self with introducing a number of queries, in some cases suggestive of additional experiments, in others presenting hypotheses as to the nature of light and explanations of the phenomena discovered. Only a few of these queries appeared in the first edition, but their number was increased in the second edition to thirty-one. They are of great interest as showing Newton's mind when it turned to speculation. No one was more adverse to speculation in science than Newton. In the present book he reiterates the *hypotheses non fingo* of the Principia, and yet he could not keep himself entirely from hypotheses. Indeed it is difficult to see how progress can be made in such a science as optics without the help of hypothesis. Yet even in this hypothesis making, Newton's caution is evident.

He supposes that the emission of light results from the vibrations of the parts of the luminous body and that light is seen by vibrations excited in the retina of the eye. He suggests that different rays make vibrations of different bigness and that these excite colors, just as the vibrations in air make sounds of different pitch, and that the most refringent rays make the shortest vibrations. He suggests again that the rays when they fall on the refracting medium may excite waves which overtake the rays of light and thus make the alternate fits which observation discloses. By experiment he proves that heat may be transmitted through vacuum and therefore, he suggests, through a much subtiler medium than air. This medium he thinks is possibly rarer in bodies than it is outside them, and on the supposition that its density increases slightly as the distance from the body increases, he suggests that gravitation may be explained by possible pressures in this medium. He insists, however, that this medium must be of excessive rarity and that a dense medium in which waves could be transmitted, such as is suggested by Huygens, can be of no use for explaining the phenomena of nature and he goes on to say that "as it is of no use and hinders the operation of nature, and makes her languish, so there is no evidence for its existence and therefore it ought to be rejected. And if it be rejected, the hypotheses that light consists in pression or motion, propagated through such a medium, are rejected with it." Earlier in this query he rejects the wave theory on the ground that "if light consisted of pression or motion propagated either in an instant or in time, it would bend into the shadow." From the consideration of the phenomenon of polarized light as discussed by Huygens he concludes that "the rays of light have four sides or quarters, two of which opposite to one another incline the ray to be refracted after the unusual manner, . . . and the other two . . . do not incline it to be otherwise refracted than after the usual manner." This property he thinks is proof positive against a wave theory. In query 29, he presents his corpuscular theory of light. He points out that if the rays of light are very small bodies emitted from shining substances they will travel in straight lines and will be able to preserve their properties unchanged as they pass through various media. They may also be reflected and refracted according to the ordinary laws. To produce the various colors, he suggests that the rays of light may be bodies of different sizes and that they may be put into the fits of easy reflection and easy transmission by stirring up vibrations in the bodies on which they act "which vibrations being swifter than the rays overtake them successively, and agitate them so as by turns to increase and decrease their velocities, and thereby put them into those fits."

In the introduction Professor Whittaker has pointed out that these speculations of Newton present analogies to those which are prevalent at the present day in quantum theory and in wave mechanics. They are of great interest as showing how far an acute mind may go in the speculative interpretation of a body of phenomena without really committing itself to a definite conclusion. What Newton would have thought if he had been shown Young's demonstration of interference and Fresnel and Arago's work on polarized light we can not certainly determine, but it is an interesting subject for speculation.

The book is well printed. In two or three places the long "s" of the original has misled the typesetter into saying that certain intervals "found a common chord," but generally it is remarkably free from error. The publishers should be thanked for this timely issue of a very important book.

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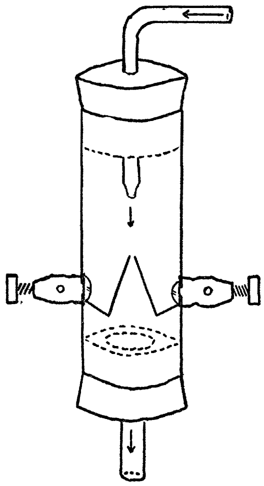
SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ELECTRICAL DROP COUNTER

WHILE making a study of physiological secretions, a drop flow record over an extended period of time was desired. Several different types of apparatus for this purpose were designed, but the one presented here was found to be efficient. Besides its use to record such fluids as urine, saliva, bile, pancreatic and other such secretions, it might be used wherever a record of drop flow is desired over an extended period of time, *e.g.*, slow titrations, evaporation experiments or condensation rates, etc.

A glass tube with inside diameter of about three



centimeters and about eight centimeters long was used. Two holes were blown opposite each other about six centimeters from one end of the tube. Through these holes were placed brass binding posts held in place by a screw from the inside. Small rubber washers were used to prevent breaking the tube on tightening these binding posts. Each screw head carries a length of platinum or non-corroding wire shaped as shown. These contact points are about one millimeter apart.

The top of the tube is stoppered with a rubber stopper carrying the inlet tube of glass, the tip of which is shaped to deliver drops on the contact points. The rubber stopper in the bottom of the tube carries a large bore glass tube funnelled to catch and drain the liquid.

In use the two binding posts are connected across one lead wire of a signal magnet. The writing point of this magnet inscribes a record on a slowly moving surface. If one desires to use this apparatus on such weak electrolytes as urine or tap water it is best to obtain small coil magnets from radio receivers and make special magnets for recording purposes. A voltage supply suitable for such an assembly is a twenty-two and a half volt radio dry cell, although we have found line voltages of ten and twelve as used in our laboratories of sufficient strength.

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PAPER APRON TO PREVENT CURLING OF MICROTOME SECTIONS

A VERY simple process, far more difficult to describe than to perform, of using a small wet paper on a paraffine or celloidin block will prevent curling.

A piece of wet tissue paper narrower than the knifeward edge of the block and longer, so it will overlap the side away from the blade, is placed on the paraffine or celloidin block. Capillarity will hold the paper in place. The paper should not overlap the knifeward edge or the blade will slide over all. The cut section with the paper will rest flat on the knife with the overlapped edge in such position that the paper, with section adhering, can be easily removed with forceps or scalpel and placed on a wet slide, where the section can be oriented, and the paper, with a backward bend of the overlapped edge, removed, leaving the section in place. With a little practice this will become easy. Though unruly sections are very infrequent it is desirable to leave a wider margin of paraffine on sections by not trimming block as close as usual. This gives an area where a needle or scalpel point can be inserted to wedge off the few unruly sections that do occur. I find it desirable on a Thoma Jung to flip the paper and section into my hand with the edge of a scalpel or pair of forceps, as the edge of section adheres to edge of knife.

This process works more easily with a sliding microtome than with a rotary, though it will work with either. Obviously, ribbons can not be cut in this manner, and the process is much slower, but sections, either paraffine or celloidin, are obtained uncurled. A sharp blade is just as necessary with this method. Using woody apple buds I have obtained excellent five micron sections and good three micron sections on a Thoma Jung.

I am indebted to Dr. E. J. Schreiner, research forester of the Oxford Paper Co., who told me that for unembedded wood he used wet slips of paper, one to each section, to prevent curling, and later floated off the paper. Because paraffine sections will not spread properly with the paper adhering, I find it necessary to remove paper before heating slide. Whether the process is new or not we do not know. Lee, "Vade Mecum," does not mention it, and we have never heard of its being used elsewhere.

Let me add that for sections that tear readily, not being well embedded, I can not recommend too highly the "collodionisation" method suggested in Lee, "Vade Mecum." Merely paint surface of block with very thin celloidin, allow a second or two to dry, place on wet paper and cut. Spread with heat as usual. After drying, before placing slide in xylol, I find it desirable to remove celloidin surface by first immersing a minute in ether-alcohol.

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