Griscom was extremely exhausted; but on the fortieth, after he had been refreshed by a rather long excursion on the lake, the corpuscles returned to a normal condition, except as regards size. This improvement was not lost during the remainder of the fast, though the abnormal appearance to some extent returned.

In the joint section of Geography and Geology are some interesting papers—one, the substance of an evening lecture, describes the Grand Cañon of the Colorado River, and shows that the denudation, of which it is a consequence, commenced in Middle Eocene, and has been continued to the present time, the greater part however having been accomplished by the end of the Miocene. During the whole period there has been a vertical uplift of from 16,000 to 19,000 feet, and a removal of a total thickness of rock equal to about 10,000 feet.

Another interesting paper connected with physiography is by Mr. J. W. Spencer, "Notes on the Origin of the Great Lakes of North America," together with one by Mr. W. Claypole, on "Evidence from the Drift of Ohio, Indiana, and Illinois, in support of the Preglacial Origin of the Basins of Lakes Erie and Ontario." The authors discuss the physiography and geology of the districts in which these lakes are situated, and show the most probable theory of their origin to be that they are fluviatile valleys of preglacial age, which during glacial times were obstructed by the accumulation of drift. This, aided by submergence owing to change of level, has produced the lakes in their present form. These papers are well worth the study of some English geologists, to whom no work seems too small or too great for a glacier, and whose faith at one time seemed quite equal to gulping down Lake Superior itself, sooner than falter in supporting a fascinating theory.

We would venture in conclusion to suggest to the American Association one improvement in detail: this is to imitate the British, and give their volume a cloth binding instead of sending it forth merely stitched in a paper cover, so loosely as to tumble to pieces after a few days' use.

T. G. BONNEY

PRINGSHEIM'S BOTANICAL YEAR-BOOKS

Jahrbücher für wissenschaftliche Botanik. Herausgegeben von Dr. N. Pringsheim. Vol. XII. Part 4, and Vol. XIII. Part 3. (Leipzig: W. Engelmann, 1881 and 1882.)

THE two parts now before us include six papers dealing with anatomical and physiological subjects, illustrated by 13 plates, some of them of great beauty. In the concluding part of vol. xii. there are papers by Westermaier, Ambronn, and Zimmermann; while in the third part of vol. xiii. the editor, Dr. Pringsheim, contributes a long controversial paper, and there are two papers—a long one by Godlewski, and a short one by Tschirch.

Westermaier's paper is on the "Intensity of Growth of the Apical Cell and of the Youngest Segments." From an examination of figures of Dictyota, Hypoglossum, Metzgeria, Salvinia, Equisetum, and Selaginella, as given by Naegeli, Goebel, Pringsheim, Cramer, Rees, and Pfeffer, Westermaier concludes that the maximum of the increase in volume in the apical region occurs in general either in the apical cell itself or in the youngest segments,

and that taking the region which includes the apical cell itself and the four youngest segments, in none of the plants examined was the increase in volume of the apical cell found to be the minimum for the region. The results are represented graphically and afford very instructive curves.

A paper on the "Development and Mechanical Properties of Collenchyma, a Contribution to the Knowledge of the Mechanical System of Tissues," is contributed by Dr. Ambronn, and is illustrated by six plates of microscopical sections. The Collenchyma with the prosenchymatous fibres of the wood and bast form the mechanical system of Schwendener and Haberland. When the mechanical elements form separate plates, or bundles, or individual isolated cells, the cells are known as *Stereides*, and the whole tissue as *Stereome*. When on the other hand the mechanical cells are united with others which are non-mechanical, as in wood and bast bundles, then Schwendener has distinguished them as *Mestome*. The investigation of the structure of a number of plants shows that the Collenchyma may be arranged in bundles or in the form of a ring, and that in both the arrangement of Collenchyma and Mestome may follow a uniform plan, or the arrangement of the Collenchyma may be quite independent of the Mestome. Ambronn confirms the statement of Haberland that Collenchyma does not originate from any special morphological series of cells, but has the most variable origin: and further confirms the statement of Schwendener that the grouping and arranging of the cells depends entirely upon mechanical and not upon morphological causes. In *Fœniculum vulgare* the bast and Collenchyma of the external bundles are connected together and lie in the same radii, while in *Clematis vitalba* the bast and Collenchyma lie in the same radii but are not connected. In *Philodendron eximium* the Collenchyma forms a ring and is connected with the separate peripheral fibro-vascular bundles, both developing from a zone of secondary meristem. In *Peperomia latifolia* a ring of Collenchyma is formed, but it is independent of the bast. These plants afford examples of the four great types of structure. The Collenchyma cells are always prosenchymatous, often two millimetres in length, or even longer, and they frequently contain secondary partitions, being chambered by numerous fine transverse walls. They always contain fluid very rarely with any chlorophyll. The walls when viewed in a longitudinal section present elongated slit-like pores. Other collenchymatous cells are more parenchymatous in character, and originate by secondary collenchymatous thickening of parenchymatous cells. The wall always colours blue with Schultz's iodochloride of zinc, but is not coloured by the combined action of phoroglucin and hydrochloric acid, Wiesner's exceedingly delicate test for lignin, which is coloured a fine and intense rose-red by the reagents. Collenchyma swells up but little in water, contrary to the usual opinion, and only contracts about $\frac{1}{2}$ per cent. when deprived of water. Collenchyma may originate from Cambium, from Meristem, or from Parenchyma, but the origin is found to be unimportant. The strength of collenchymatous cells is very little inferior to that of bast fibres, which have been shown by Schwendener to equal that of wrought iron wire.

The last paper is by Albrecht Zimmermann, "On the

Mechanism of the Scattering of Seeds and Fruits, with Special Reference to Torsion." The paper deals with the torsion in the awn of grasses, such as *Avena sterilis* and *Stipa pennata*, torsion of the legume of *Orobus* and *Caragana*, the curving and torsion of the awn or beak of the fruits of *Geraniaceæ*, and the scattering of the seeds of *Oxalis*, and is illustrated by three plates. The author points out the relation of the different phenomena observed to the mechanical cells in the part, as demonstrated by a microscopical examination of the different structures. Sometimes the cells of the part contract, at other times they swell up, and one or other or a combination of both these causes, gives rise to the effects noticed in the different plants under examination. Thus swelling of the cell-walls causes the remarkable ejection of the seeds of *Oxalis*. Unequal contraction of the mechanical cells causes the movements in the beaks of *Geraniaceæ*, and combined contraction and swelling in different layers of cells may be observed in the awns of *Stipa* and *Avena*.

In the second part under consideration, namely, vol. xiii. part 3, there is a paper by E. Godlewski, with the title "Contributions to the Knowledge of Vegetable Respiration." The details of a large number of experiments are given which were made, with an ingeniously contrived and simple apparatus, upon the respiration of germinating seeds with both fatty and starchy endosperm, and a smaller series of experiments made on the respiration of the flower buds of *Papaver somniferum* and on the ripening fruits with oily seeds of the same poppy and the castor oil plant. Some of the more important results as set forth by Godlewski himself may here be alluded to. During the early stage of germination in which the seeds swell up by imbibing water, the volume of CO_2 given off equals or is only a little less than the volume of oxygen taken up, both in fatty and in starchy seeds. When the swelling takes place under water or when air is excluded, *intramolecular* respiration takes place. When air is admitted the intramolecular respiration does not immediately cease, but is gradually replaced by normal respiration. As the rootlets of the seedlings are developed the volume of carbonic acid gas evolved gradually diminishes in proportion to the quantity of oxygen taken up, so that at the period of most active respiration only from 55–65 volumes of CO_2 are given off for every 100 volumes of O taken up. The formation of transitory starch during the germination of fatty seeds probably depends upon the action of atmospheric oxygen in each molecule of fat, converting it into CO_2 , water, a certain quantity of an undetermined substance, and three molecules of starch. In the later stages of germination of fatty seeds the transitory starch is used as well as the fat, so that the difference between the volume of CO_2 given off and O taken up became gradually smaller, until at last the volumes are equal.

In the germination of starchy seeds the volume of CO_2 given off in all stages nearly equals that of O taken up, in peas sometimes a little more or a little less, but in wheat maintaining a seemingly constant relation of 1 to 1.05, the CO_2 being a little in excess of the O taken up.

In the buds of *Papaver somniferum* the CO_2 given off practically equals the O taken up (100.9 CO_2 for every 100 vols. O). In ripening fruits with oily seeds more

CO_2 is given off than O absorbed; in *Papaver somniferum* 150 CO_2 for every 100 vols. of oxygen.

When oxygen is supplied under diminished pressure, respiration is variously influenced in different parts of the plant, but respiration is more affected in fatty than in starchy seeds. When the pressure of the oxygen is very slight *normal* respiration is reduced to a minimum, and *intramolecular* respiration commences. Intramolecular respiration is, under normal conditions, not a primary phenomenon as Pfeffer and Wortmann assert. *Normal* respiration consists in the immediate action of atmospheric oxygen upon the molecules of living protoplasm. Intramolecular respiration only begins when the normal respiration is rendered difficult by the want of atmospheric oxygen. Under ordinary conditions intramolecular respiration only begins when processes of reduction are going on in the plant as when fat is formed from carbohydrates.

The concluding paper in this part is "Contributions to the Anatomy and Mechanism of the Rolling up of the Leaves of certain Grasses," by Dr. A. Tschirch, with three plates. In this paper the author fully describes the mechanism by which such grasses as *Macrochloa tenacissima* (Esparto), *Lygeum spartum*, *Aristida pungens*, and others, which he groups as Steppe grasses, roll up their leaves in dry weather to protect the upper surface which bears the stomata, and prevent too great evaporation.

The first paper in the part and the longest is by the editor, Dr. N. Pringsheim, himself, "On the Function of Chlorophyll and the Action of Light in the Plant." This paper is a controversial one, issued in the form of an open letter to the Philosophical Faculty of the University of Würzburg. The first part of the paper includes a "personal defence," in which the statements contained in a paper by Dr. A. Hansen, with the title "History of Assimilation and the Function of Chlorophyll," published separately as a "Habilitationsschrift," and also reprinted in Sachs' "Arbeiten," vol. ii. p. 557, are minutely criticised. The second part of the paper is an historical discussion of the theory of assimilation, of the function of chlorophyll, and of the action of light on the plant. In this part Pringsheim does not seem to bring forward any new experiments, but gives a careful *résumé* of the whole subject under three heads. These are (1) Problem of the primary action of light on the cell; (2) the function of the colouring matter of chlorophyll in the exchange of gases in the plant; and (3) the function of the chlorophyll bodies and the primary product of assimilation of carbon. Into the merits of the controversy we cannot enter.

W. R. McNAB

OUR BOOK SHELF

Mexico To-day. By Thomas Unett Brocklehurst.
(London: Murray, 1883.)

DURING a recent tour round the world Mr. Brocklehurst turned from the beaten track in the United States southwards to Mexico, where he spent seven profitable months in the capital and neighbourhood in the year 1881. Since the suspension of our diplomatic relations with that country in 1860, great difficulties have been felt in procuring accurate information regarding its internal rela-