the relation of the more important specimens to the development of the art. Where the history or authenticity of a certain instrument is of importance the evidence bearing on these points is furnished. No expense has been spared in bringing out the volume, for its preparation is stated to have cost over two thousand dollars.

But unfortunately the work leaves something to be desired. Generally the instruments were placed for photographing in position to show the whole to the best advantage, and especially any ornamental features. This procedure has two disadvantages; the figures being in photographic perspective, they are much distorted and can not be scaled; and while the general appearance of an instrument is well shown, the details that interest the student can rarely be made out. Views taken in different positions diminish somewhat this disadvantage, and the excellent plate XXVIII. of the clavichord action is a notable exception to the general criticism. A useful addition to the descriptions would have been statements of the vibrating lengths of strings, say for all the C's in the principal instruments, and the striking point; also the diameters of the wires where these appear to be the original ones. Almost any details of construction would be welcome, since they are not easily obtained by the student and yet are of great significance in the technical development of the piano. The few cuts of actions are very unsatisfactory; apparently the draftsman was not familiar with mechanism or mechanical drawing, so some of the figures are misleading or unintelligible.

This catalogue, however, in spite of any defects, is a very valuable addition to the small collection of books that illustrate the predecessors of the modern piano, and nothing else can fill its place. CHARLES K. WEAD.

SCIENTIFIC JOURNALS AND ARTICLES.

IN the *Botanical Gazette* for February Mr. Francis Darwin describes a method of studying the movements of stomata, which depends on the fact that when widely open the stomata permit more rapid evaporation than when closed, the leaves becoming correspondingly cooler. The differences of temperature are measured by a Callendar recorder, in which the difference between the temperatures of two fine platinum wires is recorded on the revolving drum. He describes the apparatus and the various tests that were made to discover the errors and limitations of the method.—G. M. Holferty has investigated the development of the archegonium of *Mnium* and reports that a two-celled apical cell is organized by the archegonium initial, that this later gives place to a three-sided one which is truncate, that this terminal cell gives rise to the first cell of the canal row and also contributes to the growth of the neck, that the terminal cell contributes to the growth of the axial row by the addition of cells cut from its truncate face, and that growth in length of the archegonium neck is intercalary as well as apical in both the neck and canal rows. Unusual conditions were found in which the canal series is double for a greater or less distance, in which the venter contains two eggs and two ventral canal cells, in which there was a double venter with two eggs, and one in which a mass of sperm mother cells was developing in the pedicel tissues of the archegonium. Conclusions are drawn that archegonia and antheridia are homologous structures throughout, and that they probably had a common origin from an isogamous gametangium, which in turn was derived from a multilocular sporangium.—Charles E. Lewis, in studies of certain anomalous dicotyledons (*Podophyllum, Jeffersonia* and *Caulophyllum*), finds small embryos surrounded by an abundant endosperm, and a cotyledonar primordium consisting of a broad ridge-like structure opening at one side, the ridge later bifurcating to form the two lobes known as the cotyledons.—F. A. Shriner and E. B. Copeland give definite data in reference to the relation between deforestation and creek flow about Monroe, Wisconsin. —Laetitia M. Snow publishes a preliminary notice of results in the investigation of the effects of external agents on the production of root hairs, showing that there is a relation between the production of root hairs and the elongation of the roots. The same causes which control growth determine the formation

of root hairs.—J. W. T. Duvel records the germination of seeds buried in soil at least three and a half years, the seedlings obtained being 128 in number and representing seven genera and nine species.—Conway MacMillan describes cumaphytism in *Alaria*, showing how strongly the *Alaria*-type of body may become modified by existence in the surf.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 579th meeting was held January 30, 1904.

Mr. O. H. Tittmann, superintendent of the Coast and Geodetic Survey, gave a brief account of the meeting of the International Geodetic Association during the past summer, at Copenhagen. The most important questions considered during the nine days' meeting were longitude, gravity on land and sea, and variation of latitude.

Mr. L. A. Fischer, of the Bureau of Standards, read a paper on 'The International Bureau of Weights and Measures,' which was established in accordance with an agreement signed by seventeen of the principal nations of the world, including the United States, at Paris, in 1875. A description was given of the laboratory and other buildings, situated on neutral territory in the Park of St. Cloud, at Sèvres, near Paris. An account of the principal work of the bureau was given. This included the comparison of the various national prototypes of the kilogram and meter with one another and with the international kilogram and meter, at present deposited in an underground vault at the International Bureau. The investigation of nickel-steel alloys, the determination of the volume of the kilogram of water, and the establishment of the present standard hydrogen temperature scale were also mentioned. The paper closed with a brief account of the recent comparison of the U. S. Prototype Meter No. 27 with the two standards of the International Bureau. Only preliminary results of this comparison were given, the final results being deferred until further comparisons have been made between No. 27 and the two other copies of the International Meter in possession of the Bureau of Standards.

Mr. James Page, of the Hydrographic Office, then presented the modern view of 'ocean currents.'

Two independent circulations are involved in the movement of the waters of the sea: (1) The vertical, sustained by differences of temperature; (2) the horizontal, having its source in the energy supplied by the wind. The phenomena ordinarily described as ocean currents belong wholly to the latter. These currents have their origin in the impulse given the layer of water immediately at the surface by the wind. This impulse, by virtue of internal friction, is communicated downward, but with extreme slowness; the rate of propagation being expressed by the formula

$$\sqrt{t} = 1736 \cdot x \cdot \frac{v_0}{n}$$

in which v_0 is the velocity at the surface, and t the interval (in seconds) required to communicate a velocity v_0/n to a layer at a depth of x meters. Immediately at and near the surface the currents will thus be quite as variable as the winds themselves. The truth of this was shown by a comparison of the observed frequency of winds from the several quadrants with the observed frequency of currents towards the opposite quadrants for various portions of the sea. For the area in the North Atlantic Ocean bounded by the parallels 40°–45° N., and the meridians 30°–35° W. the percentages were as follows:

Winds....N. E. 16, S. E. 20, S. W. 36, N. W. 28.
Currents.. S. W. 20, N. W. 18, N. E. 31, S. E. 31.

At some little distance below the surface these irregularities disappear, in consequence of the sluggishness with which the impulse given by the wind is transmitted downward. Here the changes of the wind, as they occur from day to day, are no longer felt; and the waters probably move in a fixed direction and with a constant velocity, namely, that which the above formula would give them if there prevailed continuously at the surface a wind having the force and direction of the resultant of the actual winds.

At the 580th meeting, held February 13,