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Science Education in Alabama

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COVER PHOTOGRAPH: This painting titled *Plato's Cave* is by Sheri Lynn Schumacher, Associate Professor in the School of Architecture, Auburn University. The work was inspired by Plato's "Allegory of the Cave" found in *Republic*: Book VII.

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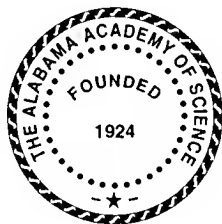
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EDITOR'S PREFACE

The theme uniting the articles in this special issue of the *Journal of the Alabama Academy of Science* is science education in Alabama, and a particular focus of several articles is the perennial controversy over teaching biological evolution in the state's public schools. The lead article by Richard Dawkins, the author of numerous popular books on evolution including *The Selfish Gene*, *The Blind Watchmaker* and *Climbing Mount Improbable*, offers an exquisitely concise and instructive line by line critique of the "insert" for biology textbooks that was adopted by the Alabama State board of Education in 1995. This is followed by contributions from Dail W. Mullins and Guy V. Beckwith that recount diverse reactions to and social ramifications of Darwinism in the United States and Europe in this and the last century. Next are two articles by Scott Brande and John C. Frandsen that provide revealing histories and analyses of the hexennial process whereby the Alabama State Board of Education adopts a science course of study and a list of science text books for use in the public school system. It was the most recent (1995) adoption cycle of the Board that produced the "insert" critiqued by Dawkins and whose origin and evolution are so diligently traced by Brande and Frandsen in their article *The Evolution/Creation Controversy During the 1995 Alabama Science Textbook Adoptions*. Robert B. Greenleaf's *Just Where Do I Fit in the Universe?* is a synthesis of the ideas and issues that comprise a trilogy of courses called *The Human Odyssey*, a component of the core curriculum at Auburn University that examines connections between science and the humanities. In these courses freshmen undergraduates grapple with the great questions of science, art, philosophy and theology including: "What is Nature?" and "Where do I fit and what are my responsibilities within Nature? As can be imagined, a student's experience in these courses reflects the quality of preparedness obtained during her/his primary and secondary school education, particularly in science. This assembly of articles is concluded with Ellen Buckner's profiles of 1990-1996 recipients of the Wright A. Gardner Award that honors achievement in science while in residence in Alabama. It is hoped that reading these profiles of outstanding scientists who are also educators will give one inspiration to work for a continually improving quality of science education in Alabama. It is also hoped that this special issue will become a valuable handbook of information for public school educators throughout the state who are devoting their time, creative energy and intellect toward providing a high quality education for our children. Through Sheri Schumacher's painting on the front cover, Plato challenges us as students, teachers, legislators, governor and citizens to leave the cave and its shadows in favor of the sunlight.

Franklin Lectures in Science & Humanities
Auburn University April 1, 1996

THE "ALABAMA INSERT": A STUDY IN IGNORANCE AND DISHONESTY

Richard Dawkins
Charles Simonyi Professor
In the Public Understanding of Science
Oxford University
Oxford, England

As a former prime minister of my country, Neville Chamberlain once said: "I have here a piece of paper." It says "A message from the Alabama State Board of Education." This is a flier that is designed to be - *ordered* to be - stuck into the front of every textbook of Biology used in the public schools. What I thought I would do, with your permission, is to depart from the prepared text I brought with me. Instead I should like to go through every sentence of this document, one by one.

"THIS TEXTBOOK DISCUSSES EVOLUTION, A CONTROVERSIAL THEORY THAT SOME SCIENTISTS PRESENT AS A SCIENTIFIC EXPLANATION FOR THE ORIGIN OF LIVING THINGS SUCH AS PLANTS, ANIMALS, AND HUMANS."

This is dishonest. The use of "*some* scientists" suggests the existence of a substantial number of respectable scientists who do not accept evolution. In fact, the proportion of qualified scientists who do not accept evolution is tiny. A few so called "creation scientists" are much touted as possessing PhDs, but it does not do to look too carefully where they got their PhDs from nor the subjects they got them in. They are, I think, never in relevant subjects. They are in subjects perfectly respectable in themselves, like marine engineering or chemical engineering, which have nothing to do with the matter at hand.

"NO ONE WAS PRESENT WHEN LIFE FIRST APPEARED ON EARTH"

Well, that is true.

"THEREFORE, ANY STATEMENT ABOUT LIFE'S ORIGINS SHOULD BE CONSIDERED AS THEORY, NOT FACT."

That's also true but the word theory is being used in a misleading way. Philosophers of science use the word theory for pieces of knowledge that anybody else would call fact, as well as for ideas that are little more than a hunch. It is strictly only a theory that the earth goes around the sun. It is a theory but it's a theory supported by all the evidence. A fact is a theory that is supported by all the evidence. What this is playing upon is the ordinary language meaning of theory which implies something really pretty dubious or which at least will need a lot more evidence one way or another.

For example, nobody knows why the dinosaurs went extinct and there are various theories of it which are interesting and for which we hope to get evidence in the future. There's a theory that a meteorite or comet hit the earth and indirectly caused the death of the dinosaurs. There's a theory that the dinosaurs were killed by competition from mammals. There's a theory that they were killed by viruses. There are various other theories and it is a genuinely open question which (at the time of speaking) we need more evidence to decide. That is also true of the origin of life, but it is not the case with the theory of evolution itself. Evolution is as true as the theory that the world goes around the sun.

While talking about the theories of the dinosaurs I want to make a little aside. You will sometimes see maps of the world in which the places where people speak different languages are shaded. So, you'll say, "English is spoken here," "Russian is spoken there," "French is spoken here, etc." And that's fine; that's exactly what you would expect because people speak the language of their parents.

But imagine how ridiculous it would be if you could construct a similar map for theories of, say, how the dinosaurs went extinct. Over here they all believe in the meteorite theory. Over on that continent they all believe the virus theory, down here they all believe the dinosaurs were driven extinct by the mammals. But if you think about it that's more or less exactly the situation with the world's religions.

We are all brought up with the religion of our parents, grandparents and great-grandparents and by golly that just happens to be the one true religion. Isn't that remarkable! Creation myths themselves are numerous and varied. The creation myth that happens to be being taught to the children of Alabama is the Jewish creation myth which in turn was taken over from Babylonian creation myths and was first written down not very long ago when the Jews were in captivity. There's a tribe in West Africa that believes that the world was created from the excrement of ants. The Hindus, I am told, believe that the world was created in a cosmic butter churn. No doubt every tribe and every valley of New Guinea has its own origin myth. There is absolutely nothing special about the Jewish origin myth, which is the one we happen to have in the Christian world.

Moving on in the "Alabama Insert" as I shall call it.

"THE WORD 'EVOLUTION' MAY REFER TO MANY TYPES OF CHANGES. EVOLUTION DESCRIBES CHANGES THAT OCCUR WITHIN A SPECIES (WHITE MOTHS, FOR EXAMPLE, MAY "EVOLVE" INTO GRAY MOTHS). THIS PROCESS IS CALLED MICROEVOLUTION WHICH CAN BE OBSERVED

"Alabama Insert"

AND DESCRIBED AS FACT. EVOLUTION MAY ALSO REFER TO CHANGES OF ONE LIVING THING INTO ANOTHER SUCH AS REPTILES CHANGING INTO BIRDS. THIS PROCESS CALLED MACROEVOLUTION HAS NEVER BEEN OBSERVED AND SHOULD BE CONSIDERED A THEORY."

The distinction between microevolution and macroevolution is becoming a favorite one for creationists. Actually, it's no big deal. Macroevolution is nothing more than microevolution stretched out over a much greater time span.

The moth being referred to, I presume, is the famous peppered moth, *Biston betularia*, studied in England by my late colleague Bernard Kettlewell. It is a famous story about how, in the Industrial Revolution when the trees went black from pollution, the peppered pale colored version of this moth was eaten by birds because it was conspicuous against the black tree trunks. After the Industrial Revolution years, the black moths became by far the majority in industrial areas of England. But if you go into country areas where there is no pollution, the original peppered variety is still in a majority. I presume that's what the document is referring to.

The point about that story is that it's one of the few examples we know of genuine natural selection in action. We are not normally privileged to see natural selection in action because we don't live long enough. The Industrial Revolution, however unfortunate it may have been in other respects, did have the fortunate by-product of changing the environment in such a way that you could study natural selection.

To study other examples of natural selection I recommend the book *The Beak of the Finch* by J. Weiner. He is describing the work of Peter and Rosemary Grant on the Galapagos finches. Those finches, perhaps more than any other animal, inspired Charles Darwin himself. What the Grants have done studying Galapagos Island finches is actually to sample populations from year to year and show that climatic changes have immediate and dramatic effects on the population ratios of various physical structures such as beak sizes.

Darwin was inspired by the example of the Galapagos finches; he was also inspired by the examples of domestication.

These are all domestic dogs (Fig. 1) except the top one which is a wolf. The point of it is, as observed by Darwin, how remarkable that we could go by human artificial selection from a wolf ancestor to all these breeds - a Great Dane, a Bulldog, a Whippet, etc. They were all produced by a process analogous to natural selection - artificial selection. Humans did the choosing whereas in natural selection, as you know, it is nature that does the choosing. Nature selects the ones that survive and are good at reproducing, to leave their genes behind. With artificial selection, humans do the choosing of which dogs should breed and with whom they should mate.

These plants (Fig. 2) are all members of the same species. They are all descended quite recently from the wild cabbage *Brassica oleracea* and they are very different - cauliflower, brussels sprouts, kale, broccoli, etc. This great variety of vegetables, which look completely different, has been shaped - they have been sculpted - by the process of artificial selection from the same common ancestor.

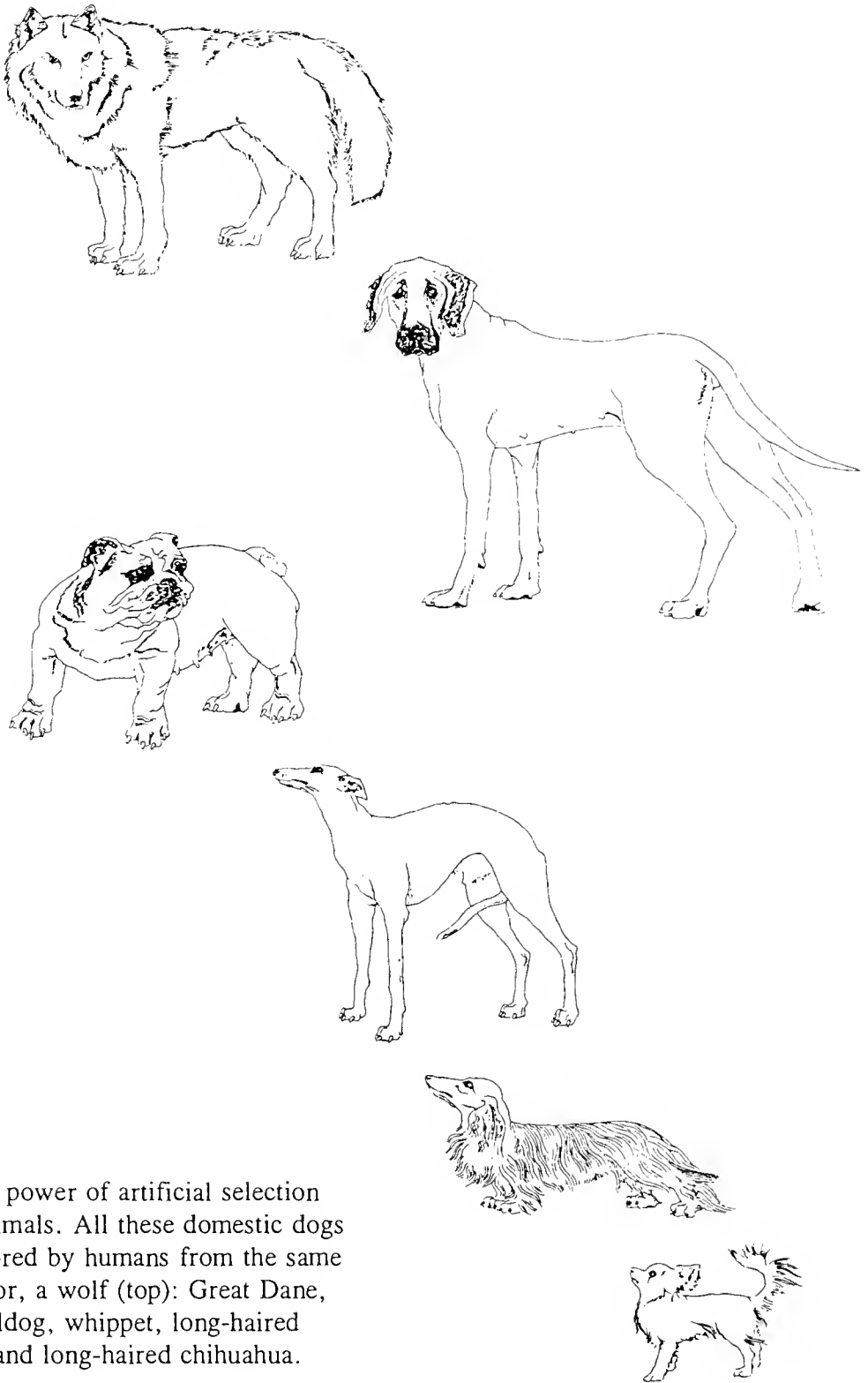


Fig. 1 The power of artificial selection to shape animals. All these domestic dogs have been bred by humans from the same wild ancestor, a wolf (top): Great Dane, English bulldog, whippet, long-haired dachshund and long-haired chihuahua.

“Alabama Insert”



Fig. 2 All these vegetables have been bred from the same ancestor, the wild cabbage, *Brassica oleracea*: (clockwise from top left) Brussels sprout, kohlrabi, Swedish turnip, drumhead cabbage, cauliflower and golden savoy.

That's an example of what can be achieved in a few centuries when the selection is powerful enough. When the selection goes on for thousands of centuries the change is going to be correspondingly greater - that's macroevolution. It's just microevolution going on for a long time.

It's difficult for the human mind to grasp how much time geology allows us, so various picturesque metaphors have been developed. The one I like is as follows: I stand with my arm outstretched and the distance from the center of my tie to my fingers represents the total time available since life began. That's about four thousand million years. Out to about my shoulder we still get nothing but bacteria. At my elbow you might be starting to get slightly more complicated cells - eukaryotic cells - but still single cells. About mid-forearm you start getting multicellular organisms, animals you can see without a microscope. At my palm you would get the dinosaurs. Somewhere toward the end of my finger you would get the mammals. At the beginning of my nail you would get early humans. And the whole of history - all of documented written human history, all the Babylonians, Biblical history, Egyptians, the Chinese, the whole of recorded history would fall as the dust from a nail file across the tip of my furthest finger.

This is hard for the human brain to grasp, time spans of that order. Remember that the time represented by the dust from the nail includes the time it took these cabbage varieties to evolve by artificial selection (human selection) and dogs to evolve from wolves. Just think how much change could be achieved by natural selection during the thousands of millions of years before recorded history.

To reinforce that point there was a theoretical calculation made by the great American botanical evolutionist, Ledyard Stebbins. He wanted to calculate theoretically how long it would take to evolve from a tiny mouse sized animal (ancestor) to a descendant animal the size of an elephant. So what we are talking about is a selection pressure for increased size. Selection pressure means that in any generation slightly larger than average individuals have a slight advantage. They are slightly more likely to survive for whatever reason, slightly more likely to reproduce. Stebbins needed a number to represent that selection pressure, a way to show how strong to assume it to be. He decided to assume it (the pressure) to be so weak that you couldn't actually detect it if you were doing a field study out there trapping mice.

So Stebbins assumed his theoretical selection pressure to be so weak that it is undetectable, it vanishes in the sampling error of an ordinary research study. Nevertheless, it's there. How long would it take under this small but relentless pressure for these mouse-like animals to grow and grow over the generations until they became the size of an elephant? He concluded that it would take about 20,000 generations. Well, mouse generations would be several in a year, elephant generations would take several years. Let's compromise and assume one year per generation. Even at 5 years per generation, that's not many years, say 100,000 years at the most. Well, 100,000 years is too short to be detected on the geological time scale for most of geologic history.

For most characteristics a selection pressure as weak as that, so weak that you couldn't even measure it, is sufficiently strong as to propel evolution so fast that it appears

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to be instantaneous on the geological time scale. In practice it probably isn't even as fast as that, but geological time is so vast that there is plenty of time for the evolution of all of life to have happened.

Another theoretical calculation was made by the Swedish biologist, Dan Nilsson. He took up the question which Darwin himself was interested in - the eye, the famous eye, the darling of creationist literature. Darwin himself recognized the eye as a difficult case because it is very complicated. Many people have thought, wrongly, that the eye is a difficult problem for evolutionists because - "Doesn't it have to be all there with all the bits working for the thing to work?"

No. Of course they don't all have to be there. An animal that has half an eye can see half as well as an animal with a whole eye. An animal with a quarter eye has a quarter vision. An animal with 1/100 eye has 1/100 quality vision. It's not quite as simple as that. The point I am making is that you can be aided in your survival by every little tiny increment in quality of eyesight. If you have 1/100 quality eyesight, you can't see an image but you can see light and that might be useful. The animal might be able to tell which direction the light is coming from or which direction a shadow is coming from which could portend a predator. There are all sorts of things you could do that help you to survive if you have a small fraction of an eye, to survive better than an animal which has no eye at all. With 1/100 of an eye you can just about survive. With 2/100 of an eye you can survive a little better. There is a slow, gradual ramp of increasing probability of surviving as the eye gradually gets better.

Going back to the question of the rate at which all this happens, Nilsson did a computer modeling exercise of the evolution of the eye (Fig. 3). He starts from a computer model which is not really eye shaped at all but is just a flat sheet of light sensitive cells. You've got to start somewhere. You could start before that if you wanted to, but that's where he started. He made the computer gradually change the shapes of this model eye. The only rule was that the changes had to be small and each change had to result in an improvement in vision. The beautiful thing about the eye is that by using the actual rules of physics, the ordinary rules of optics, you can calculate how good each of the hypothetical intermediates would be at forming an image.

These intermediates all formed spontaneously in the computer as a result of gradual improvement in what the computer could measure as the optical quality of the model eye, and it goes all the way from a flat sheet of cells to a proper camera eye with a lens such as you might see in a fish. It is even better than that. The exact focusing of the lens is precisely as it should be. The details of this are written down in Nilsson's paper. By feeding in assumptions which are based upon field work in population genetics he was able to make calculations as to how long it would plausibly take under realistic conditions of natural selection. This is similar to the Stebbins calculation of how long it would take to go from the start of the series to the end. Once again it was startlingly fast. Nilsson calculated that it would take fewer than half a million generations. The sort of small animals we are talking about, in which the eye originally evolved, would probably have had about 1 generation/year. Half a million years is a very short time on the geologic time scale.

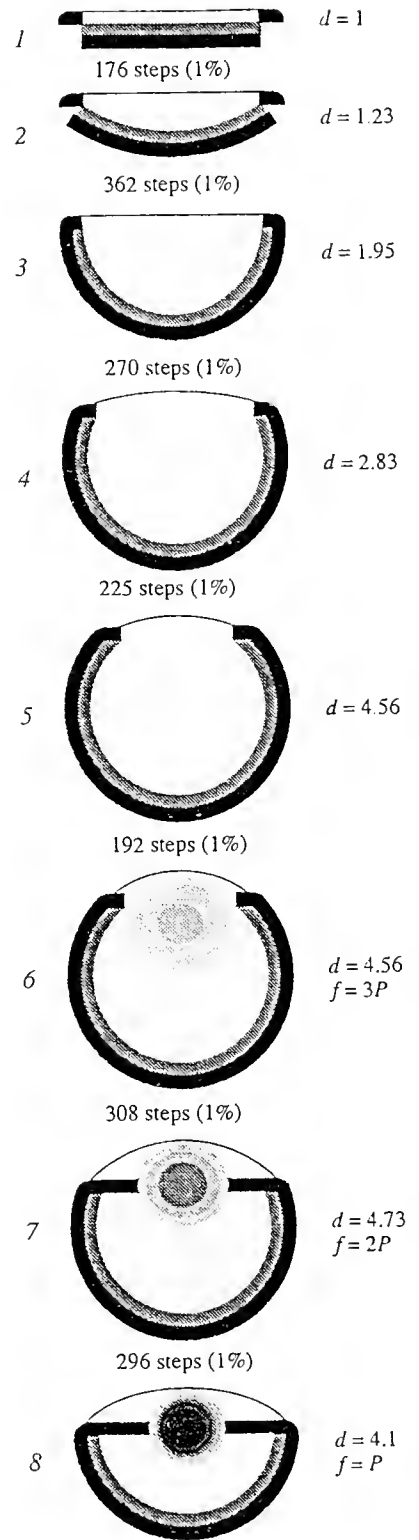


Fig. 3 Nilsson and Pelger's theoretical evolutionary series leading to a 'fish' eye. The number of steps between stages assumes, arbitrarily, that each step represents a 1 percent change in magnitude of something. See text for translation from these arbitrary units into numbers of generations of evolution.

"Alabama Insert"

Therefore, it's not surprising that when you look around the animal kingdom you find all the intermediates you could wish for in the evolution of the eye, in various groups of worms, etc. The eye has evolved no less than 40 times independently around the animal kingdom, and possibly as many as 60 times. So, "the" eye is really some 40-60 different eyes and it evolves very rapidly and exceedingly easily. There are 9 different optical principles that have been used in the design of eyes and all 9 are represented more than once in the animal kingdom.

“EVOLUTION ALSO REFERS TO THE UNPROVEN BELIEF THAT RANDOM, UNDIRECTED FORCES PRODUCED A WORLD OF LIVING THINGS.”

Where *did* this ridiculous idea come from that evolution has something to do with randomness? The theory of evolution by natural selection has a random element -- mutation -- but by far the most important part of the theory of evolution is non-random: natural selection. Mutation is random. Mutation is the process whereby parent genes are changed, at random. Random in the sense of not directed toward improvement. Improvement comes about through natural selection, through the survival of that minority of genes which are good at helping bodies survive and reproduce. It is the non-random natural selection we are talking about when we talk about the directing force which propels evolution in the direction of increasing complexity, increasing elegance and increasing apparent design.

The statement that “evolution refers to the unproven belief that random undirected forces. . .” is not only unproven itself, it is stupid. No rational person could believe that random forces could produce a world of living things.

Fred Hoyle, the eminent British astronomer who is less eminent in the field of biology, has likened the theory of evolution to the following metaphor: “It's like a tornado blowing through a junk yard and having the luck to assemble a Boeing 747.” His statement is a classic example of the erroneous belief that natural selection is nothing but a theory of chance. A 'Boeing 747' is the end product that any theory of life must explain. The riddle for any theory to answer is, "how do you get complicated, statistically improbable apparent design?" Darwin's theory of evolution by natural selection is the only known theory that can answer this riddle. It is also supported by a great deal of evidence. With his explanation Darwin, in effect, smears out the chance or "luck" factor. There is luck in the theory, but the luck is found in small steps. Each generational step in the evolutionary process is only a little bit different from the step before. These little bits of difference are not too great to come about by chance, by mutation. However if, after the accumulation of a sufficient number of these small steps (perhaps 100), one after the other, you've got something like an eye at the end of this process, it could not have come all of a sudden by chance. Each individual step could occur by chance, but all 100 steps together could not. All 100 steps are pieced together cumulatively by natural selection.

Another metaphor along these lines is of a bank robber who went into a bank and started fiddling with the combination lock on the safe. Theoretically the thief could fiddle

with the lock and have the luck to open the safe. Of course you know in practice he couldn't do that. That's why your money is safe in the bank. But just suppose that every time you twiddled that knob and got a little bit closer to the correct number, a one dollar bill fell out of the safe. Then when you twiddled it another way and got a little closer still, another dollar fell out. You would very rapidly open the safe. It's like that with natural selection. Each step has a little bit of luck but when the steps are put together you end up with something that looks like a 'Boeing 747'.

“THERE ARE MANY UNANSWERED QUESTIONS ABOUT THE ORIGIN OF LIFE WHICH ARE NOT MENTIONED IN YOUR TEXTBOOK INCLUDING: WHY DID THE MAJOR GROUPS OF ANIMALS SUDDENLY APPEAR IN THE FOSSIL RECORD KNOWN AS THE “CAMBRIAN EXPLOSION.”

We are very lucky to have fossils at all. After an animal dies many conditions have to be met if it is to become a fossil, and one or other of those conditions usually is not met. Personally, I would consider it an honor to be fossilized but I don't have much hope of it. If all the creatures which had ever lived had in fact been fossilized we would be wading knee deep in fossils. The world would be filled with fossils. Perhaps it is just as well that it hasn't happened that way.

Because it is particularly difficult for an animal without a hard skeleton to be fossilized, most of the fossils we find are of animals with hard skeletons - vertebrates with bones, mollusks with their shells, arthropods with their external skeleton. If the ancestors of these were all soft and then some offspring evolved a hard skeleton, the only fossilized animals would be those more recent varieties. Therefore, we expect fossils to appear suddenly in the geologic record and that's one reason groups of animals suddenly appear in the Cambrian Explosion.

There are rare instances in which the soft parts of animals are preserved as fossils. One case is the famous Burgess Shale which is one of the best beds from the Cambrian Era (between 500 million and 600 million years ago) mentioned in this quotation. What must have happened is that the ancestors of these creatures were evolving by the ordinary slow processes of evolution, but they were evolving before the Cambrian when fossilizing conditions were not very good and many of them did not have skeletons anyway. It is probably genuinely true that in the Cambrian there was a very rapid flowering of multicellular life and this may have been when a large number of the great animal phyla did evolve. If they did, their essential divergence during a period of about 10 million years is very fast. However, bearing in mind the Stebbins calculation and the Nilsson calculation, it is actually not all that fast. There is some recent evidence from molecular comparisons among modern animals which suggests that there may not have been a Cambrian explosion at all, anyway. Modern phyla may well have their most recent common ancestors way back in the Precambrian.

As I said, we're actually lucky to have fossils at all. In any case, it is misleading to think that fossils are the most important evidence for evolution. Even if there were not a

"Alabama Insert"

single fossil anywhere in the earth, the evidence for evolution would still be utterly overwhelming. We would be in the position of a detective who comes upon a crime after the fact. You can't see the crime being committed because it has already happened. But there is evidence lying all around. To pursue any case, most detectives and most courts of law are happy with 2-3 clues that point in the right direction.

Even discounting fossils, the clues that are left for us to see that prove the truth of evolution are numbered in the tens of millions. The number of clues, the sheer weight of evidence, totally and utterly, sledgehammeringly, overwhelmingly strongly supports the conclusion that evolution is true - unless you are prepared to believe the Almighty deliberately faked the evidence in order to make it look as though evolution is true. (And there are people who believe that.)

The evidence comes from comparative studies of modern animals. If you look at the millions of modern species and compare them with each other - looking at the comparative evidence of biochemistry, especially molecular evidence - you get a pattern, an exceedingly significant pattern, whereby some pairs of animals like rats and mice are very similar to each other. Other pairs of animals like rats and squirrels are a bit more different. Pairs like rats and porcupines are a bit more different still in all their characteristics. Others like rats and humans are a bit more different still, and so forth. The pattern that you see is a pattern of cousinship; that is the only way to interpret it. Some are close cousins like rats and mice; others are slightly more distant cousins (rats and porcupines) which means they have a common ancestor that lived a bit longer ago. More distinctly different cousins like rats and humans had a common ancestor who lived a bit longer ago still. Every single fact that you can find about animals is compatible with that pattern.

Similarly you can look at the geographical distribution of an animal species. Why do animals in the Galapagos Islands more closely resemble animals on neighboring islands and resemble less the animals on the mainland? It's all exactly what you would expect if evolution goes on in isolation on islands with occasional island hopping. New foci for evolution start with migration from mainland to island and then progress from there to other islands.

If you look at the imperfections of nature you see evidence for evolution. Figure 4 shows animals that don't necessarily fly but are at plausible intermediate stages on the way to flight. These stages are relevant to the discussion of what's the use of half an eye or what's the use of half a wing. These animals all glide and by gliding save themselves from falling out of trees.

There are two different ways of being a flat fish. The top fish in Figure 5 is a skate; the bottom one is a flounder. The skate is flat the way a designer might have designed - flattened out on its belly as symmetrically as it can be. The flounder is not symmetrical because when its ancestors went flat they lay on their side, their right side. That meant that the right eye was looking down into the bottom of the sea (not good). Over many generations, natural selection favored the migration of the right eye from the underside to the top. The whole skull became distorted in an interesting way - no designer would ever have built a fish like that. The flounder has its history written all over it. Its ancestors were once

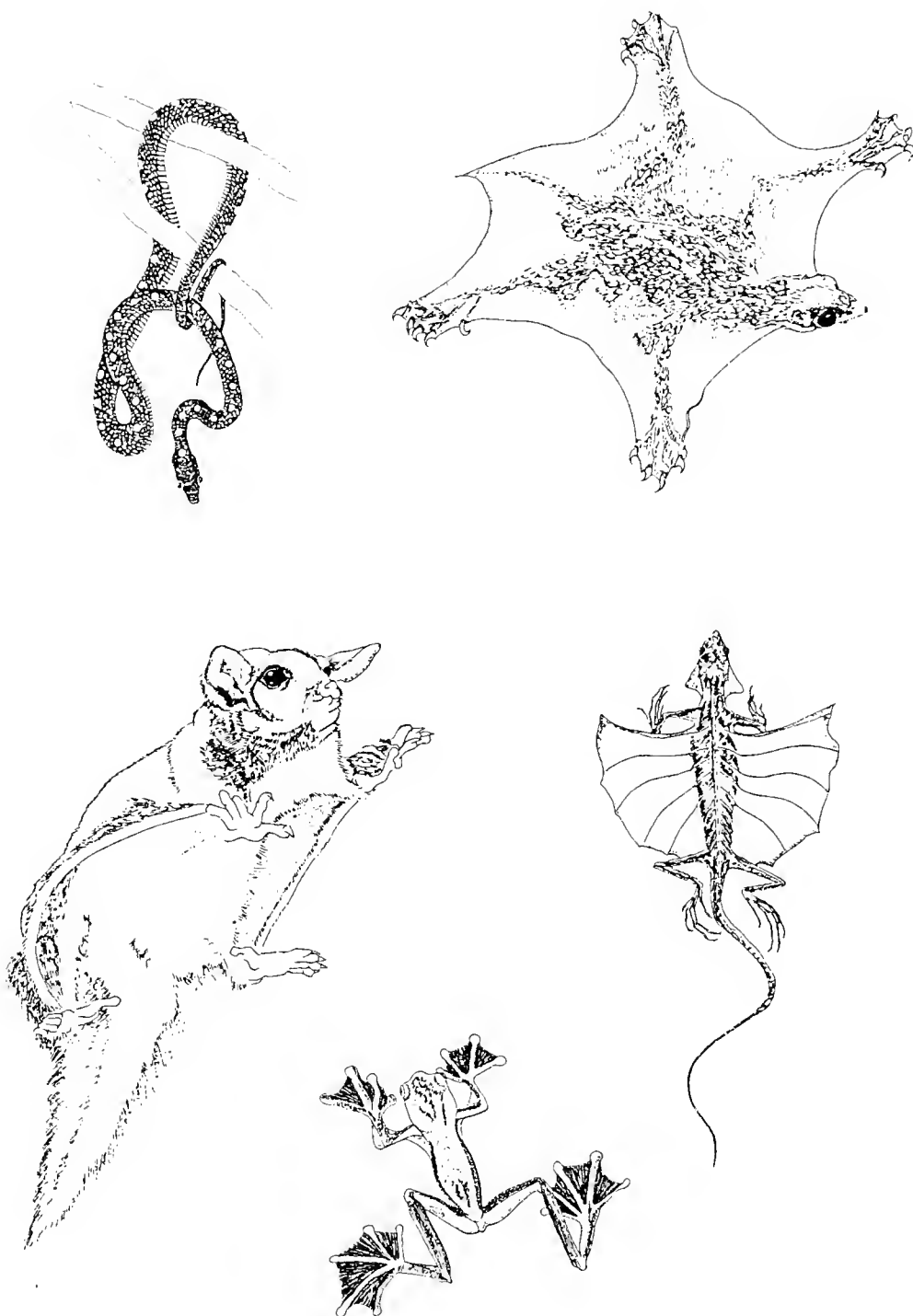


Fig. 4 Vertebrates that glide down from trees but do not truly fly: (clockwise from top right) colugo, *Cynocephalus volans*, flying lizard, *Draco volans*; Wallace's flying frog, *Rhacophorus nigropalmatus*; marsupial sugar glider, *Petaurus breviceps*; and flying snake, *Chrysopelea paradisi*.

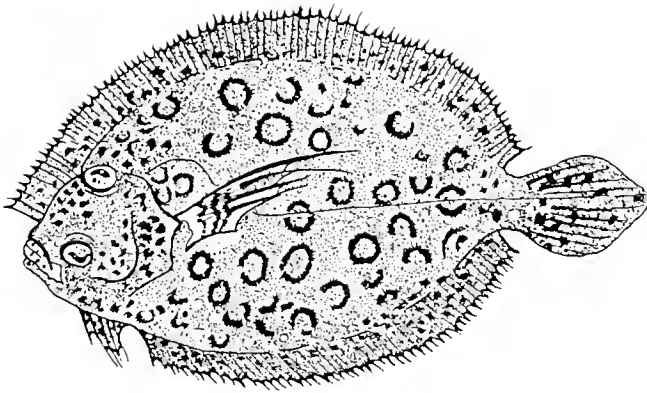
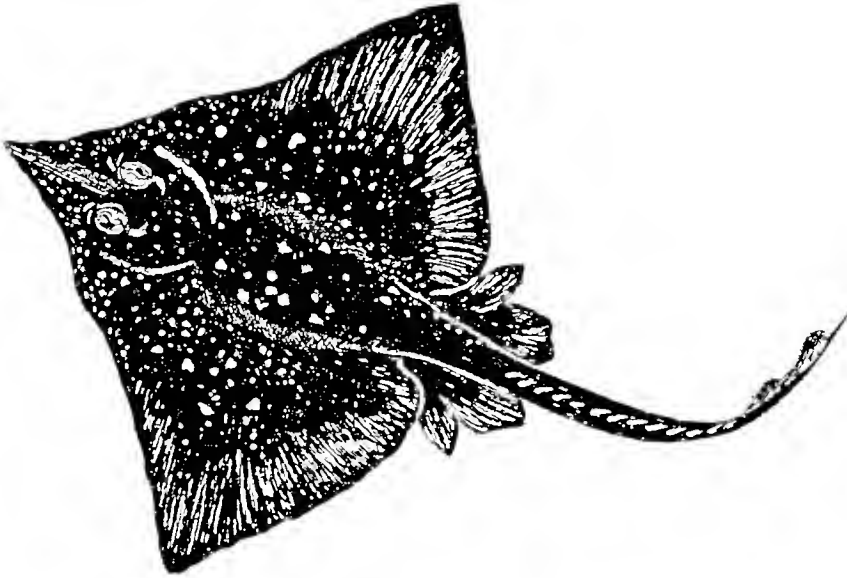


Fig. 5 Two ways of being a flat-fish: the skate, *Raja batis* (top), lies on its belly, while the flounder, *Bothus lunatus*, lies on its side.

free swimming in the normal way, like a trout or a salmon, and then over many generations changed into a flat fish.

“WHY HAVE NO NEW MAJOR GROUPS OF LIVING THINGS APPEARED IN THE FOSSIL RECORD FOR A LONG TIME?”

We are moving well down the list of the Alabama State Board of Education. In zoology, "major groups" would be called phyla - a phylum being a category such as mollusks, which includes snails and shellfish; echinoderms, which are starfish, sea urchins and so on; chordates, which are animals with spinal cords, including ourselves; arthropods which include insects and crustaceans. The question is, "Why have no major ones appeared in a long time?"

Well, major groups don't and shouldn't, according to the Darwinian Theory, just appear. They evolve gradually. Major phyla are different from each other, though ancestrally they were like brothers. They diverged and became separate species, then separate families, then separate orders. It takes time to do that.

Think of this analogy. Suppose you have a great oak tree with huge limbs at the base and smaller and smaller branches toward the outer layers where finally there are just lots and lots of little twigs. Obviously the little tiny twigs appeared most recently. The larger boughs appeared a long time ago and when they did appear, they were little twigs. What would you think if a gardener said, "Isn't it funny that no major boughs have appeared on this tree in recent years, only small twigs?" You'd say he is stupid.

“WHY DO MAJOR NEW GROUPS OF PLANTS AND ANIMALS HAVE NO TRANSITIONAL FORMS IN THE FOSSIL RECORD.”

It's amazing how often this is stated in the creationist literature. It's amazing because it simply isn't true. There are plenty of transitional forms. There are gaps, of course, for reasons I have stated - not all animals fossilize. But what is significant is that not a single fossil has turned up in the wrong place. Fossils are all in the right order. Creationists know that fossils all appear in the right order and it is quite an embarrassment for them. The best explanation they have come up with so far is based on Noah's flood. They say that when the great flood came the animals all rushed for the hills. The clever ones all got to the top of the hill while the stupid ones were stuck at the bottom and that's why the fossils are all neatly laid out in just the right order!

Part of the error about transitional forms may come from a misreading of a theory by my colleagues Niles Eldredge and Stephen J. Gould. Their theory is called 'punctuated equilibrium'. It is really about rapid gradualism or, to say it another way, gradual change that occurs rapidly repeated by periods of stasis when nothing changes at all. Eldredge and Gould are rightly annoyed about the misuse of their idea by creationists, who in my terminology, think punctuated equilibrium is about huge Boeing 747 type mutations. I quote Stephen Gould, "We proposed punctuated equilibrium to explain trends; it is infuriating to be quoted again and again, whether through design or stupidity I do not know, as admitting

'the fossil record includes no transition forms'. Transitional forms are generally lacking at the species level but they are abundant between larger group forms." Dr. Gould goes on, "I am both angry at and amused by the creationists and mostly I am deeply sad."

Finally, there is a semantic point about transitional forms. Zoologists, when they classify, are forced by the rules of the game to put each specimen in one species or another. In the classification business we are not allowed to say, "Well this is half-way between *Homo sapiens* and *Homo erectus*". People who dig up human fossils will always be forced to choose between one or the other. Is it *Homo erectus* or archaic *Homo sapiens*? It is forced to be one or the other. Given this definition, it is almost a legalistic point that fossils have got to be classified as one or the other. The analogy I'd offer is this. When you reach the age of majority - legal age - of 18 in Alabama you can vote. So, at the stroke of midnight on your eighteenth birthday you become an adult. Suppose somebody were to say, "Isn't it remarkable, there are no intermediates between children and adults?" That would be ridiculous.

"HOW DID YOU AND ALL LIVING THINGS COME TO POSSESS SUCH A COMPLETE AND COMPLEX SET OF INSTRUCTIONS FOR BUILDING A LIVING BODY."

The set of instructions is our DNA. We got it from our parents and they got it from their parents. We can all look back through the generations, through 4000 million years to a tiny bacterium who lived in the sea and was the ancestor of us all. We are all cousins.

We can all look back at our ancestors and claim (it's a proud claim) we are all descended from the elite. Not a single one of my ancestors died in infancy; they all reached adulthood. Not one of my ancestors failed to achieve at least one heterosexual copulation. All our ancestors were good at surviving and reproducing. We are descended from an elite.

Thousands of our ancestors' contemporaries failed. None of our ancestors did. Our DNA is DNA that has come down through thousands of millions of successful ancestors. We have inherited DNA that is pretty good at the job of surviving and, when DNA survives, it programs bodies to be good at surviving and reproducing. The world is bound to become filled with DNA that is good at surviving and reproducing. The DNA that is alive today has survived thousands of filters. Millions of generations of ancestors that survived as a consequence of the efficient programming of their DNA, have produced an unbroken lineage. There is more to it than that. Evolution is progressive - not all the time, not uniformly - but generally it is progressive. Lineages become progressively better at what they do. Predators get better at catching prey. They have to because prey become better at getting away from predators. Just as in the human arms race there must be advances on one side to counterbalance advances on the other side.

Just a few examples of animals I would consider to be at the end of an arms race are: butterflies and leaf-insects (related to stick insects) that look exactly like leaves; and bugs that look like rose thorns and sit on rose stems. All of these are the result of generations of natural selection in which predators have been put off eating the ancestors of these insects. The ancestors that look most like leaves or rose thorns were the least likely to end up in

predators' bellies.

The leafy sea dragon is a fish, related to sea horses. It has 'fronds' that look exactly like seaweed for camouflage. This constitutes the end of an arms race in which genes that did not look like seaweed were eaten, whereas genes that did look like seaweed swam on to reproduce another day.

It's not all just survival, it's also winning mates. Birds of paradise are brightly colored because that's what females like. Genes that make pretty males are more likely to get mates and have children. This is an arms race between the salesmanship of males and the sales resistance of females.

Finally, one of the most rapid and dramatic stories of evolution -- the evolution of the human brain from the brain of ape-like ancestors. The human brain constitutes the major difference between us and our close cousins, the great apes. Fossil evidence shows that our brain has blown up like a balloon during the last 2 or 3 million years as our evolution passed through the ancestral stage *Australopithecus*, *Homo erectus* and finally *Homo sapiens*. No one knows why the human brain blew up in this way. I suspect again it was like some kind of arms race - some kind of positive feedback.

“STUDY HARD AND KEEP AN OPEN MIND. SOMEDAY YOU MAY CONTRIBUTE TO THE THEORIES OF HOW LIVING THINGS APPEARED ON EARTH.”

Well, at last we have found something we can agree with. This seems to me to be an admirable sentiment. I really have less trouble than some of my colleagues with so-called creation science being taught in the public schools as long as evolution is taught as well. By all means let creation science be taught in the schools. It should take all of about 10 minutes to teach it and then children can be allowed to make up their own minds in the face of evidence. For children who study hard and keep an open mind, it seems to me utterly inconceivable that they could conclude anything other than that evolution is true.

THE EVOLUTION - CREATIONISM CONTROVERSY:
A BRIEF SOCIAL AND LEGAL HISTORY

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It takes human beings a long time to adjust to an existential shock.

Marvin Minsky

On March 21, 1925, sixty-six years after the publication of Charles Darwin's *On the Origin of Species by Means of Natural Selection*, the Tennessee state legislature passed the Butler Act, which stated in part (Section I):

That it shall be unlawful for any teacher in any of the universities, normals and all other public schools of the state...to teach any theory that denies the story of the Divine Creator of man as taught in the Bible, and to teach instead that man has descended from a low order of animal. (Milner, 1990)

It was to be the opening salvo of a rhetorical, political, and legal battle in this country between proponents of what biologist E.O. Wilson (1978) has characterized as two competing and ultimately irreconcilable "mythological narratives" to explain ourselves and our place in the "grand scheme" of things -- scientific materialism and religion -- and this controversy has continued virtually unabated until the present day.

The Scopes Trial

We must respect the other fellow's religion, but only in the sense and to the extent that we respect his theory that his wife is beautiful and his children smart.

H.L. Mencken

Mullins

Two months after the Butler Act was passed, a part-time substitute teacher from Dayton, Tennessee, John T. Scopes, acting at the request of the American Civil Liberties Union, agreed to provoke a test case to challenge the new law. Scopes notified school administrators and state officials of his intentions and was subsequently charged with violating the Butler Act. His trial, which the press (and most notably the *Baltimore Sun* correspondent, H.L. Mencken) came to refer to as the "Tennessee Monkey Trial," began on July 10, 1925, in a small and crowded courtroom in the town of Dayton, Tennessee. Almost one hundred newspaper reporters and radio correspondents were in attendance, some from as far away as Japan.

Scopes was represented by the liberal and flamboyant Chicago attorney Clarence Darrow, who agreed to waive all legal expenses because of the constitutional importance of the case. For its part, the prosecution acquired the services of William Jennings Bryan, a charismatic Christian fundamentalist politician and three-time presidential nominee, to represent its side and, presumably, lend credence to the supposed scriptural authority underlying the intent of the Butler Act. The presiding judge, John Raulston, did not permit any evidence or expert testimony from scientists about evolution, limiting the case solely to the question of whether Scopes had violated the law -- which, of course, he had admitted doing.

Eleven days later, on July 21, John Scopes was found guilty and fined \$100, although the conviction was subsequently overturned on a technicality by the Tennessee State Supreme Court. Never enforced again, the Butler Act was eventually repealed by the Tennessee state legislature in 1967.

It is perhaps worth recounting statements made by both Darrow and Bryan near the close of the Scopes trial, since they seem still to be timely and representative voices which underscore the opposing sides and passions of this continuing controversy.

In a summation response to Darrow's intense and often hostile questioning of him during the trial, Bryan stated:

There is no place for the miracle in this train of evolution...and [yet] the Old Testament and the New are filled with miracles...[Evolutionists] eliminate the virgin birth...the resurrection of the body...the doctrine of atonement. [Scientists] believe man has been rising all the time, that man never fell; that when the Savior came there was not any reason for His coming...[Outsiders] force upon the children of this state a doctrine that refutes...their belief in a Savior and...heaven, and takes from them every moral standard that the Bible gives us...(Milner, 1990)

Bryan's remarks appear to highlight two different, albeit overlapping, voices in contemporary Christian fundamentalist criticisms of evolution: namely those who view Darwin's ideas as unacceptable because they challenge a literal interpretation of cosmological and historical events as described in the Judeo-Christian Bible; and those who fear more the concomitant

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loss of what they believe to be absolute and vital moral standards embedded within this same text.

In 1975, for example, a group critical of evolutionary theory argued that "teaching evolution may tend to rob life of meaning and purpose in view of the implanted concept that the student is merely a chance product of a meaningless, random process". That same year, in a Georgia court ruling, an Atlanta judge blamed Darwin's "monkey mythology...for permissiveness, promiscuity, pills, prophylactics, perversions, abortions, pornography, pollution, poisoning, and proliferation of crimes of all types" (*UAB Magazine*, 1985). In addition, Bryan's reference to "outsiders" attempting to influence the education of Tennessee children in 1925 seems especially relevant today in Alabama, where the governor has refused to accept some federal monies for education because of perceived curricular demands in the form of national (i.e., non-local) educational standards of achievement for promotion and graduation.

For his part, Darrow was equally passionate during closing argument:

Freedom cannot be preserved in written constitutions when the spirit of freedom has fled from the hearts of the people...Bigotry and ignorance are ever active...Always it is feeding. Today it is the public school teachers, tomorrow the private. The next day the preachers...the magazines, the books, the newspapers. After a while, your Honor, it is the setting of man against man and creed against creed, until with flying banners and beating drums we are marching backward to the glorious ages of the sixteenth century, when bigots lighted fagots to burn the men who dared to bring any intelligence and enlightenment and culture to the human mind. (Milner, 1990)

Although he was not a scientist, Darrow's comments seem accurately to reflect the attitude of many members of the scientific community today toward the creationist movement -- namely, that it is less a threat to the validity and vitality of science itself than it is to science education.

Following what essayist John Milner (1990) has described as their "hollow victory" in Tennessee, opponents of Darwinism shifted their attention to other states. In 1926 and 1927, respectively, they were successful in enacting new legislation in both Mississippi and Arkansas which prohibited the teaching of evolutionary theory in the public schools. Like the Butler Act in the wake of the Scopes trial, however, neither law was ever enforced, and the Arkansas statute was eventually declared unconstitutional by the United States Supreme Court in 1968.

Scopes II

If evolutionary theory is going to be taught in the schools, then I would think that also the biblical theory of creation, which is not a theory but the biblical story of creation, should also be taught.

Ronald Reagan

Faced with the realization that laws prohibiting the teaching of evolution in public schools were not going to be tolerated by the courts, Christian fundamentalists launched a new tactic during the late 1970s and early 1980s -- the passage of so-called "Balanced Treatment," or "Equal Time," Acts. Unable to have evolution excluded from the classroom, these activists instead lobbied several state legislatures to have creationism included as part of the science curriculum. During several heated court battles which resulted from this new strategy (mainly in Louisiana and Arkansas), proponents of the creationist viewpoint began employing the term "creation science," presumably as a way of trying to legitimize the inclusion of this view into science classrooms (Morris, 1976; Gish, 1978; Gish, Bliss and Bird, 1981).

Advocates of "creation science" argued that it was a legitimate area of scientific inquiry and that it had "no reliance upon biblical revelation, utilizing only scientific data to support and expound the creation model" (Morris, 1976). Henry Morris, Duane Gish and their colleagues at the Institute for Creation Research in San Diego, California, referred often to a growing body of published scientific research supporting creationist interpretations in biology, geology, and even modern cosmology (*Physics Today*, 1982; Milner, 1990). A subsequent three-year survey of 1,000 scientific and technical journals conducted by biologists Eugenie Scott and Henry Cole during the early 1980s, however, revealed "nothing resembling empirical or experimental evidence for creationism," nor was any evidence found to suggest that legitimate, peer-reviewed scientific journals had discriminated against creationist submissions solely on philosophical grounds. Indeed, virtually the entire body of "creation science" literature was found to consist of books and tracts published by the Institute for Creation Research itself (Milner, 1990).

Arkansas is one of only a few states which allows the enactment of new laws by means of popular public referenda, and on the last day of the 1981 Arkansas legislative session, Christian fundamentalists succeeded in having a balanced treatment law, Act 590, so added to the state's legal code. This statute required equal time, or balanced treatment, in biology and earth science classrooms for the teaching of the theories of "creation science." Interestingly, Act 590 was not written in Arkansas, but rather by Paul Ellwanger, head of a South Carolina organization called Citizens for Fairness in Education, with the help of Henry Morris and Duane Gish of the Institute for Creation Research (Lyons, 1982).

In late 1981, a Little Rock minister, Bill McLean, and the American Civil Liberties

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Union, filed suit against the Arkansas State Board of Education in an attempt to enjoin it from enforcing what they believed to be an unconstitutional law because it violated the principle of separation of church and state. Trial was set for Little Rock on December 7, 1981, in the courtroom of Judge William Overton. Creationists described the upcoming proceedings as "a test of fairness for two scientific models". Scientists called it "Scopes II" (Milner, 1990).

ACLU attorneys, again working *pro bono*, brought in several dozen expert witnesses in the fields of science and religion, including paleontologists Stephen Jay Gould and Niles Eldredge; philosopher Michael Ruse; biochemist Harold Morowitz; and theologians Bruce Vawter and Langdon Gilkey. Fully one-half of the witnesses for the plaintiffs were priests, ministers, theologians, and historians of religion (Milner, 1990).

The state countered with testimony from several prominent "creation scientists", including Duane Gish and Wendell Bird, a legal consultant for the Institute for Creation Research; representatives from the Reverend Jerry Falwell's Moral Majority, including Falwell himself; Norman Geisler of the Dallas Theological Seminary; and Chandra Wickramasinghe, a cosmological theorist from Wales, England, who has argued that early lifeforms may have been "transported" to earth in comets (Lyons, 1982).

According to Milner (1990), "...experts on evolution gave the court their own view of science, revealing a complex tapestry of astronomy, geophysics, paleontology, biochemistry, genetics, anthropology and more". Perhaps the most erudite and persuasive witness in the defense of science, however, was University of Chicago theologian Langdon Gilkey, who remarked near the close of the trial:

Without this thesis of a universe in process over eons of time...there simply is no modern science. Creation science rejects the scientific content of evolutionary biology -- if triumphant, it would discard the entire fabric of natural science. Science creationists deny the validity of science's premises and methods, and reject its tested and unified theoretical structure; [they] would effectively end science altogether. (Gilkey, 1985)

Judge Overton agreed and, on January 5, 1982, found that "creation science" could not qualify as an alternative scientific theory or explanation in an educational setting and that Act 590 was therefore unconstitutional under the first amendment to the U.S. Constitution. In his written opinion, Judge Overton stated:

If creation science is, in fact, science and not religion, as the defendants claim, it is difficult to see how the teaching of such a science could "neutralize" the religious nature of evolution. Assuming for the purposes of argument, however, that evolution is a religion or religious tenet, the remedy is to stop the teaching of evolution, not establish another religion in opposition to it. Yet, it is clearly established in the case law, and perhaps also in common sense, that evolution is not a religion and that teaching

evolution does not violate the establishment clause. (Lyons, 1982)

The state of Arkansas did not appeal the ruling.

Old Arguments, New Strategies

This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things...

Alabama State board of Education
Textbook Insert Statement

Following "Scopes II," as well as the U.S. Supreme Court's later ruling that a similar law enacted in Louisiana was unconstitutional (Edwards v. Aguillard, 1987), proponents of the teaching of Biblical creationism in public schools have had to adopt more subtle social, political, and cultural mechanisms to achieve their goals. Included among such tactics is the recent suggestion by some educational practitioners that "orthodox Christians" be aligned in the classroom setting with other individuals and groups who perceive themselves subject to personally debilitating "stereotypes and prejudices...[and] threats to person self-esteem" (Jackson et al, 1995). Similarly, Phillip E. Johnson (1993), professor of law at the University of California, Berkeley, and the author of *Darwin on Trial*, has argued that Christianity, "a belief system that retains great vitality in the culture at large is...marginalized and [wrongly] shut out of academic discourse."

In effect, the "battle" seems now to have shifted from the legal to the political arena; from the courtroom to the school board meeting; and perhaps even the guidance counselor's office.

In California, for example, Christian fundamentalists succeeded in having the State board of Education issue a written proposition which stated that:

...discussions of any scientific fact, hypothesis or theory related to the origins of the universe, the earth and of life (the "how") are appropriate to the science curriculum. Discussions of divine creation, ultimate purposes or ultimate causes (the "why") are appropriate to the history, social science, English and language arts curricula. (*New York Times*, 1993)

While not necessarily a "red flag" for members of the scientific community -- many of whom likely have no objection to the teaching of religious cosmology in the public schools so long as it is not promoted as a bona fide "alternative" theory for such matters in the science classroom -- the California proposition would still seem to raise legal questions related to the constitutional guarantee of separation of church and state. Then, too, there is always the

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issue of which religious cosmologies are to be presented.

Similar pressures have been brought to bear on local school boards by creationists in other southern states, most notably Georgia (Saladin, 1986), Tennessee, and Alabama, although the issue has surfaced as a contentious topic at school board proceedings in places "as far flung as Friendly, Nevada; Paradise, California; Moon, Pennsylvania; and Merrimack, New Hampshire" (*New York Times*, 1996). A Tennessee bill, sent back to Senate committee hearings in March, 1996, at the advice of the state attorney general, would urge "homes, businesses, places of worship and schools to post and observe the Ten Commandments...and permit local school boards to dismiss teachers who present evolution as a fact rather than a theory of human origins" (*New York Times*, 1996).

In Alabama, creationists and Christian fundamentalists have recently succeeded in having the State Board of Education publish a textbook insert, or "disclaimer," to be affixed to the inside front cover of all newly adopted science textbooks which discuss evolution (Figure 1). In addition, the Governor has used some of his discretionary funds to provide all Alabama science teachers with a copy of Phillip E. Johnson's book, *Darwin on Trial*, which his office has described as emphasizing "perceived weaknesses in the Darwinian theory of evolution...[such as] the failure of natural selection to explain how large-scale evolution took place" (*Birmingham News*, 1996).

Without question, the most chilling effect of recent renewed political activism on the part of creationists has been in individual middle school and high school science classrooms. As UAB paleontologist Scott Brande has remarked:

Creationism has no scientific implication. It's not going to change the nature of funding from the National Science Foundation, nor will it change the nature of agricultural research in the United States. But I know it's had an impact on the education of children in 9th grade biology classes across the nation. (*UAB Magazine*, 1985)

Indeed, many educators fear that, at a time of widespread concern about the nation's scientific illiteracy, it would be disastrous to undermine the fundamentals of evolution in the classroom (*New York Times*, 1996).

In school districts around the country, as reported by the *New York Times* science correspondent Peter Applebome, teachers know that discussing evolution, whether as fact or theory, is likely to result in complaints from fundamentalist parents and also "inquiries" from school officials. "Many teachers won't teach evolution at all because of the stigma and the controversy," said Wesley Roberts, a high school biology teacher in Nashville, Tennessee. "I do polls of kids in my class. In my last class of 30 kids, three had studied evolution. I taught a course at a local college and maybe one or two [of the students] had had any instruction in evolution. Teachers aren't comfortable with it, so they don't teach it at all." (*New York Times*, 1996)

Mullins

Discussion

It is morally as bad not to care whether a thing
is true or not, so long as it makes you feel good,
as it is not to care how you got your money
as long as you have got it.

Edmund Way Teale

Marvin Minsky, professor of computer science at the Massachusetts Institute of Technology and a pioneering influence in the field of artificial, or machine, intelligence, once remarked that "It takes human beings a long time to adjust to an existential shock." (Minsky, 1989) Thus, it has been nearly 400 years since Giordano Bruno was burned at the stake for too-vociferously promoting the Copernican notion of a heliocentric universe (i.e., solar system) -- time enough, it would seem for most individuals to have adjusted to this existential shock.

Evolution, and especially the idea of non-directed and non-purposeful natural selection, of course, is another matter altogether, and the nearly 140 years which have elapsed since the publication of Darwin's theory have clearly not been enough to quell the existential unease and uncertainty prompted in us by his insightful ideas. This fact is perhaps best underscored by recent Gallup polls which indicate that nearly half of all adult Americans surveyed do not believe in evolution, and that forty percent of those who do accept evolution by natural selection believe that "...God guided this process, including Man's creation. Only nine percent agreed that natural processes now operating have led to the advent of humans over time, without benefit of some sort of conscious, active, ongoing, divine intervention." (Jackson et al, 1995)

Given the fact that similar surveys also suggest an appalling and growing level of basic scientific illiteracy among the adult American public, including a profound lack of understanding of such fundamental concepts as "molecule," "DNA" and "radiation" (Miller, 1987), it is conceivable that contemporary negative attitudes toward evolutionary theory might be explained by such findings. Conceivable, perhaps, but not likely.

It is doubtful that any better clue as to what is at least partly responsible for this decades-old controversy can be found beyond the words of William Jennings Bryan in his passionate comments to the court near the close of the Scopes trial (see above). Put simply, many people are afraid of, and deeply disturbed by, the idea of evolution because it seems so radically to conflict with a different, more familiar, and more comforting narrative to help explain the "greatest mysteries," including our deepest anxieties about such matters as the nature of good and evil, the purpose of human existence, and the meaning of life and death. As the classical historian Walter Burkert states in his most recent book, *Creation of the Sacred*, religion provides direction and meaning for those who feel helpless in the face of the infinite complexity of the world -- and particularly in the face of the inescapable fact of death.

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"The idea of the supernatural emerges within the landscape of nature... If reality appears dangerous or downright hostile to life, religion calls for something beyond experience to restore the balance" (Burkert, 1996).

While it is true that evolutionary theory does not -- and, in fact, cannot -- explicitly address any of these topics, most people (including, I suspect, many thoughtful scientists) are certainly aware of the implicit assumptions attendant to Darwin's ideas and to the full thesis of scientific materialism in general:

Let me repeat its minimum claims: that the laws of the physical sciences are consistent with those of the biological and social sciences and can be linked in chains of causal explanation; that life and mind have a physical basis; that the world as we know it has evolved from earlier worlds obedient to the same laws; and that the visible universe today is everywhere subject to these materialist explanations...[Scientific materialism] denies immortality to the individual and divine privilege to the society, and it suggests only an existential meaning for the human species. (Wilson, 1978)

Thus, it is likely that the so-called "evolution-creationism controversy" will be with us for many decades, if not centuries, to come.

Literature Cited

- Birmingham News*. 1996. Teacher sees little effect from anti-evolution book. March 20.
- Burkert, W. 1996. *Creation of the Sacred: Tracks of Biology in Early Religions*. Harvard University Press, Cambridge.
- Edwards v. Aguillard. 1987. 107 S. Ct. 2573.
- Gilkey, L. 1985. *Creationism on Trial: Evolution and God at Little Rock*. Winston, Minneapolis.
- Gish, D. T. 1978. *Evolution: The Fossils Say No!* Creation-Life Publishers, San Diego.
- Gish, D. T., Bliss, B. and Bird, W. 1981. *Summary of Scientific Evidence for Creation*. Institute for Creation Research (*Impact Series No. 95*), San Diego.
- Jackson, D. F., Doster, E. C., Meadows, L. and Wood, T. 1995. Hearts and minds in the science classroom: the education of a confirmed evolutionist. *J. Research in Science Teaching* 32(6).
- Lyons, G. 1982. Repealing the enlightenment. *Harper's*. April.
- Miller, J. 1987. The scientifically illiterate. *American Demographics* 9, 26.
- Milner, R. 1990. *The Encyclopedia of Evolution*. Facts on File, New York.
- Minsky, M. 1989. Artificial intelligence comes of age. *Discover*. March.

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- Morris, H. M. 1976. *The Genesis Record: A Scientific and Devotional Commentary on The Book of Beginnings*. Baker Book House, Grand Rapids.
- New York Times*. 1992. In search of the average American. July 26.
- New York Times*. 1993. Battle over teaching of creation may rumble far from California. July 27.
- New York Times*. 1996. 70 years after Scopes trial, creation debate lives. March 10
- Physics Today*. 1982. Mainstream scientists respond to creationists. February.
- Saladin, K. 1986. Educational approaches to creationist politics in Georgia in W. Hanson (Ed) *Science and Creation: Geological, Theological and Educational Perspectives*. American Association for the Advancement of Science. Macmillan, New York.
- UAB Magazine*. 1985. Fossil fishes and faith. 5(2), 2.
- Wilson, E. O. 1978. *On Human Nature*. Harvard University Press, Cambridge.

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A MESSAGE FROM THE ALABAMA STATE BOARD OF EDUCATION [to be pasted in all biology textbooks]

This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things, such as plants, animals and humans.

No one was present when life first appeared on earth. Therefore, any statement about life's origins should be considered as theory, not fact.

The word "evolution" may refer to many types of change. Evolution describes changes that occur within a species. (White moths, for example, may "evolve" into gray moths.) This process is microevolution, which can be observed and described as fact. Evolution may also refer to the change of one living thing to another, such as reptiles into birds. This process, called macroevolution, has never been observed and should be considered a theory. Evolution also refers to the unproven belief that random, undirected forces produced a world of living things.

There are many unanswered questions about the origin of life which are not mentioned in your textbooks, including:

Why did the major groups of animals suddenly appear in the fossil record (known as the Cambrian Explosion)?

Why have no new major groups of living things appeared in the fossil record in a long time?

Why do major groups of plants and animals have no transitional forms in the fossil record?

How did you and all living things come to possess such a complete and complex set of "instructions" for building a living body?

Study hard and keep an open mind. Someday you may contribute to the theories of how living things appeared on earth.

Figure 1. Text of the amendment to the Alabama Course of Study - Science, adopted by the Alabama State Board of Education in 1995, and to be included in all state-approved biology textbooks beginning fall, 1996.

DARWIN AND SOCIAL DARWINISM: THE USE AND MISUSE OF SCIENCE

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Sigmund Freud, the father of psychoanalysis, wrote that in the history of science there had been three great shocks to human pride. The first was the Copernican revolution, which destroyed the idea that the Earth was at the center of the cosmos, thereby displacing the Earth's inhabitants from the center as well. Copernicus' discoveries deflated human pretensions. The second historic shock we will turn to in a moment. The third was Freud's own work, which demonstrated that humans were not the completely rational, self-determining creatures they thought they were; instead they were prey to all manner of unconscious and irrational forces. In other words, humans were not even masters of their own souls, let alone of the cosmos. I hope we can forgive Freud's ranking himself as the equal of Copernicus. Who knows, though he is out of favor at present, we may eventually conclude that his pioneering work did occur on that high level.

But it is the second great shock to human pride that I want to discuss. Freud says that was the *Darwinian revolution*, because Darwin demonstrated that humans were not the result of a special creative act by a divine being, but were descended from the lower animals. Humans were not the divinely appointed lords of creation, but were biological organisms subject to the laws of evolutionary biology. This, Freud declared, was a shattering blow to our pride--such a blow that many people rejected Darwinism without a real hearing in the decades following the publication of the *Origin of Species* (1859); such a blow that some still reject the theory today, not because they dismiss all science or because they have carefully studied the theory as science, but merely because it strikes them where they live: it strikes at a certain kind of human arrogance. There may be good reasons to reject or modify Darwin, but those reasons are all too often lost in the rhetoric of wounded egotism.

I think Freud was right: Darwinism was a shock to the collective psyche of Western civilization. James Burke puts it bluntly: "The *Origin of Species* hit the world like a bombshell...." (1) One of Darwin's fellow scientists wrote to him shortly after the publication of the book, and clearly understood the revolutionary impact Darwin's theory would have for science and scientists:

Your leading idea will assuredly become recognized as an established truth in science, i.e., "Natural Selection." It has the characteristics of all great

natural truths, clarifying what was obscure, simplifying what was intricate, adding greatly to previous knowledge. You are the greatest revolutionist in natural history of this century, if not of all centuries. (2)

But the shock waves would not be limited to the world of "natural truths." As historian of science Anthony Alioto tells us, "Darwin's mechanism of evolution fostered one of the greatest revolutions in Western thought, for he dispensed with the ancient and honored doctrine of teleology, replacing it with continuous [accidental] variation. His was a philosophical revolution as much as a biological one." (3)

It wasn't the idea of evolution, in and of itself, that was so revolutionary. Evolutionary theories were already on the scene, and were championed by eminent thinkers such as Jean Lamarck in France and Darwin's own grandfather, Erasmus Darwin, in Britain. But these theories were *speculative*. They were essentially works of natural philosophy rather than of natural science. Darwin turned evolution into a scientific theory by basing it on careful observations, finely crafted hypotheses, and sustained (though primarily indirect) testing of those hypotheses. He gave the theory real force by working toward it inductively, and by proposing a mechanism that both explained much of the raw data of biology and gave its fundamental principles a dynamism and inner coherence reminiscent of Newton's grand synthesis of physics and astronomy.

That mechanism--the heart of Darwin's theory and of its scientific success--was Natural Selection. Darwin argued that variations, or mutations, arise by chance in every generation. Some may be beneficial to the organism in its particular environment, as it competes with other organisms for the necessities of life. These positive changes tend to be preserved and passed on to later generations. Changes that are not beneficial, that do not improve an organism's ability to compete in the general struggle for survival, tend over time to drop out because they cripple or hamper the organism. Gradually, from generation to generation, descendants diverge from their parent stock, becoming new subspecies, new species, and ultimately whole new families and orders of creatures. The process is a blind, mechanistic, one: chance provides the variations, and a chance congruence between mutation and the local environment provides the selection and the direction of development. With these mechanisms Darwin could explain design in nature strictly by natural laws and natural randomness. He could explain design without a Designer, whether that designer be conceived of as God or as a spiritual principle in matter. Thus Darwin could be the Newton of biology--demonstrating the laws and mechanisms of life--while at the same time he could be the David Hume of biology, magisterially refuting the traditional Argument from Design. This was the revolution, and it threw Western thought into confusion, because it was a frontal attack on so many cherished ideas and values. The revolutionary force of his ideas made Darwin, on top of everything else, the Copernicus of biology, taking away the old stability, the old sense of a fixed and central place for humanity in the cosmos, and replacing it with a dizzying whirl of movement and change; for even preserved adaptations were not perfect, and could be

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improved by new modifications and selections; and even a well-adapted organism or population could become unfit if the environment itself changed. What's more, species could and did become extinct. This terrible kind of death--death not just for one individual or another, but for a whole type--gave people a cold and frightening sense of the power of chance and of change: "Blind chance, purposeless mechanism, tremendous biological waste--this was surely not the universe imagined by Natural Theology all the way back to Newton." (4) It was, instead, the darker world captured in Tennyson's chilling phrase, "Nature red in tooth and claw...." Since Darwin's theory excluded design from "outside," it rejected special creation. Hence it was a terrible blow to human pride. There was no higher or lower realm, not in the old, strict, and reassuring sense; all adaptations were disconcertingly equal, and the human brain was in the last analysis no better an adaptation than the shark's teeth. Thus humanity lost its exalted position in the cosmos.(5) The so-called "descent from the ape," destined to disturb and scandalize so many, was a side issue compared to the real, the larger, implications of National Selection. Yet both themes had the same effect: they sparked a furor of rejection and debate.

The religious reaction was, predictably, the strongest. Spokesmen for the churches, including the Church of England, saw Darwin's theory as an attack on scripture and on the Church, an attack on the pivotal conceptions of spirit, soul, and human dignity, indeed, a radical reduction of the human to the animal. They saw Darwinism as an attack on religious authority, and an attempt to replace it with an alternate authority, namely a secularized science. In Darwin, they saw science giving aid and comfort to the enemy, i.e. to atheism and agnosticism, and in so doing threatening the very foundations of social order and civilization. (6)

Perhaps Bishop Samuel Wilberforce of Oxford stands as the best example of this initial, outraged reaction. He attacked Darwin's *Origin of Species* in an important intellectual journal, and at the Oxford meeting of the British Association for the Advancement of Science in 1860. There the bishop engaged in a spirited debate of the issues, not with Darwin himself, but with Darwin's friend and champion, Thomas Henry Huxley. In this exchange, Huxley clearly got the better of the bishop. This celebrated confrontation spurred the acceptance of Darwinism among the scientific community and the scientifically educated, not only in Britain, but throughout the industrialized world.(7) The surprisingly rapid acceptance of the theory by scientists made its enemies initially all the more angry and vocal. Then even some of them began to seriously consider Darwin's "descent with modification."

Why was the theory of evolution by natural selection accepted so rapidly? If it was such a shock to traditional beliefs, why wasn't it ignored or marginalized? The Victorians were certainly not without resources when it came to suppressing or containing new and disturbing emotions and ideas. Why then did Darwinism, despite strong opposition, flourish?

First of all, it spread quickly because it was "good science." The *Origin of Species* sold out the first day of its release. It became a tremendous best-seller, for a book of hard science, as did the *Descent of Man* which followed in 1871. Scientists and non-scientists alike

devoured these books *for the science*. Many laypersons became amateur naturalists as a result of the experience.(8) Keep in mind that Darwin already had a solid reputation among professional naturalists as a result of his voyage on the *H.M.S Beagle*. He returned from this adventure of discovery with an extraordinary collection of specimens, with a Journal of his observations and preliminary conclusions, and with a new theory of the formation of coral islands. These won him fame among naturalists and election to important scientific societies decades before he published his masterwork. He was a great scientist: a patient observer, a meticulous recorder of observations and measurements, a rigorous thinker; and he had the imagination to synthesize his observations in a daring theory. Scientists recognized these qualities, adopted the theory, and, drawing on their scientific authority and status, helped spread it among non-scientists.

The testimony of contemporaries helps illustrate Darwin's extraordinary powers of observation. Historian Timothy Ferris quotes Dr. Edward Lane, a friend of Darwin's who frequently accompanied him on his long walks. Lane tells us:

No object in nature, whether Flower, or Bird, or Insect of any kind, could avoid his loving recognition. He knew about them all...could give you endless information...in a manner so full of point and pith and living interest, and so full of charm, that you could not but be supremely delighted, nor fail to feel...that you were enjoying a vast intellectual treat to be never forgotten. (9)

This kind of inspired empiricism--this love of precise observation, of painstaking care for facts--is undoubtedly part of what it means to generate "good science." (10)

In addition, Darwin's work led to good science on the part of his disciples and followers. In other words, his was a fruitful theory, sparking new discoveries in biology, geology, paleontology, comparative anatomy, embryology, biochemistry, genetics, selective breeding in plants and animals, etc. Darwin himself stressed the importance of this continuation and testing of his approach. In a letter to Huxley, Darwin says:

I have got fairly sick of hostile reviews. Nevertheless, they have been of use in showing me when to expatiate a little and to introduce a few new discussions. I entirely agree with you, that the difficulties in my notions are terrific, yet having seen what all the Reviews have said against me, I have far more confidence in the general truth of the doctrine than I formerly had. Another thing gives me confidence, namely that some who went half an inch with me now go farther, and some who were bitterly opposed are now less bitterly opposed....I can pretty plainly see that, if my view is ever to be generally adopted, it will be by young Men growing up and replacing the old workers, and those young ones finding that they can group facts and search

out new lines of investigation better on the notion of descent than on that of creation. (11)

This is the voice of the scientist: he is stung by hostility, but does not respond in kind. He thinks in terms of the future, and does not fear the testing of his conceptions that the future will bring. There is a mildness to his reaction that is the hallmark of the open, humanistic brand of science Jacob Bronowski celebrates. And Darwin was right about the future: new generations of scientists up to and including our own time have found continued inspiration for further research in Darwin's theory. With all of our accumulated knowledge of genetics and of prehistoric and historic development, the basic Darwinian edifice survives. Modern biology, with all its subdisciplines, and modern biomedicine, with all its complexities and wonders, stand on the shoulders of Darwin. Thus Darwin is recognized today as a scientific genius, and his theory as a triumph of human effort and discovery.

But--and this is a crucial point--Darwinism also spread for less noble reasons. As George Bernard Shaw put it: "Darwin had the luck to please anybody with an axe to grind." (12) That is, it was easy for those with a political or social agenda to adopt Darwinism as a way of advancing that agenda. And there were a lot of agendas around: nationalism, militarism, Marxism, laissez-faire capitalism, racism, imperialism, anti-semitism. The effort to apply Darwinism to human society is called Social Darwinism. It was launched not by Darwin, who was quite skeptical of it, but by Herbert Spencer, a British philosopher who extended evolutionary theory to human life, arguing that "survival of the fittest" was more than the mechanism of organic evolution: it was also the basic law of society. It was the way humankind progressed. Thus Darwin was used to justify Spencer's philosophical commitment to laissez-faire capitalism: dog-eat-dog competition in the economic sphere was evolution in action. (13)

William Graham Sumner championed Social Darwinism in the United States. He closely followed Spencer, using Darwinism to justify American "rugged individualism" and laissez-faire economics. To quote Sumner: "It may shock you to hear me say it, but when you get over the shock, it will do you good to think of it: A drunkard in the gutter is just where he ought to be. Nature is working away at him to get him out of the way, just as she sets up her processes of dissolution to remove whatever is a failure in its line." (14) Perhaps Sumner was not vindictive, or at least not actively so; at other points in his writings he suggests a somewhat more charitable line. But given the long history of human irrationality, given what Hannah Arendt terms the "banality of evil," it is only a short step from his "shocking" suggestion that the drunkard be left in the gutter to actively shooting the man in order to get him "out of the way" all the faster. But for a time Sumner's more passive form of Social Darwinism held sway.

The movement had a major impact in the U.S., where such great industrialists as Andrew Carnegie and John D. Rockefeller became enthusiastic advocates. Here's what Andrew Carnegie said about his first encounter with Social Darwinism:

Beckwith

That light came in as a flood and all was clear. Not only had I got rid of theology and the supernatural, but I found the truth of evolution. 'All's well since all grows better' became my motto...Man was not created with an instinct for his own degradation, but from the lower he had risen to the higher forms. Nor is there any conceivable end to his march to perfection...

We accept and welcome, therefore, as conditions to which we must accommodate ourselves, great inequality of environment; the concentration of business, industrial and commercial, in the hands of a few; the law of competition between these, as being not only beneficial but essential to the future progress of the human race.

John D. Rockefeller, echoed these sentiments, though with a touch of traditional piety:

The growth of a large business is merely the survival of the fittest. The American Beauty Rose can be produced in the splendor and fragrance which bring cheer to the beholder only by sacrificing the early buds which grow up round it. This is not an evil tendency in business. It is merely the working out of a law of Nature and a law of God. (15)

It difficult to avoid a skeptical view of these grandiose pronouncements. They obviously did not flow from dispassionate scientific analysis. Great industrialists and financiers were enthusiastic about Social Darwinism because, in their eyes, the doctrine proved that they were wealthy and powerful because they were the most fit, the most highly evolved, the most deserving, and that the poor--even those made poor by the deliberate actions of a Rockefeller or a Carnegie--were the unfit, who therefore deserved to be poor. This wasn't exactly a new position in America, or in Britain, because the works of Adam Smith on laissez-faire capitalism had already been misread to serve this kind of conclusion. But it wrapped laissez-faire up in the borrowed roles of hard science, and led to conclusions even more cruel than the old economic theory.

But the most frightening example of Social Darwinism appeared in Germany. The young scientist Ernst Haeckel (1834-1919), professor of zoology and comparative anatomy at the University of Jena, became the primary exponent of Darwinism in Germany. He gleefully accepted the Social Darwinist principle that humans were part of nature and subject to natural law, including the law of the "survival of the fittest." But he went much farther. He argued for a direct, literal, and militant application of the laws of evolutionary biology to human life and society. He believed that Darwinian science proved German racial superiority. The German form of racism antedated Haeckel and Darwin, but Haeckel now gave it fake scientific credentials. In doing so, he became one of the forefathers of Nazi ideology. His

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Social Darwinism influenced all levels of German society. He taught that some races were more highly evolved than others and thus "worth more," and that some individuals were more highly evolved and so their lives were "naturally" more valuable. He rejected free will as unscientific; thus he rejected liberalism and democracy.

It is ironic: British and American Social Darwinism accepted individualism and liberal democracy as consistent with Darwin, while German Social Darwinism rejected individualism for immersion in society, and rejected democracy for obedience and command--again, all in the name of Darwin. Haeckel and his followers declared that natural selection merely pointed us in the right direction: the primary business of the state and of society was eugenics or artificial selection, politics as "applied biology." They advocated infanticide for sickly or deformed children, and euthanasia for the insane, for habitual criminals, and for people with incurable diseases. They believed that we should breed human beings in order to improve the race. A surprising number of people, including many scientists, saw these startling proposals as reasonable and, indeed, as the fruit of the latest and best scientific thinking. (16)

Hitler took up the torch from Ernst Haeckel and his disciples. He became a fanatical Social Darwinist, and put the most cold-blooded of the ideas of the eugenics movement into effect in the Nazi State. During the short period of Nazi rule, women of pure--supposedly pure--German stock were urged to mate with young, healthy German soldiers and stormtroopers, outside of marriage, as a way of improving the German race (which was, according to Nazi theory, already a super-race, biologically and in every other way). Those judged "unfit" were routinely mocked, exploited, and eliminated.

Eugenics in the hands of the Nazis gave birth to a nightmare. The infamous death camps were in part a way of keeping those groups and races the Nazi's detested from propagating themselves. Men like Goebbels and Himmler were enthusiastic about the idea that people they deemed genetically inferior would not be allowed to propagate. Sterilization experiments were carried out on a large scale at some of the camps. Dr. Pokorny, a notorious, brutal S.S. doctor, wrote his superiors that he had discovered a plant-derivative which induced lasting sterility in the prisoners: "The thought alone that the 3 million Bolsheviks now in German captivity could be sterilized, so that they would be available for work but precluded from propagation, opens up the most far-reaching perspectives." (17) (This was Hitlerian bureaucratese for ecstatic approval.)

Let me reiterate: racism, rabid nationalism, and ethnocentrism were already well-entrenched in Western civilization. Darwinism didn't create them. But Darwinism was appropriated by them, and used to give them a pseudo-scientific legitimacy. You can almost see the fallacy involved if you look at the language of Haeckel:

Evolution and progress stand on the one side, marshaled under the bright banner of science; on the other side, marshaled under the black flag of hierarchy, stand spiritual servitude and falsehood, want of reason and barbarism, superstition and retrogression...Evolution is the heavy artillery in

the struggle for truth; whole ranks of dualistic sophisms fall before [it]..as before the chain shot of artillery. (18)

This is the language of propaganda, of ideology, of war--not the language of reason, of criticism, of genuine concern for the truth. And this man was a *trained scientist*. Hitler's rhetoric was even worse--yet, questioned, he would have insisted that National Socialist eugenics was firmly based in science--in Darwinian evolution. But Darwin himself was a man of charity and benevolence, who felt the need to apologize in his *Autobiography* for not devoting all of his time to philanthropy. (19) This is perhaps the most painful irony of all.

What, then, can we learn about science as a way of thinking, and about the uses of science in human life and history, from this profoundly disturbing devolution of ideas? I am reminded of Jacob Bronowski's film "Knowledge or Certainty," one of the best works in his groundbreaking Ascent of Man series. In that film, Bronowski argues that the horrors of the Thirties and of World War Two were not the tragedy of science, but the tragedy of humankind. By this, I take it he means that the death camps and atomic bombs were not a tragedy of science as a method, as a system, and as an intention. In other words, this wasn't the tragedy of science at its best. But it was a tragedy of science in another sense, as a *human activity*, subject to the manifold errors, confusions, and cruelties of human life. It stands as a warning: even the best science can be diluted and misused. Often this dilution and diversion is the work of non-scientists, of politicians and financiers and ordinary people in the street. But sometimes it is the work of scientists themselves, in moments of ignorance, twisted enthusiasm, and moral failure. The clear historical fact that science can be misused even by scientists should remind us that what Shaw called "moral passion," the all-consuming desire to discover and actually do what is right, requires a vigilant, continuous interrogation of self and situation. Not only is the unexamined life not worth living; armed with the physical and theoretical powers of the sciences, it is an invitation to catastrophe.

We can learn something else as well. In the sciences--human as well as natural--context is everything. Principles and conclusions that are perfectly valid *within* their proper context become invalid when ripped out of it. When Einstein's Theory of Relativity, one of the high watermarks of human intelligence, becomes the catch phrase "all is relative"--its real meaning disappears, and a terrible closing of the mind results. When Heisenberg's Principle of Uncertainty becomes the sophomoric assertion that "all is uncertain"--knowledge becomes impossible, including the knowledge that gave rise to the Principle in the first place. When Evolution by Natural Selection, Darwin's historic contribution to biology, is forced from its context and artificially grafted to politics or economics, you have the same dismal result.

This is not to say that science cannot contribute to other areas of life, and to our daily lives. But it must be *real science*, understood first within the limits and qualifications of its origin. We must use science with wisdom and a healthy humility--or we destroy its capacity to give us understanding and authentic progress.

Ironically, Social Darwinists managed to re-introduce the human, all-too-human

arrogance that the shock of Darwinism had, in principle, exorcised. Yet the real lesson of Darwinism is greater humility, grounded in a sense of kinship with all life and an acceptance of the value, to life and to human life, of diversity. This lesson is all the more important today, for Social Darwinism is not dead. It is still very much alive, though it does not usually go under its old name. Any person who says that everyone who is poor deserves to be poor--that other races are inherently inferior--that power and wealth are sure signs of fitness, of value to society--is very much a part of this old and discredited movement. Such phrases misuse scientific terms and discoveries, and make a mockery of the lives and labors of genuine scientists.

Certainly we must have science, and *use* science, or we will cripple ourselves in the art of living. But we must learn to use science with, as Bruno Bettelheim suggested, an "informed heart." This is admittedly no easy task. We have had much more historical (and personal) experience inflating false pride and pandering to it. But if we pay careful attention to that history, painful as it has been, and to all the ways in which our egotism and irrationality have perverted the most promising of our intellectual and technical achievements; if, in other words, we foster a heightened historical awareness of our use and misuse of science; then we stand a much better chance of transforming science, and all forms of knowledge, into tools in service to life. (20)

Endnotes

1. James Burke, *The Day the Universe Changed* (Little, Brown, 1985), 260.
2. Loren C. Eiseley, "Charles Darwin," *Scientific American* (February 1956): 8.
3. Anthony M. Alioto, *A History of Western Science* (Prentice-Hall, 1987), 276.
4. *ibid.*, 285.
5. "The Victorian Age," M.H. Abrams (ed.), *Norton Anthology of English Literature*, Vol. 2, 3rd Ed. (Norton, 1974), 882.
6. Walter E. Houghton, *The Victorian Frame of Mind* (Yale UP, 1957), 58-9.
7. Timothy Ferris, *Coming of Age in the Milky Way* (Morrow, 1988), 244-5; Stephen Mason, *A History of the Sciences* (Collier Macmillan, 1962), 422; Eiseley, 7.
8. Burke, 261.
9. Quoted in Ferris, 232; see also Eiseley, 9.
10. A.N. Whitehead, *Science in the Modern World* (New American Library, 1925), 2-3.
11. Quoted in John F. Henahan (ed.), *The Ascent of Man: Sources & Interpretations* (Little, Brown, 1975), 207.
12. Quoted in Burke, 261.
13. Mason, 421.
14. William Graham Sumner, "The Forgotten Man," *Social Darwinism: Selected Essays of William Graham Sumner* (Prentice-Hall, 1963), 122.

15. Quoted in Burke, 271.
16. George J. Stein, "Biological Science and the Roots of Nazism," *American Scientist*, Vol. 76, No. 1 (January-February 1988): 53-7.
17. Quoted in William L. Shirer, *The Rise and Fall of the Third Reich* (Fawcett, 1959, 1960), 1275.
18. Quoted in Stephen Jay Gould, *Ever Since Darwin* (Norton, 1977), 217.
19. Charles Darwin, *The Autobiography of Charles Darwin*, ed. Nora Barlow (Norton, 1958), 95.
20. Stephen Jay Gould, "The Most Unkindest Cut of All," *Natural History* (June 1992): 8-11; Gabriel Marcel, *Man Against Mass Society* (Henry Regnery, 1971), 55-6; Hans Jonas, *The Imperative of Responsibility: In Search of an Ethics for the Technological Age* (University of Chicago Press, 1984), ix-xi.

AN ANALYSIS OF THE 1995 ALABAMA DRAFT AND ADOPTED COURSE OF
STUDY: SCIENCE

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ABSTRACT

A number of recent national reform projects in science education (National Research Council, 1996) have stimulated similar reform efforts at the state level. The adoption of the 1995 Alabama course of study was preceded by intense public debate. The state Board of Education yielded to anti-evolution pressure in an unprecedented way: the board authored a statement and added it to science texts, thus meddling in affairs of academic content previously left to content specialists. The board also instructed the course of study committee to meet with opponents to the committee's draft document for the purpose of altering parts opponents found objectionable. These changes included 1) the removal of the term "evolution" from three of four content standards, 2) the deletion of the term "evolution" from the Biology Core, 3) the re-wording of five content standards, the effect of which is to cast doubt on evolution, and 4) the removal of terms that promote discussion of science in relationship to society. However, changes made in the adopted course of study will not necessarily alter the delivery of instruction in the public school science classroom because of a number of intervening factors, including local curriculum planning and supplementation, individual teacher knowledge and determination, and textbook content. In our opinion, the adopted Course of Study: Science represents a vast improvement over those of the past, and should benefit student preparation for life in the 21st century.

Introduction

The science course of study in Alabama

In Alabama, the Course of Study: Science (COSS) is written by a committee of citizens, the number and composition of which is determined by law (Alabama Code, 16-35-1). The course of study committee (COSC) constructs a draft document (Draft), that it submits to the state Board of Education, whose ex-officio president is the governor. The board holds public hearings on the Draft, then votes to adopt or reject it. Once adopted, the COSS

becomes the "framework for the science education program in Alabama's public schools" (Teague, 1995, p. v). A brief description in the 1995 COSS emphasizes its essential functions in directing public school science education in Alabama:

"Content standards in this document are minimum and required... They are fundamental and specific but not exhaustive. In developing local curriculum plans, school systems may include additional content standards to reflect local philosophies and add implementation guidelines, resources, and/or activities, which, by design, are not contained in this document" (Teague, 1995, p. v).

Two parts of this description are particularly noteworthy: 1) the "minimum and required" clause, and 2) the "supplementation" clause. The significance of these clauses will be discussed below.

The hexennial subject revision cycle in Alabama

As all academic disciplines are aggregated into six major subjects (of which one is science), each subject is revised only once every six years. The next year for revision of the COSS will be 2000. Once the subject course of study is revised by the COSC and adopted by the state Board of Education, and a list of textbooks to support it is approved by the board, it is implemented the following academic year. Consequently, the COSS adopted in 1995 was implemented with the beginning of the 1996-97 academic year.

The Evolution/Creation Controversy

The evolution/creation controversy normally erupts with significant public comment during the two-year period in which the COSS and its supporting list of approved science textbooks are developed and adopted. During the 1994-95 COSS adoption, the degree of public opposition to the Draft was, in our opinion, the most intense to date.

Since 1983, opponents of evolution have had varying degrees of success in influencing content of science courses in the public schools, primarily by membership or influence on the COSC. In previous years, such as 1983 and 1988, the science COSC worked in relative obscurity. In 1994, the Alabama Department of Education opened the process of science curriculum development to an unprecedented extent: it called public hearings at four locations throughout the state, thus providing public input to the COSC, and it solicited comment on the Draft from all deans of schools of education and from all 127 public school districts. The Draft was available for public inspection at 23 locations throughout the state, and was available upon request from the State Department of Education.

It was not until less than a month prior to the board's meeting on February 9, 1995, at which the COSS was to be considered, that we became aware of strong public opposition to adoption of the Draft. This opposition developed and coalesced around the Eagle Forum of Alabama (EFA - the Alabama affiliate of the Eagle Forum, the national conservative organization founded by Phyllis Schlafly). Because seven of the eight state board members were newly elected the previous November, the board passed a motion to table consideration

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of the COSS until their March 9th, 1995 meeting. This additional month provided time during which both opponents and supporters of the draft COSS prepared documents and recruited speakers, and during which publicity about the upcoming public hearing intensified (Dean, 1995a).

When we write of "Opponents" below, we refer to representatives and supporters of EFA and others (individuals, representatives of various citizen groups and churches) who argued that the Draft should be rejected or modified by 1) the elimination, reduction, or neutralization of evolution or evolutionary topics, or 2) the elimination or reduction of discussion of the relationship of science and technology to society.

The Draft Course of Study - Science: Opponent Charges

Two major topics of concern voiced by Opponents of the Draft focused on 1) evolution, and 2) social applications and implications of science. We cannot presume to know the specific motivational origins for each objection. However, written documents distributed by Opponents, and statements reported in various newspaper articles, reveal the reasons for a number of their significant objections. In a statement prepared for a public hearing before the state Board of Education (Brande, 1995), one of us (Brande) analyzed a large number of the objections, from which a few selected examples are discussed below.

Christian Coalition of Alabama

In a brief letter to the board from the Christian Coalition of Alabama (Russell, 1995), Mr. Bob Russell states in part that "The Christian Coalition of Alabama respectfully asks you to reject the new science curriculum... Please vote no." Furthermore, Mr. Russell states that "Our chapter leaders, representing 20,000 members...", as if to emphasize a significant number of potential voters. No argument supporting the stated opinion of the Christian coalition members is provided in the letter. Nothing specific in the Draft is stated as being objectionable to Christian Coalition members. We can only surmise with uncertainty the parts of the Draft to which Mr. Russell and coalition members objected.

Eagle Forum of Alabama charges political bias

Prior to the board's March 9th meeting, EFA distributed a number of letters and documents critical of the Draft COSS. For example,

"Its [the Drafts] teaching of 'scientific literacy' is part of the national agenda to use science for social change - instead of science being a pure enterprise in which one is trying to investigate the universe" (Smith, 1995a).

On behalf of EFA, Mrs. Smith urged state board members to reject the Draft because it departs from "traditional science education"

"...the proposed course of study advances politically correct attitudes, radical social agendas, and treats debatable issues as nondebatable" (Smith, 1995b).

EFA charged the Draft was biased with values drawn from national science education reform programs, such as those described in *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993), and *Science for All Americans* (Rutherford and Ahlgren, 1990). "It can thus be assumed that the Alabama Course of Study is based on and reflects the values inherent in these two documents" (Anonymous, nd). If true, one ought to find the strongest evidence of such bias in the Draft. But in the analysis that followed, all quotations were from the national program documents, not the Alabama Draft.

Prior to the board's public hearing, EFA issued an alert charging that the Draft pursued a "social agenda" because it promoted "population control, redistribution of wealth, environmentalism, negative view of the military", and was therefore "unacceptable" (Eagle Forum of Alabama, nd). We could not, however, find support for such critical charges, and neither could *The Birmingham News* (Editor, 1995). For example, the word "military" occurs just once in a content standard identical for the sixth through eighth grades:

"Discuss the ethical issues of science." Examples: use of animals and humans in research, use of military technology" (Teague, 1995, pp. 68, 76, 86).

We do not understand how EFA concluded this content standard promotes a negative view of the military (presumably that of the United States), when in fact it promotes no particular position at all. EFA invented a negative characterization where none existed, presumably to influence opinion against the Draft.

Eagle Forum of Alabama fears national control of state education

A common theme of Opponent objections to the Draft was the COSC's use of references such as *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993), and *Science for All Americans* (Rutherford and Ahlgren, 1990). For example, EFA concludes that the use of Project 2061 materials by the COSC somehow commits Alabama to all of the project's future materials as well.

"Continuing research has convinced us that this COS MUST be rejected. Elements of it... [are] part of the national agenda to use science for social change" (Smith, 1995a).

"The proposed course of study,... is merely the groundwork [for future adoption of Project 2061 curricula, resources, teacher training and evaluation]" (Smith, 1995a).

[The curriculum] "Links Alabama to a national program planned to last until the year 2061" (Eagle Forum of Alabama, nd).

Course of Study: Science

The COSC did not in fact adopt Project 2061 curricula; instead they studied and adapted Project 2061 reports, including *Science for All Americans* (Rutherford and Ahlgren, 1990) and *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993), and consulted 39 other references, including science courses of study for such other states as Arizona, Florida, Idaho, Massachusetts, Michigan, North Carolina, Ohio and West Virginia. Whether future COSS committees will choose to utilize any materials from Project 2061 is unknown to all, including the EFA.

EFA documents criticize the Draft for promoting relative ethics and morality. The Draft is “unacceptable because it... Assumes ethics and morality are relative (BSL, p. 153)” (Eagle Forum of Alabama, nd). Again note that the referenced work is *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993) not the Draft COSS. The only references to “ethics” are found in the three identical content standards mentioned previously: “Discuss the ethical issues of science” (Teague, 1995, pp. 68, 76, 86). How such a statement can be interpreted as promoting either relative ethics or morality is beyond our comprehension.

Eagle Forum of Alabama objects to evolution

The teaching of evolution in the public schools has long been a prime target of opposition by EFA, some church-related groups, and like-minded citizens. EFA charged that the Draft was unacceptable in part because 1) it treated evolution as a non-debatable fact when it is not (Dean, 1995b), 2) its inclusion of evolution implied man originated without purpose and by chance (Eagle Forum of Alabama, nd), and 3) its inclusion of evolution is degrading because mankind is “view[ed]... as an animal” (Eagle Forum of Alabama, nd). These charges are similar to those made during previous adoptions of COSSs and science textbooks (Harris, 1982; Lash, 1983; Brande, 1991).

Eagle Forum of Alabama decries omission of alternative theories

EFA and other opponents objected that the Draft COSS did not include any theories other than evolution that might explain the origins of biological species:

“Eagle Forum of Alabama ... advocates teaching evolution and ‘facts ... at odds with it’”(Smith, 1995c).

Opponents rarely articulate the details of what alternative theories they would prefer as a balance to evolution. A revealing insight is provided by the president of EFA who quoted Dr. Werner Von Braun’s view that “It would be an error to overlook the possibility that the universe was *planned* rather than happened by *chance*” (Smith, 1995c italics in original). A “planned” universe is quite clearly a product of a creator. EFA and other opponents argued previously (Anderson, 1989; Kendall, 1989) and subsequently (Dean, 1995d) for adoption of *Of Pandas and People* (Davis et al., 1993), a textbook characterized by its promoter (the

Foundation for Thought and Ethics) as "designed to give students a broader understanding and reliable scientific rationale for creation" (Brande, 1991).

Norris Anderson objects to societal issues

Norris Anderson, a former science textbook consultant, objected to the Draft in part because it discusses "societal issues": "This should not be the major thrust of science education" (Anderson, nd). Anderson charged that the Draft was too heavily weighted in mandatory coverage of science and society. Let us examine this charge.

In the Draft, application of science to societal issues was taken up largely in the strand "Science, Technology, and Society" found in various content standards from grade 6 through the high school core courses.

Grade 6, #48. "Place scientific discoveries in historical, social, economical, and ethical perspective" (Teague, 1995, p. 73),

Grade 6, #53. "Serve the community through a science-related project" (Teague, 1995, p. 73),

Grade 7, #59. "Discuss the limits of technology in fulfilling human needs" (Teague, 1995, p. 84),

Biology Core, #46. "Identify trade-offs that individuals and society must consider when making decisions concerning the use or conservation of resources" (Teague, 1995, p. 121).

In grades 6 through the core courses, there are 395 content standards. Of these, 34 are listed under Science, Technology, and Society, thus constituting about 8.6% of the total. Whether 8.6% is too much, too little, or just right is obviously a matter of opinion, and Anderson is entitled to his own. However, for the 26 Alabama citizens who constructed the Draft (members of the COSC), 8.6% obviously constituted a majority opinion.

Let us consider some consequences if Anderson's view had prevailed, that science and society should not be discussed to the extent it is mandated in the COSS. Students would not be challenged to think about and discuss significant individual and community issues in everyday life they may often face after graduation from high school. For example, assume as part of a project in a high school science class, a student team finds a local stream polluted by run-off, and they discover a potential source of nitrate at the chicken farm over a nearby hill. Anderson's restrictive view might be implemented in the following way. Students would observe, measure and discuss issues of water quality in the stream, but the teacher should restrict that discussion from areas where the economic interests of the farmer potentially collide with those of the people living downstream who voted for clean water.

We believe Anderson's position is wrong. It is becoming more important, not less, to teach our children to face honestly and squarely those scientific and societal problems they will later encounter, such as electing qualified representatives who campaign on environmental issues, and choosing either "paper" or "plastic" at the grocery store. In our opinion, a course of study that continually challenges students to inquire about the implications of science will help to empower them to make more informed decisions by the time they graduate from high school.

Norris Anderson charges the Draft is religious

Norris Anderson also charged that "values and religious ideas" underlie the COSS because it is based on *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993) and *Science for All Americans* (Rutherford and Ahlgren, 1990), publications that promote an evolutionary origin for life on earth, including mankind.

"One definition of 'religion' is 'a system of beliefs held with ardor, devotion, conscientiousness, and faith'... According to this definition, the Alabama Science Course of Study is religious" (Anderson, nd).

Although one might hold that scientists entertain a "system of beliefs" (belief = probable knowledge, mental conviction, acceptance of something as true or actual), and that scientists exhibit ardor (warmth or intensity of passion), devotion (strong attachment or affection), and conscientiousness (scrupulousness), the enterprise, methods, and results of science are logically distinguishable from religion.

"Science (knowledge as of facts, phenomena, laws, and proximate causes, gained or verified by exact observation, organized experiment and logical thinking) is thus basically distinguished from religion as follows: scientific belief is based on evidence, religious belief is based on faith" (Read, 1960).

Anderson is wrong to ascribe faith (belief without evidence) as a common attitude of scientists toward their work, as a definitive characteristic of science, or as a characteristic of the COSS. Anderson's proposition that the Draft COSS is religious is incompatible with an accepted understanding of faith, religion and science.

Changes to the Draft COSS

Until the final draft of a COSS is approved by the state Board of Education, it is a document subject to extensive review. The draft is initially formulated by the COSC. As a product of the committee's consensus approval, the draft represents a document of compromise among the diverse interests of 28 committee members who represent teachers, school administrators, the system of higher education, and citizens of Alabama, including interests of the governor, who by law may appoint seven representatives. Public input to the COSC was provided in four public hearings at the beginning of the committee's work in May, 1994. Throughout the rest of the year, the committee formulated the Draft, which was then subjected to three reviews (for accuracy of scientific, educational and administrative content). The superintendent of education then recommended the Draft to the state Board of Education for its approval in January, 1995, at which time the board tabled the Draft for later consideration.

After the draft of a COSS is submitted to the state Board of Education for approval, further public comment cannot be allowed to result in significant changes in the text. Such

changes would unacceptably delay approval of the draft and the subsequent process of development of a list of approved textbooks to support the COSS.

Mandatory and optional components of the COSS

The COSS is built upon a fundamental unit: the science content standard. Each standard is composed of a statement, termed the stem, which may stand alone or may be accompanied by up to two types of supplemental statements: examples and blips. For example, content standard #7 for eighth grade (Teague, 1995, p. 86) is as follows:

"Discuss ethical issues of science.

Examples, use of animals and humans in research, use of military technology".

The stem "Discuss ethical issues of science" is a required part of the COSS, while the examples are merely suggested topics; they are not mandatory by law. Blips, generally indicated by hyphens, are a mandatory part of the required standard. For example, standard #30 of the Biology Core (Teague, 1995, p. 118) is accompanied by three required additional elements.

"Analyze factors in the production of genetic mutations in an organism and/or its off-spring.

-Radiation

-Chemicals

-Chance".

Opponents campaign for changes in the COSS

The 1994 draft was written by the COSC during the course of its work in 1994, reviewed for scientific, educational and administrative content, recommended by the superintendent of education, and was to be considered by the state Board of Education for approval on March 9, 1995. That Opponents had influenced the board became clear by the date of the board's work session (Wednesday, March 8) because it instructed the COSC to meet with Opponents of the draft in order to hear objections and modify it as necessary. At the scheduled public hearing on Thursday, March 9, the document presented to the board for its approval was the version of the Draft that included some modifications demanded by Opponents during the previous 24 hours.

An audience composed largely of Opponents, including EFA members and supporters, church-affiliated groups, and individuals attended the public hearing in Montgomery on Thursday, March 9. A much smaller number of individuals who spoke for the Draft included representatives of the Alabama Academy of Sciences (Frandsen and Brande), teachers and school administrators, and even an astronaut (Larry DeLucas, UAB). Governor Fob James attended the first part of the hearing (morning session) and stated that he would not be able to return for the afternoon discussion at which the board would vote.

Under extreme pressure to placate Opponents, the board and COSC modified the Draft in the following significant ways. The Board of Education 1) inserted statements addressing evolution, and science and social agendas (Table 1, #1), 2) deleted a statement defining science literacy (Table 1, #2), and 3) removed the term evolution from a statement on DIVERSITY, one of the 10 major strands of the entire Course of Study (Table 1, #3). As instructed by the state Board of Education, the COSC met with Norris Anderson, a representative of the Opponent groups, to consider objections. In response, the committee modified 15 science content standards by insertions, deletions, and/or re-wordings (Table 1, #4-#15). In some cases, the re-wording appeared to clarify or enhance original intent (e.g., Table 1, #10). In others, however, Opponents achieved some considerable measure of success, for example, in eliminating or neutralizing evolution in the new science curriculum (Table 1, #4, #6, #8, #11, #12).

An analysis of the modified content standards reveals that in a majority of cases, substitute language devised in response to Opponent objections is clearly flawed (see Table 1 and discussion below).

Analysis and implications of Changes in the Adopted COSS

The state board's intrusion into matters of science content

The importance of scientific literacy for students of the 21st century is spelled out in the "Vision for Alabama's K-12 Science Education Program", an introductory section of the COSS. In adopting an unprecedented motion during the March 9th public hearing, the state Board of Education added a final paragraph to the "Vision" section.

"Explanations of the origin of life and major groups of plants and animals, including humans, shall be treated as theory and not as fact" (Teague, 1995, p. 2).

In the Draft, evolution was taken as fact. In the adopted document, evolution is to be treated as only a "theory". With this pejorative language, the board implies evolution is suspect in the pantheon of scientific theories, and consequently teachers and students should approach it with a great deal of skepticism, an approach forcefully advocated by Opponents.

Perhaps more significant are flaws present in the statement's logical construction and wording that seem to present a "back door" to the inclusion of creationism in the public school classroom. Deliberately or not, the board failed to qualify "Explanations" with "scientific". The board's transparent attempt to appease Opponents conflicts with other text in the adopted COSS that specifically limits discussions of the origins of biological diversity to "scientific explanations" (Teague, 1995, p. 4) which may not permit intrusion of creationist origins into the science classroom.

The board was clearly uninformed as to the current classification of life on earth when it addressed only those "major groups of plants and animals" in its statement inserted into the COSS. We may infer that these "major groups" correspond to kingdoms, but in doing so, we find it curious that the board omitted the additional known kingdoms of Protoctista (Protista),

Fungi, and Monera. In effect, the board now requires that teachers discuss plant and animal origins by evolution as theory. However, because of the board's omissions, it also *permits teachers to discuss the evolutionary origins of the rest of life on earth as fact!* Furthermore, of all the possible species of plants and animals, the board specifically identifies only one: humans. It therefore seems abundantly clear that the primary motivation for this extraordinary action of the board in the face of vociferous anti-evolution sentiment is appeasement of fundamentalist religious factions that are primarily concerned with the religious status of mankind.

Reduction of evolution by the COSC

The occurrence of the term "evolution" has been severely reduced in the adopted COSS. "Evolution" or its derivatives occurred in only four content standards in the Draft (eighth grade and the biology core); deletions by the COSC reduced that number to 1, a reduction of 75%. It is particularly distressing to us that the COSC removed the term "evolution" from the entire Biology Core (a high school course), even though evolution is recognized as the cornerstone theory of modern biology.

When taken together with changes the committee made in various content standards (see Table 1, #4, #6, #8, #11, #12, #15), the board's statement inserted into the COSS sends a strong signal of considerable uncertainty about the status of evolution as an accepted scientific theory

Evolution remaining in the adopted COSS

Although explicit references to evolution have been reduced in the adopted COSS, some of the altered content standards point clearly to evolution (e.g., Fourth Grade, content standard #42: "Examine fossil evidence for change in organisms over time" (Teague, 1995, p. 52)). Other mandatory standards are intimately related to evolution: (e.g., "Discuss the relationships among organisms as the basis for the biological system of classification", Biology Core, content standard #15, (Teague, 1995, p. 129)). Finally, discussion of Darwin's theory of evolution is explicitly mandated (Teague, 1995, p. 91).

Science, Technology, and Society in the draft and the adopted COSS

Opponents charged that the Draft promoted "radical social agendas" (Smith, 1995b), and pressured the board to neutralize any such content. The board formulated a statement as part of their insert that addressed these concerns:

"When attempting to apply scientific knowledge to world problems, no social agenda shall be promoted" (Teague, 1995, p. 2).

Notice that the board did not prohibit discussion of the relationships between science and society, because to do so would require a radical restructuring of the COSS, for the Science,

Technology and Society strand pervades the entire document. Such a restructuring would also cause an unacceptable delay in the necessary implementation of the COSS.

The board instructed the committee to meet with Opponents to discuss their objections to the Science, Technology and Society strand, and in response, the committee deleted both a non-mandatory discussion of greenhouse gas emissions (Table 1, #9), and a redundant phrase in four content standards that implied science may have practical as well as intrinsic value (Table 1, #10). We do not understand why Opponents targeted only the greenhouse effect for deletion, when the same global environmental issues could be discussed with reference to deforestation or changes in atmospheric ozone.

The science COSC declined to modify or eliminate a content standard found in grades six through eight: "Discuss the ethical issues of science. Examples: use of animals and humans in research, use of military technology" (Teague, 1995, pp. 68, 76, 86). This standard was a focal point of attacks by EFA, which falsely advertised that it promoted a negative view of the military (Eagle Forum of Alabama, nd).

It appears to us that Opponents gained little of substantive value from their efforts to reduce discussion of science, technology and society.

Do adopted changes necessarily modify the COSS in practice?

Changes made to the Draft include additions, re-wording, and deletions. Whether these changes result in deliveries of science education different from that which would have occurred without the changes made to the Draft is uncertain. Some factors that may affect science classroom conduct and content might include the following:

- 1) course of study component in which the change was made,
- 2) local school system philosophies, standards, and degree of parental involvement in curriculum planning,
- 3) school and classroom resources,
- 4) individual science teacher knowledge, determination, philosophy, and bias
- 5) textbook content.

Some changes were made to the required content standard, and result in a significant shift in meaning or intention. For example, the Eighth grade content standard #42 (Table 1, #6,) "Trace evolutionary change through fossil evidence", became "Evaluate fossil evidence for change in organisms over time".

Modifications in stems or blips are also mandatory, and must be incorporated into the curriculum implemented at the local level. How a teacher implements a content standard, such as that above, is unspecified by the COSS. Although "evaluation" of fossil evidence denotes an activity and outcome significantly different from "tracing" evolutionary change, the teacher's classroom conduct and leadership may result in student instruction quite different from that envisioned by the board or Opponents of the Draft.

Other changes were made in non-mandatory examples: for example, opponents argued for the addition of "horseshoe crabs" (Table 1, #4, Fourth grade content standard #42) to list of organisms to be examined for change over time. Opponents promote discussion of the horseshoe crab because it has been described as a "living fossil", thus casting doubt on the

validity of evolutionary change. Such additions (or other modifications) to an example list are not required inclusions in an implemented curriculum. Consequently, a teacher may conduct classroom instruction on this topic as if the Draft had not been modified, and she may choose not to use horseshoe crabs to "evaluate" the fossil evidence.

Although it appeared that Opponents made considerable progress in deleting the term "evolution" from the Draft, it could be argued that such changes represent a hollow victory. By law, the COSS contains content standards that are at best "minimum and required" (Teague, 1995, p. v). Furthermore, the supplementation clause permits local curriculum planners to "include additional content standards", "resources, and/or activities, which, by design, are not contained in this document" (Teague, 1995, p. v).

Thus, it appears to us that a teacher could supplement his lesson plans with instructional standards first included, and then deleted by, the COSC. Take, for example, the contentious issues of evolution or the environment. The term "evolution" was deleted from three mandatory content standards, and greenhouse gas emissions was deleted from a non-mandatory example list. Both evolution and the greenhouse effect could be added back into the curriculum by any teacher wishing to supplement the COSS. In similar fashion, it seems to us, the standards of science literacy (Table 1, #2) deleted by the board may be adopted by individual teachers, or even local school system curriculum planners.

In our opinion, however, a more likely result of such deletions or reductions is that controversial topics (such as evolution and the environment) will simply be bypassed by some teachers, especially those lacking the academic background to discuss such issues with confidence, or by those teachers, especially untenured ones, who fear displeasing parents or administrators. The board's deletion of science standards from the Draft signals that they reject a 21st century vision of scientific literacy formulated by thousands of scientists, educators, and citizens nationwide (American Association for the Advancement of Science, 1993; National Research Council, 1996). The "supplementation" clause appears, however, to permit local curriculum planners to adopt the deleted goals for science literacy, thus extending the board's restricted vision statement to its original breadth.

Forward towards the 21st century, or backwards towards 1983?

Objections and compromises over language in the 1995 COSS reflect striking similarities to public debate on previous COSSs, especially those from 1977 to 1988 (Table 2). Evolution was a visible component of the 1977 COSS. Revision of the COSS in 1983 resulted in its removal and replacement by the meaningless term "universal change". In 1988 the COSC was challenged once again by many of the same anti-evolutionary groups and individuals protesting the 1994 Draft Course of Study in Science.

Supporters of a strong COSS argued before the state Board of Education that evolution should be reinserted in its rightful place. As reported at the time, state Board of Education member Spencer Bachus recognized that bending the COSS in response to political pressure was wron

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"If our science teachers present the theory of evolution and are sued, then I can guarantee them that the Board of Education will be 100 percent behind them" (Jennings and Sanford, 1988).

Faced with a Draft COSS that minimized the teaching of evolution and that failed to even mention the dreaded E-word (Jennings, 1988), the state Board of Education refused to bow to political pressure and instead sent the 1988 draft back to the Department of Education with explicit instructions to strengthen the treatment of evolution (State Board of Education, 1988), where it remained in the high school biology curriculum until removed once again from the Biology Core of the 1995 Draft.

Politics of science education

That the decisions of the state Board of Education were based upon a complex appraisal of political currency is supported by an assessment of the potential votes for and against the Draft Course of Study conducted by Charles J. Dean, a reporter for *The Birmingham News* prior to the March 9 public hearing: "Five of the nine members of the school board said Wednesday March 8 they intended to vote to adopt the new curriculum" (Dean, 1995c). By this reckoning, there was enough support to pass the COSS by a 5-4 vote. However, at the end of the public hearing, after "compromise" language had been reached, the board voted 7 for adoption (including Gov. James), with 2 abstentions. The board thus avoided a more serious split. Because the COSS would have passed by the earlier vote, it appears the board's surgery performed on the Draft was designed to minimize the political cost of alienation of Opponent voters.

Minor "clarifications"?

The editorial position of one newspaper published after the board adopted the COSS suggested changes made to the Draft were relatively minor:

"...all the state Board of Education did was make a semantic clarification and explicitly state what was the intention all along." (Editor, 1996).

But as we've shown above, language stating that evolution ought to be taught only as theory is in significant error in a number of ways. In our opinion, the board erred by injecting into to the COSS its uninformed opinions on matters of instructional content. It's "minor clarifications" express sentiment at variance with scientific consensus opinion, contradict other parts of the COSS, and appear as if changes were made because of the necessity for political compromise in the face of intense anti-evolution pressure.

Linkages of COSS adoption with science textbook adoption

The textbook committee that evaluates textbooks examines the suitability of each title for use in Alabama's public schools. Among the many criteria the committee uses is whether the text is substantially concordant with the subject course of study. After the COSS adoption, we believed that the Board of Education would find that its meddling with instructional content

might result in generating additional controversy with potentially unintended effects during the succeeding science textbook adoptions. The board's specific language that "Explanations of the origins of ... shall be treated as theory and not as fact" could be used for two different demands by the same anti-evolution opponents who objected to the Draft: 1) elimination of texts that do not explicitly treat evolution as theory only, and 2) adoption of texts that promote non-scientific "alternative" theories, such as creationism.

For a report on the science textbook adoptions, see the accompanying article (Brandt and Frandsen, 1997).

Conclusions

In our opinion, the COSS represents a substantive improvement over those of previous years. The Alabama State Department of Education and COSC are to be commended for constructing a COSS that in general should lead to significant improvements during the next six years in the Alabama public school science classroom. We also laud Dr. Ed Richardson, superintendent of education, for his steadfast resistance against the intense onslaught of special interest opposition. Dr. Richardson demonstrated he would not compromise his professional leadership for a more popular public sentiment. His dedication to Alabama's public school system deserves our respect and continuing support.

Against this positive backdrop, however, a shadow is cast on the COSS by the state Board of Education because it altered the Draft in significant ways. The board inserted its own erroneous concepts of evolution and biology that contradict those of the scientific community, and conflict with other parts of the COSS. And the board instructed the COSC to meet with Opponents in order to consider their objections. In response, the committee altered 16 content standards by re-wording, insertion, or deletion, including the removal of the term "evolution" from the high school Biology Core. Other modifications in wording change clear references of evolutionary trends to static comparisons (deletion of "progressive"; "explain" replaced by "evaluate").

The proportion of the COSS affected by Opponent challenges is numerically minor (15/628), and the major elements of science educational reform remain largely unaffected. To this extent, the political campaign of EFA and other Opponents whose initial campaign was to argue for the outright rejection of the draft (Smith, 1995a) may be considered a failure. Perhaps faced with a nearly certain decision for adoption of a COSS, Opponents then argued for a long list of alterations, only some of which the COSC implemented in various ways (Table 1).

The success with which Opponents were able to alter the Draft, especially during the last 24 hours of a nearly nine month long process proves a significant degree of political strength, thus reinforcing recent assessments (Dean, 1996).

Whether alterations to the Draft will affect the delivery of science instruction in Alabama's public school classroom cannot be predicted in advance because of a large number of intervening factors between the COSS (the function of which is to guide local content planners) and the classroom.

Although the state Board of Education may believe that with the adoption of the new COSS the current controversies are largely over, we envisioned that Opponents would use the

qualifying language of the board's inserted statement (Teague, 1995, p. 2) to argue against adoption of some mainstream biology texts, and for adoption of texts that present "alternative" (creationist) theories.

It is particularly distressing that as we approach the 21st Century, science education reforms continue to be held hostage because a significant percentage of the public do not understand the scientific method of investigation, the nature of scientific evidence, the differences between science and religion, or between scientific theory and fact, and believe that creationism belongs in the public school science classroom (Holmes, 1995).

Many other states have undergone, or are in the process of reforming their science instruction. It remains to be seen whether opponents (largely of evolution) exert similar political pressures and gain similarly significant results.

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References

- Alabama. 1975. Code of Alabama, vol. 13. The Michie Co.: Charlottesville, Virginia.
- American Association for the Advancement of Science. 1993. *Benchmarks for Science Literacy*. Oxford University Press: New York. 418 p.
- Anderson, N. nd. Major questions about the 1995 proposed Alabama Science Course of Study. 5p.
- Anderson, N. 1989. "New biology book will let our children think for themselves". *The Birmingham News*, Dec. 12, p. 11A.
- Anonymous. nd. "Religious and political biases underlying the Alabama Course of Study in Science".
- Brande, S. 1991. Pandas attack science education. *Free Inquiry*, 11(3): 28-31.
- Brande, S. 1995. Statement to the state Board of Education on adoption of the Draft Course of Study - Science.
- Brande, S. and J. Frandsen. 1997. The Evolution/Creation Controversy during the 1995 Alabama Science Textbook Adoption in Alabama. *Journal of the Alabama Academy of Science*, 68:59-76.
- Davis, Percival, Dean H. Kenyon, and Charles B. Thaxton. 1993. *Of Pandas and People: The central question of biological origins*, 2nd Edition. Haughton Publishing Company: Dallas, Texas.
- Dean, C. J. 1995a. Science curriculum: In-depth teaching or a social agenda? *The Birmingham News*, March 8, p. 1
- Dean, Charles J. 1995b. Heated school debate rises over proposed science studies, *The Birmingham News*, March 5, p. 24A.

- Dean, Charles J. 1995c. School science program expected to win OK. *The Birmingham News*, March 9.
- Dean, Charles J. 1995d. Science textbooks rekindle old debate. *The Birmingham News*, October 13, p. 1A.
- Dean, Charles J. 1996. Goals 2000 funds OK'd. *The Birmingham News*, August 23, p. 1A.
- Eagle Forum of Alabama. nd. Science Course of Study Alert.
- Editor. 1995. Science in Alabama. *The Birmingham News*, March 7, p. 6A.
- Editor. 1996. A new science curriculum. *Birmingham Post-Herald*, March 11, p. C2.
- Harris, Kate. 1982. Fight shaping up over the way state textbooks chosen. *The Birmingham News*, January 21.
- Holmes, Parker. 1995. Alabamians favor creationism. *The Mobile Register*, March 19, p. 1A.
- Jennings, M. And P. Sanford. 1988. Message about teaching evolution gets garbled. *The Birmingham News*, July 3.
- Jennings, Michael. 1988. New science curriculum dodges the 'E' word. *The Birmingham News*, June 12
- Kendall, J. 1989. We don't need textbooks that teach theory as fact. *The Birmingham News*, Sept. 28.
- Lash, Cindi. 1983. Reject books teaching evolution as fact, groups tell Alabama textbook committee. *The Birmingham News*, September 28.
- National Research Council. 1996. *National Science Education Standards*. National Academy Press: Washington, DC. 262p.
- Read, A. W. (editor). 1960. *Funk & Wagnalls Standard Dictionary of the English Language, International Edition*. Funk & Wagnalls: New York.
- Rutherford, F. James and Andrew Ahlgren. 1990. *Science for all Americans*. Oxford University Press: New York.
- Russell, B. 1995. Letter dated February 23 to the state Board of Education from the chair of the Christian Coalition of Alabama.
- Smith, E. 1995a. Letter dated February 13 to Alabama teachers, from Eagle Forum of Alabama.
- Smith, E. 1995b. Letter dated February 21 to state Board of Education members, from Eagle Forum of Alabama.
- Smith, E. 1995c. Proposed science course omits opposing theories. *The Birmingham News*, March 9. p. 11A.
- State Board of Education. 1988. Minutes of the State Board of Education for July 12, adopted August 11.
- Teague, W. 1995b. Alabama Course of Study: Science. Alabama State Department of Education: Montgomery, Alabama, Bulletin 1995, No. 4.

Table 1: Analysis of changes made to draft Course of Study: Science by course of study committee and state Board of Education

Strike-outs indicate deletions, and bold-face font indicates additions made in the Draft.

Analysis of Changes

Number Section and Page of Adopted Course of Study Adopted and Draft Texts

Change of	Section and Page of Adopted Course of Study	Adopted and Draft Texts
#1	Introduction: Scientific Literacy: A Vision for Alabama's K-12 Science Education Program (p. 2)	<p>Explanations of the origin of life and major groups of plants and animals, including humans, shall be treated as theory and not as fact. When attempting to apply scientific knowledge to world problems, no social agenda shall be promoted.</p> <p><u>Critical Problems with Change:</u> (1) No definition of "major groups" in terms of biological classification categories (kingdom, phylum, etc.) is provided. (2) "Origins" is not qualified as "scientific", thus opening potential classroom discussion to non-scientific theories of origins, such as creationism. (3) Three of the five kingdoms of life on earth (Monera, Protista, Fungi) are exempt from this requirement because they have not been specified in the statement. Teachers may speak of their origins as fact, but are constrained to discuss the origins of animals and plants as theory.</p> <p><u>Analysis of Change:</u> (1) Opponents use "theory" as a synonym of conjecture, as in "only a theory" or even merely guesswork, thus casting doubt on strength of evolutionary theory. This strategy supports opponent contention that creationist conjectures ("theory of intelligent design", "model of initial complexity", "theory of abrupt appearances") are as legitimate as evolution, and therefore merit inclusion in the science curriculum on par with evolution. (2) Opponents are against to specific "social agendas" or policies, such as family planning to stem population growth, environmental regulations that would limit the rights of real property owners to do whatever they wish with their holdings, and international agreements limiting national policies in such areas as exploitation of natural resources and preservation of environmental quality.</p> <p><u>Effects of Change:</u> (1) Creates confusion because "major groups" and "world problems" are not defined. (2) Reinforces the common misconception of the meaning of the word "theory" as used in science, viz. that a "theory" is not factual, but only a notion. (3) Permits the presentation of any sort of explanation, including religious creation because the word "explanations" is not qualified by "scientific". Consequently—and perhaps inadvertently—the two lawyer-members of the state Board of Education (Byrne and Byers) who drafted this language to appease the opponents of the Draft opened the door to the teaching of <u>all</u> of the great multitude of religious creation stories, including Hindu, Bhuddist, Judeo-Christian, Native American Indian, and others. (4) Stifles the discussion of such scientifically germane subjects as the relevance of population growth patterns and rates to family planning, and levels of air and water pollutants</p>

to the following:

Recognize the diversity and the unity of the natural world.
Use the appropriate circumstances and uses of scientific knowledge and scientific ways of thinking to address individual and social needs.
Perceive the interdependence of science, technology, and society
Understand the strengths and limitations of science in the improvement of life for humanity.

Benchmarks for Science Literacy and Science for All Americans form the basis of a national agenda that will establish national control of science education. (2) Recognition of unity of the natural world implies acceptance of evolutionary theory, whereas creationism posits a separate, special creation of each kind of organism. (3) Opponents do not believe that science education should include consideration of societal issues, nor do they believe that scientific evidence or concepts can or should serve as a basis for value judgments. (4) Opponents believe that a perception of an interdependence of science, technology and society would lead to a Godless technological society without values. (5) Opponents believe that only religious principles, texts, leaders, and revealed truths provide the means for improving human life.
Effects of Change: Deprives teachers of specific standards for assessing student acquisition of scientific literacy.

#3
Conceptual Framework: Categories of Content: Scientific Knowledge: Life Science: Diversity (p. 4)

Diversity focuses on identification of similarities and differences in organisms and on the classification of living things. The theory of natural selection and the process of evolution serve to explain scientifically this diversity, on their classification, and on scientific explanations for this diversity.

Analysis of Change: Removes statement that evolution and natural selection are accepted facts, and that they explain biodiversity.

Effects of Change: Conceptual framework of Life Science Diversity is less precise. Removal of explicit underlying mechanisms emphasizes sensitivity that may result in avoidance of topics. Inclusion of "scientific" as qualifier of "explanations" challenges non-specificity in statement by state board (see #1 above). "Scientific explanations" may provide justification for teachers who wish to include aspects of creationism in the classroom advertised as "scientific".

#4
Fourth Grade: Minimum Required Content of Scientific Knowledge: Strand Diversity: Content Standard 42 (p. 52)

Explain how fossils provide evidence that life has changed over time.
Examine fossil evidence for change in organisms over time.
Examples: dinosaurs became extinct, some plant species are extinct or have changed, horseshoe crabs have remained relatively unchanged

Analysis of Change: The sense of the factual statement that life has changed over time is significantly changed, as "examination" of fossils suggests uncertainty of outcomes of such studies. The addition of horseshoe crabs, a group of "living fossils", bolsters creationist claims that life hasn't changed over time.

Effects of Change: Provides an opportunity for teachers who wish to use scientific data to discuss creationism.

#5
Seventh Grade: Minimum Required Content of Scientific Knowledge: Strand The Dynamic Earth: Content Standard 20 (p. 79)

Trace the historical origins and scientific development of the idea of continental drift and the resulting plate tectonics theory.

Analysis of Change: Uncertain.

Effects of Change: Uncertain.

#6
Eighth Grade: Minimum Required Content of Scientific Knowledge: Strand Diversity: Content Standard 41 (p. 91)

Trace evolutionary change through Evaluate fossil evidence: for change in organisms over time.

Analysis of Change: To negate assumption that evolution occurred.

"Evaluate" implies no restrictions on explanations for fossil changes, thus implying consideration of alternative reasons, such as creationism.

Effects of Change: Use of the code phrase "change over time" as a substitute for "evolution" signals to curriculum planners that evolution is a sensitive and objectionable term to be avoided.

<p>#7 Eighth Grade: Minimum Required Content of Scientific Knowledge: Strand Diversity: Content Standard 42 (p. 91)</p>	<p>Analyze the development of Charles Darwin's ideas theory of biological evolution.</p>	<p><u>Analysis of Change:</u> Uncertain. Perhaps to provide an opportunity in the classroom to use "theory" pejoratively, according to statement by board (see #1 above). <u>Effect of Change:</u> Uncertain.</p>
<p>#8 Eighth Grade: Minimum Required Content of Scientific Knowledge: Strand Cells: Content Standard 51 (p. 92)</p>	<p>Trace progressive- Compare the complexity of circulatory and nervous systems in earthworms, frogs, and humans.</p>	<p><u>Analysis of Change:</u> Trace means "1. To follow the course or trail of...; 2. To ascertain the successive stages in the development or progress of..."; whereas compare means "2. To examine in order to note the similarities or differences of." (The American Heritage® Dictionary, 3rd ed., 1992.) Consequently, this substitution of terms removes any sense of gradient of change over time, which for heritable characters of organisms would be evolutionary. The deleted word "progressive" also implies gradient changes. Opponents object to the biological relationships between humans and other animals, hence a tracing of development of anatomical systems is especially offensive to them. <u>Effects of Change:</u> Signals that sequential changes predicted by evolution are to be hidden behind a facade of "compare". Dampens incentive to teach current understanding of biological relationships.</p>
<p>#9 Eighth Grade: Minimum Required Content of Scientific Knowledge: Strand Interdependence: Content Standard 52 (p. 93)</p>	<p>...Predict the potential impact of human activities on long-range changes in the surface and climate of the Earth —Negative impact Examples: deforestation, ozone depletion, "greenhouse" gas emission</p>	<p><u>Analysis of Change:</u> Uncertain. Opponents believe the concept of a developing greenhouse effect to be a "social agenda". <u>Effects of Change:</u> As examples are not mandatory, removal of term here may have no practical effect. But as deletion signals controversy, some local content planners may choose to avoid the suggested topic.</p>
<p>#10 Physical Science Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Nature of Science: Content Standard 2 (p. 102) Biology Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Nature of Science: Content Standard 2 (p. 114) Chemistry Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Nature of Science: Content Standard 2 (p. 126) Physics Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Nature of Science: Content Standard 2 (p. 136)</p>	<p>Discuss science as a body of knowledge and an investigative process. -Pure science developed for its intrinsic worth without regard to social ethics and practical requirements.</p>	<p><u>Analysis of Change:</u> Deleted phrase was redundant. Because Opponents disapprove of the teaching of "social agendas" in science classes, they may have regarded the deleted phrase as implying that scientific knowledge might validly be considered in some contexts when formulating ethical and practical policies. <u>Effects of Change:</u> Deletion appears to clarify the statement. However, it also removes a reminder that scientific knowledge may have some ethical and practical applications.</p>

<p>#11 Biology Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Diversity: Content Standard 20 (p. 117)</p>	<p>Compare the progressive complexity of major anatomical structures in sponges, worms, echinoderms, arthropods, and vertebrates.</p>	<p><u>Analysis of Change:</u> To remove a sense of evolutionary change through geologic time, and an implication that humans (vertebrates) are related to "lower" forms of life. <u>Result of Change:</u> Eliminates implication that organic evolution occurred. Removes an opportunity for teachers to introduce or reinforce concepts that foster deductive and inductive reasoning.</p>
<p>#12 Biology Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Diversity: Content Standard 21 (p. 117)</p>	<p>Evaluate evidence that supports the theory of natural selection. —Survival in particular environments —Fossil records —Evolution —Climatic events</p>	<p><u>Analysis of Change:</u> Deleted phrase mandated instruction in evidence for natural selection, and thus presumes natural selection to be true. Modification suggests natural selection remains an unproved theory. Deletion of term "evolution" removes one more explicit reference to theory Opponents find objectionable. <u>Result of Change:</u> Removes the requirement that evidence for natural selection (as a cause of organic evolution) be presented. Casts doubt on natural selection, that it may be unproved. May provide an opportunity for teachers who wish to introduce creationist arguments into the classroom.</p>
<p>#13 Biology Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Diversity: Content Standard 22 (p. 117)</p>	<p>Describe the individual versus population distinction related to diversity through natural selection: how natural selection affects populations as compared to individuals. Examine factors that affect changes in populations.</p>	<p><u>Analysis of Change:</u> To prevent presenting natural selection as an engine of biological diversity and, over time, of evolution. <u>Result of Change:</u> Discussion now ends with a simple comparison, rather than with building on the mechanism of natural selection as a cause of organic evolution.</p>
<p>#14 Biology Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Diversity: Content Standard 23 (p. 118)</p>	<p>Discuss factors that might affect the dynamic equilibrium of ecosystems. —Disasters —Climate changes —Introduction of new species —Human activities</p>	<p><u>Analysis of Change:</u> Makes less clear how factors (—migration, distribution, competition for limited resources, disease, and natural disaster—) might lead to changes in these populations: i.e., that these factors might be agents of natural selection, and thus a cause of evolution. <u>Result of Change:</u> Breaks the logical inference that "changes in populations" resulting from natural selection result in organic evolution.</p>
<p>#15 Biology Core, Grades 9-12: Minimum Required Content of Scientific Processes: Strand Interdependence: Content Standard 39 (p. 120)</p>	<p>Remove another explicit reference to evolution. Leaves discussion of ecosystems incomplete.</p>	<p><u>Analysis of Change:</u> Removes another explicit reference to evolution. <u>Result of Change:</u> Leaves discussion of ecosystems incomplete.</p>

Table 2: Some changes in the treatment of evolution in Alabama draft and adopted science courses of study, 1977-1995

1977 Adopted	1983 Adopted	1988 Draft	1988 Adopted	1994 Draft	1995 Adopted
EVOLUTION	UNIVERSAL CHANGE	SPECIE (sic) MODIFICATION (1 week)	EVOLUTIONARY PROCESSES (2 weeks)	DIVERSITY	DIVERSITY
Comprehend that evolution has resulted in a wide variety of living organisms that have been able to survive or have become extinct	Consider that a wide variety of organisms exist or have existed	<ul style="list-style-type: none"> Identify evidence of changes Discuss fossils and fossil histories 	<ul style="list-style-type: none"> Specie (sic) modification Environmental Factors Scientific Theories of Origin and Evolution 	8th grade #41. Trace evolutionary change through fossil evidence	8th grade #41. Evaluate fossil evidence for change in organisms over time.
				Biology Core #21. Evaluate evidence that supports the theory of natural selection <ul style="list-style-type: none"> Survival in particular environments Fossil records Evolution 	Biology Core #21. Evaluate evidence the theory of natural selection <ul style="list-style-type: none"> Survival in particular environments Fossil and genetic records Climatic events

THE EVOLUTION/CREATION CONTROVERSY DURING THE 1995 ALABAMA
SCIENCE TEXTBOOK ADOPTIONS

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ABSTRACT

In Alabama, the state Board of Education revises the course of study for each public school academic subject once every six years. Following the board's revision of the science course of study, the board adopted science texts and supplementary materials on November 9, 1995. A number of the same individuals and groups that opposed the presence of evolution in the science course of study returned during the textbook adoption process to oppose the factual treatment of evolution in the textbooks and the public school biology classrooms. These opponents employed a number of strategies designed to minimize the impact of biology texts containing evolutionary theory on the world views of students: 1) block some texts from the list the state textbook committee recommended to the Board of Education; 2) add anti-evolution books to the textbook committee recommended list, and 3) pressure the board to pass an anti-evolution statement for insertion into every biology textbook purchased with state funds for use in public school science classrooms. Only the last strategy was successful. Whether the presence of an anti-evolution textbook insert has any effect on students can only be determined by a future survey. The history of opposition to evolution in Alabama's public schools is a long one, and the intensity of opposition is not likely to abate in future course of study revisions and textbook adoptions during the coming century.

Introduction

The hexennial course of study revision cycle in Alabama

Science, like all other academic subjects in Alabama's K-12 public school system, is revisited for updating once every six years by the state Board of Education. Some of the previous years for revision of the Course of Study: Science (COSS) were 1988, 1983, and 1977. The next year for revision of the COSS will be in the year 2000. Once the subject

course of study is revised by the Course of Study Committee and adopted by the state Board of Education, and a list of textbooks is approved by the board for purchase and use in Alabama, the new course of study is then implemented in the following academic year.

The state textbook committee

Purpose and Composition of the state textbook committee

The function of the state textbook committee is to "consider the merit of textbooks offered for use in the public elementary and high schools of the state and to make recommendations to the state Board of Education" (Alabama Code, 16-36-1).

The composition of the state textbook committee is determined by law (Alabama Code, 16-36-2). Presently, 16 of the 23 members are recommended to the governor for appointment by the superintendent of education, and 7 members are appointed strictly by the governor. The superintendent's recommended members represent teachers and administrators at the elementary, secondary, and higher education levels. The Governor's appointees represent the seven congressional districts, and they "shall have general knowledge of the subject area and shall have a demonstrated ability to read and write at a post high school level and shall not be employed in education" (Alabama Code, 16-36-2).

In the past, a smaller proportion of the state textbook committee was appointed by the governor. It was during Governor James's previous administration that textbooks and the selection process were targeted for change by, among others, the Alabama chapter of the Moral Majority. Stuart Gaines, that organization's executive director, said the textbook committee is "overloaded with educators" (Harris, 1982). Of the textbook selection process, Governor James said "This whole textbook think stinks from here to New York" (Harris, 1982). At that time, the state legislature increased membership on the committee from 16 (of whom 14 were educators) to 23, and increased the governor's representation on the committee.

The Evolution/Creation Controversy in previous textbook adoptions

In our opinion, the dominant issue in science textbook adoptions in Alabama since at least 1983 has been evolution. One of us (Brande) was appointed a member of the 1983 state textbook committee. During that committee's public hearing, numerous speakers repetitively argued that textbooks submitted for evaluation 1) treated evolution dogmatically, 2) lacked discussion of problems with evolutionary theory, and 3) lacked discussion of alternative theories. Major speakers against the science textbooks included Eagle Forum of Alabama (EFA) and Norris Anderson, a former Biological Sciences Curriculum Study (BSCS) consultant who is now with Cornerstone Ministries.

During the 1989 science textbook adoptions, EFA's position was carefully crafted to avoid the charge of promoting religion in the public school science classroom. What EFA wanted was the ability to discuss scientific evidence against evolution, and scientific evidence for creationism. In describing a "good education", Joan Kendall, education chair of EFA, said "this goal cannot be reached when students are taught theories as facts when students are not

allowed to wrestle with conflicting data, and when opposing theories are excluded from textbooks” (Kendall, 1989). Because traditional biology textbooks did not discuss “opposing theories”, EFA supported the adoption of *Of Pandas and People* (Davis et al., 1989) (Pandas), a slim volume promoted as a supplementary biology book by the Foundation for Thought and Ethics (FTE), a Christian “think-tank” (Larson, 1994; Thomas, 1990). *Pandas*’ alternative to evolution is an “intelligent designer”, harking back to the ideas of William Paley (1831), who helped popularize the notion that, just as a watch implies a watchmaker, the intricacies of living things imply a designer.

The FTE’s Alabama campaign for official adoption of *Pandas* was protracted, intense, and full of surprises (Bereckis, 1990; Brande, 1991; Lindley, 1990a,b). A majority of the state textbook committee originally voted to exclude *Pandas* from its list recommended to the Board of Education. FTE then appealed directly to the Board of Education and requested that it overrule the textbook committee majority vote and add *Pandas* to the recommended list. Without clear legal authority to do so, the board refused FTE’s request, but did instruct the textbook committee to conduct a second review of the book. In the face of imminent defeat by a majority of the textbook committee, FTE withdrew its title, thus preventing *Pandas*’ purchase with state funds and distribution in Alabama for a period of six years. Below we will note that *Pandas* arose from its temporary extinction to surface once again during the 1995 science textbook adoptions in Alabama.

The Evolution/Creation Controversy in the 1995 textbook adoptions

Opponents of evolution in Alabama’s Course of Study: Science (Frandsen and Brande, 1997) reappeared to argue against the adoption of science textbooks that contained evolution. In a statement distributed to reporters (Kendall, 1995a), EFA charged the textbooks submitted for adoption conflicted with board policy as stated in the COSS: “Explanations of the origin and life and major groups of plants and animals, including humans, shall be treated as theory and not as fact” (Teague, 1995, p. 2). EFA declared that “all the textbooks submitted that deal with origins fail to comply with the reasonable directive” (Kendall, 1995a).

EFA stated that the current textbook controversy was not about the debate between evolution and creation: “It is important that you understand Eagle Forum’s position. At issue is how evolutionary theory is taught. Evolution, natural selection, the geologic column should be taught as theory, which means: 1) using clearly defined terms; 2) showing the distinction between data and its interpretation; 3) presenting problems that have not yet been solved by the most widely held explanations” (emphasis included in the original) (Kendall, 1995a). These seemingly reasonable requests for better teaching belie fundamental views at odds today with a vast majority of the scientific community. We can obtain insights into the anti-evolution positions by examining the written report of a minority of the textbook committee who strongly objected to a number of the biology texts.

State Textbook Committee Actions

Minority bloc: dissenting views

The large number of members on the textbook committee results in a diversity of opinions about the suitability of texts for use in Alabama's public schools. The committee usually unanimously recommends a list of texts to the state Board of Education. At the end of the 1995 textbook committee's deliberations, however, both majority and minority reports were filed with the board. The majority report recommended the vast majority of textbooks that publishers submitted for consideration. The minority report dissented and argued that "all secondary biology texts, all AP biology texts, and some elementary texts fail to meet the directive of the Alabama state school board. 'Explanations of the origin of life and major groups of plants and animals, including humans, shall be treated as theory and not as fact. When attempting to apply scientific knowledge to world problems, no social agenda shall be promoted'" (Aderholt, et al., 1995).

The members of the textbook committee who filed the minority report stated that the texts they identified "fail to conform to the Course of Study" in three significant ways.

"1) The textbooks contain unqualified factual statements such as 'You are an animal, and share a common heritage with earthworms'";

"2) Most of these textbooks fail to mention any problems left unsolved by evolutionary theory. If there are no problems left unsolved by a theory, it should then be called a law, and this is exactly how evolution is presented in the textbooks. Furthermore, withholding such information indoctrinates the student by leaving the impression there is no possible alternative view of origins other than the evolutionary one";

"3) Confusion is caused by the lack of precision in defining terms. For example, 'evolution' is defined as simply change over time as well as descent through common ancestry. The texts then extend 'evolution' to cover the highly speculative idea that all major life forms developed from a common ancestor. A big jump is made from microevolution (changes within a species) which is an observable process to macroevolution (formation of major groups of life forms) which is an unobservable process. This misuse of language is intellectually dishonest and confuses rather than instructs students in the proper methods of scientific inquiry" (Aderholt, et al., 1995).

One might conclude that the minority report authors are concerned simply with what they see as muddled text: "Some may question our motives for criticizing how evolution is taught. Let it be said at the outset that we have no desire to indoctrinate students in any view of origins. Good science teaching demands that students learn to distinguish between facts and theories, between data and ideas about that data" (emphasis in the original) (Aderholt, et al., 1995).

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However, good pedagogy is not the only concern of these minority members, as is made clear in the following explanation:

“Macroevolution is the idea that mankind developed from lower animals by purely natural means. If human beings are solely the product of chance meaningless forces as these books teach, then one can rightly question the value of man, the significance of life, and whether there is any basis for morality. If children are taught to see themselves as animals, they may well act like animals.

“When [evolution] is presented under the guise of ‘scientific knowledge’, a constitutional line is crossed. What results is a state-sponsored religion that clearly violates the view about human origins held by a majority of Alabama students and parents. Many who hold to a Jewish, Muslim, or Christian view of mankind are being driven out of Alabama public schools because they cannot hold to their beliefs without being classified as superstitious or irrational. Teaching as fact that life and all its forms result from ‘random and undirected’ forces is offensive to their beliefs.”

“The taxpayers have reached the end of their tolerance for the pseudoscience being promoted in our schools” (Aderholt, et al., 1995).

The minority report authors explain their objection to evolution as stemming from its serious intellectual challenges to the religious beliefs of many people. Aderholt et al. (1995) thus ally themselves with the many opponents to evolution who began the battle immediately following the publication of Darwin’s big book (Darwin, 1964).

We would not challenge such opinions relating to personal choices in theology, but believe that such challenges are entirely inappropriate in the public school science classroom. Other inferences made by Aderholt, et al. (1995), however, appear unreasonable, illogical, or unsupported by evidence. For example, we know of no information that students in Alabama’s public school science classes are taught to “see themselves as animals”. We fully expect that these students will learn about animals, and about man’s biological characteristics that mark our interpreted position within the animal kingdom. Apparently Aderholt et al. (1995) believe that such instruction may lead to behavioral changes that would not otherwise occur in the absence of such instruction. We are unaware of any scientific studies that suggest the unspecified “animal”-like behavior in children is caused solely by public school instruction in evolution.

Aderholt et al. (1995) apparently believe that public school instruction in evolution constitutes the teaching of “a state sponsored religion”, thus violating various unspecified aspects of the Constitution. Legal challenges to the teaching of evolution in public schools that are based upon religious issues have a long history in the United States (Edwards, 1983; Le Clercq, 1978; *Edwards v. Aguillard et al.*). Although the various challenges differ in character, from the proposed banning of evolution to required instruction (equal-time balancing) of “scientific” creationism, none have survived judicial review. Aderholt’s et al.

(1995) understanding of the constitutional issues involving public school science instruction in evolution is at variance with court opinions spanning more than three decades.

Conflict between evolution and theology is not the only problem the minority report authors have with evolution. Aderholt et al. (1995) characterize evolution as “pseudoscience”, thus implying that the subject should in fact not be included at all in the public school science curriculum. Whatever Aderholt et al. (1995) may mean by pseudoscience, their understanding is clearly at odds with science educators and curriculum planners nationwide responsible for public school science instruction.

Minority report recommendations

The minority bloc of the textbook committee identified ten biology and science books that “at a minimum must not be adopted [because they] contain excessive, dogmatic, naturalistic macroevolution [and] also promote social agenda items in violations of the Course of Study” (Aderholt, et al., 1995). In light of the “defective nature of all of the texts”, the textbook committee members who signed the minority report recommended the Board of Education take three actions: 1) attach a position statement to each text that “inform[s] students, parents, and teachers of the board’s position on the teaching of origins [and] in general terms the assumptions upon which macroevolution is based and some of the unanswered questions that remain” (Aderholt et al., 1995), 2) adopt supplementary materials for student use (presumably to counterbalance texts with evolution), and 3) approve additional works for supplementary use by teachers (Aderholt et al., 1995).

Majority recommendations

At the end of the review process, the textbook committee votes on each and every title submitted by publishers. If a title receives a majority of the 23 votes, it is placed on a list the committee recommends to the Board of Education.

The minority bloc argued that at least ten biology and science texts should not be included on the textbook committee’s recommended list. One of these titles was the green version of BSCS’s *Biological Science: An ecological approach* (Milani, 1992). It is interesting that Norris Anderson, a signatory to the minority report, argued for this text’s elimination because he had consulted previously with BSCS on the second edition of the BSCS green version as a member of its revision team. Anderson’s involvement with BSCS ended with that edition, for BSCS chose not to retain him on the revision team for the third edition (McInerney, pers. comm.).

Of the hundreds of titles submitted for committee approval, less than five were not recommended by majority vote of the textbook committee, including the BSCS green version. It is likely that internal dissension lead the majority to vote the elimination of a few titles in order to placate the intense pressure of the minority bloc.

Below we review actions taken by the state Board of Education relative to the recommendations of the state textbook committee.

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State Board of Education Actions

Multiple textbook inserts

The textbook committee's minority bloc recommended the board adopt an informative position statement "on the teaching of origins" and other matters of evolution. In the month prior to the board's November 9, 1995 meeting, a statement was written that addressed the points in the textbook committee's minority report (Appendix 1). This statement was then endorsed by Eagle Forum of Alabama, which said it was necessary "because all of the biology textbooks recommended for adoption treat evolution as fact" (Dean, 1995a). (We do not know the author(s) of the statement endorsed by EFA. What we do know is that Joan Kendall, education chairman of EFA, wrote in a letter to the *Birmingham News* that the one EFA endorsed was "developed by science teachers" (Kendall, 1995a)).

EFA had proved itself capable of reaching the board and the Governor during previous debates on public science education. Given the intense public interest in education, and the apparent political weight of EFA, we felt it more likely the board would choose to adopt some statement rather than none at all. If the board were to adopt a particular statement, the question then arose as to who would influence its final content.

In order to counterbalance the statement endorsed by EFA, we consulted with a number of colleagues and wrote a rather bland, alternative statement that accurately reflected the current state of scientific knowledge about the origin and life and evolution (Appendix 2).

By November 8, the day before the board was to vote on the textbook committee's recommendations, we learned there would be three additional different statements proposed for insertion into the biology texts (see Appendices 3-5), including those of Ed Richardson, state superintendent of education, Stephanie Bell, member of the state Board of Education, and David Byers, also a member of the state Board of Education. These three statements seem quite similar in many respects, including the retention of specific language and sequential ordering of topics. The statements endorsed by Bell and Byers appear to be direct literary descendants of the EFA statement, if we provisionally assume the latter was written before the others.

At the board's public hearing on November 9, the number of statements to be considered was reduced to four; board members Byers and Bell agreed to support a single statement (Appendix 6), the language of which is most similar to that previously endorsed by Bell.

Governor James acts like an ape

During the morning session of the board's public hearing, Governor James (president of the board) addressed the board with his thoughts on the issues of evolution because he would not be present during the afternoon when the board was to hear from the public and act on the textbook committee's recommendations.

As eyewitnesses, we can confirm the account of the Governor's actions and comments as reported by the *Birmingham News* (Dean, 1995b). Standing between the board and the audience, Governor James dropped his hands nearly to the floor of the auditorium, ambled a few steps like a quadrupedal primate, and then slowly straightened up as if evolving to the upright posture of humans, thus mocking the classical textbook illustration of the evolution of man from ape. Governor James made his position on evolution perfectly clear to the majority of supporters in the audience: "That's the notion behind evolution. It's no more than a theory. If one wants to understand something about the origins of human life, you might ought to look at Genesis to get the whole story" (Dean, 1995b).

The board hears from the public

During the afternoon session, the board heard from nearly 30 speakers who voiced various opinions on various subjects, ranging from the textbook insert to evolution in the texts. Speakers ranged from university professors to church leaders, and even members of the state textbook committee. As representatives of the Alabama Academy of Science Committee on Science & Public Policy, one of us (Frandsen) strongly supported the adoption of all the textbooks, and opposed the textbook insert.

The board's actions

After the board listened to all the speakers, it voted on and approved (by 6-1-1) the motion to approve the Byers/Bell statement (Appendix 6). Mrs. Bell then moved to strike two biology texts objected to by the textbook committee minority from the list the majority recommended to the board. This motion failed (2-6), being supported only by Mrs. Bell and Mr. Byers. The board then voted to accept the textbook committee's recommended list (which now remained intact), and the motion carried on a 5-3 vote (with Bell, Byers and Paul voting against it). Finally, the board then considered Mr. Byers' motion that the state Board of Education supply all high school biology teachers in the state with a copy of Phillip Johnson's book, *Darwin on Trial* (Johnson, 1993). This motion failed on a 3-5 vote (supported only by Bell, Byers, and Caylor).

Politics of Textbook Adoptions in Alabama

Opponents of evolution appeared to coordinate their efforts between the board's adoption of the science course of study and that of textbooks. In the accompanying article (Brande and Frandsen, 1997), we noted that the board first adopts a course of study, and then a list of textbooks approved for purchase and distribution. Before the board adopted the science course of study in March, 1995, it inserted the "evolution as fact, not theory" statement. It is now clear that those opposed to the acceptance of the theory of evolution (EFA and its supporters) used this statement as a basis for their arguments against the adoption of the science texts, none of which treat evolution as only a theory.

But this strategy ultimately failed. The board could not reject all the biology textbooks as EFA initially requested, for then there would be no texts for use in the biology classes. Furthermore, the board may have felt that since they inserted the "evolution as fact, not

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theory” statement into the science course of study, they satisfied to some degree Opponent objections.

The failure of the board to reject the biology textbooks did not stop Opponents from supporting alternative strategies aimed at reducing the impact of evolution in the biology classroom. Members of the textbook committee who signed the minority report also wanted the textbook committee to recommend to the board some anti-evolution texts not included on the recommended list. By majority vote, the minority bloc effort failed. Perhaps prompted by those same members of the textbook committee minority, the board was asked to delete some offensive texts, thus overriding the textbook committee majority vote. But this motion also failed.

Finally, Mr. Byers then moved that the board approve the purchase of an anti-evolution text, *Darwin on Trial* (Johnson, 1993) for distribution to all biology teachers in the state. The board was informed by the superintendent that no funds were available for such a purpose. Mr. Byers then amended his motion to one of distribution by the board, if private funds could be found for that book’s purchase. The board also declined that motion.

Success or failure of Opponents’ political pressure

The success of Opponents in accessing critical pressure points (the governor, the state Board of Education) in the political structure of public education is not surprising to us, given a history of similar access in previous years. But this successful access was not matched equally by results where it counted, majority votes by the state textbook committee or the Board of Education. A majority of the state textbook committee recommended all but a few of the hundreds of texts and materials submitted by publishers, and did not include on its recommended list any books designed to counterbalance evolution, such as *Darwin on Trial* (Johnson, 1993) or *Of Pandas and People* (Davis et al., 1989). The Board of Education declined to override the state textbook committee’s recommendations, leaving its majority decisions intact. But the board apparently felt it could not totally ignore the intense political pressure of opponents, and so passed a textbook insert that may have comforted to some degree those opposed to evolution.

In our view, the concept and implementation of the textbook insert the board adopted is repugnant because 1) the inserted text is misleading, 2) it represents interference by the board in matters of science content which the board is not prepared to address, 3) the motivation of the insert stems from special interest groups that promote the introduction of religion-based concepts into the public school science classroom and 4) it singles-out biology texts for special treatment, attaching to them—and to biology itself as a subject—a stigma not conferred on other science texts or science subjects. On the other hand, we believe the effects of this insert may well prove to be quite minimal, especially considering the board’s adoption of a science course of study that survived the challenges of anti-evolution opponents largely intact, and a renewed emphasis on school accountability and student performance as assessed by national examinations.

Conclusions

Over the objections of opponents of evolution, the state Board of Education finished the revision of the science course of study with its adoption of the majority recommendations of the state textbook committee. Over objections of many others, including the Alabama Academy of Science Committee on Science & Public Policy, and the state superintendent of education, the board adopted an anti-evolution statement for insertion into all biology texts. These actions may have been meant to balance conflicting political pressures, but in our opinion, they should not be seen as symmetrical. The vast majority of textbooks submitted by publishers were adopted for use in Alabama, a majority of the state textbook committee refused to add any anti-evolution texts to its recommended list, and the board refused to overrule the state textbook committee and purchase or distribute the anti-evolution text, *Darwin on Trial* (Johnson, 1993). We predict that during the first science course of study revision of the 21st century (2001), we will see once again see largely the same anti-evolution opponents before the state Board of Education. What we cannot predict is how their strategies may have evolved in the interim or how much success they will have in achieving their objectives. What we can predict is that the preservation of objectivity in science instruction in the public schools of this state, and prevention of the introduction of pseudoscience into the subject matter of science classes, will require continued vigilance and involvement in political processes by members of the scientific and educational communities.

References

- Aderholt, C., Anderson, N., Davis, C., Holland, J. W., McLain, and W. Garrett. 1995. 1995 Alabama science textbook committee minority report. Submitted to the state Board of Education, October 12.
- Alabama. 1975. Code of Alabama, vol. 13. The Michie Co.: Charlottesville, Virginia.
- Bereckis, N. 1990. Publisher withdraws 'Pandas' book. *Birmingham Post-Herald*, Jan. 9, p. 1.
- Brande, S. 1991. Pandas attack science education. *Free Inquiry* 11(3):28-31.
- Darwin, C. 1964. *On the Origin of Species - A Facsimile of the First Edition*. Harvard University Press: Cambridge, MA.
- Davis, P. W., D. H. Kenyon and C. B. Thaxton. 1989. *Of Pandas and People: The central question of biological origins*. Houghton Publishing Company: Dallas, Texas.
- Dean, C. 1995a. State texts may carry creation statement. *The Birmingham News*, Oct. 27, p. 1.
- Dean, C. 1995b. Biology books get disclaimer about evolution. *The Birmingham News*, Nov. 10, p. 1.
- Eagle Forum of Alabama. nd. 1995 Science Textbooks Conflict with State School Board Policy. Statement included in distributed packet; see Kendall, 1995a.
- Edwin W. Edwards, etc., et al. v. Don Aguillard et al.*, 107S.Ct. 2573 (1987).
- Edwards, F. 1983. Why Creationism Should Not Be Taught as Science: The Legal Issues, in Zetterberg, J. P. (editor), *Evolution versus Creationism: The Public Education Controversy*. Oryx Press: Phoenix, Arizona.
- Frandsen, J. C. and S. Brande. 1997. An analysis of the 1995 Alabama draft and adopted Course of Study:Science. *Journal of the Alabama Academy of Science*, 68:38-58.

Science Textbook Adoptions

- Harris, K. 1982. Fight shaping up over the way state textbooks are chosen. *The Birmingham News*, Jan. 21.
- Johnson, P. E. 1993. *Darwin on Trial*. Regnery Gateway: Washington, DC
- Kendall, J. 1989. We don't need textbooks that teach theory as fact. *The Birmingham News*, Sept. 28.
- Kendall, J. 1995a. Letter on Eagle Forum of Alabama stationary and packet sent to education reporters, October 6.
- Kendall, J. 1995b. Eagle Forum textbook insert is one that addresses problem. *The Birmingham News*, Nov. 4, p.11A.
- Larson, Erik. 1994. Darwinian Struggle: Instead of Evolution, A Textbook Proposes 'Intelligent Design'. *The Wall Street Journal*, Nov. 14, p. 1.
- Le Clercq, F. S. 1978[1974]. The Constitution and Creationism, in *A compendium of information on the theory of evolution and the evolution-creationism controversy*. The National Association of Biology Teachers: Reston, Virginia, pp. 1-11.
- Lindley, T. 1990a. Politics upstage science in state textbook hearing - publisher withdraws controversial offering. *The Birmingham News*, Jan. 9, p. 1.
- Lindley, T. 1990b. Member of textbook panel quits over selection process. *The Birmingham News*, Jan. 12, p. 1.
- Milani, J. P. (revision coordinator) et al. 1992. *Biological Science: An Ecological Approach*. Seventh Edition. Kendall/Hunt Publishing Co.: Dubuque, Iowa.
- Paley, W. 1831. The works of William Paley... Containing his life, Moral and political philosophy, Evidences of Christianity, Natural theology, Tracts, Horae Paulinae, Clergyman's companion, and sermons, printed verbatim from the original editions. J. J. Woodward: Philadelphia. 604p.
- Teague, W. 1995b. Alabama Course of Study: Science. Alabama State Department of Education: Montgomery, Alabama, Bulletin 1995, No. 4.
- Thomas, J. A. 1990. The Foundation for Thought and Ethics. *NCSE Reports* 10(4):18-19. The National Center for Science Education: Berkeley, California.

Table 1: Eagle Forum of Alabama objections and comments to science literature and textbook content (Eagle Forum of Alabama, nd., see also Kendall, 1995a)

Objection category	Cited example in textbook or literature	Example comments
<p>“A. Naturalistic theories of origins taught as fact” (p. 1).</p>	<p>“You are an animal, and share a common heritage with earthworms... (Biology, <u>Visualizing Life</u>, Johnson, Holt Rinehart Winston, 1994, p. 203)” (p. 1).</p>	<p>1) Statement is “scientifically repugnant” because “the concept is presented... as unquestioned scientific fact” and “underlying beliefs are not identified” (p. 1).</p> <p>2) Authors “believe in the underlying untestable, philosophical, ‘religious’ view of nature that there is no explanation for the origin of all life forms, including man, other than that of a purposeless, random, and materialistic process” (p. 1).</p> <p>3) “Ideas have consequences. Is it any wonder that, after many years of communicating to children that they are mere animals, we now find so many behaving like animals?” (p. 2).</p>
<p>“B. The meaning of ‘theory’ redefined” (p. 2)</p>	<p>“...nearly all biologists now see evolution as an extensively documented feature of life, much as historians who did not personally witness the U.S. Civil War are convinced, based on accumulation of evidence, that the war really happened. (Biology, Campbell, Benjamin/Cummings, 1993, p. 12)”.</p>	<p>“The descent of all life from a common ancestor(s) is treated as historical fact, like the Civil War... The critical difference is that no written documents exist for evolutionary descent” (p. 2).</p>
<p>“C. Problems with evolutionary theory not mentioned” (p. 2)</p>	<p>“Our results provide no support for the theories proposing that new species are very likely to appear as by-products of founder events. (Founder-effect Speciation Theory: Failure of Experimental Corroboration, Proc Natl. Acad. Sci. USA, Vol 92, pp. 3983-3986, April 1995)” (p. 3).</p>	<p>1) “No mention is made of <u>any</u> problems with current theories of origins... If there are no problems left unsolved by a theory, it should be called a law” (p. 2).</p> <p>2) “This effect [the founder effect] is vital to the punctuated equilibrium theory” (p. 3).</p>

Brande

Appendix 1: Proposed statement endorsed by Eagle Forum of Alabama, for insertion into biology texts upon adoption by the state Board of Education.

In this textbook you will encounter the interesting and controversial theory of evolution. Your textbook presents what many scientists believe to be a scientific explanation of how living things, such as plants, animals, and humans came about. As you study this material please keep the following in mind.

No one was present when living things first appeared on the earth. Therefore, any statement about how they appeared is a statement of theory, not a statement of fact.

Be sure you know the exact meaning of words used when discussing evolution. The word "evolution" itself is often used to mean "change" of any sort, such as: "Our ideas about life are constantly evolving." "Evolution" also describes the changes which take place within a species. For example, a population of white moths can "evolve" into a population of gray moths. This process is called "microevolution." It is a process that can be observed, and can be described as fact. Finally, "evolution" is used for the change of one type of living thing into another, such as reptiles into birds. Called "macroevolution" this type of evolution has never been directly observed; it should be considered as theory, not fact. Whenever your textbook mentions "evolution" you need to ask yourself which type of evolution is being discussed.

Science Textbook Adoptions

Appendix 2: Proposed statement endorsed by the Alabama Academy of Sciences Committee on Science & Public Policy, for insertion into biology texts upon adoption by the state Board of Education.

In this textbook you may encounter evolutionary biology. Your textbook may present scientific explanations of two different issues: 1) the origin of life on earth, and 2) life's subsequent evolution. While it is difficult at present to provide conclusive arguments about how life originated on earth, scientists are more knowledgeable about the processes and mechanisms of life's subsequent evolution. Please recognize that advances in evolutionary biology as in all science depend upon open inquiry, the free exchange of ideas and lively discussion of controversial issues. And remember that all scientific explanations are subject to revision.

We hope that you will study hard, keep your mind open, and perhaps someday you may contribute to the scientific research that helps us all to better understand and enjoy the world in which we live.

Appendix 3: Proposed statement endorsed by, state superintendent of education Ed Richardson, for insertion into biology texts upon adoption by the state Board of Education.

Message from the state Board of Education

We hope that will find this science textbook informative and challenging. There will be many scientific theories introduced which should be thoughtfully considered. Among these is the theory of evolution which is a scientific explanation of how our world, including plants and animals, has changed over a long period of time. No person was present when the Earth and its living organisms first appeared; therefore, no absolute facts are available and many explanations are offered for your consideration.

There are many unanswered questions about the origin of life. We also hope that you take advantage of the many resources available such as your teachers, parents, technology and the library. We encourage you to study hard, keep an open mind, carefully consider all theories and work to formulate a solid base of knowledge which will serve you well in the future.

Have a great school year.

Science Textbook Adoptions

Appendix 4: Proposed statement endorsed by Stephanie Bell, member of the state Board of Education, for insertion into biology texts upon adoption by the state Board of Education.

A MESSAGE FROM THE ALABAMA BOARD OF EDUCATION

This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things, such as plants, animals, and humans.

No one was present when life first appeared on the earth. Therefore, any statement about life's origins should be considered as theory, not fact.

The word evolution may refer to many types of change. Evolution describes changes that occur within a species. (White moths, for example, can evolve into gray moths.) This process is microevolution, which can be observed and described as fact. The change of one living thing to another --- such as reptiles into birds --- is called macroevolution, which has never been observed and should be considered a theory. Evolution also refers to the unproven belief that random, undirected forces produced a world of living things.

In science, we must observe and experiment to understand facts. There are many unanswered questions about the origin of life which are not mentioned in your textbook, including:

Why did the major groups of animal suddenly appear in the fossil record (known as the Cambrian Explosion)?

Why have no new major groups of living things appeared in the fossil record for a long time?

Why do major groups of plants and animals have no transitional forms in the fossil record?

How did you and all living things come to possess such a complete and complex set of instructions for building a living body?

Study hard and keep an open mind. Someday, you may contribute to the theories of how living things appeared on earth.

Appendix 5: Proposed statement endorsed by David Byers, member of the state Board of Education, for insertion into biology texts upon adoption by the state Board of Education.

Dear Student,

In this textbook you will encounter the interesting and controversial theory of evolution. Your textbook presents what many scientists believe to be a scientific explanation of how living things, such as plants, animals, and humans came about. As you study this material please keep the following in mind.

No one was present when living things first appeared on the earth. Therefore, any statement about how they appeared is a statement of theory, not a statement of fact.

Be sure you know the exact meaning of words used when discussing evolution. The word evolution itself is often used to mean change of any sort, such as: Our ideas about life are constantly evolving. Evolution also describes the changes which take place within a species. For example, a population of white moths can evolve into a population of gray moths. This process is called microevolution. It is a process that can be observed, and can be described as fact. Finally, evolution is used for the change of one type of living thing into another, such as reptiles into birds. Called macroevolution this type of evolution has never been directly observed; it should be considered as theory, not fact. Evolution also refers to the unproven belief that only random and undirected forces have produced the complex world of living things. Whenever your textbook mentions evolution you need to ask yourself which type of evolution is being discussed.

Good science students should always ask questions. But remember, in science our answers must be based, not on the opinions of others, but upon facts produced by observations and experiments. There are many unanswered questions about the origin of living things which are not discussed in your textbook such as:

- Why did the major groups of animal suddenly appear in the fossil record (known as the Cambrian Explosion)?
- Why have no new major groups of living things appeared in the fossil record for a long time?
- Why do major groups of plants and animals have no transitional forms in the fossil record?
- How did you and all living things come to possess such a complete and complex set of instructions for building a living body?

We hope you will study hard, keep your mind open, and someday even contribute to the theories of how we and living things appeared on this earth.

Alabama State Board of Education

Appendix 6: Statement approved by the state Board of Education for insertion into biology texts.

This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things, such as plants, animals, and humans.

No one was present when life first appeared on the earth. Therefore, any statement about life's origins should be considered as theory, not fact.

The word "evolution" may refer to many types of change. Evolution describes changes that occur within a species. (White moths, for example, can evolve into gray moths.) This process is microevolution, which can be observed and described as fact. Evolution may also refer to the change of one living thing to another, such as reptiles into birds. This process, called macroevolution, has never been observed and should be considered a theory. Evolution may also refer to the unproven belief that random, undirected forces produced a world of living things.

There are many unanswered questions about the origin of life which are not mentioned in your textbook, including:

- Why did the major groups of animal suddenly appear in the fossil record (known as the "Cambrian Explosion")?
- Why have no new major groups of living things appeared in the fossil record for a long time?
- Why do major groups of plants and animals have no transitional forms in the fossil record?
- How did you and all living things come to possess such a complete and complex set of "Instructions" for building a living body?

Study hard and keep an open mind. Someday, you may contribute to the theories of how living things appeared on earth.

JUST WHERE DO I FIT IN THE UNIVERSE?*

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Introduction

One of the continuing readings for this quarter is C. P. Snow's *The Two Cultures* (1952). It seems to me that these two cultures, the Arts and Humanities on one hand and the Sciences on the other, reflect the fundamental ways our species has viewed ourselves and the world—through emotion and reason. I am firmly convinced that the successful integration of the two is what has made us what we are, a remarkably dominant species in the relatively short time we have existed on this planet. I am equally convinced that there are biological and evolutionary reasons for us to view ourselves and the world this way and that when these bases for our views are understood, that we will have a framework on which to make informed, practical decisions on what we should do with our lives and how we should shape our futures.

I hope each of you has found the information presented in the Human Odyssey Series of courses rewarding. After all, surely no subject is more interesting to us than ourselves. I also hope that ideas and concepts presented in this course will serve as part of the framework for your decision making in the future. At the very least I hope these ideas will have stimulated you to ask questions rather than merely accept answers on their face value. Let me, then, summarize this framework, and assess where we have been, where we are, and where we might be going.

Myth

With Plato's *Allegory of the Cave* (c. 375 B.C.) as our first frame of reference, we began with myth as a way of knowing. Myth was presented as an emotionally gratifying metaphor, and we read a number of creation myths, including the one from Genesis and several from the Navaho tradition. In Bill Moyer's *The Message of the Myth* (1988), we saw and heard Joseph Campbell tell a myth of Hindu origin. These myths from widely different

*Human Odyssey, Final LECTure, Spring, 1996

cultures endeavored to explain where we came from, who we are, and why we are here. On reading or hearing these myths, a question which came to my mind was why we, as human beings, felt, and continue to feel the need to ask such questions. Why do we need to search for such answers?

Brain Function and Evolution

As though in response to my questions, what followed was Sagan's chapter from the *Dragon's of Eden* (1977) which discussed the evolution of the brain, and presented MacLean's triune brain model. This includes the Reptilian complex, the Limbic system and the Neocortex. A likely answer to my questions, then, was that the emotional needs which the myths were trying to satisfy were created by the limbic system in our brains.

Next, we turned to the best known scientific explanation for answers to the same questions that the myths themselves tried to answer. We studied the evolution of our species from about five million years ago to a period of about 10,000 years ago. Of particular interest to me were the articles on *Carrying and Sharing* (Lancaster, 1978) and the development of the larynx (Laitman, 1984). That a major component of our cooperative nature is likely to be genetic and highly evolved is an important concept as we shall see. What was also most interesting to me was the process of scientific discovery at work. For instance, *Homo erectus* is now considered to have appeared in Asia a full one million years earlier than had been previously thought, and Neanderthal appears to have co-existed with *Homo sapiens*.

The fact that information in this field changes so rapidly and has significantly changed in the three years I have taught this course aptly demonstrates the flexibility and power of this scientific way of knowing.

Cave Art

Also of particular interest to me were articles dealing with the creative explosion in the activities of our species that apparently began about 30,000 years ago and which is reflected in cave art. What possessed our species to draw such dramatic figures in the caves in southern France and northern Spain? Did something new happen in the evolution of our brain? Was this creative "playful" impulse lurking in the limbic system? After all, play in mammalian young is an important part of the maturation process. What caused it to be unleashed in this new form of adult expression? Had it been present for a much longer period of time and evidence of it was simply not preserved?

To me, the *Allegory of the Cave* provides an interesting juxtaposition to the cave at Lascaux. In Plato, to grow, one must leave the cave. At Lascaux, did one grow by entering? Were these paintings in some way the beginnings of written language? Most likely, they were part of a religious ceremony. Were the animals being worshipped? Since the animals were central to survival, that would hardly be a surprise.

Universe

Agriculture and War

Next, we discussed the settling down of our species, the gradual move from hunter/gathers to domesticators and gardeners. I think it is significant that without the cereal grains suitable for cultivation and animals which could be domesticated, our species is unable to develop any significant new technology, and we remain hunter/gathers. With settling down, comes specialization and war. Remember the excerpt from Plato's *Republic*, (c. 375 B.C.) how a simple life was unlikely to satisfy most people and so more and more territory was required, along with professional soldiers to defend it? Is territoriality a basic part of our nature? Is it only expressed when we have something to protect? It was also interesting to me that the earliest of the settled down societies worshipped women goddess for production and fertility and that it was only with war that male gods seem to appear. In these earliest agrarian societies, fertility and successful growing of crops is essential to survival. Hence women in the form of Goddesses are worshipped.

The Greeks

That brought us to certain of the Greeks, and to that particular moment in the history of human thought when a new view, a new way of thinking emerges. From the mythopoeic, the sensory/imaginative emotive creation of myths and the viewing of the inanimate as a "thou" (which certainly continued in most of Greek society), we find as Bergamini put it a "fresh spirit of skepticism and reason" (1963). This spirit is applied to mathematics through the mental processes of abstraction and proof. Most importantly, one proof could be built upon another so there was a continual building of a large block of useful mathematical information. These concepts were applied to the concrete, physical world as well. From Thales, to Pythagorus, to Eudoxus and to Euclid, we found this mathematical tradition built upon and passed on to each new generation. Euclid's *Elements* still exists today and provides the basis for the geometry you and I were taught in high school. By about 200 B.C. , Eratosthenes had applied these principles to making a close estimate of the earth's circumference. He also suggested that the earth moves around the sun. The idea of being able to understand an ordering of nature through numbers was so compelling that the Pythagoreans made a religion of whole numbers.

We spent considerable time on the philosophers Plato and Aristotle, who stand as giants in their influence on Western thought. The Platonic concepts of the ideal forms and the form of the good exercised a profound influence on the Christian church and this abstract, detached view of the material world held sway for a thousand years in Western Europe until Aristotelian concepts of empiricism actually helped to begin the Scholastic Awakening.

Moslem *taqlid* and *itjihad*

This Greek tradition of logical, reasoned thinking, of skepticism and reason applied to mathematics and the natural world, then, is suppressed by the Christian church. But we found that the Alexandrian library had been copied over a period of several hundred years and stored in the desert near what is now Baghdad. So this Greek tradition and much of the information gained by it was kept alive in the Moslem world, where it was not only preserved but added to by significant Moslem thinkers. In his article *Can Science Come Back to Islam?*, Sardar (1980) pointed out that in the Moslem world the discovery of the lesser pulmonary system and complicated eye surgery took place 600 years earlier than in Europe and that spherical trigonometry was invented in the late 10th century. While the Greek tradition reemerges in the West, beginning with the crusades and the Scholastic Awakening, and culminates in the Renaissance and a bit later with Galileo, what was happening in the Moslem countries? Why did it not continue there? We discovered the terms *itjihad*, the striving to know and to learn, as an act of worship, and *taqlid*, or passive acceptance. By the end of the 14th century the Asharites had gained ascendance over the Mutazilites in the Islamic world and the attitude of *taqlid* effectively silenced Muslim scientists and thinkers.

The New Spirit in Architecture and Art

The reemergence in the West of this spirit of skepticism and reason is reflected by the changes which occurred in architecture and art. We learned how the cathedrals were based on the Roman basilicas and we noted how in a relatively short period of time in the late middle ages, the art that had been merely symbolic became concrete and real. For instance the leaves decorating a column which were simply generic might, on a column carved 75 years later, be identified as belonging to a specific species of tree. This represented the new view which according to Lynn White, Jr., (1947) was a result of a number of factors, including a larger European population whose relatively prosperous merchant class was interested in technology, practical tangible goods, and making money. Remember Adelard of Bath saying: "I am not the sort of fellow who can be fed with the picture of a beefsteak!?" It is amazing how financial motivation can change one's view, even that of an entire church hierarchy.

The Age of Discovery, Printing, The Renaissance

We sailed through the age of discovery, perspective in architecture and art, the old Ptolemaic grid lines helping to change old the Ptolemaic view of the universe, the invention of printing, and the splintering of the Catholic church by the Reformation, each of which leaves us a legacy to this day. The new perspective is really a new view of the world which Bronowski (1978) symbolized with the change from Black magic to White magic, the concept of working with nature instead of against it. What a remarkable period, a flowering of

Universe

humanity this Renaissance is. What a tremendously exciting and dangerous time to be alive. The Copernican view of the universe (remember Eratosthenes) challenges the status quo, and Galileo, one of first true scientists, confronts the Catholic Church with the Copernican view, and with predictable results.

Brahe, Kepler, Newton, The Framers

But by then the genie was out of the bottle—the spirit of skepticism and reason was alive, and using Brahe's data Kepler derived the laws of planetary motion. Newton then gave us a basis for a mechanistic understanding of the universe. These developments, coupled with the philosophies of Hobbes, Locke and Rousseau inspired the framers of our constitution to create a "social contract" which they felt would take into account the vagaries of human emotion and provide a mechanistic framework of government. Theirs' is a remarkable achievement, the longest lasting continuous form of government in recorded history, one that peaceably transfers the reins of power to elected officials on a regular basis. It was truly the age of the Enlightenment.

Industrial Revolution, The Dissenters, Medicine

Back in England, major changes were underway as well. Precipitated by 30 years of good weather and subsequent good harvests, the population had grown and a group known as the dissenters carved a niche for themselves in business and industry. Excluded from the prevailing social order in England because of their religious views, they created their own educational system, created the new roads and canals, brought steam power out of the hills down to the factories in the lowlands and generally provided the impetus for the industrial revolution. We read a bit of Goldsmith's poem *The Deserted Village*, lamenting the results of the Enclosure Acts which moved the yeoman farmers to this country or into the cities to become laborers in the new factories. Of course, this revolution (remember the title of Copernicus' book?) required a healthy work force and we discussed a few of the significant developments which occurred when rational thinking and the scientific method were applied to medicine and disease. These including the development of anesthesia, Snow's statistical work in finding the *Mode of Communication of Cholera*, Lind dealing with Scurvy, Walter Reed's work on Yellow Fever, and Oliver Wendell Holmes on Puerperal Fever. We also read about the shameful medical treatment of women in general and, in particular, during childbirth. Who could forget the Chamberlens, who chose to let thousands of women die in childbirth while they profited from their exclusive use of forceps?

Another outgrowth of the period was the treatment of agriculture as an industry and we read about the subsequent consequences thereof. Our own genetics were changing as well. Because of the new transportation systems people were marrying outside of their own little communities, and the overall population grew in stature and possibly ability with this heterosus, this new mixing of the gene pool.

Greenleaf

Darwin

This brought us to Darwin and a new revolution. Without question, one of the major turning points in human history occurred with the publication of Darwin's *Origin of Species*. Our view of our place in the cosmos was challenged and changed forever (notwithstanding continuing attacks on the concept of evolution by process of natural selection by those fearful of new ideas). This opened up an entirely new approach to the biological sciences. The evidence since the *Origin of Species* has continued to clearly support Darwin and refine his concepts—Mendelian genetics, the fossil record, studies of other species, and, in particular, the discovery of DNA. We discussed the misapplication of Darwin's concepts to society in the form of Social Darwinism and the disastrous results of this attempt to support racist, political and/or social agendas with pseudo reason. Our emotions are ever involved in our actions are they not?

Chemistry & Physics, DNA

The increase in new and powerful information produced by the scientific way of knowing has continued unabated through the last part of the 19th century and into our own. We learned of Mendeleev and his brilliant approach to ordering the elements. Just after the turn of the century, Einstein turned the world upside down with Special and then General Relativity, whose implications not only changed our view of the world again but led to us confronting our own annihilation through the bomb. Planck, Bohr, Heisenberg and Hubble have given us a much better though curiously limited understanding of the very small and the very large aspects of our cosmos. The concepts from chemistry coupled with the DNA molecule point to the biochemical origins of life which might well be an inevitable occurrence throughout the universe following the coalescing of stardust some billions of years after the big bang.

In preparation for last week's lecture, we read a bit about ourselves as a social species and our social evolution. We also read about the mind, intelligence, and the differences between the brains of men and women.

Where do we go from here?

So what sense is there in this remarkable set of human efforts and achievements? Where is the continuity, the meaning in our existence? Where do we go from here?

If you think back on what I just summarized you might notice that I didn't bring up many of the dilemmas which we have faced or created for ourselves as a species. Being an opera composer, a semi-detached observer of the ever changing human drama that is continuously playing about me, I tend to want to know the motivation of the various characters. What drove Galileo to pursue science and eventually challenge the church? Why did the pope at the time feel threatened enough by Galileo's *Dialogue concerning the Two*

Chief World Systems to have Galileo arrested? Why did Galileo provoke the Pope by calling him Simplicio in his book? What was the motivation of Kepler to not gloss over the discrepancy of eight minutes of arc in the position of Mars? Why might anyone want to misuse DNA to create a super race? Why are some people afraid of Darwin's ideas? Why would Calvin, who had been persecuted himself, have Michael Servetus burned at the stake over simple biblical interpretation? Why do we face off with the Russians and threaten to kill each other with nuclear weapons? Why did the Pythagoreans execute a follower who pointed out that the ratio of the circumference of a circle to its radius is not a whole number? And the questions go on and on.

This brings us back to the two cultures and to emotion and reason. I believe that the answers to these questions and to the others I have asked lie, literally, within ourselves, in the internal structure and workings of our brains. To give you one example of why I think this to be true I would like to relate to you part of the a case history from the book *The Man Who Mistook His Wife for a Hat* by neurologist Oliver Sacks (1985).

In this particular case, Dr. Sacks describes Dr. P., a professional singer and music professor at a New York University who has come to Dr. Sacks because of apparent trouble with the visual part of his brain. His condition, of which he is actually pretty much unaware, has been gradually worsening for about three years. At first to Dr. Sacks, Dr. P. appears to be perfectly healthy but he realizes that something is seriously wrong when Dr. P. fails to be able to tell the difference between his foot and his shoe. After additional tests at the office Dr. Sacks decides he needs to see Dr. P. at Dr. P's home where the familiar surroundings might show a difference in Dr. P's condition. Dr. Sacks, who is also a pianist, brings with him the *Dichterliebe*, a song cycle by Robert Schumann, and persuades Dr. P. to sing while he accompanies him on the old Bosendorfer piano in Dr. P's apartment. I quote:

On that wonderful old piano even my playing sounded right, and Dr. P. was an aged but infinitely mellow Fischer-Dieskau, combining a perfect ear and voice with the most incisive musical intelligence. It was clear that the Music School was not keeping him on out of charity. Dr. P's temporal lobes were obviously intact: he had a wonderful musical cortex. What, I wondered, was going on in his parietal and occipital lobes, especially in those areas where visual processing occurred? I carry the Platonic solids in my neurological kit and decided to start with these. "What is this?" I asked, drawing out the first one.

"A cube, of course."

"Now this?" I asked, brandishing another. He asked if he might examine it, which he did swiftly and systematically.

"A dodecahedron, of course. And don't bother with the others — I'll get the icosahedron, too."

Abstract shapes clearly presented no problems. What about faces?

Dr. Sacks showed Dr. P. the faces on playing cards all of which were correctly identified. Dr. P. also did well with cartoon characters. However, on viewing a television program, an old love scene from a Bette Davis movie, his comments were, to quote Dr. Sacks, "positively Martian." He also had no recognition of the people in the various photographs that were displayed on the walls of his apartment. Dr. Sacks continues:

What had been funny, or farcical, in relation to the movie was tragic in relation to real life. By and large, he recognized nobody: neither his family, nor his colleagues, nor his pupils, not himself. . . .

Then Dr. Sacks tries another test and again I quote:

I had stopped at a florist on my way to his apartment and bought myself an extravagant red rose for my buttonhole. Now I removed this and handed it to him. He took it like a botanist or morphologist given a specimen, not like a person given a flower.

"About six inches in length," he commented. "A convoluted red form with a linear green attachment."

"Yes," I said encouragingly, "and what do you think it is, Dr. P.?"

"Not easy to say." He seemed perplexed. "It lacks the simple symmetry of the Platonic solids, although it may have a higher symmetry of its own . . . I think this could be an inflorescence or flower."

"Could be?" I queried.

"Could be," he confirmed.

"Smell it," I suggested, and he again looked somewhat puzzled, as if I had asked him to smell a higher symmetry. But he complied courteously, and took it to his nose. Now, suddenly, he came to life.

"Beautiful!" he exclaimed. "An early rose. What a heavenly smell!" He started to hum "*Die Rose, die Lillie* . . ."

Reality, it seemed, might be conveyed by smell, not by sight. (*Die Rose, die Lillie* is a song from *Dichterliebe*.)

Dr. Sacks comments that Dr. P. "construed the (visual) world as a computer construes it, by means of key features and schematic relationships. The scheme might be identified—in an 'identi-kit' way—without the reality being grasped at all."

Therefore, it seems logical that for us as human beings to assign meaning to the input that enters our neocortex there must also be a connection made in the limbic or emotional center of

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our brain. It is likely then that in addition to an 'identi-kit' of information stored for each and all of the various types of input from our senses in the neo-cortex, there is also an 'identi-kit' of corresponding emotional responses in the limbic system as well. Thus, when we see a loved one we not only recognize her or him as a "generic" person but as a whole set of varied (and for the most part) pleasant and pleasurable emotional responses which gives that particular person deeper meaning to us. And with each experience the 'identi-kits' are subtly refined. (Of course, some experiences might dramatically and radically change the 'identi-kits'.')

But since the brain is able to conjure up its own emotional responses without immediate external input (I assume we all have dreamed) and some of these are undesired, and surely we have all experienced emotional responses of which we were later not very proud, how might we learn to recognize, codify, organize, evaluate and utilize these emotions in a useful, non-destructive way?

I believe that Dr. Edward O. Wilson (1978) points out a number of meaningful ways of doing this in his profound and wonderful book titled *On Human Nature*. He begins with two dilemmas we face as individuals and as a species and then discusses our heredity and development, our emergence (where he discusses free will), aggression, sex, altruism, and religion. The last chapter is titled Hope. Using sociobiology, he discusses those of our emotions which are particularly important in a social context in an effort to clarify how much of each is genetically determined and how much is learned. While it is beyond the scope of this lecture to give this book the detailed discussion it deserves, I would like to give you an example of the kind of insight into our emotional selves that Wilson provides. It comes from his chapter on altruism. Wilson divides altruism into two types. Of the first, he says (and I quote):

The altruistic impulse can be irrational and unilaterally directed at others; the bestower expresses no desire for equal return and performs no unconscious actions leading to the same end. I have called this form of behavior "hard-core" altruism, a set of responses relatively unaffected by social reward or punishment beyond childhood. Where such behavior exists, it is likely to have evolved through kin selection or natural selection operating on entire, competing family or tribal units. [I break the quote for a moment to point out that this refers to the several million years of natural selection of emotional responses that enhanced survival of our species while we were hunter/gatherers.] We would expect hardcore altruism to serve the altruist's closest relatives and to decline steeply in frequency and intensity as relationship becomes more distant. 'Soft core' altruism, in contrast, is ultimately selfish. The 'altruist' expects reciprocation from society for himself or his closest relatives. His good behavior is calculating, often in a wholly conscious way, and his maneuvers are orchestrated by the excruciatingly intricate sanctions and demands of society. The capacity for soft-core altruism can be expected to have evolved primarily by selection of individuals and to be deeply influenced by the vagaries of cultural evolution. Its psychological vehicles are lying, pretense, and deceit, including

self-deceit, because the actor is most convincing who believes that his performance is real.

Wilson believes that human beings are wired with a much larger amount of soft-core altruism than hard-core altruism, and that this is a good thing. Otherwise we would have bloody clan wars, we would never cooperate as a society, and life would consist of constant terrible conflict. He says then:

In summary, soft-core altruism is characterized by strong emotion and protean allegiance. Human beings are consistent in their codes of honor but endlessly fickle with reference to who the codes apply. The genius of human sociality is in fact the ease with which alliances are formed, broken, and reconstituted, always with strong emotional appeals to rules believed to be absolute. The important distinction is today, as it appears to have been since the Ice Age, between the in-group and the out-group, but the precise location of the dividing line is shifted back and forth with ease. Professional sports thrive on the durability of this basic phenomenon. For an hour or so the spectator can resolve his world into an elemental physical struggle between tribal surrogates. The athletes come from everywhere and are sold and traded on an almost yearly basis. The teams themselves are sold from city to city. But it does not matter; the fan identifies with an aggressive in-group, admires teamwork, bravery, and sacrifice, and shares the exultation of victory. . . .

It is exquisitely human to make spiritual commitments that are absolute to the very moment they are broken. People invest great energies in arranging their alliances while keeping other, equally cathetic options available. So long as the altruistic impulse is so powerful, it is fortunate that it is also mostly soft. . . there is [in us] a flawed capacity for a social contract, mammalian in its limitations, combined with a perpetually renewing, optimistic cynicism with which rational people can accomplish a great deal.

Surely, each of us recognizes the ring of truth in Wilson's observations as they apply to our own experience. Each chapter of the book contains equally revealing insights into our emotional selves but I must leave them to your own discovery.

However, I would like to discuss the two dilemmas which frame the beginning and end of Wilson's book. The first is, "If humankind evolved by Darwinian natural selection, genetic chance and environmental necessity, not God, made the species. Deity can still be sought in the origin of the ultimate units of matter, in quarks, and electron shells but not in the origin of species. The species lacks any goal external to its own biological nature."

The second dilemma is how to make, "the conscious choices that must be made among our innate mental propensities."

Essentially, then, what is the moral basis for our decision making if there is no external purpose to our existence? Or, to put it another way, let us assume that we learn enough useful

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information about the biological basis for our emotional makeup, so we can guide our emotions ourselves or at least channel them in one way or another. Where does this leave us? We still have to make the decision as to what is meaningful and that involves the very emotion or emotions that we are manipulating.

Traditionally, we have turned to religion for this moral purpose and decision making process. But, I ask you to recall the fact that as a species, our worship of whatever deity—animals, goddesses, gods, God, Brahma, or Mohammed has changed conveniently, depending on what was required for our survival in a given situation. Can we depend on a religious impulse that condemned a Galileo and obdurately refuses to recognize the urgency of birth control if our species is to survive on this planet? When Dr. Wilson was here several months ago, he mentioned that a center for religious mental activity has been discovered in the temporal lobes in the brain and that lesions in this brain area can lead to a condition called hyper-religiosity. This is connected to a kind of temporal lobe epilepsy as well. So it is likely that our religious nature is innate and has proved to be a useful part of our evolution. But can we distill from the religious impulse the various emotional responses which are profoundly important to our survival as a species and discard or re-channel those, which while valuable 10,000 years ago, might well prove disastrous in our day and age? I certainly hope we can. It seems to me that the admonition *Do Unto Others as You Would Have Them Do Unto You*, has a powerful biological basis in the cooperative nature of our species and is one impulse, though not regularly practiced, that should be encouraged. In his chapter titled *Hope*, Wilson suggests that the framework for such decisions must be one that includes the entire history and gene pool of our species and that will give us a sense of the "nobility" of ourselves, rather than give in to those imperatives of selfishness and tribalism which stem from blind natural selection. I am not quite sure how this should be done, but I believe that to solve the problems before us we must try to achieve it even now. I suggest that one extremely useful way of doing so is through the arts—music, creative writing, visual arts, theatre, and dance—using them as a positive channel for our very strong proclivities to think in a mythopoeic fashion and as a channel for the very powerful emotional responses which are connected to that way of thinking. I think that this makes biological sense because the center for music, and the centers verbal nuance and language all of which overlap broadly, apparently reside in the temporal lobes along with religion. Thus, our emotional quest for transcendence might well be met in a purely symbolic way, without the concrete appendages and literalness which have created so many problems for us in the past.

I would like to briefly return to Dr. P. and Dr. Sacks to demonstrate one remarkable example of how useful music can be. Dr. Sacks states that after his examination of Dr. P., Mrs. P. had laid out a table full of cakes and poured fresh coffee. Dr. P. immediately began humming to himself while he placed cakes on his plate and ate. Dr. Sacks called it "an edible song of food." A sudden knock at the door, however, interrupted this song and Dr. P. sat frozen until his wife wafted a cup of coffee under his nose, at which point "the melody of eating resumed." When alone with Mrs. P., Dr. Sacks asked how Dr. P. managed the mundane acts of daily living. She replied, "It's just like the eating. . . I put his usual clothes out, in all the usual places, and he dresses without difficulty, singing to himself. He does everything singing to

himself. But if he is interrupted and loses the thread, he comes to a complete stop, doesn't know his clothes -- or his own body. He sings all the time—eating songs, dressing songs, bathing songs everything. He can't do anything unless he makes it a song."

I find this a truly remarkable compensatory mechanism of the brain. Perhaps it is a kind of reflection of the DNA molecule's many mechanisms to correct errors in replication so that if one doesn't work, another is likely to. I think it also points out our own fragility, how some seemingly small change in our brain wiring or function can be devastating and remove from us an entire dimension of our humanity. Yet there is a certain charm and nobility in the singing of one's way through life.

And this brings me back to Wilson's concept of nobility. I think that the following musical excerpt is an excellent example of the nobility of the human spirit. It was written by the composer Ludwig von Beethoven, who, by the time the piece was written had gone completely deaf. I find it a certain irony that many of you will recognize the main melody as one which is used as a hymn by a number of Protestant churches. The German text is Schiller's *Ode to Joy* and the piece is intended in the spirit of the Enlightenment to celebrate the brotherhood of mankind. I ask you to listen to the music in that spirit, one that celebrates our ability to cooperate with one another, to value one another and to respect one another. (The reader should listen to the first five to seven minutes of the fourth movement of Beethoven's 9th Symphony.)

Like Dr. P., Beethoven has overcome a devastating condition in a remarkable fashion. I hope you will carry the spirit of this piece with you along with the ideas you have gained from this course. Before I conclude, I would like to add several thoughts on how you might find this course valuable in your future career whatever that may be. First, choose a field of endeavor that you are passionate about. Each of the individuals who has made a contribution to this history of human thought was passionately involved in what he or she did. I have had the pleasure of teaching with a marvelous group of scientists, humanists, and artists as faculty colleagues. Without question, each and everyone of them is passionate about his or her own field of study and about teaching it to his or her students. All are equally passionate about teaching this course. Without this passion there would be no success. Second, as in teaching, it is the emotional, creative spark that when combined with reason makes for significant contributions to a field. Third, don't be afraid to try to tackle the really difficult problems. Remember Einstein's willingness to spend years thinking about a problem. Take a long range point of view. Most of all believe in yourself. It is better to try and fail than to never try at all.

In conclusion, is it really a dilemma if the only reason for our existence is to pass our genes down to future generations? I don't think so. After all, we carry the capacity to be noble to one another and to the other living creatures around us. We have the capacity to express this nobility to each other as we have just heard. Indeed, most importantly, we have each other. As Joseph Campbell said in the *Message of the Myth* — this is eternity. Use it well.

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REFERENCES

- Bergamini, David (1963) "The Shapely Thinking of the Ancient Greeks," *Mathematics*.
- Bronowski, Jacob (1978) "Black Magic and White Magic," *Magic, Science, and Civilization*, Columbia University Press.
- Gingerich, Owen (1982) "The Galileo Affair," *Scientific American*, August, 1982, pp. 132-143.
- Goldsmith, Oliver (1770) *The Deserted Village, a Poem*, Printed for W. Griffin, London, 1770.
- Clendening, Logan (1942) *The Source Book of Medical History*, Dover Publications, NY, 1942, 1960.
- Lancaster, Jane B. (1978) "Carrying and Sharing in Human Evolution," *Human Nature*, February, 1978.
- Laitman, Jeffrey T. (1984) "The Anatomy of Human Speech," *Natural History*, August 1984.
- Moyers, William (1988) "The Message of the Myth," *Joseph Campbell and The Power of Myth*, Mystic Fire Video, Inc. NY.
- Plato (c. 375 B.C.) "The Allegory of the Cave," from *Republic*, Bk. II, 373-374, Jowett trans., The Modern Library, NY.
- Plato (c. 375 B.C.) *Republic*, Bk. VII, 514-521, Jowett trans., The Modern Library, NY.
- Sacks, Oliver (1985) *The Man Who Mistook His Wife for a Hat*, Harper & Row, NY, pp.8-22.
- Sagan, Carl (1977) Chapter 3, *The Dragons of Eden*, Random House, NY.
- Sardar, Ziauddin (1980) "Can Science Come Back to Islam?" *New Scientist*, October 23, 1980.
- Snow, C. P. (1959) *The Two Cultures*, Cambridge University Press, Cambridge, Great Britain.
- White, Lynn Jr. (1947) "Natural Science and Naturalistic Art in the Middle Ages," *American Historical Review*.
- Wilson, Edward O. (1978) *On Human Nature*, Harvard University Press, Cambridge, Massachusetts, pp. 1-13, 155-156, 163-164, 195-209.

OUTSTANDING ALABAMA SCIENTISTS:
PROFILES OF RECIPIENTS OF
THE WRIGHT A. GARDNER AWARD

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In 1984 the Alabama Academy of Science established the Wright A. Gardner Award to honor individuals for noteworthy achievement in science done while in residence in Alabama. Profiles of the first five recipients have been described previously (Buckner, 1989). This report reviews the contributions and ongoing work of those receiving the award since 1988. Individuals nominated for this award have included outstanding researchers, teachers and clinicians. The award has been consistently made, however, to individuals with a significant scientific contribution of their work. Although outstanding educators have been nominated, the Gardner Award Committee, with new members annually and a length of service of only three years, has designated the award be reserved for individuals with outstanding individual science achievement. Thus, in some years no award was made. These scientists have chosen to develop their skills and talents in various sections. Their work has added to the body of knowledge of each discipline.

Scientists receiving the Gardner Award since 1988 are Dr. Max Cooper, Professor of Medicine and Director of the Division of Developmental and Clinical Immunology, University of Alabama at Birmingham (1990), Dr. Dan Urry, Professor of Biochemistry, Physiology and Biophysics and Director of the Laboratory of Molecular Biophysics, University of Alabama at Birmingham (1991), Dr. Gail Cassell, Professor of Microbiology and Director of the Mycoplasma Diagnostic Laboratory, University of Alabama at Birmingham (1992), Dr. Frank M. Rose, Professor of Electrical Engineering and Director of the Space Power Institute, Auburn University (1994) and Dr. Prakash Sharma, Professor of Physics, Tuskegee University (1996).

Max Dale Cooper - 1990

Max Dale Cooper was born in Hazelhurst, Mississippi in 1933. He is married to Rosalie Lazzara Cooper. Dr. Cooper attended Holmes Junior College and the University of Mississippi and received his M.D. degree from Tulane University Medical School in 1957. He is currently an Investigator with the Howard Hughes Medical Institute, University of Alabama at Birmingham and holds the rank of Professor in the Departments of Medicine, Pediatrics and Microbiology. He is director of the Division of Developmental/Clinical Immunology, UAB and serves as a Senior Scientist in the Cystic Fibrosis Research Center, Multipurpose Arthritis Center, and Comprehensive Cancer Center. He has served as a Visiting Scientist at the Institute Pasteur in Paris, France and University College London in England.

Dr. Cooper gained recognition for his work in Alabama on the ontogeny of the immune system and understanding immune deficiency diseases. His contributions have included identification of separate T and B lymphocyte lineages and the subclassification of leukemias. Dr. Cooper's scientific contributions are matched by recognized humanistic and interpersonal skills in working with patients, families, students and colleagues.

Max Cooper has received numerous awards for excellence in science, medicine, and teaching including the Distinguished Faculty Lecturer and the President's Medal, University of Alabama at Birmingham, the Samuel J. Meltzer Founder's Award of The Society of Experimental Biology and Medicine for definition of T and B cell pathways, the 3M Life Sciences Award and Sandoz Prize in Immunology. He has served as the President of both the American Association of Immunologists and the Clinical Immunology Society. He was selected a Life "Member d'Honneur," Societe Francais d'Immunologie and has chaired the Southern Society for Pediatric Research. In 1994 he received the American College of Physicians Award.

Dr. Cooper has served as scientific advisor to numerous national organizations including National Institute of Allergy and Infectious Diseases, St. Jude Hospital in Memphis, the Immune Deficiency Foundation, National Cancer Institute, the Leukemia Society of America, Medical Biology Institute in LaJolla, California, the Cancer Center, University of California, San Diego, Gladstone Institute of Virology and Immunology, University of California San Francisco, Massachusetts Institute of Technology, and Rockefeller University. Internationally, he has served on World Health Organization committees on immunodeficiencies, reproduction and T and B cell recognition, a US-Japanese Panel on Immunology, the Radiation Effects Research Foundation in Hiroshima, Japan and on the International Advisory Board for the Science University of Tokyo. International advisory activities have been conducted also at the Basel Institute for Immunology, Switzerland, the Institute Merieux, Lyon, France and the International Union of Immunology Societies.

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Dr. Cooper's current research and scholarly interests center on developmental immunology, with emphasis on B and T cell differentiation, and clinical immunology, with emphasis on immunodeficiency diseases and lymphoid malignancies. He is an Investigator in the Howard Hughes Medical Institute at the University of Alabama at Birmingham.



Dan W. Urry - 1991

Dan W. Urry was born in Salt Lake City, Utah in 1935 and received both his B.A. in Medical Biology and his Ph.D. in Physical Chemistry from the University of Utah. He is married to the former Kathleen Lake and they are the parents of four children--sons Weston, Douglas (deceased) and David and daughter Kelley Danielle. He is currently Director of Laboratory of Molecular Biophysics, University of Alabama at Birmingham.

Dr. Urry's work has focused on the properties and preparation of bioelastic materials. These materials are under development for medical applications in drug therapy, adhesion prevention, tissue reconstruction, and strabismus surgery among others. He holds numerous patents on bioelastomers, elastin, drug delivery systems, superabsorbant materials, photo responsive polymers and other substances in interaction with biologic systems. Current research is focusing on development of elastomeric polypeptide biomaterials, development of unique fibers using renewable resources environmental-friendly technology, bioelastic materials for prevention of pressure ulcers and elastic and plastic protein-based polymers as advanced materials from renewable resources.

Dr Urry's primary appointment at the University of Alabama at Birmingham is Professor of Biochemistry School of Medicine-wide, which position he has held since 1970. He currently holds faculty positions in departments of Physiology and Biophysics, Chemistry and Physics, is adjunct Professor of Materials Science at the University of Alabama in Huntsville. He is a Senior Scientist in the Comprehensive Cancer Center, UAB, and has served as a member of the Executive Committee of the University of Alabama System Joint Materials Science Program. He has served on editorial boards of Research/Development Magazine, Biochemica Et Biophysica Acta, Journal of Membrane Biology, and Journal of Protein Chemistry.

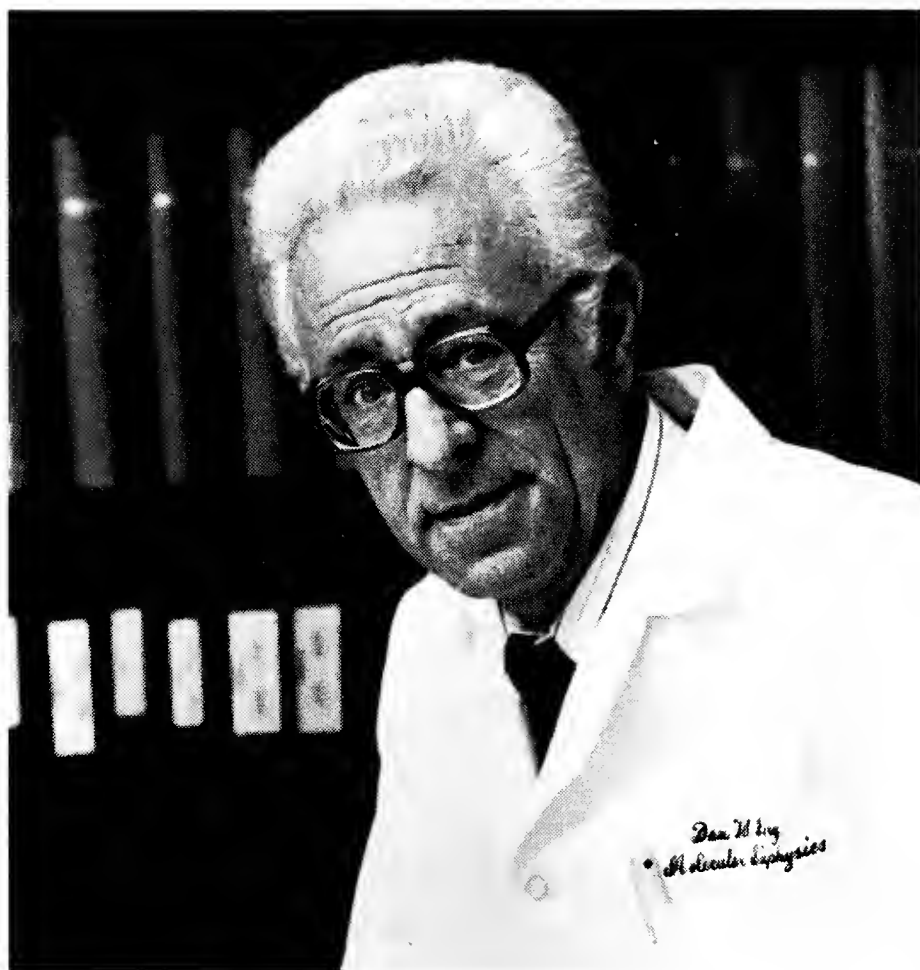
Dr. Urry's international activities have included presentations and visiting professorships in Italy, France, Germany, England, Netherlands, Switzerland, Canada, Japan, China, Poland, Denmark, Czechoslovakia and Kenya and he has served on the international scientific committees of the International Center of Advanced Studies in Molecular Biophysics and Biology. He is a founding Fellow of the American Institute of Medical and Biological Engineering. He has chaired numerous Southern region committees of the American Heart Association.

Dr. Urry has been listed as Who's Who Worldwide (1993), Men of Achievement, International Biographical Center, Cambridge, England (1993), and received the Scientist of the Year Award (1988) from Research and Development Magazine. He is listed on several other national and international rosters of outstanding scientists and is a member of Phi Beta Kappa, Phi Kappa Phi and Phi Eta Sigma. He has received the Sigma Xi Award from the University of the Utah (1963), the UAB Distinguished Faculty Lecturer (1987), and the Alexander Von Humboldt Foundation Preis (1980). Dr. Urry's work has been featured on the covers of numerous national periodicals including Medical World News, Research Development, Chemistry and Biology of Peptides, Spectroscopic Approaches to Bimolecular

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Conformation, Journal of Biomolecular Structure and Dynamics and Angewandte Chemie International Edition (in English and German). He is identified as one of the 1000 most-cited contemporary scientists from 1965-78 and one of the 10 most-cited in the area of Biophysics.

Finally, Dr. Urry's contributions on the UAB campus have also been notable. He has participated in advisory capacities with regard to cardiovascular research and training, diabetes research and training, dental research and institutional self study. He is a faculty preceptor in Ph.D programs in Biophysical Science, Cellular and Molecular Biology, Materials Science, Chemistry, Physics, Surgical Scientist Training, MD/Ph.D Training and Academic Internist Training. Dr Urry's accomplishments in research enliven an active academic role in teaching. His work while in residence in Alabama has distinguished him among scientists.



Dr. Gail Houston Cassell - 1992

Dr. Gail Houston Cassell was born in Alexander City, AL in 1946. Dr. Cassell 's student experiences in science began early and she was a recipient of the Gorgas Scholarship and attended the International Science Fair as a high school junior and senior, winning the first place award in 1963 and the American Medical Association Award in 1964. She attended the University of Alabama where she earned a B.S. in Bacteriology. In 1993 she was selected as one of the 30 most outstanding female graduates of the University of Alabama in the past century. Her graduate work was done at the University of Alabama at Birmingham in Microbiology earning the Ph.D. in 1973. Dr. Cassell is married to Ralph H. Cassell and they have one daughter, Cynthia.

Dr. Cassell is currently Chairman of the Department of Microbiology, University of Alabama at Birmingham, having been appointed to that position in 1987. She holds professorships in three departments; Microbiology, Pediatrics and Comparative Medicine.

Dr. Cassell's work has focused on numerous aspects of microbiology and clinical and comparative medicine. Her most outstanding contributions, however, have been in the study of mycoplasma. Her early studies examined respiratory mycoplasma infection including immunologic and treatment mechanisms. Further work examined the role these and related mycoplasma played in etiology of respiratory and central nervous system illnesses in preterm infants. Recent studies have examined the role of mycoplasma infection in the etiology of arthritis.

Dr. Cassell has received numerous awards and honors including recent election into the National Academy of Science, Institute of Medicine (1995). She is a recipient of the Holley Research Prize in Rheumatology (1995), the Brewer Award for Scientific Achievement in Comparative Medicine (1995), and the Edward Award for outstanding contributions in Mycoplasma Research (1980).

Dr. Cassell has been a Visiting Scientist internationally in France, England and Japan. She has headed numerous international conferences including the 1987 and the 1988-6th and 7th Congresses, International Organization for Mycoplasma, held in Birmingham, Alabama, and Vienna, Austria respectively, and three international symposia held in the U.S. She has served as external advisor on doctoral dissertation committees of students from Belgium, India and Australia and serves on international advisory committees for comparative research and mycoplasma research.

Nationally, Dr. Cassell has applied her experience and skills in research advisory capacities, policy making initiatives and programs for students of varied backgrounds. She is currently a member of the Advisory Committee to Director of NIH, the Advisory Council of the National Institute of Allergy and Infectious Diseases and has served as a member of national work groups on respiratory, infections, pelvic inflammatory disease, biological warfare, vaccine research, mycology, and rheumatic disorders. She is a member of the Advisory Committee to the Director, National Center for Disease Control (CDC) and has served on numerous committees on infectious disease programs within the CDC. She chairs

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the Board of Scientific Counselors of the Center for Infectious Diseases at CDC. She has served on other governmental advisory boards including White House conferences and institutes.

As an educator she is a member of the Association of American Medical Colleges through which she has worked on strategy planning, accreditation, and the Committee for Distinguished Teaching Award. She is a member of the Gorgas Scholarship Foundation Board of Trustees. At UAB she has received the President's Achievement Award (1995), is a Sparkman Center Scholar for international public health, and serves on several advisory committees.

Dr. Cassell is a fellow of the American Society of Microbiology and has served as national President (1993-94). The ASM is the single largest (740,000 members) and oldest life sciences organization in the world. She has also held the position of Chairman of the International Organization for Mycoplasmaology.

Dr. Cassell's extensive work continues. Current funded projects include work in control of respiratory mycoplasmosis, identification and characterization of U. urealyticum antigens, pre-and post-doctoral training programs, short-term training programs for students in health professional schools, studies on the role of mycoplasma and chlamydia in rheumatorial arthritis, and studies of the risk factors for chorioamnion infection among women.



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Millard Franklin Rose - 1994

Millard Franklin Rose was born in Clintwood Virginia in 1938. He and his wife Carolyn are parents of two daughters Laura and Lisa. Rose began his collegiate education at The University of Virginia, earning a certificate in Electrical Engineering and a B.S. in Physics. He went on to develop his work in Solid State Physics completing the Ph.D. in 1966 at Pennsylvania State University.

Dr. Rose is currently the Director of the Space Power Institute, Auburn University and Professor of Electrical Engineering. Responsibilities as director include managing and directing a multi-disciplinary research institute with goals to solve research and development problems in advanced power technology for space and terrestrial applications. Also as part of his role he conducts research into high power electrical and energy conversion systems and is involved in teaching and curriculum development in space and advanced energy conversion technology.

There are a number of achievements which have distinguished his work while in Alabama. Dr. Rose was instrumental in establishing a unique research initiative advocating the use of a "Systems Approach" to solving power related technical issues, many of which were interdisciplinary in nature. He was instrumental in establishing the Auburn Center for Commercial Development (CCD) of space related technologies, recognized as an outstanding program by NASA. Through his leadership licensing arrangements were created with industrial partners. One of the products designed and marketed through this partnership was a capacitor charging power supply.

Second, he has been a key factor in advocating strong cooperative education programs for undergraduate students. Over 70 students received part or all of their educational funding through Institute Contracts from 1985-1997. He is active in space science curriculum development funding visiting scientist visits, summer graduate student research, and a Distinguished Lecturer Series on Space Science Issues. He initiated more than seven national and international workshops in advanced power system technology.

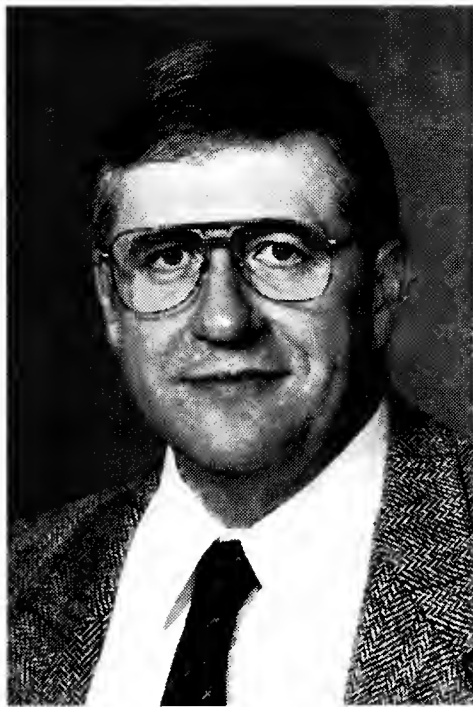
In 1993, because of his commitment to improve the capabilities of Alabama universities to conduct research and educate scientists and engineers he was named State of Alabama Director for the Defense Experimental Program to Stimulate Competitive Research (DEPSCOR).

Dr. Rose is a technical writer, authoring or editing 4 books, over 150 technical papers and other publications. He is a Fellow with the Institute of Electrical and Electronics Engineers (IEEE) and a Senior Member of the American Institute for Aeronautics and Astronautics (AIAA). He holds 16 patents on advanced technologies. Dr. Rose has served as consultant to NASA on shock effects on lunar soils, space system technology and space station science. He has participated on two governmental weapons advisory groups and has been an industrial consultant. He held the highest rank for a research scientist within the Naval Research and Development Community. *He has accompanied congressional groups

as scientific advisor to European and Russian laboratories and been an US Delegate to numerous international institutes hosted by NATO and other countries.

Recent publications have included descriptions of "Novel Techniques for the Management of Space-Based, High Power Microwave Tubes," "A Comparative Analysis of Energy Storage Media and Techniques," "High Temperature Emitters for Thermophotovoltaic Power Systems," "Carbon-Metal Composite Electrodes from Fiber Precursors," "Fabrication of Polycrystalline Diamond Thin Film for Heat Sinking Applications" and "A Parametric Study of Thermophoto-Voltaic Systems and the Importance of Thermal Management in System Design and Optimization." He recently co-authored an AIAA position paper on The "Maintenance of the US Space Nuclear Power Program." Dr. Rose is currently a member of a National Research council panel to assess power technology for army applications.

Dr. Rose has fostered cooperation among universities, government laboratories, and industry in compact power technology, ensuring that young scientists and engineers are taught the basic science of power systems and the techniques needed to design future compact power systems for diverse applications. His strong advocacy of sustained technological growth in the State of Alabama are coupled with his achievements in providing a high quality educational environment.



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Prakash C. Sharma - 1996

Prakash Sharma was born in 1949 in India. He received his M.S. degree in Solid State Physics in 1969 and PH.D. in 1972 from one of the leading international centers of theoretical physics, Banaras University. He received post-doctoral and collaborative training in Switzerland and Sweden. In 1985 he joined the Tuskegee University faculty where he is currently Professor of Physics. He is married to the former Renu Sinha and they have a son, Jyotirmay, and a daughter Swati.

Dr. Sharma's contributions to the field of Solid State Physics are extensive. Since 1985 he has served as principal investigator on one million dollars worth of research grants. He has been consultant to the Space Power Institute, Auburn University, and Universal Energy Systems, Dayton, Ohio. He has developed a new technique to calculate and predict the temperature dependence of lattice conductivity of newly synthesized polymers and composite semi conducting materials. This technique is cited in literature as the Sharma Model.

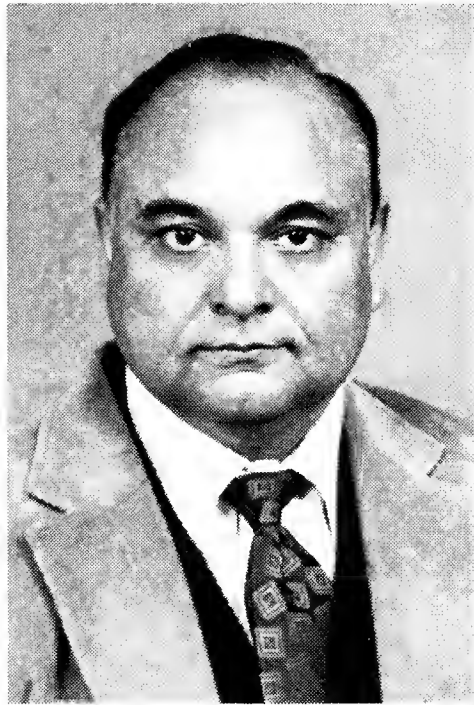
In addition to the Gardner Award, Dr. Sharma has received numerous other recognitions. Tuskegee University has awarded him Outstanding Faculty Performance Award for Research (1993 and 1989) and Faculty Achievement Award (1990). He was the first recipient of The Russell W. Brown Distinguished Scientist Award, Sigma Xi Society, Tuskegee University (1987). He has studied as a NATO Advanced Institute Fellow (1991) and International Consortium of University Researchers working in the area of Space Science and Technology, (1988).

His publications include one text, Perspectives in Physics (1991), and numerous articles including topics of conductivity of Germanium in temperature range of 2-1000K, electron-phonon scattering in low temperature, conductivity of zinc and gallium, temperature dependence and scattering events, lattice thermal conductivity, harmonic and anharmonic field scattering, conductivity studies in nitrates of barium, strontium, lead, mercury, cadmium, metals and organic compounds such as carbon tetrachloride. Recent studies have included investigation into the properties of these substances in space, in conduction uses and at extremes of temperature. He has authored over 60 research publications and technical reports in journals of the USA, Germany, England, France, Holland and India.

Dr. Sharma is a past President of The Alabama Academy of Science (1993-4) and past Chairman of The Physics and Mathematics Section. Students from his research group have won the student award competition repeatedly. He is a distinguished life member of the American Physical Society and the Indian Physics Association Chapter of USA. He has participated in or coordinated workshops on Solid State and Laser Physics (Banaras, 1990) Physics of Aerospace Vehicles (Washington, D. C., 1988) and Physics and Arms Control (Center for International Studies, Harvard, 1987) He is an active speaker and lecturer within and outside Alabama. He is currently a member of the editorial board of the Journal of The Alabama Academy of Science, and a reviewer for the Journal of Solid State Chemistry.

Buckner

Dr. Sharma's work is continuing with current research grants exploring (1) thermal conductivity of non-crystalline materials, (2) electronic materials and semiconductors and (3) lasers, organic solid State chemical conducting compounds and silicon devices. The Academy is pleased to recognize his substantial contributions.



Alabama Scientists

Bibliography

Buckner, E.B. (1989). Outstanding Alabama Scientist: Profiles of five years recipients of the Wright A. Gardner Award. Journal of the Alabama Academy of Science, Vol. 60, No. 2, p.49-55.

Sources for these biographies include curriculum vitae of the recipients, personal communications and prepared citations submitted to the Gardner Award Committee of the AAS.

MY TERM ON THE SCIENCE TEXTBOOK COMMITTEE

Patricia Sigers

New science textbooks will be placed in the hands of children throughout the state of Alabama for the 1996-97 school year. As a member of the science textbook committee, I am proud of the work that was completed by this committee. This committee ensured that several different science textbooks for each subject and grade were recommended to the State Board of Education. The Board then had the opportunity to select the specific textbooks that would be adopted to implement the Alabama's Science Course of Study.

The science textbook committee, as all other state textbook committees, is composed of twenty-three (23) members and is required by law to be composed of educators and lay persons from areas throughout the state.

Fourteen (14) educators are recommended by the State Superintendent of Education and are appointed by the State Board of Education. Nine (9) lay members are appointed by the Governor. I was one of the nine appointed by Governor Fob James.

Once the committee was appointed, we were charged with the responsibility of reviewing science textbooks that correlated with the Alabama Course of Study for students throughout the state. This was a big task and was not taken lightly by any member that served on this committee.

In view of the fact that this committee had to recommend science textbooks for K-12 and the enormous volume of books and kits sent to each committee member by publishers, we decided to divide into three sub-groups to more effectively review all the material. (Books and kits enough to fill a 12' x 12' area were sent to each committee member.) The sub-groups were elementary, middle, and high school grades. Each member selected the sub-group where they wished to work. I decided to work with high school material. In the sub-committees the major areas of concern for recommending materials for adoption were:

1. Did the book correlate with the Alabama Course of Study?
2. Was the material accurate?
3. Did the book represent a diverse population free of racial, religious, ethnic and sexual bias or stereotyping?
4. Did the book reflect the significant historical, cultural, and artistic contributions of all people?

After the committee appointment in June, 1995, we began the review process. In February of 1996 we began meeting from 9:00 AM - 4 PM two days per month. We

normally met collectively in the early morning and split into sub-committees after lunch. The sub-committees collectively reviewed the material provided by the publishers and reported at different intervals to the entire committee. Upon the completion of the review process each member had to vote on the selection of books and materials for grades K-12. The decision of the majority was accepted as to which materials would be presented to the State Board of Education for approval.

It should be noted again at this point that the committee function is to consider textbooks/support materials offered for use in the public elementary, middle, and secondary schools of the state and to make recommendations to the State Board for approval. By law, the actual selection of textbooks for use in a particular school system is the duty of local school boards of education.

I would also like to note that our committee was required to attend a public hearing where written and oral comments were received on the textbooks for review. To enhance this process state textbooks for adoption were displayed in twenty-three (23) libraries located at institutions of higher education and/or junior colleges for public review at the onset of the committee appointment. In consideration of the huge amount of material reviewed and the time, energy, and thoughtfulness required, I cannot over emphasize the hard work and dedication of the members that served on this committee.

At this time, I would like to acknowledge the fact that the Science State Textbook Committee had no input in the message that is posted in all biology textbooks. This message reads: "A Message From The Alabama State Board of Education." It is my opinion that this message on "Evolution" is one without merit. Opinions of organizations should not be a part of our educational process. It is the biology/life science teachers' responsibility to teach the theory of evolution as accepted by the scientific community. It is not the responsibility of the State Department of Education to place any information in a textbook. This message is the only part of the textbook selection process where the *entire committee had no input*.

Finally, I shall conclude with emphasizing that the method used to select State Textbook Committee members is sound in that representation is present throughout the state. However, I believe that the State Board of Education should stay free of opinions being placed in state textbooks from any organization/groups. The textbook selection process allows for consideration of individual and group concerns in the public hearings setting where committee members can hear comments and decide on the merit of what has been presented for the good of *all* the children throughout the state.

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ALABAMA ACADEMY OF SCIENCE
FALL EXECUTIVE COMMITTEE MEETING
SOUTHERN RESEARCH INSTITUTE
BIRMINGHAM, AL
OCTOBER 25, 1996

- A. Dr. Tom Jandebour, President of the AAS, called the Fall meeting of the AAS to order at 10:00 a.m. The minutes of the Spring meeting (March 6, 1996) were discussed briefly and approved.
- B. Officer's Reports
1. Board of Trustees - no formal report was offered at this time.
 2. President - Dr. Jandebour submitted the following:

Report of the President

Represented Academy at ASTA conference held September 13-14, 1996 at The University of Alabama at Birmingham.

Developed home page and several documents for distribution to Academy members via Internet; Academy is now "on-line".

Based on member mailing addresses supplied by Larry Boots, AAS Secretary, created Visual FoxPro database of Academy members; used database to develop rosters for trustees, elected officers, committees, executive committee, and steering committee; also developed mailing lists for each section of Academy for use by section officers.

Created Visual FoxPro database of junior/community college science and mathematics (including nursing) faculty for use in membership recruitment.

Developed AAS Campus/Area Sectional Coordinators directory for distribution to elected officers.

Developed handout re: National Association of Academies of Science (NAAS) reflecting Alabama Academy of Science's pages in the NAAS "Directory, Proceedings, and Handbook", and size of AAS membership relative to other state academies of science.

Corresponded invitations to members of the Steering Committee and certain other Academy members to attend Steering Committee meeting and dinner held at Birmingham-Southern College, October 25, 1996.

Corresponded invitations to members of the Executive Committee to attend meeting held at Southern Research Institute in Birmingham, October 26, 1996.

Internet address for AAS is:

<http://www.athens.edu/AAS/aasindex.ntm>

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3. President-Elect - Dr. Ellen Buckner presented the following report:

Report of 2nd Vice President

Thus far this year, I have assisted the President in completing officer and committee appointments. I have submitted announcements to the Newsletter and conferred with its editor regarding fall publication. I have assisted in appointment of Dr. Richard Holland, University of West Alabama as a regional science fair coordinator. I have also initiated work on a brochure describing the Academy's history for distribution at the 75th annual meeting. An announcement of a group AAS membership photo to be taken at the Spring meeting is attached.

I would like to request suggestions for speakers at the 1998 annual meeting at the University of South Alabama. Please indicate if the person suggested has an association with science activities in Alabama and include your name if you would be willing to contact the individual.

75th Anniversary Photo

The 75th Annual Meeting of the Alabama Academy of Science will take place in 1998 at The University of South Alabama. In anticipation of that milestone a brochure detailing some of the Academy's activities - past and present - is being developed from archives, news accounts, and interviews. In the early years of the AAS, a photo of the membership was taken at noon, Friday, of the Annual meeting. For the 1997 meeting at Auburn University at Montgomery we are reviving that tradition. Please plan to come to the front steps of University Center at 12:00 noon, Friday, March 21st, for an Academy photo. Please bring graduate student members with you.

4. Second Vice-President - Dr. Moore Asouzu reported verbally that he has been developing a list of science speakers to be used for science promotion.
5. Secretary - Dr. Larry Boots reported as follows:

SECRETARY'S REPORT - AAS

October 26, 1996

Membership as of October 26, 1996	642
Membership on March 5, 1996	571
New Members since January 1, 1996	99

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Trends in Membership:	<u>MEMBERS</u>
April, 1992	728
March, 1993	661
March, 1994	739
March, 1995	650
October, 1995	670
March, 1996	571
October, 1996	642

MEMBERSHIP BY SECTION

SECTION M A R C H 1 9 9 6
OCTOBER, 1996

I. Biological Science	136	160
II. Chemistry	65	68
III. Geology	21	26
IV. Geography, Forestry, Conserv., Planning	15	18
V. Physics & Mathematics	60	65
VI. Industry & Economics	17	25
VII. Science Education	28	30
VIII. Social Science	30	33
IX. Health Science	83	96
X. Engineering & Computer Science	30	33
XI. Anthropology	8	11
77. University Libraries	24	25
88. High School Libraries	51	50
Unknown	3	2

MEMBERS

Emeritus	35
High School Libraries	50
University Libraries	25
Honorary	8
Individual	415
Student	76
Life	32
Sustaining	1

Minutes

Please note that the following members were in attendance:

John Young	Dan Holliman	Mike Moeller
Alan Sprague	Walter Wilborn	Bill Barrett
Glynn Wheeler	Tom Vocino	Ken Marion
P.G. Sharma	Elsie S. Spencer	Gene Omasta
B.J. Bateman	Dan O'Donnell	Roland Dute
John Frandsen	Helen Buford	Steven D. Carey
David H. Nelson	Larry Krannich	Ellen Buckner
Sam Barker	Larry Boots	L.S. Hazlegrove
Tom Jandebeur	Moore U. Asouzu	

6. Treasurer - Dr. Larry Krannich submitted the following report:

The Treasurer's Report consists of copies of the following:

ALL ACCOUNT BALANCES as of October 22, 1996

INCOME & EXPENSE STATEMENT as of October 22, 1996

ACTIVITIES RELATIVE TO 1996 BUDGET for the period 1/1/96 through 10/22/96

TREASURER'S SUMMARY REPORT BY QUARTER (1/1/96 through 10/22/96)

TREASURER'S SUMMARY REPORT BY ACCOUNT (1/1/96 through 10/22/96)

PROPOSED BUDGET 1997 vs 1996

Not reflected in the income for the Academy is the revenue (\$3,385.35) generated by this year's Annual Meeting. The check in that amount has not arrived, but is expected any day. If we consider this revenue, a comparison of the accounts for this year (1/1/96 - 10/22/96) with those last year (1/1/95 - 10/24/95) for the same time frame indicates that the total income to the Academy for 1996 ($\$16,224.20 + \$3,385.35 = \$19,609.55$) is slightly more than that for 1995 (\$18,577.75). Such a comparison is legitimate, because the revenue for the 1994 meeting was received prior to our Fall meeting and counted in the 1995 budget.

On the expense side, we are expending at about the same rate as in 1995 (\$23,093.22 in 1996 vs \$22,769.12 in 1995).

In summary, we are on budget for income and expenses, and should again finish the year on budget.

A copy of the Proposed Budget for 1997 is also attached. This budget is analogous to that submitted in 1996, except for eliminating the item "Income for Jr. Academy". We have had no entries for this item for the past few years. Thus, the 1997 budget is realistic relative to our 1996 expenditures without including a projection for large annual meeting revenue. Both last and this years' balanced budgets are due largely to such meeting revenues.

Additional budget information is available upon request.

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7. Journal Editor - Dr. Bradley sent the following report:

So far in 1996, 4 research articles were published in the January issue, and 4 are in press for the July issue. October's volume will be a special issue containing invited articles on the general subject of "Science Education and the Human Enterprise of Knowing". Subjects addressed by the articles will include but not be limited to the creation/evolution issue in Alabama.

The April, 1996, issue of the JAAS contained 157 abstracts of papers and posters presented at the annual meeting. This compares to 221 abstracts published in the April, 1995, issue of **The Journal**.

Please continue to solicit submissions from your graduate students and professional colleagues.

8. Counselor to AJAS - Dr. Bateman submitted his report as follows:
1996 Annual Report of the Alabama Junior Academy of Science
and the Junior Science and Humanities Symposium

State Officers/Counselors Meeting

The State Officers and the State Counselors met at the University of Alabama at Birmingham on March 17, 1995 to discuss the State Officer's roles for the upcoming year (1995-96).

Fall Planning Meeting

The Executive Committee at the Alabama Jr. Academy of Science (AJAS) met at the Kellog Center at Tuskegee University, for the purpose of planning the program of activities for the forthcoming year. The letter sent to each counselor and the meeting agenda appears as Appendix A.

The proposed budget of \$14,323.60 for 1995-96, the actual budget expenditures of \$11,519.97 for 1995-96 and the proposed budget of \$15,411.00 for 1996-97 are detailed on pages 7-8 of this report.

The executive committee was unanimous again in its support of pre-registration which placed greater responsibility on individual club sponsors for making all motel, banquet, and tour reservations for their students. Details were to be worked out with the local program-coordinator (B.J. Bateman, Troy State University, Troy, Alabama).

The paper competition again would be held on Friday morning, with the winners announced at the Friday night banquet. The state-wide JSBS paper competition in Alabama falls within the long-established program of AJAS and utilizes the organizational structure of the latter. The AJAS consists of nine regions within the geographic boundaries of the state. The activities of the nine regions are coordinated through nine Regional Counselors, two Associate Counselors, and a State Counselor, utilizing a variety of forms and established deadlines. The forms designed for this purpose were distributed during the fall meeting of the Executive Committee and appear as Appendix C.

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Fall AAS Executive Meeting

The State Counselor (B.J. Bateman) attended the Fall Executive meeting of the Senior Academy of Science held at the Southern Research Institute, October 28, 1995. A report was given concerning the forthcoming annual meeting to be held at Tuskegee University.

Regional Meetings

Meetings were held in each of the nine regions of the state prior to December 1, 1995, for the purpose of organizing their regions and planning activities for the year. Major emphasis was given to strengthening science clubs, discussing appropriate science project work, and reviewing the several aspects of paper competitions.

Annual Meeting

The 1996 Annual Meeting, like all previous meetings of AJAS, was shared jointly with the Alabama Academy of Science. The host institution was Tuskegee University.

Adriane Ludwick coordinator for the AAS/AJAS meeting, B.J. Bateman, Counselor to the AJAS, and Donnie Hatcher, Southeast Region Counselor, planned registration procedures, space needs, and arrangements for the AJAS-JSHS social and banquet. All mail-out materials appear as Appendix D.

Registration was held at the Kellog Center at Tuskegee University. Students and their teachers from the North Region, the South Region, the State Officers, and the State Counselors assisted with registration. The AJAS Journal and the official program for the Annual Meeting were given to each student.

Highlights of the program were:

- 1) Social on Thursday night.
- 2) Paper Competition - The paper competition was conducted on Friday and Saturday mornings in Armstrong Hall on the Tuskegee University Campus. The names of the participants and the respective papers appear as Appendix E.

Following the morning competition, the judges deliberated through lunch and into the afternoon while the students participated in visual essay as previously described. The names of the judges, including their institutions, and the materials sent to judges appear as Appendix F.

David Goldenberg was chosen to be the overall winner and would therefore represent Alabama in the National Competition held at San Diego, CA, April 25-28. The other four state winners (Dorek Biglari, Allison Tanev, Jeremy Brown, Stephen Cooper), and the State Counselor (B.J. Bateman), would accompany Mark to San Diego for this competition.

- 3) Banquet - More than two hundred fifty students, teachers, university professors, and members of business, industry and government shared the Friday night banquet at Kellog Center Banquet Hall. A major part of the after-dinner program was the recognition of the first and second-place winners of the paper competition, and other competitions, including the Westinghouse Talent Search, in which many of our students had participated.

On alternate years the Junior Academy is responsible for the banquet speaker. This year the Alabama Academy of Science provided the banquet speaker, Dr. Lawrence DeLucas, former astronaut, spoke on his experience as an astronaut.

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4) AJAS-JSHS Social Activities - A Thursday night hot dog and hamburger party at the student center was the main social activity. Bad weather forced the cancellation of the after banquet social. Support of these social activities came through donations from industry, the Southeast Region and a payment of a \$15.00 registration fee.

5) Business Meeting - The customary AJAS business meeting was held on Saturday morning. This provided a time for awarding a plaque to the outstanding teacher(s), the Army Award to the teacher of the overall first place winner, and other awards.

AWARDS

Most with the Least Award

BIOLOGY: Mary Butts, The Altamont School

PHYSICAL SCIENCE: Alan Stephens, Handley High School

MATHEMATICS: Jon David McAnally, Brewer High School

ENGINEERING: Stephanie Brown, AP Brewer High School

Second Place Award

BIOLOGY: Kwabena (Bobo) Blankson, The Altamont School

PHYSICAL SCIENCE: Petronella Lugemwa, The Altamont School

MATHEMATICS: Casey Tidwell, Brooks High School

ENGINEERING: Stephanie Brown, AP Brewer High School

HUMANITIES: Anna Marie Simpson, Alabama School of Fine Arts

First Place Award

BIOLOGY: David Goldenberg, The Altamont School

PHYSICAL SCIENCE: Dorek Biglari, Covenant Christian Academy

MATHEMATICS: Jeremiah Brown, Covenant Christian Academy

ENGINEERING: Stephen Cooper, Bradshaw High School

HUMANITIES: Alison Tanev, AP Brewer High School

Grant for Research Projects

Allison Tanev

Jason R. Jones

AAAS Award

Allison Tanev

Heath Speegle

Outstanding Region

North

Outstanding Teacher and Audubon Workshop Scholarship

None

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Newly elected officers for 1996-97

President	Jason Jones	Brooks High School
Vice-President	Allison Tanev	AP Brewer High School
Treasurer	BoBo Blankston	Altamont
Secretary	Bart Boothe	Opp High School

JSHS Participants Attending the Annual Meeting

84 students, sponsors, counselors attended the annual meeting as JSJS participants (expense paid). An additional 17 persons attended at their own expense for a total of 101. The list of these attendees is found in Appendix G.

National Symposium and Paper Competition

David Goldenberg was chosen to be the overall winner and therefore represented Alabama in national competition and symposium held at San Diego, CA. Four other state winners (Allison Tanev, Stephen Cooper, Jeremy Brown, Dorek Biglari), Regional Counselor Mary Thomaskutty and the State Counselor (B.J. Bateman) accompanied David.

9. Science Fair Coordinator - no report.
10. Science Olympiad Coordinator - Steven Carey made a brief verbal report summarizing the Academy's successes in this area for the past year.
11. Counselor to AAAS - no report.
12. Section Officers:
 - I. Biological Sciences - Dr. David Nelson reported that 58 papers were presented at the last annual meeting and plans were under way for the next meeting.
 - II. Chemistry - no report.
 - III. Geology - Dr. Haywick sent the following report:

I regret that teaching commitments do not allow me attend the autumn executive meeting. The following is my report.

At this year's meeting of the Alabama Academy of Sciences, 13 presentations were made. Eight of these were oral while 5 were in poster format. Seven presentations were by undergraduate or graduate students. Student membership in the Geology Section of the AAS has improved slightly over previous years, however, the total membership has remained more or less stagnant. There are clearly many geologists in this state who are either not aware of the Geology Section of the AAS or who are not interested in membership at this time. I feel that membership in the Geology Section could be improved with some advertisement and will attempt this before the 1997 meeting.

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The new vice chair of the Geology Section is Dan O'Donnell, a geologist with Volkert Environmental Co. in Mobile. Dan is a valuable asset to the section as he provides an industry link that will stimulate professional interest in the AAS. It is our goal to increase industry-relevant presentations at up-coming conferences.

I share the sentiments of my immediate predecessor David Kopaska-Merkel who stated in last year's report that the most to benefit from membership in the AAS are students. We should do our best to encourage student membership in all sections of the Academy. The 1996 AAS meeting in Tuskegee did not offer reduced registration fees for students. I have only been a member of the AAS for a couple of years so I am not certain as to whether this was typical or an unusual circumstance. Whatever, I recommend that in the future, student registration fees be reduced to encourage their attendance and participation at our annual meeting. If it is simply a matter of cost, registration fees for professionals (and Academies, etc.), should be increased to cover the difference. It really is time to recruit as many students into the Academy as possible.

IV. Geography, Forestry, Conservation and Planning - no report.

V. Physics and Mathematics - Dr. Young reported that efforts were being made to improve the sections participation at the annual meeting.

VI. Industry and Economics - no report.

VII. Science Education - Someone (I apologize for missing their name) presented a brief oral report in Dr. Johnson's absence).

VIII. Social Sciences - no report.

IX. Health Sciences - no report.

X. Engineering and Computer Sciences - Dr. Alan Sprague gave a brief oral report.

XI. Anthropology - no report.

13. Executive Officer - Dr. Leven Hazlegrove submitted the following:

Since the Spring Executive Meeting, 3/16/96, Tuskegee, we have been working on the following projects during the last 7 months:

1) Set up and prepared the Gorgas Scholarship Foundation, Inc., Science Talent Search in cooperation with the Westinghouse Scholarship Science Service, Inc. D.C. for the Auburn University at Montgomery March 19-22, 1997 with the leadership of Glynn Wheeler, Secretary Treasurer and Dr. Tom Vocino, Auburn University at Montgomery.

2) Prepared for bulk mail 850 "Call for Paper Titles" for Auburn University at

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Montgomery meeting for March 19-22, 1997 entitled by Dr. William J. Barrett.

- 3) Sent development letters to 4 industrial companies and foundations with positive reply from one.
- 4) Sent hand written notes to 50 outstanding Scientist and Engineers, Mathematicians, and potential members whose "write-up" appeared in local publications. (Twenty New Members!!)
- 5) Met twice with Dr. Tom Vocino, Professor and Head, Political Science and Public Administration and his local committee for the AAS dates: March 19-22, 1997.
- 6) Set up ASTA booth at UAB Arena, September 12-13, 1996 with the able supervision of Dr. William J. Barrett, Dr. Dan Holliman, Dr. Tom Jandebour, Dr. Ellen Buckner and Dr. B.J. Bateman.
- 7) Prepared 250 abstract forms for the Auburn University at Montgomery meeting, March 19-22, 1997 for eleven section chairs.
- 8) Moved the AAS Executive Director's office to the New Chemistry Department (901 14th Street South - CHEM 266); new phone (205)975-9146, FAX (205)934-2543.
- 9) Your Director studied flora, fauna and pollution in USA, February 13-16, 1996 with the Alabama Fisheries Association, Gulf State Park.
- 10) Set-up the 74th Annual Meeting with the able direction of Dr. Tom Vocino, Professor of Political Science and Administration, Auburn University at Montgomery, Montgomery, AL, March 19-22, 1997.
- 11) Set-up with Dr. David Nelson's able help the 1997 meeting at AUM with the kind invitation of Chancellor Roy H. Saigo, (334)244-3696 and the USA meeting late March or early April, 1998.

C. Committee Reports

- 1) Local Arrangements - Dr. Tom Vocino discussed his plans for the upcoming annual meeting. Extensive plans have been made and everything appears to be under control.
- 2) Finance - Dr. Sam Barker reported that:
As before, our worthy Treasurer has submitted a colorful report, again illustrating his ability to transform a deficit budget into a black ink financial report for our last complete year, 1995. To be sure, the positive balance is only \$225, but that is better than the same amount in the red.
I accompany these remarks with my usual tabulated comparison of income and outgo on both a 10-month and 12-month basis, for the years 1992-1995 to emphasize the fluctuations within each year as Dr. Krannich has done in his white pages "Summary Report by Quarter" for 1995. Anticipating that he will not want to make a life-time career out of his role as treasurer, it will be necessary for future treasurers to brace themselves for a 600% variation in quarterly income and expenses but only a 25% variation on an annual basis over 5 years.
- 3) Membership - Dr. Moore Asouzu presented several ideas relative to increasing the AAS membership. Included was using Dr. Jandebour's data base of all the Jr. College

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faculty. He intends to send information to all of these people.

4) Research - Dr. Hudiburg presented his report which is reproduced below:

There was considerable interest expressed by students through 38 requests for application materials related to the Student Research Award Competition, Student Research Grants, and Student Travel Awards for the 1996 annual meeting. Attached you will find a list of awards for the 1996 annual meeting of AAS. The later deadline for applications will be continued for the 1997 meeting. Please communicate to interested students that the application deadline for completed material will be **February 3, 1997**. Students need to be informed that membership in AAS is required to receive these awards.

There is one problem related to the student research award competition. Four of the student winners have failed to become members of the academy. The committee chair has made numerous attempts to contact these individuals (e.g., letters, telephone, and e-mail) but they have not completed the membership process. The committee recommends to the section chairs and vice-chairs to remind the students in these competitions of the requirement of AAS membership to receive these awards.

STUDENT RESEARCH AWARD COMPETITION - Winners **PAPERS**

Section I. Biological Sciences: Co-Winners

Anglea C. Morrow	AU	\$25
Seth Pritchard	AU	\$25

Section III: Chemistry: Co-Winners

Sara Jane Sudmeier	UAB	\$25
Chao-Cheng Wang	UAB	\$25

Section IV: Geography, Conservation, & Environment: Co-winners

Brian W. Mimbs	TSU	\$25
Patrick B. Murphy	AU	\$25

Section VIII. Behavioral and Social Sciences: Winner

Jason Smith	UAB	\$50
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Section IX. Health Science: Winner

Evelyn L. Fitzwater	UAB	\$50
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Section X. Engineering and Computer Science: Co-winners

Mallikharjun V. Yalamanchili	UAB	\$25
Prakash Muthukrishnan	UAB	\$25

Section V. Physics and Mathematics(1): Joint winners

Kory T. Morrow & S.R. Roy	TU	\$25 & \$25
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TRAVEL AWARDS

David Forester	UNA	\$55
Jason Freund	UAB	\$45
Hiryong Kim	UAB	\$45
Prakash Muthukrishnan	UAB	\$45
Viswanathan Vaidyanathan	UAB	\$45
Brian W. Mimbs	TSU	\$40

Student Research Grants Awards - 1996

<u>NAME</u>	<u>AFFILIATION</u>	<u>SECTION ADVISOR</u>	<u>AWARD</u>
Jason Jennings	AU	Biology/Lishak	\$250
Seth Greeley	AU	Biology/Peterson	\$250
Marilyn Wyatt Harris	UAH	Biology/Campbell	\$250
Charles D. Bishop	UAB	Biology/Watts	\$250
Hugh S. Hammer	UAB	Biology/Watts	\$250
Hollye McCulloch	UAB	Biology/Watts	\$155
Tony McKenzie	UAB	Biology/Watts	\$155
Mickie Lynn Powell	UAB	Biology/Watts	\$250
Daniel P. Swenson	UAB	Biology/McClintock	\$250
Mark Behrens	UA	Physics/Math/Baksay	\$200
Jason Freund	UAB	Eng. & CS/Slean	\$90
Wangpi Pan	UAB	Eng. & CS/Jones	\$150

- 5) Long-Range Planning - no report.
- 6) Auditing - Sr. Academy - Dr. Denny Bearce sent a report, indicating that the AAS records were in order.
- 7) Auditing - Jr. Academy - a favorable report concerning the records of the Jr. Academy was presented at the annual meeting.
- 8) Editorial Board and Associate Journal Editors - This group will report at the annual meeting.
- 9) Please and Date of Meeting - Dr. David Nelson submitted the following:

The following sites have been previously approved by the Executive Committee of the AAS:

- 1997 Auburn University at Montgomery (19-22 March)
- 1998 University of South Alabama (18-21 March)

Following a 4-year cycle adopted by our committee a few years ago, we have attempted to rotate meeting sites once in the north, once in the south and twice in the interior of the state. Next we are due to meet in the northern part of the state. We have received a

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letter from Dr. Jerry F. Bartlett, President of Athens State College, inviting us to meet there from 31 March to 3 April, 1999. The committee recommends that we meet at Athens State College in 1999; otherwise we should consider UNA (met there in 1987) or Auburn (met there in 1988). It was agreed that we should accept the invitation of Athens State College.

Committee on Place and Date of Meeting:

David H. Nelson, Department of Biological Sciences, University of South Alabama, Mobile, AL. 36688, (334)460-6331.

James E. Brown, Department of Horticulture, Auburn University, Auburn, AL. 36849, (334)944-4862.

Moore U. Asouzu, Physical Science Department, Troy State University, Troy, AL. 36082, (334)670-3571.

Richard Modlin*, Department of Biological Sciences, University of Alabama in Huntsville, Huntsville, AL. 35899, (205)895-6360.

Ken B. Waites, Departments of Pathology and Microbiology, University of Alabama at Birmingham, Birmingham, AL. 35233, (205)934-6421.

*no longer active; asked to be replaced

10. Newsletter - no report.

11. Public Relations - no report.

12. Archives - Dr. Troy Best reported the following:

This seems to be an appropriate time for us to review the archives of the AAS. I contacted Dr. Dwayne Cox, the archivist in charge of AAS materials at the Auburn University Ralph B. Draughton Library, and asked for his assistance in determining what is present in the AAS archives and to solicit his suggestions as to what types of materials we might want to add.

Dr. Cox provided a listing of holdings (see attached summary). We have a number of items from the 1980's, some financial information from the late 1960's and early 1970's, and some items dating back to the 1920's. Dr. Cox also indicated that it would be appropriate to identify the types of records that routinely should be preserved in the archives. These items might include minutes of meetings, annual financial summaries, publications (to be kept in "mint" condition), programs of meetings, policy correspondence, photographs of officers and activities, etc. He is willing to attend at Executive Committee meeting to answer questions, etc., if you would like.

Because the archives represent the history of the AAS, it is especially important that we preserve items of significance. I was surprised to see that no items have been archived since the late 1980s...we certainly have had meetings, activities, etc.

I encourage all officers and members of the AAS to donate significant documents, photographs, etc. to the archives.

Minutes

Historical & Organizational Sketch

The Alabama Academy of Science was organized at Mobile in 1924 for the purpose of promoting interest in science in the state, providing means for the publication of papers and abstracts, providing cooperation and fellowship among scientists, and promoting the study of science by the youth of Alabama. In 1930, the Academy divided into a Biology section and a Chemistry and Mathematics section. In 1947, the Academy was incorporated as a non-profit organization under the laws of the State of Alabama. The Academy is affiliated with the American Association of the Advancement of Science, having representatives on the Council of the AAAS and also in the Academy Conference.

The elected officers of the Academy are the President, President-Elect, Vice-President, Secretary, Treasurer, Counselor of the AAAS, Editor of the Journal, Counselor of the AAAS, Editor of the Journal, Counselor to the Junior Academy, and a rotating Board of Trustees. The standing committees include the Executive Comm., Membership Comm., Research Comm., Long Range Planning Comm., Finance Comm., Editorial Board, and the Committee on Junior Academy. The present-day eight main sections are: 1) Biology and Medical Sciences, 2) Chemistry, 3) Geology and Anthropology, 4) Geography and Conservation, 5) Physics and Mathematics, 6) Industry and Economics, 7) Science Education, and 8) the Social Sciences.

The activities of the Academy revolve around meetings, publications, research awards, and youth activities. The Academy and Junior Academy have one annual meeting in the Spring. Publications include the Journal (first published in 1930), the Newsletter, and the Program of the Annual Meeting. Research consists of grants-in-aid and cooperation with other groups in the establishment of the Southern Research Institute and Southern Association of Science and Industry. Awards and recognition consists of the Academy Award and the Founder's Prizes. Important youth activities include the Alabama Junior Academy of Science, the State Science Talent Searches, and the Science Fairs.

Scope & Content

Types of papers within this collection include directories (1961-1977), grants (1962-1969), correspondence (1923-1980), minutes (1927-1976), financial records (1927-1969), membership forms (1939-1953), programs (1928-1975), and publications (1935-1974). Correspondence looms the largest and is arranged by year, there-under alphabetically by correspondence. There is also a sizable mass of minutes, which include minutes of the Executive Committee, financial reports, committee reports, programs, etc. Audits are found mainly in the financial reports. Significant corporate bodies with material in the collection include the Alabama Library Association (1961-1963; 2 folders, low quality); the American Association for the Advance of Science (1936-1978; 10 folders, medium quality); and the Junior Academy of Science (1933-1976; 21 folders, medium-high quality). In addition, the High School Section in the Junior Academy is arranged alphabetically by school name. The AAS is an organization that promotes interest in science in the state, provides means for the publication of papers and abstracts, provides cooperation and fellowship among scientist and promotes the study of science by the youth of Alabama.

Minutes

Addendum

Accession #88-42 includes lists of officers and committees (1977-87), minutes (1975-87), officer and committee reports (1979-87), correspondence (1979-88), copies of the Newsletter (1980-88), and financial records (1974-81).

Accession #89-51 includes programs (1924-37; 1940-41; 1982-89), copies of the Newsletter (1972-89), administrative officer's reports (1982-89), committee files (1979-88), correspondence (1958-87), Alabama Junior Academy of Science contributions (1968-87), call for papers (1972-89), files of AAS President Geraldine Emerson (1968-83), and Urban Diener's Resource Directory (1977).

13. Science and Public Policy - Dr. Frandsen submitted the following report:

Environmental Panel Formed & Functioning

The Expert Panel on Environmental Issues, functioning as a subcommittee of this committee, has been appointed by the President of the Academy, and is organized and functioning to identify environmental issues that may be of concern to the Academy and to recommend relevant actions that the Academy may wish to take. The membership of this panel is as follows:

John R. Christy, Steve Bearce, John C. Bliss, William G. Deutsch, Richard McNider, Douglas Waites and Kevin White.

NAS/NRC Booklet on Creationism Mailed to All Public School Superintendents

The booklet Creationism: A View from the National Academy of Sciences, was mailed to all public school superintendents last April, as a jointly-funded education project with the Alabama Science Teachers Association. This project was authorized by the Executive Committee of the Academy at its meeting last October.

Committee Organizes Response to Governor's Mailing of Anti-Evolution Book

Last Spring, Governor James used his discretionary funds to purchase copies of Phillip Johnson's anti-evolution book Darwin on Trial and mail them to all biology teachers in the public schools as a "resource" that he, in a covering letter, strongly recommend that they use.

In response to this action, this committee organized the mailing of a packet produced by the National Center for Science Education (NCSE), the National Association of Biology Teachers (NABT), and People for the American Way (PFAW), to these same teachers. The mailing was funded by NABT. The packet included a letter from the NABT Executive Director; a critical review of Johnson's book, produced by NCSE; and a letter from PFAW informing the recipients of the legal risks of teaching creation science in public classrooms.

Draft Course of Study: Health Education Neglects Sex Education Subjects

The draft of this course of study has been distributed to public schools of education and libraries for public comment. Such comment must be sent in writing to Ms. Regina Stringer, State Department of Education, Gordon Persons Bldg., 50 N. Ripley Street, Montgomery, AL 36130-3901, to be received no later than November 6. Notable in this draft is the absence of subjects that would logically be included in "sex education". Reliable

Minutes

sources have informed us that the committee that drafted this course of study was ever fearful of offending the Eagle Forum of Alabama, a group that is on record as opposed to sex education in the schools.

If you wish to inspect this draft Course of Study, copies of it may be found in the libraries listed below. Copies are not available from the State Department of Education for individual citizens.

Depositories of Alabama Courses of Study

Northeast Alabama State Community College
University Learning Resource Ctr., Alabama State University
Ralph Brown Draughton Library, Auburn University
Brewer State Junior College Library
Enterprise State Junior College Library
Wallace State Community College Library
Troy State University at Dothan Library
Houston Cole Library, Jacksonville State University
Leigh Library, Jefferson Davis Community College
Wallace Community College at Hanceville Library
Media Center, Livingston University
Northwest Shoals Community College Library
Hobson State Technical College Library
Curriculum Materials Center, Samford University
Minnie Slade Bishop Library, Bishop State Community College
Central Alabama Community College Library
McLure Library, University of Alabama
Troy State University Library
Sterne Library, UAB
University of Alabama at Huntsville Library
Oliver Cromwell Carmichael Library, University of Montevallo
Learning Resources Center, University of North Alabama
Reading Center, University of South Alabama

14. Gardner Award - Dr. Ellen Buckner submitted a resolution for the Executive committee's consideration in relation to the Gardner Award. This statement and its amendment were passed.

"Be it resolved that the Gardner Award committee be directed to interpret the by-laws' definition of "outstanding achievement in science" to include teaching of science and service to the Academy and to the public. Furthermore, the committee is authorized to seek out applications for the award".

Dr. Buckner also submitted the following:

This committee was reformulated by the President to more accurately reflex the By-laws designations for term of office. In that reformulation, Dr. Ellen Buckner was appointed chair for one year. An announcement of the call for nominations is attached and has been

Minutes

sent to the newsletter for fall publication. Several individuals have indicated possible interest in submitting nominations.

A manuscript with biographical sketches of the last five (5) Gardner Award recipients has been prepared and is being submitted to the Journal for review. Of interest to the Academy might be that Dr. Gail Cassell, a previous Gardner recipient, was the Distinguished Faculty Lecturer at UAB this year.

Nominations are welcomed and must be submitted by December 1.

GARDNER AWARD

The Alabama Academy of Science annually considers nominations for the Wright A. Gardner Award to an individual for outstanding achievement in science while in residence in Alabama. Although it is not always awarded, 10 men and women have been so honored since its inauguration. Those recipients are:

- 1984 Robert P. Bauman, Physics
- 1985 Nolan E. Richards, Manufacturing Technology
- 1986 S.T. Wu, Mechanical Engineering
- 1987 Herbert H. Winkler, Microbiology
- 1988 Richard W. Compans, Microbiology
- 1990 Max Dale Cooper, Developmental and Clinical Immunology
- 1991 Dan W. Urry, Biochemistry
- 1992 Gail H. Cassell, Microbiology
- 1994 Millard Franklin Rose, Engineering
- 1996 Prakash C. Sharma, Physics

Deadline for nominations is December 1. Nominations package should include a C.V., list of publications, or other documentation detailing the individual's contribution to science. Other letters of recommendation are desirable. The nomination should be summarized in the form of a one page citation. Four copies should be submitted.

If you have further questions, contact Dr. Ellen Buckner, Chairman, Gardner Award Committee (205)934-6799 or NURS 119@uabdp.dpo.uab.edu). Nominations may be sent to:

Dr. Ellen Buckner
204 School of Nursing
University of Alabama at Birmingham
Birmingham AL 35294-1210

- 15. Carmichael Award - no report.
- 16. Resolutions - no report.
- 17. Nominating Committee - Dr. Asouzu reported that the committee was busy working on the nominations which will be presented at the annual meeting.
- 18. Mason Scholarship - Dr. Moeller reported as follows:

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Last year we had two completed applications for the William H. Mason Scholarship. After reviewing all application materials, the scholarship committee voted to offer the award to Tina Anne Beams and Ms. Beams has accepted the fellowship.

The previous recipients of the William H. Mason Scholarship are:

1990-91	Amy Livengood Summer
1991-92	Leella Shook Holt
1992-93	Joni Justice Shankles
1993-94	Jeffrey Baumbach
1994-95	(not awarded)
1995-96	Laura W. Cochran
1996-97	Tina Anne Beams

Attached to this report is a copy of the announcement the committee plans to be sending soon to deans in schools of science and education within Alabama.

\$1000 FELLOWSHIPS IN SCIENCE TEACHING

Fifth-year Program

The non-traditional fifth-year program is designed to offer individuals possessing a bachelor's degree outside of education the opportunity to earn a master's degree in education with Class A certification. Further information, admission requirements and application procedures can be obtained from education departmental offices at Alabama colleges and universities offering the fifth-year program.

Awards

Recognizing the need for promoting superior science teaching at all levels, the Alabama Academy of Science has established awards to encourage scientifically trained students to enter the teaching profession. These William H. Mason Fellowships are in the amount of \$1000 for one year (non-renewable), and are tenable at any institution in the state of Alabama offering a teacher certification program. Awardees may choose to specialize in any area Kindergarten through the 12th grade. Selection will be based on the extent to which the applicant shows promise for incorporating quality science instruction in his or her classroom.

Eligibility

Students who will have earned a B.S. or B.A. degree by the summer of 1997 are invited to apply for a William H. Mason Fellowship. Applicants must have the equivalent of a minor or major in a natural science, and must be applicants for a program leading to certification in teaching at any level K-12. Recipients will be required to teach in the state of Alabama for at least one year following the completion of the degree program for which the award is given.

Procedures

A fellowship application form can be obtained from or by writing to:

Dr. Michael B. Moeller

Minutes

Alabama Academy of Science
Box 5139, University of North Alabama
Florence, AL 35632
mmoeller@unanov.una.edu

DEADLINE FOR RECEIPT OF ALL MATERIALS IS FEBRUARY 14, 1997.

D. Old Business

Dr. Bill Barrett and Glynn Wheeler reported on the discussions involving the future of the Gorgas Program. The following memorandum summarizes the status of these discussions:

In our report to the Executive Committee in March, it was indicated that some action by the Academy might be needed before the next meeting of the Gorgas Board of Trustees, then scheduled for October 7. The purpose of this memorandum is to let you know, before our Executive Committee meets again next Saturday, that the issue is still very much alive, though not as pressing as it may have seemed earlier.

You should have received last March a copy of Glynn Wheeler's memo to Mr. Art Beattie, Chairman of the Gorgas Board. It suggested that the next step should be taken by the Gorgas Officers. They were not able to respond until October 9, when Dr. Wheeler, Dr. Hazelgrove and Dr. Barrett met with Mr. Beattie and Mr. Bill Zales, an officer of the Alabama Power Foundation. They outlined a proposal that they intend to submit to the Gorgas board at its delayed meeting, now scheduled for Monday, October 28. The principal elements of the proposal are the following:

1) The present assets of the Gorgas Scholarship Foundation would be used to establish an account with the Alabama Power Foundation.

2) According to the APF's Legacy Endowment Plan, the APF would add an equal amount to the account, making an approximate total of \$240,000 for the Gorgas scholarship program.

3) The account would earn a minimum of 5% annually, the total being determined by the return on APF's investment. The scholarship program would then have available at least \$12,000 annually, almost double the presently available income of the GSF.

4) The Board of Trustees of the GSF would be dissolved.

5) The Academy would establish acceptable procedures for dealing with the APR account; maintaining the Gorgas name; and continuing the scholarship competition and awards essentially as at present, possibly increasing the amounts and/or number of the awards.

We expect that Mr. Beattie and Mr. Zales will provide additional details after the GSF board meeting on October 28. We will attend that meeting and will let you know the outcome.

If we have any further significant information, we will present it at the Executive Committee meeting next Saturday. Your comments are expected and will be welcomed!

E. New Business - none.

F. The meeting was adjourned.

INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. Larry R. Boots, Department of Obstetrics & Gynecology, University of Alabama, Birmingham, AL 35294. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology; Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics; Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the *Journal* implies that it has not been published previously and that it is not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

Manuscripts: Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. Submit the original and two copies to the Editor. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. An abstract not exceeding 200 words will be published if the author so desires. Use headings and subdivisions where necessary for clarity. Common headings are: **Introduction** (including a literature review), **Procedures** (or **Materials and Methods**), **Results**, **Discussion**, and **Literature Cited**. Other formats may be more appropriate for certain subject matter areas. Headings should be in all-caps and centered on the typed page; sub-headings should be italicized (underlined) and placed at the margin. Avoid excessive use of footnotes. Do not use the number 1 for footnotes; begin with 2. Skip additional footnote numbers if one or more authors must have their present address footnoted.

Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must not exceed 15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in the text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

Tables: Place each table on a separate sheet. Place a table title directly above each table. Number tables consecutively. Use symbols or letters, not numerals, for table footnotes. Cite all tables in the text.

Literature Cited: Only references cited in the text should be listed under **Literature Cited**. Do not group references according to source (books, periodicals, newspapers, etc.). List in alphabetical order of senior author names. Cite references in the text by number or by author-date.

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COVER PHOTOGRAPH: The Library Tower on the campus of Auburn University at Montgomery, site of the 74th annual meeting of the Alabama Academy of Science.

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NO. 2

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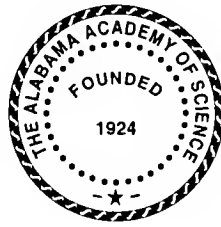
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ABSTRACTS

Papers presented at the 74th Annual Meeting
Auburn University at Montgomery
Montgomery, Alabama
March 19-22, 1997

BIOLOGICAL SCIENCES

A COMPARATIVE BIOTIC AND CHEMICAL ASSESSMENT OF TWO TRIBUTARIES OF TERRAPIN CREEK, CLEBURNE COUNTY, ALABAMA. Althea Thompson, Jason Adams, John Moser, Jackie Carter, Amanda Eddings, Dr. Frank A. Romano, and Dr. R. David Whetstone, Dept. of Biology, Jacksonville State Univ., Jacksonville AL 36265.

Two stream communities were studied using chemical analyses and macroinvertebrate surveys. Data collected over a five month period were compiled into a comparative summary so that overall stream quality could be determined. Site A, located off FS 500, is characterized as a first order stream. Site B, located in the vicinity of The Chief Ladiga Trail, is characterized as a third order stream. Assessment of the two sites suggests that stream order plays an important role in the abundance of invertebrates and the overall water chemistry. Invertebrate communities at the two sites are similar in their distribution and abundance with differences occurring in community diversity. Water chemistry analyses at the two sites reveal similarities between dissolved oxygen and pH with differences occurring in calcium carbonate concentrations.

Electrophoretic analysis of two geographically isolated populations of Elimia acutocarinata. Samantha J. Bone and Dr. Roger Sauterer, Dept. of Biology, Jacksonville St. Univ., Jacksonville, AL 36265.

Two populations of Elimia acutocarinata that have been geographically isolated from one another for seventy-five years was discovered in Georgia. They exhibit two distinct breeding patterns and do not appear to recognize one another reproductively. It is hypothesized that speciation has occurred between the two populations. This hypothesis will be tested using iso-electric focusing in coordination with enzyme assays to establish differences in protein pattern. Preliminary results indicate differences between the populations both in over all IEF patterns and in acid phosphatase isoenzymes.

Abstracts

ICHTHYOFAUNAL ASSEMBLAGES IN THE UPPER CAHABA RIVER: POSSIBLE ALTERATIONS IN THE HISTORICAL COMPOSITION OF ASSEMBLAGES RESULTING FROM THE EFFECTS OF URBAN DEVELOPMENT. Dave Onorato, Robert A. Angus, Melinda M. Lalor and Ken R. Marion, University of Alabama at Birmingham, Birmingham, AL 35294-1170.

During the past 10 to 15 years, urban development has been increasing very rapidly in the drainage basin of the upper Cahaba River in central Alabama. To decipher the effects of this urbanization on the ichthyofaunal assemblages of the upper Cahaba River, a fish bioassessment was conducted during the fall of 1995 and the spring and fall of 1996. Data collected were compared with historical collections and indicate that several species which were abundant in the past have now become less common at several sampling stations. Among the ichthyofauna which have become less abundant are several species of percids and cyprinids which are often considered sensitive indicators of pollution. Changes in the species which dominate at certain sites have also been noted. These shifts and changes in the ichthyofaunal assemblages of the upper Cahaba River can in all probability be attributed to the rapid urban growth in the upper Cahaba River basin.

GUANIDINOBENZOATASE ACTIVITY OF MURINE SPERM. Karen Groves and Gary R. Poirier, Department of Biology, University of Alabama at Birmingham, Birmingham, AL 35294.

Guanidinobenzoatase (GB) is a serine proteinase found free in epididymal fluids and bound to the sperm surface. Recently the soluble form was isolated and characterized. Treating cumulus free, zona intact oocytes with the purified enzyme will reduce, in a concentration dependent manner, the number of sperm able to bind. In addition, pure GB is as effective as bovine testicular hyaluronidase in the dispersal of cumulus cells from freshly ovulated oocytes. These observations suggest that GB may be involved in two important facets of fertilization, cumulus matrix penetration and sperm-zona binding. However for GB to function as proposed it must be sperm bound for soluble seminal components are seldom present at the site of fertilization. This presentation is an attempt to characterize the sperm bound form and compare its features to the soluble form. Sperm bound GB was purified to apparent homogeneity by molecular sieving and affinity chromatography. It has a molecular weight of 71,000 and is heat labile. GB activity increases linearly with the sperm concentration. Sperm bound activity also increases with incubation under capacitating conditions. Purified sperm bound GB, will like the soluble form, disperse follicle cells from freshly ovulated oocytes. These preliminary data suggest that sperm bound GB is similar to the soluble form and supports the suggestion that it may function in in vivo fertilization.

Abstracts

VITELLIN PROTEOLYSIS AND ITS RELATIONSHIP TO ECDYSTEROID LEVELS DURING INSECT EMBRYOGENESIS. Austin M. Hitt II and James T. Bradley, Department of Zoology, Auburn University, Auburn AL 36849)

During vitellogenesis insect oocytes acquire large amounts of egg proteins and ecdysteroids. Ecdysteroids have been demonstrated to be bound to egg proteins, vitellins (VN), and their hemolymphatic precursors vitellogenins (VG), and are presumably transported into the egg with the latter. Once the egg is oviposited and embryogenesis begins VNs undergo stage-specific limited proteolysis. We hypothesized that this results in the release of free ecdysteroids. In *Acheta domesticus* the levels of ecdysteroids during embryogenesis were estimated using a radioimmunoassay. Two types of polyclonal antibodies, produced by Dr. W. E. Bollenbacher (University of North Carolina, Chapel Hill) and provided by Dr. E. S. Chang (Bodega Marine Laboratory, Bodega Bay, CA), were used. Anti-ecdysone B, directed against the carbon 20 side chain, revealed the presence of free ecdysteroid peaks at days 6, 9, and 12 of embryogenesis. VN-bound ecdysteroid levels remained relatively constant throughout embryogenesis indicating that VN proteolysis was not responsible for increases in free ecdysteroids. RIAs using the anti-ecdysone A series of antibody, directed against the tetra-ringed nucleus of ecdysone, showed lower reactivity but supported the data obtained from anti-ecdysone B assays. In *Acheta domesticus* the source of free ecdysteroids during embryogenesis may therefore be either *de novo* synthesis or stored pools of ecdysone within the egg. (Supported by Alabama Agricultural Experiment Station project 862 to JTB)

CUMULUS CELL DISPERSAL BY A EPIDIDYMAL GUANIDINOBENZOATASE.

Stelline Pedoto and Gary R. Poirier, Department of Biology, Univ. of Alabama at Birmingham, Birmingham, Alabama 35294.

Guanidinobenzoatase (GB), a serine proteinase with a molecular weight 71,000, is found both free in the epididymal fluids of the mouse and bound to the sperm surface. Microgram quantities of the enzyme purified from epididymal fluid disperses follicle cells from freshly ovulated oocytes as effectively as bovine testicular hyaluronidase. Purified GB exhibits no hyaluronidase activity as determined by the acid albumin assay. The ability of GB to disperse follicle cells is blocked by a proteinase inhibitor endogenous to the male reproductive tract. The inhibitor has no effect on bovine testicular hyaluronidase. Although the function of GB has not been defined the observations presented here indicate that it may play a role in cumulus matrix penetration during fertilization.

STRUCTURE AND BIOCHEMICAL COMPOSITION OF NUAGE BODIES IN CRICKET OOCYTES. Marina Falany and J.T. Bradley. Department of Zoology, Auburn University, Auburn, AL 36849.

In developing oocytes including ones undergoing vitellogeneseis, nuage bodies are congregations of organelles that develop adjacent to the nucleus. As the oocytes develop they migrate to the poles of the cell and disintegrate. Nomarski optics provide clear pictures of the presence of nuage bodies in developing oocytes in the house cricket, *Acheta Domesticus*. Confocal laser scanning microscopy shows concentrations of alpha-tubulin, mitochondria, and material reactive with the antibody MAB 2D1 (against a vitellin polypeptide) in the nuage bodies. The presence of mitochondria in sizeable amounts in the nuage bodies of last nymphal instar crickets was demonstrated by indirect immunofluorescence and FITC-labeled secondary antibody. Nuage bodies develop adjacent to the nucleus of each oocyte, migrate to the poles of the cell, and disintegrate; the presence of tubulin suggests that the bodies may play a role in the orientation of the developing oocytes. Preliminary work done using SDS-PAGE and Western blotting to test the reactivity of MAB 2D1 showed no reactive polypeptides in previtellogenic follicles. (Supported by Alabama Agricultural Experiment Station Project 862 to J.T. B. and Howard Hughes Medical Institute Science Scholars Program).

BIOGEOGRAPHY OF *ACRIS* (ANURA, HYLIDAE) AT THE SAVANNAH RIVER SITE, AIKEN, SOUTH CAROLINA. D. S. Moore, S. F. Michael, K. R. Marion, University of Alabama at Birmingham, Birmingham, AL 35294. J. W. Gibbons, Savannah River Ecology Laboratory, Aiken SC 29802.

The herpetofauna of the Savannah River Site (SRS) is one of the most studied and well documented herpetofaunas known. It is unusual then to find a new species that is not an isolated introduction. The presence of the Northern Cricket Frog at SRS has been suspected since 1985 when advertisement calls were heard and identified as those of *Acris crepitans*, but no specimens were obtained. The sister species *Acris gryllus* has long been known to be found in the Carolina bays of SRS. Morphologically, the two species are very similar. The advertisement call of the males differ, but it is a fine distinction not readily apparent. The presence of *A. crepitans* has now been validated by mtDNA sequence analyses of frogs collected from various sites in SRS. Screening of large numbers of specimens is performed using PAMSA (PCR Amplification of Multiple Specific Alleles). Preliminary analyses indicate that the presence of *A. crepitans* is restricted to the western border of SRS, with *A. gryllus* present throughout the site.

DIATOM FLORA OF OPHRYDIUM COLONIES FROM SOUTH ALABAMA. Roland R. Dute, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849. Michael J. Sullivan, Dept. of Biological Sciences, Miss. State Univ., Mississippi State, MS 39762.

Ophrydium colonies were collected from a cypress swamp near Florala, Alabama and examined for diatoms. Observations of living colonies showed large numbers of motile diatoms with the ability to traverse the mucilage of the gelatinous ball. SEM observations indicated that diatoms were more concentrated on the surface of the protozoan colony than within. Although numerous, the diatoms were not taxonomically diverse. The most prevalent species was Stenopterobia delicatissima. Other common species were S. curvula, Navicula mediocris, Pinnularia dactylus, Eunotia flexuosa, E. naegelii, E. curvata, and Frustulia rhomboides. Also present was an unidentified species of Pinnularia morphologically similar to P. abaujensis. This flora was taxonomically identical to that collected from leaf debris within the swamp. However, relative to the other species, S. delicatissima was ten times more common in Ophrydium colonies than in debris. This diatom flora is typical of an acidic, softwater situation and reflects the water chemistry of the cypress swamp. It is unlike the diatom floras collected so far from Ophrydium colonies elsewhere. It seems as if the diatom flora of Ophrydium colonies is determined primarily not by the colony itself but by external factors such as water chemistry and climate.

PIT MEMBRANE STRUCTURE IN SOME COMMON ALABAMA HARDWOODS. Roland R. Dute, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849.

Pit membranes in wood are sites of communication between cells and undergo varying degrees of modification with time. Pit membranes between water-conducting cells (tracheary elements) lose their matrix material with the death of their associated cells leaving only a porous weave of cellulose microfibrils. The same is true of pit membranes between supporting cells (fibers). However, in some species (such as Carya tomentosa), many interfiber pit membranes are completely destroyed resulting in perforated fibers. Such cells could, in theory, take part in water movement or enhance the uptake of preservatives. In contrast, pit membranes between parenchyma cells in all species so far investigated retain their matrix material and their original structure. These pit membranes are traversed by numerous plasmodesmata which enhance communication. Pit membranes between parenchyma cells and mature vessel members in C. tomentosa have transfer wall ingrowths. This feature indicates an efficient mechanism for nutrient exchange with the transpiration stream. (Supported by Alabama Agricultural Experiment Station Project 06-016).

Abstracts

A RARE MYGALOMORPH SPIDER FROM ALABAMA. W. Mike Howell and Ronald Jenkins, Department of Biology, Samford Univ., Birmingham, AL 35229

In 1875, a large, morphologically strange, Mygalomorph spider was discovered in north Alabama and sent to Dr. N.M. Hentz, who named it Mygale truncata. Mygalomorph spiders are large, sedentary spiders which include the trapdoor spiders, the sheet web tarantulas, and the purse web spiders. In the original description Dr. Hentz assigned this odd species to the trapdoor spider group. Dr. Hentz presented a drawing of the species detailing the odd-looking, truncated and highly sculptured abdomen, consisting of about 50 longitudinal ridges and grooves and six circular depressions on the rear. Later, Comstock (1940) stated in regards to this spider, "This is a rare species which has been redescribed by Gertsch and Wallace ('36)." Comstock also said, "Specimens of this species have been taken so far only in Florida, Alabama and Louisiana. Since the time of Hentz scarcely more than a dozen examples have been collected." Gertsch and Wallace (1936) in their redescription of this spider, placed it into the genus Cyclocosmia. Some authors have referred to this as one of the "rarest spiders in the world. Interviews with numerous naturalists within Alabama showed that only three of the interviewees had actually collected this species or even knew of its existence within the State, i. e., Drs. Debbie and George Folkerts of Auburn University, and Dr. Cole Benton of Jacksonville State University. The Folkerts had found it common in certain portions of south and central Alabama, while Dr. Benton had found many specimens in northeast Alabama. In our field studies since 1994, we have located a number of sites near Birmingham, AL, in Jefferson and Shelby counties, where this spider is apparently abundant. The spider is perhaps not as rare as once believed.

COMPARATIVE TUBE FOOT MORPHOLOGY OF ANTARCTIC ASTEROIDS. Minako Sugiyama and James B. McClintock, Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham, Alabama 35294-1170.

Asteroids (Echinodermata) are known to have a body plan based on a pentaradial symmetry. However, it is not only the body plan but also the water vascular system including the tube feet that make them unique among the marine invertebrates. Although the species belonging to the order Paxillosida have pointed non-suckered tube feet, most asteroids have suckered tube feet. The presence or absence of a tube foot sucker has been considered an important character in asteroid taxonomy. Komatsu has recently described a third type of tube foot morphology in asteroids from Japan. In the present study, the external tube foot morphologies of seven species of asteroids from Antarctica are described using scanning electron microscopy. The results suggest that the use of tube foot morphology may not be an appropriate character in asteroid taxonomic classification.

THE COPPER LILY HABRANTHUS TUBISPATHUS (L'HER.) TRAUB, NEW TO THE FLORA OF ALABAMA. Jim Brummett, Alvin R. Diamond, Jr., Department of Biology, Troy State University, Troy, AL 36082.

The Copper Lily (*Habranthus tubispathus* (L'Her.) Traub) is reported as new to the flora of Alabama. It has previously been known in North America only from northwest Louisiana and southeast Texas near old Spanish missions. The species main range is in southern South America in Argentina, Brasil, Chile, Paraguay, and Uruguay. It was first collected in Troy, Pike County in July of 1988. It was later collected in China Grove, Pike County and the High Ridge area of Bullock County. The Copper Lily inhabits a wide range of disturbed sandy sites including roadsides and lawns. Flowering is sporadic throughout the summer months following heavy rains. Vegetative growth occurs in the late winter and early spring months.

ANDROGEN AND CORTICOSTEROID PRODUCTION IN THE SOUTHERN TOAD (BUFO TERRESTRIS) EXPOSED TO COAL COMBUSTION WASTE. William A. Hopkins, Mary T. Mendonca, Dept. of Zoology & Wildlife, Auburn University, Al 36849., Justin D. Congdon, Savannah River Ecology Laboratory, Aiken, SC 29802.

The current study demonstrates that an adult amphibian, *Bufo terrestris*, exhibits an adrenal stress response after exposure to coal combustion waste from a coal burning power plant. Free ranging male toads captured at the polluted site (ash basins) exhibited significantly higher circulating levels of corticosterone (B) in both June and August than conspecifics at uncontaminated (control) sites. In addition, both calling and noncalling males from the ash basins had higher B levels than conspecifics engaged in the same behaviors at control sites. Interestingly, testosterone (T) levels were elevated in toads from the ash basins, regardless of capture month or behavioral state, possibly suggesting impairment of androgen utilization and/or metabolic clearance rates. In the second portion of this study, male toads (N=32) from uncontaminated sites were transplanted to enclosures at the ash basin and to enclosures at another uncontaminated control site. Toads at the ash basin exhibited substantial increases in B after 5 days of exposure and significant increases after 10 days. B levels remained significantly elevated in ash basin transplants after 7 and 12 weeks. T levels decreased in toads transplanted to both the ash basins and control sites. It is likely that high concentrations of numerous trace elements in the ash basin sediment are provoking these hormonal responses. In fact, preliminary data indicate high whole body concentrations of As, Cd, Cu, Ba, and Se in ash basin toads. Funding provided by SREL.

INACTIVATION OF *GIARDIA LAMBLIA* CYSTS BY INSOLUBLE CHLORINATED AND BROMINATED POLYMERS. Barbara H. Estridge, Christine A. Sundermann, S. D. Worley,* and T. Y. Chen.* Dept. Zoology & Wildlife Science and *Dept. Chemistry, Auburn University, AL 36849.

Giardia lamblia, a flagellated protozoan, is a significant cause of gastrointestinal disease in humans. Infection occurs following ingestion of infective cysts, which are found in natural and recreational waters as well as municipal water supplies. Because cysts survive in water and are somewhat resistant to some conventional disinfectants, new, safe and efficient alternative water treatments are being sought. Some novel insoluble cyclic organic N-halamines that contain an N-Cl or N-Br moiety have been synthesized at Auburn University and analyzed for activity against *G. lamblia* cysts using a filter apparatus such that low/no residual disinfectant is present in the final effluent. In one study, cysts (1-20 million/L) were passed through columns containing insoluble polystyrene with attached bromine (Poly I-B), chlorine (Poly I-C), or without halogen (control) at a constant flow rate, and effluents were collected. The numbers of cysts recovered from columns varied, ranging from <0.01-51%. Recovered cysts were inoculated into gerbils at varying doses and fecal samples and duodenal tissue were analyzed at 9 and 13 days post-inoculation (dpi), respectively, for the presence of *G. lamblia*. Poly I-B was efficient in killing cysts in demand-free water; Poly I-C was effective 60% of the time. Neither Poly I-B nor Poly I-C performed well when cysts in pH 9, 4°C water with a heavy organic load was used. In another study, cysts (10000/ml) were incubated in buffer containing 0-20 ppm soluble Br+ for varying times, collected, washed and tested for viability by inoculation into gerbils (as above). Br+ at 5 and 10 ppm was effective in inactivating cysts after 5 min exposure; 2 ppm Br+ inactivated cysts after 10 min exposure in 50% of trials. These findings suggest that bromine and compounds containing its moieties have potential for disinfection of potable water that contains *G. lamblia* cysts. Supported by DoD, USDA.

PIT TAG IMPLANTATION IN THE RED HILLS SALAMANDER (*PHAEognathus hubrichti*). Mark A. Bailey, Alabama Natural Heritage Program, Huntingdon College, Massey Hall, 1500 Fairview Ave, Montgomery, AL 36106. Emmett L. Blankenship and Craig Guyer, Auburn University Dept. of Zoology and Wildlife Science, Auburn University, AL 36849.

Twenty-five adult *Phacognathus hubrichti*, a federally listed threatened species, were collected from a Monroe County, Alabama study site in October, 1995. In the laboratory, passive integrated transponder (PIT) tags were experimentally implanted in the body cavities of 15 adults. There was no mortality or observable loss of vigor in the 15 tagged and 10 control animals after several weeks in captivity, and all were released at the point of capture in November 1996. More than six months after the release, eight tagged animals were recaptured and positively identified at the study site. This study demonstrates the feasibility of implanting PIT tags in Red Hills salamanders, the utility of which will best be realized if used in conjunction with long-term studies spanning several years.

THE DISTINGUISHING FEATURES OF THE SPECIES OF THE REINDEER MOSSES, GENUS *CLADINA* IN COFFEE COUNTY, ALABAMA. Nadine Scarborough, Alvin Diamond, and Charles Chapman, Biology Department, Troy State University Troy, Alabama 36082.

Three species of Reindeer Mosses in the genus *Cladina* were collected in Coffee County. These included *Cladina evansii*, *Cladina rangiferina*, and *Cladina subtenuis*. *Cladina subtenuis* may be distinguished due to the presence of usnic acid which imparts a yellowish green color to the thallus. *Cladina evansii* and *Cladina rangiferina* are ash white to grayish in color. *Cladina evansii* lacks a distinct central stem and the thallus occurs in discrete small clumps 2 to 3 cm in diameter. *Cladina rangiferina* has a central stem and occurs in large clumps up to 30 cm or more in diameter. All three species can often be found growing in close proximity.

SYMPATRIC SPECIATION OF THE STARFISH, *LUIDIA CLATHRATA* (SAY) ON THE MID-WESTERN CONTINENTAL SHELF OF THE ATLANTIC OCEAN AND GULF OF MEXICO; FURTHER EVIDENCE Tracie A. Tingle, Emily K. Knott, and Thomas S. Hopkins, Dept of Biol. Sci., Univ. of Ala., Tuscaloosa, AL 35487-0344.

Luidia clathrata is commonly encountered on bottom areas of the shallow water and bay environments of the inner continental shelf of the mid-western Atlantic Ocean and the Gulf of Mexico. The color forms are documented as "gray" and "tricolor"; they are distributed at different depths; Gray forms live closer in shore and on bay bottoms; Tricolor forms occur farther off shore. Isoenzyme biochemical systematic analysis has established that the two forms are genetically distinct. This study examines the measurable differences in the paxillar counts of the two color morph populations. Standardized paxillar counts from a 1 cm. zone, located at the same relative distance from the center of the disk, on two different randomly selected arms of a sample size of N=30 starfish was established for each color type. We conducted designed statistical tests on the standardized paxillar counts, and the relation of arm length to paxillar counts for each color type. Our findings show: an all pair-wise SNK and Tukey and Bonferroni t-test each indicate a significant difference in paxillar counts at $p < 0.001$; a student "t" test indicates a significant difference in paxillar counts at $p < 0.001$; a Pearson Product Moment Correlation Test $p < 0.01$; $p < 0.01$ each case. We conclude that present data coupled with the data established by genetic analysis is very favorable and supports the separation of the two forms into separate species.

Abstracts

PRELIMINARY RADIOTELEMETRIC STUDY OF THE ALABAMA REDBELLY TURTLE (Pseudemys alabamensis). David H. Nelson, Sean P. O'Hare, and William M. Turner, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688.

The Alabama Redbelly turtle (Pseudemys alabamensis) is an endangered species of freshwater turtle endemic to the Mobile River, Tensaw River delta area. Turtles were captured in hoop traps with lead nets around Gravine Island in the Tensaw River (Baldwin County), Alabama. Sixteen turtles (8 males, 8 females) were fitted with radio transmitters (ca. 100g, measuring approx. 6.5x4.5x3.5 cm) constructed in the laboratory to emit a pulsed signal on discreet channels in the 26.965 - 27.405 MHz, 11 meter Citizen's band. The devices were attached to the rear of the turtles' carapaces with epoxy. Turtles were then released at the capture site. As of 31 January 1997, three telemeters had failed from battery exhaustion. These transmitters lasted 98 days, 99 days and 113 days. One transmitter was never detected after the release date. The twelve other transmitters continue to operate. Lack of movement of some turtles indicates either dormancy or detachment of telemeters. Several turtles continue to move in the study area. Two of the most active specimens have moved more than 4 km and 6 km since release.

GEOGRAPHIC DISTRIBUTION OF THE ALABAMA REDBELLY TURTLE (PSEUDEMYX ALABAMENSIS) ALONG COASTAL ALABAMA. David H. Nelson, William M. Turner, Sean P. O'Hare, and Jolene M. Williams, Department of Biological Sciences, University of South Alabama, Mobile, AL. 36688.

The Alabama Redbelly turtle (Pseudemys alabamensis) is an endangered species endemic to freshwater habitats within the Mobile-Tensaw Delta. To determine specific freshwater locations where the turtles occur, hoop traps with lead nets were placed systematically along coastal Alabama from June to September, 1996. Traps were deployed among the major freshwater tributaries east and west of the Mobile Delta. Alabama Redbelly turtles were captured as far west as Bayou La Batre (Mobile County) and as far east as the Fish River (Baldwin County). None were encountered in freshwater tributaries of Bayou Heron or Wolf Bay (both saline embayments). Bayou Heron traps did not yield any turtles at all. During the entire study (1602 trap days), 663 turtles were captured: 135 Pseudemys alabamensis, 301 Pseudemys concinna, 104 Pseudemys floridana, 36 Trachemys scripta elegans, 17 Graptemys nigrinoda delticola, 16 Apalone spinifera, 50 Macroclemys temminckii and 4 Chelydra serpentina. The Southern geographic distribution of the Alabama Redbelly turtle appears to be immediately adjacent to the Mobile-Tensaw Delta. The turtles occur in waterways that now enter or formerly entered the Mobile Bay. Waterways beyond the bay that directly enter the Gulf of Mexico apparently do not harbor the endangered freshwater turtle.

Abstracts

ULTRASTRUCTURE OF IN SITU SYMBIODINIUM MICROADRIATICUM. Timothy S. Wakefield, Dept. of Zoology & Wildlife Science, Auburn Univ., AL 36849. Mark A. Farmer, Ctr. for Advanced Ultrastructural Research, Univ. of Georgia, Athens, GA 30601. Stephen C. Kempf, Dept. of Zoology & Wildlife Science, Auburn Univ., AL 36849

The symbiotic marine dinoflagellate *Symbiodinium microadriaticum* was first isolated from its host *Cassiopeia* sp. and described by Freudenthal in 1962. This early description did not include any ultrastructural data and was based only on light microscope observations. In 1968 Taylor published the first ultrastructural description of a dinoflagellate symbiont found in the anemone *Anemonia sulcata*. This was quickly followed by another study of *S. microadriaticum* by Kevin, *et al.* (1969) wherein an amended description of the species based on ultrastructural features was published. Subsequent authors have relied heavily on this description to explain the ultrstructure of dinoflagellate symbionts. In 1987, Trench and Blank published another amended description of the genus *Symbiodinium* that established 3 new species. In both of these amended descriptions the cell covering or periplast is described as being composed of "a continuous cell wall of varying thickness...underlain by a series of membranes" (Trench & Blank 1987). Our investigations have revealed that these "underlying" membranes do not exist in the symbionts of *Aiptasia pallida* and *Paradisicosoma* sp. Using freeze substitution as a fixation method has resulted in better resolution of this area and has instead revealed the presence of thecal vesicles with internal thecal plates underlain by an array of microtubules. Cultured *S. microadriaticum* have been identified as having these structures, but this is the first report of their *in situ* presence.

EASTERN BLUEBIRD (*Sialia sialis*) STUDIES DURING THE CONSTRUCTION OF A GOLFING COMMUNITY IN NORTH SHELBY COUNTY, ALABAMA Dan C. Holliman, Faculty of Biology, Birmingham-Southern College, Birmingham, AL 35254.

This eight year study traces the history of an Eastern bluebird population on lands that were being developed for a golfing community in north Shelby Co., AL. Usually Eastern bluebird trails are installed after a development has been completed, not while one is under construction. The results of a nest box and banding program are discussed. One thousand and three hundred and sixty birds were fledged and 736 banded during the construction period from 1991-1996. The effects of human disturbance associated with PGA tournaments during five nesting seasons are analyzed. A strategy for the establishment of an Eastern bluebird population in a newly created planned urban development is given.

Abstracts

5 β -ANDROSTANE-3 α ,17 β -DIOL IS NOT AN EFFECTIVE SEX REVERSAL AGENT IN THE TILAPIA *OREOCHROMIS NILOTICUS*. Stephen A. Watts, Kristina Wasson and Michele Patrick. Dept. of Biology, Univ. Ala. Birmingham, Birmingham, AL 35294.

Oreochromis niloticus, the Nile tilapia, is an important food-fish worldwide. Producers prefer to culture all male populations of fish due to their fast rates of growth and lack of reproductive activities which can diminish energy reserves. To this end, genetically mixed-sex populations of tilapia fry are often "sex reversed" using masculinizing agents that produce phenotypic males (functional) from genotypic females. 17 α -methyltestosterone (MT), a synthetic androgen, is the most common agent used for sex reversal in tilapia, although it is not approved at this time for use in the United States. 5 β -androstane-3 α ,17 β -diol (5 β -diol) is the predominant androgen produced naturally in tilapia during the period of sexual differentiation and is synthesized significantly in adult testes. This androgen was fed to developing mixed-sex populations of fry (starting at 11 days post fertilization) at a dose of 60 mg/kg feed; negative control populations received nontreated feed, positive control populations received 60 mg MT/ kg feed for a 28 day period during gonadal differentiation (n=300 fry per treatment). Sex was determined by microscopic examination of gonadal tissues at three months following differentiation. Final sex ratio in negative control populations was 38:62, females: males. Those populations fed MT had a ratio of 4:96 females: males. Those populations fed 5 β -diol had a ratio of 50:50 females: males, which was significantly different from negative control populations (p<0.05, Chi Square). These data suggest that 5 β -diol is weakly androgenic and is not involved in the sex differentiation cascade of Nile tilapia during early development. Supported by the Alabama Academy of Science and USDA.

PURIFICATION AND LOCALIZATION OF THE ENZYME CARBONIC ANHYDRASE FROM THE SCYPHOZOAN *CASSIOPEIA XAMACHANA*. Scott L. Parrish, Raymond P. Henry and Stephen C. Kempf, Dept. of Zoology and Wildlife Science, Auburn Univ., Auburn, AL 36849.

The enzyme carbonic anhydrase (CA), which converts CO₂ to HCO₃⁻ and vice versa, was isolated from homogenates of intact *Cassiopeia xamachana* by gel filtration followed by p-aminomethylbenzene-sulfonamide affinity chromatography. Purity was determined using SDS-PAGE gels stained with Coomassie Brilliant Blue. The purified enzyme has an approximate molecular weight of 34 kD as determined by SDS-PAGE. Following purification, the enzyme was used to produce two murine monoclonal antibodies. The anti-carbonic anhydrase antibodies (4ECA95, 2GCA95) obtained were used to localize the enzyme in the tissues of *Cassiopeia*. Using epifluorescence and confocal microscopy CA was localized to the ectodermal tissues. *Cassiopeia* bears zooxanthellae within the mesoglea near the ectoderm and not within the gastroderm, as seen in other zooxanthellate cnidarians. We conclude that ectoderm is a likely candidate tissue to aid in the supply of inorganic carbon to symbiotic zooxanthellae.

Abstracts

PROTECTION - A VITAL LINK! Susie H. Shepard (Retired), College of Education, Department of Natural Science, University of South Alabama, Mobile, Alabama 36688.

There are four (4) species of gopher tortoise in the United States; only one of the species (Gopherus polyphemus) is found in Alabama's coastal counties. This species is currently protected (under the Endangered Species Act, 1973), west of the Tombigbee and Mobile Rivers. In July 1992, proposed construction of an underground pipeline in north Mobile County threatened a significant population of G. polyphemus. Population density studies were begun as early as 1990. The proposed easement (75 - 100' wide and 3919.52 feet long) involved 36 active, 29 inactive and 6 old burrows. Inactive and old burrows are often "reopened" and/or used as "danger escape" burrows by the G. polyphemus. They are therefore, a vital link of tortoise protection. Studies indicated the chambers of the active and inactive burrows were deep as 8 feet and as long as 31 feet. These data indicated substantial steps would have to be made to secure the habitat of the population. This presentation documents two (2) years of tenacious efforts by a landowner to preserve this G. polyphemus population.

FOODS OF THE ALABAMA BEACH MOUSE (PEROMYSCUS POLIONOTUS AMMOBATES).

James E. Moyers and Nicholas R. Holler, Alabama Cooperative Fish and Wildlife Research Unit, 302 Funches Hall, Auburn University, Alabama 36849-5414.

Food habits of Alabama beach mice (Peromyscus polionotus ammobates) were determined by microscopic analysis of fecal materials collected from populations at two units of the Bon Secour National Wildlife Refuge. Relative Occurrence and Species diversity of food items were computed by season and year for both units. Comparisons of seasonal food habits were made between years and units using parametric and non-parametric tests. Primary foods (>10%) by season were: autumn; bluestem (Schizachyrium maritimum), evening primrose (Oenothera humifusa), dune spurge (Chamaesyche ammannioides), and jointweed (Polygonella gracilis), winter; sea oats (Uniola paniculata), bluestem, and jointweed, spring; evening primrose, toad flax (Linaria floridana), beach pea (Gallactia sp.), and pennywort (Hydrocotyle bonariensis), summer; evening primrose and dune spurge. Insects were consumed year round with highest consumption occurring in winter and spring. Diversity of diets was highest in winter for mice at both units. Differences in consumption of individual diet items occurred between years and units, presumably due to differences in availability of foods at the time of sampling. Based on these data, beach mice are granivore/omnivore rodents that primarily consume products of low-growing, prostrate plants or plant products that have dropped to the dune surface. Management practices that increase foods for beach mice and speed recovery of dune habitat will be discussed.

Abstracts

NESTING BIOLOGY OF THE GRASS-CARRIER WASP, ISODONTIA MEXICANA (SPHECIDAE). T. Paige Carithers and Debbie R. Folkerts, Dept. of Zoology and Wildlife Science, Auburn University, AL 36849.

The effects of variable nest cavity parameters (pitcher plant species, leaf height and diameter, and nest opening) and construction parameters (number of cells per nest and nest length) on reproductive success were investigated in populations of Isodontia mexicana (Hymenoptera: Sphecidae) nesting in the tubular leaves of pitcher plants (Sarracenia spp.). This species is one of a group of "grass carrier" wasps, so called because they are often seen flying with blades of grass with which they build their nests. In the Gulf Coastal Plain, this wasp nests in 5 different species of pitcher plants. Neither the species of pitcher plant, leaf height, or nest opening had any significant effect on nest success. However, the diameters of successful nests were significantly smaller than unsuccessful nests. The average percent of success among 1, 2, 3, and 4-celled nests did not significantly differ. However, among 1-celled nests, those with greater lengths were more successful. The significantly smaller leaf diameters of successful nests may relate to an increase in their total length. Longer nests may indicate that more grass was used in their construction which may provide more protection against outside elements and parasites. Future analysis will investigate this possibility. This research was supported in part by an Alabama Academy of Science grant.

PRELIMINARY STUDIES ON THE USE OF POECILIID FISHES AS SENSITIVE BIOINDICATORS OF ENVIRONMENTAL ANDROGENS

Connie L. Miller and Robert Angus, Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham, Al 35294

Chemicals which display hormone-like activity in animals or humans, and which have the potential to interfere with the critical timing of events in growth and development are known as endocrine disruptors. With the recognition of the potentially serious effects of environmental endocrine disruptors on humans and wildlife comes the realization that we badly need methods for identifying compounds with effects on endocrine systems. Our research focuses on the use of mosquitofish (Gambusia affinis, Poeciliidae) as a test system for the detection of endocrine disruptors in the environment. We are using a morphological trait to test for androgenic activity. Male mosquitofish have a modified anal fin (gonopodium) used in mating. Although this structure is normally present only in males, it is readily induced to develop in females exposed to androgens. Currently we are treating female mosquitofish with testosterone in order to establish a dose-response curve. Our goal is to document the suitability of these fish as sensitive bioindicators for use in testing compounds with suspected androgenic activity.

THE EPIPHYTIC FRUTICOSE LICHEN SPECIES IN COFFEE COUNTY, ALABAMA AND THEIR DIAGNOSTIC FEATURES. Nadine Scarborough, Alvin Diamond, and Charles Chapman, Biology Department, Troy State University Troy, Alabama 36082

Four species of epiphytic fruticose lichens were collected in a study in Coffee County. These included Ramalina americana, Teloschistes exilis, Usnea mutabilis, and Usnea strigosa. Ramalina americana and Teloschistes exilis have flattened thalli in cross section. Ramalina is greenish in color due to the presence of usnic acid whereas Teloschistes is orange in color due to the presence of parietin. The thallus of Usnea mutabilis and Usnea strigosa are round in cross section. Usnea mutabilis possesses soredia and lacks apothecia whereas Usnea strigosa lacks soredia but commonly has apothecia. All four species can be found growing in the same tree but Teloschistes and Usnea mutabilis were encountered much less frequently.

PLASMID DNA CURING: A SIMPLE AND EFFICIENT METHOD. Joy E. Bagley and Richard E. Musso, Department of Botany and Microbiology, Auburn University, AL 36849.

Multi-copy plasmids are invaluable vectors for the cloning of DNA into bacterial cells. Plasmid transformed cells are selectable on media containing antibiotics because the plasmids carry genes for various drug resistances. However, the presence of a large amount of multi-copy plasmid DNA often obscures some types of genetic or biochemical analyses of the single-copy genomic DNA. This can cause serious difficulties when Southern hybridization analyses are performed on DNA isolated from transformed cells. Ideally, the plasmids should be eliminated before such analyses but existing methods for plasmid curing have required construction of special strains or the problematic treatment with chemical agents. We have discovered a much simpler and widely applicable method for curing plasmids from their bacterial host. The method involves prolonged incubation at elevated temperatures under non-selective growth conditions: typically 3 days at 42° C. This simple procedure resulted in colonies which generally contained a high percentage of cured cells. It has been successfully used to cure derivatives of the widely used plasmid vectors pBS(+), pUC18, pBR322, and pACYC184 from bacterial host strains including XL1-Blue and derivatives of E. coli K12, E. coli C, and E. coli B. Less efficient curing is observed after incubation at lower temperatures or for shorter times. This research has been supported by the Howard Hughes Medical Institute and the Alabama Agricultural Experiment Station.

STEROID METABOLISM IN HUMAN MONONUCLEOCYTES. Tony McKenzie, Kristina Wasson, Stephen Watts and John Kappes*. Dept. of Biology and Center for Aids Research*, Univ. Ala. Birmingham, Birmingham, AL 35294.

Dehydroepiandrosterone (DHEA), produced commonly in the adrenals, has little androgenic activity. It is reported to have immunostimulatory functions in other tissues, and can inhibit *in vitro* HIV-1 replication in human lymphocytes and macrophages. In fact, a high affinity receptor for DHEA is found in CD4 helper T-cells. Other studies have reported that DHEA blood levels fall during the progression of HIV. Since DHEA can be metabolized to other androgens and estrogens, we investigated the metabolic fate of DHEA and pregnenolone (a precursor steroid) in a white blood cell population. A "buffy" from a non-infected donor containing neutrophils, eosinophils, basophils, lymphocytes and macrophages was incubated in ^3H -DHEA, ^3H -pregnenolone or ^3H -testosterone for 3 hr. DHEA and testosterone were not metabolized; a small percentage of the pregnenolone precursor was esterified, presumably with a fatty acid. The lack of metabolic products in this cell preparation was unusual since most cells contain various dehydrogenases, isomerases and aromatases, usually resulting in the conversion of these precursors to other steroid metabolites. Because DHEA was not metabolized, we hypothesize that DHEA is a direct biological activator. The previous discovery of the DHEA receptor in T-cells supports this hypothesis. Future work includes an examination of HIV infected cells and the effects of pre-exposure of non-infected white blood cells to DHEA on the subsequent rates of HIV infectivity. Supported by the Alabama Academy of Science.

A COMPARITIVE ASSESSMENT OF RIPARIAN VEGETATION AND STREAM HYDROGEOMORPHOLOGY OF TWO STREAM CHARACTERIZATIONS WITHIN THE TERRAPIN CREEK WATERSHED, CLEBURNE COUNTY, AL.

Jason R. Adams, Althea Thompson, John Moser, Jackie Carter, Amanda Eddings, Dr. Frank A. Romano, and Dr. R. David Whetstone, Dept. of Biology, Jacksonville State Univ., Jacksonville, AL 36265.

From September 1996 to February 1997, a stream characterization was performed on two locations of the Terrapin Creek watershed located in Cleburne County, AL. Site I is located on an unnamed tributary west of Forestry Service 500, Cleburne County, AL. Site II is located on South Fork Creek in Cleburne County approximately 8km south of the Seaboard Coastline Railroad, now part of the "Rails to Trails Program". The purpose of this project was to assess stream hydrogeomorphology, riparian vegetation, benthic invertebrate communities, and stream chemistry of the two sites. Preliminary results indicate topographic changes within the stream from Site I and Site II influence differences in the stream's hydrogeomorphic, chemical, and biotic composition.

Abstracts

THE MOLECULAR CLONING OF A CDNA ENCODING PUTATIVE MOLT-INHIBITING HORMONE OF THE DUNGENESS CRAB, CANCER MAGISTER. H.R. Umphrey, K.J. Lee, R.D. Watson, Dept. of Biology, University of Alabama at Birmingham, AL. 35294. E. Spaziani, Dept. of Biological Sciences, University of Iowa, Iowa City, IA. 52242.

Secretion of ecdysteroid molting hormones by crustacean Y-organs is negatively regulated by a neuropeptide, molt-inhibiting hormone (MIH), produced in eyestalk neurosecretory cells. We report here the molecular cloning of a cDNA encoding putative MIH of the Dungeness crab, Cancer magister. A unidirectional cDNA library was commercially prepared in the Uni-Zap XR Vector (Stratagene Custom Library Service) using poly(A+) RNA isolated from eyestalk neural ganglia of C. magister. The library was screened using a 253 base pair fragment of a previously cloned cDNA encoding putative MIH of the blue crab, Callinectes sapidus. The DNA sequence of one positive clone contained a 339 base pair open reading frame encoding a 78 amino acid putative MIH and a 35 amino acid signal peptide. The deduced amino acid sequence of C. magister MIH is 79% identical with the deduced amino acid sequence of C. sapidus MIH, 75% identical with MIH purified from the shore crab (Carcinus maenas), and 98% identical with that purified from the edible crab, Cancer pagurus. Supported by NSF (IBN-9419916) and NOAA/MS-AL Sea Grant (NA16RG0155).

HERON COLONIES IN THE MONTGOMERY AREA 1961 - 1996. Julian L. Dusi, Dept. of Zoology and Wildlife Science, Auburn Univ., Auburn Univ, AL 36849. Rosemary D. Dusi, 560 Sherwood Dr., Auburn AL 36830.

The Montgomery, Ala. area, 1961-1996, has always had at least one heron colony. In 1961, we first knew about the Little Blue Heron colony at Mountain Creek, north of Montgomery. It was active until 1967. Cattle Egrets dispersed into Alabama in 1963 and from 1964 - 1970, formed a colony in the Montgomery suburb of Pinedale. From 1970-1972, a mostly Cattle Egret colony was located near Pintlala, just south of Montgomery. At the McLemore Plantation east of Montgomery a Cattle Egret/Little Blue Heron colony was present in 1972. In Millbrook, to the north of Montgomery, a mixed colony was present from 1973-1983. In 1984-1985, a mostly Cattle Egret colony formed on an island in Cooter's Pond, in Alabama River north of Montgomery. In 1990, the colony moved just south of Millbrook to a gravel pit. In the Normandale suburb, a Black-crowned Night-Heron colony was present at least from 1983-1986 and may still be there. Near the Hooper Academy, located near the I-65 Pintlala Exit, a Great Blue Heron colony has been present in a single osage-orange tree, from at least 1985 to the present.

POLLINATION BIOLOGY OF *CYRILLA RACEMIFLORA* L. James E. Watkins, Jr.¹, Roland R. Dute¹, and Debbie R. Folkerts^{1,2}, Department of Botany and Microbiology¹ and Department of Zoology², Auburn University, AL 36830.

Understanding pollinator diversity and floral morphology helps explain pollination syndromes and the speciation processes in plants. This study was conducted to better understand stigmatic morphology, secretory characteristics, pollen morphology, and pollinator diversity of *Cyrilla racemiflora* L. The effects of flower age and time of day were examined using scanning electron microscopy to determine which variable, if either, had an effect on stigmatic secretions. Pollinator diversity was examined and pollen load diversity from *Bombus fraternus* (Hymenoptera: Apidae) and *Dialictus* sp. (Hymenoptera: Halictidae) was obtained using light microscopy to determine if either species acted as probable primary pollinators. The stigma of *C. racemiflora* was discovered to be bilobed with a glandular trichome tip correlated with a stigmatic exudate and a proximal zone of unmodified epidermal cells. The stigmatic secretion was neither time of day nor floral age dependent, and it was discovered that chemical processing of stigmas from scanning electron microscopy dissolved the secreted material. Pollen from 10 different species was discovered in the corbiculi of *B. fraternus* with 54% originating from *C. racemiflora*. Pollen from three different species was observed on *Dialictus* sp. with 90% from *C. racemiflora*. It was therefore determined that *Dialictus* sp. act as probable primary pollinators of *C. racemiflora*.

THE DISTINGUISHING FEATURES OF EPIPHYTIC FRUTICOSE LICHEN SPECIES IN PIKE COUNTY, ALABAMA. Jason Lowe, Alvin Diamond, and Charles Chapman, Biology Department, Troy State University Troy, Alabama 36082.

Seven species of epiphytic fruticose lichens were collected in a study in Pike County. These included Ramalina americana, Heterodermia echinata, Teloschistes exilis, and four species of *Usnea*: U. antillarum, U. mutabilis, U. strigosa, U. trichodea. Ramalina, Heterodermia, and Teloschistes have flattened thalli in cross section. Ramalina and Teloschistes are upright in growth form with a single point of attachment whereas Heterodermia exhibits a procumbent growth form being upright only along the margins. Teloschistes is orange in color due to the presence of parietin. Ramalina is green in color due to the presence of usnic acid. The thalli of Usnea species are round in cross section. Usnea antillarum has a hollow thallus whereas the other species exhibit a dense central cord. Usnea strigosa commonly possesses apothecia but lacks soredia. Usnea trichodea and Usnea mutabilis possess soredia but generally lack apothecia. Usnea mutabilis differs from Usnea trichodea in that its central cord is rose pink in color versus white. Usnea mutabilis also differs from Usnea trichodea in size and habitat.

PRELIMINARY STUDIES ON THE USE OF POECILIID FISHES AS SENSITIVE BIOINDICATORS OF ENVIRONMENTAL ESTROGENS

Amy Mehollin and Robert Angus, Dept. Of Biology, Univ. of Ala. At Birmingham, Birmingham, AL 35294

Test systems for the presence of chemicals which exhibit hormone-like activity in animals and plants (endocrine disruptors) are badly needed. Our research centers around the development of mosquitofish (*Gambusia affinis* Poeciliidae) as sensitive bioindicators for the identification of environmental endocrine disruptors. We intend to use expression of the (normally female-limited) vitellogenin gene in males to test chemicals for estrogenic activity. We are developing a quantitative enzyme-linked immunosorbent assay (ELISA) for vitellogenin (VTG), a serum phospholipoglycoprotein precursor to egg yolk. The VTG gene requires estrogenic stimulation for expression and is normally undetectable in the plasma of immature animals and males. However, males can be induced to produce VTG if exposed to estrogenic hormones. Thus, VTG is potentially an ideal biomarker for detecting compounds with estrogenic activity. We will present data demonstrating that VTG expression is induced in male mosquitofish which have been treated with estrogen. Currently we are purifying VTG from female mosquitofish using polyacrylamide gel electrophoresis. Our next step is to raise anti-VTG serum in rabbits for use in the ELISA. Once developed, the ELISA will be used as a quantitative assay of VTG in the serum of male mosquitofish known, or suspected, to have been exposed to estrogenic chemicals.

COMPARISON OF SUBSTRATE PREFERENCE FOR ATTACHMENT BETWEEN FRUTICOSE LICHENS RAMALINA AMERICANA AND USNEA STRIGOSA IN PIKE COUNTY, ALABAMA. Jason Lowe, Alvin Diamond, and Charles Chapman, Biology Department, Troy State University Troy, Alabama 36082.

Two hundred and seven species of woody plants have been documented or reported to occur as native or naturalized species in Pike County. Of this number, 137 species or 66% of the total species of woody plants did not support either of the species under study. Usnea strigosa was found on 61 species or 29% of the total number of the woody species. Of this number, 20 species were dead; 18 species were living; and 23 species supported Usnea on both living and dead wood. Ramalina americana was found on 48 species or 23% of the total number of the woody species. Of this number, 14 species were dead; 14 were living; and 20 species supported Ramalina on both living and dead wood. Thirty-five species supported both Ramalina and Usnea.

A simple and rapid extraction procedure for the analysis of proteinase inhibitors from tomato plants. J. Pettus M. Newman and C. Olander. Department of Biology, Jacksonville State University, Jacksonville, AL 36265.

Proteinase inhibitors, which are toxic to insects, are a crucial part of the defense mechanism for tomato and various other related plants. In past studies of proteinase inhibitor activity, cell extracts were prepared either by homogenization or grinding by using a mortar and pestle with ice cold buffer. This procedure unfortunately lysed the chloroplasts causing chlorophyll to be released into the cell extract. We have developed a new one step extraction procedure which is simpler, faster, and allows more samples to be harvested simultaneously. This new procedure uses centrifugation alone without any grinding or homogenization. Therefore, it produces no coloration of the cell extract. With centrifugation alone, there is the additional benefit of undiluted cell extract. This undiluted cell extract makes it possible to assay proteinase inhibitor activity in smaller volumes. Using this new procedure, we followed the appearance of proteinase inhibitors in distant leaves from 0 to 168 hours after injury.

ANALYSIS OF DYNEIN POLYPEPTIDES FROM MORONE SPP. Anthony G. Moss, Susan Smith, John Watford, and Anne M. Estes. Department of Zoology and Wildlife Sciences, Auburn University, Auburn, AL 36849-5414.

Striped bass (Morone saxatilis) sperm dyneins comprise two distinct molecular complexes, one of which migrates at greater than 20 S in a 5-20% rate-zonal sucrose gradient, much like the outer arm dynein of Chlamydomonas (King, et al., *Meth Enzymol.* 134:291, and rainbow trout, Onchorhynchus mykiss (Moss et al., 1991, *Meth Enzymol.* 196:201). A second dynein peaks occurs at ~11S and presumably represent inner arm dyneins, again as is seen in Chlamydomonas, Tetrahymena (Johnson, *Annu. Rev. Biophys. Biophys. Chem* 14:161) and sea urchin. SDS-PAGE analysis of the high mass dynein polypeptides suggests that striped bass outer arm dynein may bear three high molecular weight ATPase subunits. This unexpected result was preliminarily confirmed by negative staining of sucrose gradient purified 20S+ dynein. A single major intermediate chain of approximately 70 kDa comigrates at 20S+, with four light chains of 10-25 kDa. The 11S heavy chains are substantially lower in apparent molecular weight than the 20S species, and much more complex in composition, suggesting that they may be elements of the inner arm complex. An intermediate chain of ~150 kDa is associated with the 11S complex. The 11S dynein(s) comprise in addition, 20 and 50 kDa light chains. We confirm the presence of a 6S complex strongly conserved across multiple phyla to be within the high salt extract that contains polypeptides of ~100 kDa and ~60 kDa. (Supported by a grant from the Alabama Agricultural Experiment Station to AGM).

Abstracts

A PRELIMINARY MORPHOMETRIC STUDY OF ALABAMA POPULATIONS OF CAMBARUS (LACUNICAMBARUS) AND CAMBARUS (TUBERICAMBARUS). Patrick R. Stephens, Dept. of Biology, University of South Alabama, Mobile, AL 36688.

The taxonomy of the subgenera of burrowing crayfish Cambarus (Lacunicambarus) and Cambarus (Tubericambarus) is difficult. The latter, recently erected by Jezerinac, is represented by at least one undescribed species and both subgenera are composed of species with few characters that provide sharp delineation; a problem that extends to the subgenera themselves. At least five species in the complex occur in Alabama, however no detailed analysis of Alabama populations of these subgenera has ever been undertaken. During the summer of 1996 a preliminary study was undertaken to determine whether a morphometric analysis would be useful in resolving questions about these subgenera. Fifty seven adult specimens from the collection of J.F. Fitzpatrick, Jr; including the species C. (L.) diogenes, C. (L.) miltus, C. (L.) ludovicanus, C. (T.) acanthura, and C. (T.) species A; were used. Thirty nine observations were made of each specimen. Non-parametric data were analyzed using two-way chi-square tests. From the parametric data thirteen ratios were calculated (to correct for size differences) and analyzed using two samples t-test and ANOVA procedures. Analysis showed that the species examined can be distinguished statistically using most of the measurements taken. It therefore seems that a full morphometric analysis would resolve the status of the several Alabama populations. The identity of the subgenera, however, are not so easily determined.

THE EFFECTS OF LIGHTING CONDITIONS UPON DEVELOPMENT OF THE MALE RAT REPRODUCTIVE SYSTEM. Marilyn Wyatt Harris and P. Samuel Campbell, Dept. of Biological Sciences, UAH, Huntsville, AL 35899.

Sprague-Dawley rats were raised in various lighting conditions for periods of 30 days, 48 days or 127 days. Animals were reared under constant light, 20 hrs light/4 hrs dark (20L/4D) or 20 hrs dark/4 hrs light (20D/4L) from day 1 of life. Reproductive tissues were excised and weighed on the day of necropsy. Testes were fixed in neutral buffered formalin for histological observation. A blood sample was also taken by cardiac puncture for testosterone analysis. Results indicated an interaction between length of light exposure and reproductive organ development. At 30 days of age, significant differences were noted between animals in constant light and those in the 20D/4L light schedule ($p=0.004$). Also, significant differences were noted between the 20D/4L and the 20L/4D groups ($p=0.015$). At 48 days of age, there was a significant difference between the constant light group and the 20D/4L group ($p=0.037$). By 127 days of age these significant differences were no longer apparent. Constant light exposure resulted in the male rat coming into puberty earlier than those raised under prolonged dark conditions as evident by an accelerated rate of sex accessory organ development. Additionally, the histological development of the seminiferous tubules in the constant light group was more advanced at 30 days of age than those in the 20D/4L treatment group. All treatment groups exhibited the presence of spermatozoa in the seminiferous tubules at 48 and 127 days of age. However, the density of spermatozoa in the lumen of the seminiferous tubules appeared to be somewhat lower in the 20D/4L group. Body weights also were heavier in the constant light treatment group at all ages studied. Thus, photoperiod can affect gonadotropin secretion in the laboratory male rat to differentially control rate of gonadal development. Perhaps these effects are mediated through altered melatonin secretion under conditions of constant light exposure and prolonged dark exposure.

GENOMIC VARIATION OF *ARCOBACTER SKIRROWII* DETERMINED BY PULSED-FIELD-GEL ELECTROPHORESIS. Omar A. Oyarzabal, Jason Shireman, and Donald E. Conner, Dept. of Poultry Sci. and James M. Barbaree and Steffen Beckert, Dept. of Botany and Microbiol., Auburn Univ., Auburn, AL 36849. Irene V. Wesley, NADC, USDA, Ames, IA.

Arcobacter skirrowii has been isolated from different animal species. Currently, its role is undetermined in both animal and human disease. We undertook a study to determine the genomic variation and the genome size of 18 ATCC and field isolates of *Arcobacter skirrowii* by DNA restriction with subsequent pulsed-field-gel electrophoresis (PFGE). Restriction with *Sac* II and *Sma* I yielded bands suitable for assessing the genome size. Restriction with *Sac* II yielded four to five DNA bands of different sizes in all the strains, but only two strains presented identical patterns. When DNA was restricted with *Sma* I, each strain showed a unique pattern with five to nine bands of different sizes. Restriction enzymes that produced multiple cuts in the *A.skirrowii* genome were *Bcl* I, *Cla* I, *Eco*R I, *Kpn* I, *Nsi* I, *Pvu* II, *Smn* I, *Vsp* I and *Xba* I. Other enzymes (*Alu* I, *Apa* I, *Dra* I, *Not* I, *Sfi* I) did not restrict the genome. This study shows that *A.skirrowii* exhibits remarkable genomic variation. Preliminary data reveal that *A.skirrowii* has a genome size of approximately 1.7 Mb, similar to *C.jejuni* and *C.coli*. Our results confirm that PFGE is a highly discriminatory technique that could be used in epidemiological studies of *A.skirrowii*. Furthermore, the segments of DNA generated by PFGE might be used for specific identification of this bacterium.

PRODUCTION OF POLYPHENOLS AND CONDENSED TANNINS IS SENSITIVE TO ATMOSPHERIC CO₂ CONCENTRATION, NITROGEN AVAILABILITY, AND WATER STATUS IN LONGLEAF PINE FOLIAGE. Seth G. Pritchard and Curt M. Peterson, Dept. of Botany and Microbiology, Auburn Univ. AL 36849. G. Brett Runion, School of Forestry, Auburn Univ. AL 36849. Stephen A. Prior and Hugo H. Rogers, USDS-ARS National Soil Dynamics Laboratory, Auburn, AL 36830.

Production of phenolic compounds is sensitive to environmental conditions. Longleaf pine was grown in open top chambers at two levels of atmospheric CO₂ (720 and 365 $\mu\text{mol mol}^{-1}$), two levels of soil N (4 g m⁻² y⁻¹ and 40 g m⁻² y⁻¹), and two soil moisture levels (-0.5 and -1.5 MPa). After 20 months of exposure, needles were collected and polyphenol content was determined using the Folin-Denis assay and condensed tannins were estimated by precipitation with protein. Total leaf polyphenol and condensed tannin content were increased by main effects of elevated CO₂, low soil N and well-watered conditions. Leaves from seedlings grown under limiting N had a greater percentage of total phenolics removed from solution by precipitation with protein than those plants grown under high N conditions. Results suggest that phenolic production is dictated by carbon availability.

Abstracts

RESPONSES OF GRAY SQUIRRELS (SCIURUS CAROLINENSIS) TO INTERSPECIFIC ALARM CALLS. Jason B. Jennings and Robert S. Lishak, Department of Zoology, Auburn University, AL 36849

Alarm calls of eastern chipmunks (Tamias striatus) and blue jays (Cyanocitta cristata) were recorded, digitally filtered to eliminate background noise, and were played through speakers in an effort to understand how gray squirrels (Sciurus carolinensis) respond to interspecific alarm calls. The calls used were a chipmunk "chuck" and a blue jay "jay" call, and combined chuck and jay call. Data were collected on adult males and females and on juvenile males and females during summer and fall. All research was conducted in front of the Ralph B. Draughon library at Auburn University, Alabama. Financial support was through a grant from the Alabama Academy of Science. All sexes and ages responded significantly higher in the summer than in the fall except adult females for which there were no significant differences. Adult males and juvenile males responded approximately the same during the summer, however, adult males responded significantly higher than juvenile males in the fall. Juvenile females responded significantly higher than adult females during the summer. The reverse is true for the fall. Adult males responded significantly higher than adult females in the summer and fall. Juvenile males responded more than juvenile females in the summer. During the fall, juvenile females responded significantly more than juvenile males. The chuck call elicited more responses than either the jay call or the combined chuck/jay call.

EXPRESSION AND PURIFICATION OF RECOMBINANT MOLT-INHIBITING HORMONE FROM THE BLUE CRAB CALLINECTES Sapidus. K.J. Lee, R. D. Watson, Dept. of Biology, University of Alabama at Birmingham, Birmingham, AL 35294. T. S. Elton, Dept. of Chem. and Biochem., Brigham Young University, Provo, UT 84602.

In crustaceans, cycles of growth and molting are controlled by steroid hormones (ecdysteroids) secreted by paired endocrine glands, the Y-organs. The synthesis of ecdysteroids by Y-organs is negatively regulated by a neuropeptide, molt-inhibiting hormone (MIH), produced by a cluster of neurosecretory cells (the X-organ) in eyestalk neural ganglia. The availability of recombinant MIH would facilitate investigation of its structure and function. In studies reported here, a baculovirus/Sf9 insect cell expression system was used for production of recombinant MIH. A portion of a cDNA encoding MIH from the blue crab Callinectes sapidus (Lee et al., Biochem. Biophys. Res. Comm. 209: 1126-1131, 1995) was inserted into the baculovirus transfer vector pBlueBacIII. Spodoptera frugiperda Sf9 cells were cotransfected with the recombinant pBlueBacIII vector and wild type Autographa californica nuclear polyhedrosis virus DNA. Several baculovirus recombinants were analyzed for their ability to express recombinant MIH. Western blot results (using antiserum raised against MIH of Carcinus maenas) indicated expression of two MIH-immunoreactive proteins; the sizes correspond to those predicted for MIH with and without the signal peptide. A preparation enriched for the expressed recombinant MIH was achieved by heating (100°C, 2 min.) insect cell lysates; the MIH protein is heat stable and remains in the soluble fraction. Further purification by ion exchange chromatography is in progress. Supported by NSF (IBN-9419916) and NOAA/MS-AL SeaGrant (NA16RG0155-03).

EFFECTS OF VITAMIN E DEFICIENCY ON THE REPRODUCTIVE PERFORMANCE IN THE FEMALE RAT. Miriosh A. Higgs and Ashton F. E. Gibbons, Dept. Biological Sciences, Oakwood College, Huntsville, AL 35896.

Pregnant rats were maintained on a diet deficient in Vitamin E throughout the entire period of gestation. During and after pregnancy observations on a variety of parameters relating to early development were studied. Follicular development in the ovaries was studied, ovulation rate, fertilization rate, egg transport and implantation rate were also observed. We also noted the time of onset of the estrous cycle. The data show clearly that follicular development was significantly depressed when compared with controls. The ovulation rate was also lowered. Egg passage through the oviduct was speeded up so that by the fourth day post coitum all eggs had already reach the uterus. Perhaps as a result of this swift passage of eggs through the oviduct several fertilized eggs were unable to implant; thereby decreasing the overall implantation rate. These findings extended earlier reports (Masm, 1972) that Vitamin E deficiency did produce certain deleterious impact on fetal rat development.

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DISTRIBUTION OF OXYTOCIN RECEPTORS IN THE BRAIN: A COMPARISON OF BATS AND VOLES. Michelle L. Davis and Mary T. Mendonca, Dept. of Zoology, Auburn Univ., AL 36849. Larry J. Young, Dept. of Psychiatry, Emory Univ., Atlanta, GA 30322.

Previous research has shown that the neuropeptide oxytocin affects affiliative behavior, such as sex behavior and parental care. Two voles of the genus Microtus display different patterns of social affiliation, as the prairie vole (M. ochrogaster) is monogamous and the montane vole (M. montanus) is polygamous. These two species also differ in their regions of oxytocin receptor distribution in the brain. Using receptor autoradiography, M. ochrogaster showed high receptor densities in the bed nucleus of the stria terminalis, midline nucleus of the thalamus, and the lateral aspects of the amygdala. M. montanus had little binding in these areas, but showed binding in the ventromedial nucleus of the hypothalamus and the cortical nucleus of the amygdala. Big brown bats, Eptesicus fuscus, have varying degrees of affiliative behavior, depending on the season. In fall, they are often found in large groups, while they prefer isolation in spring. Bats from fall have high levels of oxytocin receptors in the arcuate, amygdala, and bed nucleus of the stria terminalis. To determine if oxytocin distribution varies seasonally, future studies will examine bats at different times of the year.

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EFFECTS OF CIGARETTE SMOKE ON THE MAMMALIAN TRACHEAL CILIATED EPITHELIUM. Darrell D. Morgan and Anthony G. Moss. Dept. of Zoology and Wildlife Science, Auburn University, Auburn, AL 36849-5414.

The mammalian trachea is lined with a pseudostratified columnar epithelium that provides an important line of defense for the lungs against inhaled toxins and particulate material. Primary defense is provided by cephalad mucociliary clearance which is driven by the beating of cilia located on the apical surface of ciliated epithelial cells lining the trachea. This work examines cytostructural consequences of the inhalation of cigarette smoke that lead to the breakdown of mucociliary clearance. An electronically controlled "smoking machine" was constructed to deliver a controlled rate and volume of smoke from research grade type 4A1 (University of Kentucky) cigarettes to the tracheal lining. Neonatal pigs provided healthy tracheal tissue which had not previously experienced air-borne irritants. Digitally-enhanced immunofluorescence microscopy and laser scanning confocal microscopy revealed that epithelia exposed to the smoke of five cigarettes experienced profound apically-directed redistribution of the endoplasmic reticulum, and the breakdown of cytoskeletal F-actin and cytoplasmic microtubules. Closer examination *via* transmission electron microscopy reveals epithelial cell dissociation from the basement membrane. Cell dissociation accompanies ciliary abscission and severe apical membrane blebbing, suggesting profound disruption of membrane-cytoskeletal linkages essential to normal cytoplasmic organization. (Supported by AHA A-1-G-940012 to AGM)

APPLICATION OF BIOTECHNOLOGY IN BIOREMEDIATION OF CONTAMINATED SEDIMENTS. Vanosia S. Faison and Shivendra V. Sahi, Dept. of Biology, Alabama State University, Montgomery, AL 36101-0271

The goal of this study is to use Sesbania drummondii to remove heavy metals and other pollutants from contaminated sites. In order to achieve this goal: 1.) we are using cell culture of Sesbania to isolate cell lines which have the ability to grow in high concentrations of copper (Cu) and nickel (Ni). Experiments are underway to regenerate these cell lines for further study of the metals uptake. 2.) the hydroponic experiments with varying concentrations of Cu have shown an increase in the Cu uptake by Sesbania seedlings. Seedlings were healthy and growing in 500mg/l Cu, and were able to sequester up to 154.4 micro mol Cu/g dry weight of Sesbania. There was an increase in Cu uptake as the concentrations were increased beyond 500mg/l, but the seedlings were unable to survive. This study suggests that Sesbania may have potential in phytoremediation of toxic metal(s). this research was supported, in part, by a research grant from EPA/HSRC (S & SW Center).

Abstracts

NOVEL GENES ASSOCIATED WITH ABSCISSION IN COTTON. Liwei Chen, Narendra K. Singh and Curt M. Peterson, Department of Botany and Microbiology, Auburn University, AL 36849

Abscission is a process whereby plants shed their organs such as leaves, flowers and fruits. The process of abscission involves a series of physiological and biochemical changes that lead to the breakdown of the middle lamella and primary cell wall of target cells in the abscission zone, then separation of the target cells and abscission. In cotton, flower and boll abscission limit yield potential and delayed abscission of later formed leaves in the upper part of the canopy contributes to increased staining and trash in lint during harvesting. Studying the genes associated with abscission in cotton may permit genetic manipulation of this crop for increased yield and improved lint quality. The objectives of this study are: (1) to isolate and characterize genes associated with abscission in cotton, and (2) determine the temporal and spatial expression of abscission associated genes in abscission zone tissues. CA43, a cDNA clone, was isolated from a cotton abscission cDNA library which was constructed using mRNA extracted from petiole abscission zones 48 h after ethephon treatment. The CA43 cDNA hybridized to an mRNA of about 1.1kb that exhibited its highest level of expression in abscission zones 24 to 48 h after ethephon treatment. Southern blot analysis of CA43 suggests that it is encoded by a single gene in the cotton genome. Translation of the CA43 DNA sequence revealed 140 amino acid residues which likely represents a partial length of gene, because the initiator methionine codon was not found. The predicted amino acid sequence of CA43 cDNA exhibited maximum homology with Tasselseed2 (Ts2), showing 47.14% identity and 18.57% similarity. The predicted CA43 product belongs to a family of short-chain alcohol dehydrogenase having a highly conserved YxxSK motif which is thought to be involved in catalysis or subunit interaction. Clone CA73 was isolated from the abscission cDNA library and was expressed significantly in abscission zone 24 h after ethephon treatment. Comparison of the CA73 nucleotide and protein sequences has not revealed any significant sequence similarity. The roles of these two genes remain to be elucidated

THE EFFECTS OF QUALITATIVELY DIFFERENT DIETS OR STARVATION ON THE ONTOGENY OF A FUNCTIONAL DIGESTIVE SYSTEM IN THE CICHLID OREOCHROMIS NILOTICUS. Charles D. Bishop and Stephen A. Watts, Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294-1170.

The early developmental trends in gut morphology and digestive enzyme physiology are profoundly affected by the diet proffered and accessible to the individual at first feed (8 days post-fertilization). Several broods of fertilized eggs were removed from the mouths of female tilapia and, at first feed, were proffered either a good quality diet (Artemia sp. + Trout Chow Starter, Purina), a poor quality diet (pulverized Catfish Chow, Purina) or starved. Samples from each brood were prepared for histological analysis to monitor the affect of diet or starvation on the development of the alimentary canal and accessory digestive organs, a separate group of individuals were preserved and analysed to delineate significant trends in digestive enzyme production (pepsin, trypsin, bile-salt dependant lipase and alpha-amylase). The development of the gut epithelium (specifically the stomach mucosae) coincided with shifts in key digestive enzyme production. Diet had the greatest impact on the timing of the digestive enzyme production primarily due to a delay in the normal development of the gastric mucosae. It was evident that the absence of a live diet at first feed caused a delay in the proper development of the digestive system and had a significant impact on the overall growth of the individual during early development, and may adversely affect the growth potential of the individual.

Abstracts

USE OF PCR TO DETECT ESCHERICHIA COLI O157:H7 AND ENTEROHEMORRHAGIC E. COLI IN BOVINE FECES. Jared G. Kerr, James .M. Barbaree, and Alex E. Smith, Botany and Microbiology Dept., and Stuart B. Price, Pathobiology Dept., Auburn Univ., Auburn University, AL 36849.

Escherichia coli O157:H7 is a member of the Enterohemorrhagic *E. coli* group (EHEC) which causes diseases such as hemorrhagic colitis and hemolytic uremia syndrome. Several *E. coli* O157:H7 infections are diagnosed each year in Alabama, and research is needed to pinpoint the sources. Since the apparent main reservoir for *E. coli* O157:H7 is the intestinal tract of a minor part of the bovine (cattle) population, sensitive procedures are needed to detect this organism. Our studies employed a polymerase chain reaction (PCR) procedure to detect this bacterium in bovine feces. Amplicon primers targeting the uidA and eaeA primers specific for *E. coli* O157:H7 were used to detect it in experimental bovine feces seeded with varying concentrations of the bacterium. Extraction of the DNA was accomplished best using a commercial kit, and the thermalcycle was optimized. Consistent results were not attainable with high concentrations of *E. coli* O157:H7 ($10^3/g$), but 0.1 CFU per gram of feces was detected in the low level range using the eaeA primer system. Further work is needed to improve the reproducibility and make it faster than a 12 hour procedure.

CONNECTING THE HYOID TO THE DELPHINID CRANIUM. Gerald T. Regan, Dept. of Biology, Spring Hill College, Mobile, AL 36608.

Few displays of head skeletons of dolphins include their hyoid system. Following Rommel (1990), I investigated a way to do it. The hyoid system has ventrally a sturdy structure in the shape of a shallow U, open end posteriad. It consists of a single, medial basihyal with a thyrohyal on each side. From the anterior edge of the basihyal two cartilaginous rods rise dorsally. At its dorsal end each rod joins a straight bone, the stylohyal, which extends posteriad. The posterior end of the stylohyal terminates in a fossa on the base of the cranium. The fossa is a feature of the exoccipital bone and is found by looking at an occipital condyle and noting how the bone to the side of it has a coneave surface. The high region of the coneavity farthest from the occipital condyle is known as the paroccipital process. It is the anterolateral surface of this process that has the fossa. The shape of the fossa is roughly that of a half moon. It is useful to term it the hyoid fossa. The hyoid system itself must be prepared as a two-layered structure with the basihyal and thyrohyals forming the bottom layer and the stylohyals forming the top layer. The cartilaginous rods connecting the two layers may have to be simulated if they shrink, twist, or lose their strength during preparation. Meehanically, the stylohyals must be supported at both their anterior and posterior ends, as by doweling or wire. The bottom layer will hang from the stylohyals, supported anteriorly by the simulated cartilaginous rods and posteriorly by wire or the like. I have found no non-muscular connection from the thyrohyals to the thyroid cartilage of the larynx in the specimens I have examined. From my observations of *Tursiops truncatus*, *Stenella* sp., and *Feresa attenuata*, I conjecture that the articulation of the hyoid system is the same throughout the family Delphinidae and perhaps in other families of odontocete cetaceans.

Abstracts

Trichodina ctenophorii, a new symbiont from comb plates of ctenophores.
Anne M. Estes, Barbara S. Reynolds, and Anthony G. Moss, Department of Zoology and Wildlife Sciences, Auburn University, Auburn, AL 36849-55414.

Peritrich ciliates of the genus Trichodina are both internal and external symbionts of a broad spectrum of hosts, ranging from invertebrates such as Hydra and Mya to the teleost fishes. We describe here Trichodina ctenophorii, sp. nov., a symbiont of the ctenophores Mnemiopsis mccradyi and Beroë ovata endemic to the northern Gulf of Mexico, specifically the Dauphin Island region of Mobile Bay and Apalachicola Bay / St. George Island area of northern Florida. The morphology of fixed and living specimens is revealed by silver impregnation, scanning electron microscopy, transmission electron microscopy, and video- and digitally-enhanced differential interference microscopy. Distinguishing features of Trichodina ctenophorii are a denticular morphology composed of falcate, blunt-tipped blades, and long, straight thorns, with five pins per denticle. T. ctenophorii preferentially inhabits the aboral side of the giant comb plates of both species of ctenophores, where it shares space with a number of other protistan and prokaryotic commensals. To the best of our knowledge this is the first report of a trichodinid from the Gulf of Mexico and the first trichodinid associated with ctenophores. (Supported by the Howard Hughes Future Life Sciences Program to BR, grants from the Office of the Vice President for Research of Auburn University and the NIH, and funds from the Ala. Agricult. Experiment Station to AGM)

NESTING OF THE LOGGERHEAD SEA TURTLE (CARETTA CARETTA) ON DAUPHIN ISLAND, ALABAMA. David H. Nelson and Anna M. Cinkovich, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688.

Field surveys for sea turtle nests were conducted from June to September 1996 along the beaches of Dauphin Island (Mobile Co.), Alabama. Beaches were searched three times a week by all-terrain vehicle to identify, locate, protect, and mark individual nests. Only two clutches of eggs were found. On 7-8-96, a clutch of 82 eggs demonstrated 22% viability (18/82). Later, this nest could not be relocated to confirm hatching success. The second clutch of 112 eggs, found on 7-29-96, later proved to be completely non-viable. Four false crawls were observed from 22 June to 17 July 1996. There were five dead sea turtles stranded on Dauphin Island beaches last summer from 21 June to 12 July 1996: two specimens of loggerheads and three specimens of leatherbacks (Dermochelys coriacea). Although we were unable to document any nests in 1995, there were two believable reports. Last year we also recorded two false crawls of nesting sea turtles and 12 stranded (dead) sea turtles: 3 leatherbacks, 4 loggerheads and 5 Atlantic Rيدleys (Lepidochelys kempii). One resident of Dauphin Island reported seeing 3 hatchlings on the beach in the fall of 1995.

CHEMISTRY

SYNTHESIS AND SPECTROSCOPIC CHARACTERIZATION OF TRICHLORO-NITRIDO(IMIDOTETRAPHENYLDITHIOPHOSPHINO-S,S)OSMATE(VI), $\text{Bu}_4\text{N}\{\text{OsNCl}_3[\text{N}(\text{Ph}_2\text{PS}_2)]\}$. Jerome Smith and Zewdu Gebeyehu*, Department of Chemistry, Tuskegee University, Tuskegee, AL 36088.

Complexes prepared from sulfur containing ligands and transition metals are of great importance because of their applications as catalysts and their relevance in many biological systems such as iron-sulfur metalloenzymes. Trichloronitrido(imidotetraphenyldithiophosphino-S,S)osmate(VI) complex, $\{\text{Bu}_4\text{N}\}[\text{OsNCl}_3[\text{N}(\text{Ph}_2\text{PS}_2)_2]]$, was synthesized in 35% yield by the reaction of $[\text{Bu}_4\text{N}][\text{OsNCl}_4]$ with an equimolar amount of $\text{K}[\text{N}(\text{Ph}_2\text{PS}_2)_2]$ in CH_2Cl_2 . The complex was characterized by spectroscopic methods and elemental analysis. The IR-spectrum displayed strong bands at 1107 cm^{-1} $\nu(\text{Os}\equiv\text{N})$, $850\text{-}700\text{ cm}^{-1}$ phenyl group, 556 cm^{-1} $\nu(\text{Os-S})$, and 524 cm^{-1} $\nu(\text{p-S})$, 360 cm^{-1} $\nu(\text{Os-Cl})$. $^1\text{H-NMR}$ 7.80 - 7.38 ppm aromatic proton; 3.35, 1.61, 1.27 and 1.00 ppm, N- $\text{CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_3$ protons; $^{13}\text{C-NMR}$ - 131-133 ppm phenyl carbons; 59.1, 24.2, 19.8, and 13.7 ppm, N- $\text{CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_3$ carbons. The compound was found to be stable in air and moisture, and soluble in CH_2Cl_2 and CH_3CN , but partially soluble in CDCl_3 .

CHEMICAL METHODS FOR CLEANING AND REPAIRING OLD MARBLE TOMBSTONES. Richard C. Sheridan, TVA (retired), 105 Terrace Street, Sheffield, AL 35666

Historic stone structures throughout the world are deteriorating due to pollution and other causes. This is also true of tombstones, many of which have been vandalized. Improper attempts to preserve old grave markers can result in serious damage. Fortunately, approved methods for cleaning and repairing broken stones are available. Polyester and other adhesives developed for use by the stone industry can be utilized to make very durable repairs.

ISOTOPE EFFECTS ON PHOSPHATE HYDROLYSIS. J. Rawlings, Chemistry Dept, Auburn U at Montgomery, Montgomery, AL 36117, and A.C. Hengge, Enzyme Institute, U. of Wisconsin, Madison, WI 53705.

Since phosphate transfer reactions play an important role in biochemistry, determining the mechanism of such reactions is important in understanding the behavior of many enzymes. The mechanism may be dissociative, associative or involve distinct phosphorane intermediates. Heavy atom isotope effects can be used to distinguish between these mechanisms. These effects were determined for the hydrolysis of p-nitrophenyl phosphate by a variety of cobalt(III)-ammine compounds. These reactions had a primarily associative mechanism. (This project was supported by the AUM Grant-in-Aid Program)

PALLADIUM(II) METALLACROWN ETHERS AN INVESTIGATION OF THERMODYNAMICS OF CIS-TRANS ISOMERIZATION AND REVERSIBLE POLYMERIZATION. Dale C. Smith, Jr. and Gary M. Gray, Department of Chemistry, The University of Alabama at Birmingham, Birmingham, Alabama 35294.

Prior investigations into reactions of $\text{Ph}_2\text{P}(\text{CH}_2\text{CH}_2\text{O})_n\text{CH}_2\text{CH}_2\text{PPh}_2$ ($n = 3 - 5$) ligands with either $\text{Pd}(\text{PhCN})_2\text{Cl}_2$ or K_2PdCl_4 indicated that numerous inseparable species with the empirical formula $[\text{PdCl}_2\{\text{Ph}_2\text{P}(\text{CH}_2\text{CH}_2\text{O})_n\text{CH}_2\text{CH}_2\text{PPh}_2\}]$ were formed. Similar behavior is reported for related $[\text{PdX}_2\{\text{R}_2\text{P}(\text{CH}_2)_n\text{R}_2\text{P},\text{P}'\}]$ ($n = 8 - 12$) complexes, and remains poorly understood. The fact that numerous products are formed when Pd(II) precursors react with long chain polyether α,ω -bis(phosphine) ligands and related long chain methylene α,ω -bis(phosphine), somewhat limits application of these complexes to homogenous catalysis. To identify the numerous species present, we have performed an intensive multinuclear NMR study on $\text{PdCl}_2\{\text{Ph}_2\text{P}(\text{CH}_2\text{CH}_2\text{O})_4\text{CH}_2\text{CH}_2\text{PPh}_2\text{-P}'\}_n$, and its non-chelate analog $\text{PdCl}_2\{\text{Ph}_2\text{P}(\text{CH}_2\text{CH}_2\text{O})_2\text{CH}_2\text{CH}_3\}_2$. We have used the results from this study to construct a model of the dynamic equilibria existing between the various $\text{PdCl}_2\{\text{Ph}_2\text{P}(\text{CH}_2\text{CH}_2\text{O})_4\text{CH}_2\text{CH}_2\text{PPh}_2\text{-P}'\}_n$ complexes. Our model results can predict the species present under different catalytic conditions as well as describe equilibria associations of the n -mer and stereochemical distributions.

SYNTHESIS AND CHARACTERIZATION OF TRANSITION METAL COMPLEXES WITH HYBRID PHOSPHORUS-THIOPHENE LIGANDS FOR NONLINEAR OPTICAL APPLICATIONS. Mike Dunn¹, Clark Colbert¹, Chris Lawson¹ and Gary M Gray¹, ¹Department of Chemistry, ²Department of Physics, The University of Alabama at Birmingham, Birmingham, AL 35294.

There is currently significant interest in developing materials with third-order nonlinear optical (NLO) properties. Applications for these materials include power limiters for optical components, optical switching in telecommunications and optical computing. Because of the great diversity of these applications, new materials with large third-order NLO susceptibilities must also have greater variety of physical properties and thermal stabilities. Two of the most promising classes of third-order NLO materials are conjugated polymers and transition metal organic complexes. We have begun efforts to combine these into a single material by synthesizing new phosphorus ligands with polythiophene substituents. This paper will present the synthesis and characterization of some of these ligands and their transition metal complexes.

CONFORMATIONALLY RESTRICTED METALLACROWN ETHERS. Maheswaran Hariharasarma, Charles H. Lake and Gary M Gray, Department of Chemistry, The University of Alabama at Birmingham, Birmingham, AL-35294.

Metallacrown ethers are a unique class of transition metal complexes that are formed when α,ω -bis(phosphorus-donor)polyether ligands chelate transition metals. Like crown ethers, metallacrown ethers undergo size selective binding of hard-metal cations and form hard-soft bimetallic complexes. This property of metallacrown ethers could be exploited for the activation of small molecules such as carbon monoxide and carbon dioxide in the field of catalysis. Unfortunately, most of the metallacrown ethers that have been studied to date contain conformationally flexible ethylene oxide groups in their backbone. This limits the use of powerful solution state techniques such as NMR spectroscopy as probes for cation binding because their methylene ¹H and ¹³C resonances, which should be most sensitive to hard-metal cation binding, are overlapped and cannot be assigned. We have filled this void by synthesizing a variety of transition metal complexes that are derived from α,ω -bis(phosphorus-donor)polyether ligands that contain groups such as 2,2'-biphenol and 2,2'-binaphthol in place of one of the conformationally flexible ethylene oxide groups. Such conformational restriction in the metallacrown ethers causes the remaining methylene groups to be chemically inequivalent, and well-resolved ¹H and ¹³C resonances for each of the methylenes are observed.

DYNAMIC NMR INVESTIGATION OF ATROPISOMERISM IN THE TRANSITION METAL COMPLEXES OF BIS(PHOSPHITE) LIGANDS THAT ARE DERIVED FROM 2,2'-BIPHENOL AND 2,2'-BINAPHTHOL. Maheswaran Hariharasarma, Charles H. Lake and Gary M Gray, Department of Chemistry, The University of Alabama at Birmingham, Birmingham, AL-35294.

We have synthesized and characterized several sterically congested bis(phosphite) ligands that are derived from either 2,2'-biphenol or 2,2'-binaphthol. These are of interest because related transition metal complexes of these ligands are catalysts in the enantioselective synthesis of organic compounds. The ligands in these complexes exhibit a type of optical isomerism called atropisomerism due to the restricted rotation about single bonds present in the biaryl moiety of the ligand framework. To better understand such isomerism in the bis(phosphite) ligands and in their transition metal complexes, we have designed and carried out experiments using dynamic ^{31}P NMR spectroscopy. Interestingly, our studies show that the free bis(phosphite) ligands do not exhibit any fluxional behavior or ^{31}P NMR line broadening down to 200 K. However, their complexes with Mo(0) and Pt(II) exhibit such behavior, and sharp NMR resonance's corresponding to various atropomers are observed at low temperatures. In addition, the number and type of atropisomers observed for these complexes at low temperatures, depend not only on the nature of the transition metal but also on the nature of the bis(phosphite) ligand. A careful line-shape analysis of ^{31}P NMR data yields new insight into the factors that influence dynamic processes that occur in these complexes at the molecular level.

SYNTHESIS AND CHARACTERIZATION OF $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$. Zewdu Gebeyehu, Department of Chemistry, Tuskegee University, Tuskegee, AL 36088.

A reaction between a chloronitreno complex of tungsten, $\text{Cl}_4\text{W}(\text{NCl})$, and gallium chloride in a 1:1 molar ratio in dichloromethane gave $(\text{ClN})\text{Cl}_3\text{W}(\mu\text{-Cl})_2\text{GaCl}_2$ in low yield. The complex was characterized by elemental analysis and IR-spectroscopy. The IR-spectrum showed strong bands at 1090 cm^{-1} $\nu(\text{W}\equiv\text{N})$, 420 cm^{-1} $\nu_{\text{as}}(\text{Ga-Cl})$, 390 cm^{-1} $\nu_{\text{s}}(\text{Ga-Cl})$, 360 cm^{-1} , 310 cm^{-1} , 250 cm^{-1} $\nu(\text{W-Cl})$ and very weak band at 528 cm^{-1} $\nu(\text{N-Cl})$. The compound was extremely sensitive to air and moisture and very soluble in CH_2Cl_2 , but it reacted with THF and CH_3CN giving products which could not be well characterized.

Abstracts

SYNTHESES OF GUANINE SUBSTITUTED HEPADIENES Philip B. Shevlin, Dept. of Chemistry, Auburn Univ., AL 36849. Colleen N. Gillies and Tsai, Jui-Yi, Graduate Student at Auburn Univ. Auburn Univ., AL 36849.

Protected guanine was coupled with 1,6-hepadiene-4-ol via Mitsunobu copolymerization.

CATALYSIS OF THE DECAY OF PEROXYNITRITE TO NITRATE BY CO₂ Zhi Chen¹, Tracy P. Hamilton*¹, and Joseph S. Beckman² 1) Department of Chemistry; 2) Department of Anesthesiology, The University of Alabama at Birmingham, Birmingham, AL 35294.

Peroxynitrite (ONOO⁻) is a potent oxidizing agent formed in pathological disease states. Studying the oxidation mechanism caused by peroxynitrite in physiological fluids is essential. One important reaction is the reaction of peroxynitrite with carbon dioxide, which is present in the body in millimolar quantities. In this study, the thermodynamics of reactions related to the formation and decay of the peroxynitrite-carbon dioxide adduct in solution are predicted. The energetic pathways in room temperature are described and the computed free energies of the reactions in solution are emphasized. The results indicate that carbon dioxide is a catalyst for the conversion of ONOO⁻ to NO₃⁻. A scheme for the catalytic role of CO₂ in nitration is proposed. The optimized energy minimum geometries of ONOOCO₂⁻ and ONOOCO₂H are also reported.

THE SLIME BOND. M. B. Moeller and J. M. Burney, Dept. of Chemistry and Industrial Hygiene, University of North Alabama, Florence, AL 35632.

The gelation of aqueous polyvinyl alcohol (PVA) with borax has become a popular chemical demonstration. The gel produced, frequently referred to as "slime", exhibits an interesting rheology which can fascinate an audience. In spite of the common performance of this demonstration, the nature of the crosslinking of PVA polymers by the borate ions is still in question. Casassa and coworkers in their seminal article on this gelation argued for hydrogen bonding in the borate-PVA crosslinks to explain the dilatant rheology. The total lack of gelation activity from other agents such as ethylenediamine which could form bridges by hydrogen bonding with PVA casts doubt on this hypothesis. Our observations of the pH changes which occur with the gelation reaction suggest the crosslinking is by the formation of a covalently bonded borate ester complex. Quantitative treatment of the pH data to evaluate stability constants of the 1:1 and 1:2 borate-glycol complexes shows anomalous behavior. This may indicate that the 1:2 complex formation is a cooperative phenomenon.

SYNTHESIS AND CHARACTERIZATION OF A PHOSPHORANIMINATO COMPLEX OF TUNGSTEN, $\text{Cl}_5\text{W}(\text{NPCl}_3)$. Zewdu Gebeyehu, Department of Chemistry, Tuskegee University, Tuskegee, AL 36088

Tungsten (VI) phosphoraniminato complex, $\text{Cl}_5\text{W}(\text{NPCl}_3)$, was synthesized in quantitative yield by the reaction of a chloronitreno complex of tungsten, $\text{Cl}_4\text{W}(\text{NCl})$ with an equimolar amount of phosphorous trichloride in CCl_4 . $\text{Cl}_5\text{W}(\text{NPCl}_3)$ was characterized by elemental analysis and IR-spectroscopy. The IR-spectrum of the compound showed strong absorption bands at 1161 cm^{-1} $\nu(\text{WNP})$, 640 cm^{-1} $\nu_{\text{as}}(\text{P-Cl})$, 600 cm^{-1} $\nu_{\text{s}}(\text{P-Cl})$, 380 cm^{-1} $\nu_{\text{as}}(\text{W-Cl})$ and 335 cm^{-1} $\nu_{\text{s}}(\text{W-Cl})$. The compound was found to be very sensitive to air and moisture, and soluble in polar solvents. However, an attempt to dissolve it in CH_3CN gave a reaction product characterized to be $[\text{PCl}_4][\text{WNC}_4] \cdot 1.5\text{CH}_3\text{CN}$.

Abstracts

Third Order Nonlinear Optical Characterization of Metal Organic Compounds using Degenerate Four-Wave Mixing. Clare C. Byeon, Dr. Vladimir Fleurov, Dr. Christopher M. Lawson, Dept. of Physics, Univ. of Al. at Birmingham, Birmingham, AL 35294. Dr. Gary M. Gray, Dept. of Chemistry, Univ. of Al. at Birmingham, Birmingham, AL 35294.

We are developing practical third-order nonlinear optical materials related to metal-organic complexes with high transparency and strong optical nonlinearities. To develop NLO materials for optical device applications, it is important to characterize intensity induced changes in refractive index and absorption, as described by the effective third order susceptibility $\chi^{(3)}$, of the materials. Degenerate four-wave mixing is being performed to measure the third order susceptibility. The microscopic second order molecular hyperpolarizability is being found from the concentration dependence of $\chi^{(3)}$.

CIS-TRANS ISOMERIZATION AND MOLECULAR STRUCTURAL STUDIES OF $[\text{Me}_2\text{M}(\mu\text{-N}(\text{Me})\text{SiMe}_3)_2]$ WHERE M = Al, Ga, and In. E. Styron, S. Schauer, C. Lake, C. Watkins, and L. Krannich, Dept. of Chemistry, University of Alabama at Birmingham, Birmingham, AL 35294-1240.

Equimolar mixtures of Me_3M (M = Al, Ga, In) with $\text{HN}(\text{Me})\text{SiMe}_3$ in toluene were thermolyzed to obtain $[\text{Me}_2\text{AlN}(\text{Me})\text{SiMe}_3]_2$, $[\text{Me}_2\text{GaN}(\text{Me})\text{SiMe}_3]_2$, and $[\text{Me}_2\text{InN}(\text{Me})\text{SiMe}_3]_2$. An X-ray diffraction study indicates that the molecular geometry of the Indium analog consists of a centrosymmetric dimeric unit with two bridging amino groups and two terminal methyl groups bound to each In atom. The two N-SiMe₃ groups are trans to each other with respect to the (In-N)₂ ring. ¹H NMR solution spectra denote resonances for both trans and cis conformations. The isomerization process is shown to obey reversible first order kinetics. Thus, the trans to cis isomerization has been studied by ¹H NMR as a function of time and temperature. K_{eq} , k_{obs} , k_1 , and k_{-1} are tabulated for several temperatures. The rate at which equilibrium is established is in the order In>Ga>>Al. From these data the thermodynamic and kinetic parameters for the isomerization processes have been determined.

GEOLOGY

THE ETHNOBOTANY OF SANGRE DE GRADO (*CROTON LECHLERI*).
Allan G. Phipps and *L. J. Davenport*, Dept. of Biology, Samford University,
Birmingham, AL 35229-2234.

Croton lechleri, a member of the Euphorbiaceae, is a tree which grows in the Amazonian basin and is used extensively in the traditional medicines of the ribereño people of Peru. The bark of *Croton lechleri*, when slashed, produces a blood-red sap, commonly termed Sangre de Grado or dragon's blood. This viscous latex has been used by South Americans for the treatment of a number of illnesses including wounds, inflammation, infection, intestinal and stomach ulcers, cancer, and rheumatism. It is available commercially and may be taken orally or applied externally. So popular is this traditional medicine that the trees from which it is obtained are in danger of extinction owing to the excessive demand in countries such as Peru and Ecuador. Scientists are currently investigating the chemical constituents responsible for *C. lechleri's* biological activities and are particularly interested in the alkaloid taspine and a mixture of proanthocyanidins.

LATERAL SYSTEM TRACT VARIATIONS WITHIN ON-LAND SEDIMENTARY SUCCESSIONS IN NEW ZEALAND: WHEN IS A SEQUENCE BOUNDARY NOT A SEQUENCE BOUNDARY? *Douglas W. Haywick*, Depart. of Geology & Geography, Univ. of South Alabama, Mobile, AL 36688.

Cyclothem, Plio-Pleistocene coquina limestones and sandstones-mudstones outcrop over a large, shallow-dipping area in the Tangoio block of Hawkes Bay, New Zealand. They are the products of shelf sedimentation controlled by glacio-eustatic sea-level fluctuation within a subsiding forearc basin. Each cyclothem is also a depositional sequence, and the sedimentary facies can be grouped into conventional transgressive (TST), highstand (HST), regressive (RST) and lowstand (LST) systems tracts. Unlike most examples inferred from the stratigraphic record, these systems tracts were deposited during phases of certainly-known sea-level cycles, as indicated by their contemporary oxygen isotope ice-volume curve. The forearc setting of Tangoio was associated with high rates of sedimentation and high tectonic subsidence and uplift rates (up to 4 m/ky), which caused HST-RST-LST cyclothems to build progressively seawards across narrow shelves during the fall of sea-level from highstand to lowstand. The resulting sequences exhibit a generally thin TST, a terrigenous-rich HST-RST, and a carbonate-rich LST (the Tangoio cyclothem motif). The carbonate-rich nature of Tangoio LSTs probably results from several factors associated with glacial climate, including starvation of terrigenous sediment due to reduced precipitation and a distant source, efficient bypassing, and prolific growth of cold-water molluscs.

THE ETHNOBOTANY OF UÑA DE GATO (*UNCARLA TOMENTOSA*).

L. J. Davenport and Allan G. Phipps, Dept. of Biology, Samford University, Birmingham, AL 35229-2234.

Uncaria tomentosa, a member of the Rubiaceae, is a liana used extensively in the traditional medicines of the ribereño people of Amazonian Peru. The "cure-all" usage of this plant--known locally as *uña de gato* or cat's claw--has sparked growing interest in its medicinal properties and potential marketability, both in the United States and in Europe. The ribereños use *uña de gato* for its anti-inflammatory and anti-rheumatic properties; women use it when recovering from childbirth, as a contraceptive, and in the treatment of urinary tract problems: Other local uses include treatment of gastritis, cirrhosis, gonorrhoea, and dysentery. Many people drink cat's claw tea as a preventive measure. Such a wide variety of uses suggests that *Uncaria* might have certain anti-cancer or immune boosting properties. It is currently popular in Europe for cancer treatment, and has recently begun clinical trials in Peru as an anti-HIV agent.

STRATAL ARCHITECTURAL CONTROL OF PORE WATER EVOLUTION AND GROUNDWATER FLOW IN CYCLOTHEMIC SEDIMENTARY SUCCESSIONS.

Douglas W. Haywick, Depart. of Geology & Geography, Univ. of South Alabama, Mobile, AL 36688.

Groundwater flow in sedimentary successions is, in part, controlled by the regional dip of the strata in which the pore waters are confined. Complex flow patterns and subsequent localized diagenetic changes can occur in sedimentary successions where there is an abrupt alternation between porous and non-porous layers. This situation occurs in Plio-Pleistocene cyclothemic sedimentary rocks of central Hawke's Bay, New Zealand. Here, the layering resulted from multiple glacio-eustatic sea-level changes. Porous layers (sandstone and limestone) were deposited during periods of sea-level lowstand, whereas non-porous layers (mudstone) were deposited during periods of sea-level highstand. The strata are wholly contained within a single uplifted block some 450 km² in size that is tilted 2 to 10° eastward. This structural inclination produced a series of 5 aquifer-aquiclude couplets which ultimately controlled the flow of pore fluids and the diagenetic alteration of the strata. Temperate shelf carbonate sediments comprise the upper three aquifers of the strata. All three limestones are characterized by the same diagenetic history of shell alteration and calcite cementation. Five phases of cement are recognized: 1) pore-lining, bladed spar (rare; possibly marine phreatic), 2) isopachous, ferroan, equant spar (meteoric phreatic), 3) moderately ferroan, equant spar (meteoric phreatic), 4) non-ferroan, equant spar (meteoric phreatic) and 5) sinter-related cements (meteoric vadose).

That all three carbonate aquifers display consistent cement stratigraphies and alteration pathways suggests that pervasive diagenesis did not occur until regional deformation had uplifted the area into the meteoric regime. No evidence exists to support eustacy-induced diagenesis anywhere in the study area.

MOLLUSCAN ALTERATION IN THE TERTIARY TAMIAMI FORMATION OF SOUTHWESTERN FLORIDA. Laura C. Quinn and Douglas W. Haywick, Depart. of Geology & Geography, University of South Alabama, Mobile, AL 36688.

Geologists have long recognized the importance of aragonite diagenesis in the cementation of limestones. Aragonite is more soluble in meteoric water than is calcite. Hence in polymineralic carbonate sediment, aragonite dissolves. In many instances, it is re-precipitated again as a calcite cement which acts as the binding agent in most limestones.

The specific geochemical changes that occur to aragonite during dissolution are not well documented. Previous work has suggested that aragonite preferentially loses Sr^{2+} and O^{18} during the dissolution stage. We are testing this hypothesis by comparing and contrasting the geochemistry of pristine and altered bivalves (Chione cancellata and Chione sp.) from southwest Florida. Pristine bivalves were collected from beach environments near Fort Meyers. Variably altered (chalky and re-crystallized) specimens were collected from the Tertiary Tamiami Formation near Naples. Trace element geochemistry (Sr^{2+} , Mn^{2+} , Mg^{2+} , Fe^{2+}) is being established through electron microprobe and ICPS analysis. Initial results have been mixed. Some data do however, support the contention that Sr^{2+} content of shells decreases with progressive dissolution of aragonite. Chalky aragonite generally does contain less Sr^{2+} (and occasionally more Fe^{2+}) than does pristine aragonite. Stable isotopic geochemistry of the shells and their crystallography will be established through isotopic analyses and x-ray diffractometry.

In addition to geochemical changes, we are also establishing what, if any, petrographic and morphological changes occur as aragonite dissolves.

MEAN TEST SIZE OF *NUTALLIDES UMBONIFERUS* AND *GLOBOCASSIDULINA SUBGLOBOSA* AS A FUNCTION OF ENVIRONMENT. Murlene W. Clark, Dept. of Geology and Geography, Univ. of South Alabama, Mobile, AL 36688.

Pliocene populations of *Globocassidulina subglobosa* and *Nuttallides umboniferus* were examined with respect to mean test size from DSDP Site 541 located in the Lesser Antilles Forearc region of the eastern Caribbean. Mean size values for each species were compared from samples representing a range of oxygen isotope and food supply values. Food supply was estimated from the percent phytodetrital species in each sample and oxygen isotope values were obtained from the analysis of monospecific samples of *Planulina wuellerstorfi*. The mean test size of *G. subglobosa* was found to be smaller in high food environments, whereas the smallest mean size of *N. umboniferus* correlated with more negative oxygen isotope values. Smaller mean test size values may result from shortened reproductive cycles in a species' optimal environment. *G. subglobosa* may, therefore, respond to conditions of increased food supply, whereas *N. umboniferus* may prefer colder water temperatures or the related parameter of increased carbonate corrosivity.

STUDIES TO DETERMINE VARIOUS HYDRODYNAMIC AND SEDIMENTPARAMETERS AT GAURIER, MISSISSIPPI. William F. Geers, TAI Environmental Sciences; Douglas W. Haywick, Dept. of Geology, Univ. of South Alabama, Mobile, Alabama.

This Mississippi site is bordered on the east by the western bank of the Pascagoula River and on the west by Bayou Pierre. These are two vastly different sedimentary systems, but both are ultimately controlled by fluvial and tidal processes. The location of the study site and its proximity to the Gulf of Mexico coastline also means that storm events (e.g. Hurricanes must be considered in any study examining sedimentary dynamics of the western Pascagoula River and Bayou Pierre in the areas immediately adjacent to the study site. The goals of the study were; 1) to produce maps illustrating typical bottom sediment in the study areas, 2) to estimate the amount of sediment moved through the study site during normal fair-weather (and if possible storm) processes, and 3) to determine the degree of disturbance and turn over of bottom sediment by bioturbation and physical processes in the waterways adjacent to the study site. In order to complete these objectives, it was necessary to establish a series of monitoring stations in both the river and the bayou. The river stations were organized along 7 profile lines, 4 north of the railroad bridge and three south of the bridge. Three lines and 2 isolated sampling stations were established in the bayou. The study ran from October 1995 to July 1996.

AN OVERVIEW OF CARBONATE DIAGENESIS AND ITS SIGNIFICANCE IN SEQUENCE STRATIGRAPHY. Douglas W. Haywick, Depart. of Geology & Geography, Univ. of South Alabama, Mobile, AL 36688.

System tract modeling of sedimentary successions in the field can be difficult because many of the important stratal surfaces distinguishable in seismic profiles, are subtle in outcrop, or are conceptual rather than physical in nature (e.g., the maximum flooding surface, correlative conformity etc.). Carbonate petrography can prove useful for resolving some of these surfaces, particularly those formed during periods of subaerial exposure. A transition from sea-level highstand to sea-level lowstand generates a pulse of meteoric water directly below the sequence boundary, and this will produce diagenetic changes even if a significant proportion of the high-stand systems tract (HST) sediments are removed during exposure. In instances where no overlying lowstand system tract (LST) deposits are deposited or preserved, diagenetic alteration may be the only way to resolve the sequence boundary between systems tracts. The most likely diagenetic changes include; 1) partial dissolution of metastable carbonate skeletal remains (especially aragonitic components such as bivalves), 2) early generations of vadose meteoric cements, possibly predating later stages of marine cement or geopetal marine sediment in-filling and 3) net changes in trace element and isotope geochemistry of skeletal fragments and carbonate allochems. These diagenetic changes would be most evident in limestone-rich or mixed limestone-siliciclastic sedimentary successions where the faunas are dominated by aragonitic forms such as in the Plio-Pleistocene of eastern North Island, New Zealand. Calcite-dominated successions are unlikely to display much if any evidence of diagenetic alteration, particularly if subaerial exposure was short. In these instances, it may be impossible to positively identify stratal surfaces or sequence boundaries.

Abstracts

WHAT GOES IN, MIGHT COME OUT: SEDIMENT ASSIMILATION AND EXPULSION FROM THE TROPICAL ZOANTHID Palythoa spp. Mary Grace, Stephanie Fisher and Douglas W. Haywick, Dept. of Geology, University of South Alabama, Mobile, AL 36688

Organisms inhabiting reef substrates must deal with a constant rain of sediment transported across the reef by waves and currents. Encrusting zoanthids (genus Palythoa) shed some sediment, but they are also capable of incorporating sediment less than approximately 250 μm in size into their tissue.

In 1995, we began a laboratory experiment to quantify the rate of sediment intake and to gain insight as to the mechanism(s) of assimilation. As part of the experiment, we established three small satellite aquaria (10 gallon tanks) adjacent to a main aquarium (200 gallons). Three to five colonies of Palythoa spp. were placed in each satellite tank. Ten colonies were established in the main tank for control and to provide additional specimens in the event of some of the colonies in the satellite tanks died.

Mineralogically pure carbonate sand, quartz sand or feldspar sand, each with a mean grain size of 125 μm , was placed in one of the three satellite aquaria. Randomly engaged power heads designed to mimic wave conditions were placed in each aquaria. In general, enough sediment agitation occurred to sprinkle the top of the tissue at least once every day or so. Of the three sediment types, only the feldspar sand seems to have any obvious detrimental effects on the Palythoa spp. colonies. This sediment promoted rapid algal growth in the aquaria which may have accelerated zoanthid demise due to nutrient poisoning. The other sediment was assimilated into Palythoa spp. tissue in much the same way as natural carbonate sediment would be assimilated in a reef ecosystem.

Palythoa spp. tissue mass loss is occurring in all of the aquaria, possibly because experimental conditions are not ideal. However, this does allow us to observe the fate of the assimilated sediment during tissue loss. It is gradually returned to the environment through which it was initially obtained and frequently infiltrates cracks and void spaces between colonies. Similar areas of deposition probably also occur in reef environments.

RECONSTRUCTION OF THE STRATIGRAPHIC DISTRIBUTION OF ADULT AND JUVENILE MOSASAURS {CLIDASTES, TYLOSAURUS AND PLATECARPUS} IN THE SMOKY HILL MEMBER OF THE NIOBRARA FORMATION FROM COLLECTIONS MADE BETWEEN 1870 AND 1904.

M. Amy Sheldon Dept. of Geology and Geography, Univ. of S. Ala., Mobile, AL 36688 Rochester Inst. of Vert. Paleo., 928 Whalen Road, Penfield, NY 14526.

Since the late 1800's, mosasaur specimens have been recovered from beds deposited on the North American continent by an epicontinental seaway. These Late Cretaceous beds are Smoky Hill Member of the Niobrara Formation. Williston (1904) constructed theories about the geographic distribution and ecology of mosasaurs. These concepts were formulated before concepts of ontogeny of mosasaurs were developed and before the careful stratigraphic study of the Smokey Hill Member. Recently developed size independent criteria is used for determining ontogenetic stages of mosasaurs. Further, the arrival of Hattin's (1982) analysis of the internal structure of the Smokey Hill Member has given a tool for examining the distribution of mosasurs in this portion of the epicontinental seaway. Intergration of these two methodologies provides a means for investigation of the demographic distribution of mosasaurs. Juveniles of mosasaur have been recovered throughout most of the section. No horizon or geographic locality can be identified as a birthing or nursery area. Further, several growth stages were recovered from the same localities and horizons. These data suggest that assorted growth stages of mosasaurs may have occupied the same geographic area at the same time. The data from the Niobrara do not support the view that mosasaurs migrated to other distant geographic localities to have and rear their young.

Abstracts

AQUIFER IN A JUG GOES ON THE ROAD. David Kopaska-Merkel, Geological Survey of Alabama, Tuscaloosa, AL and Laura C. Quinn, Dept. of Geology and Geography, Uni. of South Alabama, Mobile, AL

More than half the world's drinking water is ground water. Ground water tends to be cleaner than surface water, but once contaminated ground water is difficult or impossible to clean economically. It is important for children to learn about this life-sustaining resource because it is both valuable and vulnerable.

Two activities demonstrate a simple aquifer model. In the first activity, drawdown in an unconfined aquifer caused by overpumping and recharge by precipitation illustrate aspects of water economics. In the second activity, aquifer contamination caused by a surficial spill and the difficulty of aquifer clean-up are simulated. The model also can be used to demonstrate differences between confined and unconfined aquifers, artificial recharge, and dense and light nonaqueous contaminants. A larger version could illustrate pump-and-treat decontamination techniques.

The model consists of a 2-liter clear plastic jug containing marbles (simulating soil or sediment) and water. The narrow neck of the jug is cut off to facilitate access to the "land" surface for well installation and to permit model disassembly, cleaning, and reassembly. A well is simulated by a straw attached to a plastic pump (e.g., from a liquid-soap bottle). Some activities using this model involve consumable substances. Food coloring simulates water-soluble contamination; liquids such as vegetable oil and honey can be used to simulate DNAPLs and LNAPLs. Clay provides the confining layer in versions of the model involving confined aquifers. The model can be constructed and operated by teachers or students at low cost.

SIGNIFICANCE OF GEOLOGIC PLACE NAMES IN ALABAMA. Lewis S. Dean, Geological Survey of Alabama, P. O. Box O, Tuscaloosa, AL 35486.

A variety of geologic place names in Alabama reflect the economic interest and importance given to minerals, rocks, mining operations, as well as the extreme geologic diversity of the state. Limestone Creek in the Tennessee River valley was named in 1797 for bedrock exposures (Mississippian Tuscumia Limestone), and Limestone County (established 1818) has the oldest geologic place name for a county in the United States.

Numerous historic and present-day communities derived a name from local rocks and minerals, such as Bauxite (Cherokee Co.), Clay City (Baldwin Co.), Coal City (St. Clair Co.), Dolomite (Jefferson Co.), Goethite (Tuscaloosa Co.), Golddust (Macon Co.), Goldville (Tallapoosa Co.), Graphite (Clay Co.), Kaolin (DeKalb and Russell Cos.), Limestone (Madison and Monroe Cos.), Marble Valley (Coosa Co.), Marl (Geneva Co.), Micaville (Randolph Co.), Pyriton (Clay Co.), and Slate (St. Clair Co.). Other geologic place names include Strata (Montgomery Co.), Siluria (Shelby Co.), and Salt Mountain (Clarke Co.).

Toponymic lapses regarding geologic place names include misspellings, misunderstandings, and unresolved cases. Lim Rock in Jackson Co., resulted from a variant spelling related to a historic lime operation in the area. Diamond (Marshall Co.) was named (unrelated to drilling for an oil well) due to the occurrence of translucent quartz crystals contained in soils derived from cherty and siliceous limestones. Chalkville (Jefferson Co.) was named due to the occurrence of white halloysite weathered from argillaceous dolomites of the Knox Group. Chalk Bluff in Marion Co. was named for white clay beds (kaolinite) in the basal Tuscaloosa Group overlying bluffs of the Pottsville Formation. Circumstances in naming Gold Mine in Marion Co. (unrelated to coal, or black gold, mining) refer to natural trenches (opened joints) along sandstone bluffs of the Pottsville Formation. As early as 1838, it was supposed that these were remains of ancient gold and silver diggings worked by the Spaniards or Indians. However, in the 1870s trace amounts of gold were reported in the Gold Mine area of Marion Co. This gold was panned from stream-sediment heavy-mineral concentrates from the basal Tuscaloosa Group clastic sequence derived from crystalline rocks of the Piedmont. Silver Hill in Tallapoosa Co. was named for the aboriginal soapstone quarries in the area thought to be precious metal mining artifacts. Also, there is no authenticated description of limestone-hosted gypsum minerals in the Alabaster area of Shelby County.

Abstracts

LABORATORY EXPERIMENTATION SIMULATING METEORIC DIAGENESIS OF BIOGENIC ARAGONITE. Charles Stapleton and Douglas W. Haywick, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688

Experimental modeling of mineral alteration provides useful information concerning rates and processes involved in diagenesis. Our interest in aragonite alteration and calcite cementation lead us to formulate an experiment whereby we could monitor the rate of dissolution of biogenic aragonite in bivalves. Four commercially available water filter canisters were erected in a laboratory. Three were connected to a purified water supply (representing meteoric water); one was connected to a supply of sea water to act as a control. Siliciclastic sand obtained from Orange Beach dunes was placed in 3 of the 4 canisters (2 freshwater, 1 saltwater). Polymineralic carbonate sand collected from the Florida Keys was placed in the remaining canister connected to the freshwater supply.

Approximately 40 specimens of the bivalve Donax variabilis were collected from nearshore and beach facies in the Gulf Shores area. They were treated with bleach and/or hydrogen peroxide to remove organic tissue and then separated into paired valves. One valve from each pair was dried for a minimum of 2 hours at 50°C and then weighed to 4 decimal places. The remaining valve from each pair was reserved for future geochemical and isotopic analysis. Ten weighed valves were placed in each of the 4 canisters. In order to avoid confusion, shells were placed into individually labeled pockets manufactured for each canister. Freshwater and sea water was then allowed to percolate through the canisters at a rate of approximately 2 l/day/canister.

In the 15 weeks since the experiment began, we have observed that rapid dissolution of biogenic aragonite leading to external chalkiness and mass loss occurred concurrently with pigment loss in shells packed in siliciclastic sand through which meteoric water passed. Less rapid dissolution occurred in shells packed in carbonate sand, presumably because of the buffering provided by the sediment. Surprisingly, some dissolution to shells also occurred during exposure to sea water. This may reflect carbonate undersaturation of the cool sea water obtained from Orange Beach.

FORESTRY, GEOGRAPHY, CONSERVATION, AND PLANNING

A SURVEY OF TARDIGRADES ON JACKSONVILLE STATE UNIVERSITY'S CAMPUS. Chris Chandler and Dr. Frank A. Romano, Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265.

Tardigrades are a group of microinvertebrates which are relatively unknown. A total of 750 species, in 3 classes have been found. Tardigrades are said to be cosmopolitan in their distribution and are found in most habitats; terrestrial, aquatic, and marine. Tardigrades are confined to an aqueous habitat (limno-terrestrial) regardless of where they are found, since their body surfaces must be wet in order to survive. Adaptations such as cryptobiosis enable them to colonize a wide variety of habitats. They are primarily found either in the water trapped by nonvascular plants (mosses, lichens, and liverworts) or in the interstices of aquatic and marine sands. Moss samples were collected from trees widely distributed on the campus of Jacksonville State University. Tardigrades were then extracted and identified from each of these samples. Heterotardigrades and Eutardigrades (the two major classes of the phylum Tardigrada) were found. This presentation provides an insight into limno-terrestrial tardigrades indigenous to Alabama.

Collaborative Rural Diversification Cases. William K. McAllister, Phillip West and Berneese Herbert, Department of Community Planning and Urban Studies, Alabama A & M University, Huntsville, AL 35762.

As the largest land manager within the U.S. government, the USDA Forest Service's plans, policies and practices have considerable impacts on the many communities that surround their 156 forests and grasslands. Reductions in timber harvest levels have been particularly devastating to some local economies, and after the initial shock period, many examples of economic and community diversification have surfaced. A Forest Service funded study resulted in twelve cases being highlighted in 1994, and this research reports on a follow-up to that work. Some communities had not quite bottomed-out and continued to experience job losses. But most are well on the way to diversifying their economies and their collective spirits. A key factor seems to be the role played by the respective state departments of community affairs and by forest rangers and their supervisors. External seed money helped, but leadership development efforts were even more impressive. Those communities showing the greatest recoveries relative to other factors, seem to have developed key local leadership in the form of individuals who persevere through a series of crises. These new leaders serve as role models for others to follow.

An Environmental Profile of Alabama: Is Equity An Issue? Terry Mercer, Berneese Herbert, and Constance J. Wilson, Department of Community Planning and Urban Studies, Alabama A&M University, Huntsville, AL 35762.

This session will provide a brief description of the environmental climate in the state of Alabama. The topic of environmental quality is important due to the fact that there is approximately 55 Hazardous Waste and Substance sites and 10 Superfund sites in the State. The locations and demographics associated with these sites will be presented. This presentation will also include a discussion of the current-day debate surrounding the subject of environmental justice and the question of equity in the location pattern of environmental hazards.

Environmental Justice is the term applied to the concept of the "fair treatment of all people of all races, cultures and incomes with respect to the development, implementation and enforcement of environmental laws, regulations, programs and policies". Robert Bullard and Charles Lee (noted scholars on the subject of environmental justice), have both specifically cited the state of Alabama in reference to the issue in their publications, "Dumping in Dixie: Race, Class and Environmental Quality" and "Toxic Race and Waste in the United States", respectively.

Abstracts

ENVIRONMENTAL CONTAMINATION AND THE REUSE OF MILITARY BASES: SELECTED CASE STUDIES OF CLOSED SITES BY BRAC '88 AND '91. Keith A. Vasseur, Alabama A&M University, AL 35762. William K. McAllister, AICP, Dept. of Community Planning and Urban Studies, AL A&M University.

Environmental damage caused by past Department of Defense activities can lengthen the transition period between the announced military base closure and its successful economic recovery. Research has determined that environmentally contaminated sites on four closed military bases had an impact on base reuse and redevelopment. The study of each base includes a history of former activities, the identification of contamination, and the degree to which contamination limits, restricts, delays or prohibits redevelopment. Each site was evaluated to determine the extent of environmental damage, the status of remediation, the site's role in any redevelopment plans and the constraints the presence of contamination places on redevelopment. The three of the four case studies contamination has prevented conveyance and transfer of title to the affected communities. Limited reuse is being conducted under a long-term lease at two of the bases. In three of the four case study bases, environmental contamination has had a major impact on reuse and redevelopment, particularly in time and cost of remediation. In some instances the condition of contaminated land has restricted or prohibited future use of a site. In only one case study was environmental contamination not considered a deterrent to reuse and redevelopment. As military down-sizing continues and more federal land is made available, communities can learn about planning for the redevelopment of former military bases and the creative reuse of existing land from the experiences of these case studies. This research has identified the need for cohesive community action to develop a plan that can withstand the presence of environmental contamination.

SAVING "GEORGIA BACON" AND "FLORIDA CHICKEN" IN SOUTH ALABAMA: A CASE STUDY. Susie H. Shepard (Retired), College of Education, Department of Natural Science, University of South Alabama, Mobile, Alabama 36688.

Previous studies document the rapidly declining populations of gopher tortoise (Gopherus polyphemus) in the southeastern United States. The deleterious activity of man has encroached upon the habitat of these very docile tortoise (e.g. clear cutting of timberlands, windrowing of timber debris, replanting large tracks in slash and loblolly pine, deep trench construction of underground pipelines, extensive real estate and roadway construction and human predation). Studies in 1969 predicted such prencious activity. The future has abruptly arrived. In recent years, the Federal Fish and Wildlife Service (FFW) recognized the G. polyphemus as a threatened/endangered species (Endangered Species Act, 1973). Due to the accelerating rate of current timber harvest, the demands of pipeline constructing, and population growth to more urban and rural settings, the "red flag" warnings of impending demise of the tortoise abound. This case study documents the systematic efforts in south Alabama, Mobile County, to prevent the detrimental habitat modification of a significant population of G. polyphemus.

Abstracts

THE MOST COMMON MYGALOMORPH SPIDER FROM ALABAMA (*MYRMECIOPHILIA FLUVIATILIS*).
Ronald Jenkins and W. Mike Howell, Samford Univ., Birmingham, AL 35229.

Since 1994, we have collected and photographed trapdoor spiders predominately in Jefferson and Shelby counties, however, specimens have been collected throughout the state. As a Mygalomorph, the trapdoor spider bears paraxial chelicera and spinnerets typical of the tarantulas. To date, we have collected representatives of three genera, including *Cyclocosmia truncata* (Hentz) (Ctenizidae), *Myrmeciophila fluviatilis* (Hentz) (Ctenizidae) and single specimen of *Antrodiaetus unicolor* (Hentz) (Antrodiaetidae). All three species are burrowing spiders which predominate hardwood forests.

The burrow opening of these three species was very similar, ranging in diameter from 0.8 cm to 1.5 cm and are frequently lined with damp webbing matted with subhumal soils. The specimen of *Antrodiaetus unicolor* was found in an 8" deep burrow in the flood plain of Turkey Creek of Blount County. *Cyclocosmia* and *Myrmeciophila* specimens have been found above the flood plain of creeks and rivers.

Myrmeciophila fluviatilis was found with the greatest frequency and widest distribution throughout the state, ranging from collections in Nashville, TN to Geneva, AL. Males were collected in September and October wandering from their burrows. Females have been collected year round from burrows in hardwood forests, as well as, older residential areas. Micro habitats involved several inches of leaf litter overlaying soils as loose as sandy looms to as dense as clays with an abundance of rock. The nature of the soil seemed to be a determining factor in the architecture of the spider's burrow. In loose soils the burrows extended down about 45° from the surface of the ground to a depth of 12 or more inches and with frequent branching. In denser soils with rock and clay the burrows were straight and as shallow as three to four inches.

Alabama is fortunate to have such a rich population of trapdoor spiders.

GIS and Organizational Change: A Review of Public Agency Experiences. William K. McAllister, Department of Community Planning and Urban Studies, Alabama A & M University, Huntsville, AL 35762.

The acquisition of a different technology-based system by an organization affects that organization in ways not completely understood, and sometimes differently than its leaders intended. In planning offices, the adoption of Geographical Information Systems (GIS) to enhance both internal and external decision-making is a common trend. Other organizations with such diverse activities as forestry, utilities, transportation, finance, and location analysis are buying GIS systems. Much is written about its technical capabilities and possible application to various planning related tasks, but only recently has attention turned to its impacts, both positive and negative, on the organization itself. Does GIS really improve decision-making in significant ways that can be documented, or is this just another expensive internal analysis toy with pretty outputs? This phase of the research reports on what the literature seems to say, while a follow-up study will investigate local government planning agency experience in the field. On the positive side, GIS is helping consolidate ways of storing, displaying and analyzing information and "one-stop shopping" for multi-department services is a resulting structural response that public customers can enjoy. A GIS also can be a friendly way of interacting with external stakeholders such as neighborhood organizations. Conversely, organizational conflict has been identified as a major cause of GIS failures. The more effective GISs require information sharing between subunits and this sharing raises issues concerning effective cooperation and collaboration. If a GIS is tailored to organizational needs as well as technical needs, conflict might be significantly reduced.

Abstracts

SMALL BUSINESS PLANNING - SOME DEMOGRAPHIC CONSIDERATIONS. Wilbur B. DeVall, Proxy Services, Ltd., Auburn, AL 36830.

Small businesses don't plan to fail, they fail to plan! This oft-quoted statement remains true today. A small business is considered one employing fewer than fifty persons in this paper. Planning a new business, whether for home operation or at a wholesale or retail location, requires that the potential manager engage in five steps: 1) Pre-planning, 2) Feasibility, 3) Planning, 4) Marketing, and 5) Demographics impinging on the proposed operation. Small businesses are created to offer a product for sale, a service for a fee, or a combination. The Pre-planning step consists of a self-evaluation to determine whether or not the manager is personally qualified to manage money, time, personnel, inventory, etc. Step two is a feasibility study to ascertain that there is a public that would buy the product or engage the service. Planning, the third step, is most essential and takes time. It consists of developing a Business Plan with projected costs and income by month for the first year, and the same estimates by quarter for a second and third year or more. Marketing involves a plan to reach the potential consumers or targeting one or more segments of the consumer public and keeping records of income and expenses, both fixed and variable, for purposes of evaluating the cash flow of the business over time and for use at tax time. The final step, acquisition and study of pertinent demographics, will help select the market and ultimate success of the venture. Of concern to most new businesses will be: 1) population in selected age classes, 2) median family income by class of employment, 3) retail sales in the area to be served, and 4) miscellaneous facts including education levels, motor vehicle registrations, unemployment, and number of cases receiving public assistance or welfare.

LOCAL ECONOMIC DEVELOPMENT, PLANNING POLICY AND CROPLAND CONVERSION IN TARCOG REGION, ALABAMA; Chukudi V. Izeogu, Ph.D., Department of Community Planning & Urban Studies, Alabama A&M University, Normal, AL 35762

Agriculture and agriculture related industries have been the mainstay of Alabama's economy during this century. While urban-based industrialization has continued to grow and exert a strong influence on the economy of the five counties of Top of Alabama Regional Council of Governments (TARCOG), agricultural based economic activities have continued to play an important role in the region's economy. In spite of it's significance, the most serious challenge faced by the region's agriculture, as in the rest of the state, is the rapid rate of cropland loss. In this study, the growing trend of cropland loss in TARCOG and its correlation with changes in population, urbanization and economic growth, as well as its planning implications are examined. The study shows that from 1982 to 1992 Madison county recorded the highest loss in cropland (17.6%), followed by Limestone county (11.6%), Jackson county (8.7%), and DeKalb county (7.0%). Marshall county showed the least loss in cropland. Analysis of the relationships between cropland loss as a dependent variable and a set of independent variables such as population growth, urbanization and economic growth indicates a fairly strong association between cropland loss, and population growth and increase in income - an indicator of economic growth. This has implications for cropland protection and conservation measures in urban and regional planning policy for the region.

PHYSICS AND MATHEMATICS

SOLAR ACTIVITY AND FREQUENCIES FROM THE GLOBAL OSCILLATION NETWORK GROUP. Kurt T. Bachmann and Brett Collins, Birmingham-Southern College, Birmingham, AL 35254.

The six detectors of the Global Oscillation Network Group (GONG) have been collecting Doppler images of the Sun on a one-minute cadence almost continuously for well over a year, and the GONG Data Management and Analysis Center (DMAC) has completed its preliminary analysis of thousands of monthly averaged frequencies of solar acoustic oscillations through early 1996. For the six months May 1995 and September 1995 through January 1996, we compare changes in monthly m -averaged frequencies with changes in the average flux of 10.7 cm radio emission, a standard indicator of global solar activity. Even though the Sun remained at the minimum of its activity cycle during this time period, we present evidence that small changes in frequencies of acoustic oscillations correlate positively with small changes in the average 10.7 cm flux as measured by the Dominion Radio Astrophysical Observatory in British Columbia, Canada. We also show that the changes in solar oscillation frequencies increase dramatically with frequency over the range $1500 < f < 4000 \mu\text{Hz}$. Both of these observations are well documented at times other than solar minimum.

The validity of our results depends on the validity of the frequency-fitting procedures used by GONG/DMAC. Two competing procedures produce frequencies that are different from the DMAC's and from each other at levels of tens of microhertz, comparable to the frequency changes that we see. We are joining the community effort to decide which analysis method best reproduces the actual frequencies of solar oscillations to the unprecedented levels of accuracy made possible by GONG.

MATHEMATICS OF THE PERFECT BASKETBALL FREE THROW. Dr. Randy J. York, School of Math and Science, Athens State College, Athens, AL 35611

A mathematical model is developed for the flight of the basketball. The problem posed is to find just the right combination of initial velocity and initial angle that will send the basketball through the hoop — *nothing but net*.

This problem relating sports and mathematics illustrates quite nicely the necessity to draw upon a wide variety of mathematical topics to solve the posed problem and demonstrate the resulting successful free throw. Maple is used extensively to pose/solve/display the mathematical results.

TRIMODAL PDF SIGNATURE MODEL FOR LANDSAT DATA. Dr. Randy J. York, School of Math and Science, Athens State College, Athens, AL 35611

We seek a signature for spectral brightness data collected over three bandwidths. Our signature candidate is a tri-modal normal pdf. We use Maple to generate a non-linear system of eight equations with eight unknowns whose solution is the necessary means, standard deviations, and weighting coefficients. An algorithm is developed for the solution of the non-linear system. This initial work assumes a region of uniform appearance.

Note: supported by NASA EPSCoR Grant No. SUB94-199: Remote Sensing Cluster. This work automates and extends a paper appearing in the International Journal of Remote Sensing, 1995, Vol. 16, No. 9, p. 1599.

COMPUTATIONAL AND CLINICAL STUDY OF THE HUMAN SCAPHOID BONE. Kurt T. Bachmann, Robert C. Baird, and Thomas D. Holley, Birmingham-Southern College, Birmingham, AL 35254, and Ekkehard Bonatz, Alan Eberhardt, and Jack E. Lemons, University of Alabama at Birmingham, Birmingham, AL 35294.

The carpal scaphoid is the most frequently fractured of the eight bones in the human wrist, most often by falls where the hand is bent back severely but also by kickback of crank handles, by punching, and in traffic accidents. Often, the peanut-shaped scaphoid is broken into two pieces that must be united by surgical means, and much care must be exercised in treatment to ensure that the complicated mechanical operation of the wrist returns to a normal state.

We describe the status of our project to determine the shape and structure of a human scaphoid bone and to analyze its response to external forces using standard finite-element computational techniques. Our goals are to examine differences in mechanism among the various causes of fracture and to investigate relative merits of treatments and surgical technologies. Progress to date includes acquisition of a cadaver forearm and surgical removal of the scaphoid, production of a Computed Tomography (CT) scan of this scaphoid bone, and input of the scaphoid shape and structure data from the CT scan into a powerful engineering-design software package, the I-DEAS Master Series*. We are starting to perform computational experiments using this software in order to realize our above-mentioned goals.

*KTB thanks the Structural Dynamics Research Corporation for granting a one-year license of the I-DEAS Master Series software to Birmingham-Southern College.

AN UNDERGRADUATE SIMULATION OF THE SPINNING GOLF BALL.

John T. Tarvin, Department of Physics, Samford University, Birmingham, AL 35229.

The trajectory of a point mass, ignoring air resistance, is a standard example of Newtonian motion at the introductory undergraduate level. Since this problem can be solved algebraically, it is appropriate for the non-calculus course. In the calculus-based course, air resistance is often included in the analysis. Usually, however, a lift force proportional to the spin of the object is not covered. This problem is especially appropriate for numerical simulation, in that it is familiar to most students and is capable of attracting and maintaining their attention. This problem has been used by the author in an advanced problem-solving course for scientists and engineers. The goal is to write, usually in BASIC, a computer program that will numerically integrate the equations of motion and plot, on the screen, the resulting trajectory of the ball. A theoretical basis for the problem is provided from the literature (Am. J. Phys. **59**, 213-218 (1991); Am. J. Phys. **51**, 357-362 (1983)). Appropriate values of drag and lift coefficients are determined from these papers, and the student's code is run under control conditions (no drag or lift) to validate that it is working correctly. One can then investigate the trajectory effects of varying spin and drag. In particular, one can show the characteristic low start, rapid rise, and sharp fall of the golf ball. By increasing the spin to unrealistic levels, the distinction between a numerically correct solution and a physically correct solution can be shown. The above points will be demonstrated with a computer program developed for this problem.

ANALYSIS OF THE GEOMETRIC STABILITY OF THE SILICON MICROVERTEX DETECTOR IN L3 AT LEP. Laszlo Baksay, Mark Behrens, Hans Tuchscherer, Univ. of Ala., Tuscaloosa, AL 35487.

The use of the Silicon Microvertex Detector (SMD) in precision measurements of fundamental processes is contingent on the accuracy to which its position can be determined. Knowledge of SMD stability is vital in this respect. An analysis technique has been developed for the Laser Displacement Monitoring System (LDMS) to allow for the monitoring of SMD stability. The algorithms and statistical methods are discussed, as well as the results obtained from the 1995 data taking period.

A POSSIBLE CASE OF A REPULSIVE FEATURE OF GRAVITY SUGGESTING RADIAL OSCILLATIONS OF A TEST PARTICLE. J. H. Young and G. K. Menon, Dept. of Physics, Univ. of Al. at Birmingham.

One of the fundamental differences between Newtonian and Einsteinian gravity is that sources of the latter include energies in addition to mass. Gravity produced by a charged mass, therefore, will differ in Einsteinian gravity from that due to a uncharged mass. An examination of the motion of a neutral test particle gravitationally effected by a charged mass having spherical symmetry reveals some distinctly non-Newtonian features. In particular, the case of a very compact mass carrying a large charge indicates that a neutral test particle might experience a repulsion. A discussion of that repulsion will be presented, along with the further possibility of radial oscillations of the test particle resulting.

MÖSSBAUER ANALYSIS OF K-T BOUNDARY CLAYS. L. P. Armendarez, D. G. Agresti, T. J. Wdowiak, E. L. Wills, M. L. Wade, Astro and Solar System Physics Program, Department of Physics, University of Alabama at Birmingham, Birmingham, AL 35294-1700.

Luis Alvarez and coworkers (Science, 208 (1980) 1095) theorized that the extinction of the dinosaurs was due to a bolide impact occurring 65 million years ago at the boundary of the Cretaceous and Tertiary geologic time periods. The primary evidence for such an impact was the large abundance of iridium found in the sedimentary layer between these two time periods, which was as much as 30 times greater than that found in surrounding layers. This could most easily be explained by "a sudden influx of extraterrestrial material", such as an asteroid or comet, where iridium and other heavier elements are more prevalent than on earth. "One of the remaining mysteries is the nature of the carrier of the iridium. Measurements show that it is present but not in what form or what it is associated with." (W. Alvarez, personal communication to T. Wdowiak). Having acquired several K-T boundary clays from around the world, we plan to use Mössbauer spectroscopy as one of several techniques to examine these clays, which were collected from El Mimbral and Bochil, Mexico, Petriccio and Contessa, Italy, Stevns Klint, Denmark, and Moscow Landing, Alabama. Mössbauer spectra have been accumulated at temperatures ranging from 300K to 12K. The samples collected in Mexico both show strong magnetic splitting with the El Mimbral sample being superparamagnetic indicating nanophase material. The samples taken from Italy and Denmark are dominated by a strong ferric component, at all temperatures, along with some weak magnetic ordering and a much smaller ferrous doublet. One goal is to measure the Fe^{3+} / Fe^{2+} ratio in these samples, a task for which the Mössbauer technique is ideally suited. This measurement can be useful in identifying the conditions in which the material was formed. Preliminary results from such measurements will be displayed along with a general discussion on how this might relate to the impact theory.

Abstracts

DIAMOND FILM GROWTH ON TITANIUM ALLOY. Andrea Nelson and John T. Tarvin, Department of Physics, Samford University, Birmingham, AL 35229. Yogesh K. Vohra, University of Alabama at Birmingham, AL 35294.

Diamond film coatings have applications in a wide variety of fields, including medical implants and the aerospace industry. The present study examined diamond film growth on titanium (Ti) alloy, an alloy that is important in the aerospace industry. These films were grown using a microwave-plasma-chemical-vapor-deposition (MPCVD) technique. In this technique, diamond film quality is a function of several parameters, including substrate temperature, gas pressure and composition, and sample geometry. A wide difference in the thermal expansion coefficient of the film and the substrate can result in detachment of the film from the substrate during the cooling process. In an effort to minimize this effect, films were grown on Ti-alloy disks at low substrate temperatures. Micro-Raman spectroscopy was used to determine the quality of the diamond film; the structural integrity of the film (i.e., the degree of attachment) was determined by visual examination of the film under low magnifications. It was found that there was still spontaneous detachment of the film from the substrate during sample cooling. Film coverage of the alloy appeared to be uniform, except for voids that were formed when the film detached from the substrate. The quality of the film was high, as indicated by the narrow linewidth and high relative amplitude of the 1332 cm^{-1} diamond line. Details of this study, including film growth rates, will be presented.

GENERALIZATION OF A THEOREM OF SZEGO ON ORTHOGONAL POLYNOMIALS. Carl A. Libis, Mathematics Department, University of West Alabama, Livingston, AL 35470

Orthogonal polynomials satisfy a constrained minimization problem. This property was proved by Szego. When the constraints of the minimization problem are changed, the properties of the solution are changed. We generalize Szego's theorem by changing the constraints. We analyze properties that the new polynomial solutions satisfy.

GAS CLOUD VERSUS STAR ORBITS IN BARRED SPIRAL GALAXIES.
D. Ousley and G. Byrd, Dept. of Physics and Astronomy, University of Alabama,
Tuscaloosa, AL 35487-0324.

Some barred disk galaxies show interesting ring features both around and interior to the bar. The rings are made of gas clouds plus recently formed stars. These rings are thought to result from resonances between the gravitational field of the turning bar, the original circular orbital motion of the disk objects and their resulting oscillation about the circular orbits. An analytical formulation of this interaction has been developed which includes gas cloud collisions. We plot the orbits of gas clouds and stars for different parameters of the analytical formulation: the circular rotation speed versus distance, the angular rate at which the bar turns, the strength of the bar, and the degree of collisional dissipation. These plots along with other computer simulations and observations should help in better understanding of how the rings form, the dynamics of barred galaxies, and the amount of missing mass (dark matter) in these galaxies.

MODELING OF RF ENERGY DEPOSITION IN MAGNETIC RESONANCE IMAGING AT 4.1 T. Joseph G. Harrison, Dept. of Physics, U. Alabama Birmingham, Birmingham, AL 35294. J. Thomas Vaughan, Magnetic Resonance Center, Mass. Gen. Hospital, Charlestown, MA 02129

Very high-resolution magnetic resonance imaging which exceeds current state-of-the-art capabilities in other imaging modalities (PET, CAT, etc) is now possible with magnets operating at 4.1 teslas. One part of our research effort has been to use computational modeling to address issues of coil design. Using finite element software we model high-frequency (175 MHz) surface and head coils used in magnetic resonance imaging. The principal efforts are directed at 1) accurate modeling of the magnetic flux density (B_1) of the loaded and unloaded coils for design purposes and 2) study of the power deposition in models of loads incorporating gross features of bulk tissue and the human head. We find good agreement especially in terms of reproducing some artifactual features that are well known in imaging (bright spots, asymmetric features, etc). We use the calculated power-density to couple to the problem of steady-state heating using the bioheat equation. With this we are then able to further address the safety issues associated with operation at these frequencies. Our head model incorporates only major features (gray-matter, skull/fat layer, and eyes) thus far. Results for these will be presented as well as prospects for future work using more detailed and accurate digital models for the head.

VISUALIZATION OF WORMHOLE SOLUTIONS TO EINSTEIN'S FIELD EQUATIONS IN GENERAL RELATIVITY. William C. Niedbala and Kurt T. Bachmann, Birmingham-Southern College, Birmingham, AL 35254.

A wormhole is a hypothetical shortcut for travel between distant points in the Universe that is often invoked in science fiction literature. However, relativists generally interpret several classes of simple, exact solutions to the Einstein field equations to be descriptions of wormholes. Many of these solutions were discovered less than ten years ago.*

We present our rigorous embedding diagrams representing wormhole solutions to Einstein's field equations, and we discuss the mathematical and computational details for producing these visualizations. We discuss the important features of each solution such as stability, traversability, existence and positions of horizons, and the stress-energy that generates the wormhole's curvature.

* M. S. Morris and K. S. Thorne, *Am. J. Phys.* 56(5), May 1988.

SOLID-LIQUID INTERFACE STUDIES RELATING TO ORGANIC NONLINEAR OPTICAL MATERIALS *

J. Choi, M.D. Aggarwal, Sonya McCall, K.J. Chang, and W.S. Wang
Dept. of Physics, Alabama A&M Univ. Normal, AL 35762

The solid-liquid interface shape and location are the most important factors during the growth process in the Bridgman-Stockbarger(BS) system to get good quality single crystals. The interface shape strongly influences the dislocation, grain size, and dopant concentration in this directional solidification process. Interface shape and position can be controlled by changing growth parameters such as the temperature gradient and lowering rate. Real-time observation is needed to grow novel good quality bulk single crystals of organic materials in order to control the growth parameters during the growth process. A flat solid-liquid interface is most desirable to grow high quality single crystals. A transparent furnace and observation system are required for real-time measurement. Two transparent BS systems have been designed and fabricated in the workshop at the Department of Physics, Alabama A&M University. The interface shape, location and growth rate have been observed under different growth conditions to understand their influence on growth factors and eventually on the quality of the crystals. Faceted growth is observed at higher lowering rate for binary organic materials.

* Work performed under NASA-Alliance for nonlinear optics project NAGW-4078.

Analysis of a nonspherical, axially symmetric geometry of the Einstein-Maxwell system

G.K. Menon and J.H. Young, Univ. Al. at Birmingham, Birmingham, AL 35294

The Erez-Rosen extension of the vacuum Schwarzschild solution to the nonspherical case gave one of the first physically significant solutions of the Einstein field equations. Nonvacuum extensions of the Erez-Rosen solution representing a nonspherical mass containing a net charge will be discussed. The special case of spherical symmetry, as would be expected, results in the Reissner-Nordstrom solution. In addition, the causal and geodesic properties for the resulting space-time are examined.

OPTICAL LOW COHERENCE INTERFEROMETRY FOR SUBSURFACE NONINVASIVE IMAGING. Neil W. Jenkins, Dr. Chris Lawson, Dr. V.Fleurov, D.Brown, D.Forrestall, Dept. of Physics, Univ. of Ala. Birmingham, AL,35294

Optical sensors are necessary tools in modern applied sciences and engineering. These sensors vary in type and performance based on the applications they monitor. Optical interferometry has proven itself as an invaluable method for optical sensing; interferometers themselves vary in type ranging from the Mach-Zender interferometer to the Michelson interferometer, that we use in our research. The Michelson interferometer easily lends itself to a fiber optic geometry consisting of two legs of single mode fibers joined by an evanescent wave coupler. Fundamentals of fiber optic low coherence interferometry (OLCI) are discussed, using the Michelson configuration, as a method of noninvasive subsurface imaging. We have previously used Light Emitting Diodes (LEDs) for this research and are now beginning the use of a Titanium:Sapphire laser. The Ti:Sapphire laser is capable of producing mode-locked pulses on the order of a few hundred femtoseconds which makes for an excellent low temporal coherence source in our studies. Finally, direct applications of this non-invasive subsurface imaging are discussed for monitoring the growth of protein crystals. Growing large protein crystals is important for determining the structure of important proteins, e.g., vaccines, by x-ray diffraction.

SPECTROSCOPIC STUDIES OF 2-AMINOPURINE IN OLIGONUCLEOTIDES. Kervin O. Evans, Anatoly Kudryavtsev, Da-Guang Xu, Thomas Nordlund, Dept. of Physics, Univ. of Alabama-Birmingham, Birmingham, AL 35294.

2-Aminopurine (2ap), a sister molecule of the DNA base adenine, has been identified as a highly fluorescent (1000x that of adenine) molecular probe of DNA local conformational changes. Once incorporated into the decamer d[CTG(2ap)TTCAG]₂, 2ap exhibits a multi-exponential fluorescence decay, suggesting multiple states of 2ap (1). NMR measurements confirm multiple conformations in solution for 2-aminopurine-2'-deoxyriboside free base; however, time-resolved and steady-state fluorescence analysis (2,3,4) showed no such clear evidence. Thus, the mere presence of the syn- and anti- conformations of 2ap is not enough to cause a multi-exponential decay. But, the addition of at least one other nucleotide appears to be. The effect of nearest neighbor on the time-resolved fluorescence and Raman spectroscopies will be presented.

1 P. Wu, H. Li, T.M. Nordlund, R. Rigler (1990) Proc. SPIE 1204, 262-69

2 K.O. Evans, D. Xu, Y. Kim, T.M. Nordlund (1992) J. Fluorescence 2, 209-16.

3 D. Xu, K.O. Evans, T.M. Nordlund (1994) Biochemistry 33, 9592-99.

4 K.O. Evans MS Thesis, University of Alabama-Birmingham (1996)

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ELECTRON PARAMAGNETIC RESONANCE (EPR) AS A MONITOR OF CRYSTAL GROWTH OF CHEMICAL VAPOR DEPOSITED DIAMOND. C.S. Yan, H.T. Tohver, Y. Vohra, Physics Department of UAB, Birmingham, A.L. 35294-1170.

A homoepitaxial diamond film was grown on a polished, single crystal {100} oriented natural type IIa diamond circular plate using high density microwave plasma chemical vapor deposition (MPCVD). Two grown-diamond films were prepared under different temperature $T_a=850^\circ\text{C}$, $T_b=1200^\circ\text{C}$. EPR exhibits the P1 substitutional nitrogen impurity with concentrations $N_a=20$ PPM, $N_b=4$ PPM. EPR is also used to investigate the property of twin formation which strongly affects the structure and morphology of grown diamond.

SEMI-ANNUAL VARIATION OF THE EARTH'S ATMOSPHERE FROM THE ORBITAL DECAY OF THE ODERACS SPHERES. A. Tan and J. C. Wang, Department of Physics, Alabama A&M University, Normal, AL 35762.

The orbital decay curve of a satellite having constant cross-sectional area can furnish valuable information regarding the dynamical state of the atmosphere. Tan and Badhwar recently demonstrated how the expansion, contraction and stability of the atmosphere can be extracted from the slope and curvature of the decay curve of a satellite in near circular orbits. Further information on the atmosphere, such as the rate of expansion or contraction and the scale height can be obtained from the orbital decay of two satellites descending at different levels in the atmosphere. Such techniques when applied to the orbital decay of the ODERACS I and II spheres clearly betray the semi-annual variation of the atmosphere in 1994 and 1995. The dynamical states of the atmosphere in 1994 and 1995 showed strikingly similar patterns with primary maxima in February-March and secondary maxima in October, which are indicative of the semi-annual variation in the descending phase of the sunspot cycle. Overall, the solar $F_{10.7}$ fluxes, which are responsible for the atmospheric dynamics, were three standard deviations below the predicted values in 1994 and 1995, thus marking these years with an unusually quiet Sun.

LOW COHERENCE IMAGING WITH NONLINEAR OPTICAL MATERIALS. Vladimir Fleurov, Denise Brown, and Chris Lawson, Dept. of Physics, University of Alabama at Birmingham, Birmingham, AL 35294-1170.

There are a number of important applications that require non-invasive imaging of the internal structure of diffusive or scattering media, including subsurface imaging of biological tissue for medical diagnostics. Optical low-coherence reflectometry (OLCR) utilizes an optical Michelson interferometer with a low temporal coherence light source in conjunction with some type of coherence filter to yield profiles of backscatter versus depth. Three-dimensional images are typically obtained by transversely scanning the sensor head. We will present some of our recent investigations where we have used nonlinear degenerate four-wave mixing (DFWM) based techniques to provide two-dimensional (2-D) imaging through turbid media without the need for transversely scanning the sensor head. These techniques require nonlinear optical films which yield very high phase conjugate reflectivities. Thus, we will also describe our recent imaging attempts using liquid crystal films that we have fabricated in our lab.

INDUSTRY AND ECONOMICS

THE IMPORTANCE OF GOVERNMENT HOUSING PROGRAMS. Terry Carter and Eric Rahimian, Department of Economics and Finance, Alabama A&M University, Normal, AL 35762.

The Federal Government has been involved in the housing industry since the establishment of the Federal Housing Administration (FHA) in 1934. The current system which subsidizes public housing, reflects the federal government's dependence on local housing authorities to administer the program. The local authority must cover a substantial amount of the costs through rents. Rents in public housing are supposed to be based on ability to pay. Nevertheless, based on their financial needs, the local authorities establish a level of minimum rent which also covers the costs not covered by other sources. Due to this requirement, the Dept. of Housing and Urban Development (HUD) and local authorities have in effect been encouraging admission of tenants in the upper range of income limits.

According to an article by Jason DeParle (*Journal of Housing and Community Development*, Feb. 97), about 15 million American households qualify for federal housing assistance. Nevertheless, only 4.5 million are actually getting federal assistance. From this number, about 1.5 million people live in government-run developments. The other 3 million rent from private landlords with government help. From 10.5 million other qualified people, about 5 million people spend at least half of their income for shelter. These people include the disabled, the elderly, welfare recipients, and also some working families whose wage simply can not catch up with the rising housing costs. About 5 million of these people are working, where 1.2 million of them are working full-time. Certainly, inadequate housing means more hungry and undernourished children. Over all, as compared with 1970, there are now 12% fewer cheap apartments and 72% more demand for low-cost housing. The new welfare reform law will also add to the demand for the public housing. Obviously, these figures indicate that the government assistance has become more critical for the survival of our social economic balance. We conclude that though, in the 1980's and 1990's there has been a slight improvement in the quality of construction of public housing units, the current public housing program is not sufficient, and indeed may be unavailable to the very poor. As several economic analyses have indicated, we believe the federal government can improve the housing of many people by improving its planning process and lowering the housing costs for the true needy.

STATE LEVEL DEBT: THE INTERGENERATIONAL CONSEQUENCES. Jim F. Couch and Neil Thorne, University of North Alabama, Florence, Alabama 35630

In this paper, the notion of Ricardian Equivalence is subjected to empirical scrutiny. It was Ricardo (1821) who first claimed that public debt issues and taxation exert identical effects upon aggregate savings and consumption. The result, however, rests upon an assumption that many find unrealistic--human beings with infinite time horizons. Barro (1974, 1979) extended the argument by asserting that individuals wish to make significantquests to their heirs. The analysis, however, ignores a rather strong incentive older generations have to finance current public goods through future taxes, thereby shifting the burden to future generations. Using net long-term state debt as the dependent variable, and a number of other variables thought to influence debt finance, we find no relationship between state level debt and senior citizen population.

Abstracts

GNP AND WELFARE DEPENDENCY: DOES A RISING TIDE LIFE ALL BOATS? Lori Allen, Jim F. Couch, and Kristy Van Rensselaer, University of North Alabama, Florence, Alabama 35630.

Attempts to alleviate poverty--a long-term problem in this country--have, for the most part, proved unsuccessful. After spending billions of dollars through means-tested income transfer programs, Americans have seen the number of individuals below the official poverty rate climb, not fall. In this paper, we estimate an equation in which the percentage of the population below the poverty line serves as the dependent variable. We find that poverty is significantly and positively related to public aid. It seems we have been paying people to be poor. Our results also suggest that a healthy economy results in fewer people below the poverty rate. In spite of recent criticism of trickle down economics, an improving economy does lead to a higher standard of living for everyone.

LIV OR LET LIVE: THE LINE ITEM VETO VIEWED PARADIGMATICALLY. James G. Alexander and Marsha D. Griffin, AL A&M Univ., Daniel C. Morgan, Univ. of TX, and Paulette S. Alexander, Univ. of North AL.

Public policy is a major outcome of political processes -- processes which are generally and properly analyzed in terms of power relationships among groups and coalitions. Needless to say, some groups may promote interests extending beyond the bounds of self-interest, and at times there is sufficient overlap of extended interest among the power contestants to justify application of the old-fashioned concept of "the public interest." Public policy shifts -- even revolutions occasionally -- in large part reflect altered power relationships resulting from technological and demographic reconstructions. But public policy revolutions, like scientific ones, also find origin in paradigm shifts. Indeed, the 1996 passage of a presidential line item veto (LIV) constitutes a particularly striking example of policy following paradigm rather than power: modified power relationships can be expected to be more an effect than they were a cause in this case. The notion of the LIV is far from new: pre-Clinton presidential proponents include Grant (1870s), Roosevelt (1930s), Eisenhower (1950s), and Reagan (1980s), at least two of whom easily eclipsed Clinton in political power. The ascendent paradigm now presenting the President with an enormous grant of power from a contrarian Congress is the budget balancing paradigm. The hope of many is that the veto pen will instill budget discipline which Congress lacks, though this is distinctly founded in hope more than in analysis. (Indeed, budgetary increases could conceivably result.) Other paradigms of relevance -- analytical frameworks which have prevailed in past presidential attempts to get the LIV -- include: legal/constitutional; democratized economic policy; economic progress and advancing civilization; and balance of power. The last has historically been central to denial of the LIV, the concern being that such power would dramatically alter the American political system toward the "imperial presidency." LIV having passed, the central question now revolves around the life and power of Congress.

Abstracts

WELFARE AND WORK. James G. Alexander, Department of Economics and Finance, and Marsha D. Griffin, Department of Management and Marketing, Alabama A&M University, Normal, AL 35762.

The catchword in welfare reform today is "workfare," and almost no one disagrees that welfare reform is needed. However, as the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 is being implemented, many questions remain. While this legislation is a distinct breakpoint in historical terms, notably with the ending of federal entitlement status of AFDC, it is clear that this is not the end of either the need for or existence of "welfare." Rather, the path has been modified, with the intent that the route to work and economic independence be enhanced in comparison with the route to economic dependence and socio-political marginalization. All recognize that workfare cannot end all welfare because age, disability, and circumstance inevitably render some persons unavailable for (and incapable of) work. Operationalization of the workfare concept has a number of dimensions yet to be fully specified -- and this is to some extent intentional within the concept of multi-level state-by-state experimentation. Obvious elements here are how "work" is to be defined and what to do with innocents if requirements are not met (i.e., how to handle cases of poor children when their parents are not compliant with society's rules). But there is another issue yet to be seriously and fully addressed: the federalism question of responsibility assignment and linkage. In one sense, the welfare reform underway is a step in the devolution movement in progress for well over a decade: both power and burden being increasingly shifted from the federal to lower levels of government. But such a transfer of welfare assignment does not absolve the federal government of its responsibilities, including those imposed by the Employment Act of 1946. For over half a century, the federal government has faced the legal mandate -- and incumbent administrations have faced the political necessity -- of promoting economic prosperity. In this regard, "workfare" ups the ante: workfare without work availability is not only derelict in legal terms, it is also an ethical breach of America's social contract.

TELEVISION EXPOSURE AND ALUMNI GIVING: DOES FOOTBALL PRODUCE TANGIBLE RESULTS? Neil Thorne and Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

One of the most frequently debated subjects on college campuses across the nation is the value of athletics to sponsoring institutions of higher education. To some, athletics takes resources away from more important areas of the university. On the other hand, proponents of college sports contend that these activities enhance the "university experience" and, furthermore, pay indirect dividends to sponsoring institutions in the form of increased applications and more active alumni. This paper investigates the relationship between television exposure and alumni giving to the university. We find that a greater percentage of alumni make contributions to the school when the football team was viewed by a larger audience the year before.

RETIREMENT PLANNING: OPTIMIZING FOR GENERATION X. Tommie Singleton and Paul Holley, College of Business, University of North Alabama, Florence, AL 35632.

The political, economic, and social environment of today is increasing the pressures on working people to make more plans for retirement than their parents, and to start at a much earlier age. Generation Xers (20-something) need to identify simple but effective strategies that will empower them to enjoy their years of retirement with reasonable financial resources. The strategies that a generation Xer should employ involve various insurance's, deferred compensation plans, managing assets, and financial emergencies. Each strategy involves some thorough research and conscientious consideration. A retirement specialist might be worth the fee to assist in creating the most effective retirement plan (e.g., stock broker, insurance agent). The strategies used early in life will likely need adjusting as one gets older, i.e., the plan must be dynamic.

WELFARE: CULTURAL.VS. ECONOMIC ASPECTS. James G. Alexander and Marsha D. Griffin, Alabama A&M University, Normal, AL 35762.

It is said that success has many fathers but failure is an orphan. The 1996 welfare reform legislation constitutes by its passage a political success. Despite widespread agreement for many years that major modification was needed, disagreements about the desirable form of reform blocked programmatic reconstruction. The 1996 welfare act was cited by *The World Almanac 1997* (and others) as one of the top ten news stories of 1996 (the only legislation so designated, notwithstanding contemporaneous passage of momentous legislation affecting telecommunications, separation and balance of power among governmental branches, etc. Even in the early stages of implementation, however, the new welfare framework confronts a fading of fathers -- though not yet orphanhood. "Reopening" of the welfare act is not only a matter of Presidential interest, but was also a contentious issue at the latest meeting of the National Governors Association. States, long-time advocates of an autonomy shift in their direction, are now in a multi-dimensional scramble to devise implementation mechanisms which will allow them to meet their own needs. This scramble includes application for waivers from certain of the law's provisions and circumvention of certain of the law's directives; e.g., about 40 states seek waivers of the restrictive food stamp time limits on able-bodied working agers lacking child dependents and "work" definitions are being stretched hither and yon to comport with state conditions and concerns. The political basis necessary for passage of welfare reform was formed by an eclectic and partially erroneous conceptualization wherein society's ills were attributed to the "welfare system:" by the political imagery it corroded character, fed on freedom, expanded expenditures, busted budgets, and eroded the economy. The quandary now for would be "fathers" is whether the objective is essentially economic or cultural and whether the instrumental mechanism is essentially economic or cultural. While the two are intimately linked, their linkage is also intricate: sorting of cultural and economic aspects is essential to policy rationalization.

TELECOMMUNICATIONS INFRASTRUCTURE DEVELOPMENT IN THE APPALACHIAN REGION. Paulette S. Alexander and Jason Wilcoxson, University of North Alabama, Florence, Alabama 35632-0001.

The development of advanced telecommunications infrastructure is important to the Appalachian Region for two primary reasons: 1) general economic development of the area (including the generation of good jobs that are attendant to information- and technology-intensive businesses and the opportunities that are opened in the telecommunications industry itself), and 2) the quality of life that accrues due to improvements in education, health care and other vital services. This paper includes the following concepts related to the development of advanced telecommunications infrastructure:

- definition of telecommunications infrastructure,
- analysis of the Telecommunications Act of 1996,
- comparison of the regulatory responses in the states and municipalities within the Appalachian Region and outside the region,
- consideration of corporate restructuring that has occurred or could occur within the telecommunications industry, and
- identification of factors that are associated with higher levels of telecommunications infrastructure development within some states and regions.

The Appalachian Regional Commission has recognized the role of telecommunications and the region's needs for a well-developed infrastructure. If the infrastructure necessary to transport information is not well developed, Appalachia will not be able to keep up with the rest of the country in terms of good jobs, incomes, education and other quality of life factors. This pattern would parallel the stagnation that existed in the first half of the twentieth century due to deficiencies in physical transportation infrastructure -- road and rail -- necessary for the efficient movement of goods and services.

THE BASE-CLOSURE COMMISSION: A PARADIGM OF HIGHER EDUCATION IN ALABAMA? Jim F. Couch and Neil Thorne, University of North Alabama, Florence, Alabama 35630.

Higher education has come under pressure in Alabama to trim costs. Some observers feel that the State simply has too many universities and 2-year colleges. Because of the political ramifications and especially in light of the fact that numerous legislators are employed by such institution, a commission to close selected schools based on the base-closure commission has been proposed. In this paper, we empirically test to see if the base-closure commission was insulated from political influence.

Abstracts

WELFARE REFORM: POLICY AND PROSPECTS. Sophia Ellis, Eric Rahimian and Alexious Roller, Dept. of Economics and Finance, Ala. A&M Univ., Normal, AL 35762.

The welfare reform bill was signed into law on Aug. 22, 1996. After 60 years, control of welfare is being passed from the federal government to the state governments. In this paper, we review the implications of the new law. It is true that the old system was condemned due to abuse and ineffectiveness. The question is, if the new system will be effective and sufficient. To answer this question, we review the summary data of poverty rate and welfare assistance. Finally, we make some projections and policy recommendations.

According to the new law, each state government puts its new welfare program in place by July 1, 1997. The Aid to Families with Dependent Children (AFDC) program will be replaced by the new program which is called Temporary Assistance for Needy Families (TANF). The Government perceives the TANF block grant as a step in the right direction which transforms the welfare program into a work-based system. Under TANF, the states have the right to determine who will receive assistance and under what conditions. Currently, the poverty rate, particularly for blacks, is high. During 1994, about 30.6% of blacks were below the poverty level, as compared to 11.7% for whites. For the 1994 fiscal year the Bureau of the Census reported about 29.2 million persons or 11% of the population received food stamps. This amount shows an increase as compared with 22.8 million people or 9% of the population in 1990. Considering the increase in poverty rate, America now is trying to move people from welfare to work. This transition, however, is not easy. Everyone must work together, support improvements in the workforce, and help low income, single parents and at-risk-citizens. This new system must be carefully monitored to carry out its intent and purpose. Welfare recipients should get the opportunity and education to gain the ability to become independent from government assistance. Under the new legislation, able-bodied adults without children and jobs can receive foodstamps only for 3 months in a three-year period. For some foodstamp recipients, this period ends by March 31, 1997. Some States currently have a high unemployment rate and they cannot easily create jobs for the people removed from Foodstamp and Welfare Programs. Hence, it seems an amendment to the Welfare Reform Act is necessary to make this transition smoother.

WORK HOURS AND STUDENT PERFORMANCE. Lori Allen and Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

In this paper, we investigate the impact of work on student achievement. Controlling for other factors that influence performance, we find some evidence that work results in lower scores on microeconomics exams. However, on campus, work drove test scores up. Also, interestingly, having had high school economics resulted in lower test scores.

POLLING HOURS AND VOTER TURNOUT. Misti Campbell and Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

In this paper, we test to see if increased polling hours result in greater voter turnout. Some have suggested that by increasing the amount of time that is available for voting--making voting more convenient--greater numbers of voters will cast ballots. We find some evidence, albeit limited, for this assertion.

Abstracts

SOCIAL "IN"SECURITY SYSTEM: EXPLORING ALTERNATIVES FOR THE FUTURE. Eric Rahimian, Dept. of Economics, Alabama A&M Univ., Normal, AL. 35762. Nancy Walker Willuhn, Alabama A&M Univ. Normal, AL. 35762.

For the last sixty years the United States has provided a guarantee against elder poverty via an old age retirement system, Social Security. The system has evolved and grown over the past decades and now encompasses Disability Insurance (1957), Medicare(1965), and other significant (although smaller in magnitude) social programs. The system is based on a pay as you go concept that places the burden of funding the program on those who are currently active in the workplace. Although the program has survived for over half of a century and encountered many difficult problems, it is commonly accepted that the program, with its current method of operation, can not meet the challenge that lies ahead as the "baby boom" generation retires.

Fiscal year 1996 left the fund with a surplus of 66 billion dollars bringing total assets of the funds to 500 billion dollars. Total assets are expected to reach 2.87 trillion in nominal dollars by the year 2018. The first of the baby boomers begins retiring in 2010 and by 2012 it is expected that expenditures will exceed contributions and the trust's assets will be exhausted by the year 2029. There are several sensitive variables used in the estimation of the Social Security Programs future viability. Despite controversy concerning the exact year of appearing deficit or when the assets will be exhausted; it is undeniable that the number of workers to retirees is declining and that the more immediate the resolve to correct the system the more alternatives exist. Although the specifics and intensity vary among the recommendations being put forth, the general resolutions' center around a common core. The core recommendations concern the modification of benefits offered by the program, opening investment opportunities outside of government securities, adjustment of the indexing method applied to benefits, an increase in contributions from taxation (payroll or benefit taxation), and diversion of funds from other sources.

INDUSTRIAL POLLUTION: A FUNCTION OF MINORITY POPULATION. Tywana M. Pride and Jim F. Couch, University of North Alabama, Florence, AL 35632-0001.

Much anecdotal evidence exists suggesting that heavy polluting industry frequently locates in areas heavily populated by minorities. Such low income individuals, with little or no political clout, are unable to defend themselves from industry. We subject this notion to empirical scrutiny. Total emissions in each of Mississippi's 82 counties serve as the dependent variable. Minority population, the percentage of persons below the poverty level, the percentage of residents with a high school education, and the amount of existing manufacturing make up the independent variables. Unlike the conventional wisdom, we find no evidence that heavy polluting firms are targeting areas with large minority populations. Instead, our results suggest that labor market considerations are primarily driving the location decision.

Abstracts

THE BENEFITS OF PRIVATIZATION. Misti Campbell and Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

Numerous studies exist which suggest that the private sector is more efficient than the public sector at producing goods and services. We review some of this literature and extend it to Social Security.

DISABILITY BENEFITS AND LOST WORKDAYS IN THE CONSTRUCTION INDUSTRY. Neil Thorne and Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

In this paper, we examine the impact of disability benefits on lost workdays. Controlling for cost of living differentials and using the states as observations, we find some evidence that higher benefits result in more days away from work in the construction industry.

THE QUALITY OF OUR ENVIRONMENT: NATIONAL AND GLOBAL CONCERNS.
Eric Rahimian, Dept. of Economics and Finance, Alabama A&M University, Normal AL 37762

The Quality of our environment depends on the quality of several economic and public resources which are shared by current and future generations. Although, the deterioration of quality of an environmental resource may easily lead to damage to other environmental resources, our discussion will be simplified if we divide public resources into three groups: water resources, air and space resources, and land-based public resources. First, the important national and global concerns about the quality of these resources are reviewed. Then, considering the implications of the current trends in data, basic economic analysis is used to make some policy recommendations for improvement of the quality of our environment.

Briefly, there are some indications that the increased utilization of environmental resources due to the increase in population as well as the short-sighted, profit-seeking production activities which have externalized the cost of environmental damage, are the main culprits for degradation of earth's ecosystems. In some occasions, the ill-effects on the ecosystems are globalized with negative impact on the life expectancy and welfare of this and future generations in some regions of the world. A meaningful environmental policy is based on preservation of healthy ecosystems and sustainable economic development. It is recommended that the government and concerned constituent groups should strengthen their educational programs to inform the public about the risks of deterioration of our environment. The activities of businesses, corporations, and the Government agencies should be monitored. Despite a need for cooperation between the Government agencies and the private sector, the monitoring policies should have some teeth, i.e. prohibitive taxes and penalties should be imposed, as necessary, for preventing irresponsible behavior toward careless utilization of environmental resources. Citizen groups are encouraged to participate in monitoring the quality of their environment. Consumers should pay for any damage to the environment which is caused by them and can be rectified by the Government agencies through cleanup. Finally, since the ill effects of application of some chemicals such as pesticides and herbicides will appear several years after their use, the application of chemicals which have not been sufficiently tested should be stopped.

Abstracts

THE INTERNET: A POWERFUL NEW TEACHING AND RESEARCH TOOL FOR INTERNATIONAL BUSINESS FACULTY. Gerald Crawford and Robert B. Sweeney, College of Business, University of North Alabama, Florence, AL 35632

The American Assembly of Collegiate Schools of Business (AACSB) has recognized the importance of two trends which are causing dramatic changes in modern business practices. These trends include the globalization of business and the rapid advances occurring in information and communication technology. One technological advancement which holds particular value as a teaching mechanism is the Internet. The pedagogical power of the Internet has not been adequately harnessed to date in part due to a lack of technical expertise on the part of business school professors and administrators. This research focuses on remedying this problem by illustrating how the Internet can be used to build an international learning environment and to conduct international research. In addition, the Internet can be used to meet and recruit foreign students and faculty or to set-up travel arrangements for international trips or conferences. Furthermore, the Internet has the potential to facilitate classroom administration, make international documents available to students which are unavailable elsewhere, or provide a University or College with an international presence through the use of a World Wide Web home page.

Case Analysis of a Northwest Alabama Mall. Donna Yancey, Beverly Dyer, and Keith Absher, Dept. of Marketing, University of North Ala., Florence, AL 35632.

The mall studied is a regional mall consisting of five anchor stores and sixty smaller stores. The surrounding trade area has a population base of 390,000 including 150,000 households. Information for this research was collected randomly over a period of one week. The survey, which involved 403 respondents, was profiled by examining the following areas: demographic data, reasons for shopping, average amount spent during the surveyed shopping trip, number of times the shopper frequented this mall in one month, the most common shopping day and time period of the week to shop, and the primary trading area of respondents. Other data was collected that may provide the basis for further analysis.

Abstracts

WHAT DETERMINED THE ALLOCATION OF PUBLIC WORK ADMINISTRATION EXPENDITURES? Misti Campbell and Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

Harold Ickes, the administrator of the New Deal Program, the Public Works Administration, was long held by historians to be above political influence. In this paper, we subject this view to empirical scrutiny. We find evidence that a political motivation was present when PWA funds were allocated across the states.

GETTING SET (SECURE ELECTRONIC TRANSMISSIONS) TO DO BUSINESS ON THE INTERNET. Robert B. Sweeney and Tommie Singleton, Department of Computer Information Systems, University of North Alabama, Florence, AL 35632

In order for the Internet to reach its full potential as a medium for transacting business, a method for ensuring the privacy and security of electronic commerce must be introduced. The SET (Secure Electronic Transmission) standard expands the use a popular device for completing transactions in the non-Internet world, the credit card, to the Internet. SET was developed by a coalition which included many of the major players in the credit card and Internet commerce markets, including VISA, MasterCard, Microsoft, IBM, and Netscape. Although several methods for making secure transactions over the Internet already exist, the SET standard is unique in that it is endorsed by these influential organizations and because it models the credit card--a familiar and widely-used transaction device. SET also provides for transmitting valuable financial information across the Internet in a secure and confidential manner. The SET standard is currently being tested in Europe and its introduction in the U.S. is planned for early 1997.

WHO REALLY BENEFITS FROM REGULATION? Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

Since "The Capture Theory of Regulation" has become widely accepted, most economists agree that much government regulation exists to benefit the regulated. A recent proposal to mandate training, licensing and inspection for those performing electrical wiring was put forward in Alabama in order to protect the lives and property of home owners. In this paper, I find no connection between electrical licensing requirements and fewer house fires.

Abstracts

CEO ENDORSEMENTS AND PRESIDENTIAL CANDIDATES. Bruce Gordon and Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

The 1992 presidential election was marked by a number of prominent CEOs endorsing either George Bush or Bill Clinton. In this paper, we seek to discover if certain characteristics of firms resulted in the endorsement. We also look to see how each portfolio of stocks performed.

THE LAW OF THE FEW: AN EMPIRICAL INVESTIGATION. Bruce Gordon and Jim F. Couch, University of North Alabama, Florence, Alabama 35630.

In this paper, we investigate the law of the few--the idea that small groups are more effective when engaging in vent-seeking. We find that environmental pressure groups effectively influence state environment expenditures up to a point. As the size of the group increases, however, spending eventually declines. Thus, our results support the law of the few.

Distance Learning Delivery Systems in Higher Education: Quality and Accountability Issues. Paulette S. Alexander, Dept. of Management, Marketing and Computer Information Systems, Univ. of North Alabama, Florence, AL 35632-0001.

Distance learning is any educational service delivery system which permits separation by time and/or space of the learner from the teacher. New technologies enable many modes of distance learning, as educational services are delivered when and where they are needed from the most appropriate source (in terms of location and time). Several delivery modes are being used by education systems around the world. Two of the fastest growing areas of distance learning course delivery are the Internet and two-way interactive video. Other modes of delivery range from open broadcast video to videotape correspondence-type courses. Using technologies to facilitate the delivery of educational services has significant appeal in a time of increased competition for students, increased costs associated with the delivery of educational services in classroom settings and the needs of increasingly diverse, busy and cost/benefit conscious learner populations. There are many opportunities and pitfalls associated with these delivery systems. The opportunities involve being able to address educational needs at the time and at the place that the learners are able and willing to take advantage of the services. Pitfalls include the possibilities that students fail to get needed personal attention and that institutions create courses that are available to be used repeatedly and then do so without timely updating. Evaluation of the quality of educational program has been a subject of much controversy in traditional classrooms; in distance learning situations, evaluation is more difficult and perhaps more important.

STUDENT ATTITUDES TOWARD INFORMATION PRIVACY. Paulette S. Alexander, T. Morris Jones, Department of Management, Marketing and Computer Information Systems, and Sarah R. Brown, Department of Accounting, University of North Alabama, Florence AL 35632.

Information privacy recently has come to the forefront as one of the most challenging ethical issues of the information age. Mason, Mason & Culnan chronicled in detail the research they have termed "the ascent of information." Mason, Mason and Culnan also provided a model professional covenant dealing with the ethical issues surrounding information systems professionals and their practical responsibilities. This concern has become more apparent as communications and computer technologies have become more pervasive. Because of the unique role of information systems faculty in teaching and shaping future information systems professionals and because of the exposure that students in general have to the use of these new technologies, study of student attitudes toward information privacy can be instructive. This research helps to provide the framework for understanding an undergraduate student population's attitudes toward information privacy. Information privacy research has been enhanced by the recent publication of a validated instrument to measure individuals' concerns about information privacy. H. Jeff Smith and others have "developed and validated an instrument that identifies and measures the primary dimensions of individuals' concerns about organization information privacy practices." The instrument provides a high degree of validity, reliability and generalizability since it was rigorously tested and validated. A random sample of the graduate and undergraduate student population was taken at a small regional university. Respondents were asked to complete the instrument created by Smith and others along with an additional set of demographic questions. Comparisons will be made with the student responses in the Smith study and will be presented at the 74th annual meeting of the AAS.

THE NEW DEAL AND THE SOUTH: THE CONVENTIONAL WISDOM IS WRONG. Jim F. Couch, University of North Alabama, Florence, Alabama 35630

The conventional wisdom has been that Roosevelt lavishly spent New Deal dollars in the Southeastern United States during the Great Depression. While the region was definitely poorer, in this paper, I present evidence suggesting that this view is incorrect. In fact, the region received the smallest appropriations from Roosevelt.

STATE EXPENDITURES FOR PUBLIC LIBRARIES: WHAT ARE WE PURCHASING? Misti Campbell and Jim F. Couch, University of North Alabama, Florence, Alabama 35630

Ranking states according to state expenditures for libraries reveals some interesting results; southern states are some of the most generous when funding their public libraries. Most observers, we feel, would be surprised by this finding. In this paper, we ask the question just what does such spending do to benefit the community.

Telecommunications Advances and Copyright Laws: The State of the Art.

Paulette S. Alexander, Department of Management, Marketing and Computer Information Systems, University of North Alabama, Florence, AL 35632-0001.

Origins of the copyright law are found in the Constitution of the United States, where Article 1, section 8, assign to Congress the power "to promote Science and the useful arts, by securing for limited times to authors... the exclusive right to their... writings." In 1976, Congress enacted the copyright law which is still current law, applicable to "original works of authorship fixed in any medium of expression, now known or later developed." As of 1988, copyright protection comes into being when a work is created whether there is a copyright notice attached or not. Issues for higher education emerge from the application of current copyright law in many complex new ways because of the capability to create images that are stored on computers and can be transmitted almost without limitation across computer networks. Copyrighted works have come to be clearly and increasingly recognized as intellectual property owned by their creators. Simultaneously, the capability to create electronic copies of works without identification of the creator has become easier and more widespread. The current "fair use" provisions to allow use of materials by educators involved in distance learning as well as traditional classroom settings provide standards that are difficult to interpret and difficult to enforce. Efforts are underway by several interest groups to provide guidelines for use of materials owned by others in today's world of education facilitated by computer and communications technologies. These efforts attempt to balance the needs of educators against the rights of owners.

POLITICS AND THE BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS. Tommie Singleton and Jim Couch, College of Business, University of North Alabama, Florence, AL 35632.

The law enforcement activities of the Bureau of Alcohol, Tobacco, and Firearms (BATF) are shown to be influenced by both public-interest and private-interest motives. While the BATF makes more referrals for criminal prosecution to U.S. Attorneys in states where there is more violent crime and where state and local law enforcement agencies have fewer resources to combat it, we also find evidence that the BATF harasses law-abiding gun owners. In particular, more criminal referrals are made in states where the National Rifle Association enrolls relatively large numbers of members, even though violent crime rates are significantly lower in those states. Evidence that the BATF engages in harassment is given by the fact that, other things being equal, U.S. Attorneys tend to decline to prosecute more of the cases referred to them in states having more NRA members. Finally, our analysis provides no support for notions that gun control laws deter violent crime or that the licensing of private citizens to carry concealed weapons encourages it.

Abstracts

THE MISSING ELEMENT IN THE TEACHING OF ECONOMICS. Uchenna Elike.

Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762.

Many students who take courses in economics usually complain that the abstract nature of economics is a turn-off. At the same time, in teaching economics, many teachers may ignore the fact that in addition to the overall ability of the student, his personality traits and the test type will impact the student's performance in the course.

Using regression analysis, this study measures the student's performance in economics as a factor of his personality traits, grade point average(GPA), and the type of test given(multiple choice vs. essay). Personality traits are broken down into four groups and represented by four dummy variables: DP1 is 0 for sensing and 1 for intuition; DP2 is 0 for extroversion and 1 for introversion; DP3 is 0 for perception and 1 for judgment; and DP4 is 0 for feeling and 1 for thinking. Also sex is represented by a dummy variable: 0 for males and 1 for females. The subject group for this study consists of 101 students of non-business majors who take a course in economics as part of their general education requirements.

The results show that all the coefficients of the variables have the right sign. Also, it is found that all coefficients are significant at $\alpha=.05$ except for two personality traits, extroversion/introversion and thinking/feeling. The implication of the result is that in addition to the student's GPA which affects his performance in economics, personality traits and type of test also affect a student's performance. These results suggest the missing element which, to me, is the linkage between personality traits and the student's ability to learn and comprehend materials in economics which eventually affect the student's performance. A highly qualified teacher may try to consider the personality traits of a student at the beginning of the course and will work with the student to become more receptive to learning economics.

THE OPIUM TRADE AND SINO-WESTERN RELATIONS IN THE NINETEENTH CENTURY. Catherine Pagani, Dept. of Art, Univ. of Ala., Box 870270, Tuscaloosa, AL 35487-0270

The Opium War of 1839 to 1842 was the most dramatic conflict between China and the West. Although disastrous diplomatic encounters contributed to the decades-long tensions, at the centre was the imbalance of trade which flowed in favour of the Chinese. The British redressed this imbalance with opium grown in the British-controlled regions of India, and opium quickly became the single most important trade good passing between these empires. The British handily won the ensuing war, and the shift in economic power resulted in a decline in the esteem Britain felt for China and the Chinese. This paper explores the connection between attitudes the British had for the Chinese and how they regarded Chinese goods both during and immediately following the Opium War. Initial observations suggest that two opposing attitudes prevailed: China as the land of the uncivilized savage, and China as the producer of the wonderful and the exotic. However, an examination of the flow of Chinese commodities into Britain and discourses regarding their consumption reveals that these attitudes are not so contradictory. Both were connected to the level of trade with China and the availability of Chinese goods in England. Ultimately, China was regarded as a marketable commodity just as were her goods, and these attitudes were linked to feelings of cultural and economic superiority, reflecting the jingoistic attitudes of a society which triumphed over the Chinese in the Opium War.

Abstracts

RECRUITMENT EFFORTS OF ALABAMA INSTITUTIONS OF HIGHER EDUCATION: RESPONSIVENESS TO REQUESTS FOR INFORMATION. Marsha D. Griffin, Department of Management and Marketing, and James G. Alexander, Department of Economics and Finance, Alabama A&M University, Normal, AL 35762.

On February 20, 1997, a letter expressing interest and requesting certain types of information was sent to the undergraduate admissions office of each Alabama institution of higher education. The letter mentioned the following specific topics (in bullet format): 1) application, 2) undergraduate catalog, information on 3) campus activities 4) housing, 5) financial aid, 6) scholarships, and 7) their marketing program. The letter also asked for any other details which described the attractiveness of their program. It was the judgment of the authors that schools without marketing programs should send information about their schools of business/at least acknowledge the request, as appropriate. Also, schools without campus housing were expected to send a list of names and addresses of nearby apartments. As of March 20, 1997, 86% had sent at least some of the desired documents. Sadly, two of the seven institutions which did not respond are in the same city as the person requesting information. Regarding turnaround time, two days was the record, with over 25% achieving that mark. The slowest time was 16 days. Almost 14% of the respondents took more than 10 days to mail their packages. Nearly 54% mailed more than half of the items sought, with three schools sending over 80% of the articles. No institution mailed everything. The return rate of mentioned items was: application (86%); catalog (74%); financial aid (74%); other (62%); scholarships (58%); campus activities (53%); housing (37%); and school of business/marketing brochure (16%). It is notable and disappointing that 14% of the respondents did not send an application. Three schools sent follow-up notes/cards.

PRIOR MILITARY SERVICE AND CORPORATE ETHICAL CONDUCT: AN EXAMINATION OF RELATIONSHIPS. Neil B. Thorne, Robert J. Williams, and Gerald Crawford, Dept. of Marketing and Management, University of North Alabama, Florence, AL 35632.

The top management teams of most firms include some executives who have prior military experience. The strong culture associated with the military demands discipline, sacrifice, and a sense of duty and honor. Military service instills an allegiance to a greater cause than the individual, and encourages fraternity and a sense of community among fellow military veterans. Considering these viewpoints, some have argued that prior military service sharpens an individual's code of conduct and ethical behavior. Therefore, military experience among members of a firm's management team may serve to reduce the firm's involvement in illegal activity. A recent study involving 184 Fortune 500 firms examined the link between military service among managers and their firms' involvement in illegal activities. Contrary to the arguments presented, no evidence was found to support the relationship between the prior military service of managers and corporate criminal activity.

THE VALUE OF ARTS RELATED ACTIVITY IN THE ECONOMIC DEVELOPMENT OF A COMMUNITY. Keith Absher, Barry Morris and Marlon Rico, The University of North Alabama, Florence, AL 35630.

In May of 1995, the Shoals Chamber of Commerce Arts and Cultural Activities Committee requested the University of North Alabama's Marketing Department to conduct research on the economic impact of arts and cultural activities on the Shoals Area. The highlights of the study include: (1) Arts and cultural organizations provide 597 performances, programs, or events in the Shoals annually. (2) There are 17 museums and attractions that are open year round. (3) Performances, museums, and events attract an audience of 799,839 (duplicated audience included). (4) The arts provide direct employment for 96 full-time employees, 101 part-time employees and 304 outside personnel. (5) Arts and cultural organizations pay \$2,817,260 in wages and salaries. (6) Arts and cultural organizations have an annual budget of \$5,902,752. (7) Arts and cultural organizations purchase local goods and services of \$1,072,122 annually. (8) Total direct expenditures of arts organizations and audiences (total salaries and wages + total local purchases of the 72 arts and culturally related organizations + audience expenditures) = \$5,597,252. (9) Arts related occupants account for 6% of all room rentals in the Shoals in one year. (10) Dollar expenditures of audiences attending events in the Shoals are \$1,707,870. (11) Total economic impact of arts-related activities is \$12,313,954.

ORGANIZATIONAL STRUCTURE FOR ENVIRONMENTAL PROTECTION. Sharon N. Campbell, Dept. of Accounting and Bus. Law, Univ. of North Alabama, Florence, AL 35632.

Environmental protection is a critical issue for publicly-held manufacturing companies. The manuscript examines attributes of the organizational structures developed by industry to address this issue. Written environmental policy statements, corporate-level environmental management functions, and board-level responsibility for environmental affairs provide evidence of upper-level commitment to environmental protection in the responding organizations. Environmental goals for management and environmental awareness programs for employees are used to disseminate environmental protection values throughout the organizations. At a minimum, the responding manufacturing companies use environmental auditing as a tool to assess compliance with environmental regulations. The respondents often take a more comprehensive approach to environmental auditing that includes audits of environmental management systems and audits of pollution prevention and waste minimization programs.

Abstracts

MBA GRADUATES AND THEIR PROPENSITIES TOWARD CORPORATE CRIMINAL ACTIVITY. Gerald Crawford, Robert J. Williams, and Neil B. Thorne, Dept. of Marketing and Management, University of North Alabama, Florence, AL 35632.

It has been argued by some researchers that managers who possess graduate business education, i. e., an MBA degree, may have a greater propensity to engage in corporate criminal activity than managers with academic training from other areas. The rationale for this view lies in the nature of graduate business education. In general, the standard business curriculum teaches a language devoid of ethical symbols, and in many cases provides a set of simplified assumptions about how the world works by emphasizing the acceptance of a rational/economic world view. In a recent study involving 184 Fortune 500 companies, the link between firm size, MBA education among top management team members, and corporate criminal activity was examined. The results suggest that after controlling for a firm's prior performance, managerial tenure, and management team cohesion, graduate business education strengthens the relationship between firm size and corporate criminal activity. The results suggest that while corporate wrongdoing is more prevalent in larger firms, the incidence of illegal activity will be even more pronounced in larger firms headed by managers possessing MBA degrees.

A LOOK AT MANAGERS' ILLEGAL ACTIVITIES BY FUNCTIONAL DISCIPLINE. Robert J. Williams, Gerald Crawford, and Neil B. Thorne, Dept. of Marketing and Management, University of North Alabama, Florence, AL 35632.

Some researchers propose that the functional backgrounds of managers may influence their willingness to engage in illegal behaviors on behalf of their firms. Some propose that managers having backgrounds in the "throughput functions" (e.g., production, engineering, and accounting) of the firm are primarily concerned with efficiency issues. In contrast, managers with backgrounds in the "output functions" (marketing, sales, advertising, and product R & D) tend to concentrate on sales growth and the search for new market opportunities. Thus, it has been proposed that output oriented managers should be more likely to commit illegal activity in their firms' names than throughput oriented managers. In a recent study, 184 Fortune 500 firms having top management teams dominated by managers from four functional areas, namely accounting, production, management and administration, and marketing and sales, were compared as to their firm's record of criminal activity. Contrary to theory, the results suggest that firms headed by managers with backgrounds in marketing and sales had the lowest incidence of criminal activity, while firms headed by managers with accounting and general management backgrounds recorded the highest number of criminal violations.

SAVE A CORNER FOR DTP. Margie S. Crocker, Morris T. Jones, College of Business, University of North Alabama, Florence, AL 35632-0001.

Desktop publishing is to a business what the tractor is to the farmer. The business who still objects to in-house desktop publishing does so generally because they have not yet mastered its usefulness. As computers are discovered it's like going from a Volkswagen to a Cadillac. Computer technology can transform the way to plan, organize, and conduct a business. The creation of attractive certificates, advertisements, brochures, flyers, programs, reports, etc., can now be designed and produced with in house desktop publishing programs. The skills are becoming more and more a requirement of all business students, especially those who plan to own and/or manage their own business. Research indicate companies utilizing desktop publishing technology feel they have better quality control, cost savings, and allows for last-minute changes and/or future changes without much effort limited additional expense. The cost-saving feature can not only enhance the business, but play a big part in originality and confidentiality of business advertisements and public relations. Whether a business teacher, a student, an entrepreneur or a business owner including DPT in your daily schedule should be a serious consideration.

THE 'YEAR 2000' PROBLEM WILL ADVERSELY AFFECT THE U.S. ECONOMY. Tommie Singleton and Margie Crocker, College of Business, University of North Alabama, Florence, AL 35632.

Computers have been using the familiar MM/DD/YY format for dates for decades. On the horizon, the use of this format by various organizations, including the Federal government, is likely to adversely affect the U.S. economy at the end of this millennium. The problem is not limited to simply changing a few software programs. First, the problem is worldwide. Second, the cost to "fix" the programs and data is probably much higher than one would first surmise. One consultant suggests that the Fortune 500 companies will spend approximately \$100 million *each* to correct the problem. Third, the Federal government is facing some significant costs in order to be Year 2000 compliant. The scope of the effect of the year 2000 problem is much broader than the cost of the programming. Unquestionably, the cost of fixing the problem will be high. But, in the process, it may even affect the U.S. economy. Programming is already being outsourced to foreign entities. Another consideration is potential business risks in the form of liability or loss of ability to function. For example, one consultant warned a public utility that the lights would go out on January 1, 2000, due to the date problem. The problem needs to be approached on two fronts: the computer date itself and the reluctance to address the problem.

THE IMPERATIVE FOR MELDING INFORMATION TECHNOLOGY INTO ANY CURRICULA. Margie S. Crocker, Tommie Singleton, Robert Sweeney, College of Business, University of North Alabama, Florence, AL 35632.

Numerous articles have been written illustrating the benefits of using emerging technologies in the classroom. If business students are to be adequately prepared upon graduation, they need to be adequately exposed to emerging technologies. Many university professors are unable to keep up with all of the Information Technology (IT) changes that would better enable the institutions to educate its students. There are many reasons for this dilemma; the greatest being a lack of expertise. Yet the MIS/CIS or ASM Faculty generally have relevant skills to diminish these problems. This paper proposes that regardless of the discipline, every curriculum should incorporate some form of IT into the classroom, even if only for instructional purposes. IT can be used either as a topic to be taught (e.g., word processing) or as a tool for instruction (e.g., Powerpoint). It is especially important in business education classes to empower existing or new secondary education teachers with IT, who will in turn use that knowledge in teaching of their students at the high school level. Most technologies are amenable to a variety of business disciplines, but the emerging Internet, and associated World-Wide Web, are unquestionably applicable to every single discipline. The use of faculty members who are expert in an emerging technology can potentially mitigate most of the obstacles in business schools to implementing emerging technologies in the classrooms. The experience at the University of North Alabama reveals the potential of melding IT into curricula.

ORGANIZATIONAL LEARNING AND EFFECTIVENESS. Robert Wheatley, Dept. of Marketing, Management, and Economics, Troy State University, Troy, AL 36082.

Characteristics of learning organizations are identified and a framework is presented for analyzing organizational behavior in terms of learning opportunities and strategies. An examination of the performance appraisal and reward systems of selected institutions revealed that while individual learning is generally promoted, cultural and structural factors may be operating to limit organizational learning capacity and effectiveness.

Abstracts

GRANT WRITING: AN INTRODUCTION TO THE PROCESS. Marlon Rico, Natasha Stockton, and Keith Absher, University of North Alabama.

Large sums of money are constantly being made available by federal agencies, state agencies, private foundations, and business firms to organizations and individuals with a worthy cause. These grants provide an additional source of funds to schools, government entities, and other not-for-profit organizations as well as business firms and in some cases individuals.

Two important factors are involved in obtaining grant funds. The first job is locating a funding source that is about to make funds available for a grant. The second factor is concerned with how to write a successful grant proposal.

Last year private foundations made available 28,919 grants totaling almost 2.9 billion dollars. The unique thing about this source of grant money is that foundations are required to donate a certain percent of their accumulated assets by the end of each year. This pool of money usually gets larger year by year and will be donated based on which proposal is most persuasive.

The amount of money made available from the federal, state, and local governments for grants is enormous compared to private foundations. There are also grants available from private companies and private individuals.

An organization known as the Grantsmanship Center based in Los Angeles, California has developed a program to train people to research and write grant proposals. This organization sponsors dozens of week long seminars in various cities throughout this country. The fee to attend is expensive but they invite you to bring a worthwhile cause to work into a proposal as you learn their approach to grant writing.

ECONOMIES OF SCALE AND PUBLIC EDUCATION. Neil Thorne, Jim F. Couch, and Twana Pride, University of North Alabama, Florence, Alabama 35630

In this paper, we examine the relationship between the number of school districts in a state and student performance on standardized exams. We find that the number of districts exerts a significant influence on test scores and, in particular, greater performance is associated with small, numerous school districts.

Abstracts

PERFORMANCE APPRAISAL FAIRNESS INFLUENCE ON EMPLOYEE ATTITUDES AND BEHAVIOR. Henry M. Findley, Management Dept., Troy State University, Troy, AL 36082

In general, performance fairness perceptions did predict citizenship behavior, supervisor satisfaction, pay satisfaction, intention to turnover, effective commitment, and to a lesser degree, continuance commitment. However, the individual components of the performance appraisal predicted employee attitudes and behavior differently.

CHAMBERS OF COMMERCE: RESOURCE PROVIDER. Gerrald Murray, Dana Ross, and Dr. Keith Absher, University of North Alabama.

The U.S. Chamber of Commerce is the largest volunteer business federation in the United States. The U.S. Chamber and the many city and county chambers throughout this country are resource providers to the business communities. A high priority goal of these organizations is to improve the economic well-being of the business community and thereby the quality of life for local citizens.

Chamber leaders like to refer to themselves as the voice of business. The attitude is that the work they do to promote good citizenship and good government is just part of good business.

Many people including some interviewed chamber members were not aware of benefits this organization has to offer to members and to the community at large. To whom does the chamber president report and where does it get operating funds is also an avenue of misconceptions.

This paper is intended to provide an overview into the operating methods of various chambers as they strive to foster a more favorable business climate in their community. Areas discussed in this report include funding sources, work projects, organization structure, promotional efforts, and some reoccurring problems in chamber operations.

Although each chapter throughout this country is independent of each other, organizational efforts have provided a forum for chambers to share information. In addition, the U.S. Chamber of Commerce has in place an accrediting program designed to enhance professionalism by recognizing superior performance.

SCIENCE EDUCATION

MODIFYING INTRODUCTORY MOLECULAR BIOLOGY KITS TO PROMOTE CRITICAL THINKING. Helen H. Benford, Department of Biology, Tuskegee University, Tuskegee, AL 36088.

Commercial kits that apply concepts and techniques of molecular biology are readily available for classroom use. At a recent workshop, college science teachers tested a number of these kits. A summary to be presented includes cost, instructional level, advantages/disadvantages, and technical tips. Like many traditional laboratory exercises, kits tend to detail not only experimental procedure, but also expected results and "correct" conclusions, leaving little room for student input. The challenge is to use these kits in ways that retain their clear benefits and also provide opportunity for critical thinking, creativity, and application of scientific method. A kit using the luciferase gene to transform *E. coli* produces glow-in-the dark bacteria and provides dramatic focus to a laboratory module planned for introductory biology. The module begins with manipulation of the firefly luciferase reaction and moves to the gene-protein connection. During a discussion that introduces plasmids and antibiotic resistance, student teams outline the rationale for an experiment that will produce bioluminescent bacteria, including controls and selection for transformants. When introduced to the kit materials, students make predictions, carry out the transformation, and analyze results. To connect this laboratory exercise to the real world and provide practice in interpreting graphical information, students analyze data demonstrating that luciferase from genes engineered into mycobacteria can be used to assay antibiotic susceptibility of strains from tuberculosis patients.

A RAPID, NON-TOXIC METHOD OF DNA EXTRACTION FROM WHOLE BLOOD.
Rick A. Bright, Sue Thomson, and Jeff Barksdale, Dept. of Biology, Auburn University at Montgomery, Montgomery, AL 36116.

Previously published protocols for DNA extraction from whole blood are time-consuming, costly, and utilize toxic chemicals such as phenol, chloroform, and isoamyl alcohol. We present a modification that avoids these factors, making it adaptable to a teaching laboratory environment. The modified procedure utilizes a "salting out" technique with a saturated sodium chloride solution. The resulting product has an A260/A280 ratio of 1.833 ± 0.04 and an average yield of 112 ug of DNA from 5 mL of whole blood. These results are obtained in under two hours, from fresh or frozen blood, without any additional purification methods.

THE DETERMINATION OF AMINO ACID pK_a 's BY FTIR SPECTROSCOPY. Dawn Arant and Massimo D. Bezoari, Huntingdon College, Montgomery, AL 36106.

Undergraduate projects provide students with research experience in carrying out a literature search, planning and carrying out experiments, analyzing and interpreting data, and communicating project results in weekly meetings, papers, and presentations. In addition, the student augments his/her expertise in various areas of study. The acquisition of an FTIR spectrometer with NSF funding (1993 ILI-IG program, grant no. DUE 9450945) has stimulated student interest in undergraduate research, and increased the quality of such projects.

This presentation relates to the acid-base chemistry of amino acids and the student's experiences in pursuing the investigation of these properties by quantitative FTIR spectroscopy. The project poses many challenges, such as (i) selection of appropriate IR cell materials for analyzing aqueous solutions, (ii) selection of analysis method (HATR, or solution cells), (iii) the measurement of absorbances in multicomponent solutions, and (iv) determination of Beer's law adherence/non-adherence. In addressing these issues, the student has learned about the zwitterion nature of amino acids, used IR sampling methods and other FTIR instrumental capabilities not normally encountered by undergraduates, and studied the scope and limitations of Beer's law. The project has also provided a valuable experience in making a formal presentation of this work-in-progress.

THE NEED TO VERIFY SCIENTIFIC INFORMATION GLEANED FROM ELECTRONIC SOURCES. Ernest D. Riggsby, Dutchie Riggsby, and Joseph George, School of Education, Columbus State University, Columbus, GA 31907-5645.

There always has existed a critical need to carefully verify scientific information and data taken from all sources. The advent of electronic gateways, including the Internet, has perpetuated some inaccurate information and data acquisition. These resources avoid the careful screening by editors of hardcopy journals and peer review, which reduce the chances of using unscientific, untested, and often uncritical information. The establishing of webpages and placing easily accessible and retrievable information in the hand and works of our students may generate a ripple effect that turns into a flood of misinformation. This paper was aimed at alerting middle school students who use on-line searches to this possible source of error.

THREE YEAR EVALUATION OF GENERAL CHEMISTRY RETENTION STRATEGIES.

Barbara G. Rackley, Aaron I. Baba, Adriane G. Ludwick and Melissa S. Reeves, Dept. of Chemistry. Tuskegee University, Tuskegee, AL 36088

Decreasing the attrition rate in General Chemistry is a major concern for the faculty at Tuskegee University. A perceived cause of the high attrition rate was the poor backgrounds of some of the students. The Toledo Placement Examination was administered to incoming freshman, and the scores used to place students into introductory chemistry. Toledo Placement scores and final grades were collected for chemistry students for the year 93-94, 94-95, and 95-96. Preliminary statistical analysis shows that students with low placement scores who took the two nontraditional classes performed as well in college chemistry as students who were placed directly into college chemistry. Partial support of this project was provided by a USDA Capacity Building Grant.

LEARNING BY ROLE-PLAYING: THE CPX MODEL FOR BIOLOGY LABS. John C. Frandsen, Dept. of Biology, Tuskegee University, Tuskegee, AL 36088

An extended role-playing exercise for parasitology laboratory classes has been developed based on the military "command post exercise" (CPX). In a CPX, the participants play roles in a simulated, rapidly-moving, highly-plausible situation which develops in a manner sufficiently unpredictable to thoroughly test the coping abilities of the players. Since it is impossible to predict precisely the reactions of each player in a given set of circumstances, or to predict the relevant inter-personal interactions in each group of players, the exercise tends to develop its own scenarios and take on a life of its own, though the instructional personnel—acting as umpires—impose changes to channel its development and test the knowledge and reactions of the players. The umpires continually assess and rate the performance of the players individually and as groups.

The parasitology class is divided into 3-4-person teams, each team becoming an entity located at a real geographic location. Each team member is given a specific role within the entity, which may change. Initially, each team must find its site on a map and prepare a site analysis. Then each team is briefed on its duties and functions and given an urgent situation—a patient with certain symptoms, a specimen, an autopsy report—demanding prompt action. As soon as this action is completed, or sometimes before it can be completed, the situation is altered to present new challenges. "Rounds" are held periodically, wherein the students sit in a circle, and the teacher asks each team to report on its activities and actions. These are critiqued by all. The exercise continues for several weeks. It has been used for four years, and student response and participation have been uniformly enthusiastic, each class expressing the wish that it could have been longer. Assessment indicates that it is a much more efficient method of teaching such subject matter than the classic ones of memorization and "practical" laboratory examinations. Perhaps the CPX can be used as a model for other science laboratory instruction.

MATTER AND ENERGY: A MOST BASIC CONCEPT IN BIOLOGY.

William R. Bowen, Department of Biology, Jacksonville State University, Jacksonville, AL 36265

Biologists have long defined life as that which exhibits certain characteristics or properties associated with being alive. But, there are exceptions, for each property is not necessarily associated with every kind of living thing. Hence, this approach has always been a difficult one at best. However, there is no exception when one chooses to "define" life as a unique system of matter and energy. The expression, unique, serves to distinguish living systems of matter and energy from non-living systems. Such an approach enables biologists to consider 3 models of systems of matter and energy--namely, living, once-living, and non-living systems--each of which is governed by the First and Second Laws of Thermodynamics. The progressively greater degrees of interaction--from atoms, molecules, cells, organisms, ecosystems, and the biosphere--that occur between the "less organized" non-living systems of matter and energy and the "more organized" living systems yield the unique properties of all life. Moreover, one can then address evolution as an inevitable phenomenon which applies equally well to both non-living and living systems.

NEW COMPUTER APPROACHES TO ASSIST STUDENTS IN GENERAL CHEMISTRY.

Larry M. Ludwick, Department of Chemistry; Mbakop Ivan, Department of Electrical Engineering; and Kolongo Mulumba, Department of Electrical Engineering, Tuskegee University, Tuskegee, AL 36088.

The difficulties that students have with college chemistry are legendary. Most chemistry instructors attribute these problems to inadequate preparation in mathematics and difficulties in reading comprehension skills. While many approaches are being taken to surmount these difficulties, we are experimenting with two tools that may be successful with the increasingly computer-literate students in general chemistry. The first approach is to use HyperCard™ as a simple programming approach that instructors may find useful in many situations. The techniques can produce usable products with minimal effort by the teacher/author. An example of this programming will be shown using calculations based on the simple gas laws. Similar programs can be constructed for other specific difficult areas of chemistry. The second approach has been to construct an outline of the textbook chapters using HTML. This procedure creates an attractive product that is easy to read and provides an alternate approach to the printed textbook. Both of these tools are being designed for supplemental use in the general chemistry curriculum and will be evaluated for their effectiveness. Partial support for this effort was provided from USARO (Infrastructure Development in Engineering) and USDA (Capacity Building Grant) and is gratefully acknowledged.

LABORATORY ADAPTIONS FOR STUDENTS WITH DISABILITIES

John E. Teggin, Christopher A.L. Mahaffy and Randall E. Richardson, Department of Chemistry, and Nancy B. McDaniel, Gerri L. Wolfe and Reed L. Bigelow, Center for Special Services, Auburn University at Montgomery, Montgomery, AL 36117-3596, U.S.A.

The authors will report on 'Project L.A.B.S.S.' (Laboratory Adaptations for the Betterment of Special Students); a program to allow students with disabilities to participate fully in first year college chemistry courses. Twenty-four experiments have been devised that involve no temperatures above 50 degrees C. or corrosive materials at concentrations greater than 1% in aqueous solution. Almost all materials were obtained from retail outlets. These safe inexpensive experiments covered the same chemical principles that were previously included in our General Chemistry sequence without requiring special equipment or laboratory furniture for students with physical disabilities.

Attendees at the presentation, which will include a demonstration of one of the modified experiments, will be given an opportunity to obtain a complimentary copy of the manual containing all experimental details.

BEHAVIORAL AND SOCIAL SCIENCES

A QUALITY CONTROL PLAN APPROACH TO CRIMINAL JUSTICE EDUCATION: A QUEST FOR ACADEMIC EXCELLENCE. Jerald C. Burns, Dept. of Criminology and Criminal Justice, Alabama State University, Montgomery, AL 36101.

This paper charts the history of Alabama State University's Quality Control Plan and its implementation by the Department of Criminology and Criminal Justice. The paper explores the use of Bloom's taxonomy of learning and its implications for the preparation of syllabi and tests for the department, as well as the development of degree competency statements. The paper concludes that to achieve academic excellence in criminal justice, instructors must have measurable objectives and be a part of the university's efforts to be accountable for its product.

Abstracts

TRAINING EFFECTIVENESS: APPLYING THE CONCEPT OF PERSONALITY PREFERENCES. Bryan Kennedy, and Dahlia B. Newton, School of Business, Athens State College, Athens, AL 35611

Trainers are more successful when they can identify factors that enable individuals to learn effectively. An understanding of personality traits such as locus of control, self esteem, and emotional stability, is helpful to trainers. The concept of personality preferences, based on Jung and Myers-Briggs, also helps trainers take into account individual differences that affect learning. Guidelines for providing positive and corrective feedback, based primarily on the work of Hirsch and Kummerow, enable trainers to fulfill their roles.

CORRECTIONAL REFORM: POTENTIAL IMPACT OF THE PRISON LITIGATION REFORM ACT. William E. Osterhoff, Dept. of Justice & Public Safety, Auburn Univ. at Montgomery, and Maureen C. Trussell, Psychology Dept., Auburn Univ. at Montgomery, Montgomery, AL 36117.

Prison litigation was uncommon in the United States until the 1960s. Based on the separation of powers doctrine, management of prisons and jails was the responsibility of the executive levels of government. For most of the nation's history the courts exercised a "hands-off" policy toward corrections and reflected the view that inmates did not have the same rights as other citizens.

The "hands-off" policy changed during the 1960s. The number of lawsuits filed by inmates has increased dramatically. Courts became involved in almost every aspect of correctional management. As a result, prison and jail conditions improved dramatically throughout the nation. During recent years, however, the courts have shown more deference to correctional administrators, particularly as the number and cost of inmate suits became more burdensome. The increase in inmate litigation also was of concern to the legislative and executive branches of government.

On April 26, 1996, the Prison Litigation Reform Act (PLRA) was signed into law. The bill limits the scope of the federal courts in prison and jail reform and limits access by inmates to the federal courts. PLRA's short term impact will result in a reduction in the number of inmate lawsuits filed, fewer consent orders, and less intrusion by the courts in correctional management. The long range impact, however, may be less optimistic. Many of the gains that have been achieved for inmates and for corrections in general may erode as federal court involvement is reduced. Constitutionality of some provisions of PLRA also may be questionable.

Confirmatory Factor Analysis of the Computer Hassles Scale. Richard A. Hudiburg, Dept. of Psychology, Univ. of North Alabama, Florence, AL.

The Computer Hassles Scale, a measure of computer stress, was developed by Hudiburg (1992) as a shortened version of the Computer Technology Hassles Scale (Hudiburg, 1989). The Computer Hassles Scale (CHS) was defined from the first two factors derived from a factor analysis of the Computer Technology Hassles Scale. These two factors were composed of "hassles" that related more specifically to the use of computers rather than computer technology in general. The two factors were identified as Computer Runtime Problems and Computer Information Problems. The specific objective of this research was to determine whether the *latent structure* of the Computer Hassles Scale fit the two factor structure defined as a result of the data reduction from its parent scale or whether another structure better fit the scale.

This study employed a normative database of 1199 student computer users. *Exploratory* factor analysis and *confirmatory* factor analyses were performed using SPSS 6.1 for Windows (SPSS, 1994) and the LISREL 7.2 structural equation modeling computer program (Jöreskog & Sörbom, 1991). Three models were tested using LISREL: Model 1 -- the two factors based on the parent scale; Model 2 -- a two factor structure identified from an *exploratory* factor analysis of the CHS; and Model 3 -- other factor structures with 3 or more factors identified in the *exploratory* factor analyses of the CHS. Using various goodness-of-fit indices, it was found that a three factor solution Model 3 was the best fitted structure for the scale. The current study suggests that future research explore possible *latent structure* differences of the CHS as a function of demographic variables such as gender and computer experience.

UNREPORTED DECISIONS OF THE U.S. CIRCUIT COURTS OF APPEALS. Robert J. Van Der Velde, Justice & Public Safety Dept., Auburn Univ. at Montg., Montgomery, AL 36117.

As the number of appeals continues to grow, the U.S. Circuit Courts of Appeals are increasingly choosing not to publish large numbers of decisions. This article explores how unreported appellate decisions differ from reported decisions and whether court policies and practices regarding non-publication of decisions should be changed. Part I reviews the literature regarding unreported decisions. Part II presents an empirical analysis of appellate decisions. Focusing on 1992-1994, data are compiled for every case to answer the previously unexplored issue of whether cases with unpublished decisions are resolved significantly faster than those where the court publishes its decisions. Part III describes the local rules of each of the circuits regarding publication, and examines whether litigants or the courts rely on unpublished decisions despite rules which discourage such reliance. Finally, Part IV sets forth proposed revisions to court policies regarding publication, and assesses the possible consequences of the suggested changes.

Abstracts

Orientation: a key step in the personnel selection process. Louis M. Harris, Jr., Criminal Justice Department, Faulkner University, Montgomery, Alabama 36109.

Police officer turnover has been recognized as a problem since the earliest writings in police administration. To explain turnover researchers have focused on predictor variables such as attitudinal factors, biological factors, work-related factors and test-score factors. While not discounting these factors, recent attention has been paid to the selection process and specifically the orientation step as a predictor variable for turnover within a police agency. Orientation may consist of a brief explanation of the department's benefits to an extensive disclosure of the department's goals and objectives.

CHARACTERISTICS OF THE MEMBERS OF THE WIDOWED PERSONS' SERVICE IN CENTRAL ALABAMA. Larry C. Mullins, Department of Sociology, and Nelya J. McKenzie, Department of Communication and Dramatic Arts, Auburn University at Montgomery, Alabama 36117.

This study examines the loneliness and depressed mood of older persons who are members of the Widowed Persons' Service (WPS) in a medium-sized southern city. Of particular interest is: A) The association between loneliness and depressed mood, and B) the set of factors that may influence these two socioemotional states. The antecedent variables of interest include age, sex, living arrangements, self-rated health and self-rated economic condition, existence (or not) of children and friends, and several support variables with regard to both children and friends. Of the 230 members of the WPS in the Winter, 1996, 134 (58%) responded to a mailed survey. These persons are neither especially lonely, nor especially depressed. The sample is predominately female and white with an average age of 74.45 years. Most live alone. The average number of children is 2.30. The average number of "best" friends is 4.02. These persons view their health condition and their economic condition as quite good. Results indicate a moderate association, $r=.41$ ($p<.001$), between the Loneliness Scale and the Geriatric Depression Scale. Separate multiple regression analyses for loneliness and depression indicate: A) lesser loneliness is associated only with having more friends, and B) lesser depressed mood is associated with a more positive health assessment, a better economic situation, and having female friends. These and other findings are discussed along with their implications.

Abstracts

BAIL ISSUES: ASSESSING VARIOUS STATE PROCEDURES. Gerald P. Fisher, Dept. of Criminal Justice, Alabama State University, Montgomery, AL. 36101.

The public and the media attack bail systems when an individual released on bail commits additional crimes. It particularly becomes a major public concern when pre-adjudicated individuals are released merely to relieve jail crowding. This paper will provide a discussion and evaluation of current bail programs in varied jurisdictions. The author will also present recent technological developments which impact on the success of pre-adjudication community release programs.

MEDICAL MARIHUANA LEGISLATION. Nicholas A. Astone, Dept. Criminal Justice, Alabama State University, Montgomery, AL. 36101.

Medical marijuana is one of the most controversial issues facing American policy makers in the 1990s. California and Arizona have initiated a movement to prescribe marijuana as medicine in specific cases. Government response has been repressive. This paper presents a view of the trend medical marijuana has taken in the beginning of 1996, including state initiatives, legislative statutes and governmental responses at the national level.

HEALTH SCIENCES

ATHEROEMBOLISM: A MULTIFACETED DISORDER. Sara Kim and Robert E. Pieroni, Dept. of Internal Medicine, Univ. of Ala. School of Medicine, Tuscaloosa, AL 35487.

Atheroembolism develops when thrombotic and atherosclerotic material, originating in a more proximal arterial system, lodge distally resulting in vessel occlusion. This may occur spontaneously or following invasive procedures, such as angiography. The condition is often undiagnosed because of lack of clinical recognition, and frequent difficulty in its diagnosis, especially since it can mimic a variety of other disorders. Because atheroembolism may involve numerous organs, its sequelae are serious and may be fatal. We shall discuss risk factors, clinical and laboratory manifestations, differential diagnoses and possible treatment modalities for atheroembolism. The importance of early recognition of this ominous entity will be underscored as will the use of appropriate preventive measures, as well as the possible avoidance of exhaustive diagnostic studies.

SURVEY OF STATE DEPARTMENTS OF EDUCATION ON CHILD ABUSE PREVENTION EDUCATION. Elaine Marshall, Samford University, Birmingham, AL and Ellen B. Buckner, University of Alabama at Birmingham, Birmingham, AL 35294-1210.

Child Abuse prevention initiatives have been attempted in many areas due to the alarming rise of reported cases of child abuse. Health and education reform have both emphasized the need for comprehensive school health education, however, child abuse prevention education is not routinely listed as a component. This study surveyed state school officers to determine current offerings in health with particular emphasis on child abuse prevention. Thirty-seven (37) state departments returned surveys with respondents averaging 19.2 years experience in education. Thirty (81%) required a health course for graduation, however, only eight (21%) required a child abuse prevention unit. Several other respondents indicated health or child abuse prevention education was recommended and several states sent well-developed K-12 curricular materials in response to the survey. Several state officers indicated that decisions were made locally, not at the state level. Regarding future offerings respondents indicated that specific content was best presented within a comprehensive framework not as a crisis-oriented topic. Barriers to implementation included concern for family responsibility in this area and difficulties in discussing some aspects of the topic. Respondents recommended inclusion of positive parenting, stress management and conflict resolution. A broad range of state initiatives in this area was noted.

ANTIPROLIFERATIVE EFFECT OF GEMCITABINE AND 5-FLUOROURACIL IN COMBINATION ON TISSUE CULTURE MODELS.

L.G. Eley & E. Felts, Samford University McWhorter School of Pharmacy, Birmingham, Alabama. S. Schmid, Experimental Therapeutics Department, Southern Research Institute Birmingham, Alabama.

Gemcitabine is a relatively new anticancer nucleoside being an analog of deoxycytidine. It's activity against DNA is gained by replacing the two hydrogen atoms of the 2-carbon with two fluorine atoms. Therapeutic activity against a number of murine solid tumors and leukemias led to clinical trials(1). Chemotherapeutic regimens for pancreatic cancer usually include 5-fluorouracil (5-FU). As a single agent 5-FU has about a 7-30% response rate. Among new agents currently being tested is gemcitabine which has produced overall clinical benefits in 25% of cases as a single agent. HT29-C1.19A, a clone of HT29 cells which form tight junctions in a continuous monolayer culture, were maintained under standard conditions. Cytotoxicity was analyzed by a colorimetric assay. Samples from the CoStar 96-well plates were read with an Anthos colorimetric reader 2001, used specifically to measure light absorbance. Results of the combination compared with single agents shows ID_{50} values that indicated a three and two log increase in inhibition for the combination compared to Gemcitabine and 5-FU respectively. The curve is shifted to the left showing an exponential increase over a 5-FU and a faster onset of activity over Gemcitabine itself. By varying the proportions of drug it may be possible to further increase the potency of the combination.

1). Hertel L.W., Boder BG Jr. et al. Evaluation of the antitumor activity of gemcitabine. *Cancer Res.* 50. 4417-4422 (1990)

THE INFLUENCE OF BEHAVIORAL CUES ON THE IMMUNIZATION PRACTICES OF ELDERS.

Dr. Lynn A. Chilton, Div. of Nursing, Mississippi University for Women, Columbus, MS

A quasi-experimental intervention study was designed to compare the influence of behavioral cues on immunization practices of elders, to determine immunization practices related to influenza and pneumonia, and to ascertain reasons for underimmunization among this age group. Data were collected utilizing a Demographic Survey (DS) and the Chilton Immunization Survey (CIS). The sample consisted of 393 elders who were patients in rural health clinics where nurse practitioners (NPs) were the primary care providers. Subjects were divided into four groups which included one control group (Group 1) and three treatment groups. Subjects in Group 2 received a postcard reminder as a cue to obtain inoculations. Elders in Group 3 did not receive a postcard reminder but did obtain care from NPs who received immunization fact sheets as a cue to increase awareness about underimmunization consequences for elders. Subjects in Group 4 received both a postcard reminder and care from NPs who were exposed to the fact sheets. Descriptive statistics were used to analyze the DS and CIS. Also, for each group of elders, it was determined how many subjects received influenza and/or pneumonia immunizations during the three months of data collection and a score was given to each group. A comparison of groups mean scores was made among the four groups utilizing an ANOVA and post hoc analysis. Analysis revealed that while the majority of the subjects (n=289, 73.5%) had received an influenza inoculation last year, only 38.3% had ever received an immunization to prevent pneumonia. Analysis also indicated that the group of elders who received both a postcard reminder and care from a NP exposed to immunization fact sheets, had significantly higher immunization rates than all other groups. Conclusions from this study were that primary care providers develop fact sheets on immunizations as a cue to discuss immunizations with elders and that postcard reminders should be sent by as effective strategies to improve immunization rates among elders.

ADDISON'S DISEASE: DIAGNOSTIC FEATURES. Robert E. Pieroni, Univ. of Ala. School of Medicine, Tuscaloosa, AL 35487.

Primary adrenal insufficiency (Addison's Disease), although uncommon, should be promptly considered in the differential diagnosis of patients presenting with a variety of signs and symptoms that have been noted in this disorder. Left untreated, adrenal crisis and death may ensue. Clinical features have been categorized as: 1) asthenic, e.g. decreased strength, and lethargy; 2) cardiovascular, e.g. orthostatic hypotension, small heart; 3) gastrointestinal, e.g. anorexia, nausea, diarrhea, abdominal pain; 4) salt wasting, with possible hyperkalemia, hyponatremia, azotemia and metabolic acidosis; 5) hypoglycemia and 6) alterations in pigmentation. These and other clinical manifestations may vary in occurrence among patients. Although autoimmune adrenal destruction is the most common cause of Addison's Disease in this country, there are a variety of other disorders, for example, bleeding and fulminant infection, which can result in adrenal insufficiency. Case reports, as well as an approach to the diagnosis of Addison's Disease will be presented, as will discussions of pathophysiology, physical and laboratory abnormalities, as well as appropriate diagnostic and therapeutic interventions.

PERINATAL SUBSTANCE ABUSE: NURSING STRATEGIES AND OUTCOMES.

Wan-Ting Wu, James Andrew Atkins and Ellen Buckner,
University of Alabama at Birmingham, Birmingham, AL 35294-1210 and Marian Hoge
and Sabrina Boswell, Aletheia House Substance Abuse Treatment and Prevention
Program, Birmingham, Alabama

Participants in a perinatal substance abuse treatment program were visited by nursing students during a clinical rotation. Students visited clients approximately 6 times a day at a treatment facility to assist clients to adapt to their pregnancy and to enhance adherence to the program promoting drug-free lifestyle and self-care. Student activities consisted of assessment and intervention in areas of educational needs, psychosocial support, and anticipation of developmental maturation. Students encouraged clients to participate fully in prenatal care and to consult with their primary physician or nurse practitioner as needed. Students identified nursing diagnoses including (1) Alteration in nutrition, (2) Lack of knowledge of several pregnancy related topics (anatomy, physiology, drug and nicotine effects, growth of fetus, processes of labor and birth, hygiene, safety, birth control, newborn care, postpartum self-care, etc.), and (3) Alteration or delay in achieving developmental tasks of pregnancy (acceptance of the pregnancy, seeking safe passage, self-care). Students established a therapeutic relationship with emphasis on educational modalities and support for healthy behaviors. Clients who were visited by nursing students averaged 63 days in the program and 54% graduated from the program. Students and clients reported beneficial effects from the relationships which were established. Future plans include strengthening communication and procedures to facilitate student visits and determination of other beneficial outcomes of the intervention.

EFFECT OF AGED GARLIC EXTRACT (AGE) ON BENZOYL PEROXIDE

(BPO) CYTOTOXICITY. Noma Gwebu, Joanne Williams, Lakeisha Perkins, Arley Brutus, Woodley Benoit, Stephanie Richardson, Ephraim Gwebu, Department of Chemistry, Oakwood College, Huntsville, AL 35896.

Garlic is a common food item with both anti-atherosclerotic and hypotensive properties. According to Wakunaga of America Co., Ltd (Mission Viejo, CA), Aged Garlic Extract™ is a product of organically grown garlic cloves that have undergone a unique natural aging process. Their claim is that aged garlic extract is an antioxidant form of garlic, according to *in vitro* tests. Studies from our laboratory have shown that BPO, a progenitor of free radicals, is cytotoxic. The purpose of this study was to determine whether AGE protects human aortic smooth muscle cells against BPO cytotoxicity. Proliferating human aortic smooth muscle cells (SMCs) were purchased from Clonetics Co., trypsinized and maintained in Clonetics SMGM3 BulletKit cell growth medium. At passage 3 in our laboratory, SMCs were split and transferred to 24-well petri dishes at a density of 10^5 per mL. The cells were preincubated with AGE at 70% confluency for 40-48 hours. BPO (33 micromolar) was added to each well and incubation followed by cell viability assay. The results show that AGE may provide some protection. Funded in part by NIGMS/NIH MARC Grant #T34GMO8259-09.

EFFECT OF PROPYL GALLATE ON BENZOYL PEROXIDE CYTOTOXICITY IN HUMAN AORTIC SMOOTH MUSCLE CELLS. Sharon Ngwenya, Tamara Young, Stephanie Richardson and E.T. Gwebu. Department of Chemistry, Oakwood College, Huntsville, Alabama 35896.

Certain antioxidants have been found to protect living cells from oxygen free radicals that are implicated to be among the causes of chronic diseases such as cancer, Alzheimer disease, and atherosclerosis. Benzoyl peroxide (BPO) is known to be a generator of oxygen free radicals. Benzoyl peroxide can be found to be an active ingredient in treatments for various conditions such as inflammatory acne and decubitus ulcers. We have also shown that BPO is indeed toxic to vascular smooth muscle cells with an LD₅₀ of 30 micromolar. Since propyl gallate is an antioxidant, it may be capable of protecting living cells from the cytotoxicity of BPO. The purpose of this experiment is to determine if propyl gallate protects human aortic smooth muscle cells from the cytotoxicity of BPO. Proliferating human aortic cells were purchased from Clonetics Inc., trypsinized and cultured and cultured at 37 degrees Celcius, 5% carbon dioxide, and 95% humidity. At passage 3, the cells were transferred to wells and allowed to grow to 70% confluency before exposure to propyl gallate and BPO. Cell viability was determined using the methylthioletrazolium (MTT) test kit purchased from Sigma Chemical Company. The results will be discussed.

NDGA AND BENZOYL PEROXIDE CYTOTOXICITY ON VASCULAR SMOOTH MUSCLE CELLS. Ariel J. Warden, Stanton Dulan, Stephanie Richardson, Tamara Young, Kelly Darby, Michael Selassie, Ephraim T. Gwebu. Dept. of Chemistry, Oakwood College, Huntsville, AL 35896.

Benzoyl peroxide (BPO) has been shown to generate oxygen free radicals that are implicated to be among the causes of chronic diseases such as Alzheimer disease, atherosclerosis, and cancer. Lab results show that BPO is toxic to human vascular smooth muscle cells by the generation of free radicals at 0.33 μ M concentrations. Certain antioxidants have been found to protect cells that have generated free radicals. Since nordihydroguaiaretic acid (NDGA) is a known antioxidant, the purpose of our experiment is to determine if NDGA protects cell viability against BPO. Proliferating human vascular smooth muscle cells were purchased from Clonetics, Inc., trypsinized and cultured at 37 degrees Celsius, 5% carbon dioxide, and 95% humidity. The cells were allowed to grow to 70% confluency before being exposed to BPO and NDGA. Cell viability was determined using the methyl thiazole tetrazolium (MTT) test kit purchased from Sigma Chemical Company. The results will be discussed. This research was supported in part by NIGMS-MBRS #GS14-GM 48439-03, and NIGMS-MARC #T34-GM08259-09.

Abstracts

THE RELATIONSHIPS BETWEEN INTENTION, HABIT, AND BREAST SELF-EXAMINATION BEHAVIOR. Youngshook Han, School of Nursing, The University of Alabama at Birmingham, Birmingham, AL 35294.

This study examined the role of confidence and perception of vulnerability to breast cancer in predicting intention to perform Breast Self-Examination (BSE) and BSE behavior 2 years later using the Triandis model of choice (Triandis, 1977). The subjects (N=2212) consisted of women between the ages of 52 and 64 years who were divided into four groups based on their responses to confidence (have confidence versus no confidence) and perception of vulnerability (high versus low). Structural equation analyses were performed to test the components of the Triandis model (i.e., consequence, affect, social factors, intention, habit, and behavior) along with the effects of confidence and vulnerability for each group. Results showed only limited support for the Triandis model in predicting the relationships between BSE intention, habit, and BSE behavior. Intention influenced BSE behavior depending on the interactive effect of confidence and vulnerability, while habit influenced BSE behavior regardless of the interactive effect. A significant relationship between intention and BSE behavior was found only in women who had no confidence and low vulnerability. This study was supported by Grant PBR-51a from the American Cancer Society.

TREATMENT OF ACUTE ALLERGIC REACTIONS TO FOODS BY A TRADITIONAL BY A TRADITIONAL HEALER IN ZIMBABWE. Ephraim T. Gwebu and Nkenge Jackson, Oakwood College, Huntsville AL. 35896, Dumezweni Sidambe, Barbara Sibanda, Zimbabwe Traditional and Medical Clinic, 19 Fifth Avenue, Jason Moyo Street, Bulawayo, Zimbabwe. Sam. Sibanda, Chemistry Department, University of Zimbabwe, P.O. box MP 167 Mt. Pleasant, Harare.

Nkenge Jackson went to Zimbabwe with the Minority International Research Training scholars during the 1996 summer. From infancy Nkenge had severe allergic reactions to most types of food including cow's milk. As she grew up, she discovered that she could not even ingest anything that had tomato, citrus products, fruit juices, sodas and fruits of any kind without suffering the symptoms of allergy. In June 1996, when she was leaving for Zimbabwe, her father (a physician) and mother (Ph.D. in pharmacology) gave her a mobile pharmacy composed of every conceivable anti allergy prescription. Upon arrival in Zimbabwe she drank bottled water only and scrupulously examined everything before putting it in her mouth. A few weeks later, she was introduced to a traditional healer, Dr. Sidambe. A nationally known herbal medicinal practitioner. After examining her, he told her that he was going to prepare a prescription that would contain most of her sources of allergies. She returned the next day and was given a liquid prescription. Nkenge was on the treatment program for about a week. During that period she did not change her eating habits. However, one day she ran out of her bottled water and decided to take just a sip of soda belonging to her roommate. To her surprise, there was complete absence of allergic reactions. She tried a few more foods, with the same results. A few days later, Nkenge discovered the joy of eating anything she wanted. Presently, Nkenge is a first year medical student at Morehouse College of Medicine eating to her heart's delight.

Funded by Mirt Grant #5T37 TW00070-02

THE CYTOTOXICITY OF DDT AND DDE ON HUMAN VASCULAR SMOOTH MUSCLE CELLS. Stephanie M. Richardson, Michael Selassie, Joanne Williams, Rashaye Freeman, Marisssa Cummings, Marc-Yriane-Borieux, and Ephraim T. Gwebu. Chemistry Department, Oakwood College, Huntsville, Alabama 35896.

The compound DDT (1,1,1-trichloro 2,2 bis (p-chlorophenyl) ethane) and DDE (2,2-Bis(4-chlorophenyl)-1,1-dichloroethylene) were used in insecticides to destroy mosquitoes to prevent the spread of malaria. Unfortunately, scientist did not understand that these compounds would alter wildlife that it came in contact. Scientist have found evidence that some chemicals block or imitate biological signals in the body.

The health effect of DDT are a concern to the people of North Alabama because of a history of water contamination by the xenobiotic (DDT). The objective of this study is to determine the cytotoxic effect of DDT and DDE on human vascular smooth muscle cells. Proliferating human vascular smooth muscle cells were purchased by Clonetics Co., and maintained in Clonetics SMGM-3 Bulletkit cell growth medium. At the third passage the cells where transferred into 24-well petri dishes and allowed to grow to confluency before experimentation. The method of Mosmann (Mosmann, T. Rapid colorimetric assay for cellular growth and survival: application to proliferation and cytotoxicity assays. *J. Immunol. Methods* 65: 55-63; 1983) was used with some modifications. The method involves use of MTT (methylthiazol tetrazolium) assay kit purchased from Sigma Chemical Company was used to estimate the cell viability. Our results show that DDT and DDE are toxic to vascular smooth muscle cells.

Funded by NIGMS/NIH MARC Grant #2 T34 GM08259-06A1

EVALUATION OF THE MAJOR GENE DELETION FOUND IN JUVENILE NEURONAL CEROID LIPOFUSCINOSIS (BATTENS DISEASE) IN A FAMILY WITH THE ADULT FORM, KUFS DISEASE. Tim Wood and Maria Descartes, Laboratory of Medical Genetics, University of Alabama at Birmingham, Birmingham, Alabama 35294. Ruben Kuzniecky and Edward Faught, Epilepsy Center, University of Alabama at Birmingham, Birmingham, Alabama 35294.

Kufs disease is a rare adult onset neurological disorder, the adult form of the neuronal ceroid lipofuscinoses (NCL). NCL clinical diagnosis includes seizures, dementia, premature death and the accumulation of autofluorescent lipopigments in neuronal cells. Adult neuronal ceroid lipofuscinoses (NCL) differs from classical forms of NCL by lacking ocular symptoms and having onset in adulthood. Recently, a candidate gene (CLN3) for the juvenile form of NCL (JNCL, Battens disease) has been isolated and between 70-80% of affected JNCL individuals carry a 1 kb deletion. We used a recently published PCR-based test for the major JNCL deletion to examine the locus of a known JNCL patient. The patient revealed the 1 kb deletion in both alleles. Also, examination of the JNCL locus in one affected ANCL patient and three family members did not show the CLN3 deletion. Our data suggest ANCL is not caused by the common Battens disease deletion.

ATTEMPTS TO AUTHENTICATE ZIMBABWEAN TRADITIONAL

REMEDIES. Donald Peghee, Jr., Mueni Mutinga, Gadia Peabody, Melvin Poole, Jr., Ephraim Gwebu, Department of Chemistry, Oakwood College Huntsville, Al 35896. Sam Sibanda, Department of Chemistry, University of Zimbabwe P.O. Box MP 167 Mount Pleasant Harare, Zimbabwe. William Setzer, Department of Chemistry, University of Alabama in Huntsville, Huntsville, Al 35899.

The plant, commonly known as Isagogwana in Sindebele, the local Zimbabwean language, *Pappea capensis* is from the area of Mbizingwe in Zimbabwe, Africa. The root bark is used for the treatment of coughs. Therefore the root bark was collected and taken to the University of Zimbabwe. Exhaustive extraction with cold methanol was carried out, followed by evaporation of the solvent by the rotovapor. A high vacuum air pump was used to dry the substance into a glass. The material was then packaged and brought to the United States. In the laboratory at the University of Alabama in Huntsville, a chromatography column was prepared and fractions gathered of the material. One fraction showed biological activity (brine shrimp lethality) and was sub-fractionated using a preparative TLC method. The results from this are now being subjected to further analysis by NMR spectroscopy. The prediction is that the plant exhibits some cytotoxicity activity. Cytotoxicity studies have been initiated in the laboratory at Oakwood College. This study was supported in part by NIH/Fogarty International Center-Minority International Research Training Program (MIRT) Grant # 5 T37 TW00070-01.

PARENTING A HOSPITALIZED PRETERM INFANT: A PHENOMENOLOGICAL STUDY. Margaret Findlay, R.N., Ph.D., School of Nursing, Univ. of Ala. at B'ham., Birmingham, AL 35294.

This phenomenological study was designed to explicate the meaning of the lived experience of parenting a hospitalized preterm infant. Seven females and two males whose preterm infants were at least four weeks old were interviewed to obtain complete descriptions of their experiences. Data were analyzed using a seven-stage process process. Triangulating analysts validated the findings. The meaning of the experience of parenting a hospitalized preterm infant was multidimensional and best represented through three interrelated themes: adaptation, autonomy, and future. Subthemes which supported the theme, adaptation, were fear of death, attachment, support systems, personal strength, faith in God, and decisions regarding life situation. Subthemes which supported the theme, autonomy, were communication, assuming parenting role, seeking information, and gaining confidence. Subthemes which supported the theme, future, were going home, growth and development of the child, parenting style, and future childbearing. Multidisciplinary implications for practice and education were identified. Recommendations for research included additional phenomenological studies with parents of preterm infants and care providers. Recommendations were also provided related to intervention and efficacy studies within the neonatal intensive care unit.

Abstracts

PAX 2 GENE EXON 3 SILENT MUTATION IDENTIFIED. Lewis O. Maddox and Maria Descartes, Laboratory of Medical Genetics, University of Alabama at Birmingham, Birmingham, AL 35294. Martin S. Cogen, Alabama Eye Foundation Hospital, Birmingham, AL 35294.

The Paired Box (PAX) gene family encodes transcription factors involved in the development of several tissues. The PAX gene family currently consists of nine genes, PAX 1 to PAX 9. Developmental abnormalities have been described for mutations of the PAX 2, PAX 3, and PAX 6 genes. PAX 2 gene expression during embryogenesis has been detected in the developing central nervous system, ear, eye, kidney, and ureter. The PAX 2 gene, containing 12 exons and spanning 70 kb, has been localized to chromosome 10q25. Mutations with the PAX 2 gene have been associated with renal-coloboma syndrome resulting in optic nerve coloboma and renal anomalies. We have identified a silent mutation (A120A) in exon 3 of the PAX 2 gene that results from a C to T transition in the third position of the codon. The variant sequence was detected by SSCP analysis. Cycle sequencing has shown that the forward and reverse strand sequences were not complementary to each other. The sequence discrepancy occurred around the C to T transition which was confirmed by digestion of the patient's PAX 2 exon 3 PCR product with the restriction enzyme DdeI. Computer analysis of the DNA sequence suggested that the C to T silent mutation alters the DNA secondary structure, thus hindering the fidelity of the polymerase during cycle sequencing. Results of Cleavase fragment length polymorphism (CFLP) analysis in which the enzyme cleaves at the 5' end of secondary structure may be useful to further support this hypothesis.

THE EFFECT OF BUTYLATED HYDROXYLTOLUENE (BHT) ON BENZOYL PEROXIDE CYTOTOXICITY. Khalid Parris, Joseph Cheatham, Stephanie Richardson, and Ephraim T. Gwebu. Chemistry Department, Oakwood College, Huntsville, Alabama 35896.

In an effort to alleviate the occurrences of certain diseases which are caused by free radicals, experiments must be implemented to mock physiological conditions. Certain antioxidants have been found to protect living cells from oxygen free radicals. Benzoyl peroxide (BPO) is known to solicit the occurrences of oxygen free radicals in tissues and is toxic to the cells. However, butylated hydroxytoluene (BHT), a widely used phenolic antioxidant in processed foods, cosmetics, and petroleum products, has been shown to completely protect the endoplasmic reticulum membrane from free radical induced changes (Peter Kaplan et. Al. And Y. Nakagawa et. al.). In this experiment, BHT was evaluated as a possible protector against the cytotoxic effects of BPO on proliferating human aortic smooth muscle cells. Our results show that BHT protects human aortic smooth muscle cells against BPO. This research was supported in part by NIGMS-MARC #2 T34-GM08259.

EFFECT OF VITAMIN E AND RADICAL SCAVENGERS ON VASCULAR SMOOTH MUSCLE CELLS AGAINST BENZOYL PEROXIDE CYTOTOXICITY. Joanne Williams, Luke Carthen, Noma Gwebu, Nalo Hamilton and Ephraim T. Gwebu. Department of Chemistry, Oakwood College, Huntsville, Alabama 35896.

Generation of oxygen free radicals and concomitant cytotoxicity is implicated in such chronic diseases as cancer, Alzheimer disease (AD), and atherosclerosis. Oxygen free radical neurotoxicity can be attenuated by vitamin E and other free radical scavengers. Because there are different types of oxygen radicals, the protective potential of these scavengers may vary accordingly. Benzoyl peroxide (BPO) is an oxygen free radical generator used in the treatment of such conditions as decubitus ulcers and inflammatory acne. Studies from our laboratory have shown that BPO induces platelet aggregation and the platelet release reaction. We have also shown that BPO is toxic to vascular smooth muscle cells.

The purpose of this study was to compare the protective potential of vitamin E (an antioxidant) and hydroxyl radical scavengers against BPO cytotoxicity. Human aortic smooth muscle cells in culture were used. The methylthio-tetrazolium (MTT) assay was used to estimate cell viability. In this report, we show that vitamin E, mannitol, and dimethyl sulfoxide, protect cells against BPO cytotoxicity, differentially.

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THROMBOTIC THROMBOCYTOPENIC PURPURA (TTP). Lisa Sward and Robert E. Pieroni, Depts. of Family Medicine and Internal Medicine, Univ. of Ala. School of Medicine, Tuscaloosa, AL 35487.

A fifty-seven year old female presented to the emergency department because of acute onset of slurred speech and behavioral changes. She had a past medical history of hypertension and depression, and had recently experienced mild respiratory symptoms. There was no history of sputum production, nausea or vomiting. Physical examination revealed a stuporous female with a temperature of 100.2° and tachycardia. The examination was otherwise unrevealing. Laboratory evaluation revealed anemia and severe thrombocytopenia. Schistocytes were present on the peripheral smear. CT scan revealed no significant intracranial abnormality. Elevations of hematological, hepatic and muscle enzymes, as well as serum globulin were noted. Urinalysis revealed proteinuria and hematuria, but renal function was otherwise preserved. A clinical diagnosis of thrombotic thrombocytopenic purpura was made and the patient was promptly transferred to a tertiary care center for plasmaphoresis. TTP is a rare hematologic disorder that presents with many systemic signs and symptoms. Prompt diagnosis and treatment can lead to a response rate approaching 80%, whereas without treatment, the disease is almost universally fatal. Clinical features of this intriguing entity will be discussed, including proposed etiological factors as well as diagnostic and therapeutic considerations.

HAMARTOMA: THE PULMONARY MIMIC. Robert E. Pieroni, Dept. of Internal Medicine, Univ. of Ala. School of Medicine, Tuscaloosa, AL 35487.

Pulmonary hamartomas are benign lung neoplasms occurring most frequently in asymptomatic older males. Although originally felt to represent developmental anomalies, recent cytogenetic studies indicate that hamartomas represent clonal mesenchymal neoplasms. Recently we encountered an elderly male with symptoms of mild congestive heart failure. A chest x-ray revealed a pulmonary nodule, which was felt to be suspicious for bronchogenic carcinoma. At surgery, his lesion was found to be a pulmonary hamartoma. Subsequently, his coughing and mild dyspnea improved considerably. Since pulmonary hamartoma can masquerade as other lung disorders, including carcinoma, knowledge of this entity and its characteristics are essential. We shall discuss various aspects of this anomaly, including its etiology, presenting features, diagnostic work-up, methods of possible resection as well as controversial issues, such as its possible contribution to pulmonary symptoms and exceptions to its usually favorable prognosis.

Mutational Analysis and Carrier Detection of Hunter Syndrome. Amy Bennett, Peining Li, and Jerry Thompson, Laboratory of Medical Genetics, University of Alabama at Birmingham, Birmingham, Alabama, 35294.

Hunter Syndrome (Mucopolysaccharidosis II) is a X-linked lysosomal storage disorder resulting from a deficiency of iduronate-2-sulfatase (IDS) activity. The IDS gene, which is mapped to Xq28, spans 24 kb and is comprised of 9 exons and 8 introns. An IDS-2 locus, located 20 kb distal to the IDS gene, contains sequences homologous to exons 2 and 3 as well as introns 2, 3, and 7 of the IDS gene. The clinical variability observed in Hunter patients is believed to result from extensive genetic heterogeneity at the IDS locus. Recently, recombinations between the IDS and IDS-2 loci have been discovered which further complicate the molecular analysis of Hunter syndrome. Our laboratory has developed a molecular strategy involving reverse-transcription polymerase chain reaction (RT-PCR) and sequencing for mutational analysis of patients with enzymatically diagnosed Hunter syndrome. The detected mutations were confirmed and carrier detection was performed by restriction enzyme digestion, cycle sequencing, and/or haplotype analysis of genomic DNA. In the present investigation, ten probands and their families were studied. The mutations detected include 4 missense mutations (D334G, A82E, P120H, Y348H), 3 small deletions and insertions (596delAACA, 729delC, 1269insCC), 1 insertion which disrupts a splice site (879+2insC), and 2 large deletions. Identification of these novel mutations provides further evidence for the mutational heterogeneity of the IDS gene.

Abstracts

AMYLOID BETA PEPTIDE 25-35 IS TOXIC TO ARTERIAL SMOOTH MUSCLE CELLS: ATTENUATION BY VITAMIN E. Michael M. Selassie, Joanne M. Williams, Stephanie Richardson, Dwayne Mathis, Noma T. Gwebu, Jeanine A. Warden, Ephraim T. Gwebu. Dept. Of Chemistry, Oakwood College., Huntsville, AL 35896.

Alzheimer's disease (AD) is the most common cause of progressive intellectual failure and memory impairment in the elderly. A crucial pathological process in AD is deposition of Beta-amyloid on arterial blood vessels. Arterial smooth muscle cells (SMCs) produce and deposit vascular amyloid peptides in AD and Down's syndrome. SMCs accumulate Beta-Amyloid in their intracytoplasmic granules. The effect of this accumulated beta-amyloid peptide on SMC viability is not clearly understood. However, beta-amyloid peptide deposition on blood vessels is associated with degeneration of SMCs. Degeneration of SMCs, whether a cause of amyloid deposition or a response to it, may predispose the blood vessel to rupture and cerebral hemorrhage. The purpose of our study was to determine whether beta-amyloid peptide 25-35 (A_β) is cytotoxic to SMCs which may account for the vascular degeneration in AD. In this study, we show that A_β is cytotoxic to human SMCs. We further demonstrate that this cytotoxicity is attenuated by vitamin E. This research was supported in part by NIGMS-MBRS #GS14-GM 48439-03, and NIGMS-MARC #T34-GM08259-09.

PROBLEM-BASED LEARNING PROGRAM FOR FAMILY PRACTICE RESIDENTS: A ROLE FOR THE LIBRARIAN. Helvi McCall, MLS and James R. Philp, MD, University of Alabama School of Medicine, Tuscaloosa Program. Eileen Burg, graduate student, University of Alabama, SLIS.

Many U.S. and Canadian medical schools have adapted Problem-Based Learning methods to improve the medical curriculum to prepare physicians and students for effective patient management. The Univ. of Alabama Sch. of Medicine in Tuscaloosa, established in 1972, provides medical education and FP residency training to prepare primary care physicians to practice in rural Alabama. In January 1995 Dr. Philp, Associate Dean of Academic Affairs and Chairman of the Depart. of Internal Medicine implemented the PBL program for the FP residents on the Internal Medicine rotation. Participants in the small weekly tutorial sessions are: 2 physician facilitators, 4-5 FP residents, the Medical Information Services Librarian, and from time to time a pharmacotherapist. The tutorial process begins with a current patient problem, presented by a resident. With the guidance of the facilitators, residents generate a series of differential hypotheses or diagnoses. The discussion helps to teach the process of clinical reasoning and disease mechanisms. The residents choose their own learning issues to research and present to the group at the following weekly session. The role of the librarian is to ensure that access to information or instruction is available to the residents for their learning issues. The librarian may advise on core texts, Medline search strategies, databases, and Internet sources. Most of the instruction takes place one-on-one in the library following the PBL session. Usually, students are found to be reluctant to learn about library resources. The presence of the librarian in the tutorials helps to integrate the teaching of information seeking skills at 'teachable moments' or 'at the point of need' when the resident is highly motivated to learn how to find information. We will present our evaluative strategies and some results.

ENGINEERING AND COMPUTER SCIENCE

GASOLINE PRODUCTION FROM WASTE PLASTICS BY PYROLYSIS AND CATALYTIC UPGRADING. H. S. Joo and James A. Guin, Chemical Engineering Department, Auburn University, Auburn, AL 36849.

Landfill disposal of waste plastics is becoming increasingly costly while plastics volumes are increasing. Most plastics are not readily biodegradable and will remain in the landfill for long periods. Increasing public resistance to the creation of new landfills and higher costs have led to efforts toward finding economically feasible and environmentally acceptable means of plastics recycling. Several methods including pyrolysis, gasification, and catalytic liquefaction might deal more effectively with waste plastics than simple mechanical recycling or incineration, since mechanical recycling often yields lower quality products, while incineration produces greenhouse gases. In a pyrolysis type process, shredded mixed plastics are heated in the absence of oxygen and depolymerized into liquids and gases. The gases are burned to provide heat needed for the process. Pyrolysis produces both light naphtha range and significant quantities of heavier gas-oil range liquids. The objective of our research is to investigate the upgrading potential of the heavier gas oil fraction of a typical plastics pyrolysis liquid to gasoline using a combination of catalytic hydrotreatment and hydrocracking. The kinetics of the upgrading process were investigated in batch reactions and a simple consecutive reaction model was applied to the experimental data. Continuous reactions using fixed bed catalysts at around 400° C and 60 atm were performed to examine the feasibility of gasoline production. Reasonable yields of good quality gasoline were produced by a sequential process consisting of catalytic hydrotreatment to remove N, hydrocracking to reduce boiling range, and distillation.

C++ TO JAVA VIRTUAL MACHINE CODE TRANSLATION.
Rajesh Ganesan, Dept. of CIS, Univ. of Alabama at Birmingham,
AL 35294.

A prominent stumbling block in the spread of C++ as an internet programming language is the lack of security enforcing schemes. This maybe overcome by removing pointers and references from C++ and providing an interpreter for the object code. The java interpreter maybe used for this purpose. This model parses the input C++ program, abstracts it into an Object-Oriented representation of the abstract syntax tree and emits equivalent "java assembly language" code, as it "walks" the tree. A java assembler is then used to convert this intermediate code to the java virtual machine code. The final output is a java class file which can be run using the java interpreter.

Sporadic demand forecasting – problems and models. Ramesh Yerramsetti, Dept. of Management Science and Statistics, University of Alabama, Tuscaloosa, AL 35486.

The demand arrival process of certain classes of demand is found to be highly varying over time and can be classified as sporadic. When this pattern is compounded by “lumpy” arrivals (followed by several periods of zero or negligible demand), the conventional time series analysis yields high Mean Absolute Percentage Errors (MAPE). The problems associated with analyzing the time series and application of statistical models have given rise to several heuristics. A *service level criterion* approach has been used as a common technique to solve this problem of sporadic series. However this approach combines the inventory and customer service level decisions with forecasting. While such combined methods may compensate for the forecasting deficiencies, a clear understanding of the demand arrival mechanism is lost. The idea behind the proposed scheme is to reformulate the problem such that some techniques from machine learning and statistics can be beneficially employed. Embedding the sporadic series into a standard series of a predictable product of the same group provides us with a series that can be predicted with smaller errors. Two techniques, Bootstrap and Neural Networks, are discussed as approaches to solving the reformulated problem.

THE CORRESPONDENCE PROBLEM IN CONTOUR RECONSTRUCTION. Lara A. Francis, Dept. of Computer and Information Sciences, Univ. of Alabama at Birmingham, AL - 35294.

In this talk we present some approaches to solving the correspondence problem in reconstructing a surface from parallel contours. The goal here is to find correspondences (connections) between polygonal contours on parallel, adjacent sections, and related information for the purpose of three-dimensional display. A *contour* is a set of points describing a planar polygon perpendicular to the z axis. A *section* consists of a set of contours that lie on the same plane. Some contours produce simple surfaces, i.e. no branching and only one contour per section. The problem arises when there are multiple contours in different sections. In that case a branching surface will result, and to triangulate that the location of *branches*, *bridge points* and *aliases* need to be computed. The proposed algorithm is an adaptation of Meyer's algorithm which uses a minimum spanning tree heuristic to compute the above information. We have modified the cost function to handle some of the cases not addressed in the original algorithm.

Abstracts

DISTRIBUTED SYSTEM FOR GPSS AND ANIMATOR PROVIDER. Dongni Chen, Department of Computer and Information Sciences, The University of Alabama at Birmingham, Birmingham, Alabama 35294-1170

GPSS is a simulation application that we run under a UNIX environment. A GPSS model is developed with statements which allow generation of an animation trace file (abbreviated as *.atf). By running GPSS with the simulation data file, it will generate *.atf file. This data file is used by the animation package, Proof Animation, which as of now runs on a PC under DOS. This data file is used in animator Provider. But this software right now can only run well under a DOS environment. The usual method is that: first run the GPSS model under UNIX, sending the *.atf file followed by transferring the file, e.g., by ftp and then running animator simulation on the PC. This method has some shortcomings. People should be able to work at either the PC or the SUN WS. If the PC and the WorkStation have long distance, the user will have great difficulty in running this whole system under the "usual" method. The purpose of this project is to create a distributed system for GPSS and the animator provider, so that the user can control the running of either system from long distance from either a PC or a WS. We use Java to implement the communication of this system, so that we don't need to worry about the environment in which it is running. By using this distributed system, the interface is enhanced so that a program may be run on any computer in the distributed system and access data on any other machine. We can control the running of different software in different environment from long distance. we can even distribute the models themselves across the network and also drive multiple animators, though such work is not a part of this paper.

THREE DIMENSIONAL OBJECT RECOGNITION USING ALPHA SHAPES.

Mariętta E. Cameron, Department of Computer Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294.

The automatic recognition of three-dimensional objects within a scene has been the goal of many computer vision systems. One definition of the problem can be stated as follows: Given a set of points in three-dimensional space, identify the objects and their poses. A new system that strives to solve this problem using alpha shapes is proposed. This system currently identifies a single object from a cloud of points through the curve matching of alpha shape signatures. In this paper a review of issues in object recognition, a brief tutorial of alpha shapes, and a description of the system's current state are presented.

A Decision Support System for forecasting machine load based on historical demand and market analysis. Ramesh Yerramsetti, Dept. of Computer and Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294.

The implementation of a decision support system(DSS) for predicting loads and utilization on machines in a shop is discussed. Forecasting and delivery schedules are the important inputs for effectively designing this DSS. Accurate forecasting can help in properly scheduling the machines to produce a range of products without backorders. Traditional statistical forecasting techniques vary in their philosophy and methodology yielding different results for the same datasets. Since the bias in each statistical model is different, a weighted model is being proposed to reduce the overall errors. Forecast obtained through market analysis by the sales personnel results in a forecast different from that of statistical techniques since the salesmen use information on the economic activity in their region. An approach is outlined to weight the different forecasts from several statistical models and the sales force generated numbers. Weighting methodologies, both human and machine based, are discussed. Application of Artificial Intelligence(AI) techniques to dynamically compute the weight given to different models is explored.

COMPUTER SUPPORTED COOPERATIVE ENVIRONMENT FOR KNOWLEDGE DISCOVERY. Daisy Y. Wong, Dept. of Computer and Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294.

Knowledge discovery is concerned with the development of novel methods and techniques for extracting previously unknown but potentially useful patterns from large volumes of data.. An example would be the detection of trends of an infectious disease in a hospital which may signal a potential epidemic. Human interpretation is necessary in order to determine whether the newly discovered patterns are indeed useful knowledge, or are just another form of the data which simply adds to information overload. Since the patterns are novel, a priori expertise may not be available to correctly interpret the new data. Indeed, expertise in multiple fields might be necessary in order to perform the interpretation in a timely manner so as to affect outcomes and decision making. In addition, the needed expertise might be distributed in multiple individuals who in turn are located separately. A Computer Supported Cooperative Environment uses computer technology to provide the tools to support collaboration among multiple people with diverse expertise, varied knowledge level, and different geographical locations, to interpret the newly discovered patterns in a timely manner and to determine whether they are useful knowledge. Such an environment would facilitate the communication among group members, allow members to reveal views from different expertise areas, and foster the growth of a group memory based on the knowledge discovered, which would in turn be used to interpret new patterns, The group memory provides a basis for continuity of knowledge even when the composition of the group changes over time. This paper reviews the requirements of such environment.

Abstracts

MICRO-BRAIN: MULTI-MODAL MEMORY VIA NEURAL NETWORKING, Steve Donaldson, Dept of Computer Science, Univ of Alabama at Birmingham, 35294.

Human brains are the apparent embodiment of multiple types of memory systems which work together to produce intelligent behavior. The holy grail of artificial intelligence research is the production of an autonomous system which demonstrates significant aspects of such behavior. This research is an attempt to extend current efforts in this direction by combining multiple neurally inspired memory paradigms into a functional architecture capable of exhibiting autonomous performance and unmistakable signs of intelligence. Such signs are to be interpreted as foundational elements whose composite function is both independently significant and capable of playing an eventual role in more extensive cognitive processing. Specifically, this investigation is intended to produce a system which can: 1) Solve multiple tasks within the framework of a composite, synergistic architecture; 2) Act autonomously under the sole internal control of neural network type processes; 3) Learn without external supervision; 4) Operate at a scale significantly larger than normally found in single purpose networks; 5) Acquire knowledge in a manner reminiscent of biological constraints (eg. fixed input spaces for external stimuli, temporal processing, etc.); 6) Transfer information across tasks, thus dealing with new situations using previously acquired knowledge; 7) Exhibit multiple memory modalities typical of human information processing (eg. short and long term memory, episodic storage, and explicit/implicit memory distinctions); 8) Perform lifetime plastic learning without catastrophic loss of previously acquired knowledge; 9) Learn from internal as well as external stimuli. The initial phases of this effort involve an investigation of the temporal, multi-modal acquisition of memories, particularly auto-association (recognition) and predictive learning (in context), within a composite architecture. It explores unsupervised, Hebbian learning approaches and implementation of continuous processing in recursive auto-associative (RAAM) and Elman-like sparse memory networks.

ANTHROPOLOGY

DEEPLY BURIED PRECERAMIC SITES ALONG THE GULF COAST. Bill B. Baxter, Panamerican Consultants, Inc., P.O. Box 16287, Pensacola, FL 32507.

Many preceramic sites in the Gulf Coastal Lowlands are covered by layers of sand deposited by natural processes. Four sites in northwest Florida illustrate the sometimes deeply buried proveniences of Paleoindian and Archaic cultural resources. In order to adequately document the archaeological record, it is necessary to test at deeper levels than is often the case in other physiographic regions.

Abstracts

CANIS FAMILIARIS (DOMESTIC DOG) SKELETAL REMAINS FROM WEYANOKE OLD TOWN, (44PG51), VIRGINIA. Jeffrey P. Blick, 1515 19th Avenue East #701, Tuscaloosa, AL 35404.

Weyanoke Old Town (44PG51), Prince George County, Virginia, has yielded approximately 130 Canis familiaris (domestic dog) remains from numerous features on a Late Woodland Virginia Algonquian (Weyanoke) village; features include trash pits, human burials, and two apparent ritual deposits in which dogs accompany severed human forearms. Pathologies have been identified in about 34 percent of the dogs and dental abnormalities (subnumerary and supernumerary teeth, hypodontia, dental crowding, dental attrition) have been recorded in about 53 percent of the dogs analyzed to date. Skeletal abnormalities include healed fractures (perhaps indicative of mistreatment), disease (periostitis, arthritis), fused limb, ankle, and toe bones, and possible congenital limb malformation. Cranial measurements indicate that these dogs fall into the mesaticephalic skull type; generally these canids would be classified as medium-sized dogs standing 42 cm high and weighing 10.1 kg (22.3 lbs). The role of the canine in Virginia Algonquian culture is also explored.

THE SKELETAL BIOLOGY OF THE HARRINGTON SITE

Sharon Kestle-Cobb, Auburn University at Montgomery, Montgomery, Alabama 36117.

The Harrington site (1Mt231), located in Montgomery County, Alabama, is dated from A.D. 175-550. Excavations unearthed ten human burials which have not been fully analyzed until now. Reichs (1986) has emphasized that even small skeletal populations are worthy of investigation. Infectious and mycotic diseases were researched using differential diagnosis and lesion patterning, which play a crucial role in determining skeletal pathological conditions of prehistoric populations. This skeletal sample exhibits both idiosyncratic and common pathologies such as: osteoarthritis, abscesses due to extreme attrition, vertebral osteophytosis, trauma, and malocclusion. The contribution of this research and other small skeletal samples of the poorly known Middle Woodland Period in Central Alabama may enhance current and future reconstructions of prehistoric lifeways.

Abstracts

Late Postclassic Mayan Architecture of Quintana Roo, Mexico: Some Architectural Observations. Thomas Mark Shelby, Department of Latin American Studies, The University of Alabama, Box 870254, Tuscaloosa, Al 35487-0254.

Late Postclassic architecture of Quintana Roo represents the close of prehispanic Mayan civilization. However, it also represents new and innovative ideas concerning Mayan architecture. The basic characteristics of the style are reviewed and an approximate architectural chronology is proposed based on comparisons of building sequences at selected structures. This chronology is then discussed in relation to structures at other sites with a range of occupational periods. A geographical area is also outlined based on current data. Enhancement of this chronology through various avenues of research may provide us with a better understanding of Postclassic Quintana Roo.

A HISTORIC CREEK HOUSE AT FUSIHATCHEE, ALABAMA 1Ee191.
Jason A. Mann, Dept. of Sociology, Auburn Univ. at
Montgomery, Mont., Ala 36117.

A brief discussion will be presented on the types of features, artifacts, and cultural remnants associated with a Creek Indian house from the time period of 1750-1800. Discussion will be limited to the architectural elements, burials and associated aboriginal and European items, and storage pits of one selected house structure (Structure K) from the Creek town of Fusihatchee, Elmore County, Alabama.

ARCHAEOLOGICAL PERSPECTIVES FROM THE TENNESSEE VALLEY IN RELATION TO LATE PLEISTOCENE AND HOLOCENE SEA-LEVEL OSCILLATIONS. Keith J. Little, Panamerican Consultants, Inc., P.O. Box 16287, Pensacola, FL 32507. Russell Holloway, Panamerican Consultants, Inc., P.O. Box 16287, Pensacola, FL 32507.

Investigations from multiple scientific disciplines are refining our understanding of Late Pleistocene and Holocene environmental and cultural events. Studies of sea-level increase along the Florida Gulf coast during this period have documented at least two events dating from approximately 10,000 to 8,000 B.C. and A.D. 100 to 600. These climate-related events have correlations in the Tennessee Valley archaeological record, which in turn provide important implications for those investigating global climate change and human adaptations.

Abstracts

RURAL CULTURE AND HANIDCRAFT IN SOUTHWESTERN SICHUAN.
Catherine Pagani, Dept. of Art, Univ. of Ala., Box 870270, Tuscaloosa, AL 35487-0270

The distinctive blue-and-white cotton embroideries of rural Sichuan have received little attention from scholars and collectors. These pieces, cross-stitched in indigo-dyed thread on a plain-weave cotton ground, date from the mid-nineteenth to mid-twentieth centuries. Few pieces survive today as most were used until they were worn out or cut up for patches. This lack of a large body of both extant material and written sources has posed problems in conducting research in this area and has necessitated the use of other related art forms to gain insight into the embroideries. This study examines the production of these textiles by rural women, their consumption by their makers and their families, their use primarily as household furnishings, and the symbolism of the designs to reveal aspects of rural culture. Central to this study is an analysis of the motifs whose subject matter, composition, and symbolic meaning reveal connections between rural and elite Chinese populations. These embroideries provide an important link to a little-studied segment of society and yield insight into rural south-western Chinese culture which has left little in terms of a written legacy. The study of their manufacture, use, and design reveal inuch not only on the level of craft in Sichuan, but also on aspects of culture such as women's roles, rural Chinese beliefs, and the artistic influences of a population removed from the educated elite.

JANNEY IRON FURNACE (1Ca407), RESTORATION AND ARCHAEOLOGICAL INVESTIGATIONS. Curtis E. Hill, Dept. of Physical and Earth Sciences, Jacksonville State University, Jacksonville, AL 36265.

Janney Iron Furnace (1Ca407), located in Calhoun County in northeastern Alabama, is one of the few surviving Civil War Era blast furnaces still standing in the state. Having survived attack by Union forces led by General Lovell H. Rousseau in 1864, this historical structure has recently fallen victim to the elements, age and vandalism. Currently, the furnace has been purchased by the Calhoun County Commission with contributions by Jacksonville State University and Alabama Power Company. Plans are presently underway to restore the furnace to its original glory and to conduct an archaeological investigation. Professional archaeological investigations should provide an answer to one of the major controversies about Janney furnace; the question of whether or not the furnacé was ever blown in. The end result will be the creation of a county historical park, which will serve as an educational tool for the general public, as well as area school systems. Janney Iron Furnace, properly restored and investigated, can only help educate those who visit it about the rich history of Alabama's iron industry.

Abstracts

WRIGHT'S FARM, 1Ca18, MULTICOMPONENT PREHISTORIC INDIAN VILLAGE IN CALHOUN COUNTY REVISITED IN 1996. Harry O. Holstein, Dept. of Physical and Earth Sciences, Jacksonville State University, Jacksonville, AL 36265.

1996 excavations at Wright's Farm, 1Ca18, resulted in the location of an additional 50 Aboriginal features. The majority of these features were storage pits containing nut shells, periwinkle shells, and deer bone. Additional maize kernels were recovered from several of the features. One goal of the 1996 excavations was to locate the trench features originally uncovered on the southeast edge of the site in 1994 and southern portion of the site in 1995. An east/west 7 meter long trench, Fea. 105, was encountered on the southwest portion of the site. Maize kernels again were found in association with this feature. No indication yet has been discovered as to the purpose of this Late Woodland/Mississippian feature. Two radiocarbon dates were obtained from Feature 15 and Feature 54. Feature 15 yielded Early Woodland Kellog Phase pottery and an associated radiocarbon date of 490 B.C.+70. Feature 54 yielded maize kernels and Late Woodland/Emergent Mississippian Cane Creek Phase ceramic and a radiocarbon date of 1100 A.D.+50.

MINUTES

Alabama Academy of Science
Spring Executive Committee Meeting
Auburn University at Montgomery
Montgomery, AL
March 19, 1997

A. Dr. Tom Jandebour, President of the AAS, called the Spring meeting of the AAS Executive Committee to order. The minutes of the Fall Meeting were discussed and approved.

B. Officer's Reports

1. Board of Trustees - No formal report was tendered at this time. However, Dr. Barker pointed out that seven Trustees were present, a very good turn-out. They were Ken Marion, Prakesh Sharma, Walter Wilborn, Sam Barker, Michael Moeller, Elsie Spencer and James Wilkes.

Dr. Barker also noted that this was probably the first meeting Dr. Bill Barrett has ever missed and asked that a resolution expressing our appreciation to him be sent.

2. President - Dr. Tom Jandebour submitted the following report:

Updated AAS home page for distribution to Academy members via Internet; Academy is now "on-line" at the following address - <http://www.athens.edu/sos/aas.htm>

Based on database of addresses for junior/community college science and mathematics (including nursing) faculty, developed and mailed invitations for membership to approximately 450 junior/community college faculty.

Using databases for trustees, elected officers, and committees, corresponded invitations to members of the Executive Committee to attend Spring 1997 Executive Committee Meeting.

Extended invitation to Dwayne Cox, Archivist at Auburn University's Ralph Brown Draughton Library, to attend Spring Executive Committee meeting to address Committee regarding importance of systematic contributions to the Academy's archive.

By telephone and correspondence to Tom Vocino, Local Arrangements Chairman, assisted to develop program for 1997 Joint Banquet.

Appointed William Boardman as Chairman of Carmichael Award Committee; participated as temporary member of this committee.

Minutes

Corresponded letters of congratulations and invitations to attend 1997 Joint Banquet to Gardner and Carmichael Award recipients.

For display at the 1997 Annual Meeting, developed "showboard" advertising 1998 Annual Meeting and Mobile area attractions of potential interest to Academy members.

3. President-Elect - Dr. Ellen Buckner reported as follows:

The Visiting Scientist Program Directory was mailed to members of the Alabama Science Teacher Association. Postage for this mailing was paid by the ASTA. To date, only 2 completed summaries of visits have been received, both complementary of the scientists' presentation. As requested in that mail-out, several schools sent e-mail or internet addresses (see attached list). It is hoped that electronic visits at our annual meeting or linkages between schools and scientists' institutions can be arranged. I would like to propose a change in the name of this program to Visiting Scientist Network to include both the directory and potential for electronic "visits". Also I would like to propose addition of responsibility for this program to those duties of the 2nd vice president.

At this meeting a group photo is scheduled to be made (see attached and posted fliers). Please encourage your colleagues and graduate students to attend. In particular, posters should be set up after the photo. This photo will be included in a brochure detailing some of the history of the Academy for the 75th Annual Meeting. Thank you for your assistance in encouraging participation.

4. Second Vice-President - Dr. Moore Asouzu did not submit a formal report.

5. Secretary - Dr. Larry Boots reported as follows:

SECRETARY'S REPORT - AAS

March 19, 1997

Membership as of March 19, 1997	598
Membership on October 26, 1996	642
Members Deleted to Non-payment 3/10/97	124
New Members since January 1, 1997	71

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Trends in Membership:

MEMBERS

March, 1993	661
March, 1994	739
March, 1995	650
October, 1995	670
March, 1996	571
October, 1996	642
March, 1997	598

MEMBERSHIP BY SECTION

SECTION

OCTOBER, 1996

MARCH, 1997

I.	Biological Science	160	152
II.	Chemistry	68	57
III.	Geology	26	22
IV.	Forestry, Geography, Conserv., Planning	18	20
V.	Physics & Mathematics	65	65
VI.	Industry & Economics	25	24
VII.	Science Education	30	25
VIII.	Social Science	33	33
IX.	Health Science	96	77
X.	Engineering & Computer Science	33	30
XI.	Anthropology	11	13
77.	University Libraries	25	26
88.	High School Libraries	50	51
	Unknown	2	1
	Honorary		2

MEMBERS

Emeritus	35
High School Libraries	51
University Libraries	26
Honorary	10
Individual	379
Student	63
Life	33
Sustaining	1

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Members Present

Larry Boots	Doug Haywick
David H. Nelson	L.S. Hazlegrove
Dan Holliman	John Frandsen
Richard A. Hudiburg	Jerry Burns
Michael Moeller	Dwayne Cox
Jim Bradley	P.C.Sharma
William Boardman	S.B. Barker
Gerald T. Regan	James C. Wilkes
Elsie S. Spencer	Betty Bigham
B.J. Bateman	Moore U. Asouzu
Ellen Buckner	Jian Han
Ken Marion	Walter Wilborn
Thomas Vocino	Roland Dute
Adriel D. Johnson	Thomas Jandebour
Larry Krannich	

6. Treasurer - Dr. Larry Krannich submitted the following report:

The Treasurer's Report consists of copies of the following:

Information for Calendar Year 1997

ALL ACCOUNT BALANCES as of 3/7/97

TREASURER'S SUMMARY REPORT BY QUARTER as of 3/7/97 for the period 1/1/97 through 3/7/97.

ACTIVITIES RELATIVE TO 1996 BUDGET for the period 1/1/97 through 3/7/97.

Information for Calendar Year 1996

ALL ACCOUNT BALANCES as of 12/31/96

ACTIVITIES RELATIVE TO 1995 BUDGET for the period 1/1/96 through 12/31/96.

TREASURER'S SUMMARY REPORT BY QUARTER for the period 1/1/96 through 12/31/96.

TREASURER'S SUMMARY REPORT BY ACCOUNT for the period 1/1/96 through 12/31/96.

The Academy operated with a deficit greater than that projected for the 1996 Budget and ended the year with expenditures exceeding income by \$4,485.15. Actual income was \$4,285.92 less than projected. This shortfall was due to a decrease of \$950 in Journal support and a decrease of \$850 in dues. Because the \$2,500 projected income for the support of the Junior Academy has never been realized and has been removed from the 1997 budget, the real loss of income is in dues and journal support. In addition, we did not receive the

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proceeds from the annual meeting during the 1996 fiscal year (see discussion for 1997 fiscal year). This is the third year during which we have experienced declines in dues receipts and Journal certificate of deposits were almost twice our projections. Expenses were \$3,690.77 less than budgeted, because of the decrease in expenses for the annual meeting and by the Executive Director. As usual, the officer's expenses were less than allocated in the budget.

For the first quarter of 1997, our dues income is at the level expected while the contributions for support for the Journal are less than projected. The income from last year's annual meeting was not received until late January and approximately \$400 in additional income is still anticipated. Thus, the seemingly high income level for the first quarter of 1997 relative to that seen in 1996 is anomalous. Our expenses are as expected for the first two months of a fiscal year. Thus, we appear to be keeping within the budget for 1997 and do not anticipate any budgetary problems.

Additional budget information is available upon request.

7. Journal Editor - Dr. Bradley sent the following report:

This report covers the calendar year 1996 and the four issues of Vol. 67 of the *Journal of the Alabama Academy of Science*, 1996. The October issue (No.4) is with the printer, expected mailing to be within a month.

During this period, 22 manuscripts were submitted for publication. Sixteen of these were accepted for publication after minor revisions, 12 were published in Volume 67, 2 were accepted pending major revision, and 4 were rejected.

In 1996, 156 abstracts from the annual meeting were published in the April issue of the *Journal*. This is up from 124 abstracts published in 1995.

Inquiries about cost of publication for the *Journal* are being made to out-of-state publishing companies at the request of Dr. Hazlegrove and others. Unless significant savings can be obtained elsewhere, I recommend staying with Auburn University Printing because of the high quality work they have done for us and the advantages of local interactions with those who work on the publication of the *Journal*.

The Instructions to Authors have been revised so that authors no longer suggest reviewers for their manuscripts. The editor will send manuscripts to members of the Editorial Board or to Section Chairs, asking that they identify appropriate reviewers.

The Vol.68, No.1 issue of the *Journal* is planned to be a special issue devoted to the general topic of science and education. It will contain invited and contributed essays on the subject.

I encourage the members of the Academy to submit more manuscripts to me, including book reviews and full length review articles.

8. Counselor to AJAS - Dr. Bateman reported that:

The Alabama Junior Academy of Science has a full schedule of activities planned for the annual meeting, including: the paper competition among 30 regional winners, local tours, the caucus and the election of state officers, presentation of awards, and the joint banquet.

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At the time, about 95 students and sponsors have pre-registered for the meeting and about 95 plan to attend the joint banquet.

9. Science Fair Coordinator - no report.

10. Science Olympiad Coordinator - Steven Carey submitted the following report:

The Alabama Science Olympiad currently consists of six Division C (grades 9-12) Regional Science Olympiad tournaments (although the University of Mobile did not conduct a regional Science Olympiad this year, it is planning to do so next year) and four Division B (grades 6-9) Regional Science Olympiad dates for 1997 is attached. The Division C State Science Olympiad will be held at the University of Mobile on 26 April 1997; the State Division B Science Olympiad will be held at the Alabama School of Mathematics and Science on 19 April 1997. State winners in both divisions advance to the National Science Olympiad to be hosted by North Carolina State University, May 16-17, 1997.

Because not all Science Olympiad regional tournaments have been conducted as of this date, I do not have final numbers concerning student participation; however, from the information provided me by the regional coordinators that have conducted their tournaments, I am confident that the totals statewide will be similar to years past.

For those of you interested in learning more about the Science Olympiad program, you can access the Science Olympiad Web Page at: <http://www.macomb.k12.mi.us/science/sciolyml.htm>

The Science Olympiad is a volunteer effort and everyone who gives of their time and expertise to make this program a success deserves the support and thanks of the Academy.

11. Counselor to AAAS - no report.

12. Section Officers:

I. Biological Sciences - Dr. David Nelson reported that the section had increased to 63 presentations, 9 of which were competing for research awards.

II. Chemistry - no report.

III. Geology - Dr. Haywick reported that their section will have 11 presentations.

IV. Geography, Forestry, Conservation and Planning - Priscilla Holland reported that: The Geography, Forestry, Conservation and Planning Section has 7 paper presentations for the 1997 Seventy-Fourth Annual Meeting. A business meeting to elect a Vice Chair for section IV will be held after the paper presentations. The 1996 Annual Meeting had 13 papers presented with 6 of those being student papers.

Again as has been done in the past, to increase participation, letters will be mailed

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to department(s) of geography, forestry, etc. at Colleges and Universities and to agencies (i.e., Alabama Forestry Commission) with information about the Alabama Academy of Science and a call for papers for the 1998 Seventy-Fifth Annual Meeting.

The Vice Chair would like to thank the Executive Committee on its vote to change the name of Section IV from Forestry, Geography, Conservation and Planning to **Geography, Forestry, Conservation and Planning**. The name change has been well received by geographer and others.

V. Physics and Mathematics - Dr. Young reported that their presentations are up this year to 21.

VI. Industry and Economics - no report.

VII. Science Education - Adriel Johnson reported that the section will have nine presentations.

VIII. Behavioral and Social Sciences - Gerald Burns reported that they will have 11 presentations.

IX. Health Sciences - Jian Han reported that this section will have 24 presentations.

X. Engineering and Computer Science - no report.

XI. Anthropology - no report.

13. Executive Director - Dr. Leven Hazlegrove submitted the following:

Since the Fall Executive Meeting, 10-6-96, SRI, we have been working on the following projects during the last 5 months:

1. Set up the Gorgas Scholarship Foundation, Inc., Science Talent Search in cooperation with the Westinghouse Scholarship Ranking Science Service, Inc., D.C., for the Auburn University meeting, March 21, 1997 with the leadership of Dr. Glynn Wheeler, Secretary/Treasurer and Dr. Thomas Vocino.

2. Mailed by bulk mail over 700 AUM meeting programs for March 19-22, 1997 edited by Dr. William J. Barrett, February 18, 1997 and prepared by Mrs. Karen Waits and Ms. Sharon Cordell.

3. Sent development letters to 4 industrial companies and foundations with positive reply from one.

4. Assembled, edited and prepared for bulk mail, 900 AUM "Call for Papers" for the meeting March 19-22, 1997, with the able assistance of Mrs. Karen Waits and Ms. Tammie Wyatt, Chemistry, UAB, 975-7821.

5. Sent hand written notes to 50 outstanding Scientist and Engineers, Mathematicians,

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and potential members whose "write-up" appeared in local publications. (Ten new members!!)

6. Met with Dr. Thomas Vocino, Professor and Chair, Political Science and Public Administration and his local committee for the 1997 AAS dates: March 19-22, 1997.
7. Set up ASTA booth at UAB Arena, September 12-13, 1996 with the able supervision of Dr. William J. Barrett, Dr. Dan Holliman, Dr. Tom Jandebour and Dr. Ellen Buckner.
8. Prepared 350 abstract forms for the AUM meeting, March 19-22, 1997 for eleven section chairs.
9. Moved the AAS Executive Director's office to the Chemistry Department (901 14th Street South - CHEM 266); new phone (205) 975-9146, FAX: (205)934-2543.
10. Your Director studied flora, fauna and pollution in USA, February 13-16, 1996 with the Alabama Fisheries Association, Gulf State Park.
11. Set-up the 74th Annual Meeting with the able direction of Dr. Tom Vocino, Professor of Political Science, Auburn University in Montgomery, Montgomery, AL, March 19-22, 1997.
12. Helped set-up with Dr. David Nelson's leadership the 1997 meeting at AUM with the kind invitation of Chancellor Roy H. Saigo, (334)244-3696 and the 1998 meeting at USA, March 18-21, 1998.

C. Committee Reports

1. Local arrangements - Dr. Tom Vocino gave an oral report. All arrangements were under control.
2. Finance - Dr. Barker submitted the following report:

Finally, after 5 years of deficit budget proposals, our Treasurer has made good! For 1996, the projected \$3,890 deficit of Expenses over Income has been slightly exceeded by the actual figure of \$4,485. As pointed out by Dr. Krannich, almost three thousand of the forty-five hundred dollar deficit was wiped out by the late arrival of income from the 1996 Annual Meeting. Since that payment came in during the first quarter of 1997, it artificially raises income this early in the year.

With financial reserves approximately twice our annual turnover, it does not seem reasonable to quarrel with our treasurer's conclusion that "we appear to be keeping within the budget for 1997 and do not anticipate any budgetary problems".

It will be most interesting to see if the sixth consecutive projected budget deficit (that for 1997) will revert to an actual positive balance.
3. Membership - no report.
4. Research - Dr. Hudiburg presented the following report:

The Chairperson of the Committee on Research received 51 requests for application

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materials (an increase of 13 over last year) related to the Student Research Award Competition, Student Research Grants, and Student Travel Awards. There was little difficulty in processing these requests. There was some confusion by some of the requesters to where they should direct the request. It is requested that members advise their students to the correct procedures for apply for these competitions. E-mail has facilitated some of the requests and cuts down on response time.

Six travel grants were awarded. A total of 22 papers and 6 posters, covering 7 of the AAS sections, are in the Student Research Award Competition. There are 8 applications for Student Research Grants. The section Vice-Chairpersons will need to provide the names of his/her competition winners to the Chairperson of the Committee on Research before the annual co-winners according to the decision of the judges.

A small problem has occurred with four co-winners of the Student Research Award competition of 1996. These four students have failed to join AAS. Numerous attempts at contacting these individuals have failed a response. How long should these awards be held before they are rescinded? What is the status of a rescinded award? Should it be given to another competitor if possible?

5. Long-Range Planning - no report.

6. Auditing - Sr. Academy - no report.

7. Auditing - Jr. Academy - Frederick Viohl and Danice Costes submitted this report:

This is a report of the Alabama Junior Academy of Science Auditing Committee for the July 1995-July 1996 financial year. We have examined the books provided by the Alabama Junior Academy of Science Treasurer, Dr. B.J. Bateman. We are satisfied ourselves that the receipts and expenditures, as presented to us, are correct and that all expenditures are legitimate expenses.

The net worth as of June 27, 1996 is \$19,209.23.

8. Editorial Board and Associate Journal Editors - The following report was submitted:

I am pleased to announce that the following institutions have supported the Journal of the Alabama Academy of Science as benefactors:

Samford University	\$500.00
Univ. of South Alabama	\$500.00
Auburn Univ. at Montg.	\$400.00
University of Mobile	\$100.00
Tuskegee University	\$100.00
University of Alabama	\$500.00
University of No. Alabama	\$100.00
Jacksonville State Univ.	\$250.00
Birmingham Southern	\$100.00

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Univ. of Alabama at B'ham.	\$500.00
The Univ. of Montevallo	\$250.00
Troy State University	<u>\$250.00</u>
Total	\$3,550.00

Please note that Auburn University is also listed as a benefactor of the Journal because of its significant annual contribution to our publishing costs.

9. Place and Date of Meeting - Dr. Nelson reported that:

The following sites have been previously approved by the Executive Committee of the AAS:

1998 University of South Alabama (18-21 March)

1999 Athens State College

Following a 4-year cycle adopted by our committee a few years ago, we have attempted to rotate meeting sites once in the north, once in the south and twice in the interior of the state. The committee recommends that we approach Alabama State University about meeting there in 2000; we have never met there. Otherwise we should consider Auburn University (met there last in 1988) or Birmingham Southern College (met there last in 1989).

Committee on Place and Date of Meeting

David H. Nelson, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688, (334)460-6331.

James E. Brown, Department of Horticulture, Auburn University, Auburn, AL 36849, (334)844-3034.

Moore U. Asouzu, Physical Science Department, Troy State University, Troy, AL 36082, (334)670-3571.

Richard Modlin*, Department of Biological Sciences, University of Alabama in Huntsville, Huntsville, AL 36599, (205)895-6360.

Ken B. Waites, Departments of Pathology and Microbiology, University of Alabama at Birmingham, Birmingham, AL 35294, (205)934-6421.

*no longer active; asked to be replaced

10. Newsletter - no report.

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11. Public Relations - no report.

12. Archives - Dr. Troy Best submitted the following:

Archival materials were solicited from the AAS Executive Committee and membership in the report provided for the October meeting.

No materials have been submitted for deposition in the archives...not even one document...not even one photograph...not even the minutes of the most recent meeting of the AAS Executive Committee.

Dr. Dwayne Cox, the archivist in charge of AAS materials at the Auburn University Ralph B. Draughon Library, has agreed to come the AAS Executive Committee meeting to answer questions and to provide suggestions as to what types of materials should be archived.

Again, I encourage all officers and members of the AAS to donate significant documents, photographs, etc. to the archives.

13. **Science and Public Policy** - Dr. Frandsen submitted the following report:

Members of the Committee: Scott Brande (UAB), John Frandsen-Chair (Tuskegee), Michael Friedman (Auburn), Barbara Hilyer (CLEAR, UAB), Robert Rowsey (Auburn), Shiva Singh (ASU)

This has been a period of relative calm for this committee, after the several years of turbulence that accompanied the periodic revision/review of the Course of Study: Science for the public schools of the state. Consequently, this report will be devoted to a description of some of the environmental issues brought to our attention by our Environmental Subcommittee (formerly the Environmental Panel), which has been chaired by John Christy (UAH).

Global Warming. The issue of global warming due to the enhanced greenhouse effect (driven mainly by the combustion of fossil fuels) has extremely serious consequences for the residents of Alabama. The Business Council of Alabama has taken this up as a major theme of study this year. The possibility of carbon taxes could impact Alabama's employment and economy to a dramatic extent. Since CO₂ is not a pollutant, legislating a reduction in the use of carbon burning must rely on the possibility of climate change and/or the lingering environmental effects created during extraction and production of the fuels.

Eutrophication of Waters. Excess nutrients (nitrogen and phosphorus) are degrading the rivers and reservoirs of the state, as is runoff from disturbed watersheds. Alabama does not have nutrient standards for regulating point discharges. It has not established a mechanism for estimating the importance of nonpoint sources for these pollutants. Today, only about 15% of the surface water is monitored. This concern is widespread as the Alabama Fisheries Association (which has a Eutrophication Committee) has submitted a draft to the Alabama Department of Environmental Management which documents the problem. With recent publicity, this may be an issue with which the Academy will want to deal.

Pollution of Groundwaters. Groundwater pollution is related to surface water and air via the new trend of risk-based corrective action which is a policy of proving that the

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pollution is not harmful or does something that needs to be done. Many cities are entirely reliant on groundwater as a source of water. Mismanagement can lead to diminished and chemically degraded supplies. Currently, there are no policies in the State to avoid the depletion and degradation of these aquifers. It seems policy should be set to establish pollution and management guidelines, based on sound scientific research.

Degradation of the Coastal Zone Environment. There appears to be a lack of attention to the development of Alabama's limited coastline. Future disasters are certain from only moderately intense hurricanes. In addition, degradation of the coastal zone environment appears to be the future course unless management of the development is addressed. Protection of Mobile Bay's water quality and wildlife, as it relates to the National Estuary Program designation, will be on the agenda.

It is obvious that this environmental subcommittee will in the future bring to the attention of the Academy issues on which we will wish to take a position and influence public policy. We do not have a strong record of such influence. Our press releases concerning positions taken by the Academy, or public statements issued, are carried by few, or no, newspapers, and are rarely, if ever, quoted. It is doubtful that a legislator, or member of a state administration, has ever sought-out the Academy to learn its position, or seek its advice, during the preparation of legislation.

We presently lack the mechanism to influence the development of public policy concerning matters in which we believe we have a vital interest. It is time for the Executive Committee to consider retaining the services of a lobbyist. Surely, strong arguments will be presented both pro and con. A major concern will be the cost. Yet, it is urgent that the debate begin.

14. Gardner Award - The following report was submitted:

Two outstanding nominations were received for the 1997 award. The recipient will be present at the banquet. This individual truly has numerous scientific contributions statewide and has been an active participant in the Academy.

I would like to commend those members who nominated or considered nominating a candidate. Deadline for nomination is 1 December. Dr. George Cline, Department of Biology, Jacksonville State University, Jacksonville, AL 36265 (205)782-5798 has agreed to serve as chair next year and nominations should be sent to him.

15. Carmichael Award - Dr. Boardman reported that:

Dr. S.V. Sahi resigned as chair of the committee. At the request of Dr. Tom Jandebour, Dr. William Boardman at Birmingham Southern College accepted the appointment to fill the vacancy.

The committee selected the outstanding paper published in Volume 67 (1996) of the *Journal of the Alabama Academy of Science* to receive the Emmett B. Carmichael Award. The announcement of the recipient(s) of the award and the title of the paper will be made at the banquet. Voting members of the committee included Dr. Jandebour who exercised

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presidential prerogative to remedy the decrease in membership. Dr. James T. Bradley, ex officio member as editor of the Journal, was co-author of an eligible paper and did not vote.

16. Resolutions - Gerald Regan submitted the following:

-- Be it resolved by the Executive Committee that the following script be employed at the appropriate time:

(PRESENTATIONS AT THE ANNUAL BANQUET)

Each year the Academy recognizes individuals who have served it in an exceptional manner.

1. First and foremost we recognize Roy Saigo, Chancellor of Auburn University at Montgomery for graciously hosting the 74th Annual Meeting of the Alabama Academy of Science.

2. The Academy would also like to recognize Thomas Vocino, chairperson of the local arrangements committee for the many weeks of planning and hard work that enabled us to have this very successful annual meeting.

3. Lastly, the Academy thanks Tom Jandebaur for his able leadership of the Academy as its President during the past year.

Deaths:

The Academy would like to take a moment to recognize the following members of the Academy whom it has lost through death over the past year:

John M. McKibbin

Helmut Hoelzer

George O. Twellmeyer

Our loss of them and of others whom we have not yet learned is a loss to science and to education, and we mourn their passing.

-- Be it resolved by the Executive Committee that it approve of the use of letter-sized stock for the printing of resolutions.

The case for the affirmative: The supply of 11 X-14 stock became warped over the years so that it would no longer feed through machines nor bond with the ink or toner. Although that size was impressive, it was also difficult to print on, to store, to transport, and to frame or file. For 1997, the chair of the committee on resolutions unilaterally changed to letter-sized stock in desperation and now seeks the authorization of the Executive Committee to continue to use it.

17. Nominating Committee - Dr. Moore announced that the committee's full report would be presented at the business meeting.

18. Mason Scholarship - Dr. Moeller submitted the following:

We had ten applicants for the William H. Mason Fellowship this year. After considering all the application material, the committee has selected Carole Collins Clegg for

Minutes

the \$1,000 fellowship. Miss Clegg has been notified of this award.

D. Old Business - Glynn Wheeler reported on the Gorgas Foundation situation again. It still appears to be in a discussion stage.

E. New Business - none.

F. The meeting was adjourned.

REPORT ON THE GORGAS SCHOLARSHIP COMPETITION, 1997

Today the Gorgas Scholarship Foundation, Inc. announced the ranking of the finalists in the 1997 Alabama Science Talent Search. The Search was held at the meeting of the Alabama Academy of Science at Auburn University at Montgomery in Montgomery, Alabama.

The winner of the first-place tuition grant of \$2500 was

Vishakha Subodchandra Modi, 4927 Altadena South Drive, Birmingham, AL 35244. Jefferson County IB School. Dr. Trudy Anderson - Teacher.

First alternate and winner of a \$1500 tuition grant was

(S) Wei Zhou, 3304 Shallowford Road, Vestavia Hills, AL 35216. Vestavia Hills High School. Jim Shoemaker - Teacher.

Second alternate and winner of a \$1000 tuition grant was

Lindsay Janet Bach, 2316 Finley Drive, Florence, AL 35630. Bradshaw High School. Cynthia Tillery - Teacher.

Third alternate was

Holly Da Lyn Hartsell, 308 Crossmore Drive, Florence, AL 35633. Bradshaw High School. Cynthia Tillery - Teacher.

Fourth alternate was

Casey Nicole Tidwell, Route 2, Box 327-1, Killen, AL 35645. Brooks High School. Wanda Phillips - Teacher.

Fifth alternate was

Matthew Rogers Jarrell, 217 Oakview Street, Florence, AL 35633. Bradshaw High School. Cynthia Tillery - Teacher.

Gorgas Scholarship

Sixth alternate was

Oliver Pharr Matthews, 450 Bradford Street, Florence, AL 35633. Bradshaw High School. Cynthia Tillery - Teacher.

Unable to exhibit:

Richard Ryan Williams 4007 E. Upper River Road, Somerville, AL 45670. Alabama School of Mathematics and Science. Henry Albert Lilly - Teacher.

(S) Kwabena Lartey Blankson, 544 Iroquis Drive, Birmingham, AL 35215. The Altamont School. Mrs. Sophia Clifford - Teacher.

(S) David Andrew Goldenberg, 807 Essex Road, Birmingham, AL 35222. The Altamont School. Mrs. Sophia Clifford - Teacher.

The rankings were established by a panel of judges consisting of department heads, deans, and professors from many of the leading universities and industries in Alabama.

Winners and finalists in the Gorgas Contests receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Foundation is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone and later became the Surgeon General of the U.S. Army. The purposes of the Foundation are to promote interest in science and to aid in the education of promising students.

(S) = Semifinalist for the 56th Westinghouse Science Talent Search

From:

The Chairman of the Judges:

L.L. Hazlegrove

208 Rockaway Road

Birmingham, AL 35209

GORGAS SCHOLARSHIP FOUNDATION

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Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. Larry R. Boots, Department of Obstetrics & Gynecology, University of Alabama, Birmingham, AL 35294. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology; Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics; Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the *Journal* implies that it has not been published previously and that it is not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

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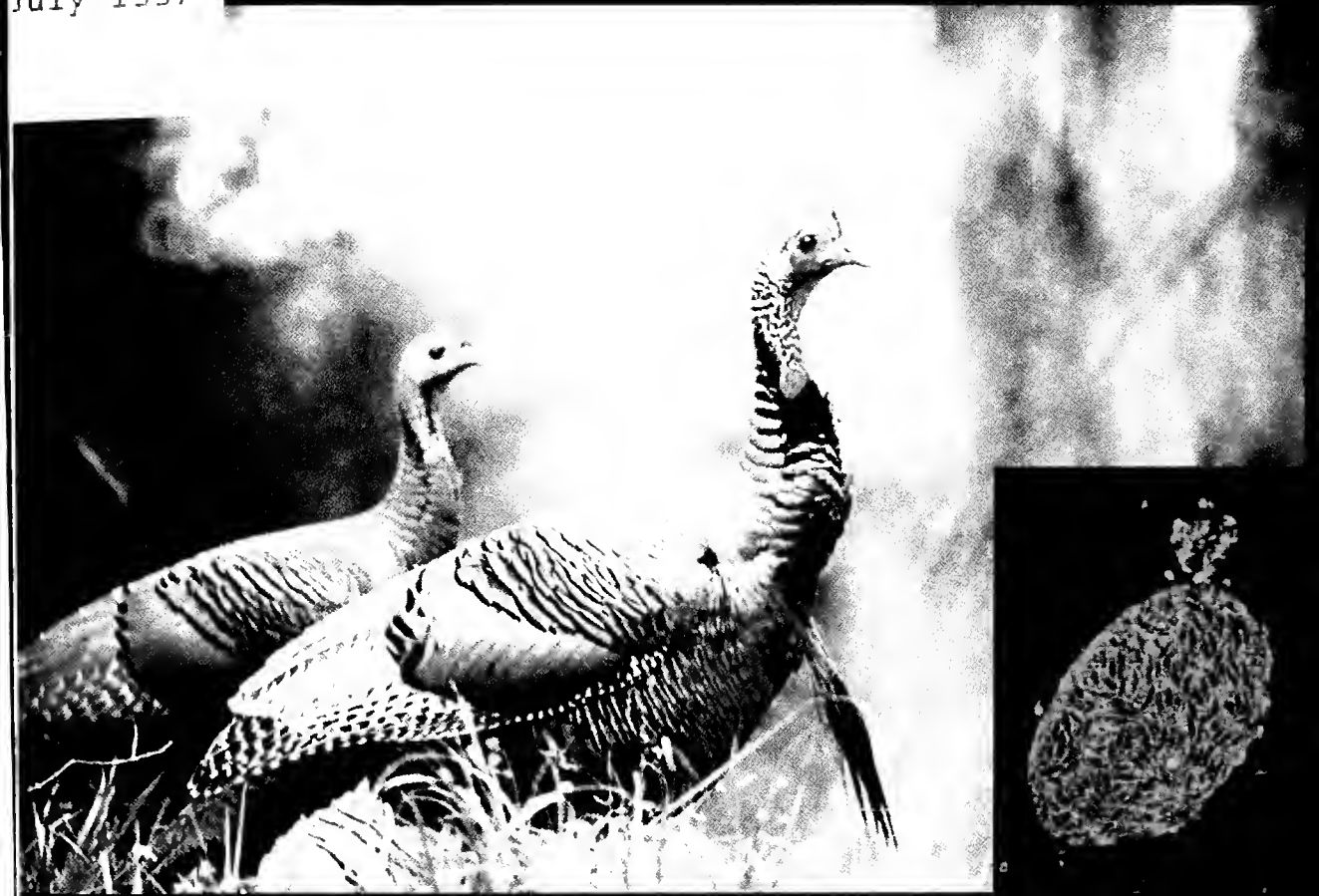
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COVER PHOTOGRAPH: Gobbler and wild hen, *Meleagris gallopavo*, a game species that is prevalent in Alabama. **INSET:** Confocal micrograph of a *Toxoplasma gondii* tissue cyst filled with bradyzoites that have been labeled with a fluorescently-tagged monoclonal antibody. *T.gondii* is found in a number of species of wildlife in the state and, fortunately, causes little mortality. Humans can be infected by ingesting undercooked meat that contains tissue cysts. **PHOTO CREDIT:** Dr. Dan Speake, Barbara Estridge, Christine Sundermann, Department of Zoology & Wildlife Science, Auburn University.

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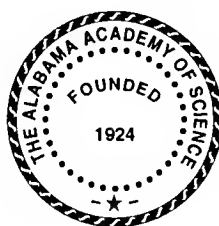
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UPDATE ON *TOXOPLASMA GONDII* INFECTIONS
IN WILDLIFE AND EXOTIC ANIMALS FROM ALABAMA

David S. Lindsay^{1,4}
Christine A. Sundermann²
J. P. Dubey³
Byron L. Blagburn¹

ABSTRACT

Toxoplasma gondii is an important protozoal parasite of man, and domestic and wild animals. The parasite is transmitted by consumption of infected tissue, by ingestion of the resistant oocyst stage excreted in the feces of cats, or transplacentally. Infection with this parasite can cause severe disease in congenitally infected children and in immunocompromised individuals. It is a significant cause of morbidity and mortality in AIDS patients. We examined the prevalence of this parasite in wildlife and exotic species from Alabama from 1989 to 1996. Infection with this parasite was common in white-tailed deer and wild turkeys. These species are hunted for food and may be a source of human infections. Infection was also common in raptors and the wild carnivores/omnivores examined. Llamas and emus were also commonly infected with *T. gondii*.

INTRODUCTION

Toxoplasma gondii is a protozoal parasite that is an important pathogen of man, and domestic, and wild animals. Most warm-blooded animals are susceptible to infection. The life cycle of *T. gondii* is complex. Cats serve as both definitive and intermediate hosts for the parasite. Domestic cats and other felids excrete resistant oocysts in their feces. These oocysts will develop infectivity in the environment and will contain infective sporozoites. Humans and other animals can become infected by ingesting oocysts in contaminated food or water. In the intestinal tissue of the intermediate host, the parasite invades the mucosa and transforms into

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a tachyzoite. Tachyzoites are rapidly dividing stages that cause tissue damage and disseminate the infection throughout the host's tissues. Tachyzoites are also the stages that are maternally transmitted. After a period of multiplication (about 3 days) some tachyzoites will begin to produce the latent tissue cyst stages that contain bradyzoites. Bradyzoites are slowly dividing stages that are found in tissue cysts. Tissue cysts are present for many years and probably the life of the host. Humans and other animals can become infected by ingesting tissue cysts in raw or rare meat or organs. In this case, the bradyzoites will penetrate the intestinal mucosa and transform into tachyzoites which will disseminate the infection.

Most *T. gondii* infections in humans are asymptomatic. However, pregnant women and immunocompromised individuals are two groups that can suffer serious effects from infection. Pregnant women can transmit the infection to their fetuses resulting in fetal death, neonatal death, mental retardation, vision problems, blindness and other neurological dysfunctions (Remington *et al.*, 1995). Immunosuppressed individuals are at risk of developing life threatening toxoplasmosis (Dubey and Beattie, 1988). Persons that have existing *T. gondii* infection prior to becoming immunosuppressed may develop encephalitis due to the reactivation of tissue cysts in their brain. Toxoplasmic encephalitis is common in AIDS patients. The bradyzoites transform into tachyzoites and the tachyzoites destroy large areas of the brain if the patient is not treated. Persons that acquire *T. gondii* infection while immunosuppressed may develop disseminated infection. These patients may die of pneumonia, liver disease or systemic disease if not treated. This is particularly common in organ transplantation when the donor organ contains tissue cysts (Lindsay *et al.*, 1995).

Most *T. gondii* infections in animals are asymptomatic. Clinical infections are more common in young animals and abortions are common in several species. Adult Australian marsupials, lemurs, and several species of aboral monkeys are also highly susceptible to developing fatal toxoplasmosis (Dubey and Beattie, 1988).

The present study was done to summarize and extend our previous studies of *T. gondii* infections in Alabama wildlife (Lindsay *et al.*, 1991b; 1993; 1994) and to present new data on several wildlife and exotic animal species.

MATERIALS AND METHODS

Detection of *T. gondii* infection

Two methods were used alone or in combination to detect *T. gondii* infection. Serum from animals was examined for IgG antibodies to *T. gondii* in the modified direct agglutination test (MAT) using formalin-fixed tachyzoites as antigen (Dubey and Desmonts, 1987). The MAT has been validated in several wildlife species (Dubey *et al.*, 1993; Dubey *et al.*, 1995) and will detect antibodies in avian species (Lindsay *et al.*, 1991a; Dubey *et al.*, 1992c), which other serological tests may not (Frenkel, 1981).

Mouse bioassay using acid pepsin-digestion (Jacobs *et al.*, 1960) of host tissue was used to detect viable *T. gondii* tissue cysts in animals. Host tissue (1.8 to 25 g), usually heart or heart and breast muscle, was homogenized in a blender in Hanks' balanced salt solution (HBSS) and mixed with an equal volume of acid-pepsin solution (0.52 g pepsin, 0.5 g NaCl, 1.4 ml concentrated HCl, 98.6 ml distilled water) and incubated for 30 minutes at 37 C in a water bath. The mixture was washed free of acid in HBSS by centrifugation and 0.5 to 1.0 ml was subcutaneously inoculated into groups of 2 to 5 mice. Surviving mice were bled and

killed 4 to 6 weeks later. The sera were examined for IgG antibodies to *T. gondii* in an indirect fluorescent antibody test (IFAT) using tachyzoites as antigen. A portion of cerebrum (about 4 by 4 mm) was removed from both sides of the brain, squashed under a coverslip and examined for tissue cysts.

White-tailed deer

The hearts (20 g) from 21 white-tailed deer (*Odocoileus virginianus*) were examined by bioassay, and serum samples from 50 white-tailed deer were examined in the MAT. Results from 19 of these white-tailed deer have previously been reported (Lindsay *et al.*, 1991b). The samples were collected from hunter killed males and females from Chambers (N=26), Henry (N=6), Lee (N=4), Macon (N=10), Monroe (N=2), Montgomery (N=1), Russell (N=1) and Wilcox (N=5) Counties.

Wild turkeys

Heart tissue (19 to 25 g) from 16 hunter killed male wild turkeys (*Meleagris gallopavo*) collected in Lee, Macon, and Russell Counties were each examined by bioassay and the serum from these 16 birds and an additional wild turkey were examined in the MAT (Lindsay *et al.*, 1994).

Raccoons

The tongues and hearts (18 to 20 g total) from 3 hunter killed female raccoons (*Procyon lotor*) were examined by bioassay. Two were from Macon County and 1 was from Chambers County.

Bobcats

Tongue, heart, and skeletal muscle (25 g total) were examined by bioassay from 3 adult male bobcats (*Felis rufus*). One was from Lee County and it had been struck and killed by a motor vehicle. The other 2 were from Covington County and had been killed by dogs.

Coyote

Heart and skeletal muscle (28 g total) from an adult male coyote (*Canis latrans*) from Lee County were examined by bioassay. The coyote had been struck and killed by a motor vehicle.

Raptors

Heart and breast muscle (1.8 to 20 g) from 101 raptors were examined by bioassay (Lindsay *et al.*, 1993). The source of raptor tissue was from animals examined at necropsy by the C. S. Roberts State Veterinary Diagnostic Laboratory, Auburn, Alabama. Ninety-seven had been patients at the Southeastern Raptor Rehabilitation Center, College of Veterinary Medicine, Auburn University, Alabama.

Llamas

Serum samples from 24 llamas (*Lama glama*) housed at the College of Veterinary Medicine, Auburn University, Alabama in Lee County were examined by the MAT. No data were available on sex or age. Six of the llamas were examined at about 12 month intervals in 1992 and 1993. The other 18 were examined in 1992 (8 llamas) or 1993 (10 llamas).

Emus

Serum samples from 9 emus (*Dromiceius novaehollandiae*) from various locations in Alabama were examined by the MAT. Six were males, 2 were females and the sex of 1 was not recorded. One emu was 6 weeks-old, 3 were 11 months old, 3 were 1 year old and the age of 2 was not determined.

RESULTS**White-tailed deer**

Four of the 21 heart samples (19%) examined from white-tailed deer were positive. One of the *T. gondii* isolates caused fatal infections in 3 of 4 mice on primary isolation. Seventeen of the 50 serum samples (34%) were positive in the MAT. Table 1 lists the counties of origin and sexes of white-tailed deer examined for *T. gondii*.

Table 1. Prevalence of *Toxoplasma gondii* in white-tailed deer from Alabama.

<u>County</u>	<u>Total # examined/# positive (%)</u>	<u>Sex of Positive*</u>
Chambers	26/9 (35%)	3M, 1F, 5NR
Lee	4/2 (50%)	2M
Henry	6/1 (17%)	1M
Macon	10/4 (40%)	3M, 1F
Montgomery	1/1 (100%)	1M
Monroe	2/0 (0%)	No positives
Russell	1/0 (0%)	No positives
Wilcox	5/2 (40%)	2F

* M=male, F=female, NR=sex not recorded.

Wild turkeys

Toxoplasma gondii was isolated from the hearts of 8 (50%) of 16 wild turkeys. Six of the 8 isolates caused fatal infection in mice on primary isolation. Antibodies to *T. gondii* were present in 12 (71%) of 17 samples.

Raccoons

One raccoon (33%) from Macon County was positive by bioassay. The other 2 raccoons were negative.

Bobcats

All 3 bobcats (100%) were positive by bioassay.

Coyote

The coyote was positive by bioassay. The isolate caused fatal infection in 1 of the inoculated mice.

Toxoplasma gondii

Raptors

Toxoplasma gondii was isolated by bioassay from 27 of the 101 raptors (27%). Specifically, it was found in 8 of 12 (67%) red-shouldered hawks (*Buteo lineatus*), 13 of 27 (41%) red-tailed hawks (*Buteo jamaicensis*), 1 of 4 (25%) Cooper's hawks (*Accipiter cooperi*), 1 of 5 (20%) great horned owls (*Bubo virginianus*), 4 of 15 (27%) barred owls (*Strix varia*), and 1 of 3 (33%) kestrels (*Falco sparverius*). *Toxoplasma gondii* was not detected by bioassay of tissues from 3 broad-winged hawks (*Buteo platypterus*), 3 sharp-shinned hawks (*Accipiter striatus*), 6 barn owls (*Tyto alba*), 9 screech owls (*Asio otus*), a Mississippi kite (*Ictinia mississippiensis*), 2 golden eagles, (*Aquila chrysaetos*), a bald eagle (*Haliaeetus leucocephalus*), 4 ospreys (*Pandion haliaetus*), 4 turkey vultures (*Cathartes aura*), or 2 black vultures (*Coragyps atratus*). Three of the *T. gondii* isolates caused fatal infection in mice on primary isolation: 1 from a red-tailed hawk, 1 from a red-shouldered hawk, and 1 from a kestrel.

Llamas

Fifteen (63%) of the 24 llamas were positive in the MAT. The serological results from the 6 llamas examined both in 1992 and in 1993 were the same. Four were positive on both occasions and 2 were negative on both occasions.

Emus

Three (33%) of the 9 emus were positive. Two were males and the sex of 1 was not recorded. The 2 positive males were 11 months and 1 year old.

DISCUSSION

Results of our studies indicate that *T. gondii* is prevalent in wild and exotic animals from Alabama. The serological test we chose was the MAT because it has been validated in many of the host species we examined and it has been found to be generally superior to the indirect hemagglutination test (IHT) and latex agglutination test while being similar or somewhat superior to the dye test and IFAT (Dubey and Beattie, 1988). We used the mouse bioassay test because positive results are unquestionable. We selected heart and muscle tissue because it has been our experience with domestic animals that these tissues are often infected with *T. gondii* (Dubey and Beattie, 1988).

Consumption of white-tailed deer meat has been implicated in 3 cases of human toxoplasmosis (Sacks *et al.*, 1983) and results of our study and others (Humphreys *et al.*, 1995; Vanek *et al.*, 1996) indicate that infection is common in white-tailed deer. We observed that 34% of 50 white-tailed deer from Alabama were positive using the MAT while Brillhart *et al.* (1994), Humphreys *et al.* (1995), and Vanek *et al.* (1996) observed that 44% of 106 white-tailed deer from Kansas, 60% of 593 white-tailed deer from Pennsylvania, and 30% of 1,367 white-tailed deer from Minnesota, respectively, were positive using the MAT.

We observed a high rate of *T. gondii* infection in wild turkeys by both bioassay (50% of 16) and by MAT (71% of 17). Quist *et al.* (1995) found 10% of 130 wild turkeys collected from Georgia, Kentucky, Louisiana, Missouri, and North Carolina positive by the MAT.

Toxoplasma gondii was isolated from heart and tongue tissue of 1 (33%) of 3 raccoons in our study, while Walton and Walls (1964) isolated *T. gondii* by bioassay of brain

tissue from 4 (8%) of 50 raccoons from Georgia. The reported serological prevalence of *T. gondii* in raccoons is variable. Using the MAT, 48% of 93 raccoons from Pennsylvania, 73% of 45 raccoons from New Jersey, 35% of 72 raccoons from South Carolina, 56% of 119 raccoons from Ohio, 37% of 68 raccoons from Virginia, and 67% of 30 raccoons from Iowa were positive for antibodies (Dubey *et al.*, 1992a). Brillhart *et al.* (1994) found 70% of 20 raccoons from Kansas were positive by the MAT. The MAT test has been validated in raccoons (Dubey *et al.*, 1993). Burrige *et al.* (1979) found that only 17% of 530 raccoons examined from Florida were positive using the IHT and Forrester (1992) indicated that antibodies to *T. gondii* were not detected in 56 raccoons from Florida using the IFAT. Using the dye test, 23% of 77 raccoons from Maryland (Jacobs and Stanley, 1962) and 33% of 67 raccoons from Georgia (Walton and Walls, 1964) were positive for *T. gondii*.

All the bobcats examined in this study were positive by bioassay. Walton and Walls (1964) found that 100% of 15 bobcats from Georgia were positive by the dye test and isolated *T. gondii* from 6% of 16 animals examined by bioassay. They used brain tissue only which may explain the high seroprevalence but low isolation prevalence. Burrige *et al.* (1979) found that 66% of 3 bobcats from Florida were positive using the IHT. Marchiondo *et al.* (1976) found that 44% of 27 bobcats from New Mexico were positive by the dye test while a single bobcat from Arizona was negative. Smith and Frenkel (1995) found that 50% of 2 bobcats from Missouri and Kansas were positive by the dye test.

The single coyote we examined was positive. Other studies have indicated that *T. gondii* infection in coyotes is common. Lindsay *et al.* (1996) found that 62% of 52 coyotes from Texas had antibodies to *T. gondii* in the MAT. This is identical to the 62% (8 of 13) prevalence reported by Smith and Frenkel (1995) for coyotes in Missouri and east central Kansas using the dye test. Marchiondo *et al.* (1976) observed *T. gondii* antibodies in 26% of 87 coyotes from New Mexico and 20% of 5 coyotes from Arizona using the dye test. Franti *et al.* (1975, 1976) found *T. gondii* antibodies in 40% of 10 (1975) and 28% of 58 (1976) in coyotes from California using an IHT.

Our study on the prevalence of *T. gondii* in raptors is the largest reported to date. Kirkpatrick *et al.* (1990) found that 17% of 66 adult and 15% of 124 nestling barn owls had antibodies to *T. gondii* in the MAT however we did not isolate *T. gondii* from barn owls we examined.

We found a high (63%) prevalence of *T. gondii* antibodies in the llamas we examined. Llamas from Oregon and Washington were found to have a 34% prevalence using the same MAT test as used in our study (Dubey *et al.*, 1992b).

Little is known about *T. gondii* in ratites. Oroaz *et al.* (1992) found high *T. gondii* MAT titers in a cassowary (*Casuarius casuarius*) with respiratory disease and a rhea (*Rhea americana*) with bloody diarrhea and anorexia.

We isolated *T. gondii* from the tissues of 44 (30%) of 145 wild animals that were examined in the bioassay. Fatal infections were observed in mice inoculated with 11 (25%) of the 44 isolates. *Toxoplasma gondii* isolates can be classified into 3 intraspecies subgroups based on genotype (Parmley *et al.*, 1994) which correlates with mouse pathogenicity. Group I isolates are pathogenic for mice while groups II and III are not pathogenic for mice. Animals are different in their susceptibility to *T. gondii* infection and it is not possible to correlate pathogenicity for mice with pathogenicity for humans or other animals.

Little is known about the impact of *T. gondii* infection on wildlife species. Fatal cases

Toxoplasma gondii

of toxoplasmosis have been reported in the literature from a red fox (*Vulpes vulpes*) (Dubey *et al.*, 1990), a gray fox (*Urocyon cinereoargenteus*) (Dubey and Lin, 1994), and wild turkeys (Howerth and Rodenroth, 1985; Quist *et al.*, 1995). The impact of *T. gondii* infection on reproduction of wildlife species is unknown.

Acknowledgments

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LITERATURE CITED

- Brillhart, D. B., L. B. Fox, J. P. Dubey, and S. J. Upton. 1994. Prevalence of *Toxoplasma gondii* in wild mammals in Kansas. *Journal of the Helminthological Society of Washington* 61: 117-121.
- Burridge, M. J., W. J. Bigler, D. J. Forrester, and J. M. Hennemann. 1979. Serologic survey of *Toxoplasma gondii* in wild animals in Florida. *Journal of the American Veterinary Medical Association* 175: 964-967.
- Dubey, J. P., and C. P. Beattie. 1988. *Toxoplasmosis of Animals and Man*. CRC Press. Boca Raton, Florida. 220 p.
- Dubey, J. P., and G. Desmonts. 1987. Serological responses of equines fed *Toxoplasma gondii* oocysts. *Equine Veterinary Journal* 9: 337-339.
- Dubey, J. P., and T. L. Lin. 1994. Acute toxoplasmosis in a gray fox (*Urocyon cinereoargenteus*). *Veterinary Parasitology* 51: 321-325.
- Dubey, J. P., A. N. Hamir, and C. E. Rupprecht. 1990. Acute disseminated toxoplasmosis in a red fox (*Vulpes vulpes*). *Journal of the Wildlife Diseases Association* 26: 286-290.
- Dubey, J. P., A. N. Hamir, C. A. Hanlon, and C. E. Rupprecht. 1992a. Prevalence of *Toxoplasma gondii* infection in raccoons. *Journal of the American Veterinary Medical Association* 200: 534-536.
- Dubey, J. P., L. G. Rickard, G. L. Zimmerman, and D. M. Mulroony. 1992b. Seroprevalence of *Toxoplasma gondii* in llamas (*Lama glama*) in the northwest USA. *Veterinary Parasitology* 44: 295-298.
- Dubey, J. P., S. I. Porter, F. Tseng, S. K. Shen, and P. Thulliez. 1992c. Induced toxoplasmosis in owls. *Journal of Zoo and Wildlife Medicine* 23: 98-102.
- Dubey, J. P., A. N. Hamir, S. K. Shen, P. Thulliez, and C. E. Rupprecht. 1993. Experimental *Toxoplasma gondii* infection in raccoons (*Procyon lotor*). *Journal of Parasitology* 79: 548-552.
- Dubey, J. P., J. G. Humphreys, and P. Thulliez. 1995. Prevalence of viable *Toxoplasma gondii* tissue cysts and antibodies to *T. gondii* by various serologic tests in black bears (*Ursus americanus*) from Pennsylvania. *Journal of Parasitology* 81: 109-112.
- Forrester, D. J. 1992. *Parasites and Diseases of Wild Mammals in Florida*. University Press of Florida, Gainesville, Florida, p 459.

- Franti, C. E., G. E. Connolly, H. P. Riemann, D. E. Behymer, R. Ruppner, C. M. Willadesn, and W. Longhurst. 1975. A survey for *Toxoplasma gondii* antibodies in deer and other wildlife on a sheep range. *Journal of the American Veterinary Medical Association* 167: 565-568.
- Franti, C. E., H. P. Riemann, D. E. Behymer, D. Suther, J. A. Howarth, and R. Ruppner. 1976. Prevalence of *Toxoplasma gondii* antibodies in wild and domestic animals in northern California. *Journal of the American Veterinary Medical Association* 169: 901-906.
- Frenkel, J. K. 1981. False-negative serologic tests for *Toxoplasma* in birds. *Journal of Parasitology* 76: 952-953.
- Howerth, E. W., and N. Rodenroth. 1985. Fatal systemic toxoplasmosis in a wild turkey. *Journal of Wildlife Diseases* 21: 446-449.
- Humphreys, J. G., R. L. Stewart, and J. P. Dubey. 1995. Prevalence of *Toxoplasma gondii* antibodies in sera of hunter-killed white-tailed deer in Pennsylvania. *American Journal of Veterinary Research* 56: 172-173.
- Jacobs, L. J. S. Remington, and M. L. Melton. 1960. The resistance of the encysted form of *Toxoplasma gondii*. *Journal of Parasitology* 46: 11-21.
- Jacobs, L. And A. M. Stanley. 1962. Prevalence of *Toxoplasma* antibodies in rabbits, squirrels, and raccoons collected in and near the Patuxent Wildlife Research Center. *Journal of Parasitology* 48: 550.
- Kirkpatrick, C. E., B. A. Colvin, and J. P. Dubey. 1990. *Toxoplasma gondii* antibodies in common barn-owls (*Tyto alba*) and pigeons (*Columba livia*) in New Jersey. *Veterinary Parasitology* 36: 177-180.
- Lindsay, D.S., J.P. Dubey, and B.L. Blagburn. 1991a. *Toxoplasma gondii* infections in red-tailed hawks orally inoculated with tissue cysts. *Journal of Parasitology* 77: 322-325.
- Lindsay, D.S., B.L. Blagburn, J.P. Dubey, and W.H. Mason. 1991b. Prevalence and isolation of *Toxoplasma gondii* from white-tailed deer in Alabama. *Journal of Parasitology* 77: 62-64.
- Lindsay, D. S., P. C. Smith, J. F. Hoerr, and B. L. Blagburn. 1993. Prevalence of encysted *Toxoplasma gondii* in Alabama raptors. *Journal of Parasitology* 79: 870-873.
- Lindsay, D.S., P.C. Smith, and B.L. Blagburn. 1994. Prevalence and isolation of *Toxoplasma gondii* from wild turkeys from Alabama. *Journal of the Helminthological Society of Washington* 61: 111-113.
- Lindsay, D. S., B. L. Blagburn, and K. G. Braund. 1995. A review of *Toxoplasma gondii* and muscular toxoplasmosis. *Basic and Applied Myology* 3: 255-260.
- Lindsay, D. S., J. E. Kelly, R. McKown, F. J. Stein, J. Herman, J. P. Dubey, and B. L. Blagburn. 1996. Prevalence of *Neospora caninum* and *Toxoplasma gondii* antibodies in coyotes (*Canis latrans*) and experimental infections of coyotes with *Neospora caninum*. *Journal of Parasitology* 82: 657-659.
- Marchiondo, A. A., D. W. Duszynski, and G. O. Maupin. 1976. Prevalence of antibodies to *Toxoplasma gondii* in wild and domestic animals of New Mexico, Arizona and Colorado. *Journal of Wildlife Diseases* 12: 226-232.
- Oroaz, S. E., J. D. Mullins, and S. Patton. 1992. Evidence of toxoplasmosis in two ratites. *Journal of the Association of Avian Veterinarians* 6: 219-222.

Toxoplasma gondii

- Parmley, S. F., U. Gross, A. Sucharczuk, T. Windeck, G. D. Sgarlato, and J.S. Remington. 1994. Two alleles of the gene encoding surface antigen p22 in 25 strains of *Toxoplasma gondii*. *Journal of Parasitology* 80: 293-301.
- Quist, C. F., J. P. Dubey, M. P. Luttrell, and W. R. Davidson. 1995. Toxoplasmosis in wild turkeys: A case report and serologic survey. *Journal of Wildlife Diseases* 31: 255-258.
- Remington, J. S., R. McLeod, and G. Desmonts. 1995. Toxoplasmosis. In: Infectious diseases of the fetus and newborn infant, 4th Edition, J. S. Remington and J. O. Klein, (eds). W. B. Saunders, Philadelphia, Pennsylvania, p. 140-267.
- Sacks, J. J., D. G. Delgado, H. O. Lobel, and R. L. Parker. 1983. Toxoplasmosis infection associated with eating undercooked venison. *American Journal of Epidemiology* 118: 832-837.
- Smith, D. D., and J. K. Frenkel. 1995. Prevalence of antibodies to *Toxoplasma gondii* in wild mammals in Missouri and east central Kansas: Biological and ecological considerations of transmission. *Journal of Wildlife Diseases* 31: 15-21.
- Vanek, J. A., J. P. Dubey, P. Thulliez, M. R. Riggs, and B. E. Stromberg. 1996. Prevalence of *Toxoplasma gondii* antibodies in hunter-killed white-tailed deer (*Odocoileus virginianus*) in four regions of Minnesota. *Journal of Parasitology* 82: 41-44.
- Walton, B. C., and K. W. Walls. 1964. Prevalence of toxoplasmosis in wild animals from Fort Stewart, Georgia, as indicated by serologic tests and mouse inoculation. *American Journal of Tropical Medicine and Hygiene* 13: 530-533.

THE GENUS *PSEUDODENDROMONAS* BOURRELLY IN NORTH AMERICA

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ABSTRACT

During a TEM survey of pigmented silica-scaled protists present in Alabama fresh waters during the late winter in 1996, scales identified as belonging to *Pseudodendromonas vlkii* Bourrelly, a genus not previously reported from North America, were observed from the plankton of two ponds in Lauderdale County. Species of *Pseudodendromonas* are free-swimming or more usually stalked scale-bearing colorless flagellates of uncertain phylogenetic affinity. They are found only in freshwater, mostly at the meniscus of samples which have been allowed to stand for some time.

INTRODUCTION

Heterotrophic protists, particularly flagellates, play a substantial role in the flow of energy in aquatic ecosystems and soils (Vørs 1992). Taxonomically, the heterotrophic flagellates form a heterogeneous assemblage of species that belong to a number of groups, including the Choanoflagellida, Cryptophyceae, Dinophyceae, Euglenophyceae and the "Stramenopiles." The stramenopiles have recently become a rival nomenclatural candidate for the Kingdom Chromista (Corliss et al. 1994). Perhaps more correctly spelled "straminopiles" (Vørs 1993), this is an important non-protzoa, non-plant kingdom of algal protists.

Taxa of *Pseudodendromonas* are free-swimming biflagellate cells or, more usually, stalked scale-bearing colorless flagellates of uncertain affinity. The appearance of the scales has been described by Mignot (1974), but their exact structure and variability are best seen with the transmission electron microscope (TEM).

Species of the genus *Pseudodendromonas* have been reported, frequently in large numbers, from a broad range of acidic freshwater habitats (as plankton in ponds, including squeezings from *Sphagnum*; Hibberd 1976).

Pseudodendromonas

The present paper documents with TEM, the first report of *Pseudodendromonas vlkii* Bourrelly in North America.

MATERIALS AND METHODS

Plankton samples (10 μm mesh) were taken on 29 February 1996 from two small eutrophic freshwater ponds located in Lauderdale County, Alabama (Size More Pond, T45, R9W, Sect. 18 and an unnamed farm pond, T35N, R10W, Sect. 3). Physico-chemical data-Size More Pond: surface water temperature 8.5 $^{\circ}\text{C}$, pH 8.5 and conductance 83 μS at 25 $^{\circ}\text{C}$; farm pond: surface water temperature 8.9 $^{\circ}\text{C}$, pH 8.1 and conductance 41.2 μS . Samples were fixed and stored in acidic Lugol's iodine. Material for examination by TEM was air-dried on formvar-coated, carbon-stabilized mesh grids. The grids were examined without staining or shadowing in a Philips 300 TEM.

RESULTS AND DISCUSSION

Only isolated scales were observed in the TEM preparations (Fig. 1), but the structure of these scales clearly identified them as belonging to *Pseudodendromonas vlkii* Bourrelly.



Figure 1. Electron micrograph of a surface scale of *Pseudodendromonas vlkii*.
Scale bar = 1 μm .

The scales are oval, with length varying from 1.0-1.75 μm (mean 1.5 μm , N=15) and the ratio of length to width 1.5-2 (average 1.8, N=15). Each scale consists of a thin plate on which there are usually 20-25 angled transverse bars and a rim. The rim collapses in the type of preparations we used. However, from sectioned material, Mignot (1974) has shown that the rim does not stand vertically, but that it is curved inwardly, and also that the whole scale is bent with the rim on the concave side. Cells were not observed with light microscopy.

Pseudodendromonas was described by Bourrelly (1953) to accommodate the species *P. vlkii*. Three species are now recognized (Hibberd 1985). Electron microscopy of the scales is now required for species identification (Hibberd 1985).

The taxonomic position of the genus has been the subject of dispute. It has been variously described as a colorless member of the algal classes Chrysophyceae (Bourrelly 1953) or Prymnesiophyceae (Mignot 1974). Recent zoological treatments place the genus in the protozoan class Zoomastigophorea (as characterized by Levine et al. 1980) and in a new order Pseudodendromonadida (Hibberd 1985), family Pseudodendromonadidae (Patterson and Zölffel 1991) or the Phylum Opalozoa, Class Proterozoea, Order Cyathobodonida (Corliss 1994).

This report is the first EM observation of this taxon for North America. Other locations for *P. vlkii* are France (Bourrelly 1953, Mignot 1974) and England (Hibberd 1975). Our observations are also the first report of *P. vlkii* from a nonacidic environment.

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LITERATURE CITED

- Bourrelly, P. 1953. Flagellé incolores rares ou nouveaux. *Österreichische Botanische Zeitschrift* 100: 533-539.
- Corliss, J.O. 1994. An interim utilitarian ("user-friendly") hierarchical classification and characterization of the protists. *Acta Protozoologica* 33:1-51.
- Hibberd, D.J. 1976. Observations on the ultrastructure of three new species of *Cyathobodo* Petersen and Hansen (*C. salpinx*, *C. intricatus* and *C. simplex*) and on the external morphology of *Pseudodendromonas vlkii* Bourrelly. *Protistologica* 12: 249-261.
- _____. 1985. Observations on the ultrastructure of new species of *Pseudodendromonas* Bourrelly (*P. operculifera* and *P. insignis*) and *Cyathobodo* Petersen and Hansen (*C. peltatus* and *C. gemmatus*), Pseudodendromonadida ord. nov. *Archive für Protistenkunde* 129: 3-11.

Pseudodendromonas

- Levine, N.D., J.O. Corliss, F.E.G. Cox, G. Deroux, J. Grain, B.M. Honigberg, G.F. Leedale, A.R. Loeblich, III, J. Lom, D. Lynn, E.G. Merinfeld, F.C. Page, G. Poljansky, V. Sprague, J. Vavra and F.G. Wallace. 1980. A newly revised classification of the Protozoa. *Journal of Protozoology* 27: 37-58.
- Mignot, J.P. 1974. Étude ultrastructurale d'un protiste flagellé incolore: *Pseudodendromonas vlkii* Bourrelly. *Protistologica* 10: 397-412.
- Patterson, D.J. and M. Zöllffel 1991. Heterotrophic flagellates of uncertain taxonomic position. In: *The Biology of Free-living Heterotrophic Flagellates*, D.J. Patterson and J. Larsen (eds). Clarendon Press, Oxford. pp 453-476.
- Vørs, N. 1992. Heterotrophic amoebae, flagellates and heliozoa from the Tvärminne Area, Gulf of Finland, in 1988-1990. *Ophelia* 36: 1-109.
- _____ 1993. Marine heterotrophic amoebae, flagellates and heliozoa from Belize (Central America) and Tenerife (Canary Islands), with descriptions of a new species, *Luffisphaera bulbochaete* n. sp., *L. logihastis* n. sp., *L. turriiformis* n. sp. and *Paulinella intermedia* n. sp. *Journal of Eukaryotic Microbiology* 40: 272-287.

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DNA SOLUTIONS OF WEIGHTED CYCLE SEARCHING PROBLEMS

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ABSTRACT

Computational problems for which an algorithm can not be determined by polynomial time are classified as NP complete problems. Taking advantage of their great capacity to conduct parallel reactions, DNA molecules and their experimental protocols have been proposed to solve such problems which otherwise are time-consuming for electronic computers. Based on a working archetype, models are presented here to compute two NP-complete problems: searching for the Hamiltonian cycle and the traveling-salesman cycle.

INTRODUCTION

Solving a problem, not only correctly but also efficiently, is one of the main goals of algorithm design and analysis in computer science. An algorithm is a collection of computational procedures that can be programmed on computers to solve a specific problem. A problem may have more than one algorithm for its solution, but the performance might vary according to different computer architectures or data layouts.

For example, assume the summation problem, $S(n)$, defined as

$$S(n) = a_1 + a_2 + \dots + a_n,$$

where a_i is a real number for $i = 1, \dots, n$. The number n is defined as the problem size. A natural way to solve this problem is to add those n numbers one by one. The operations required for such a solution are $n-1$ additions. However, if a parallel computer with two processors is used, half of those numbers can be assigned to one processor and the rest of the numbers to the other processor. The final answer can be obtained by adding the two local sums resulting from applying the above method individually to each processor. This two-processor algorithm still requires $n-1$ additions, but the elapsed time can be theoretically cut to half of the time required by the primary solution (the actual elapsed time for the two-

processor algorithm will be slightly longer than half of the first method's required time because there is a communication cost for sending the local sums between processors for the final addition).

Two conclusions can be derived from this example. First, using a parallel computer may be advantageous for some problems. Second, both algorithms are classified as *polynomial time* since the leading term, which dominates the total count, has the form αn^k , where k is an integer and both α and k are nonnegative and independent of the problem size n . A problem that can be solved by a polynomial-time algorithm is tractable for extant electronic-based computers.

However, not all problems are so readily addressed, including the class of problems known as *NP-complete* problems (the term "NP" is short for "nondeterministic polynomial time" [3, p. 927]). No polynomial-time algorithm has been discovered for an NP-complete problem. In our example, a parallel computer with a large number of processors may be a solution to get a polynomial elapsed time with respect to n even though there is no polynomial-time algorithm. Unfortunately, for current electronic-based parallel computers, more processors cause a greater cost in communication channels and synchronization.

Nevertheless, a totally different system that employs biomolecules may revolutionize computational procedures. In 1994, Adleman [1] first introduced an algorithm and a practical DNA computer to solve one type of NP-complete problem, the Hamiltonian path problem. Later, Lipton [8] described the DNA-based solution of another type of NP-complete problem, the SAT problem. These solutions demonstrated both the feasibility of solving computational problems by manipulating biological molecules and the potential usefulness of the massively parallel processing power derived from such an approach. In this paper, we propose new algorithms to solve two other NP-complete problems: the Hamiltonian cycle problem and the traveling-salesman problem.

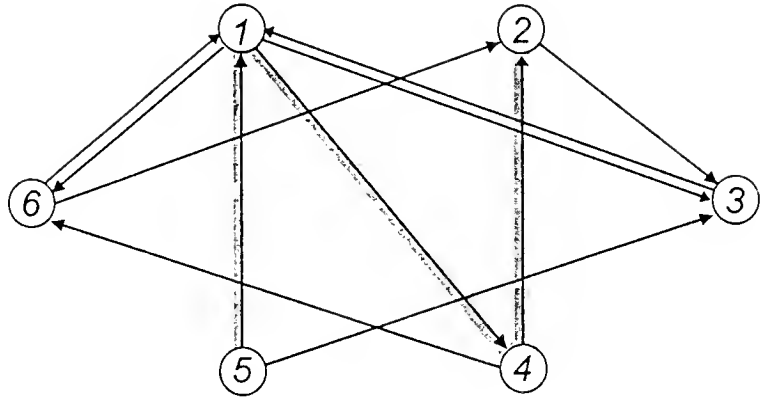
PROBLEMS AND ALGORITHMS

Graphs

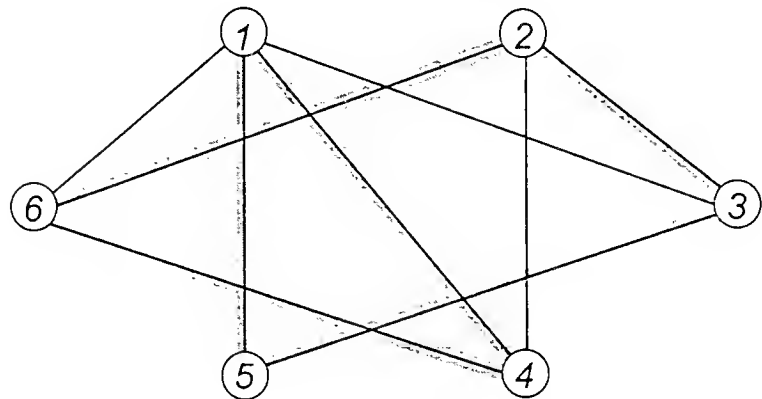
Before we describe the problems and the algorithms, we like to introduce some required background of graphs. A graph consists of two sets: vertex and edge. The vertex set contains a finite number of points, called vertices, and the elements of edge set, called edges, defining relations on some pairs of vertices. There are two kinds of edges: directed and undirected. A directed edge permits only one direction of transit between a pair of vertices, whereas an undirected edge allows two-way transit between two vertices. Consequently, we have both directed and undirected graphs. Figure 1A shows a directed graph and Figure 1B gives an example of an undirected graph. Both graphs have the same vertex set $\{1,2,3,4,5,6\}$.

A path is a sequence of vertices such that every pair of consecutive vertices has an edge. In Figure 1A, those edges with shadow show a path $\langle 5,1,4,2 \rangle$. A path is said to be simple if all the vertices in the sequence are distinct. Furthermore, a path is called a cycle if the first and the last vertices in the sequence are identical and the path contains at least one edge. Finally, a cycle is said to be simple if all the vertices in the sequence are distinct except the first and the last vertices. Now we can describe the Hamiltonian cycle and traveling-salesman problem formally.

A



B



C

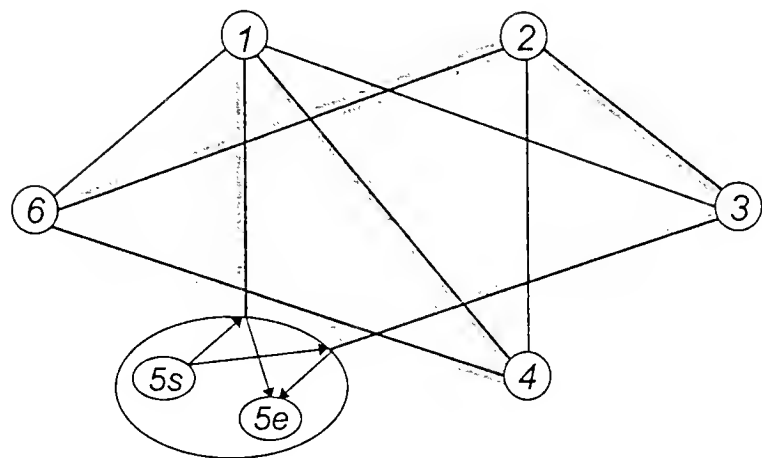


Figure 1. (A) A directed graph with a path $\langle 5,1,4,2 \rangle$ shown by shaded edges. (B) An undirected graph containing two Hamiltonian cycles, $\langle 5,1,4,6,2,3,5 \rangle$ and $\langle 5,1,6,4,2,3,5 \rangle$. The former one is shown by shaded edges. (C) To execute the first step of the algorithm, one of the vertex (vertex 5) is chosen and divided to form two fictitious vertices as starting (vertex $5s$) and ending (vertex $5e$) points.

The Hamiltonian Cycle

A Hamiltonian cycle is a simple cycle of an undirected graph that contains all vertices of the graph [3, pp. 953-959]. In Figure 1B, the shadowed edges depict a Hamiltonian cycle of a graph. A graph that defines a Hamiltonian cycle is said to be Hamiltonian, not all graphs have a Hamiltonian cycle. The problem will be to decide if a given graph is Hamiltonian. If the answer is yes, we present a cycle. Note that if every undirected edge in an undirected graph is replaced by two directed edges with opposite directions, then solution for the Hamiltonian cycle problem is similar to find a Hamiltonian path that starts from and ends at the same vertex of a directed graph. Therefore, the following algorithm based on Adleman's algorithm [1] is proposed for DNA-based computation to search for a Hamiltonian cycle:

Given an undirected graph with n vertices.

1. Pick one vertex, say v , as the starting and ending vertex.
2. Form all possible paths.
3. Collect paths that start from and end at the vertex v , and discard the rest. The resulting paths are cycles.
4. Collect cycles that contain n edges and discard the rest.
5. Collect cycles that visit all vertices and discard the rest.
6. Examine the result from step 5. If the result is empty, the graph does not have Hamiltonian cycles, and the process stops here.
7. If the result is not empty, reveal the Hamiltonian cycles.

The graph shown in Figure 1B provides an example of the experimental design for implementing such an algorithm. The vertex 5 is chosen as the starting and ending vertex at step 1. Because of the cyclic nature, the choice of starting/ending vertex can be random. This vertex will be virtually treated as two vertices, the starting one and the ending one (Figure 1C).

At the step 2, for $i = 1, \dots, 4$, and 6, oligonucleotide O_i of 20 bases is assigned to represent vertex i and its complementary strand is denoted as \bar{O}_i . As for vertex 5, two additional distinct oligonucleotides, O_{5s} and O_{5e} , as well as their complementary strands, are assigned to represent the practical starting and ending vertices respectively. For each edge connecting vertices i and j , oligonucleotides $O_{i,j}$ and $O_{j,i}$ are designed to represent the two-way traffic, wherein the traffic direction is denoted by the polarity of DNA molecule (Figure 2A). For transit from vertex i to vertex j , the 5' end of $O_{i,j}$ is identical to either all 20 bases of O_{5s} for $i = 5$ or the 10 bases at the 3' end of O_i for all other values of i . Similarly, the 3' end of $O_{i,j}$ is identical to either all 20 bases of O_{5e} for $j = 5$, or the 10 bases at the 5' end of O_j for all other values of j . $O_{j,i}$ is prepared by the same principle as the counterpart of $O_{i,j}$. When the essential DNA molecules are ready, \bar{O}_i and $O_{i,j} / O_{j,i}$ are mixed in solution and allowed to anneal. \bar{O}_i serve as bridges to bring the various edge oligonucleotides together. A subsequent ligation reaction then generates longer DNA fragments from all the possible combinations of the edge oligonucleotides (Figure 2B).

To implement step 3, the products from the ligation reaction are amplified by PCR with the primer pair O_{5s} and \bar{O}_{5e} . The signals encoded by DNA fragments starting from O_{5s} and ending at O_{5e} are boosted and can be detected visually after agarose gel electrophoresis. Since the graph has only six vertices, seven 20 bp oligonucleotides (corresponding to five original vertices and the two virtual start and stop vertices) are expected to be included in the

desired DNA fragments. Thus, at step 4, those amplified products of 140 base pairs in length will be excised and electroeluted.

The DNA fragments thus collected meet the requirements at steps 3 and 4: specifically, they all begin with and end at vertex 5 and contain six edges. Any of the fragments that contain all O_i for $i = 1, \dots, 4$, and 6 will represent one Hamiltonian cycle. Such DNA fragments are extracted by affinity purification. Single stranded DNA fragments generated from the electroeluted fragments are annealed to biotinylated \bar{O}_i . Those fragments that hybridize to biotinylated \bar{O}_i will reveal the presence of O_i and are recovered by streptavidin paramagnetic particles. The extraction procedure is re-employed by using the newly isolated O_i -containing DNA with the next biotinylated \bar{O}_j . Purification steps with \bar{O}_{5s} and \bar{O}_{5e} are not required because the prior PCR amplification included them, by definition. The final extract can be amplified again by using the primer pair O_{5s} and \bar{O}_{5e} to create enough molecules for further analysis.

At step 6, final amplified products are electrophoresed on an agarose gel. If no DNA band is detected, the graph is not Hamiltonian. If a 140 bp DNA band is found, at least one Hamiltonian cycle exists, and the following procedure is implemented.

Multiple graduated PCRs are employed at step 7 to reveal the cycle. For the first graduated PCR, O_{5s} serves as forward primer and \bar{O}_i for $i = 1, \dots, 4$, and 6, are used as reverse primers. Note that the amplified DNA fragments with a length of 40 bp denote those vertices that are adjacent to vertex 5. Furthermore, for each Hamiltonian cycle, there will be a pair of affinity purified DNA fragments with opposite orders (e.g., $\langle 5s, 1, 4, 6, 2, 3, 5e \rangle$ and $\langle 5s, 3, 2, 6, 4, 1, 5e \rangle$ in Figure 1B). Therefore, at least two distinct fragments with a length of 40 bp will be formed after the first graduated PCR (e.g. vertices 1 and 3 in our example). Users can select either order through choice of the next adjacent vertex.

Suppose that vertex 1 is selected, O_{5s-1} will serve as the forward primer in the second round of graduated PCR, with reverse primers \bar{O}_2 , \bar{O}_3 , \bar{O}_4 , and \bar{O}_6 . Amplified DNA fragments with a length of 60 bp will denote those vertices that are adjacent to vertex 1 (e.g. vertices 4 and 6 in our example, see Figure 1B). Again, we can pick either O_{1-4} or O_{1-6} as the forward primer for the third round of graduated PCR. If there is only one fragment type with a length of 50 bp, it implies that the adjacent vertex is unique. The search then progresses to those amplified DNA fragments with a length of 70 bp. Eventually, the sizes will reveal the order of a Hamiltonian cycle starting from vertex 5.

The traveling-salesman problem

Now let us move to the traveling-salesman problem. This problem is a variant of the Hamiltonian cycle problem with more sophisticated conditions. Start with an undirected complete graph in which each pair of vertices are connected each other. Furthermore, the edges of this graph are weighed; that is, an integer is assigned to each edge to represent the cost of travel between the vertices connected by the edge. A total cost of a cycle is the sum of those individual weights of the edges in the cycle. The problem is to find a Hamiltonian cycle of a given graph with the minimum cost [3, pp. 959-960]. An algorithm similar to the one above but with several modifications is proposed to solve the traveling-salesman problem.

Imagine a complete, weighted, and undirected graph with n vertices.

1. Pick one vertex, v , as the starting and ending vertex.
2. Form all possible paths.

3. Collect those paths that start from and end at the vertex v , and discard all other paths. The resultant paths are cycles.
4. Collect cycles that visit all vertices, and discard all others.
5. Collect those cycles with the minimum cost to reveal a traveling-salesman cycle.

The graph shown in Figure 3A is used as an example. At the first step, vertex W is randomly chosen and practically treated as two vertices, W_s and W_e , to accommodate the dual roles as a starting and ending point (see Figure 3B).

At step 2, distinct oligonucleotides (O_i) of 18 bases are assigned to represent each vertex, and their complementary strands are denoted as \bar{O}_i . However, a more complicated design of the oligonucleotides $O_{i,j} / O_{j,i}$ is required to represent the weighted edges. Basically, they are all composed of three segments. The 5' end of $O_{i,j}$ consists of 9 bases which are identical to the 3' end 9 bases of O_i (except when $i = W$, all 18 bases of O_{W_s} are contained within) while the 3' end contains another 9 bases exactly as same as the 5' end 9 bases of O_j (unless $j = W$, in which case it is all of O_{W_e}). The third segment of DNA is of variable length, and is positioned in the middle of the oligonucleotide. Consider the cost or length ratio depicted in Figure 3A, if the minimum length of the edge is 18 bases (the cost is 3), the other two costs can be represented by oligonucleotides of 24 (cost = 4) and 30 (cost = 5) bases. Hence, for the shortest edges like $O_{x,y}$, the third DNA segment contains no extra nucleotides. But, 6 or 12 bases are included for longer edges. Since this additional DNA segment merely represents part of the weighted cost of each individual edge, thus the sequences can be random (Figure 4A). As described above, $O_{i,j}$ designates one-way traffic from vertex i to vertex j . Both $O_{i,j}$ and $O_{j,i}$ are prepared for each undirected edge.

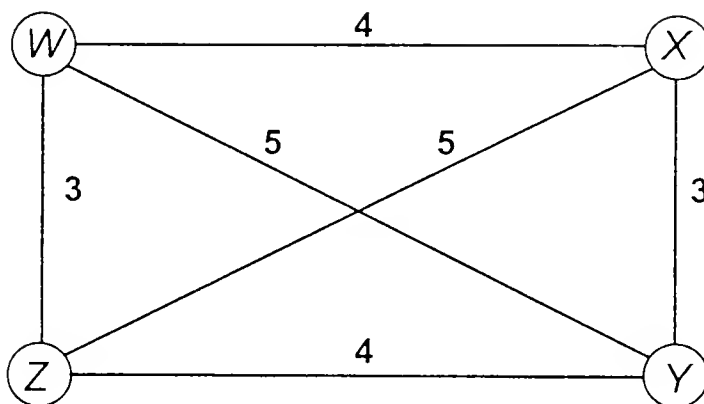
Once again, all essential DNA molecules ($O_{i,j} / O_{j,i}$ and \bar{O}_i) are mixed and allowed to anneal. A ligation reaction generates longer DNA fragments from all possible combinations of edges oligonucleotides, though not all \bar{O}_i are ligated together due to the gaps created by the additional DNA segments in some $O_{i,j}$ (Figure 4B). Those DNA fragments that start from and end at vertex W are then amplified by PCR with primer pair O_{W_s} and \bar{O}_{W_e} (step 3).

In the Hamiltonian cycle problem, amplified DNA fragments resulting from step 3 are screened on an agarose gel to isolate those sizes corresponding to the sum of vertices. However, because of the variant lengths of $O_{i,j}$, the size of desired DNA fragment here is not predictable, and therefore affinity purification is conducted directly at step 4. DNA fragments purified in this step are amplified again by using primer pair O_{W_s} and \bar{O}_{W_e} to produce a large enough quantity for further analysis.

In the case presented here, six DNA fragments encoding three Hamiltonian cycles are contained in the affinity purified DNA pool (Figure 5). The sizes are 102 bp, 114 bp and 126 bp. At step 5, agarose gel electrophoresis will separate them, and the 102 bp DNA fragments that carry the desired information (the least cost) can be isolated. Of course, many DNA fragments encoding paths other than these six will also exist in the affinity purified DNA pool. However, these fragments are not a concern. They encode multiple visits to some vertices so that they have larger sizes, and thus can be eliminated by the electrophoresis step.

To consummate the final step, multiple graduated PCRs are again employed. In the first round of graduated PCR, the smallest DNA fragment whose size is 36 bp is amplified with primers O_{W_s} and \bar{O}_Z . This result provides the information that one of the two vertices adjacent to vertex W in the traveling-salesman cycle is vertex Z . This information is

A



B

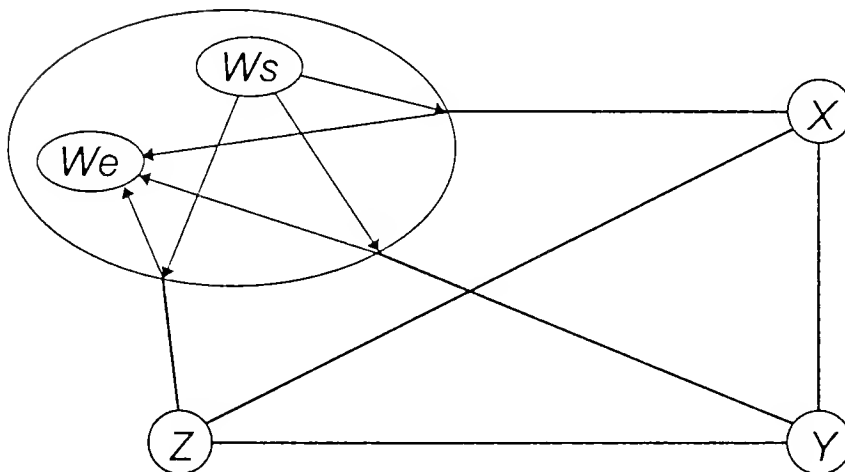


Figure 3. (A) An undirected graph showing the traveling-salesman problem. The digits indicate the relative costs of individual edges between vertices. (B) To facilitate the computation, vertex W is denoted twice, W_s and W_e , for starting and ending point respectively.

A

O_x	18-mer	5'	GGAACCTTTGGGAACCTT	3'
\bar{O}_x	18-mer	3'	CCTTGGAAACCCTTGGAA	5'
\bar{O}_y	18-mer	3'	GATCGATCGATCGATCGA	5'
\bar{O}_z	18-mer	3'	TAGCTTAAGCTAGAGCTG	5'
$O_{x,y}$	18-mer	5'	GGGAACCTTCTAGCTAGC	3'
$O_{y,z}$	24-mer	5'	TAGCTAGCTNNNNNNATCGAATC	3'
$O_{z,x}$	30-mer	5'	GATCTCGACNNNNNNNNNNGGAAACCTTT	3'

B

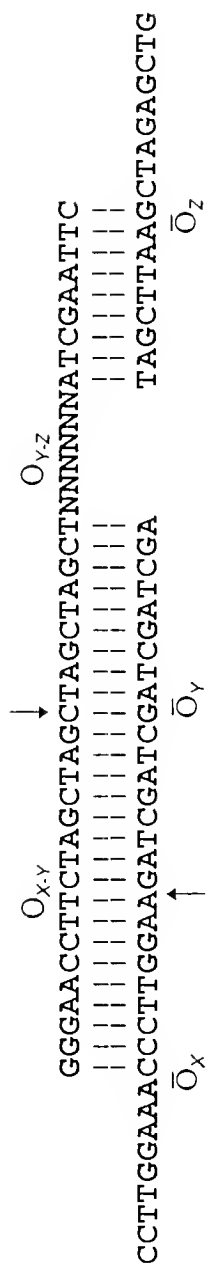


Figure 4. Vertices and edges are encoded in oligonucleotides for searching the traveling-salesman cycle. **(A)** 18-mer oligonucleotides O_i are assigned to each vertex (O_x is shown). Their complementary strands are \bar{O}_i (shown are \bar{O}_x , \bar{O}_y and \bar{O}_z). For oligonucleotides $O_{i,j}$ which encode the edges, the direction of transit from vertex i to vertex j is determined by using 9 bases from the 3' end of O_i (except when $i = W$, in which case all 18 bases of O_w are contained within) and 9 bases from the 5' end of O_j (unless $j = W$, in which case it is the same as O_w). The cost of edges is adjusted by additional bases wedged between both ends (shown are $O_{x,y}$, $O_{y,z}$ and $O_{z,x}$). Bases presented here are for descriptive purpose only. **(B)** Ligation events (arrows) between $O_{i,j}$ or \bar{O}_i can occur when oligonucleotides anneal properly. A gap between \bar{O}_y and \bar{O}_z caused by additional bases remains open.

DNA solves weighted cycle searching problems

sufficient for conducting the second round of graduated PCR, and the other vertex next to W (vertex X in this case) is irrelevant. In the second round of graduated PCR, DNA fragments with sizes of 60 and 78 bp are amplified using $O_{W\text{-}Z}$ as the forward primer and \bar{O}_Y , \bar{O}_X as the reverse primers, respectively. Amplified DNA fragments are then run on an agarose gel and the traveling-salesman cycle is revealed.

DISCUSSION

Advantages of molecular computation include energy efficiency and high information storage density [1]. The true power of the DNA computation, however, resides in its massive parallel capabilities and unique screening strategies. One Weiss unit of T4 DNA ligase yields approximately 4.8×10^{13} concatenating events in 30 minutes, or 2.7×10^{10} events per second, thus an immense amount of combination results can be generated in parallel within a short time when scaled up properly. In addition, PCR amplification and affinity purification allow identification of the answer to be straightforward. A conventional electronic-based single processor computer must employ trial-and-error tactics for these nonpolynomial-time algorithms, attempting first one path and then another in a labyrinth of possibilities, finally deciding the answer. In contrast, a DNA-based computer constructs all path combinations simultaneously, and picks out the answer directly.

There are several aspects of this current study that bear reiterating because of the complexity of some of the arguments and because some of the arguments rely heavily upon principles demonstrated experimentally by Aldeman [1]. First, the procedures employed will identify a legitimate path that contains no redundancies because the sample size is small and because of the selective criteria [1]. Secondly, selection of the correct answer(s) is carried out by the use of graduated PCR procedures. This step provides a convenient alternative to direct sequencing, and it also harnesses the real parallel computing power of DNA molecules by searching among thousands of molecules at the same time. Thirdly, the techniques here are suitable only for use with pure DNA molecules, such as would be available by oligonucleotide synthesis and such as were used by Aldeman [1].

The schematic design of algorithms introduced in this article is based directly on Adleman's model [1], all techniques involved have been proven and are considered feasible. However, two major differences occur in the problems presented here and the specific propositions are made. First of all, the starting and the ending vertices are the same in the cycle-searching problem. Dividing one of the vertices in the graph into two fictitious vertices (v_{start} and v_{end}) converts every cycle searching problem into a path searching problem, although this approach requires the use of extra oligonucleotides during data input. Moreover, the edges are undirected, and this distinction causes the desired answer to be encoded by two diverse DNA fragments concurrently. To unveil the answer, we introduced multiple graduated PCRs to decipher the cycle order. This procedure should also prove useful for solving other path searching problems, such as two Hamiltonian paths within a single graph.

The second innovation in our model is that the edges are weighted in the traveling-salesman problem. This makes the length of desired DNA fragment unpredictable, and affinity purification must be executed prior to size-dependent gel isolation. Although the tripartite design of the oligonucleotides allows the encoding of weight information, the coupling efficiency during oligonucleotide synthesis may cause a potential problem during the synthesis of the longer oligonucleotides. Assuming an average coupling efficiency of 99.5%,

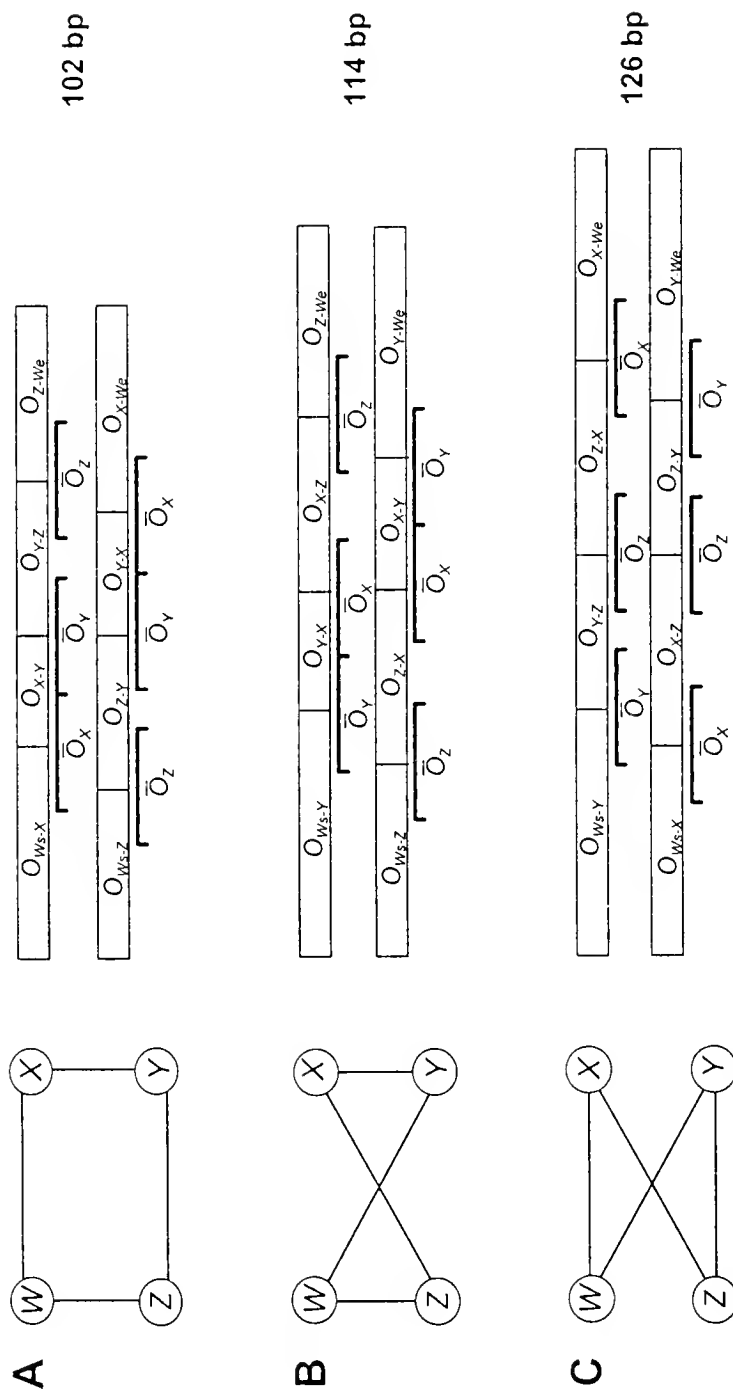


Figure 5. Three Hamiltonian cycles and their encoding DNA fragments. (A) Two DNA fragments with 102 bp encode the cycle W-X-Y-Z-W. (B) Two DNA fragments with 114 bp encode the cycle W-Y-X-Z-W. (C) Two DNA fragments with 126 bp encode the cycle W-Y-Z-X-W. Those two encoding the traveling-salesman cycle (the shortest in length) can be separated from others by size-dependent gel electrophoresis and the answer is revealed by multiple graduated PCR.

the overall yield would be 90.92% ($0.995^{19} = 0.9092$) for a 20-mer, but only 60.88% for a 100-mer, and 36.88% for a 200-mer. Without proper post synthesis purification, the truncated products will certainly interfere with computational reactions. One possible effect is that shorter oligonucleotides will compete with full length oligonucleotides during the annealing step, decreasing the parallel operation power. A possible solution for this concern may lie in the use of PCR procedures to generate the necessary oligonucleotides, rather than the use of a DNA synthesizer. Thus, a large molecule need be synthesized only once; thereafter, DNA fragments of the desired lengths can be obtained by amplification of various portions of large DNA molecules. Single stranded DNA isolation may be required for this alternative method.

The feasibility of using biological molecules for computation has been the subject of controversy and argument since its inception [6, 9, 10, 11]. Even though models have been proposed and DNA computers have been constructed, several fundamental issues remain to be resolved. First, biological reactions usually take minutes or hours to complete. Thus, although the ligation reaction and the polymerase chain reaction provide strong combination and screening power, the overall time consumed may ultimately be impractical (especially if an affinity purification step must be performed sequentially in these cases). Second, the feasibility and accuracy of DNA-based computation when the problem size is very large remains untested. Moreover, the DNA computation models addressed to date solve only very specific types of problems and do not address universal applications. However, Guarnieri et al. [7] reported the use of DNA molecules to achieve addition, and more recently Wu et al. [12] proposed a model for DNA arithmetic calculator, very welcome broadening of this new field of molecular computation.

The applications of biocomputation remain to be explored. The prospect of biocomputation should not be restricted in DNA molecules only. Other biological properties and biochemical reactions, such as the signal perception and transduction by a neural network, could perhaps be the bases for a more versatile and intelligent biocomputer. More studies are definitely required to reveal the full capacity of biocomputation, and such studies should include both computer and biological sciences. Knowledge of how to use biomolecules to achieve computation may also provide insight into the sophisticated machinery of life. Moreover, because the genomes of several organisms have been fully sequenced [2, 4, 5], computation using cellular processes in an entire life form may be a possibility in the future.

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REFERENCES

- [1] Adleman, L.M. (1994) Molecular Computation of Solutions to Combinatorial Problems. *Science* 266: 1021-1024.
- [2] Bult, C.J., White, O., Olsen, C.J., Zhou, L., Fleischmann, R.D., Sutton, G.G., Blake, J.A., FitzGerald, L.M., Clayton, R.A., Gocayne, J.D., Kerlavage, A.R., Dougherty, B.A., Tomb, J.F., Adams, M.D., Reich, C.I., Overbeek, R., Kirkness,

- E.F., Weinstock, K.G., Merrick, J.M., Glodek, A., Scott, J.L., Geoghagen, N.S.M., Weidman, J.F., Fuhrmann, J.L., Nguyen, D., Utterback, T.R., Kelley, J.M., Peterson, J.D., Sadow, P.W., Hanna, M.C., Cotton, M.D., Roberts, K.M., Hurst, M.A., Kaine, B.P., Borodovsky, M., Klenk, H.P., Fraser, C.M., Smith, H.O., Woese, C.R. & Venter, J.C. (1996) Complete Genome Sequence of the Methanogenic Archaeon, *Methanococcus jannaschii*. *Science* 273: 1058-1073.
- [3] Cormen, T.H., Leiserson, C.E. & Rivest, R.L. (1990) *Introduction to Algorithms*. MIT Press, Cambridge, Mass.
- [4] Fleischmann, R.D., Adams, M.D., White, R., Clayton, R.A., Kirkness, E.F., Kerlavage, A.R., Bult, C.J., Tomb, J.F., Dougherty, B.A., Merrick, J.M., McKenney, K., Sutton, G., FitzHugh, W., Fields, C., Gocayne, J.D., Scott, J., Shirley, R., Liu, L.I., Glodek, A., Kelley, J.M., Weidman, J.F., Phillips, C.A., Spriggs, T., Hedblom, E., Cotton, M.D., Utterback, T.R., Hanna, M.C., Nguyen, D.T., Saudek, D.M., Brandon, R.C., Fine, L.D., Fritchman, J.L., Fuhrmann, J.L., Groghagen, N.S.M., Gnehm, C.L., McDonald, L.A., Small, K.V., Fraser, C.M., Smith, H.O. & Venter, J.C. (1995). Whole-Genome Random Sequencing and Assembly of *Haemophilus influenzae* Rd. *Science* 269: 496-512.
- [5] Fraser, C.M., Gocayne, J.D., White, O., Adams, M.D., Clayton, R.A., Fleischmann, R.D., Bult, C.J., Kerlavage, A.R., Sutton, G., Kelley, J.M., Fritchman, J.L., Weidman, J.F., Small, K.V., Sandusky, M., Fuhrmann, J., Nguyen, D., Utterback, T.R., Saudek, D.M., Phillips, C.A., Merrick, J.M., Tomb, J.F., Dougherty, B.A., Bott, K.F., Hu, P.C., Lucier, T.S., Peterson, S.N., Smith, H.O., Hutchison III, C.A., and Venter, J.C. (1995) The Minimal Gene Complement of *Mycoplasma genitalium*. *Science* 270: 397-403.
- [6] Gifford, D.K. (1994) On the Path to Computation with DNA. *Science* 266: 993-994.
- [7] Guarnieri, F., Fliss, M. and Bancroft, C. (1996) Making DNA Add. *Science* 273: 220-223.
- [8] Lipton, R.J. (1995) DNA Solution of Hard Computational Problems. *Science* 268: 542-545.
- [9] Lo, Y.M.D., Yiu, K.F.C. and Wong, S.L. (1995) On the potential of molecular computing. *Science* 268: 481-482.
- [10] Pool, R. (1995). A Boom in Plans for DNA Computing. *Science* 268: 498-499.
- [11] Stemmer, W.P.C. (1995) The evolution of molecular computation. *Science* 270: 1510.
- [12] Wu, S.J., Wu, Y.J.J. and Shaw, J.J. (1996) A comprehensive DNA arithmetic calculator. Mathematics and Computer Science Division Preprint ANL/MCS p630-1296, Argonne National Laboratory, IL.

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REACTION OF A CHLORONITRENO COMPLEX OF TUNGSTEN WITH
PHOSPHOROUS TRICHLORIDE: SYNTHESIS, CHARACTERIZATION AND
REACTIVITY OF $\text{Cl}_5\text{W}(\text{NPCI}_3)$

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ABSTRACT

Tungsten (VI) phosphoraniminato complex, $\text{Cl}_5\text{W}(\text{NPCI}_3)$, was prepared in quantitative yield by the reaction of chloronitreno complex of tungsten, $\text{Cl}_4\text{W}(\text{NCl})$, and phosphorous trichloride in CCl_4 . $\text{Cl}_5\text{W}(\text{NPCI}_3)$ was characterized by elemental analysis and IR-spectroscopy. This compound was found to be very sensitive to air and moisture, and soluble in polar solvents. However, an attempt to dissolve it in CH_3CN gave a reaction product characterized to be $[\text{PCl}_4][\text{WNCI}_4] \cdot 1.5\text{CH}_3\text{CN}$.

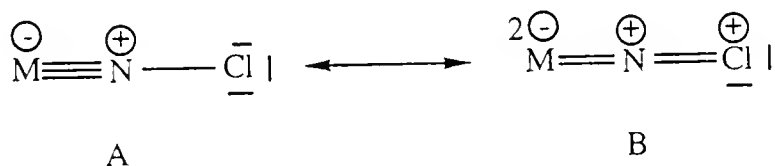
INTRODUCTION

Chloronitreno complexes of transition metals with a linear $\text{M} \equiv \text{N}-\text{Cl}$ group resemble asymmetric nitrido complexes, $\text{M} \equiv \text{N}-\text{M}'$ in their mode of bonding and structure. However, the two differ in the stability of the σ -bond of the bridging nitrogen atom. In a chloronitreno complex, the σ -bond between nitrogen and chlorine is formed as a result of the overlap of an sp hybrid orbital of nitrogen and sp^3 hybrid orbitals of chlorine. In contrast to this, in the asymmetric nitrido complexes of type $\text{M} \equiv \text{N}-\text{M}'$, a donor-acceptor bond formation between N and M' is observed.

Nitreno complexes of vanadium, rhenium and osmium have been known for a long time.¹ However, nitreno complexes of molybdenum and tungsten are relatively new and have been prepared by the reaction of $\text{M}(\text{CO})_6$ ($\text{M} = \text{Mo}, \text{W}$) with excess of NCl_3 according to equation 1.^{1,2}



The resulting complex is dimeric, where two chlorides bridge two metal centers. The MNCl fragment of this complex can be represented by two resonance forms shown below.



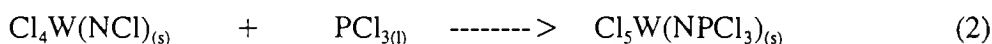
In both forms the nitrogen is electron deficient and therefore can be easily attacked by a Lewis base. On the other hand, the chlorine atom acts as a nucleophile in A and as an electrophile in B. In A, the chloride can be substituted by ligands which have a higher tendency of binding to the nitrogen, whereas, in B the chloride can be dissociated as Cl^+ by species with high electron densities.^{3,4} Therefore, several reactions of chloronitreno complexes are conceivable. Some of these reactions are addition of ligands to the metal, substitution of the chloride ligand, and nucleophilic addition on the nitrogen.

In this paper the reaction of a chloronitreno complex of tungsten with phosphorous trichloride is reported, and the characterization, properties and reactivity of the resulting product are discussed.

RESULTS AND DISCUSSION

Synthesis and properties

The reaction of PCl_3 with $\text{Cl}_4\text{W}(\text{NCl})$ in equivalent molar ratios in CCl_4 (-45°C , inert atmosphere) initially gave an orange-red solution. Stirring the solution for two more hours while warming to room temperature resulted in an orange-red powder and a colorless solution. The reaction product was extremely air and moisture sensitive. In air, it changed its color first to yellow and then to colorless. The product was insoluble in CCl_4 and hexane; sparingly soluble in CH_2Cl_2 , and soluble in THF. The product was found to be very soluble in CH_3CN at first but produced a yellow powder on further stirring, indicating a reaction had taken place. The orange-red powder was characterized by elemental analysis and IR-spectroscopy. The elemental analysis showed good agreements between the calculated and experimental results for most elements. However, a difference of 1.06% was found for tungsten. This difference may be due to mutual interference of the ions analyzed. Poor agreement for the analysis of tungsten has been found for other compounds as well.⁵ The results of the elemental analysis and IR-spectrum suggest that the reaction proceeded as shown in equation 2. In this reaction, the Lewis base PCl_3 attacks the electron deficient nitrogen of $\text{Cl}_4\text{W}(\text{NCl})$ to generate the $(\text{NPCl}_3)^-$ ligand.



Complexes of transition metals containing the $(\text{NPX}_3)^-$ ligand (X = organic group or halogen), which does not exist as a free ion, are known as phosphoraniminato complexes and have been thoroughly reviewed.⁶ The MNP group in these complexes is often nearly linear with a bond angle of 157 - 177° . X-ray data of some phosphoraniminato complexes show that the M-N and N-P bonds are fairly short with bond lengths of 170 - 185 pm and 160 - 165 pm respectively.⁷⁻¹⁰ These bond distances indicate a double bond between M-N as well as N-P.

Most phosphoraniminato complexes known have an organic group attached to the phosphorous atom. Complexes where a halide is attached to the phosphorous atom are very few in number, however, $[\text{Ph}_4\text{P}][\text{MoCl}_5(\text{NPCl}_3)]^{11}$ and $\text{Cl}_5\text{W}(\text{NPCl}_2\text{NPCl}_3)^7$ are very well known.

IR-Spectrum

The IR-spectra of all phosphoraniminato complexes show a strong absorption band in the region of 1100 - 1170 cm^{-1} due to an asymmetric stretching vibration of the MNP

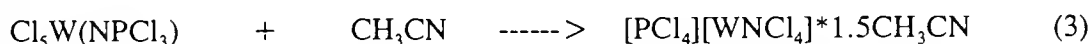
group.⁶ The symmetric stretching vibration sometimes appear a little below 600 cm⁻¹ as a weak band and is observed only for a few complexes. The shift to lower wavelength is due to a strong coupling of the asymmetric and symmetric stretching vibrations, caused by the linearity of the MNP group.^{8,6} The IR-spectrum of Cl₅W(NPCl₃) is shown in Fig. 1, the assignment of bands is listed in Table 1, and a proposed structure for the compound is shown in Fig. 2. The strong band at 1161 cm⁻¹ corresponds to asymmetric vibration of the WNP-group. The symmetric vibration is not observed, and the absence is common in these type of complexes. The bands at 640 cm⁻¹ and 600 cm⁻¹ are due to asymmetric and symmetric vibrations of the PCl₃ group respectively.¹¹ In the region of W-Cl vibrations, three bands are observed. The asymmetric W-Cl vibration appear at 380 cm⁻¹ as a strong band and the symmetric at 335 cm⁻¹ as very strong band. The band at 281 cm⁻¹ is also assigned to W-Cl vibration, for the chloride at *trans* position to NPCl₃⁻ ligand. The medium bands at 193 and 145 cm⁻¹ could be due to W-Cl deformational vibrations.¹ Table 2 lists characteristic vibrational frequencies of some phosphoraniminato complexes for comparison with the result obtained for Cl₅W(NPCl₃).

Table 1. IR-spectrum of Cl₅W(NPCl₃) vs = very strong, s = strong, m = medium

cm-1	Intensity	Assignment
1161	vs	$\nu_{as}(\text{WNP})$
640	vs	$\nu_{as}(\text{PCl}_3)$
600	s	$\nu_s(\text{PCl}_3)$
380	s	$\nu_{as}(\text{W-Cl})$
335	vs	$\nu_s(\text{W-Cl})$
281	s	$\nu(\text{W-Cl})$
193	m	$\delta(\text{W-Cl})$
145	m	$\delta(\text{W-Cl})$

Reaction of Cl₅W(NPCl₃) with CH₃CN

Stirring a suspension of Cl₅W(NPCl₃) in an excess amount of CH₃CN at 0°C, initially gave a red-orange solution, which on further stirring for two more hours while warming it to room temperature gave yellow powder and a faint yellow solution. The product was characterized by elemental analysis and IR-spectroscopy. The results obtained confirmed that the reaction proceeded as shown by equation 3.



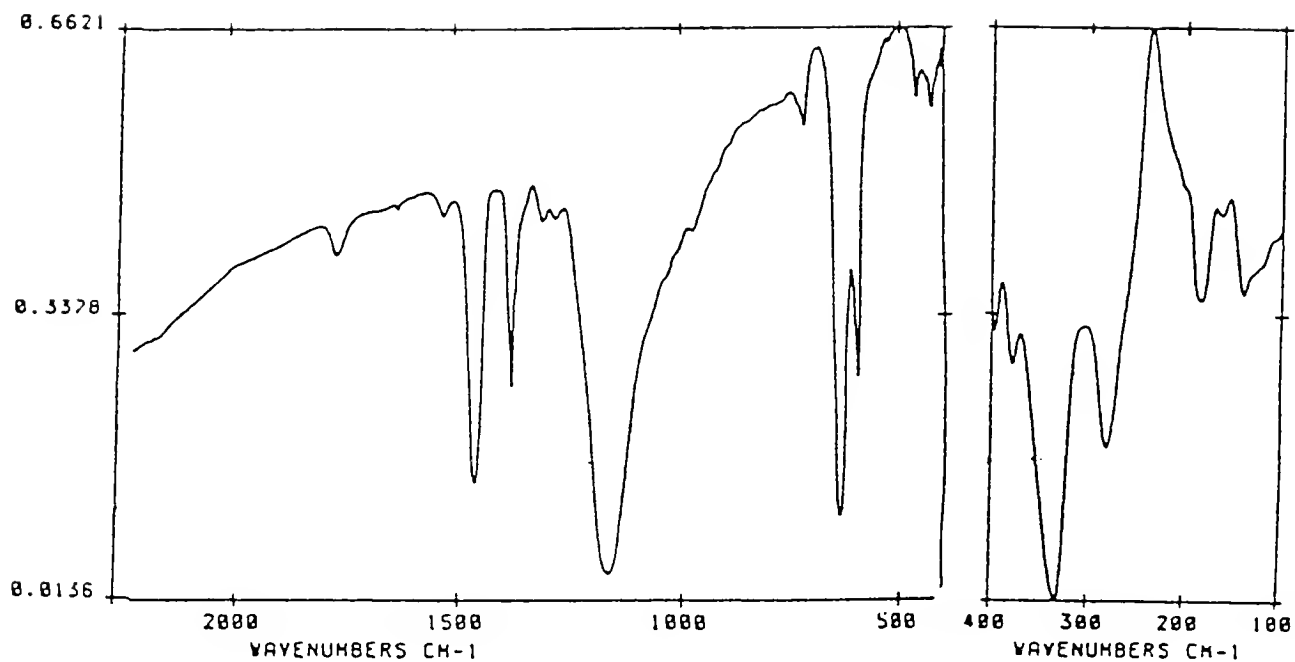


Fig. 1. IR- spectrum of $\text{Cl}_5\text{W}(\text{NPCl}_3)$

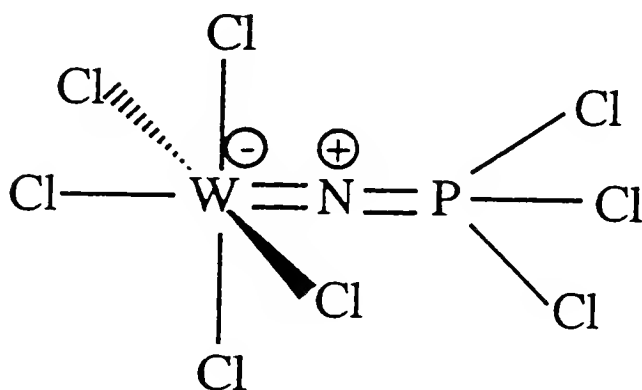


Fig. 2. Proposed structure for $\text{Cl}_5\text{W}(\text{NPCl}_3)$

Reaction

Table 2. Characteristic vibrational frequencies of phosphoraniminato complexes.

Complexes	$\nu_{as}(MNP)$ (cm^{-1})	$\nu_s(MNP)$ (cm^{-1})	Ref.
$[\text{NbCl}_4(\text{NPPPh}_3)]_2$	1177	-	13
$[\text{MoCl}_4(\text{NPPPh}_3)]_2 \cdot 2\text{CH}_2\text{Cl}_2$	1132	573	10
$[\text{Cl}_5\text{WNP}(\text{Cl}_2)\text{NPCl}_3]$	1168	-	7
$[\text{WF}_4(\text{NPMe}_3)_2]$	1110	575	14
$[\text{Re}(\text{SPh})_4(\text{NPPPh}_3)]$	1120	-	15
$[\text{RuCl}_3(\text{NPPPhEt}_2)(\text{PPhEt}_2)_2]$	1090	-	16
$[\text{Cl}_5\text{W}(\text{NPCl}_3)]$	1161	-	This work

The results of elemental analysis indicated the presence of 1.5 mole of CH_3CN bound to the crystal lattice. Solvent molecule coordination of this type has also been observed in similar molecules.¹⁷ The IR-spectrum of the product showed strong bands at 2320 and 2995 cm^{-1} due to CH_3CN and a very strong band at 1100 cm^{-1} corresponding to $\nu(\text{W}\equiv\text{N})$. Similar vibrational frequencies have been observed for related complexes such as $\text{Ph}_4\text{As}[\text{WNCI}_4]$ (1036 cm^{-1})¹⁸, $\text{Ph}_4\text{As}[\text{MoNCI}_4]$ (1054 cm^{-1})¹⁸, and $\text{Ph}_4\text{As}[\text{OsNCI}_4]$ (1123 cm^{-1}).¹⁹ The shift to a higher wavenumber in this product may be due to the effect of the counter cation and presence of the solvent molecule bound to the crystal. Bands at 650 and 590 cm^{-1} are characteristic to the cation PCl_4^+ and these bands are also observed for $[\text{PCl}_4]^+[\text{PCl}_6]^-$.¹¹ In the region of W-Cl vibration, two bands at 370 and 340 cm^{-1} are observed.

EXPERIMENTAL

Methods and Materials

All of the experiments were carried out under an argon atmosphere using the Schlenk technique. The Schlenk tubes were thoroughly heated under vacuum to remove traces of moisture. All solvents were carefully dried and degassed. Acetonitrile, dichloromethane and carbon tetrachloride were refluxed over P_2O_5 for three to four days and distilled under argon. Diethyl ether, tetrahydrofuran and hexane were distilled from a Na/benzophenone mixture under argon. $\text{WCl}_4(\text{NCl})$ was synthesized by a literature method.³ PCl_3 was purchased from Aldrich (99.99%) and refluxed for several hours and distilled. The IR spectrum was measured as a Nujol mull between cesium iodide plates on a Bruker FTIR Spectrometer model IFS 88 (4000 - 100 cm^{-1}). Elemental analysis was performed in the Analytical Unit of Philipps University, Marburg, Germany.

Synthesis of Cl₅W(NPCl₃)

5.23 g (13.95 mmol) Cl₄W(NCl) were suspended in 50 mL of CCl₄ under an argon atmosphere and cooled to -45°C. While stirring, 1.92 g (13.95 mmol; 1.22 mL) of PCl₃ were added drop wise. The initially formed orange-red solution was stirred for two more hours while raising its temperature to 20°C. An orange-red crystalline powder and a colorless solution resulted. The product was filtered and washed three times with 5 mL portions of CCl₄ and dried under high vacuum. Yield: 7.01 g (98.11% based on WCl₄(NCl)). Elemental analysis: Calculated for Cl₅W(NPCl₃); N, 2.73; Cl, 55.35; P, 6.04; W, 35.88; Found: N, 2.98; Cl, 55.52; P, 6.31; W, 36.94

Reaction of Cl₅W(NPCl₃) with CH₃CN

2.41 g (4.70 mmol) of Cl₅W(NPCl₃) were added to 50 mL CH₃CN at 0°C while stirring. A red-orange solution formed immediately. Stirring this solution for thirty minutes while warming to room temperature gave a yellow powder and light yellow solution. The yellow product was filtered and washed three times with a 5 mL portion of CH₃CN and dried under high vacuum. Yield: 2.22 g (90.98% based on Cl₅W(NPCl₃)). Elemental analysis: Calculated for [PCl₄][WNCl₄]*1.5CH₃CN N, 6.09; C, 6.27; H, 0.78; Cl, 49.41; P, 5.39; Found: N, 5.99; C, 6.03; H, 0.58; Cl, 48.95, P, 5.31.

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REFERENCES

- Görge, A.; Dehnicke, K. *Z. Naturforsch.* 1988, 43b, 677.
Görge, A. Ph.D. Dissertation, Philipps-Universität, Marburg, Germany (1989)
- Frankenau, A.; Dehnicke, K. *Z. Naturforsch.* 1989, 44b, 493.
- Görge, A.; Patt-Siebel, U.; Müller, U.; Dehnicke, K. *Z. Naturforsch.* 1988, 43b, 1633.
- Görge, A.; Patt-Siebel, U.; Müller, U.; Dehnicke, K. *Z. Naturforsch.* 1989, 44b, 903.
- Gebeyehu, Z. *The Journal of the Alabalma Academy of Science*, 1997, 67, 243.
- Dehnicke, K.; Strahle, J. *Polyhedron*, 1989, 8, 707.
- Müller, U.; Patt-Siebel, U.; Khabou, K.; Dehnicke, K. *Chem. Ztg.* 1987, 111, 371.
- Mronga, N.; Weller, F.; Dehnicke, K. *Z. anorg. allg. chem.* 1983, 502, 35.
- Sellmann, D.; Keller, J.; Moll, M.; Beck, H.; Milius, W. *Z. Naturforsch.* 1986, 41b, 1551.
- Hösler, K.; Weller, F.; Dehnicke, K. *Z. Naturforsch.* 1987, 42b, 1563.
- Schmidt, I.; Kynast, U.; Hanich, J.; Dehnicke, K. *Z. Naturforsch.* 1984, 39b, 1248.
- Weidlein, J.; Müller, U.; Dehnicke, K. *Schwingungsspektroskopie*, 2. Aufl. G. Thieme-Verlag: Stuttgart, New York, 1988.
- Betzler, H.; Strahle, J. *Z. Naturforsch.* 1979, 34b, 1199.

Reaction

14. Roesky, H.W.; Katti, K.V.; Seseke, U.; Scholz, U.; Herbst, R.; Egert, E.; Sheldrick, G.M. *Z. Naturforsch.* 1986, *41b*, 1509.
15. Dilworth, J.R.; Neaves, B.D.; Hutchinson, J.P.; Zubieta, J.A. *Inorg. Chim. Acta.* 1982, *65*, L 223.
16. Phillips, F.L.; Skapski, A.C. *J. Chem. Soc. Dalton Trans.* 1976, 1448.
17. Close, M.R.; McCarley, R.E. *Inorg. Chem.* 1994, *33*, 4198
18. Dehnicke, K.; Kolitsch, W. *Z. Naturforsch.* 1977, *32b*, 1485
19. Griffith, W. P.; Pawson, D. *J. Chem. Soc. Dalton Trans.* 1973, 1315.

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Notes

INSTRUCTIONS TO AUTHORS

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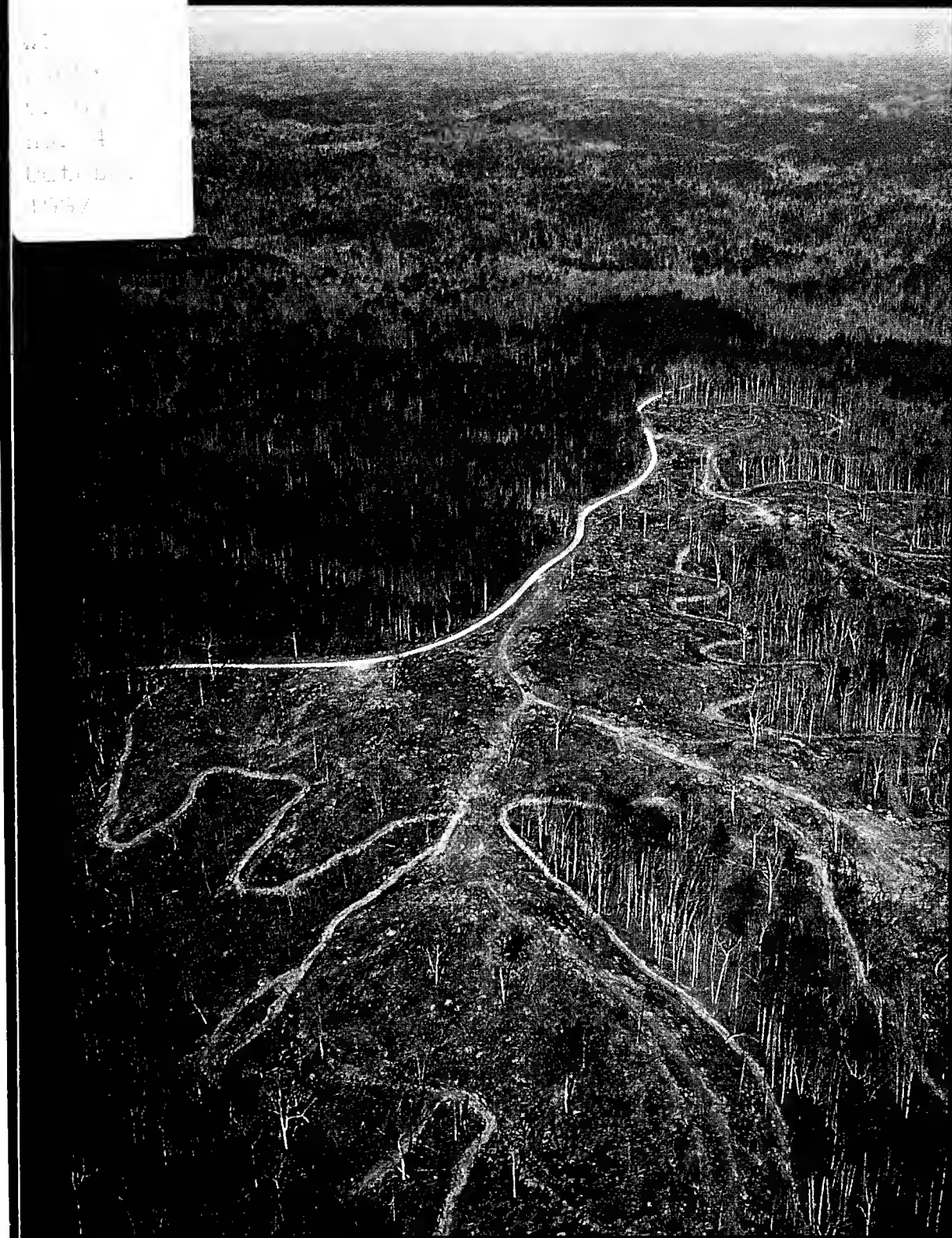
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COVER PHOTOGRAPH: Aerial view of a recently cut hardwood stand in the Bankhead National Forest, provided by Geoffrey Hill. When cut areas are replanted in loblolly pine (*Pinus taeda*) this type of forest disturbance and conversion has a major impact on breeding birds. Photo by Charles Seifried.

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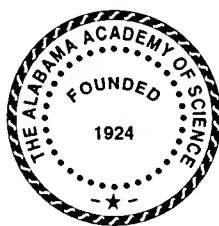
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PHYSIOLOGICAL RESPONSES OF *AZOLLA CAROLINIANA* WILLD. TO POLYLACTIC ACID

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ABSTRACT

Azolla caroliniana Willd. growth, chlorophyll, carotenoid and anthocyanin concentrations and carbohydrate accumulation were evaluated at different concentrations of the polymer L-lactic acid (0.0, 0.01, 0.1, and 1.0 $\mu\text{g/l}$). Plants were grown for ten days in a growth chamber at 25 ± 1 °C (day/night), day length of 14 h and photosynthetic photon fluxdensity of $220 \mu\text{mol m}^{-2} \text{s}^{-1}$. Growth was greatest in the presence of polylactic acid, with the highest significant dry weight increase (41.4%) at 1 $\mu\text{g/L}$, followed by a 34.5% increase of 0.1 $\mu\text{g/l}$. Polylactic acid also increased chlorophyll *a* and *b* concentrations. Similar results were obtained for carotenoids. On the other hand, anthocyanin concentration was unaffected by the different concentrations of polylactic acid. Starch, soluble sugar and total nonstructural carbohydrates (TNC) also were not influenced by polylactic acid presence in the growth media.

INTRODUCTION

The earliest recorded use of lactic acid as a plant growth regulator was in 1924 when callus formation from carrot slices exposed to lactic acid was observed (Blumenthal and Meyer, 1924). Polymers of lactic acid were reported to promote growth in a variety of plants and unicellular algae (Kinnersley, 1993). In earlier studies Kinnersley and coworkers (1990) found that 1000 $\mu\text{g/l}$ of the polymer L-lactic acid significantly increased plant biomass in duckweed (*Lemna minor*) and corn (*Zea mays*) along with an accompanying increase in chlorophyll accumulation and root growth. In an other study, it was reported that adding 100 $\mu\text{g/l}$ of polylactic acid to the medium containing reduced amounts of nutrients produced significant growth increase in duckweed (Kinnersley *et al.*, 1989). This study showed that such polymers not only enhance growth, but also reduced the amount of nutrients required for growth.

Lactic acid was described by Lipinsky and Sinclair (1986) as a "sleeping giant" waiting to be awakened. The above statement is supported by the fact that lactic acid has been shown to have a significant positive influence on growth and development of those plant species examined (Kinnersley *et al.*, 1989; Young, 1989; Kinnersley *et al.*, 1990; Kinnersley, 1993). However, more information is needed to evaluate the role of lactic acid as a plant growth regulator.

In this investigation, the influence of the polymer L-lactic acid within a concentration range of 0.01 to 1.0 $\mu\text{g/l}$ on *Azolla* growth, chlorophyll, carotenoid and anthocyanin content and carbohydrate accumulation was evaluated.

MATERIALS AND METHODS

Cultures of *Azolla caroliniana* were grown in a modified Hoagland solution (Hoagland and Arnon, 1938), diluted 1:40 (Sela *et al.*, 1989) at pH 6.0. The plants were placed in a growth chamber with a 14 h photoperiod and 220 $\mu\text{mol m}^{-2} \text{s}^{-1}$ photosynthetic photon flux density and constant day/night temperatures of $25 \pm 1^\circ\text{C}$. Twenty randomly selected plants from the stock culture were placed in 250 ml Erlenmeyer flasks (ten flasks per treatment) containing 125 ml of diluted Hoagland's solution with dissolved polymer L-lactic acid concentrations of 0, 0.01, 0.10, and 1.0 $\mu\text{g/l}$. Plants were grown for 10 days under these conditions. On the last day of treatment application, the plants from five randomly selected flasks of each treatment were used for dry weight and nonstructural carbohydrates measurements. The plants in the remaining five flasks of each treatment were used for chlorophyll a and b, carotenoid and anthocyanin determinations.

Dry weight

Samples were oven dried for 48 h at 70°C and then the dry weight was recorded. The plant samples were then stored at -20°C for subsequent carbohydrate determinations.

Chlorophyll/carotenoid content

A plant sample of 0.10 g fresh weight was placed in separate 10 ml vial (5 per treatment) containing 5 ml of N,N-Dimethylformamide (DMF). The samples were stored in the dark at 4°C for 36 hours. Chlorophyll a and b content was determined spectrophotometrically by the method of Inskeep and Bloom (1985). Extractable carotenoid was determined spectrophotometrically from the N,N-DMF extraction and the total carotenoid concentration was calculated using the formula of Doong and coworkers (1993).

Anthocyanin content

Samples of 0.10 g fresh weight were homogenized in 5 ml of methanol containing 1% HCl (v/v). Homogenates were then filtered and anthocyanin content was determined spectrophotometrically by the method of Mancinelli (1990).

Carbohydrate Determination

Carbohydrate analysis of the plant samples was conducted following procedure slightly modified of Chatterton and coworkers (1987). The samples were ground into a fine powder and a 100-500 mg portion was placed in a sealed vial and used for the determination of soluble sugars, starch, and total nonstructural carbohydrates (TNC) as reported in detail by Gardner and Al-Hamdani (1997) and Wilson and Al-Hamdani (1997).

Statistical analysis

This experiment was replicated twice and statistically analyzed as a randomized complete block design (Steel and Torrie, 1980). This design ensured that observed differences in plant performances were largely due to treatments rather than variation among blocks (replicate series conducted at different times). Differences between treatment means were computed on the basis of the least significant difference (LSD) test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

After *Azolla* was grown for ten days in media containing different polylactic acid concentrations, the greatest significant growth increase of 41.4% was obtained on a concentration of 1 $\mu\text{g/l}$ followed by a 34.5% dry weight increase at 0.1 $\mu\text{g/l}$ (Table 1). Young (1989) reported that application of 0.001 $\mu\text{M/l}$ polylactic acid to tomato (*Lycopersicon esculentum*) plants resulted in an increase in fruit and vegetative growth. Kinnersley (1993) found that a significant increase in duckweed (*Lemna minor*) growth was obtained when 1 mg/l of polylactic acid was added to the growth medium. In the present study, we examined in several experiments the influence of additional polylactic acid concentrations (10, 25, 50, 100, 250, 500, and 1000 $\mu\text{g/l}$) on *Azolla* growth (data not shown). The results of these experiments indicated that concentrations of 10-100 $\mu\text{g/l}$ had no significant effect on *Azolla* growth whereas concentration of 250 $\mu\text{g/l}$ and above exhibited toxicity and caused the plants to senesce.

Chlorophyll *a* and *b* concentrations increased in the presence of polylactic acid in the growth media (Table 2). However, significant increases were only obtained for plants grown in 1.0 $\mu\text{g/l}$. Similar results were obtained for carotenoids concentration (Table 2). It was reported that polylactic acid caused a significant increase in chlorophyll concentration of duckweed and corn (Kinnersley *et al.*, 1990). Anthocyanin concentrations were not significantly affected by the different concentrations of polylactic acid concentration (Table 2).

The mechanism of action of polylactic acid is not unknown. However, significant increases in plant growth and chlorophyll concentration could be due to the possibility that polylactic acid enhances plant nutrient assimilation or utilization. Kinnersley and coworkers (1990) observed that polylactic acid increased duckweed growth in a reduced nutrient media.

The different concentrations of polylactic acid had no significant effect on soluble sugars, starch, and total nonstructural carbohydrate concentration (Table 3). However, because plant growth was increased in the presence of polylactic acid (Table 1), more carbohydrates may have been utilized by these plants to support this additional growth observed in comparison to control plants.

The *Azolla-Anabaena* association has been used as an important source of green manure for rice (*Sativa oriza* L.) in China and other Far East countries (Moor, 1969; Lumpkin and Plucknett, 1980). Polylactic acid application in concentrations of 0.1 and 1.0 $\mu\text{g/l}$ may be useful to enhance *Azolla* growth and possibly increase nitrogen availability for rice crops. On the other hand, *Azolla* is frequently considered a weed in many areas. Thus application of 250 $\mu\text{g/l}$ of polylactic acid can possibly provide a biodegradable and

environmentally safe way of limiting its growth. Lipinski and Sinclair (1986) reported that polylactic acid is biodegradable and bioenvironmentally compatible and degrades back to safe natural harmless products.

Table 1 Effects of different polylactic acid (PLA) concentrations ($\mu\text{g}/1$) on *Azolla caroliniana* growth

PLA conc.	Plant-Dry wt. (mg)
0.00	29.0a
0.01	31.0ab
0.10	39.0bc
1.00	41.0c

NOTE: Means followed by the same letter in each column are not significantly different based on the LSD test ($P=0.05$).

The numbers represent the means of two replicates with a total of ten observations for each treatment.

Table 2 Effects of different polylactic acid (PLA) concentrations ($\mu\text{g}/1$) on chlorophyll, carotenoid and anthocyanin concentrations in *Azolla caroliniana*

PLA conc.	Chl a [‡] -----($\mu\text{g}/\text{g}$)	Chl b (fresh weight)	Carotenoid -----	Anthocyanin
0.00	8630.0a	5060.0a	79.5a	3.4a
0.01	9080.0ab	5330.0ab	88.5ab	3.2a
0.10	9200.0ab	5430.0ab	89.0ab	3.4a
1.00	9920.0b	6190.0b	115.5b	4.8a

[‡] Chl a, Chl b represents chlorophyll a and chlorophyll b respectively.

NOTE: Means followed by the same letter in each column are not significantly different based on the LSD test ($P=0.05$).

The numbers represent the means of two replicates with a total of ten observations for each treatment.

Azolla caroliniana Willd.

Table 3 Effects of different polylactic acid (PLA) concentrations ($\mu\text{g/l}$) on carbohydrate concentration in *Azolla caroliniana*

PLA conc.	Soluble sugar	Starch	TNC
	-----($\mu\text{g/g}$	dry wt.)-----	
0.00	25.8	170.7	247.4
0.01	28.1	140.1	232.4
0.10	28.1	145.0	232.4
1.00	31.4	149.1	238.2

TNC = Total nonstructural carbohydrates.

NOTE: Means in each column are not significantly different based on the LSD test ($P=0.05$).

The numbers represent the means of two replicates with a total of ten observations for each treatment.

LITERATURE CITED

- Blumenthal, F. and Meyer, P. 1924. Uber durch acidum lacticum erzeugte tumoren auf mohrrubenscheiben. *Z. F. Kregsg.* 21:250-252.
- Chatterton, N. J., Harrison, P. A., Bennett, J. H. and Thornley, W. R. 1987. Fructan, starch and sucrose concentrations in crested wheatgrass and redtop as affected by temperature. *Plant Physiol. Biochem.* 25:617-623.
- Doong, R. L., MacDonald, G. E. and Shilling, D. G. 1993. Effect of fluridone on chlorophyll, carotenoid and anthocyanin content of Hydrilla. *J. Aquat. Plant Manage.* 31:55-59.
- Gardner, J. L. and S. H. Al-Hamdani. 1997. Interactive effects of aluminum and humic substances on salvinia. *J. Aquat. Plant Manage.* 35:30-34.
- Hoagland, D. R., and Arnon, D. I. 1938. The water-culture method for growing plants without soil. *Univ. Calif., Agri. Exp. Stn. Cir. No. 347*, PP. 1-32.
- Inskeep, W. P., and Bloom, P. R. 1985. Extinction coefficients of chlorophyll and \underline{b} in N, N dimethylformamide and 80% acetone. *Plant Physiol.* 77:483-485.
- Kinnersley, A. M., Scott, T. C. III, Yopp, J. H., and Whitten, G. H. 1989. Method for regulating plant growth. *U.S. Patent 4813997. U.S. Patent and Trademark Office, Washington, D.C.*
- Kinnersley, A.M., Scott, T.C. III, Yopp, J.H., and Whitten, G.H. 1990. Promotion of plant growth by polymers of lactic acid. *Plant Growth Regul.* 9:137-146.

- Kinnersley, A. M. 1993. The role of phytochelates in plant growth and productivity. *Plant Growth Regul.* 12:207-218.
- Lipinsky, E. S. and Sinclair, R.G. 1986. Is lactic acid a commodity chemical? *Chem. Eng. Prog.* 82:26-32.
- Lumpkin, T. A. and Plucknett, D. L. 1980. Azolla: botany, physiology and use a green manure. *Econ. Bot.* 34:111-153.
- Mancinelli, A. L. 1990. Interaction between light quality and light quantity in the photoregulation of anthocyanin production. *Plant Physiol.* 92:1191-1195.
- Moor, A. W. 1969. Azolla: biology and agronomic significance. *Bot. Rev.* 35:17-35.
- Sela, M. Garty, J. and Tel-Or, E. 1989. The accumulation and the effect of heavy metals on the water fern *Azolla folliculitis*. *New Phytol.* 112:7-12.
- Steel, R.G.D. and Torrie, J.D. 1980. Principles and procedures of statistics: a biometrical approach. 2nd edition, McGraw-Hill, New York, NY, pp.196.
- Wilson, J. G., and S. H. Al-Hamdani. 1997. Effects of Cr (VI) and humic substances on selected physiological responses of *Azolla caroliniana*. *Am. Fern J.* 87(1):17-27
- Young, Donald C. 1989. Methods for regulating the growth of plants and growth regulant compositions. U.S. Patent 4,863,506. U.S. Patent and Trademark Office, Washington, D.C.

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THE EFFECTS ON BIRD COMMUNITIES OF CONVERTING SOUTHERN
HARDWOOD FORESTS TO PINE PLANTATIONS

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ABSTRACT

Large areas of hardwood forest in the southeastern U.S. are being converted to even-aged stands of loblolly pine. The effect of this habitat alteration on communities of breeding birds in the southern Appalachian region has not been adequately studied. I compared birds present in three ridge top forest types in Bankhead National Forest, Alabama: (1) second-growth hardwood forest, (2) established loblolly pine stands with trees 20 - 30 years old, and (3) plots recently cut and replanted in loblolly pine (regeneration plots). Censuses were conducted in June when only breeding birds were present. I found more individual birds and a greater number of bird species in hardwood sites compared to either regeneration sites or established loblolly sites. There was little overlap in species between the three forest types, and virtually none of the species typical of southern hardwood forests were found in stands of loblolly pine. The impacts on forest bird communities of converting hardwood forests to pine plantations need to be considered when formulating management plans for southern forests.

INTRODUCTION

Over large areas of the southeastern U. S., native forests have been and are being replaced with monocultures of loblolly pine (*Pinus taeda*) planted in stands of uniform age (Alig et al. 1990, McWilliams 1992). Over the next fifty years, the area in pine plantation in the south is projected to increase by over 20 million acres (Alig et al. 1990). Much of this gain in pine plantation will come at the expense of native pine forests and reclaimed agricultural and grazing land, but hardwood forest acreage in the south is projected to decrease by ten percent over then next fifty years (Alig et al. 1990). Much of the conversion of hardwood forest to pine plantation in the south will occur in the southern Appalachian Region.

Conversion of hardwood to pine has many obvious effects on the gross structure and appearance of a forest (Felix et al. 1983). The effects on breeding birds of conversion from

Forest Management and Bird Communities

hardwood to pine and of the maturation of pine plantations have been documented in several studies in the Piedmont, Central Appalachian, and Coastal Plain (Noble and Hamilton 1975, Meyers and Johnson 1978, Conner et al. 1979, Crawford et al. 1981, Childers et al. 1986). Despite the large areas of the Southern Appalachian Region that have been and will be affected by conversion from hardwood forest to pine plantation, no studies have quantified the effects on breeding birds of converting hardwood forest to loblolly pine forest in this region.

The Bankhead National Forest lies primarily in the Black Warrior Mountains at the southwestern edge of the Appalachian Plateau in north-central Alabama. The native vegetation of the region is characterized by southern hardwood forests dominated by American beech (*Fagus grandifolia*) and white oak (*Quercus alba*) in the valleys and by southern red oak (*Q. falcata*), white oak, and hickory (*Carya spp.*) on slopes and ridgetops (Harper 1943, Wills 1995). American chestnut (*Castanea dentata*) once was the dominant tree from stream valleys to ridge tops throughout the region but was eliminated almost entirely by chestnut blight in the early part of this century (Harper 1943, Wills 1995). Before European settlement, pine (*Pinus spp.*) comprised from 4% to 18% of trees in the region, with the highest proportion on dry upper slopes and lowest proportion in stream valleys (Wills 1995).

Although deciduous trees dominated the native forests of the Bankhead National Forest (Wills 1995), the USDA Forest Service has adopted a policy under which some hardwood forests are being cut and replanted with loblolly pine (USDA Forest Service 1986). Approximately 55% of the forested area of Bankhead National Forest (excluding the Sipsey Wilderness) is currently classified as pine and more acreage is slated for conversion (USDA Forest Service 1986). Conversion of native forests to pine plantations has been most extensive on ridge tops; of the 128,155 acres in Bankhead National Forest on which timber may be managed (primarily upland sites), 69% is planted pine (U. S. Forest Service 1986). In this study, I compared the presence of both breeding and transient birds among three ridge top forest types in Bankhead National Forest: (1) second-growth hardwood forest approximately 50 years old, (2) stands of planted pines 3 - 5 years old, and (3) pine plantation with trees > 20 years old.

METHODS

This study focused on upland sites (upper slope, bluffline, and ridge top; Wills 1995) in the Bankhead National Forest, Alabama north of Highway 278 (north of 340 10'). No counts were conducted in stream valleys (i. e. in drain bottoms, lower slopes, or middle slopes; Wills 1995). I surveyed three predominant forest habitat types of this region: (1) second-growth oak-hickory woodland, hereafter referred to as "hardwood sites". To be selected, these sites had to have been largely undisturbed for 50 years (as determined from U. S. Forest Service compartment maps) and have less than 10% pine (as estimated from visual assessment). (2) Plots of planted loblolly pine at least 20 years old (as determined from U. S. Forest Service compartment maps), hereafter referred to a "pine sites". To be included as a pine site, a stand had to have no large hardwood trees although most had a

dense hardwood midstory to about 3 m. No pine sites had trees older than 26 years (as determined by USDA compartmental maps). (3) Areas recently cut and replanted with either Virginia (*P. virginiana*) or loblolly pine, hereafter referred to as "regeneration sites". Only plots with young pines 1 - 3 m tall (3 - 5 years post-cut) were included.

The purpose of this study was to characterize bird use of the predominant forest habitats in the region. It was not possible to compare same-age hardwood and loblolly pine forests and thus avoid the confounding effect of stand age. Loblolly pine sites have been maintained on a 25-year harvest rotation (USDA Forest Service 1986), and there are few hardwood stands less than fifty years old. Thus, young hardwood stands and old pine stands simply do not occur in the area covered by the study.

Thirty plots in each habitat type were selected by systematically searching Forest Service roads from a car with the windows rolled up and a radio playing so no bird sounds could be heard. In this way, site selection was not biased by preconceptions of bird activity. To be suitable, a habitat patch had to be at least 200m in diameter and at least 1 km from any other sampling point of the same habitat type. When a suitable patch of habitat was located, I stopped the car at least 100 m from the nearest edge of the patch and walked 70 m into the patch perpendicular to the road. When I reached the 70-m point, the count began and it lasted for 10 minutes. During a point-count period, all birds heard or seen within 50 m were recorded.

I conducted point counts between 8 and 17 June 1995, at least two weeks after the last passerine migrants had passed through the area (Imhof 1976). All birds counted during this period were assumed to be potential breeders. All counts were conducted during the first five hours of daylight, and counts in all habitat types were uniformly distributed through the morning hours (ANOVA comparing sampling time among habitat types: $F = 1.37$, $df = 2, 87$, $P = 0.26$).

I compared habitat types by mean number of individual birds recorded and by mean number of bird species recorded using a one-way ANOVA. (Parametric statistics were used because both number of total individuals and number of species were approximately normally distributed across points and the variances of total individuals and species were similar among sites). When a significant difference among habitats was indicated by the ANOVA, I determined which particular habitat types differed significantly using a Scheffe's Test. For each species observed during fifteen or more point counts during the June 1995 sampling, I also compared whether the distribution of observations across habitats differed from that expected by chance using a chi square contingency table. By using only species observed fifteen or more times, the expected value of all cells in the chi squared test was five or greater, as is required for the analysis to be valid (Abacus Concepts 1992). In this way, I looked at the effects of timber management on community-level processes such as mean number of species, as well as on specific species.

RESULTS

The mean number of individuals and the mean number of species differed markedly among habitat types (individuals: $F = 6.93$, $df = 2, 87$, $P = 0.002$; species: $F = 10.89$, $df = 2, 87$, $P = 0.0001$; Table 1). Although regeneration sites had the highest cumulative species total for the thirty sampling sites, when means were compared across sites, hardwood sites had significantly higher mean individuals and significantly higher mean number of species than either regeneration or pine sites ($P < 0.05$). Regeneration and pine sites did not differ significantly in either mean number of individuals or mean number of species ($P > 0.05$).

Many species differed significantly in occurrence among habitat types. Pileated woodpeckers, Red-bellied Woodpeckers, Red-eyed Vireos, Scarlet Tanagers, Worm-eating Warblers, and Yellow-billed Cuckoos occurred at significantly higher frequency in hardwood sites than in either regeneration or pine sites (Table 2; Fig. 1; Scientific names of all bird species recorded in this study are given in Table 2). Acadian Flycatchers, Black-and-white Warblers, Hooded Warblers, Northern Parulas, Ovenbirds, and Yellow-throated Vireos were observed exclusively in hardwood sites (Table 2), but they were recorded too few times during June counts for statistical comparison of frequency of occurrence.

Most species that occurred in pine sites also occurred in regeneration sites with the exception of the Pine Warbler, which occurred exclusively in pine sites (Table 2, Fig. 1). Kentucky Warblers and Carolina Wrens also were found more frequently in pine sites than in other habitats, and Northern Cardinals occurred in regeneration and pine sites at about equal frequency. Common Yellowthroats, Indigo Buntings, Prairie Warblers, Rufous-sided Towhees, Yellow-breasted Chats, and White-eyed Vireos occurred at higher frequency in regeneration than pine sites and were completely absent from hardwood sites (Table 2, Fig. 1). American Crows, Blue-gray Gnatcatchers, Carolina Chickadees, Eastern Wood-pewees, and Summer Tanagers were generalists relative to the three habitat types sampled and did not differ in frequency of occurrence among habitat types (Table 2).

Table 1. Mean (\pm standard deviation) total individual and number of species for 30 point counts conducted in each of three forest types in the Bankhead National Forest in June 1995.

Forest Types	Total Individuals	Number of Species
Hardwood	10.46 \pm 3.38	7.97 \pm 2.40
Pine	7.50 \pm 3.56	2.01 \pm 5.53
Regeneration	8.83 \pm 2.13	6.30 \pm 1.73

Hill

Table 2. Number of point counts out of 30 at which species were encountered in three forest types in Bankhead National Forest, Alabama in June 1995.

CommonName ^a	Scientific Name ^a	Hardwood	Pine	Regener- ation	χ^2	pb
Acadian Flycatcher	<i>Empidonax virescens</i>	13	0	0	30.39	0.0001
American Crow	<i>Corvus brachyrhynchos</i>	7	2	5	3.21	0.20
American Goldfinch	<i>Carduelis tristis</i>	0	3	0	----	----
American Robin	<i>Turdus migratorius</i>	0	0	3	----	----
Black-and-white Warbler	<i>Mniotilta varia</i>	3	0	0	----	----
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	4	3	9	4.71	0.09
Brown-headed Cowbird	<i>Molothrus ater</i>	0	1	9	20.00	0.0001
Blue Jay	<i>Cyanocitta cristata</i>	5	1	1	----	----
Brown Thrasher	<i>Toxostoma rufum</i>	0	0	1	----	----
Broad-winged Hawk	<i>Buteo platypterus</i>	3	1	0	----	----
Blue-winged Warbler	<i>Vermivora pinus</i>	0	1	0	----	----
Carolina Chickadee	<i>Parus carolinensis</i>	7	9	4	2.44	0.29
Carolina Wren	<i>Thryothorus ludovicianus</i>	9	12	3	7.16	0.03
Common Yellowthroat	<i>Geothlypis trichas</i>	0	4	7	7.66	0.02
Downy Woodpecker	<i>Picoides pubescens</i>	5	0	2	----	----
Eastern Phoebe	<i>Sayornis phoebe</i>	1	0	0	----	----
Eastern Wood-pewee	<i>Contopus virens</i>	3	6	1	4.28	0.12
Field Sparrow	<i>Spizella pusilla</i>	0	1	10	18.85	0.0001
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	6	3	0	----	----
Hairy Woodpecker	<i>Picoides villosus</i>	2	2	0	----	----
Hooded Warbler	<i>Wilsonia citrina</i>	3	0	0	----	----
Indigo Bunting	<i>Passerina cyanea</i>	0	17	28	53.07	0.0001

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Kentucky Warbler	<i>Oporornis formosus</i>	3	6	0	----	----
Mourning Dove	<i>Zenaida macroura</i>	0	1	3	----	----
Northern Bobwhite	<i>Colinus virginianus</i>	0	2	4	----	----
Northern Cardinal	<i>Cardinalis cardinalis</i>	2	11	14	12.38	0.002
Northern Flicker	<i>Colaptes auratus</i>	0	1	0	----	----
Northern Parula	<i>Parula americana</i>	3	0	0	----	----
Ovenbird	<i>Seiurus aurocapillus</i>	5	0	0	----	----
Pine Warbler	<i>Dendroica pinus</i>	0	25	0	69.23	0.0001
Pileated Woodpecker	<i>Dryocopus pileatus</i>	16	0	1	34.96	0.0001
Prairie Warbler	<i>Dendroica discolor</i>	0	11	28	54.03	0.0001
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>	16	0	0	39.92	0.0001
Red-eyed Vireo	<i>Vireo olivaceus</i>	29	3	0	74.00	0.0001
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	0	1	0	----	----
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>	0	4	10	12.86	0.002
Scarlet Tanager	<i>Piranga olivacea</i>	23	0	0	61.79	0.0001
Summer Tanager	<i>Piranga rubra</i>	3	6	3	1.73	0.42
Tufted Titmouse	<i>Parus bicolor</i>	10	2	0	16.51	0.0003
White-eyed Vireo	<i>Vireo griseus</i>	0	3	16	28.95	0.0001
Wild Turkey	<i>Meleagris gallopavo</i>	0	1	0	----	----
Worm-eating Warbler	<i>Helmitheros vermivorus</i>	17	0	0	41.92	0.0001
Wood Thrush	<i>Hylocichla mustelina</i>	1	0	0	----	----
Yellow-breasted Chat	<i>Icteria virens</i>	0	20	30	63.00	0.0001
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	26	2	0	65.12	0.0001
Yellow-throated Vireo	<i>Vireo flavifrons</i>	3	0	0	----	----

^a Common and scientific names follow American Ornithologists' Union (1983).

^bProbability that distribution among habitat types differed from random; species detected ten or more times only.

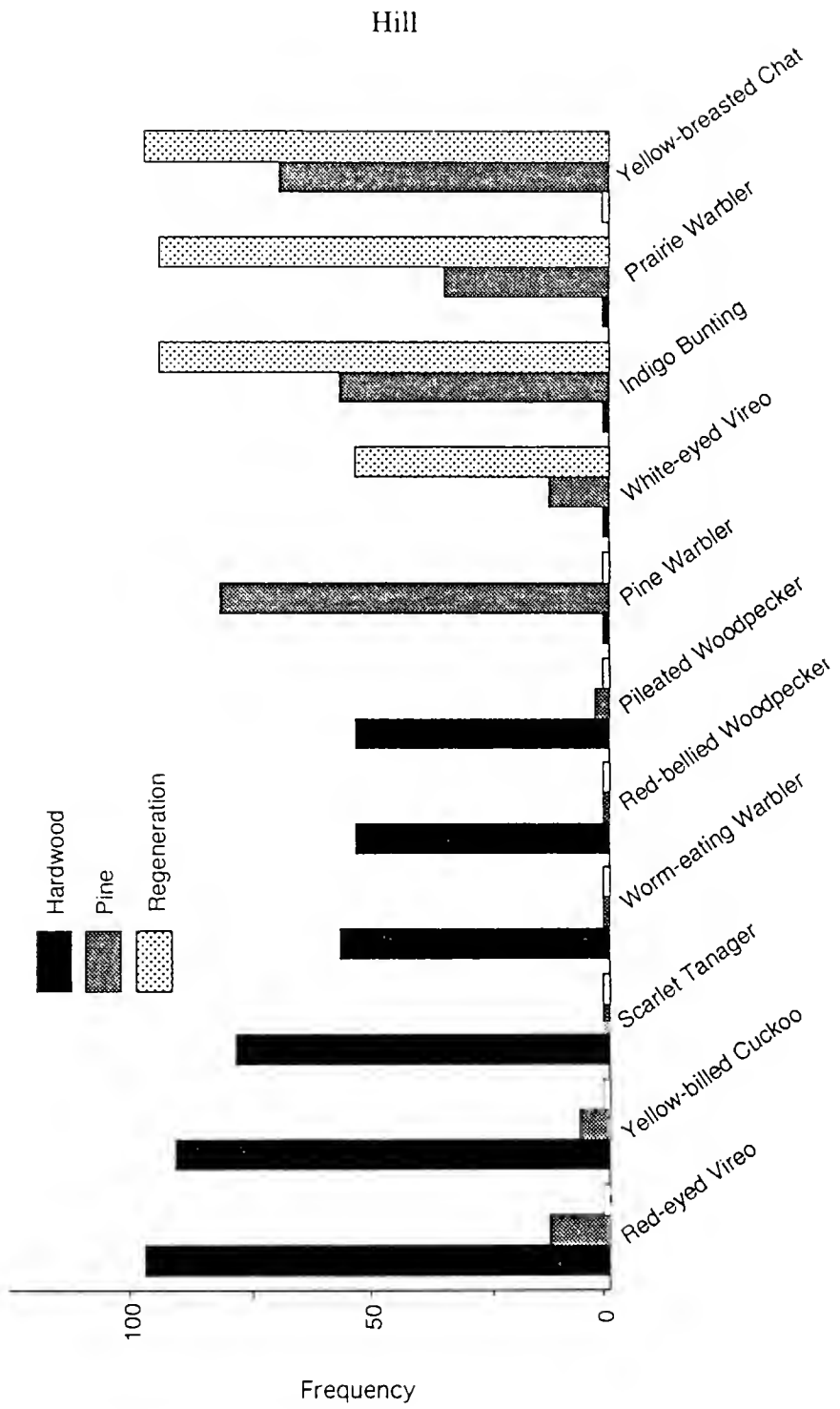


Figure 1. Frequency of occurrence of bird species during 30 point counts in each of three habitat types in the Bankhead National Forest, June 1995. Only species recorded during 50% or more of counts in at least one habitat type are included. Short bars (ending at zero) indicate that the species was not recorded in that habitat type.

DISCUSSION

Hardwood sites, which were areas covered in relatively mature, second-growth hardwood forest, had on average more individuals and more species of birds than either recently planted or established pine sites. Reduced abundance and diversity of breeding birds when forests are converted from hardwood to pine plantation also has been observed in other parts of the southeastern U. S. (Noble and Hamilton 1975, Meyers and Johnson 1978, Conner et al. 1979, Crawford et al. 1981, Childers et al. 1986). Moreover, the bird species composition of hardwood sites was very different than that of both regeneration and pine sites. Of the 24 species recorded three or more times in hardwood sites, nine were not recorded in either regeneration or pine sites. Of the 17 species recorded three or more times in regeneration sites, 11 were not recorded in hardwood sites. These observations suggest that as stands of loblolly pine mature they are not re-colonized by species typical of native hardwood forests. Rather, as pine stands grow older, breeding species that prefer recently disturbed habitats decline and only a few species such as Pine Warblers and Northern Cardinals move into the areas.

The Bankhead National Forest lies in the Cumberland Plateau Ecological Unit, as defined by the USFWS (Hunter et al. 1993a). Under the Partners in Flight Species Prioritization Scheme, species are grouped according to their concern scores as "extremely high concern", "very high concern", "high concern", "moderate concern", and "low concern" (Hunter et al. 1993b). Ten Neotropical migrants with very high concern scores were recorded in point counts (based on unpublished concern scores for the Cumberland Plateau Ecological Unit supplied by W. C. Hunter). Wood Thrushes were observed only once, so no meaningful assessment of habitat requirements of this species could be made. Two of the species on the list, Prairie Warbler and Field Sparrows, benefit from conversion of forest stands to regeneration plots. Field sparrows were recorded significantly more frequently in regeneration sites than in pine sites or hardwood sites. Prairie Warblers were recorded in 93% of regeneration sites and 37% of pine sites but were not recorded in hardwood sites. Two species on the list of very high concern, Summer Tanager and Eastern Wood-pewees, occurred at about the same frequency in all three habitat types and are not obviously affected by the conversion of hardwoods to pines. Five species listed as being of very high concern, Acadian Flycatcher, Hooded Warbler, Ovenbird, Worm-eating Warbler, and Yellow-throated Vireo, were found almost exclusively in hardwood sites and were detrimentally affected by the conversion of hardwood forest to pine forest. It is interesting to note that no birds of management concern benefited from conversion of hardwood stands to pine stands. (Regeneration plots could be produced without planting pine).

Throughout the Southeast Region, industrial forestry practices annually generate large blocks of clearcut areas (Aglin et al. 1990) that provide suitable breeding habitat for Prairie Warblers and Field Sparrows (pers. obs.). If these species continue to decline within the region, the declines will have to be attributed to factors other than insufficient breeding habitat. At the same time, most of the large blocks of old secondary growth hardwood forest remaining in southeast are on public land. Therefore, in considering the costs and benefits of various forest management plans relative to impacts on breeding bird communities, priority

should be given to species that are dependent on unique features of the land area in question.

Because the remaining ridge-top hardwood habitats in the Bankhead National Forest are under greatest threat of being cut and replanted in pines (U. S. Forest Service 1986), this study focused on ridge-top forest habitat and purposely excluded riparian habitats. Riparian habitats are more generally protected under streamside management plans (U. S. Forest Service 1986). In the central Appalachian Mountains, Murray & Stauffer (1995) found no difference in mean number of bird species or total bird abundance between riparian and upland habitats but did find shifts in the species compositions of bird communities. In particular, Acadian Flycatchers and Louisiana Waterthrushes (*Seiurus motacilla*) were found primarily in riparian corridors and Worm-eating Warblers and Scarlet Tanagers were most abundant in upland forest. Thus, the conversion of upland hardwood forest to pine plantations can be expected to have a particularly severe impact on species like Worm-eating Warblers and Scarlet Tanagers, and the future of these species, which require large blocks of mature upland hardwood forest (Robbins et al. 1989, Wenny et al. 1993), will likely be determined by how public forest lands are managed.

One unexpected finding in this study was that Kentucky Warblers were found in the established loblolly pine stands. Kentucky Warblers are generally thought to be birds of lush hardwood bottoms with dense herbaceous growth (Hamil 1992, Ehrlich 1988). However, loblolly stands in which Kentucky Warblers were recorded had dense herbaceous ground cover that was structurally similar to the sort of dense herbaceous ground cover of hardwood bottoms.

In conclusion, converting hardwood forest to loblolly or Virginia pine forests in the southern Appalachian Region causes dramatic changes in bird communities. Both the number of individual birds and the mean number of bird species decline when a hardwood forest is cut. Even after 20 to 30 years of recovery, areas that are planted in pines do not regain the numbers of individuals or bird species that were present in hardwood forests before cutting. Many of the birds that are adversely affected by the cutting of hardwood forest are of management concern because of shrinking populations. The impacts on forest bird communities need to be considered when formulating forest management plans for southern hardwood forests.

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LITERATURE CITED

- Abacus Concepts. 1992. Statview. Abacus Concepts, Inc., Berkeley, CA.
- Alig, R. , W. G. Hohenstein, B. C. B. C. Murray, and R. G. Haight. 1990. Changes in Area of Timberland in the United States, 1952-2040 by Ownership, Forest Type, Region, and State. General Report SE-64.1. USDA Forest Service, Southeastern Forest Experimental Station, Ashville, NC.
- American Ornithologists' Union. 1983. Checklist of North American Birds, 6th edition. Allen Press, Lawrence, Kansas.
- Childers, E. L., T. L. Sharik, and C. S. Adkisson. 1986. Effects of loblolly pine plantations on songbird dynamics in the Virginia Piedmont. *J. Wildl. Manage.* 50:406-413.
- Conner, R. N., J. W. Via, and I. D. Prather. 1979. Effects of pine-oak clearcutting on winter and breeding birds in southwestern Virginia. *Wilson Bull.* 91:301-316.
- Crawford, H. S., R. G. Hooper, and R. W. Titterington. 1981. Songbird population response to silviculture practices in central Appalachian hardwoods. *J. Wildl. Manage.* 45:680-692.
- Ehrlich, P. R. 1988. *The birder's handbook: a field guide to the natural history of North American birds.* Simon and Schuster, New York, NY.
- Felix, A. C., T. L. Sharik, B. S. McGinnes, and W. C. Johnson. 1983. Succession in loblolly pine plantations converted from second-growth forest in the Central Piedmont of Virginia. *Am. Midl. Nat.* 110:
- Hamel, P. B. 1992. *The land manager's guide to the birds of the south.* The Nature Conservancy, Chapel Hill, N.C.
- Harper, R. M. 1943. *Forests of Alabama.* Monogr. 10. Geological Survey of Alabama, University, Alabama.
- Hunter, W. C., M. F. Carter, D. N. Pashley, and K. Barker. 1993a. The partners in flight species prioritization scheme. Pages 109-119 in D. M. Finch and P. W. Stangel, editors. *Status and management of Neotropical migratory birds.* USDA Forest Service, General Technical Report RM-229.
- Hunter, W. C., D. N. Pashley, and R. E. F. Escano. 1993b. Neotropical migratory landbird species and their habitats of special concern within the southeast region. Pages 159-171 in D. M. Finch and P. W. Stangel, editors. *Status and management of Neotropical migratory birds.* USDA Forest Service, General Technical Report RM-229.
- Imhof, T. A. 1976. *Alabama birds.* University of Alabama Press, Tuscalusa, Alabama.
- McWilliams, W. H. 1992. *Forest Resources of Alabama.* Resource Bulletin SO-170. U. S. Dept. Agriculture, Southern Forest Experiment Station, New Orleans, Louisiana.
- Meyers, J. M. and A. S. Johnson. 1978. Bird communities associated with succession and management of loblolly-shortleaf pine forests. In *Proceedings of the Workshop: Management of Southern Forests for Nongame Birds.* U. S. Forest Service Gen. Tech. Rep. SE-14, pp. 50 - 65.
- Murray, N. L. and D. F. Stauffer. 1995. Nongame bird use of habitat in central Appalachian riparian forests. *J. Wildl. Manage.* 59:78-88.

Hill

- Noble, R. E. and R. B. Hamilton. 1975. bird populations in even-aged loblolly pine forests of southeastern Louisiana. Proc. Annu. Conf. southeast. Assoc. Game Fish Agencies 29:441-450.
- Robbins, C. S., D. K. Dawson, and B. A. Dowell. 1989. Habitat area requirements of breeding forest birds of the Middle Atlantic States. J. Wildl. Manage. 53 supp. 103:1-34.
- U. S. Forest Service. 1986. Land and resource management plan: National Forests in Alabama. U. S. Dept. Agriculture, Atlanta, Georgia.
- Wenny, D. G., R. L. Clawson, J. Faaborg, and S. L. Sheriff. 1993. Population density, habitat selection and minimum area requirements of three forest interior warblers in central Missouri. Condor 95:968-979.
- Wills, K. 1995. Presettlement forest communities of the Warrior Mountains, Alabama. The Alabama Conservancy, Montgomery, Alabama.

PREVALENCE OF *SARCOCYSTIS* SPP. IN WHITE-TAILED DEER
FROM ALABAMA

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ABSTRACT

Sarcocystis spp. are apicomplexan parasites that have an obligatory two host life cycle. We examined the prevalence of *Sarcocystis* spp. infection in 102 white-tailed deer collected in Alabama from 1989 to 1995. Acid-pepsin digestion of muscle tissue (tongue, heart) and direct histological examination of muscle tissue (tongue, heart, skeletal) were used to detect infection. Seventy-two (71%) of 102 white-deer examined were positive. The muscle tissue selected for examination and method of examination influenced the results. The tongues from white-tailed deer was more likely to contain sarcocysts than were the hearts and acid-pepsin digestion of tissues was superior to histological examination for detecting infections.

INTRODUCTION

Sarcocystis spp. are apicomplexan parasites that have a 2-host life cycle (Dubey et al., 1988; Lindsay et al., 1995). The intermediate host is usually a herbivore or an omnivore, while the definitive host is usually a carnivore or omnivore. The intermediate host becomes infected by ingesting sporocysts in food or water that has been contaminated by the feces of the definitive host which produces the sporocysts. Sporozoites excyst from the sporocyst in the intermediate host's digestive tract, penetrate the intestinal mucosa, and enter the vascular system. The sporozoites penetrate endothelial cells in capillaries in various organs in the body. The sporozoites undergo transformation into schizonts which produce numerous merozoites. These are first-generation merozoites, and they will enter additional endothelial cells and become second-generation schizonts. The second-generation merozoites will enter muscle cells and produce the sarcocyst stage (muscle cyst). The sarcocyst contains merozoites which are cells that divide by endodyogeny (a specialized form of binary fission) and produce bradyzoites. Some species of *Sarcocystis* spp. produce sarcocysts that become large and grossly visible, while others remain microscopic. The bradyzoites are the stages that are infectious for the definitive host. When infected muscle tissue is ingested by an appropriate definitive host, the bradyzoites will penetrate into the lamina propria and develop in host cells. No asexual division occurs and the bradyzoites transform directly into microgamonts (male stages) that produce biflagellated microgametes (sperm-like stage) and macrogamonts (egg-like stage). The microgametes fertilize a macrogamont and an oocyst is produced. The

oocyst sporulates and contains 2 sporocysts each that contain 4 sporozoites. The oocyst wall is usually ruptured as the oocyst is being excreted into the lumen of the intestine. Therefore, sporocysts are usually the stage present in the feces.

Host specificity is usually more strict for the intermediate host than for the definitive host. The structure of the sarcocyst stage is used for diagnosis and for speciation. The structure of the sporocyst in the feces of the definitive host is of little value in determining which species of *Sarcocystis* is present. *Sarcocystis* spp. infections are usually asymptomatic in the intermediate host but if large numbers of sporocysts are ingested by pregnant or young animals clinical disease and death can occur (Dubey et al., 1988; Lindsay et al., 1995). Abortion, wasting, and hemorrhaging of mucosal surfaces are the main signs observed in acute sarcocystosis in the intermediate host. No clinical signs are associated with infection of the definitive host.

White-tailed deer (*Odocoileus virginianus*) are the intermediate hosts for 2 named species of *Sarcocystis*. *Sarcocystis odocoileocanis* produces microscopic sarcocysts that have a 2-3 μm thick sarcocyst wall (Crum et al., 1981). The definitive hosts for *S. odocoileocanis* include dogs (*Canis familiaris*), wolves (*Canis lupus*), coyotes (*Canis latrans*) and gray foxes (*Urocyon cinereoargenteus*) (Crum et al., 1981; Emnett and Huggins, 1982; Emnett, 1986; Lindsay et al., 1988). *Sarcocysts odoi* produces sarcocysts that have a 5-10 μm thick sarcocyst wall (Dubey and Lozier, 1983). The definitive host for *S. odoi* are cats (*Felis catus*) (Dubey and Lozier, 1983).

The present study was conducted to determine the prevalence of *Sarcocystis* infection in hunter-killed white-tailed deer in Alabama.

MATERIALS AND METHODS

Hearts, tongues, and/or skeletal muscle (type unspecified) were collected from 102 hunter killed white-tailed deer in Alabama from 1989 to 1995. Samples came from Chambers (n = 58), Dale (n = 1), Henry (n = 7), Lee (n = 16), Macon (n = 10), Montgomery (n = 1), Monroe (n = 2), Russell (n = 1), Talapoosa (n = 1), and Wilcox (n = 5) counties as part of our on going studies on parasites in Alabama wildlife (Lindsay et al., 1997). Adult and yearling, male and female white-tailed deer were collected by hunters and brought to the Parasitology Section, Department of Pathobiology, College of Veterinary Medicine, Auburn University, Alabama for processing.

Portions of heart, tongue, or skeletal muscle were fixed in 10% (v/v) neutral buffered formalin solution and processed for histological examination after staining with hematoxylin and eosin. Selected hearts and tongues were also examined by acid-pepsin digestion. A 20 g portion of heart or tongue was homogenized in a blender in 100 ml of 0.85% (w/v) NaCl solution (saline) and mixed with 100 ml of acid-pepsin solution (0.5 g NaCl, 0.52 g pepsin, 1.4 ml concentrated HCl, and 98.6 ml of deionized water). This mixture was incubated for 1 hour at 37 C in a water bath. The solution was manually mixed by shaking every 5-10 minutes during the incubation process. After 1 hour, the mixture was filtered through cheese cloth and concentrated by centrifugation. The pellet was resuspended in 5 to 10 ml of saline and a drop (about 30 μl) was examined for bradyzoites using light microscopy.

RESULTS

No grossly visible sarcocysts were observed. Seventy-two (71%) of 102 white-tailed deer were positive by either histologic examination of tissues or by acid-pepsin digestion of tissues. The numbers of sarcocysts in tissues ranged from 1 to >100. Table 1 contains the results of white-tailed deer from individual counties.

Sex was determined for 50 of white-tailed deer examined. Sixty-one percent of males (20 of 33) and 53% of females (9 of 17) were positive. Eighty-three percent (43 of 52) of the white-tailed deer examined with undetermined sex were positive.

The tissue examined and method of examination influenced the demonstration of infection. Histologic examination of 82 hearts indicated that 27 (33%) were infected, while histologic examination of 55 tongues indicated that 44 (80%) were infected. Acid-pepsin digestion indicated that 20 (44%) of 45 hearts were positive and that 17 (85%) of 20 tongues were positive.

DISCUSSION

The overall prevalence of *Sarcocystis* spp. infection in our study was 71%. This is less than the 88% prevalence we have previously observed in white-tailed deer from Alabama (Lindsay et al., 1988). However, in that study we examined histologically both the heart and tongues from 34 white-tailed deer. Thirty (88%) of the tongues were positive, while 13 (38%) of the hearts were positive (Lindsay et al., 1988). In the present study, histologic examination detected infection in 80% of the tongues and 33% of the hearts which is similar to our earlier study. Emnett and Huggins (1982) observed *Sarcocystis* spp. infection histologically in 56 (44%) of 125 white-tailed deer tongues collected in South Dakota. Emnett (1986) found *Sarcocystis* spp. infection histologically in 79 (79%) of 100 white-tailed deer tongues collected from Minnesota. Pond and Speer (1979) found *Sarcocystis* spp. infection histologically in 12 (50%) of 24 muscle samples (heart, esophagus, diaphragm, skeletal muscle) from white-tailed deer collected in Montana. Mahrt and Colwell (1980) found *Sarcocystis* spp. infection histologically in 137 (49%) of 277 muscle samples (thigh, tongue) from white-tailed deer collected in Alberta, Canada. Crum and Prestwood found *Sarcocystis* spp. infection histologically in 199 (51%) of 390 muscle samples (tongue, heart, skeletal muscle, diaphragm, esophagus) collected from white-tailed deer in the southeastern United States.

We did not observe grossly visible sarcocysts in any white-tailed deer. Pond and Speer (1979) and Mahrt and Colwell (1980) have reported grossly visible sarcocysts in white-tailed deer muscles. The structure of these macroscopic sarcocysts has not been determined by light or electron microscopy. Although not described as being grossly visible, the largest *S. odoi* sarcocyst reported by Dubey and Lozier (1983) was 1 mm. This suggests that the macroscopic sarcocysts may be sarcocysts of *S. odoi*. Additionally, cat-transmitted *Sarcocystis* spp. are more likely to become macroscopic than are dog transmitted *Sarcocystis* spp. (Dubey et al., 1988).

In the present study, acid-pepsin digestion of tissue produced a higher number of

positive samples than did histological examination. This is because a larger amount of tissue is examined in the acid-pepsin digestion procedure than by histologic examination of tissues.

Table 1. Prevalence of *Sarcocystis* spp. infection in white-tailed deer from Alabama

County	# Ex/# Pos ¹	Males ²	Females ³	Unknown ⁴
Chambers	58/50	10/9	7/6	41/35
Dale	1/0	1/0	NA ⁵	NA
Henry	7/4	5/2	2/2	NA
Lee	16/10	7/4	NA	9/6
Macon	10/4	6/2	3/1	1/1
Monroe	2/1	NA	1/0	1/1
Montgomery	1/1	1/1	NA	NA
Russell	1/1	1/1	NA	NA
Talapoosa	1/0	1/0	NA	NA
Wilcox	5/1	1/1	4/0	NA
Total	102/72	33/20	17/9	52/43

¹ Number of white-tailed deer examined/number positive.

² Number of males examined/number positive.

³ Number of females examined/number positive.

⁴ Number of animals examined for which the sex was not known/number of these animal that were positive.

⁵ NA = not applicable.

LITERATURE CITED

- Crum, J. M., and A. K. Prestwood. 1982. Prevalence and distribution of *Sarcocystis* spp. among white-tailed deer of the southeastern United States. *Journal of Wildlife Diseases* 18: 195-203.
- Crum, J. M., R. Fayer, and A. K. Prestwood. 1981. *Sarcocystis* spp. in white-tailed deer I. Definitive and intermediate host spectrum with a description of *Sarcocystis odocoileocanis* n. sp. *Journal of Wildlife Diseases* 17: 567-579.
- Dubey, J. P., and S. M. Lozier. 1983. *Sarcocystis* infections in white-tailed deer (*Odocoileus virginianus*) in Montana: Intensity and description of *Sarcocystis odoi* sp. n. *American Journal of Veterinary Research* 44:1738-1743.
- Dubey, J. P., C. A. Speer, and R. Fayer. 1989. *Sarcocystosis of Man and Animals*. CRC Press, Boca Raton, Florida. pp 215.
- Emnett, C. W. 1986. Prevalence of *Sarcocystis* in wolves and white-tailed deer in northeastern Minnesota. *Journal of Wildlife Diseases* 22: 193-195.
- Emnett, C. W., and E. J. Huggins. 1982. *Sarcocystis* of deer in South Dakota. *Journal of Wildlife Diseases* 18: 187-193.

Sarcocystis spp. in White-tailed Deer

- Lindsay, D. S., B. L. Blagburn, W. H. Mason, and J. C. Frandsen. 1988. Prevalence of *Sarcocystis odocoileocanis* from white-tailed deer in Alabama and its attempted transmission to goats. *Journal of Wildlife Diseases* 24: 154-156.
- Lindsay, D. S., B. L. Blagburn, and K. G. Braund. 1995. *Sarcocystis* spp. and sarcocystosis. *Basic and Applied Myology* 5: 249-254.
- Lindsay, D.S., C.A. Sundermann, J. P. Dubey, and B.L. Blagburn. 1997. Update on *Toxoplasma gondii* infections in wildlife and exotic animals from Alabama. *Journal of the Alabama Academy of Science* 68: 246-254.
- Mahrt, J. L., and D. D. Colwell. 1980. *Sarcocystis* in wild ungulates in Alberta. *Journal of Wildlife Diseases* 16: 571-576.
- Pond, D. B., and C. A. Speer. 1979. *Sarcocystis* in free-ranging herbivores on the national bison range. *Journal of Wildlife Diseases* 15: 51-53.

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MINUTES

Alabama Academy of Science
Fall Executive Committee Meeting
Reynolds Historical Library
University of Alabama Birmingham
Birmingham, AL

October 4, 1997

- A. Dr. Ellen Buckner, President of the AAS, called the Fall meeting of the AAS Executive Committee to order at 10:00 a.m. The minutes of the Spring Meeting were discussed and approved.
- B. Officers' Reports
1. Board of Trustees - No formal report was tendered at this time. Dr. Sam Barker reminded everyone that the Alabama Academy of Science will host its 75th Annual meeting in 1998. Five Trustees were present: Sam Barker, Bill Barrett, Ken Marion, Prakesh Harman, and James Wilkes.
2. President - Dr. Ellen Buckner. Presented the following report:
At the request of the University of Alabama in Huntsville, a signed Contract for Professional Services for Mrs. Mary Thomaskutty to serve as Chaperone for the four winners of the Alabama Science and Engineering Fair to attend the International Fair (ISEF). Expenses for the winners were paid by the AAS, then reimbursed by UAH. It is anticipated that this contractual relationship will be required each year.

Sent letters to 1997 meeting participants in which there were identified deficits of author/member or registration requirement. Several removed those deficits; however, all abstracts were published as planned. Letters were then sent asking for reinstatement of membership by payment of 1998 dues. Discussion of this issue was held with Drs. Johnson (Membership Committee Chair) and Boots to encourage Section Chairmen to inform authors and screen titles at time of program preparation.

Appointed committee chairs and committee members. This included discussion with University of Alabama, Dr. Stan Jones, who continues to support publication of the Newsletter. Mrs. Helvi McCall has agreed to edit the Newsletter and Dr.

Tom Jandebeur has agreed to serve as Associate Editor for Electronic Media to update the AAS Home Page and plan other uses of electronic networking. Thank you all who agreed to serve and especially to those who made a special effort to attend this meeting.

Developed, revised, and received estimate of printing costs for a brochure detailing history and current activities of AAS for the 75th Annual Meeting. Distribution after the meeting will be to all members. The cost of printing is estimated at \$1700 for 750 copies with printing to be done by AU printing. Letters requesting sponsorship of this and other special activities of the Annual Meeting were sent to nine potential/past sponsors in the Mobile area.

Corresponded with Dr. Jim Bradley regarding announcement of the Special Issue of the AAS to the ASTA Newsletter (available upon request).

Sent Visiting Scientist Directories to Dr. Asouzu and Dr. Bob Davis, State Department of Education.

Corresponded with Secretary, Dr. Priscilla Holland, to send letters of welcome to new members and letters of invitation to former members and 1997 meeting non-member participants.

Planned Fall Executive Committee meeting with assistance of Dr. Charlotte Borst, Director, Reynolds Historical Library.

Consulted with nationally known scientists as possible speakers for banquet and AJAS rap session. Travel expenses are estimated to be approximately \$500.

Other correspondence activities included forwarding information on the Environmental Panel, planning AAS contributions to AAAS 150th anniversary, compiling correspondence for archives, and planning for Executive Committee meeting.

Met with Dr. Nelson and others for the Annual Meeting/Site Visit to the University of South Alabama, July 18, 1997, Mobile, AL.

Reviewed minutes and reports of Gorgas Board of Trustees, AAS Ad Hoc Committee on Gorgas Scholarship Foundation and draft documents on dissolution and transfer of Gorgas funds. Met with Drs. Hazlegrove and Barrett and Dr. Glynn Wheeler (by phone) to discuss Academy involvement. Drafted description of Constitution and By-laws changes which could be used to create a standing committee of the Academy for the Gorgas Scholarship Program. Sent this description to several officers for review.

3. President-Elect -Dr. Moore Asouzu - No report

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- 4. Second Vice-President - Dr. Larry Boots - No report
- 5. Secretary - Dr. Priscilla Holland

Membership

Membership as of October 4, 1997	633
New members since June 30, 1997	11
Membership as of October 16, 1996	642

Trends in Membership:

April 1992	728
March 1993	661
March 1994	739
March 1995	650
October 1995	670
March 1996	571
October 1996	642
October 1997	633

Membership by Section

Section	October 1996	October 1997
I. Biological Science	160	168
II. Chemistry	68	60
III. Geology	26	23
IV. Geography, Forestry, Conservation, Planning	18	20
V. Physics & Mathematics	65	67
VI. Industry & Economics	25	27
VII. Science Education	30	29
VIII. Social Science	33	34
IX. Health Science	96	80
X. Engineering & Computer Science	33	31
XI. Anthropology	11	13
77. University Libraries	25	27
88. High School Libraries	50	51
Unknown	2	3

- 6. Treasurer - Dr. Larry Krannich submitted the following report:
Copies of the following (available upon request) were presented:

ALL ACCOUNT BALANCES as of September 23, 1997
INCOME AND EXPENSE STATEMENT as of September 23, 1997

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ACTIVITIES RELATIVE TO 1996 BUDGET for the period 1/1/97-9/23/97 TREASURER'S SUMMARY REPORT BY QUARTER (1/1/97-9/23/97) TREASURER'S SUMMARY REPORT BY ACCOUNT (1/1/97-9/23/97) PROPOSED BUDGET 1998 vs 1997

Although the time period for this Fall 1997 report is one month shorter than that for the Fall 1996 report, valid comparisons can be made if we utilize the Summary Report by Quarter. Two areas are noticeably different from last year. Our meeting revenue received from the 1997 annual meeting is roughly \$1,100 greater than that from the 1996 meeting and the 1996 meeting revenue was received in January, 1997. Thus, the total meeting revenue received in 1997 (\$7,046.51) is somewhat deceptive. Most alarming is the significant decrease in dues received. For the first three quarters in 1997 we received only \$4,490 compared with \$5,995 in 1996. If this dues income trend continues, we will experience another year with significant decreased dues income. The fourth quarter is the quarter of greatest dues income, but at best we should collect \$5,500. Although our total income for the first three quarters is significantly greater than for that timeframe in 1996, the big increase is in meeting income because of the late receipt of 1996 income.

On the expense side, we are expending at a slightly greater rate in the first three quarters than in 1996 (\$25,109.69 in 1997 vs \$23,093.22 in 1996). The largest increase is in journal expenses -- \$11,145.90 in 1997 and \$6,695.22 in 1996. The bill for the next JAAS printing should arrive within the next quarter.

In summary, we will probably finish the year over budget, but the deficit amount will be greatly moderated by the large meeting revenues.

A copy of the Proposed Budget is also provided. This budget is markedly different from that of prior years. It takes into account the realistic situation for higher meeting revenues, decreasing dues revenues, and increasing journal costs we have experienced these past few years. Also, there are additional secretarial expenses and a decrease in program printing costs for the annual meeting. The new Secretary's department will not be able to absorb the costs associated with mailings.

7. Journal Editor - Dr. James T. Bradley - Printing cost has escalated. Ideas on how to cut cost were discussed.
8. Counselor to AJAS - Dr. B. J. Bateman - Report by Dr. Gene O'Moska - AJAS is in excellent shape financially. There is a need for regional counselors in the Mobile, Tuscaloosa, and Jacksonville regions. Received a \$5,000 grant from the National JSHA to conduct workshops to increase participation. Need your help: Judge at regional or state level and sign up with the Visiting Scientist Program to be a mentor.

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9. Science Fair Coordinator - Dr. May Thomaskutty - No report
10. Science Olympiad Coordinator - Steven Carey - All information on the Science Olympiad Program can be accessed at the Science Olympiad Web page: <http://www.macombo.k12.mi.us/science/sciolym1.htm>. A copy of material distributed is available upon request.
11. Counselor to AAAS - Dr. Katharine Mayne - The 150th Annual Meeting of the American Association for the Advancement of Science is February 11-15, 1998, in Philadelphia; information can be accessed at: <http://www.aaas.org/meetings/meetings.htm>. Information on the satellite American Junior Academy of Science - National Association of Academies of Science meeting can be obtained by e-mailing kmayne@bsc.edu.
12. Section Officers:
 - I. Biological Sciences - Roland Dute - Last year's sectional meeting at Auburn University at Montgomery saw the presentation of 45 talks and 16 posters. This year's program at the University of South Alabama will feature a symposium entitled "Coastal Resources Development" produced by Dr. David Nelson of USA. Dr. Frank A. Romano of the Dept. of Biology at Jacksonville State University has been named vice chair of the section.
 - II. Chemistry - Stephen Beale - No report
 - III. Geology - Douglas Haywick - Report as follows:

Eleven presentations were made in the Geology section at this year's meeting of the Alabama Academy of Sciences in Montgomery (7 oral, 4 poster). This was down slightly from last year. Four presentations were by undergraduate students; the rest were by industrial and/or academic geologists. Laura Quinn received the student research award for the best paper presentation and Mary Grace received the award for best poster.

Membership in the Geology Section of the Alabama Academy of Sciences is, in my opinion, still too low given the number of geologists in this state. Both I and Dan O'Donnell, the vice-chair of the Geology Section, believe that membership in our section can be improved with increased advertising, especially before the next AAS meeting in Mobile next year. Dan, a geologist in Mobile, will contact industrial and environmental geologists in various parts of the state to inform them about the Academy. I will do the same for geologists in academic and State agencies. It is our goal to increase the number of members in our section and the number of quality geological presentations at annual meetings two-fold within the next couple of years.

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IV. Geography, Forestry, Conservation and Planning - Victoria Rivizzigno Report by Priscilla Holland

The Geography, Forestry, Conservation, and Planning Section elected a chair for section IV at the Spring meeting. Dr. Victoria Rivizzigno has agreed to serve as chair. At the Spring Annual Conference a vice chair will be elected.

Again as has been done in the past, to increase participation, letters will be mailed to department(s) of geography, forestry, etc., at colleges and universities and to agencies (i.e., Alabama Forestry Commission) with information about the AAS and a call for papers for the 1998 75th Annual Meeting. These letters will be mailed in early November with a note to the Department Chairs encouraging them to get their students working on a paper for the Spring Conference.

V. Physics and Mathematics - John Young - Report as follows:

Immediately prior to the 1997 annual meeting I was notified by the Section Vice-Chair, Dr. Wayne Yeh, that he was about to relocate from Alabama and would, therefore, have to resign his Academy position. During the Section business meeting, held on March 20, Dr. John (Tom) Tarvin of Sanford University was nominated to fill the Vice-Chair position; he was elected to that position by a unanimous vote of attending members.

The Section hosted a total of 21 presentations during the annual meeting, 18 oral and 3 by way of posters.

The Section Chair anticipates initiating a vigorous campaign in the near future in an effort to solicit presentations during the 1998 meeting.

VI. Industry and Economics - T. Morris Jones - No report

VII. Science Education - Adriel Johnson - No report

VIII. Social Science - Jerald Burns - No report

IX. Health Science - Jerald Burns - No report

X. Engineering and Computer Science - Alan Sprague - No report

XI. Anthropology - Curtis Hill - No report

13. Executive Officer - Dr. Leven Hazlegrove

Since the Spring Executive Meeting, 3/18/97, AUM, we have been working on the

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following projects during the last seven months:

1. Set up and prepared the Gorgas Scholarship Foundation, Inc., Science Talent Search in cooperation with the Westinghouse Scholarship Science Service, Inc. D.C. for USA March 19-22, 1998, with the leadership of Dr. Glynn Wheeler, Secretary Treasurer, and Dr. David Nelson, USA.
2. Prepared for bulk mail 850 "Call for Paper Titles" for USA meeting for March 19-22, 1998, edited by Dr. William J. Barrett.
3. Sent development letters to five industrial companies and foundations with positive reply from one.
4. Sent handwritten notes to 40 outstanding Scientists and Engineers, Mathematicians, and potential members whose "writeup" appeared in local publications. (Ten New Members!!)
5. Met twice with Dr. David Nelson, Professor of Biology, and his site committee for the AAS meeting dates: March 19-22, 1998.
6. Set up ASTA booth at Hoover High School, Friday, October 24, and Saturday, October 25, 1997, with the able supervision of Dr. William J. Barrett, Dr. Dan Holliman, Dr. Tom Jandebour, Dr. Ellen Buckner, and Dr. B. J. Bateman.
7. Prepared 250 abstract forms for the USA meeting, March 19-22, 1998, for eleven section chairs.
 - 1.2. Your Director studied flora, fauna, and pollution in the USA, February 13-16, 1997, with the Alabama Fisheries Association, Gulf State Park.
8. Set-up with Dr. David Nelson's, (334)460-6331, able help the 1998 meeting at USA with the kind invitation of the President and the USA Faculty March 19-22, 1998.
9. Set up the 76th Annual Meeting at Athens College with the able direction of Dr. Tom Jandebour, Professor of Biology, March 1999.

C. Committee Reports

1. Local Arrangements - Dr. David Nelson submitted an oral report. Arrangements for the 75th Annual AAS meeting are progressing.
2. Finance - Dr. Sam Barker
When Dr. Krannich became Treasurer (6 years ago), I believe he was the first Treasurer to show in hard copy the extreme quarterly fluctuations in Academy finances. With our major activity, the Annual Meeting, taking place in the second quarter, a great deal of our money flow occurs then. With the Annual Fall Meeting of the Executive Committee requiring presentation of a budget proposal for the next calendar (and fiscal) year, a truly reliable estimate of the next year's income and outgo is largely a matter of faith - not just in the Treasurer, but in our fellow Academy members.

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Over the last 6 years, I have issued semiannual displays of data from Dr. Krannich's financial reports through 1995, showing that, despite deficit budget proposals, we had come through with positive balances (from \$225 to \$6,589) at the end of each full year. In 1996, two unfavorable trends started: (1) dues payments were considerably less than expected and (2) Journal publication expenses were unexpectedly high. When the income from the 1996 Annual Meeting was not sent to the Academy until well into 1997, the 1996 projected deficit of \$3,980 increased to the actual figure of \$4,485. This was the first true full-year deficit in Larry's 2 terms as Treasurer.

In spite of the January 1997 receipt of 1996 meeting income, the 1997 deficit, anticipated one year ago as \$6,390, will clearly be even worse, with dues far less than budgeted, and Journal publication already running 69% above budgeted, with one of four issues yet to go.

Since the proposed 1997 budget, set forth one year ago, is now obviously inadequate, I have encouraged Dr. Krannich to submit a more realistic budget for 1998, increasing Annual Meeting income to \$4,500, dropping to \$9,000 for dues with total income of \$24,200. Total Journal expenses are shown at \$16,600, raising total expenses to \$38,765. Overall deficit (\$24,200 income minus \$38,765 outgo) would then be projected as \$14,565. Our Academy assets, total \$58,710, would be depleted by 25%.

This obviously is not a pleasant prospect, and deserves a hard look. I do not recommend an increase in dues, but clearly our sagging membership roster needs a boost. Since our members are obviously willing to pay a meeting registration fee high enough over meeting expenses to yield significant income to the Academy, this trend is necessary. The Journal is a problem.

3. Membership - Dr. Larry Boots reported that ideas to increase membership are being addressed in the Membership Committee.
4. Research - Dr. Hudiburg submitted a written report and a request that the research forms be placed at his URL address. This was approved. His report is as follows:
There was considerable interest expressed by students through 51 requests for application materials related to the Student Research Award Competition, Student Research Grants, and Student Travel Awards for the 1997 annual meeting (list of winners available upon request). The later deadline for applications will be continued at the 1998 meeting. Please communicate to interested students that the application deadline for completed materials will be **February 2, 1998**. Students need to be informed that membership in AAS is required to receive the cash portion of these awards.

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To facilitate the application process, I propose that my web page on the internet be listed in the call for papers flyer. Additionally, it should be stated in the application instructions that I can be contacted by mail, phone, fax or the application information and forms can be printed from the web page.

My URL for my web page is:

<http://www2.unaedu/psychology/hudiburg.htm>

If this is made possible, it should make the application forms more accessible to the students.

5. Long-Range Planning - Ken Marion - No report
6. Auditing - Sr. Academy - Denny Bearce - No report
7. Auditing - Jr. Academy - Danice Costes - Report as follows:
Report for July 1996-July 1997 fiscal year:
We have examined the books provided by the Alabama Junior Academy of Science Treasurer, Dr. B. J. Bateman. We are satisfied ourselves that the receipts and expenditures, as presented to us, are correct and that all expenditures are legitimate expenses.

The net worth as of June 30, 1997, is \$9,246.98.
8. Editorial Board and Associate Journal Editors - Douglas Watson/Larry Witt/Bill Osterhoff - No report
9. Place and Date of Meeting - Steven Carey
10. Newsletter - New Editors: Helvi McCall, Editor and Tom Jandebaur, Associate Editor for Electronic Media. A call for news items was issued. The Newsletter will be mailed by the end of the year.
11. Public Relations - Myra Smith - No report
12. Archives - Troy Best - Written report as follows:
Archival materials were solicited from the AAS Executive Committee and membership at each of our recent meetings.

Several items have been submitted for deposition in the archives, but we still need to obtain photographs (especially of members of the Executive

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Committee), committee reports, minutes of the AAS Executive Committee meetings, etc.

If you have items that you believe may be worthy of inclusion in the AAES Archives, please send them to me or to Dr. Dwayne Cox, the archivist in charge of AAS materials at the Auburn University Ralph B. Draughon Library.

Again, I encourage all officers and members of the AAS to donate significant documents, photographs, etc. to the archives.

13. Science and Public Policy - John Frandsen - Report as follows:
Science Education. All is presently quiet on the science education front. The "insert" is in all of the biology texts, and, though it has been examined by several groups to identify possible grounds for challenging it in the courts, none of these groups has decided to mount such a challenge to it as of this date. It is now simply one of a number of such inserts, or statements to be presented orally in biology courses, adopted by several states, and organizations such as the National Center for Science Education (NCSE) must decide which one is most vulnerable to challenge on constitutional grounds, and which judicial district would be the best site for a suit.

The members of the State Board of Education will all be up for election next year (1998). Certainly it would be desirable to have some members who have a background in the sciences or science education, and appreciate the need for science to be taught as science. Has a member of this Academy ever served on this board? Is there, perhaps, a way that we might encourage such a person to seek election?

The ongoing process of consolidating and eliminating programs in state-supported 4-year colleges and universities with the goal of conserving resources and preventing duplication raises some insufficiently-addressed questions: When departments that presently provide science courses to meet general education requirements are abolished, what of the future quality of these courses when the surviving faculty members who teach them are incorporated into other departments? When departments, such as philosophy, that presently provide "service" courses in logic and ethics, for example, required for science majors, are abolished, what of the future quality of these courses? Can colleges and universities continue to attract instructors of the quality needed to teach these important courses when the present buyer's market in higher education becomes a seller's market, and these instructors have no opportunity to conduct research or teach advanced courses? Should

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society allow the “invisible hand” of the marketplace to guide higher education unfettered?

This committee doesn't know the answers to these questions, but believes they are worthy of thoughtful consideration by lawmakers and the Alabama Commission on Higher Education.

Environmental Issues. A number of issues concerning the environment are likely to become subjects of intense interest and political debate in the next few years. The first of these is likely to be non-point pollution of the state's freshwater streams. There is strong evidence that many of these are becoming over-enriched by non-point-source nutrients, leading to eutrophication, with attendant disruptions of aquatic ecosystems and accompanying multiplication of “water weed” vegetation. On the one side of this issue will be those alarmed over the “loss of quality” of these waters. On the other side will be those individuals who feel their rights will be curtailed, and their profits reduced, by the measures necessary to address the pollution problem.

The Academy must be prepared to adopt a public position on these environmental issues. Our Environmental Panel--operating as a subcommittee of this committee--was created to provide us with the expertise necessary to develop such positions and to provide advice to those preparing relevant legislation. Though this panel is composed of well-qualified individuals with the requisite expertise, its efficient operation has been impeded since its appointment by the unwillingness or inability of any of its members to provide the time and energy required to function effectively as its Chair. The original Chair resigned more than a year ago, pleading lack of time to continue, and none of the other members has been willing to take his place. This Committee solicits suggestions of the names of qualified individuals who might be willing to accept appointment to the Environmental Panel and serve as its Chair.

14. Gardner Award - George Cline - Report as follows:

The Alabama Academy of Science established the Wright A. Gardner Award to honor outstanding contributions to science while in residence in Alabama. Recent recipients have included individuals from academia, industry, and the health professions. The Awards Committee is now accepting nominations for the Wright A. Gardner Award. Individuals may nominate others by providing:

- a 1-page summary of the nominee's accomplishments, and
- a Curriculum Vitae of the nominee.

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Additional letters of support are optional. Please submit nominations to:

Dr. George Cline
Wright A. Gardner Award Committee Chair
Biology Department
Jacksonville State University
700 Pelham Road North
Jacksonville, AL 36265-1602

Deadline for receipt of applications is **1 December 1997**. Questions can be addressed to Dr. Cline at the above address or at (205)782-5798 or via e-mail (gcline@jsucc.jsu.edu).

15. Carmichael Award - William Boardman - Report as follows:

The committee presented its annual award for the outstanding paper published in the JAAS during the previous year to B. H. Estridge and J. T. Bradley, Department of Zoology and Wildlife Sciences, Auburn University. The title of their paper is "Brefeldin A Alters Fat Body Vitellogenin Secretion in the Stick Insect Carausius Morosus Br."

Two newly appointed members of the committee are: Dr. Ephriam Gwebu, Department of Chemistry at Oakwood College in Huntsville, and Dr. Robert E. Pitts, Department of Engineering at UAB. Continuing members are: Dr. William Boardman, Division of Science and Math at Birmingham-Southern; Dr. Velma Richardson, Department of Biology at Tuskegee; Dr. Linda Reed, UAB School; of Nursing; and ex officio as JAAS editor, Dr. James T. Bradley, Department of Zoology and Wildlife at Auburn University.

16. Resolutions - Gerald Regan - Report as follows (line numbers supplied with draft to ease any amendment process that may develop):

1. WHEREAS, the Alabama Academy of Science is a professional
2. organization that represents
3. all scientific disciplines
4. from around the State of Alabama; and
5. WHEREAS, Jeffrey P. Richetto brought his training
6. and experience to the service of the Academy
7. in a special way as editor of the NEWSLETTER
8. from 1990 to 1996;
9. LET IT THEREFORE BE RESOLVED
10. that the Alabama Academy of Science express
11. its sincere gratitude to Jeffrey P. Richetto
12. for the labor and dedication he demonstrated

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13. as the editor.

17. Nominating Committee - Larry Boots - No report

18. Mason Scholarship - Mike Moeller - Report as follows:

Last year we had seven completed applications for the William H. Mason Scholarship. After reviewing all application materials, the scholarship committee voted to offer the \$1000 award to Carole Collins Crabbe Clegg and Ms. Clegg accepted the fellowship. The previous recipients of the William H. Mason Scholarship are:

1990-91	Amy Livengood Sumner
1991-92	Leella Shook Holt
1992-93	Joni Justice Shankles
1993-94	Jeffrey Baumbach
1994-95	(Not awarded)
1995-96	Tina Anne Beams
1996-97	Carole Collins Clegg

The Mason Scholarship Committee plans soon to send a fellowship announcement to deans in schools of science and education within Alabama. Members of the AAS Executive Committee are encouraged to copy and disseminate this information.

D. Old Business

Proposals regarding Gorgas Program were discussed.

E. New Business - None

F. The meeting was adjourned - Dr. Charlotte Borst, Curator, Reynolds Library, gave a brief to our of the Library and its holdings.

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COVER PHOTOGRAPH: At the center is a colonial scaled-chrysophyte of the genus *Chrysosphaerella*, each cell bearing siliceous bristles and scales used in species identification at the ultrastructural level; in the corner is a single-celled chrysophyte of the genus *Mallomonas*. Species from both genera are reported for the first time from Alabama in a report by Daniel E. Wujek in this issue. Micrograph by Daniel E. Wujek.

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PROBING THE GENOME OF *TETRAHYMENA PYRIFORMIS* FOR AN INSULIN RECEPTOR TYROSINE KINASE HOMOLOGOUS SEQUENCE

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ABSTRACT

Tetrahymena pyriformis binds insulin and responds with metabolic changes and amplification of hormone binding that is maintained over successive generations. Insulin binding occurs both on the cell surface and intracellularly, but information about the nature of the binding sites is far from complete. Some data suggest that tyrosine kinase activity may be involved in the signal transduction mechanism in *Tetrahymena pyriformis* just as in other systems that have been studied. The *Drosophila* insulin receptor (DIR) has been studied extensively and has a structure very similar to the human insulin receptor. In a recent study, we probed the genome of *T. pyriformis* for a sequence homologous to the DIR tyrosine kinase domain using a probe made by the polymerase chain reaction (PCR). Results indicate that *T. pyriformis* mRNA hybridizes with the probe under low stringency conditions, but a genomic homologous sequence could not be detected by Southern analysis.

Key Words: *Tetrahymena pyriformis*, insulin binding structure, PCR, tyrosine kinase

INTRODUCTION

Insulin binding in *Tetrahymena pyriformis* has been shown to occur, both on the cell membrane and intracellularly. (Csaba, 1980, 1984, Christopher & Sundermann, 1992, Kovacs & Csaba, 1990) Increases in insulin binding capacity have been observed in cultures having prior exposure to the hormone and this amplification, also known as imprinting, is seen in as many as 500 subsequent generations. (Csaba et al, 1982) Insulin and portions of the insulin molecule can substitute for as yet undefined autocrine factors to rescue low initial cell density *T. pyriformis* cultures from dying. (Christensen, 1993) Alterations in cellular metabolism and growth result from insulin binding to undefined membrane structures. (Csaba & Lantos, 1975, Fulop & Csaba, 1990, Kovacs, 1986) Insulin-like substances have been found in both cells and cell conditioned media. (LeRoith et al, 1980) Experimental evidence suggests that insulin may bind to an insulin-like precursor protein in the cell membrane as has been suggested for EGF, TGF α and *Euplotes* mating pheromones. (Christopher & Sundermann, 1995a) It is unlikely that the cell membrane insulin binding structure has homology to the insulin binding portion of the human insulin receptor since no reactivity to an α -subunit specific antibody was found in cell membrane extracts or by immunoelectron microscopy. (Christopher & Sundermann, 1995a,b)

Regardless of the nature of the membrane structure insulin binding domain, some mechanism for signal transduction must exist to effect the insulin stimulated changes in cellular metabolism that result from insulin binding. Alterations in second messenger concentrations have been reported following insulin treatment in *T. pyriformis* (Kovacs, 1986) and the effect of tyrosine kinase inhibitors and activators on insulin imprinting have been studied. (Kovacs & Csaba, 1992, Kovacs et al, 1992) The human insulin receptor (hIR) is a member of the tyrosine kinase family of receptors and is a heterotetramer comprised of two α subunits containing the insulin binding region and two β subunits having signal transduction capabilities. (Olefsky, 1990) The genomic sequence encoding tyrosine kinase activity is highly conserved within receptor family and across species. (Cadena & Gill, 1992, Petruzzelli et al, 1986) The *Drosophila* insulin receptor (DIR) is remarkably homologous to the hIR in both deduced amino acid sequence, subunit structure, and functions. (Petruzzelli et al, 1986, Fernandez-Almonacid & Rosen, 1987) The tyrosine kinase domain of the DIR has an overall amino acid sequence identity to the hIR of 53% with a region of approximately 70 amino acids having greater than 90% identity. (Petruzzelli et al, 1986)

Here we report the use of a PCR probe corresponding to the DIR tyrosine kinase sequence to probe the genome of *Tetrahymena pyriformis*. We also examined total cellular RNA for homology to this sequence. Results indicate that *T. pyriformis* mRNA hybridizes with the probe under low stringency conditions but a homologous genomic sequence was not detected by Southern blotting. Insulin receptor characteristics across species are briefly discussed.

MATERIALS AND METHODS

Cultures. Original cultures of *Tetrahymena pyriformis* were obtained from the American Type Culture Collection (#30327, Simon strain, Phenoset A, amiconucleate) and maintained axenically in Medium 357 (5.0 g proteose peptone, 5.0 g tryptone, 0.2 g K_2HPO_4 , 1 L distilled water, adjust pH to 7.2 before autoclaving) at 28° C.

Insulin Treatment. Insulin treatment (IT) was accomplished by the method of Kovács and Csaba (1990). Briefly, cells from logarithmic cultures (48 h from transfer) in centrifuge tubes were exposed to 0 or 6 μ g/ml porcine insulin (Sigma Chemical Co., St. Louis, MO) in Medium 357 for 1 h at 28° C, washed in plain media, and used to inoculate batch cultures (500 ml) of Medium 357. The batch cultures were incubated at 28 °C for 2 days prior to harvesting the cells for nucleic acid extraction by standard procedures. (Current Protocols in Molecular Biology, 1989)

Total RNA Preparation. Batch cultures were chilled on ice and the cells harvested by centrifugation (1000 x g) in 50 ml conical centrifuge tubes until concentrated to a volume of approximately 2.5 ml. Guanidinium solution (7.5 ml, 4 M guanidinium isothiocyanate, 20 mM sodium acetate, 0.1 mM dithiothreitol, 0.5% N-lauroylsarcosine, pH 5.5) was added prior to homogenation by 12-15 strokes of an autoclaved tissue grinder. The homogenate was layered on top of a 5.7 M CsCl cushion in clear centrifuge tubes (Beckman #344057) and spun 12 hrs in SW55 rotor (32,000 rpm, 20 °C).

The resultant supernatant and CsCl layers were removed and the RNA pellet washed with 95% ethanol, drained, and resuspended in TE (1.0 mM EDTA, 10 mM Tris-HCl, pH

Tetrahymena, tyrosine kinase

7.6). A phenol extraction (PCI, 25:24:1 phenol/chloroform/isoamyl alcohol) was performed and the RNA precipitated by the addition of 100% ethanol and 4 M NaCl. The RNA was pelleted by centrifugation and washed with 80% ethanol, resuspended in DEPC treated H₂O before the RNA concentration (approx. 2 µg/ml) was determined. Pelleted RNA was stored at -70 °C. Precautions were taken to inhibit RNase activity such as treating solutions with DEPC (diethylpyrocarbonate) and the use of autoclaved glassware and plastics.

Genomic DNA Extraction. Pelleted cells were incubated overnight at 55 °C in the presence of digest buffer (50 mM Tris, pH 8.0, 100 mM EDTA, 0.5% SDS, 0.5 mg/ml proteinase K) followed by phenol extraction. Phenol:chloroform:isoamyl alcohol extraction of the supernatant, followed by ethanol precipitation of the aqueous phase produced a pellet that was rinsed with 80% ethanol, resuspended in 1 ml of double distilled H₂O plus 2 µl of 0.5 mM EDTA, pH 8.0 before the DNA concentration (approx. 1 µg/ml) was determined. DNA was stored at 4°C.

Probe Synthesis and Labeling. Probe DNA was synthesized by the polymerase chain reaction (PCR) using standard procedures. Oligonucleotide primers were generated (15 mers) based on the published sequence of the *Drosophila* insulin receptor β-subunit. (Petruzzelli et al 1986) *Drosophila* genomic DNA (1µg, #6940-1, Clontech Laboratories, Inc., Palo Alto, CA) was mixed with primers, *Taq* DNA polymerase, deoxyribonucleoside triphosphates and buffer (Promega Corporation, Madison, WI). (Current Protocols in Molecular Biology, 1989) The mixture was cycled through denaturation (92°C), annealing (55°C), and synthesis (72°C) using an automated thermocycler. Products were electrophoresed on 1% agarose gel and stained with ethidium bromide and photographed. The band of interest (by size) was excised and the DNA electroeluted from the gel, followed by PCI extraction, ethanol precipitation and resuspension. DNA concentration was estimated at 24 ng/µl prior to storage at 4°C.

Probe DNA was labeled with [α -³²P] CTP by random primer extension using standard procedures (Promega Protocols, 1991) (Prime-a-Gene[®], Promega Corporation, Madison, WI) and purified by column chromatography according to manufacturer's directions. (Nensorb 20, DuPont NEN Products, Boston, MA) The resultant labeled probe was added directly to the hybridization solution during Northern and Southern blotting.

Northern Analysis. *T. pyriformis* total RNA samples (15 µg/lane), from both untreated and insulin treated cells, human thymic RNA (10 µg/lane) and *Drosophila* larval poly A+ RNA (3 µg/lane, #6946-1, Clontech Laboratories, Inc., Palo Alto, CA) were loaded onto 1% agarose gel containing 1.1 M formaldehyde. Gels were run at approximately 80V for 1 h using MOPS running buffer (0.02 M 3-(*N*-morpholino)-propanesulfonic acid, 0.005 M sodium acetate, 0.001 M EDTA) followed by a rinse in DEPC H₂O for 20 min and staining with ethidium bromide. Gels were again rinsed in DEPC H₂O and photographed followed by equilibration in 20X SSC (3 M NaCl, 0.3 M sodium citrate, pH 7.0) prior to blotting onto nylon membrane (MagnaGraph, 0.45µ, Micron Separations, Inc., Westborough, MA), overnight. Resultant blots were rinsed briefly with 2X SSC and allowed to air dry prior to UV crosslinking.

Prehybridization was performed at 37°C (50% formamide, 10% dextran sulfate, 5X Denharts solution, 6X SSC, 0.5% SDS, 100 µg/ml salmon sperm DNA) for 3-4 h prior to the addition of labeled probe. After an overnight hybridization, blots were washed twice (15 min each, 37°C or 42°C) with 2X SSC, 0.1% SDS, then once each with 0.5X SSC, 0.1%

SDS and 0.1X SSC, 0.1% SDS. Blots were allowed to air dry before exposing to X-ray film at -70°C.

Southern Analysis. *T. pyriformis*, *D. melanogaster*, and human genomic DNA ($\cong 20 \mu\text{g}$ each) were digested with various restriction enzymes (*Pst*I, *Eco*RI, *Hae*III, *Hpa*I, *Kpn*I, *Xho*I, *Bam*HI, *Hind*III, Promega Corp., Madison, WI) at 37°C for 3 h before being mixed with loading buffer and loaded (20 μl /lane) onto a 1% agarose gel made with TAE (0.04 M Tris-acetate, 0.002 M EDTA) and run at 75V for 1 $\frac{1}{2}$ h. (Promega Protocols, 1991) Gels were then stained with ethidium bromide, photographed, rinsed in distilled H₂O, and soaked in 0.2 N HCL for 15 min, rinsed in distilled H₂O, equilibrated in 20X SSC and blotted onto nylon membrane (MagnaGraph, 0.45 μ , Micron Separations, Inc., Westborough, MA) overnight. Blots were then rinsed with 2X SSC and air dried prior to prehybridization. Prehybridization and hybridization were performed as with Northern analysis except for differences in hybridization and wash temperatures. Prehybridizations and hybridizations were performed at 32°C and 37°C and washes were performed at 42°C and room temperature.

RESULTS

Primers (15mers) were synthesized having the sequence given in Fig. 1 at the 5' and 3' ends of the published sequence for the DIR β -subunit tyrosine kinase domain with approximately 850 base pairs in between. (Petruzzelli et al, 1986) PCR utilizing *Drosophila* genomic DNA as the template resulted in a single band of probe DNA consistent with the published sequence as seen in Fig. 2, Lane 2. Southern blotting revealed one reactive band (1.7 kb) in *Drosophila* genomic DNA cut with the restriction enzyme *Pst* I under both low and high stringency conditions (Fig. 3, Lane D, A & B, respectively), while no specific binding was seen with *Tetrahymena* or human DNA (Fig. 3A & B, Lanes T & H). Indeed, specific and nonspecific binding was lacking in the *Tetrahymena* lanes after digestion with all of enzymes and stringencies used. (data not shown) Of all the restriction enzymes used, only *Pst* I yielded a *Drosophila* DNA fragment that hybridized with the probe DNA. Two to three lighter bands of greater size were detected in *Drosophila* *Pst* I digests (Fig. 3B, Lane D) under high stringency conditions that were obscured under low stringency conditions (Fig. 3A, Lane D).

Northern analysis revealed some hybridization of the probe to *Tetrahymena* RNA from both control (Tc) and imprinted (Ti) cultures under low stringency conditions (Fig. 4). As total RNA was used, some of the weak activity on Northern blots could reflect unprocessed nuclear transcripts. Higher stringencies produced no reaction with *Tetrahymena* RNA and a much reduced hybridization in human (H) and *Drosophila* (D) RNA than shown in Fig 4. At low stringency the DIR probe hybridized to *Tetrahymena* RNA beginning at about 3.5kb. The probe hybridized to human RNA slightly at 4.5kb and at 3.5kb and lower. Three or four bands within *Drosophila* RNA could be seen when the negative was viewed over a light box and became more obvious with more stringent analysis conditions at approximately 1.6, 4, 6, and 8.5 kb. (data not shown)

Tetrahymena, tyrosine kinase

1 TTAATTCAACAGCCTCCGCCGAGCTATGCTAAGGTCTTTTTCTGGCTACTGGGAATCGGC
5' PRIMER CGATACGATTCCAGA
61 CTAGCGTTCCTGATCGTTTCCCTGTTCCGGCTATGTCTGTTACCTGCACAAGAGGAAGGTT
121 CCCTCTAATGACCTCCATATGAACACAGAGGTGAATCCGTTCTATGCGAGCATGCAATAC
181 TCCCAGACGATTGGGAGGTGCTGCGAGAGAACATCATTAGTTGGCTCCACTAGGCCAG
241 GGATCCTTTGGCATGGTGTATGAGGGTATCCTGAAGTCCTTTCCACCCAATGGCGTGGAT
301 CGCGAGTGTGCCATTAAGACTGTCAACGAAAATGCTACGGATCGCGAGCGAACCAATTTTC
361 CTGAGCGAGGCGAGCGTCATGAAGGAGTTCGATACGTATCATGTCTGTAAGATTGCTCGGT
421 GTTTGTTCACAGGGGTCAGCCGGCTCTGGTGGTCATGGAGCTAATGAAGAAGGGTGATCTT
481 AAGTCCTATTTGCGTGCCCATCGTCCCGAGGAGCGGGATGACGGCCATGATGACGTATCT
541 AATCGCATCGGAGTGACTGGTAATGTGCAGCCTCCTACTTATGGAAGAATCTACCAGATG
601 GCCATTGAGATTGCGGATGGCATGGCATATTTGGCCGCCAAGAAGTTCGTCCATCGTCCC
661 TTTGCAGCTCGAAATTGCATGGTTGCTGATGATTTGACGGTGAAAATTGGTGACTTTGGA
721 ATGACCCGTGACATCTATGAGACGGATTACTATCGGAAGGGCACTAAAGGGCTGCTGCCA
781 GTTCGCTGGATGCCACCGGAGAGCTTGCAGGCATGGTGTCTACTCCTAGTGCCAGTGACT
841 TATTCAGCTTTGGAGTGGTTCTCTGGGAAATGGCCATTCTTTCTCTGTGGAGGAGTCCA
3' PRIMER ACCTACCAAGAGAC

Fig. 1. Nucleotide sequence of the *Drosophila* insulin receptor kinase domain (Petruzzelli, 1986) and primers used to synthesize probe DNA by PCR.

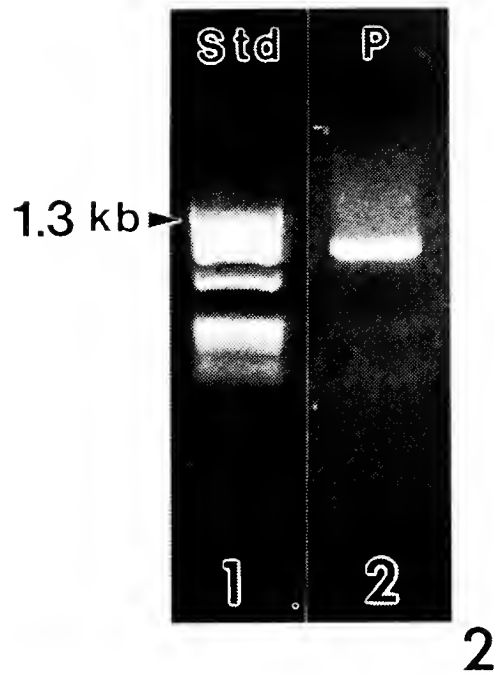


Fig. 2. Ethidium bromide stained electrophoretic gel of ϕ X174 *Hae* II size standards (lane 1) and PCR product (Lane 2) resultant from the use of *Drosophila* genomic DNA template and primers shown in Fig. 1. A single band (\approx 900 bp) in Lane 2 was excised and the DNA extracted by electroelution for use as probe.

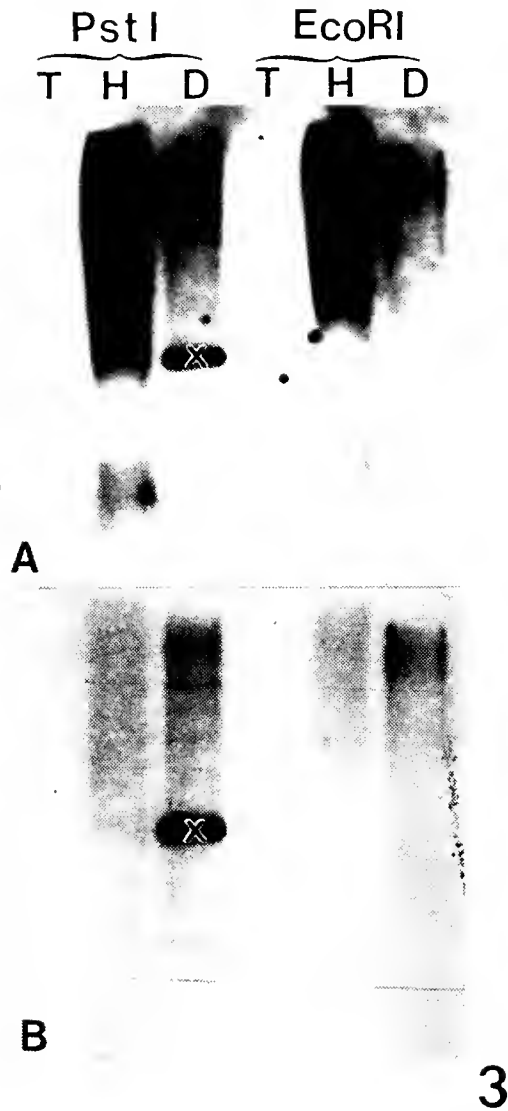


Fig. 3. Southern hybridization of *Tetrahymena pyriformis* (T), human (H) and *Drosophila* (D) genomic DNA with PCR probe to DIR tyrosine kinase sequence. DNA (5 μ g per lane) was digested with *Pst* I or *Eco*RI. Hybridizations and washing were done at A) 37° C or B) 42° C. λ DNA digested with *Bst*E II was used as size standard.



4

Fig. 4. Northern Blot of control (Tc) and insulin treated (Ti) *T. pyriformis* total RNA (15 μ g/lane), human thymus total RNA (H, 10 μ g/lane) and *Drosophila* Poly (A)⁺ RNA (D, 3 μ g/lane) performed under low stringency conditions (37° C).

DISCUSSION

PCR was used in this study to produce a probe for the highly conserved sequence of the *Drosophila* insulin receptor tyrosine kinase domain. The size of the resultant probe was of the appropriate estimated size and hybridized with a 1.7 kb fragment of *Pst*I digests of *Drosophila* genomic DNA as was published previously. (Petruzzelli et al, 1986) None of the restriction enzymes used (*Pst*I, *Eco*RI, *Hae*III, *Hpa*I, *Kpn*I, *Xho*I, *Bam*HI, *Hind*III) produced a similar band in *Tetrahymena* or human genomic DNA digests. This was as expected since the probe was synthesized based on the published sequence for the 1.7 kb fragment of *Pst*I digests of *Drosophila* genomic DNA which was found to hybridize with human cDNA. In contrast to cDNA, the coding sequence of genomic DNA may be interrupted by numerous non-coding regions. Though some diffuse hybridization was seen in human DNA *Eco*RI and *Pst*I digests, none was detected in *Tetrahymena* DNA digests regardless of the stringency or restriction enzyme. Even at the lowest of stringencies, where sequence homology could be as little as 85% (Current Protocols in Molecular Biology, 1989), no hybridization occurred, such that confirmation of nucleic acid transfer was required. This lack of hybridization could be due to the comparatively low G-C content of the Tetrahymenine genome (Sleigh, 1981), numerous non-coding regions within the coding sequence and/or absence of a tyrosine kinase domain of sufficient homology. Both the DIR and hIR are single copy genes and belonging to the *src* family of tyrosine-specific protein kinases. (Olefsky, 1990, Cadena & Gill, 1992, Petruzzelli et al, 1986) The overall sequence similarity of the DIR kinase domain to the deduced amino acid sequence of the hIR kinase domain is 53% and in one 70 amino acid segment within the domain the similarity is 90%. (Petruzzelli et al, 1986) Of those studied thus far, tyrosine kinase domains are very well conserved across receptors and species. (Cadena & Gill, 1992, Petruzzelli et al, 1986) In this study, we were unable to detect a tyrosine kinase homologous sequence within the genome of *T. pyriformis*.

Both the DIR and hIR are well studied receptors. Insulin binding proteins or receptors have been reported in several other organisms including *T. pyriformis* (Fawell & Leonard, 1988, Foty & Liversage, 1993, Jeanmart et al, 1976, Kerschbaum et al, 1993, Kole & lenard, 1991, Legros et al, 1975, Lin et al, 1993, Nowak and Mackowiak, 1993, Saavedra et al, 1989, Sonetti & Bianchi, 1993, Stuart, 1988); some of them containing tyrosine kinase activity. An insulin receptor composed of two identical 210 kDa proteins having insulin binding and insulin stimulated tyrosine kinase activities has been isolated from stingray liver. (Stuart, 1988) A heterodimeric receptor having subunits of 70 and 58 kDa has been purified from the shrimp hepatopancreas. (Lin et al, 1993) *Neurospora crassa* cells have a specific, high affinity putative insulin receptor that is 66 kDa and has no protein kinase activity. (Fawell & Leonard, 1988, Kole & Lenard, 1991) The newt insulin receptor is composed of an α subunit of 130 kDa and a β subunit of 95 kDa that undergoes insulin stimulated phosphorylation. (Foty & Liversage, 1993) Other published reports of insulin binding proteins of unknown character include alga (Legros et al, 1975), sea urchin eggs (Jeanmart et al, 1976), snail (Kerschbaum et al, 1993, Saavedra et al, 1989), and molluscs (Sonetti & Bianchi, 1993).

Because tyrosine kinase activity is necessary for signal transduction in the hIR and DIR, studies have utilized activators and inhibitors of tyrosine kinase activity to investigate

mechanisms of insulin imprinting in *T. pyriformis*. Both metavanadate and orthovanadate increased insulin binding in *T. pyriformis* progeny generations.(Kovacs & Csaba, 1992, Kovacs et al, 1992) Vanadate, a documented insulin-mimetic,(Fantus et al, 1990) is a potent and selective inhibitor of phosphotyrosyl-protein phosphatase and therefore potentiates the activity of tyrosine kinases.(Swarup et al, 1982) Insulin and vanadate together produced a further increase in insulin binding.(Kovacs & Csaba, 1992) The tyrosine kinase inhibitor, genistein,(Akiyama et al, 1987) in combination with insulin reduced insulin binding in *T. pyriformis* offspring.(Kovacs & Csaba, 1992) Taken together these findings suggest a role for tyrosine kinase activity in the mechanism of imprinting.

T. pyriformis mRNA hybridizes with a probe for the tyrosine kinase domain of the DIR generated by PCR under low stringency conditions but not under higher stringencies. Hybridization was not confined to one specific band. Northern analysis has revealed two principal transcripts of 11 and 8.6 kb with expression varying with the lifecycle in *Drosophila* (Garofalo & Rosen, 1988) and two major transcripts of 6.5 and 8.2 kb and minor transcripts of 7.3, 5.5, 4.6 and 2.9 kb synthesized from one human insulin receptor gene.(Ullrich et al, 1985) The present study found major transcripts at 4, 6, and 8.5 kb in *Drosophila*, transcripts 4.5 kb and less in human and transcripts of 3.5 kb and less in *Tetrahymena* mRNA. The predominance of the 8.5 kb transcript was consistent with previously reported stage specific expression in *Drosophila*.(Garofalo & Rosen, 1988)

Although the evidence for insulin imprinting in *T. pyriformis* is becoming convincing, further investigations are necessary to elucidate the proteins, second messengers, mechanisms, and gene level events involved in the phenomenon known as insulin imprinting. The results reported herein represent preliminary investigations into the gene level events involved in imprinting in *Tetrahymena pyriformis*.

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REFERENCES

- Akiyama, T., Ishida, J., Nakagawa, S., Ogawara, H., Watanabe, S., Itoh, N., Shibuya, M., and Fukami, Y. (1987) Genistein, a specific inhibitor of tyrosine-specific protein kinases. *J. Biol. Chem.* 262(12), 5592-5.
- Cadena, D.L. and Gill, G.N. (1992) Receptor tyrosine kinases. *FASEB J.* 6, 2332-7.
- Christensen, S.T. (1993) Insulin rescues the unicellular eukaryote *Tetrahymena* from dying in a complete synthetic nutrient media. *Cell Biol. Internat.* 16(9), 833-7.
- Christopher, G.K. and Sundermann, C.A. (1992) Conventional and confocal microscopic studies of insulin receptor induction in *Tetrahymena pyriformis*. *Exp. Cell Res.* 201, 477-84.
- Christopher, G.K. and Sundermann, C.A. (1995a) Isolation and partial characterization of the insulin binding sites of *Tetrahymena pyriformis*. *Biochem. Biophys. Res. Comm.* 212(2), 515-23.
- Christopher, G.K. and Sundermann, C.A. (1995b) Intracellular insulin binding in *Tetrahymena*. *Tissue & Cell.* 28(4), 427-37.
- Csaba, G. (1980) Phylogeny and ontogeny of hormone receptors: the selection theory of receptor formation and hormonal imprinting. *Biol. Rev.* 55, 47-63.
- Csaba, G. (1984) The present state in the phylogeny and ontogeny of hormone receptors. *Horm. metabol. Res.* 16, 329-335.
- Csaba, G., Nemeth, G. and Vargha, P. (1982) Influence of hormone concentration and time factor in development of receptor memory in a unicellular (*Tetrahymena*) model system. *Comp. Biochem. Physiol.* 73B(2), 357-60.
- Csaba, G. and Lantos, T. (1975) Effect of insulin on glucose uptake in protozoa. *Experientia* 31, 1097-98.
- Current Protocols in Molecular Biology (1989) Ed.s. Ausubel, I. and Fredrick, M. Vol.1. John Wiley & Sons, Inc. New York, NY.
- Fantus, I.G., Ahmad, F., and Deragon, G. (1990) Vanadate augments insulin binding and prolongs insulin action in rat adipocytes. *Endocrinology* 127, 2716-25.
- Fawell, S.E. and Leonard, J. (1988) A specific insulin receptor and tyrosine kinase activity in the membranes of *Neurospora crassa*. *Biochem. Biophys. Res. Comm.* 155, 59-65.
- Fernandez-Almonacid, R. and Rosen, O.M. (1987) Structure and ligand specificity of the *Drosophila melanogaster* insulin receptor. *Molec. Cell. Biol.* 7(8), 2718-27.
- Foty, R.A. and Liversage, R.A. (1993) Detection of insulin receptors in newt liver and forelimb regenerates and the effects of local insulin deprivation on epimorphic regeneration. *J. Exp. Zool.* 266(4), 299-311.
- Fulop, A.K., and Csaba, G. (1990) Effect of insulin imprinting on the ³H-amino acid uptake of the *Tetrahymena*. *Acta Physiol. Hung.* 75(4), 261-5.
- Garofalo, R.S. and Rosen, O.M. (1988) Tissue localization of *Drosophila melanogaster* insulin receptor transcripts during development. *Mol. Cell. Biol.* 8(4), 1638-47.
- Jeanmart, J., Uytendhoef, P., DeSutter, G. and Legros, F. (1976) Insulin receptor sites as membrane markers during embryonic development. I. Data obtained with unfertilized and fertilized sea urchin eggs. *Differentiation* 7, 23-30.

- Kerschbaum, H.H., Holzinger, K. and Herman, A. (1993) Endocrine-like cells and insulin-binding sites in the epineurium of *Helix pomatia*. *Tissue & Cell* 25(2), 237-43.
- Kole, H.K. and Lenard, J. (1991) Insulin-induced stimulation of protein phosphorylation in *Neurospora crassa* cells. *FASEB J.* 5, 2728-2734.
- Kovács, P. (1986) The mechanism of receptor development as implied from hormone imprinting studies on unicellular organisms. *Horm. Metab. Res.* 42, 770-5.
- Kovács, P. and Csaba, G. (1990) Evidence if the receptor nature of the binding sites induced in *Tetrahymena* by insulin treatment. A quantitative cytofluorimetric technique for the study of binding kinetics. *Cell Biochem. Funct.* 8, 49-56.
- Kovács, P. and Csaba, G. (1992) Effect of inhibitors and activators of tyrosine kinase on insulin imprinting in *Tetrahymena*. *Cell Biochem. Funct.* 10, 267-71.
- Kovács, P., Hegyesi, H. and Csaba, G. (1992) Effect of vanadate and oubain on insulin binding and insulin imprinting in *Tetrahymena*. *Cell Biochem. Funct.* 10, 31-4.
- Legros, F., Uytendhoef, P., Dumont, I., Hanson, B. Jeanmart, J., Massant, B. and Conard, V. (1975) Specific binding of insulin to the unicellular alga *Acetabularia mediterranea*. *Protoplasma* 86, 119-22.
- LeRoith, D., Shiloach, J., Roth, J. and Lesniak, M.A. (1980) Evolutionary origins of vertebrate hormones: Substances similar to mammalian insulins are native to unicellular organisms. *Proc. Natl. Acad. Sci. USA* 77, 6184-88.
- Lin, C.L., Wang, P.C. and Chuang, N.N. (1993) Specific phosphorylation of membrane proteins of Mr 44,000 and Mr 32,000 by autophosphorylated insulin receptor from the hepatopancreas of the shrimp *Panaeus monodon* (Crustacea: Decapoda). *J. Exp. Zool.* 267(2), 113-9.
- Nowak, K.W. and Mackowiak, P. (1993) Preliminary investigations of bony fish—tench (*Tinca tinca* L.)—erythrocyte insulin receptors. *Horm. Metabol. Res.* 25(10), 518-20.
- Olefsky, J.M. (1990) The insulin receptor. A multifunctional protein. *Diabetes* 39, 1009-16.
- Petruzzelli, L., Herrera, R., Arenas-Garcia, R., Fernandez, R., Birnbaum, M.J. and Rosen, O.M. (1986) Isolation of a *Drosophila* genomic sequence homologous to the kinase domain of the human insulin receptor and detection of the phosphorylated *Drosophila* receptor with an anti-peptide antibody. *Proc. Natl. Acad. Sci. USA* 83, 4710-14.
- Promega Protocols and Applications Guide. (1991) 2nd Edition. Ed. D.E. Titus, Promega Corporation, Madison, WI. pp 141-142.
- Sleigh, M. (1981) *The Biology of Protozoa*, Edward Arnold, London.
- Saavedra, J.M., Juorio, A.V., Shigematsu, K. and Pinto, J.E. (1989) Specific insulin binding sites in snail (*Helix apersa*) ganglia. *Cell Molec. Neurobiol.* 9(2), 273-9.
- Sonetti, D. and Bianchi, F. (1993) Occurrence and distribution of insulin receptor-like immunoreactivity in molluscan brains. *Acta Biol. Hung.* 44(1), 77-82.
- Stuart, C.A. (1988) Characterization of a novel insulin receptor from stingray liver. *J. Biol. Chem.* 263(16), 7881-6.
- Swarup, G., Cohen, S., and Garbers, L. (1982) Inhibition of membrane phosphotyrosyl-protein phosphatase activity by vanadate. *Biochem. Biophys. Res. Comm.* 107(3), 1104-6.

Tetrahymena, tyrosine kinase

Ullrich, A., Bell, J.R., Chen, E.Y., Herrera, R., Petruzelli, L.M., Dull, T.J., Gray, A., Coussens, L., Liao, Y.-C., Tsubokawa, M., Mason, A., Seeburg, P.H., Grunfeld, C., Rosen, O.M. and Ramachandran, J. (1985) Human insulin receptor and its relation to the tyrosine kinase family of oncogenes. *Nature (London)* 313:756-71.

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PREVALENCE OF PHYSICAL ACTIVITY
PATTERNS IN ALABAMA, 1994-1996

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ABSTRACT

As a part of the Healthy People 2000 national initiative, Alabama established a state goal for the year 2000 which targeted the reduction in physical inactivity and an increase in the proportion of Alabamians who engage regularly in light to moderate activity on a regular basis. In order to assist in the determination of progress in meeting this goal, Alabama participates in the Behavioral Risk Factor Surveillance System (BRFSS). The results of the two most recent BRFSS surveys indicate that despite some improvement in the number of Alabamians reporting no leisure-time physical activity, Alabama has remained a predominantly sedentary populace. In 1996, more than 1/3 of Alabamian's reported they performed "no leisure-time" physical activity. The prevalence of a sedentary lifestyle was inversely related to income and education and directly related to age. The four most popular activities among the respondents who indicated they performed leisure-time physical activities were walking, yard work, running and aerobics. However, of those who indicated they were active, more than 3/4 reported performing only one leisure-time physical activity in the past month. Implications of these trends are discussed and suggestions are offered for improvement.

INTRODUCTION

Regular physical activity has long been regarded as an important component of a healthy lifestyle. Regular physical activity can play an important role in both prevention and treatment of cardiovascular disease (2,7). Despite the research and widespread recognition of a positive association between regular physical activity and a reduction in cardiovascular disease, the American adult population has remained a predominately inactive society (3,5,9,13).

In response to the accumulated research and the widespread recognition that physical inactivity is a major public health issue, the U.S. Public Health Service in 1990 released *Healthy People 2000* (18), the national objectives for health promotion and disease prevention for the year 2000. As a part of the national initiative, Alabama established a state

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goal for the year 2000 which targeted the reduction in physical inactivity and an increase in the proportion of Alabamians who engage regularly in light to moderate activity on a regular basis. Specifically the physical activity goal as stated in *Healthy Alabama 2000* is: "to increase the proportion of Alabamians aged 13 - 18 to 50% and adults aged 18 and over to 30% who engage regularly, preferably daily, in light to moderate activity for at least 30 minutes a day" (1).

Since 1986, an increasing number of states including Alabama have participated in the Behavioral Risk Factor Surveillance System (BRFSS) in order to track the progress in attaining the goals outlined in *Healthy People 2000*. The BRFSS is a population-based, random-digit-dialed telephone survey of the non-institutionalized U.S. population aged ≥ 18 years. Currently all 50 states plus the District of Columbia participate in the BRFSS. In addition, Alabama is one of 19 states that have established specific priority areas covering the improvement of physical activity of the populace (11). The initial progress towards meeting the year 2000 physical activity goals by the State of Alabama was reviewed in 1994 (8). This report included applicable data up through 1992. Since that accounting, two additional Alabama BRFSS surveys (1994 and 1996) have been completed. The purpose of this paper is to present the most pertinent data from these recent surveys in an attempt to assess current status toward meeting Alabama's Year 2000 physical activity goal.

METHODS

The BRFSS, developed jointly by state health departments and the Centers for Disease Control, is a state-based telephone monitoring system for estimating health behaviors related to the ten principle causes of premature death in the United States (10). Non-institutionalized residents with telephones were randomly selected from non-commercial telephone numbers using a multi-stage cluster design based on the Waksburg method of random digit dialing (19). A successful household contact was followed by the random selection of one adult, aged 18 or older, who was interviewed immediately or during a convenient follow-up call. Three interviews were completed per cluster of 100 numbers. Data was collected from 2,069 persons in 1994 and 1,436 persons in 1996.

Since 1986 there has been a steady evolution of the types and wording of the Alabama BRFSS survey questions in an attempt to conform to and standardize the questions as found in the national BRFSS surveys. Because of these revisions standardization and categorization of the questions across the years is somewhat limited. Because of these limitations, the results presented in this paper represent the most applicable and comparable physical activity data available from these two surveys.

RESULTS

The number of Alabamians 18 and over who reported the performance of no leisure-time physical activity has steadily improved since the 1992 BRFSS (Figure 1). In 1992, 49.4 % of Alabamians reported no leisure-time activity which declined to 32.5% in 1996 toward the goal of 30% for the year 2000. The four most popular activities among those reporting the performance of some leisure-time physical activity were walking, yard work, running and aerobics. Among these activities, walking was by far the most popular activity with a reported frequency of over 50% (Figure 2).

Prevalence of Alabama Respondents Aged 18+ Who are Completely Sedentary

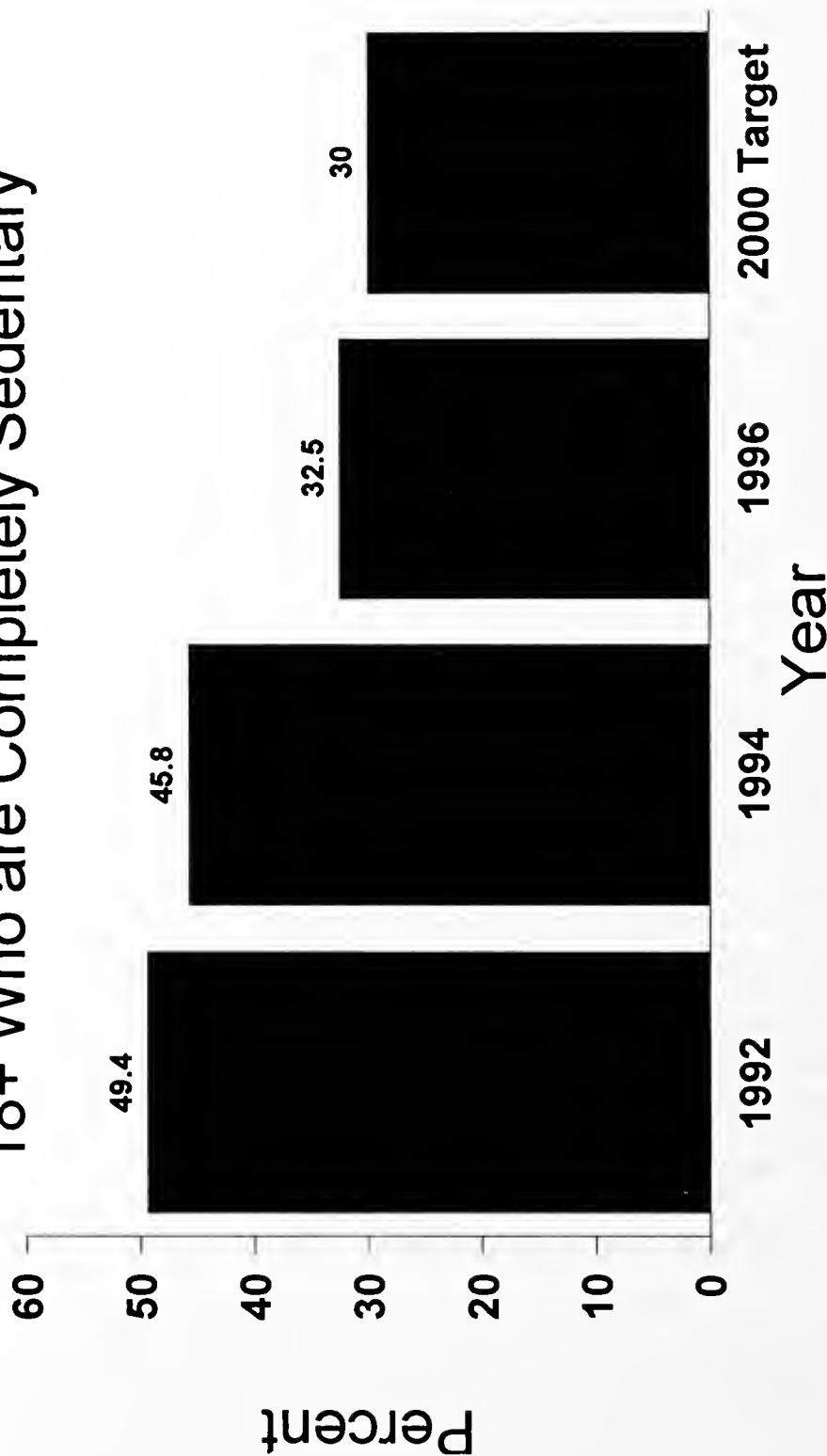


Fig 1. Prevalence of Alabamians Ages 18+ Reporting a Sedentary Lifestyle. Data obtained from Centers for Disease Control Behavioral Risk Factor Surveillance System 1992, 1994 and 1996 as conducted by the Alabama Department of Public Health, Bureau of Health Promotion and Information. Montgomery, Ala.

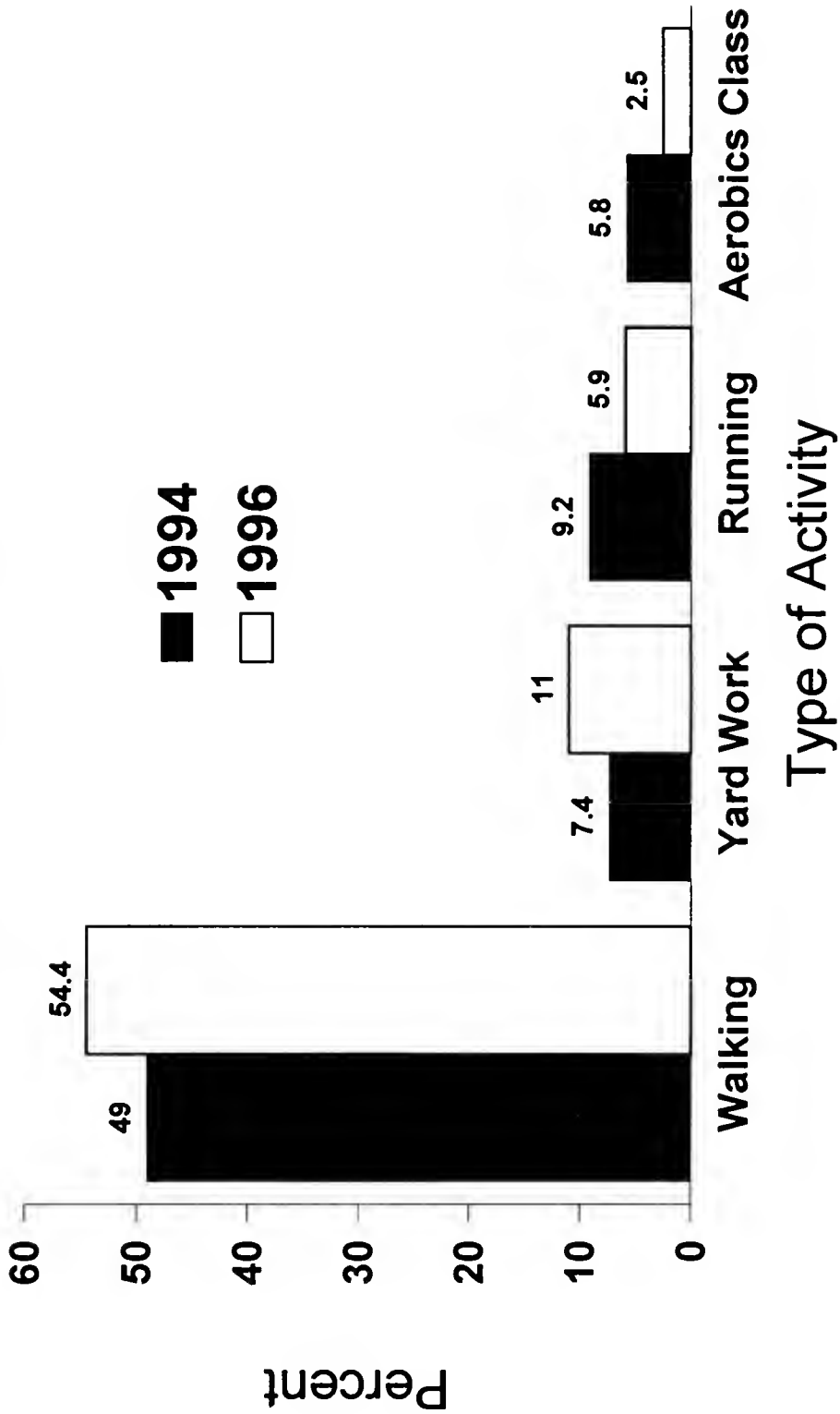


Fig 2. Type of physical activity respondents spend most of their time doing during leisure time. Data obtained from Centers for Disease Control 1994 and 1996 Behavioral Risk Factor Surveillance System as conducted by the Alabama Department of Public Health, Bureau of Health Promotion and Information. Montgomery, Ala.

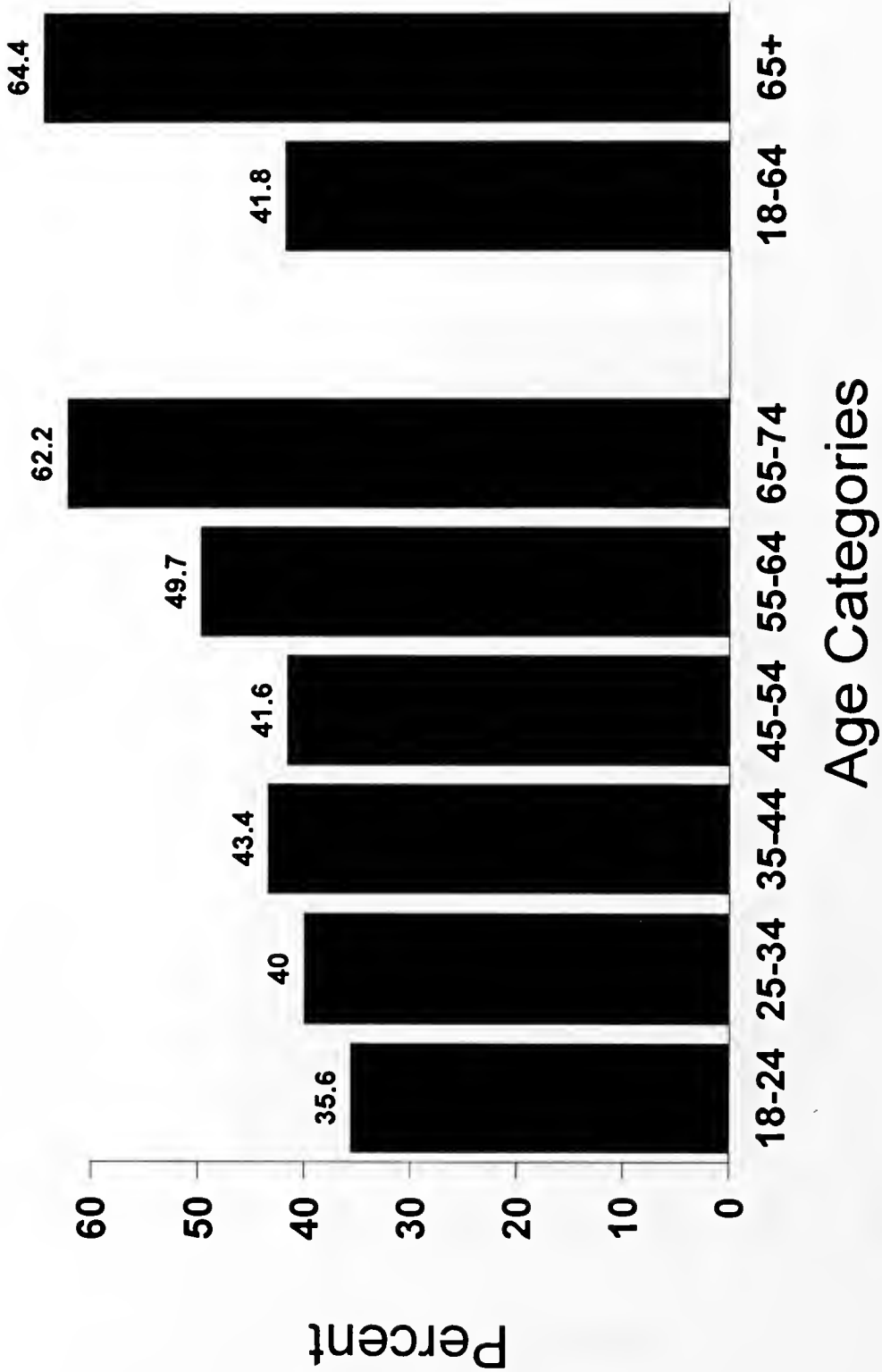


Fig 3. Prevalence of Alabamians Ages 18+ in 1994 Reporting a Sedentary Lifestyle by Age. Data obtained from Centers for Disease Control 1994 Behavioral Risk Factor Surveillance System as conducted by the Alabama Department of Public Health, Bureau of Health Promotion and Information. Montgomery, Ala.

Prevalence of 1994 Respondents Who are Completely Sedentary by Income

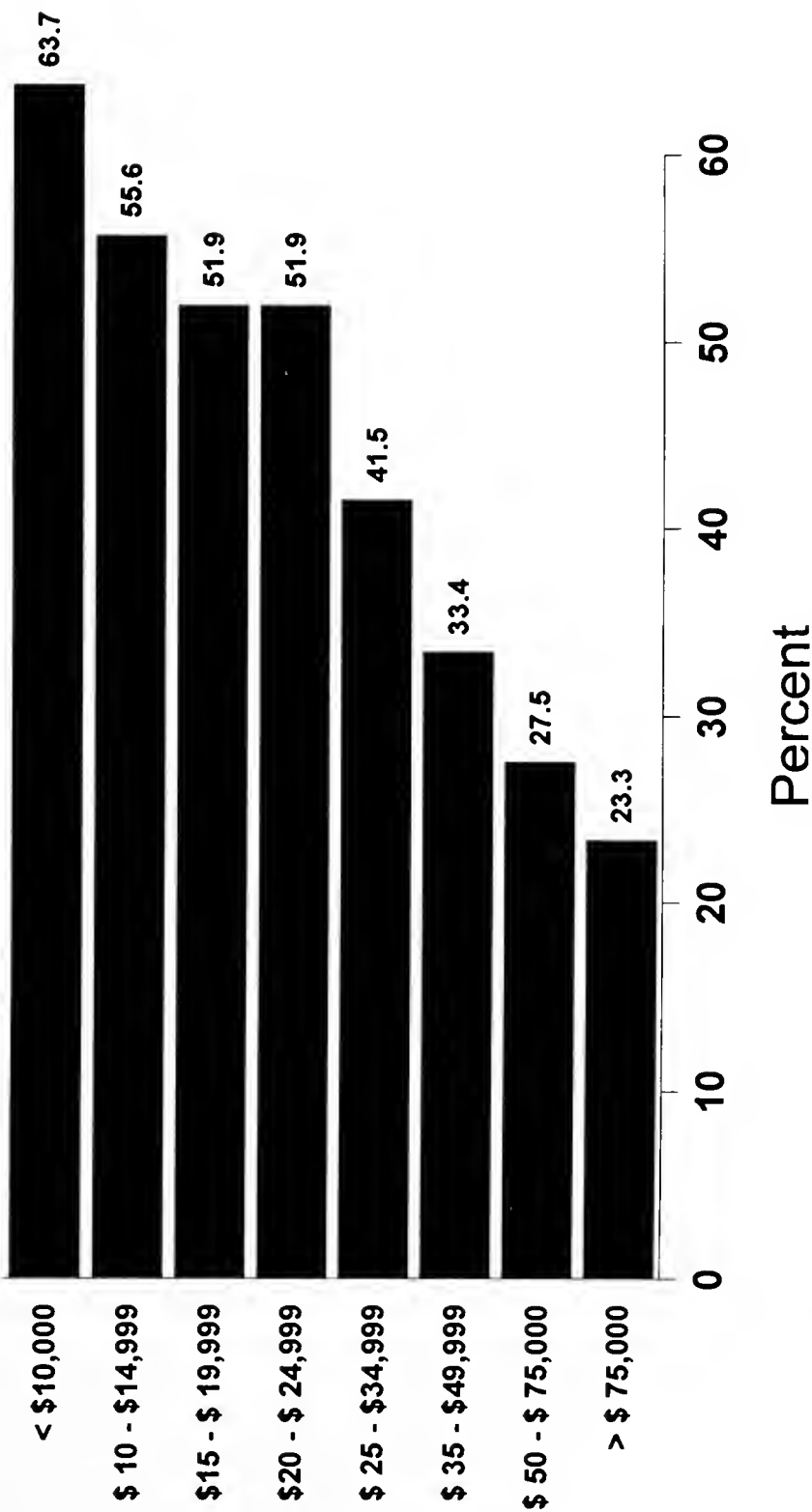


Fig 4. Prevalence of Alabamians Ages 18+ in 1994 Reporting a Sedentary Lifestyle by Income. Data obtained from Centers for Disease Control 1994 Behavioral Risk Factor Surveillance System as conducted by the Alabama Department of Public Health, Bureau of Health Promotion and Information. Montgomery, Ala.

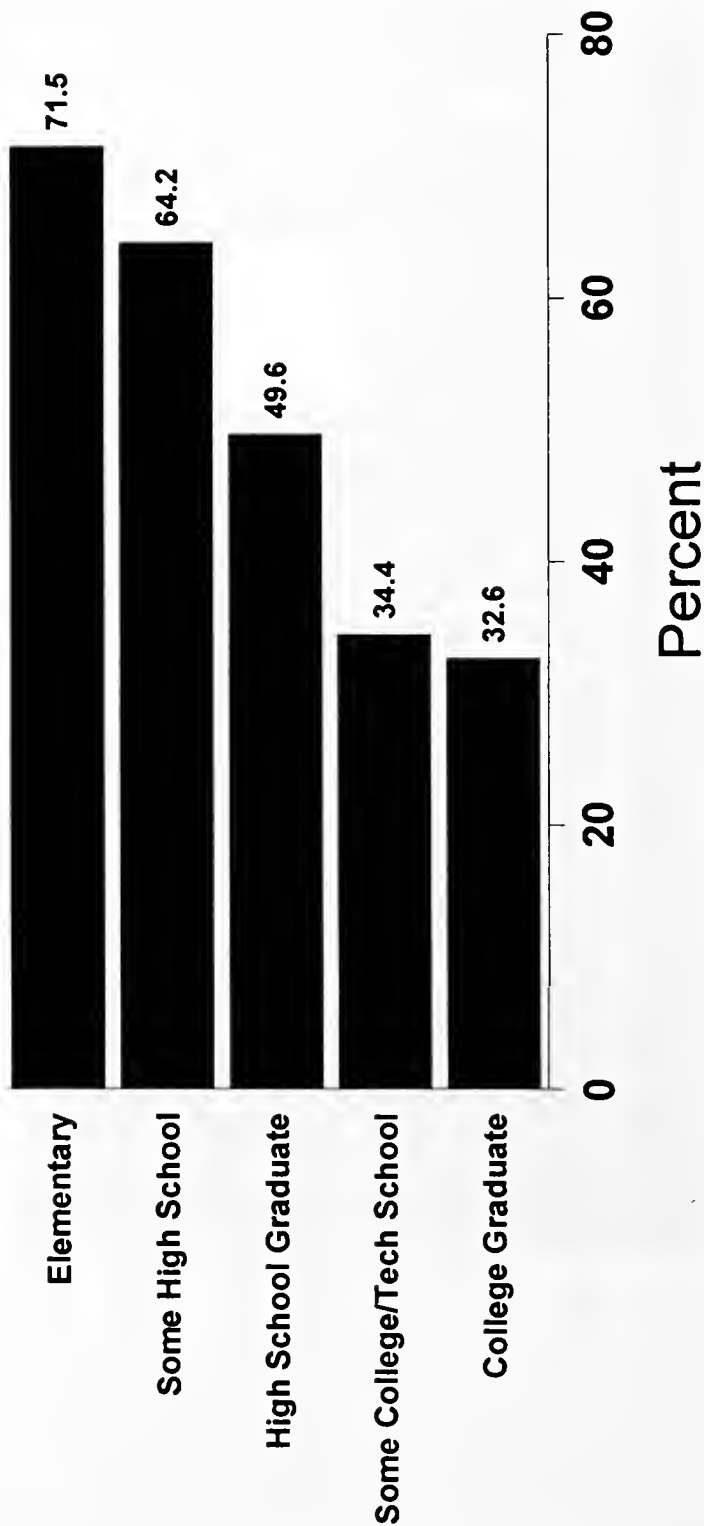


Fig 5. Prevalence of Alabamians Ages 18+ in 1994 Reporting a Sedentary Lifestyle by Educational Level. Data obtained from Centers for Disease Control 1994 Behavioral Risk Factor Surveillance System as conducted by the Alabama Department of Public Health, Bureau of Health Promotion and Information. Montgomery, Ala.

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The prevalence of a sedentary lifestyle in 1994 increased steadily with age (Figure 3). For younger respondents (aged 18 - 64 years) the prevalence of a sedentary lifestyle was 41.8 % in comparison to older respondents (aged ≥ 65 years) whose prevalence rate increased to 64.4%. The prevalence of sedentary lifestyle in 1994 was inversely related to income (Figure 4) (i.e., prevalence was highest [63.7%] for the lowest income category [$\$ < 10,000$] and lowest [23%] for persons in the highest income category [$\$ > 75,000$]). Prevalence was also inversely related to education. The prevalence rate was 100% among individuals that never attended school compared with 32.6% among persons with a college education (Figure 5). Comparable data for these three activity categories were not available for the 1996 survey.

DISCUSSION

Despite this mounting evidence of the health benefits of physical activity, Alabama like the rest of the United States (4,5,8) has remained a predominantly sedentary populace. In 1996, more than 1/3 of Alabamian's report they perform "no leisure-time" physical activity and of those who are active, more than 3/4 report performing only one leisure-time physical activity in the past month. The gap between the present status and the health promotion goals established by the state of Alabama in *Healthy Alabama 2000* illustrate the scope of the task ahead.

One of the most important public health challenges is moving our state from a sedentary one to a more physically active one. In the past few years, a number of studies have reported that moderate physical activity levels which are lower than the recommendations of the ACSM may reduce the risk for death from cardiovascular disease even though they may not be of sufficient quantity or quality to improve VO_{2max} (6,12,15,16). Moderate physical activity below the level recommended for cardiorespiratory fitness can have significant benefits in reducing the risk for cardiovascular disease (14,17).

The effort to understand how to promote more active lifestyles is of great importance to the health of this state and nation. Although the study of physical activity determinants and interventions is at an early stage, determining the most effective and cost-effective intervention approaches is a challenge for the future. Even though the latest trends in the exercise habits of Alabamians indicate that it has been difficult to effect a change in the exercise behavior of those who are currently inactive, it is important to realize that a transformation to a more active lifestyle could pay large dividends both to the individual and to society. Motivating people to make a substantial investment of personal time in increased physical activity may be Alabama's "best investment" which could mean a significant reduction in risk of cardiovascular disease, a decrease in demand for medical services and reduction of health care cost.

REFERENCES

- Alabama Department of Public Health. *Healthy Alabama 2000: Health Promotion & Disease Prevention Objectives for the Year 2000*, Bureau of Health Promotion and Information, Montgomery, Ala, October 1991.
- Bernadet P. Benefits of physical activity in the prevention of cardiovascular diseases. *J Cardiovas Pharmacol*. 1995; 25(Suppl 1): S3-S8.

- Caspersen C, Merritt R. Physical activity trends among 26 states, 1986-1990. *Med Sci Sports Exerc.* 1995; 27:713-720.
- Centers for Disease Control. Monthly estimates of leisure-time physical inactivity- United States, 1994. *MOIRE* 1997; 46:393-397.
- Centers for Disease Control. Prevalence of sedentary lifestyle - Behavioral Risk Factor Surveillance System, United States 1991. *MOIRE* 1993; 42:576 - 579.
- DeBusk R, Stenestrådn U, Sheehan M, Haskell W. Training effects of long versus short bouts of exercise in healthy subjects. *Am J Cardiol.* 1990; 65:1010 - 1013.
- Francis KT. Benefits of physical activity and cardiovascular health and disease. *Phys Ther.* 1996; 76:456-480.
- Francis KT, Hataway J. Prevalence of physical activity patterns: Behavioral Risk Factor Surveillance Systems, Alabama. *J Ala Acad Sci* 1994; 65:214-224.
- Francis KT. Progress toward Healthy People 2000. *Phys Ther Magazine.* 1994; 2:59-64.
- Gentry E, Kalsbeck W, Hogelin G, Jones J, Gaines K. The Behavioral Risk Factors Surveys II. Design, methods and estimates from the combined state data. *Am J Prev Med* 1:9-14, 1985.
- Healthy People 2000: State Action 1992.* Washington, D.C. Government Printing Office , Washington, DC 20402-9328.
- Leon A, Connett J, Jacobs D, Rauramaa R. Leisure-time physical activity levels and risk of coronary heart disease and death: the Multiple Risk Factor Intervention Trial. *JAMA* 1987; 258:2388-2395.
- McGinnis J. Healthy People 2000 at mid decade. *JAMA.* 1995;273:1123-1129. NIH Consensus Development Panel on Physical Activity and Cardiovascular Health. Physical activity and cardiovascular health. *JAMA.* 1996; 276: 241-245.
- Paffenbarger R, Hyde R, Hsieh C. Physical activity, other lifestyle patterns, cardiovascular disease and longevity. *Acta Med Scand* 1986; 711(suppl):85-91.
- Paffenbarger R, Kampert J, Lee I, Hyde R, Leung R, Wing A. Changes in physical activity and other lifeway patterns influencing longevity. *Med Sci Sports Exerc* 1994; 26:857-865.
- Pate R, Pratt M, Blair S, Haskell W, Macer C, Bouchard C, Buchner D, Ettinger W, Heath G, King A, Kriska A, Leon A, Marcus B, Morris J, Paffenbarger R, Patrick K, Pollock M, Rippe J, Sallis J. Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA.* 1995; 273:402- 407.
- Public Health Service. *Healthy People 2000: National Health Promotion and Disease Prevention Objectives.* Washington, DC; U.S. Department of Health and Human Services, 1990; DHHS pub. no. (PHS) 91-50212.
- Waksburg J. Sampling methods for random digit dialing. *J Am Statistical Assoc* 73:40-46, 1978.

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AN EXAMINATION OF ALABAMA'S USE OF THE DEATH PENALTY:
DO WE LIVE IN AN INSANE SOCIETY?

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INTRODUCTION

The criminal justice system, like the human brain, is comprised of many intricate components, and subsystems. As we observe the behavior of the system of crime and the system of the brain we can recognize several similarities: (1) each component and subsystem is discrete (Kolb & Whishaw, 1980; Bullock, 1993; Pursley, 1994; Hugdahl, 1995; Samaha, 1997); (2) though discrete, each component and subsystem is connected (Milner, 1967; Ader, Felten & Cohen, 1991; Pursley, 1994; Kelso, 1995; Samaha, 1997); (3) though connected, each component and or subsystem may become slightly or seriously dysfunctional (Milner, 1967; Ader, Felten & Cohen, 1991; Bullock, 1993; Kelso, 1995; *U.S. News & World Report*, 1995).

When a part of the brain becomes dysfunctional through environmental or certain social stimuli, the mind operates abnormally, producing aberrant or abnormal behavior. The person may suffer grave psychological distress where the rational thinking process becomes disordered. He or she may display severe maladjustive behavior and may even lose contact with reality. The study of this type of degeneration is referred to as psychopathology (Dobson & Kendall, 1993). Frequently, treatment or therapy is needed to correct the diseased conduct.

A dysfunctional brain metaphor may be useful to examine the criminal justice system and its dysfunctional parts. Because it would be untenable to thoroughly test each component of the system in one short article, the intent herein is to look generally at judicial, legislative, and executive treatments of capital punishment as they affect its imposition in Alabama. This article, then, is an exercise designed to examine the practice of death penalty administration in Alabama within the context of "disordered behavior" as this term is used in psychopathology and is being used here to frame a socio-psychopathological theory. In the last few years, as abolitionists of the death penalty continue to actively oppose its imposition, the government has not halted the use of the punishment. A concerned public should wonder whether the government seriously believes that the continued implementation of capital punishment serves a useful purpose, such as deterrence, cost effectiveness, or a reduction in homicide. The behavior of state government in this regard would be extremely irrational and would indeed be psychopathological if it were not able to articulate a rational purpose.

The generic term "pathology" is customarily accepted to mean the study of disease, and the conditions which lead to and foster disease (Lundin, 1965; Dobson & Kendall, 1993; Berzoff, Flanagan, & Hertz, 1996; Fewtrell & O'Connor, 1995). To complete a description of pathology it is also necessary to characterize the consequences of the disease.

Death Penalty

The concept of pathology as used in medicine, psychology, sociology, biology, theology, and many other fields, seeks to describe disordered or abnormal behaviors of individuals. It is no novelty for behaviorists and other scientists to offer explanations on the aberrant or deviant behavior of a crime violator. It is rare, however, to find literature devoted to assigning and examining whether total societies or governments are diseased. Nonetheless, it is necessary to continually test whether our society is in an evolving or devolving state of decency and civilization. To explore whether pathology exists in society's operational activities, then, is an essential factor in the assessment. Most people would probably agree that when disease is discovered it should be eliminated. In this light, this article seeks to examine whether the behavior of Alabama, in its use of capital punishment, indicates and sustains a pathology of disorder, hysteria, and chaos; and, if so, whether it should be abolished. In psychological terms, the word used to describe the type of phenomenon which causes disorder, hysteria and chaos is "psychotic" (Lundin, 1965). In the legal sense, insanity.

Some general principles of psychopathology are used herein as a basic framework in this examination more so than any other science because it is more closely connected to studying disordered ways of behavior which could be classified as "maladjustments to the environment" (Lundin, 1965). While some may question the unseasoned "borrowing" of psychopathological principles for this discussion, few are likely to argue about the need to identify a rational basis for the use of such an irrevocable punishment. The very finality of the death penalty should necessitate some logical reasoning in its imposition.

ALABAMA'S DEATH PENALTY LAW AND PRACTICE

Alabama's capital punishment statute is governed by a sequence of provisions contained in the state's criminal code at Section 13A-5-39 through 13A-5-59 entitled "Death Penalty and Life Imprisonment Without Parole" (Alabama Criminal Code Annotated, 1997).

This law has existed in its present form since 1981 when Alabama, along with several other jurisdictions, decided to reimpose death as a punishment in response to the U.S. Supreme Court's decision of 1976, *Gregg v. Georgia*, which reintroduced capital punishment as a legal sentence after a four year hiatus.

The four year moratorium was created in 1972 with the High Court's decision, *Furman v. Georgia*, wherein the Court determined that state's use of capital sentencing amounted to cruel and unusual punishment. The Court was able to make this judgment based upon a finding of wide and overwhelming discretionary authority with which sentencing bodies were empowered. This discretionary power allowed sentencers to make arbitrary and capricious decisions based on their own subjective emotions and beliefs. In the South, this opportunity for selective enforcement of the punishment produced frightening results for black people and the poor. In fact, between 1930 (the year the federal government began to compile nationwide data on capital punishment) and 1967, Florida executed 196 persons, 66.83% black; Alabama executed 153, 82.35% black; Virginia 237, 86.08% black; and Louisiana 11, 90.90% black (Radelet & Vandiver, 1985). Nearly 100% of those executed in these jurisdictions (and others nationwide) were poor. As noted in *Furman* by Justice William O. Douglas, "One searches our chronicles in vain for the execution of any member of the affluent strata in this society." Because of these disparities and "freakish" applications, the *Furman* Court struck down capital punishment statutes in virtually all state jurisdictions.

State legislatures, post-*Gregg*, revised their statutes, seeking to approach at least minimal provisions suggested by the *Furman* decision. As all capital punishment statutes contemporarily reveal, the circumstances upon which the death penalty can be imposed are certainly less vague than they were prior to this landmark case. Alabama lists 18 offenses, murder plus some other aggravating factor, which qualify as capital murder (Alabama Criminal Code, Section 13A-5-40). The laws also require a process of bifurcation where sentencing juries are required to first find the accused guilty of the offense charged. If the jury finds him guilty, it must almost immediately move into the second phase of the trial to weigh special criteria in their determinations, so-called aggravating and mitigating circumstances, to determine whether the "proper" sentence should be execution or the alternative life in prison without the possibility of parole (Alabama Criminal Code, Sections 13A-5-45 through 13A-5-52). It is questionable, however, that the language of these laws in the abstract produces fair and rational treatment in practice. Is it possible that the public is being deluded into believing that the purported objective legislative prose of capital sentencing laws yields sensible results? Is it possible that the public is being deceived, that it is in the dark about the real facts? Is it also possible, that if the public were well-informed about the effects of imposing capital punishment in Alabama and the nation, that there would be little support for its continued use?

Historically, the easiest way to gauge the public's beliefs is by public opinion polls. There is some indication that even though the public may appear to support the death penalty, most people, when given all the facts will only support it under certain circumstances (Durham, Elrod, & Kinkade, 1996) or not at all. For instance, if asked the general question, "Are you in favor of the death penalty?" the response might be "yes." The affirmative reply might indicate that the responder believes in the propriety of the punishment based on an "eye for an eye" concept, "just deserts," or a similar type of reason. If asked "Are you in favor of the death penalty if the accused is mentally defective, mentally retarded or is a juvenile?" the answer might understandably be "no." The negative reply might be given based on citizens' inability to tolerate government execution of "troubled" individuals. Clearly the former question is more abstract than the latter. Polled responses do change when the questions asked are not oversimplified (Durham, et. al., 1996). Alabama uses the death penalty not only for the sane, but also for the mentally defective, mentally ill, juveniles of a certain age, and sometimes for those that the state system has not definitively established as sane or insane. I will address this subject in greater detail later in this article. It should be noted here, however, that on the issue of insanity and the death penalty the U.S. Supreme Court, in *Ford v. Wainwright* (1986), has prohibited the execution of an insane offender.

Currently Alabama has 163 people on death row, and is the seventh most prolific user of capital punishment in the country (NAACP Legal Defense and Educational Fund, Inc., 1998). The Alabama legislature continues to revise its capital offenses statute. At this writing, the legislature is seriously considering applying the punishment to those convicted of sex offenses against children, even in the absence of a killing despite the fact that in 1977 the U.S. Supreme Court in *Coker v. Georgia* struck down a death sentence for the crime of rape as grossly disproportionate and excessive punishment in violation of the Eighth Amendment. If the legislature extends capital sentencing in this way, this would make Alabama one of just a few jurisdictions to allow the imposition of capital punishment for a sex crime when murder is not also a factor; the other states are Mississippi, and Louisiana (Snell, 1997). Does the state really believe, and expect the public to believe, that imposing

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death against sex offenders is going to rid society of child rapists? The Alabama legislature is also presently considering offering an alternative to the electric chair for those convicted of a capital offense. Because the Governor and certain members of the legislature believe that lethal injection is a more "humane" form of capital punishment, the move now is toward a kinder and gentler execution. It could be argued that implicit in this rhetoric is the tacit acknowledgment that there is something inhumane, abnormal, unusual about the government's inflicting death by electrocution as punishment. In this regard, at least one study indicates that, although lethal injections are the most common form of government imposed death, they are also the most frequently bungled means of execution, often leaving inmates to die in excruciating and unnecessary pain, making it questionable whether it is indeed more humane (Borg & Radelet, 1998).

COSTS OF GOVERNMENT SPONSORED KILLING

How is the state's use of capital punishment disordered or disorganized? It can be argued that the use of the penalty represents group type schizophrenia. One characteristic of this disorder, according to early psychopathologist Emil Bleuler (1911), is a denial of reality. Fantasy replaces normal logical thinking. The creation of fantasy can be extremely debilitating for both the manufacturer as well as the consumer of it. Robert Firestone (1985) convincingly maintains that a fantasy bond where an individual is dependent upon another "out of a desire for security is one of the most prevalent forms of human addiction and plays a prominent role in the deterioration... of relationships" and leads to anxiety and the alienation of people in a society one from another. The schizophrenic process is both an attempt to withdraw as well as an attempt to preserve some integrity (Firestone, 1985). Alienation, withdrawal, fear, and anxiety are but a few costs we pay to keep the death penalty. There is another, perhaps more tangible, price. One fantasy which has been created by the state, upon which the public relies, is the semblance that the use of the death penalty is cost effective. It is not.

Forty jurisdictions in the U.S. have death penalty statutes. Though several of them have conducted studies on the cost of imposing the punishment, Alabama has not published any data on this expenditure. Other states, however, offer some elucidation, and Alabama's cost, no doubt, is analogous. A 1992 study conducted by the Death Penalty Information Center (Washington, DC) indicates that Texas spends about \$200 million per year; Florida, approximately \$120 million per year; New Jersey, \$16 million per year; and New York an estimated total yearly cost of \$118 million. In light of these figures, a logical estimate for Alabama's cost could range somewhere between \$15-\$90 million per year, or roughly \$1.5-\$3.5 million per case. This approximation is partly based on the number of death row inmates held in the aforementioned jurisdictions, New Jersey being the least likely to prosecute and convict, and Texas being the most likely. The alternative, life in prison without the possibility of parole, is much more cost effective for Alabama. The state spends approximately \$15,000 per year to incarcerate. An extremely liberal estimate of longevity in prison per capital offender is 50 years. This amounts to a total cost of about \$750,000. Admittedly, this figure might deviate depending on other variables. The life time incarceration cost might be more if one calculates medical expenditures for elderly prisoners. The same cost, however, might be less if the state decided to nullify the death penalty and its concomitant death row. Death row is treated differently in terms of its mega-expensive super-maximum security, and

inmates are not allowed to work within the prison to pay any restitution costs back to the system or their victims.

Why does capital punishment cost so much? As noted earlier, almost all offenders chosen to be charged by the government with capital murder are indigent. The state is required to provide counsel to those who cannot afford to do so. This means that the state pays for the entire prosecution, defense and appeals of all capitally charged persons. This includes, among other items, the hiring of expert witnesses, investigators, analysts, and defense support teams. No serious argument can be made to justify eliminating these costs if the state insists on keeping the punishment, because the stakes are too high. Moreover, constitutional due process, and protection from grievous miscarriages of justice are stalwart ideals within the criminal justice system. Accused people and the system are likely to suffer tremendously if the state decided to reduce the cost.

The state has to know the national figures but it continues to disregard capital punishment's high financial cost. Such disregard of this economic reality is schizophrenic in nature, delusional and regressive. It may even produce a degenerating government personality, causing rapid deterioration, the final outcome of which may result in great defects or impoverishment (Lundin, 1965). It could even be asserted that such gross misuse of funds has the pathological personality of the traumatic, where there occurs organic destruction of an essential member of the body, the destruction of society itself, strategic organ by strategic organ (Lundin, 1965.) Obviously, if government uses financial resources continuously in this manner, other programs targeted for long-term crime reduction, drug-rehabilitation, teen intervention and diagnostic programs, domestic violence initiatives, and integration strategies for coping with stress will suffer for lack of funding. As noted by Massachusetts Attorney General, Scott Harshbarger: "Virtually every major program designed to address the underlying causes of violence and to support their, vulnerable, powerless victims of crime is being cut even further to the bone....In this context, the proposition that the death penalty is a needed addition to our arsenal of weapons lacks credibility" (Death Penalty Information Center, 1992).

ONE OR TWO FLEW OVER THE CUCKOO'S NEST AND OTHER STRANGE PHENOMENA

Deterrence

One of the results of the psychopathological nature of the use of government sponsored death as punishment is that society is drawn into a fantasy. The fantasy is created to produce an illusion of crime reduction and safety from violence. The concept and reality of heinous murder become too terrible to tolerate, thus the public becomes willing to accept the fantasy of deterrence in order to eliminate the pain and fear. These illusions are created for the purpose of vicariously gratifying the public's need to rid itself of fear of violent crime. Fear becomes dissociated from the normal rational thinking process; however, the fantasy producer, the government, is not able to do in reality that which it has purported to have done (Carlisle, 1993). In other words, there is no reduction in murder in Alabama (or any other capital punishment jurisdiction) by the use of the death penalty. In fact, some studies indicate that criminal homicide is higher in death penalty states than in abolition states, and may even rise slightly in years of execution (Bedau, 1996). Capital punishment simply does not

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generally deter murder. This fact is not even a part of any capital punishment debate anymore, as even proponents of the punishment acknowledge that murder rates continue to be higher in death penalty states than in non-executing states (Bedau, 1996; Richard Dieter, 1995). One of the major reasons the death penalty does not deter is because capital offenses in Alabama most often involve murder plus another felony. Often the murder, attendant with the other felony, is an unanticipated consequence of the underlying felony.

Innocence and the Possibility of Error

In 1992 Alabama released Walter McMillian from prison after he served six years of his life on death row for a crime he did not commit. The lawyer working for his release uncovered a governmental conspiracy of law enforcement and corrections working complicitly to place him on death row even though the evidence, as known by governmental officials, clearly placed McMillian in a different location at the time the murder occurred (A Panel Discussion, 21 *Fordham Urban Law Journal*, 1994). Notwithstanding McMillian's release, research indicates that Alabama has made other such errors, has executed several innocent people, and is one of the states most likely to do so (Bedau & Radelet, 1987; Radelet, Bedau, & Putnam, 1992).

The question of innocence and the horrifying reality that we have executed innocent people obviously are two of the most difficult problems with the state's imposition of death. I would argue for the demise of the punishment based on these factors alone.

Mental Illness and Death Row

Most accused capital offenders suffer from some form of mental incapacity, either mental retardation, brain disease, or psychosis. Such incapacity does not reverse itself once the convicted person is placed on death row. Alabama has executed several mentally disabled inmates. They include: (1) Herbert Richardson, a Vietnam War veteran suffering from post-traumatic stress disorder (PTSD), was discharged from the military after he suffered a mental breakdown while on combat duty. This condition is often referred to as "shell-shock," related to the legal insanity term, irresistible impulse. He was convicted of capital murder and subsequently executed in 1989; (2) Cornelius Singleton was mentally retarded and unable to read. Part of the evidence which convicted him of capital murder was a signed confession. There were significant questions, never investigated, about his guilt largely due to his incapacity to read or sign a confession statement. He was executed in 1992; (3) Often while on death row Varnell Weeks expressed a desire to be married on the back of a hippo. He also believed that he would return as a giant tortoise to rule the universe after his execution. He was determined psychotic by both state and defense doctors. Nevertheless, a judge ruled four days before his execution that he was competent to understand the procedure against him because he was able to nod affirmatively to all the questions posed to him while in his death row cell. The judge also noted that there was significant evidence of mental incapacity in Weeks, but that the state law was not clear on insanity; (4) In 1981 George Daniel was capitally tried and sentenced to death even though his mental illness was clear. He could not recognize any of his family members, did not have the ability to speak coherently with his lawyers, ate his own excrement while confined in jail, and had organic brain damage brought on by a head injury he suffered in a car accident six weeks before he committed murder

(Friedman & Stevenson, 1992).

This is a list of just a few cases where the inmate was noticeably mentally deficient; nevertheless, the system allowed them to be tried, convicted, and many have already been executed. There are many more cases like these (Penland, 1998). What these situations indicate is that homicide may often be caused by a non-deterrable circumstance. Additionally, and perhaps more important, should the state execute the mentally infirm? According to one juror in the case of Horace Dunkins, a severely mentally retarded man with an IQ of 56, the answer should be no. The juror wrote the governor in 1989 just prior to Dunkins' electrocution and said that if they (the jury) had known he was mentally retarded they never would have sentenced him to death (Applebone, 1989).

Politics

The political practice of advancing the death penalty as an answer to the problem of violent crime is another way the state creates an illusion. The whole political process gets corrupted by the desire of campaigning politicians to present the biggest "get tough on crime" platform they can muster. Government politics and public support for the death penalty are almost inextricably interwoven, one seemingly affecting the other, in a tango of alternating leads. The perception that the death penalty is largely supported by the public has tremendous impact on government policy because policymakers believe that in order to survive re-election campaigns and ensure another term in office the public's beliefs cannot be disregarded. Whether the perceptions are real or imagined, the effects are quite tangible. Capital punishment is more politicized now than ever in our history, and affects legislators, prosecutors, courts, clemency proceedings, judges, other politicians, and the entire criminal justice system (21 *Fordham Urban Law Journal*, 1994).

A graphic illustration of how this mania is projected is told by Bryan Stevenson, Executive Director of the Equal Justice Initiative in Montgomery, Alabama, who recalls an incident in a judge's chambers during a post-conviction appeal. He recounts listening to a judge impassionedly criticize a gubernatorial candidate who had run on the slogan, "Fry them 'til their eyes pop out," and proceeded to speak as if he would never support such a platform. Ironically, this same judge in the same meeting proceeded to discuss how he wanted the execution of Stevenson's client to be carried out quickly and that it had already taken too long to do so. This desire, however, was expressed only after the court reporter had entered (prompting the judge to quickly put on his black robe of justice and impartiality) to record the chamber proceedings (21 *Fordham Urban Law Journal*, 1994). The donning of such attire in this fashion metaphorically represents the masking which may be necessary to disguise some truths about the death penalty that some government officials may not be willing to share with the general public. It is not clear from this particular incident, but it may very well be the case that this judge does not even favor capital punishment but finds it politically prudent to appear to support it.

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CONCLUSION

Capital charging and sentencing are presently being used extensively in Alabama despite substantial evidence that indicates it is being imposed irrationally, unfairly, and at a high cost. The decision to charge, prosecute, and sentence an offender appears largely to be based on political motivation, being able to gather enough votes through a "tough on crime" scheme rather than seeking to rid society of the ills that support violence, such as drug abuse and alcoholism, domestic violence, mental illness, and physio-psychological problems that run rampant in the bodies and minds of those on death row both before and after their incarceration. Even if there were a rational basis for capital punishment, is violence really the appropriate response to violence? It has been argued herein that the behavior of Alabama state government regarding capital punishment is psychopathological, seeming to feed on certain acute sociological conditions largely ignored by government officials, and paradoxically helping to maintain a perpetually disorganized society.

The public needs to know the relevant facts about this important issue. It is possible that society, once properly informed, would refuse to support this punishment. Other topics affecting capital punishment in Alabama not addressed in this article but which also deserve serious examination, include the following: (1) racial bias as an historical practice within the state; (2) jury override as abnormally implemented in the state vis-à-vis other death penalty jurisdictions; (3) the unused power of executive clemency and the state's refusal to acknowledge its potential utility.

Finally, Bryan Stevenson offers a compelling statement for capital punishment's destruction. He talks about his spending some time with a condemned man down in Atmore:

I went down there and spent the last thirty minutes with this man, and we were standing there and we were trying to deal with all the horrible things that were going on and he started asking questions, and he said: "You know, it's been a very strange day". I said, "What do you mean?" He said, "When I woke up this morning, the guards, they said, 'What can I get you for breakfast?', and then they said, 'What can we get you for lunch?', and then they said, 'Do you need to use the phone?' He said, "Every fifteen minutes somebody came and said, 'What can we do to help you? Can we get you some cigarettes? Can we get you some coffee? Do you need to call somebody? Do you need some stamps?'" And he said something that still resonates in my mind. He said, "You know, it's interesting. More people have asked me what they can do to help me in the last fourteen hours of my life than they ever did in the first nineteen years of my life".

(21 *Fordham Urban Law Journal*, 1994: 258)

Taylor

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REFERENCES CITED

- Ader, Robert, David L. Felten, and Nicholas Cohen, editors (1991). *Psychoneuroimmunology*. pp. 194-196.
- Alabama Criminal Code Annotated (1997). Sections 13A-5-39 through 13A-5-59.
- Applebone, Peter (1989). "Two Electric Jolts in Alabama Execution," *NY Times*, July 15, 1989. p. A6.
- Bedau, Hugo Adam (1996). "The Case Against the Death Penalty," *Criminal InJustice: Confronting the Prison Crisis*, edited by Elihu Rosenblatt, pp.211, 212, 213.
- Bedau, Hugo Adam, and Michael Radelet (1987). "Miscarriages of Justice in Potentially Capital Cases," 40 *Stanford Law Review* 21, pp.22-90.
- Berzoff, Joan, Laura Flanagan, and Patricia Hertz (1996). *Inside Out and Outside In*. pp.191-194.
- Bleuler, Emil (1911). *Dementia Praecox or the Group of Schizophrenias*, translated by Zinkin, J. (1950). pp. 62-74.
- Borg, Marian J., and Michael L Radelet (1998). "Botched Lethal Injections," *Capital Report #53*, National Legal Aid and Defender Association. pp. 4, 5.
- Bullock, Theodore Holmes (1993). *How Do Brains Work? Papers of a Comparative Neurophysiologist*. pp. 1-7, 491-493, 613-614.
- Carlisle, A. L. (1993). "The Divided Self: Toward and Understanding of the Dark Side of the Serial Killer," *American Journal of Criminal Justice*, Vol. XVII, No. 2, p. 26.
- Death Penalty Information Center (1992). *Millions Misspent: What Politicians Don't Say About the High Costs of the Death Penalty*. Washington, D.C., pp. 3-5, 8.
- Dieter, Richard, and Death Penalty Information Center, Washington, D.C. (1995). "On the Front Line: Law Enforcement Views on the Death Penalty," pp. 4-9.
- Dobson, Keith S. and Phillip C. Kendall. (1993). *Psychopathology and Cognition*. pp. 3-4.
- Durham, Alexis, H. Preston Elrod, and Patricia Kinkade (1996). "Public Support for the Death Penalty: Beyond Gallup," *Justice Quarterly* 13, 705-730.
- Fewtrell, David, and Kieron O'Connor (1995). *Clinical Phenomenology and Cognitive Psychology*. p. 169-172.
- Firestone, Robert (1985). *The Fantasy Bond*. pp. 168, 192.
- Friedman, Ruth E., and Bryan A. Stevenson (1992). "Solving Alabama's Capital Defense Problems: It's a Dollars and Sense Thing," 44 *Alabama Law Review* 1-60, p. 1.
- Hugdahl, Kenneth (1995). *Psychophysiology: The Mind-Body Perspective*. pp. 63-83.
- Kelso, J. A. Scott (1995). *Dynamic Patterns: The Self-Organization of Brain and Behavior*. pp. 279-289.
- Kolb, Bryan, and Ian Q. Whishaw (1980). *Fundamentals of Human Neuropsychology*. pp. 11-30.
- Lundin, Robert W. (1965). *Principles of Psychopathology*. pp. 2, 3, 372, 478.

Death Penalty

- Milner, Esther (1967). *Human Neural and Behavioral Development: A Relational Inquiry With Implications for Personality*. pp. 293-358.
- NAACP Legal Defense and Educational Fund, Inc. (1998), *Death Row, USA*. NY, NY, pp. 1, 10, 14.
- Penland, Lucia (Executive Director of the Alabama Prison Project). Personal telephone conference, Montgomery, Alabama, March, 1998.
- "Politics and the Death Penalty: Can Rational Discourse and Due Process Survive the Perceived Political Pressure?" A Panel Discussion, *21 Fordham Urban Law Journal*, 239-298, Winter, 1994, pp. 240, 258-260.
- Pursley, Robert D. (1994). *Introduction to Criminal Justice* Sixth Edition. pp.4-31.
- Radelet, Michael L., Hugo Adam Bedau, and Constance E. Putnam (1992). *In Spite of Innocence*. p. 359.
- Radelet, Michael L., and Margaret Vandiver (1985). "Race and Capital Punishment: An Overview of the Issues," *Crime and Social Justice*, Vol. 25.
- Samaha, Joel (1997). *Criminal Justice* Fourth Edition. pp.6-38.
- Snell, Tracy (1997). "Capital Punishment 1996." *Bureau of Justice Statistics Bulletin*. U.S. Department of Justice, NCJ-167031, December. pp. 1-3.
- U.S. News & World Report*, "The Real Problems in American Justice," October 9, 1995. pp.52, 54-55.

CASES CITED

- Coker v. Georgia*, 433 U.S. 584 (1977).
- Ford v. Wainwright*, 477 U.S. 399 (1986).
- Furman v. Georgia*, 408 U.S. 238 (1972).
- Gregg v. Georgia*, 428 U.S. 153 (1976).

SILICA-SCALED CHRYSOPHYTES FROM ALABAMA

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ABSTRACT

A total of 45 scale-bearing chrysophytes and synurophytes, herein referred to as scaled chrysophytes (25 Mallomonas spp, 10 Synura spp, 4 Paraphysomonas spp, 4 Spiniferomonas spp, and 2 Chryso-sphaerella spp) in 33 water bodies from eight northern Alabama counties was recorded using TEM. The number of taxa per location varied from 0 to 18. Forty-four taxa are new records from Alabama.

INTRODUCTION

The first published electron micrographs of silica-scaled chrysophytes from Alabama are those describing a new species of Mallomonas (Wujek and Asmund, 1979). All other reports are based on light microscopy. The chrysophyte flora of neighboring Florida (see Wujek and Siver, 1997 and references therein) and Louisiana (Wee et al., 1993) have been previously studied using electron microscopy. Adjacent states, such as Tennessee and Mississippi remain to be investigated.

Silica-scaled chrysophytes are taxonomically placed in the division Chrysophyta, classes Chrysophyceae and the recently described Synurophyceae based on ultrastructural and biochemical characteristics (Andersen, 1987). The majority of chrysophyte genera lack the siliceous covering of the type reported in this study and exhibit "a great plasticity in regard to both morphology and nutrition" (Bold and Wynne, 1985). Most of the common chrysophytes are flagellated single cells or colonial. Evolutionary, the relationships between photosynthetic and heterotrophic members "illustrates very aptly the taxonomic artificiality of the traditional categories 'algae', 'protozoa' and 'fungi'" (Van den Hoek et al., 1995).

In this study, the silica-scaled algal flora from 33 Alabama locations is examined using transmission electron microscopy (TEM).

MATERIALS AND METHODS

Phytoplankton samples were collected with a plankton net (10 μ m mesh size) in late February and early March 1996 from 33 different ponds and lakes (Table 1). Samples were fixed in acid Lugol's (10g KI and 5g I in 200 ml distilled water containing 10% acetic acid). For TEM, subsamples were placed on Formvar coated, carbon stabilized grids, air dried, and examined with a Philips 300 transmission electron microscope. All identifications were based on TEM. Physio-chemical parameters taken in the field were surface water temperature, pH (Markson model 85), and conductivity (Oakton WD-60).

OBSERVATIONS AND DISCUSSION

The taxa identified, and the collection sites (Table 1) from which each taxon was found, are listed in Table 2. A total of 45 silica-scaled chrysophyte taxa from the genera Mallomonas (25 taxa), Synura (10 taxa), Paraphysomonas (4 taxa), Spiniferomonas (4 taxa), and Chrysosphaerella (2 taxa) were observed from the 33 samples. Included in this number are five taxa (Figs. 1-5) reported three times or less from North America. With additional warm water sampling, given that the collections were taken during late February and early March, it is suspected that additional warm water species known to Florida and Louisiana will be found to occur in northern Alabama.

The number of scale-bearing chrysophyte taxa observed per sample varied from 0 to 18 (Table 1). Species diversity was greatest with a decreased water temperature (Table 2). The most frequent Mallomonas species in the study were M. crassisquama (27%; percentages are based on the number of samples in which a taxon was observed divided by the total number of samples), M. akrokomos (24%), and M. annulata, M. cristata, M. hamata, M. heterospina and M. papillosa var. papillosa (15% each). The latter species was also one of three most common species noted in Wee et al.'s (1993) Louisiana survey. Common species from other genera were Synura petersenii f. petersenii (39%) the most common species, S. uvella (36%), S. echinulata (24%), Spiniferomonas trioralis (30%) and Paraphysomonas vestita (27%). Species observed from only one collecting site included Mallomonas cyathellata var. cyathellata, M. doignonii, M. flora, M. guttata, M. lelymene, M. mangofera, M. parvula, M. pillula f. valdiviana, M. pumilio var. pumilio, M. rasilis, M. tonsurata, M. transsylvanica, M. sp 1, Synura curtispina, S. mollispina, S. petersenii f. glabra, Paraphysomonas butcheri, P. gladiata, Chrysosphaerella coronacircumspina, and Spiniferomonas bilacunosa.

Scales of an unknown Mallomonas taxon (Fig. 4) resembling species in Section Tortquatae, Series Eoae Asmund & Kristiansen (1986) was observed in the Wheller National Wildlife Refuge sample. The shield in our taxon possesses regularly spaced pores that are not circular as they are in M. eoa. But, until a complete cell is observed it is best left unidentified.

Silica-scaled Chrysophytes

Three samples lacked scaled chrysophytes (samples 2, 16 and 26). The reason(s) for this is unknown, although all three sites had high pH values, ≥ 8.8 (Table 1).

The range in water temperatures (8.5 to 17.5 °C) and the time of year may indicate that the collections contained elements of both late spring and summer floras. Species observed, such as *Mallomonas akrokomos* and *M. transsylvanica*, have often been observed under the ice in more northern regions (Siver 1991; Cronberg and Kristiansen, 1980). On the other hand, taxa such as *M. crassisquama*, *M. tonsurata* and *Synura curtispina*, are more commonly observed during the summer (Siver, 1991), supporting the idea that our collections do contain elements of both the summer and winter floras.

The pH ranged from 5.9 to 10.0. Many of the species observed in localities with low pH values, including *Mallomonas hamata*, *M. transsylvanica*, and *Synura echinulata*, have been previously reported as common in acidic habitats (Siver, 1988, 1989, 1991). Our observations clearly support these earlier findings.

The pH-range of the 13 most frequently observed species (in five or more collections) is depicted in Fig. 6. *Synura petersenii* f. *petersenii* showed the largest range from 5.8 to 10.0, followed by *S. spinosa*, 5.9 to 8.6 and then *Paraphysomonas vestita* with 7.2 to 10.0. Both *Mallomonas hamata* and *M. heterospina* had the narrowest ranges, 7.9 to 8.6. The data for all 13 species are within the values reported in the literature.

Conductivity ranged from 20.6 to 348 $\mu\text{S}/\text{M}$ (the conductivity range for the 13 most frequently observed species is depicted in Fig. 7). *Mallomonas cristata* and *Synura echinulata* had the narrowest ranges, 21.7 to 63.6 and 20.6 to 120 $\mu\text{S}/\text{M}$ respectively. The largest ranges were observed in *Paraphysomonas vestita* (24.1-348), *Synura uvella* (24.1-341) and *Spiniferomonas trioralis* (29.9-348). As Siver (1993) reported, until more work such as this account, and studies incorporating culture studies, it is unknown "at this time whether individual taxa are responding" to specific anions and cations or "some combination thereof".

In conclusion, as has been demonstrated in other regions of the southeastern U.S., Alabama contains a diverse flora of scaled chrysophytes. This investigation is by no means exhaustive, and we believe further collections and observations from other Alabama sites will yield additional species. Including this paper, the silica-scaled chrysophytes known from Alabama based on electron microscopy now comprise 45 taxa.

ACKNOWLEDGMENTS

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LITERATURE CITED

- Andersen, R.A. 1987. Synurophyceae Classis Nov., a new class of algae. Amer. J. Bot. 74:337-353.
- Asmund, B. and J. Kristiansen. 1986. The genus Mallomonas (Chrysophyceae). Opera Botanica 85:1-128.
- Bold, H.C. and M.J. Wynne. 1985. Introduction to the Algae. Prentice-Hall, Inc., Englewood, N.J. 720pp.
- Cronberg, G. 1996. Scaled chrysophytes from the Okavango Delta, Botswana, Africa. Beih. Nova Hedwigia 114:91-108.
- Cronberg, G. and J. Kristiansen. 1980. Synuraceae and other Chrysophyceae from central Småland, Sweden. Bot. Notiser 133:595-618.
- Hansen, P. 1996. Silica-scaled Chrysophyceae and Synurophyceae from Madagascar. Arch. Protistenkd. 147:145-172.
- Siver, P.A. 1988. Distribution of scaled chrysophytes in 17 Adirondack (New York) lakes with special reference to pH. Can. J. Bot. 66:1391-1403.
- _____. 1989. The distribution of scaled chrysophytes along a pH gradient. Can. J. Bot. 67:2120-2130.
- _____. 1991. The biology of Mallomonas: Morphology, taxonomy and ecology. Kluwer, The Netherlands, 230pp.
- _____. 1993. Inferring the specific conductivity of lake water with scaled chrysophytes. Limnol. Oceanogr. 38:1480-1492.
- Van den Hoek, C., D.G. Mann and H.M. Jahns. 1995. Algae, An introduction to phycology. Cambridge University Press, 623pp.
- Wee, J.L., Booth, D.J. and Bossier, M.A. 1993. Synurophyceae from the Southern Atlantic Coastal Plain of North America: A preliminary survey in Louisiana, U.S.A. Nord. J. Bot. 13:95-106.
- Wujek, D.E. and B.C. Asmund. 1979. Mallomonas cyathellata sp. nov. and Mallomonas cyathellata var. kenyana var. nov. (Chrysophyceae) studied by means of scanning and transmission electron microscopy. Phycologia 18:115-119.
- Wujek, D.E. and P.A. Siver. 1997. Studies on Florida Chrysophyceae (Paraphysomonadaceae) and Synurophyceae (Mallomonadaceae). V. The flora of north-central Florida. Florida Scient. 60:21-27.

Scilica-scaled Chrysophytes

Table 1. Collection sites for silica-scaled chrysophytes from Alabama, 1996.

Sample/Location	pH	Temp (°C)	Conductivity (µS/M)	No. of taxa
Madison County - 28 February				
1 Song Bird Circle Pond T1S, R2W, Sect. 17	10.0	14.1	29.5	3
2 Mullins Pond T1S, R2W, Sect. 15	9.6	14.6	49	0
3 Mitchell Catfish Pond T2S, R1E, Sect. 27	9.0	13.9	79.9	1
4 Madison County Lake T3S, R2E, Sect. 2	9.1	10.4	223	1
Lauderdale County - 29 February				
5 Walker Pond T3S, R12W, Sect. 18	8.6	11.2	55.9	2
6 Swamp along Sinking Creek T3S, R12W, Sect. 3	7.4	10.2	136.6	5
7 Winnie Pond T3S, R13W, Sect. 3	8.16	11.3	59.8	1
Colbert County - 29 February				
8 Fawn Lake T5S, R13W, Sect. 3	8.6	13	104.7	5
9 Rutland's Pond T4S, R13W, Sect. 24	8.4	9.8	204	4
10 Sherrod's Pond T4S, R12W, Sect. 22	---	10.6	24.1	3
11 Size More T4S, R9W, Sect. 18	7.4	8.5	83	9
12 Large Pond, CR 61 & 24 T4S, R10W, Sect. 3	8.0	9.4	258	2
13 Farm Pond T3S, R10W, Sect. 14	8.1	8.9	41.2	5
Franklin County - 1 March				
14 Number Six Lake T6S, R11W, Sect. 26	7.8	12.7	43.1	2
15 Sloss Lake T6S, R11W, Sect. 32	8.4	17.5	348	5
16 Elliot Lake T6S, R12W, Sect. 22	8.8	12.4	226	0
17 Cedar Creek Reservoir T6S, R1W, Sect. 21 & 28	8.2	17.1	185	6
18 Little Bear Creek Reservoir T7S, R14W, Sect. 14	8.8	12.5	97.9	6
19 Bear Creek Reservoir T8S, R14W, Sect. 2	7.9	11.4	51.5	14

Table 1. (continued)

Marion County - 1 March						
20	Hodges Lake	T9S, R13W, Sect. 5	8.3	11.5	21.7	4
21	Private Pond	T11S, R13W, Sect. 32	7.5	10.0	20.6	4
22	Lake Buttahatchee	T11S, R11W, Sect. 8	7.5	9.9	39.9	4
Limestone County - 2 March						
23	Lawson's Pond	T4S, R5W, Sect. 8	8.3	10.6	63.6	6
24	Dogwood Flats Pond	T4S, R4W, Sect. 1	7.9	13.1	66.6	18
Morgan County - 2 March						
25	Wheller National Wildlife Refuge	T6S, R4W, Sect. 2	8.6	13.9	207	17
26	Travis Grocery Pond	T6S, R4W, Sect. 18	9.8	11.9	89.6	0
27	White's Pond	T6S, R5W, Sect. 20	8.4	14.5	284	3
Lawrence County - 2 March						
28	Simms Lake	T6S, R5W, Sect. 20	7.5	12.4	118.9	3
29	Swoope Pond	T4S, R7W, Sect. 22	8.2	13.1	338	2
Lauderdale County - 3 March						
30	Winn Dixie Pond	T2S, R11W, Sect. 34	6.8	17.2	341	7
31	UNA Wetland	T2S, R11W, Section 27	7.2	14.4	40	3
32	McFarland Park Golf Pond	T3S, R11W, Sect. 22	6.7	11.7	121	1
33	King Spring	T2S, R11W, Sect. 26	5.9	14.5	120	4

Table 2. Survey of the occurrence of silica-scaled chrysophytes from Alabama. See Table 1 for descriptions of localities. Bolding indicates samples in which both isolated scales and complete cells were observed.

Taxon	Sampling Site
Synurophyceae	
Mallomonas	
<u>M. akrokomos</u> Ruttner in Pascher	5, 6, 13, 19, 23, 24, 28, 29
<u>M. alata</u> Asmund, Cronberg & Dürschmidt	11, 13, 30
<u>M. annulata</u> Harris	23, 24, 25, 30, 31
<u>M. caudata</u> Iwanoff em. Krieger	6, 11, 14, 20
<u>M. crassisquama</u> (Asmund) Fott	6, 8, 10, 15, 17, 18, 19, 24, 25
<u>M. cristata</u> Dürschmidt	11, 13, 14, 20, 23
* <u>M. cyathellata</u> var. <u>cyathellata</u> Wujek & Asmund	30
<u>M. doignonii</u> Bourrelly em. Nicholls	19
<u>M. flora</u> Harris & Bradley	30
** <u>M. guttata</u> Wujek	8
<u>M. hamata</u> Asmund	12, 13, 19, 24, 25
<u>M. heterospina</u> Lund	9, 19, 20, 24, 25
<u>M. lelymene</u> Harris & Bradley	21
<u>M. mangofera</u> Harris & Bradley var. <u>mangofera</u>	25
<u>M. matvienkoeae</u> Asmund & Kristiansen var. <u>matvienkoeae</u>	24, 25, 32, 33
<u>M. papillosa</u> Harris & Bradley var. <u>papillosa</u>	11, 21, 22, 25, 31
<u>M. parvula</u> Dürschmidt	30
** <u>M. peronoides</u> (Harris) Momeu & Péterfi	30
<u>M. pillula</u> f. <u>valdiviana</u> Dürschmidt	27
** <u>M. portae-ferreae</u> Péterfi & Asmund	24, 30
<u>M. pumilio</u> Harris & Bradley var. <u>pumilio</u>	19
<u>M. rasilis</u> Dürschmidt	21
<u>M. tonsurata</u> Teiling em. Krieger	17
<u>M. transsylvanica</u> Péterfi & Momeu	19
<u>M. sp. 1</u>	25

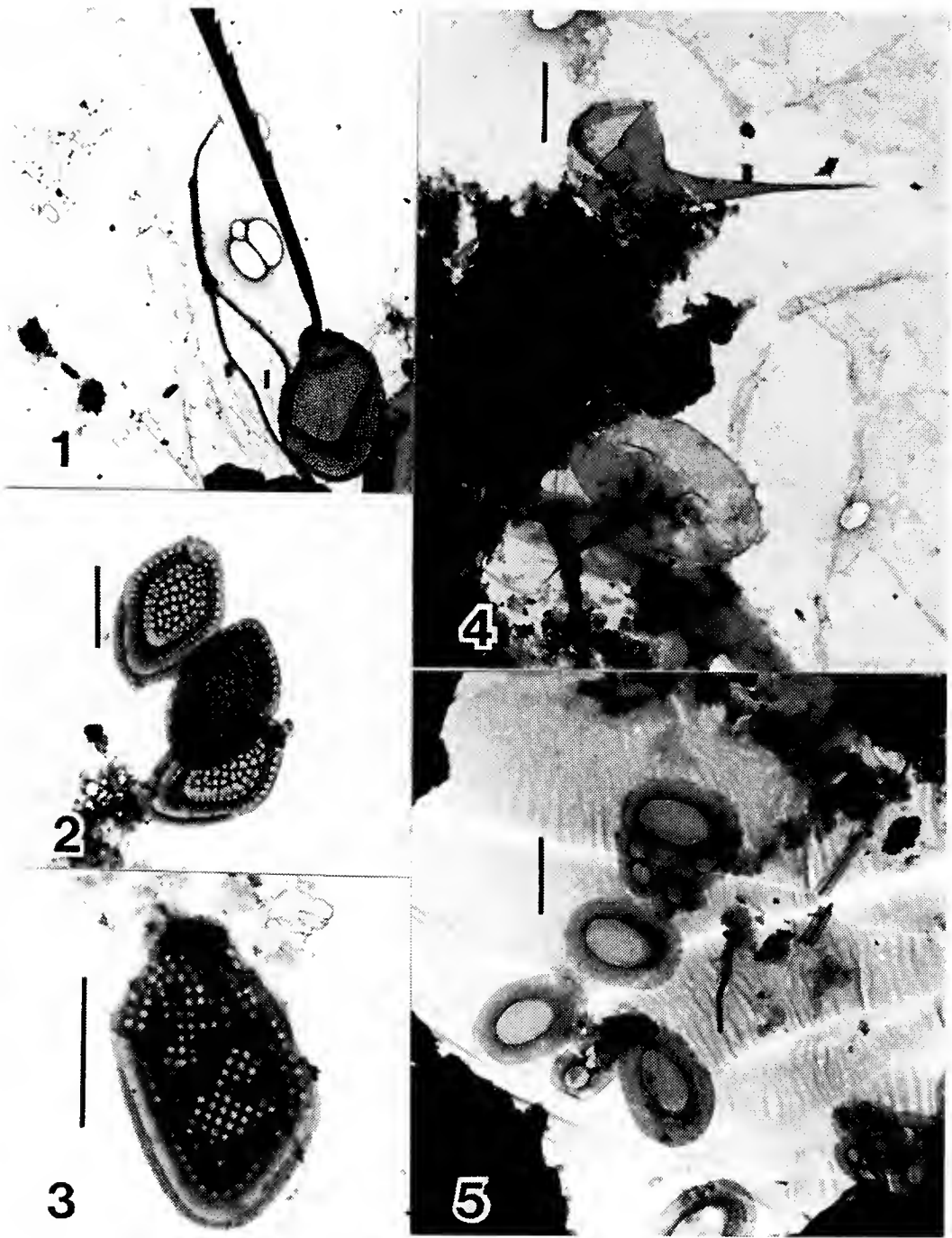
Table 2. (continued)

<u>Synura</u>	
<u>Synura curtispina</u> (Petersen & Hansen) Asmund	19
<u>S. echinulata</u> Korshikov	11, 19, 20, 21, 22, 23, 24, 33
<u>S. mammillosa</u> Takahashi	11, 31
<u>S. mollispina</u> (Petersen & Hansen) Péterfi & Momeu	19
<u>S. petersenii</u> Korshikov f. <u>petersenii</u>	4, 6, 10, 11, 18 , 19, 22, 24, 25, 27, 28, 29, 33
<u>S. petersenii</u> f. <u>glabra</u> (Korshikov) Huber-Pestalozzi	7
<u>S. petersenii</u> f. <u>kufferathi</u> Petersen & Hansen	9, 18, 25
<u>S. spinosa</u> Korshikov	8, 9, 24, 25, 28, 33
<u>S. spinosa</u> f. <u>longispina</u> Petersen & Hansen	11, 19
<u>S. uvella</u> Stein em. Korshikov	6, 8, 9 , 10 , 12, 13, 19, 24, 25, 27, 30
Chrysophyceae	
<u>Chrysoosphaerella</u>	
<u>C. brevispina</u> Korshikov	8, 24, 25
<u>C. coronacircumspina</u> Wujek & Kristiansen	1
<u>Paraphysomonas</u>	
<u>P. butcheri</u> Pennick & Clarke	24
<u>P. gladiata</u> Preisig & Hibberd	15
<u>P. imperforata</u> Lucas	15 , 17, 18
<u>P. vestita</u> (Stokes) de Saedeller	1, 11, 15 , 17 , 19 , 22, 23, 24, 25
<u>Spiniferomonas</u>	
<u>S. bilacunosa</u> Takahashi	24
<u>S. bourrellyi</u> Takahashi	18 , 24, 25
<u>S. crucigera</u> Takahashi	17, 24 , 25
<u>S. trioralis</u> Takahashi	1, 3, 5, 15 , 17 , 18, 19, 23, 24 , 25

* = Previously reported from Alabama (Wujek and Asmund, 1979)

** = Regarded as tropical (Cronberg, 1996; Hansen, 1996)

Silica-scaled Chrysophytes



Figures 1-5. 1. Mallomonas cyathellata var. cyathellata. 2. M. pillula f. valdiviana. 3. M. sp. 1. 4. Paraphysomonas gladiata. 5. Spiniferomonas crucigera. Scale bars = 1 μ m.

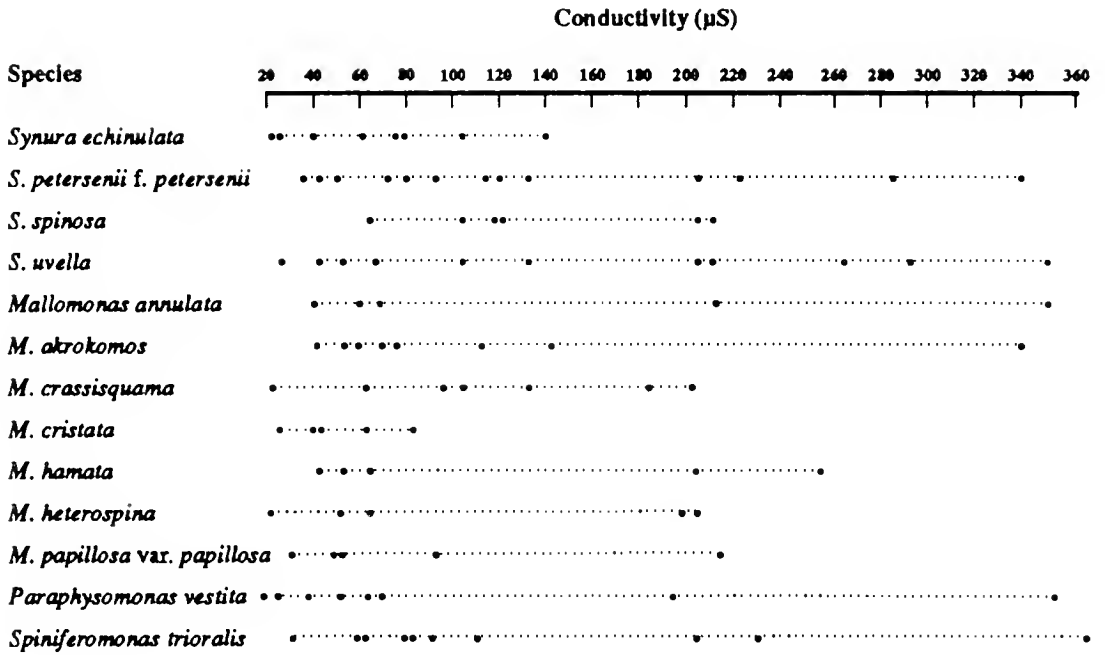


Fig. 6. pH-range for the 13 most frequently observed species. Enlarged circles indicate two sites with identical pH.

Scilica-scaled Chrysophytes

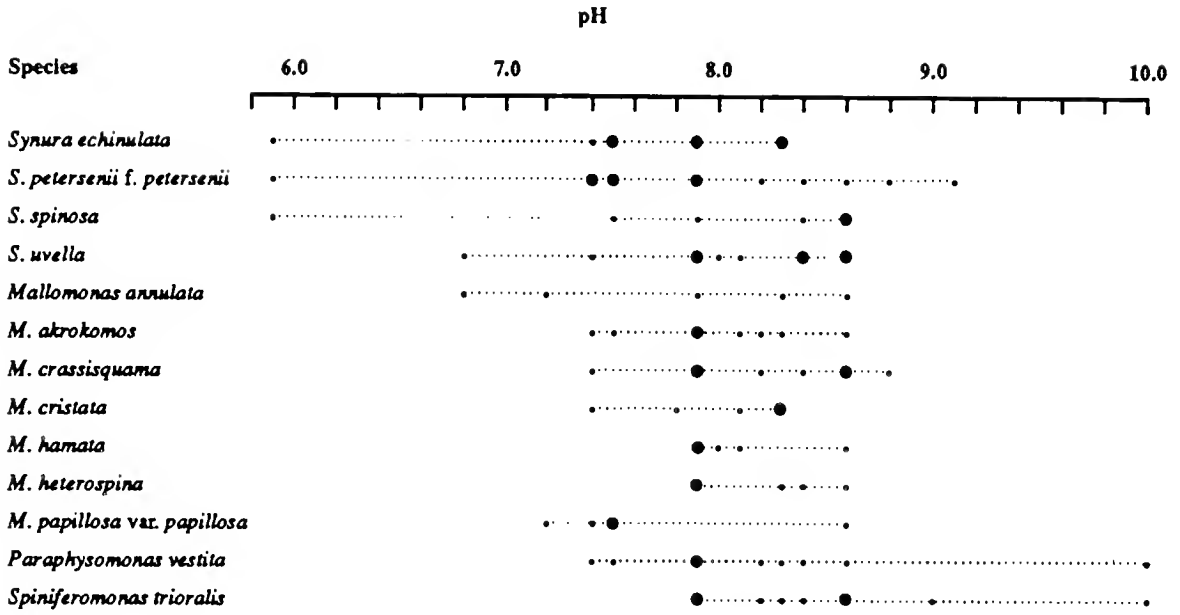


Fig. 7. Conductivity range for the 13 most frequently observed species.

A NEW RECORD OF THE FRESHWATER GREEN ALGA *PSEUDULVELLA AMERICANA* FROM ALABAMA

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ABSTRACT

This is the first report of the green alga *Pseudulvella americana* (Snow) Wille from Alabama and is the fourth report for North America.

INTRODUCTION

There are only a few genera of the green algal family Chaetophoraceae (Chaetophorales) that are widely reported in North America. They include the freshwater genera *Chaetophora* Schrank, *Stigeoclonium* Kützing, *Draparnaldia* Bory, and to a lesser extent, *Aphanochaete* A. Braun (Whitford and Schumacher, 1973). Knowledge of their distribution has been limited until recently. One genus of the family, *Pseudulvella* Wille (= *Pseudoulvella* of some authors) has not been investigated extensively. O'Kelly (personnel communication) is of the opinion that the only freshwater species of the genus, *Pseudulvella americana* (Snow) Wille, belongs to the order Chaetopeltidales, Chaetopeltidaceae.

This paper reports the first occurrence of the green alga *P. americana* for Alabama.

MATERIALS AND METHODS

Samples were collected from scrapings made from a 270 L aquarium originally prepared by placing rocks (Fort Payne Chert [Mississippian]) and surrounding regolith and soil from the property of Dr. Robert Daly, Lauderdale County, Alabama. It was filled with tap water in December 1995. Scrapings were made from the green algae coating the sides of the aquarium, 2 March 1996.

RESULTS AND DISCUSSION

An alga agreeing in all respects with *Pseudulvella americana* (Snow) Wille was found growing on the sides of an aquarium in the botany laboratory at University of North Alabama. Originally described from Michigan by Snow (1907), it has since been reported from Iowa (Prescott, 1931), Wisconsin (Prescott, 1951) and several locations from North Carolina (Whitford, 1982; Dillard, 1969, 1989). Only one record outside of North America exists, India (Philipose, 1946).

In appearance this freshwater species resembled greatly *Coleochaete scutata* de Brébisson or *C. orbicularis* Pringsheim, but the appearance of all differentiated sexual organs, and the presence of many chromatophores instead of one, indicated that the nature and development are quite different from that genus.

The disk-shaped thallus varied from 140 μm to 2.5 mm in diameter. The cells were arranged more regularly toward the periphery than at the center. Radiating rows of cells originated from periclinal divisions of one or more projections of the exterior side of the mother cell. The occurrence of long gelatinous hairs observed by Snow (1899) were not present in our material; they were not depicted in his plate of illustrations. Indeed, they have not been observed by others reporting on the genus.

The collection of *P. americana* from Alabama demonstrates the need for more critical study of epilithic and epiphytic algae along rocky littoral zones of both lentic and lotic systems [or even on glass slides which have been left immersed for 10 months (Dillard, 1969)]. Knowledge of *P. americana* biogeography is believed incomplete, although it is possible that the species may have a disjunct distribution. This is the fourth report of this organism for North America.

ACKNOWLEDGMENT

This study was undertaken during a sabbatical visit by the first author to the University of North Alabama. The first author thanks the FRCE Committee of Central Michigan University for financial support.

REFERENCES

- Dillard, G.E. 1969. The benthic algal communities of a North Carolina Piedmont stream. *Nova Hedwigia* 19:9-29.
- Dillard, G.E. 1989. Freshwater algae of the Southeastern United States. *Biblio. Phycologica* 83:1-163 + plates.
- Philipose, M.T. 1946. A note on *Pseudulvella americana* (Snow) Wille growing in Madras. *M.O.P. Iyengar Comm. Vol.*, Bangalore Press, Bangalore. pp 321-325.
- Prescott, G.W. 1931. Iowa algae. *Univ. Iowa Studies* 13:1-235.

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- Prescott, G.W. 1951. Algae of the Western Great Lakes Area. Cranbrook Institute of Science, Bulletin 31, Bloomfield Hills, MI.
- Smith, G.M. 1950. The Freshwater Algae of the United States. McGraw-Hill Book Co., New York. 719 p.
- Snow, J.W. 1899. *Ulvella americana*. Bot. Gaz. 27:309-314.
- Whitford, L.A. 1982. Additions to the freshwater algae in North Carolina, X. J. Elisha Mitchell Sci. Soc. 98:32-36.
- Whitford, L.A. and G.J. Schumacher. 1973. A Manual of Fresh-Water Algae. Sparks Press, Raleigh, N.C. 324 p.

Notes

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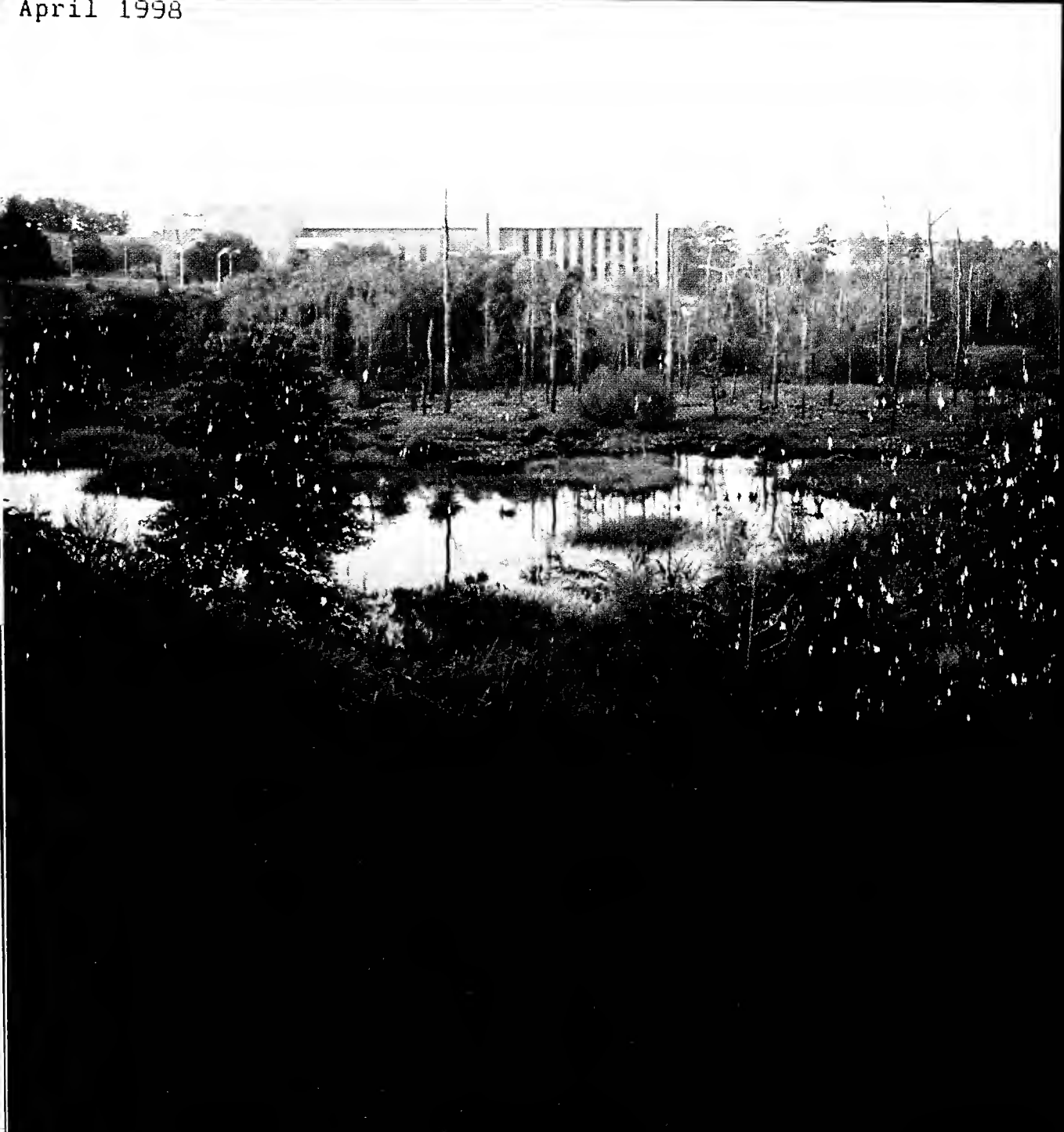
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COVER PHOTOGRAPH: School of Medicine with swamp habitat preserve in foreground at the University of South Alabama, Mobile, site of the 75th annual meeting of The Alabama Academy of Science. Photograph by J.L. "Woody" Wooden.

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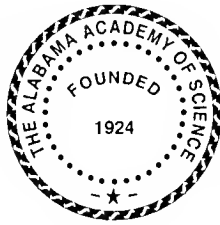
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ABSTRACTS

Papers presented at the 75th Annual Meeting
University of South Alabama
Mobile, Alabama
March 18-21, 1998

BIOLOGICAL SCIENCES

THE HAIR OF THE BOTTLENOSE DOLPHIN REVISITED. Amanda Eberle and Gerald T. Regan, Department of Biology, Spring Hill College, Mobile, AL 36608.

Volunteers in Alabama participating in the Southeastern U.S. Marine Mammal Stranding Network since 1987 encountered 10 bottlenose dolphins that had from one to 11 hairs on their snouts. Three of them were fetuses (body lengths 51.5 - 101 cm). None was longer than 110 cm, about their length at birth. As part of the protocol used by the volunteers, the hairs were routinely plucked, dried, and stored in plastic bags without being cleaned, or they were temporarily left on the dolphin while it was stored in a freezer for further study. Almost no force was needed to pluck a hair from a follicle. A collection of 48 hairs was available at the time of this study, the oldest of which had been collected in 1990. Shampoo and dishwashing detergents failed to clean the unknown foreign matter from the hair, as did an industrial degreasing solvent. An enzyme-containing laundry stain remover succeeded, indicating that the foreign matter was not purely a fatty substance. The number of follicles on the snout usually exceeded the number of hairs, with six follicles on the left side and six on the right. A hair typically curled backward and toward the dolphin's centerline after emerging from its follicle pit. In cross section a hair was not round, but flattened as is expected when hair is curly rather than straight. The medulla of the shaft was solid, not hollow. The lengths of the hairs ranged from 3 mm on the 51.5 cm fetus to 18 mm on the 106 cm neonate. Hairs were not found on dolphins longer than 110 cm. The hairs were only lightly pigmented, looking blonde to the unaided eye but golden-tan at 100X magnification. They tapered gently from a bulbous root to the tip of the shaft. The maximum diameter of the shaft of the longest hair was 0.27 mm, compared to 0.16 mm for a pelage hair of a manatee, to 0.13 mm for a hair from the baleen of a Sei whale, and 0.29 mm for a cat's whisker. The maximum diameter of the shortest hair was 0.14, indicating that a hair grows in both length and diameter during fetal development.

Abstracts

Distribution and ecology of *Elassoma alabamae* (spring pygmy sunfish). Tom Jandebour, Athens State College, Department of Biology, Athens, AL 35611. e-mail: jandets@athens.edu

Objectives for this study were to gather distributional and ecological information on *Elassoma alabamae* (spring pygmy sunfish), and to locate potential habitat within its former range for translocation. Significantly, a new population for the species was discovered. The species appears to be semelparous, but not strictly an annual, and an "opportunistic" spawner: males were observed to be reproductive at approximately 11.5 mm SL, and females to be gravid at approximately 14.5 mm SL. Apparently restricted to Beaverdam Creek and Pryor Branch watersheds in Limestone County, Alabama, spring pygmy sunfish inhabit springs and spring-influenced areas characterized primarily by fine-leaved submersed plants (e.g., *Myriophyllum*, *Callitriche*, *Ceratophyllum*) as well as areas characterized primarily by emergent plants (e.g., *Polygonum*, *Nuphar*, *Lythrum*). Considering the widespread distribution and local abundance of the species in Beaverdam Creek watershed, the apparent success of two translocations to Pryor Branch watershed, and the fact that it has survived and continues to coexist with agricultural and animal husbandry landuse practices, including substantial modification especially of its spring habitats, the species does not appear to me to be a candidate for listing by the U. S. Fish and Wildlife Service as a threatened species, much less an endangered species. Emphasizing the importance of minimal mechanical disturbance, conservation of aquatic vegetation, and maintenance of a minimum pool level for all springs within these watersheds, especially those springs populated by *E. alabamae*, a conservation agreement between the U. S. Fish and Wildlife Service and landowners should assure continued healthy populations for the species.

WADING BIRDS IN THE MOBILE AREA: 1956 - 1997.
Julian L. Dusi, Dept. of Zoology & Wildlife Sciences,
Auburn Univ., Auburn University, AL 36849.
Rosemary D. Dusi, P. O. Box 742, Auburn, AL 36831.

The Mobile area has always been excellent for wading birds and their colonies. In 1956, James E. Keeler located the first White Ibis nesting colony for Alabama. Other colonies frequently were found in Mobile Delta near Spanish Fort. Cat Island has had a colony of mixed species since 1965. Gaillard Island, the dredge island in Mobile Bay near Theodore, has had Brown Pelican and heron colonies on it since 1987.

Abstracts

SURVEY RESULTS FROM THE FORT MCCLELLAN HERPETOFAUNAL INVENTORY AND MONITORING PROJECT (AUG 1996-MAR 1998). Jason R. Adams and George R. Cline, Dept. Of Biology, Jacksonville State University, Jacksonville, AL 36265

The goal of the North American Amphibian Monitoring Program (NAAMP) is to create a nationwide protocol for amphibian inventory and biological monitoring to accurately assess amphibian population dynamics. Establishing local inventories and monitoring amphibians is crucial to assess the status of these populations (Heyer, et. al. 1994). Fort McClellan, Alabama, has been documented (Whetstone et. al. 1996) to contain many diverse plant communities. Three areas on the Main Post which are being routinely monitored include Reilly Lake, Yahoo Lake, and Three Mile Pond on Range 19D. Several NAAMP protocols were utilized to monitor herp abundance including: 1) Time visual encounter surveys, 2) Extended road cruises, 3) Drift fencing, 4) Call chorus indexing and 5) Standard sweeps with a dip net. Results from an 18 month survey indicate that Fort McClellan contains ~90% of all herp species expected to occur in northeast Alabama including: 16 anurans, 11 caudatans, 5 lacertilians, 17 ophidians, and 7 chelonians.

POPULATION TREND ANALYSIS USING CALLING INDICES IN NORTHEASTERN ALABAMA WETLANDS. Jason R. Adams and George R. Cline, Dept. Of Biology, Jacksonville State University, Jacksonville, AL 36265.

Studies of reproductive habits of anurans in the United States have shown that some general patterns exist in the timing of breeding at specific sites (Wiest, 1981). Typical sites include temporal pools, ponds, lakes, streams, and other types of wetlands. Phenological studies of various durations have been reported (i.e. Goin and Goin 1953; Blair 1961; Murphy 1963) but little quantitative work has been conducted in the southeastern United States. Recent concerns about amphibian population declines have prompted the development of standardized methods for analyzing population size using call chorus indices. We used the Wisconsin Calling Index (0,1,2,3) for monitoring chorus intensity at 3 wetlands on Fort McClellan in Northeast Alabama. Calling indices are discussed for anuran species. Breeding phenologies varied in starting dates, but the patterns observed were similar at all sites.

PLANT COMMUNITIES OF LITTLE RIVER CANYON,
DEKALB COUNTY, ALABAMA. Althea I. Thompson, K. R. Brodeur,
S. J. Threlkeld, T. L. Hofmann, and R. D. Whetstone, Herbarium, Jacksonville
State University, Jacksonville, Alabama 36265.

Little River Canyon is located within the Cumberland Plateau section of the Appalachian Highland physiographic region of Alabama. Studies performed over the last seventeen years show that Little River Canyon is an area rich in plant biodiversity. Little River Canyon contains many distinct plant communities, including: Oak-Hickory, Pine, and Riparian communities. Each of these communities contain many species that are of special concern. Species of special concern include disjuncts (populations that occur outside of the known range), taxa known only from coastal, or montane areas, and endemics (native species that have a very restricted range). These communities occupy a range of habitats from managed to natural environments.

PRELIMINARY RESULTS OF A FLORA OF LIMESTONE
COUNTY, ALABAMA. Timothy L. Hofmann and R. David Whetstone,
Herbarium, Department of Biology, Jacksonville State University, Jacksonville,
Alabama 36265.

Limestone County is located in north central Alabama and lies within the Interior Low Plateau physiographic province. A vascular plant survey was begun in Limestone County, Alabama, in 1997. To this point, over five hundred species have been documented. Numerous county records and range extensions are included among these data. State listed species include: *Claytonia caroliniana*, *Erythronium albidum*, *Lesquerella densipila*, *Lilium canadense*, and *Minuartia muriculata*. Continued plant collecting is planned for 1998 to document a representative flora of the county.

A VASCULAR FLORA OF MADISON COUNTY, ALABAMA.
Steven J. Threlkeld, Herbarium, Department of Biology, Jacksonville State
University, Jacksonville Alabama 36265

A vascular flora is documented for Madison County located in North Alabama. The study area lies within the Interior Low Plateau and the Appalachian Plateau. Ten major plant communities are defined within the County. A total of 862 specific and infraspecific taxa representing 458 genera and 132 families are documented for the County. Fifty-seven species are listed by state or federal agencies as rare, threatened or endangered in Alabama. One hundred and thirty species in the County are non-native and growing outside of cultivation comprising 15.0% of flora.

BRASSICA RAPA GROWTH UNDER THE INFLUENCE OF EXOGENOUS GIBBERELIC ACID. Emily B. Baggett and Jeanette Runquist, Department of Biology, Birmingham-Southern College, Birmingham, AL 35254.

Brassica rapa appears in two forms, wild-type and rosette, a mutant form. The mutant form of this plant has an inhibition of the hormone gibberellic acid resulting in a decreased shoot elongation. The exogenous application of gibberellic acid has been known to promote bolting or rapid shoot elongation and, in some cases, compensate for the lack of gibberellic acid. This causes the phenotype of the rosette plants to appear the same as the phenotype of the normal plants. In this experiment, the wild-type and the rosette plants were grown with a control group, by applying water, and a group with every other day application of gibberellic acid. The heights of each plant were recorded and analyzed. The findings were that the wild type plants with gibberellic acid did not have a significant increase in growth when compared to the wild type plants with water ($p=0.91$). The rosette plants with gibberellic acid did have a significant increase in growth when compared to the rosette plants with water ($p=0.00$). When the gibberellic acid was tested to find the day of first effect, it appeared that the time interval between day 9 and day 11 was most significant ($p=0.015$). In fact, it was concluded that the exogenous applications of gibberellic acid actually compensated for the inhibited gibberellic acid in rosette plants ($p=0.57$).

ADDITIONAL NOTEWORTHY VASCULAR PLANTS OF THE MOBILE REGION. Michel G. Lelong, Department of Biological Sciences, University of South Alabama, Mobile, AL. 36688.

The following vascular plants collected in Mobile and/or Baldwin Counties represent new or noteworthy records: Anemone berlandieri, Anthoxanthum aristatum, Botrychium jenmanni, Diplazium japonicum, Drymaria cordata, Eragrostis atrovirens, Hydrilla verticillata, Lilaeopsis carolinensis, Medicago minima, Paspalum minus, Paspalum pubiflorum, Pennisetum glaucum, Phyllanthus tenellus, Portulaca amilis, Pteris multifida, Pteris vittata, Quercus austrina, Richardia humistrata, Salvinia minima, Setaria sphacelata, Scleranthus annuus, Spermolepis inermis, Thelypteris hispidula var. versicolor and Trifolium lappaceum.

INSECTICIDAL PROTEIN PRODUCTION VIA CHLOROPLAST TRANSFORMATION. Nelson Moseley, William Moar, and Henry Daniell, Dept. of Botany and Microbiology, Auburn Univ., Auburn, Al. 36830.

The problems associated with the use of conventional insecticides has necessitated the discovery of more efficient and environmentally-friendly means of combating insects. Insecticidal proteins produced by the soil bacterium, Bacillus thuringiensis (B.t.), have been used for years as an alternative to synthetic chemical insecticides. In the effort of achieving optimal economic control in the field with B.t., transgenic plants were designed to continuously express B.t. in all plant tissues, even though the amount of protein expression was less than desired. Increased concern has been raised regarding the buildup of insect resistance to these proteins expressed in plants. One solution could be the use of a protein with a different spectrum of activity, such as CryIIA, which has been shown to overcome typical B.t. resistance in some insects. Additionally, an increase in the level of CryIIA protein expression can be achieved via chloroplast transformation, because there are about 10,000 copies of the chloroplast genome per cell versus only two copies of the nuclear genome. This would result in an increased host range, thereby significantly reducing the amount of chemical insecticides necessary to combat insects.

Traditionally, transgenic plants have been genetically engineered in the nucleus. Chloroplast plasmid constructs are more complex, because they require unique chloroplast DNA borders for CryIIA integration. Construction of a plasmid vector containing the CryIIA gene is complete. Experiments are now underway to transform the tobacco chloroplast via microprojectile bombardment with the gene gun. The bombarded plant tissues will be regenerated, yielding the transgenic tobacco plants.

VEGETATION AT OAK MOUNTAIN STATE PARK. D. Keener Morrow, J.S.U. Herbarium, Dept. of Biology, Jacksonville State University, Jacksonville, AL 35125.

Oak Mountain State Park is the largest State Park in Alabama at approximately 4,000 hectares. Located in Shelby County, the park is at the southern end of the Cahaba Valley district of the Tennessee section of the Ridge and Valley Province of the Appalachian Highlands division. This park was created in the late 1960's as a day use park for multiple activities and is a wildlife preserve. One of the major visions of the park was its ability to act as an educational tool due to its location, size, and physical features. This area is an important green way that acts as a buffer for vegetation and wildlife that has been relatively undisturbed for nearly a century. Throughout the park, the physical nature of the land dictates a definite distinction in the variation among plant communities. To study the woody plant community structure, the releve method was chosen and implemented on the western slope of Double Oak Mountain including ridgeline vegetation. Species were assigned importance values and species diversity was determined using the Shannon-Weiner index of diversity. This sample analysis relates the species composition and importance found upon Double Oak Mountain. The microhabitats at O.M.S.P. vary greatly in community structure and physical features, hence the need for defining the micro-habitats as well as the parks' macro-habitat. Defining the vegetation promotes a greater understanding of the park and its boundaries.

EFFECTS OF RECOMBINANT MOLT-INHIBITING HORMONE ON ECDYSTEROID SECRETION BY CRUSTACEAN Y-ORGANS *IN VITRO*. Kara J. Lee and R. Douglas Watson. Dept. of Biology, University of Alabama at Birmingham, AL 35294.

Molt-inhibiting hormone (MIH) regulates the secretion of ecdysteroids by crustacean Y-organs. The availability of recombinant MIH would facilitate investigation of its structure and function. In studies reported here, a baculovirus expression system was used to produce recombinant MIH. A portion of a cDNA encoding MIH of the blue crab, *Callinectes sapidus*, was inserted into a baculovirus transfer vector (pBluBacIII) designed to yield a fully processed MIH. Western blot results (using antiserum raised against MIH of *Carcinus maenas*) indicated abundant expression of an MIH-immunoreactive protein (~9 kD). Cell lysates containing the recombinant protein were tested for their ability to suppress ecdysteroid secretion by Y-organs *in vitro*. Lysates containing the recombinant protein inhibited ecdysteroid secretion in a dose-dependent manner; maximal inhibition was 44%. Lysates from non-infected cells did not inhibit ecdysteroid secretion.

Supported by NSF IBN-9419916, NOAA/MS-AL Sea Grant NA56RG0129, and the Alabama Academy of Science.

PENETRATION RATES, GENERATION TIMES AND CONCURRENT GROWTH OF *TOXOPLASMA GONDII* AND *NEOSPORA CANINUM* *IN VITRO*. B.H. Estridge and C. A. Sundermann. Dept. Zoology-Wildlife Sciences, Auburn University, AL.

This study compares *in vitro* host cell penetration rates, generation times and concurrent growth of isolates of *Toxoplasma gondii* and *Neospora caninum*, two closely related coccidians that parasitize nucleated cells of birds and mammals. Monolayers of human foreskin fibroblast (FSF) cells propagated in tissue culture flasks or on culture slides were used as host cells for the parasites. For penetration rate, 20,000 tachyzoites were inoculated to triplicate wells of culture slides, wells were rinsed at 1 and 3 h, slides were stained, and intracellular tachyzoites counted. For generation time, culture slides were inoculated as for penetration rate, wells were rinsed at 3 h, and slides were incubated for various times up to 30 h. At timed intervals, slides were stained and intracellular tachyzoites were counted. Results of regression analyses showed that *N. caninum* penetrated host cells up to three times faster than *T. gondii*, but generation time of *T. gondii* was 6 h compared to 15 h for *N. caninum*. For concurrent growth, flasks of FSF cells inoculated with equal numbers of *N. caninum* and *T. gondii* tachyzoites were incubated until monolayer was 90% lysed (3-4 da). Tachyzoites were harvested, filtered, counted, sampled and passed to new flasks; this procedure was repeated for up to 30 days post inoculation (DPI). At each passage (and at initial inoculation) aliquots of tachyzoites were stained using species-specific monoclonal antibodies/peroxidase label and tachyzoites of each species were counted. Although *N. caninum* penetrated cells at a higher rate, *T. gondii* was the predominate species by 20 DPI. Supported by the Ala. Agricultural Experiment Station.

ESCHERICHIA COLI HOST GENES ARE NOT INVOLVED IN IS2 EXCISION. Joy E. Bagley and Richard E. Musso, Department of Botany and Microbiology, Auburn University, AL 36849.

Transposable elements (TE) encode genes for proteins necessary for their transposition process. The bacterial TE IS2 codes two proteins involved in the transposition and excision processes. Some TE also require host proteins encoded outside the TE which are involved in transposition. So far, no host proteins are known to be involved in the IS2 transposition or excision processes. We have developed a quantitative but indirect assay for excision based on reversion of a *gal-IS2* mutant to a Gal⁺ phenotype. Using this convenient assay, we have tested mutations in ten genes for proteins thought to be involved in transposition of other elements; none of these affected the IS2 excision frequency. To search for other possible host genes, we used transposon mutagenesis. Among 20,000 mutants, none showed elevated but several showed reduced apparent excision rates. The latter were mapped to fourteen different loci. Sequencing of two of these indicated that the mutated genes were required for the assay phenotype rather than directly for IS2 excision. We therefore developed a direct assay for IS2 excision and tested the fourteen host mutants. None produced significant changes in IS2 excision. Thus it appears that there are no host genes involved in the IS2 excision process.

This research has been supported by the Howard Hughes Medical Institute and the Alabama Agricultural Experiment Station.

PHOTOTACTIC RESPONSES OF RHIZOCEPHALAN LARVAE AS A FUNCTION OF WAVELENGTH. Adriane C. Cej and Jack J. O'Brien Dept. Biol. Sci., Univ. South Alabama, Mobile, AL 36688.

Loxothylacus texanus is a parasitic barnacle that castrates blue crabs in the Gulf of Mexico. Larvae of the parasite are released as nauplii and within two to three days metamorphose into cypris larvae that either infect new hosts or inseminate female parasites. Both nauplii and cyprids were exposed independently for 10 minutes to a unidirectional beam of light of a specific wavelength (400-700nm; 50 nm increments) in a 40 ml chamber. Following exposure, a divider isolated larvae into either of two subchambers that were either proximal or distal to the light source. Positive phototaxis was defined as a significantly greater percentage of exposed larvae in the proximal subchamber than larvae maintained in the dark (49-50%) Nauplii exhibited pronounced positive phototaxis (72-87%) at wavelengths between 400-600 nm. Cypris larval response was more ambivalent; they exhibited only a slight (62-65%) positive phototaxis over a narrow range of wavelengths (550-650 nm). These data suggest that nauplii probably concentrate in surface waters (at least during the day), a behavior that would increase dispersion of the parasite. Cyprids (even on sunny days) would be more likely to found in deeper regions of estuaries where they would encounter hosts vulnerable to infection.

THE USE OF PCR TO DETECT RHIZOCEPHALAN PARASITES IN CRAB HOSTS. Andrew M. Woodard, Tim D. Sherman and Jack J. O'Brien. Dept. Biol. Sci., Univ. South Alabama, Mobile, AL 36688.

Within the Gulf of Mexico the rhizocephalan, *Loxothylacus texanus*, is an important economic pest of the blue crab fishery; parasitized blue crabs are castrated and do not grow to harvestable size. Seasonal and annual variation of parasite prevalences suggest that the success rate of parasitization is affected by either host defense mechanisms and/or environmental conditions. In order to understand the mechanisms causing variations in parasite prevalence, to predict the annual loss to the fishery caused by the parasite, and to develop management policies that would increase harvest yields by reducing parasitism, it will be necessary to pinpoint where and when crabs are infected in local estuaries. To address this need we have developed an assay using the polymerase chain reaction (PCR). This sensitive technique can detect as little as a few strands of parasite DNA in either the hepatopancreas or claw muscle tissue of a host crab. We have been able to identify parasitized crabs as parasitized within days following infection in the laboratory.

EFFECTS OF CIGARETTE SMOKE ON THE BEAT FREQUENCY OF MAMMALIAN AIRWAY EPITHELIUM AS DETERMINED BY FFT ANALYSIS. Darrell D. Morgan and Anthony G. Moss. Dept. of Zoology and Wildlife Science, Auburn University, Auburn, AL 36849-5414.

Herein we describe a simple approach to analyze biological systems that undergo rapid periodic movement, such as ciliary motion, using a laser scanning confocal microscope (LSCM) and an analog-to-digital computer converter/analyzer. Our system is able to analyze high frequency activity and as a result our data are very accurate and reliable. This system is attractive because it requires only minor macro-programming by the investigator and can be readily assembled from currently available commercial hardware and software. Furthermore, the LSCM and attendant imaging devices (photomultipliers and photodiode arrays) allows us to analyze ciliary and flagellar movement from a variety of preparations in several different imaging modes, taking advantage of the unique spatial control over imaging available only in a confocal microscope. Our arrangement allows transmitted imaging in two modes (illumination by laser or tungsten lamp), by fluorescence, and by reflectance. The Kr-Ar laser allows us to select laser lines that are most suitable to the preparation. Analysis of bivalve cilia treated with the neurociliary agonist 5-hydroxytryptamine (5-HT) reveals an increase in ciliary beat frequency (CBF). *Chlamydomonas reinhardtii* analysis supports the hypothesis that the outer dynein arm is differentially regulated between the *cis* and *trans* flagella, and reveals the ciliomodulatory effects of photokinesis. Analysis of normal ciliated epithelia demonstrates CBF at 6, 12, 18 and 29s⁻¹, whereas cilia exposed to a single cigarette display similar, lower power frequencies and multiple frequencies at values up to 65s⁻¹. Cilia exposed to the smoke of five cigarettes demonstrate a rapid and continual decrease in CBF with ciliostasis occurring 30 min. post-exposure.

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PATTERNS OF VITELLIN PROCESSING AND PROTEIN SYNTHESIS DURING EMBRYOGENESIS IN *ACHETA DOMESTICUS*. B. H. Estridge, H. Handley and J. T. Bradley. Dept. Zoology, Auburn University, AL 36849 USA.

During embryogenesis, insect embryos utilize phospholipoglycoproteins called vitellins (VN) that are sequestered from the hemolymph during vitellogenesis and stored within the eggs. To examine the time course of VN proteolytic processing during embryogenesis in *Acheta domesticus*, oviposited eggs incubated at 28°C were sampled over the 14-day period. The eggs were subjected to polyacrylamide gel electrophoresis (PAGE), peptide mapping, immunoblotting, radiolabeling, and gelatin lysis assays (GLA). Yolk polypeptides (YP) I-IV were present throughout the period of embryogenesis, with the levels decreasing as development progressed. A previously unreported 107 kD VN polypeptide, designated YPIIb, was observed in vitellogenic and oviposited eggs and was found to be a subunit of native vitellogenin/vitellin (VG/VN) I. More than 30 embryo polypeptides (EP) (polypeptides appearing after embryogenesis begins but absent from ovulated, unoviposited eggs) were observed via PAGE. Radiolabeling, peptide mapping, and immunoblotting experiments showed that EPs 1-3, 6 and 7 appeared during the first 24 h of embryogenesis (blastoderm formation) and derived from single, different YPs; EPs 4 and 5 appeared and increased between days 4 and 6 of embryogenesis and were synthesized *de novo*. GLAs performed using homogenates of eggs 0-4 da post-oviposition indicated that protease activity (opt. pH 7.0) was absent 0-3 h after oviposition but was present 14 h-4 da following oviposition. The mechanisms regulating VN processing and the relationship of protease activity in developing eggs to the formation of EPs from VN is currently under study. Supported by the Ala. Agricultural Experiment Station.

BIOCHEMICAL COMPOSITION AND STRUCTURE OF NUAGE-LIKE BODIES IN CRICKET OOCYTES. ((M.L. Falany and J.T. Bradley)) Department of Zoology, Auburn University, Auburn, AL 36849.

In developing oocytes of many animals there are congregations of organelles called nuage bodies that form adjacent to the nucleus. Nomarski optics provide clear images of the development of nuage bodies in oocytes of the cricket, *Acheta domesticus*. Two nuage bodies develop adjacent to the germinal vesicle inside previtellogenic oocytes. One faces each pole of the oblong shaped oocyte, and as oocyte growth continues, the nuage bodies migrate to the poles and then disintegrate. Confocal laser scanning microscopy shows concentrations of alpha-tubulin, mitochondria, and material reactive with the antibody MAB 2D1 (against a vitellin polypeptide) in the nuage bodies. The presence of mitochondria in sizeable amounts in the nuage bodies of last nymphal instar crickets was demonstrated by indirect immunofluorescence and FITC-labeled secondary antibody. The reactivity of cricket nuage bodies with anti-clathrin and anti-calmodulin has also been examined. Nuage bodies develop adjacent to the nucleus of each oocyte, migrate to the poles of the cell, and disintegrate; the presence of tubulin suggests that the bodies may play a role in the organization of the cytoplasm in developing oocytes. (Supported by Alabama Agricultural Experiment Station Project 862 to J.T. B. and Howard Hughes Medical Institute Science Scholars Program).

PHOTOTACTIC RESPONSES OF RHIZOCEPHALAN NAUPLIAR LARVAE AT A HALOCLINE. Ed I. Hed and Jack J. O'Brien. Dept. Biol. Sci., Univ. South Alabama, Mobile, AL 36688.

The naupliar larval stage of the parasitic barnacle, *Loxothylacus texanus*, exhibits positive phototaxis suggesting that on sunny days nauplii concentrate in surface waters. Although larval presence in surface waters could result in greater larval dispersion by wind-driven currents, there are situations where it could also be maladaptive. Nauplii do not survive at salinities less than 15‰ and Gulf Coast estuaries are often stratified; light, fresh water can sit for days above dense, saline, bottom water. In this environment, positive phototaxis would increase the likelihood that larvae would encounter salinities exceeding their osmoregulatory capabilities. We examined the phototactic behavior of *L. texanus* nauplii at haloclines or interfaces between water masses of different salinities. Solutions of saltwater at 10, 14, 17, 20, & 24‰ were dyed with food coloring. Haloclines were created in either a SDS slab gel apparatus or a 100 ml graduated cylinder. Nauplii were introduced into the bottom solution and their responses to a light from above were observed. Nauplii moved upward toward the light (positive phototaxis) until they entered a water mass with a salinity 14‰ or less. At this time, the larvae ceased moving their appendages. Since they were immobile rather than actively swimming away from light, this response was not deemed true negative phototaxis. Immobilized nauplii sank below the halocline and continued passively drifting deeper into the saltier water. When larvae did resume moving, they quickly swam upward through the halocline whereupon they became immobile and the cycle was repeated. The overall effect of these differential responses was that at any one time most larvae were passively drifting in a narrow region immediately below the halocline.

GIS DELINEATION OF MICROHABITAT IN AN AQUATIC SYSTEM Michael A. Measels, (Dr. Paul Blanchard), Biology Department, Samford University, 800 Lakeshore Drive, Birmingham, AL 35229

A Geographic Information System (GIS) is a useful tool in the area of aquatic system modeling due to its capability for database analysis associated with a spatial display. The system provides the user with the ability to examine and visualize data so that the decision making process can be facilitated. This study focuses on using GIS technology and global positioning systems (GPS) technology as tools in analyzing and studying different effects and parameters of water quality and stream characteristics related to the habitat and sustainability of *Etheostoma chermocki*, the vermilion darter, a potentially threatened species that occurs in a unique habitat in Jefferson County, Alabama.

THE FIRST RECORDED DISTRIBUTION OF THE PURSEWEB SPIDER, SPHODROS RUFIPES (FAMILY ATYPIDAE, FROM ALABAMA. Rose M. Parrino, W. Mike Howell, and Ronald L. Jenkins, Department of Biology, Samford Univ., Birmingham, AL 35229.

The spider family Atypidae is an ancient branch of the infraorder Mygalomorphae. This family has been recorded for most of the southeastern U. S., but no records have been documented for Alabama. The purpose of this report is to officially record the purseweb spider, Sphodros rufipes Latreille from Alabama. The name "Purseweb Spider" refers to the tough, tubular, camouflaged web constructed in the ground at the base of a tree, prolonged aerially up the side, and attached to the bark. When an insect disturbs the surface of the web, the spider reacts by biting its prey through the tube, cutting a slit, pulling the prey inside and consuming it. S. rufipes has been previously found at 4 sites in TN, 2 in NC, 0 in SC, 1 in GA, 6 in northern FL, 2 in MS, 4 in LA, 1 in TX and 0 in AL (Gertsch and Platnick, 1980, Amer. Mus. Novitates No. 2704:1-39, figs. 1-60). A population of S. rufipes was discovered at Ruffner Mountain Nature Center, Jefferson Co, AL (T17S, R2W S13), on 16 Oct. 1997. The aerial portion of the web was 140 mm in length and uniformly 20 mm in width. Excavation and opening of the 160 mm underground portion of the web found that it contained a large female 25 mm in total body length. The web also contained approximately 228 spiderlings, each 2.5 mm in total body length. The adult and 10 spiderlings were preserved and deposited in the American Museum of Natural History where Dr. Norman Platnick verified them as S. rufipes. The remaining young were returned to the site.

SELENIUM ACCUMULATION IN PLANTS: AN HERBIVORY DEFENSE MECHANISM? Jessica R. Ward and Dr. Robert Boyd, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849-5407.

Selenium is an essential micronutrient for all animals, including humans. Due to a low threshold for toxicity, high levels of selenium cause severe problems and death in animals. Certain plants accumulate high amounts of selenium in their tissues. This fact is interesting because selenium is not a required nutrient for plants. It is believed that the selenium accumulation may then be an herbivory defense mechanism. Herbivores would consume plant tissue, including the selenium, thus poisoning them and causing decreased fecundity and increased mortality. Research has provided some clues to the mechanism of selenium uptake and storage within the plant, but has yet to focus on the ecological function of selenium accumulation. Thus, in this study we examine what we believe to be the ecological function of selenium accumulation. This work is supported by a grant from Auburn University and the Howard Hughes Medical Institute through the Auburn University Future Life Science Scholars Program.

Abstracts

FUMARATE REDUCTASE INHIBITORS AS POTENTIAL DRUGS AGAINST CHAGAS DISEASE. Julio F. Turrens and Benjamin P. Watts, Jr., Department of Biomedical Sciences, University of South Alabama, Mobile, AL 36688. Li Zhong and Roberto Docampo, Department of Pathobiology, University of Illinois at Urbana-Champaign, Urbana, IL 61801.

The enzyme NADH-fumarate reductase is present in several parasitic protozoa of the genus *Trypanosoma* including *T. cruzi*, the parasite that causes Chagas' disease. This enzyme is not found in mammalian cells. The product of fumarate reductase, succinate, serves two major roles in these parasites: it provides one of the main respiratory substrates for energy production, and it also constitutes a route for the elimination of excessive reduction equivalents (similar to lactate dehydrogenase in mammals, an enzyme missing in trypanosomatids). The lack of fumarate reductase in mammalian cells provides a unique target against Chagas' disease. Several nitro-imidazoles and benzimidazoles, some of which are currently used for the treatment of either Chagas' disease or helminthiases, are powerful fumarate reductase inhibitors. Other non-imidazolic antihelminths such as the drug L-092,201 (developed by Merck, Sharp and Dohme against the form of fumarate reductase found in *Haemonchus contortus*) have also been found to inhibit the enzyme fumarate reductase from *T. brucei* and the growth of procyclic trypomastigotes in culture. One of the precursors of the drug L-092,201, 2-mercapto-pyridine-N-oxide (MPNO) not only inhibits fumarate reductase of *T. cruzi*, but also inhibits epimastigote (culture form) and amastigote (intracellular parasite) growth in either cultures or infected mammalian myoblasts. MPNO did not affect mammalian cells. In summary, a variety of compounds which only have in common their inhibitory effect on the enzyme fumarate reductase inhibit *T. cruzi* growth, suggesting that inhibition of this enzyme is a suitable target against Chagas' disease. (Supported by PSH grants #R15AI39692-01 to JFT).

EXPERIMENTAL STUDIES OF NEW TYPES OF ANTIFREEZE PROTEINS. Travis J. Rutland and Andre Wierzbicki, Dept. of Chemistry, Univ. of South Ala., Mobile, AL 36688. Mark Hamman, Dept. Pharmacognosy, Univ. of Mississippi, University, MS 38677

Several species of fish, plants, and insects that live in cold environments are able to prevent tissue damage from freezing by producing antifreeze proteins or antifreeze glycoproteins. These proteins inhibit ice growth below the equilibrium freezing point of water. The main focus of investigation of these macromolecules has been placed on the polar fishes. Taking into account structural differences, the fish antifreezes have been classified into four main categories: Type I, II, III, and IV. These proteins are very interesting in that, although they have significant structural differences, they all have similar functionality. The ability to noncolligatively depress the freezing point of a solution is believed to be attributed to the unique stereospecificity of interactions between these proteins and ice. The protein actually become incorporated into the crystalline lattice of water via several key amino acid residues (i.e. thr, val, ala, lys, arg). In recent efforts, we have found a protein from the Antarctic Sponge *Homaxonella balfourensis* which exhibits thermal hysteresis. It is also noted that ice crystals grown in solutions of this protein exhibit the bipyramidal morphology characteristic of other antifreeze proteins. Purification attempts, along with primary, secondary, and tertiary structure determinations are currently underway.

Abstracts

STUDIES EVALUATING AMYLASE AND ACID PHOSPHATASE IN RABBIT SECRETIONS. Kaggia K. Scott, LaShaundra Perry, Ovuke Emonina, LaShanda McCants, Lydell Collier, Dewight Cowley, Debbie Carswell, Adriel D. Johnson, Dept. of Biological Sciences, Univ. of Alabama in Huntsville, Huntsville, AL 35899. Jacqueline U. Johnson, Dept. of Plant, Soil, and Animal Science, Alabama A&M Univ., Normal, AL 35762. Aimee Hulede, Dept. of Biology, Tuskegee Univ., Tuskegee, AL 36088.

Little is known about the changes in enzymatic activity in secretions associated with reproductive function in rabbits. It was demonstrated in parous and infertile women during the phases of the menstrual cycle that low amylase activity in uterine fluid may cause high acid phosphatase activity which may be indicative of infertility (Singh, 1995, *Horm. Metab. Res.*). In our preliminary studies, New Zealand White rabbits were used to determine enzymatic changes in estrus and non-estrus animals. Techniques were developed to collect uterine, vaginal, and salivary secretions. Collected secretions were assayed for amylase and acid phosphatase activities using spectrophotometric quantitative kinetic procedures. Vaginal smears were compared histologically for estrus and non-estrus rabbits. Tests were conducted on antibacterial activity of the secretions using 4 opportunistic bacteria *S. aureus*, *S. typhimurium*, *P. aeruginosa*, and *S. pneumoniae*. Results from these preliminary studies revealed low enzymatic activities and no antibacterial characteristics in the secretions. It was concluded that all fluids should be concentrated to facilitate measurement of significant levels of enzymatic activity, which could then determine whether a correlation exist between amylase and acid phosphatase activities during the phases of the estrous cycle in rabbits.

ENZYMES IN PARTNERSHIP WITH ION CHANNELS; PHOSPHORYLATION IN THE OLFACTORY BULB. Debra A. Fadool and Kristal Tucker. *Department of Zoology and Wildlife, Auburn University, Auburn, AL 36830.*

We are studying the regulation of ion channels by protein tyrosine kinases (TKs) using olfactory bulb neurons (OBNs) and a cloned voltage-dependent potassium channel, Kv1.3, as models. Rat OBNs, which express Kv1.3 channels, had whole-cell outward currents that were suppressed by picomolar quantities of margatoxin and showed a slow inactivation that increased over a 10 minute period. The insulin receptor TK was detected in the OB by Western analysis. Exogenous application of insulin was found to suppress whole-cell outward current in all OBNs tested in a time dependent manner. Perfusion of the non-receptor Src kinase likewise suppressed outward current. Current was not suppressed with heat-inactivated Src or when ATP was excluded from the pipette solution. The membrane permeant tyrosine phosphatase inhibitor, pervanadate, was found to suppress current in a subset of neurons, implying the presence of an endogenous tyrosine kinase in these neurons. Using site-directed mutagenesis of six tyrosine residues contained within good recognition motifs for tyrosine phosphorylation, we constructed conservative Y to F mutations in the Kv1.3 cDNA and expressed the Kv1.3 channels in HEK 293 cells. We found that Tyr⁴⁴⁹ is a target for both the pervanadate- and Src-induced suppression of Kv1.3 current; Tyr^{111,112,113} are also important for modulation by pervanadate; and Tyr¹³⁷ is a target for modulation by Src. In summary, tyrosine phosphorylation of Kv1.3 and related channels may be involved in the modulation of OBN excitability.

Supported by NIH grant R29DC03387-01

A STUDY OF ANURAN COMMUNICATION AND SPECIES DIVERSITY IN THE HOLLIS LAKE AREA, POSSUM TROT ROAD, CALHOUN COUNTY, AL.

Jacqueline Carter, Jon Gilbert, Stacy Dunn, Scott Clifton, and George R. Cline, Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265.

Amphibian populations have been declining since the early 1990's. This particular site studied is located off Possum Trot Road near a beaver pond adjoining Hollis Lake. The site is located approximately fifteen miles north of Jacksonville, Alabama. This study will establish baseline data for future comparisons to discover if these particular populations in Alabama are in decline. NAAMP protocols were followed and a four-month period, February 1997—May 1997 was investigated. Breeding phenology is classified on the basis of the calling indices developed within the NAAMP protocols (4 levels) and whether a species is an explosive breeder or a prolonged breeder. By recording calling indices over time a species breeding type may be discerned, i.e., whether its an explosive breeder or a prolonged breeder. At this location, twelve anuran species were identified. *Bufo americanus* usually considered an explosive breeder, called at level 2 sporadically for March through May, with a few spikes to level 3 calling. *Pseudacris crucifer*, a species with a more prolonged breeding season, generally maintained level 3 choruses from February through April, before becoming sporadic and less intense through May. Thus, recorded calling indices, in general for these 12 species, confirmed the reported breeding phenology.

LOCALIZATION OF THE INSULIN RECEPTOR IN THE OLFACTORY BULB OF THE RAT. Joseph J. Phillips, Felicia A. Murphy, Kristal Tucker, and Debra A. Fadool, *Department of Zoology and Wildlife, Auburn University, Auburn, AL 36830.*

Insulin activates a number of signaling pathways that regulate cellular metabolism and growth. Because we have previously shown that acute insulin application to olfactory bulb neurons causes current suppression of potassium channels (Kv1.3), the IR may play a secondary role in ion channel modulation via tyrosine phosphorylation in this area of the brain. We have now demonstrated by SDS-PAGE followed by Western analysis that the beta subunit of the insulin receptor (IR) is developmentally expressed in the rat olfactory bulb (OB) across postnatal (P) stages ranging from P1 to P60. Rat OBs were fixed, cryoprotected, sectioned at 12 um thickness, and then immunostained with polyclonal antibodies (Ab) directed against neurofilament 160, the IR, the Kv1.3 channel, or a combination. Positive immunolabeled cells were compared with immunolabeling observed in human embryonic kidney (HEK) 293 cells transiently transfected with cDNA for either human IR, Kv1.3 ion channels, or both constructs. Cells or sections were viewed with an Olympus CH-2 microscope equipped with fluorescence and by a BioRad MRC-1000 laser scanning confocal microscope. Observation of the rat OB sections suggests that IR may be located within the glomerular layer during early postnatal stages, although it appears that IR probably migrates as development proceeds to P17. The evidence also demonstrates that IR is located in the same neurons as the Kv1.3 channel. *This research was supported by an undergraduate Research Grant-In-Aid from the Department of Botany and Microbiology, Auburn University and NIH grant R29DC03387-01.*

THE MODERATING INFLUENCE OF CORPORATE PHILANTHROPY ON THE RELATIONSHIP BETWEEN CORPORATE CRIMINAL ACTIVITY AND CORPORATE REPUTATION. Robert J. Williams, Gerald Crawford, and Robert Sweeney, College of Business, University of North Alabama, Florence, AL 35632

This study examined the influence of corporate giving programs on the link between selected categories of corporate crime and corporate reputation. A sample of 168 corporations was drawn from a population comprised of Fortune 500 firms. Specifically, firms that violate EPA and OSHA regulations should, to some extent, experience a decline in their reputations. Conversely, firms that contribute to charitable activities, such as education, the arts, and various social programs, should see their reputations enhanced.

The results of the study support both of these contentions. Further, the results also suggest that corporate giving significantly moderates the link between the number of EPA and OSHA violations committed by a firm and its reputation. Thus, while a firm's reputation can be diminished by its violation of various government regulations, the extent of the decline in reputation can be significantly reduced by means of its level of charitable giving. Simply stated, the decline in a firm's reputation can be lessened through its giving activities. While a firm may not be able to buy its way out of trouble, a significant giving program may help a firm to preserve its reputation.

A CHECKLIST OF THE VASCULAR FLORA OF PIKE COUNTY, ALABAMA. Alvin R. Diamond, Jr. and Charles P. Chapman, Department of Biology, Troy State University, Troy AL 36082.

Based on field studies and research of herbarium collections and literature records, the vascular flora of Pike County contains 1078 species in 552 genera and 148 families. The county lies in southeast Alabama in the Eastern Red Hills subdivision of the Coastal Plain Province. Thirty-nine of the species reported appear on the Inventory List of Rare, Threatened and Endangered Plants, Animals and Natural Communities of Alabama as compiled by the Alabama Natural Heritage Program. Two hundred seventeen of the species, or 20.13 percent of the flora are considered non-indigenous. Forty five of the species previously reported for the county were not re-collected in this study. Families with the largest number of species were Asteraceae (120), Poaceae (114), Fabaceae (79), Cyperaceae (61), Rosaceae (38), and Liliaceae (35).

CLUTCH SIZES IN THE ALABAMA REDBELLY TURTLE
(*PSEUDEMYX ALABAMENSIS*) AS DETERMINED BY X-RAY
RADIOGRAPHY. William M. Turner and David H. Nelson, Department of
Biological Sciences, University of South Alabama, Mobile, AL 36688

To determine the maximum clutch size for the Alabama Redbelly turtle (*Pseudemys alabamensis*), 19 gravid females were collected from Gravine Island on the Tensaw River (Baldwin Co.) from 10 June 1997 to 1 July 1997. Another gravid specimen was collected from the Alabama River (Baldwin Co.) on 23 June 1997. All turtles were captured in aquatic hoop traps. Turtles were x-rayed to determine the clutch sizes. Clutch sizes ranged from 2 to 17 eggs (mean = 13.95; mode = 14). These numbers are considerably higher than earlier estimates that place clutch sizes between 3 and 9 eggs. Egg size was determined by measuring six intact eggs from a dead female turtle collected in the Blakeley River (Baldwin Co.) in 1996. Egg length ranged from 3.4 mm to 3.8 mm (\bar{x} = 3.6 mm). Egg diameter was found to range from 2.3 mm to 2.4 mm (\bar{x} = 2.35 mm).

COMMUNITY, HABITAT INTERACTIONS, AND THE FEEDING PREFERENCES
OF THE STRIPED HERMIT CRAB *CLIBANARIUS VITTATUS* (BOSC) AT DAUPHIN
ISLAND, AL. Jennifer J. Harrison and Thomas S. Hopkins, Department of Biological Sciences,
Univ. of Ala., Tuscaloosa, AL. 35487.

The feeding preference of the hermit crab *Clibanarius vittatus* was determined from four food sources, *Bryopsis* sp. (green algae), *Ectocarpus* sp. (brown algae), *Leiostomus xanthurus* (fish), and *Palaemonetes* sp. (grass shrimp). Observations were made to compare the behavior of sub-populations of this species between those found on Dauphin Island, Al. and those groups after being housed in the laboratory. Animal matter was found to be preferred to algal matter. The most preferred choice was the grass shrimp *Palaemonetes* sp. ($p < 0.001$). *Palaemonetes* sp. was also found to have the highest electivity index. However, the food source *Ectocarpus* sp. was the highest total biomass consumed and had the highest profitability ratio at 0.0787 g/min. The profitability ratio of *Ectocarpus* sp. was found to be significantly different from the other three sources ($p < 0.0001$). From these findings, the preferred food choice did not correlate with the highest profitability ratio. The preferred source, *Palaemonetes* sp., may provide higher calorie values and it may be easier for the crabs to assimilate. No recordable differences were found between the behaviors and interactions of the crabs in the field compared to the laboratory.

PRELIMINARY RESULTS OF A STUDY ON SAGITTARIA SECUNDIFOLIA (ALISMATACEAE). Elizabeth A. McCartney and Jeri W. Higginbotham, Department of Biology, Jacksonville State Univ., Jacksonville, AL 36265.

Sagittaria secundifolia, Kral's Water-Plantain, is a perennial aquatic herb currently known to exist only in the Little River Canyon drainage. On May 14, 1990, *S. secundifolia* was given threatened status by the United States Fish and Wildlife Service. A pedestrian survey of Little River within Little River Canyon National Preserve funded by the National Park Service was conducted in order to revisit known populations and document new populations. The West and East Forks of Little River provide the most ideal habitat for *S. secundifolia* with an abundance of shallow riffles, flat sandstone, and sandstone rubble. It is rarely found in areas with high velocity water flow, deep pools, or huge boulders. *S. secundifolia* was found emergent to submerged in water up to 1.3 meters deep. Canopy cover over populations varied considerably. Although reproduction is thought to be mainly clonal, it is possible that sexual reproduction occurs. Reproductive shoots were observed, although not in great numbers.

SEROTONIN PRODUCES CHANGES IN NOCICEPTION, BLOOD PRESSURE, AND NEURAL ACTIVITY IN THE ROSTRAL VENTRAL MEDULLA. C.L. Thurston, G.D. Santini, R. Vallabhparu, R. Ang, and M. Fayard, Dept. of Biomedical Sciences, University of South Alabama, Mobile, AL 36688.

Intravenous (i.v.) administration of serotonin produces antinociception through activation of vagal afferents. The present study analyzed the dose-dependent effects of i.v. serotonin on arterial blood pressure, nociception and on the activity of neurons in the rostral ventral medulla hypothesized to modulate nociception and/or blood pressure.

As expected, serotonin produced biphasic effects on blood pressure consisting of the Bezold-Jarisch reflex, a pressor response, and a delayed depressor response. Serotonin also produced triphasic effects on neural activity in the rostral ventral medulla, consisting of an excitation, inhibition (or less excitation), followed by another period of excitation. At the greater doses, serotonin inhibited the nociceptive tail flick reflex. The inhibition of the tail flick and the Bezold-Jarisch reflex are mediated through activation of serotonin 3 receptors. The pressor response is mediated through activation of serotonin 2 receptors. The changes in neural activity are complex, and do not clearly involve any one type of receptor tested. The changes in neural activity also tend to follow changes in blood pressure. Based on these findings, the changes in neural activity are most likely not responsible for the changes in nociception produced by serotonin. However, the changes in neural activity may be related to changes in blood pressure.

This research was supported by NIH grant NS31495 to C.L. Thurston.

SALINITY TOLERANCE IN MOSQUITOFISH (*GAMBUSIA AFFINIS*) INHABITING AN INLAND SALINE ECOSYSTEM IN CLARKE COUNTY, ALABAMA. Randy Sterling, Donald Salter, and John McCall, Department of Biological Sciences, University of West Alabama, Livingston, AL 35470

We investigated salinity tolerance of a population of mosquitofish, *Gambusia affinis*, inhabiting an inland saline habitat in Clarke County, Alabama. In this area, high salinity water emerges from the ground and mixes with freshwater from nearby springs. Fish living in the area may be subjected to wide variations in salinity as the area is alternately inundated by flooding from the nearby Tombigbee river. Salinity tolerance of fish from this area was compared with fish from a fresh water spring. Identical tanks with filtration systems were used to study the survival of three groups of fish: (1) a control group from the salt springs; (2) an experimental group from the salt springs; and (3) an experimental group from a fresh water spring. The salinity was increased in the experimental tanks in increments of 5 ppt over a period of 15 weeks. Water temperature, pH, dissolved oxygen, salinity, and survivability were recorded for each tank. The results indicated that *G. affinis* from salt and fresh water springs have an extremely high tolerance for salinity with some surviving at 70 ppt. Fish from the salt springs were slightly (5 ppt) more tolerant to increased salinity than the ones from the fresh water spring.

MOVEMENT PATTERNS OF THE ALABAMA REDBELLY TURTLE (*PSUEDEMYS ALABAMENSIS*) AS DETERMINED BY RADIOTELEMETRY. Sean P. O'Hare, David H. Nelson, and William M. Turner, Department of Biological Sciences, University of South Alabama, Mobile AL 36688.

The Alabama Redbelly turtle (*Pseudemys alabamensis*) is an endangered species endemic to the Mobile-Tensaw River delta. Fifty-six turtles (24 males, 32 females) were fitted with radio transmitters (ca. 100g, measuring approx. 6.5 x 4.5 x 3.5 cm) constructed in the laboratory to emit a pulsed signal on 26.760 - 28.200 MHz. The turtles were captured, tagged, and released near Gravine Island (Baldwin County), Alabama in three rounds. The first sixteen (8 males, 8 females) were deployed from 25 August 1996 to 25 October 1996. Turtles from this group were tracked until the last telemeter failed from battery exhaustion after 15 April 1997. Twenty more (16 females, 4 males) were deployed from 11 June 1997 to 07 July 1997, and some were tracked until 30 December 1997. Twenty additional turtles (12 males, 8 females), deployed from 31 October 1997 through 05 December 1997, are currently being tracked. Most study subjects exhibited signs of dormancy during autumn and winter months, although some specimens moved >6km despite water temperatures near 11 degrees C. Turtles were most active in July. Some subjects travelled to areas more than 9km, 11km, 12km, and 15km from their capture sites.

CIRCADIAN RHYTHMS OF INDO-PACIFIC CORALS (*Trachyphyllia geofroyi*, *Xenia sp.*, *Zoanthus*, and *Litophyton arboreum*). Bryce L. Roberts and Carol A. Leitner, M.D., Dept. of Surgery, Univ. of Ala. Birmingham 35233

Circadian rhythms directed by an internal biological clock are thought to exist in many, if not all, living organisms. This project studied the circadian rhythms of four species of coral native to the Indo-Pacific and raised in a home aquarium. From September 1997 through January 1998, weekly observation and hourly recording of the fleshy configuration of the four species (*Trachyphyllia geofroyi*, *Xenia sp.*, *Zoanthus*, and *Litophyton arboreum*) was recorded. The configurations were represented as a clock utilizing a computer drawing program. Comparison of the species' clocks revealed differences that can be explained on the dietary and environmental requirements of the organism. Hard corals such as *Trachyphyllia* live symbiotically with zooanthellae, photosynthetic algae that create food for the host coral. *Trachyphyllia* were found to open gradually during the day, allowing the algae to capture sunlight for photosynthesis. Soft corals such as *Xenia*, *Zoanthus*, and *Litophyton*, contain zooanthellae but are primarily filter feeders. Whenever light is present, these corals open and extend tentacles to filter zooplankton found in shallower waters during daylight. Other characteristics of biological clocks such as accuracy, predictability, and adaptability were documented to exist in corals as well.

BIOASSESSMENT OF THE UPPER CAHABA RIVER USING BENTHIC MACROINVERTEBRATES. Ken R. Marion, Robert A. Angus and Kristen Lindsey, Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294.

Bioassessment studies were conducted at thirteen sites along the upper Cahaba River in north central Alabama using benthic macroinvertebrate collections. This section of river is undergoing steady urbanization. Samples were taken during fall 1995, spring 1996, fall 1996, and spring 1997. Samples were collected in riffle areas with a kick net and preserved in ethanol. One hundred specimens were randomly selected from each site per collection and identified to genus by microscopic examination. General trends were seen in indices such as species diversity, similarity, and percent of dominant taxon that indicated a gradual decline in the community structure of benthic macroinvertebrates as the Cahaba passed through urbanized areas. Similarly, the Ephemeroptera + Plecoptera + Trichoptera (EPT) index indicated that these pollution-sensitive orders declined in the same fashion. Although the Cahaba clearly showed a decline in the condition of the macroinvertebrate community as it passed through the suburbs of Birmingham, indicative of deteriorating water/habitat quality, none of the sites sampled were assessed to be severely impacted.

A CHARACTERIZATION OF THREE DIGESTIVE ENZYMES FROM THE RED SWAMP CRAYFISH PROCAMBARUS CLARKII. Hugh S. Hammer, Stephen A. Watts, and Charles D. Bishop. University of Alabama at Birmingham.

The crayfish Procambarus clarkii is the most extensively cultured crustacean in the United States. Crayfish are omnivorous and potentially use a diverse array of enzymes to digest foods, however, little is known about the physiology of crayfish digestion. Adult crayfish were held in large static water tanks with aeration at 23°C and fed a formulated diet. Three crayfish were removed from the tank, the hepatopancreas was homogenized in an enzyme buffer and crudely purified to be used as a source of the digestive enzymes α -amylase, lipase/esterase and trypsin. The reactions of these enzymes were described in relation to changes in substrate concentration, pH and temperature using appropriate spectrophotometric and fluorometric assays. The activity of α -amylase increased with increasing temperature from 8-44° C and had Q_{10} values ranging from 1.57-4.06. Activity also increased with increasing substrate concentration and reached maximum maltose production at 15mg/ml starch solution. The optimal pH for α -amylase was between pH 5.5 and 7.5. Lipase/esterase activity increased with increasing temperatures (8-44°C) and had Q_{10} values ranging from 1.33-3.03. Lipase/esterase activity also increased with increasing substrate concentration to reach a maximum activity at 1 mM of 4-NPC solution. The pH optima for the lipase/esterase reaction was 8.5. The assay used to quantify trypsin activity, using the artificial substrate CBZ-L-Arg-MCA, shows a peculiar inhibition of trypsin activity with increasing substrate concentration when crayfish homogenates are used as the enzyme source. This inhibitory activity was not observed when purified bovine trypsin was the enzyme source.

GENE FREQUENCIES IN THE DOMESTIC CAT POPULATION OF BIRMINGHAM, ALABAMA. Christopher McCoy & H. Wayne Shew, Dept. of Biology, Birmingham-Southern College, Birmingham, AL 35254.

We conducted a survey to determine the allele frequencies of the cat population in the greater Birmingham area. The gene frequency profile of this population was then compared to published studies of populations in North America and other parts of the world. Phenotypic data were collected over a period of several months on cats observed in animal shelters, veterinary clinics, and in neighborhood surveys. The genetic traits studied were sex-linked orange (*O*) and autosomal brown (*bw*), nonagouti (*a*), blotched tabby (*t^b*), long-hair (*l*), piebald spotting (*S*), dominant white (*W*), polydactyly (*Pd*), and Manx (*M*). Allele frequencies for the above traits were 0.233 (Orange), 0.283 (brown), 0.822 (nonagouti), 0.657 (blotched tabby), 0.404 (long hair), 0.298 (Piebald), 0.017 (Dominant white), 0.011 (Polydactyly), and 0.011 (Manx). These data are most similar to those reported for populations of cats in Vancouver, British Columbia and Southern England. They differ from those reported for most of the populations in the United States particularly with reference to the blotched tabby trait. These data do not indicate a particular pattern of immigration of people into the Birmingham area from other regions of the United States but additional research is needed to determine if the profile is explainable in terms of the historical/immigration hypothesis.

Abstracts

DEVELOPMENT OF A QUANTITATIVE ENZYME-LINKED IMMUNOSORBENT ASSAY FOR VITELLOGENIN OF MOSQUITOFISH (*GAMBUSIA AFFINIS*). Joseph F. Tolar, R. Douglas Watson, Robert A. Angus, Univ. of Ala. at Birmingham, AL 35294.

We are currently doing studies to establish the usefulness of mosquitofish (*Gambusia affinis*) as a model organism for assaying chemicals for hormonal activity. We will use the stimulation of vitellogenin (VTG) production in males as an indicator of estrogenic activity. This protein is normally only produced in females, but production is readily induced in males exposed to estradiol. However, male mosquitofish are small (approx. 20 mm in length) and an assay is needed that does not require large amounts of sample. We are developing an enzyme-linked-immunosorbent assay (ELISA) for this reason. VTG was isolated from estrogen treated females and purified by using gel filtration chromatography and nondissociating polyacrylamide gel electrophoresis. Anti-VTG immune sera are currently being produced in rabbits. We anticipate the ELISA system will be used for both lab and field studies of estrogenic activity of pure compounds and mixtures.

GENETIC ENGINEERING: ECOLOGICAL AND BIOLOGICAL CONTAINMENT OF A HERBICIDE RESISTANT GENE VIA CHLOROPLAST TRANSFORMATION. Steven J. Gray and Dr. Henry Daniell, Program of Molecular Genetics, Dept. of Botany and Microbiology, Auburn Univ., Auburn, AL 36849-5407.

Genetic engineering of herbicide resistant crops is possibly the most powerful tool yet developed for controlling weed growth among crop plants. For the past several years, scientists have been trying to develop safe and effective ways to enhance crop yields using herbicides and genetically engineered plants. The goal is to make the crops resistant to herbicides so that one could spray a field and kill weeds but not crops. Herbicide resistant crops have already been produced, but only with transformation of the nuclear genome. Problems with this approach are: 1) the gene conferring resistance escapes through pollen and outcrosses with weedy relatives creating super weeds; 2) low level expression of the resistance due to the presence of a single gene or a few copies. In our lab the new concept of chloroplast transformation has been developed and demonstrated. Advantages of chloroplast expression of the herbicide resistance gene include 1) an increased level of expression due to multiple copies (5,000-10,000) of chloroplast genome per cell; 2) the foreign gene is maternally inherited in most crops, resulting in no outcross through pollen. This work was supported by USDA-NRICGP grants to HD.

GAMBUSIA AS A MODEL FOR TESTING ENDOCRINE DISRUPTORS: EFFECTS OF ANDROSTERONE ON ANAL FIN RAYS OF FEMALES. Girishanthu Krishnarajah, Robert A. Angus, Univ. of Ala. at Birmingham, AL 35294.

We are currently doing studies to establish the usefulness of mosquitofish (*Gambusia affinis*) as a model organism for assaying chemicals for hormonal activity. Mature male mosquitofish are much smaller than the females and have an anal fin that is modified into a complex intromittent device, the gonopodium. The development of a gonopodium is under control of androgens and normally only takes place in males during the process of sexual maturation. However, if females are exposed to chemicals with androgenic activity, their anal fin rays can be induced to develop into gonopodium-like structures. The purpose of this project is to describe the changes in gonopodial morphogenesis and the structure of the 3-4-5 and 6 terminal complex in female mosquitofish as they are masculinized by continuous exposure to the androgen androsterone. Mature females are being treated with various concentrations of androsterone. Once a week the fish are anesthetized and anal fin measurements are made using an ocular micrometer in a dissecting microscope. Measurements are taken on fin ray characters that change dramatically as rays 3 and 4 thicken and elongate to form a gonopodium. Fin rays 3 and 4 are also inspected for the presence of terminal hooks, ventral spines, serrae, and elbow that are normally only present in a mature gonopodium.

COMPARISON OF EARLY MORPHOLOGICAL DEVELOPMENT IN TWO SPECIES OF ANADROMOUS FISHES, AMERICAN SHAD (ALOSA SAPIDISSIMA) AND ATLANTIC SALMON (SALMO SALAR). Judith D. Shardo, Dept. of Biological Sciences, Univ. of South Alabama, Mobile, AL 36688.

Early development of the head and gills follows a general pattern in teleost fishes but the sequence of specific developmental events may vary. To identify the more plesiomorphic teleost patterns, I compare the embryological and larval development of a salmonoid, Atlantic salmon, with that of a clupeomorph, American shad. A staging system (Shardo, 1995), defined by fundamental morphological changes independent of age, provides the basis for comparison. Several developmental sequences differed between the two species. 1. Gill arches form slightly earlier in salmon and an opercular flap covers the arches before secondary gill lamellae form; in shad the opercular flap expands prior to formation of the opercular bone, long after secondary lamellae form. 2. Formation of cartilaginous skeletal structures begins later in salmon than in shad. 3. Unlike salmon, shad forms hypurals before notochordal flexion. 4. The level of morphological development at hatching differs. Using *Amia calva* as an outgroup, the pattern in salmon appears plesiomorphic for the first two differences; data is insufficient for the remaining two.

EXAMINATION OF THE REGENERATIVE CAPACITY OF SEA STAR LARVAE. Minako S. Vickery and James B. McClintock, Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294-1170.

Adult sea stars are well known to display strong regenerative abilities to compensate for tissue losses. Almost a decade ago, asexual reproduction in bipinnaria larvae collected from plankton was reported. However, to date no studies have examined the capacity of larvae to regenerate following damage. In this study, the regenerative capacities of sea star planktotrophic bipinnaria and brachiolaria larvae were examined in two species (*Pisaster ochraceus* and *Luidia foliolata*). Both larval types were surgically manipulated such that the larvae were separated into anterior and posterior pieces, or small portions of extremities from larval bodies were removed. Surgically treated and untreated control larvae were observed daily and regenerative processes were documented using light microscopy. Within a week most larvae began to regenerate their lost body components. Two weeks after surgical treatment most larvae were morphologically similar to control larvae. The results indicate that both adult sea stars and their larvae have the capacity to regenerate and compensate for the loss of body components. Furthermore, the results of this study have implications in larval ecology, specifically with respect to estimates of larval recruitment and mortality.

DEVELOPING INTERNET WEB SITES FOR COLLEGE CLASSES.

Gerald Crawford, Robert J. Williams, and Robert Sweeney, College of Business, University of North Alabama, Florence, AL 35632

At the present rate of growth, computers and the Internet will dominate the delivery of education materials at the college level in a few short years. These trends mandate that educational institutions fully utilize these powerful tools and teach students to use them as well. In a large research study done recently at the University of North Alabama, students were asked what information items should be made available on class-specific Internet Web sites. Further, students were asked about their patterns of computer use, and experience in using the Internet. Many useful and constructive suggestions were made by respondents.

Surprisingly, a very high percent of UNA students in the study use computers and the Internet. About half of the respondents use a computer daily. Only 10 percent of respondents use computers less than once per week, and every single respondent reported using a computer on some basis. The most important group of items that students want delivered on Internet class Web pages was "class learning aids." This was followed by "student advisement tools," "UNA registration information," "communications and resources," and "basic class information." It was not expected that advising and registration information would be of major interest to students. The findings can assist faculty in meeting curriculum needs and help the administration fulfill computer support expectations.

Abstracts

STARVATION-INDUCIBLE RESISTANCE TO POLYMYXIN IN *SALMONELLA TYPHIMURIUM*. Ross Tekulve, Robin Edwards, Patrick Smith, and Michael Spector, Department of Biomedical Sciences, University of South Alabama, Mobile, AL 36688

The enteropathogen *Salmonella typhimurium* is a facultative intracellular pathogen capable of survival and growth within macrophages, the intestines, and various external natural microcosms. For this, they must withstand an onslaught of numerous environmental challenges, *i.e.* numerous types of cationic antimicrobial peptides/proteins. Antimicrobial peptides such as polymyxin (Pm) and defensins are proposed to kill bacterial cells by disrupting membrane integrity leading to osmotic lysis. Resistance to Pm is differentially dependent upon, at least, two separate two-component sensor-regulator systems, PhoP/Q and PmrAB, and other loci referred to as *sap* loci in growing cells. We have determined that starved *S. typhimurium* cells, compared to growing cells, are resistant to a 60 min Pm challenge. Both the PmrAB and PhoPQ regulons are needed for Pm resistance generated during the first few hrs of starvation but not resistance developed in 24 hr starved cells. To determine which *pag*, *pbg*, *pcg* and *sap* genes are needed for starvation-induced Pm resistance, an assortment of *pag*, *pbg*, and *pcg* mutants, both growing and starved, were challenged with PmB. Several, but not all, *pag*, *pbg*, *pcg* and *sap* loci were required for Pm resistance generated in 3 h starved cells as might be expected. Surprisingly, a number of *pag*, *pbg* and *sap* loci were also needed for Pm resistance in 24 hr starved cells, suggesting additional regulatory circuits. Thus, physiologic state has a profound effect on the susceptibility of *S. typhimurium* to host defenses and requirements for key two-component sensor-regulator systems.

NESTING OF THE LOGGERHEAD SEA TURTLE (CARETTA CARETTA) ON DAUPHIN ISLAND, ALABAMA. David H. Nelson and Stephanie A. Alexander, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688.

Field surveys for sea turtle nests were conducted from June to September 1997 along the beaches of Dauphin Island (Mobile Co.), Alabama. The beach was monitored three times a week by all-terrain vehicle to identify, locate, protect and mark individual nests. Specific coordinates of nests and false crawls were recorded using a hand-held GPS unit. In 1997, we confirmed 3 nests, 4 false crawls and 1 stranding of a dead, adult sea turtle. Nest #1 (located 6/12/97) demonstrated emergence of hatchlings on 8/6/97. Since the location of this nest site was lost (due to Hurricane Danny), we could not determine actual clutch size or hatching rate. Nest #2 (located 6/12/97) manifested tracks of hatchlings on 8/6/97. Since 88 of the 120 eggs hatched, the hatching rate was 73.3%. Nest #3 (located 6/16/97) manifested tracks of hatchlings on 8/20/97. Since 21 of the 134 eggs hatched, the hatching rate was 15.7%. In 1996 we recorded 2 nests and 4 false crawls; in 1995 we encountered 2 nests and 2 false crawls.

GEOGRAPHIC DISTRIBUTION OF THE ALABAMA REDBELLY TURTLE (PSEUDEMYX ALABAMENSIS) ALONG ITS NORTHERN EXTREME. David H. Nelson, William M. Turner, Sean D. O'Hare and Krista K. Van Amerongen, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688.

The Alabama Redbelly turtle (Pseudemys alabamensis) is an endangered species endemic to freshwater habitats within the Mobile-Tensaw Delta. This was the fourth year of field work to delineate the present geographic distribution of the turtle. To determine the northern limits of the turtle's range, aquatic hoop traps (with lead nets) were placed in waterways north of interstate highway 65 in which the turtles had been reported. We trapped 11 areas in Baldwin, Clark, Escambia, Mobile and Washington Counties. No specimens of P. alabamensis were trapped in tributaries of the Tombigbee River, Tensaw Lake or on the Claude D. Kelley State Park. Only one specimen of P. alabamensis was trapped. It was caught in the Alabama River, adjacent to its confluence with the Mobile River. We captured 318 turtles of 7 species: 151 Trachemys scripta elegans, 113 Pseudemys concinna, 33 Graptemys nigrinoda delticola, 10 Macrochelys temminckii, 9 Apalone spinifera, 1 Chelydra serpentina, and 1 Pseudemys alabamensis. We also captured 3 alligators and 231 fishes (23 species). The geographic distribution does not extend as far north as published range maps suggest.

TURBIDITY AS A WATER QUALITY ISSUE. Frank A. Romano, Dept. of Biology, Jacksonville State University, Jacksonville, AL 36265.

Erosional soil loss and the consequent increase in suspended solids and turbidity in streams, rivers, and lakes is one of the largest forms of pollution. In 1989 the USDA estimated that 2.5 billion metric tons of soil is washed or blown away each year from cultivated croplands in this country. An additional 3.3 billion metric tons are lost from forests, pastures, stream banks, and construction sites. It is estimated that the losses of these plant nutrients via erosion is worth at least \$18 billion dollars a year and causes at least \$4 billion dollars in damage to freshwater streams, rivers, lakes, and reservoirs. This study, supported by a NASA-EPSCoR grant to the Alabama Space Grant Consortium, determined water quality at selected sites within the middle Coosa River; and 3 large tributaries; Akers Creek, Trout Creek, and Broken Arrow Creek. The following water quality parameters were measured: turbidity, temperature, total dissolved solids, and conductivity. Suspended solid loads were determined by vacuum filtering water samples and by drying samples in tared containers. Turbidity ranged from 7.63 to 15.05 NTU's in the Coosa main channel. Broken Arrow Creek was the most turbid of the tributaries, ranging from 17.1 to 36.45 NTU's. Our goal is to ultimately enter this information into the Universal soil loss equation (Wischmeier and Smith 1965) to predict soil loss from this watershed.

GRAY SQUIRREL RESPONSES TO INTERSPECIFIC ALARM CALLS IN TWO COVER TYPES. Jason B. Jennings and Robert S. Lishak, Dept. of Zoology, Auburn University, AL 36849

Alarm calls of eastern chipmunks (Tamias striatus) and blue jays (Cyanocitta cristata) were recorded, digitized, manipulated to conform to a specific internote interval, and combined to form a hybrid call. Calls were played through speakers to gray squirrels (Sciurus carolinensis) in habitats with no ground cover (open) and with ground cover (closed) in order to assess the effects cover has on the behaviors of gray squirrels. We used a chipmunk "chuck", a blue jay "jay", and a combined chuck and jay call (hybrid). Data from adults and juveniles were collected for both sexes from June 1996-December 1997. Both sex and age classes responded with greater intensity in the closed habitat than in the open habitat. Adult females had significantly higher mean responses to the jay call in the closed habitat than any other sex or age class. Juvenile males had significantly higher mean responses to the chuck and hybrid call in the closed habitat than any other sex or age class. Adult males had significantly higher mean responses to the jay call in the open habitat than any other sex or age class. Also, juvenile females had significantly higher mean responses to the chuck and hybrid call in the open habitat than any other sex or age class. Financial support was provided by a grant from the Alabama Academy of Science.

RIPARIAN ZONE VEGETATION ANALYSIS AND STREAM CHARACTERIZATION OF SHOAL CREEK'S INFLOW AND OUTFLOW TO SWEETWATER LAKE.

Jonathan Gilbert, Sharon Southern, Kregg Johnson, Daniel Carver, Kim Thompson, Stephen Turner, Dr. Frank Romano, and Dr. David Whetstone, Dept. of Biology, Jacksonville State University, AL. 36265.

A riparian zone analysis and stream characterization was conducted in the Shoal Creek watershed above and below Sweetwater Lake (Choccolocco Creek/Coosa River drainage). This report concentrates on the riparian plants and the within stream benthic invertebrate fauna collected from the area. Following USGS-NAQWA protocols, twelve transects were setup through various hydrogeomorphic units within each stream (six on each). A quarter point vegetation analysis (with nested quadrats for shrubs and herbs) within the riparian zone was established at both ends of each transect. Benthic invertebrate population levels were much higher above the reservoir than below, most likely due to anthropomorphic damage by dam construction. A total of 325 benthic invertebrates (2 phyla and 31 insect families) were collected from the inflow portion of Shoal Creek, while only 119 total benthic invertebrates (3 phyla and 13 insect families) were collected from the outflow (below the dam). It is noteworthy that the insect order Trichoptera, family Hydroscychidae formed 53% of this collection. The inflow stream banks riparian vegetation were dominated by *Acer rubrum* (importance value = 29.99), *Liriodendron tulipifera* (i.v. = 8.46), and *Carpinus caroliniana* (i.v. = 7.89) while *Quercus alba* (i.v. = 24.73), *Liriodendron tulipifera* (i.v. = 15.6), and *Fagus grandifolia* (i.v. = 12.37) dominated the outflow stream banks.

MORPHOLOGICAL STAGING SYSTEM OF EARLY EMBRYONIC RED SNAPPER (*LUTJANUS CAMPECHANUS*). Andrew Woodard and Judith Shardo, Department of Biological Sciences, University of South Alabama., Mobile, AL 36688.

A morphological staging system is currently being applied to the embryonic red snapper where developmental features are categorized independently of time (Shardo 1995). The defining criteria in each stage are fundamental throughout the teleosts while the concurrent features are species specific. We used scanning electron microscopy (SEM) and light microscopy to describe the morphological development. A developmental series from fertilization to post hatch (30h) was collected at the Alabama Marine Resource Division in Gulf Shores. The specimens were fixed in a 2.5% phosphate buffered glutaraldehyde solution for SEM work. Over 159 embryos have been examined to date, covering twenty samples and assigned to twelve stages. These twelve stages can be grouped as follows: cleavage, blastulation and gastrulation. Stages 1-7 extends from fertilization through synchronous cleavage divisions and finally formation of a high pebbled mound. During stage 8 (Blastulation) the cells become smaller, while the cell mound becomes lower and flatter and the enveloping layer is formed. Gastrulation is seen in stages 9-12 where the embryonic axis forms followed by the notochord and neural keel. The red exhibits similar developmental patterns to the American shad and Atlantic salmon, indicating early development is conserved. Minor differences are probably due the small egg diameter of the Red snapper .

CIRCADIAN RHYTHMS OF INDO-PACIFIC CORALS (*Trachyphyllia geofroyi*, *Xenia sp.*, *Zoanthus*, and *Litophyton arboreum*). Bryce L. Roberts and Carol A. Leitner, M.D., Dept. of Surgery, Univ. of Ala. Birmingham 35233

Circadian rhythms directed by an internal biological clock are thought to exist in many, if not all, living organisms. This project studied the circadian rhythms of four species of coral native to the Indo-Pacific and raised in a home aquarium. From September 1997 through January 1998, weekly observation and hourly recording of the fleshy configuration of the four species (*Trachyphyllia geofroyi*, *Xenia sp.*, *Zoanthus*, and *Litophyton arboreum*) was recorded. The configurations were represented as a clock utilizing a computer drawing program. Comparison of the species' clocks revealed differences that can be explained on the dietary and environmental requirements of the organism. Hard corals such as *Trachyphyllia* live symbiotically with zooanthellae, photosynthetic algae that create food for the host coral. *Trachyphyllia* were found to open gradually during the day, allowing the algae to capture sunlight for photosynthesis. Soft corals such as *Xenia*, *Zoanthus*, and *Litophyton*, contain zooanthellae but are primarily filter feeders. Whenever light is present, these corals open and extend tentacles to filter zooplankton found in shallower waters during daylight. Other characteristics of biological clocks such as accuracy, predictability, and adaptability were documented to exist in corals as well.

INTERVESSEL PIT MEMBRANE STRUCTURE IN POPULUS DELTOIDES--AN SEM INVESTIGATION. Kathy M. Duncan and Roland R. Dute, Department of Botany and Microbiology, Auburn University, AL 36830

This project was undertaken to investigate the hypothesis that as intervacular pit membranes age they become more porous. Cut branches of Populus deltoides were induced to take up safranin dye. Afterward, the wood was divided into stained (functional) and unstained (nonfunctional) portions. Small segments were fixed, dehydrated, and embedded in Spurr's resin. Radial longitudinal sections of 0.5 micrometers in thickness were cut and affixed to circular glass coverslips. The plastic was chemically removed and the exposed tissue was coated with a layer of gold-palladium and viewed with a scanning electron microscope. Such treatment provided support for the membranes and made them less susceptible to damage from the electron beam. Functional pit membranes gave the appearance of fibrillar mats perforated by openings of 80 nm or less. The fibrils were varied in orientation and were found in multiple layers. Radially aligned fibrils as occur in torus-bearing pit membranes in gymnosperms and angiosperms were not observed. The structure of pit membranes observed by this technique was similar to that seen in other laboratories through use of direct carbon replicas and the transmission electron microscope. Investigations are proceeding on the structure of nonfunctional pit membranes. This research was supported by the Alabama Agricultural Experiment Station.

PRELIMINARY SURVEY OF THE VASCULAR FLORA OF THE LIME WESTERN HILLS OF ALABAMA. K. R. Brodeur, R. D. Whetstone, J. W. Higginbotham, T. L. Hofmann, S. J. Threlkeld, A. I. Thompson, and K. Morrow. JSU Herbarium, Department of Biology, Jacksonville State University, Jacksonville, Alabama 36265.

The Lime Hills are located within the coastal plain province. Portions of Choctaw, Clarke, Monroe, and Washington counties occupied by the study area. Alabama and Tombigbee rivers dissect the area and expose lithified rocks; however, sediments underlie most of the study area. Nearly 1000 vouchers have been collected documenting five divisions, *i.e.*, Equisetophyta, Lycopodiophyta, Polypodiophyta, Pinophyta, and Magnoliophyta. Thus far, Equisetophyta is represented by one family, Lycopodiophyta by one family, Polypodiophyta by 10 families, Pinophyta by 3 families, and Magnoliophyta is represented by 104 families. Among the Magnoliophyta, Magnoliopsida has 90 families while Liliopsida has 14 families.

Abstracts

METABOLIC ENZYME ACTIVITIES IN THE CRAYFISH PROCAMBARUS CLARKII. Mickie L. Powell and Stephen A. Watts, Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham, AL 35294-1170.

Enzyme activities can be used to identify the metabolic pathways contributing to energy production in specific tissues. Classical energy-producing metabolic pathways exist in crustaceans, however, the level of activity of key metabolic pathway enzymes varies in the different tissues. The activities of enzymes involved in glycolysis, gluconeogenesis, Krebs cycle, protein and fatty acid metabolism were measured in the tail and hepatopancreas of the crayfish Procambarus clarkii. These tissues serve as nutrient storage sites and the mobilization of these stored energy reserves during summer aestivation may be crucial for the survival of the individual. Energy in the form of glycogen and protein are stored and utilized in the tail, hence the activities for glycolytic and amino acid metabolizing enzymes were 4-20 times higher in this tissue than in the hepatopancreas. The hepatopancreas serves as a lipid storage site and aids in digestive function. Consequently, enzyme activity levels were lower in the hepatopancreas for all enzymes with the exception of glucose-6-phosphate dehydrogenase, a gluconeogenic enzyme. The activities of enzymes involved in fatty acid degradation were low or not detected in either tissue. Information on metabolic enzyme activities for healthy crayfish may provide a baseline for future experiments examining the effects of environmental stress and disturbance on the mobilization of energy stores from these tissues.

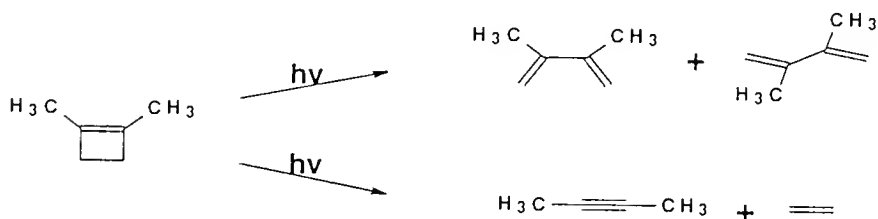
SEX STEROIDS DURING DIFFERENTIATION IN THE TILAPIA (OREOCHROMIS NILOTICUS). Craig B. Rowell and Stephen A. Watts, Dept. of Biology, University of Alabama at Birmingham, AL 35294-1170

Oreochromis niloticus has exhibited characteristics of both temperature-influenced sex determination (TISD) and gonadal sex determination (GSD). Both of these mechanisms are hypothesized to be mediated by endogenous sex steroid levels. For example, evidence indicates that detectable levels of endogenous sex steroids are present at pre-gonadal differentiation stages of development. Also, at this early stage the fish has demonstrated the ability to metabolize exogenous sex steroids and steroid precursors, producing potentially bioactive steroids. There have been extensive studies showing that exogenous applications of androgens and estrogens promotes the development of phenotypic males and females, respectively. Recent work has shown that there may be a critical period during which short-term exposure to an androgen agonist (prior to gonadal differentiation) will effectively produce a male phenotypic sex in the adult. Currently the relation of these observed effects of steroids to the differentiation of the primordial germ cells has not been determined. Further research investigating sex steroid levels during this proposed critical period, and involving influences such as temperature, should provide information regarding sex steroid roles in both sex determination and gonadal differentiation. Knowledge of mechanisms related to sex determination and sex differentiation will be of value in the aquaculture industry.

CHEMISTRY

FACTORS AFFECTING OPENING AND CLEAVAGE IN 1,2-DIMETHYLCYCLOBUTENE. B.H. Cook, W.J. Leigh, Department of Chemistry, McMaster University, Hamilton, Ontario, L8S 4M1, C.L. Michael, M. Squillacote, Department of Chemistry, Auburn University, AL 36849.

The photochemistry of 1,2-dimethylcyclobutene opening to form isomers of 2,3-dimethyl-1,3-butadiene and/or a mixture of butyne and ethylene is affected both by the de-excitation pathway of the molecule and the existence of a Rydberg or Valence type excited state. Matrix isolation experiments have been performed in nitrogen, argon, and propane in order to qualify the response to different chemical environments and to define the energy decay of this molecule in terms of conical intersections or excited state funnels. Infrared and ultraviolet spectroscopy were used to study the photoproducts of 185nm and 214nm irradiation of samples prepared at temperatures below 50K.



RESPONSE OF MIXED LB FILMS OF N-(9-ANTHRYLMETHYL)-N-(OCTADECYLETHOXY)ETHANOLAMINE (C18AE) AND Ca-ARACHIDATE TO MONOLAYER COMPOSITION AND INTERFACED SOLUTION pH. Laura L. Hemmer and William C. Neely, Dept. of Chemistry, Auburn Univ., AL 36830. Saliya De Silva, Dept. of Chemistry and Biochemistry, Montclair State Univ., NJ 07043. Suram T. Pathirana and Vitaly J. Vodyanoy, IBDS and Dept. of Physiology and Pharmacology, Auburn Univ., AL 36830.

Surface pressure-area isotherms were recorded for monolayers of C18AE/Ca arachidate mixtures (0-100 mol %) at the air/water interface. At high concentrations of C18AE, the molecular area shows a condensing effect accompanied by a minimum in free energy of mixing. Langmuir-Blodgett films of the mixed monolayers show multiphasic dose dependency of the intensity of fluorescence at 430 nm on the C18AE concentration with a maximum at 40 mol % suggesting aggregation of C18AE. The fluorescence intensity of Langmuir-Blodgett films in contact with aqueous solutions was strongly dependent on pH indicating a potential application as a solid state pH sensor. Funded by FAA-93-G-058.

PYROMETRIC INTERFEROMETRY TECHNIQUE FOR IN-SITU MONITORING OF THIN FILM THICKNESS AND SURFACE ROUGHNESS. Shane A. Catledge, Walton Comer and Yogesh K. Vohra, University of Alabama at Birmingham, AL 35294-1170.

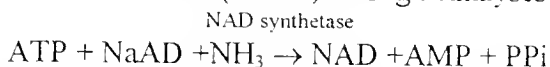
The growth rate and surface roughness of diamond films grown on Ti-6Al-4V substrates by microwave plasma chemical vapor deposition (MPCVD) was monitored by using infra-red optical pyrometry. The growing film results in oscillations of the apparent substrate temperature with time and can be explained by interference effects caused by reflections from the film/air and film/substrate interfaces. The growth rate is determined from the period of the oscillations while surface roughness manifests itself as an amplitude damping effect. Although a model has previously been developed to determine the thickness and roughness of diamond films by this technique, we show that the equation governing the transmittance of the film/substrate system is incomplete and must in general take into account the complex index of refraction of an absorbing substrate. We use the modified model to fit experimental temperature vs. time data and determine film thickness and surface roughness as a function of time. This technique can be used for any type of film in which the effects of absorption can be neglected and is useful for in-situ process diagnostics. We have shown the effect of adding increasing amounts of O₂ to a CH₄/H₂ plasma chemistry. The results indicate a decrease in growth rate and an increase in surface roughness with increasing O₂ additions.

¹H, ¹³C NMR CHEMICAL SHIFT ASSIGNMENTS of N-ACETYL-PRO-GLY-PRO to STUDY DIFFERENT CONFORMERS in SOLUTION. Yi-Chien Lee, Patricia Jackson, and, Donald D. Muccio, Department of Chemistry, UAB, Birmingham, AL, 35209.

N-acetyl-pro-gly-pro (N-Ac-PGP) is one peptide which has been isolated and identified as a powerful chemoattractant in alkali-injured cornea. Severe alkali-injuries to the eye is followed by rapid invasion of polymorphonuclear leukocytes (PMNs). Once PMNs adhere to the vascular endothelium they are induced by a chemoattractant to move to the source of the chemotactic gradient. The accumulation of PMNs in tissue is extremely destructive. In the eye, this can lead to corneal ulceration, perforation, and even loss of the eye. Understanding the structure of a chemoattractant such as N-Ac-PGP is important to understanding the molecular mechanism of corneal ulceration and in developing rational therapeutic regimens. Nuclear magnetic resonance spectroscopy is a good tool to determine the conformers of N-Ac-PGP in the aqueous solution. Cis/trans around the peptide bond of proline has been reported in both small peptides and native proteins. In order to assign proton chemical shifts and determine the spatial structure, 2D NMR experiments were performed using proton-proton through bond connectivity (DQF-COSY) and proton-proton through space connectivity (NOESY). 2D HMQC and HMQC-TOCSY experiments assign carbons correlated directly and indirectly to protons, respectively. Four conformers of N-Ac-PGP were identified through these techniques. Populations of the various conformers were estimated using 1-D proton integration and the Vant Hoff equation.

DEVELOPMENT OF A COUPLED NAD SYNTHETASE ENZYME ASSAY. Brandon Pybus¹, Meena Sthanam², Raj Singh², Marek Jedrzejewski^{2&3}, Yancho Devedjiev², Lawrence DeLucas² and Donald D. Muccio¹. Department of Chemistry¹, Center for Macromolecular Crystallography², Department of Microbiology³, University of Alabama at Birmingham, Birmingham, AL 35294.

NAD synthetase, a member of the ATP pyrophosphatase family of enzymes, plays a crucial role in the last step of the biosynthesis of nicotinamide adenine dinucleotide (NAD) from deamido nicotinamide adenine dinucleotide (NaAD) through catalyses of the following reaction.



The enzyme exists as a dimer, consisting of two subunits of 30,336 Da. By coupling the NAD synthetase mediated reaction with that of alcohol dehydrogenase, which converts ethanol to acetaldehyde in an NAD dependent manner, NAD production can be indirectly monitored through the absorbance change at 340 nm. This coupled assay can be used to elucidate the enzyme kinetics, and their dependence on each of the substrates. Kinetic studies reveal Michaelis-Menten like kinetics for both NaAD and NH₃, with K_m values on the order of 20 μM and 2 mM, respectively. However, ATP exhibited non Michaelis-Menten behavior. Funding for this project was provided by the Defense Advanced Research Projects Administration (DARPA) grant: MDA 972-56-K-0063.

BORON-MODIFIED PHENOLIC RESINS (BPR). Mohamed O. Abdalla, Adriane G. Ludwick and Temisha Mitchell, Department of Chemistry, Tuskegee University, Tuskegee, AL 36088.

Increase in the types of applications of phenolic resins has resulted in the necessity to examine the modification of these resins. Phenolic resins are thermosets that possess remarkable thermal stability and are flame-retardants. Processing of these resins into the desired products with the required properties involves a complicated series of reactions. Thus, much research has been conducted on the chemistry and processing of these systems. In this work a solid, boron-containing phenolic resin is investigated. An improvement in the thermal properties of these resins has been reported in the literature (Zairyo 36(401), 184-8, 1987; translation from Japanese). In an expansion to this citation, phenyl borates were synthesized from various molar ratios of phenol and boric acid (1:1, 2:1, 3:1 and 4:1) at 150°C. The 3:1 molar ratio phenyl borate is a liquid at low temperatures (less than 50°C) and shows promise for processing by resin transfer molding (RTM). A study of the reaction of this ester with paraformaldehyde is underway. Hence, the formation of the phenolic resin is being done in the absence of solvents, which should ultimately give a material with few voids and excellent mechanical properties. Support from the Army Research Office is gratefully acknowledged.

SYNTHESIS OF A CONFORMATIONALLY CONSTRAINED RETINOID, UAB30, AND BINDING STUDIES TO NUCLEAR RECEPTORS. Kimberly K. Vines, Brahma P. Sani, Lakshmi Reddy, Wayne J. Brouilliette, Donald D. Muccio, Department of Chemistry, University of Alabama at Birmingham, Birmingham, Al. 35294 Department of Biochemistry, Southern Research Institute, Birmingham, Al. 35205

Retinoids (RA) are valuable tools in the treatment of cancer due to their involvement in cell proliferation and differentiation. RA binds RA nuclear receptors (RAR and RXR) which are ligand activated transcription factors which modulate gene expression. Activation of RA occurs when (9-*cis*) RA binds thus promoting cell proliferation. RXR is activated upon binding of either the (9-*cis*) or (all-*trans*) isomers of RA which induces cell death by apoptosis. RXR also interacts with other receptors that are involved in metabolism leading to toxicity and side effects. In order to reduce toxicity, receptor sub-type specific analogs were designed and synthesized that were conformationally constrained to prevent isomerization *in vivo*. UAB30 was constrained by including an aromatic ring system in conjugation with a polyene chain. The starting acid was readily synthesized using the Reformatsky reaction. Reduction of the acid was followed by oxidation to the corresponding 9Z and 9E aldehydes which were separated by flash chromatography. 9Z aldehyde was converted to the ester of UAB30 via the Horner-Emmons reaction. The (9Z,13E) and (9Z,13Z) esters were separated by HPLC. The (9Z,13E) ester was hydrolyzed to yield UAB30. Binding assays were performed with radio-labeled RA-bound Cytoplasmic RA Binding Protein (CRABP). The concentration of UAB30 required to displace 50% of the bound RA was determined.

THE SIGNS OF ORBITALS DO MATTER. Tracy P. Hamilton, Dept. of Chemistry, Univ. of Ala. at Birmingham, Birmingham, AL 35294-1240.

The concept that the phases of orbitals (plus or minus) are immaterial in molecular orbital (MO) calculations is almost a mantra in quantum chemistry. This results from the simple fact that all observable properties depend on evaluation of integrals where the wave function is squared, making the sign of the orbitals irrelevant. As a result, most Hartree-Fock programs use matrix diagonalization algorithms that produce random signs for MOs (eigenvectors), and are ordered according to orbital energy (eigenvalue). While this has no impact on Hartree-Fock wave functions, it is of utmost importance in electron correlation calculations which use the form

$$\Psi_{corr} = \Psi_0 + \sum C_i^a \psi_i^a + \dots$$

The sign of the configuration interaction coefficient depends on the sign of the excited configuration, which in turn depends on the signs of the orbitals *i* and *a*. A consistent sign convention for the orbitals enables improved guesses for correlated wave functions.

Abstracts

SYNTHESES AND BIOLOGICAL EFFECTS OF SOME URACIL-CONTAINING POLY-NUCLEOTIDE ANALOGS. Lahu Saiji, Rong Wu, Adriane Ludwick and Oyewole Adeyemo, Departments of Chemistry and Biology, Tuskegee University, Tuskegee, AL 36088.

Polynucleotide analogs interfere with the production of nucleic acids either by incorporation into the cells or by inhibition of polymerases of the nucleic acids. Uracil-containing poly-nucleotide analogs are potent inhibitors of DNA and/or RNA viruses but less toxic than small molecule uracil derivatives. In this work, two groups of polynucleotide analogs were synthesized. Neutral polynucleotide analogs were synthesized by grafting the pendent, 3-(uracil-1-yl) propanoyl, to partially hydrolyzed polyethyloxazoline backbones. Anionic polynucleotide analogs were synthesized by grafting various percents of 1-(2-hydroxyethyl)uracil to poly(acrylic acid) backbones. The corresponding monomer analogs were also synthesized. C¹⁴-Labeled analogs were synthesized and used for determining the uptake of these compounds in goat synovial membrane cells. The antiviral activity of the synthesized compounds was investigated by using caprine arthritis-encephalitis virus in the goat cells. The initial biological tests of the synthesized neutral polynucleotide analogs showed that at concentrations that were not toxic to the host cells, the analogs inhibited the replication of the virus.

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Polynucleotide analogs interfere with the production of nucleic acids either by incorporation into the cells or by inhibition of polymerases of the nucleic acids. Uracil-containing polynucleotide analogs are potent inhibitors of DNA and/or RNA viruses but less toxic than small molecule uracil derivatives. In this work, two groups of polynucleotide analogs were synthesized. Neutral polynucleotide analogs were synthesized by grafting the pendent, 3-(uracil-1-yl) propanoyl, to partially hydrolyzed polyethyloxazoline backbones. Anionic polynucleotide analogs were synthesized by grafting various percents of 1-(2-hydroxyethyl)uracil to poly(acrylic acid) backbones. The corresponding monomer analogs were also synthesized. C¹⁴-Labeled analogs were synthesized and used for determining the uptake of these compounds in goat synovial membrane cells. The antiviral activity of the synthesized compounds was investigated by using caprine arthritis-encephalitis virus in the goat cells. The initial biological tests of the synthesized neutral polynucleotide analogs showed that at concentrations that were not toxic to the host cells, the analogs inhibited the replication of the virus.

HALOGENATED PHENOLIC RESINS (HPR). Ivy D. Bradford, Renee Green and Adriane G. Ludwick, Chemistry Department, Tuskegee Univ., Tuskegee, AL 36083.

Halogenated phenolic resins are being studied because of their good thermal stability, flame retardancy properties and processability by Resin Transfer Molding (RTM) to form composites. Processing of these resins into the desired products with required properties is very complicated. Thus current demands are for specific and improved properties of the phenolic resins requiring a thorough understanding of the prepolymer. The prepolymer can be synthesized in basic medium, with an excess of formaldehyde, to give resoles. In this work resoles were synthesized using pure para-bromophenol and various molar ratios of phenol to para-bromophenol (1:9, 1:1, and 9:1) and formaldehyde. In all cases, the molar ratio of total phenol content to para-formaldehyde was 1:2.5. Characterization of the resoles was done by ^{13}C NMR. Glass fiber composites were prepared from cure of the resoles (1:9, 1:1 and pure para-bromophenol) and a S2 glass fiber weave. Analysis of the composites was done by impact testing, C-scan and Scanning Electron Microscopy (SEM). The para-bromophenol:phenol (1:9)/formaldehyde composite showed the best mechanical properties. This preliminary work is being further investigated. Acid conditions to form phenolic resins and their cure products will be examined. Support of the Army Research Organization (ARO) is gratefully acknowledged.

ANALYSIS OF PROTEINS AND PEPTIDES BY CAPILLARY ELECTROPHORESIS USING TWO-COLOR LASER INDUCED FLUORESCENCE DETECTION. GUIDO F. VERBECK AND STEPHEN C. BEALE, Department of Chemistry, University of Alabama at Birmingham, Birmingham, AL 35294

Capillary electrophoresis (CE) with laser-induced fluorescence (LIF) detection can be a highly effective tool for analysis and characterization of proteins and peptides. Here we present a two channel laser induced fluorescence detection system for the CE separation of proteins and peptides. The helium-neon laser (543.5 nm) is used for simultaneous excitation of biomolecules labeled with Bodipy 530/550 and Texas Red fluorophores. The fluorescent emission signal from the different fluorophores can be separated by a dichroic mirror. The fluorescent signal in each channel is spectrally filtered and collected by photomultiplier tubes.

The system performance characteristics, such as spectral overlap in the channels and selection of fluorescent reporters, will be presented. In addition, data will be shown regarding various aspects of the probe labeling chemistry and the electrophoresis characteristics of the selected probes. Finally, we will show applications of this system to protein and peptide analysis. These will include the use of size standards and isoelectric point or migration time markers, each labeled with a fluorescent reporter moiety that is different from that used for labeling the samples to be determined. Co-injection of the standards or markers with the analytes provides for in-run calibration of gels or pH gradients or internal correction of variations in migration time.

Abstracts

Experimental Error Analysis by the Monte Carlo Method. M. B. Moeller, Dept. of Chemistry and Industrial Hygiene, University of North Alabama, Florence, AL 35632.

Whenever the objective of an experiment involves the determination of a numerical quantity, knowledge of the accuracy to be expected from the determination can be as important as the number itself. An estimation of the accuracy can in some instances be obtained from running tests with samples of known value, but in many cases this is not an option. Furthermore, selecting experimental conditions so to minimize the final uncertainty requires *a priori* understanding of how the accuracy ultimately depends on the various parameters of the experiment. This understanding can come from propagation of errors analysis, a technique using a truncated Taylor series expansion of the equation relating the final numerical result for the experiment to the independent variables but, except for rudimentary cases, this analysis can be extremely complex and laborious. An alternative technique that may appeal to many investigators is to create a stochastic computer model of the experiment and obtain an estimate of accuracy by a Monte Carlo calculation. Beginning with a spreadsheet similar to one which might be used to analyze actual experimental data, cells are added which contain precision estimates for input parameters. Assuming a normal error distribution, a Box-Muller transformation provides scattered data for the spreadsheet to analyze. The spreadsheet may be considered to generate a virtual experiment in which the experimental value can be compared to a true value. To obtain the uncertainty expected from such an experiment, a macrosheet is constructed which executes the virtual experiment 1000 times, each time storing the absolute magnitude of the error in a separate spreadsheet. By sorting these 1000 absolute error values in descending order, the 95% confidence interval is estimated by taking the average of the 49th and 50th largest errors. Repeating the entire process several times provides an indication of the stability of the uncertainty estimate obtained by this process. This paper offers three examples of this type analysis.

EARTH SCIENCE

INDICATORS OF CHRONIC IMPACTS OF TECHNOLOGICAL DISASTERS: TRENDS IN RESEARCH LITERATURE. F. H. Dennard, Social Science, Faulkner State Community College, Bay Minette, Alabama 36507. J. Steven Picou, Dept. of Sociology, Univ. of South Alabama, Mobile, AL 36688.

This research presents an analysis of empirical data collected over the past three decades relating to technological disasters. In particular the indicators of chronic impacts on human communities. This is accomplished through a review of previous technological disaster studies to determine social disruption and stress characteristics that have been identified throughout the literature. Using these characteristics to indicate recurring emergent patterns in the aftermath of technological disasters, a comparison is made to the conceptual framework of the "corrosive community." The results verify that technological disasters produce unique characteristics in exposed populations. Finally, those recurring attributes are consistent with the "corrosive community" paradigm. This study indicates that further research is justified into the complex nature of technological disaster impacts, to determine if they are event driven or arise from secondary phenomena.

Abstracts

ART 2 NEURAL NETWORK APPROACH TO RESERVOIR ANALYSIS. David C. Kopaska-Merkel, Geological Survey of Alabama, PO Box O, Tuscaloosa AL 35486. Hsien-cheng Chang, Dept. of Civil and Environmental Engineering, Univ. of Ala., Tuscaloosa, AL 35487. Hui-Chuan Chen, Dept. of Computer Science, Univ. of Ala., Tuscaloosa, AL 35487.

A novel technique is used to determine permeability from logfacies using adaptive resonance theory (ART). ART is used to create artificial neural networks capable of incremental, unsupervised, and stable clustering input data. ART2, a variety of ART which is capable of clustering analog data, is employed in this paper. This new method first employs ART2 to cluster input data (depth in the well, neutron porosity, density porosity, sonic, and velocity-deviation) into logfacies. The logfacies are calibrated to lithofacies, which are based on core description and include depositional information, and to horizontal permeability values, which are derived from core analyses. Logfacies are further processed by fuzzy inference if their values of permeability span multiple permeability categories. A case study involved five wells located in a single hydrocarbon reservoir: Smackover Formation in Appleton field, Escambia County, Ala. The ART2 network used the relationships among logfacies, lithofacies, and permeability in a training well and log data from four test wells to determine logfacies and predict lithofacies and permeability in the test wells. Permeability data and lithologic interpretation of cores from the test wells were used to test the ART2 network predictions. Lithofacies was correctly predicted in 77% of the samples and permeability category in 68% of the samples in the test wells. Because this prediction method preserves spatial information and relates log characteristics to both petrophysics and depositional rock fabric, it may permit interwell petrophysical prediction guided by sedimentary conceptual models.

GOLD IN SKARN, MINAS DE ORO, HONDURAS. Michael G. Bersch, School of Mines and Energy Development, University of Alabama, Tuscaloosa, AL 35487-0164. John E. Hiner, Champion Resources, Inc., 205-409 Granville St., Vancouver, BC V6C 1T2, Canada.

During 1996, Champion Resources, Inc., in connection with other Canadian exploration companies, conducted exploration for gold in and around Minas de Oro, Honduras. The project area covered approximately 97 km². The stratigraphy in the project area is Jurassic Todos Santos Formation, consisting of conglomerates, red beds, and carbonate-cemented sands overlain by Cretaceous Yojoa limestones which are, in turn, overlain by Cretaceous Valle de Angeles Group, another sequence of red beds and limestones. This sequence has been intruded by Tertiary(?) Minas de Oro granodiorite and later feldspar porphyry. Copper-gold mineralization occurs in skarn at the base of the Yojoa limestone in numerous places within the project area. Skarn consists of very fine-grained siliceous endoskarn to massive medium-grained garnet exoskarn. Deep weathering and oxidation have occurred in some areas where skarn has been fractured and subaerially exposed. Primary mineralization occurs as massive sulfide (pyrite-pyrrhotite-chalcopyrite) replacement of Yojoa Limestone, and quartz-pyrite-pyrrhotite-chalcopyrite veins, veinlets, and breccia fill in Todos Santos conglomerates and sands. In unoxidized skarn, gold occurs as irregular grains of electrum along mineral-grain boundaries and as encapsulated grains in oxides and sulfides. Although Champion has withdrawn from the project other companies continue exploration and testing of this interesting copper-gold skarn.

BONE MICROSTRUCTURE SHOWS HETEROCHRONY PLAYED A SIGNIFICANT ROLE IN THE ADAPTATION OF MOSASAURS TO THE MARINE. M. Amy SHELDON, Dept. of Geology and Geography, LSCB 136, Univ. of South Alabama, Mobile Alabama 36688, and the Institute of Vertebrate Paleontology, Rochester, New York, 14627.

Bone microstructure contains an untapped source of data that can be used to solve phylogenetic problems. Thin sections of juvenile and adults ribs of *Clidastes*, *Platecarpus*, and *Tylosaurus* have been studied using digital imaging analysis. Bone microstructure is distinctly different among adults of these three genera.

Significant changes in architecture occur during ontogeny. Medullary cavities of all three genera is filled in by trabecular bone during ontogeny. *Platecarpus* and *Tylosaurus* ontogenetically developed secondary osteons. Data show that cross-sectional porosity of cortical bone of *Clidastes* was increased from 5% in neonatal bone to 42% in adults. Porosity of juvenile *Platecarpus* is and 2% and adult is 16%. *Tylosaurus* porosity is 62% in adults.

Adult *Tylosaurus* retain characters that are seen only in juvenile stages of *Clidastes*. Further, *Tylosaurus* (15m) large size compared to *Clidastes* (3m) size may be the result heterochrony, specifically paedomorphism. *Platecarpus* bone porosity is lower than seen in adults of the other two genera. These data indicate that heterochrony played an important role in mosasaur evolution.

TEXTURAL AND FABRIC CHANGES IN BIVALVES FROM THE TAMIAMI FORMATION, SOUTHWESTERN FLORIDA. Laura C. Quinn, J. Ashley Jordan & Douglas Haywick, Dept. of Geology, University of South Alabama, Mobile, AL 36688

Changes in fabric and texture of two species of bivalve (*Chione cancellata* and *Chione* sp.) from southwest Florida during progressive meteoric alteration are being examined through the use of petrography and scanning electron microscopy. Pristine shells (collected from modern beach environments in Naples and Sanibel Island, FL) are characterized by a close-fitted cross-lamellar fabric of aragonite crystallites. There is virtually no intercrystalline porosity in these shells. In contrast, partially dissolved *Chione* sp. bivalves (collected from the Tertiary Tamiami Formation near Fort Meyers, FL) are characterized by a chalky texture, particularly along the outer surfaces of the shell. When examined under a scanning electron microscope, surfaces of these shells appear pitted, and irregular due to increased porosity between aragonite crystallites. Shells from the Tamiami Formation that are intensely dissolved (very chalky) have the highest amount of intercrystalline porosity. They are also characterized by significant dissolution along primary and secondary foliations. This is best viewed in thin-section under polarized light. Enlargement of intercrystalline pores greatly increases the rate of fluid transfer through the shells and may enhance the speed of dissolution of the remaining aragonite. The most chalky shells are prone to neomorphic replacement of aragonite by calcite. This is an important process in the cementation of carbonate sediment and one of the reasons why the Tamiami Formation is quarried as a building material in southwestern Florida.

DETERMINATION OF SEDIMENT CHARACTERISTICS AND BATHYMETRY IN WEEKS BAY, SOUTHERN BALDWIN COUNTY. Mary L. Grace and Douglas W. Haywick, Dept. of Geology, University of South Alabama, Mobile, AL 36688

Weeks Bay is a small (15 km²) brackish water embayment located along the eastern shoreline of Mobile Bay just south of Fairhope, AL. Our study was initiated in order to characterize the grain size of bottom sediments and the bathymetry of the bay. Bathymetric measurements (corrected for tides) were made using a specially designed probe deployed from a small boat. Bottom samples were collected concurrently with water depth measurements using a 6 inch grab sampler. Four hundred and one samples and depth readings we collected during the field work component of this study. The location of each sampling station (+/- 5 m) was determined with a GPS equipped with a differential antenna. Grain size parameters of the sediment collected from Weeks Bay was determined using the pipette and sieve method of analysis. For each sample, percentages of sand, silt and clay were determined and plotted on a grain size ternary diagram. These data, as well as bathymetric measurements, are presently being transferred to base maps of Weeks Bay. Eventually all data will be digitized using CAD and GIS software. At the present time, we are able to conclude that Weeks Bay is shallow (generally less than 2 m deep outside of river mouths and tidal channels), remarkably flat bottomed, and characterized by a dominantly silty-clay substrate. Shelly mud is most common in the vicinity of the inlet into Mobile Bay; sand dominates the sediment in the vicinity of shorelines (particularly in the southern part of the bay) and the mouths of river channels.

SIZE DISTRIBUTION OF *BOLOVINA HUNERI* AND *GLOBOCASSIDULINA SUBGLOBOSA* ACROSS THE EOCENE OLIGOCENE- BOUNDARY. Laura Quinn and Murlene W. Clark, Dept. of Geology, Univ. of South Ala., Mobile Ala. 36688.

The size distribution of populations of *B. huneri* and *G. subglobosa* were examined across the Eocene-Oligocene boundary in samples obtained from DSDP Leg 73, Site 522 located in the Angola Basin. The Eocene-Oligocene boundary has been identified as a time of faunal crisis in the deep ocean caused by the initiation of thermohaline circulation. Bottom temperatures dropped, dissolved gasses increased and surface productivity may have been locally elevated. Environmental parameters have been shown to affect the size distribution of populations of deep Neogene foraminifers. Environmentally induced changes in population size are artifacts of precocious or delayed reproduction which correlates small population size with optimum environment. *G. subglobosa* populations decrease in size under conditions of increased food supply. *B. huneri* is categorized among infaunal species and should become smaller under preferred conditions of either low oxygen or increased productivity. Across the Eocene-Oligocene boundary a significant size decrease is observed in both species examined here. *B. huneri* and *G. subglobosa* remained abundant across the Eocene-Oligocene boundary and their size distributions decreased perhaps in response to greater productivity in surface waters at this time.

Abstracts

HISTORICAL GEOLOGY OF GOLD AND SILVER DEPOSITS IN ALABAMA. Lewis S. Dean, Geological Survey of Alabama, P. O. Box O, Tuscaloosa, AL 35486.

The search for gold in Alabama has been a subject of interest for over 450 years. Three centuries before the discovery of gold in Alabama, its supposed presence lured the first European expedition into the area by Hernando de Soto. The first recorded discovery and gold production from Alabama was in 1831 from placer deposits near Chestnut Creek in old Autauga (now Chilton) County. During the antebellum period, additional placer, eluvial, and vein deposits were prospected in the northern Piedmont of Alabama with peak production occurring in the mid 1840's. The total recorded gold production for Alabama is 49,495 troy oz., approximately 2 percent of the total production from the southern Appalachians.

During the 1840's, interest in gold and other mineral resources of Alabama stimulated the effort to appoint a state geologist in 1848 to undertake a geological survey of the state. This provided the first scientific investigation of gold deposits in Alabama; however, the debate over the occurrence of supposed silver deposits led to partisan efforts to render inactive the continuation of a geological survey in 1855.

Persistent interest in the occurrence of precious metals in the state has led to numerous promotional enterprises which describe gold and silver deposits outside of the historic gold districts in the state. This circumstance has had a long lasting contribution to the amount of misinformation regarding the occurrence of precious metals and the historical significance of the early gold rush period. The most often repeated misinformation was that the gold rush towns of Arbacoochee and Goldville were the largest towns in the state during the 1840's gold rush, a claim not substantiated by any historical records.

TORNADO FAMILY EVOLVING NEAR THE APEX OF A BOW ECHO IN NORTH ALABAMA. Douglas A. Butts, Jr. and Keith G. Blackwell, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688

A supercell thunderstorm occasionally produces a sequential series of tornadoes; these are known as *tornado families*. A line of non-tornadic thunderstorms may evolve into oow-shaped patterns as damaging straight-line winds within the storms accelerate portions of the squall line ahead of other line elements. This surge is identified on Doppler weather radar as a "bow echo". Bow echoes occasionally produce tornadoes; however, these tornadoes usually occur in cyclonic rotation within the bow's northern flank. On 16 February 1995, a bow echo was observed on Birmingham, AL and Columbus, MS Doppler radars near a stationary front in northeastern Mississippi. In an unusual occurrence, a tornadic supercell rapidly developed in the *central section* of the bow's convex leading edge and sequentially spawned a family of three tornadoes as it moved over northern Alabama. Initially, two separate rotation centers developed within the bow echo, one within the "comma head" of the bow's north end, and one within a strengthening mesocyclone and hook echo near the bow apex. The first tornado (F1) formed at 3:34 am; however, a tornado warning was not issued for another 20 minutes. The supercell continued moving along a thermal boundary across North Alabama, producing wind damage over Winston County. By 4:00 am, the supercell encountered a 56 knot low-level jet over the Tennessee Valley and an hour later the storm produced its strongest tornado (F3). This tornado killed three and injured over 100 near Arab, AL. The final tornado (F2) touched down in Northeast AL by 5:30 am. After 6:00 am, the storm weakened over North Georgia as it moved over cold pool of air dammed against the Appalachians.

Abstracts

A PRACTICAL APPROACH TO CONTAMINATION ASSESSMENTS AT LEAKING UNDERGROUND STORAGE TANK SITES. Daniel J. O'Donnell, P.G., Volkert Environmental Group, 3809 Moffett Road, Mobile, Alabama 36618.

In the late 1980s, regulations governing underground fuel storage tanks were implemented at federal and state regulatory levels. In general, these regulations spelled out performance standards for new installations, outlined up-grade procedures for existing tanks, established procedures for reporting, assessing and remediating releases from USTs, and established mechanisms for financial responsibility for UST owners. Initially, few sites were being assessed and the demand for trained investigators could keep up with the work. With the increasing number of sites needing investigations and the lack of trained personnel to complete them, expertise was often lacking as more firms entered the "booming" environmental market. In some cases, individuals with no formal training in hydrogeologic investigations were thrust into responsible positions, directing investigations and providing training to lower level staff under their charge. The end result was that, at many sites across the country, contamination investigations became "hit and miss" drilling and well installations projects rather than carefully planned projects designed to answer specific regulatory requirements. Now almost a decade later, it may be time to rethink the assessment/investigative process and return to a practical approach of conducting contamination investigations at leaking UST sites. This practical approach includes a review of files on area sites, a planned soil investigation program and, if warranted, a groundwater investigation program to characterize the release and provide information on the aquifer being impacted by the release.

SIMULATION OF A TRACER TEST IN A DOUBLY POROUS AQUIFER WITH AN ADVECTIVE FLOW PARTICLE TRACKING COMPUTER PROGRAM. James L. Robinson, U.S. Geological Survey, 2350 Fairlane Dr., Suite 120, Montgomery, AL 36116.

The Upper Floridan aquifer of west-central Florida is generally simulated as a porous media (primary, or matrix porosity), although it contains secondary porosity in the form of vugs and conduits. A tracer test was conducted in the upper 300 feet of the aquifer by releasing a pulse of tracer dye into the borehole of a well 200 feet from a pumped recovery well. A dye breakthrough in the recovery well occurred 4 hours after pumping began and peak dye concentration in the recover well occurred 15 hours after pumping began. A secondary dye breakthrough occurred after 36 days of pumping and a secondary peak concentration occurred after 48 days of pumping. The bimodal distribution of tracer arrival is interpreted as ground-water flow through a doubly porous system, with the early arrival representing secondary porosity and the later arrival representing the primary porosity of the aquifer matrix. The second arrival time was used to calculate an effective porosity of 25 percent, and a longitudinal dispersivity of 1.3 feet for the aquifer matrix. A calibrated flow model and an advective flow particle-tracking program were used to simulate the tracer test. An effective porosity of 21 percent for the aquifer matrix and a secondary effective porosity of 0.15 percent were required in the simulations in order to match the field data. The results of numerical modeling support the interpretation of ground-water flow through a doubly porous aquifer, and indicate that the assumption of equivalent porous media flow in the Upper Floridan aquifer is probably valid only on an intermediate to regional scale.

Abstracts

SUMMARY OF TRACE ELEMENT LOSS AND ISOTOPIC CHANGES IN AN EXPERIMENT SIMULATING ARAGONITE DIAGENESIS. Charles Stapleton and Douglas W. Haywick, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688

We initiated an experiment approximately two years ago to simulate the effects of meteoric alteration on aragonitic bivalves. The experiment consisted of four water filtration canisters, each containing 10 to 20 portions of Donax variabilis, the common coquina shell. These shells were originally collected live from the surf zone of Orange Beach, AL. They were disarticulated, placed in hydrogen peroxide to remove all organic material and dried. Each valve was weighed to 4 decimal places (± 0.2 mg) before being placed into the canisters. Three of the canisters were packed with siliciclastic sand; one was packed in carbonate sand. Distilled water (simulating meteoric water) was allowed to pass through two of the siliciclastic sand-bearing canisters and the carbonate sand-bearing canister. Sea water was passed through the remaining canister packed with siliciclastic sand. Every so often, the shells were removed from each canister and individually weighed to determine if any mass loss due to dissolution was occurring. After 1 year, the shells were cut into thirds. One part was thin-sectioned, one part was processed for stable isotopic analysis (^{18}O and ^{13}C) and one part was returned to the canister for continued dissolution. For shells packed in siliciclastic sand through which distilled water passed, there is measurable loss in mass and in $\delta^{18}\text{O}$. For shells packed in carbonate sand, no mass loss occurred. These results are consistent with that observed in nature.

CONSTRUCTING AND MAINTAINING DIGITAL GEOLOGIC MAPS WITH CAD AND GIS: STRATEGY AND TECHNIQUE. Christie M. Hardin and David T. Allison, Department of Geology & Geography, University of South Alabama, Mobile, AL 36688.

The availability of powerful desktop computer workstations has enabled computer-aided design (CAD) and geographic information systems (GIS) to play an increasingly fundamental role in the geosciences. Some of the results of an ongoing geologic mapping project by the authors will serve to illustrate the strategy and techniques of constructing digital geologic maps- techniques that are applicable to a wide variety of projects involving geographic data. USGS 7.5 minute quadrangles containing geologic contacts, in addition to standard base map layer information (cultural features, UTM grid, river and lake boundaries, road system, etc.) are digitized with CAD to form the digital base map. Structure data is systematically posted onto the base map via a universal map projection coordinate system. Tabular data is recorded in a relational data base system for maximum storage efficiency. The CAD base map serves as a research tool for field mapping, and as a starting platform for GIS. Migration of CAD elements to the GIS system is subdivided into three steps: 1) importation of lithologic polygons, 2) importation of line work (arcs), and 3) importation of annotation features. Some geologic layers must be treated as composites, for example structural data is imported as both line work (strike & dip symbol) and annotation (dip/plunge value). The complex issues of when CAD, GIS, or a combination of both, are the most effective tool for geologic map composition/analysis will serve as the underlying theme of this presentation.

PROFESSIONAL LICENSING OF GEOLOGISTS IN ALABAMA. Thornton L. Neathery, Neathery and Associates, Tuscaloosa, Alabama, 35404 for the Alabama Board of Licensure for Professional Geologists, Montgomery, AL, 36101.

In response to national concerns dealing with the accuracy and quality of geologic data included and incorporated into various reports and documents submitted to governmental agencies for compliance with federal and state laws, many states have passed professional licensing laws to set minimum educational and practice requirements for persons engaged in the practice of geology. In 1995, the Alabama Legislature, with the encouragement of many professional geologists in Alabama, passed public law 95-399 - Alabama Professional Geologists Licensing Act. The law established a governing board, and set minimum educational and practice requirements for individuals engaged in the public practice of geology. The public practice of geology is defined as "The performance of geological service or work, including, but not limited to, consultation, geological investigation, surveys, evaluations, planning, mapping or review of geological work related to the public practice of geology, or both, in which the performance is related to the public welfare or safeguarding of life, health, property and the environment except as otherwise specifically provided for in the Act." All geologists currently practicing in Alabama, or plan to practice in Alabama, should be knowledgeable of the Act, Rules and Policies of the Licensure Board. This talk will outline the substance of the Act, history of the Board, basic qualifications of licensees, and the licensure process.

SIMULATION OF A TRACER TEST IN A DOUBLY POROUS AQUIFER WITH AN ADVECTIVE FLOW PARTICLE TRACKING COMPUTER PROGRAM. James L. Robinson, U.S. Geological Survey, 2350 Fairlane Dr., Suite 120, Montgomery, AL 36116.

The Upper Floridan aquifer of west-central Florida is generally simulated as a porous media (primary, or matrix porosity), although it contains secondary porosity in the form of vugs and conduits. A tracer test was conducted in the upper 300 feet of the aquifer by releasing a pulse of tracer dye into the borehole of a well 200 feet from a pumped recovery well. A dye breakthrough in the recovery well occurred 4 hours after pumping began and peak dye concentration in the recovery well occurred 15 hours after pumping began. A secondary dye breakthrough occurred after 36 days of pumping and a secondary peak concentration occurred after 48 days of pumping. The bimodal distribution of tracer arrival is interpreted as ground-water flow through a doubly porous system, with the early arrival representing secondary porosity and the later arrival representing the primary porosity of the aquifer matrix. The second arrival time was used to calculate an effective porosity of 25 percent, and a longitudinal dispersivity of 1.3 feet for the aquifer matrix. A calibrated flow model and an advective flow particle-tracking program were used to simulate the tracer test. An effective porosity of 21 percent for the aquifer matrix and a secondary effective porosity of 1.5 percent were required in the simulations in order to match the field data. The results of numerical modeling support the interpretation of ground-water flow through a doubly porous aquifer, and indicate that the assumption of equivalent porous media flow in the Upper Floridan aquifer is probably valid only on an intermediate to regional scale.

Abstracts

SEDIMENTARY PROVENANCE: NON-VOLCANIC DOMINANCE IN A VOLCANIC FORE-ARC BASIN. Douglas W. Haywick, Department of Geology and Geography, University of South Alabama, Mobile, AL 36688

The source of sediment (i.e. sedimentary provenance), that enters into basins and other depositional environments is usually determined by petrographic methods and via estimations of framework composition (e.g., %quartz, %feldspar, %lithic fragments etc.). These data, when plotted on ternary classification diagrams, yield useful information about the plate tectonic setting of the depositional environment under study. The premise:

different tectonic hinterlands shed sediment of different and characteristic composition

appears to be valid in most situations; however, exceptions can, and do, occur. For example, the Plio-Pleistocene Petanc Group which crops out along eastern North Island New Zealand was deposited in a fore-arc basin. But here, siliciclastic sedimentary rocks are dominated by quartz and sandstone rock fragments that were derived from Permian-Triassic greywacke basement rocks that lay to the west. Ternary plots clearly indicate a recycled orogenic provenance with virtually no volcanogenic contribution for the siliciclastic sand fraction during much of the Plio-Pleistocene. Although this has been observed in other forearc basins described in the literature, it is nonetheless surprising for this area of New Zealand considering its proximity to a major volcanic area (Taupo Volcanic Zone) and the volume of dominantly rhyolitic material erupted from there since the Pliocene (c. 16,000 km³).

MINERALOGICAL AND GRAIN SIZE VARIATIONS IN THE CRETACEOUS PIERRE SHALE FORMATION, SOUTHERN SOUTH DAKOTA. Andrew P. Feltman, Douglas Haywick, Dept. of Geology, Uni. of South Alabama, Mobile, AL 36688 and Gorden L. Bell Jr., South Dakota School of Mines & Technology, Rapid City, SD 57701

The Upper Cretaceous Pierre Shale Formation was deposited within a shallow marine environment and is well known for containing marine vertebrates such as mosasaurs and turtles. Despite the paleontological importance of this formation, little sedimentological data exists by which to characterize the Pierre Shale in southern South Dakota. The purpose of this project is to provide these data for the middle portion of the Pierre Shale Formation (Gregory, Crow Creek and De Grey Members), and in particular, to determine a possible method by which to discriminate several bentonite layers within the Gregory Member. We have collected 66 samples from an outcrop of Pierre Shale that extended across the interval of interest. Grain size parameters of each sample were determined in a laboratory. The $\geq 63 \mu\text{m}$ fraction of each sample was examined in order to determine the mineralogy of the sand component. Overall, the Pierre Shale is dominated by silt and clay. Many samples, primarily those from the Crow Creek Member, contained gypsum within the sand fraction. This mineral is diagenetic and either formed as an evaporite mineral during deposition of the Pierre Shale or after deposition through the action of groundwater. The sand fraction in other samples contained quartz, biotite and foraminifera. At this time, it appears that bentonite layers in the Gregory Member contain slightly more sand and less foraminifera than intervening shale units in the Pierre Shale.

Abstracts

THE 1997 ESCAMBIA COUNTY EARTHQUAKE. Dorothy E. Raymond, Geological Survey of Alabama, Tuscaloosa, AL 35486, Margaret Hopper and Joan Gomberg, U.S. Geological Survey, Memphis, TN 38152, and Lorraine Wolf and April Barnes, Auburn University, Auburn, AL 36849

On October 24, 1997, at 2:30 A.M. citizens of western Escambia County were rudely awakened by shaking windows and beds, falling pictures, and moving furniture. An earthquake centered in western Escambia County northeast of Atmore shook much of southern Alabama and was felt in the adjoining states of Florida and Mississippi. The quake had a duration magnitude (Md) of 4.9. A smaller quake (Md=3.1) on May 4, 1997, was a foreshock that had been originally attributed to a sonic boom. Historically, south Alabama is a region of low seismicity and reports of earthquakes in this area have in the past been greeted with skepticism. Only two historical earthquakes are known to have occurred within 100 km of the epicenter of this quake.

A system of 11 seismic stations was immediately deployed to monitor seismic activity and more accurately determine the epicenters of subsequent quakes. Three other aftershocks were felt at 5:50 P.M. October 26 (Md=3.7), at 3 A.M. October 28 (Md=3), and at 4:44 P.M. January 26, 1998 (Md=2.8). The epicenter for the aftershocks was about 2.4 km south of Little Rock, Escambia County. Concurrent with seismic monitoring, a comprehensive intensity survey was conducted immediately following the October 24 quake by home visits, surveys distributed to churches in the epicentral area, and surveys published in all major papers in the surrounding areas. Results compiled indicate the maximum intensity (VIII MM) to be limited to a small area 8 km southeast of the epicenters determined for the aftershocks. Intensities of VI or more are confined to Escambia County and northernmost Florida between the towns of Atmore and Brewton. Reported damage included a fallen concrete chimney cap, slope failure beneath a crane, cracks in concrete structures, and fallen objects.

GEOGRAPHY, FORESTRY, CONSERVATION, AND PLANNING

Teaching World Regional Geography in Digital Format. Tom L. Martinson, Dept. of Geography, Auburn University, Auburn, AL 36849.

Teaching world regional geography in digital format opens new possibilities for both teaching and learning. Exploring these possibilities has led to my developing the first full multimedia Web-based course at Auburn University, the first quarter-long televised course using the microwave transmission facilities between Auburn and Auburn University at Montgomery, the first use of Auburn's restricted access web site for lecture review materials, the first textbook on compact disk, the first digital on-line textbook sold by the Auburn University Bookstore, the first use of the Auburn University Media Database, and the first distance learning class on World Regional Geography submitted by Auburn University and approved by the Southern Regional Education Board for nationwide distribution. All these themes are illustrated in this presentation.

Abstracts

DIFFERENCES IN HIGH SCHOOL AND COLLEGE STUDENTS PERCEPTION ON PLANNING EDUCATION AND PRACTICE; Chukudi V. Izeogu, Ph.D. Dept. of Community Planning, Alabama A&M University, Normal, AL 35762

The need to meet state mandated program viability standard has forced administrators of small planning programs in Alabama to become more adept at developing student's recruitment programs. Students' choice of a field of study in the university, however, is often predicated upon their perception on the substance, purpose and employment prospects of various disciplines. To recruit effectively, planning educators need to know potential students' perception on planning. This study examines the perception of Huntsville, Alabama, high school and college students on urban planning, and the implications for students recruitment. The study focuses on what the students know urban planners do, and aspects of their community that planning influences. The results show that college students know more about what urban planners do, and associate urban planning with improving housing and community facilities than high school students. While high school students mostly hear about urban planning from TV programs, most college students know about the discipline in college and from print media. Also, more college students than high school students think that planners are mostly needed in their communities. The study reveals a need to develop different recruitment materials and programs with clear images of urban planning applications in the community for high schools and colleges.

CITYGREEN: URBAN FOREST ANALYSIS OF FLORENCE, ALABAMA. Chester Richey and Elizabeth Sutherland, Undergraduates, University of North Alabama, Florence, AL 35632

The purpose of this project is to make students, citizens and business leaders aware of the importance of trees in the urban ecosystem and to help them understand the effect that trees have on the urban environment. CITYgreen, created by American Forests, is a software extension to the ArcView Geographic Information Systems (GIS) program. With CITYgreen, natural resource managers, urban planners, environmental organizations, and even private citizens can monitor their community's resource growth and development. The program provides the user with the ability to map, measure, and analyze urban ecosystems. It helps in the determination of how urban landscapes are affected by:

- Air Pollution Removal,
- Household Energy Conservation,
- Stormwater Management,
- Carbon Storage and Sequestration, and
- Urban Wildlife.

The project involved a field inventory of selected sites of Florence urban ecosystem. The data was digitized or manually entered into a database and then formed the basis for the urban ecosystem analysis using the CITYgreen software. The project was funded research through the Alabama Forestry Commission.

GEOGRAPHY IN THE NEW SOCIAL STUDIES COURSE OF STUDY. William R. Strong, Dept. of Geography, University of North Alabama, Florence, AL 35632.

Geographic illiteracy in this country was documented by numerous surveys during the past decade. A 1988 Gallup reported that the USA came in last in the 18-24 year old cohort in a survey of 9 nations and lagged behind such countries as Japan, France, Canada and Mexico. Even before the survey, however, efforts were already underway to promote greater instruction in geography in every state of the union. The National Geographic Society provided early leadership and funding and was joined by the National Council for Geographic Education and the Association of American Geographers. One of the major goals was to establish world class national standards that could inform curriculum developments in the states. During the past year, the Alabama State Department of Education charged a select committee of teachers, professors and political appointees to develop standards for four foundational disciplines, geography, history, economics, and political science that support social studies instruction. The document produced by the committee, known as the Social Studies Course of Study, was approved by the State Board of Education in February, 1998, and will go into effect in the fall of 1999. It will guide instruction in geography and the other social studies for the following six years. This presentation reports the results of the year long deliberations and focuses on the themes, elements and standards that drive geographic education.

TVA'S ECONOMIC DEVELOPMENT EFFORTS IN THE TENNESSEE VALLEY REGION. Wanzina Jackson, Nelda Smith and Chukudi Izeogu, Dept. of Community Planning and Urban Studies, Alabama A & M University, Normal, AL 35762.

The Tennessee Valley Authority (TVA), established in the 1930's to foster economic development in the impoverished rural areas of the Tennessee Valley and to control flooding, has undergone several changes. Although its programs have expanded over the years to include community and social programs, it has been criticized for its nuclear power plants and associated environmental impacts. Currently, TVA faces several cuts in its non-power budget and environmental programs. However, TVA plans to fulfill its goals in its integrated resource plan, Energy Vision 2020. This study indicates that TVA has continued to improve its economic state with new cost-effective environmental technologies. Some of its non-power programs such as Economic Development Loan Fund, a multi-million dollar revolving loan pool fully funded through power revenues, have contributed to the social and economic development of states in the region. With the fund, TVA created over ten thousand jobs in 1996. Many of its recreation areas serve as economic stimulators as well as environmental education facilities. It offers over 170,000 acres of recreational and educational opportunities to visitors from all fifty states and twenty foreign countries. It provides continuing education opportunities for its employees. Also the TVA University, affords approximately 15,500 employees the opportunity to maintain their current jobs or obtain other high value jobs. This study suggests that the performance of TVA's regional economic development efforts has had a positive impact on the communities it serves.

CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT: A NONTECHNICAL OVERVIEW. James R. Lowery, Institutional Studies and Services, University of Alabama at Birmingham, Birmingham, AL 35294-0104.

Wetland plants clean water naturally by removing or immobilizing pollutants through several processes including slowing the flow of water so that suspended solids settle to the substrate and are removed from the water, absorbing some of the pollutants into the plants themselves, collecting some of the pollutants onto the substrate material, providing a location for aerobic bacteria to neutralize the wastewater and to break down pollutants, and providing oxidation and reduction zones for chemical transformation of pollutant components. Wetlands used for wastewater treatment (both constructed and natural wetlands) capitalize on the ability of wetland plants to clean water and to do it in a natural setting.

Treatment wetlands (constructed, "artificial," and natural) are being used throughout the world to treat various types of wastewater including wastewater from municipalities, mining operations, individual homes ("backyard wetlands"), high schools, college and university buildings, industry, commercial establishments, stormwater runoff, and agricultural operations. This is a nontechnical overview of this environmentally friendly alternative to the treatment of wastewater.

The first part focuses on what wetlands are, how wetland plants clean wastewater, the variety of applications for this proven technology, and the general concept of phytoremediation of which constructed wetlands are a part. The second part features operational constructed wetlands focusing on such facilities in Alabama.

WEATHER FORECAST SERVICE IN A UNIVERSITY ENVIRONMENT: ITS DEVELOPMENT AND OPERATION. Aaron Williams, Department of Geology-Geography, University of South Alabama, Mobile, Alabama 36688.

Although most of the growth in the private weather forecasting industry in the last ten years has involved the large forecasting companies with national and international clientele, smaller weather companies with limited service regions can compete if they locate in a strong industrial area and provide a variety of services that emphasize personal communication. The University of South Alabama's Coastal Weather Research Center provides personalized forecasts and warnings to a large and growing business and industrial community along the central Gulf Coast. However, the success of the Weather Center can also be attributed to its on-campus location where it (1) provides the university with a high profile program, (2) attracts businesses, (3) creates strong university-industrial ties, (4) supports other academic programs and university operations, and (5) serves as a training facility for future meteorologists. Thus, the on-campus setting has been highly beneficial for the Weather Center and the University of South Alabama and could be duplicated by colleges in other urban areas, especially if the National Weather Service continues to reduce its operations while businesses increase their demand for local and personal forecasts and warnings.

FROM TRADITIONAL TOURISM TO ECOTOURISM. Gloria Charles and William McAllister, Department of Community Planning and Urban Studies, Alabama A & M University, Normal, Alabama 35762.

During prehistoric times, men traveled in search of life sustaining resources. In times, other motivations for travel such as leisure, health, education, and business became equally important. With technological advancement, declining workweek paid yearly vacations, and improvements in transportation, travel demands continued to increase. The demand has led to the rapid development of infrastructure (hotels, industrial and entertainment sites) to accommodate and facilitate tourist and other travelers. The emphasis was primarily on profits and economic development. The accompanying rapid expansion of tourism, resulted often in the abuse of natural and cultural resources. Signs of environmental degradation became visible through the destruction of flora and fauna habitat, damage to archaeological and historical sites, and the loss of amenities of native residents. In response to these challenges, government officials and other stakeholders turned to find solutions to the environmental problems of the tourism industry. The solutions being sought focused on creating a balance between sustainable economic activities and environmental protection. The result was ecotourism; a term coined in the 1980s. Ecotourism promotes activities that would foster sustainable economic growth and concurrently protect the natural and cultural resources of the area. It seeks to maintain and preserve the pristine nature of the natural environment, for the use and enjoyment of present and future generations.

DOES GIS IMPROVE AGENCY EFFECTIVENESS? William K. McAllister, Department of Community Planning and Urban Studies, Alabama A&M University, Huntsville, AL

Geographic Information Systems (GISs) have become popular spatial analysis tools for public agencies at all levels of government. Now that GIS diffusion has become widespread, what can be concluded about its effectiveness and the level of effectiveness it might bring to the agencies that adopt and implement its technology? Agencies typically adopt GIS to fulfill the goal of improved decision-making by processing more and better data to higher levels of analysis. In the case of geographic data, the output can be a series of impressive-looking custom made maps with a minimum of distortion and a maximum amount of detail overlaying both physical and socio-economic data. The mental images that are created in the minds of our leaders from GIS-based presentations and analyses can have potentially powerful results for all land use decisions. As this picture unfolds for agency administrators, more investment is committed to this technology, and, in turn, GIS becomes a greater force in those agencies. Measuring GIS's effectiveness, that is its positive results toward meeting agency goals, is made more difficult in public agency settings than for other organizations due to changing leadership and varying levels of commitment to both research and the process of setting meaningful goals. Current research results suggest that GIS is a mainstay in most agencies that do spatial analysis, but more empirical research is needed as to GIS effects on organizational dynamics and its real role in improving public decision-making.

Abstracts

MOBILE COUNTYS' NATURAL RESOURCE POTENTIAL. Wilbur B. De Vall, President, Proxy Services, Ltd., Auburn, AL 36830.

The potential of a county depends primarily on having markets and processors of materials for these markets. In the case of Mobile County, having an export market (State Docks) strengthens the potential. Listed among the natural resources of the County are its people (population), land (acres), minerals including gas and oil, waterways (rivers, lakes, and salt water) all of which play a part in developing the potential markets and hence income from raw materials processed locally. The population of the County in 1990 was 378,643 and represented an increase of 3.7% in the last decade. Land area is reported to be 809,100 acres of which 16.1% is agricultural, 62.2% is forested, 10.9% covered by water, and 10.8% devoted to urbanization. Minerals include cement, sand, gravel, gas and oil both off-shore and land-based. The high percentage of land in forests provides the primary basis for projection of potential in this paper. The forest resource provides a payroll for 10,800 persons of \$290 million. This translates into an economic impact for the County of \$2.9 billion with 15% attributed to the value of the forest products and another 16% to value added through manufacture. Pulpwood represents 65% of the total and sawtimber 35%. Primary processors of the forest's raw materials number 25 while secondary processors number 57.

DIRT PITS AND OUR BACKYARDS. Stephen L. Whipkey, Student, Adult Interdisciplinary Studies (AIS), University of South Alabama, Mobile, Ala., 6535 Cheyenne Parkway, EightMile, Ala., 36613

The state of Alabama maintains an antiquated law dating back to 1969 that not only allows but also encourages property owners to mine their property and then to abandon it without reclamation. The miners suffer no penalty for their actions except the forfeiture of a mere \$150 per acre bonding fee. Not only can these operators mine the property under the current law, but they can remove the earth up to the property line, leave a high wall (bluff) and destroy the potential of their neighbor's property—all within the safety of this same law. Many of these operators purchase tracts of land that are often completely surrounded by residential neighborhoods, creating devastating monstrosities in the very back yards of the surrounding property owners. The only recourse for the people who have experienced damage to their property is to file a lawsuit and hope that the courts are understanding enough to award damages. To encourage reclamation, legislation was enacted in 1997 at the insistence of a citizens group in EightMile, Alabama, increasing the bonding fee to \$2,500 per acre. This same group is pursuing additional legislation in 1998 to place restrictions on the mine owners/operators. Restrictions will provide severe penalties if the land is not reclaimed and will deny permits to violators. By early 1997 more than 100,000 acres of mined land in Alabama had not been reclaimed. Much of this land is mined down to material that is considered unusable for construction and is incapable of supporting any form of vegetation. With nature left on its own to recover, many of these areas will not support life for several decades. It is past time to halt this assault upon our landscape and to bring open-pit mining under control in the state of Alabama.

PHYSICS AND MATHEMATICS

GROWTH OF BINARY ORGANIC NONLINEAR OPTICAL CRYSTALS*

J. Choi, T. Gebre, W.S. Wang, M.D. Aggarwal, Dept. of Physics, Alabama A&M University, Normal, AL 35762. K.J. Chang, Dept. of Chemistry, Alabama A&M University, Normal, AL 35762. Benjamin G. Penn, Donald O. Frazier, NASA /Marshall Space Flight Center, Huntsville, AL 35812.

Bulk single crystals of thermally stable binary organic system have been grown for various compositions. Benzil and 2-methyl-4-nitroaniline (MNA) binary system has been utilized to take advantage of the merits of these materials. Benzil is thermally stable in the molten state in air. MNA has the highest optical nonlinearity. However, MNA decomposes at the melting point and its surface degrades when exposed to air. A transparent Bridgman-Stockbarger chamber and an observation system with CCD camera have been used to grow these crystals. A self-sealing ampoule is used to reduce the tendency of decomposition of MNA in its molten state. Initial surface quality of grown binary crystals remain good in air for a period of 6 months. Absorption of water vapor seems to be the main cause of surface degradation of crystals. Hardness of grown crystals(5wt% benzil in MNA) is measured to be 13 Kg/mm² which is 45 % higher than benzil. It has been found that the conversion efficiency of second-harmonic generation for 5wt% benzil in MNA is 1.5 % with 4.5 mm interaction length. This organic binary crystal has the same efficiency as the commercial potassium dihydrogen phosphate (KDP) crystal.

* Work was performed under NASA Alliance for Nonlinear Optics grant NAG5-6532 and NAG8-1390.

INVERSE SPECTRAL PROBLEMS FOR OPERATOR-VALUED

R-FUNCTIONS. Sergey Belyi, Dept. of Mathematics, Troy State University, Troy, Al 36082.

We consider direct and inverse realization problems for the operator-valued *R*-functions acting in finite-dimensional Hilbert space as linear-fractional transformations of transfer functions of linear systems generated by rigged operator colligations. Certain subclasses of the class of realizable *R*-functions arise. These classes of operator-valued *R*-functions allow us to define classes of *J*-contractive operator-valued functions in half-plane that can be realized as a transfer mapping of the rigged operator colligations. A problem when the product of *J*-contractive operator-valued functions from defined class belongs to the same class is investigated.

Abstracts

DETERMINING THE TRAJECTORIES OF PROTONS IN AREAS OF RAPIDLY CHANGING ELECTRIC FIELDS IN THE EARTH'S MAGNETOSPHERE. B. J. Bateman, Physical Science Department, Troy State University, Troy, Al. T.E. Moore and Barbara Giles, Interplanetary Physics Branch, Goddard Space Flight Center, Greenbelt, Md 20771

A computer code used to determine the trajectories of charged particles works very very except in areas of rapidly changing electric fields. The code is designed to determine the trajectories by assuming the electric field is constant over a pre-defined volume of space. The code has been modified by adding a predictor-corrector routine which reduces the volume of space as the electric field changes. Preliminary results indicate that the routine produces reasonable results for the first three hours of the particles trajectory.

HEAT CONDUCTION INCORPORATING TEMPORAL FOURIER AND OHM LAWS. John H. Young, Department of Physics, University of Alabama at Birmingham, Birmingham, AL 35294.

The heat flux resulting from a temperature gradient, as originally proposed by Fourier, implicitly assumes an infinite propagation speed of thermal effects. Although not problematic in most cases of heat conduction analysis, certain contemporary engineering interests such as pulsed laser annealing have resulted in recognizing the need to modify the Fourier law in order to account for finite propagation speeds. Modification of Fourier's law to a time-dependent transient form alters the heat conduction equation from its usual form (parabolic) to a form (hyperbolic) containing a second time derivative of the temperature. Transient solutions to the latter have been shown by a number of authors to include thermal pulses having short duration and propagating at speeds dictated by material characteristics. Several recent analyses have examined the short-term solutions resulting from electrical current conduction in the host medium. The common assumption, however, is that Ohm's law holds on the exceedingly short time scales of interest. This is not the case, as Ohm's law must be cast into a transient form similar to that of the modified Fourier law and incorporated into the hyperbolic heat conduction equation. The forms of these modifications and their implications will be discussed.

ATOMIC VIBRATIONS AND ITS IMPACT ON HEAT CONDUCTIVITY* Kaylla Dixon, Thomas Jeffrey, Ben Oni and P. C. Sharma, Department of Physics, College of Engineering, Architecture and Physical Sciences, Tuskegee University, AL 36088.

Essential to electronic industry is to devise the means and ways to control the temperature of the devices fabricated by semiconductors. As widely believed and proved beyond doubts that one of the chief reasons for the failure of a device is the lack of expertise in managing the excess thermal energy. The heat energy in semiconductors is by and large transported by phonons and therefore in this paper the phonon interactions and their impact on thermal transport have been investigated. The scattering of phonons, in the semiconducting devices by the boundary, the defects and the phonon processes have been incorporated in the current analysis. A new equation for heat current has been obtained and applied to semiconducting systems. The theoretical model explains the temperature dependence of phonon conductivity very well.

GRAVITY AND DYNAMICS DUE TO A SPHEROIDAL CHARGED MASS. Govind K. Mcnon, Department of Physical Science and Chemistry, Troy State University, Troy, AL 36082, and John H. Young, Department of Physics, University of Alabama at Birmingham, Birmingham, AL 35294.

One of the bases for seemingly peculiar results predicted by Einsteinian gravity ("general relativity") is rooted in that theory's extending gravitational sources so as to include contributions in addition to conventional mass. The gravitational field of a charged point mass, for example, has been known for some eighty years and the inclusion of the electric field due to the charge gives rise to a field which differs substantially from that of an uncharged mass. It has come to be realized more recently that a neutral particle undergoing radial motion in such a field can experience the very nonNewtonian effect of gravitational repulsion. We have solved the coupled Einstein-Maxwell field equations for the case of a nonspherical mass containing a large enough net charge so as to prevent the formation of a black hole, thus making visible the entire region exterior to it. Our investigations of neutral particle motion in these regions, all of which should be accessible to a distant observer, have shown the possibility of repulsion and trapping and will be discussed.

A TERRESTRIAL RELATIVISTIC RED SHIFT EXPERIMENT. F. Neff
Weber, Department of Physics, University of South Alabama, Mobile,
Alabama 36688.

The gravitational red shift has long been observed in astronomy. Efforts to make terrestrial measurements confirming this gravitational shift of frequencies, resulting from the gravitational slowing down of the electromagnetic oscillators causing the shift, have been few indeed. The main reason for this dearth of experiments is that the slow-down is a function of v^2/c^2 , v being the speed of the source and c the speed of light in a vacuum. For most earth-bound experiments this ratio is exceedingly small. A consequence of the smallness of this effect is the need therefore for extremely precise frequency measurements, on the order of 1 part in 10^{11} . Combining an ultracentrifuge with the technique of optical heterodyning allows one in principle to overcome both of these limitations. Results will be reported at this talk on progress made in this effort.

THE SEARCH FOR CP VIOLATION IN HYPERON DECAYS:
PRELIMINARY RESULTS FROM THE HYPERCP EXPERIMENT
AT FERMILAB. C. Merrill Jenkins, Dept. of Physics, University of South
Alabama, Mobile, Alabama 36688, for the HyperCP Collaboration.

The HyperCP Experiment has taken data in the Fermilab fixed target run that ended in September 1997. This experiment has collected approximately 67 billion triggers. The angular distributions of the proton (anti-proton) in the decays of $\Lambda/\bar{\Lambda}$ from $\Xi^-/\bar{\Xi}^+$ decays are measured. Any difference in these distributions is a signal for CP violation. Based on the data set collected, the experiment expects to have a sensitivity of approximately 2.0×10^{-4} for the CP violation asymmetry. A progress report of this experiment will be presented and mass plots of the $\Lambda/\bar{\Lambda}$ and $\Xi^-/\bar{\Xi}^+$ and other particles will be shown from data collected during this run. A summary of other physics topics will be given. This work was supported in part by the Department of Energy, grant number DE-FG02-96ER40970.

INDUSTRY AND ECONOMICS

The United States Trade Balance: Prospects and Policy Recommendations. James H. Roller and Eric Rahimian. Dept. of Econ. and Finance, Alabama A&M Univ., Normal, AL 35762.

A trade deficit occurs when a country's imports exceed its exports. If the U.S. is to balance its international trade, it must become more productive and technologically advantaged as compared with its trading partners. According to the theory of comparative advantage a country can profit from international trade, when it exports items for which production opportunity costs are smaller than the trading partner's opportunity costs and imports the commodities for which the opportunity costs are high. We have studied the data of the U.S. trade balance for the most recent thirty years. For the trade of goods, services and income, one observes that the balance was negative in 1977, 1978 and again in 1983 and since then. We also have studied the value of the major commodities exported and imported by the U.S. in 1987 and 1995. The comparison of the data of these two years reveals that the U.S. has recaptured part of the lost market in automotive vehicles and has increased its net exports of chemicals. In the computer industry, the U.S. did lose some markets and indeed in 1995, it had net imports of \$16.3 billion. In addition, in 1995 the U. S. was a net exporter of aircraft (\$10.1 billion) and of grains. On the other hand, the U.S. is a net importer of petroleum. Overall, the U.S. balance of goods, services and income had a deficit of \$113 billion in 1995. The recent recession in some other countries including the Southeast Asia may have a negative impact on our trade balance. The U.S. government should evaluate its macro-economic policies, which affect the trade and practice more negotiations to eliminate the unfair trade practices of its trading partners. The producers should evaluate the micro-economic foundation of their production to improve their technology and reduce their unit costs. Overall, though the trade balance can be temporarily negative due to cyclical forces, the trade deficit of U. S. has been running too long and it is time to reverse it.

RETIREMENT PLANNING SPREADSHEET. Jerry W. Ferry and T. Morris Jones, College of Business, University of North Alabama, Florence, AL 35632.

This spreadsheet analyzes four aspects of retirement planning. First, the amount of income that you must fund during your retirement is estimated. Second, assumptions about inflation, time until retirement, and duration of retirement are used to calculate the total amount of capital you will need to fund your retirement. Third, the lump sum and monthly annuity needed to fund your retirement are calculated assuming that you have no investments. Finally, your current investments are analyzed using an asset allocation approach to refine the estimate of their future value and the lump sum and monthly annuity needed to fund any deficiency are calculated.

ANALYZING PUBLIC ACCESS IN LOW TO MODERATE INCOME COMMUNITIES IN ALABAMA'S COASTAL ZONE. Phillip A. West and William K. McAllister, Department of Community Planning and Urban Studies, Alabama A&M University, Huntsville, AL

The coast is the border to a public trust resource - the navigable rivers, waterways, and coasts that are held by the sovereign for use by all the people. Many current land development activities inhibit and discourage public access to these waters, impairing their use as a public resource. Alabama has one of the lowest public access to shore front ratios of the many states involved in the federally-approved coastal zone management program. Perhaps the most affected by this shortage of public fishing piers, boat ramps, and shore front parks are the low to moderate income persons who can not afford the high cost of property on or near shore lines. Although there are federal monies available to states for providing public access, the criteria for spending these funds are drawn up by states, which may or may not have systematic methods for targeting special needs. This research examines Alabama's coastline to see whether the present distribution of public access points are spread evenly among all communities, regardless of income.

Economic Status of Sub-Saharan Africa. Eric N. Rahimian and Fessha Gebremikael, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762

Sub-Saharan Africa (SSA) is one of the most impoverished regions of the world. The 1997 Human Development Report of the United Nations Development Program estimates that half of the population of SSA will be income poor by the turn of the century. Currently, about 220 million people in this region are income poor. In this paper we have studied the indicators of economic conditions and growth of six selected countries of SSA. We have found that SSA countries have experienced hardship in improving the economic conditions of their people. Indeed the economic productivity and growth rate are sometimes negative. The following recommendations are made to improve the economic conditions and to eliminate the absolute poverty in SSA nations and other less developed countries (LDC): (1) Educate people, particularly to make them professionally productive and to encourage them to follow family planning practices. (2) Provide health care, safe water and sanitation. (3) Establish social safety nets to reduce the poverty incidence. (4) Adopt a pro poor growth policy to reduce the gap between the top and bottom 20% income groups. (5) Eliminate gender inequality. (6) Help the rural poor by stimulating micro-enterprises and farm cooperatives. (7) Adopt export-oriented growth policies. (8) Establish full-scale regional economic unions between these countries. (9) Utilize the assistance of international organizations and other countries to provide a favorable environment for implementation of the above policies. (10) The international organizations and developed nations should feel social responsibility in promoting the growth of SSA nations and LDC. We have concluded that the growth of the SSA countries and elimination of poverty are not impossible. Nevertheless, it takes real cooperation and support of developed nations to break the cycle of poverty and stagnation.

The Economic Growth and Trade of Kenya After Its Independence. Eric Rahimian and Maria Obiero, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762

Kenya gained independence on December 12, 1963. It has a population of 28 million people. According to a recent study by David Green published by the World Bank, "Kenya's first decade as an independent nation was one of remarkable growth and structural transformation." Between 1964 and 1973, the total GDP grew at an annual rate of 6.6%. Agriculture grew rapidly at 4.7% and manufacturing grew at a rate of 8.4% annually. Despite the fast growth at the beginning of its independence, the rate of growth has not been uniform and the average growth rate has gradually slowed down. For example, the agricultural growth rate of 1972 was only 2.7%. The 1997 Human Development Report compares the real GDP per capita of all nations. Kenya has a real GDP per capita of \$1,403, adjusted for purchasing power parity (PPP) as compared with the U.S. real GDP per capita of \$6,101 (adjusted for PPP). The unadjusted GDP per capita was \$280 in 1996. The GDP per capita grew by 4.9% in 1995 and 4.2% in 1996. Today agriculture accounts for 27% of GDP and approximately 70% of employment. Tourism and manufacturing accounts for 7% and 14% of GDP respectively. The other 52% come from other areas like mining, foreign trade and services. This data indicates that there is room for using better technology in agriculture and transferring the excess population from agriculture to manufacturing and other sectors as necessary. It also shows that there should be some government subsidies to tourism industry. The government should also maintain the social and political stability to attract more tourists. New methods of making the arid and semi-arid areas productive should be initiated for more agricultural growth, and both the small and large-scale farmers should be promoted through farm cooperatives.

SUBSTANCE ABUSE IN THE WORKPLACE: HELPING ORGANIZATIONS COPE. Bryan Kennedy and Dahlia B. Newton, School of Business, Athens State College, Athens, AL 35611.

The workplace is one of the key locations in which to confront the growing problem of substance abuse. No longer viewed as just a health or law enforcement issue, such abuse is effectively dealt with in programs developed by large organizations. Increasingly, however, smaller organizations, which often have limited resources, seek help from faculty of colleges in their communities. Faculty with management and other appropriate backgrounds can help identify the presence of substance abuse or the potential for developing the problem and develop programs to deal with it. The U.S. Department of Labor (1991) provides five steps to assist with this goal. Once need is analyzed, policies and program can be developed to meet specific needs. Legal considerations, such as the need for confidentiality, must be addressed in connection with policies. Ideally, a substance abuse program will be part of a comprehensive drug free program. When faculty respond to the need of these small organizations, they support the importance of their institutions to their communities and combat the negative effects of substance abuse in organizations and the lives of employees.

THE ECONOMIC DYNAMICS OF ALABAMA IN THE 1990S. Fesseha Gebremikael, and **Eric Rahimian**, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762.

The main goal of this paper is to study the economic status of the State of Alabama in the 1990s. Some of the demographic data such as population growth, income, employment, poverty status by composition for the years 1980, 1990, and 1995 have been compared to show the trend and change in the economic status of Alabama. From 1993 to 1996, Alabama created approximately 150,000 nonagricultural jobs. This translates to 37,460 net new jobs a year for an average annual growth rate of 2.1 percent. By comparison, employment at the national level for the same period increased by 1.5 percent annually. Beginning 1996, however, Alabama's employment growth dropped well below the average for the period. The slow growth continued in 1997, when the state's employment increased by 1.1 percent, while the national average was over 2.0 percent. The primary reason for slow job creation in 1997 was that job losses did offset job gains. More than 13,000 apparel jobs were lost during 1995-1997. In 1997 alone, durable goods industries in Alabama created over 1,300 new jobs, while non-durable goods industries and primary apparel lost about 3,300 jobs. The recent events that weakened some Asian currencies imply that Alabama export to that region may fall. Given the above constraints, Alabama is expected to add about 17,100 net new nonagricultural jobs in 1998. These jobs will occur primarily in the service, trade, and construction sectors of the economy. As far as agriculture is concerned, the state of Alabama ranks third in peanuts exporting, and fourth in poultry. Currently Alabama ranks the 29th in agricultural exports nation wide. Over all our study indicates that the North Alabama performed better than the State. Some parts of the region lacked a diversified economic base. Balanced socio-economic development will require stimulating investment in these areas.

PUBLIC SCHOOL PERFORMANCE IN THE PRESENCE OF HOME SCHOOLING.

Dr. Jim Couch, Dr. J. Douglas Barrett, and Mr. Peter M. Williams, College of Business, University of North Alabama, Florence, AL 35632-0001.

The neoclassical school of thought in economics emphasizes the role of competitive forces in the provision of services. In a market where price and quality serve as margins of competition, the profitability and even the survival of firms rests on delivering a product within a reasonable range of its competitors. Monopolies have long been criticized for the lack of incentives to improve their products and services. Anecdotal evidence on the nature of competition in schools might be inferred from the fact that students of home schooling scored 18% to 28% higher on standardized tests than their public school counterparts. However, our focus is not upon the relative quality of home schooling versus public schooling. Ours is an analysis of the quality of public schooling across varying degrees of competition. In the provision of educational services, the legal restrictions on the provision of education serve to erect barriers to entry of alternative educational services, thus protecting the monopoly power of the public school system. For those states with less restrictive educational laws, the lower barriers provide greater competition for "customers," and thus increase the incentive of public school employees to improve their educational services. Using linear regression analysis, we analyze the relationship between ease of home schooling and the quality of the public school services as measured by standardized test scores.

The Contrast-Inertia Model and the Process of Systems Analysis and Design. Bob Sweeney, Dept. of Computer Information Systems, Gerald Crawford and Bob Williams, Dept. of Marketing and Management, The University of North Alabama, Florence, AL 35633

The purpose of this paper is an attempt to explain certain information gathering and processing functions of the systems analysis and design methodology using an underlying theory of human behavior involving judgment under uncertainty. The anchoring and adjustment heuristic has been used to develop several models to explain how human beliefs are updated as new information is sequentially presented. One such model, the contrast-inertia model, explains how humans update their current beliefs as new information is sequentially received by a decision maker and predicts the effects of this information on the decision maker's belief system. The process of systems analysis and design involves a number of phases or tasks which are performed in order and where, within each task, information is often received sequentially. A pilot test was performed in order to test some aspects of the contrast-inertia model in a systems analysis and design setting. The results of the pilot test conducted by this researcher did not conform to the predictions of the contrast-inertia model.

THE RICH, THE POOR, AND THE SOCIAL ORDER. James G. Alexander and Marsha Griffin, Alabama A&M University, Normal, Alabama 35762

America faces many problems of social disruption and disarray: crime, drug abuse, gangism, cultism, militia extremism, family infirmity, community dissolution, excessive litigiousness, road rage, and more. This widening disarray is related to, and largely a product of, declining authority of and respect for society's defining institutions: governments, schools, various professions, religious orders, labor organizations, business entities, and so forth. While social pathologies are not simply and singly the result of economic depravation, many of them are clustered among low income populations. Consequently, the temptation and tendency is to blame social ills on the poor. Doing so, however, constitutes a failure to recognize society as a systemic whole, a failure to understand that "society" is not a simple summation of "individuals." The weakening of institutional authority is critical because institutions serve important social purposes of cohesion and intergroup mediation. In comparison with most other developed countries, the U.S. historically has relied more heavily on nongovernmental rather than governmental institutions as social "glue" for a diverse population. Much of the strength of this social glue derived from the nation's large middle class -- the mainstream society was sufficiently large to minimize adverse effects of deviations from the norm -- from the "norms" of society. The declining size of the middle class has been an important underlying factor in the diminution of cohesive social forces. Neither poverty nor wealth provides adequate justification for exemption from society's rules. Nevertheless, the widening income disparity characterizing the past quarter-century indeed places heightened responsibility on the rich to act in ways which strengthen the social order.

Abstracts

EMAIL: FACILITATING ANDROGOGY IN A CIS COURSE. Tommie Singleton (CIS Dept.) and Margie Crocker (ASM Dept), University of North Alabama, Box 5173, Florence, AL 35632.

Faculty is being encouraged to incorporate new technologies into curriculum. New methods of delivery, such as distance learning, are forcing the increased use of technology for those methods. One easy-to-use technology for faculty is e-mail. E-mail is relatively easy to learn, being much like word processing. E-mail offers different venues for different disciplines and courses, such as chat groups or LISTSERVs. E-mail can actually cause the instructor to develop a better level of intellectual and social interaction. Research shows no difference in learning outcomes of distance learning students and traditional in-class students; therefore, e-mail would not deter learning. E-mail offers the student a much larger educational audience -- able to communicate with people all around the world. In addition, research indicates that written feedback is superior to verbal feedback. E-mail operates twenty-four hours a day, 7 days a week; so there is a potential for instant feedback to questions and problems in particular. E-mail, and distance learning tools in general, tend to make in-class lectures better because faculty become better prepared. The information learned via e-mail can enhance the curriculum the next time it is offered. The drawbacks or considerations include administrative support, technical assistance, and technical support during the course. At UNA, we found the advantages to be true, and the disadvantages to be nominal.

ARE ALABAMA'S HIGHER EDUCATION EXPENDITURES EXCESSIVE? Marsha Griffin and James G. Alexander, Alabama A&M University, Normal, Alabama 35762

Conventional wisdom holds that funding for education in the South is inadequate to provide the human capital infrastructure necessary for a productive, modern economy. This point is often implicitly conceded by industrial recruitment promotion of wage and tax concessions rather than of a skilled labor force. Nevertheless, the argument has been promulgated, most notably by Gov. James, that Alabama is *overfunding* higher education. This position is reflected in the funding decline of his current administration. Evaluation of the appropriateness of a given expenditure level involves several dimensions, including resource availability, competing public needs, interjurisdictional comparisons, and developing circumstances. A common contention is that Alabama cannot afford to provide public services at a level comparable to much of the nation due to the state's low income levels. While Alabama does rank low in income comparisons, public sector services are retarded further by our comparatively low tax effort. All states face competing needs for public sector funding, but no cogent case has been made that other public needs have disproportionately crowded out school funding in Alabama. In interstate comparison, Alabama ranks low in education funding. However, Alabama has a history of providing comparatively better funding for higher education than for the K-12 level. James's concern with distribution changes within the education budget therefore has some grounding in interjurisdictional comparisons. Perhaps the most troubling counterfact, however, lies in developing economic circumstances. Increasing economic globalization distinctly calls into question the concept of low wage competition: the relevant comparison is becoming much less that with other low wage states as with very low wage *countries*.

DEVELOPMENT OF A SCREENING ASSAY FOR CANINE MYOTONIC DYSTROPHY. Tamara M. Musso, COSAM, Auburn U., Auburn, AL 36849. Bruce F. Smith, Scott-Ritchey Research Center, Auburn U., Auburn, AL 36849.

Myotonic dystrophy is the most frequently occurring neuromuscular disease, affecting one out of every 8500 human adults. This autosomal dominant disease has a wide range of phenotypes, and is characterized by genetic anticipation. When examined at the molecular level, a direct correlation is seen between the severity of the disease and the number of trinucleotide repeats present in the gene. The affected gene of this disease consists of unstable repeats of three nucleotide bases. The instability of the gene sequence is exhibited by variation in the number of triplet repeats in successive generations, and also by variation in the number of repeats found within different tissues from a single person. When examined at the molecular level, a direct correlation is seen between the severity of the disease and the number of trinucleotide repeats present in the gene. This triplet repeat normally exists in the 3' untranslated region of the mRNA encoding the enzyme Myotonin Protein Kinase (MTPK). The lack of an appropriate animal model of this disease has seriously hampered investigations into the pathological mechanisms of repeat instability and disease progression. We are investigating whether dogs which are clinically diagnosed with myotonic dystrophy may provide an animal model for this serious disease. Through the process of sequencing the MTPK gene of normal dogs, the presence of repeats in canine MTPK can be verified. As of yet, our results have not been conclusive as to the existence of this CTG repeat. These inconclusive results may be due primarily to the nonhomology of the canine MTPK sequence from the human sequence, which is the only sequence.

MYELODYSPLASIA: DIAGNOSIS AND TREATMENT. Jennifer Burdette and Robert Pieroni, M.D., Department of Internal Medicine, University of Alabama School of Medicine, Tuscaloosa Program.

Myelodysplasia describes a variety of bone marrow abnormalities which may evolve into acute myeloid leukemia. Patients can present with anemia, bacterial infections, and bleeding. Myelodysplasia occurs predominantly in patients over 65 years of age, although it can occur at any age. Diagnosis is suggested by peripheral blood smears showing morphologic abnormalities, of neutrophils, platelets, or macrocytes. Bone marrow aspirate showing abnormalities of erythroid, myeloid, or megakaryocytic lines can help confirm the diagnosis. A differential diagnosis given these findings would also include B12 or folate deficiency, alcoholism, or HIV infection, and so a complete history and further laboratory data would be necessary to confirm myelodysplasia. Given the potential for death from bone marrow failure in approximately two-thirds of patients with myelodysplasia, an accurate diagnosis is desirable. Treatment is usually palliative, with transfusions, antibiotics, or hemopoietic growth factors. Intensive chemotherapy can offer improvement; however, remissions rarely last longer than 18 months. Young patients may be cured by allogeneic bone marrow transplantation. Overall, patients with myelodysplasia have a median survival of 20 months from time of diagnosis.

THE IMPACT OF RECAD ON ALABAMA REAL ESTATE AGENTS. Bruce Gordon and Keith Absher, University of North Alabama, Marketing and Management Department, Florence, AL 35632.

Following the lead of approximately two dozen other states, Alabama enacted a new law on October 1, 1996 that more clearly defined the types of allowable agency relationships in real estate transaction. It also prescribed how those types of relationships are to be disclosed.

This law was called the Real Estate Consumer's Agency and Disclosure Act, or RECAD. RECAD has been widely debated and criticized but, its intent was to establish whether RECAD has had a significant impact on the practice of real estate in Alabama and what the effects have been on both consumers and real estate professionals in the state. One of the most significant results from this study is the high number (46.5%) of respondents feel real estate agents do not adequately understand RECAD. The real-world implications of this are very significant because it is impossible for an agent to adequately explain RECAD to a consumer if they do not themselves fully understand the various agency relationships and the ramifications of each.

INTRANETS: BENEFITS FOR COMMERCIAL AND NON-COMMERCIAL ENTITIES. Christy Johnson (student) and Tommie Singleton (CIS Dept.), University of North Alabama, Box 5173, Florence, AL 35632.

Two major forces affect every business entity today -- globalization and the Information Age. The global economy has created a demand for global communications. Global business activities demand fast and accurate information. Organizations need a way to provide fast and accurate information. This need can be met by an intranets. An intranet is simply a closed Internet, using the same technologies and tools as the Internet, only for a limited number of clients. Intranet technology offers entities a number of benefits. An intranet can help an entity share information, to eliminate paperwork, to automate the workflow process, and to schedule meetings more efficiently. The intranet technology is already being employed by numerous entities. Commercial organizations are using this technology -- in manufacturing and retail. Non-commercial organizations are also using this technology -- in schools, government contracts, police departments, and member organizations. Why should an entity invest in this technology? Efficiencies in cutting the costs per unit, maximizing profits, saving time, and increasing productivity. Intranets also assist entities in being more effective at meeting their goals -- goals such as quality, sales, better service, and better communication. The intranet offers benefits to actually take advantage of modern-day pressures rather than succumbing to them. In fact, twenty-two percent of U.S. companies have already implemented intranets and 40 percent of U.S. companies plan to implement intranets. The intranet has arrived as a viable technological tool in winning profits for commercial entities and achieving goals for non-commercial entities.

Economic condition and trade of Ukraine after the breakup of the Soviet Union. Eric N. Rahimian and Yevheniy Y. Kompaniyets, Dept. of Economics and Finance, Alabama A&M University, Normal, AL 35762

After the breakup of the USSR in 1992, Ukraine has made significant progress in establishing new democratic institutions. However, privatization of state property and other reforms aimed at transition from the planned all-state economy towards free enterprise system have been moving very slowly. The change was somewhat inhibited by the procommunist members of the parliament and lack of qualified professionals with knowledge of the free market. During its first 4 years of independence, Ukraine experienced hyperinflation (up to 400%) and decline of the GDP (17% in 1994), triggered by the military conversion and slow privatization. Direct foreign investment in Ukraine remains among the smallest in the region. However, during the last two years inflation was curtailed to approximately 25%, decline in the GDP slowed down and a modest growth is predicted for 1998. Foreign trade is the only sector of the Ukrainian economy which has been showing fast growth (in 1995 it grew 24%). Although slowly, reforms are being implemented. In March 1998, Ukrainian president will present a 15-year reform package for approval by the newly-elected parliament. To improve its economic performance, Ukraine must reduce government control and regulation of companies, cut taxes (which are still high) and facilitate free enterprise development by speeding up privatization in all sectors. The decrease in taxes and revenues should be compensated by: (1) expanding the tax base (it is estimated that 50% of the economy is in the "gray sector"), (2) government borrowing (foreign debt of Ukraine is low compared to the size of the economy), (3) attraction of foreign and domestic business investment, which requires stability, favorable investment climate and creation of adequate business infrastructure.

SALES MANAGEMENT: A COMPARISON OF THEORY AND PRACTICE. Keith Absher, Donna Yancey and Beverly Dyer, University of North Alabama, Marketing and Management Department, Florence, AL 35632.

This study compares retail sales manager's practices in the areas of recruitment, selection, training and compensation. A survey was developed from a review of the literature on sales management. The survey consisted of a series of questions that could be ranked from very important (5) to not important (1) and don't know or no opinion. A convenience sample of 190 was collected and the resulting data was analyzed using SAS. When asked about recruiting tools retail sales managers ranked the top five as (in order of importance) (1) employee referrals, (2) business relationships, (3) internal training programs, (4) internal transfers and (5) educational institutions. When asked about the importance of various selection tools, managers ranked (1) personal interviews, (2) resumes, (3) references and (4) testing as the top four. When evaluating the choices of sales training programs, sales managers ranked as follows: (1) On the job training, (2) demonstrations, (3) discussion method, (4) role playing and (5) lecture method as the top five in order of importance to them. Sales managers ranked compensation techniques in the following ways (1) bonus, (2) combination plan, (3) salary, (4) commission and (5) draw against a commission.

ASSESSMENT OF EDUCATIONAL REQUIREMENTS FOR FUTURE OFFICE EMPLOYEES. Márgic S. Crocker, College of Business, University of North Alabama, Florence, AL 35632.

This paper presents the results of a questionnaire study of the educational requirements of businesses for future employees. The sample is well-balanced between small, medium and large businesses. Good communication skills, accuracy, promptness and dependability and telephone skills were considered most important by these businesses.

Teamwork skills, knowledge of computer usage, records management and problem solving abilities had secondary importance. Ranked toward the lower end of the scale were meeting deadlines, typewriting skills, ability to take notes, and professional dress.

The top five software computer programs used were WordPerfect, Lotus, Microsoft Excel, Microsoft Word, Microsoft Access. Some businesses were just beginning to use the presentation software programs. The businesses used a variety of other office equipment including calculators, fax machines, copiers, scanners, check encoders, postal meters satellite receivers, vital statistic fax machines, and laser/ink-jet printers.

ISO 14000: THE ROLE OF THE AUDITOR. Sharon N. Campbell and Walter Campbell, Dept. of Accounting and Bus. Law, University of North Alabama, Florence, AL 35632.

In an effort to provide a consistent, internationally recognized model for environmental management, the International Standards Organization (ISO) has developed a series of environmental management standards, ISO 14000. ISO 14001 outlines the planning and operational elements of an effective environmental management system (EMS) and requirements for review and improvement. It is the only standard of the ISO 14000 series through which a company can obtain independent certification. The environmental auditing standards, ISO 14010-14012, cover general principles of environmental auditing, auditing of EMS, and qualification criteria for environmental auditors.

In this research, respondents from the manufacturing sector provide evidence on the background of internal auditing personnel, the involvement of the internal auditing group in environmental auditing, factors limiting internal auditing involvement, and expected steps to increase the internal auditing involvement. The Institute of Internal Auditors (IIA) provides opportunities for professional development in the area of environmental auditing. Using the criteria in the ISO 14000 model, the IIA and the Environmental Auditing Roundtable formed the Board of Environmental Auditor Certifications to provide credible and professional certification of environmental auditors.

PURCHASING CARDS: AN EFFECTIVE WAY TO REDUCE COSTS.

Margie S. Crocker, College of Business, University of North Alabama, Florence, AL 35632,
Rita Smith, Student, University of North Alabama, Florence, AL.

Cost reduction is a primary way to remain competitive in today's business environment. Purchasing cards are one method of cost reduction that has proven to be effective. Purchasing cards, also called procurement cards, are an increasingly popular method of reducing the costs associated with small dollar purchases and specifically non-inventory items. The purchasing card is used like a credit card, and therefore, reduces and even eliminates some of the activity and paperwork associated with the traditional purchase order system.

However, both the purchase order system and the purchasing card system have benefits and costs associated with them. A company's management needs to evaluate both systems to determine the system that provides the most benefit to them. Due to the reduction in cost and the ease of implementation, management is increasingly deciding that the purchasing card system is more beneficial than the purchase order system.

**USING THE "DICTIONARY OF OCCUPATIONAL TITLES" AS A TOOL
IN THE COMPUTER BASED JOB SEARCH.**

Marlon Rico and Keith Absher,
Department of Marketing, Univ. of North Ala., Florence, AL 35632.

Getting a good job after graduation is an important reason why students attend school. If you think that teachers should assist their students in finding suitable work after graduation you will probably want to stay abreast of current opportunities and job search techniques. Sophisticated technology has brought about new employment opportunities at all levels of the work force. Not only are there many new jobs today that did not exist a few years ago, but the whole process of getting a job is changing drastically. Today a growing number of companies are relying on computer data base searches to match applicants with job vacancies. These computer searches match key words from a job description with the same word on the resume of an applicant. When entering resume information into any employment data bank the applicant should make sure that correct key words are included so that he or she will be matched for further consideration as a possible job candidate. The intent of this report is to familiarize the reader with the Dictionary of Occupational Titles, a U.S. Government publication that list all job titles along with detailed job descriptions. The Dictionary of Occupational Titles includes standardized and comprehensive descriptions of job duties and related information for about 20,000 different occupations. The job description includes the medical doctor, professional, managerial, clerical, sales, service, machine trades, bench work, and just about all other legal occupations in the U.S. economy. This dictionary is a good reference for new employment opportunities and an excellent source for the key words used in specific job descriptions.

Abstracts

FACULTY ATTITUDES TOWARD INFORMATION PRIVACY. Paulette S. Alexander, T. Morris Jones, Sarah R. Brown, College of Business, University of North Alabama, Florence AL 35632.

As the information age continues to develop and telecommunications capabilities continue to expand, information privacy can be threatened in many ways. Based on the landmark study by Smith, Milberg and Burke (*MIS Quarterly* June 1996), this research is designed to determine the types and levels of concerns of faculty members regarding organizational practices in the collections and use of information. Smith, Milberg and Burke developed an instrument to measure individual concerns relating to organizational use of information along four dimensions: collection, errors, unauthorized secondary use, and improper access. A survey of all faculty at one regional public university in the southeast United States was conducted. A total of 107 responses were received (49.54 percent). Differences were analyzed based on computer skills, computer usage, college within the university, and gender. Significant differences were found among faculty respondents in three of the four dimensions. From this study our conclusion is that business college faculty are less concerned about organizational practices related to collection, errors, and unauthorized secondary use of information than their counterparts in arts and sciences, education, and nursing.

USING OFFICE 97 AND/OR FRONTPAGE 98 FOR BUILDING UNIVERSITY DEPARTMENTAL WEB SITES. T. Morris Jones, Sarah Brown and Paulette Alexander, College of Business, University of North Alabama, Florence, AL 35632.

The advent of the World Wide Web and an array of sophisticated Web design tools have kept professional layout/ graphic design occupations alive and active. Moving to Web page design was quite natural for them, but many Web pages have been designed by unskilled or amateur persons, who have had little or no training in design work. More and more, colleges and universities are using the World Wide Web to provide useful information to students, prospective students, alumni, and other interested persons. Frequently individual departments within a university are asked to design and develop Web pages with specific information relating to that department. Within the last couple of years, sophisticated software has been introduced to facilitate the easy creation of well-designed Web pages. The present research has reviewed both the latest software and various design criteria as presented by professional Web page developers. Application of these findings to a variety of sites results in some "best practices" in academic department Web site development. The purpose of this paper is to provide guidance to those departments who are not professionals in both design and computer technologies. Through the use of Microsoft Office 97 and Microsoft Front Page 98, a Web page has been developed incorporating suggested building blocks of a high quality academic department Web page. Design features and considerations highlighted and illustrated include menu schemes, limiting download time, keeping flashing to a minimum, breaking up larger Web pages, checking colors and resolutions and maintaining links. The paper is a multimedia presentation consisting of illustrations of best practices (and compared with less desirable practices) and Web page design resource links to WWW sites.

Abstracts

THE ALABAMA MOTOR FUEL MARKETING ACT. Mrs. Tywana M. Pride, Dr. Jim Couch, & Mr. Peter M. Williams, College of Business, University of North Alabama, Florence, AL 35632-0001.

The Alabama Motor Fuel Marketing Act is designed to prevent monopolization and enacted because "the motor fuel marketing business has the potential for monopolization". According to proponents, the act is designed to discourage pricing practices that are claimed to be predatory in nature. Economists argue that predatory pricing is of dubious merit. Instead, legislation lessens competition and allows existing marketers to enjoy economic rents. In short, the legislation is not consumer friendly.

SCIENCE EDUCATION

THE USA SCIENCE IN MOTION PROGRAM IN PHYSICS: A FOUR YEAR PERSPECTIVE, Paul Helming, F. Neff Weber, and Robin Chestnutt, Department of Physics, University of South Alabama, Mobile, AL 36688.

Since 1994, the State of Alabama has funded the Alabama Science in Motion (ASIM) program, a state-wide high school science initiative in the areas of Chemistry, Biology, and Physics and centered around mobile science vans. Currently each of the 11 state universities designated as Teacher In-Service sites operates two science vans (9 Chemistry, 8 Biology, and 5 Physics) and the long range goal is three vans at each site. Each of the ASIM vans, driven by a state-certified science teacher, contains \$100K of laboratory equipment and typically serves 25 participating area high school teachers on a rotating basis. In Physics, the available laboratory experiments cover a wide range of topics with emphasis on computer-interfaced experiments using laptop computers. A number of the laboratories are discovery-based experiments which may be used with no prior class coverage of the specific physics topic. The ASIM program also includes a substantial commitment to teacher training. An overview of the USA program in Physics at the four-year point will be presented.

3-D "HOLLOW MOUNTAIN" MAPS: INTEGRATING TOPOGRAPHY AND CULTURAL HISTORY. James S. Brown, Jr., Dept. of History & Political Science, Samford Univ., Birmingham, AL 35229.

3-D topo maps are potentially wonderful educational tools, but several drawbacks virtually disqualify them as classroom teaching devices:

- they are bulky, requiring large storage space when not in use.
- they are passive, not very engaging or experiential.
- they are inaccurate, at least in the typical molded plastic version.

This recently patented device solves most of this difficulty. Print the same 2-D contour map on four "motherboards" of the thickness required for the vertical scale desired. Cut these motherboards along alternating contour lines: motherboard #1 on lines 1, 5, 9, etc., #2 on lines 2, 6, 10, etc., and so on. Outer contour ring from motherboard #1 is base layer for map, on top of which goes outer layer from motherboard #2, etc. Fifth layer comes again from motherboard #1. Completed model disassembles for storage in 1" thickness or less. Illustrated with slides of model of central Honshu.

The Effect of Feedback Timing and Question Format on Retention in a College Level Introductory Biology Course. Mandy E. Tinsley, L. Quinn Head and Charles P. Olander, Department of Biology and College of Education, Jacksonville State University, Jacksonville, AL. 36265

Students retention of academic material as measured by performance on delayed retention exams should be a concern of students and teachers alike. Student retention is usually assessed with standardized multiple choice exams. Our objectives were twofold. First, does the test type used in the instructional phase of a course effect the performance on a subsequent multiple choice delayed retention exam? That is, will the students do better on a multiple choice delayed retention exam if their weekly quizzes were in multiple choice format. Secondly, when is the optimum time to give informational feedback on student quiz performance? We evaluated both of these hypothesis in a college level introductory biology course at a northeastern Alabama state university. An ANOVA procedure was used to analyze the student retention data across types of information feedback and quiz question format.

BEHAVIORAL AND SOCIAL SCIENCES

GENDER DIFFERENCES IN HANDWASHING PRACTICE. Carolyn White, Community-Mental Health Department, University of South Alabama , College of Nursing, Mobile, AL 36688.

Handwashing as the sine qua non of infection control has been well established. A vast array of literature exists relevant to its significance and the reluctance of health providers to consistently practice handwashing. This study examined the phenomenon from the public perspective. The hypothesis that a lack of motivation contributes to decreased handwashing rates was explored. Random sampling of 200 mall public restroom users (100 males and 100 females) in a southeastern American city was conducted. Handwashing practices of 100 (50 males and 50 females) were observed. Subjects were predominantly young and middle-aged adults with approximately 20% children and elderly. Covert observation of the control group by the investigators determined the general public practice of handwashing after restroom use in both the male and female groups at 30%. An intervention was applied via an awareness tool. This independent variable was a poster of an elderly woman (a typical grandmother) with a caption that read "Don't forget to wash your hands." The posters were placed in each of the restroom stalls. An experimental group of 100 males (n=50) and females (n=50) was observed. After the intervention, a significant improvement in compliance to 90% was found in the female group in contrast to a minimal improvement in the male group.

DARK SHADOWS-THE STUDY OF THE IMPACT OF STRESS ON LAW ENFORCEMENT OFFICERS AND THEIR FAMILIES Marie Robinson, student, Justice and Public Safety Dept. Auburn University at Montgomery, AL 36116.

This paper addresses the types of stress effecting law enforcement officers and their families. The unique characteristics of law enforcement stress will first be identified. Furthermore, the effects of these unique characteristics will be discussed. Finally, appropriate avenues to address the problem will be explored. The focus will be on defining, and treating the problem in ways that are meaningful and effective.

Abstracts

RUSSIAN ORTHODOX CHURCH: A BRIEF HISTORY. Krissie Singleton (student) and Tommie Singleton (CIS Dept), University of North Alabama, Box 5173, Florence, AL 35632.

Russia embraced the Gospel in 992 when the Great Prince Vladimir was converted. For the first time, Russia turned toward Christianity. From Kiev, the Gospel spread throughout Russia. It is possible that the unity Christianity caused in Russia saved them from the Tartars' oppression. Moscow eventually became the "Third Rome" as it established its own Patriarchal throne. Under Godunov, the Church increased immensely in wealth and influence. Subsequently, Peter the Great instituted reforms in the Church -- including confiscation of Church properties. Protestant scholasticism and pietism influence the Russian Orthodox Church in the eighteenth century. These influences led to Westernization of theology and an attempt to develop doctrines, traditions, and sacraments. It also led to services being limited to registered churches (under the close supervision of the government), abolition of small group meetings (i.e., Sunday School), and weddings being moved for churches to chapels. The Church in Russia today uses the "Elizabethan Bible", which was written in 1751, as its Biblical text. Despite the separation of church and state in Russia, the government assumes the preservation of Cathedrals, many having been transformed into mere museums. The Church, however, did influence the social beliefs of issues such as family, divorce, and marriage. Faithful Orthodox believers still worship in the Gothic structures while some others believe the Orthodox faith has lost its meaning and only exists in emotionless traditions being observed. Whereas the history of the Church illuminates some aspects of the religion, the Church exists as much as any other with its expansion and influence dependent upon individual believers.

A STUDY OF HOMICIDES IN A SOUTHERN CITY: THE IMPLICATIONS, Jerald C. Burns, Department of Sociology and Criminal Justice, Alabama State Univ., Montgomery, AL 36101-0271.

The purpose of this study is to analyze black homicides in a medium size southeastern city using official police department data. The study looks at all the variables and theories that impact on black homicides to determine trends and whether this city mirrors other findings from previous studies. The study concludes that the theories of routine activities explains many of these black homicides.

THE PERCEPTION OF AFRICAN-AMERICAN CRIME VICTIMS IN THREE ALABAMA CITIES: DOES RACE OF VICTIM AFFECT POLICE RESPONSE? Gerald P. Fisher, Dept. of Sociology and Criminal Justice, Alabama State University, Montgomery, AL. 36101.

Minorities, especially African-American minorities, believe that the police have been biased against, or at the very least, indifferent to their needs. This opinion appears to be shared by minorities of all social and economic strata. This study is a work in progress designed to measure the perceptions of African-American victims of robbery and aggravated assault in three Alabama cities, Birmingham, Montgomery and Mobile. The perceptions to be measured include the amount of time expired between the initial report of the crime, and the arrival of officers on the scene. Additional considerations include the amount of time the responding officers spend interviewing witnesses, victim(s), possible suspects and writing reports.

Computer Stress in Small Businesses. Richard A. Hudiburg, U. of North Alabama, Florence, AL, James R. Necessary and Douglas Naffziger, Ball State Univ., Muncie, IN

A survey was conducted with 126 small business owners in a midwestern U.S. city. The owners completed a questionnaire containing questions about their business, personal demographic characteristics, computer experience, and computer use. Additionally, the owners were assessed about their computer use reactions using three scales: Computer Attitude Scale, Computer Self-Efficacy Scale, and Computer Hassles Scale. Additionally there was an assessment of the level of anxiety and somatic complaints. The small business owners were mostly male (74 %), were an average age of 44 years, had been in business an average of 13 years, used the computer an average of 18 hours a week, and had an average of 6 years computer use experience. The small business owners had positive attitudes toward computers and had moderate confidence in their basic and advanced computer skills. The owners experienced a moderate level of computer stress and reported very low levels of anxiety and somatic complaints. The ten most reported computer hassles were comparable to those reported by student users in a normative sample except for two hassles: updated software requirement (53 %) and software confusion (48 %) were reported at higher level than the normative sample student users. The typical relationship, shown in other research, between computer stress (computer hassles) and stress outcomes (anxiety/somatic complaints) was not demonstrated in this study. The absence of this relationship was probably due to the extreme low level of reported anxiety and somatic complaints.

Abstracts

THE AMISTAD AND HISTORY. Howard Jones, Dept. of History, Univ. of Ala., Tuscaloosa, AL 35487

The Amistad case has been one of the most overlooked incidents in history. In 1839, fifty-three West Africans mutinied on the Spanish Amistad in Cuban waters, sparing two Spaniards aboard to navigate the vessel to Africa. Instead, they steered northward until it landed off Long Island, New York. Abolitionists intervened to prevent the blacks' return to Cuba, arguing that they were "kidnapped Africans" with the inherent right of self-defense in winning their freedom from illegal captivity. The case culminated in a decision for freedom before the U.S. Supreme Court in early 1841, but only after the abolitionists had revealed the wide gulf between morality and the law, and won the first civil rights case in the American courts. The basic issue was human v. property rights, which lay at the heart of President Abraham Lincoln's struggle during the Civil War. In the only instance in history, the West Africans of the Amistad returned home. It comes as no surprise that Steven Spielberg has chosen to make a movie based on this incident. One outcome of the case was the formation of the American Missionary Association in Africa, with some of its students eventually coming to the United States and establishing schools such as Atlanta, Dillard, Fisk, Florida A & M, Howard, Lemoyne-Owen, and Talladega. A major outcome of the movie has been the promotion of discussions over racial relations in the United States, making it clear that the struggle for racial equality is not over.

Miranda: Who, What, When, Where, How and Why? Traci L. Roberti,
Jurisprudence student, Auburn University at Montgomery, Montgomery, Al. 36117.

In 1966, the Supreme Court ruled on the most famous self-incrimination case in history, *Miranda v. Arizona*. The courts' decision was based in accordance with the fifth amendment of the Constitution that states "No person . . . shall be compelled in any criminal case to be a witness against himself. . . ." Based on the outcome of this case, it became mandatory to inform an individual: of the right to remain silent, that anything said can and will be used in a court of law to gain a conviction, and of the right to have an attorney present during questioning. But, who is to read these rights to the defendant? What if the defendant was not informed of these rights, is the testimony useless? When is it necessary to inform someone of these rights? Where should a person be informed of these rights? How often should a defendant be informed of these rights? Why does any of this matter? Protect yourself, know what rights are afforded to law enforcement personnel and to members of the public.

EVALUATING BATTERER INTERVENTION PROGRAMS: METHODOLOGICAL CONSIDERATIONS. William E. Osterhoff, Dept. of Justice and Public Safety and Anne Permaloff, Dept. of Public Administration, Auburn Univ. Montgomery, Montgomery, AL 36124.

In recent years, declines in property and violent offenses have been reported throughout much of the nation. Domestic violence offenses, however, have been on the increase. The increase may reflect a higher incidence of domestic violence, a higher reporting rate, or a combination of both. Various reasons for the increase are discussed, as are myths commonly associated with domestic violence.

Domestic violence is a pattern of physical, psychological, and/or sexual abuse involving an intimate partner that is based on power, control, and a predictable cycle of harm. Punitive and treatment responses to domestic violence have shown only limited effectiveness.

Communities and the criminal justice system are attempting to cope with the problem by establishing batterer awareness, prevention, and intervention programs. The E.V.E.N. (End Violence Effectively Now) batterer intervention program in Montgomery, Alabama involves 16 sessions which are attended by batterers as a result of court order or on a voluntary basis. The program's goals are victim safety, victim empowerment, and acceptance of responsibility of the batterer for his/her behavior. The program attempts to change the basis of interpersonal relationships from power, control, and abuse to more equally shared interpersonal interactions, trust, and increased self esteem. Numerous impediments to evaluation of programs such as E.V.E.N. are discussed, as are potential design solutions.

HEALTH SCIENCES

UPDATE ON CHRONIC FATIGUE SYNDROME. Robert E. Pieroni, Department of Internal Medicine, Univ. of Alabama School of Medicine, Tuscaloosa, AL 35487-0326.

In 1994 the Center for Disease Control and Prevention in collaboration with other organizations worldwide developed a comprehensive approach to defining and studying chronic fatigue syndrome (CFS). This disorder, which has been branded "The Disease of a Thousand Names" has been the subject of considerable controversy as to its possible etiology, potential therapeutic options, and possible relationship to other disorders such as fibromyalgia, somatization, psychogenic processes, and neurasthenia, which was a frequent diagnosis in the 19th century. In 1934, the first reported cluster outbreak of a CFS-like disorder occurred at Los Angeles County Hospital, and similar clusters have been reported worldwide. To date, no definite evidence of an infectious agent, no specific lab abnormalities, and no definitive therapy have been found for CFS patients. Unfortunately, in view of the suffering these individuals endure, many avail themselves of unorthodox, expensive, and potentially harmful "remedies." I shall discuss the classification of CFS, hypotheses regarding causation, and its epidemiology. Intriguing similarities between the "Gulf War Illnesses" and CFS will be underscored.

EFFECT OF AGED GARLIC EXTRACT™ ON THE CYTOTOXICITY OF BETA-AMYLOID PEPTIDE IN VASCULAR SMOOTH MUSCLE CELLS AND PC12

CELLS. Nomalanga Gwebu, Michael Selassie, Brenya Griffin, Tamara Young, and Ephraim T. Gwebu. Departments of Research, Oakwood College, Huntsville, AL 35896.

Alzheimer's disease (AD) is the most common cause of progressive intellectual failure and memory impairment in the elderly, with no effective treatment. A crucial pathological process in AD is deposition of Beta-Amyloid (A β) on arterial blood vessels resulting in degeneration of both smooth muscle and neuronal cells. We have recently shown that A β is toxic to arterial smooth muscle cells (ASMCs), and this toxicity is attenuated by vitamin E in a dose-dependent manner, [Gwebu, et al (1997) *In Vitro Cell. Develop. Biol. Animal*; 33:672-673]. Garlic has antioxidant, anti-aging and anti-ischemic properties. The purpose of the present study was to determine whether aged garlic extract solution protects ASMCs and PC12 against A β cytotoxicity. Cell viability was determined using the MTT (methylthiazol tetrazolium) assay. We report that Aged Garlic Extract™ (AGE) protects both ASMCs and PC12 cells against A β toxicity in a dose dependent manner. These results suggest that AGE has antioxidant properties that ameliorate oxidative injury induced by A β in culture.

Assay Procedure	Absorbance at 570 nm)	Cell Viability (as % control)
Control (no AGE, no A β)	0.238 \pm 0.080	100
AGE (0.1%) alone	0.204 \pm 0.010	85.7
A β (no AGE)	0.111 \pm 0.029	46.6
AGE + A β	0.173 \pm 0.020	72.6

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THE ANTIPHOSPHOLIPID SYNDROME: CLINICAL SPECTRUM. Mukul Mehra, Grant Eudy, and Robert Pieroni, Department of Internal Medicine, Univ. of Alabama, Tuscaloosa, AL 35487-0326.

Antibodies against phospholipids are found in about 25 to 50% of patients with systemic lupus erythematosus, but may also occur in subjects without this disorder. These antibodies are responsible for the *in-vitro* lupus anti-coagulant test, and for false positive tests for syphilis (e.g., VDRL) because of the inclusion of the phospholipid cardiolipin in the test substrate. Among the numerous clinical conditions associated with these antibodies are habitual abortions, labile hypertension, kidney disease, heart attacks, cardiac valvular disease, pulmonary hypertension, strokes, transverse myelitis, and livedo reticularis. Additionally, elevated partial thromboplastin time, positive Coombs' test, thrombocytopenia, recurrent venous and arterial thromboses, and pulmonary emboli may occur. Clinical risk increases with higher antibody titers, and IgG antibodies appear to be of greater pathologic importance than IgM. We shall present the case of a young male who presented with lower extremity deep vein thrombosis and pulmonary embolism, and subsequently developed upper extremity arterial thrombosis and thrombocytopenia while receiving heparin. Anti-phospholipid antibody was positive. His clinical course, as well as various aspects of his disease, including differential diagnoses, will be discussed in detail.

Abstracts

UTILITY OF C-REACTIVE PROTEIN (CRP) IN INFECTIOUS AND OTHER DISEASE STATES. Chris Jahraus and Robert Pieroni, Department of Internal Medicine, Univ. of Alabama, Tuscaloosa, AL 3487-0326.

C-Reactive protein (CRP) is a prototypical acute phase reactant and a sensitive, albeit nonspecific, indicator of inflammation. CRP elevation reflects cytokine-mediated liver production resulting from most types of inflammation, infection, and tissue damage. In general, CRP increases within 12 hours of the start of inflammation, and within 1 or 2 days its rise may be a thousandfold. This increase in CRP levels is dramatic in comparison of other blood proteins such as complement and fibrinogen. The value of using CRP in assessing the presence of a wide variety of disease states, as well as in monitoring therapy, has been amply demonstrated. Its use can often preclude unnecessary surgical or medical interventions, and may provide valuable prognostic information. CRP has been used in the diagnosis and/or follow-up of patients with appendicitis, inflammatory bowel disease, pancreatitis, liver disorders including carcinoma, neonatal infections, otitis media, meningitis, osteomyelitis, pelvic inflammatory disease, rheumatologic disorders and a variety of other infections, cancers, and inflammatory states.

We shall present evidence of the extreme utility of CRP assays in numerous pathological states and emphasize the need for clinicians to avail themselves of this valuable, but underutilized test.

Physical Activity Assessment Methodology in the Older Population: Review of the Literature. Patricia O. Emplaincourt and Mark T. Richardson, Dept. of Human Performance Studies, and Robert Pieroni, College of Community Health Sciences, Univ. of Ala., University, AL 35486.

In light of the 1996 Surgeon General's report on the importance of physical activity in maintaining health and functional ability in older individuals, it is important to determine the dose/response relationship between physical activity and health outcomes in this population. This is especially true considering the projected increase in the number of individuals that will fall into the category of "older" in the future. One of the major problems with determining dose/response is that there is a need for better methods of assessing physical activity. The most widely used method for assessing physical activity in the aging population is the physical activity questionnaire. There are several surveys which have been designed specifically for use in the older population, including the Modified Baecke (Voorrips et al., 1991), the Zutphen (Caspersen et al., 1991), the Yale (DiPietro et al., 1993), and the PASE (Washburn et al., 1993). Limited data reveals that these surveys have been shown to be significantly associated with a variety of criterion measures of physical activity such as 24-hour recall and pedometer (Baecke), energy expenditure as determined by the doubly labeled water method (Zutphen), VO₂max, diastolic BP, and percent body fat (Yale), and Caltrac accelerometer, 3-day diary, and self-assessment (PASE).

Abstracts

HOMOCYSTEINE, CARDIOVASCULAR DISEASE AND AEROBIC FITNESS/PHYSICAL ACTIVITY: A REVIEW. Jane L. P. Roy, Mark T. Richardson & *Robert E. Pieroni. Dept. Human Performance Studies & *College of Community Health Sciences, The University of Alabama, Tuscaloosa, AL 35487.

Many recent clinical and epidemiological studies have suggested that elevated plasma Homocysteine (Hcyst) levels are an independent risk factor for cardiovascular disease (CVD), the number one cause of premature death in the U.S. Several studies have indicated that elevated plasma Hcyst is related to other risk factors in the CVD risk profile: LDL cholesterol, high blood pressure, smoking and obesity. However, little is known about the relationship between levels of aerobic fitness (AF) and physical activity (PA). To date, only one large scale epidemiological study has examined the relationship between plasma Hcyst levels and PA (assessed by a global self reported four item questionnaire) (Nygard et al., 1995). It was concluded that PA was inversely related to plasma Hcyst level. Wright & Francis (1997) investigated the relationship between plasma Hcyst and AF (measured by a VO_{2max} test) in 20 young healthy males. It was concluded that plasma Hcyst level was not related to AF. Clearly, more research is warranted in this area.

A COMPARISON OF THE CYTOTOXICITY OF BENZOYL PEROXIDE AND BETA-AMYLOID ON VASCULAR SMOOTH MUSCLE CELLS (SMCs). Noma Gwebu, Joanne Williams, Nalo Hamilton, Michael Selassie, Stephanie Richardson. Dwayne Mathis, Jr., and Ephraim T. Gwebu, Department of Research, Oakwood College, Huntsville, Alabama 35896.

Benzoyl peroxide (BPO) is an oxygen radical progenitor used in the treatment of decubitus ulcers and inflammatory acne. Studies from our laboratory have shown that BPO is a potent platelet aggregating agent, and that this aggregation is inhibited by antioxidants and free radical scavengers. Oxygen radical injury is implicated in cancer, atherosclerosis, and the aging process. Alzheimer's disease (AD) is the most common cause of progressive intellectual failure and memory impairment in the elderly. A crucial pathological process in AD is deposition of beta-amyloid peptides ($A\beta$) in AD and Down's syndrome. SMCs accumulate $A\beta$ in their intracytoplasmic granules. The effect of this accumulated $A\beta$ on SMC viability is not fully understood. However, $A\beta$ deposition on blood vessels is associated with the degeneration of SMCs. The purpose of this study was to compare the cytotoxicity of BPO and $A\beta$ on SMCs. Our results suggest that $A\beta$ is more toxic than BPO.

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Abstracts

HYPERLIPIDEMIC PANCREATITIS. Miranda Edwards and Robert Pieroni, Department of Internal Medicine, Univ. of Ala., Tuscaloosa, AL 35487-0326.

Patients with serious elevations of triglycerides are known to be at risk for development of potentially lethal pancreatitis. This association is extremely important to recognize for both prevention and therapy. Recently we treated a 39 year old female with anorexia, nausea, vomiting, and severe mid-epigastric pain radiating to her right lower quadrant. Appendicitis was immediately suspected. The patient was currently being treated for a dissecting thoracic and abdominal aortic aneurysm with a beta-blocker, and was also taking a diuretic for hypertension. She had a history of excessive alcohol intake and was mildly obese, having gained 20 pounds over the last 6 months. Her vital signs were stable, but evaluation revealed leucocytosis with a left shift, a marked elevation of C-reactive protein, a hundred-fold elevation of triglycerides, a threefold elevation of cholesterol, over tenfold elevation of amylase, with a lipase over 40 times normal. Abdominal ultrasound revealed a fatty liver, and CT scan was consistent with serious pancreatitis. Medical and dietary regimens resulted in marked improvement of both her pancreatitis and of her severe dyslipidemia. We shall discuss methods to prevent hyperlipidemic pancreatitis, its risk factors, especially in this patient, and various modalities of treatment. Other features of this disease, theories concerning etiology and treatment, as well as the potential for spurious lab values which may be encountered and which may effect proper diagnosis and treatment will be emphasized.

RECURRENT SERTOLI-LEYDIG CELL TUMOR IN A 24-YEAR OLD BLACK FEMALE. CLASSIC SYMPTOMATOLOGY WITH UNIQUE CHEMICAL AND OPERATIVE FINDINGS. Guy W. Sneed, D.O., Chief Medical Officer, Muscogee Creek Nation Division of Health Administration, Okemah Health System, Okemah, OK 74859

A 24-year old black female presented to the family practice clinic with a 7-month history of a non-tender left upper quadrant mass increasing in size. The patient's symptoms included frequent "upset stomach", increasing body hair, a progressive deepening of her voice, and amenorrhea. Past medical history revealed that she had a left ovarian tumor classified as a Sertoli-Leydig cell tumor surgically removed four years previously. Positive diagnostic laboratory findings included an IVP which showed non-visualization of the left kidney and upper 1/3rd of the ureter, and a markedly elevated alpha-fetoprotein (350ng/ml) and serum testosterone (420mg/dl). Surgical exploration revealed an encapsulated mass in the left upper quadrant of the abdomen which completely engulfed the left kidney and adrenal gland. No other abdominal structures were directly involved. After surgical removal, the mass measured 22cm x 16cm at its greatest length and width and weighed a remarkable 922 grams. Histopathology subsequently identified the mass as a Sertoli-Leydig cell tumor of intermediate differentiation. The patient recovered from the procedure, and was placed on a chemotherapeutic regimen of vincristine, dactinomycin, and cyclophosphamide (VAC). This patient's case is unique for a number of reasons. Apart from accounting for less than .5% of all ovarian tumors, Sertoli-Leydig cell tumors rarely produce alpha-fetoprotein. Also, never has there been a documented case in which a Sertoli-Leydig cell tumor completely engulfed another organ other than an ovary. Finally, recurrence at such a distant site, without tumors noted more proximal to the site of the original primary tumor, is intriguing. The rareness of this tumor coupled with its unusual findings upon diagnostic and surgical intervention might help to contribute to the relatively small body knowledge known about these tumors.

Abstracts

USE OF FLUMAZENIL (ROMAZICON®) IN COMBINED BENZODIAZEPINE AND ALCOHOL TOXICITY: CASE REPORT. Greg Bradford, Charles Taylor, Les Lenning and Robert Pieroni, Department of Internal Medicine, University of Alabama School of Medicine, Tuscaloosa Program., Tuscaloosa, AL 35487

Flumazenil, a benzodiazepine receptor antagonist, reverses sedation, impairment of recall, psychomotor impairment and ventilatory depression produced by benzodiazepines. It is indicated for the complete or partial reversal of sedation produced by benzodiazepines in cases of general anesthesia, diagnostic or therapeutic procedures, and for the management of benzodiazepine overdose. Flumazenil has been associated with serious adverse effects such as seizures and symptoms of acute benzodiazepine withdrawal. It may also complicate the management of withdrawal syndromes for alcohol, barbiturates and other cross-tolerant sedatives. Also, reversal with excessively high doses of flumazenil may produce anxiety, agitation, increased muscle tone, hyperesthesia and possibly seizures. We describe the clinical course of a patient with combined benzodiazepine and alcohol toxicity aggressively treated with flumazenil.

OPTICAL (NON-INVASIVE) MONITORING OF BLOOD GLUCOSE. Glenn M. Cohen, Troy State University, Dept. Biological Sciences, Troy, AL 36082 and Fred M. Ham, Florida Institute of Technology, Division of Electrical Engineering and Computer Science, Melbourne, FL 32901.

We are developing an optical device that uses near-infrared spectroscopy for monitoring blood glucose concentrations non-invasively. Our research addresses the need of people with diabetes for an improved and simplified method of monitoring blood glucose. When people with diabetes maintain blood glucose concentrations within the normal range, they significantly improve their health by reducing the severity and delaying the onset of complications associated with the disease. We have developed discrimination or signal processing algorithms that yield robust glucose concentrations predictions from the NIR data with an acceptable level of accuracy. The present study involves the development of signal processing techniques and refinements of existing methods to detect signals of interest in a noisy environment. Specifically, we have developed an incremental complexity testing scenario (sometimes called factorial analysis) that starts with a simple aqueous matrix (i.e., glucose in phosphate buffered saline solution) and adds one interfering blood constituent at a time to determine its effect on predicting glucose concentrations. By using a matrix-matched background spectrum, we can remove the major spectrophotometric effects of interfering blood constituents from the NIR data (i.e., increase the signal-to-noise ratio) that obscure the glucose signal. We evaluated a comprehensive data set which consisted of 1251 NIR spectra of human blood serum and achieved a level of predictive performance that was comparable to invasive methods for a range of glucose concentrations from 39 mg/dl to 605 mg/dl.

DIFFERENTIAL PROTECTION OF VARIOUS ANTIOXIDANTS AGAINST BENZOYL PEROXIDE CYTOTOXICITY IN VASCULAR SMOOTH MUSCLE CELLS. Joanne Williams, Noma Gwebu, Nalo Hamilton, Michael Selassie and Ephraim T. Gwebu, Department of Research, Oakwood College, Huntsville, Alabama 35896.

Oxygen radical injury is implicated in such chronic diseases as cancer, atherosclerosis Alzheimer's disease, and ischemia. Antioxidants provide protection against injuries induced by oxygen radical progenitors such as benzoyl peroxide (BPO). Studies from our lab have shown that BPO is a potent aggregating agent. This aggregation is inhibited by antioxidants and free radical scavengers. The purpose of this present study was to compare the protective potential of various antioxidants on the cytotoxicity of BPO on vascular smooth muscle cells (VSMC).

Results. Based on our previous results, benzoyl peroxide induced platelet aggregation does not involve the generation of hydroxyl radicals in VSMC. The fact that mannitol and DMSO selectively scavenge hydroxyl free-radicals may explain why there is an insignificant amount of protection from BPO. Vitamin E and methional, which are scavenge a broad spectrum of free radicals, provided the most protection from BPO toxicity.

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MISPERCEPTIONS OF WEIGHT IN ADULT CLIENTS. Portia Foster, College of Nursing and Health Sciences, Jacksonville State University, Jacksonville, AL 36265.

Senior nursing students' ability to accurately assess and measure body weight of adult clients in a community setting was investigated. The importance of weight and body shape in adult clients was stressed. Evidence of obesity in the abdominal region, as measured by the waist-to-hip ratio, has been linked to greater risk for several diseases. The students were first semester seniors enrolled in a community health nursing class in a four year baccalaureate program. The nursing students were taught appropriate body measurement techniques in a beginning level fundamentals of nursing course. Appropriate body measurement techniques for this investigation included: body weight in pounds as measured on adult scales; body shape in inches as measured at the abdomen and hips and thighs. Thirty-one adult clients were measured for weight and body shape in a community health senior citizen clinical site. There were twenty-one females and ten males. The clients age ranged from 69 to 98 years. All the clients were ambulatory with minimal or no assistance. Three clients used walkers. Fifty-one percent of the sample were assessed as overweight, 39% were evaluated as appropriate weight, and the remaining 10% were identified as underweight. Of the twenty-one females, 67% were found to be overweight. Only 20% of the males were found to be overweight. The nursing students demonstrated weight assessment of the adult clients with 81% accuracy. The implications for improvement in weight evaluation and health teaching are numerous. The nursing students and adult clients demonstrated an interest in weight and body shape. It is recommended that the measurements of weight and body shape of all clients be considered in evaluating health status.

Abstracts

DIAGNOSIS AND TREATMENT OF MYELOYDYSPLASIA. Jennifer Burdette and Robert Pieroni
Department of Internal Medicine, Univ. of Alabama, Tuscaloosa, AL 35487-0326.

Myelodysplastic syndromes (MDSs) are a heterogeneous group of diseases characterized by ineffective and disordered production of cells by the bone marrow which frequently result in reduced circulating blood cells (RBCs, platelets, and WBCs). These cells can usually be shown to be biochemically and morphologically abnormal. Although MDSs are usually found in the elderly, they are being found with increasing frequency in younger patients, especially those exposed to chemotherapy and/or radiation. Development of MDSs is usually insidious and patients may present with fatigue and diminished exercise tolerance. Patients who die from MDSs usually have developed acute leukemia (up to 40%) or progressive marrow failure.

We shall present the case of myelodysplasia in an elderly male who was originally diagnosed as having pernicious anemia and whose course has been surprisingly indolent. Features of MDSs, including recognition, classification, clinical course and available therapy will be discussed.

ENGINEERING AND COMPUTER SCIENCES

AN OBJECT ORIENTED FRAMEWORK FOR ARTIFICIAL INTELLIGENCE: GENERAL SOLUTIONS APPLIED TO A SPECIFIC DOMAIN. John Drake,
Dept. of Computer Science, Univ. of Al. at Birmingham, Dr. Kevin Reilly, Dept. of
Computer Science, Univ. of Al. at Birmingham.

A software framework is a methodology for software reuse. Frameworks move from the typical approach of programs built on top of libraries to approach of libraries as complete or near complete "open" programs. In a well designed framework, a programmer should be able to find a component similar to the one he's needs and concentrate on the changing/ extending it to fit current needs rather than concentrating on learning an entire API. Developing a framework becomes the process of developing useful programs. taking care to make "useful" features of the program open to the framework, rather than doing a complete initial analysis of all of the needed library functions. Thus framework design can be integrated with solving a particular task rather than simply developing and/or learning a complete domain library in the hopes of applying it to the task. A case study applied to the ongoing RoboKid AI research project is proposed. Some of the needs of the project have been statistical analysis, graphics and animation, and user interface issues. AI tools such as neural networks and expert systems are being applied to the project. It is desired that the framework methodology can be applied to this project in such a way that current AI tools will be more useful, and that other tools can be added to the framework in such a way that they inherit existing functionality.

Abstracts

JAVA REMOTE METHOD INVOCATION FOR DISTRIBUTED DATABASES. Oceana O. Pun, Department of Computer Science, Talladega College, Talladega, AL 35160.

Java is an object-oriented programming language which allows the development of programs across the Internet. We investigate how this technology may be used to design and query distributed object-oriented databases. First we designed a sample database representing a business enterprise. Then we distributed it in a manner consistent with the business having several branches, including the management of data stored locally as well as data replicated on several machines. We have implemented the distribution of the database using the Java Remote Method Invocation (RMI) package. The databases reside on servers implemented in RMI and are communicated with through client graphical user interfaces (GUIs) implemented using the Java Abstract Windowing Toolkit (AWT). Using RMI, we were able to distribute a database across multiple servers on a variety of different machines, and allow access to the database from multiple clients on the local network and over the Internet. Each client can communicate with the server of its choosing, and the servers can communicate among one another. The concurrency control is managed by RMI, which provides an object-oriented framework for the distributed database programming.

MEDICAL IMAGE RENDERING TECHNIQUE FOR A FILMLESS ENVIRONMENT. Mahendra Varman and Marino Niccolai, School of Computer & Information Science, Univ. of South Alabama, Mobile, AL 36688. Meera Varman, Dept. of Pediatrics and Adolescent Medicine, Univ. of South Alabama, Mobile, AL 36604.

In managing today's medical practices, significant effort must be placed on finding ways to help control the ever growing cost of quality medicine. The high cost associated with the acquisition, rendering, and storage of medical images on film is a prime target for possible savings. Medical images are acquired from various noninvasive techniques such as X-ray, CT, MRI, and Ultrasound. For many technical and cost associated reasons, plain paper printouts can be used as a viable and less expensive alternative to film. This paper describes an enhancement technique used to facilitate the rendering of radiological images for non-film based media. Further, each image's histogram distribution can be used to fine-tune the final output for improved feature recognition.

Medical images contain various anatomical features each of which presents a unique challenge to document rendering quality. In addition, images come in many diversified file formats. This paper describes Digital Imaging and Communications in Medicine (DICOM), which is the industry standard for transferal of radiological images and medical information between computers. We discuss the results of a survey conducted to validate the usage of plain paper technology to print medical images for teaching and patient care purposes. Finally this study describes various key advantages of plain paper technology, such as : cost saving, flexibility, annotation, and teleradiology.

Abstracts

SIMULATIONS OF VORTEX-GENERATOR-JET EFFECTS. Z. Charlie Zheng and Dajiang Wang, Dept. of Mechanical Engineering, Univ. of South Alabama, Mobile, AL 36688.

Vortex-generator jets (VGJ) have been found interesting in both fundamental research and practical applications. The longitudinal vortices produced by VGJ can be used to convect kinetic and thermal energy in a lateral plane. Vortex promoted mixing is required in flow and heat transfer control such as separation control, aircraft stall control, thin film cooling of turbine blades and auto-ignition control of supersonic combustion ramjet engines. However, the mechanism of the VGJ effects is not clear. In this paper, computational simulations have been used to study the fluid dynamic processes produced by VGJ. A number of jets are used to pipe and diffuser flows, in order to investigate the effects of jet strength, jet angle and Re number on vorticity generation, vortex decay as well as wall shear stresses. The simulations have been performed on both straight pipes (where there is no pressure gradient) and diffusers (where there is an adverse pressure gradient). Secondary longitudinal vortices with opposite signs have been found and their influence on separation control has been discussed. This research is partially sponsored by the University of South Alabama Research Council and the Ministry of Education, Science and Culture in Japan under the University-to-University Cooperative Research Program.

MACHINE TRANSLATION: A SIMPLE HEURISTIC APPROACH. Prasenjit Chaudhuri, Dept. of Computer and Information Sciences, Univ. of Alabama, Birmingham, AL 35294.

In the US, a large number of research groups sprang up to work on MT (usually Russian to English) in the 50s. Most of this work is based simply on bilingual dictionary lookup. The developers quickly started realizing that far more was needed. When a committee called AL-PAC was set up to evaluate the MT research, it easily came to the conclusion that research had failed to live up to its promises. It said in its report that basic research was needed and MT was not feasible in the foreseeable future. All funding ceased, the research groups disintegrated, and the field went in disrepute.

I have tried to resurrect this discipline by developing a framework for successfully translating simple English sentences to Bengali, an Indian language having its roots in Sanskrit. A source language sentence is first processed by a morphological analyzer whose output is fed to the local word grouper (LWG). Its main task is to group functional words with the content words based on local information. For each word group, the system finds a suitable root in the target language along with associated linguistic information which are passed on to a local word splitter (LWS) followed by a morphological synthesizer (GEN). LWS splits the local word groups into elements consisting of root and features. Finally, GEN generates the words from the root and the associated grammatical features. The problems encountered in MT systems are challenging but the potential benefits of resolving those problems are immense. What is needed is a will and concerted effort from workers in several disciplines including Computer Science, Artificial Intelligence, Linguistics, Logic and Philosophy.

SOFTWARE ARCHITECTURE OF WEB-BASED DISTRIBUTED MIS: A STUDY. Tao Tao, Department of Computer and Information Sciences, University of Alabama at Birmingham, AL 35205.

The MIS (Management Information System) of next generation will be required to run in a distributed environment as opposed to just a centralized one in order for employee/employer to realize working at any place/time. This paper studies the distinguishing features and work styles of the future MIS, describes ongoing work on developing Web-based Distributed MIS (WD-MIS) and its significant differences from developing web-based information retrieval system. In particular, it presents a multi-tiered architectural model to achieve this goal. This layered structure provides a practical and extensible solution to distributed information management. Based on this model, we discuss the design pattern of WD-MIS and a couple of related critical implementation issues such as programming language, tool and security supports. In addition, several approaches of transformation from old MIS to MD-MIS are suggested. Finally, we give a recent successful MD-MIS project and outline pros & cons of our MD-MIS architecture and aspects needing improvement.

DATAFLOW TESTING CRITERIA IN AN EXPERIMENTAL EVALUATION. Marino J. Niccolai, William J. Nowack and Hong Chen, School of Computer and Information Sciences, University of South Alabama, Mobile, AL 36688.

A test criterion (or test data adequacy criterion) is a predicate which is used to determine whether a program has been tested "enough." Fifteen subject programs were prepared to perform this experiment. For each subject program, one set of test cases was randomly generated. Based on these test sets, five minimal test case subsets were constructed by using test tool ATAC command *atacMin* for each program with respect to five test criteria (block, decision, c-use, p-use, and all use). A number of faults were placed into each subject program, and the ability of fault detection for each minimal test set was investigated. According to the number of detected faults by the distinct minimal test set, the relationship among the effectiveness of test criteria will be discovered.

Abstracts

USING SIGNATURES OF THREE DIMENSIONAL ALPHA SHAPES TO IDENTIFY POLYHEDRA Marietta E. Cameron, Department of Computer Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294.

The automatic recognition of three-dimensional objects within a scene has been the goal of many computer vision systems. One definition of the problem can be stated as follows: Given a set of points in three-dimensional space, identify the objects and their poses. A new system that strives to solve this problem using alpha shapes is proposed. This system currently identifies a set of polyhedral objects from a cloud of points through the curve matching of alpha shape signatures. In this paper a review of issues in object recognition, a brief tutorial of alpha shapes, a description of the curve matching algorithm, and current results of system are presented.

Toward better Computer-Assisted Instruction: Adaptive Methods. William N. Owen, School of Computer and Information Sciences, Univ. of S. Ala., Mobile, AL 36688.

The benefits of Computer-Assisted Instruction seems to be only partially realized. Many programs have been developed that do little more than automate existing teaching methods. Instructional programs from simple drill and test to more advanced constructivist systems have only begun to scratch the surface. Many of these programs use traditional feedback techniques to prescribe activities for the learner to achieve mastery. One focus for improving instruction is to take learner characteristics into account when designing systems. We need systems that can adapt to the individual learner. This study provides a first step in developing a method of adapting to individual learners. The Kolb Learning Style Inventory was used to develop an advisor that suggests the next learner activity in a computer-based lesson. This system was tested on approximately 250 college level students with mixed success.

OBTAINING SMOOTH AND MEANINGFUL GEOMETRIC REGIONS FOR DATA MINING. Madhanraj Selvaraj, Dept. of Computer and Information Sciences, Univ. of Alabama, Birmingham, AL 35294. Dr. Alan P. Sprague, Dept. of Computer and Information Sciences, Univ. of Alabama, Birmingham, AL 35294.

Data Mining is the process of querying large databases with the aim of distilling some useful information. Computational geometry has a potential role to play in solving many geometric problems found in data mining. One such problem is to obtain regular geometric regions in massive data and to find which one of them has the maximum "gain". Fukuda et al, at Tokyo Research Laboratory, found such a region, what they call a convex region, for 2-dimensional numeric attributes in time $O(n^{1.5})$, n being the number of pixels in the grid. Dr. Alan P. Sprague, at the University of Alabama at Birmingham, found an efficient algorithm with time complexity $O(n)$ for 2-dimensional regions called anchored triangular regions and anchored convex regions. This paper extends these ideas to obtain anchored triangular regions for 3-dimensional numeric attributes.

Abstracts

NON-STEREOTYPICAL SEQUENCE PROCESSING IN ARTIFICIALLY INTELLIGENT MEMORY SYSTEMS. Steve Donaldson, Department of Computer Science, University of Alabama at Birmingham, 35294.

Recall of learned or innate sequences is characteristic of animal intelligence from insects to humans. Such behavior ranges from highly stereo-typed responses such as wasp nesting activity and human alphabet learning, to a variety of non-stereotypical operations apparently found exclusively in humans. Artificial systems intended to capture the essence of human cognition must therefore show an ability to deal with such non-stereotypical processes as word replacement, recognition of semantically equivalent phrases, paraphrasing, extracting the gist, use of "memory hotels" as an aid to memory, modification of sequence order, maintenance of important sequence continuity in spite of sequence interrupts, and processing viable alternative sequence endings (as in route following or spelling completion tasks). This research considers mechanisms whereby a limited form of non-stereotypical processing may be realized in an artificial memory system based on a suitable conjunction of a recurrent neural network (Elman, 1990) with an associative memory system. A CONSYDERR (Sun, 1994) type module interface is explored, with emphasis on expanding that approach to include sequence processing, learning, distributed representations, and automatic memory selection.

ANTHROPOLOGY

A STUDY TO CORRELATE HEMOGLOBIN A1C LEVELS AND INDIAN BLOOD QUANTUM LEVELS IN MUSCOGEE CREEK INDIANS. Guy W. Sneed, D.O., Chief Medical Officer, Muscogee Creek Nation Division of Health Administration, Okemah Health System, Okemah, OK 74859

Eighty-nine Muscogee Creek Indian patients with Type II diabetes mellitus were studied over a period of six months. The patient cohort consisted of both insulin requiring and non-insulin requiring diabetics. Indian blood quantum levels were documented by way of the Certificate Degree of Indian Blood and included a range of patients from 4/4th degree to 1/256th degree of Muscogee Creek Indian Blood. Hemoglobin A1C levels were drawn at the beginning of the study, time zero, and at the end of the six-month period. In conclusion, no identifiable correlation could be deciphered between degree of Indian blood quantum and severity of diabetes. Regression analysis and scatter graph methodology confirmed the above findings. It is hypothesized that severity of diabetes is due to a multifactorial regime of biological and environmental factors in this particular population, and that these findings would be similar to like information gathered in other populations.

Abstracts

OBSERVER BIAS IN "INTERPRETATION-FREE" LITHIC DEBITAGE ANALYSIS.

James N. Ambrosino, Panamerican Consultants, Inc., Tuscaloosa, AL 35404 and Southern Methodist University, Dallas, TX 75275.

Within archaeology, the analysis of lithic debitage is recognized as an important avenue of research by which to study site function and internal organization. Unfortunately, researchers often disagree on the method of classification to be performed. A traditional scheme, one commonly preferred by students of the Old World Paleolithic, involves the classification of debitage according to the lithic reduction stage during which they were produced. However, as Alan Sullivan and Kenneth Rozen have argued in a 1985 *American Antiquity* article, this traditional scheme requires the analyst to routinely interpret the data during the classification process. Moreover, a level of observer bias is inherent in this system that makes comparison of analyses performed by different analysts tentative at best. The recently popular scheme advanced by Sullivan and Rozen seeks to avoid this problem by concentrating on specific physical attributes of debitage. These attributes, viewed as dimensions of variability, are organized into a hierarchical typology based on presence and absence. It is argued here that this hierarchical typology is not entirely interpretation-free as its authors claim. During the numerical analysis of lithic debitage from Site IWA128, Walker County, Alabama, by Panamerican Consultants, Inc., it became apparent that observer bias was the strongest factor affecting fine-grained differences in debitage distributions across the site. A formal test of this observation next was carried out on an independent data set from Site 1MR165, Marion County, Alabama. The results of these studies are presented here, and their implications are explored.

EXAMINING THE STONE MOUND ENIGMA: PREHISTORIC CEREMONIALISM OR HISTORIC FIELD CLEARINGS. Greg Hendryx and Kendall Rich, Panamerican Consultants, Inc., P.O. Box 40930, Tuscaloosa, AL 35404.

Panamerican Consultants, Inc., conducted archaeological fieldwork at the 1MR200 stone mound complex during September and December of 1997, and during January of 1998. The complex consisted of seven stone mounds, a 37 m long stone wall, and a small stone bridge. The research was geared toward determining the origin and function of the mound complex. A total of 10 units were excavated, including nine 1-x-1 m units under the mounds, and a 1-x-2 m unit under the stone wall. Four mounds were disassembled for excavation; three of these were excavated, and the fourth was determined to be a chimney fall. A thorough review of the data indicated that the mounds probably represented field clearings which were placed over a low-density prehistoric site, by Euroamerican agriculturalists.

Abstracts

A SYNTHESIS OF THE WEST JEFFERSON PHASE. Paul D. Jackson and Kristen Zschomler, Panamerican Consultants, Inc., Tuscaloosa, AL 35404.

The West Jefferson phase is a part of the Baytown culture which was active during the Late Woodland period. The West Jefferson phase was originally defined by Jenkins and Nielsen in 1974 while excavating three Late Woodland sites along Village Creek in west Jefferson County (Jenkins and Nielsen 1974). The unique occurrence of an overwhelming number of grog-tempered plain sherds and a small occurrence of shell-tempered sherds, led Jenkins to classify these sites as a new phase in the Late Woodland period. Since Jenkins' work, numerous Phase I surveys have identified West Jefferson components, and several have undertaken intensive investigations through excavation. But the information gained from these works has never been combined into one synthesis in order to better understand the nature of West Jefferson sites and recognize the problems still surrounding the phase. This is the goal of the present paper. An overview of West Jefferson sites and information from 1974 to 1997 will be discussed. Additionally, several sites recently excavated containing West Jefferson components will be discussed.

THE SHELLIE SITE, 1SC291, A LATE GULF FORMATIONAL SITE IN THE MIDDLE COOSA VALLEY. Harry O. Holstein, Jacksonville State Archaeological Resource Laboratory, Jacksonville State University, Jacksonville, Alabama. 36265.

During the Spring of 1997, Jacksonville State conducted a brief archaeological field school upon the Shellie Site, 1Sc291, located near Ragland, Alabama on the present day shore of Logan Martin Lake. Lying approximately four miles south of Ten Islands along a natural levee of the Coosa River, the Shellie Site represents the most northern expression of the Gulf Formational Culture, to date, for the Coosa drainage. Nearly a one meter thick freshwater shell midden, Alexandria Ceramics, numerous steatite vessel fragments, Flint Creek bifaces and Tallahatta quartzite attest to the cultures presence. Four archaeological storage and / or cooking features were also uncovered. Excellent bone and botanical remains should provide a clear picture of the regional adaptation of this transitional Archaic / Woodland Culture.

Abstracts

AN EXPERIMENT IN HEAT TREATING QUARTZ AND QUARTZITE. Athanasius Isaac and L. Demetrius Adair, Panamerican Consultants, Inc., Tuscaloosa, AL 35404.

Information concerning the thermal alteration of certain lithic materials is limited in the archaeological literature. In an attempt to improve on this, we conducted an experiment using quartz and quartzite derived from the Tuscaloosa Formation. Our objectives in the experiment were twofold: (1) to see if thermal alteration of the lithic material affects the knapping quality, and (2) to determine if thermal alteration results in attributes that can be identified in laboratory analysis. In this paper, we discuss the findings from the experiment.

PROBLEMS IN TYPOLOGY: THE AMBIGUITIES OF THE COASTAL SOUTH CAROLINA CERAMIC TYPOLOGIES. Teresa A. Lott, Panamerican Consultants, Inc., Tuscaloosa, Alabama 35404.

Ceramic typology is one of the most important tools utilized by archaeologists for establishing the chronology of any prehistoric site. However, several preexisting typologies are riddled with numerous ambiguities and inconsistencies. This is apparently the case with the ceramic typology of the coastal area of South Carolina. Several scholars who have worked in the coastal area of South Carolina have attempted to resolve the problems associated with the preexisting typology; however, solutions have not been agreed upon. This study attempts to explore the problems of the typology using examples of ceramics obtained by Panamerican Consultants, Inc., from various prehistoric sites located within the coastal region of South Carolina.

AN ATTRIBUTE BASED TYPOLOGY OF TRIANGULAR PROJECTILE POINTS: A CASE STUDY FROM NORTH AND CENTRAL ALABAMA Meghan LaGraff Ambrosino, Panamerican Consultants, Inc., Tuscaloosa, AL 35404 and University of Alabama, Tuscaloosa, AL 35487.

One of the most critical initial steps in an archaeological investigation is the assessment of a component's cultural and temporal affiliation. Once this is accomplished, a site can take its place in the more dynamic analysis of culture change through studies of population growth, culture contact, and technological innovation. Numerous researchers have noted certain trends and changes in triangular point size and morphology through time. Some researchers have attempted to quantify these changes in an attempt to develop a tighter, more specific chronology. This study evaluates such data recorded from archaeological contexts in North and Central Alabama.

MINUTES

Alabama Academy of Science
Shoals Community College
Muscle Shoals, AL
University of Alabama Birmingham
Birmingham, AL
December 2, 1997

Dr. Ellen Buckner, President of the AAS, called the Special Teleconference meeting of the AAS Steering Committee to order at 9:00 a.m. Those in attendance in the UAB Conference Site were: Ellen Buckner, Larry Boots, Sam Barker, Elsie Spencer, Moore Asouzu, Leven Hazlegrove, Eugene Omasta, Larry Krannich, and Ken Dillon. Attending at the Shoals Conference Site were Priscilla Holland and Tom Jandebour.

Dr. Buckner gave a brief history of the Gorgas Scholarship Foundation and its evolution to the present status. She presented the agenda for the day, which was as follows:

- I. Proposed action by the Gorgas Scholarship Foundations - Concerns and Comments. General discussion ensued on the proposal, with certain concerns expressed:
 - A. Name of the Gorgas Foundation in the Selections Agreement.
 - B. Confusion regarding continuance of GSF after its dissolution.
 - C. Administrative fee to the AAS.
 - D. Expenses of the AAS for the competition.
 - E. Concerns over the divergence of the financial side and operational side of the proposal.
 - F. Assurance of the payment of the Scholarship and reimbursement of expenses, plus administrative fee.
- II. Involvement of the Alabama Academy of Science in the selection agreement- Concerns and Comments:
 - A. AAS retaining the identity of being associated with the Gorgas Scholarship.
 - B. Select a Standing Committee for the Gorgas Scholarship and

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keep the Business and Industrial members of the Gorgas Board of Trustees involved in the process.

- C. How to operationalize the process - transition stage - from the Gorgas Scholarship Advisory Council to the more permanent Standing Committee of the AAS.
- D. Chairman of the AAS Standing Committee of the Gorgas Scholarship Program should be the Executive Director of AAS.

Formal motion was made by Dr. Eugene Omasta and seconded by Dr. Sam Barker that the Steering Committee accept the Selection Agreement with proposed changes (included below). The motion was carried by a majority of aye with one opposed.

Article IV

Section I: Standing Committees

(t) William Crawford Gorgas Scholarship Program Committee. This committee shall be chaired by the Executive Director and a co-chairman appointed by the President for a four year term. Six members shall be appointed by the co-chairmen to serve staggered three year terms. All members shall be Academy members in good standing. The duties of this committee shall be to coordinate the Alabama Science Talent Search, Gorgas Scholarship Competition and Awards. (The Gorgas Scholarship Program is a program of the Alabama Power Foundation, Inc.)

Article XIII - Gorgas Scholarship Program

Sec. I The Academy shall sponsor and supervise the Gorgas Scholarship Program to include the Alabama Science Talent Search, Gorgas Scholarship Competition and Awards.

Sec.2 The Chairman of the Gorgas Scholarship Program is the Executive Director of the Academy.

The Chairman is assisted by a Gorgas Scholarship Program Committee, a standing committee of the Academy, which functions to supervise the activities of the Alabama Science Talent Search and Gorgas Scholarship Competition and Awards.

Article XIV (renumbered from XIII) Amendments

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Alabama Academy of Science
Spring Executive Committee Meeting
USA Terrace
University of South Alabama
Mobile, AL

Wednesday, March 18, 1998

Dr. Ellen Buckner, President of the AAS, called the Spring Meeting of the AAS Executive Committee to order at 7:35 p.m. The minutes of the Fall Meeting were discussed and approved.

Officers' Reports

1. Board of Trustees - Dr. Sam Barker thanked President Buckner for her yeoman work on the Gorgas changes and gave a brief report on the timeline and changes that had taken place with the Gorgas Scholarship. Four Trustees were present: Samuel B. Barker, Michael B. Moeller, Ken R. Marion, and Prakash C. Sharma.
2. President - Dr. Ellen Buckner - Presented the amended By-laws with change on line 3 to read Chairman and Co Chairman for approval. Dr. Samuel Barker moved to accept the amendment with the change, the motion was seconded, discussed with Dr. Moeller calling the questions. The motion carried unanimously. Dr Buckner then presented the following written report:
Since the Fall Executive Committee I have done the following:
 - a. Continued discussions with Drs. William Barrett, Glynn Wheeler, Leven Hazlegrove, and Mr. Art Beattie regarding the agreements concerning the Gorgas Scholarship Program and the Academy.
 - b. With the assistance of Beverly Powers, Auburn University Archives, obtained original letter from the IRS (dated 1958) designating the AAS as a tax exempt 501(c)3 organization. Forwarded copy of that letter to Mr. Art Beattie, Chairman, Gorgas Scholarship Foundation for files.
 - c. Corresponded with the Steering Committee concerning the status of those discussions and called a meeting of the Steering Committee on December 2.
 - d. Conducted the called meeting of the Steering committee on December 2, 1997, including videoconference participation between two sites at UAB and Muscle Shoals. This meeting was called to discuss the topic of the Gorgas Scholarship Program. The Steering Committee voted to participate in a selection agreement with

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- the Alabama Power Foundation in which the AAS would annually conduct the Gorgas competition.
- e. Corresponded with Mr. Art Beattie, Chairman of the Gorgas Scholarship Foundation, to convey the Academy's willingness to participate in the selection agreement with revisions.
 - f. Corresponded with AAS members who are Gorgas Foundation Trustees to acquaint them with our willingness to participate in the selection agreement.
 - g. Arranged, edited, and proofed history brochure for 75th annual meeting, printed by Auburn University Printing Service. This printing was supported in part by a gift from Dr. Bill Barrett.
 - h. Invited and received acceptance from Dr. George F. Crozier, Executive Director, Dauphin Island Sea Lab, to speak at Joint Banquet, March 20, 1998.
 - i. Mailed AJAS materials and Visiting Scientist Network Directory to approximately 20 school teachers requesting these at the ASTA meeting.
 - j. Corresponded with the IRS to update AAS status as a 501-(c)3 tax-exempt organization. This included sending copies of Forms 990 from previous years, obtained from Dr. Krannich, Treasurer, an updated letter confirming the Academy's status has been received.
 - k. Discussed by telephone arrangements for spring meeting with Dr. David Nelson, Local Arrangements Committee Chairman.
 - l. Corresponded by e-mail with Dr. John Fransden regarding legislation affecting science textbook selection process.
 - m. Organized correspondence for archival use.
 - n. Assisted with proofreading of program for 75th Annual Meeting.
 - o. Discussed procedures for Gorgas Scholarship Competition with Drs. Hazelgrove and Wheeler. Assisted in design of letterhead stationery with acknowledgment of Gorgas Scholarship Program as a program of the Alabama Power Foundation and administered by the Academy.
 - p. With Dr. Samuel Barker, Chairman of Board of Trustees, signed "The Annual Gorgas Scholarship Winners Selection Agreement" with the Alabama Power Foundation, Inc. for the Alabama Academy of Science to administer/conduct the annual Alabama Science Talent Search and Gorgas Scholarship Program competition. This agreement was signed February 26, 1998.
 - q. Drafted By-laws revisions to create a Gorgas Scholarship Committee of the AAS as proposed and approved by the Steering Committee. Considered appointments to that Committee and discussed appointments with individuals involved.
 - r. Corresponded with Executive Committee including update on Gorgas Scholarship Program status and proposed By-laws revision.
 - s. Planned and circulated agenda for Spring Executive Committee meeting.
 - t. Requested Secretary to generate an e-mail directory of the Academy.
 - u. Requested Chairman of Editorial Board of the JAAS to look into Journal costs.
 - v. Corresponded with past presidents inviting them to the 75th annual meeting.

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President-Elect - Dr. Moore Asouzu - No report

Second Vice-President - Dr. Larry Boots - No report

Secretary - Dr. Priscilla Holland

Membership

Individual Membership	605
University Libraries	26
Secondary Schools	51

Trends in Membership:

April 1992	728
March 1993	661
March 1994	739
March 1995	650
October 1995	670
March 1996	571
October 1996	642
October 1997	633
March 1998	605

Membership by Section

<u>Section</u>	<u>March 1998</u>
I. Biological Science	185
II. Chemistry	63
III. Geology	31
IV. Geography, Forestry, Conservation, Planning	24
V. Physics & Mathematics	70
VI. Industry & Economics	27
VII. Science Education	32
VIII. Social Science	38
IX. Health Science	86
X. Engineering & Computer Science	34
XI. Anthropology	13
77. University Libraries	26
88. High School Libraries	51
Unknown.	2

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6. Treasurer - Dr. Larry Krannich submitted the following report:
Copies of the following (available upon request) were presented:
ALL ACCOUNT BALANCES as of 12/31/97
ACTIVITIES RELATIVE TO 1997 BUDGET for the period 1/1/97-12/31/97
TREASURER'S SUMMARY REPORT BY QUARTER (1/1/97-12/31/97)
TREASURER'S SUMMARY REPORT BY ACCOUNT (1/1/97-12/31/97)
ALL ACCOUNT BALANCES as of 3/9/98
TREASURER'S SUMMARY REPORT BY QUARTER (1/1/98-3/9/98)
ACTIVITIES RELATIVE TO 1998 BUDGET for the period 1/1/98-3/9/98

Total account balances as of 12/31/97 were \$62,163.96. Although the Academy budgeted a deficit of \$6,390, the year ended with income exceeding expenditures by \$349.64. This is somewhat misleading, because 1996 annual meeting income (\$2,985.35) was not received until January 1997 and appears as 1997 income. Although we had allotted \$2,000 for State Science Fair expenses, the host reimbursed us \$2,480 from the proceeds of the fair. We experienced another year of declining dues income (\$-2,825 in 1997 compared with \$-850 in 1996). Interest income from the 6 and 12 month certificates of deposits were almost twice our projections. Expenses were \$817.43 more than budgeted. Journal printing in 1997 exceeded the budgeted amount by over \$6,000. Some of this was offset by the decrease in expenses for the annual meeting, the executive director, and in other areas.

For the first quarter of 1998, our dues income is at the level expected. Although Journal support might appear to be lagging, it is at the level of last year. The low-income figure does not reflect that several of the checks received had to be returned, because they were made payable to an individual and not the Academy. The printing of the 75th anniversary booklet (President expense) is a one-time expense. Overall, our expenses are as expected for the first two months of a fiscal year. Thus, we appear to be keeping within the budget for 1998 and do not anticipate any budgetary problems.

7. Journal Editor - Dr. James T. Bradley -Presented the following written report:
1997-1998 manuscripts submitted and published:
Since the 1997 Annual meeting 17 manuscripts were submitted for publication. Each received 2-3 peer reviews. Of these, 12 were accepted for publication, 2 were rejected, and 3 remain in the review process.
Increased cost of publication:
In response to concern expressed at the last Executive Committee at increased costs for publications of the JAAS (Attachment #1), I have visited in person twice with Mr. Harvey Dahl, Director of Auburn University Printing Service. He has provided information about per-page publication costs for each issue over the past few years. There is significant fluctuation between issues due largely to issue size. He also explained to me that during the past year the cost of paper has increased somewhat and that there was a University mandated salary increase for all employees at the Printing

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Service which resulted in an increase rate for their work. Dramatic variations in the cost of individual issues are due primarily to the number of photographic plates required for the manuscripts. In one case this year, the color cover photo possessed an inset photo so that the final cover resulted in processing costs nearly equivalent to two cover photos. Mr. Dahl also discovered that the charge for the July 1997 issue had been miscalculated to the Academy's disadvantage by about \$240. This mistake arose because of an unusual binding used for that small issue; this binding should have been charged at a rate lower than that used for the usual binding. He has applied this as a credit against the cost of the January 1998 issue, which will soon go to press. Finally, I am informed by the AU Library that \$4646 earmarked for publication costs of the JAAS presently exists in their budget.

Editor's recommendations regarding immediate future of JAAS publications:

- a. Remain with AU Printing Service for 1998-1999. The quality of the publication has been very good, and the proximity to the editor has expedited the publication of the journal in several ways.
- b. Change to use of a nonglossy paper beginning with the January 1998 issue. This will reduce publication costs and remove glare, which presently makes the pages difficult to read under some lighting situations.
- c. Retain color, glossy cover, but do not use more than one photo per cover.
- d. Strive through the review process to reduce the number of photographs used in manuscripts.

Unreimbursed secretarial services:

In October 1996 the Journal lost secretarial services that had been provided by Auburn University College of Science and Mathematics for many years. Since then these services have been provided at no charge to the Academy by Sue Bradley. A specific listing of these secretarial jobs is attached (Attachment #2). I would welcome action by the Executive Committee thanking Sue Bradley for her donation of time and effort during the past 18 months and possibly recommending that some modest stipend be paid by the Academy for provision of these services in the future.

8. Counselor to AJAS - Dr. B. J. Bateman - Report by Dr. Gene Omasta - AJAS is down in participants because of the school systems going to the block semester.
9. Science Fair Coordinator - Dr. May Thomaskutty - Written report:

State and Regional Science Fair Winners for 1998:

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North Region

Director: Mr. George Williams, Calhoun Community College

Student

Jeremiah Brown
Ehrin Biglari
Jeb Orr
Jason Davis

School

Covenants Christian Academy, Huntsville
Covenant Christian Academy, Huntsville
Elkmont High School, Athens
Covenant Christian Academy, Huntsville

Central Region

Director: Dr. James Martin, University of Alabama at Birmingham

Student

John Cannon
John Mays
David Murphy

Jennifer Hools

School

Altamont School, Birmingham
Altamont School, Birmingham
Shades Mountain Christian School,
Birmingham
Shades Valley High School
Birmingham

West Region

Director: Dr. Haynes, University of Alabama

Student

Holly Hitt

School

Tuscaloosa County High School

Southeast Region

Director: Dr. Gene Omasta, Troy State University

Student

Anna Elizabeth Scheiban
Melinda Sue Ellis

School

Southwest Region

Director: Mrs. Gladys Swain, Talladega College

Student

Jonathan Day
Christina Meirs

School

Fyffe High School

South Region

Director: Dr. Jim Langdon, University of South Alabama

Student

Roopa Dhawan
Pearl Flath

School

Murphy High School, Mobile
Murphy High School, Mobile

Minutes

State Science Fair

Director: Dr. Grame Duthie

Student

Elizabeth Dillard

Lindsey Farina

Monica Sekoh

Jamie Aldes

Taylor Griswald

School

Bradshaw High School

Brooks High School

JCIB

Murphy High School

Student observer Montgomery

10. Science Olympiad Coordinator - Steven Carey - Presented the following written report: As of March 18, 1998, Science Olympiads have been conducted at the University of Alabama (Divisions B and C), Auburn University (Divisions B and C), Jacksonville State University (Division C), University of Alabama at Huntsville (Divisions B and C), and UMS-Wright Preparatory School (Division B). the regional at Troy State University (Division C) will be conducted on April 11. The State Science Olympiad for Division B will be held at the Alabama School of Math and Science on April 4, and the State Science Olympiad for Division C will be held at the University of Mobile on April 18.

Schools advancing to the state competitions (for which I have information) include: Hartsville H.S., Bob Jones H.S., Shades Valley H.S., Auburn H.S., Haleyville Jr. H.S., McBride M.S., Our Lady of the Valley, Muscle Shoals H.S., Hillcrest H.S., Academy for Science & Foreign Language, Randolph School, Hibbett M.S., Grissom High School, Alabama School of Fine Arts - Russell Math/Science Center, and UNS-Wright M.S.

I have not received a final count of all schools participating in the regional Olympiads. Attendance seems to be about the same for the Science Olympiads at Alabama and Auburn. Jacksonville State reports that attendance was down a little from previous years; however, UAH had their biggest year yet with about 275 students participating. I had the opportunity to attend the Science Olympiads at Auburn and UMS-Wright and was very please with the turnout and the enthusiasm exhibited by the students. I am planning to attend the Troy State Regional Science Olympiad and both the Division B and C state tournaments.

I should like to thank all regional coordinators and their respective institutions for all the hard work and dedication it takes to organize and run a Science Olympiad. I should like to thank the Alabama Academy of Science for its continued support of the Science Olympiad program.

Counselor to AAAS - Dr. Katharine Mayne - No Report

Minutes

12. Section Officers:
- I. Biological Sciences - Roland Dute - No report
 - II. Chemistry - Stephen Beale - No report
 - III. Earth Science - Douglas Haywick - No report
 - IV. Geography, Forestry, Conservation and Planning - Victoria Rivizzigno Oral report: Section IV has 16 presentations from 6 universities.
 - V. Physics and Mathematics - John Young - No report
 - VI. Industry and Economics - T. Morris Jones - No report
 - VII. Science Education - Adriel Johnson - Submitted the following oral report:
There were seven titles submitted with a diverse range of topics in the Science Education Section. After the paper presentations, a business meeting will be conducted to select a new vice chair; Dr. Helen Benford, current vice chair from Tuskegee University will become the new section chair until 2000.
 - VIII. Social Science - Jerald Burns - No report
 - IX. Health Science - Jian Han - No report
 - X. Engineering and Computer Science - Alan Spraque - No report
 - XI. Anthropology - Harry Holstein - No report
13. Executive Officer - Dr. Leven Hazlegrove - Presented written report as follows:
Since the Fall Executive Meeting, BSC, October 3, 1997 (Great Dining, Steering Committee) and UAB, October 10, 1997 (Lister Hill Library, Great Tour), we have been working on the following projects for the last five months:
- a. Set up and prepared the Gorgas Scholarship, Science Talent Search, in cooperation with the Westinghouse Scholarship Science Service, Inc., D.C. for USA March 20, 1998, with the leadership of Dr. Glynn Wheeler, Secretary Treasurer, and Dr. David Nelson, USA. Also, with Dr. Ellen Buckner's leadership and the guidance of Dr. Barker and Dr. Barrett's help to merge with the Alabama Power Foundation, Inc.
 - b. Prepared for bulk mail 700 "Call for Paper Titles" for USA meeting for March 1998, edited by Dr. William J. Barrett.
 - c. Sent development letters to five industrial companies and foundations, with positive reply from one.
 - d. Sent handwritten notes to 30 outstanding Scientists and Engineers, Mathematicians, and potential members whose "writeup" appeared in local publications. (Five New Members!!)
 - e. Met twice with Dr. David Nelson, Professor of Biology, and his site committee for the AAS meeting dates: March 19-22, 1998.
 - f. Set up ASTA booth at Hoover High School, Friday, October 24, and Saturday, October 25, 1997, with the able supervision of Dr. William J. Barrett, Dr. Dan Holliman, Dr. Tom Jandebour, Dr. Ellen Buckner, and Dr. B. J. Bateman.

Minutes

- g. Prepared 250 abstract forms for the USA meeting, March 19-22, 1998, for eleven section chairs.
- h. Your director studied flora, fauna, and pollution in the USA, February 11-14, 1998, with the Alabama Fisheries Association, Gulf State Park, and Dr. Ken Marion.
- i. Set up, with Dr. David Nelson's able help (334-460-6331), the 1998 meeting at USA, with the kind invitation of President Whiddon and the USA faculty, March 19-22, 1998.
- j. Set up the 76th Annual Meeting at Athens College, with the able direction of Dr. Tom Jandebeur, Professor of Biology, March 24-27, 1999, and the 77th Annual Meeting with Dr. Larry Davenport, Professor of Biology, Samford University (205-870-2584), March 29-April 1, 2000.

C. Committee Reports

1. Local Arrangements - Dr. David Nelson submitted an oral report. There were 120 preregistered, with 41 for the Awards Banquet.
2. Finance - Dr. Sam Barker - When Dr. Krannich became Treasurer (6 years ago), I believe he was the first Treasurer to show in hard copy the extreme quarterly fluctuations in Academy finances. With our major activity, the Annual Meeting, taking place in the second quarter, a great deal of our money flow occurs then. With the Annual Fall Meeting of the Executive Committee requiring presentation of a budget proposal for the next calendar (and fiscal) year, a truly reliable estimate of the next year's income and outgo is largely a matter of faith - not just in the Treasurer, but in our fellow Academy members.

Over the last 6 years, I have issued semiannual displays of data from Dr. Krannich's financial reports through 1995, showing that, despite deficit budget proposals, we had come through with positive balances (from \$225 to \$6,589) at the end of each full year. In 1996, two unfavorable trends started: (1) dues payments were considerably less than expected and (2) Journal publication expenses were unexpectedly high. When the income from the 1996 Annual Meeting was not sent to the Academy until well into 1997, the 1996 projected deficit of \$3,980 increased to the actual figure of \$4,485. This was the first true full-year deficit in Larry's 2 terms as Treasurer.

In spite of the January 1997 receipt of 1996 meeting income, the 1997 deficit, anticipated one year ago as \$6,390, will clearly be even worse, with dues far less than budgeted, and Journal publication already running 69% above budgeted, with one of four issues yet to go.

Since the proposed 1997 budget, set forth one year ago, is now obviously inadequate, I have encouraged Dr. Krannich to submit a more realistic budget for

Minutes

1998, increasing Annual Meeting income to \$4,500, dropping to \$9,000 for dues with total income of \$24,200. Total Journal expenses are shown at \$16,600, raising total expenses to \$38,765. Overall deficit (\$24,200 income minus \$38,765 outgo) would then be projected as \$14,565. Our Academy assets, total \$58,710, would be depleted by 25%.

This obviously is not a pleasant prospect, and deserves a hard look. I do not recommend an increase in dues, but clearly our sagging membership roster needs a boost. Since our members are obviously willing to pay a meeting registration fee high enough over meeting expenses to yield significant income to the Academy, this trend is necessary. The Journal is a problem.

3. Membership - Dr. Adriel Johnson's oral report included recommendations to enhance membership for AAS: 1) I would like to encourage all executive committee members to pay their dues or to confirm payment; 2) I would like to recommend that all executive committee members consider becoming lifetime members of AAS; 3) I would like to challenge the executive committee members to return to your universities and ask your undergraduates and graduate students to join AAS. Express to them the advantages of an AAS membership.
4. Research - Dr. Hudiburg submitted the following written report: The Chairperson of the Committee on Research received 22 requests for application materials related to the Student Research Award Competition, Student Research Grants, and Student Travel Awards. These requests for materials were much lower than last year due to the establishment of a webpage (<http://www2.una.edu/psychology/hudiburg.htm>) to access application materials. I recommend that the webpage be continued for next year's meeting. Once again, e-mail has facilitated communication with interested students and cuts down on the time and cost of correspondence.

Eighteen travel grants were awarded. A total of 19 papers and 4 posters, covering 8 of the AAS sections, are entered in the Student Research Award Competition. There are 6 applications for Student Research Grants. The section Vice-Chairpersons will need to provide the names of his/her competition winners to the Chairperson of the Committee on Research before the annual meeting banquet scheduled for March 20. The award in a section can be split between co-winners according to the decision of the judges.

It has been suggested by several section chairs and vice chairs there is a need to change the rules for entering the Student Research Award Competition. The suggestion is that all students who give papers or posters at the annual meeting of AAS be automatically entered into the competition of their respective sections. This suggestion might be worthy of discussion

Minutes

by the Executive Committee.

5. Long-Range Planning - Ken Marion - Submitted the following written report: The Committee considered a number of items generated from an informal discussion at a dinner for the Executive Committee hosted by Birmingham Southern College previous to the Fall AAS Executive Committee meeting. The Long-Range Planning Committee's recommendations or suggestions center around two on-going problems of the Academy: potential budgetary inadequacies and membership numbers. Items along these lines that the Committee felt should be addressed in the near future were:
 - a. Raising of Annual Dues and/or Registration Fees - It may well be time for a modest increase in annual membership dues. It has been several years since the last increase. Most other societies have higher annual dues and an AAS membership does include a journal. It was felt that a modest increase would not deter current members from renewal. Further, it was felt that meeting registration fees for senior Academy members should always be kept high enough to ensure that the Academy can receive at least a small amount of monies as income from the annual meeting. A significant profit from the annual meeting should not be the aim; instead, the aim would be to mandate that there would be no monetary loss.
 - b. Journal Expenses: Journal expenses have been rising due mostly to paper and printing costs. This is a major expense for the Academy, but at the same time the Journal is clearly a major asset. It was agreed that quality must be maintained, but the Committee suggests that it may be time for the Academy to consider an ad hoc committee to make specific recommendations (if any) for dealing with future Journal expenses. It should be noted that the Long-Range Planning Committee recommended in the recent past that the Academy consider a reduction in the number of annual issues as a potential cost saver.
 - c. Drive to Increase Membership: In recent years, the Academy has experienced steady and/or decreasing membership. The Committee generally agrees that it may be time to again do something that might encourage new membership. A possible suggestion is that each new section chair be charged with solicitation duties (in some fashion). The drive for additional members would likely be more effective at the section level, rather than appeals from the presidential level. Additional suggestions that would likely impact annual meeting attendance, but would also possibly enhance membership, include holding the annual meeting frequently in the central part of the state and the possibility of shortening the annual meeting to encourage additional attendance.
6. Auditing - Sr. Academy - Denny Bearce - No report
7. Auditing - Jr. Academy - Danice Costes - No report
8. Editorial Board and Associate Journal Editors - Douglas Watson/Larry Witt/Bill Osterhoff - No report

Minutes

9. Place and Date of Meeting – Thomas Bilbo – Reported the following written report:
10. Most of you are probably aware that Auburn University has decided not to host the year 2000 Annual Meeting because they will be changing from the quarter system to the semester system at that time, but they indicated they would be interested in hosting a future meeting (more about that later). After Auburn declined, Dr. Ellen Buckner called me and mentioned that Dr. Larry Davenport, a member of the Date and Place of Meeting Committee, had said he would be glad to inquire about whether Samford University would serve as the site for the year 2000 Annual Meeting. Dr. Davenport worked with the Provost at Samford, and Samford University has agreed to host the Annual Meeting on March 29-April 1, 2000. I appreciate very much Dr. Davenport's work in getting Samford University to host the meeting.

After we received the letter from Auburn indicating their interest in hosting a future meeting, Dr. Hazlegrove responded that Auburn University would be an ideal site for the year 2001 Annual Meeting if that time is convenient. The Vice President for Research and Associate Provost is in the process of planning for hosting the year 2001 Annual Meeting at this time. I appreciate Dr. Hazlegrove's help in working with Auburn University.

Soon after this meeting, we will be contacting individuals at Jacksonville State University and Alabama State University who have expressed interest in hosting future meetings on their campuses. If you or someone that you know may be interested in hosting a future meeting at your institution, please mention it to Dr. Buckner, Dr. Hazlegrove, or myself.

11. Newsletter - Tom Jandebour, Associate Editor for Electronic Media. Helvi McCall resigned as the Newsletter editor.
12. Public Relations - Myra Smith - Submitted the following written report: Thirty-three press releases announcing the annual meeting of the AAS, along with the Alabama Junior Academy of Science, to be held in Mobile at the University of South Alabama and the call for papers were sent to various city and school newspaper editors in December. In February, 42 press releases were mailed. These releases included information about the meeting, the oral and poster presentations, the symposium, and Dr. Howard Jones' presentation on his book, "Amistad," as well as the joint banquet and guest speaker. In addition, a separate letter was included regarding the recipient of the Gardner Award. Also, the editorial staffs of the Birmingham Post-Herald and News and Huntsville Times & News were personally contacted about Dr. Thomas Wdowiak, the winner of the Gardner Award.

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The Chair of this Committee wishes to thank Dr. Leven Hazlegrove for his preparation of the press release about the various aspects of the annual meeting.

13. Archives - Troy Best - No report
14. Science and Public Policy - John Frandsen - Submitted the following written report:

Science Education. All is presently quiet on the science education front. The “insert” is in all of the biology texts, and, though it has been examined by several groups to identify possible grounds for challenging it in the courts, none of these groups has decided to mount such a challenge to it as of this date. It is now simply one of a number of such inserts, or statements to be presented orally in biology courses, adopted by several states, and organizations such as the National Center for Science Education (NCSE) must decide which one is most vulnerable to challenge on constitutional grounds, and which judicial district would be the best site for a suit.

The members of the State Board of Education will all be up for election next year (1998). Certainly it would be desirable to have some members who have a background in the sciences or science education, and appreciate the need for science to be taught as science. Has a member of this Academy ever served on this board? Is there, perhaps, a way that we might encourage such a person to seek election?

The ongoing process of consolidating and eliminating programs in state-supported 4-year colleges and universities with the goal of conserving resources and preventing duplication raises some insufficiently-addressed questions: When departments that presently provide science courses to meet general education requirements are abolished, what of the future quality of these courses when the surviving faculty members who teach them are incorporated into other departments? When departments, such as philosophy, that presently provide “service” courses in logic and ethics, for example, required for science majors, are abolished, what of the future quality of these courses? Can colleges and universities continue to attract instructors of the quality needed to teach these important courses when the present buyer’s market in higher education becomes a seller’s market, and these instructors have no opportunity to conduct research or teach advanced courses? Should society allow the “invisible hand” of the marketplace to guide higher education unfettered?

Minutes

1. This committee doesn't know the answers to these questions, but believes they are worthy of thoughtful consideration by lawmakers and the Alabama Commission on Higher Education.

Environmental Issues. A number of issues concerning the environment are likely to become subjects of intense interest and political debate in the next few years. The first of these is likely to be non-point pollution of the state's freshwater streams. There is strong evidence that many of these are becoming over-enriched by non-point-source nutrients, leading to eutrophication, with attendant disruptions of aquatic ecosystems and accompanying multiplication of "water weed" vegetation. On the one side of this issue will be those alarmed over the "loss of quality" of these waters. On the other side will be those individuals who feel their rights will be curtailed, and their profits reduced, by the measures necessary to address the pollution problem.

The Academy must be prepared to adopt a public position on these environmental issues. Our Environmental Panel--operating as a subcommittee of this committee--was created to provide us with the expertise necessary to develop such positions and to provide advice to those preparing relevant legislation. Though this panel is composed of well-qualified individuals with the requisite expertise, its efficient operation has been impeded since its appointment by the unwillingness or inability of any of its members to provide the time and energy required to function effectively as its Chair. The original Chair resigned more than a year ago, pleading lack of time to continue and none of the other members has been willing to take his place. This Committee solicits suggestions of the names of qualified individuals who might be willing to accept appointment to the Environmental Panel and serve as its Chair.

15. Gardner Award - George Cline - No report

16. Carmichael Award - William Boardman - Written report:

The committee presented its annual award for the outstanding paper published in the JAAS during the previous year to B. H. Estridge and J. T. Bradley, Department of Zoology and Wildlife Sciences, Auburn University. The title of their paper is "Brefeldin A Alters Fat Body Vitellogenin Secretion in the Stick Insect Carausius Morosus Br."

Two newly appointed members of the committee are: Dr. Ephriam Gwebu, Department of Chemistry at Oakwood College in Huntsville, and Dr. Robert E. Pitts, Department of Engineering at UAB. Continuing members are: Dr. William Boardman, Division of Science and Math at Birmingham-Southern; Dr.

Minutes

Velma Richardson. Department of Biology at Tuskegee; Dr. Linda Reed, UAB School of Nursing; and ex officio as JAAS editor, Dr. James T. Bradley, Department of Zoology and Wildlife at Auburn University.

17. Resolutions - Gerald Regan - Written report:

The Committee presented a resolution regarding the script to be followed by the Executive Committee in making presentations at the annual banquet, as follows: Each year the Academy recognizes individuals who have served it in an exceptional manner. First and foremost we recognize Frederick P. Whiddon, president of the University of South Alabama, for graciously hosting the 75th annual meeting of the AAS. The Academy would also like to recognize David H. Nelson, chairperson of the local arrangements committee for the many weeks of planning and hard work that enabled us to have this very successful annual meeting. Lastly, the Academy thanks Ellen Buckner for her able leadership of the Academy as its president during the past year.

18. Nominating Committee - Larry Boots - Oral report:

Several positions are open, including four trustees, Second Vice Chair, and the Coordinator of the Science Olympiad.

19. Mason Scholarship - Dr. Michael B. Moeller - Written report:

We had ten completed applications for the William H. Mason Fellowship this year. After considering all the application material, the committee has selected Cynthia Ann Phillips from the University of West Alabama for the \$1000 fellowship. Miss Phillips has been notified of this award.

The committee chairperson is very appreciative of the work by Dr. Mac Braid and Dr. Sandy Caudle for their work in reading and rating the applications.

D. Old Business - None

E. New Business - A motion was made to pay a small stipend (\$50) for Secretary duties each quarter for work on the Journal; it was carried and will be effective immediately.

F. The meeting was adjourned.

**JOINT AAS / AJAS
BUSINESS MEETING
AGENDA**

**Friday March 20, 1998
6:00 p.m. 119 Life Science Building
University of South Alabama**

1. Call to Order - Dr. Ellen Buckner
2. Counselor to AJAS - Dr. B. J. Bateman
3. Counselor of Science Fairs - Ms. Mary Thomaskutty
4. Coordinator of Science Olympiads - Dr. Steven D. Carey
5. Gorgas Scholarship Program - Dr. Glynn Wheeler
6. Secretary's report on membership - Dr. Priscilla Holland
7. Treasurer's report - Dr. Larry Krannich
8. Executive Director - Dr. Leven Hazlegrove
9. Place and Date of Meeting - Dr. Thomas Bilbo
10. Research Committee - Dr. Richard Hudiburg
11. Nominating Committee - Dr. Larry Boots
12. Mason Scholarship Committee - Dr. Michael B. Moeller
13. Resolutions - Dr. Gerald Regan

JOINT BANQUET

7p.m.

**Student Center
University of South Alabama**

Old Business

Acceptance of Gorgas Winners Selection Agreement

Revision of By-laws

STATE and REGIONAL
SCIENCE FAIR WINNERS
1998

A. North Region Director: Mr. George Williams Calhoun Community College

1. Jeremiah Brown School: Covenant Christian Academy, Huntsville
2. Ehrin Biglari School: Covenant Christian Academy, Huntsville
3. Jeb Orr School: Elkmont High School, Athens
4. Jason Davis School: Covenant Christian Academy, Huntsville

B. Central Region Director: Dr. James Martin U.A.B.

5. John Cannon School: Altamont School, Birmingham
6. John Mays School: Altamont School, Birmingham
7. David Murphy School: Shades Mountain Christian School, Birmingham
8. Jennifer Hooks School: Shades Mountain Christian School, Birmingham

C. West Region Director: Dr. Haynes University of Alabama

9. Holly Hitt School: Tuscaloosa County High School

D. Southwest Region Director: Dr. Gene Omasta Troy State University

10. Anna Elizabeth Scheiban
11. Melinda Sue Ellis

E. Southwest Region Director: Mrs. Gladys Swain Talladega College

12. Jonathan Day School:
13. Christina Meirs School: Fyffe High School

F. South Region Director: Dr. Jim Langdon University of South Alabama

14. Roopa Dhawan School: Murphy High School, Mobile
15. Pearl Flath School: Murphy High School, Mobile

State Science Fair Director: Dr. Grame Duthie

16. Elizabeth Dillard School: Bradshaw High School
17. Lindsey Farina School: Brooks High School
18. Monica Sekoh School: JCIB
19. Jamie Aldes School: Murphy High School
20. Taylor Griswald Student Observer Montgomery

INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. Larry R. Boots, Department of Obstetrics & Gynecology, University of Alabama, Birmingham, AL 35294. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology; Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics; Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the implies that it has not been published previously and that it not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

Submission: Submit an original and two copies to the editor. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. The editor may request that manuscripts be submitted on a diskette upon their revision or acceptance.

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Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must not exceed 15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in the text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

Tables: Place each table on a separate sheet. Place a table title directly above each table. Number tables consecutively. Use symbols or letters, not numerals, for table footnotes. Cite all tables in the text.

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COVER: Installation of groundwater monitoring wells on the UAB campus to facilitate a study of the surficial aquifer beneath Birmingham, September 1995.

(Photograph by Michael J. Neilson)

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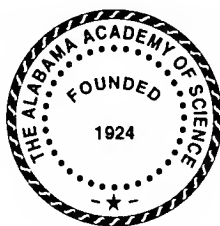
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A SIMPLE TEMPERATURE CONTROL APPARATUS FOR LIGHT MICROSCOPY

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ABSTRACT

A thermoelectric apparatus, suitable for temperature control of microscopical preparations during light microscopy, is described. The apparatus can quickly change and hold temperatures from near-freezing to 40°C. Advantages of the system are its small size, making it suitable for use with high-power oil-immersion objectives, the ease of manufacture, and its low cost. Addition of a feedback amplifier/circuit would allow close control of the temperature of the preparation; however, the apparatus as described is surprisingly stable even when used with both an oiled immersion objective and condenser.

Keywords: Peltier, thermistor detector, temperature regulation.

INTRODUCTION

Microscopists frequently find that they need to regulate temperature during the course of their experiments; this is especially true for cell biologists working with living cells. Excellent commercial equipment do exist to control the stage temperature of light microscopes, and regulation by such devices is tightly controlled; $\pm 0.1^\circ\text{C}$ is routinely reported. However, such equipment is often quite expensive. Furthermore, many do not provide the investigator with the certainty that his/her experiment is being performed at exactly the temperature reported by the readout of the thermoelectric control, since the temperature sensor is often at a distance from the actual site of observation, and the temperature varies considerably from the stage heater/cooler to the critical, observed portion of the slide. Since objective, stage and condenser can act as very effective temperature sinks, especially when the slide is fully oiled, the investigator must depend upon a long equilibration time for an accurate temperature readout. Here I describe a simple, small and easily constructed thermoelectric module that provides very accurate readout of the current temperature in the immediate vicinity of the experiment, just outside of the region of illumination and nearly in direct contact with the biological specimen. Although some drift can be expected from the design as described, one can easily modify the design to provide a negative-feedback power supply to regulate the local microscale temperature. A typical current/temperature curve is presented. The device described has been used to study the

Peltier Control Apparatus

kinetics of dynein/microtubule interactions using a gliding microtubule assay as described previously (Moss et al., 1992) (Fig. 1).

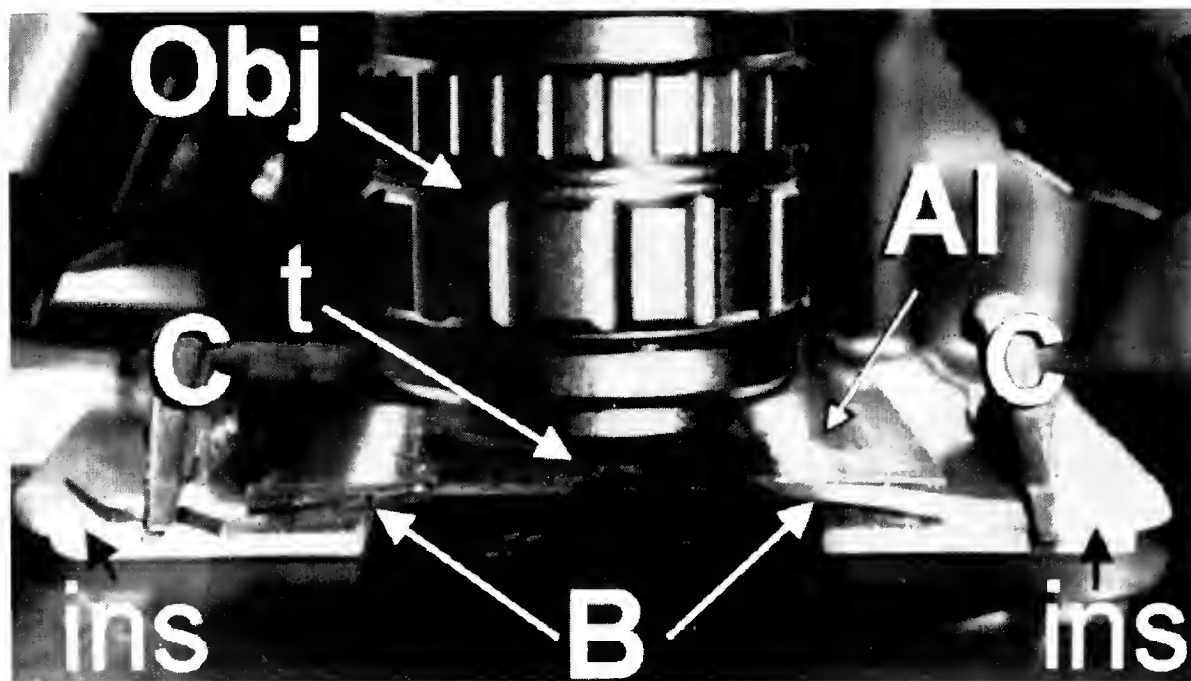


Figure 1. Overview of the thermistor-regulated Peltier-based heating and cooling device. Application is in an upright microscope (Olympus BHS). The flat surface is upward toward the objective, to allow the lenses to freely index in place. Several objectives have been for clarity. A high power objective (100X planapochromat) is fitted over the specimen. Code: t, thermistor location; AI, aluminum plate; ins, plastic insulator plate; C, clip; B, brass thermistor lead extensions.

MATERIALS, CONSTRUCTION AND CALIBRATION

Overall construction

The assembled system is shown in Figure 1. The design as described, including the Lambda power supply, cost less than \$500 but will of course vary with local machine-shop expenses and materials cost. The assembly can be separated into three distinct sections: a thermally-conductive aluminum slide block (Fig. 2), a plastic insulating block holder (Fig. 3), and a removable Sylgard™ film that contains the thermistor and provides a fluid space for the biological experiment (Fig. 4).

The metal slide insert

The thermally-conductive slide component is machined of aluminum, and should be

anodized to protect it from corrosion by the biological salt solutions. Alternatively, and from the viewpoint of toughness as well as corrosion-resistance, the slide can be machined from stainless steel. However, at the time our resident machinist found working stainless steel to such fine tolerances to be exceptionally difficult and a hard aluminum alloy has worked very well. It is very important to keep the open viewspace within the slide (a 3 mm wide slot at the end of the aluminum or stainless insert) as small as possible in order to maintain the best temperature control. The design describes a taper between the 3 mm thickness of the slide / heat sink body and the thin viewed region, but the original design merely had an abrupt step in thickness, and worked well. The taper would allow the operator to change objectives more easily so that they more smoothly fit into the viewing space (Fig. 2) in an inverted microscope. In the upright microscope it is not necessary since the flat upper surface provides no impediment to changing objectives.

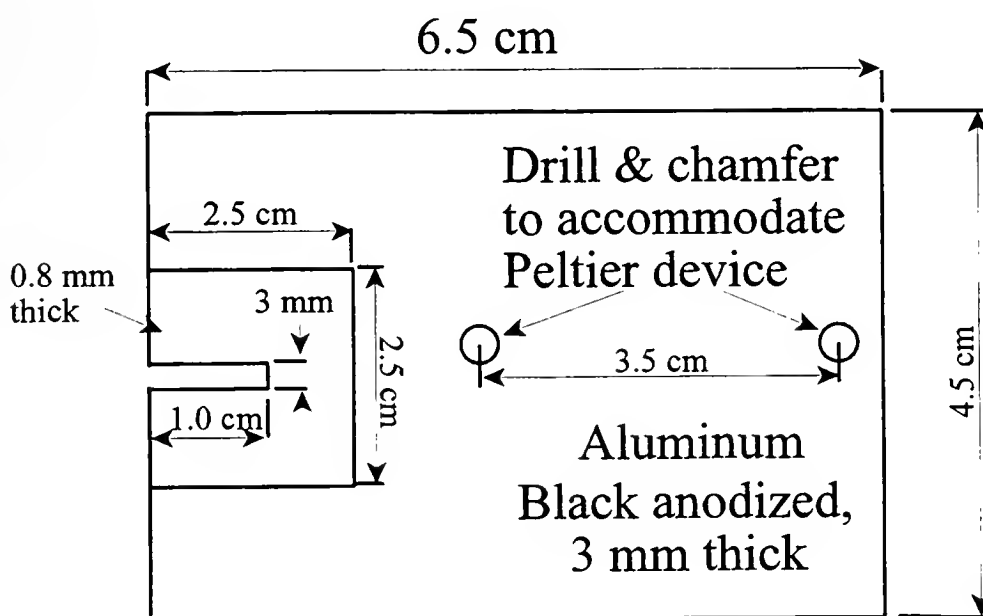


Figure 2. Thermally-conductive aluminum plate. Coverslipped region is in the 2.5 X 2.5 cm square to the left. Peltier device/water jacket (or cooling fins) must be attached to the plate by a nonconductive strap; in the author's example it was made from acrylic plastic. Dimensions are not critical and can be adjusted as needed for a particular application; dimensions provided are merely suggestions.

In the design of the optical and biological chamber it was important to try to maintain the normal optics and light-path length as close as possible, since the original work was performed at full n.a. under demanding high resolution conditions. The thin end of the thermally-conductive insert was therefore built so that #1 cover slips (22 mm square by approximately 0.1 mm thick) could be fitted to either side of the 0.8 mm-thick section, secured snugly with a tiny dab of vacuum grease, and filled with water to simulate a normal-thickness slide, thereby satisfying the optical needs of the objective lens. The region of

Peltier Control Apparatus

interest in our case could be very small since we were examining microtubule movement, and so a small coverslip chip was further attached to the concave surface of the aluminum slide, again with vacuum grease. The objective viewed the centermost region of the slot, with very little lateral (x-y) displacement possible.

The aluminum block was drilled and tapped to accommodate an acrylic strap that secured the Peltier device. Peltier devices transfer heat across their two flat surfaces dependent upon the polarity of the applied current; one side becomes cold while the other becomes warm. Therefore, although the Peltier device must be tightly attached, a heat-conducting strap cannot be used because heat is carried away to or from the slide in a small water jacket mounted to the reverse side of the Peltier thermoelectric module. A thermally-conductive strap would transfer heat back to, or away from, the aluminum plate, and would counter the effects of the thermoelectric module.

The Peltier unit (we used a Cambion model 806-1006-01 with an integral water jacket, Cambridge Thermionic Corp., Cambridge, MA) was mounted tightly to the surface, with heat-sink compound (GC Electronics, Southern Electronics, Opelika, AL) used to intimately connect the Peltier unit and the aluminum slide. Deionized water was used as the working fluid; the water line was a very flexible thin-walled vinyl tubing that ran from a nearby sink, through the water jacket, back to the sink. Water flowed at approximately 100 mL per minute through the system and did not affect the operation of the microscope. Undue vibration from water flow through the water jacket was not observed.

The Peltier thermoelectric module was powered by a stand-alone DC regulated low voltage, high current power supply, (model 300, Lambda Electronics, Westborough, MA); a Nobotron unit would also work very well. It could alternatively be powered by an automobile battery through a variable resistor (a "Variac") as are found in many laboratory settings, particularly for electrophysiological applications. The power supply must be able to deliver as much as 9 A at 12 V in order to provide full power to the thermoelectric module.

The insulating slide insert holder

The aluminum slide was mounted into a machined of polyethylene plastic insulating holder (Fig. 3). This isolated the aluminum slide from the stage and allowed the Peltier device to displace the slide temperature from the ambient temperature relatively easily. As a result, the operating temperature of the slide could vary over 0 - 40°C, with temperature changes of 10°C made in less than 2 minutes. Tolerances between the aluminum slide and the plastic insulating holder are not particularly tight, in order to allow expansion and contraction of the aluminum plate without deformation of the plastic assembly, although detectable drift in the aluminum holder must be held to a minimum.

Thermistor mount

The thermistor used in this application is an exceptionally tiny and delicate electronic element, and must be protected from damage by embedment in a uniform, tough medium. The black thermistor is encased in a clear glass 350 μm X 500 μm bead with 25 μm Pt-Ir leads. The paradox with the current arrangement is that although rather fragile, it must also

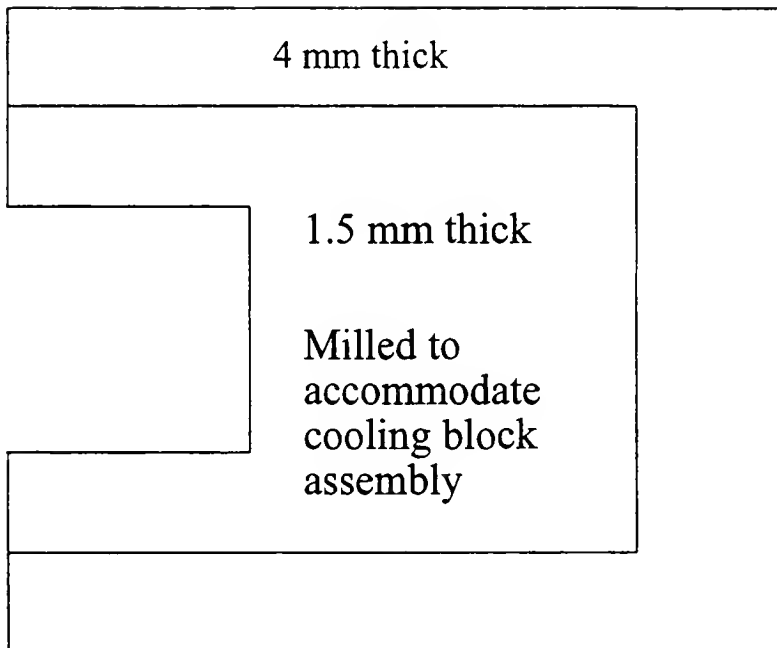


Figure 3. Polyethylene block milled to accommodate the aluminum block of Figure 2. The aluminum block drops into the central area. Dimensions are suggested and should be adjusted to fit the investigator's particular application.

be easily removed to allow cleaning of the chamber. Sylgard™, a flexible but tough, polymerizable silicone elastomer (Dow Corning, MI) normally used for a variety of electronic embedment applications, was used to protect the thermistor yet retain ease of removal and remounting. The extremely small, bipolar lead thermistor (Fenwal # GB4IL2; Fenwal Electronics, CT) was embedded in approximately a 400 μm - thick Sylgard™. The precise overall dimensions of the Sylgard™ film must allow the insertion of the thermistor into the observation chamber end of the aluminum slide near to, but outside of, the illumination path (the thermistor will absorb light strongly and thereby heat up artifactually if placed in the light path). Figure 4 depicts the thermistor/Sylgard™ film assembly.

Brass shimstock (0.001 inch) was used as a tough connecting conductor from the thermistor to the outer edge of the Sylgard™ film. The thermistor leads were carefully soldered in place on the brass, keeping the solder film very hot and thin, and allowing proper cooling characteristics to avoid a cold-soldered joint, while carrying out the process as quickly as possible. Since the thermistor conductors are a 0.001 inch diameter platinum-iridium alloy (and therefore not actually solderable), they were very carefully coiled prior to attachment

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around the shimstock material, and gently soldered in place. Solder assembly of the thermistor unit must involve great care by the technician since the thermistor is easily damaged by the high heat of the iron. Flat, polished heat sinks must be used between the iron and the thermistor bead to protect the fine wires and the thermistor unit.

A 2 mm-wide channel was cut in the Sylgard™ to allow space for the biological sample, and to allow exchange of fluid via perfusion. The Sylgard™ film/thermistor assembly was held in place with a thin film of silicone vacuum grease; the shimstock leads were clamped and stabilized by miniature flat-tip copper-coated spring clips (Radio Shack cat. no. 270-373) mounted to the plastic insulating holder with hot-melt glue. The leads from the clips made from fine, limp “pillow-speaker” wire to prevent shifting of the slide when mounted on the stage, and attached to a conventional digital VOM typically found in electronics shops (we used a common model from Radio Shack).

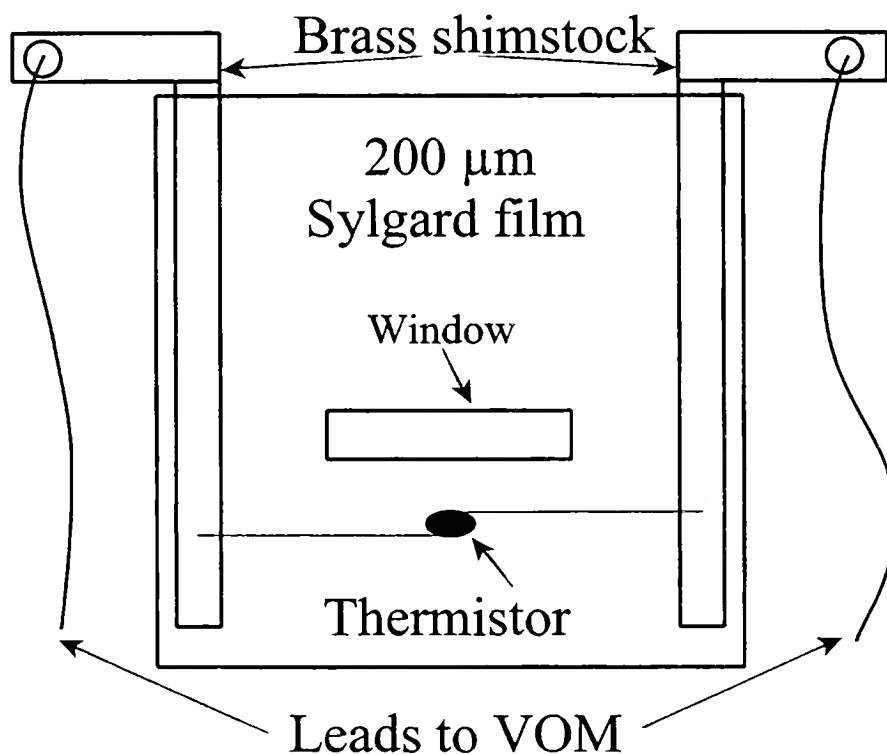


Figure 4. Sylgard™ film embedment of thermistor and brass shimstock assembly. The embedment film was made by building a structure out of plastic coverslips and carefully sealing them to make a flexible mold. Thickness was determined by stacking cover slips and then covering with a glass slide. The assembly was allowed to sit overnight at room temperature to stabilize, then heated for several hours at 60 degrees to assure complete polymerization of the Sylgard™ silicone polymer.

Calibration of the thermoelectric module

Calibration of the thermistor unit was carried out by laying the thermistor/Sylgard™ film assembly in an aluminum boat that floated in the reservoir of a recirculating water bath. Thermistors display an inverse relationship between temperature and resistance such that at low temperatures they have relatively high resistance, while at high temperatures they exhibit reduced resistance. The thermistor assembly described here was calibrated at 5 degree intervals over 0 - 40°C. The calibration curve for the described unit is shown in Figure 5.

Operation

Operation is very simple: The operator attaches coverslips around the thin (0.8 mm) portion of the aluminum assembly, and the aluminum plate is mounted into the plastic insulating holder. The Sylgard™ film is secured with silicone grease into the aluminum plate. The microclips are adjusted to hold the brass shimstock extensions are. A third coverslip is mounted in position over the window cut in the Sylgard™ film, allowing the groove to be exposed on either end if the investigator wishes to perfuse the assembly. The entire assembly is mounted onto the stage carrier. Water is applied to the open edge of the 0.8 mm thick region to simulate the full thickness if a glass microscope slide. The author has successfully followed multiple reactivation and microtubule gliding experiments over a range of 2 to 40°C using this apparatus.

The design given here fit nicely into a microtiter plate holder for the Zeiss IM 35. However, since the observation region is so small (in order to maintain good control over the chamber temperature) the assembly cannot be moved laterally very much. When used with a high-power objective it is possible that it may not be moved at all because of the objective girth. For some applications this is acceptable; for others of course it is not, and the applicability of the assembly is dependent on the limitations of each experiment.

The operator monitors thermistor resistance while adjusting the current output of the power supply. Thermistor resistance is inversely proportional to the temperature (see above; Fig. 5) and so the operator can easily and quickly determine the temperature. Although this might at first sound very cumbersome and time-consuming, with a little practice the device can be preset to different power outputs. The temperature can be quickly adjusted and stabilized to the desired temperature.

The Peltier/thermistor apparatus can be set up to drive negative-feedback circuitry to automatically regulate temperature, with a concomitant increase in complexity, time-to-completion, and cost. For many applications this is easy to do and desirable; many such control circuits are available through well-known sources (Horowitz and Hill, 1980). Inoue and Spring (1998) list several appropriate references in which various approaches have been presented. In particular, the circuitry of the designs of Chabala et al. (1985) and Datyner (1985) describe, in very great and clear detail, the construction of feedback circuitry designed to regulate temperature using a slightly different scheme, by using thermistor-regulated feedback. The talented investigator should be able easily modify such designs to his/her own needs with this simple apparatus as a basic design.

Peltier Control Apparatus

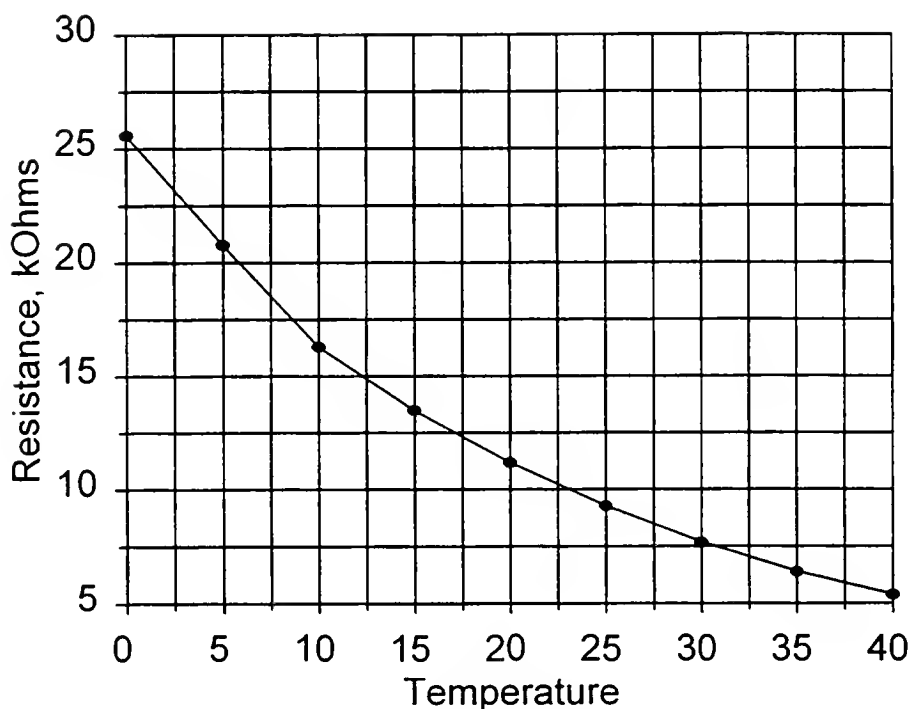


Figure 5. Thermistor response from 0 to 40°C. The operator merely glances at this relationship to determine temperature in the block assembly within a millimeter of the light path. Thermistor output could be redirected as indicated in Chabala et al. (1985) or Datyner et al. (1985) to provide automated temperature control.

DISCUSSION

Utility of the design -- considerations and cautions.

The design described here is intentionally simple, and can be easily fabricated by the investigator. There are many far more sophisticated designs reported in the instrumentation literature (see in particular the elegant design of Delbridge et al, 1990 in which the fluid is controlled with regard to level, flow rate, and temperature.) However, many investigators have limited resources (and time and money) and this design has worked very well in a particular application; the reactivation of motility in a gliding microtubule assay. Also, many designs involve the use of a considerable amount of a working fluid for heating or cooling (e.g. Inoue et al, 1975) and although they work very well, their complexity is likely to result in more leakage and potential difficulty to the investigator. I describe here a scheme to use water to draw off the heat (if the thermoelectric module is used for cooling); however, depending on the application, the user could choose to use a very efficient finned air heat-sink

such as is used on computer CPU chips; such fins are available at electronics supply houses such as Allied Electronics (Ft. Worth, TX). Such an approach would entirely eliminate potential vibration from water flow, and would also eliminate the danger of a water leak near expensive components; however the design described here never produced any significant difficulties.

Another approach, suitable for work under constant temperature, is an air-curtain assembly that heats the entire stage and optical path uniformly. Such a system provides the very best stability, and the very best image resolution, at temperatures that are distinctly different from ambient, and has been very effectively used for culturing cells directly on the microscope stage, and for following cells for an extended period of time (McKenna and Wang, 1989).

The design described here was originally made for an inverted microscope (Zeiss IM 35) but has been used quite effectively on an upright model (model BHS Olympus). Depending upon the resolution requirements of the experiment the operator has the option to oil or not oil the flat condenser surface of the apparatus and the chamber cover glass. Shifting between upright and inverted designs merely requires the relocation of the coverslipped assay space housing the specimen. Oiling of course greatly improves the resolution by increasing system n.a., but introduces a much greater heat sink problem, especially if the condenser is also oiled. Furthermore, it is obvious to this author that immersion oils vary in refractive index as the temperature changes; this was in turn manifested as changes in focus position and clarity as the temperature was lowered. If the investigator can avoid the use of oil, the temperature control will be much easier with this apparatus. If high numerical aperture is required, substitution of high n.a. water-immersion lenses, for the more usual oil-immersion objectives, would prevent development of oil/water emulsions that occur in cooled, oiled preparations.

Probably the most difficult aspect regarding day-to-day usage involves condensation of water around the cold objective barrel. Damage to the objective can be alleviated somewhat by sheathing the lens barrel with Parafilm™ or a similar wrap but sufficient insulation to prevent significant condensation requires several layers of tightly-fitting latex glove fingers with a hole cut in the finger tip; this can be difficult and they must be routinely replaced, and the opportunity for damage via repeated handlings, the possibility of dropping the lens, etc, make this a less-than- optimal approach.

Long-term exposure of the objective and condenser to fluctuations in temperature can result in loosening of the lens elements, with the unpleasant result that very expensive equipment can be rendered permanently damaged by such experiments. Furthermore, strain-free objectives such as are used for differential interference and polarization microscopy that are exposed to temperature fluctuations are likely to develop strain as a function of thermal fluctuations (see Inoué and Spring, 1998 for an in-depth discussion of these dangers) so that their crossed-polars extinction will be greatly attenuated. The investigator needs to balance such effects against the potential payoff of the temperature-control experiment.

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LITERATURE CITED

- Chabala, L. D., R. E. Sheridan, D. C. Hodge, J. N. Power, and M. P. Walsh 1985. A microscope stage temperature controller for the study of whole-cell or single-channel currents. *Pflüger's Arch.* 404:374-377.
- Datyner, N. B., G. A. Gintant, and I. S. Cohen, 1985. Versatile temperature-controlled tissue bath for studies of isolated cells using an inverted microscope. *Pflüger's Arch.* 403:318-323.
- Inoué, S., J. Fuseler, E. D. Salman, and G. W. Ellis, 1975. Functional organization of mitotic microtubules. *Physical chemistry of the *in vivo* equilibrium system.* *Biophys. J.* 15:725-744.
- Inoue, S. and K. R. Spring, 1998. *Video Microscopy. The Fundamentals*, 2nd ed. Plenum Publishing Corporation, New York, NY. 741 pp.
- Horowitz, P. and W. Hill, 1980. *The Art of Electronics.* Cambridge University Press, New York, NY. 716 pp.
- McKenna, N. M., and Y-L. Wang, 1989. Culturing cells on the microscope stage. *Meth. Cell Biol.* 29: 195-205.
- Moss, A. G., J-L. Gatti, and G. B. Witman, 1992. The motile β /IC1 subunit of sea urchin sperm outer arm dynein does not form a tight rigor bond. *J. Cell Biol.* 118(5):1177-1188.

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THE EFFECT OF DISASTERS ON WORLD POPULATION

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ABSTRACT

The purpose of this paper is to investigate the dampening effect that major disasters have had on world population. We consider only disasters which have caused a significant number of deaths and use an exponential model to predict how many people would now inhabit the earth if disasters had not brought an early end to so many millions of lives.

INTRODUCTION

Throughout the ages, planet Earth and, in particular, its most celebrated inhabitants, namely we humans, have been ravaged by disease, famine, wars, epidemics (even pandemics) and many other disasters. However, even with all of the catastrophes that mankind has endured, none has been sufficient to eliminate humans from the planet as with dinosaurs. So the human population continues to soar. Today there are about five and a half billion people on Earth, so many in fact, that one of the major problems now facing mankind is mankind himself, that is, over-population. Indeed, our own success as a species may be our next, as well as our greatest, disaster. With not enough food for the hungry and not enough homes for the homeless, even without a disaster, life may soon be grim for the planet's entire population.

The disasters that have plagued humanity throughout the centuries have been as varied as they have been destructive. They come as floods, droughts, earthquakes, famine, hurricanes, tornadoes, disease (especially disease) and as man-made disasters such as wars and massacres. The spreadsheet table in *Table 1* shows the total death toll of each significant disaster over the past two millennia. Disasters have come as erupting volcanoes that slay only a few thousand and as deadly diseases that wipe out millions. In the past two thousand years no continent on the Earth has been spared from their ravages and wanton destructiveness. In the years spanning 500 A.D. to about 620 A.D., a terrible plague swept through Europe, Asia and Africa. The plague finally subsided after more than a century but not before sending 100 million people to an early grave. Unfortunately this would not be the last time that disease would devastate the globe. In 1347, the Black Death devastated Europe and Asia killing about one-third of the world's population with what can only be described as a horrible and excruciating death preceded by exquisite torture as boils sometimes hardened and then

refused to break, leaving their host demented. Fortunately, death, at this point, was fairly quick. Although these are only two examples, Earth has seen this serial and mass murderer many times. Fortunately, with modern medicine it is unlikely that this disease will ever terrorize mankind again. However, today new strains of bacteria are becoming immune to the cures we have come to trust. A recent report in *Science News*, June 7, 1997, tells of a mutated bacterium that resisted vancomycin, the last "surefire drug" against it after it had already "acquired resistance to every other antibiotic." Though disease has been the worst of the disasters, none are unimportant. Droughts and floods also kill great numbers of people and are frequently accompanied by another disaster -- famine, with the result being an even greater death toll. For example, in 1896 and 1899, a total of 6,250,000 people were reportedly killed by droughts. This in turn caused crop failures and ultimately resulted in famine for the same years. The famine alone killed 6,200,000 people. With today's early warning systems provided by advanced communication systems, volcanoes, earthquakes and hurricanes cause little loss in terms of numbers. But, that has not always been the case. In 1737, two separate hurricanes took a total of 600,000 lives. Apparently not until this millennium have single wars and massacres caused such great destruction. The greatest massacre occurred in 1402 resulting in the deaths of 20,000,000. This was associated with the slave trade as one African tribe would capture and then sell members of other tribes into slavery. The death toll for World War I and World War II combined was almost 30 million people.

PROJECT LIMITATIONS

While all of these catastrophes have taken their share of lives and even though any loss of life is regrettable, for this project some criteria had to be set up for what constitutes a significant disaster. Obviously, for the purposes of this project, 35,000 deaths 20 centuries ago might well be even more significant than a million deaths this century. Thus, we had to make a decision as to what constituted a significant number of deaths for the various time periods. Finally, it was decided that 1,000,000 would be a reasonable number for the 20th century and then it seemed only natural to use any disaster regardless of size if its non-occurrence would have contributed 1,000,000 to the world population by 1997. This criteria reduced the number of disasters we had accumulated from several hundred to 84, all of which are given in the appendix.

COMPUTATIONS

After the data was reduced, the world population growth rates for the various time periods from 1 A.D. were needed. Most growth rates for early centuries were, of course,

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estimates and were found in Mudd's The Population Crisis and the Use of World Resources. Those rates are:

<u>Years</u>	<u>Population (billions)</u>	<u>Population Growth Rate</u>
1 - 1650	.170 - .545	1.0007 (0.07%)
1650 - 1750	.545 - .720	1.003 (0.3%)
1750 - 1850	.720 - 1.2	1.005 (0.5%)
1850 - 1950	1.2 - 2.5	1.008 (0.8%)
1950 - 1997	2.5 - 5.5	1.017 (1.7%)

All of these growth rates, except for the first one, were given in Mudd. The first one had to be determined mathematically. This was done as follows:

With an assumed world population of 170,000,000 in 1 A.D. and 545,000,000 in 1650, the following model was used for the population at time t:

$$\text{pop}(t) = ab^t$$

Now we determine a and b:

$$\text{pop}(t=0) = 170 = ab^0 = a$$

$$\text{pop}(t=1650) = 545 = ab^{1650}$$

Substituting for a in the second equation, we obtained a value of 1.0007 for b. That is, for the first sixteen and a half centuries A.D., the growth rate was a mere seven hundredths of one percent – barely enough to maintain population level. That compares poorly with today's generally accepted growth rate of 1.7 percent (some estimates are higher).

The same formula was used to determine the unknown growth rate as was used to determine the number of people who would be alive today if their assumed ancestors had not been killed by these disasters. This, of course, includes all of their likely descendants since the time of the disaster and so separate calculations had to be made for each time period. These calculations were made on an electronic spreadsheet using the following formula (which is the same as the one above except for the variables):

$$FP = IP(1 + GR)^t$$

where:

FP represents the Future population

IP represents the Initial population

GR represents the annual Growth Rate and

t represents time (which is the final year of the time period minus the initial year for that time period)

The initial year represented the year the disaster took place or the beginning year in case the disaster lasted for an extended time period. The growth rates are the average annual increase percentages experienced by the population during a time period. The initial population was the number of people that lost their lives during the disaster (or, in subsequent

calculations, the number of descendants resulting from a computation for an earlier time period). During a drought in 968, for example, 600,000 people died. Calculations, using the growth rate of .07% for the remainder of that first time period, yield 966,965 (see appendix). This means that almost a million people would have been alive in 1650 had it not been for that drought in 968. Likewise, in 1750 with its growth rate of .3%, this number would have increased to 1,304,681. By the year 1997, this number would have swollen to 10,525,637. The 1896 famine mentioned earlier served to eliminate over 16,000,000 from today's world population.

Table 1 gives the totals for the various categories of disasters, along with a grand total for all categories.

Table 1. Major disaster totals by category

	Deaths	1→1650	→1750	→1850	→1950	→1997
Hurricane Total:	900,000		623,826	1,027,234	2,798,761	6,180,883
Earthquake Total:	2,240,000	1,992,617	3,592,324	5,915,367	13,123,054	28,981,422
Famine Total:	41,488,000	517,441	830,285	7,678,635	68,874,158	157,081,430
War Total:	47,796,000	245,395	331,099	545,211	77,341,931	170,804,692
Drought Total:	51,250,000	1,104,072	1,489,672	10,795,537	79,656,719	198,001,112
Flood Total:	51,310,000	1,258,252	1,697,700	2,795,549	112,023,405	247,396,503
Massacre Total:	31,700,000	23,790,148	32,098,922	52,856,283	127,222,024	285,235,942
Plague Total:	254,000,000	305,197,499	413,515,268	682,377,826	1,611,915,545	3,559,812,068
TOTAL:	480,684,000	334,105,424	454,179,097	763,991,642	2,092,955,597	4,653,494,053

The following figure shows the number of actual deaths caused by the various disasters (except for hurricanes) used in this report, i.e., for those which would have generated at least a million additional people by 1997.

Over the centuries that mankind has existed on Earth, it has continually triumphed over adversity and consistently improved its lot. In the early centuries mankind was abused by nature, but as the species gained intelligence and even certain power over the elements, it began to gain control over the fury of its ever-present adversary. We have indeed discovered a cure for the bubonic plague, which, as already mentioned, historically has been the one thing most responsible for controlling world population by killing more than all other disasters combined. Additionally, we have developed buffers against the destructiveness of nature's other tantrums - floods, earthquakes, droughts and hurricanes. This power is a great source of pride for us humans, but everything comes with a price. As this power over our

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destiny was achieved, mankind flourished throughout the planet and began to disregard nature. The resources which nature so freely provides have been ravished by mankind as much as nature once ravished man. Indeed, rain forests are disappearing throughout the

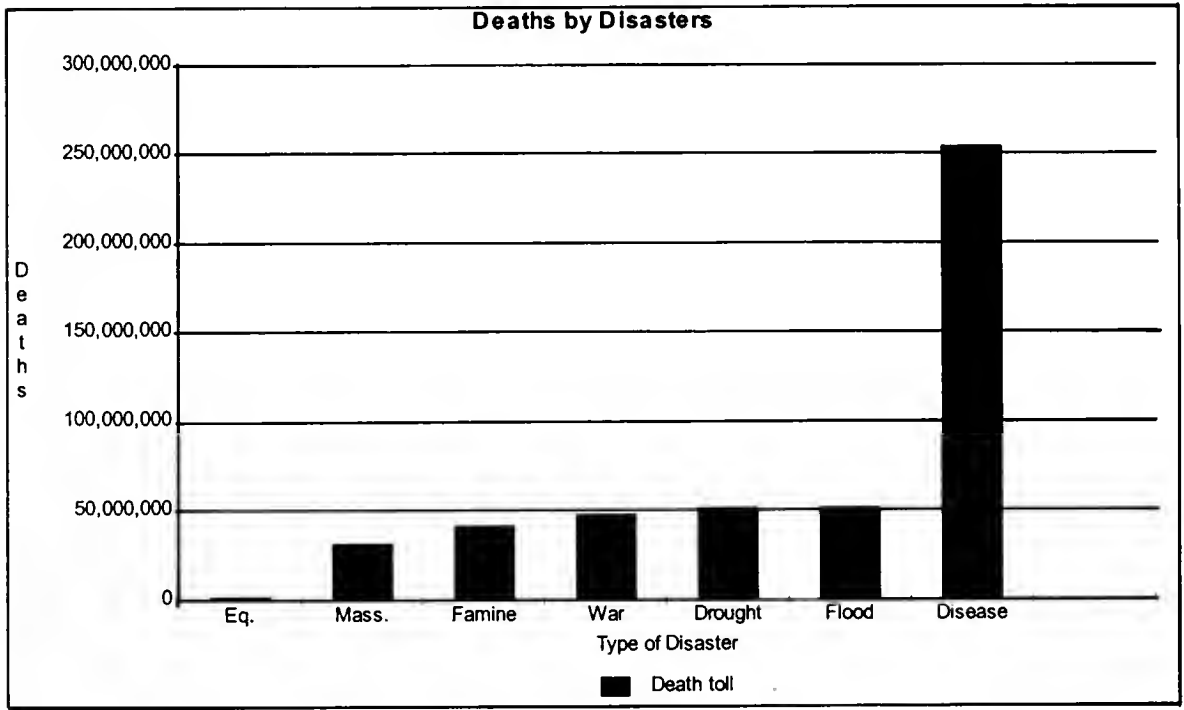


Figure 1. Number of Actual Deaths by Disasters

world and hundreds of animal species are being wiped out on an annual basis as world global temperature continues on an escalating upward march.

In the end, a lot of factors have devastated mankind, but the population of the world continues to grow. And, as it does, problems continue to torment us. These problems include more homelessness and ever-present famine for various parts of the world. It seems clear that there will not be enough food, nor enough resources to compensate for the population explosion if it continues unabated for much longer. According to Cohen, the Earth is estimated to be capable of supporting around 79 billion people (some estimates are higher, but we must all agree that there is definitely an upper limit). We are now at five and a half billion, but at the current growth of 1.7% that number is expected to double in about 41 years and then double again 41 years later. To see this, consider the following where 11 represents a doubling of the present population in billions:

$$\text{Pop}(t=1997) = 5.5(1.017)^n = 11$$

Taking logs of both sides yields:

$$n \log(1.017) = \log(2)$$

or

$$n = \frac{\log(2)}{\log(1.017)}$$

Simplifying this produces a value of 41 for n. This means, as stated, that the world population now doubles in only 41 years. This compares poorly with previous time periods as seen below:

<u>Time period</u>	<u>Growth rate</u>	<u>Years required to double</u>
1-1650	.07%	991
1650-1750	.3%	231
1750-1850	.5%	139
1850-1950	.8%	87
1959-1997	1.7%	41

With current life expectancy, many of us will, no doubt, see the world population quadruple within our own life times. This can be easily verified already by comparing the world population, given by Cohen, of 2.5 billion in 1950 with that of 5.3 billion in 1990, just 40 years later. The actual increase, slightly more than double, occurred in only 40 years.

At this rate we will reach the 79 billion mark in about 158 years. This is determined in the following manner:

$$\text{pop}(t) = 79 = 5.5 (1.017)^n$$

$$79/5.5 = (1.017)^n$$

$$n = \frac{\log(79/5.5)}{\log(1.017)} = 158 \text{ years}$$

The resulting population increase will further tax our scarce resources and cause even more troubles in the years to come. Many ideas have been considered, but have yet to solve the problem. One idea consists of population control. The idea is to reduce the number of births that occur in the world and ultimately reduce the population through contraception. As with any plan, it also has flaws as some religions do not look favorably toward contraceptive devices.

Another idea is the expansion of exploration of extraterrestrial resources. For example, by setting up extraterrestrial colonies we could house some of the world population. The lack of funds and technology needed for such an endeavor puts a damper on that idea for now. However, if the earth were at capacity and the growth rate were still 1.7%, this would mean an annual increase of

$$(0.017)(79,000,000,000)$$

or

$$1,343,000,000$$

persons each year. On a daily basis, this would mean an increase of 3.6 million people.

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That is, if we wait until the planet is at capacity, the number of people that would have to be transported off the planet to some other celestial orb each day in order not to overload earth would be 3.6 million. This would be a tremendous drain on not just energy resources but all of the planet's resources, especially since this would have to continue every day forever, or at least until the growth rate started to decline. This idea, therefore, has its drawbacks and will likely long remain in the realm of science fiction.

With a growth rate of .07%, the world population took almost a millennium to double. However, human population growth over the last millennium shows a rate of steady increase each century (with the exception of the 14th when the Black Death was pandemic). All of this is cause for alarm since certain natural resources, some of which are non-renewable, are being depleted at a likewise increasing rate each year.

Think of population growth in this way: suppose humans are cells and they divide once a day and the Earth is a jar in which the cells are kept. The jar can sustain life for only 79,000,000,000 cells. It would take less than 27 days, less than one month, for the cells to fill the jar. How long would it then take to fill a second jar? Just one more day! That is exponential growth! And that is the way populations increase under ideal conditions.

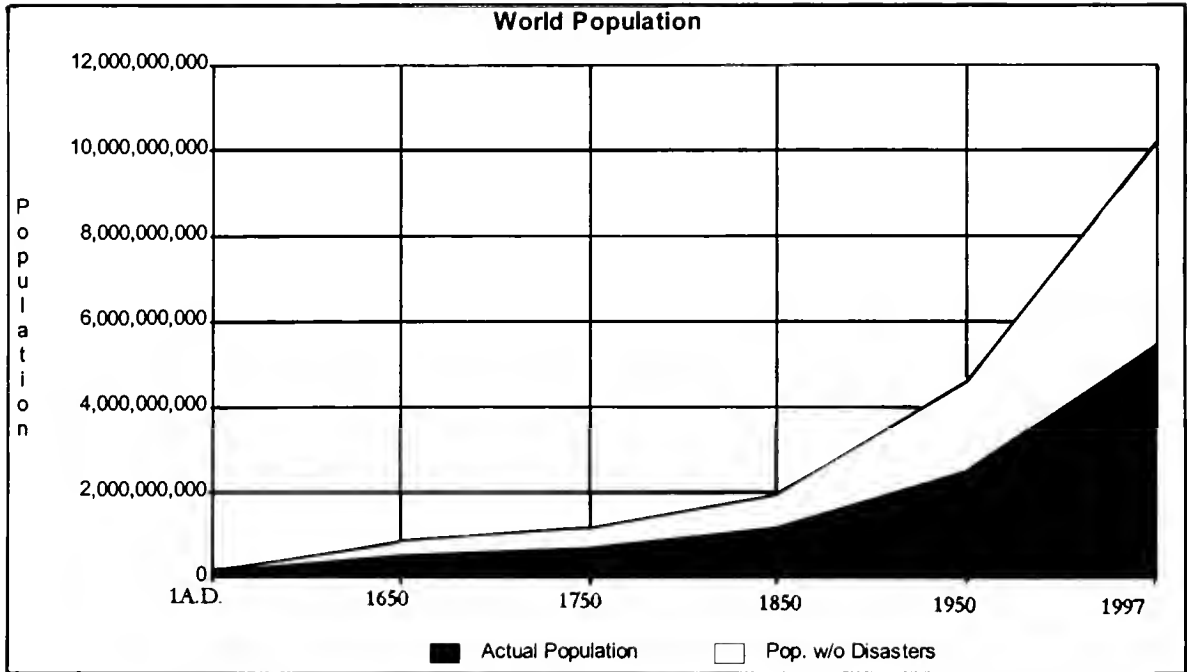
CONCLUSIONS

Now assume for the moment that the earth's population was just one couple 25 centuries ago and that the population doubled every century. Then, in only two more centuries this planet would be at its maximum capacity. Theoretically, one more century after that (without some new disaster) there would be enough people to populate a second planet the same size as earth to its maximum capacity. Another century would then see the need for a third and a fourth new planet. Of course, as pointed out already, world population now doubles every 41 years (or less) instead of every hundred years. This means that in just 41 years after reaching capacity, whenever that finally is, we will need an entirely new planet the size of our present one (the moon would be much too small) to hold the population increase. Forty-one years after that we will need two more new planets.

Without the 4.65 billion lives lost to the present population as a result of various disasters, the world population would currently be beyond 10 billion (see Figure 2). This means, among other things, that the maximum capacity of 79 billion would be reached in only 120 years from now instead of the 158 years based on a present population of 5.5 billion.

One might ask if it is likely that we will ever find a solution to this ever staggering dilemma. The answer to that question may have already presented itself. Several recent reports concerning the environment highlight the damage done to it by man. But even more troubling are numerous reports that this damage is now affecting man in an unexpected manner -- sterility. From Time Magazine, March 18, 1996, we read that sperm counts for men all over the world have dropped as much as 50% in the past half-century. At this rate and with new bacteria resistant to all antibiotics, there may never be any need for those spaceships to other worlds as man is forced to face his greatest foe -- himself.

Figure 2. World Population



LITERATURE CITED

Cohen, J., 1995. *How Many People Can the Earth Support*. New York, Norton and Company.

Cornell, J., 1982. *The Great International Disaster Book*. New York, Charles Scribner's Sons.

Flexner, S. and Flexner, D., 1992. *The Pessimist's Guide to History*. New York, Avon Books.

Hauser, P., ed., 1963. *The Population Dilemma*. Englewood Cliffs, Prentice Hall.

Mudd, S., ed., 1966. *The Population Crisis and the Use of World Resources*. Bloomington, Indiana University Press.

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Appendix

Table 2 shows disaster type, year, original number of deaths and then, for the various time periods, the number which would have lived had the original number not died in the disaster:

Type	Year	Deaths	1→1650	→1750	→1850	→1950	→1997
Drought	968	600,000	966,965	1,304,681	2,148,376	4,766,105	10,525,637
Drought	1199	100,000	137,107	184,992	304,620	675,790	1,492,438
Drought	1769	5,000,000			7,488,951	16,614,000	36,690,954
Drought	1837	800,000			853,589	1,893,660	4,182,027
Drought	1866	1,500,000				2,929,382	6,469,351
Drought	1876	5,000,000				9,016,737	19,912,884
Drought	1876	13,000,000				23,443,515	51,773,499
Drought	1892	1,000,000				1,587,490	3,505,869
Drought	1896	5,000,000				7,688,449	16,979,446
Drought	1899	1,250,000				1,876,710	4,144,593
Drought	1928	3,000,000				3,574,810	7,894,738
Drought	1936	5,000,000				5,590,073	12,345,317
Drought	1950	10,000,000					22,084,358
Drought	Total:	51,250,000	1,104,072	1,489,672	10,795,537	79,656,719	198,001,112
Earthquake	365	50,000	122,880	165,796	273,011	605,667	1,337,577
Earthquake	526	250,000	548,938	740,656	1,219,615	2,705,678	5,975,316
Earthquake	893	180,000	305,721	412,494	679,241	1,506,875	3,327,838
Earthquake	1290	100,000	128,648	173,579	285,827	634,098	1,400,365
Earthquake	1556	830,000	886,430	1,196,019	1,969,446	4,369,154	9,648,996
Earthquake	1693	93,000		110,315	181,653	402,991	889,980
Earthquake	1703	200,000		230,236	379,123	841,072	1,857,454
Earthquake	1730	137,000		145,459	239,522	531,372	1,173,501
Earthquake	1731	100,000		105,857	174,311	386,703	854,008
Earthquake	1737	300,000		311,913	513,617	1,139,443	2,516,388
Earthquake	Total:	2,240,000	1,992,617	3,592,324	5,915,367	13,123,054	28,981,422
Famine	1601	500,000	517,441	698,159	1,149,637	2,550,432	5,632,466
Famine	1657	100,000		132,126	217,567	482,665	1,065,936
Famine	1769	3,000,000			4,493,371	9,968,400	22,014,572
Famine	1770	188,000			280,184	621,579	1,372,716
Famine	1845	1,500,000			1,537,877	3,411,731	7,534,589
Famine	1866	1,500,000				2,929,382	6,469,351
Famine	1876	5,000,000				9,016,737	19,912,884
Famine	1876	11,000,000				19,836,820	43,808,345
Famine	1896	5,000,000				7,688,449	16,979,446
Famine	1899	1,200,000				1,801,642	3,978,810
Famine	1921	2,000,000				2,519,912	5,565,065
Famine	1928	3,000,000				3,574,810	7,894,738
Famine	1932	2,500,000				2,885,557	6,372,566
Famine	1943	1,500,000				1,586,043	3,502,674
Famine	1967	1,500,000					2,487,252
Famine	1984	2,000,000					2,490,017
Famine	Total:	41,488,000	517,441	830,285	7,678,635	68,874,158	157,081,430

Garza and Hill

Flood	1099	100,000	147,044	198,400	326,699	724,772	1,600,613
Flood	1228	100,000	134,352	181,275	298,501	662,214	1,462,457
Flood	1277	100,000	129,824	175,165	288,439	639,893	1,413,162
Flood	1530	400,000	435,039	586,977	966,557	2,144,276	4,735,496
Flood	1642	300,000	301,684	407,048	670,273	1,486,980	3,283,900
Flood	1646	110,000	110,308	148,834	245,080	543,702	1,200,731
Flood	1851	45,000,000				99,038,760	218,720,747
Flood	1887	1,500,000				2,478,020	5,472,548
Flood	1931	3,700,000				4,304,789	9,506,850
Flood	Total:	51,310,000	1,258,252	1,697,700	2,795,549	112,023,405	247,396,503
Hurricane	1737	300,000		311,913	513,617	1,139,443	2,516,388
Hurricane	1737	300,000		311,913	513,617	1,139,443	2,516,388
Hurricane	1881	300,000				519,874	1,148,108
Hurricane	Total:	900,000		623,826	1,027,234	2,798,761	6,180,883
Massacre	1402	20,000,000	23,790,148	32,098,922	52,856,283	117,259,984	258,961,152
Massacre	1933	8,700,000				9,962,040	22,000,527
Massacre	1976	3,000,000					4,274,263
Massacre	Total:	31,700,000	23,790,148	32,098,922	52,856,283	127,222,024	285,235,942
Disease	125	1,000,000	2,907,014	3,922,297	6,458,723	14,328,471	31,643,510
Disease	542	300,000	651,392	878,892	1,447,244	3,210,664	7,090,546
Disease	620	100,000,000	205,597,002	277,402,315	456,789,651	1,013,373,322	2,237,969,968
Disease	746	200,000	376,492	507,982	836,479	1,855,701	4,098,197
Disease	1097	100,000	147,250	198,678	327,157	725,787	1,602,854
Disease	1347	75,000,000	92,713,483	125,093,919	205,988,216	456,978,310	1,009,207,279
Disease	1528	200,000	217,824	293,900	483,955	1,073,639	2,371,064
Disease	1530	1,000,000	1,087,597	1,467,443	2,416,392	5,360,690	11,838,739
Disease	1545	250,000	269,060	363,030	597,790	1,326,179	2,928,781
Disease	1600	500,000	517,804	698,648	1,150,441	2,552,218	5,636,409
Disease	1611	200,000	205,533	277,316	456,648	1,013,059	2,237,276
Disease	1630	500,000	507,047	684,134	1,126,542	2,499,198	5,519,319
Disease	1656	400,000		530,088	872,879	1,936,454	4,276,533
Disease	1664	100,000		129,384	213,052	472,650	1,043,817
Disease	1672	400,000		505,281	832,030	1,845,832	4,076,401
Disease	1711	500,000		561,961	925,364	2,052,890	4,533,677
Disease	1792	800,000			1,068,370	2,370,144	5,234,312
Disease	1799	300,000			386,893	858,309	1,895,520
Disease	1851	250,000				550,215	1,215,115
Disease	1876	3,000,000				5,410,042	11,947,731
Disease	1898	12,000,000				18,160,547	40,106,402
Disease	1914	3,000,000				3,996,690	8,826,432
Disease	1917	3,000,000				3,902,283	8,617,943
Disease	1917	50,000,000				65,038,058	143,632,378
Disease	1947	1,000,000				1,024,193	2,261,863
Disease	Total:	254,000,000	305,197,499	413,515,268	682,377,826	1,611,915,545	3,559,812,068
War	1175	176,000	245,395	331,099	545,211	1,209,533	2,671,176
War	1850	20,000,000				44,369,364	97,986,895
War	1860	620,000				1,270,105	2,804,945
War	1919	10,000,000				12,801,961	28,272,309
War	1945	17,000,000				17,690,967	39,069,366
War	Total:	47,796,000	245,395	331,099	545,211	77,341,931	170,804,692

SEASONAL VARIATIONS IN WATER TABLE ELEVATIONS IN THE SURFICIAL AQUIFER, BIRMINGHAM VALLEY

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ABSTRACT

Three wells drilled into the surficial aquifer on the UAB campus were monitored from October 1, 1995 to September 30, 1996. Average depth to the water table was from 3.0 feet to 14.3 feet, and the yearly range in each well was up to $\pm 40\%$ of the mean depth. Wells take between 4 to 5 days to completely respond to a major rain event. Ignoring the effect of Hurricane Opal in early October 1995, depth to the water table showed a clear seasonal trend: in all three wells, the water table was depressed during the late spring through early fall and was at its highest during February and March. Monthly potential evapotranspiration explained between 17% and 50% of the variation in minimum monthly depth to the water table.

INTRODUCTION

Major urban regions such as Birmingham-Bessemer often suffer incidents of groundwater pollution from industrial, commercial, and public sources. As many contamination events, such as leaking storage tanks and spills, are confined to the soil, an understanding of the hydrogeology of this surficial material, including the depth to the water table, is important. Although seasonal fluctuations in the water table are well documented (Fetter, 1994), no data are presently available to indicate the magnitude of the fluctuation in the surficial material underlying Birmingham. Existing groundwater studies of the region (Moffett and Moser, 1978; Planert and Pritchett, 1989) are based on combined data from deep bedrock wells, springs, and sinkholes and do not address this issue. This paper presents the first study of the variations in water table level over one year in the surficial aquifer, based on records from three wells, located on the campus of the University of Alabama at Birmingham.

GEOLOGIC AND HYDROGEOLOGIC SETTING

The city of Birmingham is located on the northwestern edge of the southern Appalachian Valley and Ridge Province. The city is underlain by Paleozoic sedimentary rocks that have been folded and thrust faulted (Thomas and Bearce, 1986). The UAB campus

Variations in Water Table

is located on the southeast side of the Birmingham valley (sec. 36, T.17S., R.3W. and sec. 1, T.18S., R.3W., Birmingham North and Birmingham South 7.5' quadrangles: Figure 1) on carbonate rocks of Cambrian age that generally dip gently to the southeast. The campus is mainly on cherty dolomite of the Copper Ridge Formation, which has been subjected to groundwater solution and is cavernous. Sinkholes have developed adjacent to the campus, and campus building foundation excavations have encountered caverns. Red Mountain, on the southeast side of the UAB campus, is a cuesta composed of Ordovician-Mississippian limestone, shale, sandstone and chert that dip gently southeastward.

Groundwater flow in the surficial soil of the Birmingham valley in Jefferson County has a general southwesterly flow (Bearce and others, 1994), but unpublished data from the campus indicates a flow to the northwest, generally following the contour of the land. Planert and Pritchett (1989) show flow in the deeper confined aquifers from Center Point in northeast Birmingham southwest to the vicinity of the UAB campus and I-65, where flow direction becomes westerly, parallel to Village Creek through Boyles Gap in Sand Mountain.

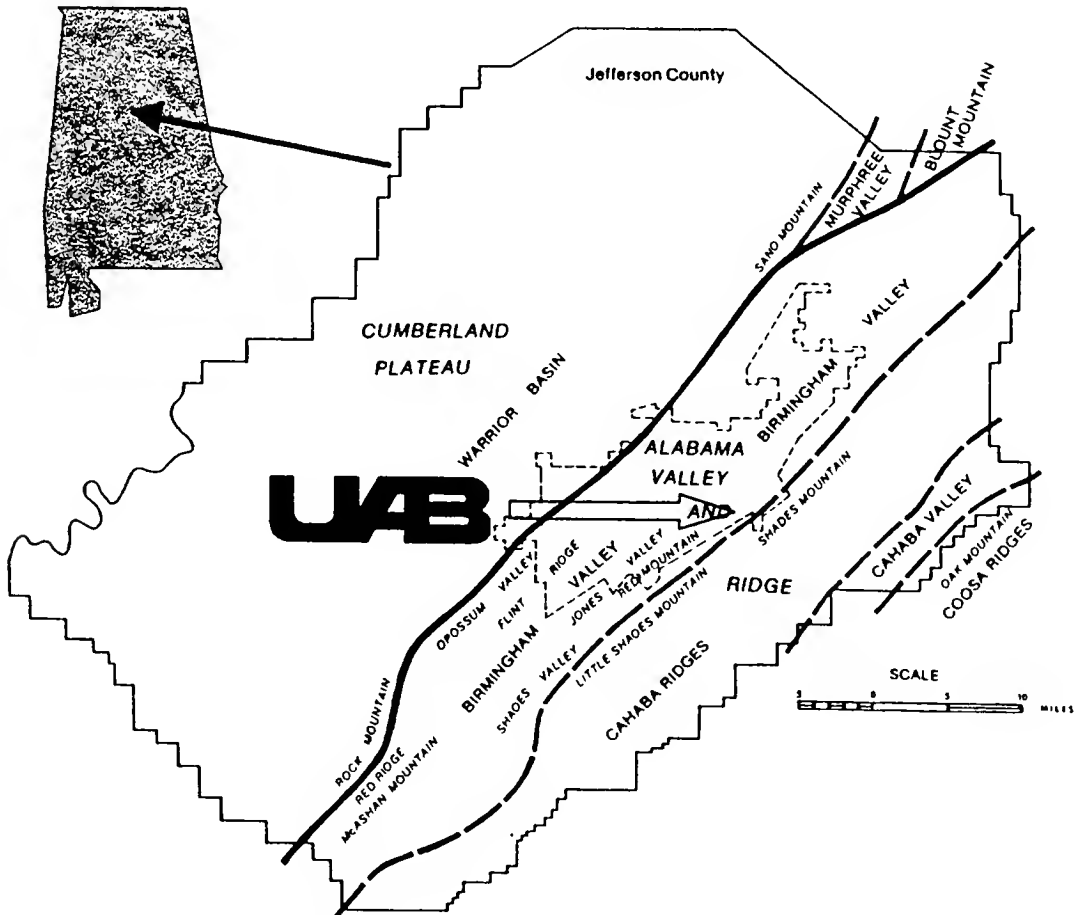


Figure 1. Location of the UAB Campus in Jefferson County, Alabama.

Base map and physiographic boundaries from Kidd and Shannon, 1977.

MONITORING WELLS

Three monitoring wells were developed during September 1995. Wells 4 and 5 were completed as two-inch diameter polyurethane wells, and Well 1 as a six-inch diameter well. All wells had interrupted slot screens ranging in length from 5 to 10 feet, depending on borehole depth. All wells were provided with a three-inch sand pack ($C_u = 5.4$, $D_{10} = 0.007$ inch) that extends at least one foot above screen tops. A bentonite seal at least one foot thick was installed above the sand pack, extending to about 18 inches below ground surface. The casing top is within a few inches of ground surface and was surveyed and used as datum for water level measurements. Each well has a sump about 8 inches deep that surrounds each casing and is lined with a metal jacket, topped with a cast iron lid, and floored with concrete.

Water level depths were measured during the period October 1, 1995 to September 30, 1996 with a battery-powered depth meter. The same depth meter was used to record water levels periodically during slug tests. In October, levels were measured each day; however, in subsequent months, measurements were made less frequently, but always within one day of significant precipitation.

THE SURFICIAL AQUIFER

The surficial aquifer is a mixture of residual and colluvial soil and the debris of urban development. Classified as urban land soil by the U.S. Soil Conservation Service (Spivey, 1982), the soil contains asphalt and concrete pavement, lumber, sand, gravel, and slag in the upper few feet. Beneath the urban-modified zone, the soil is composed mainly of red, cherty, silty, and locally sandy clay. A zone with an apparent thickness ranging from 0.1 to 0.7 foot of fine grained dolomite rhomb sand, and/or fine grained quartz sand, and/or chert fragments occurs at the soil-bedrock interface. This weathered sandy zone overlying the bedrock has been observed to be up to two feet thick elsewhere in the carbonate valley (Steven C. Bearce, Southern Company Services geologist, personal communication). Soil varies in thickness from 5 to 25 feet over the UAB campus, with thickness increasing markedly on the northwestern slope of Red Mountain.

Hydraulic conductivity of the surficial aquifer, determined from slug tests analyzed by the Bouwer and Rice method, ranges from 5.29×10^{-6} feet per minute in Well 4 to 8.45×10^{-5} feet per minute in Well 1. The material responsible for this conductivity is uncertain: the dominant soil material is clay, but scattered seams of quartz sand and chert fragments are present, as well as the sandy interval at the soil-bedrock interface. It is possible that this fine sandy zone is the primary flow pathway to the monitoring wells and that the slug test conductivities reflect mainly this thin zone. The overlying clays may have conductivities of more than an order of magnitude lower. If this is the case, a reasonable model for flow of groundwater in the UAB campus soil might consist of three layers: 1) an upper unconfined (where unpaved) sandy anthropogenic soil of high conductivity containing perched ground water supplies, 2) a middle confining clay layer of very low conductivity, and 3) a basal confined sandy layer of moderately low conductivity receiving flow from and discharging to underlying bedrock through fissures.

Variations in Water Table

WATER TABLE VARIATIONS

Table 1 lists the locations of the wells and other pertinent data. Depth to bedrock varied between 7.5 and 24 feet, with the greatest thickness of overburden occurring in Well 5, which is located at the lowest elevation. Mean depth to the water table ranged from 3.0 feet in the shallowest well (Well 4) to 14.4 feet in the deepest well (Well 5). The range of depths to water table varied from 2.0 feet in Well 4 to 7.1 feet in Well 1. These variations, which are up to $\pm 40\%$ of the mean depth, are typical of seasonal variations seen in shallow aquifers (Mew and others, 1997).

Table 1. Depth to Water Table (feet), UAB Wells October 1, 1995 – September 30, 1996.

	Location	Elevation (ft)	Well Depth (ft)	N	Mean Depth To Water Table (ft)	s	Minimum Depth to Water Table(ft)	Maximum Depth to Water Table (ft)
Well 1	1117 14 th St. S	645	17.3	82	9.6	1.56	5.7	12.8
Well 4	901 14 th St. S	615	7.5	81	3.0	0.51	2.2	4.2
Well 5	500 12 th St. S	601	24.0	80	14.3	1.43	11.0	17.8

Figure 2 shows the depth to water table for each well plotted against time. Wells 1 and 5 show remarkably similar trends, including the notable spikes in water table elevations in early October 1995 and in February and August 1996. Variation in Well 4 is somewhat subdued compared with Wells 1 and 5; however, when depths to the water table in all three are plotted as percentage variation from their mean values, Well 4 has as large a variation and a trend similar to the other wells. All three wells display a definite seasonality, with the lowest water table levels occurring in the summer months and consistently high water tables in January and February. All three wells also show unusually high water table levels in October, the result of Hurricane Opal (Figure 2).

Lag Time

The data for early October can be used to estimate the lag time between a major precipitation event and its expression as a rise in the water table. As a result of the remnants of Hurricane Opal, October 3-5, 1995 saw 10.1 inches of rainfall in the Birmingham region, with 6.94 inches falling at the Birmingham Municipal Airport in one 24-hour period. (All temperature and precipitation data used in this paper were collected at the NWS station at the Birmingham Municipal Airport, 4 miles northeast of the UAB campus.) Prior to the October 3 deluge, 0.6 inch of rain fell on September 22; no rain occurred after the deluge until October 14. Thus, the rainfall event was preceded by a ten-day dry spell and was followed by a nine-day dry spell. Figure 3 shows a plot of water table variation in Wells 1 and 5 and precipitation for early October. As can be seen, the water table in each well responded within hours of precipitation beginning, but took several days before peaking. Fifty percent of the

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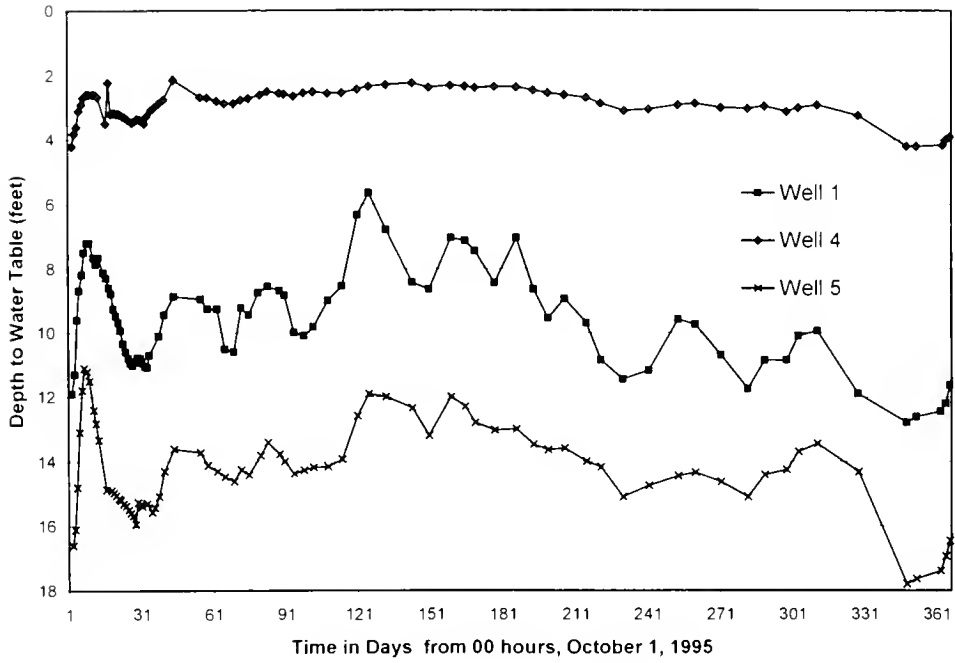


Figure 2. Depth of water table in Wells 1, 4, 5, UAB Campus.
Data collected October 1, 1995 to September 30, 1996.

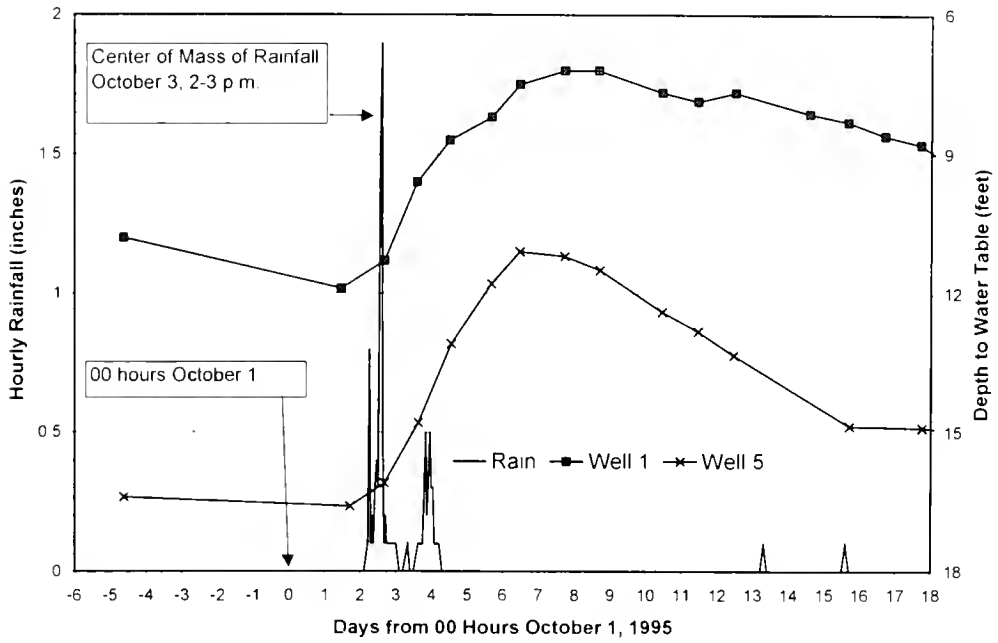


Figure 3. Response of Wells 1 and 5 to Hurricane Opal.

Variations in Water Table

rainfall from this event had fallen by 3 p.m., October 3, and the event finished by 6 a.m., October 5. Well 5 reached its highest recorded level on October 7 at 1 p.m., and Well 1 reached its highest recorded level on October 9 at 4 p.m. Both then began to decline. (Interestingly the small rainfall events on October 14 and 16 apparently had no influence on water table elevations.) Thus, the wells took between four and five days to completely respond to the event.

Seasonal Response

Figure 4 shows both the minimum and maximum monthly depths to the water table in each well. Discounting the effect of Hurricane Hugo (the average rainfall in October is 2.81 inches, compared with the 11.9 inches that fell in October 1995), a clear seasonality of the data is apparent, with the water table being shallowest during winter. Depth to the water table is greatest in the fall, particularly the month of September.

Figure 4 also shows monthly precipitation for the twelve-month period. As can be seen, the greatest precipitation occurred in October. Although the highest water tables were recorded in two wells in October, variations in precipitation alone do not explain water table changes. Linear regression analysis shows that variation in total monthly precipitation only explains between 0% and 10% of the variation in minimum monthly depth to the water table and 0% of the variation in the maximum monthly depth to the water table.

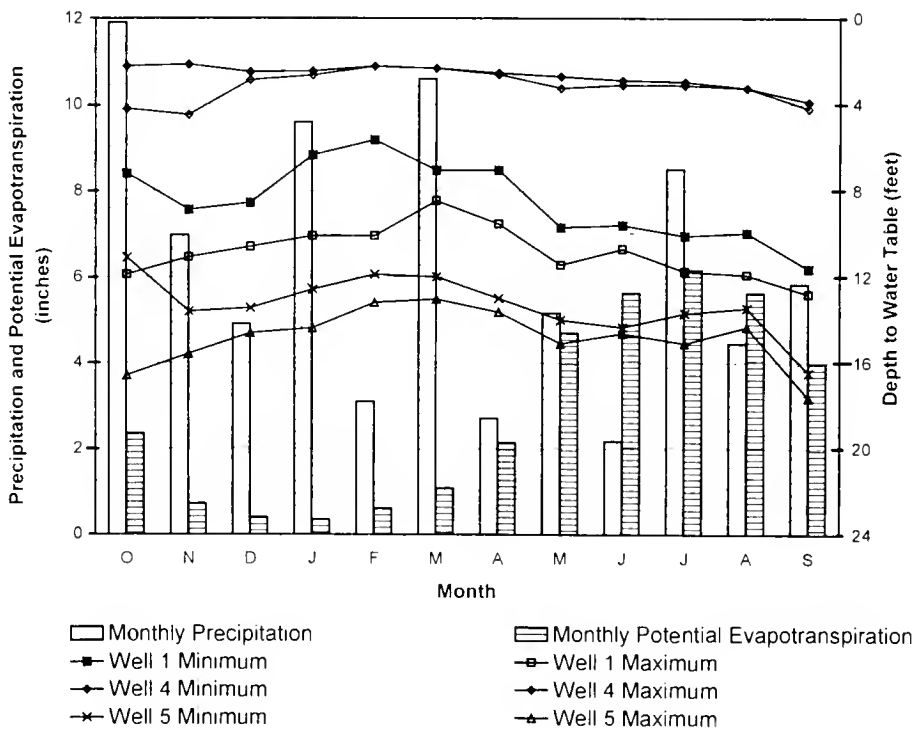


Figure 4. Minimum and maximum monthly depths to the water table in Wells 1, 4, and 5 UAB Campus, October 1995 to September 1996.

In addition, Figure 4 shows monthly potential evapotranspiration, calculated by Thornthwaite's method (Dunne and Leopold, 1978). This method considers average monthly temperature as a measure of energy available, adjusted for latitude, but does not include soil type or vegetation cover as variables. As can be seen, depth to the water table is roughly inversely proportional to potential evapotranspiration. Linear regression analysis shows that variation in total monthly evapotranspiration explains 40 to 50% of the variation in minimum monthly depth to the water table in Wells 4 and 1, but only 17% of the variation in Well 5. Linear regression of maximum monthly water table depths against potential evapotranspiration shows that the variable can explain 26% of the variability in Well 1, but 0% of the variability in Wells 4 and 5. Well 1 is situated in a well-vegetated area of the campus and is at the foot of the thickly wooded slope of Red Mountain. Wells 4 and 5 are situated in parking lots on campus with few trees and little grass in the vicinity. The relative success of potential evapotranspiration as a predictor of both maximum and minimum monthly water table levels in Well 1 suggests that phreatophytic vegetation may be tapping the surficial aquifer in that area and having a controlling influence on levels (Meyboom, 1967).

CONCLUSIONS

These data demonstrate that the water table in the surficial aquifer beneath Birmingham displays a definite seasonality, with depths to the water table varying throughout the year by up to 40% of the mean value. Discounting the dramatic effect of Hurricane Opal, the water table is at its lowest in the summer and early fall and at its highest in winter. The data also clearly indicate the danger of using a single reading or the average of two to three days readings from a monitoring well to estimate depth to the water table. Measurements made during summer months clearly underestimate highest yearly elevation, and those made within one to two days of a significant rainfall event probably do not record the full impact of that event. Regulations governing the timing of monitoring well water level measurements lack constraints based on precipitation events and seasonal water level fluctuations. During contamination site assessment, the primary goal is to establish flow direction. Commonly only a single reading per well is required. If an extensive cleanup is undertaken, the most stringent requirement, as a general rule, is a quarterly reading per well. These facts should be considered when compiling data from various sources, such as ADEM contamination site reports, when preparing potentiometric surface contour maps or when relying on such maps for flow direction determination.

REFERENCES

- Bearce, D.N., Neilson, M.J., and Carter, S.A. (1994). Preliminary water table map of surficial aquifer, Birmingham-Bessemer, Alabama from ADEM environmental assessment database. Geological Society of America Abstracts with Programs 26, 4, 3.
- Dunne, T. and Leopold, L.B. (1978). *Water in Environmental Planning*. San Francisco: W.H. Freeman and Company, 818 p.

Variations in Water Table

- Fetter, C.W. (1994). Applied Hydrology. Upper Slade River: Prentice-Hall, Inc., 691 p.
- Kidd, J.T. and Shannon, S.W. (1977). Preliminary areal geologic maps of the Valley and Ridge Province, Jefferson County, Alabama. University, AL: Geological Survey of Alabama Atlas Series 10, 1-41.
- Mew, H.E., Medina, M.A., Heath, R.C., Reckhow, K.H., and Jacobs, T.L. (1997). Cost-effective monitoring strategies to estimate mean water table depth. *Ground Water* 35, 1089-1096.
- Meyboom, P. (1967). Groundwater studies in the Assiniboine River drainage basin Part II: Hydrologic characteristics of phreatophytic vegetation in South-Central Saskatchewan. Geological Survey of Canada Bulletin 139, 1-69.
- Moffett, T.B. and Moser, P.H. (1978). Ground-water resources of the Birmingham and Cahaba valleys, Jefferson County, Alabama. Geological Survey of Alabama Circular 103, 1-78.
- Planert, M. and Pritchett, J.L. (1989). Geohydrology and susceptibility of major aquifers to surface contamination in Alabama; Area 4. U. S. Geological Survey Water Resources Investigations Report 88-4133, 1-31.
- Spivey, L.D., Jr. (1982). Soil Survey of Jefferson County, Alabama. Washington, D.C.: U.S. Department of Agriculture, Soil Conservation Service, 140 p.
- Thomas, W.A. and Bearce D.N. (1986). Birmingham anticlinorium in the Appalachian fold-thrust belt. In Southeastern Section Geological Society of America Centennial Field Guide 6. T.L. Neathery, ed., 191-200.

ATMOSPHERIC OZONE CONCENTRATIONS AND FOOTBALL ATTENDANCE

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ABSTRACT

Atmospheric ozone (O₃) concentrations were monitored every 0.5 hour at Auburn University for four years (1988, 1989, 1990, 1994) as part of a project studying the effects of ozone and acid-rain on southern pines. As an auxiliary project, a study was undertaken to determine if there was a relationship between meteorological factors, intermittent vehicular traffic, and atmospheric ozone concentration. Using linear regression techniques, an R² of 0.52 was attained using both meteorological variables and Auburn University football game attendance as independent variables. Ozone concentrations averaged 38.28 ± 12.58 parts per billion (ppb) (\pm standard deviation (s.d.)) during game weekends and 33.58 ± 12.87 ppb on non-game weekends during football season over four years. Daytime solar radiation, maximum daily temperature and ozone concentration from the previous day were significant predictors of ambient ozone. Ozone concentration was also significantly related ($p = 0.09$) to attendance at Jordan-Hare Stadium, Auburn University, AL (@ 1.5 km).

INTRODUCTION

Atmospheric ozone has been well documented in large urban areas, particularly those with topography-limited air movement, such as the Los Angeles, California basin (Edinger, 1973; Pitts et al., 1973) and the Denver, Colorado metropolitan area (Altshuller, 1975). Ozone pollution is produced by photochemical reactions in conjunction with various forms of internal combustion processes (Demerjian et al., 1974; Demerjian, 1990). Thus, tropospheric O₃ is frequently associated with automobile traffic (Cleveland and McRae, 1978). What is lacking in ozone studies is a quantifiable anthropogenic input, which varies substantially from one period to another. A study was undertaken to determine if there was a relationship between meteorological factors, intermittent vehicular traffic, and atmospheric ozone concentration. The ozone-monitoring data in this study are unique, having been collected on the outskirts of a moderate-sized town (Auburn-Opelika area approximate

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population = 60,000) which undergoes approximate population doubling on game weekends during the college football season (September-December). In addition, there are no local mountain ranges to limit dispersal of pollutants.

METHODS

Ozone Monitoring

The ozone data were collected for a study examining the effects of ozone and acidic precipitation on loblolly pine (*Pinus taeda* L.) growth (Chappelka et al., 1989). The monitoring site was approximately 1.5 km south of the football stadium. U.S. Highway 29 is 0.7-km southeast of the site and U.S. Interstate Highway 85 is 3 km south (Figure 1). The

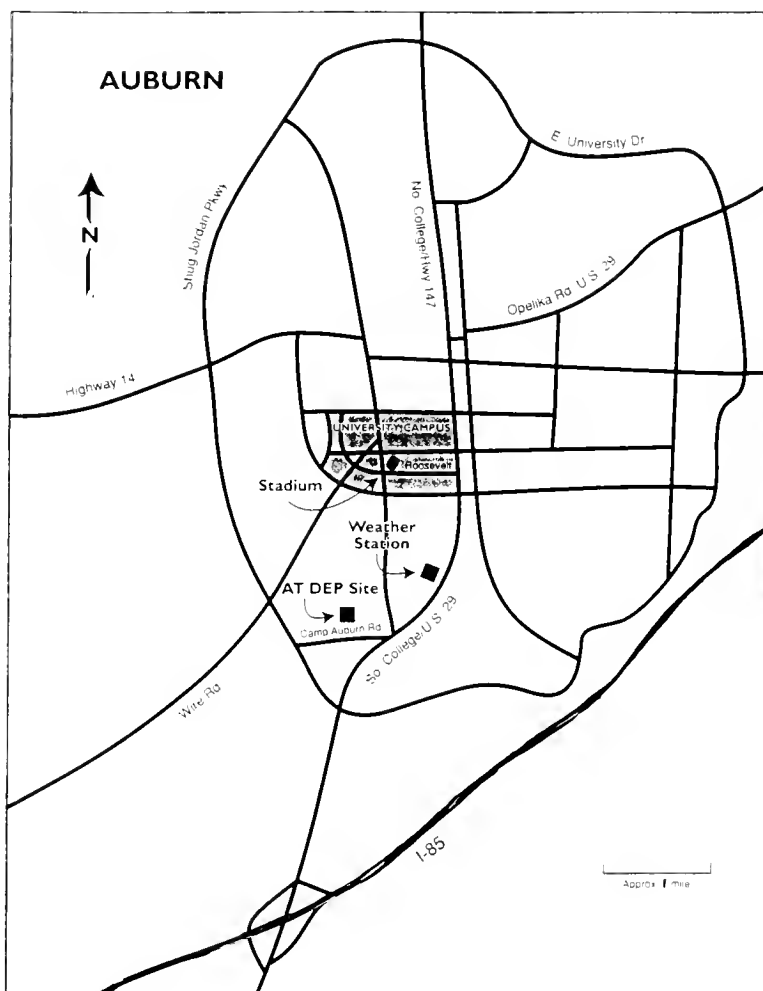


Figure 1. Map of Auburn, AL showing the location of Jordan-Hare stadium, weather station, and the AT DEP site.

site is on the Auburn University campus in a rural setting. Other than vehicular traffic, no other local sources that could generate detectable amounts of O₃ are known to us.

Ozone was monitored every 30 minutes (Thermo Environmental Instruments, Hopkinton, MA) at a 1-m height above ground. Twelve-hour (0900-2100) mean ambient ozone concentrations (ppb) were computed for the months of September through December (football season) for the years 1988, 1989, 1990 and 1994. The monitor was calibrated and audited each year of the study.

Meteorological Data

Meteorological data were obtained from the Auburn, Alabama station of the National Oceanic and Atmospheric Administration (NOAA) (NOAA 1989, 1990, 1991). A NOAA monitoring site is located approximately 1 km east of the ozone-monitoring site. Variables obtained from the NOAA station were 24-hour precipitation, maximum daily temperature, and incident solar radiation (24-hour period). Wind speed and wind direction was available but more than 50% of the wind direction observations were recorded as "variable." Since a direction was not available, the decision was made not to include wind in modeling efforts.

Football traffic

In addition to the meteorological variables, the reported paid attendance at Jordan-Hare stadium was obtained for each of the four seasons. The stadium is located approximately 1.5 km north of the monitoring site and has a theoretical paid attendance capacity of 85,214. Exact automobile traffic was not possible to monitor, so attendance data from the Auburn University Athletic Department were used as a surrogate for traffic volume. No effort was made to calculate the ratio of attendance to automobiles, but it is clearly a strongly positive correlation. On a game day, the number of automobiles far exceeds the approximately 10,000 parking spaces available on the Auburn University campus. Additionally, no estimates of non-football traffic activity were included in the model. It was assumed that these activities would be approximately the same as on non-game days when attendance was zero and would remain roughly constant throughout the observation period.

Statistical Model

Mean 12-hour ozone concentration was used as the dependent variable in a linear regression model (SAS Institute, Cary, NC). The meteorological variables, along with game attendance and mean 12-hour ozone concentration from the previous day were treated as independent variables. Solar radiation was entered as both a linear and quadratic term.

The attendance data were not normally distributed, as football games were only scheduled on some weekends: all other days had paid attendance of zero. Game days represented 29 of the 484 days used in the analysis. The robustness of the F-test to non-normal distributions of independent variables was considered sufficient to apply ANOVA techniques. Day of week (weekday/weekend classification) was entered into the model in an attempt to account for local variations in traffic due to work or recreational activities independent of the football schedule.

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RESULTS

The parameter estimates and F-ratios for the variables in the model are presented in Table 1. The regression model indicated that ambient ozone levels are highly significantly related to incident solar radiation from the current day ($p=0.0025$ quadratic term), maximum daily temperature ($p = 0.0337$) and ozone concentrations from the previous day ($p < 0.0001$). Attendance at the football games was significantly related to the ambient ozone ($p = 0.0945$, Figure 2), with game days exhibiting 14% higher concentrations of O_3 than non-game days (38.28 ± 12.58 ppb and 33.58 ± 12.87 ppb, respectively). No relationship was found between day-of-week with average weekend and weekday O_3 levels of 33.60 ± 11.97 ppb and 33.97 ± 13.26 ppb, respectively (Figure 2); precipitation; or solar radiation (linear term) and the ambient concentration of O_3 .

Table 1. Regression results of mean daily ozone concentrations (ppb) against solar radiation ($W\ hr\ m^{-2}$), maximum daily temperature ($^{\circ}C$), precipitation (cm), previous day O_3 concentration, weekday/weekend classification, and football game attendance at Jordan-Hare Stadium, Auburn University, AL.

Variable	Parameter Estimate	F-value (475 df)	p > F
Intercept	13.40	0.001	
Attendance	3.95E-5	2.81	0.0945
Solar radiation	-0.0018	2.40	0.1216
(Solar radiation) ²	5.0E-7	9.26	0.0025
Weekday/weekend	-0.8183	0.71	0.4005
Maximum temperature	0.1554	4.54	0.0337
Precipitation	-0.5787	1.21	0.2710
Prior O_3 concentration	0.5025	96.45	0.0001

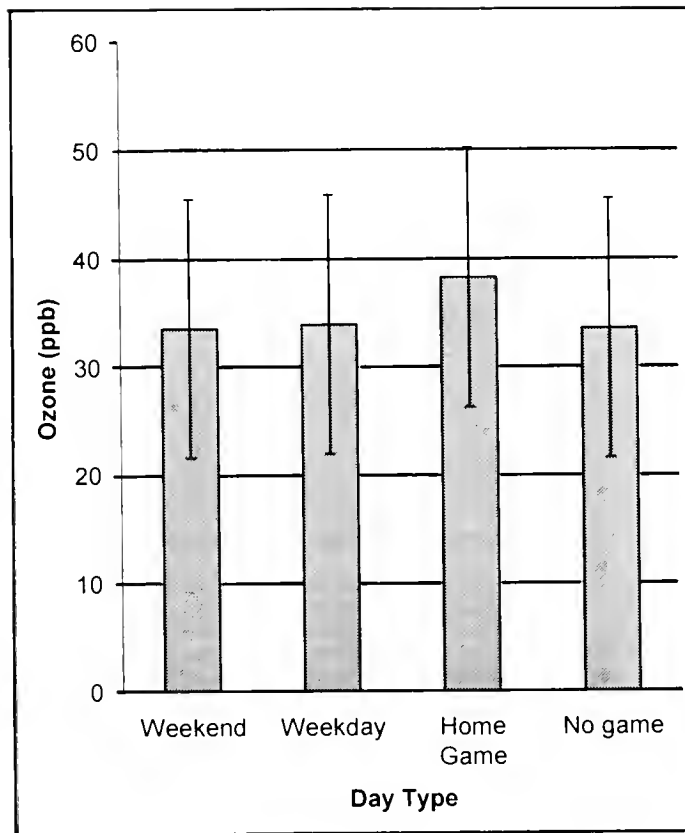


Figure 2. Ozone concentrations (ppb) for weekday/weekend and home game/no home game classification.

DISCUSSION

Football-related traffic is linked to concentrations of atmospheric ozone. This correlation may represent the first time that regional pollution has been related to a single sporting activity. The weekend/weekday analysis indicates that traffic variations during a week are insufficient to increase ozone concentrations to levels significantly greater than background concentrations. The football/ozone phenomena is observed during a portion of the year when O_3 concentrations are not near an annual maximum and the levels observed were not in excess of the EPA standards (McKee, 1990).

In this study, the pollution source is best described as a non-point source, caused by increased traffic density converging on the area. The traffic relationship to ozone concentration is probably limited to the immediate region due to the dispersal of ozone at greater distances from the sources (roads and stadium parking lots) and the sporadic nature of the source. Further studies addressing the actual number of vehicle-miles or vehicle-hours

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driven in the area on game day might make it possible to quantify the effect of the average car on the air quality of the region. Related internal combustion pollutants such as carbon monoxide, nitrogen oxides, and particulate contamination were not addressed in this study. The significance of the ozone observation from the previous day may be related to persistent meteorological conditions and/or availability of precursors in the atmosphere. The ambient ozone measured on any given day is most likely not a reflection of the same ozone molecules that were present on the previous day, as nocturnal ozone concentrations typically are reduced to levels well below those observed during the day.

ACKNOWLEDGEMENTS

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LITERATURE CITED

- Altshuller, A.P. 1975. Evaluation of oxidant results at CAMP sites in the United States. *J. Air Poll. Control Assoc.* 25:19-24.
- Chappelka, A.H., Lockaby, B.G., Meldahl, R.S. and Kush, J.S. 1989. Atmospheric deposition effects on loblolly pine: development of an intensive field research site. In *Proceedings of the Fifth Biennial Southern Silvicultural Research Conference*, Memphis, TN, 1988 November 1-3 (edited by Miller J.H.), pp.57-60. U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station Gen. Tech. Rep. SO-74.
- Cleveland, W.S. and McRae, J.E. 1978. Weekday-weekend ozone concentrations in the Northeast United States. In *Air Quality Meteorology and Atmospheric Ozone*, Boulder, CO, 1977 July 31-August 6 (edited by: Morris, A.L. and Barras, R.C.), pp.407-420. ASTM STP 653.
- Demerjian, K.L. 1990. Factors affecting the formation of ozone. In *Ozone Risk Communication and Management* (edited by Calabrese, E.J., Gilbert, C.E. and Beck, B.D.) pp.1-21. Lewis Pub., Chelsea, MI.
- Demerjian, K.L., Kerr, J.A. and Calvert, J.G. 1974. The mechanisms of photochemical smog formation. *Adv. Environ. Sci. Technol.* 4:1-262.
- Edinger, J.G. 1973. Vertical distribution of photochemical smog in Los Angeles basin. *Environ. Sci. Technol.* 7:247-252.

- McKee, D.J. 1990. Factors affecting the formation of ozone. In *Ozone Risk Communication and Management* (edited by Calabrese, E.J., Gilbert, C.E. and Beck, B.D.) pp.163-191. Lewis Pub. Chelsea, MI.
- National Oceanic and Atmospheric Administration. 1989. 1988 Weather Data. *Auburn University (AL) Agr. Exp. Sta. Agricultural Weather Series*, No. 28, 148pp.
- National Oceanic and Atmospheric Administration. 1990. 1989 Weather Data. *Auburn University (AL) Agr. Exp. Sta. Agricultural Weather Series*, No. 29, 149pp.
- National Oceanic and Atmospheric Administration. 1991. 1990 Weather Data. *Auburn University (AL) Agr. Exp. Sta. Agricultural Weather Series*, No. 30, 149pp.
- Pitts, J.N., Jr., Lloyd, A.C. and Sprung, J.L. 1973. Chemical reactions in urban atmosphere and their application to air pollution control strategies. In *International Symposium on Environment Measurements*, Geneva, Switzerland, 1973, 2-4 October, 35pp.

THE VASCULAR FLORA OF PIKE COUNTY LAKE, ALABAMA

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ABSTRACT

Pike County Lake is located four miles south of Troy, Alabama, off County Road 39, 1.9 miles from the junction with Highway 87. The lake property consists of 500 acres of land and 45 acres of lake water. Six major habitats, including marshes, lowland and dry upland forests, and shorelines, were systematically collected from June of 1995 through May of 1997. The 274 species and varieties, representing 198 genera and 86 families, found to occur at Pike County Lake are presented in an annotated checklist.

INTRODUCTION

The lack of botanical information available for southeast Alabama makes it a high priority area for a floristic study. Since 1977, four floristic studies have contributed to our knowledge of the vascular flora of south Alabama. Lelong (1977) compiled an annotated list of 876 taxa of vascular plants in Mobile. In their work on a survey of the fauna and flora of Fort Rucker, Mount and Diamond (1992) collected 549 taxa of vascular plants. Diamond and Freeman (1993) listed 908 species and varieties of vascular plants in Conecuh County. Crouch and Golden (1997) reported 450 species of vascular plants from an area along the Tombigbee River in northeastern Choctaw County. Although these studies were comprehensive treatments of their collection areas, additional records are needed to adequately represent the diversity of plants found in south Alabama.

DESCRIPTION OF PIKE COUNTY LAKE

Opened in June of 1951, Pike County Lake, consisting of 500 acres of land and 45 acres of water, is one of the smallest Alabama state lakes. In addition to the primary lake

body, there are also several adjoining ponds and marshes created by natural damming of the intermittent streams which feed the lake and by runoff from the surrounding upland area. Due to their nature, these ponds receive a fairly regular inflow of fresh water which then works its way into the lake. From the shoreline, the land rises gradually through a range of habitats, finally reaching a region of dryer upland woods surrounding the property.

The exposed geologic units at Pike County Lake range in age from Cretaceous to Quaternary. The soils are characteristic of those formed in the humid, subtropical type climate of the southeast section of the United States. Seven soil series have been identified in the study area: LeE-Luverne, TaE-Troup, TgC-Troup, BnB-Bonifay, SpC2-Springhill, LcB-Lucy, and CoC-Cowarts (Neal 1997).

The climate of Pike County Lake is subtropical, with an average annual precipitation of about 132 cm. Of this, 71 cm usually fall in April through October. The growing season, from the last subfreezing temperature in the spring to the first subfreezing temperature in the fall, is 225 to 235 days (Neal 1997).

In early October of 1995, shortly after this study began, Hurricane Opal caused significant damage in the area. Due to the large number of trees blown over and uprooted, the lake was closed and logging crews were called in to remove as many of the downed trees as possible. Unfortunately, additional damage by the logging equipment and subsequent erosion was unavoidable. The lake reopened in January of 1997.

DESCRIPTION OF HABITATS

Six habitats were defined at Pike County Lake on the basis of topography, moisture content, and vegetation. The shoreline habitat consists of a narrow region surrounding the edge of the lake and various ponds. It contains plants growing in or at the edge of the water, ranging from totally submersed to partially or completely emersed. Marshes can be found in several areas surrounding the lake where water from runoff and intermittent streams collects and remains at or just beneath the ground surface. These are areas of high humidity and due to dense overhead vegetation light is limited at ground level. A lowland wooded habitat occurs around the edge of the lake and marshes. This habitat has a rich supply of ground water and also has limited light at ground level due to a dense canopy. An upland wooded habitat surrounds the lake. It ranges from densely wooded to relatively open with thick undergrowth. This habitat is more xeric and is characterized by well drained sandy soil. Along the north side of the lake a lightly wooded habitat occurs with soils ranging from mesic to slightly xeric. The canopy is thin and light is abundant at ground level. Numerous drainage pipes empty into this area forming intermittent pools where herbaceous plants flourish. Several open grassy areas occur along the dam and land piers around the lake. Since the lake has reopened, many of these areas have been closely cut to benefit the fishermen.

METHODS

The systematic collection of vascular plants at Pike County Lake began in June of 1995 and continued through May of 1997. To obtain a more complete floristic list, the six

specific habitats were collected three times a month from March through November and once a month from December through February. All seed plants, with the exception of some shrubs and trees, were collected with either flowers or fruits. Seedless vascular plants were collected with sporangia. Voucher specimens were deposited in the Troy State University Herbarium (TROY).

Sources used for identification were: Hitchcock and Chase (1950), Dean (1961), Radford, Ahles and Bell (1968), Duncan (1975), Godfrey and Wooten (1979, 1981), Cronquist (1980), Clewell (1985), Godfrey (1988), and Isely (1990).

RESULTS AND CONCLUSION

A total of 274 taxa representing 198 genera and 86 families were found to occur at Pike County Lake. The Asteraceae was represented by the largest number of species, with a total of 42. Fabaceae was the next largest family with 19 species. *Quercus* was the largest genus, with 7 species.

After two years of intensive collecting, it should be noted that this study is certainly not complete. It is highly unlikely that all of the species of vascular plants once growing at Pike County Lake will ever be documented because of man's continued alteration of their habitats. Many plants were either destroyed or repressed by Hurricane Opal, logging, or burning prior to the lake's reopening.

It is hoped that this initial study will provide a basis of comparison for future studies and encourage interest in the rich variety of habitats and flora provided by Pike County Lake.

ANNOTATED CHECKLIST

The nomenclature follows that of Kartesz and Kartesz (1980). The families are arranged in alphabetical order. Generic names and specific epithets, within each family, are also listed alphabetically. A collection number is given for each taxon.

ACANTHACEAE

Ruellia caroliniensis (J.F. Gmel.) Steud.; 204

ACERACEAE

Acer rubrum L.; 91

A. saccharum Marsh.; 89

AGAVACEAE

Yucca flaccida Haw.; 216

ALISMATACEAE

Sagittaria latifolia Willd.; 17

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AMARANTHACEAE

Amaranthus spinosus L.; 201

ANACARDIACEAE

Rhus copallina L.; 313

R. glabra L.; 312

Toxicodendron radicans (L.) Kuntze; 166, 183

ANNONACEAE

Asimina parviflora (Michx.) Dunal; 306

APIACEAE

Chaerophyllum tainturieri Hook.; 156

Hydrocotyl umbellata L.; 1

Sanicula canadensis L.; 291

APOCYNACEAE

Amsonia tabernaemontana Walt.; 287

AQUIFOLIACEAE

Ilex opaca Ait.; 106

I. vomitoria Ait.; 116

ARACEAE

Arisaema triphyllum (L.) Schott; 236, 261

Peltandra virginica (L.) Schott; 171

ARALIACEAE

Aralia spinosa L.; 283

ARISTOLOCHIACEAE

Hexastylis arifolia (Michx.) Small; 133

ASCLEPIADACEAE

Asclepius tuberosa L.; 2, 194

A. variegata L.; 182

ASPLENIACEAE

Asplenium platyneuron (L.) Oakes ex D.C. Eat.; 34

Athyrium filix-femina (L.) Roth var. *asplenioides* (Michx.) Farw.; 41, 102

ASTERACEAE

- Antennaria plantaginifolia* (L.) Richards.; 253
Aster dumosus L.; 82
A. patens Ait.; 105
A. paternus Cronq.; 220
A. undulatus L.; 76
Baccharis halimifolia L.; 74, 77
Brickellia eupatorioides (L.) Shinnery; 56
Cirsium horridulum Michx.; 151
Coreopsis lanceolata L.; 139
Elephantopus elatus Bertol.; 233
E. tomentosus L.; 47
Erigeron philadelphicus L.; 159
E. vernus (L.) Torr. & Gray; 21
Eupatorium aromaticum L.; 83
E. capillifolium (Lam.) Small; 73, 250
E. coelestinum L.; 79
E. compositifolium Walt.; 314
E. fistulosum Barratt; 298
Facelis retusa (Lam.) Schultz-Bip.; 311
Gnaphalium obtusifolium L.; 59
G. purpureum L.; 286
Haplopappus divaricatus (Nutt.) Gray; 66
Helenium amarum (Raf.) H. Rock; 78
H. brevifolium (Nutt.) Wood; 191
Helianthus angustifolius L.; 80, 244
H. resinosus Small; 35
Heterotheca subaxillaris (Lam.) Britt. & Rusby; 65
Krigia caespitosa (Raf.) Chambers; 135, 165
K. virginica (L.) Willd.; 164
Lactuca canadensis L.; 25, 280
Liatris elegans (Walt.) Michx.; 61
Mikania scandens (L.) Willd.; 239
Pluchea camphorata (L.) DC.; 240
Pyrrhopappus carolinianus (Walt.) DC.; 154
Senecio anonymus Wood; 152
S. glabellus Poir.; 274
Silphium asteriscus L.; 20
Solidago fistulosa P. Mill.; 70
S. nemoralis Ait.; 51
S. odora Ait.; 71
Sonchus asper (L.) Hill; 158
Taraxacum officinale Weber; 124

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BIGNONIACEAE

- Bignonia capreolata* L.; 257
Campsis radicans (L.) Seem. ex Bureau; 215
Catalpa bignonioides Walt.; 188

BLECHNACEAE

- Woodwardia areolata* (L.) T. Moore; 101

BRASSICACEAE

- Cardamine hirsuta* L.; 121

CACTACEAE

- Opuntia humifusa* (Raf.) Raf.; 190

CAESALPINIACEAE

- Cassia obtusifolia* L.; 226
C. occidentalis L.; 225

CALYCANTHACEAE

- Calycanthus floridus* L.; 180

CAMPANULACEAE

- Lobelia amoena* Michx.; 98
L. puberula Michx.; 63
Triodanis perfoliata (L.) Nieuwl. var. *perfoliata* ; 308
T. perfoliata var. *biflora* (Ruiz & Pavon) Bradley; 307
Wahlenbergia marginata (Thunb.) A. DC.; 15, 176

CAPRIFOLIACEAE

- Lonicera japonica* Thunb. var. *japonica* ; 167
L. japonica var. *chinensis* (P.W. Wats.) Baker; 168
L. sempervirens L.; 185
Viburnum nudum L.; 100

CARYOPHYLLACEAE

- Cerastium fontanum* Baumg. ssp. *triviale* (Link) Jalas; 138
Stipulicida setacea Michx.; 285

CLUSIACEAE

- Hypericum gentianoides* (L.) B.S.P.; 30, 228
H. hypericoides (L.) Crantz; 31
H. mutilum L.; 18
Triandenum walteri (J.G. Gmel.) Gleason; 241

COMMELINACEAE

Tradescantia ohiensis Raf.; 297

CONVOLVULACEAE

Cuscuta gronovii Willd.; 230

Dichondra carolinensis Michx.; 295

Ipomoea pandurata (L.) G.F.W. Mey.; 22

Jacquemontia tamnifolia (L.) Griseb.; 248

Stylisma humistrata (Walt.) Chapman; 209, 229

CORNACEAE

Cornus florida L.; 88

CUPRESSACEAE

Juniperus silicicola (Small) Bailey; 189

J. virginiana L.; 109, 249

CYPERACEAE

Carex howei Mackenzie; 279

C. lurida Wahlenb.; 169

Cyperus strigosus L.; 85

Eleocharis tuberculosa (Michx.) Roemer & Shultes; 303

Rhynchospora glomerata (L.) Vahl; 19

R. mixta Britt. ex Small; 304

Scleria ciliata Michx.; 325

DIOSCOREACEAE

Dioscorea villosa L.; 289

ERICACEAE

Gaylussacia dumosa (Andr.) Torr. & Gray; 110, 126

Oxydendrum arboreum (L.) DC.; 96

Rhododendron periclymenoides (Michx.) Shinnery; 256

R. viscosum (L.) Torr.; 302

Vaccinium arboreum Marsh.; 181, 234

V. stamineum L.; 172, 245

EUPHORBIACEAE

Acalypha gracilens Gray; 84

Cnidioscolus stimulosus (Michx.) Engelm. & Gray; 184, 235

Croton glandulosus L. var. *septentrionalis* Muell.-Arg.; 221

Euphorbia corollata L.; 206

Stillingia sylvatica Garden ex L.; 224

Tragia urens L.; 223

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FABACEAE

- Apios americana* Medic.; 107
Centrosema virginianum (L.) Benth.; 16, 57
Crotalaria rotundifolia (Walt.) Poir. var. *vulgaris* Windler; 43
Desmodium lineatum DC.; 64
D. tortuosum (Sw.) DC.; 227
Kummerowia striata (Thunb.) Schindl.; 219
Lespedeza cuneata (Dum.-Cours.) G. Don; 13
L. intermedia (S. Wats.) Britt.; 5
Rhynchosia reniformis (Pursh) DC.; 38
Schrankia microphylla (Dry.) J.F. Macbr.; 8
Strophostyles helvola (L.) Ell.; 58
S. umbellata (Muhl. ex Willd.) Britt.; 14
Stylosanthes biflora (L.) B.S.P.; 6
Tephrosia spicata (Walter) Torr. & Gray; 4, 195
Trifolium campestre Schreb.; 264
T. dubium Sibthorp; 130, 263
T. incarnatum L.; 299
Vicia hirsuta (L.) S.F. Gray; 144
V. sativa L.; 129

FAGACEAE

- Fagus grandifolia* Ehrh.; 322
Quercus alba L.; 104, 111
Q. falcata Michx.; 273
Q. laurifolia Michx.; 318
Q. muehlenbergii Engelm.; 323
Q. nigra L.; 40, 75
Q. shumardii Buckl.; 324
Q. stellata Wang.; 32

GENTIANACEAE

- Gentiana catesbaei* Walt.; 99

GERANIACEAE (1)

- Geranium carolinianum* L.; 162

HALORAGACEAE

- Myriophyllum aquaticum* (Vell.) Verdc.; 252

HAMAMELIDACEAE

- Hamamelis virginiana* L.; 321
Liquidambar styraciflua L.; 33, 55

HIPPOCASTANACEAE

Aesculus pavia L.; 150

HYDROPHYLLACEAE

Hydrolea quadrivalvis Walt.; 11

IRIDACEAE

Sisyrinchium rosulatum Michx.; 177

JUGLANDACEAE

Carya glabra (P. Mill.) Sweet; 81, 93

C. pallida (Ashe) Engl. & Graebn.; 316

C. tomentosa (Poir.) Nutt.; 94

JUNCACEAE

Juncus coriaceus Mackenzie; 296

J. effusus L.; 281

J. gymnocarpus Coville; 114

J. marginatus Rostk.; 173

LAMIACEAE

Lamium amplexicaule L.; 131

Lycopus rubellus Moench; 243

Monarda punctata L.; 69

Salvia lyrata L.; 143

Stachys floridana Shuttlw.; 155

LAURACEAE

Sassafras albidum (Nutt.) Nees; 48, 92

LILIACEAE

Allium canadense L.; 120, 157

A. vineale L.; 192, 200

Chamaelirium luteum (L.) Gray; 290

Hypoxis micrantha Pollard; 272

Medeola virginiana L.; 320

Polygonatum biflorum (Walt.) Ell.; 284

Trillium underwoodii Small; 137

Uvularia perfoliata L.; 294

LOGANIACEAE

Gelsemium sempervirens (L.) St. Hil.; 132

Polypremum procumbens L.; 7

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LORANTHACEAE

Phoradendron serotinum (Raf.) M.C. Johnston; 118

MAGNOLIACEAE

Liriodendron tulipifera L.; 95, 54

Magnolia grandiflora L.; 266

M. virginiana L.; 62

MALVACEAE

Sida rhombifolia L.; 44

MELASTOMATACEAE

Rhexia virginica L.; 205, 46

MIMOSACEAE

Albizia julibrissin Durz.; 28

MORACEAE

Morus rubra L.; 292

MYRICACEAE

Myrica cerifera L.; 269

NYSSACEAE

Nyssa sylvatica Marsh.; 282

OLEACEAE

Chionanthus virginicus L.; 278

Ligustrum sinense Lour.; 186

Osmanthus americanus (L.) Benth. & Hook. f. ex Gray; 134, 45

ONAGRACEAE

Ludwigia alternifolia L.; 309

Oenothera biennis L.; 60

O. laciniata Hill; 310, 161

ORCHIDACEAE

Platanthera cristata (Michx.) Lindl.; 237

OSMUNDACEAE

Osmunda cinnamomea L.; 277

O. regalis L. var. *spectabilis* (Willd.) Gray; 232

OXALIDACEAE

Oxalis dillenii Jacq.; 163

PAPAVERACEAE

Sanguinaria canadensis L.; 293

PASSIFLORACEAE

Passiflora incarnata L.; 197

P. lutea L.; 305

PHYTOLACCACEAE

Phytolacca americana L.; 207

PINACEAE

Pinus echinata P. Mill.; 86, 87

P. elliottii Engelm.; 68

P. glabra Walt.; 67, 108

P. taeda L.; 42

PLANTAGINACEAE

Plantago lanceolata L.; 199

P. virginica L.; 141

POACEAE

Andropogon virginicus L.; 72

Arundinaria gigantea (Walt.) Muhl.; 97

Chasmanthium sessiliflorum (Poir.) Yates; 37

Danthonia spicata (L.) Beauv. ex Roemer & Schultes; 24

Dichanthelium boscii (Poir.) Gould & Clark; 246

Eragrostis pilosa (L.) Beauv.; 52

Erianthus alopecuroides (L.) Ell.; 50

Panicum virgatum L.; 36

Paspalum notatum Flugge var. *saurae* Parodi; 27

Poa annua L.; 254

Sphenopholis obtusata (Michx.) Scribn.; 142

Tridens flavus (L.) A.S. Hitchc.; 53

POLYGALACEAE

Polygala incarnata L.; 208

P. polygama Walt.; 175

POLYGONACEAE

Polygonum setaceum Baldw. ex Ell.; 218

Rumex hastatulus Baldw. ex Ell.; 145, 146

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POLYPODIACEAE

Polypodium polypodioides (L.) Watt; 117

POTAMOGETONACEAE

Potamogeton diversifolius Raf.; 170

RANUNCULACEAE

Clematis reticulata Walt.; 3, 178

ROSACEAE

Aronia arbutifolia (L.) Pers.; 259

Duchesnea indica (Andr.) Focke; 174

Prunus americana Marsh.; 317

P. serotina Ehrh.; 49, 260

Rosa carolina L.; 315

R. palustris Marsh.; 179

Rubus cuneifolius Pursh; 160, 275

R. trivialis Michx.; 267

RUBIACEAE

Cephalanthus occidentalis L.; 214

Diodia teres Walt.; 222

D. virginiana L.; 12

Galium aparine L.; 271

G. circaezans Michx.; 319

Hedyotis crassifolia Raf.; 122, 128

Mitchella repens L.; 103

Richardia brasiliensis Gomez; 39

SAXIFRAGACEAE

Itea virginica L.; 112, 187

SCROPHULARIACEAE

Agalinus fasciculata (Ell.) Raf.; 247

Aureolaria virginica (L.) Pennell; 238

Gratiola floridana Nutt.; 258

G. virginiana L.; 276

Linaria canadensis (L.) Dum.-Cours.; 147

Verbascum thapsus L.; 270

Veronica arvensis L.; 127

SMILACEAE

Smilax bona-nox L.; 242

S. glauca Walt.; 29, 210

S. laurifolia L.; 125, 212

S. smallii Morong; 115, 119, 202, 211

SOLANACEAE

- Physalis virginiana* P. Mill.; 300
Solanum americanum P. Mill.; 301
S. carolinense L.; 198

TAXODIACEAE

- Taxodium distichum* (L.) L.C. Rich.; 113

ULMACEAE

- Ulmus alata* Michx.; 262

URTICACEAE

- Boehmeria cylindrica* (L.) Sw.; 217

VALERIANACEAE

- Valerianella radiata* (L.) Dufr.; 231

VERBENACEAE

- Callicarpa americana* L.; 203
Verbena bonariensis L.; 10
V. halei Small; 9, 153
V. rigida Spreng.; 23

VIOLACEAE

- Viola palmata* L.; 148
V. priceana Pollard; 140
V. primulifolia L.; 149
V. rafinesquii Greene; 123
V. villosa Walt.; 136

VITACEAE

- Ampelopsis arborea* (L.) Koehne; 196
Parthenocissus quinquefolia (L.) Planch.; 265
Vitis cineria Engelm. ex Millard; 288
V. rotundifolia Michx.; 268

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LITERATURE CITED

- Clewell, A. F. 1985. Guide to the vascular plants of the Florida Panhandle. University Presses of Florida, Tallahassee.
- Cronquist, A. 1980. Vascular flora of the southeastern United States, Vol. 1. Asteraceae. The University of North Carolina Press, Chapel Hill.
- Crouch, V. E. and M. S. Golden. 1997. Floristics of a bottomland forest and adjacent uplands near the Tombigbee River, Choctaw County, Alabama. *Castanea* 62(4): 219-228.
- Dean, B.E. 1961. Trees and shrubs in the Heart of Dixie. Coxe Publishing Co. Birmingham, Alabama.
- Diamond, A. R. and J. D. Freeman. 1993. A checklist of the vascular flora of Conecuh County, Alabama. *Sida* 15(4): 623-638.
- Duncan, W. H. 1975. Woody vines of the southeastern United States. University of Georgia Press, Athens.
- Godfrey, R. K. 1988. Trees, shrubs, and woody vines of northern Florida and adjacent Georgia and Alabama. University of Georgia Press, Athens.
- Godfrey, R. K. and J. W. Wooten. 1979. Aquatic and wetland plants of the southeastern United States. Monocotyledons. University of Georgia Press, Athens.
- Godfrey, R. K. and J. W. Wooten. 1981. Aquatic and wetland plants of the southeastern United States. Dicotyledons. University of Georgia Press, Athens.
- Hitchcock, A. S. and A. Chase. 1950. Manual of the grasses of the United States, 2nd Ed. U. S. D. A. Misc. Publ. 200. U. S. Government Printing Office, Washington, D.C.
- Isely, D. 1990. Vascular flora of the southeastern United States, Vol. 3, Part 2. Leguminosae (Fabaceae). The University of North Carolina Press, Chapel Hill.
- Kartesz, J. T. and R. Kartesz. 1980. A synonymized checklist of the vascular flora of the United States, Canada and Greenland. University of North Carolina Press, Chapel Hill.
- Lelong, M. G. 1977. Annotated list of vascular plants in Mobile, Alabama. *Sida* 2:118-146.
- Mount, R. M. and A. R. Diamond. 1992. Final survey of the fauna and flora of Fort Rucker, Alabama. Auburn University.
- Neal, H. B. 1997. Soil survey of Pike County, Alabama. United States Department of Agriculture. Washington, D. C.
- Radford, A. E., H. E. Ahles and C. R. Bell. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill.

REPORT ON THE GORGAS SCHOLARSHIP RANKING, 1998

On March 20, 1998, the Gorgas Scholarship Committee announced the ranking of the finalists in the 1998 Alabama Science Talent Search. The Search was held at the meeting of the Alabama Academy of Science at the University of South Alabama, Mobile, Alabama.

The winner of the first-place tuition grant of \$3,000 was

Mr. Daniel Christian Killilea, 305 Saddle Court, Mobile, AL 36608. Murphy High School, Mobile, AL 36606. Teacher - Ms. Wanda Griffis.

First alternate and winner of a \$2,000 tuition grant was

Ms. Emily Allison Ackley, 7620 Lakewood Drive, Florence, AL 35634. Brooks High School, Killen, AL 35645. Teacher - Ms. Wanda Phillips.

Second alternate and winner of a \$1,500 tuition grant was

Ms. Petronella Rita Lugenwa, 848 Sun Valley Road, Birmingham, AL 35215-3114. The Altamont School, Birmingham, AL 35222. Teacher - Ms. Sophia Clifford.

Third alternate and winner of a \$1,000 tuition grant was

Ms. Cathryn Marie Sterling, 4104 Brookmont Drive, Birmingham, AL 35210. Jefferson County International Baccalaureate School, Birmingham, AL 35210. Teacher - Dr. Trudy Anderson.

Fourth alternate and winner of a \$500 tuition grant was

Ms. Lindsay Meredith Farina, 110 Cedar point Lane, Killen, AL 35645. Brooks High School, Killen, AL 35645. Teacher - Ms. Vicki Farina.

Fifth alternate was

Ms. Angela Scott Cato, 3427 Sheffield Circle, Birmingham, AL 35223. Jefferson County International Baccalaureate School, Birmingham, AL 35210. Teacher - Dr. Trudy Anderson.

Sixth alternate was

Mr. William David Lyndon, 321 Nottingham Road, Florence, AL 35633. Henry A. Bradshaw High School, Florence, AL 35630. Teacher - Ms. Cynthia Tillery.

Seventh alternate was

Mr. Steven Douglas Hyde, 150 Doubletree Lane, Florence, AL 35634. Bradshaw High School, Florence, AL 35630. Teacher - Mrs. Cynthia Tillery.

Gorgas Report

Eighth alternate was

Ms. Lawren Elizabeth Olenchak, 123 Canyon Trail, Pelham, AL 35124.
Jefferson County International Baccalaureate School Birmingham, AL 35210.
Teacher - Dr. Trudy Anderson.

Unable to exhibit:

Ms. Annukka Aida Antar, 12021 Comanche Trail, Huntsville, AL 35803.
Virgil I. Grissom High School, Huntsville, AL 35802.
Teacher - Ms. Lady Emrich.

Ms. Roopa Dhawan, 2900 Steeplechase Court South, Mobile, AL 36695.
S.S. Murphy High School, Mobile, AL 36606.
Teacher - Ms. Wanda S. Griffis.

The rankings were established by a panel of judges consisting of department heads, deans, and professors from many of the leading universities and industries in Alabama.

Winners and finalists in the Gorgas Contests receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Committee is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone and later became the Surgeon General of the U.S. Army. The purposes of the Committee are to promote interest in science and to aid in the education of promising students.



INSTRUCTIONS TO AUTHORS

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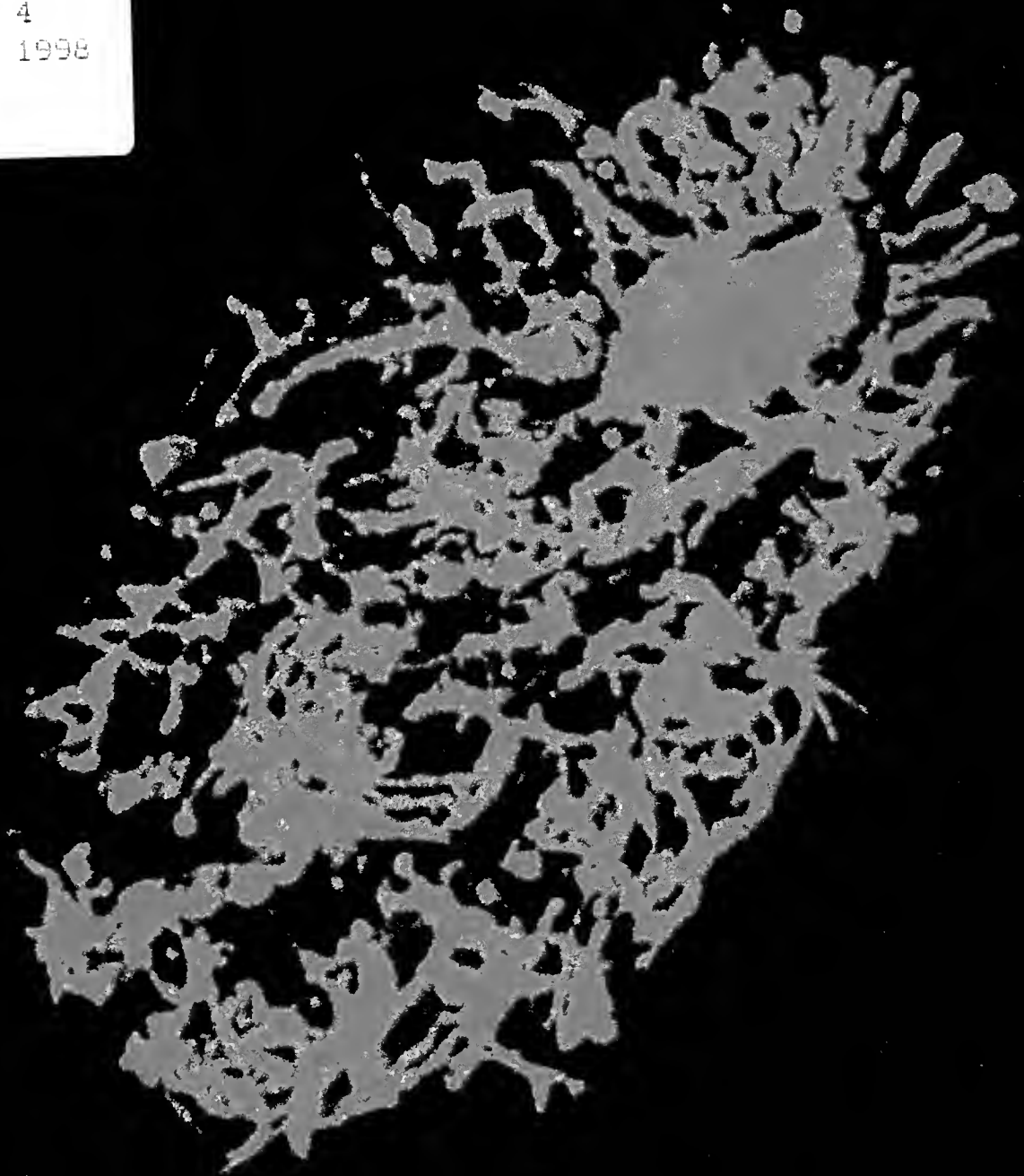
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Cover Photograph: Confocal laser scanning photomicrograph of the protozoan *Tetrahymena thermophila* fluorescently labeled with a mouse monoclonal antibody directed against a surface (membrane) antigen localized to somatic and oral cilia. **Photo Credit:** Barbara Estridge and Dr. Christine Sundermann, Department of Zoology and Wildlife Sciences, Auburn University.

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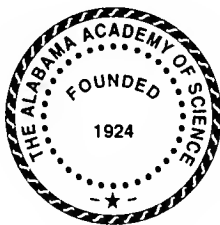
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THE IMPORTANCE OF LONGLEAF PINE (*Pinus palustris*) AND HARDWOOD FORESTS FOR BREEDING BIRDS IN THE TALLADEGA MOUNTAINS, ALABAMA

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ABSTRACT

The Talladega Mountains in the extreme southern Appalachian Region support a complex forest that includes longleaf pine (*Pinus palustris*) forest, hardwood forest, and pine/hardwood forest. Much of the native longleaf pine forest of the region has been degraded through fire suppression and encroachment by hardwood forest. In an effort to restore longleaf pine to its original distribution and condition the USDA Forest Service has been converting hardwood and pine/hardwood forests to longleaf pine. To assess the impact of forest management practices on breeding birds in the region, I compared the birds present in the four dominant forest types of the region: hardwood forest, mixed pine/hardwood forest, established longleaf pine stands, and sites that had been recently cut and replanted in longleaf pine. The greatest diversity and abundance of birds along with many species of concern occurred in established and recently planted longleaf pine sites. Hardwood sites supported a lower diversity and abundance of birds but provided critical habitat for several species of Neotropical migrant birds.

INTRODUCTION

The Talladega Mountains of eastern Alabama form the extreme southwest extension of the Appalachian chain. The natural vegetation of the region was not well documented before most of the area's forests were cut and altered. However, reconstruction of the pre-settlement forests of the region based on witness trees indicate that fire and the highly variable soil moisture of the steep rocky slopes maintained diverse forest types (Shankman and Wills, 1995). An isolated population of longleaf pine (*Pinus palustris*) grew on ridge tops and dry south-facing slopes that were periodically swept by fire (Shankman and Wills, 1995; Harper, 1943). Hardwood forests of American beech (*Fagus grandifolia*), oak (*Quercus* sp.), hickory (*Carya* sp.), and American chestnut (*Castanea dentata*) grew on moist, north-facing slopes and in the stream valleys. In the broad transitional zones between stands of pine on the ridgetops and hardwoods in the stream bottoms pine/hardwood forest grew (Shankman and Wills, 1995).

Surprisingly little is known of the bird-habitat relationships of this region. For instance, the bird communities of longleaf pine stands in the southern Appalachian Mountains are virtually unknown (Chuck Hunter, USFWS Regional Partners-in-Flight Director, pers. comm.). Moreover, nesting habitat of many species of birds in this region is characterized as "hardwood" or "pine", but few data exist on how various bird species fare in the mixed pine/hardwood forests that dominate the region or what proportion of pine or hardwood trees is necessary to provide suitable breeding habitat for particular species of birds.

The Talladega Ranger District of the U. S. Forest Service is working to restore mountain longleaf pine stands in the Talladega National Forest (USDA Forest Service, 1986). A primary impetus for this agenda is restoration of breeding populations of endangered Red-cockaded Woodpeckers (*Picoides borealis*), which historically bred in longleaf pine throughout the region. Currently only six breeding pairs occur in the Talladega Ranger District of the Talladega National Forest (R. Smith, USDA Forest Service District Ranger, pers. comm.). The restoration process is complex. Before disturbance by European settlers, stands of longleaf pine in the Talladega Mountains were thought to have been structurally similar to the longleaf pine stands of the coastal plain -- large, well-spaced trees with little midstory, and a dense ground cover of grasses and forbs (Shankman and Wills, 1995). Although Shankman and Wills (1995) indicate that stands of longleaf pine dominated ridgetops (see also Harper, 1943, pgs 116-119), the original extent of longleaf pine stands in the Talladega Mountains remains unknown. In an effort to restore longleaf pine stands to estimated original conditions, the USDA Forest Service has (1) burned stands of mountain longleaf, (2) cut hardwood from stands of mixed hardwood and longleaf pine, (3) cut planted stands of loblolly pine (*P. taeda*) and replanted with longleaf pine, or (4) cut stands of hardwoods or mixed loblolly pine/hardwoods and replanted with longleaf pine.

The purpose of this study was to assess habitat use by breeding birds in the Talladega Ranger District of the Talladega National Forest. I compared the presence of breeding birds among four dominant upland forest types: (1) hardwood stands, (2) mixed pine/hardwood stands, (3) established longleaf pine stands, and (4) recently planted longleaf pine stands. I also assessed the effect of forest composition and structure, including percentage of pine, tree size, and tree density on the songbird community as a whole and on particular species of birds.

METHODS

This study focused on the Talladega Ranger District of the Talladega National Forest in northeast Alabama, including Cheaha State Park. I included in the study only ridgetops and slopes; valleys of major drainages were excluded from this study. Valleys were excluded because they are not being altered by the Forest Service as part of the longleaf pine recovery program and the purpose of this study was to compare use by breeding birds of various upland forest habitat.

I surveyed four general habitat types: (1) Oak-hickory or beech-oak-hickory forest, hereafter referred to as "Hardwood Sites". To be selected, these sites had to have trees mature enough to produce a closed canopy and had to have few or no pines (maximum 23% pine; see Results). Hardwood Sites varied in tree composition depending on the elevation, slope, exposure, and soil characteristics. Lower, moister Hardwood Sites were typically dominated by American beech (*Fagus grandifolia*), white oak (*Quercus alba*), and black oak (*Quercus velutina*). Hardwood sites on ridgetops or upper slopes were characterized by white oak, chestnut oak (*Quercus prinus*), post oak (*Quercus stellata*), pignut hickory (*Carya glabra*), and shagbark hickory (*Carya ovata*). (2) Mixed pine/hardwood with more than 50% of trunks (DBH > 8 cm) comprised of pine, hereafter referred to as "Mixed Pine/Hardwood Sites". Eight out of the 64 "pine/hardwood sites" had no hardwood stems with DBH > 8 cm and thus were described as 100% pine. The predominant pine of these sites was loblolly pine with some shortleaf pine (*Pinus echinata*) and some longleaf pine. Predominant hardwood species included the same species as for ridgetop/upper slope Hardwoods Sites listed above with Sweetgum (*Liquidambar styraciflua*) also a predominant species. None of these sites were "pine plantations" with trees planted in rows. All sites appeared to have naturally regenerated following disturbance. (3) Longleaf pine forest with little hardwood midstory or canopy, hereafter referred to as "Longleaf Sites". These sites

Forests for Breeding Birds

were open with scattered longleaf pine (DBH > 17 cm) and dense and highly variable ground cover of grasses, forbs, and shrubs. Most Longleaf Sites had longleaf pine as the only mature trees but some sites had a small component of loblolly or shortleaf pine (not more than 10% or the site was not used). (4) Sites that had been recently cut and replanted within the previous 3 - 7 years in longleaf pine, hereafter referred to as "Regeneration Sites". To be selected, these sites had to have longleaf pine seedlings 1 - 3 m tall. Ground cover of Regeneration Sites varied from grass to shrubs depending on how each site was prepared before reseeding and whether and how frequently it had been burned.

Plots were selected by systematically searching Forest Service roads from a car. To be suitable, a site had to have a patch of more-or-less uniform vegetation that was at least 200 m in diameter and that was at least 1 km from any other sampling points. When a suitable patch of habitat was located, I stopped the car at least 50 m from the nearest edge of the patch and walked 70 m into the patch perpendicular to the road. When I reached the 70-m point, I waited 3 min for birds in the area to recover from the disturbance caused by the vehicle and my movement in the habitat and then began the count. Point counts lasted 5 min, during which I recorded all birds heard or seen within a radius of 50 m of my position.

After each count I quantified the vegetation of the site. Maximum diameter at breast height (DBH) measured to the nearest inch (2.5 cm) was recorded for each stand by taking the DBH of the maximum size class of trees represented by at least four individual trees (± 5 cm DBH) in the 50-m count circle. In other words, the DBH of one large tree in a stand of much younger trees would not be used as maximum DBH; the DBH of the next largest size class represented by at least four trees was used as maximum DBH. Virtually all stands counted in this study were of relatively uniform age (because all forests were second growth, regenerating from clearcuts) and it was almost always straightforward to unambiguously assign a maximum DBH. Tree density was added to the protocol for site description after some counts were completed so not all stands had trunk density recorded. I counted the number of pine versus hardwood trunks of any species within 10 m of the center of the count circle by orienting north and counting trunks as I rotated clockwise until thirty trunks (DBH > 8 cm) were tallied as hardwood or pine. As a measure of tree density, I also recorded the number of degrees of rotation that were required to tally 30 trunks (0 to 360 degrees). In the few very sparse stands that had fewer than 30 trunks in the entire area within 10 m of the center of the count circle, I calculated proportion of pine based on the number of trunks within 10 m and I designated trunk density as 360 degrees. I then converted degrees of rotation to trunks/m².

A total of 209 point counts were conducted between 25 May and 28 June 1997, a period in which all birds observed in this part of Alabama can be assumed to be potential breeders rather than transients (Imhof, 1972). Sampling was conducted at 65 Hardwood Sites, 64 Mixed Pine/Hardwood Sites, 41 Longleaf Sites, and 39 Regeneration Sites. Each site was counted only once. All counts were conducted between fifteen minutes before sunrise and 1100 CST and I rotated the order in which counts were conducted so that counts in all habitat types were uniformly distributed through the morning hours.

I compared the four habitat types by mean number of individual birds recorded per count (hereafter "mean individuals") and by mean number of bird species recorded (hereafter "species richness") using a one-way ANOVA. When a significant difference among habitats was indicated by the ANOVA, I determined which particular habitat types differed significantly using a Scheffe's Test. I performed a similar analysis among habitat types for mean DBH, proportion of pine, and trunk density, but I only compared Hardwood Sites, Mixed Pine/Hardwood Sites, and Longleaf Sites because forest descriptors were not meaningful for Regeneration Sites. For each of the 10 bird species observed during 20 or more point counts in the study, I also compared whether the distribution of observations across habitats differed from that expected by chance using a chi-square test. To correct for multiple comparisons I adjusted the α for rejection of the null hypothesis to 0.05/number of

Hill

comparisons = $0.05/10 = 0.005$. I used regression analysis to examine the effect of proportion pine, tree density, and DBH on mean individuals and species richness as well as on individual species of birds. The scientific names of all bird species recorded in this study are given in Table 1.

Comparison to Bankhead National Forest

In June 1995, I conducted point counts in hardwood forests in Bankhead National Forest, which lies approximately 70 miles northwest of the Talladega Mountains (Hill 1997). The criteria for selecting Hardwood sites in the Bankhead National Forest were identical to the criteria used at in the Talladega Mountains. Moreover, point counts in Bankhead National Forest were conducted using the same counting methods and by the same observer as point counts in the Talladega Mountains, allowing comparisons among these two regions. For species recorded at least ten times in the Bankhead and Talladega counts I compared the distribution of occurrences using a Chi-squared Test. Such comparisons assume no effect of year. To correct for multiple comparisons I adjusted the α for rejection of the null hypothesis to $0.05/\text{number of comparisons} = 0.05/7 = 0.007$.

RESULTS

Site characteristics—Hardwood Sites used in this study ranged in proportion of pine from 0 to 23% ($x = 4.1 \pm 5.5\%$, $n = 65$), in maximum DBH from 20 to 76 cm ($x = 48.5 \pm 11.2$ cm, $n = 52$), and in tree density from 0.14 to 0.77 trees/m² ($x = 0.32 \pm 0.15$ trees/m², $n = 33$). Mixed Pine/Hardwood Sites ranged in proportion of pine from 33% to 100% ($x = 72.4 \pm 19.7\%$, $n = 64$), in maximum DBH from 10 to 70 cm ($x = 28.0 \pm 10.8$ cm, $n = 52$), and in tree density from 0.10 to 0.77 trees/m² ($x = 0.38 \pm 0.20$ trees/m², $n = 40$). Longleaf Sites ranged in proportion of pine from 73% to 100% ($x = 92.3 \pm 5.9\%$, $n = 41$), in maximum DBH from 18 cm to 50 cm ($x = 38.8 \pm 7.8$ cm, $n = 37$), and in tree density from 0.10 to 0.77 trees/m² ($x = 0.36 \pm 0.25$ trees/m², $n = 12$). Some Regeneration Sites had scattered snags or standing trees but no forest descriptors were relevant to these sites.

Hardwood Sites, Longleaf Sites, and Mixed Pine/Hardwood Sites did not differ significantly in tree density ($F = 0.89$, $df = 2, 82$, $P = 0.41$), but they did differ in maximum DBH ($F = 56.7$, $df = 2, 150$, $P = 0.0001$; Table 2). Hardwood Sites had significantly greater DBH than Longleaf Sites which had significantly greater DBH than Mixed Pine/Hardwood Sites ($p < 0.05$ for all comparisons).

Comparisons of bird distributions among habitat types—Both mean individuals and species richness differed significantly among habitat types (total individuals: $F = 13.74$, $df = 3, 203$, $P = 0.0001$; species richness: $F = 17.32$, $df = 3, 205$, $P = 0.0001$). Regeneration Sites and Longleaf Sites had significantly higher mean bird species richness and mean individuals than Hardwood or Mixed Pine/Hardwood Sites (Table 2). There was no significant difference between Hardwood Sites and Mixed Pine/Hardwood Sites or between Longleaf Sites and Regeneration Sites in mean number of individuals or mean species richness (Table 2).

The distribution among habitats of Carolina wren ($\chi^2 = 6.12$, $P = 0.10$), Carolina chickadee ($\chi^2 = 4.52$, $P = 0.21$), and northern cardinal ($\chi^2 = 4.15$, $P = 0.25$) did not differ significantly from that expected by chance ($d.f. = 3$ for all comparisons; Table 1). Scarlet tanagers ($\chi^2 = 41.66$, $P = 0.0001$) and red-eyed vireos ($\chi^2 = 47.85$, $P = 0.0001$) were found more often than expected by chance in Hardwood and Mixed Pine/Hardwood Sites ($d.f. = 3$ for all comparisons; Table 1). Both species were found significantly more often

Forests for Breeding Birds

Table 1. Occurrence of birds during point counts in four forest types in Talladega National Forest, Alabama in June 1997.

Common Name ^a	Scientific Name ^a	Hardwood		Pine/hardwood		Longleaf Pine		Regeneration	
		Sites ^b	%	Sites ^c	%	Sites ^d	%	Sites ^e	%
Acadian Flycatcher	<i>Empidonax vireescens</i>	2	3.1	0	0	0	0	0	0
American Crow	<i>Corvus brachyrhynchos</i>	0	0	1	1.6	0	0	0	0
American Goldfinch	<i>Carduelis tristis</i>	0	0	1	1.6	0	0	2	5.1
American Robin	<i>Turdus migratorius</i>	0	0	0	0	1	2.4	0	0
Bachman's sparrow	<i>Aimophila aestivalis</i>	0	0	0	0	1	2.4	3	7.7
Barn Swallow	<i>Hirundo rustica</i>	0	0	0	0	0	0	2	5.1
Black-and-white Warbler	<i>Mniotilta varia</i>	6	9.2	1	1.6	6	14.6	1	2.6
Black-throated Green Warbler	<i>Dendroica virens</i>	6	9.2	2	3.1	2	4.9	1	2.6
Blue-gray Gnatcatcher	<i>Poliopila caerulea</i>	4	6.2	4	6.2	2	4.9	1	2.6
Brown-headed Cowbird	<i>Molothrus ater</i>	3	4.6	1	1.6	4	9.8	4	10.3
Brown-headed Nuthatch	<i>Sitta pusilla</i>	0	0	3	4.7	5	12.2	1	2.6
Blue Grosbeak	<i>Guiraca caerulea</i>	0	0	0	0	0	0	2	5.1
Blue Jay	<i>Cyanocitta cristata</i>	5	7.7	8	12.5	0	0	1	2.6
Brown Thrasher	<i>Toxostoma rufum</i>	0	0	1	1.6	1	2.4	1	2.6
Broad-winged Hawk	<i>Buteo platypterus</i>	0	0	1	1.6	0	0	0	0

Table 1 continued

Blue-winged Warbler	<i>Vermivora pinus</i>	0	0	1	1.6	0	0	0	0
Carolina Chickadee	<i>Parus carolinensis</i>	5	7.7	13	20.3	5	12.2	5	12.8
Carolina Wren	<i>Thryothorus ludovicianus</i>	8	12.3	11	17.2	1	2.4	3	7.7
Chimney Swift	<i>Chaetura pelagica</i>	0	0	1	1.6	0	0	0	0
Common Yellowthroat	<i>Geothlypis trichas</i>	0	0	1	1.6	2	4.9	7	17.9
Downy Woodpecker	<i>Picoides pubescens</i>	4	6.2	7	10.9	3	7.3	3	7.7
Eastern bluebird	<i>Sialia sialis</i>	0	0	0	0	2	4.9	4	10.3
Eastern Phoebe	<i>Sayornis phoebe</i>	2	3.1	0	0	0	0	0	0
Eastern Wood-pewee	<i>Contopus virens</i>	0	0	0	0	4	9.8	0	0
Field Sparrow	<i>Spizella pusilla</i>	0	0	0	0	2	4.9	11	28.2
Gray Catbird	<i>Dumetella carolinensis</i>	2	3.1	1	1.6	0	0	1	2.6
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	5	7.7	5	7.8	3	7.3	4	10.3
Hairy Woodpecker	<i>Picoides villosus</i>	0	0	0	0	0	0	1	2.6
Hooded Warbler	<i>Wilsonia citrina</i>	2	3.1	5	7.8	2	4.9	1	2.6
Indigo Bunting	<i>Passerina cyanea</i>	5	7.7	16	25	25	61	32	82.1
Kentucky Warbler	<i>Oporornis formosus</i>	1	1.5	3	4.7	0	0	0	0
Mourning Dove	<i>Zenaidura macroura</i>	5	7.7	0	0	0	0	2	5.1
Northern Bobwhite	<i>Colinus virginianus</i>	0	0	0	0	1	2.4	3	7.7
Northern Cardinal	<i>Cardinalis cardinalis</i>	6	9.2	11	17.2	4	9.8	2	5.1

Forests for Breeding Birds

Table 1 continued

Northern Flicker	<i>Colaptes auratus</i>	0	0	1	1.6	0	0	1	2.6
Northern mockingbird	<i>Mimus polyglottus</i>	0	0	1	1.6	0	0	0	0
Ovenbird	<i>Seiurus aurocapillus</i>	12	18.5	2	3.1	2	4.9	0	0
Pine Warbler	<i>Dendroica pinus</i>	0	0	20	31.2	21	51.2	5	12.8
Pileated Woodpecker	<i>Dryocopus pileatus</i>	3	4.6	2	3.1	1	2.4	1	2.6
Prairie Warbler	<i>Dendroica discolor</i>	1	1.5	1	1.6	19	46.3	20	51.3
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>	4	6.2	3	4.7	4	9.8	3	7.7
Red-eyed Vireo	<i>Vireo olivaceus</i>	40	61.5	26	40.6	7	17.1	5	12.8
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	1	1.5	0	0	1	2.4	1	2.6
Red-shouldered Hawk	<i>Buteo lineatus</i>	1	1.5	0	0	0	0	0	0
Ruby-throated hummingbird	<i>Archilochus colubris</i>	0	0	0	0	0	0	2	5.1
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>	1	1.5	0	0	8	19.5	16	41
Scarlet Tanager	<i>Piranga olivacea</i>	27	41.5	11	17.2	0	0	0	0
Solitary Vireo	<i>Vireo solitarius</i>	0	0	1	1.6	0	0	0	0
Summer Tanager	<i>Piranga rubra</i>	6	9.2	12	18.8	9	22	14	35.9
Tufted Titmouse	<i>Parus bicolor</i>	9	13.8	8	12.5	1	2.4	1	2.6
White-eyed Vireo	<i>Vireo griseus</i>	0	0	2	3.1	1	2.4	1	2.6
White-breasted Nuthatch	<i>Sitta carolinensis</i>	5	7.7	4	6.2	3	7.3	1	2.6
Worm-eating Warbler	<i>Helminthos vermivorus</i>	1	1.5	0	0	0	0	0	0

Table 1 continued

Wood Thrush	<i>Hylocichla mustelina</i>	5	7.7	3	4.7	0	0	0
Yellow Warbler	<i>Dendroica petechia</i>	0	0	1	1.6	0	0	0
Yellow-breasted Chat	<i>Icteria virens</i>	1	1.5	11	17.2	14	34.1	82.1
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	9	13.8	3	4.7	0	0	2.6
Yellow-throated Vireo	<i>Vireo flavifrons</i>	4	6.2	1	1.6	1	2.4	2.6
Yellow-throated Warbler	<i>Dendroica dominica</i>	0	0	0	0	5	12.2	2.6

^aCommon and scientific names follow American Ornithologists' Union (1983).

^bNumber of counts out of 65 in which species was recorded.

^cNumber of counts out of 64 in which species was recorded.

^dNumber of counts out of 41 in which species was recorded.

^eNumber of counts out of 39 in which species was recorded.

Table 2. Mean (\pm standard deviation) total individual and bird species richness for point counts conducted in each of four forest types in Talladega National Forest in June 1997. Number of counts in each habitat type is given in parentheses.

Forest Types (N)	Total Individuals	Species Richness	% Pine	DBH (cm)	Trunk Density ^a
Hardwood (65)	3.83 \pm 2.10	3.57 \pm 1.93	4.1 \pm 5.5	48.5 \pm 11.2	0.32 \pm 0.15
Mixed pine/hardwood (64)	3.77 \pm 2.17	3.34 \pm 1.79	72.4 \pm 19.7	28.0 \pm 10.8	0.37 \pm 0.20
Longleaf pine (41)	5.56 \pm 2.51	5.17 \pm 2.45	92.3 \pm 5.9	38.8 \pm 7.8	0.36 \pm 0.25
Regeneration (39)	6.33 \pm 3.05	6.12 \pm 2.92	N/A	N/A	N/A

^a trunks/m²

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Table 3. Percentage of point counts in hardwood during which bird species were recorded in the Talladega National Forest (point count number = 65) and in the Bankhead National Forest (point count number = 30) in June 1995 and 1997, respectively.

Common Name	Talladega	Bankhead	χ^2	P
	%	%		
Acadian Flycatcher	3.1	43.3	22.08	0.001
Blue Jay	7.7	16.7	0.93	0.33
Carolina Chickadee	7.7	23.3	3.32	0.07
Carolina Wren	12.3	30	3.25	0.07
Great Crested Flycatcher	7.7	20	0.19	0.66
Ovenbird	18.5	16.7	0.005	0.94
Pileated Woodpecker	4.6	53.3	27.48	0.0001
Red-bellied Woodpecker	6.2	53.3	24.72	0.0001
Red-eyed Vireo	61.5	96.7	11.03	0.0009
Scarlet Tanager	41.5	76.7	8.79	0.003
Tufted Titmouse	13.8	33.3	3.73	0.05
White-breasted Nuthatch	7.7	33.3	8.31	0.004
Worm-eating Warbler	1.5	56.7	37.11	0.0001
Yellow-billed Cuckoo	13.8	86.7	50.45	0.0001

than expected by chance in Hardwood Sites compared to mixed Hardwood/pine Sites (scarlet tanager: $\chi^2 = 8.07$, d.f. = 1, $P = 0.004$; red-eyed vireo: $\chi^2 = 4.84$, d.f. = 1, $P = 0.03$). Indigo buntings ($\chi^2 = 71.71$, $P = 0.0001$) and rufous-sided towhees ($\chi^2 = 48.90$, $P = 0.0001$) were found more often in regeneration sites and less often in Hardwood Sites than expected by chance (d.f. = 3 for all comparisons; Table 1). Prairie warblers ($\chi^2 = 70.07$, $P = 0.0001$) were abundant in both Longleaf and Regeneration Sites but nearly absent from Hardwood and Mixed Pine/Hardwood Sites, and pine warblers ($\chi^2 = 43.83$, $P = 0.0001$) were abundant in Mixed Pine/Hardwood and Longleaf Sites but lacking in Hardwood Sites (d.f. = 3 for all comparisons; Table 1). Finally, summer tanagers were about equally abundant in Regeneration, Mixed Pine/Hardwood, and Longleaf Sites but were less abundant than expected by chance in Hardwood sites ($\chi^2 = 11.17$, $P = 0.01$).

Effect of forest characteristics—There was no relationship in Hardwood Sites and Mixed Pine/Hardwood Sites between percent pine and mean individuals or mean bird species richness (total individuals: $r^2 = 0.0003$, $n = 129$, $P = 0.85$; species richness: $r^2 = 0.002$, $n = 129$, $P = 0.63$; Fig. 1). I then looked at the relationship between mean number detected and percent pine for the nine species that were observed at least 18 time in Hardwood or Mixed Pine/Hardwood Sites. Scarlet tanagers and red-eyed vireos declined significantly in abundance with increasing proportion of pine in forest stands (scarlet tanager: $r^2 = 0.09$, $n = 129$, $P = 0.0005$; red-eyed vireo: $r^2 = 0.10$, $n = 129$, $P = 0.0002$; Fig. 2). Carolina chickadee, indigo bunting, and pine warbler increased significantly in abundance with increasing proportion of pine in forest stands (Carolina chickadee: $r^2 = 0.03$, $n = 129$, $P = 0.05$; indigo bunting: $r^2 = 0.05$, $n = 129$, $P = 0.01$; pine warbler: $r^2 = 0.17$, $n = 129$, $P = 0.0001$; Fig. 3). Proportion of pine in forest stands had no significant affect on abundance for Carolina wren ($r^2 = 0.04$, $n = 129$, $P = 0.62$), northern cardinal ($r^2 = 0.01$, $n = 129$, $P = 0.39$), or summer tanager ($r^2 = 0.01$, $n = 129$, $P = 0.17$; Fig. 4).

Comparison to Bankhead National Forest

Overall mean number of individuals was significantly lower for Hardwood Sites in the Talladega Mountains than in Hardwood Sites the Bankhead National Forest (Bankhead: $x = 10.5 \pm 3.4$; Talladega: $x = 3.82 \pm 2.10$; $t = 11.6$, d.f. = 92, $P = 0.001$, two-tailed t-test). I found that acadian flycatcher, pileated woodpecker, red-bellied woodpecker, red-eyed vireo, scarlet tanager, white-breasted nuthatch, worm-eating warbler, and yellow-billed cuckoo were encountered significantly less often in point counts in the Talladega National Forest than in point counts in the Bankhead National Forest (Table 3). Blue jay, Carolina chickadee, Carolina wren, great crested flycatcher, ovenbird, and tufted titmouse did not differ significantly in frequency of encounter on point counts in the Talladega and Bankhead National Forests (Table 3).

DISCUSSION

The highest mean diversity of birds and greatest mean number of individual birds were recorded in Longleaf Sites and at sites that had been recently cut and replanted in longleaf pine (Regeneration Sites). These sites not only contained a high diversity of birds, they also provided habitat for several species of management concern in the Southern Ridge and Valley Ecological Unit, as defined by the USFWS (Hunter *et al.*, 1993a). Under the Partners in Flight Species Prioritization Scheme (Hunter *et al.*, 1993b), species are grouped according to their concern scores as "highest overall priority", "high overall priority", and simply "priority" (Hunter *et al.*, 1993b). The following species ranking are based on concern scores for the Southern Ridge and Valley/Southern Cumberland Plateau Ecological

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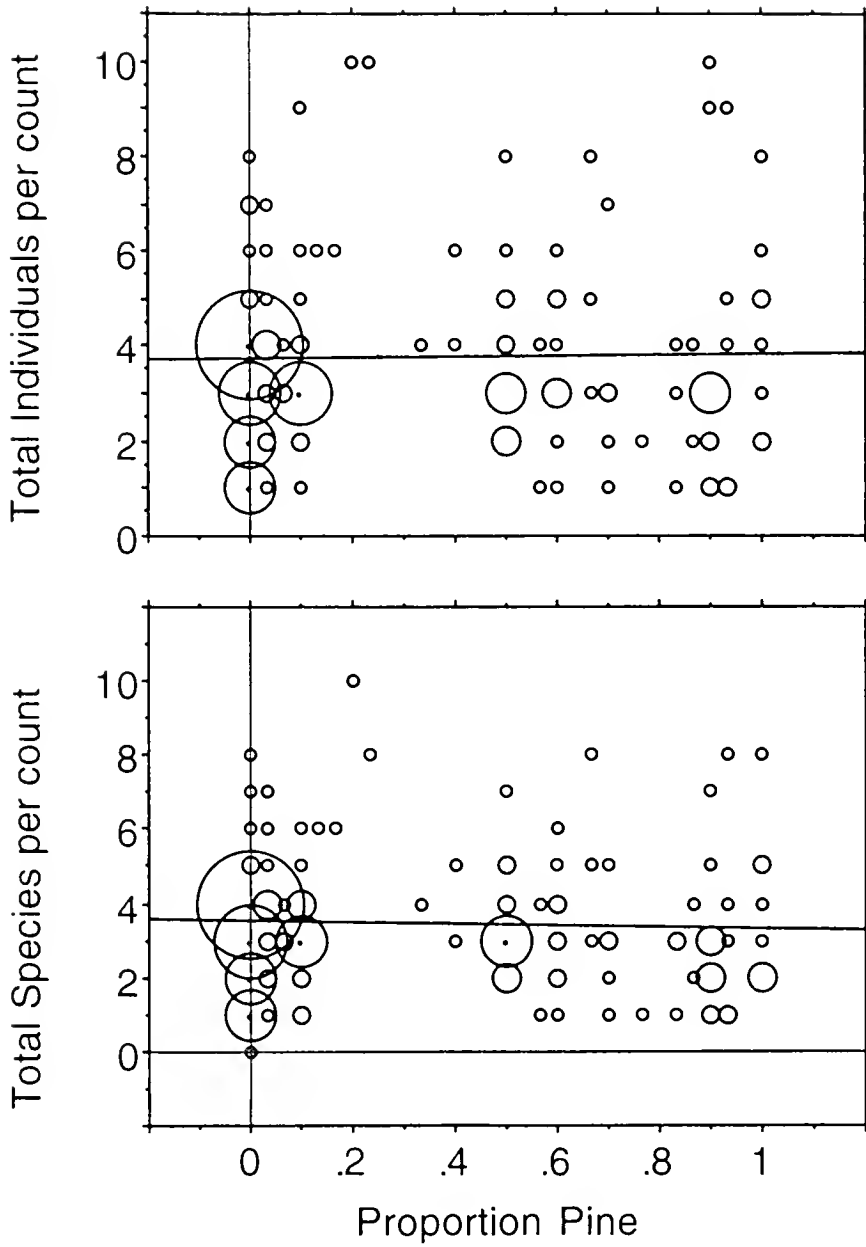


Figure 1. Total individual birds and total bird species richness per count in relation to the percent of pines in the forest habitat sampled. Point size is proportional to the number of overlapping observations.

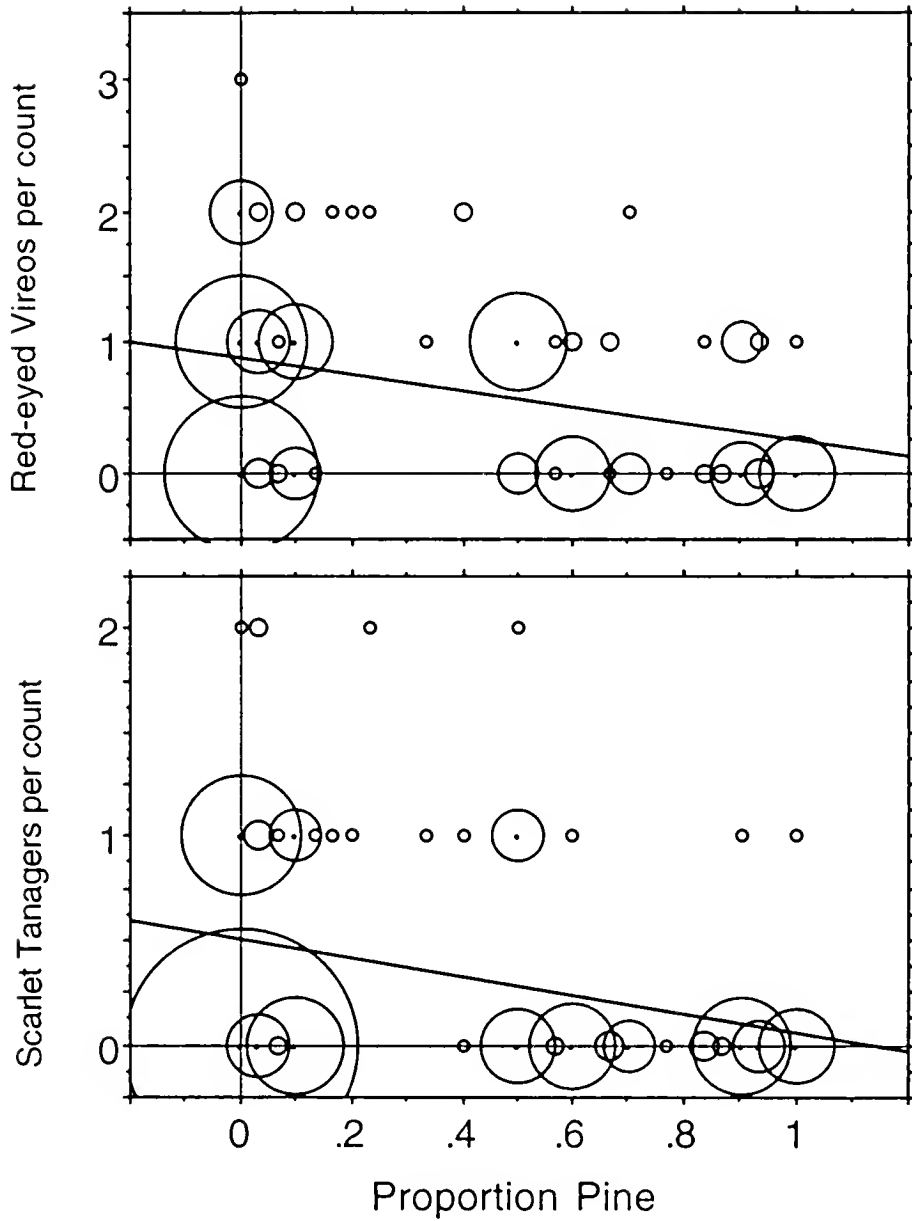


Figure 2. Number of Scarlet Tanagers and Red-eyed Vireos per count in relation to the percent of pines in the forest habitat sampled. Point size is proportional to the number of overlapping observations.

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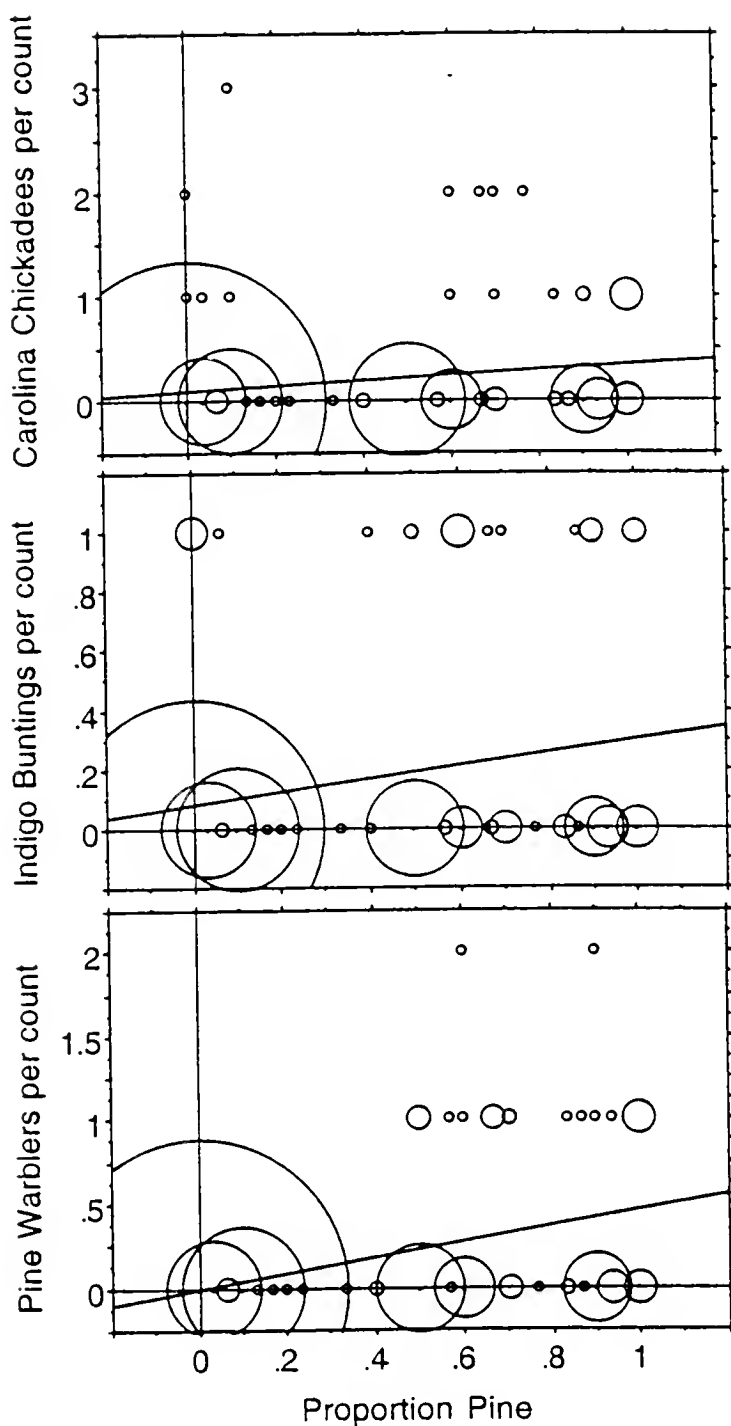


Figure 3. Number of Carolina Chickadees, Indigo Buntings, and Pine Warblers per count in relation to the percent of pines in the forest habitat sampled. Point size is proportional to the number of overlapping observations.

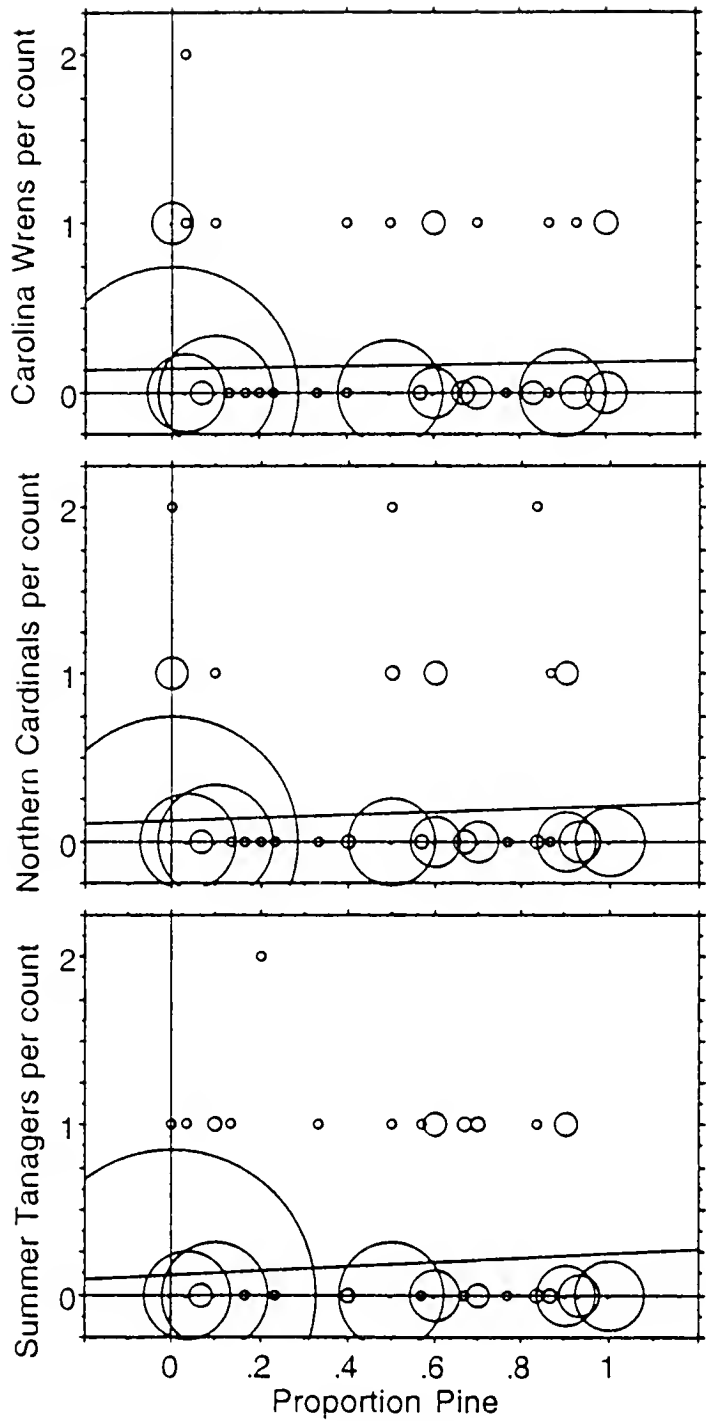


Figure 4. Number of Carolina Wrens, Northern Cardinals, and Summer Tanagers per count in relation to the percent of pines in the forest habitat sampled. Point size is proportional to the number of overlapping observations.

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Units supplied by B. Ford, The Nature Conservancy). Red-cockaded woodpecker is one of four species in the region with a "highest overall priority" ranking, and although no red-cockaded woodpeckers were recorded in Longleaf Sites in this study, the restoration of longleaf pine habitat by the USDA Forest Service is directed toward increasing red-cockaded woodpecker habitat in the Talladega National Forest (USDA Forest Service, 1986). Bachman's sparrow, brown-headed nuthatch, field sparrow, yellow-throated warblers, and prairie warblers, all of which are ranked as "high overall priority" for the region, were found exclusively or almost exclusively in Longleaf Pine or Regeneration sites. In other parts of the southeast, Bachman's sparrows have been shown to prefer areas with sparse midstory and a dense groundcover of grass (Dunning and Watts, 1990, Plentovich *et al.* 1998). In this study, all four sites with Bachman's sparrows had been recently burned and, consequently, had dense ground cover of grasses and forbs and virtually no midstory. Yellow-throated warblers were found only in Longleaf Sites and in one Regeneration Site in which a 20-to-30-year-old longleaf pine had been left standing. Clearly, both the established and recently planted longleaf pine stands in the Talladega National Forest are providing important habitat for a number of bird species of management concern.

Although both established and newly planted longleaf pine forest had the greatest abundance and richness of birds, Hardwood Sites provided critical habitat to several species. Scarlet tanagers and red-eyed vireos, neither listed as of special management concern for the region but both of which have shown continent-wide declines in recent years (Robbins *et al.* 1989), were more abundant in Hardwood Sites than in any other habitat type. Neither species was found in either Longleaf Pine or Regeneration Sites. Acadian flycatcher, wood thrush, Kentucky warbler, and worm-eating warbler, all species of "high overall priority" were infrequently encountered, but all of these species were recorded almost exclusively in Hardwood sites. Yellow-throated vireo, another species of "high overall priority", was found more frequently in Hardwood Sites. Summer tanagers, another species of "high overall priority", were equally common in pine and hardwood forests.

The proportion of pine in forest stands had a significant effect on several species of birds. Scarlet tanagers and red-eyed vireos showed a significant decline as the proportion of pine increased. Carolina chickadee, indigo bunting, and especially pine warbler showed significant increase in abundance with increasing pine. The net effect was no change in total bird abundance or species richness with change in percent pine across sites in mixed loblolly pine/hardwood sites. These observations suggest that loblolly pine stands with a hardwood component can provide habitat for a relatively diverse bird community, but that relatively pure hardwood stands are required for some breeding Neotropical migrant birds.

To my knowledge, this is the first study to look at the effects on breeding bird communities of converting of hardwood and mixed pine/hardwood forests to longleaf pine forests. However, other studies have looked at bird communities in longleaf pine forests and pine plantations in the Gulf Coastal Plain. In general, these studies agree with the observations made in the current study: the greatest diversity and numbers of birds are found in native longleaf pine stands compared to pine plantations (Engstrom 1984, Hill 1998). Previous studies in the southern Appalachians have generally found a negative effect on native forest birds of converting hardwood or pine/hardwood forest to loblolly pine plantations but many species of birds that prefer open successional habitats benefit for the first few years postcut (Conner *et al.* 1979, Crawford *et al.* 1981, Childers *et al.* 1986, Hill 1987). The longleaf pine stands surveyed in this study differ from stands of loblolly pine by maintaining high bird species numbers and richness from seedling stage until mature trees are present.

Comparison of point counts conducted in Hardwood Sites in the Bankhead National Forest in June 1995 to the point counts in Hardwood Sites in the Talladega Mountains from the present study suggests that hardwood forest birds are much less abundant in the Talladega Mountains. Compared to Hardwood Sites in the Bankhead National Forest, the

Hardwood Sites in the Talladega National Forest had significantly lower density of Acadian flycatcher, pileated woodpecker, red-bellied woodpecker, scarlet tanagers, red-eyed vireo, worm-eating warbler, and yellow-billed cuckoo. The differences in density for some species were striking. Worm-eating warblers were found at only one site (2% of counts) in the Talladega Mountains but at 37% of counts in the Bankhead National Forest. Pileated woodpeckers were found at only 5% of counts in the Talladega Mountains but at 53% of counts in the Bankhead National Forest. The differences in abundance of several other species were also of an order of magnitude or more.

Point counts in the Talladega and Bankhead National Forests were conducted in different years, and it is possible that some unknown year effect is responsible for the difference in the number of birds detected. However, the difference in bird abundance was so striking that a year effect does not seem sufficient to explain it. A likely explanation for the relative scarcity of hardwood forest species in the Talladega National Forest compared to the Bankhead National Forest is the dry, rocky conditions that prevail in the Talladega Mountains (Harper, 1943; Wills pers. comm.).

Another difference between the hardwood forests of the Bankhead and Talladega National Forests is the size of hardwood stands. In the Bankhead National Forest large contiguous blocks of hardwood forest remain, while hardwoods in the Talladega National Forest are mostly located in small pockets surrounded by pine/hardwood forest; there were simply few large contiguous patches of hardwood forest in which to place point counts. Thus, the size of the hardwood stands in which point counts were conducted may have influenced the abundance of species that are sensitive to forest area (Robbins *et al.*, 1989; Wenny *et al.*, 1993). In the forests of Fort McClellan, which lies adjacent to the Talladega National Forest, the number and diversity of breeding birds declined (Soehren, 1995) and nest predation increased (Keyser *et al.*, 1998) with decreasing size of hardwood stands. Species such as worm-eating Warbler and pileated woodpecker were most strongly affected. To better test the idea that fragmentation of hardwood forests has caused a decline in hardwood forest bird species would require point counts in forest patches of known size. Such a study would be difficult in the Talladega National Forest, however, because most hardwood forests are surrounded by other types of forest, not clearings, making it very difficult to define an edge and hence to delineate forest fragments.

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LITERATURE CITED

- Childers, E. L., T. L. Sharik, and C. S. Adkisson. 1986. Effects of loblolly pine plantations on songbird dynamics in the Virginia Piedmont. *J. Wildl. Manage.* 50:406-413.
- Conner, R. N., J. W. Via, and I. D. Prather. 1979. Effects of pine-oak clearcutting on winter and breeding birds in southwestern Virginia. *Wilson Bull.* 91:301-316.
- Crawford, H. S., R. G. Hooper, and R. W. Titterington. 1981. Songbird population response to silviculture practices in central Appalachian hardwoods. *J. Wildl. Manage.* 45:680-692.
- Dunning, J. B., Jr., and B. D. Watts. 1990. Regional differences in habitat occupancy by Bachman's Sparrow. *Auk* 107:463-472.
- Engstrom, R. T., Crawford, R. L. and Baker, W. W. 1984. Breeding bird populations in relation to changing forest structure following fire exclusion: a fifteen year study. *Wilson Bull.* 96:437-450.
- Harper, R. M. 1943. Forests of Alabama. Monogr. 10. Geological Survey of Alabama, University, Alabama. 230 p.

Forests for Breeding Birds

- Hill, G. E. 1997. The effects on bird communities of converting southern Hardwood forests to pine plantations. *J. Ala. Acad. Sci.* 68:285 - 295.
- Hill, G. E. 1998. Habitat Use by Breeding Birds in the Southern Coastal Plain, Alabama. *South. J. Appl. For.* 22:133-137.
- Hunter, W. C., M. F. Carter, D. N. Pashley, and K. Barker. 1993a. The partners in flight species prioritization scheme. Pages 109-119 in D. M. Finch and P. W. Stangel, editors. Status and management of Neotropical migratory birds. USDA Forest Service, General Technical Report RM-229.
- Hunter, W. C., D. N. Pashley, and R. E. F. Escano. 1993b. Neotropical migratory landbird species and their habitats of special concern within the southeast region. Pages 159-171 in D. M. Finch and P. W. Stangel, editors. Status and management of Neotropical migratory birds. USDA Forest Service, General Technical Report RM-229.
- Imhof, T. A. 1976. Alabama birds. University of Alabama Press, Tuscaloosa, AL.
- Keyser, A., G. E. Hill, and E. Soehren. 1998. The effect of fragment size, nest density, and proximity to edge on the risk of predation to ground-nesting passerine birds. *Cons. Biol.* 12:986-994.
- Plentovich, S., Tucker, J., Holler, N. and Hill, G. E. 1998. Enhancing Bachman's Sparrow habitat via management of Red-cockaded Woodpeckers. *J. Wildl. Manage.* 61:347-354.
- Robbins, C. S., J. R. Sauer, R. Greenburg, and S. Droege. 1989. Populations declines in North American birds that migrate to the Neotropics. *Proc. Nat. Acad. Sci., USA* 86:7658-7662.
- Robinson, S. K., F. R. Thompson III and T. M. Donovan. 1995. Regional forest fragmentation and the nesting success of migratory birds. *Science* 267:1987-1990.
- Shankman, D., And Wills, K. 1995. Pre-European settlement forest communities of the Talladega, Alabama. *Southeastern Geographer* 35: 118-131.
- Soehren, E. C. 1995. Effects of forest fragmentation on breeding populations of Neotropical migratory birds on Fort McClellan, Alabama. Unpublished masters thesis, Jacksonville State Univ., Jacksonville, Alabama.
- USDA Forest Service. 1986. Land and resource management plan : National Forests in Alabama. U. S. Dept. Agriculture, Atlanta, Georgia.
- Wenny, D. G., R. L. Clawson, J. Faaborg, and S. L. Sheriff. 1993. Population density, habitat selection and minimum area requirements of three forest interior warblers in central Missouri. *Condor* 95:968-979.
- Wilcove, D. S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. *Ecology* 66:1211-1214.

ELECTROPHORETIC ANALYSIS OF CHANNEL CATFISH *ICTALURUS PUNCTATUS* (LESUER, 1840), BLUE CATFISH *I. FURCATUS* (RAFINESQUE, 1818), AND THEIR INTERSPECIFIC HYBRID

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ABSTRACT

In their natural habitat, channel catfish *Ictalurus punctatus* (Lesueur, 1840) and blue catfish *Ictalurus furcatus* (Rafinesque, 1818) spawn during different seasons. Hybrids of the two species are commonly produced artificially in fisheries but, historically, are rarely observed in the wild. Several sources suggest that hybrid catfish are commonly being produced in native Alabama waterways. Identification of channel, blue, and hybrid catfish using morphological keys is often difficult, particularly when examining fry or juveniles. Gel electrophoresis coupled with histochemical staining is a rapid and relatively inexpensive method for examining phenotypic differences among species. The purpose of this study was to determine if electrophoretic fingerprints could be used to identify tissue samples taken from either channel, blue, or hybrid catfish fry. Tail muscle tissue samples were analyzed using standard protocols for IEF electrophoresis and staining of soluble proteins. Protein patterns for channel, blue, and hybrid catfish fry were distinct. Major protein bands in the pI range from 3.5-5.8 were identified as species-specific markers. Preliminary analysis suggests that these marker proteins may be muscle parvalbumins, a group of highly conserved proteins commonly found in vertebrate muscle.

KEYWORDS: catfish, biochemical identification, electrophoresis, IEF

INTRODUCTION

Difficulty in identifying juveniles of many species has been one of the major obstacles in the development of sound ecological theories regarding fish population dynamics. Morphological keys for a variety of fish species are available, however, due to the plasticity of juvenile morphology, particularly when examining potential sub-species, strains, and hybrids, identification remains a difficult task. An alternative method of identification is the use of laboratory techniques that can distinguish individuals based on biochemical data.

Electrophoresis is a powerful yet relatively simple tool that can be used to separate and visualize soluble tissue proteins. Electrophoresis patterns, often termed "fingerprints", have successfully been used to demonstrate patterns of ontogenetic, phylogenetic, or

zoogeographic variation among organisms (Buth, 1990). One method of electrophoresis, isoelectric focusing (IEF), has been particularly effective in distinguishing hybrid fish from their parent species (Whitmore and Hellier, 1988; Whitmore, 1990). In many cases IEF protein fingerprints are so specific that identification can be determined solely without the use of morphological keys.

The production of hybrid catfish in the Southeast is rapidly expanding as the US demand for catfish products increases (NASS/USDA, 1998). Hybrid catfish are typically produced artificially. The process involves stripping eggs from female channel catfish, *Ictalurus punctatus*, and then fertilizing the eggs with milt taken from male blue catfish, *Ictalurus furcatus* (Tucker and Robinson, 1990). Natural production of hybrids is believed unlikely due to differences in spawning behavior of the two parent species (Tucker and Robinson, 1990). Since it is likely that the production of hybrid catfish will increase in the future, the ecological impact of the possible introduction of large numbers of hybrid catfish in natural waters should be addressed. Monitoring natural waters relies heavily on the successful identification of indigenous and introduced species.

Characteristics such as body coloration, body shape, and number of rays on fins can easily be used to distinguish adult hybrid catfish from their parent species (Whitis, personal communication). Morphological identification of hybrid juveniles, particularly fry, is a much more difficult task and is often impossible. The purpose of this study was to determine if IEF protein fingerprints could be used to identify hybrid fry catfish from fry of their parent species.

MATERIALS AND METHODS

Animals

One-week-old channel catfish, *Ictalurus punctatus*, and blue catfish, *Ictalurus furcatus*, fry were obtained from the Gadsden State Community College Aquaculture Education and Development Center (Gadsden AL). The channel catfish were a Kansas-Marion strain and the blue catfish were a Rio-Grande strain. The Gadsden Center originally obtained the fish strains from Mr. Bill Davis (Davis Catfish Farms, Centre AL). One-week-old hybrid catfish fry were a cross between Kansas-Marion channel catfish and Rio-Grande blue catfish and were generously donated by Mr. Davis.

Sample preparation

One week old catfish fry (~100 mg wt w) were anesthetized on ice prior to removal of tissue samples. Approximately 5 mg of tail muscle was excised from each fish and homogenized in a 1 % Triton X-100 sample preparation solution (1:3 w/v). Samples were centrifuged for 15 min at 45,000 RCF and the resultant supernatant removed and frozen at -20°C until used for electrophoresis. Samples were prepared from a total of five sibling channel, blue, and hybrid catfish fry from each of two spawning seasons (i.e., 10 total fish for each population).

Electrophoresis

Samples were analyzed using standard protocols for IEF electrophoresis and staining of soluble cytoplasmic proteins (Biorad application guide #161-0993). Briefly, 10 μ l of each muscle tissue sample was loaded into precast IEF mini-gels. Broad range IEF gels, pH 3-

Protein Fingerprints for Catfish

10, were used to maximize the total number of potential protein bands observed. Anode and cathode solutions used for electrophoresis were 100 mM arginine and 43 mM phosphoric acid, respectively. IEF standards were co-electrophoresed with fish samples and were used to determine pI values for protein bands. Power conditions for electrophoresis were followed according to standard protocol (Biorad application guide #161-0993). Following electrophoresis, gels were removed, fixed, and then silver stained to observe protein patterns. Finally, gels were preserved by soaking in a 20% ethanol/10 % glycerol solution for one hour and then dried between cellophane drying sheets.

Data Analysis

Banding patterns on gels were scored both visually and using gel analysis computer software (Sigma Gel™). Gel analysis software was used specifically to determine pI values of potential species-specific protein bands.

RESULTS

IEF protein fingerprints of channel, blue, and hybrid catfish fry were distinct. Although differences were observed in minor staining bands among siblings within a population for each spawning season, several major staining bands were consistently observed among the three populations. Specifically, major protein bands in the pI range of 3.5-5.8 were species-specific (Figure 1). For channel catfish, a unique group of proteins at a pI of 5.8 was observed that was not observed in either hybrid or blue catfish samples. Likewise, for hybrid catfish, a unique group of proteins at a pI of 5.2 was observed that was not present in either channel or blue catfish samples. Blue catfish samples exhibited no unique major staining proteins with acidic pI values. Overall, species-specific proteins were consistent within each population for both spawning season populations examined.



Figure 1. Representative IEF patterns of total muscle proteins from fry channel catfish *I. punctatus* (C), blue catfish *I. furcatus*, and their interspecific hybrid (H).

DISCUSSION

Adult catfish, *Ictalurus spp.*, can be accurately identified using morphological keys. One of the major morphological differences between channel, *I. punctatus*, and blue catfish, *I. furcatus*, are the shape and the number of rays on the caudal fin (Tucker and Robinson, 1990). Errors in identification using morphological keys rarely occur except when examining immature fish (fingerlings or fry) or when examining potential hybrids of two species (Whitmore, 1986). Identification of hybrid catfish fry from channel and blue catfish fry using morphological keys is often difficult. In the present study, IEF total protein fingerprints easily permitted the accurate identification of *I. punctatus* fry from *I. furcatus* fry and their interspecific hybrid.

IEF techniques are one of the most rapid and sensitive methods of examining tissue proteins electrophoretically (Whitmore, 1990). The ability to concentrate limited amounts of proteins into sharp zones at their respective pIs makes IEF techniques particularly useful when limited amounts of tissue are available for examination, such is the case when examining fish fry. IEF techniques are also particularly consistent in producing repeatable protein fingerprinting data. To date, the high sensitivity of this technique has proved invaluable in the biochemical analysis of genetic variation among fish populations (Whitmore, 1990).

Isoelectric focusing (IEF) techniques have been used successfully to establish species-specific protein fingerprints for a variety of fish species (Whitmore, 1990). IEF established fingerprints of blood hemoglobin and muscle parvalbumin proteins have been particularly useful in examining fish population structure and dynamics (Whitmore, 1990). IEF muscle parvalbumin fingerprints have also been successfully used to identify species and assess interspecific hybridization (Monaco et al., 1982; Whitmore and Hellier, 1988). Parvalbumins comprise a family of soluble proteins found in large quantities in fish skeletal muscle (Bhushana et al., 1973; Monaco et al., 1982; Chikou et al., 1997). Parvalbumins are typically of low molecular weight, have acidic pI's, and are extremely stable compared to other soluble muscle proteins (Pechere et al., 1971; 1974). Based on their relative abundance and pI values, it is possible that the species-specific proteins observed in this study were muscle parvalbumins.

Whitehead and Harvey (1989) examined muscle tissue proteins from six species of catfish including *I. punctatus* and *I. furcatus* using IEF techniques. The majority of the species examined were collected in Texas with a few from Louisiana (one blue and two channel) and Alabama (nine white catfish). Species specific protein fingerprints were identified for the majority of muscle samples examined on pH 4-5 IEF gels and could be used to identify the various fish populations. Although not determined in their study, acidic pI values and relative abundance suggests that these marker proteins may also be muscle parvalbumins.

Recent investigations have demonstrated ontogenetic variability in total protein patterns in developing and adult catfish, *Chrysichthys auratus* (Chikou et al., 1997). In this study, no differences were observed in muscle protein fingerprints among same-species, seven-day-old catfish fry. Analysis of muscle proteins from fry, juvenile, and adult catfish

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used in this study may reveal similar ontogenetic variability. The further examination and establishment of biochemical fingerprint "libraries" for catfish species and their hybrids may provide a secondary method of identifying unknown individuals when morphological keys prove unsuccessful.

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LITERATURE CITED

- Bhushana, Rao KSP, Gerday, Ch. (1973). Low molecular weight proteins of pike (*Esox lucius*) white muscles. *Comparative Biochemistry and Physiology* 44(B), 1113-1118.
- Buth, D.G. (1990). Genetic principles and the interpretation of electrophoretic data. In *Electrophoretic and isoelectric focusing techniques in fisheries management* (Whitmore, D.H., ed.), pp. 1-21. Boca Raton: CRC Press.
- Chikou, A., Huriaux, F., Laleye, P., Vandewalle, P., and B. Focant. (1997). Isoform distribution of parvalbumins and of some myofibrillar proteins in adult and developing *Chrysichthys auratus* (Geoffroy St. Hilaire, 1808)(Pisces, Claroteidae). *Archives of Physiology and Biochemistry* 105(6), 611-617.
- Monaco, P.J., Rasch, E.M., Balsano, J.S., and B.J. Turner. (1982). Muscle protein phenotypes and the probable evolutionary origin of a unisexual fish, *Poecilia formosa*, and its triploid derivatives. *Journal of Experimental Zoology* 221, 265-275.
- NASS/USDA. (1998). *Catfish Production Report*.
- Pechere, J.F., Capony, J.P., and J. Demaille. (1974). Evolutionary aspects of the structure of muscular parvalbumins. *Systematic Zoology* 22, 533-541.
- Pechere, J.F., Demaille, J., and J.P. Capony. (1971). Muscle parvalbumins: preparative and analytical methods of general applicability. *Biochimica and Biophysica Acta* 236, 391-400.
- Ready gels application guide. Catalog #161-0993. Bio-Rad Laboratories. Hercules, CA. Sigma Gel™. Jandel Scientific.
- Tucker, C.S. and E.H. Robinson. (1990). Breeding. In *Channel catfish farming handbook*. pp. 11-134. New York: Chapman and Hall.
- Whitelhead, P.K., and W.D. Harvey. (1989). Identification of six catfish species utilizing isoelectrically focused muscle tissue. *Proceedings of the Annual Conference of the Southeast Association of Fisheries and Wildlife* 43, 138-145.
- Whitis, G. Personal communication.
- Whitmore, D.H. (1986). Identification of sunfish species by muscle protein isoelectric focusing. *Comparative Biochemistry and Physiology* 84B(2), 177-180.
- Whitmore, DH. (1990). In *Electrophoretic and isoelectric focusing techniques in fisheries management*. (Whitmore, D.H., ed.), pp. 96-105. Boca Raton: CRC Press.
- Whitmore, D.H., and T.R. Hellier. (1988). Natural hybridization between largemouth and smallmouth bass (*Micropterus*). *Copeia*, 493-501.

EVOLUTION AND CREATIONISM:
ATTITUDES OF UAB UNDERGRADUATES

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INTRODUCTION

In January, 1997, the Alabama Academy of Science devoted an entire issue of its *Journal* to the topic of Science Education in Alabama (*Vol. 68, No. 1*). Despite the wide range of subjects and activities implied by such a broad theme, however, virtually all contributed articles dealt, either directly or indirectly, with the so-called evolution-creationism controversy in general, and the Alabama textbook insert in particular (1-5). Such focused attention on this matter is testament to the concern among members of the scientific community over the continued and growing challenge to the teaching of evolution in this state, and in the nation, coming from religious fundamentalists (6).

Although the most recent Alabama Course of Study: Science (COSS) was modified somewhat by the State Board of Education in response to pressures from anti-evolution interests (7), Frandsen and Brande (4) have argued that such changes may not markedly affect the instruction of evolution in the classroom. The textbooks themselves (despite inclusion of the cautionary disclaimer), individual teacher knowledge and initiative, and local curricular supplementation were all suggested as factors which might conceivably mitigate the de-emphasis of evolution in the state-approved curriculum.

While this optimistic assessment may well be true for some of the more affluent suburban school districts in which the sociopolitical and religious environments tend typically not to be inclined toward fundamentalist extremes, it is less clear what effect, if any, such factors as enhanced teacher initiative and local curriculum changes would have in the more religiously conservative, rural school districts of the state. As recently pointed out by Eugenie Scott, executive director of the National Center of Science Education, one of the purposes of state-mandated textbook disclaimers of evolutionary theory is teacher intimidation (8), and one suspects that such intimidation is more likely to be realized in religiously conservative rural school systems.¹

¹We have recently completed a survey similar to that reported here on 10th-, 11th- and 12th-grade biology students in a small public high school in rural northwest Alabama (Wood, S., 1998, Ed.S. thesis). Qualitative findings from this study, including interviews and informal discussions with both students and teachers, support such a view of enhanced intimidation.

As has been mentioned previously in the pages of this journal (2) and elsewhere (9), the courts have spoken clearly and decisively on the matters of banning evolutionary theory or requiring the teaching of alternative religious creation narratives in public school science classrooms. Nevertheless, as was made clear by the perceived need for the Alabama textbook insert, public (and political) sentiment is still in a state of some disquietude over these issues. Currently, fewer than one-half of adult Americans believe that human beings evolved from earlier species (2), and more than half say they would like to have creationism taught in public schools (9).

According to Morris Shamos, a past president of the National Science Teachers Association, some surveys of college and university students "have shown that a large majority favor the introduction of 'creation science' in the classroom" (10). During the height of the evolution-creationism controversy in the 1980s, a survey of high-school biology teachers in Ohio found that at least fifteen percent of the biology courses offered presented "creation science" in a favorable light (10). Nevertheless, few such attitudinal surveys have focused on students and teachers in particular, either at the secondary or college level.

In part because of the current situation in Alabama, together with my own convergent interests in both science education and evolutionary biology, I recently offered a three semester-hour honors seminar at the University of Alabama at Birmingham titled "The Evolution-Creationism Controversy." As a class project in partial fulfillment of the course requirements, students in the seminar developed a brief survey form relevant to the course theme which was subsequently administered to a random sampling of UAB undergraduates. In addition, the Gladding, Lewis and Adkins Scale of Religiosity (GLASR) (11) was included as an addendum to the survey form. Data from this instrument have not yet been correlated with responses to the students' own survey.²

THE SURVEY

The survey form (Figure 1), in addition to requesting a minimal amount of demographic information, consisted of four declarative statements which required respondents to indicate the degree to which they agreed or disagreed with each on a five-item Likert-type scale. A total of 118 surveys were completed by students representing all eight of the undergraduate academic units at UAB: Arts and Humanities (5.9 percent); Business (12.7 percent); Education (5.9 percent); Engineering (9.3 percent); Natural Sciences and Mathematics (22 percent); Nursing (4.2 percent); Social and Behavioral Sciences (24.6 percent); and the Health Related Professions (8.5 percent). 6.8 percent of the students responding were undecided with respect to an academic major. The average age of the respondents was twenty-three, and the ratio of male to female students completing the survey was 0.96.

Despite the consternation of Alabama's scientific community in the wake of the State

²The GLA Religiosity Scale, or GLASR, was developed at Rockingham Community College in Wentworth, North Carolina, 1977-1982, in an effort to provide local mental health career professionals with a useful clinical measure of the scope and intensity of religious beliefs among individuals living in a traditional rural protestant environment. Although several other survey instruments designed to measure similar kinds of attitudes have been developed, the GLASR was chosen for use here because it has been used more extensively at colleges and universities.

(Figure 1. continued)

4. Please read the following, which is required by the Alabama State Board of Education to be affixed to the inside front cover of all Alabama public school biology textbooks:

This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things, such as plants, animals and humans.

No one was present when life first appeared on earth. Therefore, any statement about life's origins should be considered as theory, not fact.

The word "evolution" may refer to many types of change. Evolution describes changes that occur within a species. (White moths, for example, may "evolve" into gray moths.)

This process is microevolution, which can be observed and described as fact. Evolution may also refer to the change of one living thing to another, such as reptiles into birds. This process, called macroevolution, has never been observed and should be considered a theory. Evolution also refers to the unproven belief that random, undirected forces produced a world of living things.

There are many unanswered questions about the origin of life which are not mentioned in your textbooks, including"

Why did the major groups of animals suddenly appear in the fossil record (known as the Cambrian Explosion)?

Why have no new major groups of living things appeared in the fossil record in a long time?

Why do major groups of plants and animals have no transitional forms in the fossil record?

How did you and all living things come to possess such a complete and complex set of "instruction" for building a living body?

Study hard and keep an open mind. Someday you may contribute to the theories of how living things appeared on earth.

Evolution and Creationism

Board of Education's textbook insert decision (5), our survey revealed that fully two-thirds of the undergraduates polled at UAB either strongly or slightly agree that the insert is appropriate (survey item four); only fifteen percent felt strongly that it was inappropriate (It should be pointed out that, although most of the students surveyed were aware of the insert—mainly from news reports—very few had actually read it prior to seeing it on our survey instrument). It is difficult, however, to know exactly what prompts such sentiment on the part of students.

It may, of course, simply reflect a poor understanding of evolution and evolutionary theory, either because these subjects were not formally taught during the students' schooling, or were taught poorly. This is likely the predominant opinion among members of the scientific community (9, 12), and the impetus behind the drafting of the National Academy of Sciences' recent publication for teachers, *Teaching About Evolution and the Nature of Science* (9).

On the other hand, our students' apparent tolerance toward the textbook insert may also be due in part to their belief that it is a "fair" document given the controversial nature of the material. As science historian and legal scholar Edward J. Larson has recently argued, the issues raised by the so-called evolution-creationism controversy "...endure precisely because they embody the characteristically American struggle between individual liberty and majoritarian democracy, and cast it in the timeless debate over science and religion" (13). In this regard, it is interesting to note that fewer students, albeit 53.9 percent, either strongly or slightly agreed that creationism ought to be taught in classrooms whenever scientific theories or explanations of such topics are discussed (survey item three) than did the number who felt likewise with respect to the appropriateness of the textbook insert (67.3 percent).

Among the more interesting findings to emerge thus far from this small study, however, were the UAB students' responses to questions one and two on the survey form (Table 1). Most striking is the fact that nearly two-thirds of the respondents definitely agree or slightly agree with *both* a Darwinian interpretation (65%) and a biblical account (67%) of the appearance and diversity of life forms on earth. While it obviously cannot be assumed that the same group of approximately eighty students gave the responses noted above (and in Table 1) to both questions, no fewer than a third of them (i.e., approximately twenty-seven students) must have. If it is further assumed, moreover, that only "strict creationists" would answer "E" to question one (i.e., twenty-two respondents), and that only "strict Darwinists" would answer "E" to question two (i.e., nineteen students), then it seems reasonable to suppose that this pool of approximately forty students could be removed from that group of eighty which might have strongly or slightly agreed with both questions, leaving forty students (34% of the total respondents) who actually did so. What are we to make of such an attitude, and how do these students reconcile such seemingly contradictory views?

The most likely explanation for this phenomenon is what Harvard paleontologist Stephen Jay Gould has termed "fallen creationism" (14). This is the notion that, while the evidence for evolution itself seems virtually incontrovertible, evolution has not occurred by "natural" selection but rather—and certainly in the case of human beings—by a kind of "divine" selection; that is, via the actions of a supreme intelligence or deity which has, in some way,

Table 1 Selected Results from the Evolution-Creationism Survey of UAB Undergraduates

I believe Charles Darwin's Theory of Evolution by Natural Selection to be a convincing explanation for the appearance and diversity of living organisms on earth, including human beings.

A. Definitely agree	36.4%
B. Slightly agree	28.8
C. Don't know	6.8
D. Slightly disagree	8.5
E. Definitely disagree	19.5

I believe in the Judeo-Christian (Biblical) account of the creation of the earth and its inhabitant life forms as described in the Book of Genesis.

A. Definitely agree	44.4%
B. Slightly agree	22.2
C. Don't know	12.0
D. Slightly disagree	6.0
E. Definitely disagree	15.4

"overseen" and "guided" the evolutionary process. Such a view, of course, allows individuals to believe in the fact of evolution without having to accept Darwin's theory that it is a mindless process void of purpose and direction. According to a 1997 poll Princeton Religion Research Center (15), thirty-nine percent of adult Americans hold to this view, exceeded only by those professing a belief in strict creationism (forty-four percent). Only ten percent of the American public holds to a strictly Darwinian picture of evolution by natural selection. According to the present study, it is likely that at least a third, and perhaps more, of UAB undergraduates also hold to the view that God has guided the appearance and evolution of (at least) humans on the earth.

It is interesting to note that the Catholic Church seems recently to have adopted a similar position with respect to biological evolution, or at least the evolution of the human mind (soul). In an open letter transmitted to the Pontifical Academy of Sciences in October, 1996, Pope John Paul II wrote:

Today...new knowledge has led to the recognition of more than a hypothesis in the theory of evolution. It is indeed remarkable that this theory

Evolution and Creationism

has been progressively accepted by researchers, following a series of discoveries in various fields of knowledge. The convergence, neither sought nor fabricated, of the results of work that was conducted independently is in itself a significant argument in favor of this theory.

[However]...if the human body takes its origin from preexistent living matter, the spiritual soul is immediately created by God. Consequently, theories of evolution which, in accordance with the philosophies inspiring them, consider the mind as emerging from the forces of living matter, or as a mere epiphenomenon of this matter, are incompatible with the truth about man (16).

One supposes that if there is any encouragement for strict Darwinists to be found amongst these numbers it is that between thirty-three and forty percent of the American public, like the Catholic church, seems now to have accepted the fact of evolution, even if they still have some serious concerns about its mechanism. In any event, the so-called "fallen creationism" phenomenon, if real, may have implications for those interested in, and concerned about, the teaching of evolution in our nation's schools.

REFERENCES

1. Dawkins, R. 1997. The "Alabama Insert": A Study in Ignorance and Dishonesty, *J. Alabama Academy of Science*, Vol. 68, No. 1.
2. Mullins, D. W., Jr. 1997. The Evolution-Creationism Controversy: A Brief Social and Legal History, *J. Alabama Academy of Science*, Vol. 68, No. 1.
3. Beckwith, G. V. 1997. Darwin and Darwinism: The Use and Misuse of Science, *J. Alabama Academy of Science*, Vol. 68, No. 1.
4. Frandsen, J. C. and Brande, S. 1997. An Analysis of the 1995 Alabama Draft and Adopted Course of Study: Science, *J. Alabama Academy of Science*, Vol. 68, No. 1.
5. Brande, S. and Frandsen, J. C. 1997. The Evolution/Creationism Controversy During the 1995 Alabama Science Textbook Adoptions, *J. Alabama Academy of Science*, Vol 68, No. 1.
6. Kennedy, D. 1998. Helping Schools to Teach Evolution, *Chronicle of Higher Education*, August 8, p. A48.
7. Teague, W. 1995. Alabama Course of Study: Science, *Alabama State Board of Education*, Bulletin 1995, No. 4.

7. Teague, W. 1995. Alabama Course of Study: Science, *Alabama State Board of Education*, Bulletin 1995, No. 4.

Mullins

8. Dougherty, M. J. and Scott, E. C. 1998. Teaching Evolution in Creationist Communities, *National Science Teachers Association Southern Area Convention*, Birmingham, Alabama, November 19-21.
9. National Academy of Sciences. 1998. *Teaching About Evolution and The Nature of Science*, National Academy Press, Washington.
10. Shamos, M. H. 1995. *The Myth of Scientific Literacy*, Rutgers University Press, New Brunswick.
11. Gladding, S. T., Lewis, E. L. and Adkins, L. 1981. Religious Beliefs and Positive Mental Health: the GLA Scale and Counseling, *Counseling and Values*, Vol. 25, No. 3.
12. Zacks, R. 1997. What Are They Thinking? Students Reasons for Rejecting Evolution Go Beyond the Bible, *Scientific American*, October (p. 34).
13. Larson, E. J. 1998. *Summer for the Gods: The Scopes Trial and America's Continuing Debate over Science and Religion*. Harvard University Press, Boston.
14. Gould, S. J. 1997. "The Fact of Evolution and the Politics of Creationism," UAB Lecture Series, May 8.
15. Princeton University Religion Research Center. 1997. "Emerging Trends."
16. Joannes Paulus Pr. II. 1996. Open letter to the Pontifical Academy Of Sciences, October 22.

AN EXAMINATION OF FAMILY AND FRIENDSHIP RELATIONSHIPS
ON THE LONELINESS EXPERIENCED
BY MEMBERS OF THE WIDOWED
PERSONS' SERVICE

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ABSTRACT

This study examines the loneliness experienced by 134 older widow(er)s who are members of the AARP sponsored Widowed Persons' Service in a medium-sized southern city. Of particular interest is the examination of the set of factors that may differentially influence these persons' experience of emotional loneliness. Using multiple regression analysis the impact on emotional loneliness of the following variables was examined: age, sex, living arrangements, self-rated health, self-rated economic condition, the existence (or not) of children, the existence (or not) of friends, the extent of social support provided by existing children, and the extent of social support provided by existing friends. The results indicate that greater loneliness is associated with having no best or closest friend -- the number of friends, among those with friends, made no difference. The existence of children, nor the social support provided by those with children, showed no association with loneliness.

Persons of all ages have needs associated with social affiliations. Older persons are especially vulnerable, due to advanced age, to the loss of significant others and the social affiliations these lost persons provided. In the absence of satisfying social relationships, most persons experience some resultant negative feeling state. One of these is emotional loneliness. Within this context, we examined a group of older persons who are widowed -- those who have experienced the most stressful life-event (Amster & Krauss, 1974) -- and are members of a group dedicated to providing support for such persons, i.e., the Widowed Persons' Service sponsored by the American Association of Retired Persons.

INTRODUCTION

Loneliness: Considerations of Social Isolation and Emotional Isolation

Loneliness in general is a distressing subjective feeling marked by a perceived deficiency in social relationships (Peplau & Perlman, 1982). A commonly recurring assumption is that loneliness is synonymous with social isolation, i.e., a lack of associates with whom one can interact. Lopata (1969), many years ago, discussed loneliness as a sentiment felt by a person whose experience level or form of interaction is in some way inadequate. More recently, Andersson (1986) defined social isolation as the experienced lack of relatedness to the social environment. Social isolation seems to reflect a general deficit in one's social life.

Loneliness has been associated also with emotional isolation. That is, loneliness has been viewed as resulting from the loss or lack of intimate ties (Riesman, 1973). Weiss (1987) further indicated that loneliness is related to the absence of an attachment figure, i.e., one to whom one is emotionally committed. Andersson (1986) defined it as an experienced lack of intimacy. In general, social isolation means there is no one to interact with, while emotional isolation indicates that while there may be others present the emotional connectedness is weak.

In the context of these two types of isolation, one can view loneliness as an affective emotional experience in which one begins to sense being apart from familiar support networks or systems and apart from others. This, in turn, can lead to a realization that social contacts are diminishing, lacking, or not at a level, quantitatively or qualitatively, that is emotionally satisfying or supportive (Johnson & Mullins, 1987).

Importance Of Social Relationships In Old Age Spousal Relations

Several researchers have indicated that individuals experience greater emotional distress in the absence of a mate (deJong-Gierveld, Kanphuis, & Dykstra, 1987; Essex & Nam, 1987). Married older persons also score significantly higher than widowed persons on measures of morale, psychological adjustment, happiness, and life satisfaction (Bachrach, 1980; Lopata, Heinemann, & Baum, 1982). Severe distress is unusual among married men, more prevalent among married women, and quite prevalent among those unmarried of both sexes, regardless of age (Weiss, 1973). As several researchers (Quinn, 1983; Troll, Miller, & Atchley, 1979) have indicated, marriage in old age is viewed as central to the "good life."

The marital relationship is seen as a source of comfort and support as well as the focal point of everyday life. Theoretically, the marital relationship is especially important to what Weiss (1974) posits as one of the six important types of social support, i.e., attachment. Attachment includes affection, security and intimate disclosure, and could be represented by the intimate relationship one has with a spouse. Thus, older widowed persons are without the one relationship that could be especially important to feelings of social and emotional integration and attachment (Weiss, 1973; 1974). There are, of course, other personal relationships, aside from the intact spousal relationship, that are important to social and emotional well-being. Primary among these relationships are those with children and friends.

Family and Friendship Relationships

Relationship With Children

Research over the years has demonstrated that older persons live near (but not with) at least one child, interact frequently with their children, and are involved in the exchange of mutual aid with their children as both providers and receivers (Atchley, Pignatiello, & Shaw, 1979; Powers & Bultena, 1976). Adult children contribute greatly to the well-being of older people -- providing many forms of care, support, and assistance (Mancini & Blieszner, 1989). Compared with those with children, childless persons are more likely to live alone and, if living alone, are less likely to have had any social contact in the past day or so. This finding indicates an association between childlessness and the likelihood of social isolation in old age (Mullins, Woodland, & Putnam, 1989).

Empirical studies examining the connection between emotional well-being and contact with children have shown conflicting results. Lee and Ellithorpe (1982) found no association between persons' emotional well-being and the frequency of interaction with their children. DeJong-Gierveld et al. (1987) found the amount of contact unimportant to loneliness, but concurrently found poor quality of relationships to be important to its manifestation. Mullins, Johnson, and Andersson (1987) in their studies of older persons residing in congregate facilities, also found frequency of contact to have little effect on loneliness. A study of older Canadian seasonal residents in Florida, however determined that persons with more children residing nearby were less likely to be lonely than those with fewer proximate children (Mullins, Tucker, Longino, & Marshall, 1989).

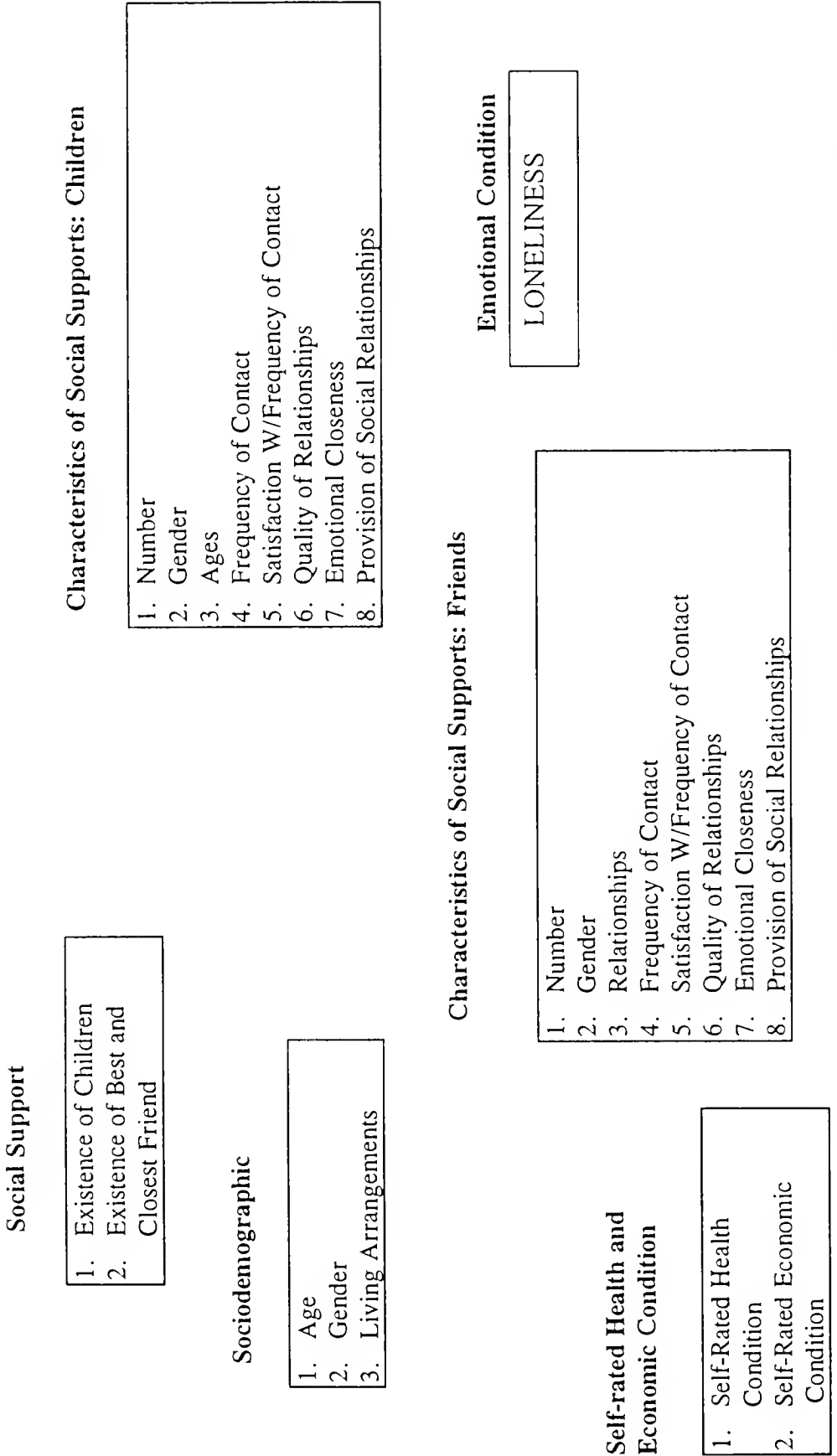
Friendship Relationships

Friendships foster a kind of belonging based on proximity and conviviality (Hochschild, 1973). Unlike family ties, which remain fairly consistent through old age, contact with friends can be subject to more variation. Because they are not formally prescribed, as kinship roles are, relations with friends require initiative by the older person. Although some conditions associated with aging (e.g., health or economic problems, geographic distance, retirement, a neighborhood change) may make interaction difficult (Allan & Adams, 1989), many older adults maintain some friendships for many decades (Shea, Thompson, & Blieszner, 1988). Research has shown that friends, especially close friends, exert a positive influence on the emotional well-being of older persons (Crohan & Antonucci, 1989). Besides serving as confidants, they provide numerous forms of social and emotional support that are valued and appreciated especially because the support is nonobligatory. Generally, older persons who have contact with friends, especially those residing near them and who experience satisfaction from those relationships, are emotionally satisfied (Mullins, et al., 1987; Mullins, Woodland, & Putnam, 1989).

THE MODEL

Based on the conceptual and theoretical considerations discussed, we offer a conceptual model, shown in Figure 1, that allows for an exploratory examination of the direct and indirect effects of the sociodemographic, health and economic condition, and social support/involvement variables on the loneliness experienced by widowed older persons, who are members of an

FIGURE 1. CONCEPTUAL MODEL OF RELATIONSHIPS



Family and Friendship Relationships

organized support group. Analysis of the model provides insight into two issues.

A) How do variables from each section of the model directly relate to loneliness?

B) How do the antecedent variables in the model relate to the identified predictors of loneliness in each section as identified in the analysis of the previous question?

METHODS

Sample

Data were collected in 1996 from the members of the Widowed Persons' Service (WPS), affiliated with the American Association of Retired Persons, serving a three county area in central Alabama. The service provides a formal program for members once a month and informal counseling on an on-going basis. No formal counseling is provided, though participants can be referred to appropriate counseling services.

Working in conjunction with the officers of the Board of Directors in order to assure and maintain confidentiality, questionnaires and stamped return mail envelopes were sent to all of the current members of the WPS (N=230). After one follow-up letter, the final response was 134 returned instruments (58%).

Variable Measurements

Loneliness was measured using the 11-item scale, shown in Appendix A, developed by deJong-Gierveld et al. (1987). Response categories were "Yes" or "No." Each scale item was scored as either 0, indicating a nonloneliness response, or 1, indicating a loneliness response. The loneliness score ranged from 0 through 11, with higher scores indicating higher degrees of loneliness. The alpha coefficient of reliability was .88 with the present data.

Three sociodemographic variables were included, i.e., chronological age, sex, and living arrangements (i.e., whether the respondents lived alone or not). One indicator for self-related health and another for self-rated economic condition, also, were used. Regarding self-rated health, respondents were asked "In general, how would you rate your health?" The four response categories were poor, fair, good, and excellent. Self-rated economic condition was measured by the respondents' selection of one of the following statements: "I really can't make ends meet;" "I just about manage to get by with the income I have now;" "I have enough to get along and even a little extra;" and "I can buy pretty much anything I want with the money I have."

In order to tap both social and emotional aspects of these older persons' relationships with children and friends -- arguably the two most important relationship categories to emotional condition, aside from marriage -- we first identified whether they had children or friends. Next, among those who indicated they had children, the respondents were asked to answer a set of both open and close-ended questions about each child. Similarly, among those who indicated they had friends, they were asked to answer a set of questions about no more than their four best and closest friends. For both children and friends, information was collected pertaining to eight variables: A) the total number of children, B) the total number of friends, C) the sex of the children, D) the sex of the closest friends, E) the ages of the children,

F) the ages of the closest friends, G) frequency of contact with the children, H) the frequency of contact with the closest friends, I) satisfaction with the contact frequency with the children, J) satisfaction with the frequency of contact with the closest friends, K) the quality of the relationships with the children (and the closest friends), L) the emotional closeness of the relationship with the children (and the closest friends), and M) an assessment of what support the relationship with the children (and the closest friends) provide.

The Analysis

With regard to the exploratory conceptual model, a series of stepwise regression analyses were conducted. First, loneliness was separately regressed on the identified variables within each antecedent component of the model. This method of analysis optimizes the use of the data and provides for the identification of the important antecedents of the dependent variable. The purpose of conducting the multiple regression analyses was to examine: A) the set of variables within each of the conceptual components of the model that were significantly related to the expression of loneliness, and B) the set of antecedent variables significantly related to those factors within a conceptual block of variables that were found to be directly related to the expression of loneliness.

RESULTS

The frequency distribution, shown in Table 1, indicates that the average age of the respondents was 74.45 years, 87% of the respondents were female, and 92% lived alone. The self-rated economic condition was predominately "enough to get along or better." The self-rated health status was good (56%) or excellent (20%) -- only 24% indicated their health was fair or poor.

Regarding social supports, 11% had no children and 6% said they had no friends. Among those with children the median number was two. Most of the children (73%) were daughters and the children's average age was 45.54 years; 15% saw a child an average of at least weekly and these older persons were quite satisfied with this contact frequency. Also, the general view was that the quality of the relationships with their children was good to excellent and the experienced emotional closeness was very close. They, also, viewed their children as exceptionally supportive. Regarding their feelings of loneliness, the descriptive results indicated that the majority of respondents did not feel lonely -- the mean score of 3.14 (SD = 3.19) was well below the scale midpoint of 5.

Regression Analysis with Loneliness

Stepwise regression results for each of the variable blocks, shown in Table 2, indicates only the existence of a best and closest friend to be directly related to loneliness. Those who indicated they had a best and closest friend were significantly less lonely (β -.38). This one variable accounted for 13.4% of the variance in the loneliness scores. There were no antecedent variables that were directly related to the existence of a best and closest friend variable.

TABLE 1. DESCRIPTIVE INFORMATION

VARIABLE*	M	SD	N**	VARIABLE*	M	SD	N**
Age(Older)	74.45	8.98	131	Emotional Closeness to Children (Closer)	2.83	0.40	118
Sex(1 = Female)	0.87	0.33	134	Provision of Social Relationships by Children (More Support)	5.30	1.13	115
Living Arrangements (1 = Not alone)	0.08	0.27	130	Existence of Best and Closest Friend (1 = Yes)	0.94	0.24	131
Self-related Economic Condition (Better)	3.17	0.78	133	Number of Friends (Higher)	4.02	2.28	119
Self-related Health Condition(Better)	2.91	0.72	133	Sex of Friends (1 = Female)	0.96	0.20	123
Existence of Children(1 = Yes)	0.89	0.32	133	Relationship of Friends(1 = Relative)	0.23	0.42	120
Number of Children (Higher)	2.30	1.07	118	Frequency of Contact w/Friends (More Often)	2.19	0.63	124
Sex of Children (1 = Daughter)	0.73	0.45	117	Satisfaction w/Frequency of Contact w/Friends (1 = Yes)	0.99	0.09	124
Ages of Children (Higher)	45.56	7.99	110	Quality of Relationships with Friends(Better)	3.69	0.53	124

(Table 1 continued)

Frequency of Contact w/Children (More Often)	1.90	0.67	114	Emotional Closeness to Friends (Closer)	2.69	0.48	124
Satisfaction with Frequency of Contact w/Children (1 = Yes)	0.91	0.29	116	Provision of Social Relationships by Friends (More Support)	5.63	0.61	118
Quality of Relationships with Children (Better)	3.59	0.63	118	Loneliness (Greater)	3.14	3.19	122

* The notation in parentheses indicates the scoring direction for each variable, e.g., the designation of "closer" for the variable "Emotional Closeness To Children" indicates that higher scores are indicative of greater closeness.

** The number of missing cases equals 134-N for each variable.

TABLE 2. STEPWISE REGRESSION OF LONELINESS ON SUBSETS OF VARIABLES:

STATISTICALLY SIGNIFICANT RESULTS

Existence of Relationships	Beta	Slope	Standard Error of Slope
Existence of a Best and Closest Friend (Yes)	-.38	-5.14	1.17
R^2 (Adjusted) = .134 (1, 118 df; $F = 19.48^*$)			

* $p < .001$

DISCUSSION

The results of this study show a group of widowed persons who are not particularly lonely. They describe themselves, in general, as experiencing good health and satisfactory economic conditions. The majority of respondents reported having children and described their relationships with their children in positive terms. For this sample, however, these interpersonal relationships did not appear to influence the loneliness of these older persons. Such a finding does little to extend our understanding of the relationship between quality of the parent-adult child relationship and an older person's socioemotional well-being. The issue remains ambiguous. Consistent, however, with previous studies (Lee & Ellithorpe, 1982; Johnson & Mullins, 1987; Mullins, Johnson, & Andersson, 1987), frequency of contact between parent and child was not an important factor in socioemotional well-being either.

The only variable found to influence loneliness was the existence of a best and closest friend. Those who indicated they had a best and closest friend were significantly less lonely. Loneliness has been conceptualized as an affective emotional experience in which one begins to sense being apart from others. Based on the current findings, the emotional experience of loneliness is better abated by friends than by children. The voluntary nature of best friend relationships appears to exert more influence on the generation of feelings of attachment or intimacy for older persons than obligatory familial relationships. Should loneliness continue to be linked to intimacy conceptually, intimacy may benefit from reconceptualization. Intimacy may have varied dimensions that are tapped by different types of relationships; e.g., voluntary versus obligatory relationships.

The consistency of the impact of the relationship with best and closest friends, rather than the relationship with children, to influence loneliness, has implications for counselors of older adults. The findings reported here suggest that fostering interpersonal relationships with friends is a better road to socioemotional well-being than fostering relationships with children. Although there is no indication here that relationships with children hinder socioemotional well-being, neither do these relationships appear to improve it. Obviously, relational issues are a factor in loneliness. Consequently, counselors should focus on development and maintenance of those interpersonal relationships, and particularly friendships, which have the most promise of moderating loneliness. Organizations such as the Widowed Persons Service provide an accessible and affordable opportunity for developing friendships; participation in such organizations should be encouraged.

A limitation of this study is that the sample under-represents men and minorities. In general, women place more value on relationships than men (Gilligan, 1982) and this feminine characteristic may have skewed the results to some extent. Also, most respondents reported good economic and health conditions. The findings here may not be generalizable to all older persons, and perhaps not even to the other members of the WPS, who do not fit this same economic and health profile. In discussions with representatives of the WPS, qualitative *post hoc* comparisons on selected and available characteristics, e.g., sex, age, and race, indicate there was no essential difference between respondents and nonrespondents. Future research could address these issues by dealing with samples with greater variability in economic and

health condition. Additionally, comparisons of widowed persons who are involved with the WPS with those who are not so involved could be enlightening.

Other social science research has tended to focus on characteristics of the individual experiencing loneliness (e.g., Bell & Daly, 1985; Zakahi & Duran, 1985). Such a focus ignores the fact that loneliness is a relational issue and as such is part of an interaction -- or lack thereof -- with others. In addition, much loneliness research, especially communications research, has tended to focus on college students (e.g., Bell & Gonzalez, 1988; Sptizberg &

Canary, 1985). Such a focus ignores the fact that loneliness is a life span issue. Findings regarding the loneliness of college students may fail to provide applicable information to those who care for or counsel older persons. Future research should address life span issues of loneliness.

These findings suggest a difference in the way interpersonal relationships with family and friends affect loneliness among older persons. The present study indicates that older persons' experience of loneliness seems to be less dependent on family than on friends. In addition, loneliness is perhaps predicated on different sets of predictors. Since this analysis is exploratory in nature and not based on the examination of a causal model, our conclusions must be cautiously stated. Thus, while it is necessary, as theorist and researchers have argued, to examine interpersonal relationships in a manner which allows for inter-relationship generalizations, the nature of the differences in relationships suggests it may be necessary to examine them independently. The number of best and close friend relationships, in fact, may decline in later years; it is clear, however, that the importance of these relationships to an individual's socioemotional well-being does not wane.

REFERENCES

- Allan, G., & Adams, R. (1989). Aging and the structure of friendship. In R. Adams & R. Blieszner (Eds.) *Older adult friendship: structure and process*. Newbury Park, CA: Sage.
- Amster, L., & Krauss, H. (1974). The relationship between life crises and mental deterioration in old age. *International Journal of Aging and Human Development*, 5, 51-55.
- Andersson, L. (1989). A model of estrangement -- including a theoretical understanding of loneliness. *Psychological Reports*, 58, 683-695.
- Atchley, R., Pignatiello, L., & Shaw, E. (1979). Interactions with family and friends. *Research on Aging*, 1, 83-95.
- Bachrach, C. (1980). Childlessness and social isolation among the elderly. *Journal of Marriage and the Family*, 38, 757-768.
- Bell, R., & Daly, J. (1985). Some communicator correlates of loneliness. *The Southern Speech Communication Journal*, 50, 121-142.
- Bell, R., & Gonzalez, M. (1988). Loneliness, negative life events, and the provisions of social relationships. *Communication Quarterly*, 36, 1-15.
- Crohan, S., & Antonucci, T. (1989). Friends as a source of support in old age. In R. Adams & R. Blieszner (Eds.), *Older adult friendship: Structure and process*. Newbury Park, CA: Sage.

Family and Friendship Relationships

- deJong-Gierveld, J., Kamphuis, J., & Dykstra, P. (1987). Old and lonely. *Comprehensive Gerontology, 1*, 13-17.
- Essex, M., & Nam, S. (1987). Marital status and loneliness among older women: The differential importance of close family and friends. *Journal of Marriage and the Family, 49*, 93-106.
- Gilligan, C. (1982). *In a different voice: Psychological theory and women's development*. Cambridge, MA: Howard University Press.
- Hochschild, A. (1973). *The unexpected community*. Englewood Cliffs, N.J.: Prentice Hall.
- Johnson, D., & Mullins, L. (1987). Growing old and lonely in different societies: Toward a comparative perspective. *Journal of Cross-Cultural Gerontology, 2*, 257-275.
- Lee, G., & Ellithorpe, E. (1982). Intergenerational exchange and subjective well-being among the elderly. *Journal of Marriage and the Family, 44*, 217-224.
- Lopata, H. (1969). Loneliness: Forms and components. *Social Problems, 17*, 248-262.
- Lopata, H., Heinemann, G., & Baum, J. (1982). Loneliness: Antecedents and coping strategies in the lives of widows. In L. Peplau & D. Perlman (Eds.), *Loneliness: A sourcebook of current theory, research and therapy*. New York: Wiley.
- Mancini, J., & Blieszner, R. (1989). Aging parents and adult children: Research themes in intergenerational relations. *Journal of Marriage and the Family, 45*, 193-202.
- Mullins, L., Johnson, D., & Andersson, L. (1987). Loneliness of the elderly: The impact of family and friends. *Journal of Social Behavior and Personality, 2*, 225-238.
- Mullins, L., Tucker, R., Longino, C., & Marshall, V. (1989). An examination of loneliness among elderly Canadian seasonal residents in Florida. *Journals of Gerontology: Social Sciences, 44*, S80-S86.
- Mullins, L., Woodland, A., & Putnam, J. (1989). Emotional and social isolation among elderly Canadian seasonal migrants in Florida: An empirical analysis of a conceptual topology. *Journal of Gerontological Social Work, 14*: 111-129.
- Peplau, L. & Perlman, D. (1982). *Loneliness: A source book of current theory, research and therapy*. New York: John Wiley & Sons, Inc.
- Quinn, W. (1983). Personal and family adjustment in later life. *Journal of Marriage and the Family, 45*, 57-73.
- Reisman, D. (1973). Forward. In R. Weiss (Ed.), *Loneliness: The experience of emotional and social isolation*. Cambridge, MA: MIT Press.
- Shea, L., Thompson, L., & Blieszner, R. (1988). Resources in older adults' old and new friendships. *Journal of Social and Personal Relationships, 5*, 83-96.
- Spitzberg, B., & Canary, D. (1985). Loneliness and relationally competent communication. *Journal of Social and Personal Relationships, 2*, 387-402.
- Troll, L., Miller, S., & Atchley, R. (1979). *Families in later life*. Belmont, CA; Wadsworth.
- Weiss, R. (1973). *Loneliness: The experience of emotional and social isolation*. Cambridge, MA: MIT Press.
- Weiss, K., 1974. The provisions of social relationships. In Z. Rubin (Ed.), *Doing unto others*. Englewood Cliffs, NJ: Prentice Hall.

- Weiss, R. (1987). Reflections on the present state of loneliness research. *Journal of Social Behavior and Personality*, 2, 1-16.
- Zakahi, W., & Durna, R. (1985). Loneliness, communicative competence, and communication apprehension: Extension and replication. *Communication Quarterly*, 33, 50-60.

APPENDIX A
Loneliness Scale*

Items	No	Yes
1. There is always someone I can talk to about my day-to-day problems.	1	0
2. I wish I had a really close friend.	0	1
3. I experience a general sense of emptiness.	0	1
4. There are plenty of people that I can lean on in case of trouble.	1	0
5. I miss the pleasure of the company of others.	0	1
6. I feel my circle of friends and acquaintances is too limited.	0	1
7. There are many people that I can count on completely.	0	1
8. There are enough people that I feel close to.	1	0
9. I miss having people around.	0	1
10. I often feel rejected.	0	1
11. I can call my friends whenever I need them.	1	0

* Higher scores indicate greater loneliness.

NOTE: Items from the Loneliness Scale are taken from deJong-Gierveld, Kamphuis, and Dykstra 1987. Copyright © 1987 Munksgaard International Publishers Ltd., Copenhagen, Denmark. Used with permission

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MINUTES
ALABAMA ACADEMY OF SCIENCE
FALL EXECUTIVE COMMITTEE MEETING
Southern Research Institute
Birmingham, AL

Saturday, October 3, 1998

- A. Dr. Moore U. Asouzu, President of the AAS, called the Fall Meeting of the AAS Executive Committee to order at 10:08 a.m. The minutes of the Spring meeting were discussed and approved with change.

B. Officers Reports

1. Board of Trustees—Dr. Sam Barker gave an oral report and recognized the trustees present: Bill Barrett, Michael Moeller and Adriane Ludwick.

2. President—Dr. Moore Asouzu presented the following written report:

I have done the following since the Spring 1998 Meeting:

- a. Corresponded with the immediate-past president, Dr. Ellen Buckner, numerous times by e-mail, telephone, and a visit to Birmingham on the Presidency, and on nominations to fill several Committee positions.
- b. Corresponded with the Executive Director and the Secretary to update the Elected Officers' list, and to set dates for various Academy events.
- c. Corresponded by telephone with some continuing and newly elected officers to thank them for their willingness to serve the Academy in their capacities.
- d. Discussed by telephone and e-mail arrangements for the Spring Meeting with Dr. Tom Jandebour, the Local Arrangement Committee Chairman.
- e. Visited Athens State University, the site of the Spring meeting, with Drs. Buckner, Hazelgrove, Bateman and Bush.
- f. Corresponded with Dr. Holliman to plan the Fall Steering Committee meeting at Birmingham-Southern College.
- g. Planned and circulated the agenda for the Fall Executive meeting
- h. Mailed out membership applications to nonmembers.

3. President Elect—Larry Boots - No report (not in attendance)

4. Second Vice President—Richard Hudiburg - Presented the following written report:

I have had several discussions with Chair of Committee on Research, Anne Cusic of UAB, concerning the duties of that committee. As Chair of the Nominating Committee, with the assistance of the committee, I will be developing a slate of nominees for the 1999-2000 elected officers.

Minutes

I would like to propose a goal for the Academy to increase electronic connectivity. This can be accomplished by using e-mail and web pages on the Internet.

I would like to solicit ideas for a theme of the 2001 annual meeting. That meeting will be the first annual meeting of the Academy in the 21st Century.

5. Secretary—Priscilla Holland – gave an oral report on dues cards and how the membership can be increased on campuses.

6. Treasurer—Larry Krannich – gave the following written report:

The Treasurer's Report consists of copies of the following:

ALL ACCOUNT BALANCES as of September 22, 1998

INCOME & EXPENSE STATEMENT as of September 22, 1998

ACTIVITIES RELATIVE TO 1998 BUDGET for the period 1/1/98 through 9/22/98)

TREASURER'S SUMMARY REPORT BY QUARTER (1/1/98 through 9/22/98)

TREASURER'S SUMMARY REPORT BY ACCOUNT (1/1/98 through 9/22/98)

PROPOSED BUDGET 1999 vs 1998

Copies of the complete treasurer's report may be obtained upon request.

Although the total funds in all accounts has decreased by approximately \$1,800 since the 1997 Fall Treasurer's Report, this is somewhat deceptive, because the anticipated revenue check from the 1998 Annual Meeting had not been received by September 22nd. Of some concern is the continued decrease in dues revenue-- down \$455 from what had been received within the same time frame in 1997. If a vigorous dues renewal campaign occurs, this decrease may be overcome by the fourth quarter dues income. Last year we received \$4,685 in dues in the fourth quarter. If this occurs, we would be on budget for 1998. A new income category, Gorgas Income, was added this year, which did not appear in the original budget, because we now receive funds from the Alabama Power Foundation for the Academy efforts in the Gorgas competition. These funds are then expended for the Gorgas program. We also receive funds from the regional science fair to offset expenses for the travel of the winners to the international science fair. This is a change from previous operations.

On the expense side, we are and expect to finish this year within the budget. We have not received any invoices for the printing of the Journal. Thus, this is an expense item which may be a major expense in the fourth quarter. Unless the cash reserves in the checking and money market account increase, we may have to cash a CD to have sufficient cash to write checks to meet expenses.

A copy of the Proposed Budget for 1999 is also attached. This budget is almost identical to the 1998 budget, but includes the Gorgas income and expense entries.

7. Journal Editor—James Bradley – No report.

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8. Counselor to AJAS—B. J. Bateman – presented the following written report:

State Officers/Counselors Meeting—The State Officers and the State Counselors met at Auburn University at Montgomery on March 21, 1997, to discuss the State Officer's roles for the upcoming year (1997-98).

Fall Planning Meeting—The Executive Committee of the Alabama Jr. Academy of Science (AJAS) did not meet this year because the state counselor B. J. Bateman was home bound with illness. The State Counselor with permission from the President of the Alabama Academy of Science made minor decisions concerning the annual meeting without consulting the executive committee. No changes in rules, bylaws, etc. were made.

The proposed budget of \$14,911.00 for 1997-98 are detailed later in this report.

The paper competition again would be held on Friday morning, with the winners announced at the Friday night banquet. The statewide JSHS paper competition in Alabama falls within the long-established program of AJAS and utilizes the organizational structure of the latter. The AJAS consists of nine regions within the geographic boundaries of the state. The activities of the nine regions are coordinated through nine Regional Counselors, two Associate Counselors, and a State Counselor, utilizing a variety of forms and established deadlines.

Fall AAS Executive Meeting—The State Counselor (B. J. Bateman) was unable to attend because of illness the Fall Executive meeting of the Senior Academy of Science held at the Southern Research Institute October 3, 1997.

Regional Meetings—Meetings were held in the nine regions of the state prior to December 1, 1997, for the purpose of organizing their regions and planning activities for the year. Major emphasis was given to strengthening science clubs, discussing appropriate science project work, and reviewing the several aspects of paper competitions.

Annual Meeting—The 1998 Annual Meeting, like all previous meetings of AJAS, was shared jointly with the Alabama Academy of Science. The host institution was University of South Alabama.

David Nelson coordinator for the AAS/AJAS meeting, Murlene Clark, local arrangements for the AJAS, B. J. Bateman, Counselor to the AJAS, and Bety Bigham, Associate Counselor, planned registration procedures, space needs, and arrangements for the AJAS-JSHS social and banquet. Registration was held at the Best Western Motel. The AJAS Journal and the official program for the Annual meeting were given to each student. Highlights of the program were:

- a. Paper Competition – The paper competition was conducted on Friday and

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Saturday mornings in the Student Center and the Life Sciences on the University of South Alabama Campus. Following the morning competition, the judges deliberated through lunch. The names of participants and the respective papers appear below.

- b. Banquet—More than two hundred students, teachers, university professors, and members of business, industry and government shared the Friday night banquet at the Student Center Banquet Hall. A major part of the after-dinner program was the recognition of the first and second-place winners of the paper competition, and other competitions, including the Westinghouse Talent Search, in which many of our students had participated.

On alternate years the Junior Academy is responsible for the banquet speaker. This year the Alabama Academy of Science provided the banquet speaker, Dr. George Crozier, Senior Marine Scientist and Executive Director, Marine Environmental Sciences Consortium, Dauphin Island Sea Lab, who spoke on the history of the Sea lab.

- c. AJAS-JSHS Social Activities—No formal social activities were planned. The participating schools chose to visit some of the many attractions in the Mobile area.
- d. Business Meeting—The customary AJAS business meeting was held on Saturday morning. This provided a time for awarding a plaque to the outstanding region, a certificate and a check to the outstanding teacher(s), the ASHS Award to the teacher of the overall first place winner, and other awards.

AWARDS

Most with the Least Award

BIOLOGY:	Melanie Sutton	A. P. Brewer
PHYSICAL SCIENCE:	Patrick Reasonover	A. P. Brewer
ENGINEERING:	Stephen Taylor	A. P. Brewer

Second Place Award

BIOLOGY:	Jimmy Huynh	Altamont
PHYSICAL SCIENCE:	Petronella Lugema	Altamont
MATHEMATICS:	Justin Knighten	A. P. Brewer
ENGINEERING:	Jared Cox	Brooks
HUMANITIES:	Jennifer Pritchett	JCIB

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First Place Award

BIOLOGY:	Kristin Dion	JCIB
PHYSICAL SCIENCE:	Elizabeth Dillard	Bradshaw
MATHEMATICS:	Sean Verma	A. P. Brewer
ENGINEERING:	David Branscomb	Sheffield
HUMANITIES:	Ryne Hazzard	Altamont

Grant for Research Projects

none

AAAS Award

Jared Cox

Outstanding Region

Northwest

Outstanding Teachers

Vicki Farini

Cynthia Tille;y

Newly elected officers for 1998-99:

President:	Patrick Reasonover	A. P. Brewer High School
Vice-President:	Josh Drinkard	A. P. Brewer High School
Treasurer:	Brandon McCaghren	A. P. Brewer High School
Secretary:	Lennis Clark	A. P. Brewer High School

JSHS Participants Attending the Annual Meeting:

Forty-two students, sponsors, and counselors attended the annual meeting as JSHS participants (expenses paid). An additional 8 persons attended at their own expense for a total of 50.

National Symposium and Paper Competition—Kristin Dion was chosen to be the overall winner, and therefore, represented Alabama in national competition and symposium held at Albuquerque, NM. Four other state winners (Ryne Hazzard, David Branscomb, Sean Verma, Elizabeth Dillard), Regional Counselor (Mary Thomaskutty) and the State Counselor (B. J. Bateman) accompanied Kristin.

9. Science Fair Coordinator—Mary Thomaskutty gave the following written report: Given below are the winners and category for 1998 ISEF held at Fort Worth, TX. I was little disappointed at our showing this year. Competition was very tough. We traveled to Texas by bus, and everyone seemed to enjoy the trip. Nineteen finalists and one student observer went to the competition along with several teachers and parents. Next year's fair will be at Philadelphia and it will be the 50th Anniversary. The ISEF will be from May 2nd to May 8th

Central Region UAB

1. Nassif Cannon – Altamont High School won the following:
\$500.00 Fourth Place category in Microbiology.

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North Alabama Region Calhoun Community College

1. Jeremiah Brown – Covenant Christian Academy won the following:
\$1500.00 Second Place category award in Physics
\$500.00 First Place special award from American Intellectual Property Law Association
Honorable Award of a certificate from American Association of Physics Teachers and the American Physical Society
2. Jeb Orr—Elkmont High School won the following:
Tuition scholarship worth \$10,000.00 for a full time, undergraduate study at University of Texas-Arlington

State Science Fair

1. Elizabeth Dillard—Bradshaw High School won the following:
\$100.00 Honorable Mention from Eastman Kodak Company,
tuition scholarship worth \$1,750.00 renewable annually for a full time undergraduate study at New Mexico Institute of Mining and Technology

This year's ISEF will be in Philadelphia, Pennsylvania on May 2-10, 1999. This is the 50th anniversary of International Science and Engineering Fair. Regional Science Fair dates will be announced later on.

Thanks for all the help the SENIOR ACADEMY provides to enhance the Scientific knowledge of the young people of Alabama.

10. Science Olympiad Coordinator—Jane Nall - No report

11. Counselor to AAAS—Katharine Mayne - No report

12. Section Officers

1. Biological Sciences—Roland Dute gave the following written report:

The 1997 meeting at the University of South Alabama saw the presentation of 44 talks and 15 posters in the Biology Section as well as 7 symposium speakers. The presentation covered various aspects of biology from molecular to ecological. The award for best paper presentation was given to Ms. Kara Lee (R. D. Watson co-author), and the award for best poster was given to Mr. Darrell Morgan (A. G. Moss, co-author). The talks were given in three sessions in order to accommodate the Coastal Resources Development Symposium arranged by Dr. David Nelson. The same format will be used to accommodate the upcoming Karst in Alabama Symposium by Dr. Tom Jandebour.

There will be an election of a new section vice president at this year's annual meeting.

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- II. Chemistry—Tracy P. Hamilton gave an oral report:

The Chemistry Section elected Regoberto Advencula as the vice-chairman. This year 12 papers and two posters were presented.

- III. Earth Science—Daniel O'Donnell gave the following written report:

I am very pleased to serve the Earth Science Section of the Academy over the next two years. I will strive to bring about greater participation in Earth Science Section activities of the Academy through dialogue with faculty at state universities and colleges, personal invitations to colleagues and through written correspondence to professional geologic organizations in the state.

The seventy-fifth annual meeting was well represented by the Earth Science Section. We had four poster presentations prepared by students from the University of South Alabama. In addition to the poster presentations, we had eleven oral presentations from individuals representing federal and state governmental agencies (United States Geological Survey and the Geological Survey of Alabama), two universities (The University of South Alabama and the University of Alabama), and one private sector firm (Volkert Environmental Group, Inc.). Following the meeting, an invited speaker, Thornton Neatherly, Chairman of the Alabama Board for Professional Geologists, outlined Alabama's professional geologist licensure process and entertained questions on the process from members of the audience.

One of my goals already reached this year was having the Alabama Board of Licensure for Professional Geologists approve four credit hours for attendance at our annual meeting. I hope to leverage this to generate more interest in our section from individuals who are registered as professional geologists in Alabama.

I will be working with my Vice-Chairman, David Allison, a professor at the University of South Alabama, not only on increasing our membership as a whole, but also on getting current members to *actively* participate in the annual meetings through poster or oral presentations.

Lastly, I would like to personally thank Doug Haywick, past chairman, for his efforts with the Earth Science Section over the previous two years. Doug was the driving force behind the tremendous participation of students from the University of South Alabama in our section. I wish him the best and certainly hope he continues his efforts in this area.

- IV. Geography, Forestry, Conservation & Planning—Chukudi Izeogu gave an oral report regarding increasing membership, encouraging students to participate and the election of a new chair and vice chair, Ted Klimasewski, Jacksonville State University. This year 13 papers were presented.
- V. Physics & Mathematics—John T. Tarvin gave an oral report on the 8 papers presented and 1 poster. The chair will use e-mail to encourage membership in the Physics and Mathematics Section.

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- VI. Industry and Economics—T. Morris Jones - No report
- VII. Science Education—Helen Benford, chair. The following written report was given:

Dr. Helen Benford, Tuskegee University, Department of Biology Tuskegee Institute, Alabama 36088, (334) 727-8824, hbenford@acd.tusk.edu, is the new Chair for the Earth Science Education Education Section. During the 75th AAS Science Education Section Business Meeting, Dr. Jane Nall was elected vice chair, University of Mobile, Division of Natural Science, Department of Biology, (334) 657-5990, Mobile, Alabama 36613, or 31110 Wakefield Drive, Spanish Fort, Alabama 36527.

The Chair for the Science Education Section has recommended the following: Letters will be written to the Chairs/Vice-Chairs of the other sections to ask them to encourage any faculty who are active in curriculum or instructional changes to present at the Science Education Section.

The Chair would suggest that the AAS allow members to list their primary affiliation and one/two secondary affiliations as well. That way, people with primary affiliation in Biology, for example, could also appear on the mailing list for the Science Education Section, and we might draw larger numbers of papers and larger audiences.

The Chair also thinks it would be nice if the 2000 or 2001 meeting had a prominent symposium with a collegiate-level science education theme.

- VIII. Behavioral and Social Sciences—Jerald Burns Chair. Dr. Gerald Fisher, Vice Chair presented the following report:

Section VIII enjoyed a very successful annual meeting at South Alabama. We had a total of 13 research paper presentations with Dr. Howard Jones of Armistad fame serving as our highlight speaker. This year we hope to acquire Dr. William Stewart, Chair of Department of Political Science at the University of Alabama, to serve as our highlight speaker. We hope to get him to do a post-mortem on the Alabama elections of November 1998, especially the governor's race and maybe a post-mortem on the Monica-Bill saga (if it is over by then).

One major goal we have is to encourage more student papers and involvement in Section VIII.

- IX. Health Sciences—Barbara Wilder - No report
- X. Engineering and Computer Science—Alan Sprague - No report
- XI. Anthropology—Curtis E. Hill - No report
13. Executive Officer—Leven Hazelgrove presented the following written report:

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Since the Spring Executive Meeting, 03-20-98, at the University of South Alabama, we have been working on the following projects during the last 7 months:

- a. Set up and prepared the Gorgas Scholarship Program for Science Talent Search in cooperation with the Westinghouse (now Intel) Scholarship Science Service, Inc. D.C. for the University of South Alabama, March 20, 1998, with the leadership of Dr. Ellen Buckner, Secretary/Treasurer and Dr. David Nelson.
- b. Prepared for bulk mail 850 "Call for Paper Titles" for Athens State University meeting for March 24-27, 1999, edited by Dr. William J. Barrett.
- c. Sent development letters to 4 industrial companies and foundations with positive reply from one.
- d. Sent hand written notes and brochures to 50 outstanding Scientists and Engineers, Mathematicians and potential members whose "write-up" appeared in local publications.
- e. Met with Dr. Tom Jandebaur, Professor and Head, Biology Administration and his local committee for the AAS dates: March 24-27, 1999, at Athens, AL with Drs. Buckner, Asouzu, Bush, Marion, Angus and Bateman.
- f. Prepared 250 abstract forms for the Athens State University meeting, March 24-27, 1999, for eleven section chairs and 650 printed programs.
- g. Your Director studies flora, fauna and pollution in USA, February 13-16, 1998, with the Alabama Fisheries Association, Gulf State Park.
- h. Set up the 76th Annual Meeting with the able direction of Dr. Tom Jandebaur, Professor of Biology, Athens State University, Athens, AL, March 24-27, 1999.
- i. Carried by hand over 100 files from Dr. Sam Barker, Chair, AAS Board to Dr. Dwayne Cox, Archivist, Ralph B. Draughton Library, Auburn University, since Dr. Troy L. Best was off campus.

C. Committee Reports

1. Local Arrangements—Tom Jandebaur gave a detailed oral report for the 76th annual meeting at Athens University in Athens, Alabama on March 24-27, 1999. The symposium for this annual meeting "Karst" in Alabama.

2. Finance—Sam Barker presented the following written report:

As in the past several years, this fall's Treasurer's Report presents many variables, such as: the lagging dues income over the second and third quarters after a \$3,565 first quarter; a delay in receipt of the anticipated income from the 1998 Annual Academy Meeting; an unusual delay in receipt of printing expenses for the journal. Since we are actually a few days into the fourth quarter of fiscal 1998 (coincident with calendar 1998), we do not know whether we shall wind up with a sizeable deficit, as in 1996, or a few hundred dollars in the black in 1997.

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I am not especially optimistic, since our operating deficit this time is (\$5,234) \$13 as contrasted with \$2,551 in September of 1997. As I have said before, come to the Executive Committee Meeting next spring to find out the exciting denouement!

Incidentally, I should point out that the final agreement between the Alabama Power Foundation and the Alabama Academy of Science covering transfer of responsibility for the Gorgas Scholarship Program provided two related sources of income to the Academy: the first to cover actual expenses incurred in administration of the Program, and the second 'an annual amount equal to one-half of one percent (0.5%) of the amount maintained in the LEP account' of the foundation. The first of these payments is divided into an advance estimate plus a final amount covering actually incurred expenses. It is the responsibility of the Academy to make a written request for the reimbursements. This activity is the specific responsibility of the Chairman and co-Chairman of the Gorgas Scholarship Committee of the Academy. It is necessary that this new Gorgas Committee be alert.

The last page of the Treasurer's Report, on pumpkin-yellow paper, has the Proposed Budget for 1999. A sizeable deficit is again predicted; although we, of course, hope not to encounter it, our reserves are available, as shown in "All Account Balances".

3. Membership—Adriel Johnson presented the following written report:

The Chair of the AAS Committee on Membership will yield to the Secretary Reports (Minutes from the 1998 Spring Meeting, Mobile, Alabama; Report to the 1998 Fall Executive Committee Meeting, AL) on the latest totals for the trends in membership, membership by section and the special categories of membership.

The Chair for Membership would like to recommend the following items to enhance membership for the Alabama Academy of Science:

- a. Encourage all executive committee members to pay their dues or to confirm payment;
- b. Strongly encourage the executive committee to consider becoming lifetime members and to then encourage other members to do the same;
- c. Executive committee members should encourage undergraduate and graduate students to join;
- d. All Membership Committee members should confirm payment, consider lifetime membership, remind your colleagues to renew their membership, invite other colleagues to join and ask your students to join;
- e. Membership Committee members should provide any recommendations to enhance membership;
- f. A general poster advertising and encouraging membership should be prepared and disseminated to all AAS members;
- g. Identify members with multiple section interest and participation;

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- h. Review past efforts to establish current AAS membership information to update and identify members;
- i. Update and prepare a current AAS Membership Directory;
- j. Encourage as many people to join the AAS which could be served by the advantages of membership (Representative membership from K-12 Teachers; Junior College Faculty and all state institutions of higher education; Industry involvement).

The Membership Committee members include: A. D. Johnson; (Chair); F. A. Romano; T.P. Hamilton; D. O'Donnell; P. Holland; W. Yeh; P. Alexander; H. Benford; B. Payne; B. Wilder; P. K. Raju; and C. E. Hill.

4. Research—Anne M. Cusic presented the following written report:

The Chairperson of the Committee on Research received 22 requests for application materials related to the Student Research Award Competition, Student Research Grants, and Student Travel Grants for the 1998 Annual meeting. This number is lower than in past years due to the availability of applications from the web page. Following is a list of the winners of the various awards:

PAPERS

Section I. Biological Sciences

Kara J. Lee	UAB	\$50	winner
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Section II. Chemistry

Guido F. Verbeck, IV	UAB	\$50	winner
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Section III. Earth Science

Mary Grace	USA	\$50	winner
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Section IV. Geography, Forestry, Conservation & Planning

Chester Richey	UNA	\$25	co-winner
Elizabeth Sutherland	UNA	\$25	co-winner

Section VII. Science Education

Mandy Tinsley	JSU	\$50	winner
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Section X. Engineering and Computer Science

Marietta E. Cameron	UAB	\$50	winner
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POSTERS

Section I. Biological Sciences

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Darrel D. Morgan	AU	\$50	winner
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Section III. Earth Science

Andrew P. Feltman	USA	\$50	winner
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Section V. Physics and Mathematics

Jeffrey A. Thomas	Tuskegee	\$50	winner
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Section IX Health Sciences

Norma T. Gwebu	Oakwood College	\$50	winner
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Student Research Grant Awards – 1998

<u>Name</u>	<u>Affiliation</u>	<u>Section</u>	<u>Advisor</u>	<u>Amount</u>
Matthew P. O’Keefe	UAH	Biology	Campbell	\$250
Craig Rowell	UAB	Biology	Watts	\$250
Daisy Wong	UAB	Eng. & CS	Jones	\$250
Marietta E. Cameron	UAB	Eng. & CS	Sloan	\$100
Tao Tao	UAB	Eng. & CS	Hyatt	no award
Stephen Donaldson	UAB	Eng. & CS	Reilly	\$250

Student Travel Grant Awards – 1998

Lahu Saiji	Tuskegee		\$30.00
Ivy D. Bradford	Tuskegee		\$30.00
Mohamed O. Abdalla	Tuskegee		\$30.00
Jeffrey A. Thomas	Tuskegee		\$30.00
Darrell D. Morgan	Auburn		\$30.00
Kara J. Lee	UAB		\$30.00
Minako S. Vickery	UAB		\$30.00
Mickie Powell	UAB		\$30.00
Madhanraj Selvaraj	UAB		\$30.00
Tao Tao	UAB		\$30.00
John Drake	UAB		\$30.00
Craig Rowell	UAB		\$30.00
Marietta Cameron	UAB		\$30.00
Jonathan Gilbert	JSU		\$35.00
Jacqueline Carter	JSU		\$35.00
Kaggia K. Scott	UAB		\$40.00
Chester Richey	UNA		\$45.00
Elizabeth Sutherland	UNA		\$45.00

The Call for Papers section for the student research and travel grants has been modified slightly for 1999. I have requested that the students include the e-mail address on the applications, so that I can communicate any problems with their applications in a timely manner. Due to the

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confusion last year of some students as to whether they had actually entered the competition, we have decided to highlight the paragraph which states that they will be sent eligibility requirements and application forms. I also suggest that the students indicate on the Title Submission Form that they are entering the research competition. I will cross check with the section chairperson to ensure that students have met the eligibility requirements for competition.

Although application forms and eligibility requirements are available on the web page developed by Dr. Richard Hudiburg (<http://ww2.una.edu/psychology/aaspage.htm>), it will not be included in the Call for Papers mail out this year. Due to the differences in names and schools of the address and my address, it was determined that this might be confusing to students. Students will be referred to this site upon requesting application and eligibility forms. Dr. Hudiburg has added a membership application form to this web site.

At the Spring meeting of the Executive Committee, it was suggested by several section chairs and vice chairs that the rules for entering the Student Research Award Competition be changed. The proposal was that all students who give papers and posters at the annual meeting be automatically entered in the competition. The Research Committee discussed this proposal and rejected it. The members of the committee felt that some students might not be ready to compete, that students should actively apply for the awards, and that it would be difficult to identify students and their eligibility.

Please encourage your students to participate in the award competitions of the AAS. Please communicate to interested students that the applicant deadline for student awards for the 1999 meeting is February 2, 1999. Students should be aware that certain eligibility requirements apply, such as membership in AAS, to receive the cash portion of the awards

5. Long-Range Planning—Ken Marion submitted a written report as follows:

As has recently been customary, the AAS Steering Committee met informally last night to discuss long-range issues to be dealt with in the upcoming months. Major issues will be verbally relayed today. The Long-Range Planning Committee will consider these issues in the upcoming months, and a formal report and recommendations will be presented at the Spring meeting.

Recommendations presented at the Spring 1998 meeting were:

- a. Consider raising annual dues and/or meeting registration fees;
- b. Continue to monitor Journal expenses and take steps to hold Journal expenses down; and
- c. Reinstate some form of membership recruitment. Committee Members: Ken Marion (Chair), Dan Holliman, Adriane Ludwick, Eugene Omasta, James Wilkes

6. Auditing – Sr. Academy—Denny Bearce - No report

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7. Auditing – Jr. Academy—Danice Costes submitted the following written report:

This is a report of the Alabama Junior Academy of Science Auditing Committee for the July 1997-July 1998 financial year. We have examined the books provided by the Alabama Junior Academy of Science Treasurer, Dr. B. J. Bateman. We are satisfied ourselves that the receipts and expenditures, as presented to us, are correct and that all expenditures are legitimate expenses.

The net worth as of June 30, 1998, is \$18,567.03.

8. Editorial Board and Associate Journal Editors—Douglas Watson/Larry Wit/Bill Osterhoff – No report

9. Place and Date of Meeting—Tom Bilbro - No report

Tentative sites are: Samford.....2000
 Auburn.....2001
 Alabama.....2002
 Jacksonville...2003

10. Newsletter—Lynn Stover/Tom Jandebeur, chairs –Lynn Stover presented the following written report:

I am very excited about serving as the newsletter editor for the next year! I am looking forward to getting to know more of you as the year progresses. I know that many of you have very important announcements that need to be publicized. Please take a moment to think about what you need to have published in the Fall newsletter, and document in the space below or send me a hard copy of your newsletter submission by Saturday, October 31.

Thank you for your assistance with the newsletter!

Please send all submissions to:

Lynn Stover, RNC, MSN
University of Alabama
Capstone College of Nursing
Box 870358
Tuscaloosa, AL 34505
Lstover@Nursing.UA.Edu
(205) 348-1035 (office)
(205) 553-1990 (home)

Please include your name, address, and phone number with your newsletter information so you can be contacted in the event that I need clarification concerning your material.

11. Public Relations—Myra Smith – No report
12. Archives—Troy Best – No report

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14. Science and Public Policy—John Frandsen, submitted the following report:
The National Academy's new book, Teaching About Evolution and the Nature of Science will be presented to every teacher and presented the following written report:

Members of the Committee: S. Brande (AUB), J. Frandsen—Chair, M. Friedman (AU), Dail Mullins (UAB), R. Rowsey (AU), S. Sign (ASU)

Teaching Evolution in the Public Schools of Alabama. When teaching evolution, Alabama teachers are doubly challenged: some parents and administrators are openly hostile to evolutionary theory, and many of the teachers are poorly prepared in the subject. In addition, some teachers do not appreciate its importance, a fact that makes it all too easy for them to neglect or avoid it, especially when they fear unfriendly parental reaction. As a means of addressing the needs of teachers for foundation in the subject and knowledge of how to teach it most effectively, this committee plans to provide each biology teacher in the public schools with a copy of the booklet Teaching About Evolution and the Nature of Science, published this year by the National Academy of Sciences. This booklet will be available to teachers at the national Association of Biology Teachers' (NABT) booth at the Birmingham Regional convention of the national Science Teachers Association (NSTA), in November. As each teacher picks up his or her booklet there, the corresponding name will be checked off on an official list of biology teachers prepared by the State Department of Education. Following this meeting, copies of the booklet will be mailed to the remaining teachers.

These booklets will be available for distribution thanks to their generous donation by the National Academy and the National Academy Press. This donation was made following unsuccessful attempts by this committee to obtain funds from private individuals or corporations within the state. We especially appreciate the assistance of the national Center for Science Education (NCSE) in obtaining this donation.

The cost of mailing booklets to teachers who did not pick up their copy at the NTSA meeting can, of course, not be determined at this time. The ncse has promised to assist us in funding this expense.

Though this booklet will be of great help to classroom teachers, we remain greatly concerned that future science teachers are generally receiving inadequate foundation in evolutionary theory in the colleges and universities of the state. These students need both a firm, solid foundation in the subject and instruction in how it can be most effectively taught in the atmosphere of hostility that pervades much of Alabama today.

We are confronted with the question of how we can most effectively advise science educators of our concern. A statement in the *Journal* has been suggested, and the editor has encouraged us to prepare one, but few science educators read the *Journal*. Past experience has demonstrated that few newspapers carry our press releases.

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14. Gardner Award—The newly elected chair of the Gardner Award Committee is Dr. Ellen W. McLaughlin, Biology Department, Samford University, Birmingham, AL 35229.

15. Carmichael Award—William J. Boardman submitted the following written report:

The committee presented its annual award for the outstanding paper published in the *JAAS* during the previous year to Geoffrey E. Hill, Department of Zoology and Wildlife Sciences, Auburn University. The title of his paper is: "The Effects on Bird Communities of Converting Southern Hardwood Forests to Pine Plantations".

16. Resolutions—Gerald Regan - No report

17. Nominating Committee—Richard Hudiburg presented the following written report:

The Nominating Committee seeks recommendations for the 14 elected offices for 1999-2000. A report on these nominations will be given at the Spring 1999 meeting. Of note are four trustees positions. In addition, there will be vacancies of five section chairs and vice chairs.

18. Mason Scholarship—Michael B. Moeller presented the following written report:

Last year we had ten completed applications for the William H. Mason Scholarship. After reviewing all application materials, the scholarship committee voted to offer the \$1000 award to Cynthia Ann Phillips and Ms. Phillips has accepted the fellowship.

The previous recipients of the William H. Mason Scholarship are:

1990-91	Amy Livengood Sumner
1990-92	Leella Shook Holt
1990-93	Joni Justice Shankles
1990-94	Jeffrey Baumback
1990-95	(not awarded)
1990-96	Laura W. Cochran
1990-97	Tina Anne Beams
1990-98	Carole Collins Clegg
1990-99	Cynthia Ann Phillips

Attached to this report is a copy of an announcement which the committee plans to be sending soon to deans in schools of science and education within Alabama. Members of the AAS Executive Committee are encouraged to copy and disseminate this information.

19. Gorgas Scholarship Program—Ellen Buckner presented the following written report:

The Gorgas Scholarship Program committee met October 2 at 1:00

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p.m. in the Alabama Power Foundation/Alabama Power Company Offices, Birmingham, AL. Members of this committee are as follows:

Dr. Leven Hazelgrove, Chairman
Dr. Ellen Buckner, Co-chairman
Dr. S. B. Barker
Dr. William Barrett
Dr. Kenneth Dillon
Dr. David Nelson
Dr. P. C. Sharma
Dr. Joseph Thomas
Mr. Art Beattie,
Alabama Power Foundation Representative

The Gorgas Scholarship Program and Alabama Science Talent Search comprise a statewide competition among Alabama entrants to the Intel National Science Talent Search (formerly Westinghouse.) Information regarding the National Competition is listed on the attached sheet.

The committee considered matters related to the competition including procedures, methods of encouraging applications, and matching scholarships from state universities and colleges. Expenses of students participating as state finalists were paid from Foundation funds as specified in the Selection Agreement and additional monies were paid to the Academy as specified. Monies remaining after scholarship awards were added to the Gorgas Scholarship Fund for future use.

The committee would like to extend resolutions of appreciation to those members of the Gorgas Scholarship Foundation Board of Trustees who served for many years and devoted their time and energies to the Alabama Science Talent Search. With the Executive Committee's approval, such resolutions will be prepared by the Resolutions Committee.

Gorgas Scholarship Program

The Alabama Science Talent Search and William Crawford Gorgas Scholarship were established in 1947 to discover and encourage students with scientific skill, creativity and conviction. Students desiring to enter the Alabama Science Talent Search must enter the Intel National Science Talent Search (formerly Westinghouse). Applications may be obtained or downloaded from

Intel Science Talent Search
Science Service
1719 N. Street, N.W.
Washington, D.C. 20036
<http://www.sciserv.org/stshome.htm>

Materials must be received by the Science Service by December 2, 1998. Entrants from Alabama are automatically entered in the Alabama

Minutes

Science Talent Search. Finalists are selected in February and notified through their sponsoring teacher. Finalists participate in the Gorgas Scholarship Competition to include presentation of their work and individual interviews with an interdisciplinary panel of judges. The 1999 Gorgas Competition will be held at Athens State University, March 26, 1999, in conjunction with the meeting of the Alabama Junior Academy of Science. Scholarships of up to \$3000 are awarded to winners, and, in addition, many Alabama colleges offer further scholarships up to full 4-year tuition awards.

The Gorgas Scholarship Program is a program of the Alabama Power Foundation, administered by the Alabama Academy of Science. If further information is desired, please contact Dr. Ellen Buckner, (205) 934-6799, 204 School of Nursing, University of Alabama at Birmingham, AL, 35294-1210, or Nurs119@uabdpdpo.dpo.uab.edu.

A move to accept all reports with the specifics, with a second by Frank A. Romano, was carried unanimously.

D. Old Business

None

E. New Business

Established a Journal—Ad Hoc Committee and a Membership—Ad Hoc Committee.

F. Adjournment

At 12.35 p.m.

Respectfully submitted,

Priscilla Holland, Secretary

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INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. A. Priscilla Holland, Office of Research, UNA Box 5121, University of North Alabama, Florence, AL 35632-0001. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology; Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics, Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the implies that it has not been published previously and that it not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

Submission: Submit an original and two copies to the editor. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. The editor may request that manuscripts be submitted on a diskette upon their revision or acceptance.

Manuscripts: Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. An abstract not exceeding 200 words will be published if the author so desires. Use heading and subdivisions where necessary for clarity. Common headings are: **Introduction** (including literature review), **Procedures** (or **Materials and Methods**), **Results**, **Discussion**, and **Literature Cited**. Other formats may be more appropriate for certain subject matter areas. Headings should be in all caps and centered on the typed page; sub-headings should be italicized (underlined) and placed at the margin. Avoid excessive use of footnotes. No not use the number 1 for footnotes; begin with 2. Skip additional footnote numbers if one or more authors must have their present address footnoted.

Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must not exceed 15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in the text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

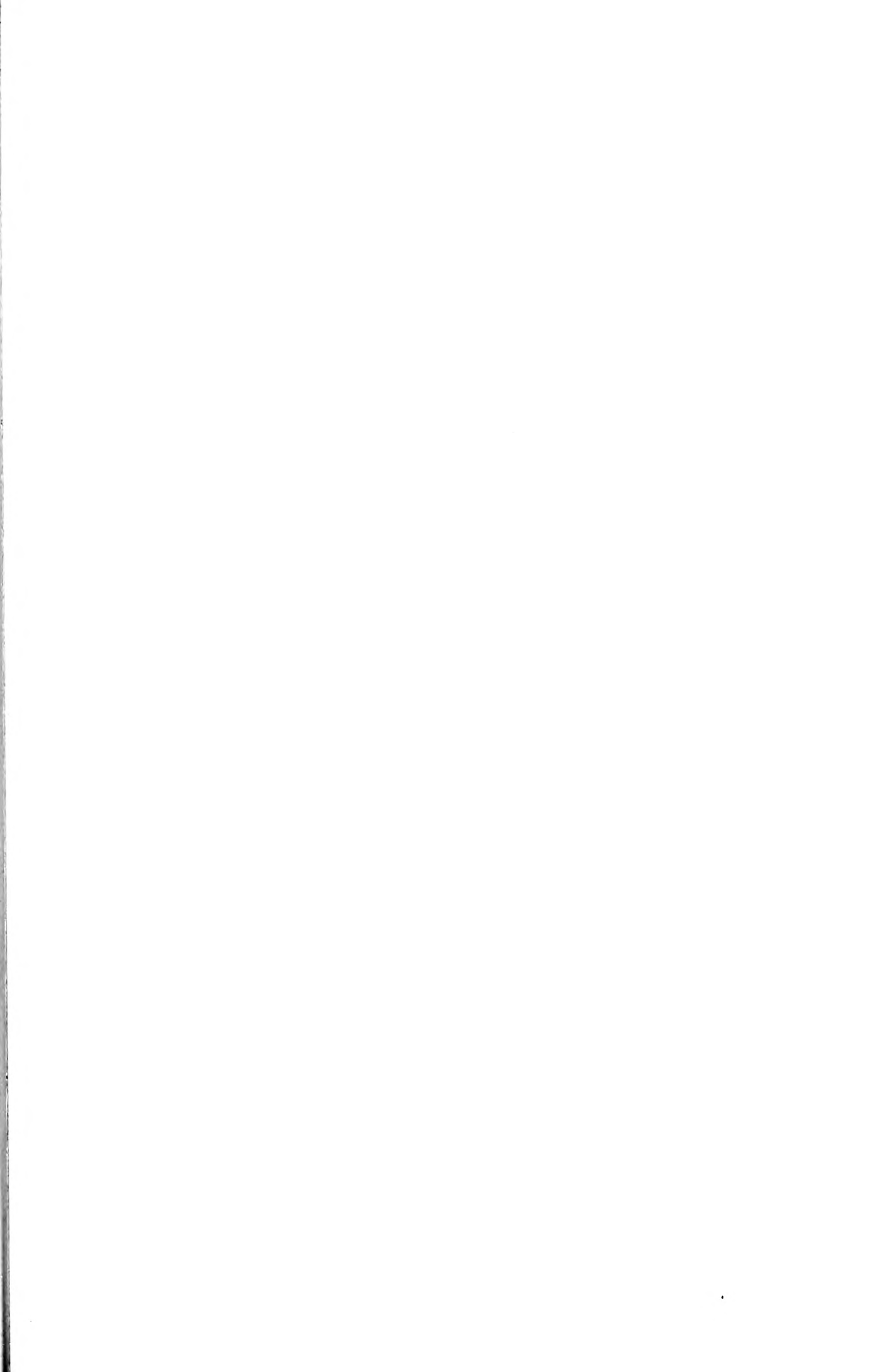
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