in bibliographic work, but also in all cases where there is no clear advantage in favor of the more cumbersome system, might have the support of quantitative data I have chosen ten well-educated, and in most cases scientifically trained individuals, and determined for each the time necessary for the writing of the Roman and the Arabic numerals from 1 to 100 and the number of errors made, also the time necessary for the reading of the Roman and the Arabic numerals from 1 to 100 when they were irregularly arranged so that the reader did not know what order to expect. In all cases the number of errors made unconsciously was recorded. These measurements furnish the following startling averages: *It takes three and one third times as long to write the Roman numerals from 1 to 100 as the Arabic, and the chance of error is twenty-one times as great; it takes three times as long to read the Roman numerals from 1 to 100 as the Arabic, and the chance of error is eight times as great.*

In case of a quick and accurate mathematician, whose familiarity with the Roman system surpassed that of most of the individuals tested, the results were: time for writing Arabics, 107″, errors, 0; time for writing Romans, 357″, errors, 5; time for reading Arabics, 62″, errors, 2; time for reading Romans, 131″, errors, 5. For one well-trained scientist, who has cause to use the Roman system almost every day, the number of errors in the rapid reading of the Romans was 15!

These figures certainly indicate the desirability of using the Arabic system wherever there is no urgent need for the simultaneous use of two or more systems of numerals. Even if there were no saving of time and strain by the avoidance of the cumbersome Roman symbols, the far greater accuracy gained by the use of the Arabic system should at once settle the matter for all scientists.

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[The best usage in bibliographic work is to use heavy-faced Arabic type for the volume number. The number should be underlined in the manuscript with a waving line, and it will then be set in heavy-faced or block type by the printers. This usage we think originated in American botanical publications. The volume number in heavy-faced type is followed by a colon and then the page numbers are given in ordinary type. The date or year then follows after a period, though we should suppose that a comma would be better. The International Catalogue of Scientific Literature has adopted the heavy-faced type for the volume number; this is followed by a comma and the year, the page numbers being then given in parentheses after another comma. We think that the American usage is the better and should be pleased if our contributors would follow it. The pages of the International Catalogue are disfigured by hundreds of thousands of needless parentheses and periods.—Ed.]

SPECIAL ARTICLES.

PUPATION OF THE KELEP ANT.

The larvæ of ants share with those of butterflies and moths the habit of spinning cocoons in which their transformation to the adult form takes place, though not all the ants make cocoons. Lubbock states that 'as a general rule, the species which have not a sting spin a cocoon, while those which have are naked,' the implication being, apparently, that less protection is required by species having stings with which to defend themselves. It would seem, however, that the absence of the cocoon rather than its presence is to be looked upon as the adaptive character. The keeping of the insects from drying out during the inactive period of transformation is probably a more important general function of cocoons than that of protection against enemies, but the moist underground chambers and compact social organization of the ants have rendered cocoons unnecessary, and in many genera they have been dispensed with.

The family Ponerida to which the kelep*

* The kelep has been identified by Dr. Ashmead and Mr. Pergande as *Ectatomma tuberculatum* Oliv., a species widely distributed in tropical America, including Mexico, and hence the more likely to become established in Texas. It does not follow, however, that the instinct of attacking the boll-weevil is possessed in an equal degree by

belongs is a primitive group, and breaks Lubbock's rule by retaining both stings and cocoons. Its method of pupation is, therefore, of special interest, and has been recently observed at Victoria, Texas, by Mr. G. P. Goll, whose summarized report reads as follows:

August 1. 5 P.M. Another larva is ready to pupate and two keleps are industriously attending it. One seems to be cleaning the larva, while the other is depositing earth around its head.

7:30 P.M. Six ants are now covering two larvæ with earth, while the latter are continually squirming about and disturbing the earth thus piled over them.

10 P.M. One larva is completely covered and the other almost so.

11:25 P.M. Two ants are removing the earth from the first larva covered, showing that it has spun a cocoon. The other larva is completely covered, and third is being worked upon.

11:35 P.M. The first cocoon has been taken to another chamber and the particles of earth are being removed.

10:10 next morning. The third larva which was being covered at 11:30 last night has finished its cocoon, and has been carried away. This is the fourth larva that has pupated since 4 P.M. yesterday, in eighteen hours.

From these and other observations the following facts and inferences have been reached:

The larva is entirely covered with earth when ready to pupate.

This earth is necessary as a basis for the cocoon.

The squirming and apparent objection on the part of the larva is an instinctive action to keep the earth from being packed too close around it, and thus not give it room enough to spin.

Time required to cover larva with earth, about six hours.

Time required for the larva to spin its cocoon so as to permit removing to another chamber, one and one half hours.

The color of the cocoons changes with age from a light gray to a pale reddish brown.

Although the matter seems not to have been considered by Lubbock and other investigators of ants, it is easy to understand that, as Mr. Goll says, the earth or some other material is necessary to furnish support for the cocoon. The naked larvæ lying about on the level floors of the chambers would have no means of supporting their silk in the air, nothing against which to spin. The majority of the lepidoptera and other insects go into the ground to pupate, with or without cocoons. Those which spin cocoons above ground generally wrap themselves up in leaves or seek crevices, corners or forks of branches, across which their outer network of threads can be fastened. It seems probable, therefore, that this curious habit of building earth cells for the pupating larvæ is no recently acquired instinct peculiar to the present species or its immediate relatives. The problem is as old as the social organization and nest-building habit of the ants, and the usual variety of solutions may be looked for among the many cocoon-making species.

The extensive labor involved in helping the young ants to pupate makes it easy to understand why so many members of the group have discontinued the process. The time used in making the earth cell is in some instances much greater than that reported by Mr. Goll. One of our larvæ was surrounded by a row of pellets of earth for over twelve hours, and, though lying quite still, was continually attended by three or four worker ants, waiting, as it were, for the final emergency. The use of earth in pupation constitutes a further reason why the earth and stone nests built into glass jar cages,* like those in which the ants were brought from Guatemala, afforded a better method of handling and observing them than the horizontal glass plates or plaster-of-Paris cells hitherto generally employed by

all the members of the species; otherwise this habit could scarcely have remained so long unknown. The occurrence of the kelep in Mexico is rendered somewhat doubtful, moreover, by the fact that the Mexican *Ectatomma ferrugineum* Norton, which Forel treats as a synonym of *E. tuberculatum*, may prove to be a distinct species. The National Museum has specimens from Mexico which agree well with Norton's description and figures, but offer appreciable differences from the keleps. The habits reported by Norton for his *E. ferrugineum* are also not those of the Guatemalan ants. "This species is found only in the *encinales*, or oak forests of the hot and temperate region, where it lives in little societies under the trunks of fallen trees."

* 'Habits of the Kelep or Guatemalan Cotton Boll Weevil Ant' Bull. 49, Bureau of Entomology, U. S. Dept. Agriculture, p. 6, Washington, 1904.

entomologists. In addition to much greater facility in capturing, transporting, feeding and keeping them moist, the ants are placed under much more natural conditions and may be expected to show more normal behavior.

O. F. Cook.

Washington, D. C.,
August 17, 1904.

IMPORTANCE OF ISOLATED REARINGS FROM CULICID LARVÆ.

The fact that four, five or more species of larvæ occur in association in the same pool, renders it difficult to separate the various species, especially as living larvæ resemble each other very closely. Particular attention has been paid to this phase of the subject during the present season with very gratifying results, as may be seen from the following:

A larva somewhat resembling and associated with *Culex impiger* presents marked differences in that the dorsal surface of the air tube is provided with a double row of hairs, each row consisting of about four tufts composed of a pair of weakly barbuled hairs. This is undoubtedly the larva which Messrs. Dyar and Knab* have confused with that of *Culex impiger*. From this larva a large, brownish-gray mosquito 6 to 7 mm. long, with the curved scales of the head white, was obtained. This species has been given the name of *Culex cinereoborealis* n. sp.

A larva somewhat resembling that of *C. impiger* was met with in a cold mountain pool at Elizabethtown, N. Y., June 9, adults emerging on the tenth and closely resembling those of *C. impiger*. The larva may be easily recognized by the conspicuous, triangular comb composed of about sixty rather large scales, each tipped with from four to seven stout, equal spines. The air tube is short, a little over twice as long as broad, slightly swollen at the basal third and bearing a double row of posterior pecten, each consisting of about twenty short, black, stout spines. The adult, *Culex lazarensis* n. sp., may be distinguished from *C. impiger* by its large size, it being 6 to 7 mm. long, and the vittate thorax with two dark lines. The wing of the female *C. lazarensis* is longer, the second longitudinal vein, particularly at its fork, is straighter, and the second fork cell is shorter and broader than in *C. impiger*. There are also marked differences in the male genitalia.

Another very interesting larva was met with June 14 in a cold mountain pool at Elizabethtown, N. Y., and may be easily recognized by the comb consisting of but six to seven thorn-like scales arranged in a curved line, with a large, finely setose, spatulate base and with a stout, apical spine. The air tube is about three times as long as wide, tapering regularly and with double posterior pecten on the basal third, each row consisting of twelve to fifteen closely set, stout spines, each bearing near the basal third one large and usually a smaller tooth. This larva produced an adult, *Culex abserratus* n. sp., which resembles *C. impiger* very closely and may be separated therefrom by the posterior cross vein being its own length or more from the mid cross vein, the thorax spotless, basal abdominal bands distinct, and the petiole of the first submarginal cell one half the length of the cell.

A long-tubed larva with a comb consisting of about eighteen triangular, stout, spined scales arranged in two or more rows, some of the scales having a very stout, terminal spine with smaller ones along each side, while others have the tips somewhat rounded and the spines more nearly of a size, was taken in a woodland pool at Karner, on May 10, adults emerging on the sixteenth. The air tube is fully five times as long as its greatest diameter, tapering somewhat regularly and with a slight bend and contraction near the middle. There are two rows of pecten, each consisting of about twenty-two closely-set teeth bearing at their bases usually two larger and three or four fine serrations. This species, *Culex fitchii* n. sp., is close to *Culex squamiger* Coq., and may be separated therefrom by the scales of the pleura being white and the posterior cross vein its own length from the one above. The basal segments of the antennæ are clothed interiorly with broad white scales; proboscis dark-brown, long; palpi dark brown, segments narrowly ringed at the base with white; occiput clothed with brown scales, with a row of silvery ones just above the eyes and

* *Ent. Soc. Wash. Proc.*, **6**: 144, 1904.