tra," of Amsterdam. This imposing volume celebrates the seventieth birthday of Dr. Max Weber, senior professor of zoology in the University of Amsterdam.

This tireless and capable investigator, of whom an excellent portrait is given, has devoted himself for many years to the study of the fauna of New Guinea and neighboring parts of the Pacific. He has interested himself particularly in the fish-fauna, transitional between the tropical "South Seas" and the continental fauna of Australia. His work has been throughout of a high order. Beginning in 1895, with the fishes of Semon's voyage to New Guinea, he has continued in active research to the present time. Twenty-eight new genera, all of them apparently valid, have been described by him, with the cooperation, in part, of his able associate, Dr. Louis F. de Beaufort. The majority of these new forms were taken in the Siboga expedition, about 1913.

In this memorial volume, 44 authors are represented. The list includes most of the naturalists of the Netherlands, several from Germany and Scandinavia, one (Dollo) from Belgium, two (Regan and Hickson) from England, one (Annandale) from India, and three (Eigenmann, A. H. Clarke and Jordan) from the United States. The essays are extremely varied and those within the comprehension of the present writer, important and interesting.

DAVID STARR JORDAN

Nutrition, The Chemistry of Life. By LAFAYETTE B. MENDEL, Sterling Professor of Physiological Chemistry, Yale University. The Yale University Press, 1923.

THE book, which contains 150 pages, represents the Hitchcock Lectures delivered by the author at the University of California in 1923. It is stated in the preface that no attempt has been made to present an elaborate summary of the current knowledge of the subject. Indeed, it would have been impossible to do so in the compass of a book of this size.

The book is divided into five chapters: The science of nutrition: a retrospect. The importance of "Little Things" in nutrition, The vitamines, The protein factor in nutrition, and The energy problem in nutrition.

There is an individuality possessed by this little book which makes it very different from any other which has yet appeared on the subject. In the first chapter the views of Magendie, Beaumont, Prout, Liebig, Mulder and Voit on nutrition are set forth in a most entertaining way.

In subsequent chapters a wise selection is made of material from the great volume of experimental data now available for presentation to a popular audience. The story of modern research is told simply and embellished with illustrations which make an appeal to a wide circle of readers. Dr. Mendel's extraordinary ability as a lecturer and teacher is reflected in this series of lectures.

E. V. MCCOLLUM

LABORATORY APPARATUS AND METHODS

A CONVENTIONAL SCHEME FOR TEACHING CELL DIVISION (MITOSIS)

So far as I am aware all the conventional schemes for teaching mitosis are defective in at least four points: (1) They do not emphasize the cyclic nature of the phenomenon. (2) Certain phases are too long and too much involved. (3) The processes are not clear cut. (4) Certain steps that normally occur at least in some forms are omitted. For fear that any one may think that my criticisms are too severe, let us examine each in detail.

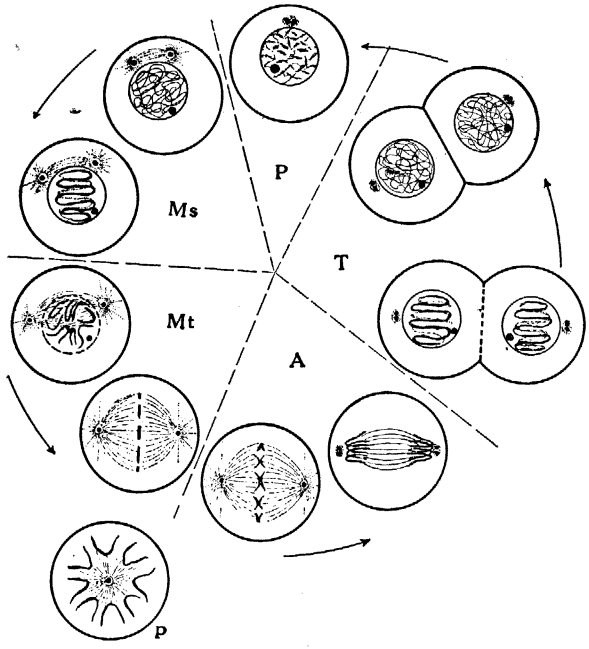
All schemes of cell division stop with the end of the telophase with the implication that these two cells transform into the prophase, but so far as I know they do not emphasize that the telophase is but the beginning of the prophase. Apparently this is of no importance, but really I believe that it has considerable pedagogic significance. In the usual scheme of mitosis the term prophase is used to cover the process from the resting nucleus until the chromosomes have arranged themselves in the equatorial plate. This involves the changes from granules to a spireme, from a spireme to chromosomes, and then the arrangement of the chromosomes into an equatorial plate, three rather distinct steps. Contrast this with the metaphase and anaphase as usually described which involves merely the splitting and separation of the chromosomes, a process of great biological significance, but involving no very difficult mechanical principles. Then too the telophase is usually described as a reconstruction stage with no or only very vague indications of how the process of reconstruction is brought about. Primarily or biologically these points may be of no great interest but pedagogically I believe that they are of more importance than is usually assumed. Any schematic arrangement it seems to me ought to be clear cut, even to the point of being dogmatic. There is always time later to point out the exceptions and deviations but once a fundamental clear cut scheme is presented it can be used as a foundation to work on. As indicated above it has seemed to me that the processes taking place in the telophase never have been elaborated sufficiently.

With these points in mind and finding myself face to face with the problem of teaching cell division to a large class in general embryology several years ago, I designed a chart which I have been using ever since. This chart seems to be so helpful in getting students to understand the complicated process of cell division

that it seems worth while to pass it on to others. The following comments will give the essential features of the diagram. The process of cell division is represented as a cycle. The cycle is represented by five phases; each phase, excepting the prophase, is represented by two stages which are intended to represent an early stage and a late stage in each phase.

The prophase, *P*, is limited to the resting (mitotically speaking) nucleus; enclosed in a nuclear membrane with its chromatin material in the form of granules as usually described; with a large nucleolus; and a centrosphere containing two centrosomes. Emphasis is always placed upon the facts that while we speak of this as a resting nucleus we are speaking mitotically and that metabolically this is the active phase of the cell and that as far as the life of the cell is concerned it is a very long period and further that it is really the end of the cell's existence as a cell and not its beginning.

The term mesophase, *Ms*, is introduced to designate that phase of the process of mitosis described as spireme thread formation. The other characteristic thing in this phase is that the centrosomes have commenced to separate. The mesophase is divided into two stages. In the first stage the spireme thread is long, slender and much coiled. In the second stage the thread has shortened and thickened and has been thrown into a definite number of loops, each loop corresponding to a future chromosome.



The metaphase, *Mt*, is characterized by the chromosomes. The chromosomes are represented as the broken loops of the short looped spireme thread. Another character is the disappearance of the nuclear membrane. In the first stage the chromosomes are represented as being scattered in the cell, while the centrosomes are about 90° from each other. In the second stage the centrosomes have reached their polar positions, 180° from each other, and the chromosomes have arranged themselves at the equator. Both equatorial and polar views, *p*, of this stage are shown for the sake of clearness. Attention is usually called to the disappearance of the nucleolus during this stage. Mitosis may be said to have reached its climax with this stage and all the rest of the process may be described as a process of reconstruction of the chromatin material.

The anaphase, *A*, means that time during mitosis when there are daughter chromosomes in the cell. It starts with the first indications of the splitting of the chromosomes and ends with them arranged at the poles. The first stage shows the beginning of the splitting and the second stage shows the chromosomes pulled to the poles and the division of the cytoplasm started. The centrosomes have usually divided by this time in preparation for the next mitosis, and the nucleolus has usually reappeared.

The telophase, *T*, may be described as the daughter spireme phase. In the first stage we have short thick looped daughter spireme threads formed apparently by the growing together of the ends of the looped chromosomes. This stage is exactly comparable with the second stage of the mesophase save that we are now "back-tracking" and have daughter spireme threads instead of a single thread. The nuclear membrane has reformed and the cytoplasmic division is usually complete. In the second stage we have long daughter spireme threads which are comparable to the first stage of the mesophase and the interesting process of mitosis is all but finished for there remains but the single step, the transformation of the thread into scattered granules and we are back with daughter prophase stages ready to start the whole process over again. And while in the minds of the older students who have learned the old nomenclature we may have appeared to add to the confusion by introducing new terms and by limiting old terms in a new way, and to have simply run round in a circle and arrived nowhere, yet my experience with beginning students leads me to believe that there is some little merit in it.

Z. P. METCALF

NORTH CAROLINA STATE COLLEGE
AND EXPERIMENT STATION

SPECIAL ARTICLES

OSCILLATIONS IN THE LOW VOLTAGE HELIUM ARC

R. BÄR, M. v Laue and E. Meyer have recently published a paper[1] explaining the apparent main-

[1] *Zs. f. Phys.*, 20, p. 83 (1923).