correlation charts, and 2 maps showing the distribution of the Mesozoic and Cenozoic igneous rocks of Eastern China.

Unfortunately the promising research of these Chinese geologists came to a halt in 1966 because of the "proletarian cultural revolution." This halt does provide an opportunity for Western geologists to catch up with the progress in tectonic thought that Chinese geologists made in the ten years prior to 1966.

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Nitrogen Source

Urea as a Protein Supplement. MICHAEL H. BRIGGS, Ed. Pergamon, New York, 1967. xii + 466 pp., illus. $18.

This book includes 23 chapters written by authors from 11 countries, including such notable nutritionists as J. Brüggemann from Munich and A. I. Virtanen from Helsinki. The book is divided rather arbitrarily into four sections entitled History, Manufacture and Role of Urea in World Food Problems; The Effect of Urea on Ruminant Physiology; Urea as a Supplement for Ruminants; and Urea in Diets for Non-ruminants.

The first chapter, on the history of the use of urea in ruminant feeds, by H. J. Stangel of Allied Chemical Corporation, gives an excellent review of the literature reflecting the thorough knowledge its author gained from editing, initially with D. F. Green, the book *Urea and Non-protein Nitrogen in Ruminant Nutrition.*

H. K. Hendrickx compares by in vitro methods the effectiveness of urea with that of other non-protein nitrogen (NPN) compounds and reports the findings from his laboratories and others that urea is second only to certain ammonium compounds and acetamide in utilization in the rumen.

Chapter 4 states that the most serious nutritional lack in the world is protein (although it is probably energy) and implies that urea will provide alleviation of this world protein shortage. The author seems unnecessarily and unrealistically intrigued with the practical usefulness of leaf-protein foods and the supplementation of the residues by urea for ruminant feed. Workers in Africa and elsewhere have suggested, much more practically, that supplementation of tropical forages with urea is productive of more animal protein for human consumption, an observation not mentioned in this chapter. The statement that there is no way of measuring the adequacy of diets for the adult is in disagreement with many years of research in quantitative nutrition.

The second section of the book is devoted primarily to the subject of urea and protein synthesis via rumen microbial fermentation. The excellent initial chapter by H. M. Schwartz points out that under non-urea dietary conditions there are a number of natural NPN sources, including urea from saliva and the bloodstream, which are converted to protein in the rumen. Ammonia is perhaps one of the most important NPN compounds discussed because it is the principal source of nitrogen utilized by the rumen flora and arises from both dietary protein and NPN sources. The retention by the ruminant of blood urea under low protein intakes as investigated by Livingston *et al.* and by Schmidt-Nielsen is discussed in the chapter on ureolytic rumen bacteria. This is a very important factor in tropical nutrition. The chapter by Brüggemann on the effect of urea on rumen microbiology and metabolism is one of the most thorough chapters, with an extensive bibliography. A chapter on the endogenous urea cycle in the ruminant by H. Le Bars follows logically. Nobel laureate A. I. Virtanen discusses experiments from his own laboratory on the production of milk by cattle on protein-free rations containing urea.

Part 3 covers some of the more applied aspects of urea as a feed supplement for ruminants. It contains a chapter by Rys from Krakow presenting a thorough review of urea utilization by dairy cows, a matter over which there has been a great deal of controversy because of the high protein needs for milk production. There is a short chapter on the feeding of urea to buffalo and zebu cattle, and a long chapter on urea in rations for fattening lambs, plus chapters on beef cattle. One of the best and most interesting chapters is one by E. C. Owen dealing with relationships among urea and other dietary constituents. Of particular importance and significance is the relationship between nitrogen source and cellulose digestion. A chapter on additives includes a discussion of much-advertised ethanol, which apparently has no useful effect. The important idea of the addition of urea to silage is discussed by J. W. Ryley. The final chapter in this section establishes, with certainty, the lack of any relationship between dietary urea and vitamin A nutrition, laying to rest another in the multitude of dietary interrelationships, almost all of which turn out to be indirect or nonexistent, leaving some few, like protein-energy and thiamine-carbohydrate as realities firmly based on biochemistry.

The last section, devoted to urea in diets for non-ruminants, discusses the demonstrated ability of urea to provide the nitrogen required for biosynthesis of nonessential amino acids when added to a diet low in protein but adequate with regard to all the essential amino acids. This experiment was discussed at the University of Wisconsin as early as 1939 and was reported by Lardy and Feldott in 1949.

While unevenness and considerable overlapping among chapters are evident, many chapters are very thorough, well-written, critical reviews. I believe the book will prove of real value to all people working in the field of ruminant nutrition, particularly those in countries that are just developing an active animal agriculture and wherever protein sources for ruminant feeding are scarce or costly.

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Improving Farm Animals

Genetics and Animal Breeding. IVAR JOHANSSON and JAN RENDEL. Translated from the Swedish edition (Stockholm, 1963) by Michael Taylor. Freeman, San Francisco, 1968. xii + 489 pp., illus. $17.50.

After World War II new books and journals appeared in almost every field of science. In the field of animal breeding, however, comparatively little has been published. The texts of Winters and Rice are far out of date, and though the works of Lush, Lerner, Falconer, Hutt, and Lerner and Donald offer good reference material in their specialized fields, there has been a great need for a textbook on animal breeding. Johansson and Rendel's new text therefore is most welcome, since it summarizes the development of animal breeding over the past 40 years and supplements it with new theories and concepts. Now that

the world is facing problems caused by the population increase in our own species, improvement in both quality and quantity of agricultural output, and therefore any literature describing methods and technics contributing to this end, is of great importance.

Significant developments have taken place in the last three or four decades in breeding technics and in the study of the heritability of traits affecting yield and performance. Johnsson and Rendel's summary of the extensive literature dealing with both breeding theory and results is most useful, in fact provides an excellent basis for a first course in animal breeding. The authors point out that estimates of heritability unquestionably vary between herds or flocks for the same traits, owing to differences in management, season variations, and sampling variations. It seems that lack of understanding of the genetic determinants for such quantitative traits as growth and performance may be another factor. Several chapters are devoted to individual discussions of congenital abnormalities, sterility or infertility, and the inheritance of traits of especial value in each species of farm animals.

The incorporation early in the book of some of the modern developments in molecular genetics, including a discussion of the Watson and Crick model of the nucleotide, and recent concepts of genes and mutations, is a good feature. Although some students using the text may already have had elementary genetics, a chapter combining formal and molecular genetics makes a good introduction to the book. Later on, examples are cited on erythrocyte antigens, isozymes, and serum and milk protein variations which pertain to some of the most exciting developments in genetic research in various species including man, and which are perhaps major areas for further development in animal breeding.

The book would be more useful to research workers as well as to students of animal husbandry if a more complete bibliography had been given. In many places the names of the original authors of important concepts are omitted. For instance, the polygenic concept was introduced by Mather and the theory of evolution of dominance by Fisher, yet neither name is cited. Many breeding results are reported but no authorship is given. Similarly, certain results from experiments with laboratory animals which are cited are essential for illustrative purposes; but the work of Thoday on the location of polygenes affecting hair bristle in the fruit fly, an important recent contribution in quantitative genetics, is not mentioned. In the discussion of the homology of mutations among farm animals it would have been well to include some other species: the white spotting in cattle affecting both pigment formation and germ cell development, for example, is very comparable with the white spotting (due to single gene mutation at the *W* locus) in mice. The primary purpose of animal breeding is of course the improvement of yield and performance; but such information is also of theoretical and practical importance to both genetics and evolution. Some theoretical discussions appear rather vague. For instance, in their explanation of inbreeding depression and hybrid vigor, the authors' reference to the consequence of gene interaction would be strengthened by the use of some example, such as the hybrid antigens demonstrated by Irwin in pigeons, and the codominance of many different serum proteins and isozymes reported in various species. I am fully in sympathy with the difficulties which the authors inevitably faced in their attempt to fit the vast amount of genetic literature into their book; I mention the above points only because the role played by animal breeding in the whole discipline of genetics is so important.

Johansson and Rendel have presented a well-balanced summary of the recent developments in animal breeding. I think they have done a great service to students of animal husbandry and genetics, and the translation should prove most useful to English-speaking readers.

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Useful Species

Dictionary of Economic Plants. J. C. Th. UPHOF. Second edition. Cramer, Würzburg, 1968 (distributed in the U.S. by Stechert-Hafner, New York). viii + 591 pp. $9.75.

Since 1959, when the first edition of the *Dictionary of Economic Plants* was published, a large amount of additional information in regard to useful plants in all parts of the world has become available. The second edition incorporates this new material and consequently is greatly enlarged and has more extensive coverage. The number of pages has been increased from 400 to 591 and the number of species listed from 6000 to 9500. Several of the original descriptions have also been rewritten.

The format of the book is similar to that of the first edition. For each species the geographical distribution, products, principal uses, and family are given. The genera, species, common names, and many synonyms are listed alphabetically. In most cases the economic genera are listed under their respective families. Also, various categories of useful plants are given with the genera concerned in each case.

Several new categories have been added, among them plants used in ceremonies, hallucinogenic mushrooms and toadstools, hallucinogenic and narcotic plants, and ordeal plants. The category of medicinal plant genera has been broken down into plants used as abortives, in Chinese medicine, for eye ailments, in Hindu medicine, among primitive peoples, for snakebites, for tooth ailments, and in Western medicine.

The bibliography is greatly expanded. The section dealing with categories of economic plants lists 836 titles compared with 179 in the first edition. The section organized on a regional basis has 504 entries as against 330.

The book is attractively printed and is remarkably free of typographical errors. Its principal defect is the use, in some instances, of incorrect names for the species listed. Taxonomists and students of nomenclature will find this a drawback, but for others it does not detract too much from the value of the work. The magnitude of the task confronting the author and the time element involved must have precluded any attempt at evaluating the names appearing in the literature, and they had to be accepted at their face value.

In spite of the large number of species included, there are some surprising omissions which perhaps will be obvious only to those who are familiar with the useful plants of some particular region. For example, residents of northeastern North America may wonder at the failure to include such species as the ostrich fern (*Pteretis pensilvanica*), cattail (*Typha latifolia*), hazelnut (*Corylus americana*), water lily (*Nymphaea odorata*), sorrel (*Rumex Acetosella*), wild sarsaparilla (*Aralia nudicaulis*), water hemlock (*Cicuta maculata*), and hobblebush (*Viburnum alnifolium*).

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