonics provided the technical basis; people had become concerned with problems of the environment; and geologists were being persuaded to apply their studies to problems of the environment."

In piloting the proposal through the administration, faculty and trustees, the departmental spokesman took note of the "back to earth" movement, which might have been seen as a fad, but argued that the response to the courses they were already offering had indicated a demand for something more than a cursory treatment of environmental problems.

When the program was approved, E&ES went into the field with the toughest set of course requirements it had ever offered and came away with 24 declared majors. The number of majors has increased since then.

* * *

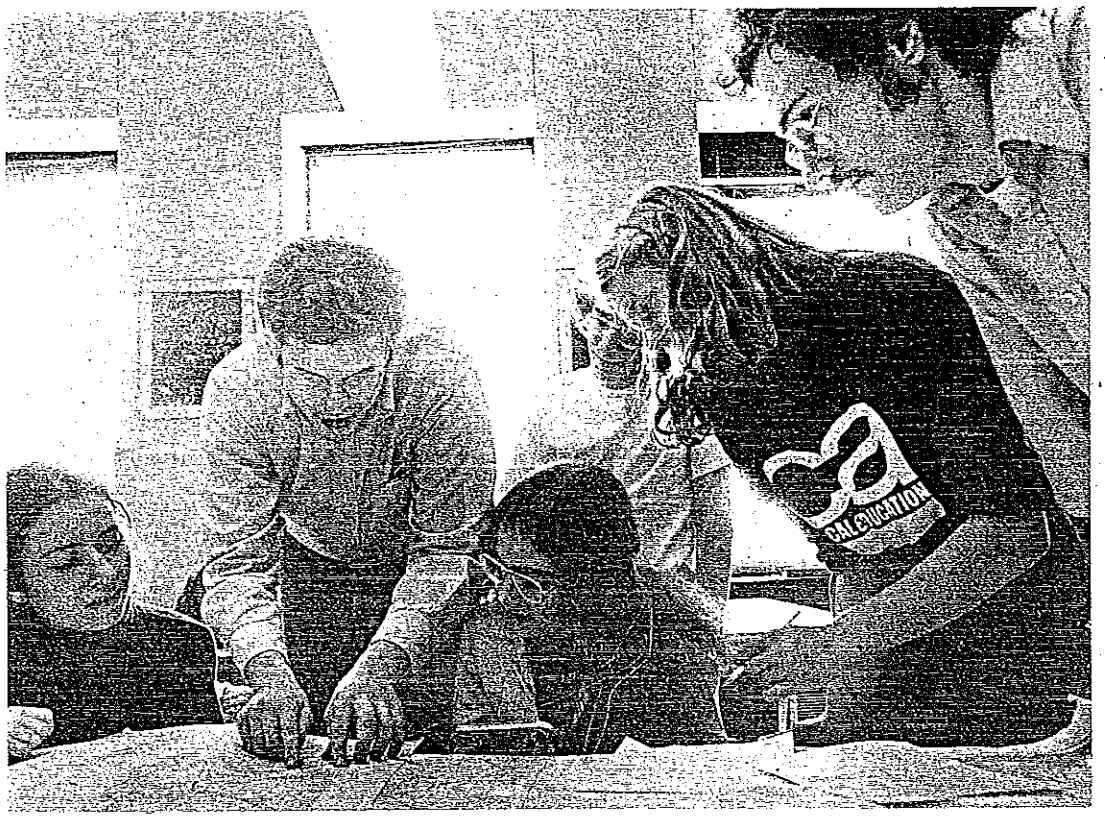
"Fascinating" is a word that recurs in student conversations about E&ES, as they explain how they became interested in the field.

In part, this is due to the subject. Nature is the laboratory for earth science. There are difficult concepts to grasp, stretches of time that are unimaginable. But there are also immediate and hair-raising events such as earthquakes, floods or erupting volcanos to be considered.

But nature is an ornery subject, too complex to be predictable or comprehended solely through controlled experiments in laboratories.

"There is virtually nothing that you can prove, because you deal with the natural system," says de Boer. "Physicists, chemists deal with parts of the system. A geologist usually presents a hypothesis. If he has reasoned well, it will be respected. But natural systems are so complex that we can rarely achieve a final answer."

A great many fourth graders have probably speculated



From the left, Assistant Professor Peter Patton in class; John Allcock in the lab; Jelle deBoer.

that the continents of North and South America would fit snugly with Europe and Africa, but it was not until about 1960 that geologists developed convincing data that matched up characteristic features of rock formations on opposing coasts of widely separated continents. For example, Horne in the mid-60's was publishing papers on the early Paleozoic history of the Appalachian mountain belt in northeastern Newfoundland which showed many similarities to the Caledonian mountain system of western Ireland. This type of evidence invites the conclusion that western Europe and northeastern North America were joined in one land mass, before it broke in parts which "drifted." Research on continental drift, ocean-floor spreading and plate tectonics was the liveliest area of geology in the '60s.

But there are holes in the tectonic theory. On the island of Luzon in the Philippines, de Boer directs a large-scale mapping project which involves building a geotectonic model to show the history of the area and what is happening now.

"We're very excited about it," he says, "because we have discovered things we did not expect. In Luzon the plates dip toward the Pacific, which is different than we thought. The subduction method (by which one plate overrides the other) is opposite to that of other regions on the western margin of the Pacific. That shows that plate tectonics is fine — you can draw the long lines of the system — but it is much more complex than we thought."

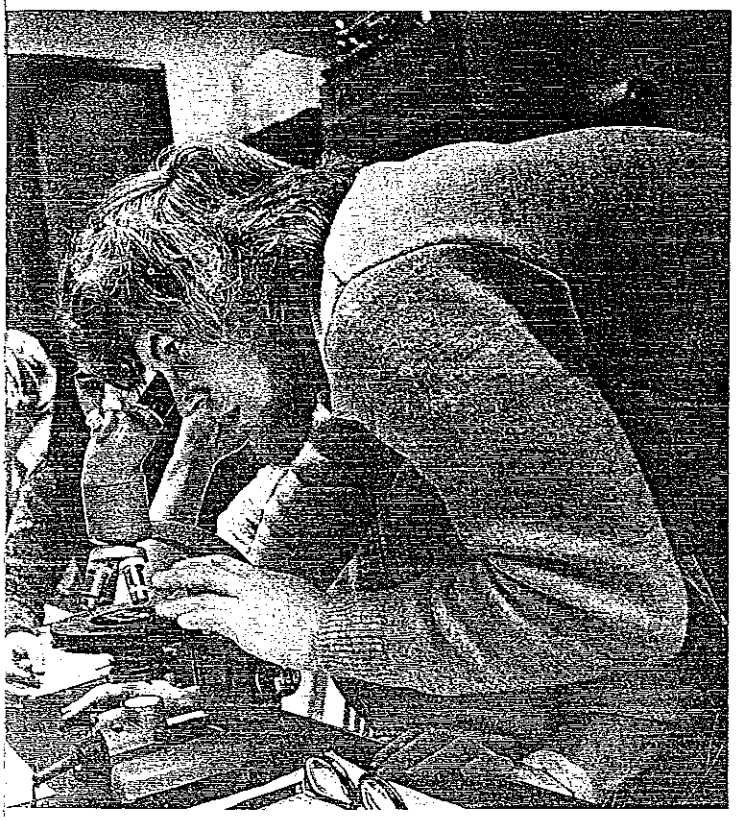
The mysterious aspects of earth science add an element of attraction. So much is yet to be known and the possibilities are exciting to students as well as to teachers.

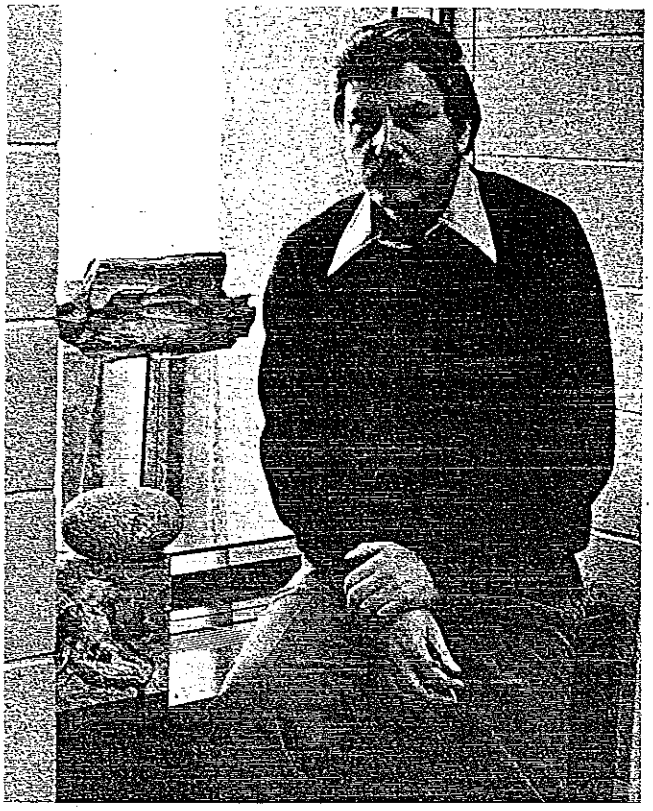
A lot of this comes out in the introductory courses, apparently. Gutmann, who has taught the basic introductory course every year he has been on hand, has written the course fresh each time. "I enjoy it enormously," he says. "It's awfully easy in upper-level courses to get off into your own little thing and to forget the fundamental assumptions underlying what you're showing to undergraduates. But in the introductory course they have a way of pinning you to the wall from time to time with thought-provoking questions. It's a stimulus to me to keep up-to-date in many more aspects than my own specialty.

"The ferment in the literature now is enormous. There is a huge body of basic data which for a long time nobody was able to fit together. Nobody had the foggiest idea of how the history of northwest Africa could be related to North America, for example. Now is a very exciting time to be in Earth Science. This makes teaching the 101 course rewarding. You're appealing to many lines of evidence, straining to understand how they all come together, and it's exciting to me to see this gradually build up in students until they catch fire."

Another part of the attraction in earth science is the field work, which is particularly appealing to undergraduates who want to be outdoors and who are impatient with abstraction. Lee Arnold, a senior who has a joint major in Biology and Environmental Sciences, voices the feeling of a number of students when he says, "You find out here that science doesn't have to be a laboratory exercise. You don't have to keep dealing with things that you can't see."

"This department has always concentrated on the field aspects, rather than the lab," says de Boer. "Joe Peoples,





PHOTOS BY WILLIAM VAN SAUN

Jim Balsley and Greg all emphasized field work. If you start in the lab, you're off on the wrong foot."

Aside from the scientific aspects of field work, de Boer believes in it as a great aid to student maturity. In American schools, he feels, there are a great many students who have not matured. "You take some of these people," he says, "and you send them out in a small group to study a volcano. They have time to think. They have to get along with the others. Perhaps they don't learn so much geology, but they find out about themselves."

Monica Montague '77 came to Wesleyan as a prospective history or English major. But she took Man's Geological Environment and was "fascinated." Along with some other Wesleyan students, she got a place on a University of Rhode Island oceanographic research vessel in the summer after her freshman year. The ship was engaged in studies of the mid-Atlantic ridge off the Azores for four weeks. It was not only interesting but enjoyable. "I liked the people. They dispelled all my stereotypes about sciences."

During the spring recess two years ago, she was engaged with other students in a two-week field mapping project (required for all majors) in the Cockaponset State Forest, about 15 miles south of Middletown. "We were mapping igneous and metamorphic rocks and eventually we turned our results over to the Connecticut Geological Survey; they differed from the state maps. Every day we would traverse a 4-by-4-mile area and then at night we would go back to Deer Lake Camp. That was in March and it was pretty cold. But we would chop wood and enter our stuff on the maps and sit around the fire listening to the professors (Gutmann and de Boer) tell stories about some of the field trips they had been on. It was really fun."

Last spring, she joined a group from the department on a trip to the Florida Keys where they dove with SCUBA and snorkel equipment to study reefs and sediments, not to meet any academic requirements but just for the sport.

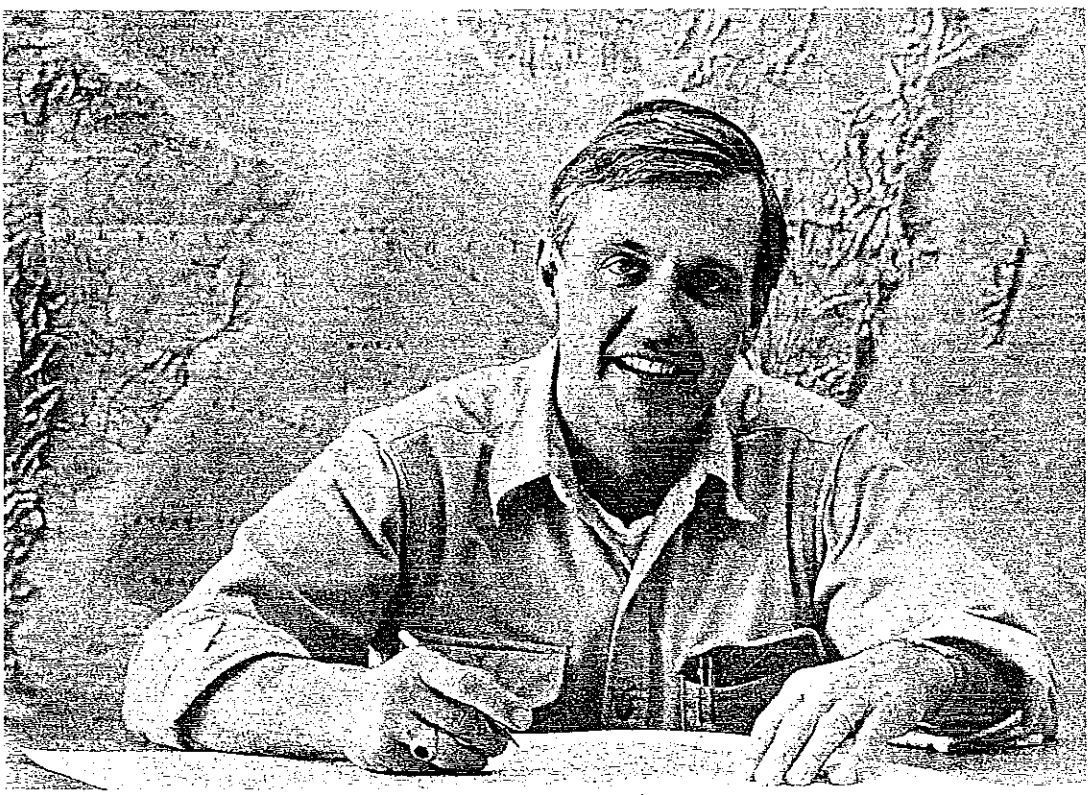
Her field experience is fairly typical of what E&ES majors do. She has also been an intern for the Nuclear Regulatory Commission in Washington, doing earthquake research. She will go on to graduate school for further study of structural geology which she likes because, "you have to go out in the field to check what you're doing. I just dread eight hours a day in an office."

* * *

Five of the six members of the E&ES faculty are earth scientists. The lone exception is Richard Moore, a microbiologist, who is teaching his first course on Pollution Ecology this spring. Moore is an Adjunct Professor of Earth and Environmental Sciences and is Director of the Essex Marine Laboratory, which came to Wesleyan by a stroke of luck in January 1975.

Essex Marine is a not-for-profit research laboratory established in 1965 by William A. Boyd who approached President Campbell with the offer to turn over the lab with all its assets to the University, provided that Wesleyan continue to operate it. The offer came just as the department was proceeding with its reform. Wesleyan accepted.

The lab had supported itself by contractual research, notably an eight-year study for the Northeast Utilities



From the left, E&ES Chairman Horne; grad student Mike Farrar showing slides in colloquium; James Gutmann; Richard Moore.

Company of the environmental impact of its Connecticut Yankee Atomic Power Plant on marine life in the Connecticut River.

The lab is situated on the North Cove in Essex where village and harbor make one of the most picturesque scenes in New England. The lab assets include half a dozen small boats, an IBM 1130 computer, and office and laboratory equipment.

"The big problem with the lab," says Horne, "is that we have to insure that it is no drain on the assets of the University. It must be self-sustaining, which means that the director must bring in a lot of contract work."

Moore, who has extensive experience in marine ecological studies as former director of the Lake Ontario Environmental Laboratory, took over the near-dormant lab in January 1976 and has been building up its activity.

The lab's permanent personnel at the moment are Moore, a secretary and a maintenance man. Graduates and undergraduates are hired as needed for the contract work. The main project now underway is a two-phased study for the Corps of Army Engineers.

There are 33 bars and shoals on the river between Hartford and Old Saybrook, a distance of some 40 miles as the river flows. The State Department of Environmental Protection won't allow the Engineers to dredge during the shad run. The shad go up river to spawn in the spring and start downriver in August. "The DEP is concerned because sediment is stirred up by the dredging," says Moore. "They want to know if it influences the fish. Does it release hydrocarbons, mainly pesticides, or heavy metals?"

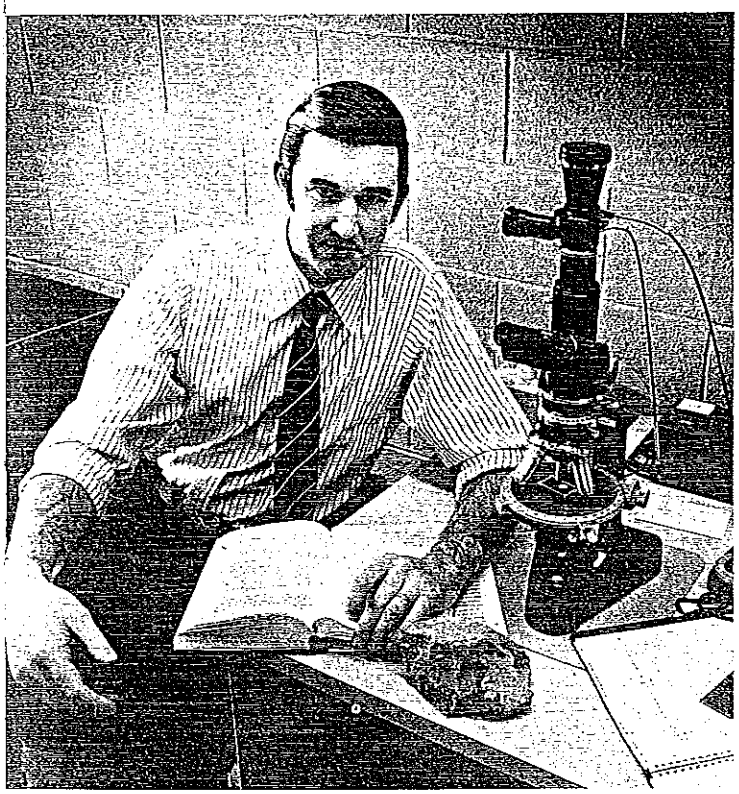
The lab began a study of the effects of dredging and in-river disposal of sediment in October, at the tail-end of the shad run. Students working on the project were out on the river in eight-hour shifts for 40 hours at a stretch while the sampling was being done during October and some very cold weeks in November. The report on this study is due in the spring.

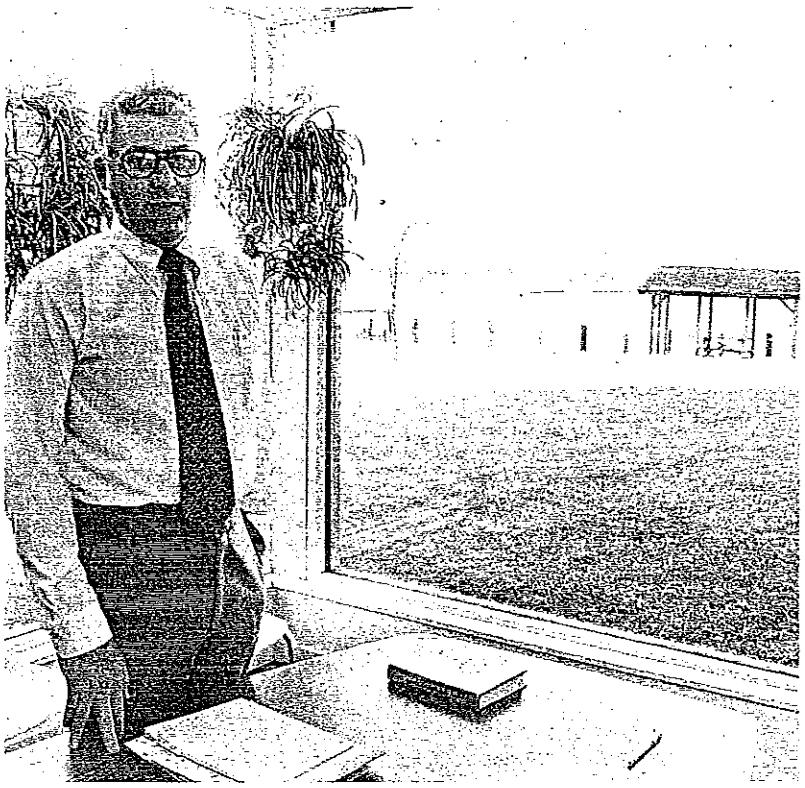
"Actually, 1977 looks good for us," says Moore. "We'll be doing a physical study of the river (hydrology and sedimentology) for the Corps of Engineers and Fish and Wildlife Service and the ecological study of dredging and dumping. We'll also be running public information seminars for community leaders on developing a plan for the maintenance of the river."

While the lab establishes itself with outside contractors, faculty and students are eager to increase their use of Essex Marine. "This is the real asset of the lab," says Horne. "It provides us with a facility for students and faculty working on independent projects and summer field programs."

Last year, the lab figured in the program of the Graduate Summer School for Teachers. "We used the lab in the regular instruction program," says Horne. "We used the boats for field trips and estuarine studies—students are very interested in that—and for small scale research projects."

Bob Demicco, a graduate student, is one who has made good use of the lab. He was a zoology major at Connecticut College and, through the exchange program, had taken two courses at Wesleyan, Man's Geological Environment and Geotectonics, "a dynamite course that got





me really interested in geology." He returned to Wesleyan as a graduate student, has been to Costa Rica with de Boer, directed fin-fish sampling on the river for Essex Marine, and has done his own thesis study of coastal stability on Griswold Point in Old Lyme, where the Connecticut River flows into Long Island Sound.

His thesis takes in three phases: a one-year study of beach morphology, using various surveying techniques to measure the impact of wave climate, wind direction and tidal patterns; a 100-year comparison of old maps and charts to see how the coastline has changed; and a geophysical study, using seismic reflection methods, to determine the long-term geological history of the area. His studies identify glacial deposits beneath the river and the sound and deal with some interesting problems such as how the sound developed after glaciation.

Demicco, who is teaching a course in earth science at Central Connecticut State College while completing his M.A. at Wesleyan, used the marine lab facilities for all his off-shore work and had plenty of help from undergraduates and summer school students. He believes the study and others like it will be of value to the state because of the growing public demand for development and use of coastal areas. "Before you can manage coastal areas, you have to know what's going on underneath," he says.

His work is indicative of how students can use the lab. "Actually," says Horne, "most of our environmental science majors are interested in marine science. Our environmental science program may be evolving into marine science."

Geologists are generally well travelled. They don't spend their leaves or vacations in Geneva or Paris or Rio de Janeiro as a rule but are more likely found on mountainsides, holes in the ground, at sea or under it.

Geologists are also unusual in that they reflect considerable experience outside the academic world. Joe Peoples worked as an engineer for two years in the coal fields of western Pennsylvania after he took his Ph.D. from Princeton. He counts those years as "among the most valuable for my academic career, not for what they taught me about geology but for providing some understanding of human situations."

John Allcock, who has served on a visiting appointment for two years and becomes a regular member of the faculty in July, is as well-travelled as anyone. He worked for mining companies in Uganda, Tanzania, Zambia, South Africa, Portugal, England, Australia and New Guinea over a period of nine years before he decided to go to Yale for a doctorate. He brings this experience to an introductory course on Earth's Resources, and upper level courses on Petrology, Ore Deposits, and Industrial Rocks and Minerals.

Allcock is currently working on a study of the relationship of ore deposits to the structure and rock formation of old copper mines on the Gaspé Peninsula in New Brunswick. The type of deposit combines classical examples of skarn, a metamorphic rock rich in iron, and porphyry copper, a large, low-grade copper deposit. This type is found usually in geologically young areas such as the western United States, the Andes, and more recently in Alaska, Canada, New Guinea and Eastern Australia.

He has developed a first-line model of the structure and will describe the deposit in detail, eventually hoping to find what is typical about it. The mines in New Brunswick are the oldest in the world where this kind of deposit, the largest kind of copper deposit, has been worked and they afford a good view of a phenomenon on which U.S. mineralogists have had a limited view in the past.

Gutmann, whose interests overlap to some extent with Allcock's, applies physical chemistry to a wide range of problems in earth science. His studies of the reactions between water and rocks and of the behavior of molten materials are also of interest to de Boer and Horne for some of the large-scale problems they deal with.

In addition to the introductory course, Our Dynamic Earth, Gutmann teaches Mineralogy, Petrology with Allcock, and upper-level courses in Geochemistry and Volcanology.

His research takes him to Sonora in northwestern Mexico near the Gulf of California, where he has furthered his interest in volcanology. "I'm interested in the mechanisms of volcanic eruption, the origin of magmas (molten rock) and volcanic rocks. I want to find out why this volcanic field is there; why do its volcanoes behave the way they do?"

The youngest member of the department is Peter Patton, a surface-water hydrologist interested in the process and evolution of forms carved by running water. He teaches an introductory course in Environmental Geology and upper-level courses on Geomorphology, Sedimentology and Geohydrology.

Most of Patton's published research has dealt with flood effects on streams in western states, particularly the southwest. He has been developing techniques for establishing the long-term flood history of various streams, principally to determine what the great flood events have been, and he will be applying these to streams in the east, including the Connecticut River and its tributaries. "When the flood wave passes through," he explains, "it flows up the tributaries and deposits fine sediment which accumulates at different stages and endures over a long time. We identify the particular types of sediment by elevation and note the elevations. The whole system works best where the runoff is great."

Patton will begin to get involved with the Essex Marine Laboratory this spring, working on the second phase of the Lab's study for the Corps of Army Engineers and again next year on a study of realignment of the channel in the Connecticut River.

Horne is another geologist who worked for private companies for eight years in West Pakistan, the Spanish Sahara, and the western United States before he decided to go back to get his Ph.D. at Columbia University. He was trained as a bedrock geologist and his published work has dealt with the stratigraphy and tectonic history of Newfoundland and, more recently, Honduras. But the change in the orientation of the department has prompted a shift in his own interests.

As he found himself drawn into environmental concerns more and more and as some of his earlier projects reached mature stages where they could be left for the time being, he decided to redirect his research during the coming year while he is on sabbatical.

He will spend much of the year at the Essex Marine Lab working on the physical study of the river, dealing with the mechanisms for the transportation of sediment and the environmental impact of dredging. "The river" he says, "is cleansed by the grains of sediment which adsorb and bind pollutants and settle them in a sink where they are concentrated. Then you dredge up these concentrated pollutants and drop them in a different chemical environment (e.g. fresh to salt water). What happens? What is the ultimate fate of this stuff? Nobody knows."

This semester de Boer is on leave, working first in Luzon and then coming back to the Caribbean to join a research group from the Woods Hole Oceanographic Institution to make deep dives in the submersibles ALVIN and TRIESTE in the Cayman Trough. De Boer is one of two geophysicists among the 11 scientists associated with the project, which started last year when they made the first dives. They descended 12,000 feet below the surface to examine the trough which extends 750 miles along the sea bottom and is located on the boundary of the North American and Caribbean crustal plates which are believed to have a great deal to do with the dynamics of that volcanic region.

The project affords the opportunity for direct observation of geological history, more immediate than the normally indirect techniques of oceanography in which photos, chemical sampling and seismographic instruments are used for observation. It is comparable to having a man walk on the bottom of the ocean. Says de Boer: "It's very exciting being where no one has ever been." (Although the ALVIN did find a beer can).

As interesting as this is, de Boer is still absorbed in large-scale geotectonic models which he is developing in Costa Rica and Luzon. He has directed a project for the government of Costa Rica, with support from the Organization of American States and the United Nations, for seven years. He and his students have found two big copper bodies among other resources for the government. One graduate student is in Costa Rica on the project now; two more undergraduates will go in the spring and four or five more next year.

On Luzon, a blueprint for economic development is being developed on the basis of the geological model. The research group de Boer directs is looking for ore deposits, oil and a safe location for a nuclear power plant, the latter objective being the most difficult.

Since most research in science and mathematics at Wesleyan is basic research, it is very unusual to hear a tenured professor speak of the importance of applied research. De Boer, who is not unaccustomed to uttering provocative views, argues that more funding should go into projects related to economic development such as his own work in Costa Rica and Luzon, Horne's in Honduras, Gutmann's in Mexico than into basic research. "The Cayman Trough project is basic research," he says. "Make no mistake about it, I know it is important. It's beautiful; I love it. But it's expensive and I would rather see some of that

money go into projects like the one in Costa Rica."

His views on this are related to his assessment of environmental problems the world faces and of what the goals of education should be in coming years. But neither he nor anyone else in the department, which straddles the worlds of basic and applied research, discounts the need for the continual advancement of fundamental research. Their own experience confirms the need for it and this is expressed best perhaps by Allcock's explanation of why he changed his career direction: "I was working in mineral exploration and I decided to go back to get a Ph.D. because I realized that I didn't really know what I was doing. All the really good people had high degrees. They knew a lot more than I did."

* * *

The Department of Earth and Environmental Sciences is in an unusually happy state. Its students and faculty are busy, enthusiastic, optimistic. But where does it go from here?

"The growth in enrollments involves the good and the bad," says Gutmann. "There's a lot more student interest. They're working with each other, talking to one another. They teach each other. But the disadvantage is that there is only so much lab equipment. Also, you need more time to develop a course for 24 people than you do for six. If you blow a point in lecture, you start losing the students and can get bogged down in questions."

One of the great fears is that the department, with greater numbers, might lose the warm informality that marks the relationships between students and faculty.

Some people feel this informality is a natural state for geologists because of the field work. The faculty members spend weeks in the field with students on their own research projects and on the two-week mapping trips. "When you're out in the middle of the Sonoran Desert and you break a fan belt, you get to know a lot about the people you're with," says Gutmann.

"Most of the professors are very charismatic," says Earl Phillips '77. "They're likable and they know their stuff, but the field trips have something to do with it. You have something more than a student-teacher relationship because you see the way they react in different situations. It even works with your fellow students. You know them more than you would know just someone you see in the classroom."

Another influence is the nature of the science, which is often speculative. The faculty encourages talk among the students in many ways. De Boer gives an examination in which he presents a problem to the students and tells them to talk it over. Then he asks them each to write their individual answers to the problem. "As a physicist I couldn't do that; as a geologist I can because there is no right answer."

Betsy Mahoney '77 took that course in Structural Geology, "a tough course conceptually," and says that the exam influenced her decision to major in the department. "People help each other out. They talk to one another. That's real life. If you don't enjoy learning, it's not worth the effort."

Peter Hansen, who graduated from Wesleyan last year as an Art major and came back as a special student to complete an Earth Science major, finds a remarkable patience among the teachers. "In the classroom, they'll go over and over a point until everyone gets it."

"Everybody knows everybody else in the department," says Hansen, "because it's all on one floor. People get together in the lounge or the colloquium room, and they go to the brown-bag luncheons (held once a week) where people get up and talk about what they're doing."

But there are problems. One is the time commitment of the faculty. Another more manageable one is the need for more equipment.

"The facilities of the Science Center are magnificent," says Horne. "But most of the equipment was acquired in the days when we had few majors."

The department now has 13 polarizing microscopes including a 19th Century instrument recently taken out of storage and reconditioned. That means a double-lab in mineralogy, petrology, etc., can handle only 26 students and any enrollment higher than that is a problem that has to be handled by either more equipment or more faculty. "We can't go to multiple labs," says Horne, "because it's our conviction that the lab should be taught by the instructor. It shouldn't be done by a graduate student. We never have done that and we won't."

The marine lab is badly in need of a vessel of 30 to 40 feet with a lot of stern deck space. "We have four Boston Whalers," Horne says, "but they're not safe on the Sound and I hate to risk a lot of expensive electronic equipment in a small open boat."

Another need is field transport. On day field trips last semester, de Boer took out parties of students from Gutmann's introductory course two afternoons a week, using a Wesleyan van that holds 12. The field transport is an expensive item in the budget and the trips are an expensive use of faculty time.

Aside from those problems, there is a large unfocused question about how the department would grow, if it is to be enlarged. There is enthusiasm for the idea of bringing in visitors on one- or two-year appointments, maintaining the Wesleyan passion for "fresh blood" and "excitement from the field."

De Boer has notions of adding people from other professions—a lawyer, economist, physician with environmental interests. These are consistent with his own ideas of how educational goals should be shifted to prepare students to live in a changing world. They are not inconsistent with the department's objective, which is to prepare not only those students who wish to become professionals in earth and environmental sciences but also to prepare students who enter other professions with a solid background on environmental concerns and issues. But such appointments are difficult to accomplish.

Over the long run, the directions are likely to be set by students who are not yet at Wesleyan. Students provide the ebb and flow which is decisive in shaping any department's efforts. And that is a point that isn't lost on a department that counsels to let nature have its way. Ride with the tide. Go with the flow. Bend with the wind.