Pierce, W.D., 1949

FOSSIL ARTHROPODS OF CALIFORNIA

17. THE SILPHID BURYING BEETLES IN THE ASPHALT DEPOSITS. W. Dwight Pierce.

The most continuous death traps in existence are the asphalt pits and seeps of the world. In some areas these deposits have been trapping animals and plant materials continuously since Middle Pleistocene times. Much has been written on the findings of bones and other remains of ancient life in the asphalt, but too little stress has been put upon the processes, which took place before the bones were finally incorporated as a part of the asphalt.

Between the living struggling animal and the final deposition of the separated bones of its skeleton in the asphalt, many things took place, and many agencies were at work. In this article one group of these agents of decomposition is to be critically studied, but first it is desirable to insert into the annals of paleontology a sketch of the periods of decomposition of animal bodies as worked out in medical jurisprudence and sanitary entomology.

THE PERIODS OF DECOMPOSITION OF ANIMAL BODIES

When an animal dies, a whole series of changes set in, and these have been divided into periods of decomposition by Mégnin and others, principally for use in legal problems, but also for guidance of undertakers. The timing of the periods naturally varies with temperature, humidity, and atmospheric pressure. In warm climates, decomposition is more rapid, and the periods are shorter. In cold climates they are comparatively longer. In dry climates desiccation will take place earlier.

Because the insects of each period of decomposition are characteristic of that period, we have a criterion to judge as to the time that a carcass was exposed before complete submergence in the asphalt.

It will be recalled that the study of the remains in the La Brea and McKittrick asphalt fields shows that flesh was completely removed or digested in the processes that took place; that horn and nails disappeared, but that occasionally hairs and tiny feather fragments survived. Insect chitin; mollusc and crustacean shell; plant tissues, especially seed coverings; all kinds of bones, sometimes ligaments, survived the processes of disintegration. Colors of insects were not altered as a rule; even setæ on insects occasionally remain.

The reasons for these survivals and disappearances can readily be found in the descriptions of decomposition to follow.

Mégnin's eight periods of progressive decomposition are based on exposed human bodies in France, in which different chemical substances are formed, and different bacteria and insects are at work. In general we can assume that the periods will be approximately the same for all animals, but that the time may also be governed by the size or bulk of the body as well as by climatic considerations.

In California asphalt deposits we may expect three degrees of atmospheric moisture to have a bearing on the relative condition of the bones and plant materials, rating Carpinteria at the side of the ocean most humid, La Brea Pits next, and McKittrick as driest.

Likewise the speed of submergence was governed by depth of the asphalt liquid, which was greatest at Carpinteria and La Brea Pits and least at McKittrick.

Inasmuch as this information has not entered the literature of paleontology I am digesting the data from many sources, because it may explain many things in our study of the life caught in these deposits.

PERIOD I. Body fresh. Internal decomposition is taking place in the nature of autolysis, brought about by the action of the body's own enzymes, breaking down proteins into amino-acids and other substances. In this period, the blue-bottle flies, *Calliphora vicina* Robineau-Desvoidy (*erythrocephala* Mèigen), and *C. vomitoria* Linnæus, are present at the moment of death, and soon afterwards the lesser housefly, *Muscina stabulans* Fallén, and the house fly, *Musca domestica* Linnæus appear. Many fly puparia belonging to this and the next period have been obtained by washing out the skulls of saber-tooth tigers, *Smilodon,* and will be reported on when studied. One species was described in Article 8 of this series.

Fly larvæ secrete amylase, lipase, and protease, ferments which digest the tissues, and the liquefied tissues are taken up by the larvæ.

PERIOD II. Decomposition commences during the first three months. This is usually accomplished by bacteria which break down various amino-acids into ptomaines. The amino-acid, lysine, is broken down into the foul smelling cadaverine or pentamethylene diamine, $NH_2.(CH_2)_5.NH_2$. This happens in the earlier stages of decomposition and may be the product of *Proteus vulgaris*.

As soon as the odor of decomposition becomes evident, the flesh flies of the genus *Sarcophaga* appear. *Lucilia* spp., the green-bottle flies, appear at the initiation of gas formation (cadaveric emphysema).

The amino-acid, ornithin, is broken down into the poisonous, ill-smelling putrescine, or tetramethylene diamine, $NH_2.(CH_2)_4.NH_2$. This reaction takes place in the later stages of the putrefactive decomposition.

The amino-acid, tyrosine, breaks down into tyramine, $NH_2.(CH_2)_2.C_6H_4OH$, commonly found in cheeses.

The very poisonous amino-acid tryptophane breaks down into skatole, C_9H_9N, and indole, C_8H_7N. This is accomplished by bacteria of the *Escherichia colon,* and *Proteus* groups.

The amino-acid, histidine, breaks down into the very poisonous histamine, $C_3H_3N_2$, $(CH_2)_2.NH_2$.

The amino-acid, cystine, breaks down into ethyl mercaptan, C_2H_5SH. Some of these reactions probably belong to the later periods.

PERIOD III. Formation of fatty acids, and beginning of caseous product formation takes place in the third to sixth month. The fatty acids have the general formula $C_nH_{2n}O_2$, or $C_{n-1}H_{2n-1}.CCOH$.

The principal fatty acids are: cerotic (n=26), lignoceric (n=24), behenic (n=22), arachidic (n=20), stearic (n=18), margaric (n=17), palmitic (n=16), capric (n=10), nonylic (n=9), caprylic (n=8), heptylic (n=7), caproic (n=6), valeric (n=5), butyric (n=4), propionic (n=3), acetic (n=2), formic (n=1).

The insects present are *Dermestes* spp., and the moth *Aglossa pinguinalis,* which are attracted to fatty substances.

Numerous *Dermestes* elytra have been recorded from the La Brea pits. These beetles destroy skins and even horn, as well as dry flesh.

PERIOD IV. Formation of caseous products, such as adipocere (grave wax), in the third to sixth months.

The insects usually present are the ham beetles, *Korynetes* spp.; *Necrobia* spp.; the cheese skipper, *Piophila casei* Linnæus; *P. petasionis* Dufour and *Anthomyia* spp. None of these have as yet been identified from the asphalt.

PERIOD V. Ammoniacal fermentation, black liquefaction in the fourth to eighth months. Ammonia may be produced by the action of such forms as *Bacillus mycoides, Proteus vulgaris, Bacillus megatherium,* and *B. ceres.*

The beetles of the genera *Ophyra, Silpha, Necrodes, Nicrophorus, Hister,* and *Saprinus,* and flies of the genera *Phora* and *Lonchæa,* are present in this period.

The present article discusses the species of *Nicrophorus* and *Silpha* so far recovered from the asphalt. Several species of Histeridæ will be reported on later.

PERIOD VI. Desiccation, in the sixth to twelfth months. The visitors are principally mites (Acarina), and none have been recovered from the asphalt.

PERIOD VII. Extreme desiccation, one to three years. The insects are the same which destroy dried animal and vegetable matter in our homes, and none have been recovered from the asphalt.

PERIOD VIII. Debris, over three years. The insects are Ptinidæ and Tenebrionidæ. Many kinds of Tenebrionidæ have been recovered, but their relationship to carcasses is not evident.

From this we find that the insects of the first five stages of decomposition are present in the asphalt, and we therefore assume that the complete submergence of carcasses was quite slow, possibly even up to five months being required at La Brea Pits. At McKittrick the first seven stages of decomposition can be observed in the present day seep.

FAMILY SILPHIDÆ

Only twelve valid species of fossil Silphidæ have been heretofore reported, according to Dr. Melville Hatch (Jour. New York Ent. Soc. 35:331-371, particularly 365-371).

From the standpoint of a paleoentomologist, the classification of the insects of the genus *Nicrophorus* is very unsatisfactory, being to a large extent a matter of color pattern. When structural characters are used, they deal with only a few parts of the skeleton, and are useful only when one has those parts.

The genera *Silpha* and *Nicrophorus* extend around the Northern Hemisphere, many European-Asiatic species extending into the United States, some as far south as California. *Silpha ramosa* and *S. lapponica* extend into Mexico, but the genus *Nicrophorus* is absent from Mexico and Central America. We have then a group of insects in two genera, which are definitely Nearctic-Palearctic in distribution.

SUBFAMILY SILPHINÆ
TRIBE SILPHINI

GENUS SILPHA LINNÆUS

Up to the present time our evidences of this genus are confined entirely to 17 elytra and elytral fragments representing two species, now classified in different subgenera. One of these species extends from Europe and Asia through Alaska to Mexico, the other is American only.

SILPHA (THANATOPHILUS) LAPPONICA HERBST
(Figures 1, 2).

Four right elytra (one perfect, two almost complete, one humeral fragment) from Pit A, one left elytron from Pit X (a lot of material from which the label was lost), four right elytra from Pit Bliss 29.

This is a necrobious insect occurring in Europe, Asia, Alaska, Greenland, Northwest Terr., Labrador, Pennsylvania, District Columbia, Michigan, Wisconsin, Iowa, Kansas, New Mexico, California, and Mexico.

The elytra (figs. 1, 2) have never been described in accordance with standard wing nomenclature. The costal margin is the deeply incised scutellar-sutural margin. Costa, subcosta and radius form the sutural edge, costa crossing underneath, and lying side by side with radius on the underside. The three veins on the remigium or disc are evident both above and below and constitute the two branches of medius and the cubitus. The lateral dorsal portion which is depressed is the vannus, marked by a row of punctures in the depression (Vannus 1), and defined on the lateral margin by Vannus 2. The jugum is beneath infolded from base to apex.

The two medial veins are sharp ridges, bordered on one side in specimen *C3d,* and on each side in the other specimens, by closely set deep punctures; the cubital vein is even more sharply ridged, but not bordered by punctures. The interspaces radiomedial, medial, medio-cubital, and cubito-vannal, contain rows of round tubercles. Second medial and cubital unite apically to form a wiggling ridge, and first medial is also apically hooked in specimen *C3b,* but not in the others. Specimen *C3d* is illustrated.

A comparative study of 2 ♂ and 2 ♀ from Skagway, Alaska, and 2 ♂ and 2 ♀ from Bodega, California indicates a great variation even between elytra on a single individual, in the number of tubercles per interspace. With these are compared the eight fossil elytra and it will be seen that the pattern is too variable to warrant varietal separation on elytral tuberculation alone. The fossil material ranges between the Bodega modern and the Skagway modern, and hence is within the range of the species as now classified.

TUBERCLES PER INTERSPACE IN SILPHA LAPPONICA ELYTRA

SINGLE ELYTRA	Sex	1 Radio-medial	2 Medial	3 Medio-cubital	4 Cubito-vannal
MODERN SPECIMENS:					
Skagway, Alaska 1	♂	9	7	10	10
2	♂	10	11	11	10
3	♀	8	8	6	8
4	♀	9	9	7	12
mean	—	9	8.7	8.5	10
Bodega, Calif. 1	♂	7	5	4	4
2	♂	8	7	5	8
3	♀	8	8	7	7
4	♀	8	5	6	9
mean	—	7.7	6.2	5.5	7
FOSSIL SPECIMENS:					
Pit X. *C3a*	—	8+	9+	10	9*
Pit A. *C3b*	♂	9	8	6	9
C3c	—	8+	6+	6+	9+*
C3d	♀?	6	8	10	8
Pit 29. *C3f*	♂	8	9	10	9
C3g	♀	9	9	11	8
C3h	—	7+	7+	7+	10*
C3i	—	6+	5+	4+	6+*
MEAN 8 FOSSIL (whole ones only)	—	8	8.5	9.4	8.8
Mean 8 recent	—	8.3	7.4	7.0	8.5
Mean 6 ♂	—	8.5	7.8	7.6	8.3
Mean 6 ♀	—	7.5	7.8	7.8	8.6

*Incomplete.

The measurements of the specimens are as follows:

SPECIMEN		LENGTH	BREADTH
Pit X. *C3a*	—	8.6 mm.	3.7 mm.
Pit A. *C3b*	♂	8.1	3.1
C3c	—	—	3.3
C3d	♀?	7.7	3.2
Pit 29. *C3f*	♂	8.0	3.0
C3g	♀	8.8	3.6
C3h	—	—	3.4
C3i	—	—	2.9
mean	—	8.2	3.27

The sexual differences in the elytra may have been noted, but not in any references before me. The female elytron is definitely lobately prolonged on the sutural apex, while in the male the apical margin is very moderately sinuate, without forming the semblance of a lobe.

SILPHA (HETEROSILPHA) RAMOSA SAY 1823
(Figs. 3a, 3b)

Three left elytra, one left fragment, two right elytra with broken tips, one right elytron entire but in two pieces from Pit Bliss 29, and one broken right elytron from Pit A, total 8 specimens, maximum 5 individuals.

This species occurs in Wisconsin, Arizona, Southern California, Baja California, and Mexico proper.

The name *ramosa* is well given, because the two medial and the cubital veins are ridged and laterally branched like the branches of a tree. The material at hand cannot be separated from the modern species.

The under side of the elytra is a metallic green, while the outer surface is black with a faint greenish tinge. While the raised striæ above do not show their origin, on the under side the first two are clearly branches of medius extending to the axillæ. The third stria is the cubitus. The jugum or shoulder and clasping edge is flattened at shoulders, and then raised to the clasping edge.

The tips of the elytra are of two types, one acute (♀) in *C1c. e, f,* and the other rounded (♂) in *C1a.* See figures 3a, 3b.

TRIBE NICROPHORINI

GENUS NICROPHORUS Fabricius

This genus is present at McKittrick and at Los Angeles, there being several distinct species in the asphalt. At present 70 heads, 63 pronota, 12 tibiæ, 6 scutella, and 20 elytra have been separated out, representing 96 individuals at least.

There are two types of scutellum, four types of elytra, three types of pronotum, two types of head in the series, and the heads can be divided by sex.

The first and most important fact emerging from the study of these fragments is that the head capsule of modern Nicrophorus has been wrongly interpreted.

There is necessity for a rectification of an error by Dr. Horn, who interpreted as clypeus all of the area in front of a transverse line in front of the eyes. This line is the frontal suture. In front of this are areas of two textures. He called the anterior portion the "rhinarium." This is the true clypeus, which more or less deeply invades the frons, the two being separated by a very arcuate epistomal suture. The frons becomes a two lobed sclerite with a more or less narrow median bridge.

A study of modern specimens shows a fine sexual character in the shape of these two organs. In the males the clypeus is usually more quadrate with its margin parallel with the margin of the frons so that the frontal bridge is narrow. In the females the clypeus is more apt to be triangular, and the frontal bridge broader, or the clypeus is shallowly rounded. This character should be studied on all modern species. See figures 7, 8, 9, 14 for outlines of the epistomal suture.

In the disintegration of the insect the eyes, antennæ, clypeus, labrum, mandibles, maxillæ, and mentum to labium have been lost. Some of these severed parts are probably chitinous enough to persist and may be found in the microscopic study of the sands recovered from the tar.

This cleavage is along the epistomal, pleurostomal, and hypostomal sutures, and leaves a perfect ring segment, with a definite neck behind the occipital suture. This does not agree with Snodgrass' claims of a segment including clypeus, pleurostoma, gula and postocciput.

If this cleavage is segmental it means that the mouth organs, including clypeus and submentum all belong to one segment, the various parts of which have been subdivided. In other words, the dorsal sclerite consists of clypeus and labrum; the dorso-pleural sclerite, the pleurostome and mandible; the ventro-pleural sclerite, the hypostome and maxilla; the ventral sclerite, the submentum, mentum and labium. The epipharynx and hypopharynx could even be considered as a segment beyond this, which has been drawn in. All of these are separated from the head capsule in the processes of disintegration.

The segment that remains includes dorsally the frons, vertex, epicranium, and postepicranium; dorso-pleurally the parietals, with antennal and ocular sclerites; ventro-pleurally, the genæ; and ventrally, the very narrow gula; behind these the occipital and postoccipital are complete rings.

Melville Hatch in his Studies on the Silphinæ (loc. cit.) divides the genus into various groups based on the shape of the pronotum, and thus assists us in placing the specimens of thoraces in species groups. His key is of no assistance for heads, scutella, elytra, or tibiæ. The only recourse is careful comparisons of modern species. While the various species differ greatly among individuals in size and color pattern, there is usually a well marked distinction between species. The new characters of frontal and clypeal sexual forms will force a reconsideration of species classification in some groups.

The elytra (figures 4a, 4b) in this genus are not only characterized by the sinuate emargination of the apex, but also by the long slanting costal margin caused by the large scutellum. The humeri are rounded. Externally there is little evidence of the striæ, beyond a few larger punctures, two being faintly indicated by a raised line on the disc, and the third on the upper edge of the lateral declivity. Internally, the raised striæ are much more pronounced. The axillary condyle very clearly shows three prongs, the lower and inner being the first axilla to which costa and subcosta are attached. At the apex of the scutellar emargination there is a notch probably indicating the end of the subcosta, and the twisting over of the costa, at which point radius takes the outer margin with costa margining an infolded strip. The two veins showing externally are the two branches of medius, quite plain on the under side, united near base, and arising from the second axilla. The cubitus is absent. The humerus is quite convex and belongs to the vannal region. The first vannal forms the dorso-lateral ridge and the second vannal the lateral margin of the elytra, both reaching the apex; the vannal area being broad at humeri and gradually narrowed to a point at apex. At the base margining the second vannal vein there is an infolded strip which corresponds to the jugum. The apex of each of the elytra is sinuate from the subacute costal angle to the obtuse vannal angle, and internally it is infolded to a transverse ridge paralleling the margin except in the radial area where it is farther from the margin and straight.

The surface of the elytra is regularly though sparsely and shallowly punctate, with occasional larger punctures.

NICROPHORUS GUTTULUS LABREÆ, new subspecies

(Figures 4 to 10)

One of the difficulties in placing the fossil fragments lies in the proper determination of the modern species. In the Museum collection running to *Nicrophorus guttulus* Motschulsky by the Hatch key, there are two distinct types of male frons and clypeus, the one with the square-cut clypeus dividing frons by a very narrow bridge; and the other in which the clypeus is small and frons has a broad bridge. There is a series with black-clubbed antennæ, and a series with reddish or orange-clubbed antennæ. Obviously the modern species needs some very critical study.

Inasmuch as the material here considered does not completely agree with *N. guttulus guttulus* Motschulsky in the collection, in the range of size of pronotum, shape of prothoracic scutellum, or in the indicated color pattern of elytra, a subspecies name is given for purposes of identification.

The material consists of 8 more or less complete ♂ heads and fragments of 5 more, 13 more or less complete ♀ heads and fragments of 4 more from Pit X; 6 complete ♂ heads, and fragments of 6 more and 21 complete ♀ heads from Pit A; 1 ♀ head from Pit B; 1 ♀ head from undesignated pit; and 2 heads from Pit Bliss 29; totalling 65 heads. There were 24 complete and 5 fragments of pronota from Pit X; 21 complete and 10 fragments from Pit A; 2 pronota from Pit B; 1 from Pit 37; 1 from Pit 28; and 5 complete, 4 partial pronota from Pit Bliss 29; total 73 pronota. Also 4 complete and 3 fragments of elytra from Pit A; one left fragment from Pit X; 2 fragments from Pit 81; 5 scutella from Pit A; one femur, 8 tibiæ from Pit A, and 3 tibiæ from Pit 81. While there are differences in sizes of heads and pronota, it is believed that all of this material represents one form. At least 77 individuals are represented as follows: Pit A—33; Pit X—30; Pit B—2; Pit 28—1; Pit 29—9; Pit 37—1; Pit 81—2.

In describing a fossil species, where the elements were separated, the description must start with the most identifiable part, and in the present state of the keys, the pronotum gives that character.

The pronotum (Figures 5, 6) of this insect is strongly cordate, much broader in front than behind, and is laterally strongly sinuate, without apical angles. The narrow anterior margin is the prescutum, set off from the scutum, by clearcut linear depression. The broad anterior portion of the scutum is defined laterally by a triangular broadening of the margin into a ledge, from which arises the transverse depression or notaulix. This depression crosses the notum and has three forward branches, which divide the anterior portion of notum into two broad quadrate median areas and two lateral parapsidal areas. The posterior ⅔ of the notum is the true scutum. Laterally and posteriorly the notum is flattened into a marginal ledge. Ventrally the tergum has anterior, lateral and posterior folds. The anterior infold is the acrotergite, lenticulate in form.

The ventro-lateral extension of the tergum is divided by the notaulix into an anterior shoulder, which might be termed the prescutal lobe; and a broad lobate part of the scutum corresponding to the suralare of a wing-bearing segment. Posteriorly, and completely concealed externally in the whole insect, though connected with the above mentioned suralare lobe, is the lenticulate scutellum, and a postscutellar bilobed area, actually in front of the scutellum. The existence of a pronotal scutellum in beetles has not previously been reported. The intersegmental skin is attached to the inner margin of the postscutellum.

Measurements of the pronota attributed to this form range in length on median line from 5.0 to 7.5 mm. (mean 6.0 mm.); in greatest breadth from 5.9 to 9.0 mm. (mean 7.15 mm.); in ratio of length to width from 1: 1.07 to 1: 1.28 (mean 1.187).

The head (figs. 7, 8, 9) in this species is readily separable by sex. The male frontal bridge (fig. 7) is narrow, with its anterior margin parallel with the margin of the frontal suture. In the female (fig. 9) the shape of the clypeal indention is more triangular, so that the bridge is narrow only at its median point.

The head has considerable movement, as the long occiput fits deeply into the pronotum and must have a wide intersegmental neck. Dorsally, the occiput has two posterior notches, and the postocciput is a complete invaginated ring. The occiput is a broad ring, cut only medianly beneath by the gular suture. In front of the occipital suture the head is abruptly swollen. Between this suture and the frontal suture above and the hypostomal suture beneath, the vertex, parietals, genæ and gula form a complete ring, with the large eye sockets in the anterior part of the parietals. The vertex is shield shaped, rounded behind, defined by smoother sculpture behind, and in front by two post frontal sutures; medianly the coronal suture is partially indicated. The gula is narrow, defined by the tentorial pits, and acutely terminating in an indistinct suture behind. In front of this solid ring are a number of smaller pieces for attachment of the deciduous appendages. Dorsally, the frons is two pronged, the frontal suture being sinuate, transverse, turning forward at the sides of the frontal processes. The antennal sockets lie at the sides of and outside the frontal lobes immediately in contact with the epistomal suture. Beneath, the central piece is a broad bridge-like hypostoma separating gula from the deciduous mentum; and laterally are two narrow subgenæ for the attachment of the maxillæ.

Thus the cranial capsule consists of four rings: (1) postocciput; (2) occiput, postgenæ, gular suture; (3) vertex, parietals with eyes, genæ, and gula; (4) frons, peristome with antennal sockets, subgenæ, and hypostome. The front outline of this last is the epistomal suture, and the deciduous parts are therefore clypeus and labrum, mandibles, maxillæ, mentum and labium, epipharynx and hypopharynx. Some of these deciduous parts may later be retrieved as the study progresses.

The mesothoracic scutellum (fig. 10) is large and interesting. It has been found five times in the pit A material, varying slightly in size. It is united with the scutum and this internally with the phragma. The scutellum proper is bluntly triangular with the ratio of breadth at base to length varying from 1:1.09 to 1:1.22 (mean 1.13), base bisinuate, sides sinuate. The scutellum is broader at base than the subquadrate scutum, which is rimmed on all sides and ridged on the median line, basal lateral angles diagonally truncate. The phragma is bilobed, but quite differently from the specimen called *N.obtusiscutellum* (fig. 12).

A total of 6 right and 5 left elytra (Figures 4a, 4b) have been found that are fairly consistent in character. These are uniformly larger than those ascribed to the other species, measuring from 11.5 to 12.1 mm: in length, and 5.2 to 5.6 mm. in width. A faint color pattern is apparent, the red being indistinct: consisting of two transverse bands connected laterally; the anterior complete with a lobe behind; the posterior not reaching the suture, and bilobed. Internally the two forks of the medial vein are distinct. The apex of the elytron is infolded with the inner edge more sinuate than the posterior edge.

NICROPHORUS GUTTULUS GUTTULUS LAJOLLÆ HATCH

Two right and one left elytra from Pit A. The two right elytra measure 9.6 by 4.4 mm.; the left is smaller and measures 7.9 by 3.8 mm. These correspond to Hatch's color variety *lajollæ*, having a basal red spot near the base of the vannus. The vannal ridge is sharp to the humerus. Punctation is clear, linear, but with no indication whatever above of Medius 1 and 2. The punctation is denser just before the smooth apical margin. Inner apex subacute, apical margin sinuate, outer apex obtuse. On the under side the 2 radial, cubital and vannal veins are clearly outlined, the medial being raised. The red vannal spot is clear on the under side.

NICROPHORUS GUTTULUS PUNCTOSTRIATUS, new subspecies

One elytron (*C132b*) from pit A is smaller than those previously discussed, measuring 7.0 by 3.4 mm., and is characterized by transverse double punctures outlining the two median veins and also cubitus.

NICROPHORUS MCKITTRICKI, new species
(Figure 11)

Based on 1 pronotum (holotype), 1 right elytron, 1 left elytron from Site 3, depth 2 ft. at McKittrick; 3 right and 3 left elytra from Site 4, depth 4 ft, at McKittrick; with which are tentatively associated 1 head, 1 pronotum from La Brea pits Pit A; 1 pronotum from Pit 28; 1 pronotum from Pit 29; 3 heads from Pit X; and 1 head from Pit B.

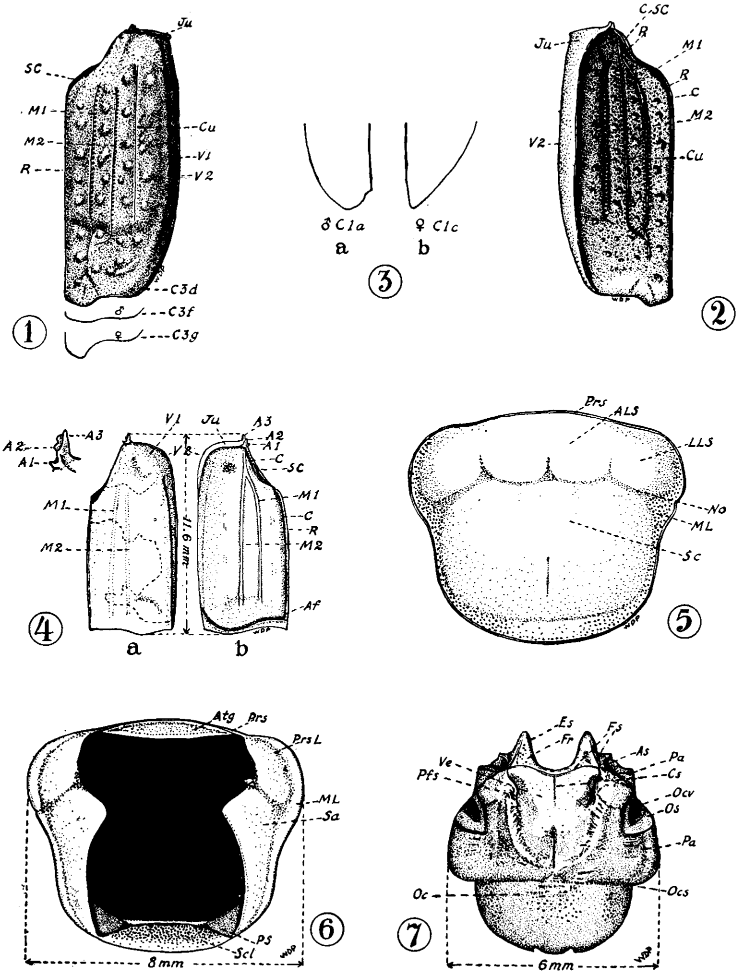
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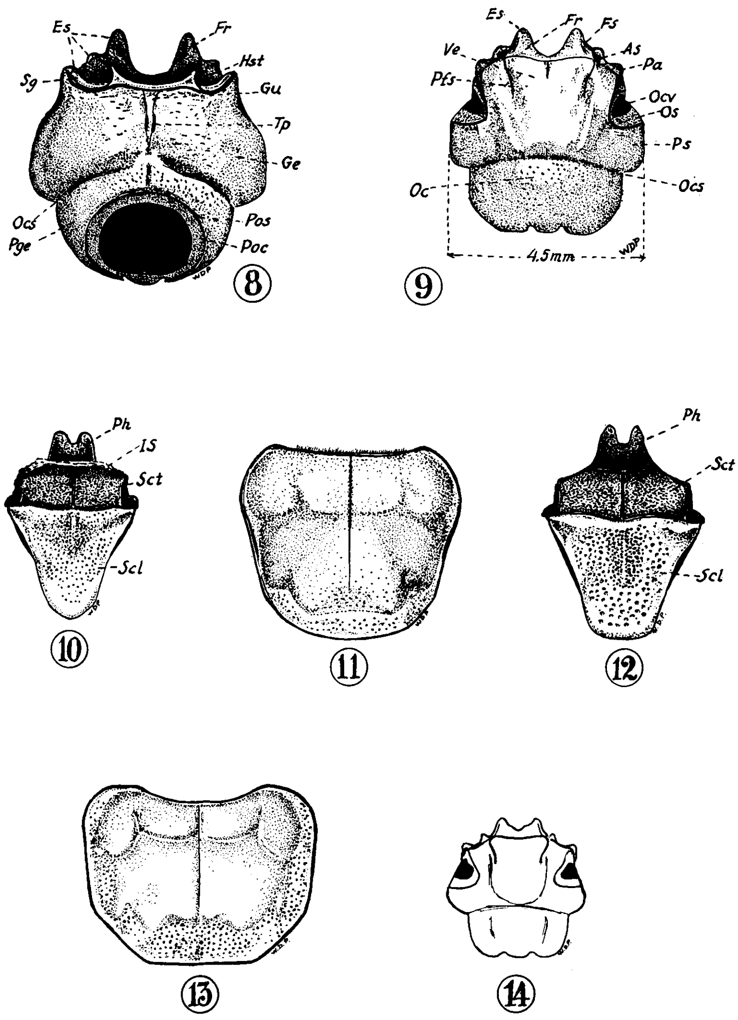
PLATE 9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Sct
Scl
10
11
Ph
Sct
Scl
12
13
14

PLATE 10

This species probably belongs to the *marginatus* group, possibly near *guttulus*, but the shape of the thorax (Figure 11) is different, being much less sinuate on the sides. The median impression on pronotum is distinct; the flattened posterior area is not rounded regularly as in *guttulus labreæ*, but has two lateral angular processes into the convex area. Pronotum *McK3a* measures 4.72 mm. in length by 5.20 mm. breadth, or a ratio of length to breadth 1: 1.101.

The elytra measure 8.1 by 3.8 mm., ratio 2.13:1. Vannal ridge extends to a point opposite the humeral angle; punctation is shallow, with no external indication of veins; the inner apical angle is slightly acute. On the inside the veins are distinct.

NICROPHORUS OBTUSISCUTELLUM, new species
(Figure 12)

One scutellum from Pit A differs so radically from that of *C. guttulus labreæ* and from any scutellum in the Museum's modern collection that it is given name pending its correlation with other materials to be later found. The scutellum proper measures 3.04 mm. in length by 3.84 mm. in breadth.

NICROPHORUS INVESTIGATOR ALPHA, new subspecies
(Figure 13)

Described from five complete and one fragmentary pronota from Pit A, obviously belonging to the *N. investigator* series. No other parts are as yet clearly associated with this species. The form belongs near to *N. i. nigritus*, and one specimen has the same ratio of length to width as a modern specimen from Pasadena.

They vary in length from 4.16 to 5.44 mm., in breadth from 6.24 to 7.52 mm., and in ratio of length to width from 1:1.27 to 1:1.50. This thorax is subquadrate with the posterior angles diagonally truncate, the median sulcus distinct, the flattened areas broad and irregular.

One head (*C120d*) from Pit X somewhat resembles heads in the Museum collection of *N. investigator*, and so it is tentatively called NICROPHORUS INVESTIGATOR LATIFRONS, new subspecies (Fig. 14).

ILLUSTRATIONS

Figure 1. *Silpha lapponica* Herbst elytron; dorsal view of specimen *C3d*, with outlines of the apex of ♂*C3f* and ♀ *C3g*. *Cu*—cubital vein; *Ju*—jugum; *M1*, *M2*—medial veins; *R*—radius; *SC*—subcosta; *V1*, *V2*—vannal veins.

Figure 2. *Silpha lapponica* Herbst elytron, under side.

Figure 3. *Silpha ramosa* Say. *a.* tip of ♂ elytron (*C1a*); *b.* tip of ♀ elytron (*C1c*).

Figure 4. *Nicrophorus guttulus labreæ* Pierce elytron (*C3d*). *a.* upper side; *b, under side. A1*, *A2*, *A3*—articular condyles; *Af*—apical fold; *C*—costa; *Ju*—jugum; *M1*, *M2*—medial veins; R—radius; *SC*—subcosta; *V1*, *V2*—vannal veins.

Figure 5. *N. g. labreæ* pronotum (*C2 f*). *ALS*—anterior lobe of scutum; *LLS*—antero-lateral lobes of scutum or parapsides; *ML*—marginal ledge; *No*—notaulix; *Prs*—prescutum; *Sc*—scutum.

Figure 6. *N. g. labreæ*, underside of pronotum. *Atg*—acrotergite; *ML*—marginal ledge; *Prs*—prescutum; *PrsL*—prescutal lobe; *PS*—postscutellum; *Sa*—suralare; *Scl*—scutellum.

Figure 7. *N. g. labreæ*, head of ♂ (*C2bg*). *As*—antennal sclerite; *Cs*—coronal suture; *Es*—epistomal suture; *Fr*—frons; *Fs*—frontal suture; *Oc*—occiput; *Ocs*—occipital suture; *Ocv*—ocular cavity; *Os*—ocular sclerite; *Pfs*—postfrontal suture; *Ve*—vertex.

Figure 8. *N. g. labreæ*, under side of ♂ head. *Es*—epistomal suture; *Fr.* frons; *Ge*—gena; *Gu*—gula; *Hst.*—Hyposterum; *Ocs*—occipital suture; *Pge*—postgena; *Poc*—postocciput; *Pos*—postoccipital suture; *Tp*—tentorial pits.

Figure 9. *N. g. labreæ*, dorsal view of ♀ head (*C2bf*). As in No. 7.

Figure 10. *N. g. labreæ*, mesonotum (*C2bh*). *IS*—intersegmental skin; *Ph*—phragma; *Scl*—scutellum; *Sct*—scutum.

Figure 11. *Nicrophorus mckittricki* Pierce, pronotum (*McK3a*).

Figure 12. *Nicrophorus obtusiscutellum* Pierce, mesonotum (*C120e*). As in No. 10.

Figure 13. *Nicrophorus investigator alpha* Pierce, pronotum *(C121d)*.

Figure 14. *Nicrophorus investigator latifrons* Pierce, dorsum of ♀ head (*C120d*).