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The Drive of the Pure Researcher

PURSUIT OF INTELLECTUAL ORGASM

A conversation with Frank Beach, animal behaviorist, about a life spent answering exact questions exactly. What—hormones or nervous system—makes a dog lift his hind leg? Why do bitches reject some males? When does impotence follow castration? Why would too many male hormones in a male rat cause female sex behavior? What can animal research tell us about human sexuality?

by Joyce Dudney Fleming and David Maxey

Joyce Dudney Fleming: What's going on at that idyllic field station up in the Berkeley hills where you do your research? Are you still looking at sexual behavior in dogs?

Frank Beach: We've got a lot of peeing going on now. We've been looking at urination behavior, trying to figure out why an adult male dog lifts his leg to urinate while a female squats.

David Maxey: Why would anyone want to know?

Beach: I want to know for the same reasons one would want to understand the biological basis of any sex difference. But here, particularly, I am interested in behavioral endocrinology, the effects of hormones on behavior. Does the male dog lift his leg because of the male hormones circulating in his blood, or is his nervous system wired differently from the females? We know that both males and females squat when they are very young, and females continue using that posture throughout their lives. But when the little males are about 30 days old they stand to urinate, all four feet on the ground and usually leaning forward a bit.

Between five and eight months of age, males start to show partial leg lifting. This occurs at about puberty, and we've always assumed that this posture was controlled by hormones because at that time the male sex glands are starting to secrete hormones. Everybody "knows" this, but my dogs were too ignorant. Males I castrated when they were born should have continued using the standing posture, but they started lifting their legs at about eight months.

I also "knew" that my masculinized females, which had received male hormones before and shortly after birth, would not lift their legs unless I injected

"DO IT RIGHT AND DO IT ALONE"

A sketch of Frank A. Beach

You don't forget the first time you meet Frank Beach. If his reputation as a hard-nosed scientist doesn't impress you, his cool blue eyes surely will. I was very impressed in 1965 as I sat on one side of a bare classroom in which new graduate students were being properly introduced to the faculty; Beach sat on the other.

Helping in his laboratory did little to decrease my awe. He was the scientist's scientist, spending long hours in the lab, keeping up with everything written about sexual behavior in animals, putting research first—always. The professional man was no smaller than the professional reputation.

It would be easy to think of him as a child with a bedroom full of experiments and a mother who knew he was destined to be a famous psychologist, but that's not the way it happened. Fresh out of college, he wanted to spend his life as a high-school English teacher, but the Depression made those jobs all but impossible to get. He turned to graduate school and psychology only because he wanted a steady job.

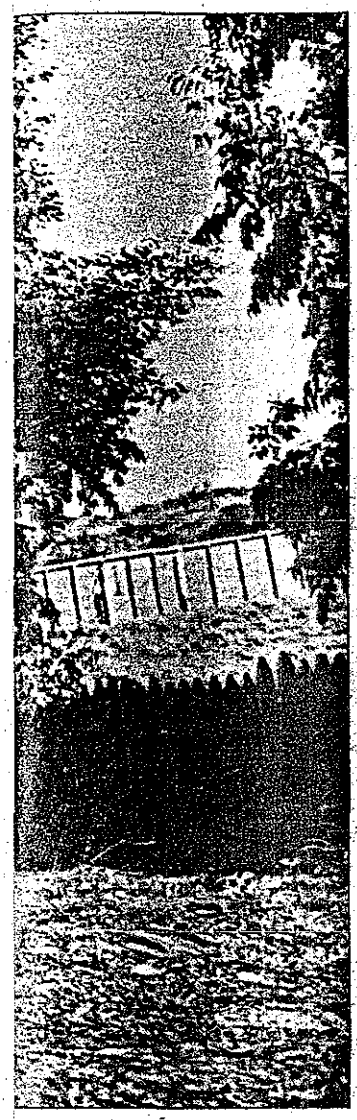
Once that decision was made, he attacked his new career with characteristic thoroughness. He put together a vita that reads like a dream—Ph.D. from the University of Chicago, research assistant with Karl S. Lashley at Harvard, curator and chairman of animal behavior at the American Museum of Natural History, then professor of psychology at Yale. His museum research and writing got him a full-professor's rank without the grueling years at the assistant and associate levels.

Two rules seem to have guided his career. The first one was "Do it right." He was supercritical of his experimental designs and the analysis of his results. By the time he was ready to publish his studies, it was difficult for anyone else to fault them.

The second rule is more evident in his conversation than in his publications. That rule is "Do it alone." He doesn't go in for multiple-author books. "I am a firm believer in a one-author book that comes out of one head." Or team research. "I like to do research all by myself. I don't like team research because when I am through I have to get something tangible, something that is all my own and is permanent in a sense. I get a sense of accomplishment and achievement out of that."

The importance of doing it yourself also comes through when he talks about other parts of his life. He was into photography at one time. He took his own stills and movies, had his own darkroom for developing and enlarging, even entered some amateur photography contests. That would be plenty for most people, but Beach was unhappy because he couldn't make his own film.

I didn't know Frank Beach as a human being when I was his graduate student. I didn't know he made furniture or his wife's first name. He gave his students the total independence he took for



himself. That was great when I knew what I was doing. Sometimes it was terrible when I needed help. Sometimes I felt it was a sin to ask for his guidance.

Beach is 63 years old now and winding down his research at the University of California at Berkeley. He wrote his own ticket for employment there in 1958—a full-time secretary, ample research space, teaching only what he chooses, and a promise never to be asked to take the chairmanship of the department. He is writing a book on behavioral endocrinology, editing one on human sexuality, and traveling a lot. He takes life easier now, throws more parties and more smiles. He seems to be accepting and enjoying the role of grand old man.

Decades ago, most of Beach's colleagues believed that he was making significant contributions to the study of animal behavior. Now, at last, I think he agrees with them. Not that he would ever admit it.

—Joyce Dudney Fleming

them afresh with male hormones. I was wrong there too. Some began to lift their legs at about eight to ten months. I don't understand exactly what's happening here. It clearly is not a simple result of the presence or absence of male hormones in adulthood, but it will take a lot more research to find out exactly what is going on.

Maxey: I suppose research like yours could be attacked rhetorically—I don't say with justice—on the emotional grounds that while children have trouble getting enough to eat, a very bright scientist is devoting precious time and money to dog urination. Do you have any trouble justifying to yourself a life of pure, unapplied research?

Beach: First of all, I don't see my research as the study of dog urination. The behavior is just a handle on a truly basic problem area, the source of sex differences. For purely practical reasons, I am studying sex differences in dogs and not in people, but I believe that in many respects the underlying mechanisms are the same. I am not claiming that anything I discover will automatically illuminate questions about human sex differences. It may, or it may not. If it does, that is wonderful. If not, I'm still working on general principles.

At the risk of descending to an *ad hominem* argument, I could ask you if you have any trouble justifying to yourself the fact that you spend your life editing *Psychology Today*, which surely puts no food in the mouths of starving children.

Maxey: Fair enough. My question was *ad hominem*.

Beach: I will admit that in my youth I often asked myself, how can a grown man earn a living this way? Why am I not doing "useful" research? Why am I not seeing patients or building bridges? I went through this frequently, and I have had a lot of graduate students who went through it too. I finally came to the conclusion that increasing knowledge, in and of itself, is a justifiable way to spend your life. I don't think that research workers should be compelled any more than artists, or magazine editors, or musicians to justify the way they spend their energies and live their lives.

Fleming: Your research with dogs goes back as far as I can remember. When did you start this work? At Yale?

Beach: Yes, it was at Yale about 25 years ago. Before I got into behavioral endocrinology I worked on a number of problems in the neurology of sexual behavior. For example, we assumed that erection and ejaculation were spinal reflexes, completely controlled by the spinal cord, not the brain. So I was going to pinpoint the tiny part of the spinal cord where male sex hormones activated these reflexes.

Fleming: Why did you choose dogs for those experiments?

Beach: Partly because one can masturbate male dogs and they will show erection and ejaculate. Vernon Kellogg had shown that you could sever a dog's spinal cord and maintain the animal for a long time. So I was going to condition male dogs to masturbation, then cut the spinal cord and show that erection and ejaculation reflexes were still present. Then my plan was to castrate those dogs. I was sure that after castration the reflexes would die out. Finally, I was going to expose the cord and put a wick in there so I could drip hormone slowly on different parts of the spinal cord until I found the exact point where the hormone worked.

Fleming: What happened?

Beach: I started out bravely but decided I had better take a look at mating behavior before I began the main experiment. I got a pretty good idea of what mating behavior looked like in laboratory conditions, and then I castrated some males. That was the end of my grandiose plans because the castration did not eliminate mating behavior. I had planned my experiments as though dogs were just big rats that barked. Since rats stop copulating after castration, I simply assumed that dogs would do the same. Anyway, under those experimental conditions the animals did not become impotent after castration. As frequently happens in research, you change your direction. It became much more pressing to find out why dogs should maintain their potency when rats didn't. The clinical literature contains a number of reports of castration in men. Sometimes they lose potency and sometimes they don't. So I thought, "This is much more like people. Let's run it down."

Maxey: We recently published an article on depression that included experiments in which dogs got electric shocks. One of the results was a number of letters objecting to such experiments. How do you feel about doing that kind of experiment?

Beach: There are usually two objections to this kind of work. One is when people say, "Dogs have feelings too, and you wouldn't do that to people. Why do you do it to dogs?" The other is the belief that sadistic scientists actually get pleasure from inflicting pain on animals. The latter, of course, is simply crazy and I don't think any reasonable person really believes it. The answer to the first objec-

tion is that this kind of work is done to advance knowledge. Even then, every possible precaution is taken to spare our animals unnecessary pain or discomfort.

Fleming: After I did surgery, I would take special care of the animal—a special diet of its favorite foods, special bedding to keep it comfortable, lots of pain killers. Do you do things like that to make you feel better about doing what you need to do to find out what you need to know?

Beach: Oh, yes. I have sat up all night with more than one operated dog. You are a human being before you are a scientist, and human beings are empathic by nature.

Maxey: Does the researcher choose the limits of what procedures he will do, or are there official rules about that sort of thing?

Beach: In the American Psychological Association we have a committee on animal care, and it's not just a pro forma committee. They hear complaints and they can take action. Too much supervision isn't good though; I'll tell you the kind of thing that can happen. People from some Government agency came to my laboratory a few years ago and said, "You have to buy new cages for your hamsters." And I said, "Why?" They said, "Well, these cages are only four inches high and they are supposed to be four and a quarter inches high." I said "Dammit, a hamster isn't four inches tall when he stands on his tiptoes." I know more about hamsters than the idiot who wrote those specs.

Fleming: Let's go back to your dogs for a minute. Did you ever find out why castration didn't stop their mating?

Beach: I found out that sometimes it did, and sometimes it didn't. When I repeated the experiment many years later, I saw the kind of potency loss I had expected in the earlier experiment. First the castrated dogs lost the ability to ejaculate and then, after about six months, they no longer had erections. But dogs in the first experiment were still performing very well five years after castration. I think the difference had to do with the test situation and the general living conditions of the animals.

Maxey: Could you characterize the way they lived?

Beach: In the original experiment they lived as most dogs do in experimental laboratories, in private cages about five feet by three feet. They spent 23 and a half hours a day like that. They were let out once a day for exercise and so the cages could be cleaned. They were physically healthy, but it had to be a very boring existence. The animals never left the colony room in the basement of the Yale psychology building, except when they were

"She simply would not mate with the fifth male, Ken. She knew him well; they weren't enemies. As a matter of fact they got along quite congenially when she was not in heat, and he clearly was socially dominant."

taken about 50 yards down the hall to a different room where a female in heat was waiting. Whenever they went out, they always went to the same room, and they always met a sexually receptive female. As you can imagine, it didn't take very long for them to discover the recreational versus the procreational aspects of sex. Whenever they were let out of their cages, they started scratching at the colony room door. If the door was opened they would go lickety split down to the test room door and scratch on that. They were strongly conditioned, and their lives were otherwise very restricted. I think those two effects interacted to make testing an extraordinarily exciting situation.

Maxey: Convicts.

Beach: Convicts don't get regular positive reinforcement. But if you did this experiment with convicts and treated them just as I treated the dogs, they might not show impotence as quickly, or as predictably, as other males who lead normal lives.

Fleming: What happened to your dog research when you moved from Yale to Berkeley?

Beach: I expanded the dog work. I wanted to breed my own dogs and raise them out of doors in social groups, which I couldn't possibly have done at Yale. I got that kind of set-up at Berkeley. I started with five pure-bred male and five pure-bred female Beagle puppies. From that n cleus, I finally had a colony of 80 do Then I repeated the original experimer on mating behavior to see whether t mating behavior shown by dogs living fr in a large field would be the same as that an indoor laboratory. And it turned o that the mating behavior was the sam but several things that I hadn't spotted i the laboratory became apparent.

I can illustrate one very interesting di covery by describing a particular anima One of the original females was name Peggy. Like most of her breed, she cam into her first heat when she was si months old. She had grown up with an played with all five males. When she cam into heat, they all wanted to mate witl her. She was very happy to mate with th male named Broadus, and she was willin to mate with three others, but she simply would not mate with the fifth male, Ken She knew him well; they weren't enemies As a matter of fact they got along quite congenially when she was not in heat, and he clearly was socially dominant over her but she would not mate with him. When he persisted in trying, she attacked and bit him until he bled. I followed this particular pair through six years. Peggy never lost her antipathy for Ken as a sexual partner, and she never lost her positive reaction to the other males.

Studying the behavior of other bitches, I found that most, but not all of them, have definite sexual preferences. They are much readier to mate with some males than with some others. In extreme cases, a female simply won't receive a given male, even though that same male may be quite acceptable to a different bitch. One of the interesting things was the consistency of this behavior; the patterns of likes and dislikes persisted right through the years. Even when we brought the female into heat artificially by injecting ovarian hormones, it was the same story. In a couple of cases, I gave double or triple the normal hormone dose to see if I could override the preference, but I couldn't.

Fleming: So if Peggy's choice was Ken or nothing she would prefer nothing?

Beach: She would prefer nothing, yes. And then there were females—I remember Kate—who didn't have any preferences. She was a very sociable gal, to describe her as charitably as possible. I looked at infantile play patterns and a number of other things, but I never did determine the basis of these preferences. Nevertheless, I did learn a great deal from this way of testing animals that hadn't been observed under laboratory conditions. Some theories that have been proposed on

the basis of studies of caged animals under highly artificial conditions aren't particularly illuminating, and actually can be misleading. I have been as guilty as anyone else on that score.

Fleming: I know that this research has taken most of each day of your life for years and years. What kinds of things have you given up to pursue this work?

Beach: Nothing I can think of.

Fleming: Nothing? How can it be that your work has not involved sacrifices in other parts of your life?

Beach: I just never thought about it that way. I suppose it is as simple as two bodies can't occupy the same space at the same time. Any time you choose one course of action, you automatically eliminate others. I've gone the way I've chosen to go. There have been times when I wished that I could just not work, but that happens to everybody. There are times when you don't want to put out the effort. But I haven't had any competing set of motivations that created conflict.

Maxey: Then I want to know the times in your work when you've had that moment, that special feeling, of having broken through, of having driven the nail all the way in straight. If you were a humanist, I'd call it a peak experience.

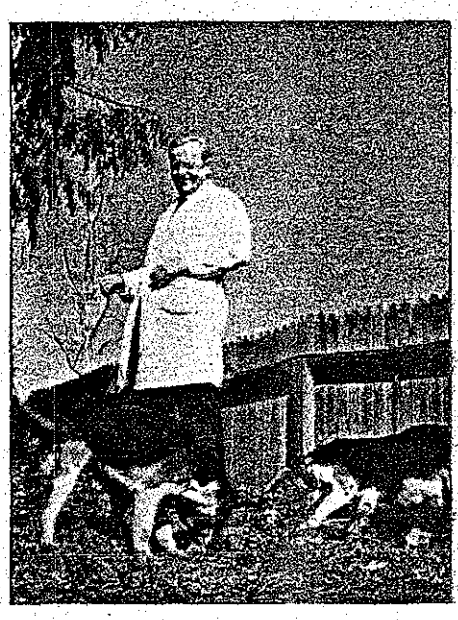
Beach: Call it an intellectual orgasm.

Maxey: That's much better.

Beach: I can think of a few times, but very few. Years ago I had been experimenting with the effects of female hormones on male rats, and male hormones on female rats, and male hormones on males and female hormones on females.

Well, one night at home I was trying to explain the results in terms of the effects of different hormones on different parts of the brain. I was drawing diagrams of the brain with arrows going this way and that, representing possible lines of influence from one part of the brain to another. It looked very pretty, but there was one arrow missing, and that was destroying the symmetry. I needed one more arrow, and that arrow would have represented this statement: If you give male rats enough male hormone, they should show female mating behavior. That is what my diagram predicted, but that was obviously impossible, unheard of. However, it happened that just at that time I had a large number of male rats that had been getting male hormone for a long, long time. So I dashed in to the lab and tested them and, by God, they showed female behavior! That was really tremendous. Never mind that the interpretation was all wrong, that moment was tremendous.

Most experiments aren't like that. It takes months or even years to get the data, and then the results are never what you expect. You publish, and five years later you know the data were good, but the interpretations have to be changed. As a matter of fact, in journals like those I've helped to edit, I think it would be ideal if we published on paper that would automatically disintegrate in five years. I am absolutely serious. Except for people who are interested in history, any data that are really worth preserving will get into the general literature by that time. Don Hebb says, "What's not worth doing is not worth doing well." Our journals report an awful lot of experiments not worth doing, but done very well.



"I don't see any point in just doing more and more experiments. There are younger, more energetic, brighter, more up-to-date people in my field who can do better work now. What can I do that they can't?"

Maxey: Up to now, you have devoted most of your life to research. Are you going to continue that pattern?

Beach: Research is a never-ending enterprise, and one comes eventually to consider the fact that you don't have forever. If you continue on five-year plans—translate "plan" to "grant"—and you write those plans on a blackboard beside your expectancy of survival or your retirement date, it becomes obvious that you have to bring the two things into some kind of meaningful temporal relationship.

Fleming: So, you can't just keep on doing research?

Beach: Not unless you want to be buried with a whole bunch of unpublished manuscripts in your coffin. I am compulsive about getting something into print before I feel the research is finished. Good, unpublished data make me uncomfortable.

That is one reason for cutting down on research. Another reason, to be very frank, is because I have found out what I can do in the way of research, and I don't see any point in just doing more and more experiments. There are younger, more energetic, brighter, more up-to-date people in my field who can do better work now. What can I do that they can't? One thing I can do is teach. It is a challenge, and I think many of us need some new mountain to climb. Doing more research isn't that mountain.

Maxey: I understand that during your 35 years as an academic psychologist you have never taught undergraduates before. How are you doing?

Beach: Well, I'll tell you a true story about that. The first time I tried to teach a large undergraduate course, I did a very mediocre job. I gave myself a C, and when the students filled out their evaluation of the course, they agreed with me. I was so upset that I went home and took a sledge hammer to the fence in the back yard. I'd been meaning to tear it down anyway, but that day it fell in short order. I'm doing better now; I gave myself a B on my last undergraduate class, and I'm shooting for an A. I'm auditing the lectures of much younger professors who have good reputations as teachers, and I'm learning a lot.

Fleming: I wasn't surprised to learn you were teaching undergraduates, but I was floored when I heard the course was in *human* sexuality. I've known you for 10 years, and if anyone had asked me if Frank Beach would ever do anything on human sex, I would have said absolutely not—it's too messy; you can't do any of the important experiments; Beach won't touch it with a 10-foot pole. You're taking it very casually, but I think it's an extraordinary change.

Beach: If you could see the manuscript of a talk I gave recently, you would see how far I have changed. I choked up a little when I got up in front of people who had taken their Ph.D.s with me and started talking about "self-concept" and "gender identity." But I did it, and I had a lot of fun. I was trying to put across a very speculative hypothesis that gender role—that is, society's definition of appropriate masculine or feminine behavior—contains certain elements that can be traced back through evolution. The roles evolved because of selection pressures and survival value. And therefore, even today, there are certain inborn sex differences in the

propensity to learn sex roles and be comfortable in them and to want to perform in them.

Fleming: William Simon and John Gagnon say that sexual behavior is the arena where sociocultural forces most completely dominate biological influences.

Beach: Don't you find it difficult to evaluate an argument that tries to assign proportional importance to social forces versus something else? That's the old heredity-environment pseudoproblem, which God knows I wish we could lay to rest once and for all. It is meaningless to say that one completely dominates the other. The very fact that people have been asking the heredity-and-environment question for so many centuries and have never come up with a satisfactory answer indicates to me that it is not a good question in the first place.

Maxey: Can you give us an example of a good question in human sexuality?

Beach: Certainly. You need specific questions so you can pin down the answers experimentally. For instance, what are the physiological correlates of the sensation of orgasm in women? William Masters and Virginia Johnson have found out something about this, and the information has proved very useful.

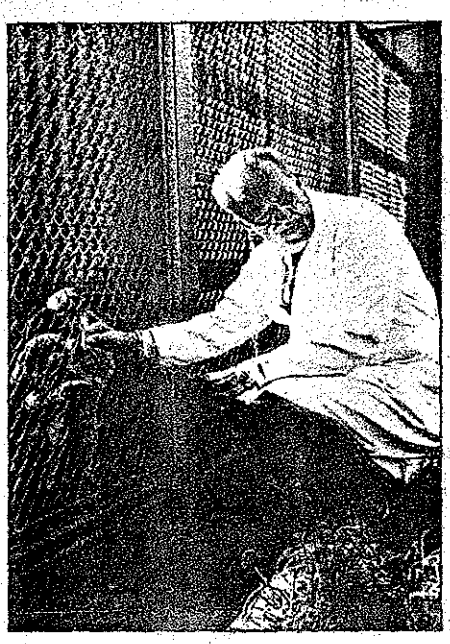
Maxey: In what way?

Beach: Consider the gynecologist who has a patient who is complaining of orgasmic failure. Obviously, that has a great effect on her life. One of the questions the gynecologist could ask is whether or not the physiological accompaniments of orgasm are present. If they are lacking, then the question could be, how can we increase the probability that this woman's uterine muscles will contract and produce orgasmic sensations? Or suppose it turned out that the woman is showing all the physiological changes, but she just doesn't experience a psychologically satisfactory response. That might indicate a different therapeutic approach.

This subject of orgasm seems to fascinate people; when I give lectures on animal mating behaviors I'm always asked if animals have orgasms. But orgasm is a feeling, so you can't really say that a dog does or doesn't have orgasm. It would be very useful to show that the female monkey or dog or cat has uterine contractions that are like those of a human female when she says she is having an orgasm.

Fleming: Why is that information useful?

Beach: It is only useful in the theoretical sense that comparisons between species are useful in advancing our understanding of natural phenomena in general. I would not study orgasms in dogs simply because of a possible value for human beings. Although—let me back down a little bit. Let's use the imaginary case of the woman with orgasmic failure again. Suppose the physician checks her out and finds she is not having uterine contractions during copulation. You might use a dog as a test animal on which to try physiological or chemical methods for controlling these contractions; that might help that nonorgasmic woman.



"Research is an extension of man's curiosity and need to explore the universe. This need is apparent in the behavior of unthinking babies. It is a need like the need for food, or avoidance of pain."

Fleming: But your research with dogs, rats and other animals has never really been aimed at telling us about human beings.

Beach: No, it hasn't. That's not my purpose in doing research. Science is one way, though not the only way, of increasing our understanding of the world, including man. And, in a moralistic sense, I believe that knowledge is good and ignorance is evil. So I prefer not to emphasize the practical or applied aspects of research because I feel it can and should be justified on its own grounds, as a source of increased understanding. Research is an extension of man's curiosity and need to explore the universe. This need is apparent in the behavior of unthinking babies. It is a need like the need for food, or avoidance of pain. Research is one way that Western man has devised for fulfilling that need.

Maxey: Well, if research is a device fulfill a need, then a lot of taxpayers paying a lot of money to fulfill that n for relatively few people. And that w no guarantee that their lives will changed at all.

Beach: I don't recall mentioning gu antees of any kind. Nor did I imply th research would or should change peopl lives. You are using a high-school bator's gimmick in attacking your op nent for failing to achieve a goal that never attempted to deal with in the fi place. The "need" I am speaking of is n ther material, nor practical. It is a "need know," to understand. The only sure turn is the satisfaction derived from creasing our understanding of the wo we live in.

Of course, the search cannot be carri out by "people" in the generic sense; must be pursued by the few who are mo vated to look for the answers, but the sults of discoveries by those few c benefit many.

Your reference to taxpayers brings an entirely different problem that is i portant. You may be much better i formed about this than I am, but I seem recall statistics indicating that gover mental expenditures for so-called "pu research" constitute a fraction of one pe cent of the national budget. Even in med cine it is not easy to choose betwee "applied research" that represents a dire and frontal attack on a problem like ca cer, and "pure research" in an area lik cellular physiology that may or may n prove helpful in solving the problem.

Frankly, I am a bit distrustful of the d rect attack, particularly when it is force by demands from political quarters, o from the public. It would surprise you know how many practical problems hav been solved incidentally as a byproduct o research aimed at answering impractica problems.

I am equally distrustful of scientist who promise practical results if they ar provided with sufficient funds. Unques tionably public money has been spent or research that yielded neither practical no theoretical returns. This is an inevitable calculated risk. Society must be educated to discriminate between science and tech nology, and must be willing to support im practical science. A society that cannot do this impoverishes itself in the long run.

Maxey: Do you think scientists should be involved in the development of public-policy questions such as what research should be done or how much money should be spent?

Beach: I think scientists should "learn

their place," and restrict their roles to their own areas of special competence. Being the world's best geneticist does not make you an expert on social reform. A few scientists, and many more nonscientists, are prey to the misconception that expertise in one area of human knowledge magically endows its possessor with wisdom in other areas. It is ridiculous to see how gullible we can be, taking as gospel truth the pronouncements of someone with a Ph.D. in child psychology or anthropology about the "national character" of another country and thereby "explaining" how wars are started or how they could be avoided.

I know as much as anyone in the world about a few little subjects, but this surely does not qualify me to answer broad questions about how much money the taxpayers should spend on my kind of research, nor how society should accept, reject, or use the kind of information my experiments provide. When I speak on such matters my opinion should be considered as important as, and no more important than, yours or that of any other intelligent, thoughtful person.

Fleming: Let's turn back to what you're thinking about gender roles, sex differences and evolution. Can you develop that for us?

Beach: I have some notions that are just armchair theorizing, but might explain some sex differences on a biological basis. I suspect that there is a physiological reason for the difference between males and females in their response to babies. Most psychologists and psychiatrists place all the emphasis on training and social conditioning. I don't deny that these factors are very important, but I think that underneath it all there are still biological differences and I have entertained myself by dreaming up explanations for some differences in terms of evolution.

For example, let's look at human sexuality and let's start at the moment the egg is fertilized. At that point in the individual's history, there is only one difference between a male and a female. One egg was fertilized by a sperm with a Y chromosome, the other by a sperm with an X. Then one fetus develops testes and the other, ovaries. A little later, but still early in development, the testes start secreting some form of male hormone that triggers the development of the accessory sex organs. In the absence of this hormone, the other fetus develops a uterus, oviducts, etc. Quite possibly, the brain is being affected at the same time. By birth, these two individuals are already very different, and at puberty the primary and secondary sex characteristics develop completely. You start with just one difference at the time of fertilization, then developmental biology drives a wedge down between males and females. The differences accumulate.

"I'm still more worried about the social environment. Man is controlling it now and that bothers me. I certainly would not want to put myself in a position of deciding which traits are desirable and which aren't."

Fleming: And none of them ever go away.

Beach: No, none of them ever go away, and because of the demands of sexual reproduction, the two systems are mutually exclusive. Now, at birth, society steps in, takes a look between the legs of this kid, and says "It's a girl!" or "It's a boy!" From that moment on, society is driving another wedge. Although society is presented with two populations of human beings that overlap in almost all other characteristics, it treats the populations as if they were dichotomous.

Fleming: But that second wedge—society's—can be changed.

Beach: Of course. The defining characteristics of masculine and feminine vary tremendously from one society to another. In one culture, making beer, or sewing, or cooking may be exclusively a feminine job, and exclusively masculine in another. But taking care of babies, and all other roles that are tied in with reproduction, are pretty well dichotomized in the same direction in all societies, and there are good reasons for this. But let me point out that the characteristics that were very adaptive early in man's history, and had high selection pressure in favor of them in a hunting and gathering society, can be extremely maladaptive in an industrialized society. A lot of things about sexual behavior that would have been appropriate for prehistoric man don't work well today.

Maxey: Did I just hear you say that sexual behavior isn't working very well?

Beach: Well, right now what we can see in America—with changes in the nuclear family—is a rearrangement of sexual activity. I am pretty sure that prehistoric man formed permanent mateships. It may not have been one to one, but some lasting bonds were formed.

Fleming: Why would that have been adaptive prehistorically?

Beach: Because of combined sexual and economic reinforcement, I think. Reinforcement in terms of promoting economic cooperation was very important when man was a hunter. Hunting put a premium on certain physical characteristics, such as endurance, strength, freedom from pregnancy and lactation, so it probably was primarily a masculine job. Gathering was probably a feminine job. But you didn't eat everything you caught or gathered by yourself. It had to be shared, and the best guess is that the initial sharing was within the family. In all probability there was a good deal of sharing between partners, and they would have been sexual partners also. It would just strengthen the bond, I think.

Maxey: Do you think the breakdown of the nuclear family is maladaptive now?

Beach: I don't know. That question is out of my ball park. I don't even know if any such thing is happening. What has happened is that with agriculture and the industrial revolution man has changed his social environment tremendously. Now he's worrying about his physical environment.

I'm still more worried about the social environment. Man is controlling it now and that bothers me. I certainly would not want to put myself in a position of deciding which traits are desirable and which aren't. An IQ score, for instance, is irrelevant. It's a good predictor for school grades, but God knows what else it is good for.

Natural selection has always made these decisions, but there hasn't been enough time for it to work, and we don't want to let it work anyway. Nature no longer decides what is maladaptive for man, man does that as he structures society. I don't think we are wise enough to make those decisions.

portion of text discussing § 218.14(1)(d), in the second line, "* * * the effect of the Warranty on those * * *" should have read "* * * the effect of the Warranty Act on those * * *".

[1610-01-M]

GENERAL ACCOUNTING OFFICE

REGULATORY REPORTS REVIEW

Receipt of Report Proposal

The following request for clearance of a report intended for use in collecting information from the public was received by the Regulatory Reports Review Staff, GAO, on November 8, 1978. See 44 U.S.C. 3512 (c) and (d). The purpose of publishing this notice in the FEDERAL REGISTER is to inform the public of such receipt.

The notice includes the title of the request received; the name of the agency sponsoring the proposed collection of information; the agency form number, if applicable; and the frequency with which the information is proposed to be collected.

Written comments on the proposed NRC request are invited from all interested persons, organizations, public interest groups, and affected businesses. Because of the limited amount of time GAO has to review the proposed request, comments (in triplicate) must be received on or before December 4, 1978, and should be addressed to Mr. John M. Lovelady, Assistant Director, Regulatory Reports Review, United States General Accounting Office, Room 5106, 441 G Street NW., Washington, D.C. 20548.

Further information may be obtained from Patsy J. Stuart of the Regulatory Reports Review Staff, 202-275-3532.

NUCLEAR REGULATORY COMMISSION

The NRC requests an extension without change clearance for Form NRC-354, Data Report on Spouse. This form is used to obtain information vital to NRC's security program, specifically, to determine whether or not certain individuals may become or continue to be eligible for NRC security clearance or access authorizations. The NRC estimates respondents will number approximately 24 annually and that burden will average 15 minutes per application.

NORMAN F. HEYL,
Regulatory Reports, Review Staff.

[FR Doc. 78-32207 Filed 11-15-78; 8:45 am]

[6820-24-M]

GENERAL SERVICES ADMINISTRATION

INSTITUTIONAL PATENT AGREEMENTS

Observance of New Effective Date

NOTE.—This notice originally was published in the FEDERAL REGISTER (43 FR 32463, July 27, 1978) at the request of the Office of Federal Procurement Policy (OFPP). OFPP now has requested that the notice be republished to include a statement regarding the resolution of Government Patent Policy desired by the Monopoly and Anticompetitive Activities Subcommittee Staff of the Senate Small Business Committee. The notice is as follows:

The use of Institutional Patent Agreements was prescribed in Federal Procurement Regulations (FPR) Amendment 187, January 20, 1978 (43 FR 4424, Feb. 2, 1978).

At the request of the Office of Federal Procurement Policy, the effective date of the amendment was changed from March 20, 1978, to July 18, 1978 (43 FR 16979, Apr. 21, 1978). The change permitted further review of the amendment by Members of Congress and others.

FPR Amendment 187 is effective on July 18, 1978, as previously announced. However, the referenced review will be continued in conjunction with the examination of Government patent policy which is in progress. The amendment is subject to change when there is a resolution of Federal Patent Policy.

Dated: November 3, 1978.

PAUL E. GOULDING,
Acting Administrator of General Services.

[FR Doc. 78-32236 Filed 11-15-78; 8:45 am]

[6820-34-M]

PRIVACY ACT OF 1974

Revocation and Transfer of Systems of Records

AGENCY: General Services Administration.

ACTION: Revocation and transfer of three systems of records.

SUMMARY: The purpose of this document is to give notice, pursuant to the provisions of the Privacy Act of 1974, 5 U.S.C. 552a, of the revocation of three systems of records which had been maintained by the National Center for Productivity and Quality of Working Life and the disposition of the records.

FOR FURTHER INFORMATION CONTACT:

Mr. William Hiebert, Records Management Branch, Paperwork Management Division, 202-566-0673.

SUPPLEMENTARY INFORMATION: Pursuant to the provisions of the Privacy Act of 1974, the National Center for Productivity and Quality of Working Life published in the FEDERAL REGISTER (42 FR 57442 and 57443) a notice of the existence of the following systems of records; Payroll Records GSA-3/1, system identification number 31-32-0001; General Financial Records GSA-3/2, system identification number 31-32-0002; and General Informal Personnel Files GSA-3/3, system identification number 31-32-0003. The National Center for Productivity and Quality of Working Life terminated operations on September 30, 1978. As the General Services Administration (GSA) has reponsibility for concluding the administrative operations of the Center, GSA hereby publishes notice that the above systems of records are revoked. The following is a summary of the disposition of the Center's systems of records subsequent to the termination date:

a. Payroll Records GSA-3/1 and General Financial Records GSA-3/2: Retained by GSA for use in concluding administrative operations of the National Center for Productivity and Quality of Working Life as part of the GSA system of records, Defunct Agency Records GSA/OAD-36.

b. General Informal Personnel Files GSA-3/3: The records in this system were copies of personnel actions and other employment records which were maintained at the National Center for Productivity and Quality of Working Life and were disposed of by the Center upon its termination.

Dated: October 26, 1978.

JANICE K. MENDENHALL,
Controller-Director of Administration.

[FR Doc. 78-32309 Filed 11-15-78; 8:45 am]

[6820-23-M]

REPORT ON ENVIRONMENTAL ACTIONS

Pursuant to the provisions of the National Environmental Policy Act of 1969 (42 U.S.C. 4321, et seq.). and § 1500.6(e) of the Council on Environmental Quality Guidelines for the Preparation of Environmental Impact Statements (38 FR 20550) the following is a list of administrative actions for which environmental impact statements were under preparation by the General Services Administration from June 1, 1978, through August 31, 1978, for real property disposal actions and for facility planning actions. Also listed are administrative actions for

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THE INNOVATION MILLIONAIRES

How They Succeed

Gene Bylinsky

Charles Scribner's Sons · New York

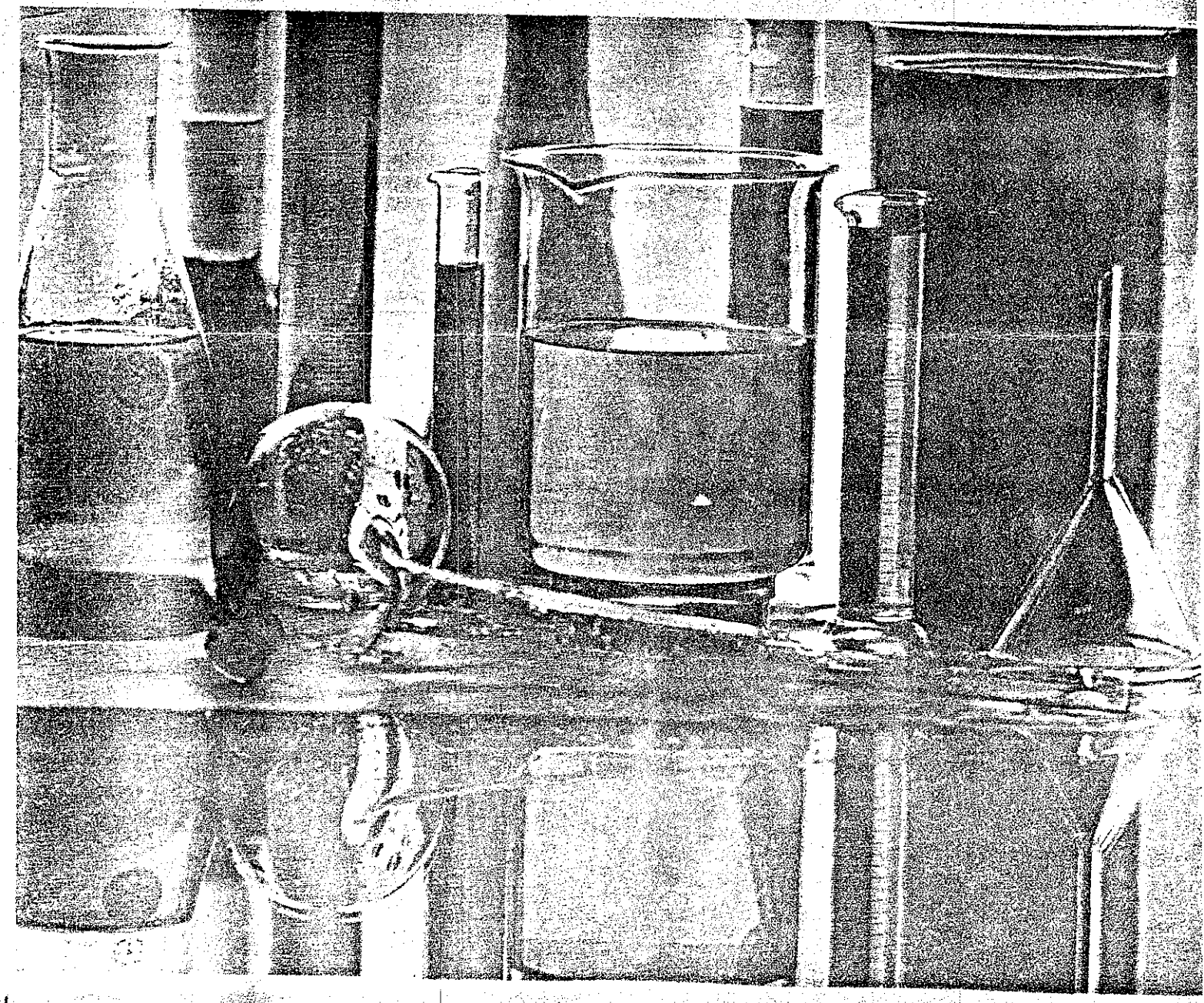
from the foreward

and high drive lose financial control of their enterprises at the troubled crossroads where finance and technology intersect. This is a pity because the really bright ideas appear to spring up in small enterprises. This is an area where the United States has yet to evolve a national pattern of support for technological innovation—to duplicate elsewhere the peculiarly attractive environment that radiates from the Stanford University campus and from Boston's Route 128 complex. The U.S. government agencies have spent fantastic sums for research and development—for example, about $60 billion for space research projects, with only the tiniest drip-out of technological benefits. The National Science Foundation has skirmished with the technological innovation problem, doing case studies of the cardiac pacemaker, steroid contraceptives, electrophotography, hybrid grains, tape recorders, and a few other such developments in an attempt to identify the critical events on the pathway leading from the bright idea to successful technology. I would draw one conclusion: the U.S. government spends the lion's share of its research and development dollars where there is the least likelihood of contributing to the national economy. Defense spending did at one time invigorate certain areas of our technical economy, but this DOD fertilization factor is now very low. The irony here is that countries like Germany and Japan who benefit from our defense hardware are free to divert their R & D dollars to products of consumer value. In effect, we subsidize our competition.

Bylinsky's prose pictures of our technological innovators invite us to speculate about many aspects of the tumultuous interface that exists between science and society, but they do more—they illuminate the human nature of the innovators. They emerge as flesh-and-blood creatures with vanities and peccadilloes—with humor and with pathos. But withal there is a sense of excitement—a thrill of the chase—that Bylinsky skillfully weaves into his narratives. Today's Magellans set out upon uncharted seas on subtle voyages of discovery where monetary rewards are more than matched by the immense payoff in human benefits.

Ralph E. Lapp

Patents and Collaboration between the Private and Public Sectors



Four by Five, Inc.

Four by Five, Inc.

Recent negotiations between nonprofit, "public sector" institutions and commercial, "private sector" firms concerning patent arrangements exemplify how the patent system can serve the public interest. Experiences of the Population Council and the Ford Foundation in negotiating patent rights for contraceptive developments under grants they made are interesting precedents for further collaboration.

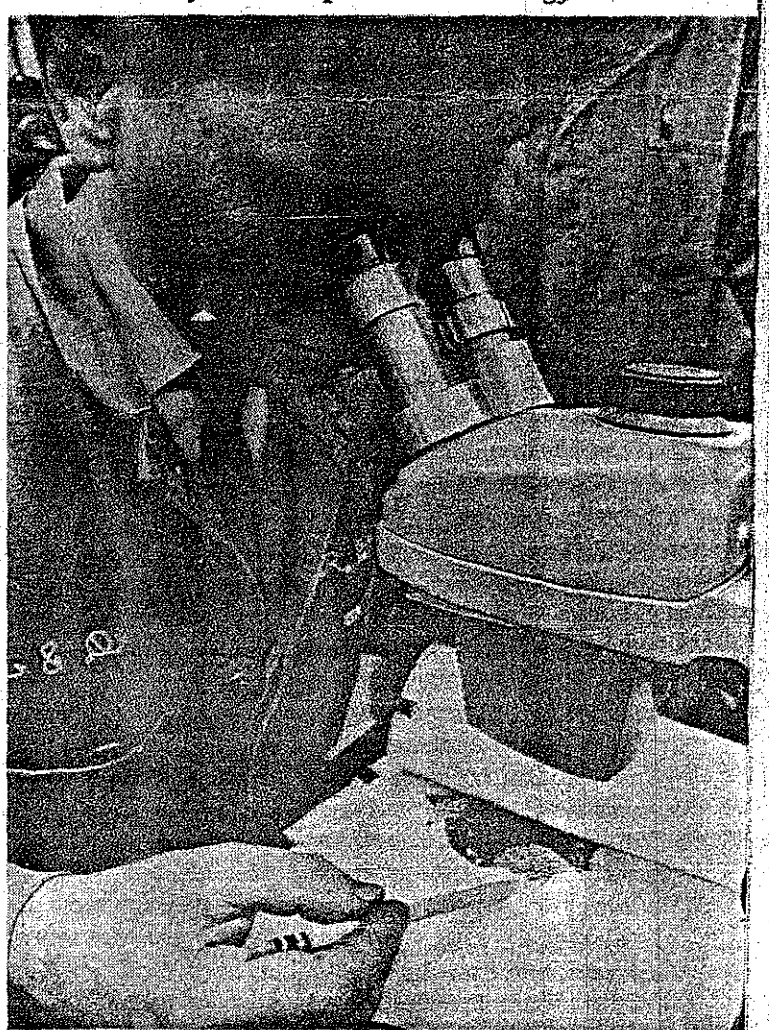
By Sheila Avrin McLean

IN RECENT years the patent system in the United States has been the subject of frequent, critical examination. T.L. Bowes's December, 1975, *American Bar Association Journal* article, "Patents and the Public Interest" (61 A.B.A.J. 1521), usefully summarizes this controversy surrounding our patent system and concludes that the system has served the public interest by helping "this nation become a pre-eminent developer of technology." Some recent negotiations between nonprofit, "public sector" institutions and commercial, "private sector" firms concerning patent arrangements provide an instructive new model of how the patent system can serve the public interest by catalyzing the further development of nonprofit-based research and technology.

It is important to recognize that collaboration between the private and public sectors is increasingly essential to the development of products that are ultimately useful to the public. Carl Djerassi, a founder of Syntex and now a Stanford professor, forcefully pointed out seven years ago in *Science* that while many basic discoveries and important steps leading to technological developments are made by researchers based in the nonprofit or public sector, pharmaceutical firms—private sector firms—"play an indispensible role in the development of any drug." His observations have been reinforced by a 1974 report prepared for the Federal Council for Science and Technology, which reflects the obvious point that universities and nonprofit hospitals do not engage in direct manufacture. Thus, industry must bring university inventions to the market place.

Since collaboration is so essential, consideration of new arrangements for bringing the private and public sectors together for their mutual benefit may be helpful to lawyers advising either sector. Some experiences of the Population Council and the Ford Foundation in negotiating patent rights for contraceptive developments under grants they had made serve as interesting precedents for further collaboration in that and other areas.

Inventions in the field of contraceptive research illustrate the way in which patented technology is often



Candida Photo

AUTHOR'S NOTE: This article is based on a report prepared for the Reproductive Biology and Contraceptive Development project under the direction of Roy O. Greep, Laboratory of Human Reproduction and Reproductive Biology, Harvard School of Medicine, which was sponsored by the Ford Foundation. The views expressed in this article are those of the author and do not represent an official policy of the Ford Foundation.

developed. Individual university-based researchers may conceive of new ideas for fertility-regulating drugs or devices or combinations thereof. Through their universities, they receive initial "seed" funding from governmental or philanthropic agencies. But to some extent the invention and to a greater extent the necessary initial research are done at organized laboratories by teams of professionals associated with medical schools, research hospitals, or nonprofit research institutions. The inventor-professor usually is required by employment arrangements to convey patent rights to the employer-university, at least in part. The work in the nonprofit sector typically does not result in a product that can be distributed to the public. Additional research and much of the necessary development is done by specially trained teams at well-equipped laboratories, frequently those maintained by profit-oriented pharmaceutical firms. This is particularly the case when development of the invention requires the Food and Drug Administration's approval, necessitating extensive and costly clinical testing.

In these cases there is a potential for conflict between the public and private sectors in the differing philosophies underlying the funding of research by public sector organizations, the availability of patent protection for new inventions, and the further funding provided by the pharmaceutical firm. The public sector donor proceeds on the premise that its reward for helping to finance an invention will be public access to the results of the supported research at minimum expense. The patent laws, on the other hand, are based on the philosophy of encouraging the development of new ideas by giving the inventor the right under a patent for a limited period to profit from the invention—either by use of the patent or through royalty arrangements with others. Because an inventor may choose to obtain patent protection in more than one country, it is possible to obtain virtually worldwide patent rights for an invention, albeit for limited periods of time.

Marketing Creates Interest in Royalties

Simply stated, if a patented invention is marketed, several parties involved in its development—the university or hospital where the original research was conducted, the investigator (inventor) in whose name the patent was prosecuted, and the pharmaceutical firm where further research and development are carried on—become interested in royalties under the patent and in the exclusive right to control the manufacture and sale of the product.

The public sector donor (for example, the Population Council, the United States Agency for International Development, or the Ford Foundation) usually retains some form of license—usually a royalty-free, nonexclusive license to make, use, and sell the invention—but it is usually impractical for these funding agencies to consider exercising this license. Not being in the business of manufacturing and not typically in the business of distributing drugs or devices, they must develop alternatives to safeguard their original purpose of public sector access, at low cost, to the patented invention they helped to finance.

Experience has shown that in exchange for providing venture capital and other support for further necessary research and development, pharmaceutical firms are likely to require an exclusive license under the patent—the exclusive right to make, use, and sell the new invention. Sometimes working together, and sometimes separately, the Population Council and the Ford Foundation have developed with pharmaceutical firms an interesting and innovative approach to this aspect of patents under research grants. At the stage when a grant for research is made, the grantee institution (usually a university) and the principal investigator enter into a patent agreement with the foundation or council under which the institution or investigator is responsible for obtaining patents on inventions and may grant only nonexclusive licenses of any patentable invention resulting from the sponsored research. The agreement requires the foundation's or council's consent before the institution or investigator may permit an exclusive license of the patent. Drug companies interested in further development and marketing of the invention usually do request the foundation's or council's consent to exclusive licenses before they will make the substantial investment to develop, test, and market the drug or device.

Royalties Can Be Fed Back into Research

The foundation and council have made an initial decision not to demand royalties in return for their consent to an exclusive license, even though it might be simpler to negotiate standard royalty arrangements with pharmaceutical firms. The donor agencies could then feed these royalties back into further research. The Population Council, for one, has considered and rejected this approach on the ground that its objectivity in advising on the use of contraceptives might be impugned if it were viewed as having a financial stake in a particular product.

Instead they take steps in their agreements with the drug companies to assure that the public sector will be able to purchase the new contraceptive devices at a price lower than that which the drug company would charge the private sector (for example, commercial suppliers to private physicians). The key issues forming the basis of these agreements are (a) definition of the "public sector," (b) pricing formulas, and (c) guaranty of supply to the public sector. "Public sector" is defined, for example, as national and voluntary family planning programs. A pricing formula for the public sector, for example, may take into account the cost of the product to the pharmaceutical firm but not give any profit to the firm from public sector purchasers. The guaranty-of-supply provisions attempt to assure

that public sector agencies that order the product at the special public sector price will have it supplied to them.

The details vary with circumstances, such as the sums of money the various parties have contributed, or will have to contribute, to research and development. Negotiating these arrangements can be extremely complex and time consuming, and the legal fees can be substantial. There are at least four parties—the donor agency, the hospital or university in which the inventor works, the inventor, and the drug company. The interests of the various parties are not, of course, identical. The hospital and inventor usually work out royalty arrangements at the same time the donor agencies negotiate the special public sector pricing formula. But if the parties approach the negotiations in good faith, and with a sense of humor, their agreement can be a workable model for collaboration between philanthropy and industry.

Justice Department Issues Position

The Justice Department has recently announced its position on a patent licensing arrangement between a nonprofit, public sector organization and several private sector pharmaceutical firms. The public sector concern is the Salk Institute for Biological Studies, a publicly supported, nonprofit organization in California that performs biological research. Salk outlined to the Justice Department a proposed licensing arrangement of patents for a drug (Somastostatin) intended to treat diabetes. Salk would grant world-wide, nonexclusive patent licenses to five pharmaceutical firms and would also agree not to grant additional licenses for a period of three years after the first sale of the drug. At the end of three years Salk would again be free to grant additional nonexclusive licenses. In return, the pharmaceutical firm licensees would pay the institute royalties and would commit themselves to clinical testing necessary to obtaining the Food and Drug Administration's approval to distribute the drug.

In February, 1975, the Antitrust Division of the Justice Department issued an unfavorable business review letter with respect to these proposed arrangements. But in December, 1975, the division reversed its earlier position. In the December letter, it found that temporary limitation of the number of licensees appeared reasonable because Salk had been unable to obtain license agreements with qualified and interested firms without such a limitation. In addition, the division found that the terms in Salk's licensing agreement were designed to minimize the anticompetitive consequences of that limitation.

This discussion of patents has focused on public access to patented inventions initially funded by the public sector. It is important to remember that the life of patents is limited in the United States for seventeen years. Indeed, some of the patents on contraceptives invented in the late 1950s and early 1960s have expired or are about to expire. For example, Syntex's patent on Norethindrone and Searle's patent on Norethynodrel expired in 1972. Once the patent expires, the invention, including all the data related to it contained in the patent application, is dedicated to the public.

Sheila Avrin McLean is associate general counsel of the Ford Foundation. A former member of the Executive Committee of the Association of the Bar of the City of New York, she was graduated from Smith College (A.B. 1963) and Yale Law School (LL.B. 1966).

In certain cases the patent holder and those with licenses to make the invention will have a large head start in developing technical know-how and market acceptance for the product, and their market position may not be affected adversely by the expiration of the patent. This may be true for patented devices such as intrauterine devices carrying releasing compounds. On the other hand, replication of available contraceptive compounds used for the female contraceptive pill is relatively simple and inexpensive. The end of patent protection on these products will almost certainly invite competition and reduce the monopoly profits assured by the patent.

Life of a Patent May Be Extended

Because the Food and Drug Administration and other regulatory requirements demand a lengthy period of testing before a patented product can be approved for general use, Carl Djerassi has suggested that the life of a patent be extended for a specified number of years after a contraceptive product has been approved by the regulatory agency. Congressional consideration might be given to granting these extensions, by amending the patent law, in return for a *quid pro quo* benefiting the public, as, for example, a stipulation that the product be made available at a special low price (at "cost") to nonprofit or governmental programs distributing the product (nonprofit government sponsored family planning programs).

As indicated by these examples, imaginative use of patent arrangements can facilitate the development and marketing of public sector inventions by collaboration between the private and public sectors despite the differing interests of the parties involved. The suggested model may encourage other public funding agencies, universities, nonprofit research institutes, and private, profit-oriented companies—and their legal counsel—to look at their negotiations over patent rights as a helpful tool for mutually beneficial collaboration. ▲

C&EN staff photo

One of the highest honors bestowed by the American Chemical Society is its Charles Lathrop Parsons Award. Given usually once every two years, it recognizes outstanding public service by members of the society. Past winners include James Conant, Glenn Seaborg, Russell Peterson, and William O. Baker. This year's recipient is Charles G. Overberger (C&EN, July 17, page 20). Active in IUPAC and ACS—he was ACS president in 1967 and chaired the society's Committee on Chemistry & Public Affairs from 1973 to 1977—Overberger has long been deeply involved in applying chemical research and chemical knowledge to world problems. The veteran polymer chemist received the award at a dinner in Washington, D.C., last week. Currently vice president for research for the University of Michigan and head of the school's Macromolecular Research Center, his address was on something very close to his professional heart—the link between the federal government and the universities. Following is the text.

Universities and the federal government: a marriage that has survived

Charles G. Overberger, vice president for research, University of Michigan

Wartime marriages are considered notoriously poor risks. I'd like to talk about one wartime marriage that has survived the years, even though some signs of rift have appeared now and then. I have in mind the research partnership of the federal government and universities formed during World War II.

What started as a wartime liaison, hastily concocted and heedless of the future, has now, like any marriage in its middle term, accumulated lots of trappings and bric-a-brac, lots of commitments, and a whopping financial problem. You all know that the partnership I am referring to is not a trivial matter, from whatever perspective it is viewed. Federally sponsored research in universities is now at about $2.9 billion per year, which is a lot of money even by federal standards. On my own campus, the federal government spends $60.6 million per year to support research. This is almost one sixth of our total budget. Clearly, we have a considerable stake in this marriage—financially, at least, if not emotionally.

Actually, I should hasten to say that this financial stake is, in reality, a double-edged sword. My campus has benefited greatly, of course, from its large and varied research program—in obtaining new buildings, in attracting high-quality faculty members and students, in developing new curricula—but there have also been costs not fully covered by the sponsors of this research. So, in one sense, the larger our research program, the more severe our financial problem.

But, finances aside, there is something of an emotional commitment as well. This much is true at least. We are strongly convinced that this marriage, if not made in heaven, is at least good in some absolute or general sense. Universities have become a great national resource as much for their research as for their training of new minds, and the continuing intellectual well-being of the nation is to some considerable extent dependent on the kind of research that is best conducted by universities.

Clearly, all parties involved admit that research in universities is part of the national research and development effort. True, not all colleges or universities have substantive research programs; so that it is clear that my remarks pertain primarily to the hundred universities that have substantial research commitments and graduate programs.

My remarks can be interpreted to be optimistic ones, rather than pessimistic ones. I do not believe that our educated society will allow direct political interference in the affairs of a national resource such as the large research-oriented university.

Currently, the national research and development effort largely consists of three sectors: first, the broad division of effort in the industrial sector; second, government laboratories and national facilities such as (a) National Institutes of Health, (b) the Fermi National Accelerator Laboratory in Batavia, (c) the National Radio Astronomy Center in Arecibo, P.R., (d) Kitt Peak National Observatory in Arizona, and (e) the National Center for Atmospheric Research in Boulder, Colo. Many of these laboratories carry out mission-oriented research but there is much basic research carried out under a general framework of a broadly defined mission.

However, most basic research is carried out in universities,

the third sector. There has been a substantial increase in basic research funds from the federal sector to the universities during the period 1955–77. The percentage of the national total R&D effort performed in universities goes from 5% in 1955 to 9% in 1975. Universities and colleges are the primary performers of basic research. They conducted 54% of the total basic research effort in 1977. During the period 1953–77 universities and colleges increased their share of total basic research performance from 25% to 54% because of increased federal funding of basic research in the university sector. This percentage has rather stabilized and indeed lost ground in more recent times because of the curse of inflation and increased competition for the same funds from federal laboratories and, indeed, even a few industrial laboratories.

I don't want to dwell on the many benefits of this marriage. I want, instead, to look at some of the concerns that I mentioned earlier. As in many marriages into their third decade, one partner seems to become increasingly suspicious, autocratic, and domineering. Divorce is out of the question, so there is an urgent need for some effective communication. Let me then highlight some of the problems that we most want to communicate about. For the most part, these are the problems that universities around the country—particularly the hundred or so universities with substantial research and graduate programs—have in common with the federal government. These must be resolved if our relationship with the federal government is going to continue to be productive and mutually beneficial. Many groups are discussing them, and I am confident that there is sufficient wisdom and patience on both sides to find workable solutions.

Looking to the future, what are the trends that will determine the soundness of the federal government/university marriage in the next 10 years? In asking this question, we must remember that some conditions and phenomena that we may not think greatly significant today may well be crucial matters after a development of 10 or 15 years—just as the patterns we are following now were set some time ago, not by some master plan, but as a result of countless smaller decisions whose cumulative effects are now visible on the national scene.

It is useless to ignore the fact that the financial health of the country will play a major role in future intellectual developments in research. Financial problems in universities are a direct result of financial problems in the federal sector and, indeed, in the country as a whole. Inflation takes its deadly toll on every part of our lives.

Within our research programs, inflation has not only eroded the total structure, but also has entirely cut away certain features of research support that we found quite essential to a healthy program. The institutional funds that used to be available from the National Science Foundation, for example, permitted us to stimulate and facilitate research across a broad spectrum of the campus. A small purchase of equipment here and there, a bit of assistance to tide someone over between projects, a modest seed grant now and then—when we could bolster our program and, so to speak, put out fires with a small amount of discretionary money, we could perform a most important service to the university. The good effects of this kind of money multiply far beyond the original amounts involved. Such money may be the single most important tool of research administration in a university, even though it may also be the most difficult to justify to unfriendly critics. Some way must be found to restore these kinds of funds.

NIH has been an exception, by the way, in that it still funds support grants by which the health-science schools that receive sizable amounts of NIH competitive grant money receive also a small sum for discretionary purposes. But even this money has been eroded, and it is a constant battle in Congress to keep these funds available.

Aside from the amount of direct financial support, the most serious problem the universities face with the federal government is the increasing pressure to conform in various ways. Although not for the first time in U.S. history, universities are again being subjected to direct political pressure from Congress and from society generally. Let us discuss a few instances of this.

There is, first of all, the pressure to mold university research according to the latest national problem or the most recent focus of Congressional attention. Wide swings in general research themes and in problem areas occur every few months. If universities were to pay too much attention to these swings of public attention, they would soon lose the center of gravity that gives their programs stability. Research excellence takes a long time to develop and must be built on a very broad foundation. We want to help the nation solve its various large problems, and there is much the universities can do—as they have demonstrated—but they cannot swing from problem area to problem area as fast and as freely as many people in public life wish. We cannot just be problem solvers. We must continue to state the case for basic research and hope we can make officials understand that problem solving must rest upon a solid base of fundamental knowledge. Turn to the universities for solutions to problems, yes—but give them also the resources that build the base.

Most serious problem faced is the increasing pressure to conform

A second pressure on universities today has resulted from the national concern with goals in affirmative action of various types. In universities we applaud the goals and are working hard to achieve them, but there are real difficulties. The available pool of applicants for top positions is small, and there is fierce competition for the best among the minority candidates. With respect to the middle ranges of quality, we face a serious dilemma in balancing our need for the best minds against our need to increase the representation of minorities at universities, both as students and as faculty members. Add to this basic dilemma a patchwork of administrative requirements for reporting progress and we have an almost insuperable problem. Different monitoring agencies have asked for different kinds of data. The ball game changes almost every inning, it seems, and the university offices charged with monitoring affirmative action have spent countless hours trying to collect and then recollect the data required. Just recently, when the Department of Labor assumed the responsibility for oversight of affirmative action programs, my university had to provide a new set of data to fulfill new requirements. To meet the deadline that was imposed, we essentially collected and compiled the data over a weekend. Every dean, chairman, and director throughout the university participated in this frantic weekend whirl, and literally hundreds of manhours were involved. The point is not that the report was unnecessary or undesirable, but ways must be worked out with the monitoring agencies so that data can be collected in a routine and consistent manner. Crash programs to change all the parameters are costly and wasteful.

Attacks on the peer review system are yet another worry. It is generally agreed within the research community that there

is no better way to identify meritorious proposals, and the review system itself has been refined and improved over the years. Nevertheless, and despite various studies which indicate otherwise, peer review is alleged by some critics to be biased in favor of prestigious institutions, to discriminate against young, female, and minority researchers, and to amount to little more than a mutual backscratching and admiration exercise. These sentiments are, to some degree, the natural outgrowth of using merit as the dominant criterion for allocating public monies in a society that is simultaneously attempting to become more egalitarian. Certainly the peer review process should be monitored and controlled so that it serves the public interest. However, it would do the public a great disservice if the primary means for identifying and supporting scientific excellence were watered down or abandoned.

Accountability has become a watchword for most of our large institutions. Public confidence has fallen in the light of many disclosures in the past few years of instances of wrongdoing or poor judgment, and universities have reaped this whirlwind along with government and organizations of all types. As a result we have had to develop complex networks for compliance with rules and regulations concerning such matters as the use of human subjects in research, the use and care of animals for research, health and safety conditions, hazardous biological research, etc. The usual requirement in monitoring these conditions is to set up review committees—sometimes with members from outside the university.

Accountability has become a watchword for large institutions

I really have been talking previously about pressure from society in general. Let us mention a few other reaction parameters with the federal sector:

- Capitation grants in the health sciences.
- The impact of the Nuclear Regulatory Commission.
- Revision of the A-21 circular and the indirect cost calculation.
- Auditing procedures of HEW and other federal agencies.
- Geographic distribution of federal R&D funds.
- Continued harassment from attention-seeking political figures on such items as indirect cost reimbursement, titles of research grants and contracts.
- Limitation of allocation of salaries to a research grant or contract at a fixed level.
- Sharing of research equipment.
- Pressures from the Office of Management & Budget to terminate projects in agencies.

We, of course, recognize the necessity for complying with regulations designed to ensure the safe and proper functioning of the research program, but, at the same time, universities must not sacrifice their autonomy. If we are to survive as the intellectual leaders of the world, we must work out a long-term arrangement between universities and the federal sector. There must be some mutual trust and understanding.

In a positive vein, it is clear that the Carter Administration is supporting the role of basic research. Let me quote briefly from some remarks by Frank Press at an [Association of American Universities] meeting in October of 1977:

"We know that universities perform over 50% of all our basic research. It is most likely that this role and this proportion will remain if not expand. Although we would like to see more basic research in industry, the trend has been in the reverse direction. Therefore, the predominance of basic research will remain with the universities and that research must somehow be strengthened. The question is how. Although I personally support the action in the fiscal 1978 budget in providing financial support above the level of inflation, pumping federal funds into this situation cannot be the sole solution to this state of affairs. Money is essential but so are improvements in the system that will absorb it. Together, we will have to do some hard thinking about this.

"One way of doing this—and I know it is on your minds—is to lighten the load of federal red tape involved in administering your research programs. We are sympathetic to this. Much can and probably will be done to improve the situation. I can assure you that there are a great many of us that are sympathetic to your burden in dealing with the requirements of federal reports."

A particularly promising development is the formation, quite recently, of a National Commission on Research. The members of this group are not only very distinguished, they are also knowledgeable regarding the present relationship between the federal government and the research universities. Likening this commission to a marriage counselor may be carrying my metaphor too far, but in fact the members will be addressing themselves to the various points of dissonance in the relationship. After a thorough, objective review they are expected to formulate recommendations which it is hoped will provide a basis for an amicable reconciliation.

Sooner or later, this whole subject, like most others of national import, will be debated in Congress, I submit. In fact, it would be healthy if this were to happen during the coming year. At the risk of being presumptuous, let me mention some important topics which should be treated in such a debate:

- Simplification of the research project support system in order to achieve a better balance of effectiveness, accountability, and equity for all parties.
- Improved modes of financing basic research so as to allow for legitimate needs, such as instrumentation and facilities, and to minimize the deleterious effects of "stop and go" funding.
- Means of encouraging industry and universities to undertake cooperative research projects, perhaps by providing financial incentives, and certainly by minimizing patent and regulatory barriers.
- Development of scientific manpower policies which take account of national needs while helping to support young researchers of outstanding promise in their chosen fields.

While universities and federal agencies try to reach some understanding of mutual problems and develop working relations that will safeguard the best interests of both parties, what about the professor who is directing the theses of graduate students and interested in publishing original creative results? It is easy to be discouraged these days in university life. In the first place, there is a very high energy gap to reach a tenured position. The turnover is much slower. New, young minds keep new ideas flowing into the system. Faculty salaries are not keeping up with inflation. The very heart of our system of education is based on the interaction of a highly talented individual with younger students. The reward system for intellectual endeavor is slowly changing. Old traditions are not always necessarily the best traditions in a changing world, but certainly the importance of a measure of excellence in creative research will never change.

If I have one message for professors of chemistry, it is simply to keep your standards high; your tendency for selfishness to a minimum. Give your time and energy to the training of young minds, not necessarily in your exact image, but in the image of a changing, creative, intellectual world of chemistry.

I am an optimist—I believe that the highly developed human species if alive will be searching for new knowledge. He will continue to search for complete explanation of his total life processes; it is hoped he will bend his marvelous intellect and will to ensure survival; and last but not least, he will continue to communicate his wisdom and knowledge to new generations.

Ordered societies, federal or otherwise, will support the endeavors of these dedicated leaders in education and research for the future. This is my long-range prediction. □