used varied from one to several weeks. To obviate at least part of this difficulty I selected a heavy brass tube having an inside diameter of 1.5 cm. and a length of 120 cm. Into this tube directly opposite one another were threaded air tight small brass tubes having an internal diameter of 4 mm. an outside diameter 7 mm. and a length of 55 mm. This tube was supported at the center, between two rows of water cultures, by a ring-stand. This arrangement eliminated the breakage that often occurred with the glass T-tubes and by being fastened together in one piece it also eliminated 27 of the 45 rubber tubing connections, besides being more convenient in other ways as to neatness, compactness, etc. The Bunsen pump as I have it arranged and when working at full capacity will send through the above mentioned tubes 4 liters of air per minute overcoming at the same time the resistance offered by a column of water 20 cm. in depth. This would amount, if the pressure of the water mains remains constant, to 240 liters per hour or 5,760 liters per day when the pump continues to work at full capacity. As, however, only about one liter per hour was generally used, at this rate, about 240 separate cultures could be aerated simultaneously with this apparatus if properly arranged and adjusted. This will depend, as before mentioned, somewhat on the size of the glass tubes which conduct the air through solutions in the culture jars. If these tubes are very small or much constricted at the end so as to make small bubbles, which is desirable, so much back pressure will be generated in moving a large quantity of air that most of it will escape at the pump. In my experiments so far, however, only about seven to fifteen cultures have been aired at once and such a size of tubes used that the difficulty just mentioned did not occur.

A STUDY OF POLLEN II.

BY

F. M. Andrews.

Since the appearance of the first of these two accounts on investigations made on pollen of various kinds, further studies have been in progress in order to study some of the points there indicated on a greater number of plants. In the first paper which appeared in 1917 I had investigated 435 plants. Since that time I have extended my study of the pollen so that now I have investigated 508 plants. This list of phanerogams include plants of many and distantly related families all of which have been subjected to the same conditions in order to ascertain how their pollen would behave. All of the pollen of these plants, as in the first paper, have been put under favorable cultural conditions in cane sugar. This medium was supplied to them in solutions of different strengths from weak to strong. Of the 73 plants so investigated since my first account appeared in 1917, about the same proportion of plants showed a response as there indicated.

The pollen of one of the plants showed an unusually rapid response in the form of a very sudden rise in its hydrostatic pressure. That plant was Scabiosa atropurpurea which belongs to the Dipsaceae. Instantly almost, or before any measure of time could be made, when the pollen of this plant was placed in distilled water it instantly put out 4 tubes about the length of the diameter of the pollen grains. No further change took place no matter how long they were left undisturbed in distilled water. On the average 96 pollen grains in each 100 put out tubes suddenly in the way just described. For rapidity of response in this way the pollen of Scabrosa excells all other pollen thus far investigated. To be sure pollen grains will often burst in a short time when placed in distilled water and the contents, as is well known, will be forced out more or less rapidly but none of them do so with the almost instantaneous action of Scabiosa. Nor do they maintain a tube form characteristic of the usual germinating methods in pollen. This sudden endosmotic action shown by the pollen of Scabiosa is an illustration of how quickly a membrane may be permeable even if only a slight amount of liquid enters. No change in the wall of the pollen as a dissolution had taken place.

Andrews, F. M. Proceedings of the Indiana Academy of Science 1917, P. 163.

A WARMING NEEDLE FOR ARRANGING SPECIMENS IN PARAFFIN.

BY

F. M. ANDREWS.

The arranging of specimens in paraffin in the box of whatever kind used, must be done quickly and orderly before the cooling process begins. When the paraffin begins to chill in the box it becomes opaque due to air. At the same time when an ordinary needle is used that is not warmed to the same temperature or above the temperature of the paraffin in the embedding box the paraffin chills on the needle and accumulates on it with each attempt to such an extent that it must be cleaned continually or it is useless. This difficulty I have overcome by the use of what I have termed an electrical needle.

The needle itself consists of a No. 10 copper wire about 19 cm. long, a small silver wire would be better, and is tapered to a point at the end which is to touch the specimens to be arranged. The other end is fastened to the electric wires. Beginning at this end the copper needle is wound with No. 22 enamelled resistance wire to within 3 cm. of the point of the needle. This small wire is connected with the direct electric current and both the needle and enamelled resistance wire wrapped together with tape to a distance of 6.5 cm. from the point. This needle was connected to the current with four 100 watt electric lamps in arranged multiple series which gave the necessary amount of heat. I found by experiment that the needle arranged as described acquired within about one minute 52 to 55 C. which is sufficient to keep the paraffin melted. If a higher or a lower temperature than 52 C. was desired then lamps having a greater or a less resistance