cluding the Hydocharideæ. Under the Glumifloræ the grasses (Gramineæ) are described as having a solitary carpel, which is certainly an error for the three-styled genera, and probably so for those with two styles. Hackel's arrangement is followed. Curiously, in the sedges (Cyperaceæ) the carpels are described as 'three or two.' How these two views as to the nature of the pistil can be harmonized is difficult to make out.

The palms and aroids (Principes and Spathifloræ of Engler) are united into the 'series' Spadicifloræ. A curious typographical error occurs on page 250 (and is repeated on page 256) where the number of species of palms is given as 11,000! The treatment of the remaining groups (Farinosæ, Liliifloræ, Scitamineæ and Microspermæ) is in all essentials in accordance with that in Engler's 'Syllabus.'

The final chapter is devoted to a general review and to suggestions of affinities between the groups. This has not been well wrought out, and the student will be much confused by some of the statements. For example, while we are told that 'the Glumifloræ represent a primitive type,' and 'we may regard them as the stock from which the higher series have been derived,' we are told over and over again that the grasses are highly specialized. The diagram at the close of the chapter, while helpful in enabling us to understand the author's position, will scarcely help the student to an understanding of nature. According to it there are three monocotyledonous phyla, viz., (1) Helobieæ, (2) Pandanales, Spadicifloræ, (3) Glumifloræ, Farinosæ, Liliifloræ, Scitamineæ, Microspermæ.

Throughout the book, 'order' of Engler is given as 'series,' and 'family' as 'order,' in deference to time-honored English usage. Here again we prefer the German practise.

The book will be useful, and while it has defects, it is the result of much painstaking work, and must prove helpful to other workers.

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Discussion and Correspondence.

Currents of the North Pacific.

To the Editor of Science: I read with interest Dr. Bishop's letter on the source of the Pacific Coast current, and the hypothesis he proposes to account for it, in Science, of September 9.

The writer, like many others who have touched on ocean currents, does not make clear the distinction between the general system of oceanic circulation and ocean currents strictly so called.

The former is influenced by the rotation of the earth, differences of specific gravity and temperature in the oceanic mass, tides, the pressure of the atmosphere and various minor causes. The movement of Antarctic water northward in the Pacific belongs in this category, and we have no observations on record which would lead us to believe that the movement is other than very slow and gradual, or that it has any marked effect in producing the superficial streams of rapidly moving water which we call currents.

Oceanic currents are produced by the winds, by atmospheric pressure, and by the tides, modified by the presence of bodies of land. Permanent currents are due almost wholly to friction of permanent currents of air like the trade winds.

Dr. Bishop is quite right in supposing that the Kuro Siwo, like the Gulf Stream, does not extend across the ocean in which it originates. Nevertheless, the water of both, but especially of the Gulf Stream, has been traced thousands of miles beyond the point where the stream, *as a current,* has disappeared. It has been carried by the prevalent winds aided by the oceanic circulation.

The most complete collection of data for the North Pacific together with a discussion and chart may be found by Dr. Bishop in the report of the U. S. Coast Survey for 1880, Appendix No. 16, published in 1882, and to which little in the way of current data for the North Pacific has since been added.

The northwest trades, blowing hard and steadily for ten months in the year, carry the warm water, which the Kuro Siwo delivers in mid-ocean, to the northwest coast, which it

reaches about latitude 54° and there divides into a northerly and southerly stream. At this point the maximum temperature of the water is 68° F., but the average about 60° F. As it moves down the coast it loses its heat and produces the rains and fogs of the Oregonian region, cooling off so that when it reaches the latitude of the Golden Gate it has only the temperature of 54°, or thereabouts, and is colder than the normal sea water for that latitude. It continues southward as a cold current as described by Dr. Bishop. That this essentially superficial stream is not due directly to the impinging of cold Antarctic water on the northwest coast seems to be certain from the fact that the temperature of the latter is only 32° F., while the current, when it first reaches the coast, is thirty degrees or more warmer than that; and also that the water of the current is *warmer* in latitude 54° than it is in the more southern part of its course, whereas, if it was abyssal water we should expect it to be colder and to gradually warm up as it moved southward exposed to the action of the sun.

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September 12, 1904.

SPECIAL ARTICLES.

ON THE PUPATION OF ANTS AND THE FEASIBILITY OF ESTABLISHING THE GUATEMALAN KELEP OR COTTON-WEEVIL ANT IN THE UNITED STATES.

IN a recent number of SCIENCE Dr. O. F. Cook publishes some of Mr. G. P. Goll's observations on the cocoon-formation of the kelep ant (*Ectatomma tuberculatum* Oliv.), apparently in the belief that similar observations have not been made on ants with enclosed pupæ. As a matter of fact, it has been known for some time that such ants bury their mature larvæ in the soil till they spin their cocoons and then, after some hours or days, unearth them and cleanse the outer surface of their envelopes. This habit has been repeatedly described for European species of *Formica*, especially by Wasmann.* It is, of course, a necessary habit, as pointed out by Dr. Cook, since the larva must have some support for the threads spun from its sericteries. In default of earth, as when ants (species of Camponotinæ or Ponerinæ) are kept in glass nests of the Fielde pattern, the workers tear off bits of sponge or toweling to spread over the larvæ as a support for the cocoon. If such materials can not be obtained, or if the larvæ are much disturbed while spinning, they will form free pupæ. I have seen this repeatedly in the case of mixed colonies of our American amazons (*Polyergus breviceps, P. bicolor* and *P. lucidus*) and their slaves, and in *Odontomachus clarus* and *Pachycondyla harpax* (a species allied to the kelep ant). The habit has been emphasized by Wasmann because it is of importance in his discovery of the interesting relations of *Formica* to the parasitic beetles *Lomechusa* and *Atemeles:*

> Both *Lomechusa* and *Atemeles* larvæ are assisted in their pupation by their hosts, exactly as are the ant larvæ. The adopted larva is placed on some soft sand, and while it moves the anterior portion of the body slowly to and fro, it is surrounded with a ring of earth, which is soon built over it like an arched roof. Within this the adopted larva spins a very fine web which merely keeps the surrounding sand particles together.
>
> This is the critical moment in the development of the *Atemeles* and *Lomechusa*. The ants are in the habit after a few days of unearthing their own larvæ which spin a dense, tough cocoon, in order to cleanse and stack up the cocoons. They attempt the same with the adopted larvæ, unfortunately, since they are thereby prevented from pupating and perish, if they are not again buried and left to themselves. Only such adopted larvæ develop, as are forgotten by the ants after they have been embedded. For this reason I obtained only one imago from thirty *Lomechusa* larvæ and not a single one from more than fifty *Atemeles* larvæ.

In this connection it is perhaps timely to call attention to the fact that C. Janet* some years ago emphasized the bearing of the presence and absence of the cocoon in ants on the

* See, *e. g.*, his 'Vergleichende Studien über Ameisen- und Termitengäste,' Haag, 1890, p. 95 *et al.*, up to his recent article: 'Zur Kontroverse über die psychischen Fähigkeiten der Ameisen,' *Natur und Schule*, Bd. 3, 1904.

* 'Les Fourmis,' *Soc. Zool. de France*, Conf. 28, Fév. 1896, Paris, 1896, pp. 3, 4.