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Women in physics

I want to congratulate PHYSICS TODAY and Vera Kistiakowsky for her excellent article, "Women in Physics" (February, page 32). The statistics Kistiakowsky presents on small increases in women faculty in higher (associate or full professor) ranks are shocking: namely from 47 in 1971–72 to only 60 in 1978–79, for all PhD-granting departments. I would like further clarification on two questions raised in this article. First: This small increase in women faculty was more than matched by a *decrease* (from 104 to 84) in MA-granting and BA-granting departments. Were the same women physicists involved? That is, did the increase in PhD-granting departments come about mainly by "raiding" MA-granting and BA-granting departments? Second: MIT stands out as the one department with *real* success in its affirmative action program, since this single department has the majority (seven) of the eleven women full professors employed (1978–79) at the "top ten" departments. What has caused this marked success of MIT, and the corresponding failure of affirmative-action programs at other departments? Three hypotheses suggest themselves: (1) MIT has better techniques for affirmative *action* than other departments—can these techniques be learned by others? (2) MIT has a more serious commitment to affirmative action than other departments. (3) The difference is an unexpectedly large statistical fluctuation, analogous to those in a liquid–vapor near the critical point. What combination of these, or other factors, accounts for MIT's success, and the failures of other departments? How can the rest of us do better than we are now doing in our affirmative action programs?

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THE AUTHOR COMMENTS: Levinger astutely asks the questions raised by the data in Table II, and unfortunately I cannot give a quantitative answer to the first of them. However, it is my impression that the change in numbers that he mentions is not due to PhD institutions "raiding" MA and BA-granting departments, but is rather a consequence of the fact that each of the three categories did not contain identically the same institutions in the two years for which data are presented. Departments started to award, or ceased to award, degrees at the various levels and thus moved from one category to another. A non-uniform distribution of women among these departments probably generated the differences in the numbers.

In response to his second question, I will only comment on what did happen at MIT, firmly resisting the temptation to speculate on what did not happen in the other nine institutions. The upper MIT administration expressed a commitment to increasing the participation of minorities and women on the faculty well in advance of 1973 when the full weight (slight as that has been) of affirmative action was brought to bear on educational institutions. And they have continued to uphold this commitment. Within MIT, the results have varied from department to department, due to differences in the attitudes of the faculty in question and to a very large degree of departmental autonomy. Summed over all departments, the number of women on the MIT faculty is in approximate agreement with the sum of the numbers expected based on the percentages of the PhD's in the relevant disciplines who are women. The MIT physics department contains individuals who also actively supported equal opportunity for minorities and women well before 1973, and who continue to be supportive of these concerns. This group includes some of the more influential members of the department, and I believe that this, in conjunction with the position of the administration, is the major factor in what has happened. However, it should be pointed out that the Boston area is unusual in the number of academic institutions and other employers it contains, and therefore this location has an advantage for women in two-career families. Also, although the MIT department has been hurt by the shrinkage in the

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number of assistant-professor appointments possible, this has not been as catastrophic as, for example, the situation at Berkeley. Finally, as I have already mentioned, the MIT physics department had an early start, three of the women presently on the faculty having been appointed before 1973.

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Vera Kistiakowsky is to be complimented on a very thorough job of fact gathering and analysis in her recent article. Yet I, personally, would question some of the basic assumptions that I sense to be underlying her thinking on this topic; assumptions which seriously alter how one interprets the facts and decides on future action.

I would first affirm that while women are in every sense *equal* to men, we are, nonetheless, *different*. And different in more than the obvious anatomical ways. Men and women complement each other. For example, women are, on the average, more feeling oriented; men are, on the average, more fact oriented. Women are more vulnerable to hurt in the area of the emotions; men in the area of the ego. It is this, I feel, that all too often discourages girls from doing their best in school, particularly in traditionally male fields such as math and science. The male ego, particularly at the high school and college age, is not strong enough to accept a girl who threatens to better him academically. The female emotions are afraid of rejection. The solution is not in doing away with masculine/feminine differences. Instead we must convince the girls that in the longer run they would be more compatible with a boy who is at least their equal intellectually.

Part of the inherent difference between men and women is that women have traditionally put a higher priority on marriage and family than men have. Many women have willingly accepted limitations in their careers in order to have the benefits of an ordered home with the man as its head. This, I feel, explains the fact that more women have and are happy in part-time jobs in physics. I suspect that many women seeking fuller employment have either taken time off to raise a family or have moved so that their husbands could take a better job. While Kistiakowsky seems concerned about this trend, I am encouraged to know that there are still women who take family responsibilities so seriously. In my view *men* with families could well consider making them a higher priority in their lives. The family is at the heart of our society. It is also necessary for physics. Sociological research indicates that children from secure, stable environments develop greater capacities for the kind of analytical reasoning so essential to scientists. Physicists, both male and female, should consciously decide on the relative priorities of career and family, preferably before they get married and have children. Husband and wife should be in agreement and accept the consequences together (either limitations on career opportunities or a less satisfactory home life). The answers will not be the same for everyone, but we should be aware of the trade-offs involved. The answer to the employment problem for women is not in more affirmative action and more pressure on women to conform to the working patterns of men. The answer is in more opportunities for part-time or interrupted employment which is, nonetheless, challenging and interesting for a competent PhD holder.

Looking further into the area of priorities, Kistiakowsky seems to agree with much of society today that personal fulfillment and happiness (however these are to be defined) are the greatest goals to be sought by the individual. Yet I feel that this sort of self-centered mentality is at the root of much of this country's difficulties. The concept of the national good has become at least as outmoded as the importance of family. "It's great, so long as I don't have to make a sacrifice for it." As a remedy, I would propose an alternative "Matthew effect" to the one quoted by Kistiakowsky. It states

> "For whosoever will save his life [*seek his own self-interest*] shall lose it and whosoever will lose his life [*give up his own self-interest*] for my sake shall find it." *Matthew* 16:25

We all have a responsibility to use our abilities, be they in physics or elsewhere, but not principally in order to fulfill ourselves. The fulfillment is a by-product. I also believe that if this alternative Matthew effect were taken seriously by physicists we would see more of a spirit of cooperation and less one of competition in research, and the result would be greater productivity.

I am a woman in physics. Thus I clearly feel that there is a place for women in physics. Women, like men, should be encouraged to develop and use their abilities. They should be given equal pay for equal work and equal opportunities for advancement. Yet we must recognize the fundamental differences between men and women. I would call for a clear recognition of priorities on the part of all physicists and a respecting of priorities that do not put research as number one. There should be more job opportunities that recognize the different working patterns of women. We should be encouraging girls not to hide their intelligence but to seek boyfriends who can at least match it. Finally we should be striving to rid physics (if not society) of self-centered individualism and encourage a spirit of cooperation.

There is much we can do to help the situation, but let's not try to force women into a male mold. We *are* different, and I say "Vive la différence."

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THE AUTHOR COMMENTS: As Kalbach says in her opening paragraph, she is not commenting on what is said in my article, but rather making assumptions concerning my assumptions and using this as a starting point for stating her beliefs on a number of issues.

Her second paragraph is apparently in response to my discussion of the situation with respect to evidence for sex-related differences relevant to scientific performance, although she does not address this directly. Instead she expresses her perception of male–female differences, a perception that conforms to the conventional stereotypes. The facts do not support these generalizations since for both men and women the distributions of the attributes mentioned span the whole possible range. Where a study has attempted quantification, male/female differences have been observed in the shapes and medians of the distributions for some attributes, but the overlap between distributions is much greater than their differences. Furthermore, the differences are substantially, if not always completely, attributable to the fact that girls and boys are brought up in an environment that encourages them to conform to the conventional stereotypes. I would argue that we should abandon sex-specific stereotypes for the purposes of child-rearing and substitute a single human ideal that incorporates the best of the attributes from both stereotypes.

In her third paragraph, Kalbach deals with relative priorities that men and women place on career and marriage. She says: "Kistiakowsky seems concerned about this trend," referring to the choice of part-time work and time off to raise a family. In fact, I did not express any concern, but reported what the demographic data indicates, which is certainly not a trend. On the contrary, within the uncertainties, the percentage of PhD women physicists who have remained professionally active has been constant in time and in the ninety-percent range, even though some of these women have taken time off or worked part-time when their children were small. I agree whole-

heartedly with Kalbach that the commitment to marriage and family should be shared with women by men, but, as she points out, there are professional consequences of various options of which individuals should be aware in making their choices. To say that "The answer is in more opportunities for part-time or interrupted employment which is, nonetheless, challenging and interesting for a competent PhD holder," ignores both those individuals who make other career choices and the realities of the present-day employment situation. The only way that such a program could be accomplished is by either a truly effective affirmative-action program or a substantial increase in the demand for PhD scientists. In view of the indifferent success of affirmative action to date, I cannot be very hopeful of the first possibility, and there is no evidence for the second.

In her fourth paragraph, Kalbach attributes to me a point of view which I am told is one that even a moderately careful reader of my article would not assume. She begins, "Kistiakowsky seems to agree with much of society that personal fulfillment and happiness (however these are to be defined) are the greatest goals to be sought by the individual," and then proceeds to make a plea for less self-centeredness. I agree with the desirability of a less me-oriented society in this country, but would like to point out that the "Matthew effect" suggested by Kalbach would better be called a "Matthew admonishment." The Matthew effect identified by Robert Merton and mentioned in my article is a sociological observation, not a desiderata. Many physicists would disagree with her last sentence linking cooperation rather than competition with scientific productivity, if this is interpreted to apply globally, and would argue that discovery is spurred by competition. On the small scale theoretical centers, experimental groups, and so on, cooperation is certainly linked to productivity, and this is one of the reasons that Merton's Matthew effect is so evident in science. If you are isolated from appropriate colleagueal interactions, it is an enormous disadvantage. Another question that can be raised is whether the creative impulse that underlies much of scientific discovery would flourish in a controlled scientific environment. Lysenkoism in the USSR has shown that subordinating science to social ends can be very destructive. These comments are made with only basic research in mind, since I believe that social good should indeed be considered in cases such as the multibillion dollar military R&D program which is part of our current national march toward a nuclear cataclysm.

Kalbach's last two paragraphs are an expression of her personal point of view and I will restrict myself to two brief comments. First, if girls should seek intelligent boyfriends, then the converse should also be true. However, I would question whether intelligence is always the overriding attribute to be considered in a personal relationship. Secondly, I would rephrase her closing sentiments as follows: "...let's not try to force humans to conform to stereotypes. Individuals are different, and in the words of Elizabeth Cady Stanton (1848): 'Every man has a different sphere, and one in which he may shine, and it is the same with every woman; . . .' "

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More on global problems

Robert Marshak's comments (November, page 9) on the need to direct some of our intellectual and research capabilities to the major problems of global concern draw attention to a vital matter confronting all of us. However, I would take issue with his proposed solutions, the setting up of interdisciplinary centers and the holding of international workshops.

A large number of such centers have been set up, and their principal function seems to be to attract and funnel governmental research funds and to support the inevitable administrative overhead cost the existence of a separate "center" entails. It has yet to be demonstrated that academic specialists are more willing or effective to tackle global, interdisciplinary problems when sponsored and "coordinated" by such a center than when housed in a discipline-oriented department.

The other fallacy relates to the assumption that a significant impact on the world's problems can be made by a group of people pontificating and building computer models while ensconced in the safe environment of a "center" in a developed country, reinforced by occasional and expensive brief visits to a developing country or by workshops attended by senior officials of such a country, on an expense account, who will make all the correct, encouraging remarks.

I believe effective technological assistance to developing countries is possible only through people who are willing to spend appreciable time (at the working level, not the official level) in selected countries. Unless one is aware of the political, economic and cultural limitations to many, otherwise excellent, solutions, many of the well-meant applications of research techniques to global problems turn out to be an expensive waste of taxpayers' money and disillusioning to all concerned.

I do not think there are global solutions to global problems and there are surprising differences in the area of technology transfer, for example, between countries with superficial similarities.

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THE AUTHOR COMMENTS: Eichholz's letter to the editor concerning my Guest Comment is rather spirited, and I am pleased that my remarks were so provocative. However, there seems to be some misapprehension concerning my basic thesis. The essential argument is given in the concluding sentence of my Guest Comment, to wit: "We can make a major contribution to meeting the global challenges facing our nation by organizing applied interdisciplinary research in our universities on the same massive scale as basic research." The research must be interdisciplinary—by definition—and the leadership role should be taken by the universities rather than government or the multinationals (the reasons are spelled out in my Guest Comment).

If one accepts the basic thesis that during the decade of the 1980's a large applied research effort should be focused on global problems within a university environment—and apparently Eichholz does not take issue with this—then the particular mechanism selected can be left to persons of good will and serious interest. If a discipline-oriented department possesses sufficient intellectual breadth and hospitality to colleagues from other disciplines to mount a concerted attack on one of the "global problems," then by all means the "program" or "institute" or "center" should be housed in this department. My own experience does not support Eichholz's contention that an interdisciplinary center necessarily requires more administrative overhead than a departmental program, and I would make the decision more in terms of the clarity of goals and talent of the investigators. (Roger Revelle and I were instrumental in creating the International Foundation for Science in 1970—an interdisciplinary organization operating out of Stockholm that awards research grants to scientists from the developing countries in a selected number of fields—and it is remarkable how low the administrative overhead can be kept if one wills it so.)

I can further assure Eichholz that I do not believe—nor should he have drawn the implication from anything I said—that "a significant impact on the world's problems can be made by a group of people pontificating and build-