still useful and even essential to ours. There seems to be need of a biography that would shed light on the specific ways by which these ideas entered Kepler's mind, on the way in which they were modified by the circumstances of his life and how they bore fruit in his works. While the third part of the book makes it clear that there is an interesting and important study to be made here, it does not seem to contribute much of a specific or exact nature to it.

Part 4, by Frederick E. Brasch, is an accessible and extensive bibliography of works by and on Kepler. It has the great advantage of brief descriptive notes on many of the important entries.

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Antony van Leeuwenhoek and his "Little Animals." Being some account of the father of protozoology and bacteriology and his multifarious discoveries in these disciplines. Collected, translated and edited from his printed works, unpublished manuscripts and contemporary records. By CLIFFORD DOBELL, F.R.S., protistologist to the Medical Research Council, London. Harcourt, Brace and Company, New York, 1932. Price, $7.50.

THIS book was published on October 24, 1932, on the 300th anniversary of Leeuwenhoek's birth. It covers 435 quarto pages and contains 32 full-page plates, consisting of portraits of Leeuwenhoek, facsimilies of his hand-written letters to the Royal Society in London, figures of bacteria, spirochaetes and protozoa reproduced from original drawings in his manuscripts, illustrations of Leeuwenhoek's "Microscope" and his pepper tube, and scenes of Delft which were intimately associated with Leeuwenhoek's everyday life. The book contains over 600 references to works referred to in the text and gives a short list of Leeuwenhoek's writings. The author gives Leeuwenhoek the title "Father of Protozoology and Bacteriology."

Dobell, with the background of a busy lifetime of research as one of the world's foremost protozoologists, interprets for the reader in copious footnotes Leeuwenhoek's simple descriptions of his "little animals" and identifies them in terms of present-day zoological and bacteriological nomenclature.

The value of the book to the reader is unspeakably enhanced by the circumstance that its author laboriously mastered the Dutch language of Leeuwenhoek's time that he might truly breathe the spirit of Leeuwenhoek's words into his English translation of the original manuscripts still preserved by the Royal Society in London.

The standards of Leeuwenhoek's micrometry of the "animalcules" are discussed—a sand-grain, a human red blood corpuscle, a vinegar-eel, the diameter of a louse's eye, the bigness of a hair on a louse, the thickness of a spider's web and the bigness of a cheese-mite.

The modern research worker, housed by towering walls, equipped with elaborate apparatus all ordered from catalogues, and assisted by a multitude of specialists: Contrast him with the Dutch janitor and his simple tools—a home-made lens, some rainwater, some pepper water, some vinegar, some thin pipes of glass and some spittle.

Leeuwenhoek's secret, which he never revealed in any of his writings or to anybody and which was buried with him, concerned the method by which he observed objects with his microscopes. Microscopes he gave and left aplenty, but Leeuwenhoek alone could see with them the minutiae of bacteria and protozoa which he described. One is stunned at the discoveries which he made with his limited equipment. Dobell supplies a notion in elucidation of the missing method by which Leeuwenhoek observed flagella, cilia and spirochaetes.

The dedicatory page affectionately names Paul de Kruif, who in "Microbe Hunters" rates this shopkeeper of Delft "First of the microbe hunters."

The printing and binding of this magnificent book are perfect specimens of the printer's art.

EDWARD FRANCIS

SCIENTIFIC APPARATUS AND LABORATORY METHODS

IMPROVEMENTS IN BIOLOGICAL LABORATORY APPARATUS

THE electrical thermostat without water-jacket has come permanently into use in biological laboratories. Its extreme convenience has made that inevitable. It has one serious disadvantage, however, namely, that the heater is apt to cause explosions if by any means a mixture of air and vapor or air and gas is set free inside the system. Some quite serious accidents have occurred in biological laboratories throughout the country on this account. The rapidly increasing use of hot nitro-cellulose, where the most perfect results in embedding are to be obtained, has made the danger of explosion much more in evidence.

The heater in baths of this type is either directly exposed inside the bath or, if shut off from the main cavity, is surrounded by walls which naturally have apertures to allow the heat to make its way. In either case the conditions for an explosion are present, since the heated wires which produce the necessary temperature are red hot or even incandescent. At the writer's suggestion the makers of some of these baths have adopted the device more than a century old, which we owe to Sir Humphry Davy, namely, the enclosing of the incandescent heater with a wire gauze envelope. This is an advantageous arrangement in baths in which the heating unit is shut off from the main cavity by walls. In baths where the heater is exposed on the floor it is sufficient merely to lay a double thickness of moderately fine mesh wire gauze over the top of the heater. The writer has experimented with baths so safeguarded by pouring ether directly on the heater, and under these circumstances there was neither explosion nor flame produced.

Another desideratum in biological laboratories for microscopic use is a powerful light of the incandescent bulb type, which will be reasonably durable. The ribbon filament bulb has been extremely satisfactory so far as supplying powerful light is concerned for use with high power objectives and particularly with binocular microscopes, in which necessarily there is considerable loss of light. The great objection to the ribbon filament bulb has been its short and extremely uncertain life. The brevity of its usefulness is due apparently to two causes, namely, the fact that the contact at the base of the bulb is made of readily fusible solder which melts on account of the heavy current used and in that way brings about disturbances which shorten the life of the bulb. This difficulty has been obviated. Another difficulty is presented by the ribbon filament itself. This in the present type of lamp is two millimeters wide and rather thin. On account of its insufficient thickness it breaks down prematurely at the points where it is inserted into the leads. It is proposed to overcome this difficulty by using a filament 50 per cent. thicker and only a millimeter and a half wide. It is hoped that with these improvements the ribbon filament bulb, which is an extremely satisfactory source of light aside from its uncertainty of life, will become more reliable in the latter respect. These improvements have been brought about at the writer's suggestion through the cooperation of the General Electric Company, Incandescent Lamp Department, and the Bausch and Lomb Optical Company.

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ON VOLUMETERS FOR SOLID BODIES

A MUCH more satisfactory volumeter than those generally mentioned in literature is one which rests on the principle of a siphon, of which the extremity outside the liquid is below that in the liquid. An inverted funnel, of mouth diameter 2.5 to 3 cms, or more (B in Fig. 1) is connected to a rubber tube (c), which in turn is connected to a glass tap (D) outside the apparatus; the wide mouth (b) of the funnel serves to break the column sharply and without gurgling. By means of the glass tap, water is sucked up to fill the siphon completely to the tap (using the tongue as valve) and then it is closed and placed in a fixed position in a stand. When the water is at rest the tap is opened to the mark (d), and after the water stops running the body is inserted in the volumeter, water again sucked up as noted above, etc., carefully replacing the tap in the same position and opening the tap to the same mark.

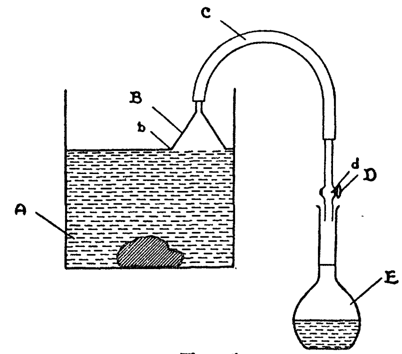

FIG. 1

By this means a volume of a liter or more, for which the apparatus is particularly recommended, may be measured to 0.1 per cent. in about 20 seconds, when the apparatus is ready for use.

Larger (or smaller) funnels may be used in the apparatus, but then greater care must be exercised to open the tap to exactly the same mark each time, for if the speed of flow of water is different after the body is inserted to before, a greater error in the volume of the body in question will result than with a funnel of the above dimensions.

In the case of larger funnels, if the speed of flow of water after the body is inserted is smaller than before it is inserted, the volume found will tend to be smaller than that of the body, and *vice versa, e.g.,* with a funnel of 14.5 cms diameter a change of speed from about 4,000 cc per minute before insertion of the body, to about 100 cc per minute after insertion gave a volume about 45 cc too low.

In the case of smaller funnels, on the other hand, (*e.g.,* one with a niche) the volume found will tend to be larger if the speed of flow is smaller after the body is inserted, and *vice versa, e.g.,* a change in the speed of flow from 1,500 cc per minute before, to about 100 cc per minute after insertion of the body gave a volume nearly 60 cc too high.

With a funnel of mouth diameter 2.7 cms a change of speed from about 1,500 cc per minute to about 100 cc per minute gave a volume not even 4 cc too high.

This remarkable reversal in the dependence on the