and after the roots had attained a length of three or four centimeters he inoculated them with a needle which had been inserted into a tubercle of alfalfa, and placed two of the young plants in a culture jar, which contained a nutrient solution free from combined nitrogen. The peas grew regularly so long as they found nourishment in the cotyledons. Then a period of nitrogen starvation set in, after which the plants recuperated and grew to maturity with the production of fruit. The period of vegetation extended from April 2 to June 10. At the latter date the roots contained numerous tubercles. The stalks and roots were separated, dried at 110° C. and weighed. The nitrogen of both portions was determined, as was also the weight and nitrogen of two seeds similar to those used in the culture experiments. The following table gives the results:

	Dry Matter, Grams.	Nitrogen, Per Cent.	Nitrogen, Total.
Stalks	3.785	2.35	0.089
Roots	1.165	2.60	0.030
Total	4.95		0.119
Seeds	0.502	3.60	0.018
Gain	4.448		0.101

The table shows that the plants contained ten times as much organic matter and six and six tenths times as much nitrogen as the seeds from which they were derived; also that the percentage of nitrogen of the roots was greater than that of the aerial portion. Now when it is considered that, in this experiment, there was no nitrogen compound of any kind present, except the infinitesimal quantity introduced by puncturing the roots with the needle, and that in two small plants there was a gain of 101 milligrams of combined nitrogen, the claim for the assimilation of free nitrogen must be regarded as established.

The order of leguminous plants, therefore, occupies a unique position in the art of agriculture. The experimental evidence herein submitted shows conclusively why leguminous crops have for ages been recognized as being of special value in maintaining soil fertility, and the discussion of this subject points to the fact that, in many walks and practices of life, empiricism has been in advance of science.

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SCIENTIFIC BOOKS.

Glacial Formations and Drainage Features of the Erie and Ohio Basins. By FRANK LEVERETT. U. S. Geol. Survey, Monograph XLI. Washington. 1902. Pp. 802; 26 pl. (maps, sections and views from photographs), and 8 figures in the text. $1.75.

Ohio is the central area described in this report, and it also includes parts of each of the adjoining states and of the Canadian province of Ontario. The great importance and interest of the glacial history of this region, early studied by Whittlesey, Newberry, Orton, Gilbert and N. H. Winchell, and later by Spencer, I. C. White, Wright, Claypole, Chamberlin, F. B. Taylor and many others, is indicated by about five hundred papers cited in a bibliography of twenty pages.

Mr. Leverett enumerates eleven epochs or stages of the glacial period, as follows: (1) The oldest recognized glaciation, called the sub-Aftonian by Chamberlin, perhaps the same as the Albertan of Dawson; (2) the Aftonian interval of recession of the ice sheet; (3) the Kansan stage of glacial readvance; (4) the second or Yarmouth interval of recession; (5) the Illinoian readvance; (6) the third or Sangamon recession; (7) the Iowan readvance, with the principal time of deposition of the loess; (8) the fourth or Peorian recession; (9) the early Wisconsin stage of readvance, with the formation of four successive systems of marginal moraines during the early part of the ensuing recession; (10) the fifth interval of glacial retreat,

with important changes in the outlines and relations of the ice lobes; and (11) the late Wisconsin stage of mainly continued retreat, with ten substages of halt or slight readvance, marked by a series of that number of marginal moraines and changes of the glacial lakes that finally occupied the Erie and Ontario basins. The chief part of the region is covered by the Late Wisconsin drift and its moraines, which in eastern Ohio extend to the boundary of the glacial drift.

Chapter III., filling a sixth part of the volume, treats of the drainage systems, noting in much detail the evidences of great modifications of the preglacial water courses. It is shown that before the ice age probably the upper and middle parts of the present Allegheny River were separately tributary to the stream then flowing along the present bed of Lake Erie; that the lower Allegheny and the Monongahela, with the upper Ohio River in Pennsylvania, flowed also north to the old River Erie by the valley of the Grand River; and that many other changes from the ancient courses of drainage also took place during the glacial period along the Ohio River, thence down to Cincinnati, where the ice sheet at its stage of farthest advance reached across that valley into the edge of Kentucky.

Descriptions of the various drift formations, and especially of the moraines, occupy the greater part of this monograph, which is the second of a series giving the results of Mr. Leverett's extensive field work. The first was published three years ago, entitled 'The Illinois Glacial Lobe,' and he has another in preparation, to treat similarly of the glacial and lacustrine geology of Michigan. His elaborate studies of the ice age in this region of the great Laurentian lakes, abounding with very instructive records of the oscillations and wavering departure of the continental ice sheet, and comprising at last a complex history of many small and large ice-dammed lakes, should be of much value as a basis of text-books for the schools and colleges of these states.

As soon as the recession of the ice sheet caused it to be a barrier on the northeastwardly sloping Erie basin, the water impounded there spread out as a lake, with outlet past Fort Wayne to the Wabash River. Its earliest stage is named Lake Maumee; a later stage, when a lower outlet was uncovered by the glacial retreat, past Ubly, in Michigan, is called Lake Whittlesey; and the still later and most extended stage of this body of water, reaching then into the Huron basin and outflowing, as Lake Whittlesey had done, to Lake Chicago in the southern part of the basin of Lake Michigan, retains the name Lake Warren, which was proposed by Spencer. The shores of these glacial lakes, marked by beach ridges of gravel and sand, have been traced from Fort Wayne east through Ohio, along the Erie shore of Pennsylvania, and to the Finger Lakes and beyond in central New York, where Fairchild has identified the routes of later eastern discharge by which Lake Warren was finally drawn away to the Mohawk and Hudson, being succeeded by the glacial lakes Algonquin and Iroquois in the Huron and Ontario basins.

While the ice sheet was melting away, the land on which it had lain was uplifted from a depression, so that the shore lines of the glacial lakes now have, along great portions of their extent, an ascent to the north and northeast, varying from a few inches per mile to a foot or more, and in some districts, notably east of Lake Ontario, even as much as five feet per mile. At the end of the Iowan stage of glacial advance, the deposition of loess in the Missouri and Mississippi valleys, and of a closely analogous silt formation in the Ohio valley, as described in this report, gives evidence of a depression of these regions probably several hundred feet below their present height. Before the accumulation of the moraines in the Wisconsin stages of general glacial recession, the greater part of the Mississippi and Ohio basins, and the southern part of the basins of lakes Michigan and Erie, had been reelevated to nearly the same altitude that they have since maintained with only slight changes. But after the moraines were formed, and during the existence of the great glacial lakes on the northern borders of the United States, much of their areas yet remained depressed, as is known by the in-

clination of the originally level shores of these lakes.

The latest completed geologic period, when an ice sheet covered the northern half of our continent, is being very satisfactorily investigated, both in the United States and Canada. As in an earlier monograph of this series, on the glacial Lake Agassiz, it will be an advantage to the geological surveys of each country that these detailed explorations about the Great Lakes be extended to give such full description and discussion of the ancient larger lake areas, with their shore lines and relations to the waning ice sheet, on both sides of the international boundary.

WARREN UPHAM.

SCIENTIFIC JOURNALS AND ARTICLES.

Bird Lore for November–December contains articles 'On Journal Keeping,' by Ernest Thompson Seton; 'Flamingoes' Nests,' illustrated, by Frank M. Chapman; 'The Weapons of Birds,' by F. A. Lucas; and 'Whiskey John in Colorado,' by E. R. Warren. The seventh paper on 'How to Name the Birds' is devoted to the Sylviidæ and Turdidæ and the first paper on 'How to Study Birds' are both by Frank M. Chapman. There is the first of a series of portraits of *Bird Lore's* advisory councilors depicting Messrs. William Dutcher, T. Gilbert Pearson, Lynds Jones and C. W. Nelson, and the usual notes, reviews and reports of societies.

The Museums Journal of Great Britain for November has an article on museum matters presented at the Belfast meeting of the British Association, and description of a dust-proof air inlet for museum cases, a feature entirely too much neglected in the construction of cases. F. A. Bather discusses 'Names on the Labels in Public Galleries,' in which he touches on the difficulties of providing so-called common names for objects and intimates that scientific names are much more generally understood than is often supposed. This article should be widely read. There is an interesting series of notes concerning museums in various parts of the world.

THE *American Museum Journal* for December gives a summarized account of the proceedings of the Thirteenth International Congress of Americanists, a review of the recent work of the museum, and a list of the December lectures. The number contains the index for Volume II.

The Plant World for October contains 'Extracts from the Note Book of a Naturalist on the Island of Guam,' by W. E. Safford; 'A Study of the Island Flora of the Mississippi River near Sabula, Iowa,' by T. J. and M. F. L. Fitzpatrick, and the second article on the 'Origin of Plant Names,' by Grace S. Niles. Among the shorter articles are the official announcements of the Wild Flower Preservation Society.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 558th regular meeting was held November 22, 1902.

Dr. H. Carrington Bolton presented a paper on 'Science and Art under Rudolph II., 1570–1612,' narrating many of his experiences with the astrologers and charlatans that he patronized so liberally, and pointing out the important results that followed his support of Tycho Brahe and Kepler.

Dr. A. F. A. King read 'Further Remarks on Sunlight, Malaria and Scoto-therapy,' in which he reviewed his former paper (see SCIENCE, December 27, 1901, p. 1007), and in support of the blue fluorescence of quinine being its curative property, cited the facts that *esculin* and *fraxin* were also fluorescent and curative like quinine. The curative power of iodine was due to its producing the *violet* iodide of starch in the stomach.

Dr. King recommended blue- or violet-colored clothing for armies in malarious regions, and purple tents instead of the white canvas now used. He suggested several experiments in scoto-therapy—keeping some patients in the dark or in rooms with purple or indigo window glass, and exposing others, nude, to brilliant sunshine—which were inexpensive and easily accomplished, and which, he hoped, those having opportunities would try, in order