To consider in what way, if any, expenditure may be limited without crippling the educational and general usefulness of the institutions, and in particular, having regard to the financial condition of the country, whether it would be desirable to institute a more general system of admission fees.

Leaving out of account the convenient loophole in the vague word "crippling," there is still about that clause a strong suggestion of Balak, and in its interim report the commission plays Balaam, but a Balaam whose blessing is strongly in Balak's true interest.

Of the warmth of that blessing the report leaves no doubt. Our national collections can not be equaled, certainly can not be surpassed, by any collections in the world either in range or splendor. Their value in money, their value in national prestige, their value in education, is immense. And we have been treating these five talents very much as the man in the Parable treated his one talent. The tendency, says the report, has been too much to take the collections as a matter of course, without any adequate attempt to make the public aware of their outstanding quality. That such possessions, it continues, should be housed and exhibited with dignity (and, it might be added, in view of the state of things at the Natural History Museum, with facility of access) is of fundamental importance, and "in too many cases the cabinet is unworthy of its contents." We are, in fact, being guilty of one of the worst and stupidest kinds of waste—the neglect and misuse of our own property. We are letting our gates drop and our hedges go wild, our cigars get damp and the moth corrupt our curtains. To a very great extent private munificence has endowed us with these priceless possessions. We are not only failing to get the full benefit of these gifts; we are wasting the very money which, as taxpayers, we have contributed to the institutions that unworthily house them. And since "economy has already been pushed beyond the point of prudent administration," some of the defects are by now so glaring that the Royal Commission has been impelled to call immediate attention to the dangers and to formulate the least that can be done to remove them. The library of the British Museum must be enlarged. The Natural History Museum must have half a new building for entomology, half a new whale room and another extension. The National Portrait Gallery, which was full as soon as ever it was opened in 1896, must within two years have the first section of a long new wing. The conference room of the Science Museum must be completed. The Royal Scottish Museum needs certain alterations, and the National Library of Scotland, the famous old Advocates' Library, at present "chaotic and inadequate," must have its extension begun without delay.

All this is demanded in the names not only of art and of learning, but also of pounds, shillings and pence. Altogether the works would cost £779,000, spread over differing periods which range from fifteen years to two, the average annual expenditure being £52,000. That is "the irreducible minimum of works which ought to be set in hand immediately." It is also the most severely economic remedy which the commission could devise for arrears that have been accumulating for many years past, and especially since the war. It is less by £800,000 than the estimated cost of the larger schemes which were from time to time under consideration before the commission began its inquiry. That is an argument which will appeal to every one. The correspondence which was published in these columns last year was a clear reminder that there are still many people who resent every penny devoted to things of the mind; but even they can only evade the conclusions of the commission by denying the pecuniary value of the national collections, or by flying in the face of the common counsels of prudence in the management and preservation of property. The commercial value of works of art may be only measurable by national prestige and the number of visitors they bring to the country. That the commercial value of the collections and the research work at the Natural History Museum can be measured in simpler terms of human life and the products of the earth is known at any rate to the Empire Marketing Board, which lately gave the museum a large grant. And true instead of false economy is the main theme of the remarkable report which the commission has issued. The publication of the final report will be awaited with keen anticipation. It is sure to contain interesting and debatable matter, including, no doubt, some remarks upon that isolation and mutual independence of our institutions which has enabled and encouraged the treasury to discharge "with rigor" the task of denying them funds. The interim report, dealing only with matters that admit of no dispute, has a simpler purpose, of which it can hardly fail—the awakening of public opinion to the value of the nation's treasures and to the determination that parsimony and neglect shall no longer be allowed to depreciate them.—*The London Times*.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE MICRO-ABRASO-TOME

WHILE acting as assistant to Dr. Carl O. Dunbar, of Yale University, in his recent research on the Fusulinids, I became impressed with the great need for a more rapid and accurate method of making thin sections of fossils. The current method of grinding on a plate-glass lap is both slow and dangerous, as often facets are ground on the specimen so that when taken to thinness parts of it are lost by being ground away. Also it is extremely difficult to properly orientate the specimen. In addition the specimen is covered with sludge and has to be washed each time it is to be observed in the process of grinding to the desired plane or to thinness. It was with these difficulties in mind that I set to work to design a machine that would take the drudgery and uncertainness out of sectioning such forms as the Fusulinids, Nummulites, Bryozoa and similar fossils. The Micro-abraso-tome was the result.

This mechanism consists essentially of a motor-driven abrading wheel of very fine texture, above the periphery of which a specimen carrier is supported by a supporting table, hinged about an axis parallel to the axis of rotation of the wheel and adjustable with respect to it. Mounted on the supporting table is a microscope for observing the operation when taking the slide to thinness.

Fig. 1 shows the machine with the supporting table

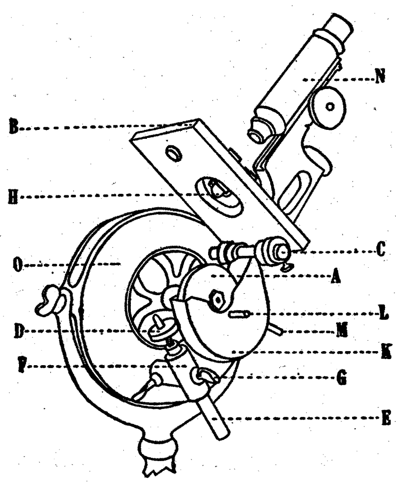

Fig. 1

raised, revealing the detail of the micrometer adjusting screw, abrading wheel and hinge axis. On the base rests the specimen carrier, with a specimen held in the jaws of the clamp. Fig. 2 shows the supporting table lowered to cutting position on the micrometer screw, the abrading wheel showing through the opening of the table. The specimen carrier has been removed. Fig. 3 shows the details of the specimen holder.

The abrading wheel (A) is motor driven and turns counter-clockwise. It is on the periphery of this wheel that the cutting is done. The supporting table (B) is hinged about the axis (C), which is parallel

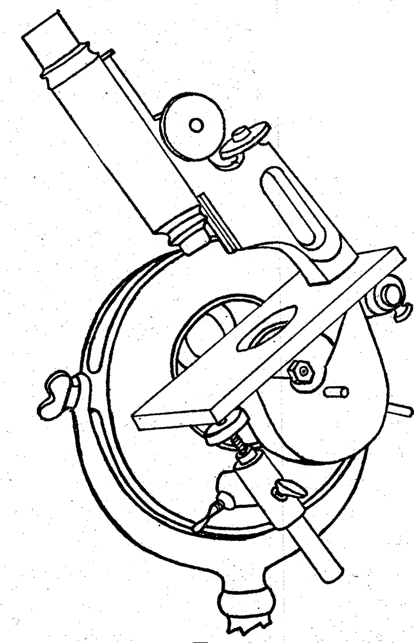

Fig. 2

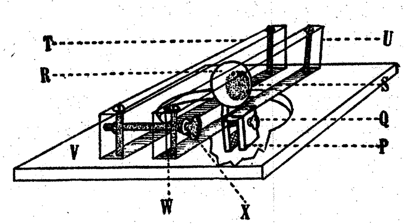

Fig. 3

to the axis of rotation of the wheel. This table is supported at the other end by the micrometer screw (D), which is inserted in the end of the rod (E). This rod has a sliding adjustment through the sleeve (F) and is clamped by the screw (G). This whole adjusting mechanism which supports the movable end of the table is for the purpose of adjusting the height of the table above the periphery of the wheel. In the center of this supporting table and directly above the periphery of the wheel is a round opening about two inches in diameter. It is in this opening that the specimen (H), held in the clamp of the specimen carrier, which in turn is supported by the plane upper surface of the table, is suspended. If the specimen has been ground to the desired plane and cemented on a slide, it is the slide that rests on the surface of the supporting table while the specimen projects down through the hole in the table as before. In either case the specimen is free to move in any direction, but only in one plane, namely, parallel to the top of the supporting table, which is at all times parallel to the axis of rotation of the abrading wheel. It will readily be seen then that drawing the specimen across the periphery of the wheel will result in grinding upon it a surface that will be a perfect plane. The depth of the cut is of course governed by the micrometer screw and the sliding rod (E).

The abrading wheel is housed in a case (K) in which is packed a sponge, in contact with which it runs. This sponge is kept moistened by a fine stream of water which enters through a hose at the inlet (L) and serves the double purpose of moistening the abrading wheel and cleaning off the sludge. The outlet (M) serves as an overflow pipe for removing surplus water and sludge.

The microscope (N) is mounted on the supporting table in such a manner that it focuses on the spot on the periphery of the wheel where the grinding is taking place. The motor (O) furnishes the motive power for the abrading wheel.

Fig. 3 shows the specimen holder, enlarged about four times with respect to the other figures. It consists of a specimen clamp P, with checkered jaws which are closed upon the specimen by set screw Q. The upper part of the clamp consists of a ball R which is fitted into two circular depressions (S) ground in the clamp bars T and U. The latter are fastened at either end to the base plate V, T being fixed in its position, while U is allowed to move slightly in a plane parallel to the base plate by means of the slot W. X is the clamp screw by means of which the ball R is clamped in the desired position.

In operation the process is simple. The specimen is placed in the jaws of the clamp of the specimen carrier, orientated and made fast. The specimen carrier is then placed with its plane lower surface upon the plane upper surface of the supporting table and the clamp, with the specimen in it, projecting down through the opening in the table. The table is then lowered by means of the sliding rod until the specimen comes in contact with the abrading wheel. It is then planed off and the lowering process continued by means of the micrometer screw until the desired plane is reached. If, however, after making a cut or two it is found that the preliminary orientation was not correct, the clamp is shifted in its universal joint until the desired position is reached and then made fast again, with respect to the specimen carrier. The specimen carrier is again placed on the supporting table and the process of grinding continued.

When the desired plane has been reached, the specimen is taken out of the clamp and cemented to a slide with Canada balsam, that has been cooked until it will shatter when crushed under a testing tool. The glass slide then assumes the rôle of specimen carrier, which it replaces at this stage, and the specimen is ground down from the other side in the same manner as before, except that now the process may be observed through the microscope as the grinding progresses. Thus one is enabled to observe the changing appearance of the slide as it becomes thinner, and to stop the process when the desired amount of detail is observed.

As will be apparent, one of the greatest advantages of this machine is the fact that it affords perfect control at all times. Once the specimen is orientated and clamped in the specimen carrier, this orientation is assured throughout the process, regardless of the number of times the specimen carrier is removed from the table for observation or other purposes. Through the micrometer screw the depth of each cut may be minutely regulated, thus enabling the operator to stop at any desired plane. As noted above, the microscope reveals the changing character of the specimen as it is ground thinner and thus enables the operator to stop at the most advantageous thickness.

Another advantage which is worthy of note is the fact that the surfaces of the specimen slice are parallel planes. This fact removes the danger of losing part of the specimen, when taking it to thinness, by grinding away one edge. And last, but by no means least, is the speed factor. While the time required to make a section of a fossil will vary with the character of the material to be sectioned and the experience of the operator, it will in most cases be found that only about one sixth as much time is required with this machine as with the older methods.

BROOKS F. ELLIS

WHITE PLAINS, N. Y.

SPECIAL ARTICLES

SERIES IN THE ARC SPECTRUM OF CHLORINE[1]

AT various times during the past five or six years wave-length measurements of the spectrum of chlorine have been made at the Bureau of Standards. This work has corroborated to a large extent previous investigations by others describing limited portions of the spectrum, and has extended our knowledge of the spectrum into the hitherto unexplored regions in the red and infra-red. These new wave-lengths, characteristic of the arc and spark spectra as emitted

[1] Publication approved by the Director of the Bureau of Standards, of the U. S. Department of Commerce.