Next Friday Is

THE CALIFORNIA TECH

Drop Day

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Two Year Degree Plan Suggested

By Bob Morrison

A plan that would allow Caltech students to leave after two years with an Associate Science degree (AS) has been suggested by Mathematics Professors Richard Dean and Gary Lorden.

At the moment, the idea is only being discussed informally. According to Lorden, the plan is aimed at those students who wish to transfer from Caltech after two years, but hesitate to do so. He believes that the principal advantage of the degree is that it would give sophomores concrete evidence of two years' work (or its equivalent in the real world), which would assist them in transferring to another college.

The degree would be awarded after a two-year program of science and mathematics courses, most of which are now required for graduation with a Bachelor of Science degree. The AS, then, would become a prerequisite for the BS.

It is important, says Dr. Lorden, that the degree be required for all students. It is not meant to create two levels of study programs because of the negative connotations that would then be associated with the degree. So that other colleges understand the meaning of the degree, it must retain the prestige of the Caltech education without giving any impressions of being a shortcut or low-level degree.

This would allow more flexibility in the student's planned schedule at Caltech, permitting him to get a basic education and then allowing him to decide if he wants to leave. This would alleviate the fears of many students who are afraid of being stuck here for four years after they have decided they do not like Caltech. Above all, says Lorden, as the degree gains acceptance, the student will get a feeling of accomplishment at a time when he has been in too long and it's too long until he gets out.

One of the most difficult problems with the degree at present is the difficulty of getting widespresd acceptance for it. The program outlined by Dean and Lorden is not in general use; in fact, Lorden knows of no universities that have tried it. Although it may sound similar to a community college degree, Lorden stresses that it is not. It is not intended to be a final degree, only something to ease the tensions of those who find that they are dissatisfied with Caltech after two years here.

Left: The space left when RFers stole the door to the top of Millikan early this week. The door was later found on the roof. Right: The door as it has been since it was first RFed in 1972.

Photo-Rich Feldman

Dean Morgan Nominated For Top Faculty Position

Prof. James Morgan has been chosen by the Faculty Nominating Committee as the candidate for Faculty Chairman. Dr. Morgan is currently Associate Dean of Students and the Executive Officer for Environmental Engineering Science. In addition to the election of its chairman, apparently a formality, the faculty will decide on a vice-chairman, a secretary, and other officers (including members of the Faculty Board). Membership on standing committees will also be decided in the balloting, which closes next Friday, May 20.

As with the faculty chairmanship, there is only one nominee each for vice-chairman and secretary—Profs. David Goodstein and David Elliot (the current secretary), respectively. These two officers, with the chairman, are mainly responsible for the functioning of faculty government.

The most interesting decisions will be in the election of the Faculty Board. The top six vote-getters of the fourteen nominees will be elected to three-year terms. In addition, another of these nominees will be elected to fill the remainder of Prof. Morgan's term on the Board (until June of next year). The nominees are Profs. T.M. Apostol, C.A. Barnes, R.E. Dickerson, R.W. Gould, D.M. Grether, D.J. Kevles, S.E. Koonin, H.A. Lester, H.W. Liepmann, B.V. McKoy, A.T. Moffet, R.W. Paul, J.P. Revel, and G.R. Rossman.

The faculty will also have a wide choice for the Academic Freedom and Tenure Committee. Three of these six nominees will be elected: Profs. N.R. Davidson, Leverett Davis Jr., S. Epstein, D.C. Goodstein, L. Hood, E.B. Lewis, and J. Quirk.

The remainder of the voting for faculty officers (the Membership and Bylaws Committee) and standing committee members is also, apparently, just a formality. In these cases, the Nominating Committee has selected only as many nominees as are needed to fill the committees. In all cases, it must be noted, the faculty is allowed to write-in votes.

Outgoing faculty members include Chairman R.E. Vogt, and Vice-Chairman Leverett Davis Jr. Nominating Committee members include Profs. N.R. Corngold, chairman, B.C. Barish, S.I. Chan, and H.B. Gray.

Bid To Buy Social Science Department Turned Down

By Kevin Drum

Carnegie Mellon University's bid to buy the Caltech Social Sciences Department was rejected Thursday after a stronger commitment to the Social Sciences here was obtained from Acting President Robert Christy.

The Pittsburgh-based university is starting a new social science program, and had offered the chairmanship to Economics Professor Roger Noll. Full professorships were offered to Political Science Professors Mo Fiorina and John Ferejohn. In addition, these three were told that they could select up to nine or ten of their colleagues at Caltech to accompany them (if they wished). Essentially, this amounted to an attempt to buy the department. Had the deal gone through,-the three professors had indicated that they would like to have taken Economics Professor Charles Plott with them.

Carnegie-Mellon approached Noll in March and Fiorina and Ferejohn late in April. According to Fiorina, "We were ready to leave," but Christy agreed to broaden Caltech's commitment to the social science program by expanding the number of social science positions. Four positions, including some now occupied by professors who will reture at the end of the year, will now be held by social science people. Also, Noll is involved in some research that he feels he wouldn't be able to continue if he assumed the chairmanship. Dr. Noll is currently on leave of absence at Stanford and cannot be reached for comment.

Although Carnegie-Mellon is now looking for a different chairman, their offer still stands. "We've bought a year," said Fiorina, who is still interested in the position if Caltech does not live up to its commitments.

"We were gratified by the administration's response," said Fiorina, who had expected the Institute to allow them to leave. However, Christy seems to have a genuine desire to expand the social science program. One of the things that made the Carnegie-Mellon offer so attractive was that the social science program at Caltech has, in the eyes of many, just been an "interesting experiment." Fiorina said that Caltech actually has one of the finest Social Science Departments in the country.

The trend in the U.S. in recent years has been toward interdisciplinary teaching in the social sciences. Interdisciplinary approaches have been tried in many places, but Fiorina thinks that Caltech's is the only one which has been an unqualified success. He attributes this to the fact that many of the professors here have interdisciplinary interests within themselves, while other programs simply have teachers with differing backgrounds in the same department. Also, the Caltech social science program has been very productive.

"We feel that with a few more positions we could be the best social science program in the country," said Fiorina.

After Carnegie-Mellon University has found a chairman for their new department, their offer will be considered again. "We would again very seriously consider an offer from them" said Fiorina. He commented that they would have to see if the administration lives up to its commitments. "It's just simple hard bargaining," he said.

The next chairman of the Division of the Humanities and Social Sciences will also weigh heavily in their consideration of Carnegie-Mellon's offer a year hence. "It's important that we find a suitable chairman," said Fiorina, "one who is nationally prominent, can raise funds, and is willing and capable of bargaining with the administration to upgrade the field."

It's Lit vs. SS vs. H vs. Ec vs. . .

Starting The Search For A Chairman

By Kevin Drum

The search for a chairman of the Division of the Humanities and Social Sciences is an especially tricky one. The Social Science Department has grown in stature in the last few years, while at the same time many feel that cutbacks in the Literature Department (for example, the elimination of the literature requirement several years ago) are reducing it to that most dreaded of entities: the service department.

So, to find an acceptable chairman for this faction-ridden division is no small task. It is unlikely that the division faculty will choose someone from within the division. According to Mo Fiorina, a member of the search committee, they are looking for someone with "national prominence." However, two years ago, when they were looking for a chairman at the end of Dr. Robert Huttenback's first term, they had no luck finding anyone from the outside world.

"Caltech's social science program simply doesn't have the respect that it should," said Fiorina.

There has been some grumbling in the Literature Department that the search committee does not properly represent the division. Out of the ten people on the committee, two are from literature, Angus Fletcher and Holly Jackson. This is Fletcher's first year here and Jackson's second.

"I would be shocked if someone from Lit were chosen as chairman," said one history professor. However, he went on to say that he thought that the committee was representative. Despite this being Fletcher's first year here, he says that "the literature people are glad he's there; he has their respect."

Is literature actually underrepresented? "Yes, I think that is true," said one literature professor. It is true that there are only four tenured literature professors. But that doesn't explain why none of them is on the committee. Explained the same prof: "They are all unsatisfactory (to Christy) in some way." Although he declined to state the reasons, he said that he knew what they were in each case.

In a memorandum to the HSS faculty, the search committee said that it would "suggest no disciplinary guidelines . . . only a commitment to the level of scholarly inquiry and teaching that has been the Caltech trademark for the past sixty years." Among other qualities,

Continued on Page Three

Inside The Tech

An examination of the controversy surrounding the recombination of DNA. Dr. Robert Sinsheimer and Dr. John Rosenberg give their views of the safety of the controversial technique.

A review of *Living Room With Six Oppressions* by Caltech's own Dr. Oscar Mandel, and *Death* by Woody Allen. **Page Seven**

Letters To The Tech

Coffeehouse

To the Editors:

Steve Oualline's phrase "food, comic books, and low prices" brings to mind a former cabinet member's joke about loose shoes.

My suggestion to the Coffeehouse managers would be to buy a cappucino machine and have a party. At this party they could have a comic book bonfire and usher in a new era of the Coffeehouse as a place to socialize rather than stare intently.

If the managers deal with many Steve Oualines, I suggest they be given a raise.

George Lake

To the People:

It's good to receive objective comments on the Coffeehouse management; Mr. Oualline's total ignorance of that management certainly qualifies as objectivity So, we of the Coffeehouse management must explain something. We try to be very intimate and comfortable; a place where you can feel relaxed. We just aren't a god-damn Jack-in-the-Box and we don't plan to operate like one. We are part of Tech, part of the community here, and we feel we need its consideration and support.

Complaints are valid. We are incredibly low-volume compared to commercial restaurants. We cannot afford the inventory to cope with the widely variable business; shortages happen. We are charged with the tricky business of making exactly zero profit. If we show a profit we are clearly hurting the customer. If we show a loss we're still hurting the customer, indirectly through ASCIT; everyone shares the liabilities. Everyone has a share.

Inflation. Facts of life, you know. The price of a hamburger has been the same for three years. But now it may have to change. Do you think sixty-five cents is too much to pay for a hamburger so conveniently located at one a.m.?

With love,

The Coffeehouse Management

By the way, you can rent our comicbooks over the summer–in case you want to eat out somewhere.

Korean Pen Pal

To the Editors:

You will probably be very surprised to receive this letter from a complete stranger.

I am a Korean boy who has been wanting to make a good friend in your country. I have heard so much about your country. I think your country is very beautiful, and I am eager to visit there someday.

I go to a high school. For my hobbies I enjoy reading, painting and travelling. My age is 18. I will be very happy if you would introduce me to a brother or sister around my age who is one of your members so that he or she could write me.

I promise to answer any letters and to write continually. I wish to thank you for your service.

Truly yours,

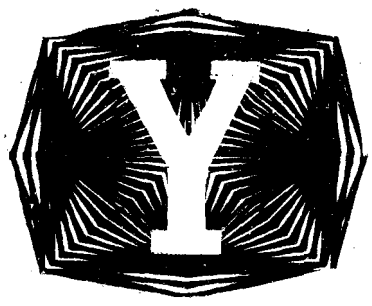
Lee. Chang-ho
c/o Heungilsanghoi
168 Boojeon-dong, Jin-goo
Boosan City, 601 Korea

The Public's Right To Know

By Bert Wells

Today: There will be a noon concert in the quad featuring Frazier Smith, a comedian who has worked with Firesign Theatre semi-extensively. He will offer swift imrovisation and absurd humor; bring your lunch and relax!

Wednesday: Dr. Lyndon Hardy, '62, the mastermind behind the famous Rose Bowl RF (which brought Caltech to the attention of millions of football fans across the nation) will be in the Y lounge at noon for an informal discussion. Dr. Hardy is a staff manager with TRW Systems Division. Do come and hear about the historic event, probably the epitome of Caltech pranks.



Thursday: Daniel Schorr, currently a Regents' Professor at UC Berkeley but best known as a former CBS news correspondent, will hold an open discussion at 2:30 p.m. in Winnett and a public lecture at 8:00 p.m. in Ramo Auditorium. Schorr has been deeply committed to the freedom of the press and this led to national controversy and confrontation with the House of Representatives Ethics Committee in 1976. Early that year he broadcast the highlights of the report of the House Intelligence Committee and arranged for the publication of the full text of that document after the House had voted that it should not be released. Moreover, Schorr refused to reveal the source of his informateon, claiming that the identity of his informant was confidential.

Schorr is a singularly talented journalist; his many awards include three Emmy Awards for his coverage of Watergate. His was one of the top twenty names on the White House's "enemies" list. And in 1974-75 he made many exposures of CIA activities including CIA involvement in assassination plots.

At the crux of the freedom of the press vs. national interest controversy, Daniel Schorr should prove to be a fascinating speaker. His theme will be "The Public's Right to Know." Don't miss this important event.

Next Friday: Peter Alsop, a talented singer-songwriter-guitarist will perform a noon concert on the quad.

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All the News That Fits

We Have
A Winner!

Izabella Kierkowska has been selected as this year's winner of the Haren Lee Fisher Memorial Award in Junior Physics. The award has been established by Mr. and Mrs. Colman Fisher in memory of their son, who was killed in an auto accident during his junior year at Caltech (1967). General Electric Foundation has also contributed matching funds to the $150 prize, which is awarded annually to a junior physics major demonstrating "the greatest promise of future contribions to physics."

Tech World
Airlines!

Places are now open to join the Caltech Flying Club. The club is actively seeking new student and private pilots from the Caltech community (i.e., students, faculty, staff, JPL). Currently there four planes (two Cessna 150s, a Cherokee 140, and a Cessna 172) at El Monte Airport. The club offers you an opportunity to fly and learn the safe operation of aircraft at a reasonable cost. So if you've ever had a desire to take flying lessons, but have never gotten off the ground, now's the time. It will never be any *cheaper* to learn to fly! For further information contact: Rich Terrile, Caltech 170-25 (est 2969) or Dave Diner, Caltech 170-25 (ext 2960). We hope you decide to join us.

Lloyd House's
Big Event

By popular demand, Lloyd House is once again proud to present The 6th Annual Spring Extravaganza, in their lounge, on Saturday, May 14. This spectacular production has had many memorable incidents in the past, and this year promises to be another biggie. Due to new restrictive laws in California, their Special Featured Live Entertainment was difficult to find. So don't miss this show; you may never be able to see one like it again. Show times are 8 p.m. and 10 p.m.; admission will be 25 cents (to help cover rising costs). The famous Lloyd House Bar will be open at 7:00. So remember, May 14, an event that you won't want to miss. The doors open at 7:30 p.m., and don't forget your two bits.

The Real
CCF???

The Caltech Cycling Federation is sponsoring a trip to Chantry Flats, beginning Sunday, May 15 at 7 a.m. from the Athenaeum lawn. Total distance is about 30 miles. Details for a bicycle trip to the beach on Sunday, May 22, will be arranged at our meeting Tuesday evening in Winnett Center at 10 p.m. For information, contact Dave Sivertsen, Ricketts, or Derek Davis, Blacker.

ASCIT
Goes Public

The newly formed ASCIT Public Affairs Council will be meeting Thursday, May 19 at 9:30 p.m. in the Y Lounge. The council will be formulating recommendations on the Caltech Affirmative Action program, particularly in regard to admissions and faculty hiring and promotion. Public invited.

Up Your
Fjord!

The Caltech Gamers will refight the Battle of Narvik in naval miniature on Saturday night, May 14, at 8 p.m. in Clubroom 1. As a radical change, ship models will be used instead of cardboard cutouts.

Please note that the location is Clubroom 1, not Dabney Hall. All are welcome.

The World
Of The Future

This week Cinematech is presenting two SF films: H.G. Wells' *Things to Come*, and Ray Bradbury's *The Illustrated Man*, starring Rod Steiger and Clare Bloom. Showtime is 7:30 p.m. Saturday in Baxter Lecture Hall. Admission is the usual $1.50 general, $1.00 ASCIT/GSC, $.75 children under 14.

Gay Discussion
Group Meets

The Caltech Gay Discussion Group will meet this Wednesday, May 18, at 7 p.m. in the Y Lounge, Winnett Center. Don't just sit in your room; come make some new friends. Phone 793–8864 for information.

Stalking
The Wild . . .

A base camp on the Pacific coast of Baja California will be headquarters for three, 14-day summer study tours planned for college students by Wilderness Trail Expeditions of San Diego. Each of the trips will include meals, transportation and instruction–all for less than $14 per day.

The first tour is scheduled June 25 with return to San Diego set for July 8. Two others are planned for July 12 through 25 and July 30 through August 11. For reservations information write Wilderness Trail Expeditions, Inc., P.O. Box 2402, La Mesa, CA 92041, or call (714) 464–2090.

And Here's
The Pepperoni . . .

The Dean's Office will be sponsoring a pizza party on Sunday, May 22, at 5 p.m., at the Fleming-Ricketts Courtyard. All invited.

HSS SEARCH

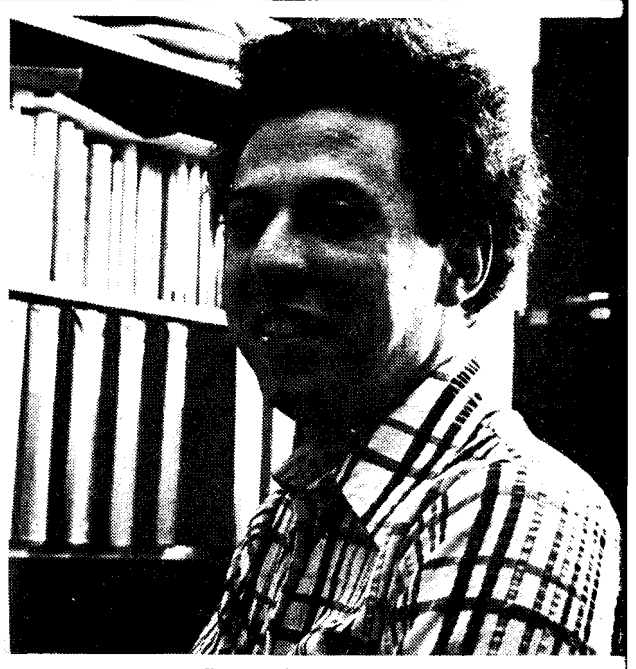
Continued from Page One

the next chairman must be able to raise money, and bargain with the administration for the expansion of the Caltech HSS Division.

Perhaps in response to the charge earlier this year by Dr. Jenijoy Labelle of sex discrimination and the ensuing crisis, two of the search committee members, Holly Jackson and James Quirk, have been asked to "pay particular attention to the possibility of women and minority candidates." Interestingly throughout the memo, the division head is always carefully referred to as the chairperson.

The memo also said that it would "not be easy to find a replacement who is equally inovative and committed to scholarly achievement and can command the respect of and support of all parts of this heterogeneous administrative unit." "However," it continued, "if the momentum that Bob (Huttenback) has built up is not wasted and if the developments in English History and Social Science are to be pushed forward towards parity with the rest of the Institute, a candidate must be found."

"While the risks are hypothetical . . . The benefits are real"



Dr. John Rosenberg

Recombinan Benefits Wo

By

Caltech, which has always been on the forefron of genetic research, has six professors who are no doing or planning to do experiments using th recently developed tool of recombinant DNA. Dr James Bonner, Eric Davidson, Norman Davidso Richard Dickerson, Tom Maniatis, and Robe Sinsheimer have all obtained both approval an funding for their experiments.

All of the work being done at Caltech now basic research aimed at understanding more abo the nature of genes, including their replicatio process, the role they play in evolution, and th reason some genes are expressed, or "turned on, while others are inactive. Recombinant DNA wi help the researchers to identify the exact structur of the genes being studied, and will help produc enough of the genes to work with.

Every living thing from the most simple bacter to the complex human being contains DNA, in th form of genes. An organism's genes contain all th information required to create another copy of tha organism, and control all of the characteristics tha make it a unique species.

Recombinant DNA refers to the process th molecular biologists have developed to ma produce any particular gene segment that they a interested in studying. This is done by inserting th gene segment into a bacterium, where it wi replicate as the bacterium reproduces itself. Thu large amounts of the gene segment can be obtaine for biochemical analysis.

To insert the gene segment, which is usuall from a higher organism, biologists make use o small rings of DNA in bacteria, called plasmid which are apart from the cell's main body of DNA but at the same time replicate with the cell. Bilogis first of all isolate these plasmids, and in a test tub using recently developed enzymes, chemically cu out a segment of the ring. Then, using oth enzymes, they combine the gene segment they a trying to study with the rest of the ring, creating hybrid, or recombinant, plasmid. The plasmid then re-inserted into the bacterium, where it replicated.

This process can also be done by using virus instead of plasmids. A virus has a DNA string th is comparable in size to a plasmid ring, and b inserting a recombinant virus DNA into th bacteria, more of the recombinant DNA will b produced.

Recombinant DNA was originally developed as basic research tool, both to understand the genet process itself, and also to be able to "map out" a organism's gene structure.

However, a vast number of possible benefici applications of the process have emerged since development several years ago. For example, if t right genes could be isolated, bacteria could made into pharmaceutical factories, producing su things as insulin, blood-clotting factors f hemophiliacs, and vitamins. Bacteria could custom-made to clean up oil spills, or fix nitrog for crops, thus making fertilizer unnecessa Finally, recombinant DNA provides a new and ve powerful tool in cancer research.

However, though recombinant DNA resear poses no known risks, many scientists feel th there are possible unknown risks. As can be se from the two opposing arguments on this page, t

By Dr. John M. Rosenberg

With the advent of recombinant DNA techniques, molecular biology is no longer a pure science, i.e. devoid of immediate practical consequences. Indeed, recombinant DNA technology can and will directly affect the lives of millions of people. The current public furor concerns itself with whether those effects are likely to be for good or ill? and hence what public policies should be adopted in the general interest. As in most controversies where the volume of the debate is high, the factual basis of many statements is frequently low and misconceptions abound. It is my purpose here to summarize the view that: (1) This research can be done and is being done safely; and (2)Society will probably derive many practical benefits from it. Recombinant DNA technology is based on three observations: (1) the discovery of a class of enzymes (termed restriction endonucleases) which can cleave double-stranded DNA at specific sites and thus break a large DNA molecule into a series of specific fragments; (2) the development of a variety of techniques whereby fragments of DNA. such as those produced by a restriction endonuclease, can be recombined in the test tube; (3) the existence of small pieces of DNA (plasmids) that replicate themselves inside a bacterium when the bacterium divides. These plasmids usually contain several genes and hence add their genetic complement to that of their host. In a typical recombinant DNA experiment, DNA is extracted from an organism (let's say a yeast) and broken into fragments. Some of those fragments are then recombined with a plasmid, thereby forming hybrid (yeast-plasmid) DNA molecules. These modified plasmids are then inserted into bacteria wherein the original plasmid replicated—usually the bacterium is *Escherichia coli*, or *E. coli*, the classical guinea pig of molecular biology. Clones are then isolated from these bacteria (a clone is a colony of bacteria such that each member of the colony is descended from a single bacterial cell). Each different clone would then contain a potentially different bit of the yeast's DNA.

It is important to note that "recombinant DNA" is a class of techniques, not an entity in itself. Up to the present, tens of thousands of strains of bacteria containing recombinant DNA have been produced and isolated by a variety of techniques similar to that outlined above. This has been done for thousands of different reasons ranging from experiments to isolate individual genes from various organisms to attempts to convert bacteria into miniature chemical factories. Whether these strains are benevolent, harmless or dnagerous is not a consequence of the fact that they contain recombinant DNA, but upon what was recombined. It must also be stressed that of those tens of thousands of strains, not one has proved harmful in the slightest.

What the fuss is about is the possibility of creating a strain of bacteria that would be the cause of a new disease (either a human disease, or an animal or plant disease that could cause ecological or economic harm). At this point, it is important to ask the question: What characteristics must a bacterium have in order to cause disease? Simply put, two criteria must be met: the bacterium must be capable of injuring or killing living tissue in the host (victim) and the possession of that capability must provide that bacterium with a selective advantage. Thus, pathogens possess a complex of genes for one or more poisons (toxins) which damage or kill host tissues. Additionally, these properties must enable the pathogen to reproduce itself more rapidly (over the entire course of its life cycle) than a bacterium that did not have these genes, but was otherwise identical to the pathogen. This last point is particularly important—if being pathogenic did not confer some advantage on the bacterial strain, it would be eliminated by natural selection.

The issue then is under what conditions could a harmless bacterium, such as a laboratory strain of *E. coli*, be converted into such a pathogen? Clearly, the *E. coli* would have to acquire genes that would give it at least some of the capabilities enumerated above. Thus, the potential danger of a recombinant DNA experiment depends on the source of the DNA that is to be recombined with the *coli* plasmids. If the source was itself a pathogen, the resulting clones of *E. coli* could conceivably be pathogenic. On this, there is no disagreement—this type of experiment is strictly prohibited under the NIH guidelines and no one has objected to this prohibition. on the other hand, if the source of the DNA was the same laboratory *E. coli* there is virtually no chance of producing a pathogen. Here too, there is general agreement—the NIH guidelines require minimal safeguards for this class of experiment, and there has been no serious objection to this.

The controversy has arisen over the middle ground wherein there is no identifiable risk, but where unidentified risks could exist. It must be emphasized that the risks in this category are entirely hypothetical. This is the source of the intensity of the dispute since it is possible to conjure up all sorts of conjectural catastrophies. Recombinant DNA research is hardly unique in this respect—almost every human activity, in some unlikely event, could create a disaster. Practically nothing can be done with an absolute guarantee of safety.

The hypothetical risks revolve around the unpredictablility of "old" genes in a new environment, i.e. around our ignorance. Thus, the question is whether a gene from a harmless organism might not be so harmless in an *E. coli*. The issue is not that we have any reason to suspect that a strain of *E. coli* carrying such a gene could be harmful, the issue is that we do not know for sure that it is not harmful.

This gets to the core of most of the misconceptions regarding recombinant DNA. Elaborate containment procedures are being used not because the bacteria that carry recombinant DNA are dangerous. In view of the previous discussion of pathogenicity, they are very probably completely harmless. However, since that is not certain, the containment procedures have been adopted by the NIH, at the request of the scientists who do the work, as a protection against the possibility that something was overlooked.

Thus, the most stringent level of physical containment (termed P4) is required by the guidelines for those experiments where the conjectural hazard would be serious in the unlikely event it actually occurred. This consists of an elaborate system of closed chambers, negative pressure, filters, air locks, etc. It is the same as the facilities used to study the Lassa fever, and Marburg and Zaire hemorrhagic fever viruses. It is virtually impossible to imagine a virulent organism more deadly than these viruses for they are quite contagious, often nearly 100% fatal, and no therapy is known to be effective against them. (These viruses, which occur naturally in Africa, are being studied because they will get here sooner or later on their own and we had better have a therapy or vaccine ready when they do.) The important point here is that the P4 facilities have already proven themselves effective in practice against these highly pathogenic viruses.

In addition to the physical containment, the guidelines require "biological" containment when the hypothetical risks are serious. Basically this requires using strains of bacteria that are "hothouse flowers," i.e. so weakened by a series of deleterious mutations that they cannot survive outside a very specialized laboratory environment. (They are so weakened that they can barely survive within the laboratory.)

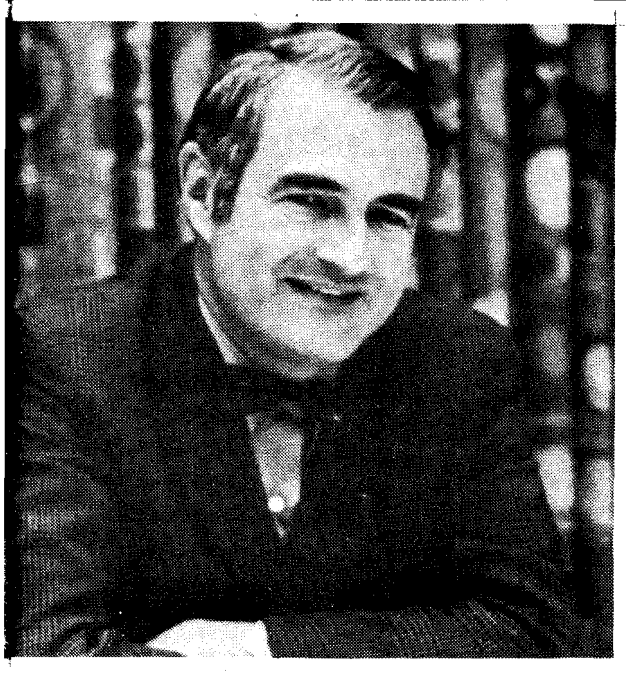
As the level of conjectural risk diminish, so do the levels of containment. In the event that the hypothetical worst is unlikely to be serious, even if it actually occurred, the physical containment level termed P2 is required. These containment procedures are currently in routine clinical use to deal with organisms that are "only" as dangerous as those which cause cholera, typhoid, and botulism.

The NIH guidelines are unique in that they are the only safeguards that have set up to protect against hypothetical risk. This has been the source of much public confusion since it is widely assumed that because they exist, the dangers must be real. All the other safeguards that have been established to protect laboratory workers and the public against such dangers as radio-isotopes, ionizing radiation, carcinogens, etc. are directed against dangers that are clear and present (excepting only those few experiments that have been banned.) It is my contention that even in the unlikely event that a dangerous organism were to be produced, it would be adequately contained by current procedures since they have proven themselves effective in practive against known pathogens. It is also fact that this research has been going on for almost four years, producing tens of thousands of strains of bacteria containing recombinant DNA—all wihtout adverse incident.

On the other hand, the benefits are real and are

Continued on Page Eight

Dr. Rosenburg is a research fellow in Chemistry



Dr. Robert Sinsheimer

NA--Are The The Risks?

troversy is basically over how much scientists ow, and of how certain that knowledge is.

The arguments first surfaced in 1973, when a up of molecular biologists publicly voiced their ncern in a letter to *Science* magazine. The tional Academy of Science formed a committee investigate the problem, and in 1974, the mmittee in a bold decision asked the scientific mmunity to honor a ban on certain experiments h the most possible danger—a self-policing move t was almost unprecedented in the history of ence.

In Asilimar, California, in 1975, over one-hun- d scientists upheld the ban, and asked the tional Institutes of Health to further police them drawing up guidelines for these experiments. In dition, they decided to wait on other experi- nts until a weakened mutation of the bacteria *E.* that would not survive outside of the lab could obtained.

The controversy has since spread to all levels of h national and local government. Hearings ore the U.S. Senate Health Committee began last tember, and more are scheduled for this mer. On the state level, California was the first e legislature to schedule hearings to investigate issue. The problem has even come down to the l level, for example, in Cambridge, Mayor ed Velluci tried to ban all recombinant DNA eriments at Harvard. The issue has come to adena, too, but here, the City Council expressed plete confidence in Caltech's ability to provide the safety of the surrounding community.

In response to the Asilomar conference, the tional Institutes of Health has formed a set of delines by which federal grantees doing mbinant DNA must abide. These guidelines egorize the experiments and specify minimum tainment precautions and laboratory procedures t are suited to the possible hazard of each type experiment. There are four levels of physical tainment, ranging from the standard laboratory, ed P-1, to the high security physical contain- nt P-4, which includes airlocks, showers for kers, gloveboxes, etc. However, the guidelines not enforceable in industry, so it will not be il national laws are passes that industry can be ulated.

At Caltech, there are two P-2 (low risk) and merous P-1 labs currently in operation. In dition, construction and testing of a P-3 oderate risk) lab in the basement of Kerchoff has ently been completed, and it should go into eration soon. The P-3 lab consists of a room with egative-pressure airlock, so that air always flows m the hall into the lab. Air leaving the room is efully filtered, as is the sewer lines, to screen out bacteria, and any materials leaving the room st first be sterilized. Finally, the most critical rk is done under a recirculating, filtered fume od for maximum containment.

The research groups under Dr. Maniatis and Dr. nner will have to do some of their work in the lab, since both groups are working with genes m higher animals such as rabbits and rats. wever, the other groups are working with anisms such as sea urchins, fruit flies, and silk ths, and so can work in the low risk P-2 and P-1 s.

"In the end we are ignorant of the extent of our ignorance"

By Dr. Robert Sinsheimer

The existence of an intellectual controversy is an indication of uncertainty—of a lack of knowledge that restricts our ability to make intelligent prediction of the consequences of our actions. The controversy may reflect factual uncertainty, concerning the nature of the substances or organisms involved and the general principles that control their interactions. The controversy may reflect human uncertainty, concerning the predictability of human actions and the limits of rationality. Or the controversy may reflect moral uncertainty concerning the virtues of differing basic value sets.

All these sources of uncertainty can be seen in the controversy over recombinant DNA.

The magnitude of our uncertainty reflects the magnitude of the scientific advance that these new techniques make possible. I believe science has not taken so large a step into the unknown since Rutherford began to split atoms. The recombinors may take comfort in this analogy, for Rutherford's experiments were not in themselves disastrous. He did not, in *his* ignorance, ignite a consuming chain reaction (in a historical sense, of course, he did if we include the subsequent three decades of physics in the chain, but I would not be so deterministic).

But, will we always be so fortunate in our explorations? Will Nature always be so benign and so resilient to our interventions? Are there really no evolutionary booby-traps for unwary species?

The recombinant DNA technology brings us at one bound into a new domain with great potentials, both for good and for harm—and all shrouded by our current ignorance. What are the factual uncertainties that may mask significant hazard and thus pose risks to the unwary?

One large cluster of uncertainties stems from the use of strains of *Escherichia coli* as hosts for much of this research. This organism is known to live in an intimate relationship with man and other animals. It is argued that the K12 strain is not "robust" and is unlikely to colonize the human bowel. The validitiy of this claim for persons on antibiotics or persons suffering from various debilitation ailments, or human infants, or other animals, is itself uncertain.

It is proposed that we will breed mortality into the *Coli* strains to be used in the "more dangerous" experiments. The effectiveness of such breeding, in a variety of ecological circumstances, remains to be demonstrated. Our ability to define the "more dangerous" is arguable.

We are ignorant of many aspects of the complex microbiological equilibria that truly underlie and maintain the entire world of life in its present form—quasi-equilibria that affect the bacteria that degrade our wastes and replenish the planetary nitrogen and carbon dioxide, which generate our soil and cleanse our waters—and again, we can therefore hardly estimate the consequence —short-term and long-term—of the introduction of novel microbial forms.

We are grossly ignorant of the structural gene content of the eukaryotic genomes that we introduce so blithely in this *E. coli*. How can we predict the consequence of the interactions of unknown gene products with the numerous macromolecules and metabolites of the *Coli* organism?

The DNAs introduced into these strains are in no sense random sequences of nucleotides. They have been, most often, selected to code for proteins that achieve a function, often a catalysis. The action of such proteins upon indigenous components of *Coli* might split off polypeptides with unfortunate sequences, or might convert normal metabolites into undesirable products—for example, converting amino acids into catecholamines with synaptic functions.

With respect to novel metabolites, one should remember that we are as yet largely ignorant of the etiology of cancer. Does anyone imagine the roster of carcinogens or mutagens has been completed?

We are ignorant of the nature and mode of transmission of slow viruses. Could their ingredients lurk in these random bits of genome we now juggle? Ailments whose symptoms are long-delayed are, of course, the most pernicious, for their causative agents could become widespread during the incubation period.

In the broadest sense we are here, through the creation of wholly new gene combinations, intervening profoundly in the evolutionary process. A plausible estimate suggests that research laboratories in the United States alone will produce some 10^{15}–10^{16} recombinant organisms/year. Industrial production could easily exceed this by several orders of magnitude, albeit probably of more limited varieties. It is unreasonable to believe that a great many of these cells will not escape our containment provisions. Such novel strains may then, in a unique development, broaden the base for future planetary evolution.

Can we predict the consequences?

Except in the most general terms, we are ignorant of the broad principles of evolution, of the factors that determine its rate and directions. We have no general theorems to account for the spectrum of organisms that we see and the gaps in between. In the microbial world, for one particular instance, what is the advantage of the botulinus toxin to the botulinus organism? Related strains seem to do well without it. Why is there no coliform that has this toxin? Did evolution simply never happen upon this path? Or was it always so lethal as to prevent the development of a successful host-parasite relation? We simply do not know.

We are ignorant of the relative importance of the various factors we currently perceive to participate in the evolutionary process. Major controversies swirl about the relative importance of neutral or advantageous mutations of mutations of structural genes or mutations of control elements—and over factors that lead to conservation of gene order or that facilitate gene rearrangement.

We are ignorant of any absolute measure of adaptation. We are ignorant of the depth of security of our own environmental niche. How many microbes or viruses now exist that are one mutation away from human pathogenicity? Or two? Or five? Or one gene, or two? We do not know.

In this new domain into which we leap, we are surrounded by terra incognita. Areas of investigation that formerly seemed of little interest are now seen, from the new perspective, to be of major import. And, of course, the new techniques provide powerful means to explore these areas. But while we reconnoiter, is not great caution advisable?

Further, of course, one should point out that we can now create combinations of DNAs from diverse organisms such as could hardly ever, plausibly, have occurred in any natural setting.

I know that some believe we will be protected from the consequences of our ignorance by the blanket theory and workings of natural selection, which, in their view, will stifle all of our inventions. They assume in effect that in each case, Nature has already achieved the highest possible level of adaptation.

I have little doubt that had they been aware of it, the buffalo and the dinosaurs would have felt protected by the same principle. I see no reason for such sanguine belief. I would add that even if Nature has indeed tried out all forms and achieved near perfectly equilibrated adaptation, that does not mean we might not introduce deeply perturbing transients.

Which leads me to the last unknown to add to the list. Simply, we are in the end, ignorant of the extent of our ignorance.

This, then, is the substratum upon which the NIH Guidelines rest. It is crisscrossed by the faults of ignorance, the discontinuities and lacunae of our knowledge. Any one of these might fail us at any time.

Research upon novel 'self-perpetuating' organisms is as different from prior science as was the first self-perpetuating cell from all prior abiotic chemistry.

There are other dimensions of hazard here. Let me refer briefly to the second class of uncertainty—human uncertainty.

Knowledge *is* power. As the result of the extraordinary advances in our science, biologists have become, without wanting it, the custodians of great and terrible power. It is idle to pretend otherwise.

A recital of risks and unknowns is lubgubrious. But every risk is also a challenge and every unknown a potential for adventure. I only caution that there is a fragile line, vague and ill-marked, but fatefully real, between self-confidence and what the Greeks knew as as hubris. When we are concerned with the fate not just of an individual, but potentially of much of humanity, if not indeed our very biosphere, it is the course of wisdom to keep that line in full view and respect.

Dr. Robert Sinsheimer is the chairman of Caltech's Division of Biology.

Peter Gabriel: Still Making It Outside Of Genesis Framework

By Rock

Here's the latest scoop on a few of the latest rock and roll releases:

Peter Gabriel, former lead singer for Genesis, has released his first album entitled *Peter Gabriel*. In it Gabriel presents an amusing collection of sounds amidst a diverse example of weird avant-garde music. Freed from the framework of Genesis, Gabriel spreads his bizarre notions about music into other less likely forms. The musical performances on the album are tight and tasteful and highlighted by the excellent guitar work of Robert Fripp. The album is held together by Gabriel's confident voice and his intriguing but elusive lyrics. This album is another sterling example for the world of the fine line which separates true genius and utter insanity.

Sea Level is the premier album from the band of the same name, Sea Level is Chuck Leavell, Jai Johanny Johanson, and Lamar Williams–all late of the Allman Brothers–and Jimmy Nalls, a hot guitarist out of Nashville. The band retains a bit of that southern rock sound, especially when Nalls lets loose on slide guitar, but is apparently most interested in playing contemporary jazz and funk. This seems to be the doing mostly of Chuck Leavell, the writer, keyboard player, and lead vocalist for the band. The rest of the players seem content to trust to Chuck's leader of the band trip (Sea Level–C. Leavell; that's no mere coincidence). This band displays a lot of promise and talent but their music occasionally sinks into the pit of commercialism (i.e., a jazz version of "Scarborough Fair"). Let the buyer beware.

Kingfish has a new live record culled form the concerts at the Roxy in March, 1975. The selected songs are all fast and furious rock and roll. Amongst them are "Good-Bye Yer Honor," "Jump for Joy," "Jump Back," and "Round and Round." This is one band at least that hasn't sold out and for that matter, they didn't even sell out the Golden Bear the last time they were in town.

The album is entitled *Live N' Kickin*, which I suppose is in contrast to Dead and kickin'. That brings up some strange but understandable point about this record. This is that Bob Weir is truly shafted in this record. His guitar and vocals are noticeably mixed down, he's listed last in the credits for the band members, and on the back is some drivel about Bob Weir sitting in with Kingfish last year. I saw Weir play with the Fish a number of times last year and I didn't see him sit down even once. This bit of bizarreness is due to the fact that the band is trying to make it without Weir now. They'll be back in Los Angeles next weekend at the Whiskey to see if they succeed. Frankly, they're just as hot without Bobby Ace, but don't tell anyone 'cause this reporter can do without a mob scene in Hollywood next weekend.

Hallelujah! May the saints be praised! Dicket Betts and Great Southern has risen out of the ashes of the Allman Brothers and brought that screaming hot Southern rock back to the people. Only Betts is a former member of the Brothers Band, but the band uses the same instrumentation as the Allmans (including two drummers) and tries to emulate their sound as much as possible. They succeed except for the fact that the vocals are not the blues-based phrasings that Greg laid out. In contrast Dickey's vocals are rather countrified (remember "Ramblin' Man" and "Blue Sky"?), but surely are listenable in their own way. The cuts on their premiere album are long and well-paced compositions by the band members. In addition the group performs many old Allman tunes, especially those Dickey wrote, and do them well. Don't pass up the chance to see this band live if you ever get the chance.

* * * * *

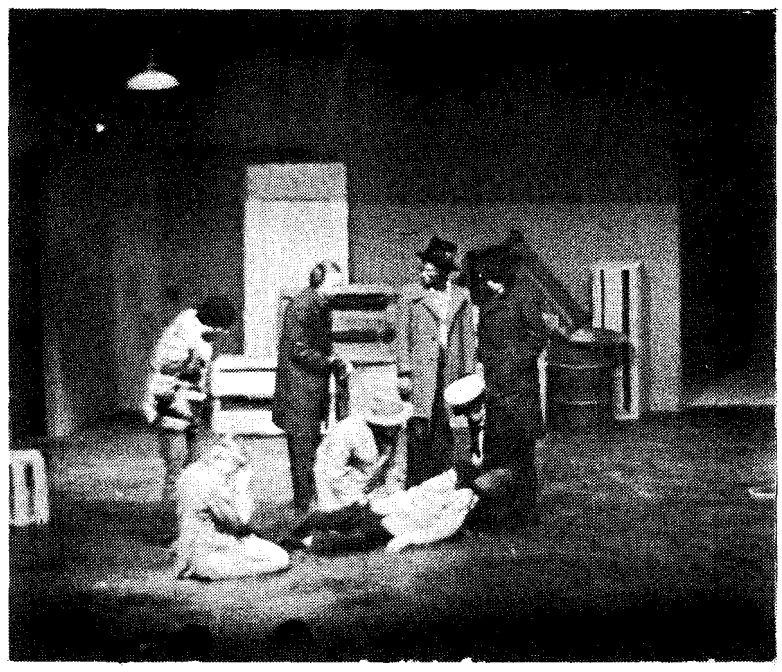
The Caltech Jazz Band played two sets at the Ice House last Monday. The show featured the compositions of Caltech graduate student Les Deutsch, and Bob O'Donnell, a guest trumpeter of some note. Bill Bing conducted this 22-piece ensemble. Amongst the players are John Ferejohn, Dick Wooden, Bruce Baker, John Brugman, and John Wellman. The enthusiasm of Mr. Bing and the many band members has provided the Tech community with some fine music during the last few years.

Unfortunately, this was not one of the band's better nights, but the packed house still was wild about the first set. The second set was less well-attended, but by the middle of this set the band was really starting to cook. Bob O'Donnell also contributed brilliantly to this set. Unfortunately, I believe the jazz band will not play again this year, but there is no reason to believe that they won't be just as good next year.

Death Made Easy, By Woody Allen

By Greenie

It takes a Woody Allen to make a subject like death humorous. *Death*, presented by Spectrum Productions in its West Coast premiere, is somewhat more philosophical than the usual Woody Allen output, but is studded with the usual nuggets of one-liners. This play represents not only Woody Allen's answer to the philosophical problem of death, but also hints at everything from his religious views to his feelings as to his position in the universe. The main character, Kleinman, in a role tailormade for Woody Allen, exclaims, "I have a great fear of death—it's one of my least favorite activities."



A scene from the Spectrum production of Woody Allen's *Death*. Photo-Don Bacon

The plot is Kafkaesque: the protagonist (well-played in the best Woody Allen style by Alan Solomon) is awakened in the middle of the night by a covey of grim-faced vigilantes who are after a Killer who has been terrorizing the city. After showering him with vague accusations and suspicions, they bully him out into the snow to play an unspecified part in a vague plan whose entirety no one appears to know. He is not told what his part is, but is ominously warned that it is his own fault that he doesn't know, that "It was your responsibility to find out" and that his lack of knowledge is suspect. He is intimidated into remaining by the vague threats and by the fear that if he goes home he will be blamed for the failure of the Plan. Splinter groups appear, each with their own plans, which supercede the original, and fighting develops among the groups.

In the end, of course, Kleinman meets the Killer, and is capriciously murdered.

It is fairly easy to attach metaphysical meanings to the undefined Plan, and to speculate as to their relevance to Woody Allen's own beliefs ("Things may seem chaotic, Kleinman," says a greyly intense vigilante, "but they're not.")

Alan Solomon's portrayal of Kleinman as a sane man desperately clinging to reality in the face of an absurd universe would receive a nod from the author; Raymond Roy as the Cop and Dan Driggans as the Maniac also deserve special note. Spectrum has certainly well-cast the play, and if Director Shirley Marneus is not Woody Allen, she has managed to infuse the play with a nightmarishly inexorable quality which keeps the audience riveted.

Living Room with 6 Oppressions is a one-act homily by Caltech's professor Oscar Mandel. Dr. Mandel waggles a sage finger of rebuke at ivory tower intellectuals, playing upon the idealism inherent in liberal philosophy, and reminding us that the fact that he is oppressed by the majority does not prevent the unfortunate from turning on those weaker than themselves.

Since *Living Room* is intended only as a proverb, a moral story, the characters are storybook people, yet they are stylized rather than wooden; prototypes rather than stereotypes. Dr. Mandel uses this stylization in intentional contrast to real people with real identities as in the end when Nanny is suddenly recognized as a human being for the first time by Mr. Available—a commentary on the intellectual's inability to see humanity as people.

Dr. Mandel tells his proverb in a comfortably jocular, once-upon-a-time avuncular tone of voice, reminiscent of afternoons spent at the knee of some wise, aged relative. While this tone is at times tinged with paternalism, the play leaves the audience with a pleasant feeling of having been edified and instructed.

Special note should be made of the performances of King Stuart as an almost grotesquely effete Mathew Available, and Maxine Elliott's complementing sturdily maternal Nanny.

Caltech Relay Team Qualifies For District Finals

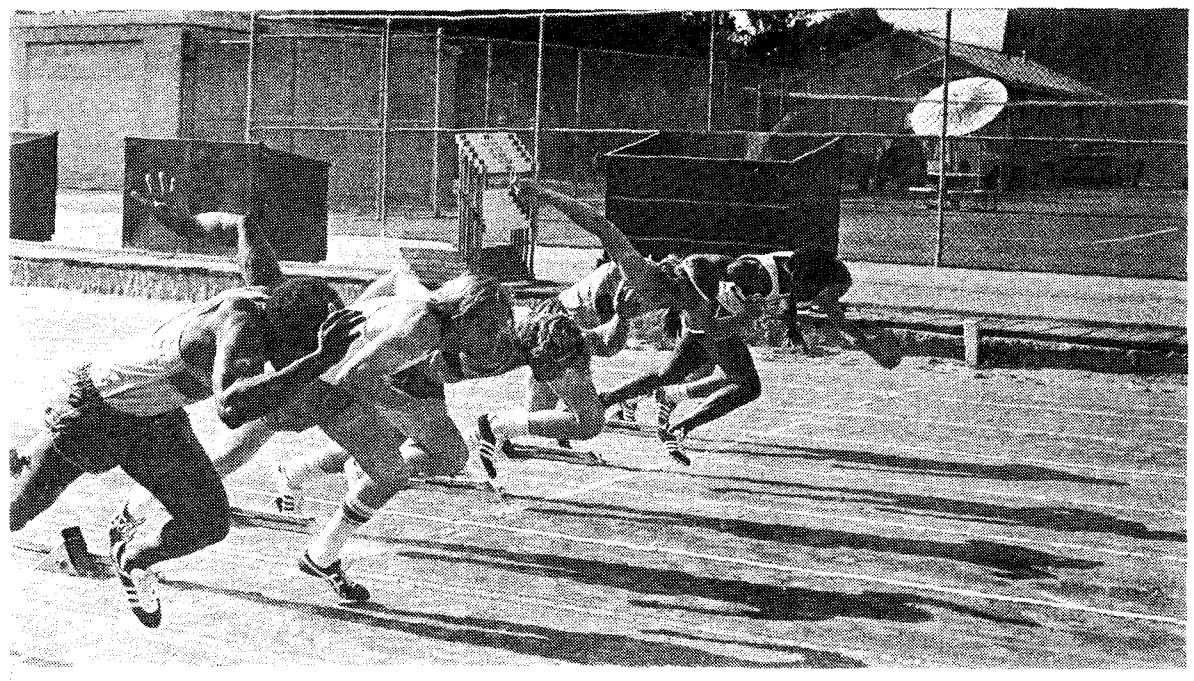
By Tommy Trolljan

The Conference Prelims last Friday and the finals on Saturday featured some unexpected surprises for some, and an inglorious end of the season for others.

One of the major breakthroughs came when the 440-yd relay team of Norm Murray, Greg Blaisdell, John Hattick, and Brian Sutula (one freshman and three sophomores) ran a 44.0. Their performance made them the only element of Caltech's track team to reach District III prelims (being held today) on their own merits. Caltech's mile relay team, third by virtue of a host of disqualifications, managed a 3:40.6.

There were several other efforts that deserve mentioning. Rob Bourret, taking off on the third lap, ran a 4:11 1500-meters (equivalent to a sub-4:30 mile) to take sixth. Norm Murray came close to getting to district on his own right, running a 22.6 in the 200-meter finals. John Hattick *somehow* made it through the prelims and into the finals with two all-time bests of 53.7 in the prelims and 53.0 in the 400-meter final. Hattick shows tremendous promise as he is a soph with few races behind him. Duane Boman continued along in the 400 intermediate hurdles, running a 59.2. Steve Kellogg, in his last collegiate race of such a horribly short distance, ran the 5000-meters, turning in a fine effort (16:25).

Watch for Norm Murray in the 200, John Hattick in the 400, Duane Boman in the 400 intermediates, Tom McCabe in the 800, Rob Bourret in the 1500, Brett Van Steenwyk in the 5000, Steve Kellogg in the 10,000, *and* our 440 relay team in district, all of which, except the 10,000 (held Saturday) will be held today at the University of Redlands.



Duane Boman at the beginning of the 110 high hurdles at this Saturday's prelims.

Golf Season Finally Over

By Rock Howard

The Caltech golf season plodded to a close as team members participated in a Southern California Intercollegiate match at San Diego and the SCIAC conference championships. No one (for Tech) shot well enough to reveal their scores to me. It is doubtful that anyone was within 20 strokes of the 36-hole total of 149 which won the conference championship for Peter Graves of Pomona.

In retrospect, the highlight of the Tech golf season was a match loss to LaVerne by the close margin of 31-23. Charlie Curatalo, Nelson Goldikener, Curt Meissner, and Robert Chess scored points for Tech in that match.

The golf team struggled along this year not only because of the usual lack of talent and/or time for the players, but also because of a lack of communication among team members.

ROSENBERG: BENEFITS OF DNA RESEARCH OUTWEIGH POSSIBLE RISKS

Continued from Page Four

already beginning to be realized in two areas: fundamental biological knowledge and practical medical and commercial applications. In the former, recombinant DNA research is already contributing to an understanding of DNA replication and the regulation of gene expression. Indeed, a significant proportion of all current experiments with DNA at the molecular level involve recombinant DNA. This technique also provides the only currently available method whereby the chromosomes of complex organisms can be dissected with the precision required to understand their organization and function. The most likely expectation of these lines of research is a major advance in our understanding of the life process.

On the practical level, recombinant DNA methodology has already contributed to an understanding of the acquisition of antibiotic resistance by disease producing bacteria and may enable production of modified antibiotics that overcome these reistances. Many antibiotics, vitamins, and other medically and industrially useful substances are currently produced by species of bacteria and fungi that are difficult to grow and process. Consequently, these substances are rare and expensive. The genes controlling their production are currently being transferred from their original source to *E. coli*. This should result, in the near future, in a significant enhancement in production for at least some of these substances.

Efforts are currently underway to transfer genes from animals and plants into *E. coli*. These experiments present greater technical difficulties than those discussed above, but the obstacles that have to be overcome have been defined and the expectation is that they will be surmounted. This should enable the large scale production of insulin and other hormones, antibodies, and many other medically and industrially useful substances.

Other applications of recombinant DNA technology are more speculative: if the genes for nitrogen fixation could be transferred from the limited number of bacteria which are natually able to carry out this process into an appropriate recipient, the agricultural requirement for fertilizers could be greatly reduced or eliminated. This would result in a tremendous saving of energy and elimination of the substanital ecological damage currently caused by nitrogen fertilizers. There are a number of energy bioconversion processes that could make a significant contribution to solving the energy crisis if several technical and biochemical difficulties attendant to the microorganisms that carry out these processes can be solved. One solution would be to transfer the requisite genes to a more suitable organism using recombinant DNA methods.

In summary, I wish to emphasize the following points: A bacterium is pathogenic only if it possesses certain definite characteristics. Based on scientific knowledge, a limited class recombinant DNA experiments might produce a pathogen and these experiments have been banned and will not be done. For all the rest, the risks are purely hypothetical. All the safeguards, guidelines and containment procedures have been applied to protect against the unlikely event that a hypothetical danger would become real. These containment procedures are working for known pathogens on natural origin and hence would be expected to work of a recombinant DNA experiment actually uced a pathogen. Recombinant DNA has the potential of providing many benefits to biology, medicine, and industry that, unlike the risks, are likely to be realized. Indeed, some of them are being realized even now.

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