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PRELIMINARY REPORT ON PTERERGATES IN POGONOMYRMEX CALIFORNICUS

By Harlow Shapley
Mount Wilson Observatory, Pasadena, California

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The phylogeny of castes among social insects has a recognized importance in the question of development of organic forms through continuous or saltatory variation. For the Formicidae the castes are already well established in the early Tertiary,[1] among the first fossil records of these insects, although in the primitive ancestral wasps neither the social habit nor the polymorphism of the female appears. Differentiation into soldier, worker, and fertile forms is also a long-standing condition with the termites, probably dating from the Cretaceous.

In discussing the origin of castes among ants, Wheeler has considered the bearing of the subapterous and apterous females (particularly in the genus *Monomorium*) on the problem of variation through mutation.[1] He concludes that although the sterile worker-females are now almost universally wingless, we should not believe that this micronotal wingless condition arose through mutants. Rather "this view of the castes, at least so far as their origin is concerned, cannot be maintained, because all the available evidence points to their being merely the surviving extremes of graduated and continuous series of forms, the annectant members of which have suffered phylogenetic suppression or extinction." For the termites Thompson and Snyder find few intermediate types, but trace a gradation of characteristics throughout the series of five castes (workers, soldiers, and three fertile forms), and find a further argument against mutational origins in the fact that the different castes are essentially constant both in occurrence and in structure.[2]

It is of interest, in connection with these views on the phylogenetic development of polymorphism, to find in typical worker ants some ontological evidence of early stages in the origin of castes—to find, in particular, that the embryonic vestiges of wings, discovered in workers of *Formica* by Dewitz,[3] do not invariably disappear with the passing of larval and

pupal stages, but occasionally persist to the adult state. Wheeler described four adult workers of this kind in 1905, naming them pterergates,[4] but such forms are apparently very uncommon. As far as I know, only six were on record before 1919. Since then, in addition to the ants discussed in the present note, Professor Wheeler has kindly sent me one pterergate taken in Nova Scotia, I have found one, taken by Blaisdell, in the collection of the California Academy of Sciences, and one in a nest of *Pogonomyrmex* in Pasadena.

The record of species and localities for these nine pterergates is as follows:[5]

Pogonomyrmex californicus subsp., taken by Blaisdell, 1885, Powai, California.
Cryptocerus aztecus, taken by Wheeler, 1900, Cuernavaca, Mexico.
Myrmica scabrinodis var. (3), taken by Wheeler, 1904, Bronxville, New York.
Lasius flavus, taken by Bondroit, 1910, Landelies, Belgium.
Leptothorax curvispinosus, 1911, Weymouth, Nova Scotia.
Myrmica scabrinodis, taken by Keys, 1913, Yelverton, England.
Pogonomyrmex californicus, taken by Shapley, 1920, Pasadena, California.

All of the above, except *Lasius*, are Myrmicine ants.

From a local nest of the red Californian Harvester, *Pogonomyrmex californicus* Buckley, I have taken during the last two years more than 1700 workers, nearly one-half of which have vestigial wings in various stages of development. A summary of observations on this unique nest is given in the following paragraphs. An analysis of the development of the wing venation is reserved for later publication.

TABLE I

NUMBERS AND RELATIVE FREQUENCY OF PTERERGATES

GROUP	DATE	PTERERGATES	NORMAL WORKERS	PERCENTAGE PTERERGATES
a	Prior to Nov. 11, 1919	13	11	54
b	Nov. 11, 1919, to June 1, 1920	89	87	51
c	June 6, 1920	266	324	45
d	June 8, 1920	56	100	36
e	Oct. 15, 1920	49	51	49
f	Oct. 19, 1920	87	159	35
g	Oct. 19, 1920	8	16	33
h	Oct. 24, 1920	172	249	41
	TOTAL	740	997	42.6

1. The occurrence during 1919 and the early months of 1920 of equal numbers of pterergates and normal workers suggested that Mendelian factors might be involved in the appearance of wing vestiges. The pterergates became relatively much less frequent, however, in June, 1920 (table 1), suggesting that the tendency to develop vestiges was less pronounced or entirely absent for the 1920 brood; but on October 15 the per-

centage of affected forms appears temporarily re-established, notwithstanding that 320 of the normal ants had been returned to the nest after the June collections. Among the ants taken October 18 and 24 were a number of callows with well-developed vestigial wings; this also indicates that the tendency to produce pterergates still exists.

2. There is no obvious external reason why this particular nest should show such frequent reversion to a remotely ancestral condition of the worker ant. The intermittent war with Argentine ants (*Iridomyrmex humilis Mayr*), which is apparently destined to end in the elimination of most of the native ants in the California valleys, is no more severe for the nest of pterergates than for many other nests of *Pogonomyrmex*. This nest, however, has access to very little wild barley and similar grasses, a common food of the species; on the other hand, it is exceptionally well provisioned with mixed grains from a nearby feed store whenever the Argentine ants permit the nest to be opened for normal harvesting activities.

3. A small colony of the same species, less than ten feet distant from the nest containing pterergates, yields workers indistinguishable from the normal ants of the affected nest, but no pterergates; in fact, an examination of several thousand individuals from some fifty other colonies of this species within a radius of two miles has shown only the one pterergate listed above.

4. In all details of thoracic structure—size, sculpture, pilosity—the pterergates are identical with normal ergates of this and neighboring nests. In excavating and guarding the nest, and in harvesting, the pterergates and the normal workers participate equally. Hence these abnormal ants are certainly workers rather than modified fertile forms, such as pseudogynes, microgynes, and β-females.

5. The seventeen young queens and two males, taken from the nest in June, 1920, appear to be normal in every way when compared with queens and males from other nests of the same species.

6. Grouping the pterergates roughly in order of the development of vestiges, we have the following enumeration:

With minute veinless wing-sacs, or with stubs of broken wings	385
With sacs from 0.5 to 1.0 mm. long and indistinct veining	219
With transparent, clearly veined winglets from 0.8 to 1.5 mm. long	132

The gradation of wing vestiges is, however, perfectly continuous, from small protuberances (without appendages) on the mesothoracic segment to the most developed winglets, with venation approaching that of the wing (6 mm. in length) of the mature queen. This continuity in structure may be significant for the problem of variation and the origin of castes.

7. Four ants from the affected nest have vestiges of both posterior and anterior wings—a phenomenon not heretofore recorded, as only anterior wings are represented in all other pterergates.

[1] Wheeler, W. M., These PROCEEDINGS, **3**, 1917 (109–117).
[2] Thompson, C. B., and Snyder, T. E., *Biol. Bull., Woods Hole, Mass.*, **36**, 1919 (115–132).
[3] Dewitz, *Zs. wiss. Zoöl., Leipzig*, **30**, 1878 (78–105).
[4] Wheeler, W. M., *Bull. Amer. Mus. Nat. Hist., New York*, **21**, 1905 (405–408).
[5] Shapley, H., *Psyche, Boston*, **27**, 1920 (72–74).

HYDROGEN ION CONCENTRATION OF THE CONTENTS OF THE SMALL INTESTINE

BY J. F. McCLENDON

DEPARTMENT OF PHYSIOLOGICAL CHEMISTRY, UNIVERSITY OF MINNESOTA MEDICAL SCHOOL

Communicated by W. A. Noyes, October 8, 1920

The contents of the small intestine were removed by swallowing a tube 7 feet long so far down that the outer end was at the teeth and there were no loops or coiled portions in the stomach. The tube was of smooth rubber, 1.5 mm. internal diameter and 3.5 mm. external diameter, and hence stiff enough to keep from collapsing. A 6-gram iron sinker was attached to the lower end to assist in the introduction of the tube. The swallowing movements of the oesophagus acting on this sinker pulled the tube down. When the tube reached the pylorus, the subject reclined on his right side with hips elevated so that the sinker would pass through the pyloric sphincter. This passage was accomplished more easily on an empty stomach, in fact, in one subject who swallowed the tube after a meal, passage of the pylorus was not accomplished until about 4 hours had elapsed and repeated trials did not lessen the time required. On an empty stomach, passage was accomplished immediately in two subjects, as demonstrated by the fact that a darkly bile-stained fluid flowed out of the tube. Bile may be regurgitated into the stomach, but is then diluted with gastric juice and saliva. The tubes were kept down in two subjects for 5 days and 4 nights. The subjects ate their meals regularly, went to lectures, went swimming, automobile riding, slept soundly, and, in fact, the only inconvenience experienced was consciousness of the presence of the tube in the throat owing to its stiffness. To alleviate this annoyance they ate ice cream and bananas during the afternoon. The withdrawal of the tube with sinker attached caused no inconvenience. It required the tube about 5 days to descend to its full length and it was examined each day with the fluoroscope by Dr. F. S. Bissell, the antimony in the rubber casting a distinct shadow.

The tube was kept clean by forcing distilled water down it when not in use. Samples of intestinal contents could be obtained only when digested food was coming down from the stomach. At other times hardly a drop of fluid could be obtained. The H ion concentration of the individual