Further it may be seen that the question of whether this type or that type of organizational set-up for research is better can only be answered on the basis of a specific analysis of what the given organizational set-up would entail.

For example, to evaluate government supervision of research or corporation supervision of research one should determine the type of government, or corporation, the basic objectives of the supervision, who would be in charge of administering the supervision, what funds would be available for research, etc. Such an analysis when applied to universities reveals as many differences in degree of freedom as would be found in the case of governments or corporations. The chief point is that the most constructive attitude here is an open-minded scientific specific analysis rather than one based on general terms which have very few ramifications in actual practice.

EUGENE V. D. ROBIN

MAY I commend you, and Mr. Stern, for his communication on "The Threat to Pure Science" in your issue of October 20, 1944? It seems to me that the point he has raised is a crucial one. The emphasis in America has been on applied science and technology rather than on pure science, but is not all applied science the application to practical uses of the principles discovered in pure science? As Whitehead has well said, our utmost abstractions are the most powerful weapons with which we control concrete fact. The paradox consists in the circumstance that the greatest practicality can be obtained only if we pursue pure science quite independently of its practical usefulness. The fact that some pure sciences are indifferent to and even disdainful of application does not prevent their work being eventually highly useful. If, in America, we do not pursue pure science along with practical and applied science, we will not continue to make advances because we will not have any future pure science on which applications could draw, so from the narrow viewpoint of practicality, the detached pursuit of pure science is an absolute necessity.

Practical experience seems to bear this out, for in the absence of pure science on which the industrial laboratories could count, they themselves have been forced more and more to add theoretical researches to their programs. However, there is no reason why pure science should have to be conducted surreptitiously or expeditiously, for it can not under those circumstances do its best work. Things can not be properly related that are not sufficiently distinguished from each other. A pure science which pursued its course indifferent to the demands of society for usefulness would eventually prove the most useful investment that society could make, even though such an investment may have to be amortized over a period of years.

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SCIENTIFIC BOOKS

A CATALOGUE OF VASCULAR PLANTS

Catalogue of the Vascular Plants of S. Tomé (with Principe and Annabon). By A. W. EXELL. xi + 428 pp. 26 figures. 3 maps. London: British Museum (Natural History).

FERNANDO PO, Principe, S. Tomé and Annabon form a group of small equatorial islands in the Gulf of Guinea close to the coast of West Africa. This catalogue is a model of what such a work should be. It is manifest that the author and his associates have made a serious attempt to account for all species previously credited to the islands covered, and at the same time have determined by a study of types and the early literature the proper status of many early names, some of which have been consistently misapplied since 1753. Adjustments in the application of widely used names in *Corchorus, Canavalia, Caesalpinia, Dichrocephala, Eclipta, Quamoclit, Ipomoea, Fimbristylis, Cyperus* and other genera for various pantropic species require that all individuals concerned with tropical floras consult this work if they are at all interested in the proper application of early published binomials. As examples, *Kyllinga pumila* Michx. becomes *Cyperus tenuifolius* (Steud.) Dandy, *Cyperus umbellatus* Benth. = *Mariscus umbellatus* Vahl becomes *Cyperus sublimis* (C. B. Clarke) Dandy, *Cyperus odoratus* Linn. stands for an entirely different species than that to which this name has long been erroneously applied, and what has long been miscalled *C. odoratus* becomes *Cyperus polystachyos* Rottb., and *Fimbristylis dichotoma* (Linn.) Vahl replaces *F. diphylla* (Retz.) Vahl and *F. annua* All., the Linnean name previously misapplied by most authors. The synonymy is critically assembled. Changes made in the names of various species are strictly in accord with the International Code of Botanical Nomenclature. The total number of species is not large, about 820 in all, including the introduced cultivated and naturalized ones. It is of interest to note that of these about 230, or about 28 per cent. also occur in the Philippines, separated from the Gulf of Guinea by the African continent, the Indian Ocean and the Malay Archipelago; about 50 of these are of

natural distribution and 180 man-distributed (weeds and cultivated plants).

The introductory chapters are replete with information regarding the islands, climate, topography, plant formations, history of botanical exploration, origin and affinities of the flora, etc. As noted by the author, S. Tomé was uninhabited when it was discovered by the Portuguese in 1470–71, and thus it has been possible to make some pertinent observations on the effect of man on the natural vegetation within a known period. By transfer seventy-five new names are published, and thirty-five new species are described, the new names being largely due to the critical bibliographic and herbarium work of the author and his associates. *Aidia* Lour. 1790 is reinstated as a valid genus, type *Aidia cochinchinensis* Lour. (*Randia cochinchinensis* Merr.; *Randia densiflora* Benth.), the group hitherto having been included in *Randia* Linn.

E. D. MERRILL

CHEMICAL MACHINERY

Chemical Machinery. An Elementary Treatise on Equipment for the Process Industries. By EMIL R. RIEGEL. vii + 583 pages. New York: Reinhold Publishing Corporation. 1944. $5.00.

IN its twenty-seven chapters this volume covers some twenty-three general types of process equipment. Also included is a three-chapter section on instruments for measuring and controlling temperature, pressure, flow and other process variables. The coverage of general types of equipment, *i.e.*, agitators, heat exchangers, filters, crystallizers, evaporators, etc., is quite complete. The book is well illustrated by the 436 photographs and line drawings which it contains. The material presented is up to date and the inclusion of cost figures with corresponding dates will be valuable in the preparation of rough cost estimates. References are included at the end of each chapter which will prove helpful to any one interested in a detailed discussion, particularly of the theoretical aspects, of the design of equipment. Theoretical discussions are almost entirely lacking and those few included are most elementary and incomplete.

This book will be helpful to any one interested in acquainting himself with the various kinds of equipment available for carrying out such operations as drying, size reduction, distillation, pumping, etc. It will enable him also to get some idea of the size and capacity, as well as the cost, of process equipment as used on a production scale. As a general descriptive survey of the process equipment field it fills a certain need in the literature of chemical engineering.

There is a tendency in the book toward lack of precision of statement which makes the presentation sometimes confusing and occasionally misleading. Technical terms are often introduced without definition and many unwarranted generalizations are made. Read with some background of training or experience in chemical engineering these difficulties are not serious.

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SPECIAL ARTICLES

RELATION OF THE STREPTOCOCCUS LACTIS R FACTOR TO "FOLIC ACID"

RECENTLY, the isolation of a growth factor for *Streptococcus lactis* R (SLR factor) was reported, which effectively replaces "folic acid" in the nutrition of this organism but is inactive for *Lactobacillus casei*.[1]

It has since been found that folic acid[2] is formed when *S. lactis* R is grown in a folic acid-free medium containing the SLR factor. The presence of folic acid in such cultures is shown by the fact that the whole culture, the cells or the culture fluid, when added in adequate amounts to folic acid-free media, support maximum growth and fermentation of *L. casei* and other folic acid requiring lactic acid bacteria. Table 1 gives results obtained with the supernatant fluid of a centrifuged culture of *S. lactis* grown for 1 day in media containing the SLR factor.

It is evident that the *S. lactis* R factor, although present in a concentration 100 times that required for optimum growth of *S. lactis*, can not replace folic acid for the lactobacilli. However, growth of *S. lactis* in a medium containing the SLR factor results in the formation of sufficient folic acid per cc to permit acid formation by the lactobacilli equal to or greater than that obtained with 0.003γ units of folic acid.

It is possible that the SLR factor stimulates *S. lactis* to synthesize folic acid from the other constituents of the medium. However, it seems more likely that the SLR factor, *per se*, is transformed into folic acid since the amount of folic acid formed increases as the quantity of SLR factor in the medium is raised even considerably beyond that required for maximum growth of the organism. Moreover, folic

[1] J. C. Keresztesy, E. R. Rickes and J. L. Stokes, SCIENCE, 97: 465, 1943.

[2] The term "folic acid" is used because activity was compared to that of a folic acid concentrate kindly supplied by Dr. R. J. Williams. However, the term is used in this paper to include any substance which can replace folic acid in the growth of *L. casei*. *Cf.* E. E. Snell and W. H. Peterson, *Jour. Bact.*, 39: 273, 1940; J. J. Pfiffner *et al.*, SCIENCE, 97: 404, 1943; R. L. R. Stokstad, *Jour. Biol. Chem.*, 149: 573, 1943; B. L. Hutchings *et al.*, SCIENCE, 99: 371, 1944.