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Facing the Issues in Plant Pathology

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It has been a privilege and an honor to have served as your President for the past year. It has been an interesting, exciting experience. No one who has served on the Council of APS can fail to be impressed with the dynamism and sense of purpose of our Society, with the care and dedication that each issue raised by our members or by persons outside of our Society is examined, or with the thoroughly democratic way in which issues are resolved and consensus is reached. I do not know of any other scientific society that does as much for its members, or involves as many of its members in society affairs, as we do. We have a rich and honorable tradition of dealing with the major issues confronted by our profession. Yet it is my purpose today to indicate to you my perception that we have, somehow, spent a great deal of time addressing problems of a lesser magnitude, while ignoring or coping inadequately with those of much greater import. What I have to say should not be interpreted as an indictment of what we have accomplished this year, for I am extremely proud of what we have done. However, now that I have an opportunity to look at where we have been and to reflect on things that were left undone, on ideas that remained unexpressed, on proposals that were never implemented, and concerns that were never resolved, I realize how frustratingly short a President's term really is and, more important, how difficult it is to disengage from the day-to-day business of running the Society to examine the broader issues.

It is interesting to note how often in the past the outgoing President has taken the opportunity, in his presidential address, to indulge in criticism of the profession, the Society, and even his own term of office. Our profession as as whole, as expressed in numerous editorials in PLANT DISEASE and in articles in ANNUAL REVIEWS OF PHYTOPATHOLOGY, apparently takes greater enjoyment in self-criticism than in any attempt to record the many positive aspects of our accomplishments. This may reflect, as Ken Baker has indicated (3), a sense of confusion as to what the mission of our profession really is. Perhaps, but it is more likely that it also reflects the perception that in self-criticism lies the real strength of our profession. We do not lack a historical perspective. Our leaders, however, have been more inclined to look ahead as to what needs to be done, rather than to wallow in self-congratulations as to what we have done in the past. Self-immolation seldom is a good thing, but constructive self-criticism always is. It is in this spirit that I want to talk to you today. True to tradition, I intend to present to you a series of issues that are of potential importance to the future of our profession but that may not have received the attention they deserve.

The Deliberate Release Issue

Let me turn first to the problem of deliberate release of genetically engineered organisms into the environment. The subject in general has been widely discussed in newspapers, magazines, and learned publications. It is not my intention to present the many arguments pro and con field experimentation with genetically engineered organisms that have been discussed in the voluminous literature that has suddenly appeared on this topic. My purpose is to relate to you how the decision-making process at the federal, state, and university levels is severely stifling applied research in the plant sciences, and indirectly affecting the whole future of an important branch of plant pathology.

In late May of this year, newspapers carried the apparently innocuous story that the Board of Regents at the University of California had ordered a temporary halt to the experiment proposed by our colleagues, Dr. Steven Lindow and Dr. Nick Panopoulos, and involving the application of ice-nucleation defective bacteria to a small plot of potatoes at Tulelake, California. That the story was buried in the back pages of newspapers, somewhere between the obituary columns and the classified ad sections, is a good indication that many editors missed the significance of that action by the regents. This significance is not merely related to the fact that yet another obstacle was placed along the tortuous path that Dr. Lindow and collaborators have had to follow over the past three years to obtain permission to carry out this field experiment. The real significance lies in the fact that the regents of one of the major universities in this country, with one of the strongest traditions of liberal support to science and scientists, should find it necessary to acquiesce to political pressures and effectively block fellow plant pathologists from exercising their right to perform experiments that had been cleared by a whole panoply of bureaucratic, regulatory agencies.

From my personal point of view, our Society and, indeed, the entire scientific establishment have been at fault for they have failed to speak with a clear voice in the Lindow case. We have left Dr. Lindow alone, hanging in the wind, subject to the vicissitudes of excessive bureaucratic regulation, as a target for ignorant publicists and environmentalists, and an even more ignorant judicial system. Individual members of our Society have attempted to support him. Also, at the request of APS officers, the Intersociety Consortium for Plant Protection has expressed its dismay at the UC regents action. Overall, however, we have remained silent in the press regarding this important issue. It is imperative that we express our opinion openly. Our collective silence is not only damaging to one of our most distinguished, young members, it is also damaging to our credibility in that by not speaking out we are inadvertently siding with the groups that consider science a menace to society. These are strong words and I must justify them. To do so, let me give you the background to the action from the regents that prompted my preamble to this whole issue.

The experiments that Dr. Lindow had proposed were a natural extension of the work that led to the discovery that certain epiphytic bacteria, including members of the *Pseudomonas syringae* group, serve as centers for ice nucleation and thus contribute to the damage caused on sensitive plants by temperatures only a few degrees below zero. Bacteria that lack the ice nucleation gene, whether obtained naturally in the field or in the laboratory by recombinant DNA methods, have the potential to protect against frost damage by virtue of their ability to multiply and become established on leaf surfaces (6). It is important that the protecting ability be demonstrated in the field; the natural mutants have been shown to do so, but the tendency to revert to the original, ice^+ phenotype presented a practical problem. Better results would be expected with the genetically engineered mutants. Dr. Lindow first requested permission to test these bacteria in 1982 and, a year later, obtained permission to go ahead from the Recombinant DNA Advisory Committee (RAC) of the National Institutes of Health after careful deliberation of the possible danger to the environment of the ice^- mutants.

Enter Mr. Jeremy Rifkin. His organization, The Foundation on Economic Trends, brought suit to prevent the Lindow experiments. He found an ally in the courts, Judge Sirica, who agreed with Rifkin that NIH had failed to comply with the requirements of the National Environmental Policy Act for an environmental impact statement. Such statements are required by law for all "major Federal actions significantly affecting the quality

of the human environment". It is, of course, hard to believe that the application of bacteria, patently similar to those present in nature, to a tiny plot of potatoes could be considered "a major Federal action". As Singer (8) has pointed out, the case probably would have been found frivolous had Judge Sirica understood the science involved. Although the court admitted ignorance of the scientific issues associated with the use of recombinant DNA, it accepted the arguments framed by Mr. Rifkin.

And what are Mr. Rifkin's credentials? He was a one-time promoter of the "People's Bicentennial Commission", author of the book "Common Sense II: The Case Against Corporate Economy" and coauthor of the unforgettable "Redneck Power: The Wit and Wisdom of Billy Carter". His mystical views of science were expressed in yet another classic, "Algeny", in 1983, in which he proposes prohibition of any experiments involving the transfer of genetic traits from one species to another. In the general concern of the public for protection of the environment, Mr. Rifkin has found a useful niche for achievement of his ultimate objective: publicity. There are not many scientists who would support Mr. Rifkin's recalcitrant position, yet his domination of public opinion is very real. It is based on unwarranted fears in the general public for the new technology and the ignorance of our legislators concerning scientific issues. Just as important is the perception that industry has no concern for public safety. Mr. Rifkin has exploited the climate created by industry's blunders that led to the Love Canal fiasco, the asbestos contamination problem, the Bhopal tragedy, and more recently, the Chernobyl reactor core meltdown. Mr. Rifkin has the ear of congressmen, the support of many misguided newspaper editors, and the acquiescence of friendly judges. As the Wall Street Journal editorialized recently, "The scientific community needs to think hard about its normal reticence when science can be stopped in its tracks by a carnival pitchman, one reporter and his editors, and maybe a judge" (10).

Judge Sirica's ruling had more far-reaching consequences than the mere delay in Dr. Lindow's plan. The ruling destroyed the bond of trust that had been established for more than a decade between the scientific community and the RAC. The RAC had been established in the 1970's as a result of widespread fears of the recombinant DNA work; it had gradually relaxed the rules for containment as experience indicated that most of the experiments in this area posed no threat to human health or to the environment. That committee worked well and enjoyed the support of both scientists and the general public. But Judge Sirica changed all that. He established that RAC had no authority to regulate the experimental release of recombinant organisms. Since then we have had a whole panoply of regulatory agencies, all elbowing their way to the front, all vying for position and claiming to have responsibility to establish the rules of the game. These include the USDA, which established the Agriculture Recombinant DNA Research Committee to review applications for release and empowered its regulatory branch, APHIS, with the authority to estimate environmental impacts of such releases. As the regulatory agency responsible for administration of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) the Environmental Protection Agency (EPA) felt obliged to establish an "Interim Policy on Small Scale Testing" in October 1984 that effectively regulated the testing of all so-called "biopesticides"; a policy so unrealistic that it prompted the immediate condemnation by many scientific societies, including APS. The Federal Drug Administration Agency also felt obliged to join forces with the USDA and EPA in a joint policy statement in December 1984 that not only failed to clarify the situation but muddled it further. At the same time, the Office of Technology Assessment (OTA), the scientific fact-finding and advisory body for the United States Congress, and the Office of Science and Technology Policy (OSTP), a scientific advisory body for the White House, all felt compelled to offer their views on what regulatory mechanisms should exist. The recent "Coordinated Framework for Regulation of Biotechnology" issued by OSTP offers an extremely complex and confusing set of policies that defy common sense. It is apparent that these various agencies have sought the advice only of environmental scientists and ecologists.

It must be considered a miracle of persistence that in spite of all the setbacks, Dr. Lindow proceeded to meet the confusion and disarray of the federal regulatory agencies by providing them with careful analyses of the projected impact of the release of his bacteria. A lesser man would have given up, but, by early spring of this year, he had succeeded in obtaining permission from the EPA and from the regulatory agencies in his own state of California to carry out the test on a small plot of potatoes. By this time, environmentalists had been busy promulgating unfounded scenarios of widespread destruction and untold effects on human health. Dr. Lindow met this challenge also and even took the trouble to present his case to the town leaders at Tulelake, to allay any fears concerning his proposed experiments. Everything was in place when, in mid-May, the regents ordered a halt. One can only speculate as to the reasons for the regents' action, but there is little question that it was a political decision. We must realize that the regents constitute a political body and, as such, is responsive to political pressures. It is indeed strange, however, that the faculty at Berkeley has not considered it necessary to state any opposition to the regents' action. I am glad to report that the regents have recently rescinded their action, but a new injunction by Mr. Rifkin's organization has blocked the Lindow experiments once again. This brings me full circle to my initial objective, that is, to challenge you, the Council, the Public Responsibilities Committee, the Committee on Bacteriology, etc., to take immediate action to support Dr. Lindow's right to carry out his experiment, to support the case for common sense, to support the principle that decisions on deliberate release of the products of recombinant DNA should be based on scientific, not political, arguments.

The Case for Deregulation

Let me move now to the broader issue of regulation of biological control agents, whether genetically engineered or not. This problem affects an important sector of our Society. There is no question in my mind that today it is absolutely impossible for anyone who wishes to test the effectiveness of a biocontrol agent to comply with all EPA requirements in a reasonable length of time. This is particularly true if the agent, as is likely, is not already present in the test site. I do not have time or inclination to describe to you the multitude of completely absurd requirements in EPA's "Interim Policy on Small Scale Testing" (now included in OSTP's combined policy). Let me just mention one, which is to describe the flora and fauna of the site. As if microbial populations in the soil, for example, were static! Even if it were possible to enumerate all the myriad organisms present in the test site, this information would have little meaning as to what the components of that population might be next day, next month, or next year. Even industries with immense resources, such as Monsanto, have found it impossible to comply with all the requirements for release of the genetically engineered strains of rhizobacteria that they have used as a test case. The problem also pertains to those organisms the EPA considers nonindigenous. Presumably this includes any organism that has been selected or manipulated in any way in the laboratory, regardless of the methods to do so.

As William Walsh, currently working for the National Research Council, has pointed out, the main problem with EPA is that it is looking for *possible* costs and benefits instead of scientifically based *probable* costs and *probable* benefits (12). A great deal of damage has already been done to the field of biological control of plant pathogens by rulings based on imagined *possible* risks rather than on the scientific assessment of *probable* risk. This is the first time in the entire history of regulation that controls are being erected for an imagined risk.

Unrealistic regulations are the product of a distorted perception of risk and, unfortunately, they will inexorably cost the United States the leadership in biotechnology. There is every indication that industry is being driven to do its testing abroad and, I suspect, "underground". The recent attempt by an animal health company to run extensive tests of a new vaccine against porcine pseudorabies without official sanction from the USDA's recombinant DNA committee is an example of frustration with

present regulatory policies. Even more ominous is the news that some companies have markedly reduced their efforts in biotechnology and that others, like ARCO and Allied Chemical, have entirely given up.

There are various reasons for the present, dangerous state of affairs. First, I believe, is the abysmal ignorance of the nature and limitations of recombinant DNA techniques among the general public and among our legislators. This allows Mr. Rifkin and others to exert extraordinary influence on people in positions of power. Second, as I mentioned before, is the climate of distrust of science and the products of science by the general public, even though it has an insatiable appetite for such products. Third, the exaggerated fears, based on prior history of exotic introductions and fostered by a few scientists as well as by Mr. Rifkin's cohorts, that prey on the confused minds of those in charge of regulatory agencies. Fourth, the lack of concerted action by the scientific community, which has allowed ideology to supplant sound scientific evidence in the media and in the courts.

No one has stated more eloquently the insidious effects of scientific ignorance among the law profession than Maxine Singer (8). She indicates that many lawyers who are legislators or even judges have unwittingly legitimized the attempts by Mr. Rifkin to prohibit genetic engineering, even though they acknowledge their lack of competence to rule on such matters. Dr. Singer considers that Mr. Rifkin's attacks on genetic engineering are not unlike the scientific debacle in the U.S.S.R. caused by Lysenko's domination of genetics for almost three decades and starting in the mid-1930's. The powerful support given this one individual led to reduced agricultural productivity in the Soviet Union, a pernicious problem that is still with them today. Lysenko found support among ignorant but powerful Soviet leaders and was able to supplant basic genetics and plant breeding with popular but scientifically invalid theories. Although these are different times and Mr. Rifkin is not being supported by autocratic rulers, like Lysenko, he uses a combination of control of the media and simplistic solutions to very complex scientific questions to manage public opinion and to influence those in positions of power. If one were to indulge in *possibilities*, as he does, one could conclude that the long-term effects of his efforts to block genetic engineering may be more damaging to this country than any purported ill effects of the release of any of the products of recombinant DNA.

One of the persistent arguments against deliberate release of genetically altered plants or microorganisms is the fear that they may cause ecological harm, in the same way that the introductions of the kudzu vine and the gypsy moth have been harmful (1). The problems resulting from the introduction of exotic species from one geographic area to another do not provide a reasonable analogy to the release of genetically engineered, indigenous organisms. The changes that can be achieved by horizontal transfer of genes or by deletions are, of course, very small. They cannot be compared with the introduction of a completely foreign genotype into a new environment. In fact, for decades plant breeders have been testing the products of widely divergent interspecific and even intergeneric crosses without problems, a situation that is much more comparable to the introduction of exotics. It is surprising that the case of exotics is presented constantly by very well known and, I am certain, well-meaning ecologists; it displays ignorance of: a) the basis for epidemics involving plant pathogens, and b) the limits and aims of genetic engineering.

In spite of my vehement denunciation of the excessive and confusing rules that EPA has imposed on the small-scale testing of the products of genetic engineering, I want to emphasize that I am not proposing absolute freedom of activity based on blind faith in the good sense of plant pathologists and/or molecular biologists. That would be absurd. I am for regulation, but based on thoroughly scientific, not ideologic arguments. As in all aspects of human endeavor, there are *risks* involved in the deliberate release of new plants or new organisms in the environment, mainly as a result of their ability to multiply and to survive. The question that needs to be addressed is whether the *cost/benefit ratio* of deliberate release, in each particular instance, is deemed so favorable that society should take the risk. Live vaccines, for example, would not exist today if we were to point only to the few instances in which individuals have had unfavorable, even fatal reactions. Society made the decision that the overall benefit to the vast majority of the population was worth placing a few individuals at risk. The issue, therefore, is risk assessment; the problem is how to measure it.

The Need for Concerted Action

It is clear to me that the present, confusing situation can be resolved only by concerted action by government, academic, professional, and industrial concerns. To begin with, we should endorse the recommendation of the American Society for Microbiology (2) that *a single board*, consisting of scientists, regulators, and their advisors, be established as a forum for discussion and a source of informed counsel. This board would have a broader mission than RAC and would have representation from a number of different agencies. It would consider experimental protocols, environmental assessments, and ethical questions concerning genetic engineering experiments. It was suggested that the board should adopt the system of working groups to analyze areas of special concern, including the testing in the environment of products of recombinant DNA techniques. The intent is that following evaluation and approval by this board of a product of biotechnology, the oversight of a field trial would be the responsibility of the appropriate regulatory agency: USDA, FDA, or EPA, but agency action would be based on the board's counsel.

We should insist that an independent body of scientists, preferably the National Research Council, consider the environmental questions regarding the release of genetically engineered organisms. I understand that the Commission on Life Sciences of the NRC proposed such a study two years ago. Whether the funds will be available for this work is still questionable at this time. Even if the funds were available tomorrow, however, it would take two years, at the very least, to develop recommendations and it is likely that their implementation would take almost as long. I fear that we do not have the luxury of waiting four years for recommendations from the NRC; action should have started years ago. The plant biotechnology industry is at a critical juncture; it must be able to test its products or it will either collapse or move abroad. The immense potential for good that is inherent in modern methods for gene transfer will not come to fruition unless scientists, via their scientific societies, join forces with industry to educate legislators and to explain their case to the public.

Many individuals, and some scientific societies, have spoken against the excessive regulation in the field of biotechnology by bureaucratic institutions. It is clear to me, however, that these efforts will fail unless we join forces to educate the public. The Rifkins and the EPA bureaucrats will stop science on its tracks unless we engage in an intensive education program to secure grass root support. Scientists, as a whole, have done a poor job of influencing public opinion; we have a natural reluctance to participate in lobbying or public relations efforts. The time has come to make a radical change; the survival of a very important branch of science is at stake.

A Crusade for Public Education

Let me move now to the broader issues of public support for the plant sciences, including genetic engineering. Plant sciences have never received adequate support from granting agencies, such as NSF or NIH. The Pound report (4) some fifteen years ago, was instrumental in the creation of a Competitive Grants Program within the USDA which has been beneficial in supporting basic research in agriculture, but the amounts involved (some 18 million dollars initially) have been minuscule by comparison with the total budgets for support of science as as whole. Over the past five years we have seen a useful addition of some 20 million dollars for biotechnology, but, at the same time, a steady decrease (to about 14 million dollars) in the allocations for basic research in plant sciences within the USDA's competitive research program. To some extent, the increases in support for biotechnology have come at the expense of basic research in physiology, biochemistry,

genetics, biological and chemical control of plant pests and diseases, etc. This is patently absurd, for biotechnology does not exist in a vaccuum; it must be based on our understanding of basic physiological and biochemical phenomena. Indeed, given that it is now possible to transfer specific genes laterally, one needs to know which are the genes of interest.

The initiative that resulted in the creation of the biotechnology program in the USDA was the result of many years of concerted action by numerous organizations, most notably by the Committee on Biotechnology of the National Association of State Universities and Land Grant Colleges. The long and arduous process of educating members of different legislative committees and the Office of Management and Budget (OMB) at numerous hearings did result in a very substantial increase in funding for biotechnology within the USDA Competitive Grants Program. The point is that the massive effort to educate those in power of the significant potential of biotechnology was successful. This was one of the few instances of a successful initiative to promote plant sciences. The fact is that we have not been very successful overall. Only about 110 million dollars are invested at present in basic research in the plant sciences, and this includes funds distributed by NSF, DOE, and USDA.

The American public is curiously schizophrenic about biotechnology; they demand its products but are terribly afraid of this new science. Nowhere is this more evident than in the halls of Congress. At the same time that congressmen provide the USDA with an extra 20 million dollars for research in this area they propose legislation that is so restrictive of any attempts to test the products of biotechnology that it is certain to hinder the progress of this branch of science. Congressman Fuqua, for example, has introduced a bill for regulating the release of genetically engineered organisms into the environment. Although the bill is supposed to encourage "successful growth of the biotechnology industry in this country" it clearly does otherwise. The bill creates yet another bureaucratic organization (a Biotechnology Science Coordinating Committee), gives the USDA the responsibility of regulating plants, but assigns to EPA jurisdiction over microorganisms and imposes requirements for data on containment that will be difficult if not impossible to collect. As is the problem with existing regulations from the EPA, the bill clearly equates the testing of genetically engineered organisms with the release of chemical pesticides. If one considers that genetically engineered organisms can be used in efforts to clean up environmental contamination by industrial chemicals, it is bewildering to consider how imposing unnecessary regulatory burdens could be construed as protecting the environment.

It is time to stop bemoaning the ignorance of the public and legislators and complaining about the poor support that plant sciences in general, and plant pathology in particular, have received. The fact is that organizations that should be lobbying on our behalf, such as AIBS and CAST, have done an inadequate job of influencing the legislative process that allocates funds for plant-oriented research in the national budget. As Al Young, a scientist with the Office of Science and Technology Policy of the White House, has expressed repeatedly, we scientists know very little about the budget-making process (13). We must become aware at which point and with which committee we must exert our influence long before the budget proposal reaches OMB. If we are going to be at all successful, two things must happen. First, APS officers need to educate themselves about the details of the national budget-making process and, inevitably, spend more time in Washington than has been the case thus far. A permanent congressional fellow, supported by APS, would be helpful in this regard. Second, as educators we must begin now with the job of reaching the general public about the needs of plant science and about the real, not imagined, problems related to biotechnology research. There is no longer any point in blaming public ignorance for the problem; let's do something about it. As educators, this is a job we should be able to do better than anyone else.

I realize that at present we are operating under difficult conditions. At a time of huge federal budget deficits, of severe cutbacks imposed by the Gramm-Rudman legislation, and the problems related to huge surpluses of agricultural commodities, it is difficult to perceive how the needs of our science can be heard. However, the fact is that support will be there for those who are better able to make their case. If we have any vision of the future of plant pathology, we must be concerned by the very low priorities afforded to the control of crop pests and diseases by the Joint Council on Food and Agricultural Sciences. Why is plant disease control deemed to have a much lower priority than soil conservation or water management? It is no small wonder that the future of the Federal Extension Service is under a very dark cloud, that it has suffered serious losses and that it is still vulnerable to even greater cutbacks. That service has reached every nook and cranny of rural and urban America; there is a great deal of grass-root support for extension out there, but, somehow it must be mobilized to influence the budget-making process. At a time when the farm economy is at its lowest ebb since the Great Depression, there is clearly a need for farmers to operate more efficiently if they are to survive. How can they grow crops more efficiently without a proper system for pest and disease management?

It seems reasonable to me that the high visibility attained by biotechnology and the needs to regulate its products can be used to advantage to support the case for additional funding for the plant sciences. Those who want to regulate the release of biopesticides inevitably want to know whether the agent will survive and, if so, where, for how long, and in what numbers. These are issues in population ecology for which we do not have the answers and cannot even offer educated guesses. Whether we are dealing with the soil, the rhizosphere, the phylloplane, or the atmosphere, we are woefully ignorant of what happens to microbes in general, let alone genetically engineered ones. If these are the questions that regulatory agencies must have answers for, then these same agencies should provide the means to obtain the answers. Clearly, we have a reasonable argument. Support for biotechnology is not enough; if this branch of science is to prosper, ancillary sciences that deal with the fate and environmental impact of introduced organisms must be supported apace. At the very least, APS and other scientific societies must give support to the Plant Science Initiative from OSTP that proposes the establishment of centers for the study of rhizosphere phenomena and ecological processes, along with support for plant biotechnology.

Closer to home, it is clear that it is in our own self-interest to support a crusade for education concerning each state's budget-making process. The fact is that most departments of plant pathology in this country have had to cut activities substantially as a result of local budgetary restrictions. This is reflected in reductions in the number of assistantships available in plant pathology. This is also reflected in the recent reductions (about 25%) in the number of student members of APS. The signs are all there. With reduced support from experiment stations and from local legislatures, we have nowhere to turn but to granting agencies and perhaps to industry for support. But we all know that competition for funds and the decreasing number of successful applications increasingly is discouraging our young staff members (as well as senior members) from applying for research support. Initiatives, such as the one proposed by OSTP, would go a long way to improve the level of support in many areas of plant pathology.

A Fine Sense of Balance

Competition for funding, particularly in areas such as biotechnology and disease physiology, is having a significant negative impact in plant pathology. The fact is that we have not done as well as we should have. Much of the funding for fundamental investigations in plant pathology has gone to scientists who have no particular allegiance to our profession. One only has to look at what has happened in the fields of crown gall and disease resistance to realize that the expertise has shifted to departments of biochemistry and/or microbiology. The fact is that many of our members no longer have the depth of training that would allow them to compete effectively in these areas at the national level. No field can grow entirely from within, of course,

and the influx of expertise from outside plant pathology is useful and important for the development of our science. What troubles me, however, is the obvious lack of collaborative efforts of biochemists or molecular biologists with plant pathologists in much of this work. We have relinquished these areas by default and, unless additional funding for better training of our young members becomes available, we may see ourselves dealing only with the more traditional areas of plant pathology and unable to participate in the modern aspects of biology. This cannot be good for the future of our science.

In the past, it has been common for the leaders in our science to decry the rise of the specialists and condemn the lack of coverage of the more applied aspects of plant disease control. J. C. Walker thought that specialists would leave plant pathology in outer space without a landing gear (11). Jim Horsfall warned us about being "smart inside, but dumb outside" (5). Ken Baker worried about the evils of grantsmanship and its effect on support for unfashionable, but important areas of research. He wondered "how many of the vocal advocates of fundamental studies have ever devised an effective control of a plant disease, or could do so" (3). While agreeing that biochemical and molecular investigations must not be continued at the expense of the applied aspects of our science, I would disagree with their evaluation that research on molecular aspects of plant pathology represents some harmful, fadish bandwagon. Even at the risk of incurring the wrath of many of my colleagues, I put it to you that the reason we find ourselves in the present predicament of having to relinquish parts of our science to other professions is due, at least in part, to our inability to compete effectively for available funds and to our lack of depth in our attention to basic problems. In the present climate for agricultural research, there is, I am afraid, little point in complaining about the evils of grantsmanship while other fields garner the support and leave us behind.

In a recent editorial for PLANT DISEASE, I noted the schizophrenic state of our profession (7). Ours is a pluralistic endeavor and, from our very beginnings, there has been a constant ebb and flow of emphasis either on applied or fundamental aspects of our science. Years ago, Jim Horsfall wondered how plant pathologists could ride a horse in both directions but offered no solutions (5). Today, most departments are faced with serious budget cuts, particularly in extension services, but are adding one or more molecular biologists to the staff in an effort to stay in the forefront of agricultural sciences and provide the training that many new students demand. This places our recent graduates in a difficult position; the departments are hiring new faculty from outside plant pathology and, as a result, there are very few positions for traditional, card-carrying plant pathologists. I realize that this is a temporary distortion of the job market, but, nevertheless, it is having a significant impact in the lives of many of our young graduates, who see the range and number of job opportunities diminishing rapidly. In 1985, Bob Stack reviewed the question of postdoctoral opportunities in the field of plant pathology and noted that 42% of the listings were in the area of biochemistry and molecular biology; similarly, most (17%) of the permanent positions were in this area (9). Because of the disparity between postdoctoral and permanent positions, Stack wondered whether a significant sector of our recent graduates were destined to be postdoctoral students forever. I doubt it, for 1986 has seen an increased number of permanent positions listed for molecularly-oriented plant pathologists.

There is a growing perception among our members that the increased emphasis on molecular aspects has come at the expense of the applied areas. The extension service keeps our feet in the furrow, as J. C. Walker used to say, and generates the grass-root support for our profession. We cannot continue to hack away at these foundations while adding more weight at the top. That is our dilemma. The answer lies in a fine sense of balance. Clearly, our professional society must join forces with other professional groups and must speak with one voice, as strongly as possible, to prevent further deterioration of support in Congress for the Federal Extension Service. This service provides our most important connection with the farming community, to which we owe our existence. At the same time, we must learn to lobby effectively for research support at the highest level of biotechnology and demand that the morass of present regulations for testing the products of this technology be simplified. Without this support, we will remain hopelessly behind the rest of biology. It is a difficult balancing act, but it is clear to me that the future strength and vitality of our profession depend on how well we can perform without leaning too far in either direction.

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