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SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Blue?

By and large, it's a miracle how closely the photographic process can match the real thing for color.

Except for an occasional special case.

Why this happens is no great mystery. Certain pigments that occur in flowers reflect quite strongly somewhat beyond the long-wavelength limit of human vision, while most color films have a red-sensing layer that does not drop off quite as rapidly at the long-wavelength end as vision drops off. The consensus of technical opinion in our establishment holds that if we were to switch sensitizers for a shorter red cutoff to please photographers of blue flowers, photographers of other subjects might be a shade less pleased with their results.

Now, in designing a color film fast enough for general use with whatever light exists, we had to make it tolerant to situations where part of the illumination might come from skylight, part from tungsten, part from fluorescents, and perhaps part from a bonfire—even if it is balanced for daylight, blue flash, and electronic flash. That's the real reason the new Kodacolor 400 film has a shorter red cutoff sensitization. When we took the above subject on this film and let the printing and processing machines take over, they turned out a print that looked like this.

If you are particularly interested in photographing blue flowers, give it a try and see if it does as well on others as it does on "Heavenly Blue" morning glories. If you would like some true sophistication on the subject of true color in color photography, we can send you an article by David L. MacAdam from the January 1967 issue of *Physics Today*. Just write "Truer Blue" with your name and address on a postcard and mail it to Dept. 55-S, Kodak, Rochester, N.Y. 14650.

P.S. To be fair, we must exclude from this discussion work by which professional photographers earn their fees. Color prints done manually by a professional, an advanced darkroom hobbyist, or a laboratory paid to use custom techniques in making a single print can deliver just about any color wanted for a given subject. This degree of freedom can not be expected from high-production machines.

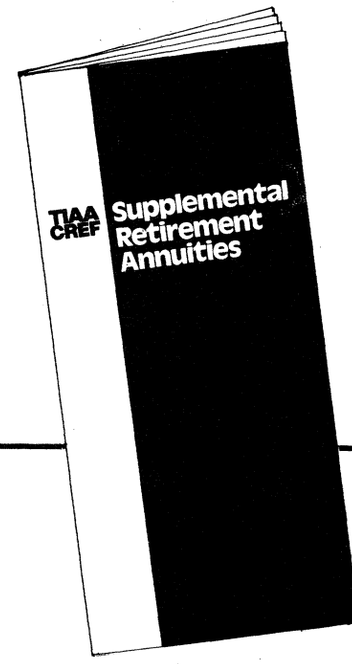
When photographed on a "long red" film and properly machine-printed and processed, "Heavenly Blue" morning glories used to turn out like this. That was before a change made in the film in 1970.

"Heavenly Blue" morning glory photographed again—but this time on our "short red" film.

Truer blue.

Kodak

TIAA-CREF Supplemental Retirement Annuities



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COVER

Plant muscle. Sequence showing contraction of rhizoplasts of the green alga *Platymonas*. The contraction is triggered by calcium and is cyclic in the presence of both calcium and adenosine triphosphate. Rhizoplast contraction is thought to be functionally linked to flagellar activity. The upper rhizoplast pair is a composite image. (Actual length of one extended rhizoplast is approximately 2.5 micrometers.) See page 975. [J. L. Salisbury and G. L. Floyd, Ohio State University, Columbus]

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The Ph.D. "Glut"

There apparently is little we can do directly to affect the demand for students receiving Ph.D. degrees. Some have hoped to increase demand by encouraging early retirement, altering the nature of the tenure contract, encouraging more part-time employment, and the like. Such actions can be expected to have only relatively minor effects on the demand for new academic employees with Ph.D.'s. The general state of the economy undoubtedly plays the major role in encouraging expansion or contraction of the job market, but we certainly can exert little influence on that.

We need to be better informed, however, about the nature of and trends in demand. We have been remiss in not following more closely how our degree students fit into the general employment market. This is the type of information we need to properly advise new applicants for graduate study. The availability of such information will almost certainly affect supply, and it may give us new insights in how we can affect demand in the future.

There are two less direct ways in which we can affect demand for Ph.D.'s. First, we can make more widely understood the utility of doctoral education, thereby creating demand where none now exists. Second, we can hope to make the expectations of students more realistic, thereby broadening the scope of acceptable employment goals. Each of these has promise for narrowing the gap between supply and demand, and each is something we can hope to affect by our own actions.

We provide added value to the individuals who go through our programs. But there is widespread misunderstanding of even what constitutes the value that is added. There is a general misconception that the main value added is knowledge of a highly specialized nature represented by the title of the dissertation. This knowledge base is by no means *the* major part, or even *a* major part, of the real value the Ph.D. received from study.

We are engaged, I believe, in ensuring that each individual possesses a background and a set of tools that enable him or her to define, to attack, and to solve new problems. We use the case-study approach in a single, narrow area as the means of teaching problem-solving. Education is a ladder used to gather fruit from the tree of knowledge, not the fruit itself.

That this principle is true is strongly indicated by what happens to individuals who receive a doctorate. Few of them continue to work in the narrow area represented by the dissertation title even for a time as short as several years, although most continue to work in the same general field. The methodology learned in pursuing one case study is usually transferred to other such studies within the basic discipline.

The fact that we educate problem-solvers is not widely appreciated. Society needs problem-solvers more than ever before, but there is often no recognition that our output of Ph.D.'s is a source of prospective candidates for positions that require this attribute. Our product is adaptable to many end uses. We are remiss in not letting others, especially the students themselves, know how adaptable they really are.

It is obviously important for the student to understand the fundamental nature of the education received. Failure to do so contributes to false expectations. The Ph.D. "glut" was a problem in part because many of those who received their degrees in the critical years failed to obtain the kind of employment they felt was befitting for an individual who had worked hard for that degree over many years. Few companies or institutions looking for employees really understood the attractiveness of bright young problem-solvers for use in a wide variety of employment areas. Were students and prospective employers to make a more realistic appraisal of the values added by graduate education, the problem of the Ph.D. "glut" would be substantially diminished.—HARRISON SHULL, *Professor of Chemistry, Indiana University, Bloomington 47401.*

Extracted from an address presented to the Conference of the Association of Graduate Schools, Austin, Texas, 2 October 1978.