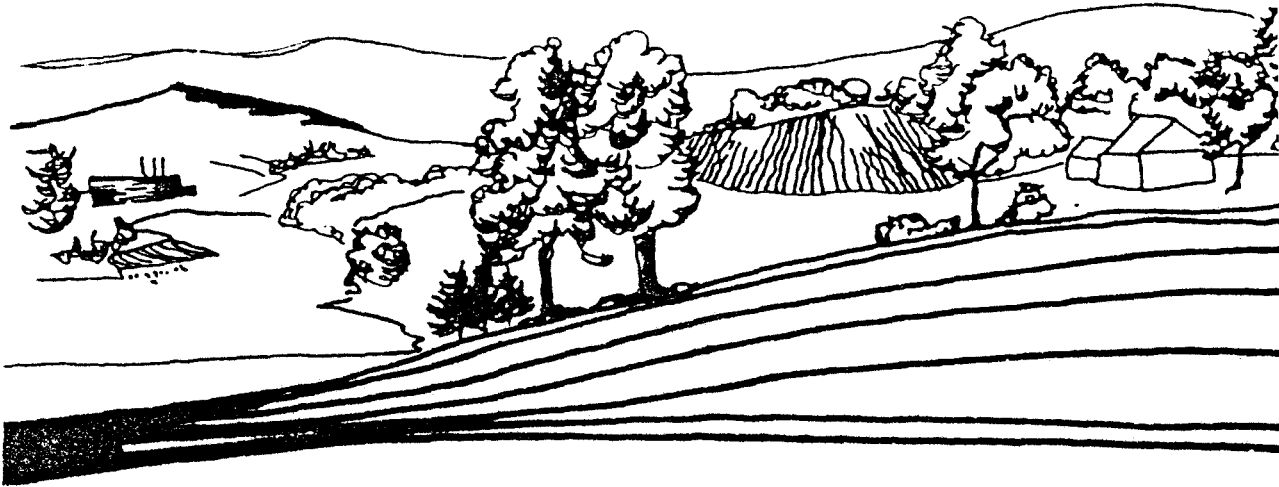


MIDWEST BIOSCENE



ASSOCIATION OF MIDWESTERN COLLEGE BIOLOGY TEACHERS

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MESSAGE FROM THE EDITOR:

This issue is the beginning of an experiment. I agreed to serve as the editor of MIDWEST BIOSCENE for the remainder of this year. In October, at the annual meeting, both the Steering Committee and I will review the results of the experiment and decide if I will continue for another year as editor. My success or failure depends on my ability to convince you to participate with me in this experiment. I love to talk, but I don't enjoy writing. Fortunately, I believe that my friends have recognized this problem and have provided many interesting articles for this issue. At the annual meeting, Jack Bennett treated all of us to a persuasive speech about the teaching of evolution. In this issue you will find an edited version of Jack's talk and summaries of other presentations made by Bruce Peterson, Mary Jane Sullivan, John Bartha, Paul Mayes and Neil Baird. Dr. Brandt's lecture, "BIOTECHNOLOGY: INDUSTRY'S FOCUS", completes a brief summary of the annual meeting. As you will discover when you read this edition, there is much more to discover in this issue including letters from members, an advertisement for a position and more. Certainly I believe that this has been a strong start and I plan to hold the pace.

The next issue of the MIDWEST BIOSCENE will be published in April so I will need to have your articles by March. In the next issue, I hope to start several columns: (1) MICROCOMPUTERS IN BIOLOGICAL EDUCATION, (2) LABORATORIES THAT WORK, (3) JOB OPENINGS, (4) BIOLOGY AND GOVERNMENT, (5) NEWS ABOUT THE MEMBERS, (6) MINORITIES IN BIOLOGY, (7) DEPARTMENTAL PROFILES, (8) CULTURE EXCHANGE, (9) FEATURED STUDENT RESEARCH REPORTS. So that all of you will be ready for "rooning", Don Huffman has prepared a guide about Midwestern mushrooms that will be included in the next issue. All of you should know that the Steering Committee has provided me with a telephone budget. So before I call you and urge you to write an article, why don't you spend a creative evening by a warm fire and write an article for the APRIL ISSUE OF THE MIDWEST BIOSCENE.

Send all of those exciting ideas and articles to: WILLIAM DOEMEL, BIOLOGY DEPARTMENT, WABASH COLLEGE, CRAWFORDSVILLE, IN. 47933. My telephone number is (317) 362-1400 Ext 219.

(EDITOR'S NOTE: Austin Brooks, Chairperson of the Honorary Member Committee, wrote the following testimonial about Russel Wagner)

OUR NEWEST HONORARY LIFE MEMBER

Russel O. Wagner became the twelfth AMCBT, Honorary Life Member at the Twenty-sixth Annual Meeting of the Association held at Central College in Pella, Iowa last October 8 and 9. In 1958, the second year of the Association, Russel attended his first meeting; he has

missed very few since then. An inspection of the annual meeting programs over the years reveals that he has been a constant contributor. As program chairman for the meetings held at Fontbonne College in 1969, Russel demonstrated his fine ability for planning. Recognizing his skills for organization and innovation, the membership elected him first to the Steering Committee (1970) and then in 1976 to the Presidency. His forte, as many of us came to realize, is that he has the ability to separate the unimportant aspects of a problem from the real issues at hand. At a number of steering committee meetings, I recall that Russel's helpful comments and his persistence allowed us to adjourn at 11:30 P.M. instead of 1:30 A.M. Although, Russel was never shy about expressing his views on a subject, he always proved to be a good listener as well. Hearing all the facts on a subject, Russel would analyze and assess the various options before making a recommendation or a decision.

In terms of his higher education, Russel is a "GOLDEN GOPHER" through and through, having received his B.S., M.S., and Ph.D all from the University of Wisconsin at Madison. Stints at the Universities of Michigan and Minnesota field stations as well as at Arizona State University and Oak Ridge National Laboratories helped to broaden his biological background for teaching and research.

Over the years, Russel Wagner has had a variety of teaching assignments. He has taught high school at Eagle River and at Waupaca and was a faculty member at the radio schools of the U.S. Army and the Navy. Additionally he taught at the U.S. Forest Products Laboratory in Madison. His teaching experiences at the University of Wisconsin in Platteville, which began in 1947, included 11 sessions at the Pigeon Lake Field Station. On two different occasions he served as Chairperson at Platteville and the Field Station prospered under his directorship between 1970 and 1973.

Besides his administrative responsibilities and teaching, Russel has been an active researcher. The ecology of prairies, with a special interest in ants, has been of keen interest to him. Since 1978 he has been investigating the ecological and entomological relationships that surround the black stain root disease of the pinyon pine. Many of the older members of the AMCBT will remember the post cards from Russel inquiring about DORs (for the uninitiated, DOR stands for dead on road; animals, that is) in our own areas.

Even in retirement, Russel Wagner is leading a very active life. For several years now, he has been a VIP or Volunteer in the Parks. Stationed at Mesa Verde National Park in southern Colorado, he has been associated with the pinyon pine research project. He has also consulted with the U.S. Fish & Wildlife Service in the lower Rio Grande Valley area.

One final note should be sounded about our newest Honorary Life Member. Of all the members of the AMCBT none appreciates a good joke more than Russel. At the final business meeting of the Association a few years ago, Ed Kos, our Executive Secretary, presented Russel with a huge trash bag stuffed with pull tabs from soft drink cans. This dubious gift was apparently made because Russel has been an outspoken critic of this innovation of the canned beverage industry. Russel accepted the gift with an impish grin and an appropriate pun. The next year Ed received from Russel a beautiful chain many feet long constructed of -- you guessed it -- folded pull tabs. Russel's ability to mince words is almost legendary but this writer will not PUNish you by resurrecting any of Russel's puns.

Talented teacher, decisive decision maker, primo punster, and fine friend to everyone; the AMCBT is justly proud of our newest life member, Russel O. Wagner.

(EDITOR'S NOTE: The following letter was received from Russel Wagner)

My receiving this year's Honorary Life Membership at Pella means a great deal to me. The first recipient, Ruth McNair, of the University of Kansas was a most worthy person. The award was created to honor her for all of her contributions to AMCBT. Those who have followed have contributed much, so I am in the company of a group of whom I have thought a great deal and of whom I admire. AMCBT's Honorary Life Membership award is something to be coveted. Thank you all.

(EDITORS NOTE: The following memo was received from Jim Holler, Program Chairperson for the 1983 AMCBT Meeting)

The response given at the 1982 meeting for program suggestions was so great that I have decided to issue another invitation for participation by those who were unable to attend the 1982 meeting. The Steering Committee has planned a tentative program which I believe you will find exciting. However, I would like to have even more participation from the membership. We need more presentations but particularly need people to chair sessions and to act as recorders.

The group discussions will center around four general areas: GENERAL EDUCATION, TRAINING OF BIOLOGY MAJORS, FACULTY CONCERNS, AND SUBJECT MATTER AREAS. In addition, we have planned some sessions by discipline e.g., MICROBIOLOGY, ECOLOGY, GENETICS, ETC.

The committee has decided to try something new this year in the form of posters. If you have instructions for a laboratory exercise which you would like to share, we would like to place them on posters so they will be available to all. Also, if anyone has bibliographies, review articles, etc., we would like to make them available at the meeting. Some of the areas could include - RECOMBINANT DNA, SCIENTIFIC CREATIONISM, ETC.

In closing, I would remind you that in these days of tight money it might be easier to obtain travel funds if one can demonstrate participation in the program.

DON'T WAIT ANOTHER MINUTE VOLUNTEER TO PARTICIPATE OR SEND YOUR IDEAS TO: DR. JIM HOLLER, DEPARTMENT OF BIOLOGY, UNIVERSITY OF WISCONSIN - PLATTEVILLE, PLATTEVILLE, WI 53818!

DO YOU NEED A JOB OR IS THERE A JOB OPPORTUNITY IN YOUR DEPARTMENT? WRITE TO THE JOB LINE, C/O W. DOEMEL, WABASH COLLEGE, CRAWFORDSVILLE, IN 47933. THIS IS A FREE SERVICE OF AMCBT.

JOB LINE, JANUARY 1983

Zoologist, Academic Staff (non-tenured) position with reappointments to teach Comparative Anatomy, Embryology, Histology, Physiology and freshman courses. Ph.D. and excellence in teaching preferred. Salary is \$18,500 - 21,000+. Send Curriculum Vitae including course work and the names of three references to: JAY DYKSTRA, Department of Biology, UW-Platteville, Platteville, WI 53818. Deadline to apply is March 1, 1983. UW-Platteville is an Equal Opportunity/Affirmative Action Employer.

(EDITOR'S NOTE: The following is an edited version of a paper presented by Jack Bennett [Biology Department, Northern Illinois University, DeKalb, IL 60115] at the 26th Annual Meeting of the AMCBT. Please do not reproduce this paper without the author's permission.)

UNDERSTANDING EVOLUTION: DARWIN AND HIS SUCCESSORS

Our topic is made particularly urgent by the challenges of the self styled "Scientific Creationists" (SC's). The SC's reasonably well exposed the religious base and motivation of their case in the Arkansas trial last winter and it was found wanting. The SC's have a mental set that seems to require them to diminish themselves and their conception of God. We have no obligation to share their confusion, or perpetuate it through the schools. Darwin's contributions were based on a lifetime of study and thought, both of nature and of his predecessors. He was profoundly influenced by his own observations and by Lyell's geology, particularly the "principle of uniformitarianism." He had the wit to synthesize the observations of Malthus, Lamarck, Lyell, etc. and to show that the addition of the principle of natural selection would provide an explanation of the various evidences of evolution. Darwin presented natural selection as the basis of observed adaptation, and adaptation through time to changing environments as the basis of evolutionary change.

August Weissmann managed to put together an excellent second step but was so far ahead of his contemporaries that it was not understood. His description of heredity about 1885 was essentially modern. He said chromosomes are made up of hereditary determiners that he called "ids" (hence our modern haplo-id and diplo-id, etc.). He pointed out how precisely they are distributed at mitosis and meiosis and suggested that an understanding of hereditary transmission would come from study of these phenomena. He made the error of looking at the wrong organism - *Ascaris* - and assuming that the discarding of unneeded chromosomal material observed there was the basis of cell differentiation and development in all organisms. This in no way invalidated his principal hereditary insight but did in fact discredit his whole hypothesis in the eyes of many nearsighted biologists. Twenty years later it was clear that he was essentially correct, as far as he went.

With the rediscovery of Mendel, the work of Sutton, Morgan and their students, the chromosome theory of heredity was finally established. Darwin would have been ecstatic. This made it possible for Castle, Hardy, Weinberg, Fisher and Wright to work out the mathematical outlines of natural selection. Because it has been easiest to quantify and has achieved its massive theoretical structure many have come to believe that it explained all of evolution. The flaw is to believe that the mathematical theory of natural selection covers all important aspects of evolution. Think about its assumptions:

1. The principle of uniformitarianism applies, that is no mechanism of evolution occurred in the past that we do not regularly observe today;
2. All genes are passed within individuals and species and recombination occurs only through meiosis;
3. It is reasonable to treat genes in populations individually locus by locus without knowledge of interactions both in time and with the environment.

These are patiently inconsistent with our observations. Many of the exceptions are rare but important in proving the point and explaining our observations. We know that the earth and its conditions were not always the same as now. We know that genes can be transferred between individuals and species by other mechanisms than fertilization. We know that interactions with other alleles, other loci and the environment can affect the properties and activities of genes and would have to be taken into account in any reasonably complete explanation of their activities. None of this should be interpreted as evidence that natural selection is unimportant. It only means that natural selection is not the only factor involved.

Natural selection appears to be continuously responsible for the maintenance of the adaptation of organisms to their environment. With environmental change it can clearly be the basis of changing adaptation and probably is responsible for the largest portion of such changes and thus for much of what we call speciation.

We should recognize that natural selection is not a one-way or unchangeable process. If the environment changes in a cyclical way, whether the seasons, the sunspots, the glaciations or whatever, then the actions of selection will change in coordinated ways. Selection may act in ways that keep multiple forms of a gene in a population for long periods of time through selection in favor of heterozygotes - heterosis - or through cyclical selection in favor of one gene in the spring and its allele in the fall. Similarly in a large population selection may favor one allele in one portion of the range and another allele in another portion, thus never achieving fixation of a particular allele, but achieving the best available adaptation for that situation. In such ways it may achieve the apparently anomalous result of producing a steady stream of poorly adapted individuals while maintaining the maximum level of adaptation for the species. Such systems are generally unstable over long periods of time (to the population geneticist) but are commonly found in

almost every species that is closely studied.

In order for natural selection to have something to select from we have to have a variety of versions of each kind of gene. Thus mutation is clearly a prerequisite for selection as well as many other evolutionary mechanisms. Too many of us fall into the trap of thinking only of DNA base changes in structural genes (those that code amino acid sequence in polypeptides). Equally important are duplications, deficiencies, translocations, transpositions, inversions, aneuploidy and polyploidy. These are all mutations and each is a basis for change of a different order of magnitude from that envisioned in the usual treatment of the mathematical theory of natural selection with its slow, barely perceptible changes in a species.

Randomness in evolution is a particularly galling concept to the SC's. They appear unable to contemplate a God that would trust random processes to achieve His ends. They share with many biologists a profound misunderstanding of the concept. Often it only means that we do not understand the underlying mechanism, or do not have the means to observe it. We know the mechanism of meiosis with some precision, and the resulting distribution rules with great precision, but the difficulty of observing the process with sufficient precision to be able to say which gene is in which gamete does not seem to be worth the cost. Thus we speak of "random distribution." When we speak of random mutation we really mean that we know how many to expect at each locus in a given number of cells, but as yet we find it difficult to predict which allele will be next and which cell it will arise in. We know that each one will likely occur in the future. The uncertainty lies primarily in our ability to predict precisely when and where. These are indeed esoteric varieties of "random." They produce many of the time dependent uncertainties in evolution.

Another phrase is "sampling error," it is the equivalent to the differences between bands in a game of cards. We know what the possibilities are, what the probabilities are, and that we may have to wait a while for a particular hand, but we do not doubt our ability to play the game. Many of us do not like to acknowledge the importance of unique events. Lyell had set the stage against considering them as important in geology as he considered the most likely alternative to the then prevalent notion that a series of catastrophes - such as Noah's flood - were responsible for all of the strange fossils in the ground. The dichotomy was "uniformitarianism versus catastrophism," everyday processes versus the biblical great flood. Biologists, beginning with Darwin, learned the lesson so well that they almost forgot that because something is rare or extremely infrequent does not mean that it can be ignored with impunity on a geological time scale. Shark attacks are certainly rare in the U.S., on the order of one per ten million citizens per year. This does not lead any of us to rush into the surf when we see those triangular fins cruising the beach. Such an attack is big news because it is rare. A unique event in evolution should also be big news.

Richard Goldschmidt understood this well. He felt that the limited number of animal phyla and classes could represent merely the few survivors of a very large variety of similar forms as the traditional Darwinians were then suggesting, or they could more likely reflect the survivors of relatively rare and unique events. Working with a comparatively primitive knowledge of the structure of hereditary material he reasoned that the basis of very different kinds of organisms lay in the rare restructuring of the genetic material. He conceived of these as being among the large kinds of mutations (systemic mutations) such as inversions, translocations, etc. For his troubles he was nearly hounded out of the profession by dogmatic selectionists who were every bit as charitable as our current SC's. Yet it was clear that the evidence even then (1940) showed instances of such changes. By the late 1950's many students of evolution were acknowledging that unique events did occur and were responsible for much speciation. Dobzhansky and Pavlovsky demonstrated that when new populations were started from small populations (sampling error) and then subjected to the same selective regimes that radically different results followed. Mayr described the same phenomenon in bird populations on strings of islands as being the basis of evolution of whole collections of related species. They carefully used different words to mask the similarities to Goldschmidt's formulations.

The same total change in the environment can be uniformitarian if it occurs over a million years but be a catastrophe if it occurs in a few minutes, or a few months. Is a glacier a daily event or a catastrophe? It depends upon where you are and how long you hang around.

We apparently owe the very existence of our species to a unique event - catastrophe - much to the discomfort of many uniformitarianist geologists. I refer to the growing evidence that a meteor strike about 65 million years ago was instrumental in ending the "age of reptiles." Mammals had been around for perhaps forty millions of years and had made little headway. In the few millions of years immediately following the surviving mammals radiated into the many vacant niches and all of the major types of mammals appeared, including the primates. Yet it is still true that through these events natural selection was operating and the array of species present today is the result.

Plant cytologists had known for many years that plant species often arise by unique events, polyploidy in particular is said to be in the history of half of our flowering plant species. Our daily bread comes from a remarkable sequence of such unique events involving the hybridization of grasses and polyploidization with subsequent selection of those that were well adapted - to humans. At least two such unique episodes are behind our hexaploid wheat. How arrogant to believe that these were not examples of natural evolution!

Edgar Anderson demonstrated transmission of blocks of genes from one species to another and carefully examined the possible consequences under the title "Introgressive Hybridization" in 1949. Our students of recombinant DNA thought they had something new! All of these kinds of unique events provided new situations for natural selection to select from and refine into new species and new adaptations.

Motoo Kimura has shown how mutation and genetic drift (sampling error) when carefully examined can account for many apparently "neutral" changes that were difficult to account for on the basis of selection. There are few truly "neutral" genes but there are many alleles that are adaptively indistinguishable in a given environment, and their evolutionary stories will be determined by mutation and drift (read random change) relatively unaffected by selection so long as that environment does not change.

Today the thoughtful student of evolution is aware that there is no question of selection versus mutation, mutation versus drift, uniformitarianism versus catastrophism, heredity versus environment that has any objective validity. The serious student knows many mechanisms are active. Some such as selection nearly all of the time, some irregularly or rarely in a particular lineage. We feel that it is our privilege to study these mechanisms the better to understand their relative contribution to any particular evolutionary sequence.

We hear of Gould's "Punctuated Equilibrium" as a new principle of evolution, and much to his embarrassment it is touted as evidence that Darwin was wrong and evolution did not occur. Acknowledged or not the concept that big changes in species tend to come only rarely and then rather rapidly is clearly an extension of Goldschmidt, Anderson, Mayr and others.

"Punctuated Equilibrium" is the view that species exist for long periods with little change except for fine tuning and then undergo relatively rapid change into a new form of adaptation which will itself be relatively stable for a long period. There is no question that the changes as they occur are selection to preserve or improve levels of adaptation as the environment changes. They clearly have to be based on mutational or other events that provide the basis for selection. The only real questions are about rates of and kinds of mechanism operating. "Rapid" to a paleontologist is generally excruciatingly slow to a population geneticist. It is only when the geneticist begins talking about hundreds of thousands of generations that he gets into a time scale even generally recognizable to the geologist or paleontologist.

We have not been very effective in legislating against ignorance. Public education has not made our species wholly rational. We should not be surprised that many remain ignorant of much of our knowledge of evolution, nor can we reasonably expect that all citizens should be aware of the details of our current knowledge of the process. Because of its central position in understanding biology, and because of the importance of biological understanding to the public policy, we can insist that the level of evolutionary knowledge among our citizens should be improved. Just as a society that believes in a list of elements consisting of earth, air, fire and water will have a difficult time competing in a technological age, so a society that is unable to recognize biological reality is doomed.

We (as biology teachers) are at the heart of the problem. We send out our college graduates so filled with biological minutia and so naked of real knowledge of the evolutionary framework that they are ill prepared to defend themselves and their knowledge against religious fanatics. We must do better. It seems apparent that the usual undergraduate courses on evolution don't do the job. We need to design a senior seminar or the equivalent that will bring the students to integrate their biological minutia into an understanding of the web of evolutionary mechanisms and to be prepared to defend this understanding. Anything less is unworthy of us as students of life.

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(EDITOR'S NOTE: The following is an edited version of a paper presented by Dr. E. J. Brandt (Monsanto Agricultural Products Company, St. Louis, Mo.) at the 26th Annual Meeting of the AMCBT. This paper may be copied for use in classes.)

BIOTECHNOLOGY: INDUSTRY'S FOCUS

I am pleased to be here today to address the AMCBT membership on business and technical opportunities in biotechnology. I believe--and many hard-headed scientists agree with me--that with the new biotechnology, almost anything that can be thought of can ultimately be achieved--new organisms, new limbs and organs, new treatments for disease, new ways of controlling pests, crops which produce their own pesticides, disease-free domestic animals, whole new industries that will sell products that even today cannot be imagined, let alone made.

Breakthroughs in understanding which have happened one after another in the past 30 years have fueled excitement, created high expectations, and turned innovative investigators like Daniel Nathans, Herbert Boyer and Stanley Cohen into popular heroes--and with some justification. Through their efforts, what was science fiction ten years ago has become

science fact today and--if everything goes according to plan--will become business-as-usual in the coming decade.

That, in fact, is what I would like to discuss with you this morning. Industry -- the biotechnology industry, specifically, faces a tremendous challenge as we move from the romance of scientific breakthroughs to the reality of the manufacturing plant.

This challenge is scientific, it is technical and it is social. For if society is to reap social benefit from biotechnology and if industries are to realize financial rewards, we must understand and deal with not only the scientific and technical questions which confront us, but with the social questions as well.

WHY ALL THE INTEREST IN BIOTECHNOLOGY?

The question is rhetorical: the answer is known to all of us. Everyone is interested in biotechnology because its methods are general and can be applied in a wide array of commercially and socially significant areas. The genetic code that instructs and runs the cells of every living creature on this planet from E. coli to Homo sapiens is universal. This universality of the genetic code makes it theoretically possible to instruct any cell to make the proteins of any other cells, be it plant, animal, human or microbial. This is the essence of molecular biology, its power, its elegance, its social and commercial importance.

Molecular biology has revealed in exquisite detail how a living cell makes the proteins that comprise most of the machinery of cells and thus most of the machinery of organisms. We are now able to take fragments of genetic material -- genes -- and transfer them from one organism -- an animal or plant -- to a much simpler organism, a bacterium or yeast, and persuade it to produce the particular protein coded for by the gene. Herein is the origin of the great industrial potential of recombinant DNA technology: by growing large batches of bacteria or yeast containing specific new genes, we can make specific proteins such as insulin or bovine growth hormone in potentially unlimited quantities.

The part of biotechnology that enjoys the best press is genetic engineering, altering the genes of living things, transferring the traits of one form of life to another. Genetic engineering unquestionably has more "sex-appeal" than chemical engineering. Yet, as far as a biotechnology-based business is concerned, genetic engineering is just the tip of the iceberg. Product development will depend not only on designing a microorganism to make a specific chemical at high yield but on the chemical and biochemical engineering which follows.

The chemical engineering challenges are enormous: designing a new generation of fermenters with high loading capacity, designing reliable continuous fermenters, developing non-aqueous fermentation systems with minimal waste streams, developing new separation methods to snatch valuable products from enormous volumes of very dilute solutions, insightful engineering evaluations of alternative processes. These areas of downstream processing require enormous resources and it is in these areas that the chemical industry has a reservoir of skills and special advantages. For example, my own company, Monsanto, has devoted itself for more than a decade to separation process technology and has a cadre of separation scientists designing novel processes to efficiently purify products of biotechnology in which we are interested. Their success will be a determining factor in the production of biotechnology-based products. Without creative chemical engineering to implement it, a good deal of creative genetic engineering will never benefit society.

The chemical industry has had a lot of experience moving ideas from the laboratory to the consumer. We know the routine and we know how long it takes. We know that once the breakthrough research has occurred, we must learn to isolate our material, purify it, assay it, test it and process it. Once we are sure we can produce the pure and effective product in large quantities, it will have to be submitted for regulatory approvals by government

agencies such as the food and drug administration or environmental protection agency. Beyond that are marketing and sales. And beyond that is the ongoing improvement of both the process and the product for the life of the product.

It is up to us to ensure that the press and the public understand these realities. Most biotechnology-based new products are not just around the corner. We must ensure that society has a realistic picture of what biotechnology can and cannot do and in what time frame. We must seek truth in packaging!

WHAT THEN IS A REALISTIC TIME TABLE FOR NEW PRODUCTS OF BIOTECHNOLOGY TO PROVIDE SOCIAL AND COMMERCIAL BENEFIT?

There is general agreement that the first significant products of the new biotechnology will be in human therapeutics and diagnostics. These will include products like insulin, interferons and some vaccines. Perhaps there will also be monoclonal antibodies coupled to a chemical that kills cells which will carry their deadly load to specific kinds of cancer cells. Shortly thereafter, say by the early 1990's, it has been suggested that products like animal growth hormones will be introduced in the livestock and dairy industries.

As far as large volume commodity chemicals are concerned, there is less agreement on the timetable. I would remind you that microbial synthesis has been developed for only seven of the 100 organic chemicals of greatest industrial importance -- ethanol, acetic acid, isopropanol, acetone, N-butanol, ethylene glycol and glycerol -- but it is used only to a limited extent because conventional petrochemical methods are so effective for simple, stable chemicals. They yield an unbroken line of important C₁ to C₈ building blocks, including aromatics, in flexible processes which can be operated on a large scale and therefore with reduced costs. Carbon yields are generally higher using chemical methods than by fermentation and feedstocks like butane and naphtha are easier to ship and store than cornstalks or wood chips.

Despite this, there are good reasons to believe that biotechnology has the long-term potential for producing organic chemicals from various renewable resources such as carbohydrates or biomass in large-scale fermenters. Let me emphasize the phrase "Long-term Potential." Because apart from the production of ethanol from biomass, most chemical companies in the U.S., Japan and Europe, seem to be looking to carbon monoxide and methanol derived from coal as the most likely replacements for some feedstocks now derived from oil and natural gas. Indeed, it is widely held that except in certain favorable situations, coal and not biomass will provide the next generation of feedstocks for certain commodity chemicals.

In the area of smaller volume, high value-added chemicals, the so-called specialty chemicals -- such as amino acids used as feed supplements in animal nutrition, food additives and the like -- there will be many targets of opportunity. Some of these will likely be commercialized in the late 1980's and early '90's. However, some amino acids such as methionine which is a \$400 million/year product world-wide and is very important in poultry nutrition, will continue to be made by chemical means for some time to come because the industrial chemical processes are so efficient.

WHAT ABOUT BIOTECHNOLOGY PRODUCTS FOR MY CURRENT AREA OF INVOLVEMENT, AGRICULTURE?

Two aspects of biotechnology are potentially important to agriculture. The first is the genetic improvement of crop plants. Within the next decade or so, genetic engineering may lead to the design of new plants with desirable properties such as temperature tolerance, drought tolerance, disease and pest resistance, higher yields and herbicide resistance. Enhanced temperature tolerance is a fantastic challenge. The aim would be to extend the northern range of specific crops. I would remind you that there are millions of acres in China, the U.S.S.R. and elsewhere where crops are produced only one or two years out of four because of the cold. In the U.S., there are many valuable crops that are limited by

temperature. There is reason to believe that temperature tolerance in various crops can be increased by the application of genetic engineering.

Increased drought tolerance in a crop would also be a major breakthrough in the hitherto non-cultivated land could become productive, thereby alleviating food shortages in less developed countries.

However, the genetic engineering of important crop plants to produce new varieties requires a small host of inventions and new discoveries. It is likely to be a decade or more before it becomes technically feasible, and even longer before it becomes a commercial reality. The task is of great social and economic significance, but I believe it will be undertaken only by companies willing to swallow large amounts of red ink for 10 to 15 years before expecting a return.

A second aspect of biotechnology potentially important to agriculture is the development of genetically engineered soil bacteria to enhance crop yields. Such genetically-modified bacteria, perhaps encapsulated in a tiny pellet, would be added to the soil. Most plants live in loose association with microorganisms, forming biological partnerships. One partner is the familiar green plant itself, the soybean or corn plant. The other tiny partners are the soil bacteria and fungi which may be intimately associated with the root system of the plant and act as "middlemen," transferring nutrients from the soil to the plants. Some of them live near the roots of the plant, others actually invade the roots. A familiar example are the bacteria that invade the roots of soybeans and "fix" nitrogen there to the benefit of the soybean plant. Much attention has been paid to these nitrogen-fixing soil bacteria which convert atmospheric nitrogen to ammonia and reduce the need for fertilizer. But there are numerous other opportunities in using soil microorganisms that could make some of today's pesticides and fertilizers obsolete. For example, one could envision soil bacteria that produce a specific fungicide and protect an important crop. A number of scientists believe that soil microorganisms may be one of the first places where genetic engineering will be applied to major crops and they expect useful products by the end of this decade. There is an informed body of opinion that believes that the long-term prospects for recombinant DNA technology in agriculture may be greater than in medicine or in any other segment of industry.

LET ME NOW DEAL BRIEFLY WITH THREE OF THE SOCIAL ISSUES RAISED BY BIOTECHNOLOGY, NAMELY ITS SAFETY, ITS IMPACT ON THE TRADITIONAL VALUES OF UNIVERSITIES, AND FINALLY ITS POSSIBLE APPLICATION TO HUMAN BEINGS THEMSELVES.

When you read most newspapers and magazines -- including Chemical Week -- you get the impression that in spite of modest disclaimers, the genetic engineering industry is moving full steam ahead and its future is secure. Ideed, the excitement that pervades most of the articles could lead the reader to assume that our society is united in its aim to conquer and exploit the new biotechnology. Here and there you might see an allusion to the Asilomar Conference or to the Cambridge controversy, but for the most part, the press is enthusiastic.

I suspect that the press's excitement over scientific breakthroughs may have eclipsed other considerations. Once the romance of discovery has run its course as a top news item, we may find that some of the questions first raised about genetic engineering are still in the minds of many citizens. Some people remain concerned about the risks of biotechnology and some of its social and ethical implications.

WHAT POTENTIAL DANGERS DOES RECOMBINANT DNA TECHNOLOGY POSE TO SOCIETY?

When the NIH guidelines on recombinant DNA technology were first adopted in 1976, some scientists believed then that harmful disease-causing organisms would be accidentally produced as a result of transferring genetic materials between species. But tens of thousands of experiments over the past five years and studies of the risks of such research

have convinced most scientists that the techniques will not generate organisms presenting a new hazard to the environment or to man.

As the field has moved forward, the NIH guidelines have become steadily less stringent and they may well be eliminated based on the recommendations of knowledgeable authorities. Even though the NIH guidelines may be changed to a code of standard practices, and even though approval from biosafety committees for recombinant DNA experiments may no longer be required, it is my belief and, indeed, my hope that industry and academic institutions will continue to observe the guidelines and use biosafety committees and that the NIH recombinant DNA panel will continue to function. There are several reasons for continuing to follow the guidelines. Firstly, investigators will continue to take most of the precautions recommended by the guidelines just because of the nature of the research. In order for a recombinant DNA experiment to be successful, it has to be done under conditions that do not contaminate either the experimental material or the investigator. Second, universities and industries have neighbors, they are part of the fabric of the communities in which they live. Even though the risks of recombinant DNA technology may not be real, some people in the community may perceive them as real. Most of us act on the basis of our perceptions of a risk, not on the basis of the reality of the risk. Hence, to satisfy public concern, it makes good sense to follow the NIH guidelines or code of standard practices which will certainly evolve as knowledge increases. We must gain consensus on the safety of the new biotechnology if its benefits are to be brought to society and to industry. As we learn more about the new biotechnology, we must inform the public of what we have learned.

A second social issue raised by biotechnology concerns the impact of its rapid commercialization on the university laboratories that spawned it. To what extent will new alliances being forged between industries and universities to advance and commercialize biotechnology damage universities and turn researchers away from tough problems of profound long-term significance to short-term problems of immediate commercial value?

From over a decade of university life, I have become convinced that a key role of the university that must be cherished and nurtured is its historic role as a place for pure scholarship, a place, to some extent, insulated from excessively utilitarian goals. There is little doubt that some insulation is necessary for the flowering of the most advanced and original investigations. Indeed, the great triumphs of molecular biology, of unlocking the molecular basis for biology, were produced and are being produced today in an environment that is largely insulated from excessively utilitarian goals. To be true to its own principle and promise, the university must sustain its commitment to the fullest possible understanding of man and nature. If, in the interest of short-term rewards, the biotechnology industry damages the basic intellectual structure of universities, it will kill the goose that lays the golden egg.

Real concern today focuses on the issue of the new genetic engineering companies whose scientific research is planned and to some extent conducted by university professors on the university campus or next door. It has been suggested that biotechnology has touched off an epidemic of entrepreneurial activity that is running rampant on university campuses. Questions are being raised about how this affects the lives of graduate students, post-doctoral fellows and faculty members. To what extent will utilitarian goals and desire for financial gain alter the research targets of the scientists involved, lead them to shorter and shorter time horizons and deprive society of the main wellspring of future technology? To what extent will the industrial laboratory custom of secrecy displace the university laboratory custom of openness and limit the free flow of scientific information from laboratory to laboratory? Or will the secrecy in competitive university laboratories merely continue as it has for years as scientists engage in healthy competition to be the first to make a particular discovery? To what extent will the traditional scientific race to be the first to publish be replaced by the race to be first to patent and market? these are issues that demand close watching and those who cherish universities, like Derek Bok, president of Harvard, Donald Kennedy, the president of Stanford, and Paul Gray, president of MIT, are actively wrestling with these issues.

I am convinced that mutually productive relationships between universities and industry can increase in size and scope without altering in any way the cultural or purposes of the university. Frankly, a Monsanto grant to a university department has fewer strings attached to it and permits more scientific freedom than most NIH or NSF grants or contracts.

Finally, we come to what I consider to be the only major ethical issue posed by biotechnology: namely, that advances in molecular biology will ultimately endow human beings with the ability to alter themselves and their progeny. Until now we have been content to modify our bodies once they formed with drugs, surgery and therapy of various kinds. But mankind may soon have the ability to alter the plans themselves, the DNA, heredity. At the outset the process of gene grafting, when applied to human beings, will be motivated by the most humanitarian ends: its purpose may be to relieve the suffering of an hereditary disease, to repair a genetic defect. But we are tampering with the very nature of human-ness. We should be enormously cautious in translating gene grafting to human therapeutics because we are still primarily in a descriptive phase in our understanding of human genetics, with little, if any, idea of how to intervene safely at any level.

Some of my colleagues are deeply troubled by the social, ethical and moral issues raised by new advances in biotechnology. Frankly, I am not. I am glad these issues exist, for it is these issues that make us human beings. We confront issues, we sweat over them and try to solve them. We are not mere creatures of sensation as some elements of counter-culture might argue, like cows in a pasture stimulated by our surroundings. Rather we are struggling to solve basic questions about how to live our lives. Without these basic ethical, social and moral questions, life would lose its excitement, its meaning, its dignity. And let us not be discouraged if we do not find consensus and continue to have serious differences. In our differences lies our salvation. It is our cultural diversity and our genetic diversity that ensures that we can continue to change, to evolve, to meet new challenges. Pure strains, culturally and genetically, are fragile and non-adaptive. If humankind is to endure and prevail, we must cherish and nurture our differences.

I have enormous confidence in our ability as a society to distinguish ideas worth pursuing from those that should be rejected. We have the best scientific reporting press in the world which can certainly help us to develop a body of sound and informed public opinion upon which our society depends. I am confident that they will inform our companions on this planet of the innumerable discussions on biotechnology to come and thereby increase the public's understanding of the enormous benefits that can be opened to humanity by biotechnology as well as fairly state the dimensions of any risks that may be perceived.

In a world plagued with problems of hunger, disease, environmental pollution, energy shortages and over-population, society is eager for help. We cannot lose sight of the fact that our products must benefit humanity if they are to be of enduring commercial worth. Once we can prove the reasonableness, safety, and essential value of biotechnology to society, then the opportunity is unlimited.

Arthur Kornberg once remarked, "There is no putting this genie back into the bottle." I for one cannot imagine any other area half as exciting or with the potential for such immense rewards to society. From my vantage point, biotechnology is not an opportunity for mankind, it is the opportunity for mankind. We must ensure that we employ the right kind of foresight to nurture this highly creative, highly visible technology into major new businesses which will best serve the future needs of the world's people.

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(EDITOR'S NOTE: The following are summaries of papers presented at the 26th Annual Meeting of the AMCBT. These papers should not be copied for class without the author's permission)

OVERCOMING BARRIERS OF HANDICAPPED STUDENTS
TO PARTICIPATING IN SCIENCE ACTIVITIES

Mary Jane Sullivan, Ed.D. (Division of Continuing Education, Southern Illinois University, Carbondale, Il. 62091)

Redden, et al (1) identified four types of barriers handicapped students encountered that have kept them from participating in science activities. These are: environmental barriers, attitudinal barriers, communication barriers and informational barriers.

Teachers, counselors, parents and handicapped students themselves often have negative attitudes toward the student's participation in science courses. They worry that the handicapped student may be physically, mentally or emotionally unable to do the work; or that efforts to accomodate handicapped students will result in the neglect of normal classmates.

These attitudinal barriers may be overcome by encouraging active participation by handicapped students and by providing supplemental training for them if it is needed.

Speech impairments of students with cerebral palsy cause lack of involvement with the instructor. Deaf students often have difficulty understanding and being understood. They may also have difficulty understanding abstractions. Blind students have difficulties with written assignments. These communication barriers can be overcome by the use of student note takers, use of concrete examples to explain ideas, use of audio tapes by blind students, and spending time informally visiting with students who have speech difficulties to better understand their speech.

Teachers need to know where to go for help to break down informational barriers. A bibliography of such sources is available from the authors.

Environmental barriers result from such problems as inadequate room for maneuver, benches that are too high, controls that are inaccessible, and inadequate labeling. Usually only minor adaptations are required to remove environmental barriers.

The key to success with handicapped students is flexibility and creativity. The students are the experts on their handicaps and should be consulted to determine what they can do for themselves, what they can do with minor changes, and what aspects of the course will require major adaptation.

Diagnose the problem, examine your lesson plan for strengths and weaknesses related to the particular handicap of your student, and use common sense in your changes.

(1) Science for Handicapped Students in Higher Education. Martha Ross Redden, Cheryl Arlene Davis and Janet Welsh Brown. 1978. American Association for the Advancement of Science Publication 78-R-2

FIELD BIOLOGY FOR PHYSICALLY HANDICAPPED STUDENTS

Bruce Peterson, Ph.D. (Department of Zoology, Southern Illinois University, Carbondale, Il. 62091)

Adapting a field biology course to handicapped students need not be the overwhelming experience you may expect. At a National Science Foundation sponsored two-week field biology course for physically handicapped students, co-directed by Dr. Mary Jane Sullivan and me last summer, a basic ecology curriculum was taught to twenty-six hearing-impaired, vision-impaired and orthopedically-impaired students at the Touch of Nature Environmental Center at Southern Illinois University at Carbondale.

Our format was a morning lecture, mid-morning field activity, recreation after lunch, afternoon field activity and evening film. Adaptations similar to those we made to

accommodate our students can be used in any biology course to enhance the educational opportunities for handicapped students. All of our handicapped students benefited from having a note taker and from having written directions the day before each exercise was begun.

Other simple adaptations made in the lecture included having a sign interpreter for the deaf students and using an overhead projector instead of a blackboard so they could read the lecturer's lips. Concrete examples of abstract ideas were included. The overhead projector also helped vision impaired students. Blind students taped the lectures.

Most of our effort was put into field experiences, which were made accessible to students in wheelchairs by providing adequate muscle power to push them across rough terrain and carry them into and out of cars, busses, boats, and canoes. We found that with extra effort and care they could go everywhere the rest of us went--even rappelling over a sixty foot cliff. Some of these students could help with many of the field exercises if they were taken out of their chairs and put on the ground. Large knobs on microscopes helped, as did lap boards for the scopes. Some of the orthopedically-impaired and vision-impaired students found writing easier with newsprint and felt-tipped pens.

An effort was made to increase the use of touch and smell. Both the blind, who tend to have narrow understanding of the physical world, and deaf, who sometimes have difficulty with abstraction, seemed to benefit from this effort. Braille labels on bottles and lab equipment enabled blind students to perform nearly all of the activities.

The students were given pretests and posttests and showed considerable improvement in their scores after only two weeks. The low pretest scores told us that these handicapped students had poor backgrounds in science. Their active participation during the course and the improvement they showed on the posttest persuaded us that they can be included in normal science courses with minimum adjustment, and when included with do as well and as poorly as those without physical handicaps.

THE JANUARY INTERIM PLUS NCEP AT CARROLL COLLEGE

John Bartha, (Biology Department, Carroll College, Waukesha, WI.)

17 years ago Carroll College undertook a college wide study of its curriculum. After reviewing many possibilities, the faculty voted (not unanimously) to go to the 4-1-4. This format seemed to provide opportunities to make innovative changes that would be more in line with a liberal arts education for the turbulent 60's.

Of particular interest to a number of the faculty was the January Interim. This time slot seemed to provide an outlet for field experiences not normally found in a semester program by providing for a time other than summer when students were involved with jobs, etc.

The early "off campus" trips were financed entirely by the students. These monies were required in addition to those of tuition, fees, room and board. The scope of programs ranged from Moscow, Russia to Jamaica and involved departments of Political Science, History, Art, Biology, English, Economics and Foreign Languages. The off campus experiences were limited to those students with Junior or Senior standing. It was obvious that it would be impossible for all Carroll upperclass students to take part in this program. Therefore, an "on campus" program had to be developed for the underclass students plus the Juniors and Seniors unable to afford the additional costs. It was decided to provide courses on campus built around a theme. Each department would provide a departmentally constructed theme-related course. In the early years there were 25 on campus "theme" courses and 6 to 10 off campus courses.

As the "off campus" courses evolved, it became apparent that those who were able to afford the added costs were not always the students who would benefit the most from these experiences. In fact the "off campus" courses were fast becoming the "rich kids" classes.

After much discussion and many meetings with the administration and Board of Trustees, a way was developed to allow all Carroll students the opportunity to take part in the January "off campus" courses. The Foreign Student Scholarship fund, an increase in tuition and a start-up grant provided funds for the first NEW CULTURAL EXPERIENCES PROGRAM. This

program is now college funded and provides up to half the cost of the course to a maximum of \$800.00 per student. At Carroll we have roughly 125 students per January in the various NCEP programs. This college funding enables many more students to take part in the off campus programs than previously.

The Biology Department at Carroll has had as many as 3 NCEP programs in a given year. A course in Tropical Ecology and Marine Biology has been taught for 17 years, both before and after NCEP. A course in Rural Health Care in the Third World was taught yearly but as a result of personnel changes, is now offered in alternate years. And a Socio-Biology course with a domestic field component is offered in June with NCEP funding. The latter focuses on Appalachia and is jointly taught with the Geography Department.

Any professor is welcome to create an NCEP course. However, an NCEP committee chaired by the Provost must pass on the viability of any new proposal. The original 6 NCEP courses have run successfully with a full compliment of students since the beginning of the concept 10 years ago. Other NCEP courses have been tried and for a variety of reasons not been sustained.

The programmers duties vary from doing all of the logistical work to calling travel agents and having them put a package together. Planning of an NCEP program is an overload, in addition to regular classwork and the myriad of normal college duties. However, the rewards are well worth the effort. Besides, after the winter of 1982, the Caribbean is not a bad place to be in January.

ARTICULATION BETWEEN COLLEGES: BIOLOGY COURSES AND PROGRAMS IN TWO AND FOUR YEAR SCHOOLS

Paul A. Mayes (Muscatine Community College, Muscatine, Iowa and Robert Satterfield (College of DuPage, DuPage, IL)

Articulation between two and four year colleges has been a major concern of faculty and administrators involved with transfer students. Articulation is the process of separate units "coming together." In an educational context, this may be articulation of individual courses, such as Biology or Zoology courses, or of entire programs of study, such as the pre-Nursing program that leads to a BSN degree from a four year college.

Local, regional and national studies have examined this concern in attempts to understand and improve upon relationships between involved colleges. The student is caught in the middle of any controversies surrounding articulation concerns, and many of these studies have focused on the student's problems of transferring from one school to another. The students attend community colleges for many reasons, and often have intentions of completing baccalaureate degrees at four year institutions. Those that feel they will lose credits or entire semesters of study often fail to transfer and complete their degree, which hurts both institutions as well as the students.

Several states have produced agreements between state universities and public community colleges to relieve some of these problems. Iowa is one of these states, and our agreement covers broad based general education requirements for students transferring into the universities as college juniors. Additional work is needed, however, to insure that the students receive credit for specific courses in the Biology curriculum at the universities. Most of the above agreements and studies involve only articulation between public schools. Many of our students transfer to private four year colleges, so agreements must also be made with these schools.

Articulation agreements that involve courses in the Biological Sciences must generally be made first between the faculty members of the proper departments of each school involved. These agreements must usually be initiated by the two year college from which the students will be transferring. Careful attention to the specific requirements of each course and professor will enhance the relationships necessary for good agreements. Counselors, registrars and administrators at the articulating schools must all be made aware of any agreements and all of the particulars involved. A smooth transition for the transferring student should be the ultimate goal of this type of activity.

Muscatine Community College has been actively involved with articulation studies, agreements, and arrangements with several four year institutions. All of these activities involved personal communications and meetings between faculty and counseling staff at the two and four year colleges. This process has been successful for us, but we are continually searching for methods of improvement and innovation.

 Ref. Illinois Community College/Sencio College Articulation Task Force. 1978. Community College/ Senior College Articulation in Illinois. Urbana, U.I. Office of Community and College Relations.

CAREER ADVISEMENT FOR BIOLOGY MAJORS

Neil M. Baird (Millikin University, Decatur, IL)

Because of the condition of the economy and the high unemployment rate, many college students and their parents are more career conscious than ever before. This concern is becoming an increasingly important factor in choosing the major for the freshman year of college. Some students have made a premature commitment to an appealing career area and some have drifted into a career choice to please expectations of family and friends. Many students simply do not understand themselves or the world of work well enough to put the two together in a meaningful and realistic career decision. The purpose of this paper is to briefly describe the process of career planning and advising for our biology majors.

Although most students are very concerned about careers, they are not too likely to devote much time to the process of career planning on their own. Therefore, faculty need to provide guidelines, prompting, encouragement and direct assistance so that this activity will take place.

There needs to be a central point where career information can be examined by students. This may be in the campus career office, the library, the biology department or a combination of the above. Such a center should include graduate and professional school information, literature on the various health and science careers, governmental career publications, industrial career publications, publications from various professional organizations, books on career planning in general, listings of job openings in the local area or the job bulletin from a nearby state school.

An early step in the career planning process is for the students to get to know themselves better. There are specific tests, exercises and workshops designed to help students to become more aware of their interests, skills, values, goals, significant accomplishments, etc. Often these activities are handled by the career office on campus. Many of these exercises utilize principles contained in the excellent book, What Color Is Your Parachute?, by John Bolles. Students need to realize what is unique about themselves and to develop and accentuate these strengths. To achieve this result, some students need to be taught that it is important to be their own person and not just continue to blend in with the crowd.

The next step in career planning is for the students to match themselves with a particular career or, better yet, a cluster of related career options. There are two basic sources of career information -- written materials and talking with people in the field. Students need to be encouraged to interview people in their chosen area for career information. Students should have the professional describe a typical day, his likes and dislikes concerning his career, his training, his major responsibilities, and future opportunities for growth in the field. Exposure to the intended field by way of observation periods, part time work, volunteer work, or internships are extremely valuable. Faculty should see that students get this first hand experience early in their college careers if possible.

Within the department it is often most effective to have faculty specialize in advising the various career directions of the students. This way it is easier to keep current with the career literature, the changing educational requirements, the application procedures, and the local contacts with professionals in that particular field. Special career programs

featuring field trips, guest speakers, discussion of application procedures and career planning in general are also very useful for the students. Utilizing alumni as guest speakers and as off-campus resource people for information on jobs, as well as for internships, is also an important part of career advising.

In conclusion, we faculty need to work toward becoming better career advisers than we are at present. It is important that we help students to know themselves and the career possibilities within biology beginning in the freshman year. The students will find that the options include many different health careers, education, a host of diverse careers (such as research, marketing, sales, technical writing, quality control, public relations and industrial hygiene) in government, the food industry, the pharmaceutical industry, and the chemical industry, as well as sewage treatment, science librarianship, wildlife management, and on and on. With jobs being tighter than before, it is all the more important that our students be prepared for the world of work by actively preparing themselves with the career knowledge and skills they will need.

I hope that you have enjoyed this issue of the MIDWEST BIOSCENE. Without the able assistance of Mrs. Sandra Roth who typed the manuscript and Dr. David Maharry who helped with the printing of the final copy, this issue would still be on my typewriter. The next issue will be published in April, so now is the time to put your creative talents to work. All articles submitted for publication should have the following format:

1. All papers should be double-spaced with all pages numbered.
2. The first page should have the following information: title, authors, author's college address, author's home and college telephone number.
3. Following pages should have the author's names at the top of the paper.
4. Tables, charts and graphs should be numbered and referred to by number in the text; these should be on separate sheets and be fully labeled and "camera-ready".

I encourage you to develop your own innovative ideas for articles to present for publication. My single criterion for selection is "reader interest". The following are some ideas for particular types of articles:

1. MICROCOMPUTERS IN BIOEDUCATION. For this section, I hope that you will submit articles about microcomputer software, hardware and applications. Brief outlines of computer programs that highlight the important aspects of the program are also welcomed. Such outlines should indicate the availability of the program to other faculty.
2. LABORATORIES THAT WORK. Short articles that review the design and structure of a laboratory. These can either be a complete presentation of the laboratory or summaries. With summaries, interested readers should be able to write to the author for a more complete outline.
3. JOB OPENINGS.
4. BIOLOGY AND GOVERNMENT. Articles that summarize activities of state and federal court and legislative bodies that are relevant to biologists, i.e. science education budget, science and religion, research funds, creation-evolution debate.
5. NEWS ABOUT MEMBERS. Advancements in rank, changing jobs, deaths, moves, etc.
6. MINORITIES IN BIOLOGY. What are you and your college doing to increase the representation and retention of minorities in science?
7. DEPARTMENTAL PROFILES. Each issue, beginning in April, I hope to have a profile of a particular department. Since we will be meeting at St. Olaf College next fall, I hope to coerce someone to summarize the curriculum and graduation requirements of their biology department.
8. CULTURE EXCHANGE. Do you have cultures that you will share with your colleagues or do you need particular cultures? If so, simply send a

description of the culture and we will publish it in the next BIOSCENE.

9. FEATURED STUDENT REPORTS. In many departments, students are expected or encouraged to undertake independent research. Some of these reports deserve wider distribution than just at the local college. Now, you have a place for your student to submit his paper. To facilitate this process, the individual member will be responsible for editorial control. Each paper will be published with a reference to the person who sponsored the article.

DON'T DELAY, INSTEAD OF SITTING IDLE, WHY SHARE YOUR INNOVATIVE IDEAS WITH THE MEMBERSHIP. ENCOURAGE YOUR COLLEAGUES TO JOIN AMCBT AND PARTICIPATE ACTIVELY IN THIS GROWING ASSOCIATION OF MIDWESTERN BIOLOGISTS!!!!!!!!!!

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