briefly the results obtained with dried cotton cultures in competition with pure cultures on agar obtained from Hiltner of Munich, by the Board of Agriculture of Great Britain. This test was conducted by thirteen different agricultural colleges and experiment stations during the year 1905. The general plan of the experiment was as follows:

1. Laboratory experiments with sterilized soil and sand.

2. Pot cultures in unsterilized soils from various sources.

3. Experiments in accord with actual agricultural or horticultural practise.

The results of these experiments are published in detail, and to any one examining them it can not but be evident that the contention that the nodule-forming bacteria properly dried upon cotton will not live is entirely erroneous. In spite of the fact that the cotton cultures were in some instances a year old and had undoubtedly been subjected to various unfavorable conditions, there was no advantage whatever in the Hiltner fresh pure culture over the dried cotton culture. The conclusion reached by the board speaks for itself:

The experiments in which positive results were obtained show that in many cases both Moore's and Hiltner's cultures were alive, and capable of infecting the plants for which they were designed and producing an increased yield.

Concerning the statement that no United States experiment station has been able to obtain 'good results' from dried cotton cultures it would seem that in view of the results obtained either by experiment stations, or under government supervision, in Great Britain, Australia, New Zealand, South Africa, China and other foreign countries—to say nothing of the unquestionable ability of those reporting success in this country—that the 'psychological' explanation should be applied to the experiment station reports rather than to those obtained from successful users of dried cotton cultures. Furthermore, an analysis of the reports from those experiment stations which I have had an opportunity to examine does not reveal the worthlessness of the cultures which it seems so desirable to demonstrate, and finally it is not an impossibility that under the circumstances the experiment station may not be the final court of appeal in such a matter, after all. One would hardly expect 'any well-marked result' from a culture which, after being prepared, was carefully kept upon ice until ready for use—a method actually employed at one of the experiment stations.

The question of the vitality of nodule-forming bacteria in dried cotton cultures is one that can not be settled by an attempt to explain away the actual results which can be and have been obtained from their use. The incompatibility of these results with the idea that the bacteria are killed by drying is admitted, but it is not the results which will have to fall. I shall be glad to send dried cotton cultures to any one who may wish to arrive at an independent conclusion regarding the ability of the nodule-forming bacteria to withstand drying. These cultures may be retained any length of time up to twelve months before testing, so there will be no question about the period during which vitality is retained. The inoculated cotton will have been dried in a room through which a current of air has been forced, not in a Petri dish.

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July 28, 1906.

SPECIAL ARTICLES.

GEOLOGY OF SOUTH BRAZIL.

[THE following note from Dr. I. C. White, chief of the Brazilian Coal Commission, should have appeared in connection with the communication of Professor Osborn on 'Vertebrate Paleontology,' published in the issue of SCIENCE of August 3, but was received too late for insertion in that issue.]

Mesosaurus Brasiliensis occurs in the Iraty black shale, state of Paraná, a formation whose base lies about 100 meters above the Brazilian Coal Measures which hold the typical Glossopteris flora of the Ecca series of South Africa, and the Karharbari series of India. It is

also the same horizon at which Dr. Derby finds *Stereosternum tumidum* in the state of São Paulo, and its geological horizon is approximately 300 meters below the *red beds* that hold reptilian remains (*Scaphonyx fischeri*) which Dr. A. Smith Woodward of the British Museum regards as closely related to *Euskelesaurus* of the Stormberg, or Triassic beds of South Africa. In fact, it appears that we have in Brazil a series of rocks which correlate closely with the Karroo system of South Africa, and that glacial conditions also existed in Brazil immediately preceding the deposition of the Coal Measures there, during the epoch of the Orleans Conglomerate which corresponds to the 'Dwyka,' and 'Talchir' conglomerates of Africa and India. The following scheme of classification, which I have adopted for the beds near Minas, Santa Catharina, will give a general idea of the stratigraphic succession in that state.

Santa Catharina System:	São Bento Series:	Serra Geral eruptives. Botucatú sandstones, great cliffs of red, gray and cream-colored sandstones. Rio do Rasto red beds, with fossil reptiles (*Scaphonyx*) and fossil trees.
	Passa Dois Series:	Rocinha limestone. Estrada Nova gray and variegated shales with cherty concretions, and sandy beds. Iraty black shale, *Mesosaurus* and *Stereosternum*.
	Tubarão Series:	Palermo shales. Rio Bonito shales and sandstones, with Coal Measures and *Glossopteris* (*Gangamopteris*) flora. Orleans conglomerate. Yellow sandstones and shales to granite floor.

The Tubarão and Passa Dois series would correlate with the Ecca series, or Lower Karroo, of South Africa, while the São Bento beds would represent the Stormberg, or Upper Karroo series. The fossils of the Beaufort or Middle Karroo series have not yet been discovered in South Brazil.

Mr. David White, of the United States Geological Survey, to whom was entrusted the study and description of the fossil plants collected from the rocks of the Santa Catharina system by the Brazilian Coal Commission, finds the typical *Glossopteris* flora in the collections from the Tubarão and Passa Dois series, and assigns both to the Permian. This conclusion is shared by the writer except that he thinks it possible the Coal Measures or Rio Bonito beds of the series given above may be of Permo-Carboniferous or Artinskian age, while all above them to the base of the São Bento series would be true Permian, and this would of course include the *Mesosaurus* zone. The very interesting and elaborate memoir of Mr. David White, illustrated with ten plates of fossil plants, will be published, along with Dr. J. H. McGregor's valuable memoir on *Mesosaurus brasiliensis*, in my final report to the Brazilian government on its coal resources. The name 'Gangamopteris flora' is preferred to that of 'Glossopteris flora' by Mr. David White for reasons that he fully explains in connection with his description of this interesting flora.

The following quotation from Mr. David White's manuscript, giving the list of species, will prove of much interest:

> That the flora of the Brazilian coal measures is composed of mingled older Gondwana and Northern Permian species has long been known. The presence of Gondwana elements in Brazil was recognized by Hettner; and Zeiller has contributed a very valuable discussion of the intermingling of Northern and Southern types, and of the consequent deductions as to the boundaries of the two great floral provinces in Permo-Carboniferous time. In the following pages it will be shown that we have in southern Brazil a typical Lower Gondwana flora, embracing the principal types characteristic of that flora in India, Australia and South Africa, to which is added a smaller part, chiefly composed of Lepidophytes, derived more or less directly from the Northern Permo-Carboniferous flora. Also

it will be seen that the Gondwana forms were present in the lowest sediments of the series, while the Northern elements, appearing a little later, seem to become more abundant and varied in the higher beds.

The total flora, so far as yet discovered, is in the following

LIST OF THE FOSSIL PLANTS FROM THE COAL-FIELDS OF BRAZIL.

Reinschia australis Bert. & Ben., var. *brasiliensis* n. var.
Rosellinites Gangamopteridis n. sp.
Hysterites brasiliensis n. sp.
Equisetites calamitinoides n. sp.
Schizoneura? sp.
Phyllotheca Griesbachi Zeill.
Phyllotheca Muelleriana n. sp.
Phyllotheca (*?*) sp.
Lycopodiopsis Derbyi Re.
Lepidodendron Pedroanum (Carr.) Zeill.
Lepidophloios laricinus Sternb.
Sigillaria Brardii Brongn.
Sigillaria australis n. sp.
Sigillaria sp.
Sigillaria (*?*) *muralis* n. sp.
Sphenopteris hastata McCoy?
Sphenopteris sp.
Psaronius brasiliensis Brongn. (Not represented in the collection.)
Neuropteridium Plantianum (Carr.) D. W. (Not represented in the collection.)
Glossopteris Browniana Brongn.
Glossopteris indica (Brongn.) Schimp.
Glossopteris ampla Dana.
Glossopteris occidentalis n. sp.
Glossopteris sp.
Vertebraria sp.
Gangamopteris obovata (Carr.) D. W.
Ottokaria ovalis n. sp.
Arberia minasica n. g., n. sp.
Derbyella aurita n. g., n. sp.
Nœggerathiopsis Hislopi (Bunb.) Feist.
Cardiocarpon Seixasi n. sp.
Cardiocarpon Moreiranum n. sp.
Cardiocarpon Oliveiranum n. sp.
Cardiocarpon Barcellosum n. sp.
Voltzia? sp.
Dadoxylon Pedroi Zeill.
Dadoxylon nummularium n. sp.
Dadoxylon meridionale n. sp.
Carpolithus? sp.
Hastimima Whitei n. g., n. sp.

Although the number of forms, forty in all, is not large, it will at once be noted that it embraces representatives of the four dominant and characteristic groups of the older Gondwana flora; namely, *Phyllotheca*, *Glossopteris*, *Gangamopteris* and *Nœggerathiopsis*, all of which are present in identical oriental species.

I. C. WHITE.

MORGANTOWN, W. VA.,
August 1, 1906.

THE FOREST DISTRICTS OF UGANDA.

A journey of inspection through the most important forest areas of the Uganda protectorate has lately been made by Mr. M. T. Dawe, officer in charge of the forestry and scientific department, who gives the results of his observations in a parliamentary paper, according to the abstract in *The Geographical Journal*. The largest forests (as shown in a sketch-map accompanying the report) lie along two strips of country, one running near the west and northwest shores of the Victoria Nyanza, the other following a more or less parallel line through the extreme west of the protectorate. Mr. Dawe describes each forest in turn, and though his point of view is mainly economic, many details of scientific interest can be gleaned from the report. A discovery was that of the Lagos silk rubber tree (*Funtumia elastica*) as an indigenous element, while several new species of *Landolphia*, some of economic importance, were also brought to light. Of the first forests visited, that of Bujeju in Buddu occupies a low-lying tract near the lake, some parts of which seem once to have formed part of the latter. The forest seems comparatively new, and to be gradually encroaching on the interior plains. It contains no good rubber-vines, though they are found in adjoining areas. One of the trees found in this district, though not of large size, is a variety of the valuable *Podocarpus milanjianus*, which occurs practically on the lake-shore. Of the western forests, that of western Ankole occupies a large area east of Lake Albert Edward. It is largely composed of three trees—*Carapa grandiflora; Symphonia globulifera* and *Parinarium excelsum*. Mr. Dawe remarks that almost every forest in Uganda possesses its own special character,