carried on in the newly established research laboratories of the Worcester Foundation.

AT a meeting of the council of the Royal Society held on October 12, amendments were made to the statutes so as to make it clear that, since the passing of the Sex Disqualification (Removal) Act of 1919, there is no barrier to the admission of women into the fellowship of the society. This decision was reached after the fellows of the society had been consulted by postal vote and had approved the amendments ratified by the council on that day.

DISCUSSION

BIOCHROMES[1]

THE natural coloring matters of plants and animals are receiving ever-increasing attention in various fields of experimental biology. The present purpose is to refer briefly to the heterogeneous class of biological pigments and to point out fundamental similarities which would appear to justify their collective designation by the title given to this communication.

Professor Sumner[2] has aptly criticized the term "pigment" as a word of relatively loose application. He insists that the word is best limited to its strictly functional sense, but points out that the term arising from a Latin verb meaning "to paint" has been extended by many biologists far beyond its original significance of an artificially imparted color, to include now all naturally colored substances in living systems. It is true that many Greek and Latin words have undergone gradual modification and expansion so that their present significance departs widely from the original limits of meaning.

The present writer, for one, would accept the broad term "pigment" as signifying, in biology, all colored substances, whether their chief functions appear to include those of imparting concealing or advertising colors, or whether they may participate in known or obscure biochemical reactions, or indeed have a known role at all. The word is widely useful, and will undoubtedly persist in general biological parlance.

There is, nevertheless, a valuable point in my colleague's criticism. The term "pigment" is often applied to a substance which is designed to, or merely happens to impart color to something else, whether man-made or naturally occurring. The classes of pigments which interest biologists do not ordinarily include colored inorganic compounds employed in commercial paints or the synthetic dyes of the organic chemist. The histologist's tissue-stains are useful to him only in the artificial differentiation and identification of protoplasmic structures. Concerning natural colored substances, while these may serve occasionally to distinguish color-variants and heritable mutations within species, or to identify organs, tissues or biological products in laboratory specimens, here again the primary consideration is the usefulness of color to the investigator. The chemical nature and possible physiological significance of the chromophoric molecule is merely incidental and often quite neglected.

From the standpoint of the biochemist whose interests are concerned with the metabolic significance of natural coloring matters, the designation of these by a discriminating scientific term has long been desirable. In response to an inquiry, Dr. George M. Calhoun,[3] late professor of Greek in the University of California, once suggested to the writer the descriptive and self-explanatory term *biochrome,* with an adjective *biochromatic* (*biochromic* is perhaps preferable), and a collective noun *biochromy.* This word and its derivatives have therefore been employed in this article and elsewhere.[4,5]

Considering the great chemical diversity among the biochromes or natural biological pigments, why should the biochemist feel justified in setting them apart as a class and in giving them a collective name? Let us return to this question in a moment.

In any series of natural classification there will occur overlappings and inexactnesses at the borders of groups. These will occur especially when both chemical and physiological or other biological criteria are involved in the system. As an example, we recognize, under the general heading of *catalysts,* an extended series of very diverse compounds whose common property is that of controlling the occurrence or the rates of various chemical reactions. Excluding now the inorganic and synthetic accelerating (or retarding) reagents of industry and the chemical laboratory, we have still a large and assorted group of biocatalysts, including the numerous enzymes, hormones and vitamins which promote, maintain, restore or otherwise influence diverse physiological functions. The biocatalysts, although necessarily further subdivided into classes, share as common characteristics, first, their origin and occurrence in living systems, and secondly, varying degrees of control over the promotion or rate of given biochemical reactions or chains of reactions in the organism.

1 Contributions from the Scripps Institution of Oceanography, New Series, No. 240.

2 F. B. Sumner, *Sci. Monthly,* 44: 350, 1937.

3 Personal communication, 1936.

4 D. L. Fox, SCIENCE, 100: 111, 1944.

5 D. L. Fox, D. M. Updegraff, and G. D. Novelli, *Archives of Biochem.,* 5: 1, 1944.

Returning to the biochromes, these are likewise placed in a subclass of a great and heterogeneous group of colored molecules because, in spite of chemical and physiological differences as great as those existing among the biocatalysts, biochromes also possess two chief characteristics in common, *i.e.,* their origin and occurrence in living organisms and their reflection of a fundamental chemical property, the selective absorption of light waves in the visible spectrum. Some biochromes are also biocatalysts, *e.g.,* chlorophyll, cytochrome, certain flavines and some of the carotenoids.

Reduction in the vibrational frequencies of certain valence electrons, and molecular resonance,[6] visible as color, are evoked by various kinds and degrees of chemical unsaturation. In many instances, unsaturated chromophoric groupings may impart both color and increased reactivity or chemical instability to the same molecule. Such compounds may therefore assume more readily important biochemical roles (*e.g.,* carotenoids, tetrapyrroles, flavines, some pterins and certain quinones) or may constitute representative byproducts of special metabolic processes (*e.g.,* bile pigments, melanins, indoles and certain pterins). Color and biochemical activity are, in such instances, two interlocked effects of the same fundamental molecular phenomenon.[7,8]

Our present understanding of the parts played by various biochromic compounds in the metabolic economy of organisms leaves much to be desired, but it is expected that increased study will extend the borders of our knowledge in this field. It is hoped to treat the subject more fully in a review to be published elsewhere.

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THE OPPORTUNITY OF PURE SCIENCE

THIS is to take issue with some of the implications of "The Threat to Pure Science"[1] by Alexander W. Stern, and to complement it with a view of the other side of the picture.

The concept referred to by the words "pure science" is not concisely exposed in Mr. Stern's comments. One gathers from the context that science is pure only when uncontaminated by the hands of those who would put it to mundane use.

Doubts are expressed that the "... majority of the industrial physicists, not being in a university environment nor under the influence of the traditions of a university, feel . . . a moral responsibility to uphold pure science. . . ." Later on we find this astonishing statement: "Science is an intellectual activity—its very nature is not practical."

From this one would conclude that Mr. Stern considers that "pure science" is only metaphysics and excludes experimental and perhaps even theoretical science, if it is useful.

We, in industrial physics, find among us the whole range of human attitudes towards science just as is found in a university. We have the technological "hack" whose whole interest is to take his routine data, to get home and to seek his inner stimulation in a bridge game. He corresponds to that type of conscientious teacher who sticks to the text, answers pertinent questions, ignores impertinent questions and goes home in the same spirit.

We find all grades of intellectual activity among industrial scientists, up to and including those whose whole satisfaction is derived from "the pursuit of truth and the passion for understanding (which) give a dignity and nobility to man." These people, in industry exactly as in the universities, have achieved an intellectual freedom which is beyond usurpation by civil or economic forces.

One sees the dawn of a great era for science in the growing demands made upon it by our industrial society. To be sure, we may expect civil controls over the practice of our professions where that practice affects the public weal. We should be proud to furnish a recognized service, and should lend our skill to the establishment of ever higher professional standards, just as the faculties of our great universities endeavor to achieve a maximum of integrity and competence.

It certainly should be no more degrading for one engaged in "pure research" to earn his living as a professional physicist than as a professor of physics. The purity of the research in either case depends upon the soundness of the man's philosophy rather than upon his environment or condition of economic stress. The "threat to pure science" lies in intellectual incompetence wherever it may be found, and can be eliminated only by the concerted efforts of professors and professional workers.

In industry wherever one finds an outstanding research organization he finds an inspired leader at its head. The same rings true of the outstanding research organizations in our universities. Scientists, whether employed by universities or by industries, have before them a growing responsibility and a tremendous opportunity. If the leaders, wherever they work, maintain intellectual integrity and encourage enjoyment of the pursuit of truth in their associates, "pure science" need fear no threat. Public accep-

6 L. Pauling, *Proc. Nat. Acad. Sci.,* 25: 577, 1939.

7 L. Zechmeister and P. Tuzson, *Naturwiss.,* 40: 680, 1935.

8 D. L. Fox, *Am. Nat.,* 70: 477, 1936.

1 SCIENCE, 100: 2599, 356, October 20, 1944.