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1946a 1946b

Reprint from Bulletin of the Southern California Academy of Sciences
Vol. XLV, September-December, 1946, Part 3

FOSSIL ARTHROPODS OF CALIFORNIA

10. EXPLORING THE MINUTE WORLD OF THE CALIFORNIA ASPHALT DEPOSITS

By W. Dwight Pierce

The larger mammals and birds, whose bones have been found in the Rancho La Brea asphalt deposits at Hancock Park, Los Angeles, are well known, and have become a vital part of the early story of this region. But, strange to say, with the exception of the passerine birds reported by A. H. Miller in 1929 and 1932, and the rodents and rabbits reported by Lee R. Dice in 1925, no one has critically studied the small life of the pits. Some plants, a few insects, a toad, and other small animals have been reported incidentally. The same may be said of the asphalt deposits of McKittrick and Carpinteria. Many people have thought that the story of the deposits was a closed book, but, in reality, it was less than half the story, and a new chapter is opening as the microfauna and microflora are studied.

In the early days of the Rancho La Brea explorations a few large beetles were found in the marginal diggings and were listed. All, however, were species still existent. A few years ago, Miss Jane Everest began a more detailed analysis of the asphaltum and isolated many insect remains from pits A, B, and Bliss 29, and other scattered excavations. These will be reported upon in the present series, group by group.

About 30 years ago, the entire solidified bone and asphaltum mass exposed in Pit 81 was boxed and brought to the Los Angeles County Museum. This deposit was located less than 5 feet from the surface of the ground, and measured in all only 4 by 5 feet in girth and 4 feet in depth. Bones of sloth, bison, horse, camel, saber-tooth cat, and wolf, examined in the course of the excavation, indicate the Pleistocene age of the accumulation. Within the last year this bone-laden block of asphaltum has been unboxed and prepared for exhibition. In the course of preparation it was necessary to chip away certain portions of the matrix to insert reinforcements. The material thus removed consisted of clumps of asphaltum, some bearing obvious fossil fragments, but some appearing to the naked eye to be unfossiliferous. Several boxes of this material were turned over to the writer for study by Mr. Eugène J. Fischer, osteologist, and preparator in the Department of Paleontology.

Later a considerable quantity of small material was handed to the writer from Pit A. These two lots of material were treated in the same manner, which was at the time a distinct advance over previous methods. We will consider this as Process No. 1.

In October 1945, the writer visited the tar field 16 miles north of Taft in Kern County, and ¾ mile south of McKittrick. The asphalt has vitrified into a very hard surface layer, but at the upper end of the great field, a few hundred yards from where the University of California excavations were made, a new road had been cut through, giving a direct straight road to McKittrick. A portion of the tarry bank had split, recently, making a clean exposure of the tar, and in this were layer after layer of insect remains, with a few small bones and considerable plant material. About 42 pounds of this material were bagged and examined. The final treatment was by a new and greatly improved technique, which we will call Process No. 2.

Process No. 1 used on material from pits 81 and A was as follows: The asphalt clumps were first soaked in jars of kerosene for preliminary softening and separation. After a week in the jars, the softened contents were poured into trays which progressed in series. The oldest tray was repeatedly washed in benzene, or benzole, and the washings were poured over tray after tray. This continued washing with benzene finally removed most of the tar, leaving only the sands and biological material. The remaining tarry liquid was strained through a double thickness of cheese cloth to catch any floating particles, and was then filtered through Johns-Manville Celite, and could be used again for softening new lots of asphaltum. The solid material was allowed to dry and became the color of brown earth. The process to this point took two or three weeks for any particular bit of material.

The dry earth was passed through several sieves to divide it into convenient sizes for examination. In the coarser material, excluded by an 8-mesh screen, were larger bones, teeth, stems, etc., all easily sorted out. The 14-mesh screen excluded material which had to be sorted with a low-power lens. In this were many bones and teeth of small birds, mammals, lizards, snakes, toads, and turtles; stems, leaf fragments, seeds; insect and millipede fragments; hairs, plant fibres, etc. Finer meshes were used and disclosed many tiny bones and insect fragments, until the 60-mesh passed a fine, powdery dust, in which no specimens have yet been found. A headpiece binocular greatly facilitated the preliminary classification of the material.

In the course of this work, the writer has had the assistance of a number of students, and Mr. George P. Kanakoff, Assistant Curator in the Department of Paleontology, has aided in the last phases of the treatment of the asphaltum from Pit 81, and in all of the Pit A work. All bones were turned over to him for arrangement by elements in Riker mounts on cotton, to hold them in place, and prevent breakage. This material will be studied by vertebrate paleontologists.

There are certain factors to be taken into consideration in interpreting the results of the separation of the material from Pit 81. The block of asphaltum was enclosed in burlap in the field before boxing, and later the matrix fragments removed from the block were put in cardboard or small wooden boxes. Frequently, chips of fresh wood, burlap fibres, and pieces of cardboard were found mixed with the fragments of asphaltum. A number of flying seeds of a modern grass, which had never been saturated with tar, were found in the course of the washings. These were separated out, for it is believed that they either blew into the pit at the time of the excavation, or were on the burlap when it was being placed around the block of asphaltum.

As a final check, in an effort to eliminate introduced material, a number of large chunks of asphaltum were treated separately, after the washing of the smaller fragments. These chunks were carefully brushed off on all sides to eliminate extraneous material, and thoroughly examined externally before being washed in clean pans with fresh liquid. The specimens obtained from them were distinguished as from Pit 81X, and will be examined later.

The materials recovered from the general washings included a great variety of elements and species. The immense quantity of insect parts will be reported upon in detail in this series of articles. Many of the best of the tiny bones were found within the capsule-like bodies of Eleodes beetles, in the ring-like thoraces, and even in the head capsules of beetles. These were carefully washed out in xyline (xylol), as they always contain treasure. Among the interesting non-arthropod specimens found were leaf and stem tissues, seeds, buds, scales, spines and glands of many kinds of plants; a few shells of small fresh-water mollusks, many limb, spine, girdle, and skull parts of small batrachians, lizards, snakes, turtles, birds, and mammals; tiny pin feathers, animal hairs of many kinds. All of these, with arthropod chitin, and even a few pieces of insect wing tissue, have survived the chemical action of the tar, and the agents of disintegration, though connective tissues, muscle, and flesh have been removed. It has been observed, also, that while bones, and wood take up the tar, chitin, feathers, hair, and the shells of mollusks do not absorb it, and it can be completely washed off, leaving the original surface finish. Occasionally on insects the tiny hairs and setae remain.

Color is not always destroyed by the tar. We find natural colors in the hair when it is washed in xylol. Leaf and plant material has, of course, lost its chlorophyll, and is either brown or yellow. The xylol wash discloses the original gloss of insect chitin, and the red, blue, purple, green, yellow, brown, and black colors correspond with the colors of the nearest living species.

Process No. 2 was initiated by a suggestion and the loan of equipment by Major Joseph B. Ficklen III of the United States Public Health Service and Los Angeles County Health Department, who felt that the open tray method of handling benzene was a double hazard to health of the worker, and to safety from accidental combustion. He provided a small Soxhlet degreaser outfit, consisting of a flask, a treatment chamber, and a water-cooled condenser. The material to be treated was placed in porous filter cups in the treatment section. An electric heater with completely closed heating unit gave the heat. The liquid in the flask boils and passes as a gas up a side tube into the upper portion of the treatment section, where it enters the condenser, and is returned as a clear distilled liquid through the filter cup of asphalt material. There is an obvious movement of tar out of the filter cup, and when a certain amount of liquid has accumulated it is all drawn off by a siphon, which returns it to the flask. Thus the tar is finally all removed from the filter cup to the flask. When the siphoned liquid is clear the process is finished, and the cup can be removed and a new one inserted. After drying on filter paper the contents of the cup is so powdery that much of it acts almost as an aerosol, and passes a 100-mesh screen.

The particular apparatus used in the tests included thimbles 45x123 mm., flask capacity 300 ml. Much larger Soxhlet apparatus is available, and the principle can be applied in making equipment to handle 25 to 30 pounds of material at a time. Henceforth this type of apparatus will be used in all extraction of tar to obtain the smaller elements in the asphaltum, from all fields, although cruder methods will be necessary in the first separations.

The solvent found most satisfactory in the 300 ml. apparatus was benzine (petroleum derivative). Carbon tetrachloride was tested, and the tar dissolved, but remained at the top of the liquid and hence was not completely siphoned off. Toluene had too high a condensing point in the apparatus, and some gas escaped. Xyline was fairly satisfactory, but was superseded by the cheaper benzine, which worked perfectly in three hours or less for each lot. Thus the cup could be filled three times a day. As this rate was faster than the material could be studied, the small apparatus will serve amply in the entomology laboratory. Instead of the filter cups, some small lots of particular importance were merely wrapped in ordinary filter paper packages, and several could be treated without mixing.

The Soxhlet extraction system does away with the health hazard of breathing the fumes. It reduces the fire danger, as the system is entirely closed and the flask sits on a sand layer in a pan, so that if it should break the liquid would not come in contact with the heating element. There is no chance of pollution of the material, as there is in open trays, for everything can be done under cover.

The separation of the insect fragments must all be done with the aid of lens or microscope, and great quantities of the sand must be studied, a spoonful or less at a time. It is slow and tedious work, and the insect remains are very fragile, easily broken.

The second step is to sort the insect material, dividing it in boxes into bodies, heads, mandibles, prothoraces, sternites, legs, elytra, etc. Often the specimens have to be rewashed in xylol, and gently brushed with camel's hair or probed with fine needles to remove dirt and other particles. Some of these particles removed are quite valuable.

In order to preserve the sorted material it is first placed on cotton in Riker mounts for species sorting and primary classification. Long series of larger material are laid out in Riker mounts, but smaller more delicate material and short series are mounted under transparent plastic in pill boxes, with the most delicate, and minute material in dry cells cut from cardboard, between two microscopic slides, sealed with cellulose tape, and properly labelled. Thus mounted it can be studied on all sides.

The beetle species are numbered, using the elytra as the basic criterion, for this element has excellent diagnostic characters, and can usually be classified to the species. The elytra so far found range from 1 mm. to 25 mm. in length, and belong to well over 100 species.

By much searching through the collections, the family, and finally the genus of the elytron is located. A specimen of the nearest California species is then chosen as the basis for comparison, and is completely dissected and the parts laid out on cotton for study in a little mount. This leads to the discovery of the appropriate head, thorax, sternites, and other parts, which can be given the temporary species number pending critical descriptive study.

The problem of association of these parts is difficult, and only the students of bird stomach contents have ever had to meet it. It immediately became apparent that there is a vast amount of work to be done in comparative morphology in insects and other arthropods. The usual keys are not of much value when one has only a head, a mandible, or a sternite to identify. With better studies of our modern insects it can be done.

The insects of the tar pits belong to several distinct categories: (1) the water insects which lived in the water above the tar; (2) the scavenger insects which lived in the flesh of the animals dying in the tar before submergence; (3) the land crawling insects, which may have walked on the exposed tar; (4) strays, which got into the pools by accident; and (5) fragments of insects in the stomach contents of birds and reptiles caught in the tar.

Perhaps because chitin is harder, beetle fragments and millipede rings are most numerous; fly puparia, wasp heads, ant heads are occasionally found. Of perhaps special interest is the fact that an Hemipterous egg, the carapace of a spider, and the front end of a small centipede were found.

There are definite relationships between the Rancho La Brea and the McKittrick insects, although the proportions of the various families appear to differ greatly. In the McKittrick field the tar flowing over the bottom of lakes or pools has deposited large numbers of water forms in layers. At Rancho La Brea the tar seeping upward was often covered with water to form pools, in which many of the insects undoubtedly lived, while others lived on the carrion or the plant life which occurred in the pool.

The study of these insect fragments will have great value in modern taxonomy. Three important morphological facts have already come to light:

1. In the course of evolution beetle elytra are now seen to have been oriented upside down, with the costal margin median, and anal margin lateral, reversing the position of the veins in the under wings; and with this clear, all striae of the elytra can be properly named. This was first brought out in Article 2 of this series (Bull. So. Calif. Acad. Sci. 43 (1):5-7) in the study of a Miocene elytron, but is many times corroborated in the new materials.

2. The Silphid head must be redescribed, because of misinterpretation of the frontal and clypeal regions.

3. The Coprine head must be redescribed for the same reason.

The work will continue with studies of material from other pits at Rancho La Brea, and from the Carpinteria and McKittrick fields as well, so that these three localities can be compared in a manner comparable to the mammal and bird studies of these areas.

Some light may be thrown, by the insect remains, on problems that relate to the antiquity of the deposits, and on climatic conditions that prevailed during the periods of accumulation. An interesting clue, for example, is furnished by fossil material of the genus *Copris* (Scarabaeoidea) found in Pit A and Pit 16. This genus does not now exist in the Pacific Coast States, and the species nearest to that found in the asphaltum occur in southern Arizona and in central Mexico. The first of the critical studies to be made will therefore be a description of this interesting insect, and other related forms.

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11. DESCRIPTIONS OF THE DUNG BEETLES (SCARABÆIDÆ) OF THE TAR PITS

By W. DWIGHT PIERCE
Illustrations by the author

In sorting the vast amount of insect material extracted from the asphaltum of Rancho La Brea, Hancock Park, Los Angeles, the most exciting material so far segregated is a series of fragments of five or six species of Scarabaeidae, or dung beetles, belonging to the genera *Canthon, Copris,* and *Onthophagus,* and one which must be separated as a new genus between *Copris* and *Phanaeus.*

Considering the great numbers of ungulate and other large animals which must have congregated around the water holes covering the treacherous asphaltum, it is not surprising that dung beetles should have been present.

It is interesting that three or four of these species come from Pit 81 and two from Pit A, one of which was also recovered from Pit 16, and Pit 13. Many things indicate Pit 81 to be older than Pit A. The absence today of *Copris, Onthophagus* and the new *Paleocopris* from California, and the presence of all the genera, except the new one, in Arizona, may be one of the clues we are seeking in the problem of Pleistocene climate. By table we indicate these distributional facts.

DISTRIBUTION OF SPECIES OF COPROPHAGOUS BEETLES

GENERA	PLEISTOCENE			MODERN		
	Pit 81	Pit 16	Pit A	Arizona	California	Baja Calif.
Scarabaeidae						
Scarabaeinae						
Scarabaeini						
Canthon.....	2	0	1	5	4	1
Coprinae						
Coprini						
Choeridium	0	0	0	1	0	0
Palaeocopris.	1	0	0	0	0	0
Copris......	0	1	1	2	0	0
Phanaeus...	0	0	0	3	0	0
Onthophagini						
Onthophagus	1	0	0	5	0	1

In the study which led to the identification of the genera of the fragments, another error in American descriptive literature was found. LeConte and Horn, Blatchley, Bradley, and others differentiate *Phanaeus* from *Copris* on the grounds that the former lacks tarsi on the front legs. This is not true for any North American species of *Phanaeus* seen by the writer, and only for some Central American species, as all have a small tarsus hidden by the spur. A separate article giving details on this point will be prepared in this laboratory.

I. THE CANTHONS OF THE TAR PITS

Elytra of three distinct sizes were found, three of the smallest size in Pit A, and one each of the two larger sizes in Pit 81. Also in Pit A was found a thorax with legs attached.

The genus *Canthon* contains about 135 species, with 16 in the United States, and 4 in California, and ranges from 41°N. to 41°S. The species recorded from California are *C. puncticollis* LeConte 1866, *C. simplex* LeConte 1857, with varieties *humeralis* Horn 1870, and *militaris* Horn 1870, *C. laevis* (Drury 1770), and *C. perplexus* LeConte 1847. *C. simplex* occurs in Los Angeles County. The material from Pit A appears to belong to *C. simplex* and will have to be so designated under subspecies name until head and other parts are found to validate or invalidate the decision.

CANTHON SIMPLEX ANTIQUUS, new subspecies

The specimens are labelled as follows: one left elytron—C114*a;* two right elytra—C114*b, c;* prothorax and legs—C114*d*. The last is designated as holotype, and illustrated in Figures 2 and 3; and elytron *a* is illustrated in Figure 1 of Plate 10.

The three elytra measure as follows: length *a.*—4.3mm., *b.*—3.5 mm., *c.*—3.5 mm.; width *a*—2.7 mm, *b.*—2.5 mm., *c.*—2.5 mm. At base there are four tiny tubercles, each in the center of interspaces 2, 3, 4, 5. The surface is very minutely and regularly granulate with dispersed clusters of 4 granules more shiny, and appearing as bare spots except under high magnification. The striae (Subcosta or sutural, Radius I, II, Medius I, II, Cubitus I, II, Postcubitus) are faintly impressed, with very faint punctures. The Vannal or lateral area is vertical, sharply marked on both edges, and with one row of deep punctures, and extends to the apex.

Pronotum 4.7 mm. in width, smooth, but with very minute reticulate granulation. An interesting point which would not be observed in a mounted specimen is that the fore coxae are attached at their lateral end only, and fit tightly into a transversely

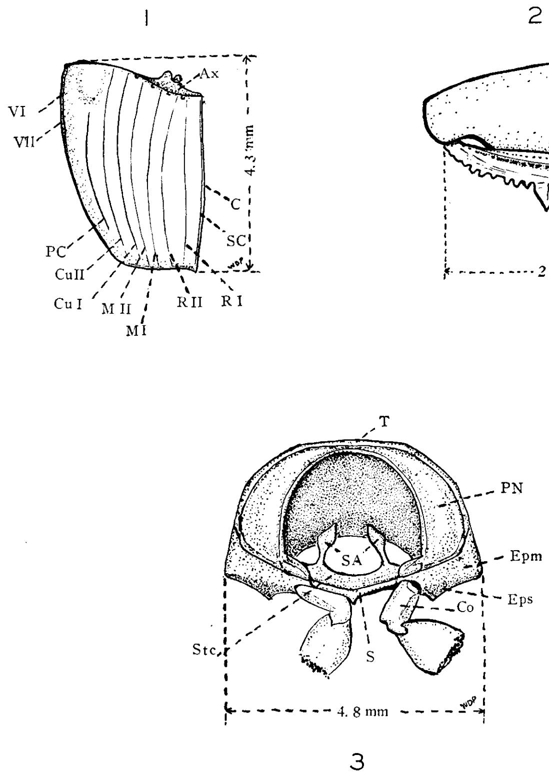

PLATE 10

FIG. 1. Elytron of *Canthon simplex antiquus*, n. ssp. *Ax.*—axillary region; C.—costa; SC.—subcosta; RI, RII—radius; MI MII—medius; Cu I, Cu II—cubitus; PC.—postcubitus; V I, V II—vannal veins.

FIG. 2. Posterior view of first coxa, femur and tibia of *Canthon simplex antiquus*, n. ssp.

FIG. 3. Posterior view of prothorax of *Canthon simplex antiquus*, n. ssp. Co.—coxa; Epm.—epimeron; Eps.—episternum; PN.—postnotum; S.—sternum; SA.—sternal apodeme; Stc.—sternacosta; T.—tergum.

grooved sternum, being minutely separated on the center line by a fine ridge, so that when in the groove they are almost in contact. Figure 3 shows from the rear view the right coxa opened out, and the left coxa reposing in its groove.

The postnotum is an infolded perpendicular plate edged all around by ridges. The epimeron is vertical, separated only by rounded edge from the triangular episternum, which lies ventral, at the sides of the coxae, and separated by the sharp lateral margin from the tergum. Within the sternum is the sternocostal plate to which are attached two vertical sternal apodemes, spearlike in form.

Casual observation of dissected parts of various species in this group indicate that the comparative morphology of these beetles will afford much better taxonomic characters for separation of genera and species than are now in use. We must be able to separate any genus or species on the merits of any of its structural parts.

CANTHON PRATICOLUS VETUSTUS, new subspecies

This name is given provisionally to two elytra from Pit 81, which may ultimately prove to belong to two species. The specimen C117*a* is considered holotype, and C118*a* as paratype. While there is a great disparity in size the disparity is not greater than that between the largest and smallest specimens of *C. praticola* in the Museum collection, from Albuquerque, New Mexico. This species does not now occur in California. The only other species with granulate elytra of a similar nature, *C. laevis,* exceeds in its smallest specimens, the size of the elytra of the larger of the two.

Elytron C117*a* measures 4.5 mm. in greatest length, and 3.25 mm. in greatest breadth. Elytron C118*a* measures 6.2 mm. in greatest length, and 5.00 mm. in greatest breadth.

The holotype is much more pronouncedly granulate than the larger paratype. Microscopically the surface is very minutely granulate with interspersed larger and obvious granules. At the bases of the third, fifth and eighth interspaces are tiny tubercles. The vannal area is vertical and defined by two raised lines, and extends from humerus to apex. No drawing was made of this subspecies.

II. THE COPRINE SPECIES OF THE PITS

The finding of two large coprine beetles in Pleistocene deposits in California is of great significance. One is definitely a *Copris,* the other has some characteristics of *Phanaeus,* but in the absence of any specimens of that genus with its main characters it is called *Palaeocopris.*

The genus *Copris* has an interesting distribution. There are about 80 species, five occurring in Europe from Russia to Spain, others in Asia and Africa, but it is absent from Australia and the Oceanic Islands. In North America, north of Mexico there are eight species from Canada to Florida and Arizona, and eight species in Mexico and Central America. It is completely absent from the Pacific Coast States of the U. S. A., and does not occur in South America.

The genus *Phanaeus,* with about 80 species, is exclusively American, extending from Kansas to South America, but it is absent from Washington, Oregon and California.

The material in the first species was found in Pit 16 and Pit A, and consists of 2 ♀ heads and 4 prothoraces from Pit 16; and 6 ♀ heads, 1 ♂ horn, 2 prothoraces, 2 prothoracic fragments, a few prosternite fragments, 1 femur and 2 tibiae of the fore legs, 1 femur and 3 tibiae of the middle legs, 1 femur and tibia of the hind legs, 1 almost complete elytron, and 3 elytral fragments, from Pit A, and 1 thorax from Pit 13.

One head capsule (C49*p*) is complete, lacking only the oral appendages, antennae and eyes. This is therefore selected as holotype ♀. The other material which is considered undoubtedly of this species must therefore be considered as paratype parts. In paleontology the words syntype and cotype are often used, but they are now held to be synonymous with paratype.

The reconstruction of the insect would indicate a species much larger than any Copris in the United States, Mexico or Central America, but somewhat resembling *Copris rebouchei* Harold of Mexico, and the much smaller *Copris remotus* LeConte of Florida to Arizona. In size and proportions it equals the largest *Copris lunaris* Linnaeus I have seen from Russia, and is almost as large as *Pinotus carolinus* Linnaeus of the Eastern States.

By its shape of head it is eliminated from *Pinotus,* and allied to *Ontherus, Copris,* and *Phanaeus.* The generic classification of this group is based on antennae, mouthparts, legs, and elytra, but this type of material cannot be keyed out in the usual manner. The anterior tibiae show articulation of a tarsus, which eliminates true *Phanaeus.* Thoracic characters, sculpture, and the absence of teeth on the anterior margin of the head narrow it to the first group in the genus *Copris.*

A study of the head capsules of these fossil species and of modern beetles discloses an error in all descriptive work on this group of beetles. The flattened dorsal part of the head is not the clypeus, but the frons and parietals. The frontal suture is clearly visible on all of the specimens, and in one is actually somewhat cleft. It extends from the anterior margin almost to the frontal horn. In *Phanaeus vindex* the frontal suture passes through the frontal horn. The true clypeus is under the ledge of the frons, and completely united, but distinctly demarked from the frons. It is arched, with lateral extensions reaching the small piece bearing the anterior mandibular articulation, located at the junctions of genae, frons and clypeus behind the antennal fossae. In a complete insect the clypeus is entirely concealed by the mouthparts. Therefore the horn is not a clypeal horn but rather a frontal suture horn. This correction should be made in all descriptions of Coprini.

No fossils in this genus are reported from North America, hence the name *pristinus* is quite appropriate.

COPRIS PRISTINUS, new species

Color black. Approximate mean size 26 mm. in length, 13 mm. in breadth. Measurements of the 8 ♀ heads are as tabulated.

MEASUREMENTS OF HEADS OF COPRIS PRISTINUS FEMALES

Specimen Number C 49—	Greatest Width	Width at eye emargination	Length on center line	Height of crest	Width of crest	Source Pit
a	11.5 mm.	6.5 mm.	7.5 mm.	1.7 mm.	2.5 mm.	Pit A
b	8.7	5.7	5.8	1.5	2.0	Pit A
e	9.5	6.0	6.0	1.8	2.5	Pit 16
g	8.2	5.2	5.6	1.2	1.6	Pit 16
k	9.5	6.5	6.5	2.0	2.5	Pit A
l	8.5	6.0	6.2	2.5	2.6	Pit A
(type) p	8.8	5.5	6.2	2.2	2.2	Pit A
aa	9.7	6.0	5.7	2.0	2.5	Pit A
Minimum	8.2	5.2	5.6	1.2	1.6	
Mean	9.3	5.92	6.18	1.85	2.3	
Maximum	11.5	6.5	7.5	2.5	2.6	

The head (Figure 4 of Plate 11) is definitely transverse in its entirety, and would appear even more so in a complete insect. Dorsally, it has a narrow basal occipital and postoccipital area, a convex vertex, most of which is normally covered by the thorax, and the visible dorsum is a flattened disc laterally projecting far beyond the eyes in a rounded 60 to 70° angle. There are deep emarginations at the base of the parietal ledge for the eye sockets, which are dorsally elliptical while ventrally the ocular sclerites are spiralled around the eye sockets. The frontal suture is deep and the cleavage extends clear through the ledge to the under side. The broad frontal horn occupies the normal position of the central ocellus (when it occurs). This horn is a hollow process, elliptical at base, flattened antero-posteriorly, concavely truncate at apex like a saddle. The anterior margin is broadly curved from parietal angles, emarginate at frontal suture, and also slightly indented on median line.

The head is hypognathous, with all mouth parts, antennae, and the major portion of the eyes ventral (Figure 5 of Plate 11). The broad plate-like extension of frons and parietals extends far beyond the insertions of all appendages. The frontal suture passes just in front of the antennal sockets and makes sharp 30° angles with the epistomal suture, which extends forward in parallel lines and then abruptly arches in front of the slightly depressed clypeus. The frons is coarsely punctate beneath. In front of the clypeus there is a narrow arched band bordering the buccal cavity. Its apical angles meet the apical angles of the frons and the subgenae. The antennal sclerites are oval with kidneyform sockets. The parietals are broad in front of the eyes, narrow between the eyes and gular suture, with a broad genal area behind. The broad gula and submentum are separately convex, inserted between the genae at posterior base of head, and are present in only one specimen, there being a definite cleavage, with infolded edges, which separates them from the remainder of the head capsule. The elongate posterior tentacular pit is on the gular suture. The gula and submentum are connate, but distinguished by texture, gula being smooth, dull surfaced, while submentum is finely, closely, shallowly punctate. Anteriorly submentum is medianly lobate truncate, laterally excavate for maxillae.

Posteriorly (Figure 6 of Plate 11), the triangular subgenal areas with a narrow occipital and postoccipital band, and the gula enclose the subquadrate foramen magnum.

Fragments of 10 prothoraces are at hand, of which 6 are measureable as follows:

MEASUREMENTS OF PROTHORACES OF COPRIS PRISTINUS

Specimen Number C49—	Greatest Width	Greatest Length	Length on Center Line	Source Pit
c	14.5 mm.	...	7.7 mm.	Pit A
d	12.5	8.5 mm.	6.8	" A
f	13.0	9.5	8.0	Pit 16
g	12.0	9.0	7.7	" 16
h	13.0	8.5	7.5	" 16 (fig. 19 of Plate 13)
i	...	...	...	" 16
n	...	...	...	" A
o	...	...	...	" A
r	...	...	...	" A
cc	...	...	...	" A
dd	15.5	11.0	9.0	" 13 (fig. 18 of Plate 13)
Minimum...	12.0	8.5	6.8	
Mean.......	13.4	9.3	7.7	
Maximum..	15.5	11.0	9.0	

EXPLANATION OF FIGURES ON PLATE 11

FIG. 4. Dorsum of head capsule of *Copris pristinus*, n. sp. Cr.—crest; Fr.—frons; Fs.—frontal suture; Oc.—occiput; Os.—ocular sclerite; Pa.—parietal; Pge.—postgena; V.—vertex.

FIG. 5. Venter of head capsule of *Copris pristinus*, n. sp. As.—antennal sclerite; C.—clypeus; Es.—epistomal suture; Fr.—frons; Fs.—frontal suture; Ge.—gena; Gs.—gular suture; Gu.—gula; Hs.—hypostomal suture; I Cr.—interior of crest; Os.—ocular sclerite; Pa.—parietal; Ps.—pleurostomal suture; Sg.—subgena; Sm.—submentum; Tp.—tentorial pit.

FIG. 6. Posterior view of head capsule of *Copris pristinus*, n. sp. Gu.—gula; Oc.—occipital; Pa.—parietal; Pge.—postgena; Poc.—post-occipital.

FIG. 7. First tibia of *Copris pristinus*, n. sp.

FIG. 8. Inner side of second femur and tibia of *Copris* pristinus, n. sp.

FIG. 9. Inner side of third femur and tibia of *Copris Pristinus*, n. sp.

FIG. 10. Dorsal view of fragment of head capsule of *Palaeocopris labreae*, n. sp. Fr.—frons; Fs.—frontal suture; Os.—ocular socket; Pa.—parietal.

FIG. 11. Ventral view of fragment of head capsule of *Palaeocopris labreae*, n. sp. As.—antennal sclerite; C.—clypeus; Es.—epistomal suture; Fr.—frons; Fs.—frontal suture; Os.—ocular sclerite; Pa.— parietal.

FIG. 12. First tibia of *Palaeocopris labreae*, n. sp.

FIG. 13. Second tibia of *Palaeocopris labreae*, n. sp.

FIG. 14. Third tibia of *Palaeocopris labreae*, n. sp.

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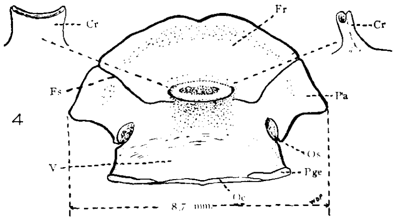

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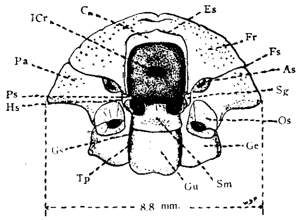

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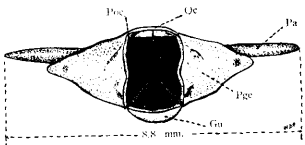

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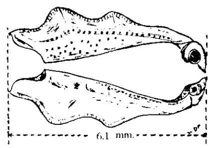

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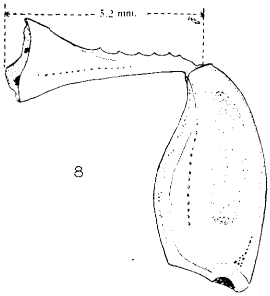

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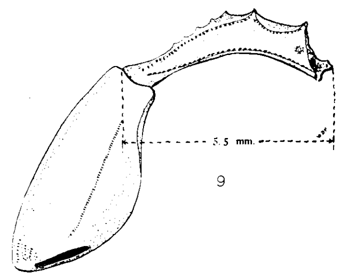

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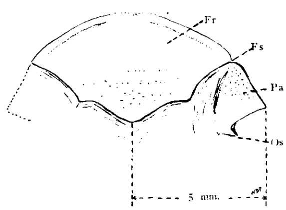

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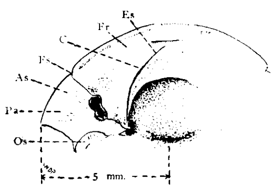

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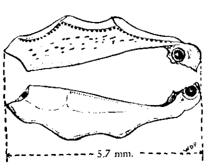

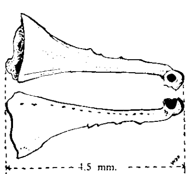

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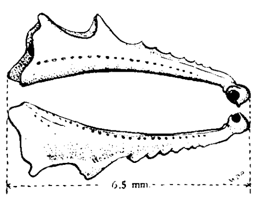

PLATE 11

The dorsum of the pronotum is divided medianly into three visible transverse areas, the narrow anterior marginal acrotergite, with a deep antecostal suture; the anteriorly sloping prescutum bounded by the transverse notal suture, a more or less distinct ridge which may be broken on the median line (but in specimens d, f, g, i, n, o, cc and dd the ridge is complete as in figure 18 of Plate 13), and again on a line with the interior edges of the anterior lobes (these depressions corresponding in position with the notaulix); and the large scutum with the lateral depressions made by notaulix in the anterior half. The depressions of the median line and the notaulices cause the anterior ridge to appear quadrituberculate in specimens *c* and *h* (figure 19 of Plate 13), whereas in the others it is laterally bituberculate. The anterior margin is laterally lobate, medianly straight; posterior margin is broadly convex; sides convex, marginate. The surface is very shallowly pitted, with lateral ridges a short distance from margin. The postnotum is a narrow infolded band, concave transversely.

Four fragments of the elytra have been found, one almost complete. The length exceeds 13 mm., and the basal width exceeds 10 mm. for each elytron. The striae are about 1 mm. apart. In the largest fragment there are 8 striae, the ninth being at the edge of the break; another fragment has 9 striae.

First femur is 5.5 mm. long, 2.8 mm. broad at broadest point before middle; externally punctate; beneath 3-carinate; apically concave with two condylar teeth to engage the tibia. First tibia (Figure 7 of Plate 11) measures 5.8 to 6.1 mm. in length; is diagonally truncate at apex, outer margin with three broadly rounded teeth, the margin being gently wavy, 3-emarginate; the outer side is inwardly convex, coarsely punctate, and outwardly abruptly, concavely declivous from a sinuate median edge, with ridges crossing the declivity from the median line to the apices of the teeth; the apex surpasses the tarsal attachment; the base fits into the femur with an internal and external condylar pit.

Second femur (Figure 8 of Plate 11) is 6 mm. long, 2.5 mm. broad at broadest point before middle, externally convex, coarsely punctate; beneath 3-carinate; apically concave with two condyles for attachment of tibia. Second tibia measures 5.5 mm., is slender at base, flared at apex, with 6 small teeth on outer edge; apically with 2 pits, one for tarsus, the other for the spur.

Third femur (Figure 9 of Plate 11) is 6 mm. long, and 2.5 mm. wide just before the middle; dorsally sparsely punctate; externally shining with two impressed punctate lines, and internally with one impressed punctate line; ventrally bicarinate; apically concave with two condyles for attachment of tibia.

Four third tibiae measure 6.0, 6.1, 6.4, 6.4 mm. in length; are diagonally truncate at apex; dorso-externally with two large teeth, beyond the middle; and dorso-internally with 6 or 7 small

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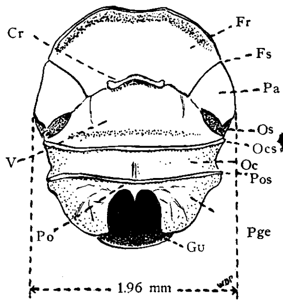

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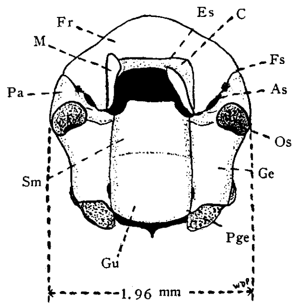

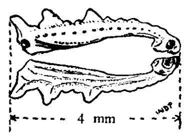

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PLATE 12

FIG. 15. Dorsal view of head capsule of *Onthophagus everestae*, n. sp. Cr.—crest; Fr.—frons; Fs.—frontal suture; Gu.—gula; Oc.—occiput; Ocs.—occipital suture: Os.—ocular sclerite; Pa.—parietal; Pge.—postgena; Po.—postocciput; Pos.—postoccipital suture.

FIG. 16. Ventral view of head capsule of *Onthophagus everestae*, n. sp. As.—antennal socket; C.—clypeus; Es.—epistomal suture; Fr.—frons; Fs.—frontal suture; Ge.—gena; Gu.—gula; M.—mandible; Os.—Ocular sclerite; Pa.—parietal; Pge.—postgena.

FIG. 17. First tibia of *Onthophagus everestae*, n. sp.

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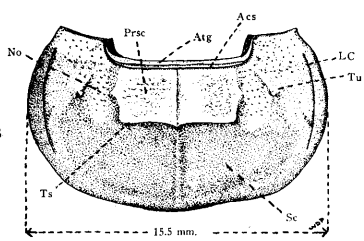

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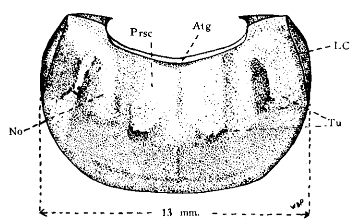

PLATE 13

FIG. 18. Pronotum of *Copris pristinus*, specimen C49*dd*. Acs.—Antecostal suture; Atg.—acrotergite; Lc.—lateral carina; No.—notaulix; Prsc.—prescutum; Sc.—scutum; Tu.—tubercule.

FIG. 19. Pronotum of *Copris pristinus*, specimen C49*h*. Atg.—acrotergite; LC.—lateral carina; Prsc.—rescutum; Tu.—tubercles.

teeth before the middle and two large teeth beyond the middle; the dorsal surface is sharply margined, and with transverse ridges connecting the margins at the two large teeth.

PALAEOCOPRIS, new genus

Closely related to *Copris*, but with the frontal suture a raised ridge instead of crest, abruptly declivous behind. Tibial structures as in Copris.

PALAEOCOPRIS LABREAE, new species

A head fragment of a Coprine beetle female (C116*a*) found in Pit 81 is the basis of this genus and species. Four tibiae of Coprine character are assigned to this species, as no true *Copris* parts were found in Pit 81. These consist of one first tibia (C116*b*), one second tibia (C116*c*), and two third tibiae (C116*d, e*). The complete absence of horn indicates an approach to Phanaeus, but other evidences point to *Copris*.

Based on half measurement the head is 10 mm. wide (Figure 10 of Plate 11), and in general shape and size is very much like *Copris pristinus* but there is a complete absence of horn, the frontal suture forming instead a broad angled ridge as illustrated, sharply declivous behind, slowly sloping in front.

Beneath, the smooth clypeal area is more ogival than in *C. pristinus*. (Figure 11 of Plate 11). The antennal sockets are somewhat peanut-shape. Only a part of the eye socket is preserved.

The tibiae attributed to this species are typically Coprine and are illustrated in Figures 12, 13, 14 of Plate 11. The first measures 5.7 mm., the second 4.5 mm., the third 6.5 mm. The first is undulately three toothed. The second tibia flares at apex, and has four minute teeth on outer margin. The hind tibiae has two large teeth (apical and post median), and seven tiny teeth in basal half. All three tibiae have tarsal sockets.

III. AN ONTHOPHAGINE BEETLE FROM THE TAR

One little head, and one small front tibia from Pit 81 belong to the genus *Onthophagus*. This genus contains about 600 species, mostly Old World, although many occur in North, Central and South America. But the genus is completely absent from Washington, Oregon and California.

This species is dedicated with pleasure to Miss Jane Everest, who initiated the modern study of the Rancho La Brea fossil insects in 1941-42, extracting hundreds of insect fragments, which are only now being critically studied.

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ONTHOPHAGUS EVERESTAE, new species

Recovered by the writer from Pit 81. Holotype head (C115*a*), and paratype first tibia (C115*b*).

The head (Figures 15, 16 of Plate 12) measures 1.96 mm. in greatest width, and 2.12 mm. in length. Dorsally it is characterized by a low arcuate ridge on the frontal suture, and two transverse ridges behind the eyes, on the occipital and postoccipital sutures. There is a short median ridge extending forward from the post-occipital ridge. The eye sockets are laterally open, dorsally diagonal, and ventrally lentiform. The parietals are not extended far beyond the eyes, but form with the frons an anterior process, which makes the mouth parts entirely ventral (hypognathous). In the specimen found, it is fortunate that the flat, ensiform mandibles, and the broad gula-submentum are in position. Clypeus is, as in *Copris,* a smooth arched plate, completely concealed when the mouth parts are in position.

The anterior tibia (Figure 17 of Plate 12) is typical, and has three large rounded teeth, two small teeth between the first two large ones, and five rounded teeth of diminishing height in basal half. The length is 4 mm.

12. DESCRIPTION OF A SERICINE BEETLE FROM THE TAR PITS

By W. DWIGHT PIERCE

Among the scarabaeoid fragments isolated from Pit 81, Rancho La Brea, Hancock Park, Los Angeles, was one tiny head, which differed quite materially from the coprophagous beetle heads discussed in Article 11. Studies of heads of beetles in the Museum collection has resulted in assigning this head to genus *Serica* (Scarabaeoidea. Melolonthidae, Sericinae). This genus is not unexpected, as the beetles are tree defoliators, and the larvae feed at the roots of trees. In California, *Serica anthracina* LeConte, is a serious defoliator of oak, manzanita, and other trees. The head capsule found in the tar is quite close to this species, which is also black. Oaks were present in the Pleistocene period, and many fragments have been found in the tar.

This species is described in honor of Mr. George P. Kanakoff, who has assisted the writer in the washing, sorting, and assembling of the vast amount of minute biological material from the asphaltum of Pits 81 and A. His help has been invaluable, and there are few men with the patient, untiring persistence that he has shown in this work.

SERICA KANAKOFFI, new species

Described from specimen C107*a* from Pit 81. Head capsule black, 2.7 mm. wide and almost as long. The dorsum (Figure 1 of Plate 14) is divided into three areas: occiput, vertex, frons. The broad occiput, normally completely covered by the pronotum, is convex and occupies over one third of the dorsal area. The occipital suture is only indicated by a change of texture. The vertex, is convexly curved behind and concavely in front, and laterally emarginate by the eye sockets, in front of which are the parietal processes guarding the eyes anteriorly. The frontal suture is broadly curved, separating the vertex from the plate-like frons, which is sharply ridged on its anterior and lateral margins, making the frons somewhat depressed.

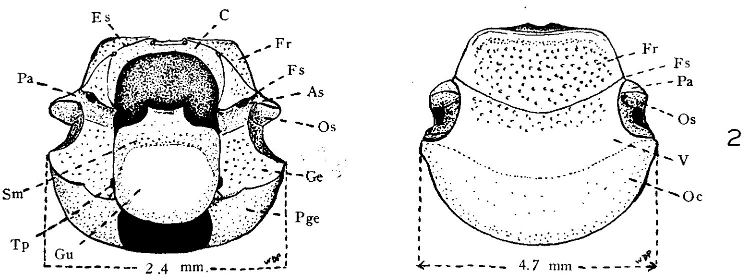

PLATE 14

FIG. 1. Dorsal view of head capsule of *Serica kanakoffi*, n. sp. Fr.—frons; Fs.—frontal suture; Oc.—Occiput; Os.—ocular sclerite; Pa.—parietal; V.—vertex.

FIG. 2. Ventral view of head capsule of *Serica kanakoffi*, n. sp. As.—antennal sclerite; C.—clypeus; Es.—epistomal suture; Fr.—frons; Fs.—frontal suture; Ge.—gena; Gu.—gula; Os.—ocular sclerite; Pa.—parietal; Pge.—postgena; Sm.—submentum; Tp.—tentorial pit.

A front view of the head discloses a vertical concave triangular area broadest above, with apex ventral. This is probably part of frons.

Ventrally (Figure 2 of Plate 14) this head differs from the Coprine heads in that the arched clypeus reaches the anterior margin at the apex of the above mentioned vertical area. The frons appears as lateral frontal triangles on the under side, with a second large triangular area bounded by clypeus, frons and gen, with apex at the tentorial pits, and base in contact with the antennal sclerite. Behind the more or less flattened frontal lobe the head suddenly deepens, so that the genae in the zone of attachment of the mouth parts, antennae and eyes are sharply declivous. The gula-submentum is very broad and convex. The posterior portion of the head is closed at the sides of the foramen magnum by the postgenae.