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PLATES I-II.

JANUARY 18, 1908.

STUDIES IN THE PHYSIOLOGY AND MORPHOL-
OGY OF SOME CALIFORNIA HEPATICÆ.

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THE morphology and physiology of the Hepaticæ have been treated by many authors, but their work has been confined mainly to the group as a whole. The intimate relations of the liverworts to their environments, have however, received only incidental treatment. Ordinarily we are inclined to associate with the Hepaticæ an environment characterized by moisture and shade. To a certain extent we are justified in doing so, for the majority of the known species occur in just such a habitat, many of the larger and more striking ones, such as *Monoclea*, *Dumortiera* and some species of *Aneura*, being common in the more humid regions of the tropics. On the other hand many species are known to occur normally in parts of the world where climatic conditions are not so evenly balanced as in the tropics; many thrive in extreme northern and southern regions where they are subject to great variations in temperature, while those growing in regions like the west coast of the United States must adapt themselves to prolonged periods of drought alternating with six or seven months of rainy weather.

It was with a view of ascertaining the nature and influence of these various conditions common to certain California hepaticæ that the present study was undertaken.

The author wishes to acknowledge his obligations to Professor Douglas H. Campbell and Associate Professor George J. Peirce under whose direction the work was pursued. Thanks are also due Professor Alexander W. Evans, Dr. Marshall A. Howe and Professor Roland Thaxter for assistance in the determination of material and for the use of certain hepaticæ sent to the writer.

PARASITISM AND SAPROPHYTISM IN HEPATICÆ.

The association of certain fungi with hepaticæ was first described in detail by Leitgeb,¹ who, in his studies on *Ptilidium ciliare*, observed the infection of young sporogonia. He found that all such sporogonia were more or less abnormal in their mode of segmentation and inferred from this that the infected organs were structurally effected by the action of the fungus.

Following Leitgeb, a number of writers have observed fungus infection in other hepaticæ. As early as 1879, Kny² discovered sterile fungal hyphæ in the rhizoids of *Lunularia* and *Marchantia*. These, he states, were found to be present in rhizoids undergoing a process of regeneration, which process may have been stimulated by the hyphæ. Cavers³ has observed that when *Marchantia* and *Lunularia* grow in ordinary soil free of humus the rhizoids are penetrated by hyphæ which grow upward as delicate filaments showing cross-walls at rather long intervals. These hyphæ occasionally become branched but never, so far as he has observed, reach the tissue of the thallus. On the other hand, he has found that when these plants grow on humus soil the hyphæ extend into the compact tissue of the thallus, to which in fact, they are largely confined.

Golenkin⁴ observed the presence of endotrophic mycorrhiza in *Marchantia palmata*, *M. paleacea*, *Preissia commutata*, *Tar-*

¹Leitgeb: Untersuchungen über die Lebermoose, Heft 2, p. 58; Tafel 3, Fig. 26.

²Kny and Bottger, 1879: Ueber eigenthümliche Durchwachsungen an den Wurzelhaaren zweier Marchantiaceen. Verhandl. d. bot. Vereins d. Prov. Brandenburg, p. 2 of Separate.

³Cavers, 1903: Saprophytism and Mycorrhiza in Hepaticæ. The New Phytologist, Vol. II, No. 2, pp. 32-33.

⁴Golenkin, 1902: Die Mycorrhiza ähnlichen Bildungen der Marchanteen. Flora, Band 90, p. 209.

gionia hypophylla, *Plagiochasma elongatum* and *Fegatella conica*. In all these the hyphæ are confined to the more compact tissue of the thallus.

Jeffrey,¹ in his paper on the Gametophyte of *Botrychium virginianum*, describes an endophytic fungus associated with this fern. His observations show that conidia develop singly within the host cells usually at the end of a hypha. These peculiar conidia germinate *in situ*, generally producing a germ-tube which forces its way into the neighboring cells of the host. Within certain cells of the host he observed the development of vesicular structures along the enclosed hyphæ. Similar structures have been observed by Bruchmann² in his recent studies on *Ophioglossum vulgatum*. In his Fig. 42 he has indicated fungal structures similar to those common to the endophytic hyphæ found by the author in cells of *Aneura multifida major*.

The same writer³ in his work upon *Botrychium lunaria* describes an endophytic fungus infecting the cells of the prothallium. He states that the hyphæ usually find entrance to the prothallial tissue through the rhizoids though in some instances they are found penetrating the outer, cuticularized surface of the prothallium. Once within the cells of the host, the hyphæ fill the cells with their sclerotia-like structures and *vesicular* enlargements. All starch of the infected cells disappears, but he finds oil and albumen within the hyphæ which he regards as reserve products to be utilized later by the growing embryo. Thus he recognizes a symbiotic relationship between fungus and host, and in another part of the same paper he advances the theory that the endophyte is a probable means in assisting the prothallium to withstand the rigors of hot and cold weather.

¹Jeffrey, 1898: The Gametophyte of *Botrychium virginianum*. University of Toronto Studies, No. 1, p. 12.

²Bruchmann, 1904: Ueber das Prothallium und die Keimpflanze von *Ophioglossum vulgatum* L. Botanische Zeitung, Heft XII, Taf. VIII, Fig. 42 und Fig. 42a.

³Bruchmann, 1906: Ueber das Prothallium und die Sporenpflanze von *Botrychium lunaria* Sw. Flora, Band 96, Heft 1, pp. 210-211.

THE PARASITIC FUNGUS ASSOCIATED WITH FOSSOMBRONIA
LONGISETA AUST.

In the writer's recent studies on the Development of *Fossombronia longiseta*¹ no reference was made to the structure of the infecting fungus; in fact, the material then in hand was too scanty to make anything like a satisfactory study. Since the publication of the above paper, however, excellent material has been found in various stages of development, and the relation of fungus to host has been clearly worked out.

So far as could be ascertained, the host is invaded from without by hyphæ that make their entrance through the rhizoids or directly through the cells of the host stem. The infection of the rhizoids is very similar to that described by Cavers² for *Lophozia*, *Cephalozia* and other hepaticæ. As a rule the hyphæ not only invade the rhizoids but extend throughout the tissues of the host, regardless of the nature of the substratum, thus differing somewhat from the nature of infection reported by Cavers where he has observed that the degree of infection varies with the amount of humus in the soil. In *Fossombronia*, as a rule, the hyphæ infecting rhizoids alone were confined to the inner wall of the organ, though in some instances not a few rhizoids were found in which hyphæ had penetrated through the wall to the exterior as shown in Fig. 3. The host thus affected was growing in soil containing little humus and in no case were these external hyphæ observed to grow longer than those figured. The hyphæ confined to the rhizoids are very seldom branched and are rather remotely septate. In certain parts, however, usually at the end of a branch, short segments not unlike conidia develop and are abstricted from the hypha. The subsequent behavior of these has not been observed. It is, however, quite probable that these structures furnish one means of transfer of infection. I did not find in *Fossombronia* anything comparable with the conidia described by Jeffrey³ as occurring in the endophyte of *Botrychium virginianum*.

¹ Humphrey, 1906: The Development of *Fossombronia longiseta* Aust. Annals of Botany, Vol. XX, No. LXXVII.

² Loc. cit.

³ Loc. cit.

In a few instances infected rhizoids were found to have undergone considerable modification of form as seen in Fig. 5. On the other hand very similar modifications were repeatedly observed in uninfected rhizoids. These were very likely due to the stimulus of contact with compact soil. Whether the fungus is instrumental in the development of such malformations as the one shown in Fig. 5 cannot be determined at this writing. It is, however, hardly probable, for the writer has observed that when infected plants are transferred to Knop's solution the new rhizoids though seriously infected maintain a uniform direction of growth and are apparently unaffected by the hyphæ.

In a previous paper¹ mention was made of the fact that *Fossombronia* plants in many instances developed a tuberous growth which, on careful examination, was found to contain a more or less complex growth of fungus hyphæ. Microchemical tests demonstrated the presence of a large quantity of starch, oil and nitrogenous food products within the cells of this tuberous growth and this, no doubt, in a measure accounts for the greater development of the fungus in this region. So far as the author has observed, none of these tuberous growths is free from infection. It is hardly probable, however, that this structure is directly due to the activity of the fungus for it is a structure common to a number of other hepaticæ such as *Geothallus tuberosus* Campb., *Riccia cancellata* Tayl., *Fossombronia tuberifera* Goobl., and a number of others in which no fungus infection has been observed. Specimens of *Geothallus tuberosus* have been carefully examined by the writer with a view to ascertaining the presence of infection, but in all material examined the tubers were uninfected and filled with reserve food products as described by Campbell,² '95. No doubt the tuber in the case of *Fossombronia longiseta* serves the same purpose as in *Geothallus tuberosus* or in *Fossombronia tuberifera*, *i. e.*, as a special structure to carry the plant through a more or less prolonged dry season. Howe³ has shown that in specimens of

¹ Loc. cit.

² Campbell, 1896: A New California Liverwort. Botanical Gazette, Vol. 21, No. 1, p. 12.

³ Howe, 1899: The Hepaticæ and Anthocerotæ of California. Memoirs of the Torrey Botanical Club, Vol. VII, p. 80.

Fossombronia longiseta collected in southern California where the dry season is longer, this tuberous growth is considerably more marked than in the case of plants in the northern half of the state. Owing to the earthquake of April 18, 1906, a break occurred in a water-pipe not far from Stanford University. As a consequence a considerable tract of ground was well irrigated throughout the past, very prolonged dry summer. Upon this thoroughly moistened soil the writer found, growing vigorously, a considerable number of plants of *Fossombronia longiseta*, *Anthoceros pcarsoni*, *Targionia hypophylla*, and some species of the more common mosses. Here were growing a number of plants accustomed to summer desiccation and it occurred to the writer that under these conditions of increased humidity certain structural changes might result both in the development of the gametophyte and sporophyte.

Careful examination of a large number of these plants revealed no evidence of anything in the nature of a tuberous growth in any part of the thallus though all plants examined showed fungus infection. It would seem therefore that this instance would lend some support to the inference that, so far as our species of *Fossombronia* is concerned, these small tuber-like structures are purely adaptive and their development depends largely upon certain external factors. Whether growth under similar conditions would result in the reduction or disappearance of the tubers in such plants as *Gcothallus tuberosus* or *Anthoceros phymatodes* is a matter that has not yet been tested. In these forms the tuber is a well-marked and doubtless long-established modification of the thallus and if reduced at all would probably require a considerable period of time during which conditions of constant moisture are allowed to act. Peirce,¹ '06, has demonstrated that such a well-marked character as the dorsiventrality of certain liverwort gametophytes is not a hereditary character as commonly supposed but is primarily due to the formative influence of light.

As elsewhere stated, some plants of *Fossombronia longiseta* were studied in which the rhizoids were apparently free from

¹ Peirce, 1906: Studies of Irritability in Plants. Annals of Botany, Vol. XX, No. LXXX, p. 459.

hyphæ, though the more compact tissue of the thallus was in many such instances thoroughly infected. Thus it would seem that infection need not necessarily take place through the rhizoids. Material carefully fixed in chromic acid (1 per cent.) and stained with the Fleming's triple combination seemed to give very satisfactory results, though it was found necessary to allow more time to the action of the stain than was customary in staining organs or structures of the host. Sections through the stem of infected plants almost always showed a well-defined zone of cells more or less given over to hyphæ. This is not unlike the condition observed by Cavers¹ ('03) in *Fcgatella* and by Golenkin² ('02) in a number of forms cited above. Golenkin states that the cells of this zone, though still retaining their protoplasm and nuclei, are void of chlorophyll and starch. Careful examination of infected cells of *Fossombronina*, except where infection was so far advanced that the cells were occupied by developing sclerotia, revealed the presence of varying amounts of chlorophyll and starch, depending upon the number and vigor of invading hyphæ.

Unlike the forms described by Golenkin, this fungus is not necessarily confined to any given zone, for any portion of the thallus may be invaded by hyphæ extending out from the more compact parts. Though several hundred fruiting plants have been studied, no evidence of infection of either antheridium or archegonium has yet been seen, and the sporophyte is apparently free from the attack by fungus.

In material fixed in January, 1904, about three months after the beginning of the rainy season, almost the entire tissue of the stem was packed with hyphæ, many branches extending through the outer layer of cells of the host into the substratum.

Although the fungus was present in virtually the whole of the stem-tissue, strictly speaking, it was found that at this stage of its development the hyphæ were more or less confined to the innermost cells of the stem while those in proximity to the growing point as well as the leaves were apparently free from infection. The epidermal cells and those immediately beneath

¹ Loc. cit., p. 33.

² Loc. cit., p. 209.

showed evidences of comparatively few hyphæ which evidently served to connect the more functionally active interior system with those in the rhizoids and with the substratum. Thus far the habit of growth of this fungus agrees quite consistently with those described by Cavers.¹

At about this period in its development one may observe, scattered here and there throughout the infected zone, vesicles of considerable size and presenting a variety of form. These appear as great enlargements of the hyphæ and are full of rather coarsely granular protoplasm (Fig. 6). This protoplasm has within it minute nuclei, at first rather few in number but as the vesicles become older and larger increasing in number until they quite fill the interior of the vesicle. It was further found that in some instances at least these vesicles are connected with the exterior by hyphæ (Fig. 8) and along the course of these hyphæ may be seen certain of these nuclear bodies. Whether or not they make their escape to the exterior as zoöspores could not be demonstrated, but their development and subsequent behavior is suggestive. In his recent work upon the development of *Ophioglossum pendulum* and other members of the genus, Campbell² has demonstrated the presence of thin-walled vesicles in the endophyte. In these the behavior of the nuclei resembles that occurring in the vesicles of the endophytic fungus found in the *Fossombronia*. In *Fossombronia* these vesicles completely fill the host cells in which they occur, in some cases causing a considerable distention of the cell.

As stated above, the amount of chlorophyll or of starch and other products of metabolism varies with the degree of infection. Certain cells of the host seem packed with hyphæ, and a micro-chemical test fails to reveal any of the products of the normal cell, and while a large part of the stem appears to be dying, the leaves and the uninfected stem tissue seem to be vigorous and unaffected by the presence of the fungus. Comparison of infected plants with those entirely or nearly free from fungus invasion seems to demonstrate that up to the vesicle stage of development the growth of the host is not abnormally stimulated, in

¹ Loc. cit., p. 32-33.

² Campbell, 1907.

fact an extensive examination of plants of both sorts leads one to conclude that the presence of the fungus is of no advantage to the host and in many instances is an evident detriment. In March, 1906, while making some field studies upon *Fossonbronnia*, the writer observed that certain plants appeared to be dying. The affected plants were in some instances almost white, apparently from loss of chlorophyll. Closer examination with a hand-lens revealed the presence of a great number of minute black bodies along the length of the stem and in the leaves. These were especially abundant near the base of the leaf. On further examination with the microscope it was found that these black bodies were sclerotia within the cells of the host and the development of these resulted ultimately in the death of the host. It was at first thought probable that this fungus was distinct from the one found invading the rhizoids and stem tissue, but a careful study seems to show that the two are identical. At least so far as concerns the host the development of these sclerotia marks the period of greatest activity of the fungus, and its truly parasitic nature is manifested. Up to the appearance of the sclerotia the life of the host is not seriously affected but as soon as the hyphæ begin to extend and to form the structures that later develop sclerotia a very evident drain upon the vitality of the host sets in and increases with the further development of these structures.

It was at first thought that these might be perithecia of some ascomycete but microtome sections demonstrated their true nature. Wherever they occur the cells containing them become considerably distended and completely filled. Their presence causes no abnormal development of the cell as regards thickness of wall or form, though the cell-contents become much modified to the extent that all vestige of any starch, oil, cytoplasm, etc., has disappeared, even the nucleus is absorbed and the entire cell cavity is filled by the sclerotium.

The behavior of the hyphæ with reference to the nucleus and chromatophores as described by Cavers¹ for the fungus infecting *Monoclea* does not occur in the case of the fungus under

¹Cavers, 1904: Contributions to the Biology of the Hepaticæ. Part I. *Targionia*, *Reboulia*, *Preissia*, *Monoclea*. p. 39.

consideration. In *Monoclea* the fungus is confined to a sharply defined mycorrhizal zone three or four cell layers in thickness. Many of the cells in this zone are filled with branched hyphæ, tufts of which seem to envelop the nucleus. In some cases even the chromatophores, like the nucleus, become surrounded by similar tufts of branching hyphæ in a manner quite suggesting the formation of a lichen.

In *Fossombronina* the hyphæ preceding the development of a sclerotium are but sparsely ramified. The first indication of the sclerotium is the increase in diameter of the hyphæ within a cell followed later by the profuse development of short, thick anastomosing branches between which may at first be seen spaces of varying size which ultimately disappear as the sclerotium increases in extent (Fig. 10). The nucleus and chromatophores at first visible finally disappear, doubtless being taken up by the actively growing fungus. As yet the writer has failed to observe how these structures are consumed.

According to Czapek¹ the tissues of *Marchantia*, *Fegatella*, *Lunularia* and other hepaticæ contain an antiseptic principle which he calls "sphagnol" because of its abundance in the peat-mosses. He has shown that this substance exists in combination with the cellulose of the cell-walls and exerts an inhibitive influence upon the development of moulds and bacteria. This, Cavers² thinks, suggests the view that in the case of certain *Fusarium*-like fungi the "sphagnol" may serve to regulate the growth of the fungus and prevent symbiosis from passing into parasitism. In the case of *Fossombronina* it cannot be shown that at any time during a period of infection the invading fungus maintains a symbiotic relation with reference to the host, for an examination of infected cells shows that the presence of hyphæ sets up a disturbance of the cell-metabolism, the cell becoming impaired to such an extent as ultimately to cause its death. The degree of this impairment varies with the activity and extent of the parasite. To be sure, many infected plants appear to be quite as healthy and fertile as

¹Czapek, 1889: Zur Chemie der Zell membranen bei den Laub. und Lebermoosen. Flora, Band 86, p. 361.

²Loc. cit., p. 33.

others yet free from the fungus, but it is owing to the fact that the degree of infection is but slight and the vigor of the host is sufficient to throw off for a time the harmful effects of the parasite just as the leaves of cultivated lettuce maintain apparent full vigor during early stages of the infection by *Bremia lactuca*.¹

Experiments designed to ascertain the effect of the fungus upon very young plants of either *Fossombronina* or *Fimbriaria* have thus far failed, and it cannot be decisively stated here that *Fimbriaria* is at all susceptible to infection by this fungus. The examination of a large number of plants of all stages of development has shown our common species, *F. californica*, comparatively free from infection by any fungus. Recently, however, the author has found a few plants of this species attacked by a fungus which seems, in material thus far examined, to be confined entirely to the cells of the first four layers on the ventral side of the thallus. Hyphæ in considerable numbers were observed in both the smooth and tuberculate rhizoids. These showed but slight tendency toward branching, in many instances extending the entire length of a rhizoid without producing a branch. The hyphæ confined to the rhizoids, compared with those within the mycorrhizal zone of the thallus, are very much more delicate; but upon extending into the cells of the thallus they branch profusely and develop relatively thick and tough walls. The fungus resembles the one described above for *Fossombronina*, in that it is filamentous and septate. Structures comparable to vesicles, conidia or sclerotia have not yet been observed. The presence of the fungus seems in no wise to retard the growth or affect the vigor of the thallus and no plants have yet been found in which the hyphæ have penetrated the chlorophyll-bearing tissue.

THE PARASITIC FUNGUS ASSOCIATED WITH ANEURA MULTIFIDA MAJOR.

While in the field collecting *Aneura* the writer observed that a considerable number of plants had taken on a rusty brown

¹An illuminating discussion of symbiosis and parasitism is to be found in Plant Physiology. Peirce. Pp. 85-92 inclusive.

color. Upon careful examination it was found that they were in a dying condition owing to the presence of a fungus. A large quantity of material consisting of plants in a normal condition as well as those visibly affected by the fungus were brought into the laboratory in September, 1906, where the relation of fungus to host could be more carefully studied. This species of *Ancura* is found growing on moist surfaces of rocks along streams, on decaying logs and moist banks of soil in which there is considerable clay. Material collected from all three of these sources contained a large number of infected plants so it is hardly probable that the fungus is one confined to plants growing on decaying wood.

Ancura multifida major, as well as other species of this genus, under certain conditions produce two-celled gemmæ in great numbers. It was found that many of these after a short time had germinated and some were infected. Figure 15 shows a young plant resulting from the germination of a gemma, into the older cells of which a fungus had penetrated by well-marked haustoria. The diseased cells contained less chlorophyll and showed unmistakable evidences of the harmful effect of the fungus. Young plants of varying age and size were found to be infected. It was first thought likely that infection took place directly while the gemma was still within its mother cell, but a very careful examination of gemmæ failed to support any such view. It seems that young plants of less than four cells are rarely infected. The fungus develops conidia freely and it is probable that infection is brought about by their germination. A small number of young plants developing from germinating spores were observed, but as yet none of these has shown the presence of a fungus.

In the older plants, hyphæ from within the cells of the thallus grow downward extending into the rhizoids, though this is by no means so common as in the case of *Fossombronia* or *Fimbriaria*. Many rhizoids whether infected or not present a strong tendency to branch as shown in Fig. 16, *a* and *b*. This is undoubtedly due to the influence of contact stimulus; in fact, rhizoids not in contact with the substratum are all quite simple and more delicate.

In his studies upon *Lophocollea bidentata*, Cavers¹ found that the tissues of the gametophyte are entirely free from hyphæ, but the rhizoids which grow out in tufts from the bases of the amphigastria penetrate the substratum of rotten wood and there become profusely branched like the haustoria of many fungi. This, he considers, enables the liverwort to assume a more or less saprophytic existence. He has not however shown that the plant actually does adapt itself to this mode of life, nor does it appear that we can assume the branching of the rhizoids as due to anything other than contact stimulus. Peirce and Randolph² have demonstrated that in the case of certain attached fresh-water algæ and in many marine forms the development of a holdfast is directly and wholly the result of contact stimulus. The complexity and extent of the holdfast were found to vary with the degree of roughness of the surface of the substratum; young plants grown on ground glass developing much more elaborate holdfasts than similar plants grown on smooth glass while those grown in dust-free water developed no holdfasts at all.

In Knop's solution the writer now has plants of *Fossombronia*, *Cryptomitrium* and other liverworts growing that were removed from a normal soil substratum some months ago. Still attached to these plants are some of the old rhizoids which are all more or less gnarled and modified, some exhibiting short lateral processes. Since placing the plants in Knop's solution a great number of rhizoids have developed and in every instance they are perfectly straight and unmodified and much more delicate in structure than those that had grown while the plants were in their normal habitat. We have here exactly the same behavior exhibited by the secondary roots and root-hairs of higher plants. If, as some botanists maintain, the rhizoids of bryophytes are simply organs of attachment is it not probable that, as in the case of certain algæ, these branches are due to the stimulus afforded by contact?

Aside from *Aneura* and *Fossombronia* the writer has observed branching rhizoids in *Cephalozia bicuspidata*, due probably to

¹Loc. cit., p. 32.

²Peirce and Randolph, 1905: Studies of Irritability in Algæ. Botanical Gazette, 40. pp. 321-350.

the same stimulus, as they were not infected by hyphæ. The fungus associated with *Aneura* differs from that attacking *Fossombronia* both as to development and habit of growth. In the case of the *Fossombronia* fungus we find it to be more truly endophytic, once infection has been brought about, while the fungus associated with *Aneura* seems to be epiphytic in habit, developing haustoria-like branches which in turn develop other branches penetrating and drawing sustenance from the host cells. The hyphæ are septate and profusely branched, especially within the tissues of the host. The hyphæ within the rhizoids are in nearly every instance unbranched and in no case were they seen to grow through the wall of the rhizoid communicating with the exterior as in *Fossombronia*.

The physiological effect of the fungus upon the host is quite as marked as any we have yet studied. The cell walls of *Aneura* are very much thicker than those of most of our liverworts, and the plants are vigorous in habit. Each cell contains usually one large oil body and numerous chromatophores. Fungal hyphæ penetrate the cell walls without any resulting modification and in some instances a single branch may pass through several cells without producing haustoria or branches of any sort. Ordinarily, however, after entrance to the host tissues is effected, the fungus becomes quite extensive, as seen in Fig. 13, where three affected cells are represented. In these it will be observed that the large oil body has already disappeared and the number of chromatophores is somewhat below the normal (compare Fig. 12 with Fig. 14). Ultimately the cells become in some instances packed with hyphæ and at this stage the death of the cell rapidly ensues. Such cells when microchemically tested are void of starch, no nucleus or cytoplasm can be made out, and the chromatophores have undergone complete disorganization; in fact, little remains but the cell wall. In certain plants where the fungus had reached an advanced stage the hyphæ within certain cells had developed into knot-like structures suggesting the beginning of sclerotia; and in a few instances these had, when sufficiently nourished, developed into blackish thick-walled sclerotia completely filling and distending the cell cavity. These, in appearance and structure, very much

resemble the sclerotia formed in the cells of *Fossombronia*, though they do not develop in such great numbers. This is doubtless due to the fact that the comparatively early decline and death of the host tissues impairs the vigor and health of the parasite before these structures can develop in great numbers.

As soon as the host cells begin to show the effects of parasitism there develop upon the surface of the host at indefinite points along the surface-hyphæ, perithecia-like structures (Fig. 11) the real function of which, however, has not been demonstrated. Professor Roland Thaxter kindly attempted to identify the fungus for me but being unable to determine the true nature of these structures was forced to wait for more advanced stages. The writer has prepared a number of slides of microtome sections which show these bodies to be hollow.

Beyond a wall no other structures have yet been observed in connection with the interior of these somewhat globular bodies. They seem to develop from short processes that appear here and there along the external hyphæ. They assume very early the spherical habit and develop at various points on their surface short spine-like processes at first pointing in different directions but ultimately either disappearing or lying all in one plane at the base of the structure bearing them. On certain host plants the tissues of which have already begun to turn brown, these perithecia-like bodies develop in such numbers as to be almost in contact, and the complex of hyphæ on the surface and within the host is very elaborate. Two-celled conidia were found on the surface of the host but it could not be proved that these spores belonged to the fungus infecting *Aneura*, although no other fungus was observed in the material.

It is the intention of the writer to work out the development and life history of this fungus and the one associated with *Fossombronia* more fully in a later paper. At the present moment the main object is to discuss the relation of parasite and host. In the case of this fungus there is less evidence of anything comparable to a symbiotic relation than in the relation of the *Fossombronia* parasite to its host. In fact, as soon as infection is brought about, the host seems to show signs of resulting

injury. The infection spreads from plant to plant quite rapidly. In a dinner-plate full of material, at first the majority of plants examined were unaccompanied by fungus, but within three weeks, on one side of the plate all the plants were turning brown; on examining these they were found to be infected. The fungus seems usually to make its attack through the ventral side of the thallus, though occasionally a plant would be found with hyphæ on both sides. Microtome sections failed to reveal any vesicular structures within the host.

Aneura, being naturally less compact and vigorous than such forms as *Fegatalla* or *Lunularia*, furnishes a poorer field for a parasitic fungus and seems less able to cope with the fungus. This, however, may be partly due to greater vigor of the parasite. It must also be noted that infected plants behave differently under varying conditions. *Aneura multifida major* as we find it here is semi-aquatic as to habitat and when growing under perfectly normal conditions may be considerably infected without showing any effect other than becoming yellowish green in color. If, however, these same plants are brought into the laboratory, even though well supplied with moisture, under a bell-jar they become brown in color finally dying, while uninfected plants seem to thrive quite as well as when growing out-of-doors under normal conditions. Plants growing along streams, though receiving little less than the required amount of water, if infected, seem less able to throw off the effects of the fungus than plants growing under perfectly normal conditions of moisture, light, etc.

Aside from the fungi found in association with *Fossombronia*, *Fimbriaria* and *Aneura*, the writer has had occasion to study infected material of *Anthoceros pearsoni* and *Porcella bolanderi*. In habit of growth the fungus associated with *Anthoceros* is very much like that infecting *Aneura* though none of the material examined showed any structures suggestive of fruiting organs other than conidia which were being formed in considerable numbers by abstriction along the external hyphæ. They branch freely and are seen to anastomose not at single points here and there but continuously for some length, both hyphæ being rather minutely septate along the length of contact. The

hyphæ produce short lateral processes which grow in length until they come in contact with a similar branch of a neighboring hypha effecting conjugation with it; or in case it fails to meet with such a branch it is seen to anastomose with a nearby hypha and in this manner a complicated web of hyphæ may develop over the surface of the host. The same seems to be true with regard to the hyphæ within the host cells, though to less extent. Within certain cells (Fig. 19) dark colored sclerotia-like structures develop, though in the material studied these were by no means abundant. With a limited amount of infected material nothing definite can be said as to the relation of the fungus to the host. All plants examined however seemed practically unaffected by the fungus. Infected cells exhibited the single chromatophore in every case except where sclerotia had formed. Just what would have been the effect had the fungus been as far advanced as in the case of *Fossombronia* or *Aneura* is mere conjecture. Our species of *Anthoceros* have, growing within the thallus, colonies of a species of *Nostoc*, but the writer saw no evidence of fungal hyphæ invading these.

Porcella bolanderi is infected by a fungus of somewhat different habit, though its ultimate effect upon the host is not greatly different from what has been described for *Fossombronia* and *Aneura*.

The principal hyphal trunks appear for the most part to be intercellular, thus differing in this respect from the others described above. A single hypha finding entrance to a leaf for example, will ramify to some extent, and these various primary branches grow along between the cells of the host, thus forming an intercellular complex that may effect nearly every cell. From these primary branches, haustoria find entrance to the host cells and here they become more or less branched, with the result that the cells lose all their contents except the nucleus; this seems to persist. After the disorganization and disappearance of the chromatophores, the fungus structures are easily visible and in many of these cells may be seen exceedingly thick-walled chlamydospores, in some instances quite filling the enclosing wall of the host cell (Fig. 17).

The fungus is not confined wholly to the interior of the tissue.

In many cases a complex of hyphæ over-runs the surface of a leaf and it is not uncommon to find chlamydospores in connection with these external hyphæ. One-celled conidia are abstricted in large numbers from branches of the external hyphæ. Sclerotia have not yet been found, though occasionally a cell may be seen well filled with knots of hyphæ, too loose in structure, however, to be regarded as sclerotia. Cells in which these knots occur are always dead and apparently empty.

The fungus behaves toward the host as a parasite. Its hyphæ produce haustoria in great numbers which in the course of time invade all the cells of a leaf, thus impairing greatly its ability to elaborate food materials. The younger leaves of the host are apparently uninfected, and even though the older parts of the thallus may be dead, growth continues at the growing point and the plant may grow indefinitely, though very evidently diseased.

The writer has not thus far observed a fungus associated with our species of *Sphærocarpus* or with *Targionia hypophylla*, although Golenkin¹ reports the existence of an endotrophic mycorrhiza for the latter, and it may be that further investigation will demonstrate the presence of a fungus in *Targionia* as we find it here. As a matter of fact it is not improbable that all the hepaticæ of this region may on further study prove to be infected, the fungus being either a symbiont or, what is more likely, a parasite. The writer has seen no evidence in favor of the view that the fungus stimulates the growth or in any way benefits the host, though the presence of hyphæ may lead up to the development of abnormal structures such as modified root-hairs, enlarged cells, etc.

Bruchmann,² in his studies on *Botrychium lunaria*, concludes as follows: "Der physiologische Nutzen des Zusammenlebens von Prothallium und Pilz scheint mir auch hier nicht darin zu bestehen, dass die wenigen und unscheinbaren Pilzfäden, welche aus dem Substrat des Gamophyten in ihn emmünden, belanglose Humusstoffe ihm zuführen, Sondern nur darin, dass die von den functionsfähigen Rhizoiden der wachsenden Schutelpartie aufgelösten und herbeigeführten Baustoffe mit-

¹Loc. cit., p. 209.

²Loc. cit.

telst des Stoffwechsels des Endophyten in haltbare Reservestoffe umgewandelt und aufgespeichert werden, von denen namentlich die auffallend grosse Oelmenge dem Prothallium die Fähigkeit verleiht, in dem sandigen Boden auch während der Sommerhitze und der Winterkälte von Austrocknung bewahrt zu bleiben."

As already stated, the author has found, in the case of all infected forms thus far investigated, oil and of necessity albumen, in the living cells of the gametophyte. In *Fossombronina* and *Ancura* at a certain stage in the development of the endophyte there is a minimum quantity of these products within the host cells containing hyphæ and a maximum amount of these same products within the cells of the fungus. The result is the death of the host or, at least, a very serious check to its development, resulting in small sickly plants. In such a case we cannot possibly regard the food products derived from the gametophyte as reserve materials later to be given up by the fungus as nourishment to further growth of the host.

The only forms examined not showing harmful effects from association with a fungus were *Fimbriaria*, *Fegatella* and *Anthoceros*. Of the first and the last, only a very limited amount of infected material was found, consequently little light can be thrown upon actual relation of host to endophyte. Howe¹ has reported an endophytic fungus associated with *Anthoceros olneyi* Aust., the septate hyphæ of which produce at the ends of lateral branches, globular clusters within which are produced numerous dark spore-like cells bearing some resemblance to those of the Tilletiaceæ. He has found the same parasite in *A. ravenellii* Ala. (Mohr.) and the same or one very similar in *A. hallii* Aus. He regards this fungus as a parasite, though no detailed account is given relative to the character of the association of the two.

DEVELOPMENT OF FRUITING ORGANS OF FEGATELLA CONICA IN CALIFORNIA.

Fegatella conica (*Conocephalum conicum*) is described by Howe² as growing in moist, deeply shaded places, especially

¹ Howe. 1898: The Anthocerotaceæ of North America, Bulletin of the Torrey Botanical Club, Vol. 25, No. 1.

² Loc. cit., p. 58.

on stones and rocks beside streams. It is not common in California and was first collected by Professor Underwood at Felton, Santa Cruz County, in 1888. In July, 1906, it was found in fruiting condition by the author on a trip up San José Cañon in the Santa Lucia Mountains in Monterey County. So far as is known, plants bearing receptacles had not been found in California prior to the above named date, though fruiting plants have been collected by C. V. Piper near Seattle, Wash. Conditions during the rainy season there and in the parts of California where *Fegatella* thrives are similar. The dry season near Puget Sound is occasionally interrupted by summer showers which may in combination with other factors influence the development of fruiting organs.

Fegatella may be found in many of our near-by cañons; in fact, it has been observed to occur along the banks of creeks well down upon the plain of the Santa Clara valley, but almost always it will be found in particularly well watered and densely shaded localities, a combination of conditions very essential to the normal development of the plant in this region of long, dry summers.

Antheridial plants bearing receptacles have been collected from several localities, though these plants are by no means common. Normally, they are of such vigorous, robust habit as to spread over a considerable area by mere vegetative growth, and it is not uncommon to find several square feet entirely covered by *Fegatella* to the exclusion of everything else.

On finding female plants in fertile condition a field study was made relative to their habitat, and conditions affecting growth and development of fruiting organs. San José Cañon is a deep, narrow gorge, the floor of which is well watered by a never-failing stream. The north wall of the cañon consists very largely of precipitous rock ledges that in many places come abruptly to the stream's edge and are only sparsely clothed with *Artemisia*, *Adenostoma* and a few other plants of xerophytic habit. The south wall rises less abruptly into hills averaging seven to eight hundred feet in height. These have a covering of rich humus and the vegetation at the base along the creek and well up on the south slope consists of *Sequoia*

sempervirens, *Alnus rhombifolia*, *Salix lasiolepis* and other trees which afford abundant shelter for a variety of shade-loving plants. Here also thrive several species of mosses and liverworts that in less favored localities would either die or pass into a dormant, air-dry condition.

Fegatella occurs throughout the length of the cañon on both banks of the creek, though most abundantly on the south side where there is a minimum of direct sunlight and evaporation. Five trips were made during the past season for at least a distance of three miles toward the head of the cañon and each time a diligent search was made for fruiting plants which were found in but few, very limited areas, where the exposure was north or northeast. It was observed that no fruiting plants were to be found in places void of sunlight, and the same was true when the plants grew within six or eight inches of the water's surface in light of the same intensity as fell upon nearby fruiting plants. Plants bearing receptacles in greatest number were found on a flat elevation about eighteen inches above the water in a break between trees through which fell a flood of strong, diffused light and at midday direct sunlight. This level bed of *Fegatella* was bathed constantly by seepage of spring-water from a moss and fern grown cliff forming the background, upon which were found a few fruiting plants of *Fegatella* and *Aneura pinguis*. Wherever fruiting plants occurred, it was noted that the combined conditions of light and moisture were relatively about the same. In places where there was strong light but insufficient moisture the plants were observed to wither, and when these conditions were reversed there was always a strikingly vigorous vegetative development, some individual plants measuring ten or more inches in length.

The time of fertilization of our California plants is not definitely known. The antherozoids are discharged during March and April and receptacles still containing intact antheridia have been found in some of our cañons as late as August.

In England, according to Cavers,¹ the receptacles begin to develop in early spring but do not mature until about the end of June, while the earliest stages in the development of the sporo-

¹ Loc. cit., p. 98.

gonium are observed about the middle of July. Owing to the very slow development of the sporogonium the spores are not discharged until the following spring. Here in California our plants behave differently. After fertilization the female receptacles grow to about two to two and one half millimeters in diameter. Though the plants may be amply supplied with moisture from below throughout the summer, proper humidity and temperature conditions do not prevail until the beginning of the winter or rainy season. Throughout the summer the growth of the receptacle is so slight as to be almost imperceptible. San José Creek empties into Carmel Bay and in late summer and autumn, the cañon, being near the sea, is quite commonly filled with heavy fogs for a part of the day, leaving all vegetation dripping wet. While these fogs are not equivalent to the drenching rains of winter, they do play a great rôle in the revival of certain mosses, liverworts and lichens and doubtless stimulate their growth to a certain extent. At any rate, up to the latter part of August the archegonial receptacle of *Fegatella* increases but slightly in size, though the increase is sufficient to enable one to distinguish fertilized from unfertilized receptacles. By the first of October (before any rain had fallen) the sporogonium had advanced to the spore tetrad stage and remained in about this condition until the opening of the rainy season. Following this, rapid development ensues and the spores are discharged in January.

This liverwort might be considered as viviparous, since the spores germinate within the capsule. Cavers states that germination occurs within the capsule before the spores are discharged, but does not say how long a time elapses between the first evidences of germination, and the ultimate elongation of the peduncle and dehiscence of the capsule. With our plants germination-stages were found at least a month preceding the liberation of the spores. How much earlier than this germination actually begins cannot be said, as material for examination was not available at that time. Germination does not take place simultaneously in all the spores of a single capsule. One may find within a capsule every stage from the ungerminated spore to the six-cell stage, and it is to be

noted that a certain percentage of spores do not germinate at all, but may be seen in a collapsed and shrunken condition within the capsule.

Most of the plants examined were infected by a mycorrhizal fungus that agrees closely in structure and habit with the one described by Cavers. Our observations confirm this as to the presence of starch within infected cells which is contrary to the view of Golenkin,¹ who investigated a number of infected hepaticæ, including *Fegatella*, and states that infected cells contain no starch or chloroplasts.

Our material was found growing on sandy soil containing considerable humus and it was found that but few rhizoids contained hyphæ. No plants were observed in which the ventral tissue of the midrib was infected to any extent as shown by Cavers in plants collected near the sewer-like drains of tanneries and similar works. All infected plants were in vigorous, healthy, growing condition and so far as could be ascertained, the presence of a fungus entails no such disastrous effects as one may observe in more delicate forms such as *Fossombronina* or *Ancura*.

ADAPTATION OF CERTAIN LIVERWORTS TO THE DRY SEASON.

It is commonly assumed that bryophytes are, in general, moisture-loving plants. While this is to a great extent true it may easily be shown that there are many important exceptions. Among the mosses we have only to note such forms as *Grimmia*, *Hedwegia*, *Andræa* and many others common to different parts of the world growing on exposed rock surfaces, with ability to revive promptly and resume growth after the first rain. Likewise many foliose Jungermanniaceæ, common in the eastern part of the United States, are capable of withstanding drought periods of considerable length, lying practically dormant throughout the rainless interval. To what extent eastern thallose Jungermanniaceæ are capable of withstanding drought is a question, that so far as the writer is aware, has not yet been investigated.

In this section of California, and more particularly the low-

¹ Loc. cit., pp. 209-220.

lying country about San Francisco Bay there is an interesting hepatic flora consisting of types of most of the principal groups. All of these forms fruit luxuriantly and are seldom found sterile during any one growing season.

Among the more common hepaticæ of this region, and especially in the vicinity of Stanford University, are certain species of *Riccia*, including *R. glauca* and *R. trichocarpa*, both of which grow vigorously in localities of extreme exposure; and especially is this true of the latter, a liverwort structurally adapted to such a habitat. Aside from several species of *Riccia* two species of *Fimbriaria* (*Asterella*), *F. californica* and *F. violacea* are met with, the former being quite common. In certain localities, especially along the high banks of arroyos, *Cryptomitrium tenerum* is found to be abundant. Along with it and in places of severer exposure, occur formations consisting almost exclusively of the highly resistant *Targionia hypophylla*.

Along the banks of our coast-range streams, even where these come down into the Santa Clara valley, occur such widely distributed forms as *Fegatella conica* and *Marchantia polymorpha*. These however always grow in close proximity to the water where throughout the year they may never be entirely deprived of a supply of moisture. It is doubtful if these forms would be capable of withstanding the effects of a dry season. Three years ago the writer transferred several plants of *Fegatella* to a locality in the valley where conditions of light and substratum were restored as nearly as could be done, at the same time modifying and finally cutting off altogether the supply of moisture. By lessening for a whole summer season the supply of moisture it was found that growth of the thallus was greatly checked and the resulting branches were much shorter. Plants that were deprived of water dried up and died, all ability to recover being lost as soon as the tissue had given up a certain amount of the water of constitution. It cannot here be said to what extent *Marchantia polymorpha* is capable of withstanding drought, but since it is almost never found except where there is a fairly constant supply of moisture it would probably endure desiccation little better than *Fegatella conica*. Other moisture-loving liverworts found in moist shaded cañons of the outer

coast ranges are two species of *Aneura* (*Riccardia*), *A. multifida major* and *A. pinguis*, the latter being far more sensitive to change of environment than the former, but neither is capable of withstanding much loss of water. They are both found growing at their best when, if not actually in running water, they are at least so situated as to receive a constant supply. The finest, most vigorous specimens I have ever collected have been found growing in such a position as to receive constant dripping of fresh water from above, which so far as has been observed does not materially influence the development of fruiting organs as is the case when *Fegatella* is too abundantly supplied.

Several specimens of *Ricciocarpus natans* found growing on soil about a small lake in the foot-hills were brought into the laboratory along with enough of the substratum to prevent any shock resulting from transference. These along with some *Aneura multifida major* were placed in a shallow earthen saucer and exposed to the dry air of the laboratory until in a normal air-dry condition. In this condition they were gradually moistened but no sign of recovery was apparent in any part of the tissue of either plant, and after several days of normal moisture supply they showed no signs of life. It is apparent from this and several other experiments upon hygrophilous forms that they lack the degree of adaptability to changed climatic conditions exhibited by such forms as *Riccia*, *Targionia* or *Porcella*.

Aside from several genera of Ricciaceæ and Marchantiaceæ, two species of *Sphærocarpus* and one of *Fossombronia*, *F. longiseta*, represent the thallose Jungermanniaceæ for the region about San Francisco Bay, as well as higher up into the hills and mountains. So far as habit is concerned *Sphærocarpus* is hardly to be compared to *Fossombronia* for the one is an annual while the other remains alive throughout the entire summer. We have here a relatively small representation of leafy liverworts, the most common being *Porcella bolanderi*, and *Frullania bolanderi*, while in certain isolated localities one may find *Radula complanata* growing on tree trunks and *Lophozia ventricosa* forming reddish-brown patches on exposed hillsides that receive abundant moisture during the rainy season.

The Anthocerotaceæ are represented by *Anthoceros fusiformis*, *A. pearsoni* and *A. phymatodes* the first two being very common, while the third, though not so widely distributed, is very abundant in certain localities near Stanford University. All three species are found growing luxuriantly in places of severe exposure, though thriving best in slightly shaded localities. At one time it was supposed that *A. fusiformis* and *A. pearsoni* were annuals but they were afterwards shown by Campbell¹ to be perennial in habit. So far as the writer has observed *Anthoceros phymatodes* survives through the agency of its conspicuous tubers. In fact, it seems that virtually all of the thallus dies during the dry season except these structures which are packed with food-materials and serve as very effective water-storage organs. The other two species, while surviving the dry season, resume development with but a comparatively small amount of the old thallus persisting, though both species are highly mucilaginous and especially adapted to extreme conditions as described by Campbell.² Careful examination of a large number of recently revived plants failed to demonstrate the presence of sex organs even in their early stages and it is probable that these develop after the new growth of thallus is well under way. With the exception of the two species of *Sphærocarpus* it has been shown that all of our xerophytic forms are perennial, persisting from year to year unless artificially interfered with. Just how extended a period of desiccation they are capable of withstanding has never, so far as I know, been determined. In the autumn of 1903 the writer attempted to germinate spores of *Fossombronia longiseta* that had been collected in 1896. Some of the old plants along with the spores were placed in petri dishes containing distilled water, while others were sown upon moist earth. None of the spores germinated nor did the plants revive. The material was sent me from an eastern herbarium and I do not know the conditions affecting the material after collection. The failure of the plants to revive and of the spores to germinate can throw little light upon the question.

¹ Campbell, 1904: Resistance of Drought by Liverworts. *Torreyia*, Vol. 4, No. 6, p. 84.

² Campbell, 1895: 1st ed., *Mosses and Ferns*, p. 117; 2d ed., 1905, p. 123.

So long as the water of constitution is not disturbed the degree of desiccation seems to make no perceptible change in the reviving powers of all our common xerophytic forms. In the preparation of a previous paper³ quantitative experiments were made upon *Fossombronia longiseta* to ascertain the actual water content of air-dried plants and to test the vitality of plants and spores that had been for several weeks subjected to the action of such a powerful drying reagent as glacial phosphoric acid. The results obtained showed that the plants of this species in the normal air-dry condition contain an appreciative amount of water which may be removed without the slightest injury to the vitality of the plant, while spores subjected to the same treatment germinate quite as readily as those under perfectly normal conditions. To extend these results the same experiment was carried out with *Targionia hypophylla*, *Fimbriaria californica*, *Riccia glauca*, *Porcella bolanderi*, *Cryptomitrium tenerum* and again with *Fossombronia longiseta*. All material was collected early in September before the first rains, was brought into the laboratory where, with a fine stiff brush and other instruments, it was carefully freed from any soil particles that might be clinging to the rhizoids. Then to correct an error that might creep in from the absorption of moisture by the plants from the fingers or breath of the operator the plants were again subjected to normal air-dry conditions a number of days.

Following this the five lots of each plant, were carefully weighed on a chemical balance and then placed at once in the receiving chamber of a desiccator over a quantity of glacial phosphoric acid. Here the material was left from September 21, 1906, until February 9, 1907, when it was again weighed and the respective weight losses recorded. The weights before and after artificial drying are given below:

<i>Fimbriaria.</i>	Normal Air-dry Weight.	Loss of Weight After Four Months Desiccation.
lot 1	0.05 g.	0.0025 g.
lot 2	0.05 g.	0.0007 g.
lot 3	thrown out as defective.	
lot 4	0.072 g.	0.0091 g.
lot 5	0.105 g.	0.0047 g.

⁴Loc. cit.

<i>Targionia.</i>	Normal Air-dry Weight.	Loss of Weight After Two Months Desiccation.
lot 1	0.055 g.	0.0035 g.
lot 2	0.070 g.	0.0150 g.
lot 3	0.052 g.	0.0066 g.
lot 4	0.075 g.	0.0046 g.
lot 5	0.055 g.	0.0017 g.
<i>Cryptomitrium.</i>	Normal Air-dry Weight.	Loss of Weight After Four Months Desiccation.
lot 1	0.050 g.	0.00250 g.
lot 2	0.040 g.	0.00310 g.
lot 3	0.040 g.	0.00325 g.
lot 4	0.060 g.	0.00230 g.
lot 5	thrown out as defective.	
<i>Riccia glauca.</i>	Normal Air-dry Weight.	Loss of Weight After Two Months Desiccation.
lot 1	0.030 g.	0.00170 g.
lot 2	0.035 g.	0.00200 g.
lot 3	0.030 g.	0.00260 g.
lot 4	0.030 g.	0.00310 g.
lot 5	0.025 g.	0.00330 g.
<i>Fossombronia.</i>	Normal Air-dry Weight.	Loss of Weight After Four Months Desiccation.
lot 1	0.025 g.	0.0020 g.
lot 2	0.020 g.	0.0020 g.
lot 3	0.040 g.	0.0020 g.
lot 4	0.030 g.	0.0026 g.
lot 5	0.025 g.	0.0021 g.
<i>Porella.</i>	Normal Air-dry Weight.	Loss of Weight After Four Months Desiccation.
lot 1	0.420 g.	0.0215 g.
lot 2	0.320 g.	0.0180 g.
lot 3	0.350 g.	0.0150 g.
lot 4	0.402 g.	0.0170 g.
lot 5	0.402 g.	0.0151 g.

The wide discrepancies existing between the weights of different lots of *Fimbriaria* and of *Targionia* are probably due to the fact that certain lots were largely made up of thick, bulky plants capable of retaining more moisture than the smaller thinner plants composing other lots. Then too, some allowance must be made for small particles of soil clinging to the rhizoids, though care was exercised in the removal of all foreign matter from the plants employed in the experiment. It will be noticed that in the case of *Cryptomitrium*, *Fossombronia* and the others where the plants were of more uniform size the discrepancies are slight.

Of the above forms *Fimbriaria*, *Targionia*, and *Porcella* are the most sensitively hygroscopic; at least when moistened they are the first to become turgid and resume activity.

By dividing the total loss in weight due to artificial desiccation by the air-dry weight we obtain in percentages the actual fraction of the air-dry weight that is lost in drying. For example it was found that *Fimbriaria*, lost 6.06 per cent. of its air-dry weight while losses for the other five were: *Targionia*, 12.3 per cent.; *Cryptomitrium*, 5.86 per cent.; *Riccia*, 8.47 per cent.; *Fossombronia*, 8.23 per cent.; *Porcella*, 4.57 per cent.

From these figures it will be seen that in the normal air dry state, *Targionia* contains the greatest amount of the water of constitution, while *Fossombronia* and *Riccia* contain about two thirds as much. *Porcella*, the only leafy liverwort used in the experiment, had given up all but a very small percentage of its air-dry weight followed closely by *Cryptomitrium*, one of the Marchantiaceæ.

As a rule our summers are characterized by heavy morning fogs which drift in over the mountains from the ocean. These hang over the valley for three or four hours after sunrise greatly reducing the temperature and leaving behind, each morning of their occurrence, considerable precipitation, enough sometimes to result in dripping from eaves. The past summer (1906), however, was unusually free from these fogs, even late in the season when ordinarily they are heaviest and most frequent. Fogless mornings are characterized here by slight or even no precipitation of dew and are forerunners of hot, extremely dry days. During such a season as the one just described it is probable that our liverworts remained in an absolutely dormant condition. It has many times been demonstrated that all our perennial forms on being moistened revive in from half an hour to twelve hours, resuming growth very promptly if the supply of moisture is constant. Campbell¹ has shown in a recent paper that this peculiar adaptation is a property not only of certain of the hepaticæ but belongs also to *Gymnogramme triangularis*, a fern common to this region, which dries up in summer, remaining dormant throughout the season, without the resulting death

¹Loc. cit., p. 85.

of the leaves as occurs in the majority of ferns. Not infrequently one finds in the field quite fully developed prothallia of this species early in the autumn before the winter rains have actually set in. It is hardly possible for these to have developed from spores that had germinated at any other time than in spring or early summer. In fact, it has been experimentally shown by Professor Peirce¹ that the prothallia of this species may endure prolonged desiccation without evidence of the slightest injury, for on being moistened they very promptly revive and young sporophytes develop normally from these gametophytes of the preceding season. Perennial prothallia developing tubers have been reported by Goebel² for the allied fern *Anogramme chærophylla*, common in southern Europe. Such structures belong to some of our liverworts but have not yet been shown to occur in the prothallia of any of our ferns. Aside from the common fern *Gymnogramme*, other pteridophytes native to California, *e. g.*, *Selaginella biglovicii* and *S. lepidophylla*, the latter the well known "resurrection plant," are reported by Campbell in the paper above referred to as remaining in a dry and dormant condition throughout the greater portion of the year, resuming active growth during the rainy season, at first absorbing considerable water through their leaves as do the leaves of *Gymnogramme*.

To test the vitality of those liverworts that had been naturally and then artificially desiccated, a certain number of plants from each lot were placed on moist earth and others in Knop's nutrient solution. In both cases the plants revived promptly and are now growing vigorously, producing fruiting organs in great number. A surprisingly small portion of the thallus of *Targionia*, *Riccia*, *Fimbriaria* and *Porella* was actually dead; though in *Fossombronia*, *Cryptomitrium* and *Anthoceros phymatodes* only the *apical* end including a small portion of the thallus appeared to be alive. Within five hours revived plants from each species were fixed with chromic one per cent. fixing solution and run up through the alcohols and bergamot oil to

²Campbell, 1904: Resistance of Drought by Liverworts. *Torreyia*, Vol. 4, No. 6, p. 85.

³Goebel, 1898: Organography of Plants. Part II, Vol. 1, p. 426.

paraffin. The same method of fixation, dehydration, clearing and infiltration were employed here as detailed in a previous paper on the development of *Fossombronina longiseta*, barring slight modifications. It was found that the best results could be obtained by following the method of dehydration described by Chamberlain.¹ The use of diffusion shells and the "constant drip" process have proved somewhat unreliable, not always giving satisfactory results for such tissues as prevail among the more delicate hepaticæ. Instead of transferring from absolute alcohol directly to a 50 per cent. solution of bergamot oil and then to pure bergamot, a more gradual transfer was employed and a similar plan was followed in running up through the paraffins.

In the autumn of 1903 the writer revived some material consisting of *Fossombronina* and *Fimbriaria* and after a few hours placed them in a fixing solution. On studying sections of each it was observed that in the case of *Fossombronina*, not only was a considerable portion of the thallus alive but it was found that there were nearly mature antheridia and archegonia. Sections of *Fimbriaria* through the median sulcus proved the presence of well-advanced antheridia. This suggested the possibility of a similar early development of sex organs in other forms than the two mentioned above. A number of slides of *Riccia*, *Targionia*, and *Cryptomitrium* as well as of *Fossombronina* and *Fimbriaria* were prepared and in each instance, at least, antheridia have been found. Only in *Fossombronina* and *Porcella* have we found archegonia. In *Fimbriaria* and *Cryptomitrium* these organs occur on special receptacles none of which showed any sign of development. In *Riccia* and *Cryptomitrium* only early stages of the antheridium were present which was rather contrary to anticipation. A large number of plants of each genus were sectioned and the great majority of them were sterile. Quite early in the rainy season we have been in the custom of collecting quantities of *Riccia* in which no difficulty is experienced in obtaining virtually all stages in the development of the sex organs. For this reason the writer feels that a more exhaustive examination of this species ought to reveal

¹Chamberlain, 1905: Methods in Plant Histology, p. 22.

fruiting organs quite as advanced as those of *Targionia* or *Fimbriaria*. As for *Cryptomitrium*, it is not surprising to find so few antheridia, for even as late as the first week of February sections of *Cryptomitrium* revealed the presence of mature antheridia while in the case of *Fimbriaria* they may be found almost ripe before the beginning of the wet season. Abrams¹ in his studies of *Cryptomitrium* found that the antheridia matured earlier than the archegonia and informs me that he found fairly well advanced stages of the antheridium as early as November. In *Porella* not only all stages in the development of sex organs are to be found but well-developed sporophytes as well. This accounts for the very sudden appearance of mature sporophytes shortly following a few days of wet weather. Growing as it ordinarily does on the exposed surfaces of rocks and tree trunks, it is liable to severe exposure and may be left quite dry in a few hours of wind or sunshine. This fact may have some influence upon its reproductive habits and, in a measure, account for the advanced sporogonia found in revived material. At any rate *Porella* is scarcely to be compared with such thallose forms as *Riccia* or *Targionia*. The differences in habit and structure might well beget differences relative to the appearance and time of development of the sex organs.

In another part of this paper the writer mentions having found *Fossombronia longiseta* so situated out of doors as to receive a constant supply of moisture from a leak in a water pipe. Many of these plants were examined on November 1 very near the close of the dry season and were found bearing embryos in various stages of development and in some instances well advanced sporogonia as shown in Fig. 1. By the first of January the spores and elaters had matured and some capsules had already dehisced.

Not having observed these plants at the time of fertilization it cannot be definitely said just when the antheridia and archegonia matured. However, the approximate date may be ascertained by observing the rate of development of the sporogonium and of the ripening of the spores. In 1904 the first rain of

¹Abrams, 1899: Structure and Development of *Cryptomitrium tenerum*. Botanical Gazette, Vol. 28, pp. 110-121.

any consequence fell on the twenty-first of August, but liverworts barely revived by it were overtaken by a period of dry, hot weather which lasted till September 23, when the rainy season began. It might justly be assumed that the resumption of growth, as regards *Fossombronia* at least, began at this time. More than the usual amount of rain was recorded for October and November and growing conditions were very favorable. Material collected in early February showed sporangia in which the spore-mother cells were preparing to pass into the tetraspore condition, and six weeks later material was collected bearing ripe spores and elaters. From this it will be seen that, having a favorable rainy season, the time required to produce ripe spores is approximately six months after the first rains of any consequence. Judging from the advanced development in which one finds antheridia and archegonia at the close of the summer season, fertilization must occur within a few weeks after resumption of growth is well established.

With regard to the plants that had grown unchecked throughout the summer, it must be noted that temperature and humidity conditions are widely different from those prevailing in winter. Though the plants were well irrigated, the atmospheric conditions were such as to influence to some extent the growth and behavior of the thallus and fruiting organs. Assuming, however, the same rate of development of the sporogonia for these plants as for those grown in winter, fertilization must have occurred during July and later. Growing in a paraffin-coated glass dish containing Knop's nutrient solution, the writer has under observation several plants of *Fossombronia*, placed there a month ago in air-dry condition as nearly free from soil particles as they could be rendered by the use of a fine, stiff brush. Antheridia and archegonia then in the initial stages of development are now about as far advanced as were the oldest of those observed as soon as the plants had revived—in the course of twelve hours. These oldest ones are now maturing. It will be shown elsewhere, however, that Knop's solution affords a very active stimulus to development of the thallus and fruiting organs, probably shortening the time of their normal development considerably.

At any rate, it is evident that under conditions prevailing in this part of California a second crop of antheridia appears before the close of a single growing season, and in the case of *Fossombronia* at least, when the supply of moisture is maintained, fertilization and ultimate development of the sporophyte proceed regularly, the spores ripening three or four months earlier than those of the winter crop. It is probable that the second growth of antheridia and archegonia begin to develop at least a month before the close of the rainy season, and this fact is of particular importance to the plant as it insures the maturity of the sporophytic generation well within the rainy season.

Certain of our liverworts show a tendency to develop tubers or other structures enabling them to resist drought. For example, in the southern part of the State, *Geothallus tuberosus* is a form bearing well-marked tubers, while in our own locality *Fossombronia* develops tuber-like thickenings of the stem, and well-defined tubers are to be found in the case of *Anthoceros phymatodes*. All the plants employed in this study showed the presence of scales or hairs which in some instances secrete mucilage; these along with the mucilage cells within the thallus are structures undoubtedly serving as water-storage organs.

According to Howe,¹ aside from *Anthoceros phymatodes*, tuberous structures are not uncommon among plants of *A. pearsoni*, both species growing ordinarily in exposed places. In other parts of the world, hepaticæ bearing tubers have been found. For example Goebel² describes two species of *Anthoceros*, *A. argentinus* and *A. dichotomus* and a species of *Fossombronia*, *F. tuberifera*, common in certain parts of Chili. He regards the organ in the last named species a true tuber not unlike the same structure developed by our *Anthoceros phymatodes*, but considers the tubers of *A. argentinus* and *A. dichotomus* as transformed branches of the thallus, the ends of which, have become swollen and filled with reserve food products, very similar to what prevails in our common species *A. pearsoni*. Goebel³ also reports certain species of *Riccia* as developing tubers,

¹ Loc. cit., p. 184.

² Loc. cit., p. 293.

³ Loc. cit., p. 70.

notably an Italian form in which he observed entire portions of the thallus developed into tuber-like structures. Stephani¹ has also described similar structures for *Riccia bulbifera*. None of our Californian Riccias has yet been described as bearing tubers or tuber-like growths, though *Riccia trichocarpa*, mentioned elsewhere in this paper, is well adapted to withstand severe exposure, the thallus being densely clothed with tawny setæ .3 to .65 mm. long, with those toward the apex in as many as eight to twelve series, affording a very effective protection against excessive drying. Though these tuber-like structures wherever they have been examined are always found to contain large quantities of reserve food, there is little doubt that they are instrumental as water-storage organs.

STUDIES IN THE GERMINATION OF SPORES.

In a previous paper the writer has described and figured the germination of the spores of *Fossombronia longiseta*. The results of experiments then carried out showed the early development of this species to agree closely with certain forms, notably *Sphærocarpus californicus*, investigated by Campbell.²

Most of the hepaticæ of this region produce spores characterized by a heavy, more or less sculptured exosporium which Leitgeb³ found to consist of two parts or layers of which the inner belongs to the spore itself and is the exine, while the perinium or outer layer is formed later and consists of parts of the sporocyte. Leitgeb suggests the probability of the perinium as a protection against drought but in the light of more recent studies of certain forms producing thick-walled spores, *e. g.*, *Corsinia*, *Preissia*, *Anthoceros* and *Sphærocarpus*, it may be held that the perinium can certainly have nothing to do with a resting period, for spores of these forms germinate readily within a few days after being sown. As to the thick exosporium furnishing a protection against excessive dryness there can be little doubt, although such forms as *Corsinia* and the aquatic Ric-

¹ Stephani, 1898: Species Hepaticarum. Bull. de l'Herb. Boiss., Vol. VI, p. 333.

² Campbell, 1896: Notes on Sphærocarpus. Erythea, Vol. IV, No. 5, Pl. 2.

³ Leitgeb, 1884. Ueber Bau und Entwicklung der Sporenhaut. Graz.

cieæ produce spores of similar character. Goebel,¹ however, suggests that localities favorable to *Corsinia* may not always be moist, and in the case of the aquatic Riccieæ the perinium very effectively serves as a protection against invasion of the spore by fungal hyphæ.

Although the great majority of our xerophilous liverworts produce thick-walled spores there are such exceptions as *Porcella bolanderi* and *Radula complanata* whose spores are protected by a thin, frail exosporium and are incapable of withstanding prolonged drying. These liverworts grow on tree trunks or exposed surfaces of rocks where they are subject to sudden drying out and we should naturally expect their spores to be better protected.

The character of the spore-wall, however, might suggest the possibility of these forms being naturally more hygrophilous in character, while their adaptation to a dry habitat is merely one phase of the extreme adaptability common to both forms.

In order to get at the relationship of the exospore to the spore a study of the life conditions of the several species is necessary and some light will be thrown upon the subject when we ascertain at what time, in nature, the spores of a large variety of forms germinate. With a large number of forms it has been repeatedly shown that spores sown on soil under conditions as nearly normal as possible germinate only after a long period of rest.

In June, 1904, the writer sowed on sterilized earth, a quantity of spores of *Fossombronia* that had been gathered a few days before sowing. The culture was made in an earthen saucer and placed within another close-fitting earthen saucer, in which was maintained a supply of water so that the dirt was kept constantly moist from below. The culture was placed on a table near a window where it could receive a nearly normal supply of light. During the latter part of August a few spores had germinated but not until October did they germinate in any great number. The spore of *Fossombronia*, while perhaps not as well protected as that of *Fimbriaria* or *Targionia*, nevertheless is furnished with a resistant exosporium and is well adapted to

¹ Loc. cit., 107.

the xerophilous conditions under which the plant grows. The spores are positively known to maintain their vitality for at least two years but for how much longer, cannot be said. The thin-walled spores of such forms as *Ancura*, *Fegatella*, *Radula* and *Porcella* withstand but little drying, losing all germinating power within a few months at most, which fact would seem to be evidence in favor of the statement that the thick exosporium is a protective structure.

Spores of *Anthoceros fusiformis* one year and eight months old, when sown on sterilized soil germinated copiously within two weeks. Here we have an instance of spores that are known not to require a resting period before germinating, yet, unlike *Ancura*, the spores of *Anthoceros* are known to endure at least two years desiccation. Spores of *Fimbriaria californica* and *Targionia hypophylla* two years of age were sown on sterilized earth and kept well watered. These germinated within twelve and fifty-six days respectively. This wide discrepancy is difficult to account for. The soil was kept as free from fungi as possible: however, only a few of the *Targionia* spores germinated and this fact may have been due to reduced vitality from prolonged drying. Further experiments with spores of this genus are necessary; in fact, germination experiments conducted out of doors are the ones of greatest value. Such a series of culture experiments was started more than a year ago in the Stanford Arboretum but before results of any value were obtained the cultures were accidentally destroyed by a workman. It was then too late in the season to start another series, it being very near the close of the rainy season. A fresh collection of spores was made from the 1906 crop and several artificial cultures were started indoors, using both sterilized and non-sterilized earth and Knop's nutrient solution. The spores used in the various cultures were of the following forms: *Riccia glauca*, *Fimbriaria violacea*, *F. californica*, *Targionia hypophylla*, *Fossombronia longiseta*, *Cryptomitrium tenerum* and *Ancura multifida major*.

No spores of the first mentioned plant have yet germinated, though sown six months ago after a resting period of five months. Spores of both species of *Fimbriaria* failed to ger-

minate, though sown at the same time as those in the case of *Riccia*. A very few of the spores of either *Fossombronia* or *Cryptomitrium* germinated. Though he did not duplicate in every case the cultures of the writer, Professor Peirce had a similar experience with all spores of the same (1906) crop. This apparent loss of vitality is difficult to account for, unless due to the unusual character of the weather during the spring months. Ordinarily our last rains occur in April, by which time the spores of the above-named hepaticæ have either been discharged or are maturing. An examination of the daily record of precipitation from April 1 to the close of the season may be instructive. Up to April 1 from January 1 the total rainfall amounted to 10.04 inches. From April 1 to June 15 the record was as follows:

Date.	Amount of Precipitation.	Date.	Amount of Precipitation.
April 1.....	0.06	May 14.....	0.02
“ 10.....	0.01	“ 25.....	0.34
“ 23.....	0.11	“ 26.....	0.04
“ 24.....	0.03	“ 27.....	0.51
“ 27.....	0.29	“ 28.....	0.11
“ 29.....	trace	“ 28.....	0.11
May 10.....	0.01	June 3.....	0.02
“ 11.....	0.02	“ 5.....	0.73
		“ 15.....	0.24
		“ 26.....	trace

From the above record it may readily be seen that from April 1 to April 23 the total precipitation amounted to but .07 of an inch — scarcely more than a trace. Between the twenty-third and twenty-seventh enough rain fell to revive the already dried mosses and liverworts to a condition of perfectly normal turgidity and they remained so at least a week after the last rainfall. Now during April the spores of a number of our liverworts are only beginning to mature, and it is barely possible that the prolonged dry period during that month interfered with the proper ripening of the spores. On the other hand, spores of certain forms, for example, *Fossombronia*, which had fully matured during March but were not gathered till after the rainy season, failed to germinate; and this suggests the possibility of the vitality of the spores having been impaired by successive

rains and rapid desiccation following one upon the other. Whatever be the cause of impairment the fact remains that almost no spores germinated even under most painstaking precautions as to culture conditions. To get at the root of the matter, however, a series of experiments is necessary in which the student should duplicate as nearly as possible the conditions prevailing from April 1 to June 15 of 1906.

It is an unsettled question as to whether the spores of many liverworts actually require a prolonged resting-period, and there is still need of investigation along this line. We are familiar with the fact that the spores of most xerophilous forms do lie dormant several weeks before germinating but it has not been shown in very many instances that this resting-period is intimately connected with the preparation of the spore for germination. The writer has demonstrated beyond doubt that the spores of *Fossombronia longisetæ*, under certain conditions, do not require a resting-period. Cultures were prepared using different media with a view to testing, if possible, the relative influences of the various media upon germination. One lot of spores collected on January 10, 1906, were sown January 12 on pulverized earth that had been thoroughly steam-sterilized and well watered with distilled water. Care was exercised to select soil on which *Fossombronia* grows vigorously out of doors; this was placed in a crystallization dish and covered with one half of a petri dish to keep the culture as free from dust as possible. A number of crystallization dishes were thoroughly cleaned and then covered on the inside with a thin coating of paraffin to prevent the water used from taking up any impurities that might exist in the glass. In three of these, Knop's nutrient solution of the following proportions was placed:

H ₂ O.....500 c.c.
Calcium nitrate	2.00 grams.
Magnesium sulphate.....	0.5 “
Potassium nitrate.....	0.5 “
Potassium phosphate.....	0.5 “

Other solutions of varying strength were employed as follows:

H ₂ O.....500 c.c.
Calcium nitrate.....	2.00 grams.
Magnesium sulphate.....	0.5 “
Potassium nitrate.....	0.5 “
Potassium phosphate omitted.	

Other stock solutions were made up in which the amounts of the various salts used in a normal solution were reduced in quantity one fourth and one eighth, though the quantity of distilled water was kept the same, 500 c.c., in all the solutions. It will be noticed that from one solution the acid salt, potassium phosphate, was left out with a view to testing its value as a stimulus to germination. Spores of the same lot were sown in the various solutions the same day they were collected; the culture dishes were carefully covered and placed on a north window-sill where a uniform amount of diffused light fell upon each culture. In another dish that had been paraffin-coated, water that had been twice distilled was placed and on the same date spores of the same lot were sown. These germinated in considerable numbers within twelve days. Some of the water used in this culture was taken from the supply bottle and evaporated on a slide. On examination, a precipitate of organic particles was found, showing that certain compounds had passed over with the water in distilling, and it was thought probable that these acted as a stimulus, for the spores in this culture germinated before those in the culture containing none of the acid salt. In fact these latter seemed to show no indications of any preparation for germination, such as change in color of exosporium from very dark brown to a lighter more translucent shade. The distilled water used in the preparation of the various culture solutions was from the same stock bottle as that used in the distilled-water culture. Why spores collected at the same time and sown at the same time on these two media should have germinated earlier in distilled water containing organic impurities than in a culture solution void of one of its constituent salts is difficult to account for unless in the latter we have a physiologically unbalanced solution which has been shown by Loeb¹ to exercise a certain toxic effect upon certain marine and fresh-water animals and by Osterhout² in his experiments upon algæ. This, however, needs far more extensive investigation than has yet been given to it.

¹ Loeb, 1905: Pflüger's Archiv, 107: 252.

² Osterhout, 1906: On the Importance of Physiologically Balanced Solutions for Plants. University of California Publications. Botany, Vol. 2, No. 10, pp. 229-230.

The spores in the unbalanced culture solution germinated within six days after those in the normal Knop's solution, which would indicate the existence of some stimulating factor in that solution. Another lot of distilled water was then prepared by allowing the first fourth or fifth part to distil as waste water, thus getting rid of the larger part of the volatile substances. Only the middle three fifths was saved and this was redistilled in the same manner. The best portion of this was again distilled and only the middle portion of the product was collected; in this way water of a high degree of purity was obtained. This was used in the preparation of another distilled water culture and spores of *Fossonbronia* sown eighteen days ago show no evidence of germinating. Spores sown on Knop's solution, normal, germinated within fourteen days producing vigorous germ tubes with rather more than the usual amount of chlorophyll. These young plants have grown more rapidly and vigorously than those in distilled water that germinated approximately at the same time. Spores sown in the normal solution germinated two days later than those in either of the reduced solutions but in the former there was a far greater number of young plants two days after the first observation of germination.

Spores of *Fimbriaria californica* collected in March, 1905, were sown in Knop's solution (normal) and germinated promptly within twelve days. Young plants in this culture that are now sixteen to twenty days old are characterized by the unusual length of the germ-tube, in some instances measuring more than one and a half millimeters from the basal end to the first cell cut off at the distal end of the germ-tube. In some instances two germ-tubes were seen to emerge from a single spore as figured by Campbell¹ for *Targionia hypophylla*. Spores of the same species were sown in an earthen saucer filled more than half-full of finely pulverized non-sterilized soil. These germinated promptly and in great numbers. Both cultures were so placed as to receive light from a north window: the Knop's solution culture received somewhat the greater amount of light being in a glass dish, coated part way up with paraffin. None of the young plants of the soil culture produced germ-

¹ Loc. cit., 1st ed., p. 65; 2d ed., p. 66.

tubes of more than usual length while some showed the formation of cross-walls very early. The young plants in the nutrient solution have grown rapidly, producing in some instances as advanced a development as is seen in Fig. 21, within eighteen days. A very few young plants in which there was only a slight germ-tube development had already begun to assume the dorsi-ventral form common to this genus. Desiccated plants of *Fimbriaria*, *Riccia* and *Fossombronia* when placed in Knop's solution revived quickly producing within a few days a greatly increased number of rhizoids and in the case of *Fossombronia*, many more than the usual number of antheridia, closely covering the dorsal surface of the young growing shoot. From these and other results it seems highly probable that Knop's nutrient solution exerts a stimulative influence upon the development of the thallus, rhizoids, and reproductive organs as well as the germination of the spores. Further investigation, however, with solutions of varying strength and composition is needed in order definitely to determine the nature and chemical composition of the salt or combination of salts that act as a stimulus to growth.

According to Goebel,¹ germination in the Marchantieæ when compared with other thallose liverworts presents certain characteristic differences. He separates the product of germination of a spore of *Preissia* for example, into three structures, *i. e.*, the germ-tube, the "pro-embryo" and the young plant. He finds that the "pro-embryo" is positively heliotropic and develops at its end a flattened cell mass which he terms the germ disk. This forms at right angles to the direction of the light-rays and the young plant arises from one quadrant of the germ disk as shown in his Fig. 95.

On the same page he states that a similar germination is common in the Riccieæ contrary to the description and figures of Campbell² who studied the germination of *Riccia trichocarpa* and a number of other forms. He refers to Campbell's Fig. 9, p. 38, as failing to bear out his statement that the axis of growth in the young plant is continuous with that of the germ-tube.

¹ Loc. cit., p. 111.

² Loc. cit., 1st ed., p. 39; 2d ed., p. 38.

An examination of the figure referred to, however, will show that although an angle was present in the young gametophyte it developed in the germ-tube itself, the upper portion of which lies in the direct axis of growth of the young plant, no such structure as a pro-embryo being present. In his study of *Fimbriaria* and *Targionia* his figures show an early development of the young plant not unlike that in the case of *Riccia trichocarpa*. The writer's investigations relative to the germination of both *Fossombronia* and *Fimbriaria* agree in detail with those of Campbell in the forms studied by him (Figs. 22 and 23).

MacDougal¹ has shown that, given the necessary intensity of light, its direction will vitally influence the form and habit of a living plant as well as the disposition of various organs incident to its development. This being true, we might, *a priori*, assume that Goebel's *Pracissia* and *Riccia* spores on germinating take on the angular form shown in his Fig. 95 because of certain external factors and, most of all, light, instead of trying to account for it on grounds of heredity or of certain inherent factors. In fact, Peirce,² Rosenvinge,³ and others have experimentally shown that in the case of certain algæ, germinating spores are profoundly influenced by the direction and intensity of light. Eliminating so far as possible all other external factors it was found that the young plants always grew towards the light, while the rhizoid or the holdfast was negatively heliotropic. Peirce has demonstrated that in addition to this, light exerts a directive influence upon the formation of cross-walls in sporelings of algæ, liverworts and certain ferns, these walls always forming at right angles to the direction of the light rays.⁴

With ferns and liverworts he has further shown that when the long axis of the germ-tube lies in the direction of the light rays, the continued growth of the young plant will be in the same direction. More than this, he has demonstrated that when the germ-tube ruptures the spore wall on the side away from the

¹ MacDougal, 1903: The Influence of Light and Darkness upon Growth and Development. Memoirs of the New York Botanical Garden, Vol. II.

² Loc. cit., p. 338.

³ Rosenvinge, 1889: Influence d'agents extérieurs sur l'organisation polaire et dorsiventral des plantes. Revue Generale de Botanique, 1.

⁴ Peirce, 1906: Studies of Irritability in Plants, p. 453.

light there is a strong tendency to turn toward the light, and if this is not accomplished by the germ-tube, the further development of the young plant will at once or gradually assume the direction of positive heliotropism.

DURATION OF VITALITY OF CERTAIN GREEN OR THIN-WALLED SPORES.

A failure to germinate the spores of *Ancura multifida major* after they had been allowed to become several weeks old, induced the writer to prepare a series of cultures to test the life duration of the spores of *Ancura*, *Radula*, *Porella* and *Fegatella*.

The first spore cultures of all these forms were started on the same day of collection in order to determine whether the spores were ready for germination under normal conditions. Practically all spores germinated in cultures consisting of sterilized earth, Knop's solution and distilled water. I next allowed spores of *Fegatella* to dry for three days, by placing them on a sheet of paper on the laboratory table. These were then sown in the various culture media. Many of the spores had already germinated within the capsule but these along with all spores still ungerminated failed to show the slightest sign of any recovery after days of constant moisture and favorable light. Later, Professor Peirce demonstrated that one hour's drying under normal conditions was sufficient to kill all spores, and further experiments with the spores of this species were regarded unnecessary. The spore wall in the case of *Fegatella* is very thin, allowing rapid loss of the water of constitution, resulting in a general contraction of spore contents and collapse of the spore wall.

On January 12 cultures were started, sowing spores of *Radula complanata* collected on the ninth of the same month. Practically all of these germinated within a few days, so another trial was not made till the twenty-eighth of January. Approximately ten per cent. of the spores of this sowing failed to recover, the cytoplasm and other spore contents having contracted towards the center forming a brownish mass.

On February 11 a third culture was started, the spores now

having dried thirty-two days. Between 20 and 25 per cent. of these spores failed to recover. The last lot of spores were sown on March 3—fifty-two days after collecting. Approximately forty per cent. of these were desiccated beyond recovery. Time does not permit at the present further testing of the spores of this species but judging from the results of the above cultures very few if any spores could endure longer than a few months at the most.

Porrella bolanderi was then experimented with, cultures being started at various intervals using the same media as in preceding cultures. The results obtained were not greatly different from those in the case of *Radula* though in my last culture which was made on March 5 not more than half the spores have recovered and fewer still have germinated after eleven days. The spores in this culture had been allowed to dry thirty-eight days, or fourteen days less than was allowed spores used in the last *Radula* culture. Making due allowance for the possibility of toxic effects due to the activity of bacteria or fungi that might have been in the various cultures it is highly improbable that the failure of constantly increasing numbers of spores to revive could have been entirely due to any such cause and we are justified in the conclusion that the spores of these forms and probably some others not yet investigated are incapable of enduring more than a comparatively slight amount of desiccation.

SUMMARY.

1. Plants of *Fossombronina longiseta*, as it occurs here, are seldom free from infection by a fungus, which, in its relation to the host, acts as a true parasite. In early stages the fungus is confined to the rhizoids and compact tissue of the stem, ultimately extending throughout all vegetative tissues of the gametophyte. Large, black sclerotia develop within the cells of the leaves and peripheral cells of the stem, resulting in the death of the host.

No instance of infection of sex organs or sporogonium has been observed.

2. *Fimbriaria californica* has been found to be infected by a fungus, the hyphæ being confined to the outermost three or

four layers of ventral cells and to both sorts of rhizoids. Its relation to the host is apparently symbiotic.

3. A fungus, evidently epiphytic in habit, was found associated with *Ancura multifida major*. Its relation to the host is that of a parasite.

4. Fungi were also found associated with *Anthoceros pcarsoni* and *Porella bolanderi*. In both cases the fungus is epiphytic, sending haustoria-like branches into the tissues of the host.

5. Fertilization in *Fegatella conica* in California occurs in early spring. At the close of the dry season the spores are in the tetrad stage. With the commencement of the rainy season, the growth of the female receptacle is resumed and the spores mature early in January.

6. When hygrophilous forms such as *Ancura pinguis* or *Fegatella conica* are transferred to a dry habitat and allowed to become desiccated they are unable to recover.

7. All of our xerophilous forms such as *Fimbriaria californica*, *Turgionia hypophylla*, several species of *Riccia*, *Fossombronia*, and others resume growth promptly after months of extreme drought. When artificially desiccated over glacial phosphoric acid until further loss of weight is imperceptible, on being moistened they revive quite as promptly as when normally air-dried.

8. Artificial drying does not impair germination of spores of xerophilous forms.

9. In *Porella bolanderi* material examined at the close of the dry season exhibits holdover antheridia and archegonia and well-advanced sporogonia. Other xerophilous forms of perennial habit show sex organs in various stages of development.

10. *Fossombronia* growing in a habitat of constant moisture matured spores in March and December to February.

11. Mucilage secreting structures are common to many forms and especially to our species of *Anthoceros*. *A. pcarsoni* and *A. phymatodes* are rendered resistant to drought by the presence of tubers. Similar structures, though less developed, are common to *Fossombronia longiseta* in dry regions.

12. Spores of xerophilous forms are known to retain their vitality at least two years and probably longer. In nature they pass through a resting period of several weeks.

13. Spores of *Fossombronina longiseta* sown in Knop's solution and in impure distilled water germinated in the former within fourteen days and in the latter within twelve days after removal from the capsule. Spores sown on sterilized soil show no evidence of germination after sixty-two days.

14. The spores of *Fegatella conica*, *Ancura pinguis*, *Porrella bolanderi* and *Radula complanata* were found incapable of withstanding prolonged desiccation. Germination occurs normally within the capsule or very soon after dispersal.

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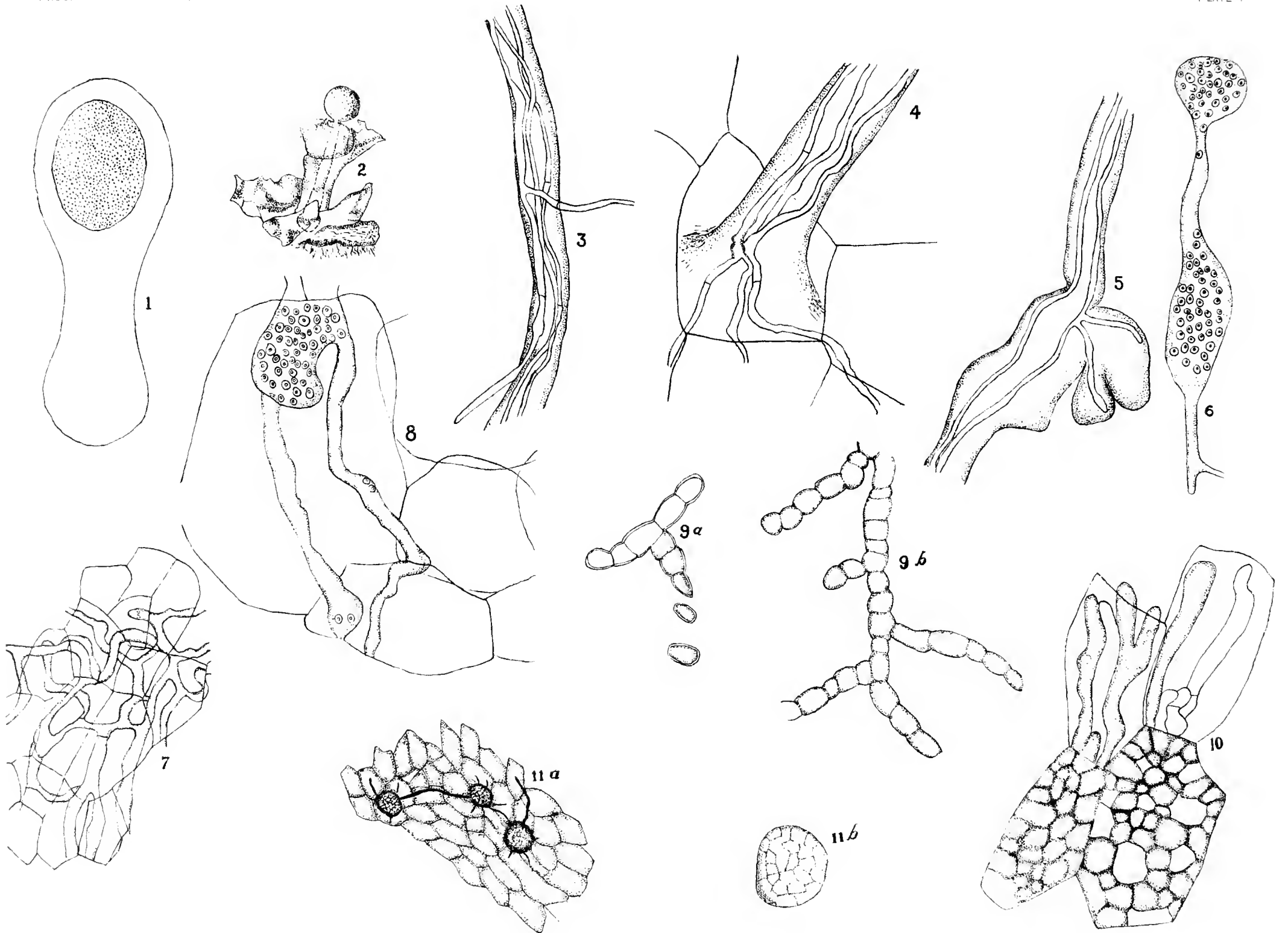
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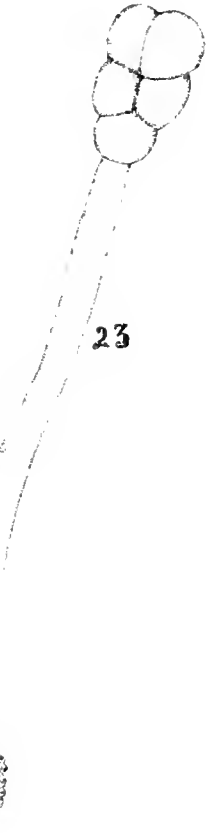
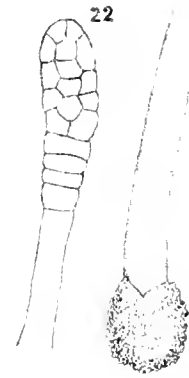
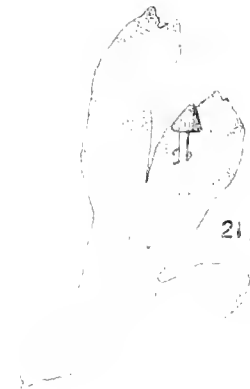
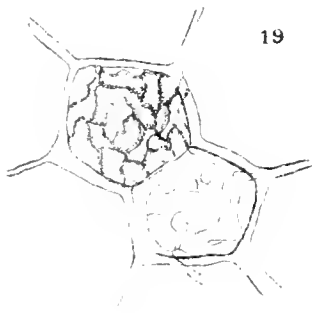
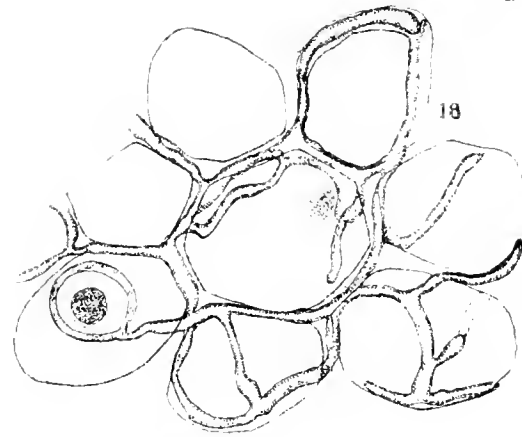
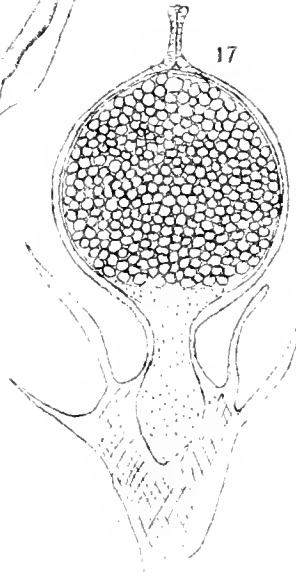
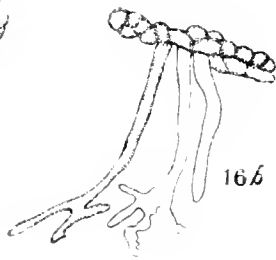
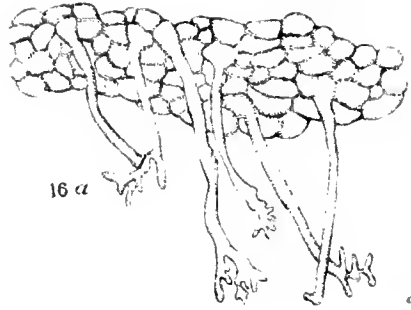
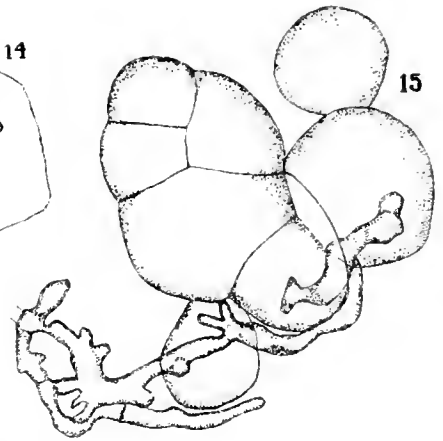
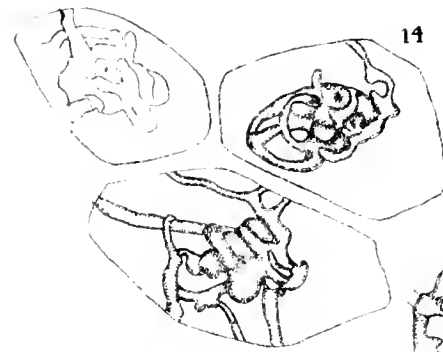
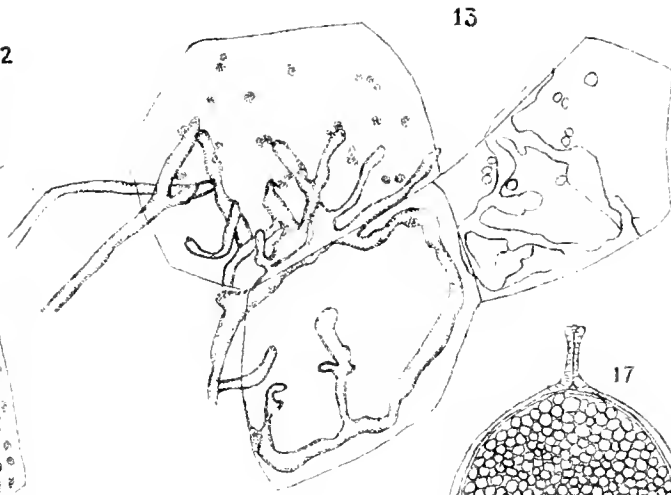
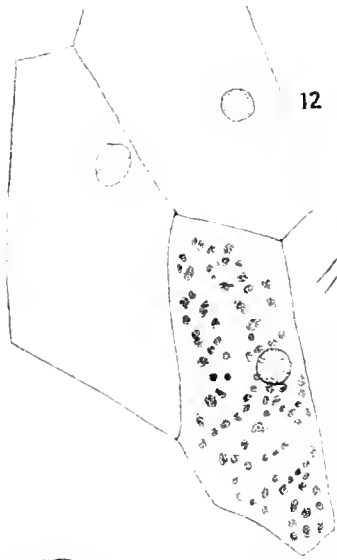
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EXPLANATION OF FIGURES IN PLATES I AND II.

- FIG. 1. Diagram of a young Sporogonium of *Fossombronina longiseta* collected November 1, 1906, near close of the dry season. Found in a locality of constant moisture.
2. Mature plant of *Fossombronina longiseta*. Had grown all summer. Collected January 6, drawn January 7.
 3. Living rhizoid of *F. longiseta* perforated by hyphæ. $\times 560$.
 4. Hyphæ passing from cells of thallus into rhizoid. $\times 560$.
 5. Abnormal rhizoid of *F. longiseta* containing hyphæ. $\times 560$.
 6. Thin-walled vesicle of the fungus associated with *F. longiseta*, within stem tissue of the host. $\times 560$.
 7. Hypha complex within cells of the host, *F. longiseta*. $\times 560$.
 8. Vesicle and hyphæ apparently communicating with the exterior. $\times 560$.
 9. (a) and (b). Formation of conidia by abstriction of hypha of the fungus infecting *F. longiseta*. $\times 560$.
 10. Development of sclerotia in cells of a leaf of *F. longiseta*. $\times 560$.
 11. Perithecia-like structures developing from hyphæ on the surface of *Aneura multifida major*.
 12. Uninfected cells of *Aneura multifida major* showing oil-bodies, *o. b.*, and chromatophores. $\times 335$.
 13. Infected cells of *Aneura multifida major*. Note the absence of oil-bodies and small number of chromatophores. $\times 335$.
 14. Three cells of *Aneura multifida major* showing knots of hyphæ. Chlorophyll and other cell contents wanting; cells, dead. $\times 335$.
 15. Infection of a young plant of *Aneura multifida major* that has developed from a gemma. $\times 560$.
 - 16a. Branching rhizoids of *Aneura multifida major*. $\times 80$.
 - 16b. Branching rhizoids of *Lepidozia attenuata*. $\times 80$.
 17. Longitudinal section of young sporogonium of *Porella bolanderi* near close of the dry-season. \times about 50.
 18. Portion of an infected leaf of *Porella bolanderi* showing chlamydospore (c). $\times 560$.
 19. Developing sclerotia within leaf cells of *Porella*. $\times 560$.
 20. Infection of tissue of *Anthoceros pearsoni*, showing sclerotium. $\times 560$.
 21. Portion of plant of *Fegatella conica* showing receptacle. Collected December 28, 1906; drawn January 2, 1907. Ad. nat.
 22. Apical end of a young *Fimbriaria* plant. $\times 560$.
 23. Young plant of *Fossombronina longiseta*. $\times 560$.

All drawings except Fig. 1, 16 and 23 were made with the aid of an Abbé camera lucida.





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A REVISION OF THE TENEBRIONID SUBFAMILY
CONIONTINÆ.

BY THOS. L. CASEY.

SUCH genera as *Eusattus*, *Coniontis*, *Cælus*, *Branchus* and *Praocis* possess a peculiar and consistent habitus distinguishing them as a special group in a somewhat heterogeneous assemblage, brought together under the subfamily name Asidinæ by LeConte and Horn. The only characters considered to be of subfamily weight by the latter authors are those relating to the coriaceous posterior margin of the penultimate abdominal segments and the presence or absence of a trochantin, but there are assuredly some other important characters, the utilization of which would serve to segregate the multitude of genera forming the first subdivision of the family into more homogeneous groups, that, in several cases, might be regarded as subfamilies without doing any great violence to precedent in other parts of the Coleopterous series. I have in mind more especially the size of the mentum and certain characters relating to the hind coxæ. In regard to subfamily division among those Tenebrionids which have no coriaceous hind margins of the abdominal segments, the following scheme might be proposed:—

Mentum large, covering both the maxillæ and ligula; hind coxæ variable, generally transverse, feebly oblique in some Eurymetoponids and strongly oblique in the Zophosini; trochantin invisible throughout. TENTYRINÆ

Mentum smaller, never concealing both the maxillæ and ligula¹.....²

¹The genera *Astrotus* and *Ologlyptus* constitute a remarkable exception to this rule, the entire buccal opening being closely filled by the mentum; but in all other characters, including facies, these genera are purely Asidid, showing how difficult it is to select characters constant through large groups in the Tenebrionidæ.

- 2 — Last abdominal segment unmodified.....3
 Last abdominal segment transversely excavated.....4
 3 — Posterior coxæ oblique and long, approaching the sides of the
 body; trochantin distinct.....CONIONTINÆ
 Posterior coxæ transverse and short, more remote from the sides of the
 body; trochantin inconstant, invisible to distinctASIDINÆ
 4 — Trochantin invisible; epipleuræ usually wholly undefined.
ZOPHERINÆ

The Tentyriinæ, as above limited, are divisible into several groups of rather more than tribal value, among which may be cited those genera having the hind coxæ much extended transversely, linear and frequently feebly oblique, the body generally winged; then those with the hind coxæ transverse and more or less oval, and, lastly, those with the hind coxæ very oblique and with the ante-coxal grooves still more oblique, known tribally as the Zophosini. If the Zophosini, which are as completely isolated in the old world fauna as the Coniontinæ are in North and South America, were placed last in the Tentyriid series, the Coniontinæ would naturally follow them, having many suggestive points of resemblance. By this arrangement, which it will be observed, greatly subordinates the importance of the trochantin, many minute forms without trochantin, such as *Aræoschizus* and *Stenosis* would be included with the Asidinæ. The Zopherinæ are so isolated as to assume subfamily rank, very obviously it would seem.

The Coniontinæ as a group have the body oblong or oblong-oval in form, compact, with the prothorax at base as wide as the elytra, usually enveloping the humeri at the sides to a more or less noticeable degree, the epistoma emarginate or sinuate at the middle, the eyes at the sides of the head, transverse, rarely divided and the mandibles short, stout and bifid at tip. The mentum is rather small, obtapezoidal and sinuate at tip and there is at the apex of the post-mental surface a transverse area, defined by a rapid divergence of the gular sutures. The ligula is large, transverse, sinuate and densely chitinized and the palpi of the usual Tenebrionid type, the last joint obtriangular. The antennæ differ from those of *Asida* in having a free, subequal club, generally of three joints. The legs are rather stout, well developed, the anterior tibiæ more or less obtriangular, with the

outer angle frequently prolonged, the tarsi always spinulose beneath, the anterior coxæ transversely oval, the intermediate very moderately separated, the prosternal process more or less extended and porrect and the mesosternum between the coxæ impressed and concave, these latter characters, with the long and well developed tibial spurs, elongate basal joint of the hind tarsi and oblique hind coxæ, recalling the *Zophosini* very forcibly. The fourth abdominal segment is very short when compared with the three anterior segments. The members of the Coniontinæ are neo-subarctic and neo-subantarctic exclusively and are represented on the Pacific slope of North America by the Coniontini and Cœlini, on the Atlantic slope by the Branchini and in South America by *Praocis* and allied genera. In the old world, as previously intimated, they are replaced by the *Zophosini*, which might be assumed to have almost if not quite subfamily rank.

The present revision omits the Praocini, as I have no representative of this South American tribe. The other tribes may be outlined briefly as follows:—

Intercoxal process of the abdomen moderately broad, truncate; elytra embracing the sides of the body beneath; antennæ well developed, elongate; hind coxæ rather more feebly oblique, body generally ridged above and roughly sculptured**Branchini**

Intercoxal process narrow, more pointed or rounded and projecting further into the metasternum2

2 — Antennæ long and slender, very well developed; basal joint of the anterior tarsi variable, elongate or short, in the latter case more or less eccentrically triangular and in some cases very prominent at the inner apical angle, suggesting the spur-like process of the next tribe.....**Coniontini**

Antennæ very small, compact, with the joints transverse; basal joint of the anterior tarsi greatly prolonged internally at apex, forming a spur which sometimes extends almost to the end of the tarsus.
Cœlini

The Coniontini are extremely abundant, having a widely extended distribution almost coincident with that of *Eleodes*, but the Cœlini are less numerous and are restricted to the seashore of California and Lower California, occurring also on the neighboring islands.

The form of the prosternal process is not always of deci-

sive importance in the Tenebrionidæ, as for example within the tribe Epitragini, but I have never noticed any species of the Coniöntinæ in which this process is not prolonged and subhorizontal, and but few of the Asidinæ in which it is not strongly and rapidly deflexed to the posterior margin of the prosternum, this being a rather consistent feature distinguishing these two subfamilies, in addition to the form and extent of the mentum and hind coxæ and structure of the antennæ. All of these differential characters are as pronounced in *Branchus* as they are in *Eusattus*, *Coniöntis* and *Cælus*, and it is therefore somewhat surprising that the true affinities of *Branchus* were not more fully dwelt upon by LeConte and Horn, who make but little mention of the subject. The gular characters given by LeConte (Class., 1 ed., p. 219) to distinguish the Branchini from the Coniöntini appear to be inconstant and of but little importance. As to the Praocini of Lacordaire, that author, it is true, includes certain genera with deflexed prosternal process, making of them a separate section of the tribe, but it is possible that they may properly be excluded from the subfamily Coniöntinæ, leaving *Praocis* and its subgenera alone to be included among the South American forms.

Tribe BRANCHINI.

This tribe, which has little or no relationship with *Asida*, is very limited in the number of its species and genera and is the Atlantic coast representative of the western Coniöntini and Cœlini, extending from Florida to Central America, although one species has recently been announced, by Mr. Champion, as inhabiting the western Mexican State of Guerrero. I have no example of our Florida or Bahama species, but a specimen of *Branchus obscurus* Horn, from Nicaragua, very kindly given me by Mr. Wickham, is a pure Eusattid in every way, except in having the hind coxæ more widely separated and the basal joint of the anterior tarsi not materially larger than those that follow it. One of its most striking points of resemblance with the Eusatti and with *Praocis* is the form of the epipleuræ, which are narrow very nearly to the base, where they suddenly expand to the sides of the elytra, forming a prominent point

at the humeri, and the acute side margins of the elytra are exactly as in *Discodemus* and *Megasattus*; the basal angles of the prothorax are prolonged backward very distinctly but to a much slighter degree than in any of the Eusatti. The scutellum is moderately developed and triangular to obsolete, the head and eyes nearly as in Coniontini, except that the notch at the extremity of each oblique suture is much more pronounced, the general form recalling *Asida*, and all the oral organs as well as the antennæ are purely Coniontid. The pronotum is finely costate along the median line and reflexed at the sides, the basal joint of the hind tarsi much elongated and the anterior tibiæ minutely dentate externally at tip.

Tribe CONIONTINI.

It appears to the writer eminently illogical to consider the remarkably diversified elytral epipleuræ, among the forms allied to *Eusattus*, as having anything less than generic value. It is unfortunate that our nomenclatorial system should be compelled to absorb so many names, but there is nothing to prove that the various and radical modifications are inconstant and I have seen no intermediate forms. The epipleuræ are perfectly constant throughout the genera *Eusattus*, with numerous species, *Discodemus*, with some seven apparently specific forms and elsewhere. A very noteworthy circumstance concerning this tribe, as well as the next, relates to the results of isolation on the islands off the coast of California, a large proportion of the forms occurring there being generically different from those of the mainland. The genera, which form two distinct subtribal groups clustering about *Eusattus* and *Coniontis* respectively, may be defined as follows:—

Elytra widely embracing the sides of the body, the epipleuræ variable; anterior tibiæ with everted external angle at apex; basal joint of the anterior tarsi long, slightly dilated at or toward tip; prothorax always prolonged backward at the sides and enveloping the humeri; scutellum nearly obsolete. [Subtribe EUSATTI]...2

Elytra narrowly embracing the sides of the body, the epipleuræ constantly narrow and occupying the entire inflexed part; anterior tibiæ with uneverted or very feebly everted external angle at apex, the basal joint of the anterior tarsi short, obliquely truncate at tip; prothorax variable at base but generally more truncate; scutellum generally well developed. [Subtribe CONIONTES]...8

- 2 — Epipleuræ very wide, occupying the entire inflexed sides of the elytra; intercoxal process of the abdomen acute; antennæ slender, dilated moderately toward apex. Habitat insular. [Type *Eusattus robustus* Lec.].....**Nesostes**
- Epipleuræ narrow, occupying much less than the entire inflexed sides of the elytra, except sometimes at the immediate base.....3
- 3 — Epipleuræ abruptly dilated at base to the lateral limits of the elytra; intercoxal process of the abdomen acute; body oblong or oblong-oval, moderately convex..... 4
- Epipleuræ gradually becoming wider basally, sometimes extending to the sides of the elytra at base; sides of the elytra always obtusely rounded in section, never acutely margined; antennæ slender, dilated apically, the joints loose and obtriangular to subcylindric7
- 4 — Sides of the elytra acute and reflexed almost to the apex; elytra conspicuously sculptured..... 5
- Sides obtusely rounded in section as in *Eusattus*.....6
- 5 — Antennæ less slender, compressed, more glabrous and more compact, gradually and more feebly enlarged distally, the joints obtrapezoidal, the subapical transverse, the eleventh narrower than the tenth; tarsi long and slender; femora and propleuræ glabrous. Habitat Sonoran of the Lower Rocky Mountains. [Type *Zophosis reticulata* Say].....**Discodemus**
- Antennæ slender, the joints obtriangular, gradually wider distally, the last joint as wide as the tenth and longer; tarsi shorter and stout; femora and propleuræ with bristling hairs. Habitat Lower California. [Type *Eusattus crosus* Horn].....**Megasattus**
- 6 — Elytra without coarse sculpture or punctuation of any kind, subopaque. Habitat Lower California. [Type *Eusattus levis* Lec.].....**Eusattodes**
- 7 — Intercoxal process of the abdomen acute, the coxæ throughout narrowly separated; body oblong-oval to parallel, moderately convex; propleuræ with or without bristling hairs. Habitat widely extended in the Sonoran and Pacific regions. [Type *E. difficilis* Lec.] = *Conipinus* Lec.....**Eusattus**
- Intercoxal process obtuse, the coxæ more widely separated throughout; body more broadly rounded, very convex, the sculpture more muricate; propleuræ with more conspicuous bristling hairs. Habitat as in *Eusattus*. [Type *Eusattus muricatus* Lec.]...**Sphæriontis**
- 8 — Scutellum well developed, triangular9
- Scutellum subobsolete, very minute, triangular.....12
- 9 — Posterior angles of the prothorax strongly posteriorly produced, as in the preceding group of genera; palpi more elongate than usual; last three joints of the antennæ moderately dilated; basal joint of the anterior tarsi rather longer than the next two com-

bined, obliquely prominent internally at tip, two to four transverse, rapidly diminishing in size. Habitat insular. [Type *Coniontis lata* Lec.].....**Coniontides**

Posterior angles of the prothorax feebly produced posteriorly, the thoracic base frequently subtruncate; anterior tarsi as in *Coniontides*10

Posterior angles not at all produced, the thoracic base transversely subtruncate11

10 — Eyes transversely reniform, entire, moderately coarsely faceted as usual; body larger in size as a rule. Habitat widely extended from eastern Colorado to British Columbia, San Diego and the islands off the Pacific coast. [Type *C. viatica* Esch.]

Coniontis

Eyes completely divided; body smaller, the legs and antennæ shorter. Habitat nearly as in *Coniontis*, excepting the immediate coast of the Pacific. [Type *Coniontis obesa* Lec.].....**Coniontellus**

11 — Body small in size, oblong, the eyes as in *Coniontis*; legs longer, the tarsi long and filiform, the four basal joints of the anterior subequal and slightly elongate, the basal joint of the posterior relatively much shorter than usual, but little longer than the next two combined; mesosternum scarcely so much as impressed on its anterior slope; palpi and antennæ elongate and slender; frontal margin of the head more nearly as in *Eusattus*. Habitat northern Pacific coast regions. [Type *C. rectus* Csy.].....**Conisattus**

12 — General habitus as in *Coniontis* but muricately and generally densely punctured, the front and eyes similar; base of the prothorax feebly and very gradually produced backward at the sides; legs, antennæ and palpi as usual; anterior tarsi moderate, the basal joint as long as the next two combined, strongly and rapidly dilated and very obliquely, sinuously truncate at apex, the inner angle pronounced and prominent though obtuse, the inner surface apically impressed, joints two to four subequal, feebly transverse. Habitat insular. [Type *C. punctulata* Horn].....**Cælotaxis**

The only one of the above genera not represented before me at present is *Eusattodes*, founded upon a very rare species inhabiting the lower extremity of Lower California near Cape San Lucas. *Cælotaxis* makes the closest approach to the Cælini in sculpture, retraction of the scutellum and form of the first anterior tarsal joint, but is a true Coniontid nevertheless. *Coniplus* Lec., was founded upon *Eusattus dubius*, a very small oblong convex species, but I cannot find any structural character to distinguish it from the other members of the true *Eusattus*, except a more oval and less pointed form of the last antennal joint. At first it seemed possible that its smooth surface and

sparse, even, muricate punctures might give it validity, but it is connected in this respect so gradually, by way of *productus* and *difficilis*, with the coarsely reticulate species of the *convexus* type, that this attempt also proves futile and we are compelled to suppress the name as a virtual synonym of *Eusattus*. In Dr. Horn's later tables of *Eusattus*, which included all of the subtribe Eusatti as defined above, he gave far too much weight to the margining of the prosternal lobe, bringing thereby into juxtaposition species that have no close mutual relationship whatever; this is especially noticeable in his latest table (Proc. Cal. Acad., Ser. 2, IV, p. 423). Although wholly without significance in delimiting groups, the beaded margin of the prosternal lobe is useful in defining species if interpreted broadly, due allowance being made for a certain amount of variability, or more especially accidental malformation. It becomes particularly valuable in the great genus *Coniontis*, so deficient in marked structural diversity, as will appear subsequently.

It is interesting to note, in view of the many points of resemblance between the Coniontinæ and Zophosini, that one of the first of our species to be described should have been assigned to the genus *Zophosis* by Say, presumably upon descriptive evidence only. It may also be observed in connection with statements made above, that more than a fourth of the genera of Coniontini are confined exclusively to the islands off the coast of California.

Nesostes n. gen.

This genus is represented at present by one or two species, among the largest of the entire subfamily and possessing many peculiarities of structure and sculpture. The epipleuræ are very wide and almost even in width in about basal half, between the simple inner margin of the inflexed part of the elytra and the acute and very narrowly reflexed lateral margins, and the elytral sculpture is notably different from anything occurring elsewhere. The type may be described as follows:—

Body broadly oblong-oval, convex, glabrous, with a few fulvous hairs near the external margin of the hypomera posteriorly and on the epipleuræ, except externally, deep black, the upper surface aluta-

ceous; head rather finely but strongly, moderately closely punctured; antennæ rather slender, moderately dilated apically, the third joint but little longer than the fourth; prothorax about two and a third times as wide as its median length, minutely and sparsely punctured throughout, the punctures but little more distinct or closer laterally, simple, the sides subexplanate, with the edges heavily beaded, the bead extending entirely across the apex, but becoming very feeble medially; scutellum obsolete; elytra but little longer than wide, nearly three times as long as the prothorax, the sides arcuately converging in about apical half, the apex obtusely ogival; surface nearly smooth, minutely, remotely punctate, the punctures slightly larger but only slightly less remote though muricate laterally and apically, the interspaces toward apex becoming closely, evenly granulose and polished; anterior tibiæ strongly produced and angulate externally at apex, the basal joint of the anterior tarsi less elongate than usual, but little longer than the next two joints combined; prosternum alutaceous, the process thickly margined and impunctate. Length 16.0–16.5 mm.; width 10.5–11.0 mm. Island of San Clemente..... *robustus* Lec.

A — Form more oblong-subparallel and narrower than in *robustus*, similarly sculptured, the sides of the prothorax more rounded and relatively more converging anteriorly and more parallel behind the middle; elytra more gradually and less obtusely subogival behind; antennæ less slender; anterior tibiæ a little shorter, relatively somewhat broader at tip; marginal bead of the prothorax not subequal in thickness throughout, as in *robustus*, but still thicker apically than basally. Length 17.0 mm.; width 10.5 mm. Island of San Clemente.

postremus n. subsp.

In the subspecies *postremus*, which is described from a single female specimen, the form is obviously different from that of the more evenly subelliptic and broader *robustus* and there are several other minor differences as enumerated above; it might be added, also, that the hind angles of the prothorax are more abruptly acute and more prolonged posteriorly. The abruptly polished area on the posterior declivity of the otherwise subopaque elytra is a rather remarkable character, peculiar to this genus.

Discodemus Lec.

The components of this genus are moderately numerous but so closely allied among themselves as inevitably to give rise to discussion concerning their true status. I have given them specific rank, by no means confidently, although they are recognizably definable and do not seem to intergrade, in fact consti-

tuting a typical example of divergence due to local environment in what may possibly be a comparatively recently evolutionized type. The genus is well represented in almost every collection and nothing further in way of description is called for at present, except to draw attention to the form of the antennæ as a generic character hitherto overlooked. The body is smaller, more oval and much less convex than in the preceding genus and the basal joint of the anterior tarsi is longer, being almost as long as the next three combined; the outer apical angle of the anterior tibiæ is not so strongly everted but is much more acute at tip; the scutellum is similarly obsolete. The specific or subspecific modifications known to me may be outlined as follows:—

- Body moderately convex, stout, very obtusely rounded behind, with a short obtuse sutural projection2
- Body narrower, more depressed, the sides more gradually, arcuately converging behind to the subacute apex..7
- 2 — Upper surface of the body only partially opaque, the elevations of the elytra rather strongly shining.....3
- Upper surface opaque throughout, the elevations of the elytra at most alutaceous6
- 3 — The irregular anastomosing depressions forming broad lines between the narrower, feebly elevated and irregular subelevated lines of the elytra, deep and better defined by the small asperulate and minutely setigerous punctures along their anterior margins..4
- The anastomosing depressions very shallow, small in size and but little less shining than the remainder of the surface, the entire upper surface more shining than in any other species.....5
- 4 — Form oblong-suboval, convex, deep black, the head dull and distinctly micro-reticulate, the pronotum more feebly and less dull, the former finely but distinctly, not densely punctate, the latter very minutely sparsely so throughout and only a little more distinctly or less sparsely laterally, the apex circularly emarginate and evidently more than half as wide as the base, the sides broadly, evenly rounded, the surface broadly explanate toward base, narrowly so anteriorly, the marginal bead fine and almost completely obsolete, the base broadly bisinuate and about two and a fourth times as wide as the median length; elytra but little longer than wide, feebly inflated, the broadly arcuate sides becoming rapidly converging and more arcuate in apical two-fifths, the apex very obtusely ogival, the reticuliform erosions deep and opaque, very confluent and irregular, the punctures on their anterior edges fine and only moderately distinct, feebly asperate, the six discal ridges on each elytron subequal and rather narrow, irregular; prosternum

finely, sparsely punctate, the process margined at the sides but only at its base between the coxæ; basal joint of the hind tarsi as long as the entire remainder. Length 12.0 mm.; width 7.8 mm. New Mexico. [= *Zophosis reticulata* Say].....**reticulatus** Say

Form and general characters nearly similar but more broadly oval and less oblong, the eroded depressions of the elytra large, less numerous and less anastomosing, the interspaces and longitudinal lines shining, the erosions deeper than in any other species and more abruptly defined by transversely irregular lines of close-set and strongly muricate punctures; inflexed sides of the elytra rather coarsely but sparsely punctured, the punctures much more distinct than in *reticulatus*. Length 12.8-13.8 mm.; width 8.7-9.5 mm. Texas (near El Paso).....**corrosus** n. sp.

5 — Form broadly oblong-oval, inflated posteriorly, strongly convex, deep black, the anterior parts alutaceous (♀) or opaque (♂), the head and pronotum very minutely and sparsely punctate, the former much more finely than in *reticulatus*; sides of the latter rather broadly, subequally explanate throughout (♀) or scarcely at all explanate (♂); elytra shorter than in any other species, much shorter than wide in both sexes, the longitudinal elevations very faint and ill-defined, stronger in the male, most of the surface rather strongly shining, the muricate punctures finer, less close-set and not forming such distinct transverse lines as in *corrosus*; inflexed sides of the elytra only very finely, remotely and indistinctly punctulate. Length 10.8-13.5 mm.; width 7.5-8.6 mm. Arizona (Grand Canyon of the Colorado), — T. Mitchell Prudden.....**brevipennis** n. sp.

6 — Body oblong-oval to oblong, convex, deep black, dull and opaque in lustre; head and prothorax alutaceous, faintly and sparsely punctulate as in *brevipennis*, the sides of the latter more narrowly and more concavely explanate, the reflexed part subequal in width throughout; elevated parts of the elytra strongly alutaceous, the erosions rather deep, irregularly confluent, the asperulate punctures fine, sparse and moderately distinct but not defining the erosions, the six longitudinal lines on each elytron unusually evident, especially in the male; elytra unusually elongate, evidently longer than wide in both sexes, the inflexed sides sparsely and sometimes distinctly punctate. Length 11.8-13.8 mm.; width 7.6-9.7 mm. Arizona (San Bernardino Ranch, Cochise Co.), — F. H. Snow.....**elongatulus** n. sp.

Body oblong-oval, smaller than in *elongatulus* and less convex, more abbreviated, the lustre subopaque, the prothorax more transverse, with the apex not more than half as wide as the base, less concavely explanate at the sides and sometimes sensibly more broadly toward base; elytra about as long as wide, the elevated lines less distinct, the eroded foveæ large, rather deep, impressed and anastomosing, not at all defined by the small punctures, which are sparse and not definitely muricate, usually hardly

visible, the inflexed sides more shining, variably but feebly and sparsely punctulate. Length 10.5–12.8 mm.; width 7.4–9.0 mm. Arizona (more especially southern).....**depressulus** n. sp.

Body oval, rather smaller than in *depressulus* and much more convex, subopaque throughout above, the elytra with sericeous lustre; head rugulose anteriorly, with the margin more reflexed than usual; prothorax less transverse, nearly as in *reticulatus* but more narrowed from base to apex, the sides evenly and concavely explanate; elytra as long as wide, inflated, the erosions small, feeble and isolated, more punctiform, the small punctures fine and very feeble, scarcely muricate and clustered in small groups of two to four at the erosions, the general surface almost smooth, the alternate elevated lines obsolete, leaving three very feeble lines on each elytron, the inflexed sides rather opaque and scarcely punctate. Length 11.6 mm.; width 8.0 mm. Arizona, — Warren Knaus.....**subsericeus** n. sp.

7 — Form much more narrowly elongate-oval than in any of the preceding and gradually pointed behind, deep black, subopaque; head flat throughout above, moderately sinuate at apex, finely and sparsely punctate; antennæ stout and strongly compressed as usual; prothorax barely two and one-half times as wide as its median length, the sides evenly converging and arcuate from base to apex, the latter somewhat more than half as wide as the base, minutely, sparsely punctate, slightly less sparsely and less obscurely toward the sides, which are moderately explanate, with a feeble thickened bead; elytra fully three times as long as the prothorax, evidently longer than wide, very feebly subcostulate and with large subisolated and feebly impressed opaque areas suturally, which completely coalesce laterally, forming a broad opaque irregular area bestrewn with very small muricate punctures, the side margin with a bilaterally symmetric sinus, corresponding with an epipleural impression, slightly behind the middle, — a character which is probably accidental in the single specimen from which the description is drawn; — under surface and epipleuræ less opaque, minutely, sparsely punctulate. Length 11.7 mm.; width 7.8 mm. Colorado (Fremont Co.), — Warren Knaus.

knausi n. sp.

The male is usually a little smaller, narrower and more parallel in form than the female, but in *brevipennis* it is very much smaller and rather more dilated than the female. Individuals appear to be more abundant than in any other genus of the Eusatti and good series of several species are before me.

Megasattus n. gen.

Two species, one of which is the largest known North American member of the subfamily Coniontinæ, are the only repre-

representatives of this genus thus far discovered. While allied more closely to *Discodemus* than to any other, it differs markedly in antennal structure, the antennæ being notably slender basally and decidedly dilated distally, in the form of the lateral margins of the elytra, which are not evenly acute but acutely rounded in section, sculptured and uneven and not smoothly cariniform and in the more parallel and oblong form of the body, with the prothorax not widest at base as in *Discodemus* but slightly behind the middle. It also inhabits a very different faunal region, which amply accounts for the present structural divergencies, though apparently springing from the same archetype at no very distant time in the geologic past, as indeed did all these allies of *Eusattus*. The species may be defined as follows:—

Form oblong, strongly convex, deep black, glabrous, the head evidently and the prothorax very feebly alutaceous in lustre, the elytra polished except in the erosions, the latter being opaque; head rather strongly, moderately closely punctate, the anterior margin slightly reflexed, moderately sinuate at the middle and feebly emarginate laterally; antennæ a little longer than the prothorax, the third joint much the longest, the tenth obtrapezoidal, slightly transverse, broadly angulate at tip, the eleventh as wide as the tenth and longer, acutely angulate; prothorax two and one-half times as wide as its median length, the deep apical sinus transverse medially, the angles prominent but rounded, the basal angles rather abruptly but only moderately produced posteriorly, acute, the lateral sinuses of the base deep, relatively small, the median lobe very broad; sides evenly rounded, strongly, moderately thickly beaded, narrowly explanate; punctures fine and sparse, becoming rather close, larger and muriculate laterally; elytra decidedly longer than wide, obtusely ogival behind, feebly dilated, the sides slightly arcuate, each with two distinct obtuse ridges, the intermediate ridges very feeble, the surface pitted with numerous small deep irregular and isolated erosions, with their anterior margins rendered very rough and jagged by the rather strong and very asperate, minutely setigerous punctures, the flanks just above the acute side margins more deeply and continuously eroded and opaque, with the included punctures less asperate; inflexed sides asperately punctate; prosternal lobe dilated and spatulate apically, laterally margined only along the coxæ; anterior tibiæ with the external apical projection very acute. Length 19.0 mm.; width 11.5 mm. Lower California.

erosus Horn

Form rounded-oval, convex, black, subopaque, the prothorax finely and sparsely punctured medially and densely though very faintly

granulate laterally, the margin not thickened; elytra subcostate, the intervals coarsely punctured and with small, smooth and rounded tubercles; inflexed sides densely and coarsely punctured. Length 16.5 mm.; width 10.0 mm. Lower California.

costatus Horn

Costatus is unknown to me and the description here given is essentially a copy of the original; it occurs in the same locality as *erosus*. The single male specimen representing the latter species in my cabinet and described above has not been compared with the original type, but appears to be an authentic example.

Eusattodes n. gen.

The chief distinctive character of this genus seems to be the abruptly and basally dilated epipleuræ, the latter at base extending laterally to the sides of the body, as in the preceding genera, but here combined with rounded *Eusattus*-like sides of the elytra in section, without trace of the acute margin there prevailing. It also differs from all except *Eusattus secutus* in the completely impunctate integuments and probably in several other characters, which must remain unknown to me for the present, in the absence of typical examples. The type and only described species is the following:—

Body oval, convex, black, subopaque above and beneath, less rounded in outline than in *Discodemus*, with the sides of the elytra almost straight from the base to beyond the middle and nearly parallel; upper surface entirely without sculpture; elytra slightly inflated posteriorly, impunctate, suddenly declivous at the sides; thoracic angles posteriorly produced, the anterior tibiæ obliquely prolonged at the outer angle, which is rounded at the tip. Length 14.0 mm.; width 8.0 mm. Lower California (Cape San Lucas).

lævis Lec.

According to Horn the prosternum is not margined in *lævis* and the tip of the process is rounded and smooth.

Eusattus Lec.

This is a large genus, embracing considerable variety in the form and sculpture of the body, but the epipleuræ throughout are virtually constant in extent and configuration, this being one of the strongest of the reasons inducing me to believe that these radical epipleural modifications must be given full generic weight

and not lightly passed over as advocated by Horn, the latter author even going so far as to advance such a trivial character as the margination of the prosternal lobe over epipleural structure in inserting *lævis* between the mutually congeneric species *politus* and *dubius* in his latest table (l. c., p. 423). The species of *Eusattus* are widely distributed from western Kansas and Oregon to Lower California and are smaller in size than in any of the preceding genera; those known to me either actually or by description may be recognized by the following characters:—

Elytra absolutely impunctate as in *Eusattodes lævis*. Form oblong-oval, nearly as in *dubius*, black, moderately shining; head opaque, sparsely punctate, the clypeus nearly entire; prothorax rather more than twice as wide as long, widest at base, the side arcuate, the margin not fimbriate and the hind angles acutely prolonged posteriorly; surface convex, completely impunctate; elytra smooth, impunctate, the epipleuræ gradually and but little wider at base, absolutely smooth; prosternum coarsely punctured between the coxæ, the tip of the process rounded and with a distinct marginal bead; abdomen very sparsely and finely punctate, shining. Length 9.0–10.0 mm. Lower California (El Taste and San José del Cabo) **secutus** Horn

Elytra with sparse but evident, more or less muricate punctures.....2

Elytra with larger, subconfluent to small and irregular but isolated, punctiform erosions, without evident muricate punctures, and having uneven, usually elevated impunctate lines; prosternal process never margined apically.....14

2 — Form oblong-elongate, the elytra smooth or nearly so, with the punctures small or moderately small in size; prothorax in the male very transverse, wider than the elytra.....3

Form oblong or oblong-oval, much less elongate, the clypeus never so distinctly emarginate at the middle of the rounded sides, at the ends of the oblique sutures, as in the preceding group.....9

3 — Body small in size, strongly convex, the elytra very smooth, the punctures very small, sparse, evenly but irregularly distributed throughout, generally becoming distinctly muricate only toward the sides; tarsi slender. [= *Conipinus* Lec.]..4

Body much larger, relatively less convex, the elytra nearly smooth but sometimes with vestigial longitudinal areas of greater elevation, the punctures less minute and strongly muricate throughout, with longitudinal and very feebly defined lines, corresponding with those of greater convexity, in which they become sparse or wanting; tarsi stouter 6

4 — Color black or piceous-black, the prothorax less transverse and with less converging sides, generally but little more than twice as wide

as long. Body oblong-elongate, very convex, shining to feebly alutaceous, glabrous, the flanks sparsely puberulent; head strongly but not densely punctate, the apical margin only moderately reflexed, sinuate at the middle, the lateral emarginations small and feeble; prothorax with the apex nearly three-fourths as wide as the base, the angles slightly acute and but little blunted, the surface convex, minutely, sparsely punctate medially, much more coarsely but rather sparsely and non-muricately laterally, the sides narrowly explanate and finely beaded; posterior angles small, not greatly prolonged though acute; scutellum wholly obsolete; elytra a fourth longer than wide, as wide at the middle as any part of the prothorax (♂) or wider (♀), the sides feebly arcuate, the apex obtuse; surface almost vertically declivous posteriorly, with small impressed and very sparse but distinct simple punctures, becoming but little larger or closer and only very feebly muricate on the flanks; hypomera ciliate; prosternum sparsely pubescent, the process impunctate, pointed and unmargined at tip; anterior tibiæ serrulate externally except apically, the external process long, rather acute; epipleuræ narrow. Length 6.3–7.9 mm.; width 3.3–4.7 mm. California (Kern Co.).....**nanus** Csy.

Color piceous-black to pale piceo-testaceous, the prothorax much more transverse, always much more than twice as wide as long, much wider than any part of the elytra (♂) or scarcely obviously so (♀), the sinuate apical margin of the head more strongly reflexed and the lateral emarginations very distinct5

5 — Body elongate, very convex, polished, glabrous though with a few small hairs laterally; head finely, sparsely punctate, densely near the transverse suture, impunctate and polished in the apical concavity behind the reflexed margin; prothorax two and one-half times as wide as its median length, the apex two-thirds as wide as the base, the angles and side margins throughout nearly as in *nanus*, the sides much more converging from base to apex, the punctures very minute even laterally and much less distinct; elytra narrower and more elongate, almost a third longer than wide, the sides less arcuate, the apex obtuse, the punctures fine but distinct, sparse, feebly asperate medially, distinctly so laterally; prosternum with only a few short hairs, the process impunctate, obtusely rounded or subtruncate and unmargined at tip; anterior tibiæ only feebly serrulate externally, the apical process moderate, not so prolonged as in *nanus*. Length 7.9–8.5 mm.; width 4.3–4.8 mm. Arizona (southwestern) and California (Colorado Desert).....**dubius** Lec.

Body nearly similar in form and size but less convex and less polished, slightly alutaceous in lustre, rufo-piceous throughout; head nearly as in *dubius* but more angularly prominent at the sides before the eyes, less strongly reflexed along the clypeal margin and more coarsely and densely punctured toward the transverse suture, the punctures also extending further anteriorly toward the reflexed

margin; prothorax similar but less narrowed at apex and more parallel toward base, with the side margins more concave and the apical sinus more transverse medially, the punctures small but less sparse and more distinct, not differing much laterally, the basal angles rather more prolonged backward, acute; elytra similar in outline but less convex, slightly narrower than the prothorax, the sides parallel and feebly arcuate, rounding at base within the thoracic angles as usual, punctured nearly as in *dubius* but somewhat less sparsely; prosternal lobe broadly rounded at tip, impunctate, very faintly and finely margined throughout its apical contour; anterior tibiæ crenulate externally, the external apical projection unusually feeble, much smaller than in *dubius*. Length 8.0 mm.; width 4.3 mm. California (Lancaster),—H. F. Wickham**oblongulus** n. sp.

6—Prosternal process not margined except along the coxal cavities...7

Prosternal process margined at the rounded apex and also along the cavities8

7—Explanate lateral margins of the pronotum deeply concave. Body (♂) cuneiform, moderately convex, black throughout, glabrous, though with a few small hairs on the flanks, the hypomera roughly punctured and ciliate, the femora fulvo-pubescent; upper surface feebly shining, alutaceous; head finely, not densely punctate, the clypeus concave anteriorly, subangularly sinuate at the middle, with the margin only moderately reflexed, the lateral emarginations feeble; prothorax very transverse, much narrowed anteriorly, the apex circularly sinuate and about three-fifths as wide as the base, the angles less than right but blunt, the basal angles only moderately produced and not very sharp, the sides arcuate; surface minutely punctate, remotely so medially, more closely but not much less finely laterally; scutellum much larger and more transverse than in the *dubius* group, though similarly confined to the basal slope; elytra about a third longer than wide, parallel, with the sides feebly arcuate, not very obtuse at tip, much narrower than the prothorax, the asperate punctures sparse and uneven in distribution, closer but not much larger laterally; surface with some very feeble and irregular longitudinal impressed lines; anterior tibiæ very finely, closely serrulate along the external edge, the apical angle acute but only very moderately developed, Length 10.5 mm.; width 5.8 mm. (♂). Arizona (southwestern).....**productus** Lec.

Explanate lateral margins nearly flat. Body (♂) rather more elongate and less cuneiform, piceo-castaneous in color, alutaceous, glabrous as in *productus* and similarly punctured, except that the punctures of the head and pronotum are even more minute and indistinct and those of the elytra larger and stronger; head nearly similar; prothorax similar but somewhat less transverse, scarcely two and one-half times as wide as its median length; elytra two-fifths longer than wide, parallel and nearly straight at the sides,

broadly ogival at tip, evidently narrower than the prothorax but not so markedly as in *productus*, the surface with more numerous lines devoid of punctures, the lines just visibly more convex than the rest of the surface; body (♀) larger, notably stouter, more parallel and more shining, the elytra fully as wide as the prothorax or a little wider, with the sides more arcuate, also having more numerous flavate hairs on the sloping sides of the pronotum; hypomera and anterior tibiæ in both sexes nearly as in *productus*. Length 11.4–11.8 mm.; width 6.0–6.9 mm. (♂, ♀). California (Colorado Desert).....**explanatus** n. sp.

- 8 — Body (♂) nearly as in *explanatus* but rather more abbreviated and somewhat smaller in size, feebly shining, piceous-black; head and prothorax nearly as in *explanatus*, the antennæ somewhat shorter and thicker; elytra not more than a fourth longer than wide, scarcely narrower than the prothorax, parallel, with the sides feebly arcuate, the surface more even, without longitudinal lines of greater convexity but with the punctures, which are still stronger, closer and more coarsely muricate, especially on the flanks, arranged in very irregular longitudinal areas of greater or less approximation; anterior tibiæ similar; basal joint of the hind tarsi similarly not longer than the last two combined. Length 10.4 mm.; width 6.0 mm. (♂). Arizona (southwestern).

vicinus n. sp.

Body more elongate than in *vicinus*, less black and more castaneo-piceous in color, almost similarly sculptured; head very slightly larger, similarly opaque and finely, sparsely punctate but having the apical reflexed edge continuous and not interrupted at the sinus; prothorax slightly less transverse and having the basal lobe not very broadly rounded but more narrowly rounded and prominent than in any other species, otherwise as in *vicinus*, except that the apical angles are less blunt and more prominent, the sides just behind them very faintly sinuate; elytra decidedly more elongate, almost a third longer than wide, more evidently narrower than the prothorax than in *vicinus* but otherwise nearly similar, the sides less arcuate and the punctures sparser; prosternal process narrower and more feebly margined at apex; anterior tibiæ less abruptly and only moderately prominent externally at tip; intro-mittent spicule stouter and more punctate, the coriaceous lobe between the lateral alæ of the genital segment canaliculate along the middle and not evenly convex as it is in *vicinus*. Length 11.0 mm.; width 5.8 mm. (♂). Arizona (southwestern).

lobatus n. sp.

- 9 — Elytral surface smooth. Body oval, very little longer than wide, convex, black, shining; head very sparsely punctate in front, the clypeus not incised [at the sides]; prothorax neither explanate nor ciliate at the sides, very narrowly margined [in original description], without marginal line [Proc. Cal. Acad., 2, IV, p. 423], the base bisinuate, the hind angles obtuse, the surface

- sparsely punctate at the sides, nearly smooth medially; elytra with very fine punctures, very remotely placed; epipleuræ gradually wider from apex to base; prosternum coarsely punctured in front, the process margined throughout; abdomen very sparsely and finely punctulate. Length 10.0 mm. California (Sta. Barbara).**politus** Horn
- Elytral surface more or less uneven..... 10
- 10 — Prosternal process margined throughout.. 11
- Prosternal process without trace of marginal bead, except basally along the acetabula; elytra with irregular impunctate lines as in *productus* 13
- 11 — Prothorax very broadly emarginate at apex, the sinus transversely rectilinear medially. Body in form and size nearly as in *difficilis* Lec., oval, feebly shining; head finely punctate, the clypeus broadly emarginate, rounded at the sides, the margin narrowly reflexed; prothorax with the apical angles very obtuse, the basal comparatively short and obtuse, the sides finely margined, the surface narrowly and feebly impressed along the margin, broadly rounded and converging before the middle, subparallel behind the middle; disk alutaceous, sparsely and finely punctate; elytra at the base slightly wider than the prothorax, without lateral margin, feebly carinate, the surface alutaceous, with small sparse submuricate granules; epipleuræ gradually wider to the base, sparsely punctate and hairy; prosternum sparsely punctate, the process narrowly oval at tip; abdomen sparsely punctate; legs with short sparse setæ. Length 11.0–11.5 mm.; width 6.0 mm. California (Los Angeles Co.) **coquilletti** Linell
- Prothorax more narrowly, deeply and circularly emarginate at tip, with the apical angles more acute and narrowly rounded, the basal angles more posteriorly produced and acute, more evidently embracing the humeri, the sides evenly converging from the base, evenly and broadly arcuate; scutellum rather more evident than usual; elytra with more or less evident ridges which are scarcely less punctate than other parts of the surface..... 12
- 12 — Form broadly oblong-oval, moderately convex, deep black, subglabrous above, ciliate at the sides, the femora with short and stiffer hairs; upper surface opaque (♂) or moderately shining (♀); head rather strongly, moderately sparsely punctate, the clypeus rather feebly reflexed, sinuate at the middle, the lateral incisures obsolete; prothorax scarcely two and one-half times as wide as its median length, convex, moderately widely declivoplaxanate at the sides, with the marginal bead fine but elevated, the punctures small but distinct, only moderately sparse, becoming rather coarse but well separated and minutely setigerous laterally; elytra barely longer than wide, the marginal line obtusely protuberant at tip, equal in width to the prothorax in both sexes, the sides feebly arcuate, the surface rugose, rather coarsely, evenly

and not very closely punctate, the punctures sharply muricate and minutely setigerous; a few very irregular and more convex longitudinal lines are evident; prosternum sparsely, shallowly punctate; anterior tibiae strongly but very obliquely prolonged externally at tip, the external edge but feebly sinuate and finely, inconspicuously spinulo-serrate; epipleuræ subconcave basally, sparsely punctate and hairy throughout. Length 8.0–11.0 mm.; width 4.8–6.6 mm. California (San Diego)**difficilis** Lec.

Form nearly as in *difficilis* but less broadly oblong-oval, opaque, glabrous, the punctures less evidently micro-setigerous, the sides beneath much less ciliate, the hairs of the epipleuræ and femora much shorter and less conspicuous; head nearly similar but with the reflexed clypeal margin still more feeble and very shallow, the lateral notches very small but more evident; prothorax nearly similar but with the sides rather less strongly converging from base to apex, the punctures almost similar; elytra more evidently elongate, as wide as the prothorax, parallel, nearly straight at the sides, with more numerous and narrower longitudinal lines of slight convexity, the surface less coarsely and more feebly rugose, with much smaller, sparser and rather less strongly muricate punctures; prosternum densely and rather finely punctato-rugose; anterior tibiae nearly similar but more strongly sinuate externally beyond the middle; epipleuræ flatter, with the outer margin less deflexed basally, rather less coarsely, very sparsely punctate; flanks of the elytra above the epipleuræ more prominently rounded in profile than in other species except *difficilis*. Length 9.7 mm.; width 5.9 mm. California (Los Angeles Co.)...**agnatus** n. sp.

13 — Body oblong, convex, rather narrow (♂) to very stout (♀), dull in the former, more alutaceous and with the elytra rather shining in the latter, glabrous, ciliate at the sides, the femora with short and sparse yellow hairs; head with moderately strong punctures, gradually close toward the transverse suture, the apex of the clypeus very feebly reflexed, not at all so near the median sinus, the lateral notches obsolete; prothorax nearly as in *difficilis* but less transverse, strongly narrowed with evenly arcuate sides from base to apex, the apex evenly, deeply, circularly emarginate, with rather pronounced and only narrowly blunt angles, the basal angles and explanate sides nearly as in *difficilis*, the explanate surface flat but diminishing in width at the basal angles, the fine raised margin similar; surface convex, more minutely, sparsely punctured, the punctures slightly larger and micro-setigerous laterally though smaller and much sparser than in *difficilis*; scutellum rather evident; elytra slightly elongate, equal in width to the prothorax, with some feebly convex longitudinal lines, the punctures, irregularly disposed for the most part between these smooth lines, unusually coarse, numerous, moderately muricate and micro-setigerous; prosternum sparsely punctate, especially strongly so on the process, feebly and sparsely fulvo-pubescent;

anterior tibiae nearly as in *difficilis*; epipleurae nearly similar but with the flanks of the elytra above them evenly and broadly rounded in section and not prominent. Length 10.0–10.3 mm.; width 5.7–5.75 mm. (♂). Length 10.7 mm.; width 6.4 mm. (♀). Oregon..... **compositus** n. sp.

14 — Erosions small, more or less isolated and punctiform, unevenly distributed, generally better defined than in the following group but never muricate.....15

Erosions of the elytra larger, generally confluent and poorly defined, the general sculpture like that prevailing in *Discodemus*18

15 — Body oblong-oval and parallel in form, not ventricose even in the female16

Body more rounded and ventricose in the female, the male generally oblong-oval and more parallel.....17

16 — Form stout, convex, glabrous, deep black, strongly alutaceous or subopaque, the elytra of the female much more shining; hypomera with a few short hairs posteriorly but otherwise not ciliate at the sides nor on the femora; head finely but distinctly punctured, rather closely toward the suture, the clypeus rather broadly sinuate, with broad but obvious lateral sinuses, the apex not reflexed but with the surface broadly impressed behind the rounded apical lobes; prothorax distinctly more than twice as wide as its median length, much narrowed and deeply, circularly emarginate at apex, with the angles right and blunt, the basal angles only moderately prolonged, acute and sharp; sides moderately converging and feebly arcuate to before the middle, then more converging and arcuate; surface moderately concavo-explanate laterally, narrowly anteriorly, more broadly basally, the bead very feeble, the punctures very minute and inconspicuous even laterally; elytra but little longer than wide, nearly straight at the sides, the margin acute and reflexed at the humeri, thence disappearing as usual from a dorsal viewpoint, very irregularly and shallowly punctate, the flanks rather abruptly inflexed, the under part much less punctate, the epipleurae nearly impunctate, polished and glabrous; prosternum finely, sparsely punctate; anterior tibiae strongly, aciculary everted at tip. Length 9.2–11.0 mm.; width 6.0–6.9 mm. New Mexico (Las Vegas)..... **congener** n. sp.

Form nearly as in *congener* but slightly narrower, deep black, glabrous, the anterior parts opaque, the elytra rather shining; head minutely, indistinctly punctate, the clypeus very feebly sinuate medially, the lateral notches subobsolete, the margin not at all reflexed at any point but with the edge very slightly thickened; prothorax shorter and more transverse but otherwise nearly similar, the sides more strongly converging from the base and but little more converging or arcuate anteriorly, the punctures extremely minute and indistinct throughout, the basal angles much produced and very acute; elytra nearly similar but more decidedly longer

than wide, the punctures smaller and very feeble, the inflexed sides, prosternum, tibiae and epipleurae similar. Length 9.5 mm.; width 6.2 mm. Colorado..... **acutangulus** n. sp.

- 17— Body oblong, small and alutaceous (♂) or ventricose and with the elytra rather shining (♀), glabrous, deep black; head alutaceous, finely and rather sparsely but distinctly punctate, the clypeus broadly sinuate medially, very obsoletely so laterally, not reflexed at apex but broadly and very obsoletely impressed behind the rounded lobes; prothorax short and transverse, very strongly narrowed from base to apex, the latter circularly sinuate, with blunt angles as usual, the hind angles moderately produced, acute and sharp, the sides explanate and nearly flat, rather widely behind, very narrowly at apex, the bead fine but distinctly elevated, the punctures sparse and very minute throughout, sometimes more evident in slight impressions laterally; elytra scarcely longer than wide, with rounded sides, and, at the middle, evidently wider than the prothorax (♀) or parallel and not wider (♂), the punctures coarse and irregular (♀) or smaller and feebler (♂), the flanks, epipleurae and prosternum as in the two preceding species, the anterior tibiae with a much smaller and less everted though very acute external angle at apex. Length 8.5–10.0 mm.; width 5.5–6.7 mm. New Mexico (Las Vegas). [Colorado, near Long's Peak, — LeConte]..... **convexus** Lec.

Body evenly and broadly elliptical, convex, rather shining though alutaceous, deep black, glabrous; head nearly as in *convexus* though smaller, with the apical sinus rather narrower and deeper; prothorax similar throughout but more evidently and rather less sparsely punctate laterally; elytra about as long as wide, rounded at the sides, the width at the reflexed humeri evidently greater than that of the prothorax, the surface strongly convex and differing from any of the three preceding species in having no elevated lines, the latter being traceable only by absence of punctures, the latter small, feeble, rather sparse and very unevenly distributed throughout, the flanks not very abruptly inflexed and almost smooth; epipleurae impunctate, more distinctly though gradually wider from apex to base than in the three preceding and similarly concave basally; prosternum finely, sparsely punctate; anterior tibiae as in *convexus*. Length 9.4 mm.; width 6.0 mm. Colorado (north of Fort Collins), — Warren Knaus.

rotundus n. sp.

- 18 — Integuments rather shining to alutaceous in lustre.....19
 Integuments densely opaque throughout above20
- 19 — Form elliptical, moderately elongate, convex, glabrous, deep black, rather shining throughout; head minutely, not conspicuously punctate, the clypeus broadly sinuate medially, obsoletely at the sides, not reflexed but with the margin somewhat thickened; prothorax two and a fourth to half times as wide as its median

length, very strongly narrowed from base to the deeply and circularly sinuate apex, with the sides very evenly arcuate, the angles rather less than right and but slightly blunt, the basal angles much produced and acute; surface scarcely evidently punctate medially, minutely and sparsely so laterally, the margin flatly explanate, rather broadly basally, very narrowly apically, the bead fine and feebly elevated; elytra slightly elongate, equal in width to the prothorax, the sides nearly straight, the reflexed humeral part of the epipleuræ arcuately prominent; surface with stronger longitudinal ridges than in any other species, about six on each elytron, the concave intervals very obscurely, coarsely and confluent foveate and subopaque, becoming more shining and more clearly punctate laterally, the flanks very abruptly inflexed along an obtusely convex line, the under part sparsely punctate; epipleuræ rapidly broader than usual from apex to base, with a few fine punctures and very small hairs internally, the outer edge much deflexed basally; hypomera with a few small decumbent hairs posteriorly. Length 9.0-9.8 mm.; width 5.6-6.2 mm. Arizona **subnitens** n. sp.

Form oval, subinflated posteriorly, larger and stouter, convex, deep black, glabrous, dull and alutaceous, the elytra less strongly so; head nearly as in *subnitens* but more closely punctate; prothorax nearly similar, except that the sides become more converging and straighter anteriorly than near the base, the lateral explaniture more concave, the apical angles more obtusely rounded and the punctures near the sides much larger and closer, though feebly impressed and rather indistinct; elytra but little longer than wide in the apparently female type, somewhat inflated, with broadly arcuate sides, at the middle slightly wider than the prothorax, more abruptly and very obtusely rounded at apex, the reflexed humeral arcuation less prominent; surface with the longitudinal lines less prominent and less shining, the opaque irregular foveæ of the intervals rather better defined, punctiform laterally, the inflexed sides and epipleuræ nearly similar. Length 10.6 mm.; width 7.0 mm. Kansas **turgidus** n. sp.

20 — Body smaller in size, stout, oblong-oval, convex, deep black, glabrous; head flat, minutely, not densely punctate, the clypeus broadly sinuate medially, more feebly but evidently emarginate at the ends of the oblique sutures, not in the least reflexed, thickened or impressed apically, the sutures forming very fine and less opaque unimpressed lines; prothorax formed as in *subnitens*, with strongly converging, evenly and moderately arcuate sides throughout, the explanate sides and basal angles similar, though with the marginal bead very much thicker than in any other species of this group, the apical angles less narrowly blunt, the surface so densely opaque as to obscure all trace of punctuation; elytra scarcely longer than wide, as wide as the prothorax, the sides parallel and straight, broadly rounding about the very obtuse apex in apical

two-fifths, the reflexed humeral part of the epipleuræ narrow and scarcely visible from above, not at all prominent; surface with the longitudinal lines obsolete basally, becoming gradually distinct posteriorly, opaque, the shallow opaque anastomosing foveæ very indistinct basally, becoming larger and more evidently defined apically; flanks rather gradually inflexed, the under side less opaque but scarcely punctured; epipleuræ nearly as in the preceding species; anterior tibiæ only very moderately produced externally at tip, very feebly sinuate externally; under surface more shining, alutaceous. Length 8.4 mm.; width 5.8 mm. Kansas (Fort Dodge), — Warren Knaus**peropacus** n. sp.

Body similarly small in size but much narrower and more gradually and acutely produced behind than in any other species, deep black, opaque; head flat, finely, sparsely punctulate, broadly sinuate at apex, the sutures very fine; prothorax nearly as in *peropacus* but much less transverse and less explanate at the sides, being only feebly declivo-explanate even posteriorly, the marginal bead much finer and feebler; elytra fully a fifth longer than wide, at base equal in width to the prothorax, the sides thence parallel nearly to the middle, then gradually arcuate and converging to the acutely rounded and prominent apex; surface convex, with distinct and close-set though feeble ridges which are wholly lost on the flanks and toward apex, the intervals with very indistinct and shallow anastomosing foveæ, which are still more opaque than the ridges; under surface rather shining though evidently alutaceous, the prosternal process flat, evenly, circularly rounded at tip; basal joint of the hind tarsi a little longer than in *peropacus* and about as long as the entire remainder. Length 9.0 mm.; width 5.4 mm. (♂). Kansas (Logan Co.), — Warren Knaus...**acutus** n. sp.

There are three evident groups of species in this genus, composed, first, of small forms allied to *dubius*, forming the *Conipinus* group, inhabiting southern California; second, the *productus* group, including two distinct divisions represented by *productus* and *difficilis*, depending upon bodily form and character of the elytral sculpture, very satisfactorily connected by *compositus*, which has the parallel form, very coarse elytral punctures and rugose surface of *difficilis* and the longitudinal impunctate lines and considerable sexual divergence characterizing *productus*, *explanatus* and *vicinus*; this second group of the genus also peculiar to the California fauna and extending only slightly into Arizona; thirdly, the last eight species of the table form a distinct group inhabiting the southern Rocky Mountain region, extending into Mexico but never occurring in California. *Secutus*, *politus* and *coquilletti* are unknown to me, but it is inferred

that they are properly placed in the table from such characters as have been published.¹

Sphærontis n. gen.

In this genus the epipleuræ have a form intermediate between the unusually narrow type of *Eusattus dubius* and the broader form, with the outer edge deflexed basally, represented by *Eusattus convexus* and allies, being nearly similar to the development occurring in *productus*, though never observable at the sides of the body when viewed dorsally. The fringe of yellow hairs at the apical and basal margins of the prothorax are much more developed than in any other genus, and the sides of the body are more conspicuously ciliate; the femora, also, bristle with longer fulvous hairs. The genus is isolated principally by the very broadly oval form and great convexity of the body, the more widely separated coxæ, even surface of the elytra and the more prolonged outer apical angle of the anterior tibiæ. The large and very broad scutellum sometimes makes a very shallow sutural notch at the base of the elytra, but, as a rule, is invisible, being covered by the base of the pronotum when the latter is tightly closed upon the elytral base, as usual in the Eusatti. The five known species may be defined as follows:—

- Prosternal lobe not margined apically, the upper surface more or less shining, the elytral punctures muricate and never more than microsetulose.....2
 - Prosternal lobe margined continuously about its contour; sculpture and vestiture variable. 3
- 2 — Form broadly rounded, very convex, rather shining in both sexes, deep black; head finely rugose and opaque, with finer isolated

¹ Since this was written I have had an opportunity to study two of the original cotypes of *coquilletti*, and have received an excellent photograph of the type from the skillful hands of Mr. H. S. Barber, of the National Museum. It appears that the transversality of the bottom of the apical thoracic sinus is by no means so pronounced as might be inferred from the original description and that the species is really closely allied to *agnatus*, from the same zoölogical region. It differs in the more swollen reflexed humeri, causing the width of the elytra at that point to be decidedly greater than that of the prothorax, as mentioned in the description; also in its slightly shorter and broader form, distinctly greater convexity when viewed in profile from the rear, rather less feebly costulate and decidedly more shining elytra, with the muricate punctures more distinct, and finally in the more decidedly explanate sides of the prothorax.

granules posteriorly, the clypeus rather narrowly and deeply sinuate medially, rounded and with minute feeble emargination at the sides, broadly and rather strongly reflexed except at the sinus; prothorax very transverse, gradually though moderately narrowed from base to apex, with evenly arcuate, very finely and feebly beaded sides, the apical sinus broad, subtransverse at the bottom, the angles moderately prominent, rounded, the basal angles posteriorly produced but rather blunt; surface convex, alutaceous, abruptly and rather widely plano-explanate at the sides, almost equally throughout the length, the punctures fine and sparse medially, rather close, strong and setulose laterally, muricate throughout though feebly so medially; elytra about as long as wide, gradually and evenly convexo-declivous posteriorly, the outline evenly rounded from about basal third to the apex, which is very obtusely subogival; surface even, very convex, rather coarsely, moderately closely and strongly muricate, each asperity with a minute posterior puncture, micro-setigerous laterally, the asperities tending sometimes to arrange themselves in transverse irregular lines; under surface rather hairy, the epipleuræ sparsely punctate and fulvo-pubescent, the abdomen nearly glabrous, finely, sparsely punctulate. Length 10.5–12.0 mm.; width 7.0–7.8 mm. Oregon.....**muricata** Lec.

Form globose, large in size as in *muricata*, posteriorly subacute, black, shining; head less densely rugose than in *muricata*, the prothorax deeply sinuate at each side of the base as usual, the sides margined, the apex and base flavo-ciliate; surface very smooth, finely granulate at the sides; elytra with the granules less elevated than in *muricata* and transversely confluent; epipleuræ very densely and finely punctulate. Length 11.2 mm. California (Colorado Desert).....**dilatata** Lec.

Form nearly as in *muricata*, but very much smaller in size, similar in color, lustre and distribution of the hairs and fringes; head similar but less opaque and less completely rugulose, finely but strongly punctato-granulose, densely toward the transverse suture, sparsely so elsewhere; prothorax similar throughout, though shorter and even more transverse, nearly three times as wide as the median length, the minute and feeble punctures completely wanting along the middle, finely muricate but sparse laterally, the sides rather less broadly explanate; elytra scarcely as long as wide, similar in form and similarly sculptured though more rugose, very convex and polished (♀) or duller and more flattened medially (♂), at basal third rather broader than the prothorax in the former but not in the latter, where the basal angles of the prothorax are more widely free; under surface nearly similar, the epipleuræ finely, sparsely punctate, with the hairs very short and inconspicuous. Length 8.0–8.5 mm.; width 5.2–5.85 mm. New Mexico.....**acomana** n. sp.

3 — Form oval, convex, black, moderately shining, slightly more

obtuse behind, the margin of the prothorax and the legs ciliate with long yellowish hairs; head sparsely, finely punctate, the clypeus deeply and broadly emarginate, with a moderately deep incisure at each side, the entire front margin reflexed; prothorax more than twice as wide as long, much narrowed in front, the sides arcuate, the side margin explanate, the hind angles slightly prolonged but not acutely; surface smooth, with a few fine piliferous punctures near the sides; elytra with minute, sparse, submuricate granules, each with a short hair, the interspaces very minutely alutaceous; epipleuræ gradually wider from apex to base, sparsely punctate and ciliate; prosternum sparsely punctate, ciliate with yellow hairs, the tip of the process narrowly oval; abdomen very sparsely, finely punctate; legs ciliate with moderately long yellowish hairs. Length 11.5 mm. Lower California (Big Canyon, Tantilles Mts.)..... **ciliata** Horn

Form more oblong than in *muricata*, very much smaller in size and more pointed behind, the sides arcuately converging from about the middle of the elytra, similarly very convex, black; head similarly sinuate laterally, feebly emarginate and apically reflexed, the surface subopaque, finely, sparsely and muricately punctate, each puncture with a small decumbent yellow hair, the punctures broadly wanting along the middle, narrowly so anteriorly; prothorax less transverse, barely two and one-half times as wide as the median length, evenly though much less strongly narrowed from base to apex than in any other species, the sides evenly and feebly arcuate, finely beaded, similarly but rather less broadly explanate, the apex more circularly emarginate, the angles similarly bluntly rounded, the basal produced, slightly less than right and not blunt; surface alutaceous, impunctate except near the sides and narrowly along the basal margin, where the punctures are rather sparse but distinct and muricate, each bearing a small yellow hair; elytra as long as wide with rounded sides, before the middle rather wider than the prothorax, convex, densely opaque though even, not very coarsely, rather sparsely punctate, the punctures but feebly muricate, each bearing a small and very coarse, decumbent fulvous hair; under surface more glabrous than usual, shining, the epipleuræ finely, sparsely punctate, subglabrous and polished; tarsi very slender; antennæ only moderately developed as usual in this genus. Length 7.6 mm.; width 4.6 mm. Texas (Sta. Rosa),—H. F. Wickham...**puberula** Lec.

The species defined above, by compilation of the descriptions of LeConte and Horn, under the name *dilatata*, appears to have been wrongfully reduced to synonymy, the densely punctulate epipleuræ and more or less confluent granules of the elytra amply distinguishing it from *muricata*, aside from its radically different habitat. *Puberula* is identified from description only, but the specimen here described is probably typical; it repre-

sents a very distinct group in the genus because of the more oblong form of the body and different outline of the prothorax, as well as by reason of its opaque elytra, with pubiferous and barely muricate punctures. The species described by Dr. Horn under the name *Eusattus ciliatus* belongs without much doubt to this genus and is defined above from published characters.

Coniontides n. gen.

So far as known, this group of the true Coniontes is confined to the islands off the coast of southern California; it is allied closely to *Coniontis* but has a very different facies due to the marked prolongation backward of the thoracic angles, recalling the Eusatti, and in every way similar to the form there prevailing. There are no other very radical differences that I have observed, excepting the more elongate maxillary palpi and the apically more strongly narrowed and more deeply and circularly sinuate apex of the prothorax, which, with the prolonged basal angles, gives the few species thus far discovered a decidedly peculiar habitus. The four species known to me may be distinguished as follows:—

Form broadly oblong-oval, moderately and evenly convex. Piceous-black in color, rather more reddish beneath, the legs evidently rufous, the antennæ dark piceous, shining, the elytra alutaceous, glabrous; head small, strongly though rather sparsely punctured, prominent at the sides before the eyes; antennæ long and very slender; prothorax fully four-fifths wider than long, the sides broadly rounded and parallel in basal third, gradually strongly converging and straighter thence to the right and narrowly rounded apical angles, the basal angles slightly blunt at tip; base deeply sinuate laterally; surface convex, evenly so to the fine marginal bead, rather coarsely, deeply, moderately closely and evenly punctured throughout from side to side; scutellum somewhat punctate, shining; elytra a fourth longer than wide, equal in width to the prothorax, the sides parallel and straight, arcuately converging behind the middle to the broadly ogival apex, evenly convex, with narrowly reflexed margins, the surface rather strongly, moderately closely punctate discally, though less coarsely so than the pronotum, the punctures becoming smaller and more shallow though similarly separated laterally; under surface with short, sparse and decumbent hairs, the prosternal process broadly and obtusely rounded at tip, not margined and rather finely though strongly, sparsely punctate. Length 11.3 mm.; width 5.9 mm. Island of San Clemente.....**latus** Lec.

Form much more narrowly oval.....2

2 — Body elongate-oval, shining, the elytra only faintly alutaceous, black, the legs piceous-black, glabrous; head only moderately small, finely, sparsely punctate, the sides before the eyes not evidently more prominent than the posterior canthus and very much less so than in *latus*; antennæ shorter and much thicker; prothorax much less transverse, about two-fifths wider than long, the sides evenly converging, evenly and feebly arcuate from base to apex, the latter two-thirds as wide as the base, with the angles only very narrowly rounded, the basal slightly blunt at tip; surface evenly convex, finely, rather sparsely and equidistantly punctate throughout, rather less finely toward the sides, the lateral bead very fine; scutellum broadly triangular, polished, slightly punctulate toward tip; elytra fully two-fifths longer than wide, otherwise nearly as in *latus*, except that the rather sparse punctures are much finer and subequal to those of the prothorax medially, though becoming much finer but not at all closer laterally; under surface with much more minute and scarcely observable hairs, the very obtuse prosternal process similarly unmarginated. Length 10.1 mm.; width 5.0 mm. Exact habitat unrecorded.

finitimus n. sp.

Body nearly similar but noticeably cuneiform posteriorly, glabrous, shining throughout above, the elytra not duller, piceous-black, the elytra, under surface and legs rufescent; head very small, strongly, rather closely punctate, less prominent at the sides than in *latus* but more so than in *finitimus*, noticeably more so than the posterior canthus; prothorax more transverse, rather more than one-half wider than long, the sides subevenly and strongly converging from base to apex and evenly arcuate, more strongly so than in *finitimus*, the angles nearly similar, the apex barely three-fifths as wide as the base; punctures only slightly less coarse and close than in *latus*, stronger than in *finitimus*, even in size and spacing throughout; elytra fully two-fifths longer than wide, at base equal in width to the prothorax, the sides thence feebly converging and just visibly arcuate to about apical two-fifths, becoming gradually thence strongly arcuato-convergent to the more narrowly ogival tip, the punctures very fine, rather sparse and evenly distributed throughout, minute laterally, very much smaller than those of the pronotum, the contrast being much greater than in either of the preceding species; under surface finely, sparsely punctulate and just visibly micro-setigerous, the prosternal process less obtuse but wholly unmarginated. Length 9.9 mm.; width 4.6 mm. Island of Sta. Cruz.....**insularis** Csy.

Body somewhat cuneiform behind the prothorax, almost as in *insularis* throughout, except that the prothorax is shorter and more transverse and the punctures, especially those of the elytra, much more close-set, deep black throughout, the legs piceo-rufous distally; head nearly as small as in *insularis*, evenly convex, similarly

evenly punctate and apically sinuate but having the sides before the eyes much more prominent and very much more so than the posterior canthus; prothorax two-thirds wider than long, the sides evenly converging and broadly, evenly arcuate from base to apex, more strongly so than in *insularis*, the apex narrower, not more than half as wide as the base, the punctures not quite so large and a little closer, the hind angles not quite so acute; scutellum somewhat smaller and less broadly triangular; elytra formed almost exactly as in *insularis* but less shining, more uneven and with the punctures not quite so small though distinctly smaller than those of the prothorax and much denser than in *insularis*, similarly finer and feeble laterally; prosternal process moderate, rounded at tip, spatulate, finely and sparsely punctate; basal joint of the hind tarsi longer than in *insularis*, being distinctly longer than the remaining joints combined. Length 9.5-9.8 mm.; width 4.3-4.8 mm. Island of San Clemente...**clementinus** n. sp.

It is my impression that the type of *finitimus* was taken on the island of Sta. Rosa, though this is little better than a surmise; it differs notably from *insularis* in form and punctuation. *Insularis* is not properly a variety of *latus* as originally described.

Coniontis Esch.

This genus, by far the most extensive of the Coniontinæ, is essentially peculiar to the Pacific coast of temperate North America, extending to the eastward in the more northern latitudes and thence southward along the Rocky Mountains to southern Colorado. It has not yet been reported from northwestern Mexico and I have seen not a single example from New Mexico and but one from Arizona, probably collected in the extreme western part; it appears to occur also on some of the islands off the southern California coast, although probably as a comparatively recent migrant. The body is oblong to oblong-oval in form, convex, stout to elongate, strongly punctured to almost smooth and glabrous to rather conspicuously setose. The basal margin of the prothorax is never more than feebly bisinuate, and the basal angles are always very much less prominent posteriorly than in the preceding genus or the Eusatti. The male is generally much smaller, less dilated and occasionally somewhat more posteriorly attenuated than the female, but does not differ much otherwise.

There is probably no group of Coleoptera that to the system-

atist has been more of a “bête noire,” figuratively as well as literally, than the genus *Coniontis*. This has arisen in great measure from the preposterous extent of variation assumed to affect the species, which for this reason, have been usually considered to be virtually undefinable. I concluded therefore to test this variability by carefully collecting series of what were indubitably single species, in each case from one isolated environment, and studying them carefully specimen by specimen. The result of this study shows that the various forms, whether species or subspecies, do not go beyond the average of the Coleoptera in point of intraspecific plasticity, but are unusually subject to modification and consequent division into closely allied forms by local conditions, which will account for the conclusions formerly drawn from study of miscellaneous material. The genus, being distributed over a greatly extended and climatically varied geographic region, is naturally composed of very numerous forms which are structurally but slightly diversified, — the usual condition in wingless and feebly migratory genera of Coleoptera, — and, although perhaps more conventionally distinguishable in the majority of cases as subspecies, varieties, aberrations, anomalies and monstrosities of the German school, I feel unable with the material at hand to make these assignments satisfactorily and therefore announce them as species for the present. The genus may be divided primarily into the three following subgenera: —

Metasternum flat, margined anteriorly; elytra always much longer than wide2

Metasternum longitudinally convex, declivous anteriorly, not margined; elytra as wide as long3

2 — Basal joint of the anterior tarsi stout, shorter, obliquely obtriangular; third palpal joint distinctly though not very greatly shorter than the fourth; mesosternum between the coxæ narrow, deeply impressed on its anterior slope; eyes very short, strongly transverse and reniform; body more or less strongly convex.

Coniontis

Basal joint of the anterior tarsi slender and more elongate, not triangular; third palpal joint very much shorter than the last, the latter unusually elongate; mesosternum a little wider between the coxæ, more feebly impressed on its anterior slope; eyes much less transverse, suboval, only feebly sinuate anteriorly; body very small, subdepressed, elongate-oval, the legs and antennæ longer than usual.

Crypticomorpha

- 3 — Body extremely short and convex, small in size, the eyes, mesosternum and basal joint of the anterior tarsi nearly as in typical *Coniontis*, the legs, and especially the antennæ, shorter and stouter, the last antennal joint relatively more developed; maxillary palpi with the third joint relatively somewhat more abbreviated though not so notably so as in the preceding section.....**Brachyontis**

These divisions are extremely unequal in extent, the last two being known at present by but a single species each.

Coniontis in sp.

For convenience the various components of this division may be assigned to eight groups, defined on broad lines of general facies as follows: —

- Punctuation of the upper surface more or less sparse, fine and inconspicuous.....2
- Punctuation conspicuous, especially that of the elytra which is generally very coarse5
- 2 — Body oblong, never much more than twice as long as wide.....3
- Body elongate, much more than twice as long as wide4
- 3 — Body large in size..... I (*abdominalis*)
- Body small in sizeII (*opaca*)
- 4 — Body parallel in form in both sexes.....III (*viatica*)
- Body more or less distinctly cuneiform in both sexes but particularly in the male.....IV (*cuneata*)
- 5 — Body decidedly more than twice as long as wide, oblong.....6
- Body shorter and generally more oval, never much more than twice as long as wide8
- 6 — Form subdepressed or much less convex than usual, the punctures bearing each a more or less elongate, subdecumbent and very evident hair.....V (*subpubescens*)
- Form normally convex.....7
- 7 — Punctures of the elytra moderate, bearing each a stiff erect and sometimes very conspicuous setaVI (*setosa*)
- Punctures generally larger and more conspicuous, nude or bearing each a small inclined and less conspicuous coarse hair, the elytral sculpture more or less rugoseVII (*eschsoltzi*)
- 8 — Elytral punctures never conspicuously setose, usually completely nude, very variable in size, the sculpture varying from comparatively smooth to extremely rugose..... VIII (*ovalis*)

These groups also correspond fairly well with geographic distribution.

Group I. — Type *abdominalis*.

This group comprises the largest species of the genus; they are oblong-suboval in form, very convex, generally sparsely and feebly punctured above, variably so beneath and are peculiar to the southern coast regions of California, but few occurring at any great distance inland. Whenever the locality of the individual species is more accurately known it will be mentioned after the respective descriptions, the exact locality of many being unrecorded; they are, as known to me at the present time, some seventeen in number, as follows: —

Abdomen more or less closely and strongly punctured and rugulose, at least at the middle of the basal segment; prosternum strongly punctured, the process margined throughout; body glabrous.....2

Abdomen very finely, sparsely punctured and smooth throughout, even at the middle of the basal segment..... 9

2 — Elytral punctures strong and distinct though rather sparse.....3

Elytral punctures equally sparse, smaller and especially shallower and much less evident.....8

3 — Elytral surface even in convexity or having each about three feebly suberoded impressed lines 4

Elytral surface very rugose, each elytron with about six more close-set, very irregular and subcostuliform lines of slight elevation.....7

4 — Prothorax transverse, evidently more than one-half wider than long and apparently a little wider than the elytra in both sexes, the sides more inflated and rounded than usual though similarly rounding and converging anteriorly. Head and pronotum alutaceous, the elytra and under surface shining, the head strongly and rather closely punctured, the surface feebly impressed at the apical lobes, the anterior canthus of the eyes obtuse and equally prominent with the posterior; prothorax rather finely but strongly, sparsely punctate medially, more closely and decidedly coarsely laterally, the margin narrowly but strongly reflexed; elytra barely one-half longer than wide, parallel, obtuse behind, with the margins rather abruptly and strongly reflexed, the surface feebly rugose, strongly so at the apex, the punctures unusually coarse for this section but sparse; prosternum densely and the abdomen sparsely, coarsely punctured and rugose. Length 15.0–17.0 mm.; width 7.3–8.0 mm. Near Monterey. [Fort Tejon, — LeConte].

abdominalis Lec

Prothorax about one-half wider than long, not inflated and not at all wider than the elytra; abdomen more finely, sparsely punctate and rugulose only medially or toward the abdominal process at base5

- 5— Sides of the prothorax almost evenly converging and evenly, very distinctly arcuate from base to apex, the latter rather narrowly, deeply and circularly emarginate, three-fifths as wide as the base, with the angles unusually broadly rounded. Body smaller and less dilated than in *abdominalis*, similarly deep black, alutaceous, the elytra less strongly so; head similar though finely and sparsely punctate; prothorax very minutely, sparsely punctate, still rather finely and sparsely but more distinctly toward the sides, the margin moderately elevated; elytra similar though rather more pointed behind, the surface moderately rugose, strongly so near the tip, the sides similarly reflexed, the punctures sparse, less coarse or deep but distinct; prosternum closely and strongly punctured, more finely and sparsely anteriorly, the abdomen distinctly but not very coarsely punctate and with only traces of rugosity even medially throughout the length. Length 13.8 mm.; width 7.0 mm. Los Angeles Co.....**tristis** n. sp.

Sides of the prothorax parallel and straight or very nearly so, converging and rounded anteriorly, the apical angles not rounded though slightly blunt.....6

- 6 — Form broad, nearly as in *abdominalis*, deep black, rather shining, the head and pronotum barely at all alutaceous, the former rather strongly and closely punctured, not evidently impressed at the apical lobes, the anterior and posterior canthi subequally prominent; prothorax fully one-half wider than long, the sides parallel and straight, becoming more abruptly converging and broadly arcuate only well before the middle, the apex nearly three-fourths as wide as the base, broadly and circularly emarginate, the angles right and with thickened bead, the surface very minutely, sparsely punctate, with a feebly defined impunctate line medially, the punctures becoming rather coarse and closer laterally, the margin narrowly explanate medially, with the bead strongly elevated; elytra as in the preceding species but with the individual apices rounded, more narrowly reflexed at the sides than in *abdominalis*, the punctures only moderate and sparse, each with an extremely minute silvery seta, the surface slightly rugose, strongly so at tip; prosternum not coarsely and decidedly sparsely punctate throughout, the abdomen with the punctures sparse, strong only medially, strongly rugose only near the basal process; tarsi stout. Length 16.0 mm.; width 8.1 mm. Sta. Barbara.....**strenua** n. sp.

Form distinctly less broad, the single female being evidently a little more than twice as long as wide, deep black, rather shining, the anterior parts but feebly alutaceous; head rather sparsely, not very coarsely but strongly punctate, deeply impressed behind each apical lobe and with the margins before the eyes somewhat deplanate, as prominent as the hind canthus; prothorax barely one-half wider than long, the sides evenly and gradually more arcuate and converging anteriorly, becoming parallel and straight only in about basal half, the apex narrower, scarcely more than

three-fifths as wide as the base, deeply and broadly parabolic, the angles slightly obtuse and not thickened; surface similarly punctured and with the side margins almost similarly concave and reflexed; elytra almost similar but with the apical angles not so individually rounded; prosternum with well separated strong punctures and having a densely, rugosely punctured area at the base of the process; abdomen strongly, more closely punctured and rugose medially. Length 16.0 mm.; width 7.8 mm. Near Monterey..**gravis** n. sp.

7—Form oblong, twice as long as wide, convex, shining, scarcely at all alutaceous anteriorly, deep black, glabrous; head rather finely but perforately, not densely punctate, not at all impressed anteriorly, the anterior canthus rounded, slightly more prominent than the posterior; antennæ slender, joints three to seven much elongated, the eighth thicker but much longer than wide, the ninth a little longer than wide; prothorax nearly three-fifths wider than long, the sides parallel and straight in basal half, then gradually rounded and strongly convergent to the broadly, circularly emarginate apex, which is fully two-thirds as wide as the base, the angles right and bluntly rounded; surface rather finely, sparsely punctured, becoming rather coarsely, more closely and conspicuously so laterally, the side margins concave and reflexed; elytra barely as wide as the prothorax, scarcely one-half longer than wide, parallel, obtuse at tip, the sides concave and reflexed, the surface coarsely and strongly rugose but polished, less rugose toward base as usual; prosternum rather finely but strongly, not very closely punctate, the process very wide, obtuse, transversely convex, less coarsely margined at tip; abdomen strongly but not very coarsely, rather sparsely punctured, very obsoletely rugulose, alutaceous in lustre. Length 15.0 mm.; width 7.3 mm.

rugosa n. sp.

8—Form oblong, convex, twice as long as wide, deep black, slightly alutaceous throughout; head strongly, rather closely punctured, finely and sparsely basally, the apical sinus rather shallow, broadly rounded, the surface obsoletely impressed behind each apical lobe; anterior canthus narrowly rounded, as prominent as the posterior; prothorax fully one-half wider than long, formed as in *rugosa*, the punctures much more minute, almost invisible and sparse medially, rather sparse and not coarse though distinct laterally, the margin much more narrowly and feebly reflexed, the fine bead strongly elevated; elytra rather less than one-half longer than wide, equal in width to the prothorax, parallel, obtuse at tip, the surface alutaceous, not rugose but with about six very feeble and broadly tumescent lines on each, coming together in some broad rugosity at apex; the punctures shallow and very feeble suturally, deeper, closer and more distinct laterally, the margin deeply concave and narrowly reflexed, each puncture with a very minute silvery seta not projecting beyond its limits; prosternum rather finely, strongly and sparsely punctate; abdomen

nearly smooth, the punctures sparse and fine for this division of the group. Length 13.8 mm.; width 6.9 mm. Sta. Barbara.

tenebrosa n. sp.

- 9 — Prosternal process margined throughout as in the preceding section. Body broadly oblong, black, alutaceous, the elytra shining, glabrous; head perfectly flat throughout, not impressed anteriorly, rather finely but strongly and unusually closely punctate, the anterior canthus not more prominent than the posterior; prothorax nearly three-fifths wider than long, as wide as the elytra, the sides parallel in about basal half, very gradually arcuate and more converging anteriorly, very narrowly reflexed and with strong elevated bead, the apex broadly, circularly emarginate, fully two-thirds as wide as the base, the angles obtuse and rather bluntly rounded, the surface minutely, remotely punctate, the punctures still very small and sparse and each bearing a minute hair laterally; scutellum not very broadly triangular; elytra a little less than one-half longer than wide, obtusely angulate at apex, smooth, very feebly rugose apically, each with three extremely obsolescent longitudinal ridges, the punctures very fine and sparse throughout, the sides very finely reflexed; prosternum with moderate, strong and rather close-set punctures; femora somewhat finely but strongly punctate, each puncture with an obvious short decumbent hair; tarsi not very stout. Length 13.8 mm.; width 7.0 mm.....*pectoralis* n. sp.

Prosternal process not at all margined at its apex.....10

10 — Elytra glabrous, the punctures never bearing setæ which project materially beyond their own limits11

Elytra sparsely pubescent, the hairs stiff, decumbent and small in size but quite obvious.....15

11 — Elytra parallel, with nearly straight sides, obtusely angulate at apex12

Elytra somewhat inflated at the middle, wider than the prothorax, with parallel and feebly arcuate sides, the apex more prolonged and acutely angulate than in any other of this group.....14

12 — Tarsi decidedly stout, the integuments strongly shining. Head flat, not impressed anteriorly, rather finely, moderately closely punctate, the anterior canthus rather more prominent than the posterior; prothorax transverse, nearly two-thirds wider than long, subparallel basally and gradually rounded and more narrowed apically (♂), or broader, somewhat inflated and with more rounded sides (♀), the margin finely reflexed, the apex broadly emarginate, with more or less blunt apical angles; surface extremely faintly alutaceous, very minutely, remotely punctate, the punctures still very fine, nude and sparse laterally though more distinct; scutellum moderate; elytra scarcely one-half longer than wide, smooth and polished, each having about three fine, very feeble and irregularly sinuous eroded lines, sending out a few still more obsolete vermiculate branches, the punctures extremely

minute and remote throughout, the sides very finely reflexed; prosternum finely, sparsely punctate; abdomen smooth and polished, with extremely minute and remote punctulation throughout. Length 14.6–15.0 mm.; width 7.0–7.25 mm. Southern California.....**integer** n. sp.

Tarsi moderately slender, the upper surface distinctly alutaceous, the elytra generally somewhat shining.....13

13 — Form very stout, convex, oblong, glabrous, alutaceous throughout above, the elytra but little less dull than the anterior parts; head not impressed, rather finely but strongly, closely punctate, the anterior canthus scarcely as prominent as the posterior; prothorax fully three-fifths wider than long, the sides rounding and converging anteriorly, becoming almost straight and parallel in about basal half, very finely reflexed and with elevated bead, the apex broadly, circularly emarginate, two-thirds as wide as the base, the angles obtuse but only slightly rounded; surface very minutely, sparsely punctate, still finely and sparsely though more distinctly so laterally; scutellum moderate, not very broadly triangular; elytra not quite one-half longer than wide, broadly angulate at apex, smooth, feebly undulato-rugose apically, very finely and sparsely punctate, finely and narrowly reflexed at the sides; prosternum finely, rather sparsely punctate, the abdomen minutely, feebly and remotely punctulate. Length 13.0–14.7 mm.; width 6.0–7.0 mm. Cab. Levette.....**levettei** n. sp.

Form oblong, rather less convex, smaller in size and narrower, the elytra more shining, the body throughout blackish-piceous in color; head nearly similar throughout but more narrowly and deeply sinuate at apex; prothorax similar and likewise very minutely and sparsely punctate, though with the lateral punctures not nude as they virtually are in the preceding species but bearing each a very small hair; scutellum similar; elytra narrower, about one-half longer than wide, the surface similarly smooth and finely, very sparsely punctate but with the punctures less fine and more distinct than in *levettei*; prosternum strongly, somewhat closely but not coarsely punctate, the abdomen very minutely and sparsely. Length 12.7–13.5 mm.; width 6.3–6.6 mm. Cab. Levette.

picescens n. sp.

Form still narrower, convex, the elytra rather shining, deep black, glabrous; head finely, closely and strongly punctate, not impressed anteriorly, the anterior canthus much less prominent than usual and not extending laterally further than the posterior, the eyes less sunken than in the preceding; prothorax nearly similar but rather less transverse, one-half wider than long, the sides finely reflexed, the punctures extremely minute, remote and barely visible, still very fine, sparse and nude but more distinct laterally; scutellum rather small, triangular; elytra about one-half longer than wide, smooth, very obsoletely rugulose posteriorly, sometimes with feeble traces of longitudinal lines of greater convexity,

finely reflexed at the sides, the punctures remote, fine, though much larger and more distinct than in *levettei* and slightly more so than in *picescens*; prosternum finely, rather sparsely punctate, the abdomen minutely and obsolescently so. Length 12.5–13.5 mm.; width 5.8–6.25 mm. Probably San Diego Co.

elliptica Csy.

A — Form and sculpture nearly as in the preceding but narrower, smaller in size and rather less convex, the elytra generally with some excessively obsolete and broadly tumescent lines, deep black, the elytra slightly more shining than in *elliptica*. Length 12.0–12.3 mm.; width 5.4–5.7 mm. Island of Sta. Catalina, — Warren Knaus.....*catalinæ* n. subsp.

14 — Body narrower and more convex than usual, glabrous, deep black, strongly shining throughout; head broadly sinuate at apex, not impressed, finely punctured posteriorly, rather coarsely, densely and subrugosely so anteriorly, the anterior canthus broadly rounded, much more prominent than the posterior; prothorax nearly three-fifths wider than long, the sides straight and parallel, broadly rounding slightly before the middle, converging and less arcuate apically, the apex broad and circularly emarginate, almost three-fourths as wide as the base, with the angles right and slightly blunt; surface very minutely, sparsely punctate, but little less minutely or remotely so laterally, the edge strongly beaded; scutellum but little wider than long, moderate, triangular; elytra rather more than one-half longer than wide, convex, smooth, with three very feeble eroded lines apically, where also there are some coarse creases, very minutely, remotely punctate, the lateral margin finely reflexed; prosternum not closely punctate, strongly and rather finely so anteriorly, very minutely on the process; abdomen smooth. Length 13.5 mm.; width 6.2 mm. Kern Co.....*lævigata* n. sp.

15 — Form oblong, more parallel, moderately convex, deep black, only slightly alutaceous throughout above, still more shining beneath; head rather finely but strongly, moderately closely and subevenly punctate throughout, deeply and broadly sinuate at apex, the lobes feebly impressed, the anterior canthus very broadly rounded, slightly more prominent than the posterior; prothorax three-fifths wider than long, the sides feebly converging from the base nearly to the apex and slightly arcuate, then gradually more arcuate and convergent to the apex, which is broadly sinuate and two-thirds as wide as the base, the angles right, narrowly rounded; surface minutely, sparsely punctate, gradually rather strongly, deeply and much less sparsely so and micro-pubiferous laterally; scutellum large and broadly triangular, obtuse at tip; elytra as wide as the prothorax, fully one-half longer than wide, the sides straight, with the margin more widely reflexed basally, the apex angulate; surface rather gradually declivous behind, nearly smooth though each with about six very obsolete lines of greater convexity, the apex

feebly undulato-rugose, the punctures fine and remote, more distinct laterally, the fulvescent hairs not at all conspicuous; prosternum more strongly, rather closely punctate, the abdomen smooth, moderately sparsely punctulate. Length 13.8 mm.; width 6.5 mm. Pomona Mts. **luctuosa** n. sp.

Form a little shorter, broader and more convex, dull in lustre throughout above, more strongly punctured than in any other species of the group, deep black; head rather coarsely, deeply, not very closely and rather unevenly punctate, not impressed, the anterior canthus rather narrowly rounded and somewhat more prominent than the posterior; prothorax a little wider than the base of the elytra, transverse, fully two-thirds wider than long, the sides subparallel and feebly arcuate, gradually more arcuate and converging anteriorly, the apex broadly sinuate and nearly three-fourths as wide as the base, the angles right and blunt; surface finely but strongly, rather sparsely punctate, gradually coarsely, somewhat closely and very conspicuously so laterally, each puncture with a small hair, the margin strongly beaded, the attendant channel deep also at apex laterally; scutellum moderate, not very transverse, triangular; elytra not quite one-half longer than wide, obtusely angulate at tip, the sides parallel and very feebly arcuate, finely reflexed; surface of each with four feebly tumescent ridges, with intermediate ridges also, though very obsolete, the four ridges very strong on the apical declivity, the punctures sparse, strong and not very fine medially, becoming very coarse, closer and conspicuous laterally, the fulvous hairs distinct; prosternum rather coarsely and closely punctate, the abdomen polished, minutely, sparsely punctulate. Length 13.0 mm.; width 6.7 mm. San Bernardino Mts. **costulata** n. sp.

Form stout, not more than twice as long as wide, not pubescent, convex, parallel, the integuments above subopaque, the pronotum and elytra very densely, rather coarsely and aciculate punctate, the elytra obscurely tricostate, with the intervals obsoletely reticulate; [abdomen minutely, sparsely punctulate]. Length 15.5 mm. Fort Tejon **robusta** Horn

Form oblong, moderately elongate, with the sides feebly arcuate, rather strongly convex, very highly polished, smooth, the vestiture minute, fulvous in color; head rather coarsely and densely punctured, the sides as prominent as the posterior canthus of the eyes, the antennæ slender; prothorax one-half wider than long, the apex nearly two-thirds as wide as the base, the angles rather broadly rounded; base transverse, very feebly sinuate laterally, the angles slightly rounded and not prominent, the sides strongly arcuate anteriorly, feebly so posteriorly; surface very finely punctured, the punctures becoming denser at the sides, the bead strong; elytra at least twice as long as the prothorax, the punctures fine though larger than those of the pronotum, rather sparse, the sides

feebly arcuate; abdomen strongly convex, polished, feebly and sparsely punctate. Length 12.5 mm.; width 6.0 mm. California (Calaveras Co., — at an elevation of 2,300 feet).

sanfordi Blaisd.

The form which I have identified as *abdominalis* displays very little sexual difference in the form of the prothorax, while in *integer* this difference is more pronounced than in any other known species of the genus. In the definition of *robusta*, as given above, I have made use of all the characters published by its author, assuming as the type the specimen numbered "1" (Rev. Ten., p. 296) and abandon the species, represented by an assumed cotype in the LeConte cabinet, described under this name in my previous revision (Col. Not., II, 1890, p. 375). The species represented by this latter specimen undoubtedly has a completely margined prosternal process and may possibly be unconsciously included above, among the forms from *abdominalis* to *rugosa* in the table; it is probable that the process is not apically margined in the true *robusta*, although the author records nothing concerning a character of which he subsequently made constant use in *Eusattus*. The sculpture of *robusta* departs to a very remarkable degree from the usual fine sparse punctures of this first group of the genus, but is suggested in the coarser punctuation of *costulata*, which is a markedly aberrant species. The species described by Blaisdell under the name *sanfordi* (Ent. News, VI, p. 235) probably belongs in this group, although rather discordant in habitat; it is described above from the published characters.

Group II. — Type *opaca*.

The probably even more numerous species of this group, reproduce the general form and sculpture of their more strenuous relatives of the *abdominalis* group, but are always very much smaller in size, including in fact some of the smaller species of the genus. They inhabit also a distinctly different region, being virtually confined to the southern Sierras and adjacent regions, not occurring, so far as known to me, very near the coast; more definite localities when recorded, will be stated below. Those known at present, representing probably but a moderate proportion of all actually existing forms, may be thus distinguished among themselves: —

- Prosternal process strongly and unequivocally margined throughout its contour 2
- Prosternal process not margined apically..... 7
- 2 — Elytral punctures rather small and sparse but very distinct..... 3
- Elytral punctures excessively minute, observable with difficulty under a hand lens..... 6
- 3 — Elytral punctures not sensibly piliferous..... 4
- Elytral punctures each with a very small but evident decumbent hair.. 5
- 4 — Body oblong, only moderately convex, deep black, rather shining throughout; head somewhat finely but strongly, not densely punctate, the lobes very feebly impressed, the anterior canthus very broadly rounded, as prominent as the posterior; prothorax not more than one-half wider than long, the sides just visibly converging and nearly straight to about the middle, then rapidly more rounded, then more strongly converging and but feebly arcuate to the apex, which is nearly three-fourths as wide as the base, circularly sinuate, with the angles right and but slightly blunt; surface very finely, sparsely punctate, becoming much less finely, more closely and rather strongly so laterally, the marginal bead very fine; elytra parallel, not quite one-half longer than wide, as wide as the prothorax, obtusely ogival at tip, nearly smooth, the margins finely reflexed; prosternum rather finely but strongly, somewhat sparsely punctate, the process broad, ogival at tip; abdomen and hind femora finely, rather sparsely punctate. Length 9.6 mm.; width 4.5 mm. Arizona (probably the extreme western part)..... **histrion** n. sp.
- Body rather stouter in outline and decidedly more convex, deep black, duller in lustre, feebly alutaceous; head more strongly and closely punctate, not impressed at the apical lobes, the anterior canthus more narrowly rounded, slightly less prominent than the posterior; antennæ similarly slender; prothorax nearly similar but more transverse, fully three-fifths wider than long, much duller, the fine punctures stronger and less sparse medially, becoming much larger, perforate and very close-set laterally; scutellum rather larger and more broadly triangular; elytra scarcely more than two-fifths longer than wide, as wide as the prothorax, very obtuse at tip, the surface feebly undulato-rugose apically, elsewhere nearly smooth but with very obsolete broadly convex lines, the punctures rather stronger and more close-set than in *histrion*, very distinct, although the surface is somewhat dull; prosternum rather sparsely and finely punctate, the process narrower, impressed along its median line, the impression terminating in a deep discal fovea near the apex — perhaps an accidental character; abdomen and hind femora very finely, sparsely punctate, polished. Length 9.5 mm.; width 4.65 mm. San Bernardino Co..... **ancilla** n. sp.
- 5 — Form stout, rather convex, oblong, deep black, only very feebly alutaceous; head unusually short and transverse, rather coarsely and

closely punctate, much more finely so basally, unimpressed, the anterior canthus somewhat narrowly rounded and very much less prominent than the posterior; antennæ blackish, slender; prothorax fully two-thirds wider than long, the sides broadly rounded and converging anteriorly, becoming nearly straight and parallel from well before the middle to the base, the apex three-fourths as wide as the base, broadly, circularly sinuate, the angles right and but slightly blunt; punctures fine but strong and moderately close-set, becoming still stronger and a little closer, perforate and conspicuous laterally, the marginal bead very fine; scutellum as in *ancilla*, broadly triangular, the elytra also similar in outline, very obtuse behind, the surface nearly smooth, slightly rugulose posteriorly, the punctures sparse but subperforate and very distinct; prosternum unusually finely, sparsely punctate, the process rather wide, circularly rounded at tip, broadly and feebly impressed along its median line; abdomen very minutely, sparsely, the hind femora rather distinctly and less sparsely, punctate. Length 9.4 mm.; width 4.4 mm. California (Lancaster), — Mr. H. F. Wickham. A single female.....**oblonga** n. sp.

- 6 — Form somewhat elongate, parallel, moderately convex, rather dull and strongly alutaceous, black with a feeble piceous tinge, glabrous, the elytral punctures with very small inconspicuous hairs; head rather finely but strongly, not densely punctate, unimpressed, the anterior canthus rather narrowly rounded, but little less prominent than the posterior; prothorax nearly as in *oblonga* though a little less transverse, fully one-half wider than long, the sides scarcely becoming parallel posteriorly but very feebly converging from the base though less arcuate, the punctures very fine and rather sparse medially, becoming much larger, deep and moderately close-set laterally, the marginal bead very fine; elytra very nearly one-half longer than wide, more gradually and acutely ogival behind than usual, as wide as the prothorax, virtually smooth but unusually opaque throughout, the sparse punctures but slightly evident even laterally; prosternum finely, not densely punctate, the process narrower; abdomen and hind femora finely, more or less sparsely punctate. Length 9.7 mm.; width 4.25 mm. California. A single female.

obsolescens n. sp.

- 7 — Hind femora finely, more or less sparsely or inconspicuously punctate.....8
Hind and other femora coarsely, closely and very conspicuously punctate.....13
- 8 — Pronotal punctures not particularly close-set laterally, separated by from three to five times their own diameters.....9
Pronotal punctures small but deep, unusually close laterally, where they are separated by from one to three times their own diameters; punctures throughout with extremely short decumbent hairs...11

- 9—Elytral punctures with very evident small decumbent hairs. Body somewhat elongate, parallel, moderately convex, rather dull and alutaceous in lustre, black with a pronounced piceous tinge, the legs frequently rufescent, the antennæ pale throughout and slender; head finely but strongly, rather sparsely punctate, not impressed, the canthi about equally prominent; prothorax nearly three-fifths wider than long, the sides broadly and moderately arcuate and converging anteriorly, becoming very feebly arcuate and but just visibly diverging thence to the base, the apical angles very bluntly rounded; punctures very minute and sparse medially, becoming much larger, deep and distinct though still well separated laterally, the marginal bead very fine; scutellum only moderate in size, broadly triangular; elytra scarcely one-half longer than wide, as wide as the prothorax, parallel, gradually parabolic at apex, virtually smooth though more opaque than the pronotum, the punctures fine, rather sparse, becoming more distinct laterally; prosternum rather strongly, more closely punctate, the abdomen remotely and extremely minutely so, shining. Length 8.1–8.8 mm.; width 3.7–3.9 mm. Southern California.....*pallidicornis* Csy.

Elytral punctures without evident decumbent hairs; size much larger.

10

- 10—Form broadly oblong, rather strongly convex, deep black throughout, shining; head finely, sparsely punctate, the apical lobes feebly impressed, the anterior canthus moderately narrowly rounded, fully as prominent as the posterior; antennæ slender, black, with the tip piceous; prothorax transverse, more than three-fourths wider than long, the sides broadly, subevenly arcuate, rather more so and more converging at apex, becoming parallel behind the middle, the apex circularly sinuate, two-thirds as wide as the base, with the angles right and but slightly blunt; punctures sparse and very minute, becoming strong but still rather fine and sparse laterally, the lateral bead very fine; scutellum rather small, but slightly transverse, triangular; elytra as wide as the prothorax, barely two-fifths longer than wide, the sides nearly straight, the tip gradually and rather acutely ogival; surface smooth, rugulose apically, only moderately sparsely punctate, finely so suturally, rather strongly and somewhat coarsely toward the sides, the margin very finely reflexed; prosternum minutely, sparsely punctate, the abdomen and hind femora still more sparsely, minutely and feebly. Length 10.0 mm.; width 4.9 mm. Locality unrecorded but probably southern California.

degener n. sp.

Form relatively less broad, the largest species of the group, convex, black, rather dull in lustre, the elytra subopaque; head somewhat finely, closely punctate, minutely and less closely posteriorly, scarcely impressed at the apical lobes, the anterior canthus very broadly rounded, not quite as prominent as the posterior; pro-

thorax barely one-half wider than long, the sides parallel and straight, becoming broadly rounded before the middle and strongly convergent and less arcuate apically, sinuate as usual at apex, the angles obtuse and bluntly rounded; surface alutaceous, extremely minutely, sparsely punctulate, the punctures becoming more visible but still minute and unusually sparse laterally, the side margins rather strongly channeled and more coarsely beaded than in any other species of the group, recalling the *abdominalis* group somewhat; scutellum moderate; elytra as wide as the prothorax, fully one-half longer than wide, gradually rather acute at apex, the surface with numerous feeble sinuous impressed lines and generally a few broader, irregular and eroded longitudinal lines, the punctures very sparse and minute, still fine and sparse laterally; punctures of the prosternum and abdomen fine and sparse, of the hind femora rather closer, more distinct and somewhat pubiferous. Length 11.0–11.6 mm.; width 5.0–5.1 mm. California *verna* n. sp.

- 11 — Elytra short, barely two-fifths longer than wide, somewhat inflated behind the middle, where they are evidently wider than the prothorax, with the sides broadly arcuate, the apex very obtuse. Body short, strongly convex, not very intense black, dull or subopaque in lustre throughout above; head finely but deeply, not closely punctate, unimpressed, the canthi equally prominent; prothorax transverse, three-fourths wider than long, the sides broadly rounded and converging before, becoming parallel and straight behind, the middle, broadly sinuate at apex, with the angles right and but slightly blunt; punctures medially very minute and rather sparse, less minute and very close-set laterally, the marginal bead very fine; scutellum broadly triangular; elytra smooth, minutely, rather sparsely punctured suturally, much more closely and strongly so laterally though still rather finely, the margin very finely reflexed; prosternum finely but strongly, rather closely punctate, the abdomen minutely, feebly and more sparsely, the hind femora finely and less sparsely. Length 8.4 mm.; width 4.0 mm. California (Owen's Valley). Described from the female..... *opaca* Horn

Elytra longer, parallel, never inflated and less obtuse at apex..12

- 12 — Form very broadly oblong. Body moderately convex, black, dull and subopaque in lustre; head rather finely and closely, strongly punctate, the apical sinus deep and rather narrow, the apical lobes unimpressed or very obsoletely so, the canthi subequally prominent; prothorax of peculiar form, transverse, fully two-thirds wider than long, the sides rounded and strongly convergent anteriorly, becoming parallel in basal two-thirds and rather deeply and evenly sinuate at each side at about basal fourth, the apical sinus broadly rounded, the angles slightly obtuse, bluntly rounded, the basal angles not pronounced, the lateral sinuses of the base moderate; surface minutely but strongly and

rather closely punctate medially, more strongly and very closely laterally, the marginal bead fine; scutellum rather small; elytra about two-fifths longer than wide, more obtusely ogival at tip than in the two following forms, smooth or with a few very feeble and irregular impressed lines, the punctures minute and sparse suturally, stronger, closer and very distinct laterally; prosternum finely, sparsely punctate, the process wide, convex, broadly arcuato-truncate at tip; abdomen extremely minutely and obsoletely but rather closely punctulate, the hind femora rather distinctly though not closely punctate. Length 9.8 mm.; width 4.7 mm. California (Amedee, Lassen Co.),—H. F. Wickham. Described from a single male specimen.....**lassenica** n. sp.

Form more narrowly oblong-elongate, rather more convex. Body black, dull and strongly alutaceous in lustre; head finely but strongly, not very closely punctate, deeply and rather narrowly sinuate at apex, the lobes flattened, the canthi subequally prominent, the anterior rather narrowly rounded; prothorax less transverse, three-fifths wider than long, the sides more broadly and evenly rounded, more gradually converging anteriorly and becoming parallel and straight only behind the middle, otherwise nearly as in *lassenica*, the basal sinuations very feeble and the inner side of the hind angles scarcely oblique; elytra parallel, as wide as the prothorax, one-half longer than wide, more gradually and acutely ogival at apex, smooth, with some feeble and uneven scratches, very minutely and sparsely punctate suturally, very distinctly and much more closely near the sides, the margin very finely reflexed; prosternum finely but strongly, rather closely punctured and micro-setigerous, the abdomen shining, very minutely, rather sparsely and obsoletely punctulate, the hind femora unusually finely, obsoletely and remotely punctulate. Length 9.8 mm.; width 4.5 mm. Nevada (Reno). A single specimen of undetermined sex taken by the writer on the banks of the Truckee River.....**nevadensis** n. sp.

A — Body very nearly as in *nevadensis* but with the prothorax very slightly less transverse and with the basal sinuations stronger, so that the hind angles project posteriorly for a very short distance, with their inner sides oblique; sculpture similar, the elytra slightly smoother, with the fine punctures near the sides relatively rather less distinct; hind femora notably more strongly and less sparsely punctate and a little more pubescent. Length 9.5 mm.; width 4.5 mm. Nevada (Carson City),—H. F. Wickham**carsonica** n. subsp.

13 — Body oblong, parallel, moderately convex, deep black, alutaceous in lustre, the elytra more strongly; minute setæ of the punctures not projecting beyond the limits of the latter; head somewhat coarsely but not very closely punctate, unimpressed at the lobes, the apical sinus rather deep and abruptly formed; anterior canthus rounded, slightly more prominent than the posterior; antennæ rather

slender, black, paler at tip; prothorax fully three-fourths wider than long, wider behind the middle than at base, the sides almost evenly arcuate, slightly more converging anteriorly, the apex very broadly and circularly sinuate, more than three-fourths as wide as the base, the angles barely right and slightly blunt, the hind angles right, not at all blunt; surface rather finely and sparsely but strongly punctate, becoming more closely, unusually coarsely and somewhat irregularly so laterally, the marginal bead fine; scutellum rather small, not strongly transverse, triangular; elytra nearly one-half longer than wide, as wide as the prothorax, the sides straight, the apex gradually narrowed to the obtuse tip; surface smooth, sparsely and rather strongly punctate suturally, somewhat coarsely and less sparsely laterally; prosternum rather strongly punctate, the process sparsely so, unusually declivous apically; abdomen very minutely, feebly and sparsely punctate. Length 9.3 mm.; width 4.25 mm. (♂). California (Barstow).
punctipes Csy.

In the catalogue of the Coleoptera of Baja California, p. 349, Horn cites *pallidicornis* as occurring there, without more definite indication of locality; the identification, moreover, is open to a good deal of doubt, as nearly all the species are very local in habitat. *Verna* has some of the characters of Group I, and is undoubtedly an intermediate form; it has more especially the grooved and narrowly reflexed thoracic side margins of the allies of *abdominalis*, but its much smaller size prompts me to include it with Group II, for convenience of identification; *degener* is likewise aberrant, having some of the characteristics of the *ovalis* group. The type of *lassenica* has, besides, the sinuation of the sides of the prothorax near the base, two oblique impressed discal lines from lateral fourth very near the base to lateral sixth near basal fifth; these lines are observable occasionally in other species of all the groups and seem to be adventitious to some extent but they are bilaterally symmetric.

Group III.—Type *viatica*.

This is one of the largest groups of the genus and the most difficult in the delimitation and definition of specific forms. The group inhabits the coast regions from San Francisco Bay well into Oregon, from which State I have a single species, and but few of its components occur as far to the eastward as the foothills of the Sierras; more definite localities will be mentioned when known. The very small species allied to *puncti-*

collis, form a tolerably distinct section by themselves and have occasionally some unusual modifications of the marginal line of the prothorax. The others, forming the larger part of the group, have a superficial interresemblance which is very confusing, necessitating prolonged and careful study before even attempting to identify them by published characters. In a number of forms it is difficult to say whether the prosternal lobe is margined or not, there being some variability in the character, and, when the margin becomes feeble, as in *opacicollis* and *longicollis*, the surface must be held so as to reflect the light at gradually varying angles in order to recognize the marginal convexity; in others, however, the margin takes the form of a strong convex bead, defined by an unequivocal groove, but the character is not altogether satisfactory.

The forms at present in my cabinet may be known as follows:—

- Larger species, never under 10.0 mm. in length 2
 Small species, never exceeding 10.0 mm. in length..... 15
 2 — Prosternal lobe margined throughout its contour 3
 Prosternal lobe margined at the sides but not at apex..... 12
 3 — Prothorax broadly rounded at the sides, sensibly wider behind the middle than at base. Form parallel, convex, deep black, polished throughout, glabrous; head rather strongly but sparsely punctured, not impressed at the lobes, the anterior canthus slightly less prominent than the posterior; prothorax one-half wider than long, the sides gradually more rounded and converging apically, the apex barely three-fifths as wide as the base, the sinus circularly rounded but not deep, the angles obtusely rounded; surface very finely and remotely punctate, less finely but still sparsely so laterally, the marginal bead rather fine, not at all incurvate at base; scutellum large, broadly triangular; elytra parallel, as wide as the prothorax, rather more than one-half longer than wide, very obtusely rounded at tip, the surface nearly smooth, somewhat finely though strongly, very remotely punctate, but little more coarsely or less sparsely so toward the sides, the margins very finely reflexed; prosternum finely, sparsely punctate, the process strongly grooved and beaded about its entire contour; hind femora rather finely but deeply, sparsely punctate, the abdomen minutely, very remotely. Length 13.5 mm.; width 5.9 mm. California.
rotundicollis n. sp.

Prothorax not conspicuously rounded at the sides, though a little narrower at base than at a short distance before the latter. Form narrower and slightly less convex, parallel, deep black, not so

shining, feebly alutaceous throughout, glabrous; head rather strongly, not very closely punctate, very obsoletely impressed at the apical lobes, the anterior canthus fuller than in the preceding, not quite as prominent as the posterior; prothorax one-half wider than long, the sides broadly and moderately rounding and not very converging anteriorly, subparallel thence to the base and feebly arcuate, the apex much more broadly though moderately sinuate in circular arc, nearly four-fifths as wide as the base, the angles right and but slightly blunt; surface finely, sparsely punctate, more coarsely but still rather sparsely laterally, the marginal bead moderate; elytra similar though less obtuse and more ogival at tip, the surface very feebly undulato-rugulose, with vague traces of two or three elevated lines, remotely punctate, the punctures rather coarse for the present group and closer and still stronger laterally; prosternum finely, rather sparsely punctate, the process margined about its entire contour by a distinct groove and unusually fine but distinct bead; femora and abdomen nearly as in the preceding species. Length 13.2 mm.; width 5.4 mm. Mokelumne Hill, Calaveras Co..... **blaisdelli** n. sp.

- Prothorax with the sides rounded and converging anteriorly, becoming straight or nearly so and parallel or subparallel thence to the base 4
- Prothorax with the sides converging from base to apex; marginal bead of the prosternal process rather fine but strong, generally entire.. 11
- 4 — Marginal groove and beading of the prosternal process strong and distinct 5
- Marginal groove and beading very feeble, sometimes observable with difficulty..... 8
- 5 — Sides of the prothorax very gradually more rounding anteriorly, not at all subangulate 6
- Sides more or less abruptly rounded or subangulate at or before the middle 7
- 6 — Prothorax more transverse, about one-half wider than long. Body elongate, moderately convex, rather shining, with short sparse pubescence, especially distinct on the elytra; head rather coarsely, not densely punctate, the lobes scarcely impressed, the transverse suture unusually broadly impressed, the anterior canthus broadly rounded, much less prominent than the posterior; prothorax rather strongly narrowed anteriorly, the sides parallel and nearly straight in basal half, the apex moderately sinuate, but little more than three-fifths as wide as the base, the angles obtuse and blunt; surface very minutely, remotely punctate, somewhat strongly but sparsely so laterally, the marginal bead fine; scutellum moderate; elytra nearly as in *blaisdelli* but more rounded and less angulate at apex, the surface almost smooth, much more finely and very remotely punctate, more strongly but still finely and sparsely so laterally, the edge very finely reflexed; prosternum finely, sparsely punctate, the process very minutely; abdomen and hind femora

finely and sparsely but rather strongly punctate. Length 14.0 mm.; width 5.75 mm. California *innocua* n. sp.

Prothorax more elongate, evidently less than one-half wider than long. Body elongate, parallel, convex, deep black, glabrous, polished, the pronotum sometimes feebly alutaceous; head strongly and rather sparsely but not very coarsely punctate, more finely and very sparsely toward base, the lobes broadly rounded, unimpressed, the anterior canthus narrowly rounded, slightly less prominent than the posterior; prothorax with the sides only moderately converging and broadly rounded anteriorly, the apex nearly three-fourths as wide as the base, the circularly rounded sinus moderate in depth, the angles rather obtuse and bluntly rounded; surface minutely, remotely punctate, much more strongly and less sparsely laterally, the marginal bead moderate; scutellum triangular, not very transverse; elytra nearly three-fourths longer than wide, about as wide as the prothorax or slightly less, rather abruptly subangulate at tip, the surface nearly smooth, rather finely, remotely punctate suturally, less remotely and more strongly toward the sides, which are finely reflexed; prosternum rather finely and sparsely punctate, the process with a distinct and entire marginal groove and moderately coarse bead; hind femora and abdomen minutely, very sparsely punctate. Length 12.2-15.0 mm.; width 5.0-6.0 mm. (♂, ♀). Benicia. Collected by the writer in considerable number..... *elongata* Csy.

A — Similar to *elongata* throughout though a little stouter, the anterior canthus fuller and less angulate at the eyes but similarly less prominent than the posterior, the elytra barely more than one-half longer than wide and more obtuse at tip (♀), and the prosternal process broader, with relatively finer marginal bead, its apex similarly circularly rounded. Length 14.8 mm.; width 6.7 mm. California. Cab. Levette... *limatula* n. subsp.

7 — Form relatively rather stout, the largest species of the group, polished throughout, glabrous and deep black above, piceo-rufous beneath; head coarsely, deeply and not densely punctate, the punctures becoming sparse and very minute toward base, the lobes unimpressed, the sinus broad and circularly rounded, the canthi nearly as in *elongata*; prothorax shorter, fully one-half wider than long, the sides subparallel and nearly straight from the base to about apical third, where they are rather strongly rounded, thence strongly converging and almost straight to the angles, which are right and somewhat blunt; apex two-thirds as wide as the base, with the sinus only moderately deep, the base sensibly wider than the base of the elytra; surface very obsoletely ridged along the median line, very minutely, remotely punctate, more distinctly but still sparsely laterally, the marginal bead moderate; scutellum as in *elongata*; elytra evidently more than one-half longer than wide, somewhat gradually acutely ogival at apex, nearly smooth, everywhere finely and very remotely punctate; prosternum finely,

rather sparsely punctate, the process not very broad, rounded at tip, the marginal bead moderate; abdomen and hind femora minutely, remotely punctate. Length 15.5 mm.; width 6.6 mm. (♀). Mt. Diablo. A single specimen taken by the writer.

obsidiana n. sp.

Form much more slender, more convex, parallel, deep black, the tarsi piceous, glabrous, alutaceous, the elytra polished; head finely, rather sparsely punctate, the sinus shallow and parabolic, the lobes unimpressed, the anterior canthus rounded, much less prominent than the posterior; prothorax short, a little more than one-half wider than long, the sides parallel and straight to slightly before the middle, then broadly rounded, becoming rather strongly convergent and but feebly arcuate thence to the angles, which are obtuse and bluntly rounded, the apex two-thirds as wide as the base, with the circularly rounded sinus shallow; surface sparsely, extremely minutely and feebly punctate, only a little more distinctly punctured and still rather sparsely and very finely so toward the sides, the marginal bead fine; scutellum moderate, transversely and obtusely triangular; elytra relatively very long, as wide as the prothorax and almost three times as long, fully three-fourths longer than wide, the apex rapidly narrowed and obtuse, ogival, the surface nearly smooth, very minutely, remotely punctate throughout; prosternum sparsely, extremely minutely punctate, the process parallel, rounded at tip, strongly margined; hind femora and abdomen very minutely, sparsely punctate. Length 13.0 mm.; width 5.25 mm. California. Cab. Levette.

cylindrica n. sp.

- 8 — Anterior canthus less prominent than the posterior.....9
 Anterior and posterior canthi subequally prominent10
 9 — Body parallel, moderately convex, black, alutaceous, the elytra less so; punctures bearing very small, decumbent and rather dark hairs; head coarsely, rather closely punctate, more finely toward base, the lobes broadly rounded, thick, unimpressed, the sinus circularly rounded, shallow; anterior canthus rather broadly rounded; prothorax one-half wider than long, the sides parallel and nearly straight, becoming gradually rounded and strongly convergent before the middle, the apex moderately sinuate, two-thirds as wide as the base, the angles obtuse though only slightly blunt; surface sparsely, very finely punctate, gradually not very coarsely but strongly and still rather sparsely so laterally, the lateral bead moderately thick; scutellum moderate, sharply triangular, but slightly transverse; elytra two-thirds longer than wide, gradually and rather acutely ogival at tip, the sides straight and parallel in basal two-thirds; surface nearly smooth, not very finely, very deeply and sparsely punctate, a little less sparsely though not much more coarsely laterally; prosternum finely, sparsely punctate, the process rather wide, constricted at the coxæ, rounded at tip, where the beaded margin becomes subobsolete; hind femora rather finely

but strongly, sparsely, the abdomen minutely, punctate. Length 12.6 mm.; width 5.5 mm. Lake Co..... **genitiva** Csy.

Body nearly similar but rather more convex, black, densely subopaque, the elytra and under surface shining; punctures without distinct short hairs; head rather finely but strongly, not densely punctate, the sinus rather deep, subparabolic, the lobes not impressed, the anterior canthus more oblique and narrowly rounded; prothorax more transverse and much more narrowed apically, somewhat more than one-half wider than long, the sides broadly rounded, becoming gradually more converging apically and parallel only near the base; apex rather deeply sinuate, only about three-fifths as wide as the base, the angles broadly rounded; surface rather sparsely, very minutely punctate, becoming rather closely and more strongly but still finely so laterally, the marginal bead fine; scutellum large, triangular, very transverse; elytra relatively very elongate, almost three times as long as the prothorax, somewhat parabolically rounded behind, two-thirds longer than wide, the surface nearly smooth, becoming somewhat rugulose apically, finely, sparsely punctate, a little more strongly so laterally; under surface nearly as in the preceding, the femora more minutely and sparsely punctate, the prosternal lobe more narrowly and parabolically rounded at tip. Length 13.0 mm.; width 5.8 mm. Not labeled in Cab. Levette **opacicollis** n. sp.

10 — Form rather stout, strongly convex, deep black, only moderately shining, glabrous; head rather coarsely but loosely punctate, very minutely so at base, the sinus broad, subevenly rounded, the lobes unimpressed, the anterior canthus broadly rounded; prothorax unusually elongate, about two-fifths wider than long, the sides broadly, rather feebly rounded though a little more converging apically but barely becoming parallel even at base, the apex evenly and moderately sinuate, almost three-fourths as wide as the base, the angles right and but slightly rounded; surface very minutely, sparsely punctate medially, becoming rather coarsely and deeply though not much more closely so toward the sides, the marginal bead rather coarse; scutellum relatively rather small, strongly transverse; elytra but little more than twice as long as the prothorax, parallel and straight at the sides, gradually and arcuately narrowed and ogival in apical two-fifths, three-fifths longer than wide; surface nearly smooth, with a few obsolete eroded lines, very finely, sparsely punctured throughout; prosternum finely, sparsely punctate, the process gradually slightly wider posteriorly, with almost straight sides, its apex broadly rounded, obsoletely reflexed, broadly concave on the disk; hind femora rather finely, remotely punctate. Length 14.0 mm.; width 6.25 mm. A single example, labeled "Texas" but undoubtedly in error and probably from the coast regions north of San Francisco.

longicollis n. sp

Form more slender and very much smaller in size, convex, black, feebly alutaceous, the elytra and under surface polished, gla-

brous; head finely but deeply, loosely punctate, the sinus broad, moderately deep and subparabolic, the lobes unimpressed, rather narrowly rounded, the anterior canthus rounded; prothorax rather long, perceptibly less than one-half wider than long, the apex moderately sinuate and fully two-thirds as wide as the base, the angles right and rather broadly rounded; sides very moderately, subevenly arcuate throughout, slightly more converging anteriorly but barely becoming parallel even at base; surface rather sparsely punctate throughout, the punctures excessively minute medially and more visible, though still very fine laterally, the marginal bead rather fine; scutellum moderate; elytra evidently more than twice as long as the prothorax, fully three-fifths longer than wide, parallel and straight at the sides, gradually and obtusely ogival behind; surface nearly smooth, with traces of close-set longitudinal costules, very finely, sparsely punctate throughout; prosternum minutely, sparsely punctate, the process but little dilated posteriorly, with its tip rather prolonged and narrowly rounded; abdomen and hind femora minutely, remotely punctate. Length 10.0 mm.; width 4.12 mm. San Francisco. A single male taken by the writer in the suburbs.

timida n. sp.

- 11 — Body rather small, elongate, strongly convex, deep black, glabrous, rather shining, the pronotum at most very feebly alutaceous; head finely, but strongly, rather sparsely punctate, the sinus rather broad and shallow, the lobes unimpressed; anterior canthus oblique, not broadly rounded, much less prominent than the posterior; prothorax visibly less than one-half wider than long, the sides somewhat strongly converging, subevenly and very feebly arcuate from base to apex, the latter feebly and circularly sinuate, two-thirds as wide as the base, the angles right and bluntly rounded; surface sparsely, extremely minutely punctate, still very finely and rather sparsely, though more distinctly, toward the sides, the lateral bead fine; scutellum moderate; elytra a little more than twice as long as the prothorax, more than one-half longer than wide, parallel, gradually ogival at apex; surface nearly smooth, very finely, remotely punctate, the punctures scarcely less remote or more distinct laterally; prosternum sparsely, very minutely punctulate; hind femora and abdomen remotely punctate, the former somewhat finely but strongly, the latter extremely minutely. Length 10.6–11.2 mm.; width 4.5–4.65 mm. San Francisco. Two male specimens taken by the writer in the suburbs.....*conicicollis* n. sp.
- 12 — Anterior canthus very oblique, much less prominent than the posterior; sides of the prothorax more or less evidently converging from base to apex.....13
- Anterior canthus much fuller and broadly rounded, as prominent as the posterior; punctuation more conspicuous than usual.....14
- 13 — Form moderately narrow and convex, alutaceous, the elytra less

obviously so and more shining, black throughout, glabrous; head finely but strongly, rather sparsely punctate, the sinus broad and shallow, the obtuse lobes unimpressed; prothorax fully one-half wider than long, the sides broadly arcuate, strongly so and very convergent anteriorly, becoming almost parallel basally, the sinus shallow, two-thirds as wide as the base, the angles much rounded; surface sparsely, extremely minutely punctate, more distinctly though still finely and rather sparsely toward the sides, the bead moderately fine; scutellum moderate, broadly triangular; elytra between two and three times as long as the prothorax, two-thirds longer than wide, gradually ogival at apex; surface not quite smooth, remotely and very finely punctate throughout, but little more closely or distinctly so laterally; prosternum minutely, sparsely punctate, the process margined almost to the tip, which is obtusely rounded, the bead sometimes virtually entire; hind femora and abdomen remotely and minutely punctate. Length 10.5-13.7 mm.; width 4.25-5.4 mm. San Francisco. A moderate series taken by the writer but not received from other sources.

viatica Esch.

Form shorter, broader, more convex longitudinally, much more shining, not alutaceous anteriorly, glabrous, deep black; head rather sparsely, very finely punctate, the apical sinus narrower and rather deeper, the antennæ stouter; prothorax a little more elongate, evidently less than one-half wider than long as a rule, the sides subsimilar though frequently subangulate at the middle, the apical sinus similarly shallow and the angles well rounded; surface polished, very minutely, sparsely punctulate, in general but little less finely so laterally; elytra much less elongate, more obtuse at tip, barely one-half longer than wide, sparsely but less finely and more strongly punctured than in *viatica*, the punctures impressed; prosternum sparsely, very finely punctate, the process broad, obtusely rounded at tip, the marginal bead rather fine, generally extending almost to the apex but in some cases entire; hind femora and abdomen minutely, remotely and scarcely distinctly punctulate. Length 11.5-12.7 mm.; width 4.9-5.8 mm. California. Cab. Levette..... *lucidula* n. sp.

Form rather less slender than in *viatica*, larger in size, black, the under surface and legs piceous or rufescent, shining, the anterior parts somewhat alutaceous, glabrous; head very finely, sparsely punctate, the apex rather broadly sinuate in circular arc, the lobes obtusely rounded, not impressed; prothorax barely one-half wider than long, somewhat conical, the sides very feebly and subevenly arcuate from base to apex, becoming parallel only very near the base, the apical sinus shallow, three-fifths as wide as the base, the angles obtuse and moderately rounded; surface sparsely, extremely minutely punctate, more distinctly but still sparsely and very finely so laterally, the marginal bead moderate; elytra about two and a third times as long as the prothorax, parallel, gradually ogival behind; surface nearly smooth, finely,

remotely punctate throughout, more strongly near the sides, the punctures impressed as in the two preceding; prosternum very minutely, sparsely punctate, the process broadly rounded, margined nearly to the apex; hind femora finely but strongly, moderately sparsely punctate, the abdomen minutely, very remotely so. Length 14.2 mm.; width 5.8 mm. Berkeley, Alameda Co.

protensa n. sp.

- 14—Body rather stout for the present group, strongly convex, black throughout, alutaceous, the elytra less so, glabrous; head rather finely and sparsely but strongly punctate, the sinus very broad and somewhat parabolic, the broadly obtuse lobes unimpressed; prothorax rather large, fully one-half wider than long, the sides parallel and nearly straight in about basal half, gradually rounded and strongly converging thence to the angles, which are right and slightly blunt; apical sinus moderately deep, three-fifths as wide as the base, the latter posteriorly obliquely sinuous laterally; surface sparsely, very minutely punctate, becoming more closely and much more strongly, though not coarsely so, laterally, the bead rather strong, the fine but strong groove flexed along the apex to lateral fourth; scutellum broadly and obtusely angulate; elytra two and a third times as long as the prothorax, rather more than one-half longer than wide, parallel, unusually obliquely and gradually narrowed to the narrowly obtuse tip; surface somewhat uneven and irregularly crumpled, the punctures sparse but rather large for this group, impressed as in the preceding; prosternum finely but strongly, sparsely punctate, the process obtuse, with a strong lateral margin not extending behind the coxæ; hind femora rather coarsely, deeply and not very sparsely punctate, the abdomen minutely, remotely so, more strongly and closely on the basal segment. Length 14.8 mm.; width 6.3 mm. California.....*thoracica* n. sp.

Body less stout, elongate, parallel, rather convex, deep black, glabrous, somewhat strongly shining, scarcely alutaceous anteriorly; head rather finely but strongly, unusually densely punctate, the sinus not very broad, rather deeply parabolic, the lobes broadly obtuse, unimpressed; prothorax fully one-half wider than long, a little wider behind the middle than at base, the sides parallel and broadly arcuate, somewhat sinuate toward base, moderately rounding and converging before the middle, the apex with shallow circular sinus, three-fourths as wide as the base, the angles somewhat obtuse but not broadly rounded; surface finely and rather sparsely but distinctly punctate, not very closely though much more strongly and relatively coarsely so laterally, the marginal groove along the beading flexed inward at apex; scutellum not very transverse, sharply triangular; elytra parallel, fully two-thirds longer than wide, the sides more arcuately and less obliquely converging at apex; surface slightly uneven, undulate and with traces of three longitudinal ribs on each apically, the punctures less sparse than usual and much larger though not

coarse, deep and less impressed, still coarser toward the sides; prosternum finely but strongly, sparsely punctate, the process broadly arcuato-truncate at tip, the beaded margin not extending quite to the apex; hind femora rather strongly and distinctly punctate, the abdomen very minutely and remotely punctulate. Length 12.2 mm.; width 5.3 mm. Oregon (Medford),—H. F. Wickham.....**proba** n. sp.

15 — Side margin of the prothorax never more than slightly curved at base 16

Side margin inflexed at base, extending along the basal margin.....21

16 — Anterior canthus very full and broadly rounded.....17

Anterior canthus, because of the more oblique and straighter sides of the front, coming to a bluntly rounded point adjoining the eye..20

17 — Upper surface virtually glabrous, the hairs borne by the punctures very minute and inconspicuous.....18

Upper surface evidently clothed sparsely with short and decumbent hairs.....19

18 — Form subcylindric, strongly convex, strongly shining throughout, deep black, the legs and antennæ dark rufous or piceous; head finely but strongly, closely punctate, the sinus broad, moderately shallow, subparabolic, the anterior canthus broadly prominent and but little less so than the posterior; antennæ rather stout, compressed; prothorax two-fifths to three-fifths wider than long, the anterior sinus circular, rather shallow, the sides strongly rounded and converging before, becoming nearly straight and parallel behind, the middle; surface finely but very strongly, distinctly and closely punctate, still more strongly and closely though only a little more coarsely so laterally, the beaded margin extremely fine, curving at base about the hind angles only and then abruptly disappearing; scutellum rather small, but little wider than long, triangular, with the apex obtusely rounded; elytra fully one-half longer than wide, parallel, as wide as the prothorax, the apex obliquely and arcuately narrowed, the extreme tip narrowly obtuse; surface very finely punctate, the punctures close-set in longitudinally lineate areas separated by narrower and comparatively impunctate lines; side margin very finely reflexed; under surface and femora very minutely, sparsely punctulate. Length 8.7–10.0 mm.; width 3.5–4.2 mm. San Francisco Co., — Chas. Fuchs. [Benicia, — Leconte]..**puncticollis** Lec.

Form a little shorter and less cylindrical, smaller in size, convex, deep black, with the legs rufo-piceous, the antennæ blackish-piceous; surface less shining, faintly alutaceous; head finely, densely punctate, nearly as in *puncticollis* but with the broadly rounded anterior canthus much less prominent than the posterior; prothorax a little shorter, transverse, with the sides very feebly converging to parallel from the base to the middle and usually nearly straight, then more strongly convergent and moderately arcuate to the right

and rounded apical angles, the sides generally with a distinct subangulation at the middle; apical sinus broad and shallow, two-thirds as wide as the base; surface more minutely and less closely punctate than in the preceding, the punctures however unusually close-set, the fine margin not curved at base so completely about the basal angles; scutellum nearly similar but less obtuse; elytra nearly similar but a little shorter and especially more gradually and acutely ogival posteriorly, the even finer punctures similarly disposed, the subimpunctate lines often irregularly costuliform; under surface and femora minutely, rather sparsely punctate. Length 8.2-9.2 mm.; width 3.2-3.85 mm. San Francisco. Taken in the suburbs by the writer and not known from other sources.....**exigua** n. sp.

Form still shorter, subcylindric, strongly convex, much more obtuse before and behind, deep black, the legs rufo-piceous; upper surface alutaceous; head finely but not very closely punctate, the sinns shallow, the oblique side margins sinuous at the ends of the oblique sutures — an unusual character in this genus, — the frontal parts rufescent as in the two preceding; prothorax rather elongate, evidently less than one-half wider than long, the sides very feebly converging and almost straight from the base nearly to apical third, then rounded and strongly converging but not angulate, the apex broadly and shallowly sinuate, nearly four-fifths as wide as the base, the angles broadly rounded; surface finely but strongly, not very closely and unevenly punctate, becoming a little more strongly and closely so laterally, the marginal bead fine, arcuate at base; scutellum rather small; elytra short, barely one-half longer than wide and but little more than twice as long as the prothorax, parallel, very obtusely ogival at tip; surface with fine but rather strong, moderately close-set punctures disposed as in the preceding, the subimpunctate lines tumescent; under surface finely punctate, the prosternum rather strongly and somewhat closely. Length 7.9 mm.; width 3.5 mm. California. Cab. Levette.

paupercula n. sp.

19 — Body moderately elongate, parallel, convex, deep black, the legs in great part and the antennæ apically rufescent; upper surface smooth and dull, strongly alutaceous; head rather small, very finely, not densely punctate, the sinus rather deep and narrower, the oblique sides straight; anterior canthus about as prominent as the posterior; prothorax short, three-fifths wider than long, the sides subevenly rounded, rather strongly converging anteriorly, becoming parallel in about basal half, the apex barely more than three-fifths as wide as the base, with moderately deep sinus and broadly rounded angles; base almost truncate, with obtuse angles; surface minutely, rather sparsely punctulate, more strongly but still not very closely so laterally, the marginal bead extremely fine, only slightly arcuate at base; scutellum moderate, polished; elytra not quite one-half longer than wide, two and one-half times as long as the prothorax, parallel, gradually moderately acute and ogi-

val in posterior two-fifths; surface very smooth, with barely a trace of tumescent lines, the punctures minute, moderately close in broad lines as in the preceding species; under surface very minutely, remotely punctulate and polished, the prosternum more opaque and minutely, rugosely punctate, the process rather narrow, margined strongly almost to the tip. Length 7.5 mm.; width 3.2 mm. Alameda Co..... **microsticta** n. sp.

20 — Form rather stout for the present group and moderately convex, glabrous, shining and only very faintly alutaceous, deep black, the legs rufo-piceous, the antennæ nearly black; head finely but not very closely punctate, the sinus moderate, the anterior canthus much less prominent than the posterior; prothorax formed nearly as in *microsticta* but much less transverse, barely one-half wider than long, the surface finely but strongly, moderately sparsely punctate, becoming still more strongly and rather closely but unevenly so laterally, the marginal bead rather fine, strongly curving about the hind angles; scutellum rather small; elytra barely one-half longer than wide, two and a third times as long as the prothorax and equally wide, the sides straight and parallel, gradually rounding and converging behind the middle, the apex narrowly parabolic; surface with fine but unusually strong, moderately close-set punctures, with the less punctate lines narrower and distinctly tumescent; under surface minutely, sparsely punctate throughout, the prosternal process rather wide, very faintly margined at the sides along the coxæ, its apex unusually deflexed and convex. Length 9.2 mm.; width 3.82 mm. California.

picipes n. sp.

21 — Lateral bead of the prothorax very fine, rounding the hind angles and extending inward along the base for only a short distance. Body rather strongly convex, subcylindric, glabrous, deep black, the legs dark rufous, the antennæ nearly black; surface rather shining though somewhat alutaceous; head rather small, finely, strongly, somewhat closely punctate anteriorly, more finely and sparsely behind the suture, the sinus moderately broad, the anterior canthus moderately full, less prominent than the posterior; prothorax as in *picipes* but rather more rapidly narrowed anteriorly, the angles obtuse but rather less rounded; surface very minutely, rather sparsely punctate, still very finely and rather sparsely so laterally; scutellum small; elytra nearly as in *picipes* but narrower, the surface similar but with the punctures still smaller and feebler; prosternal process narrower, finely though very evidently margined along the coxæ, similarly much deflexed and convex at its apex. Length 7.7 mm.; width 3.35 mm. San Francisco. A single specimen taken by the writer in the suburbs.

inflexula n. sp.

Lateral bead even finer, extending along the basal margin almost to the middle. Body rather more elongate, convex, feebly alutaceous; coloration as in *inflexula*, the upper surface bearing short but

very evident and rather coarse glistening hairs; head unusually small, finely but very strongly, rather closely punctate, the sinus rather narrow, moderately deep, the anterior canthus full and rounded, almost as prominent as the posterior; prothorax barely one-half wider than long, the sides moderately converging and broadly, feebly rounded from base to apex, slightly more converging toward the apex, which is rather deeply sinuate and three-fifths as wide as the base, with the angles right and evidently rounded; surface finely but strongly, rather closely punctate, unusually strongly and closely so toward the sides, with a feeble impression along the sides behind the middle but not attaining the base; scutellum small; elytra as in *inflexula* but still more gradually and arcuately narrowed behind to the rather acutely ogival apex; surface more uneven than usual, with distinct tumescent lines, the punctures less fine or close-set than usual but similarly disposed; under surface nearly similar. Length 8.4 mm.; width 3.6 mm. California. Cab. Levette.

inconspicua n. sp.

In the above series the margining of the prosternal lobe becomes so singularly inconstant as to lose a great deal of its supposed value elsewhere, and the divisions of the table based upon this character are somewhat arbitrary, the prosternal characters only applying to the majority of the representatives of the several species. In *elongata*, for example, the greater number of examples, all females, have an entire beaded margin, but one of the three males in the series has the lobe completely unmarginated except toward its base. So again, in *lucidula*, most of the specimens have the apical part of the lobe completely immarginate, while one, not differing otherwise to any noticeable extent, has a strong and entire beaded margin. I had separated a few forms upon this apparently important and certainly most striking character, but was obliged afterward to suppress them.¹ Some years ago Dr. F. E. Blaisdell gave me

¹These cases are very puzzling and there are some seven or eight still undescribed forms, each represented by from one to three examples, before me, in the neighborhood of *elongata*, *viatica* and *lucidula*, which possess in each case some peculiarity of habitus, sculpture or structure of the prosternal lobe. Although they would seem to represent distinct species or subspecies, the material is far too limited to enable me to form any definite opinion at present, and as three of them are from the same locality as the types of *elongata*, the exact fixation of their taxonomic status is rendered thereby all the more uncertain. I now think that the male example referred to *elongata*, having an unmarginated prosternal lobe, mentioned above, will prove to be specifically distinct, as there are some obvious differences in the α deagus distinguishing it from the adopted

a specimen, taken by him at Mokelumne Hill, and I had been under the impression that it represented the species which he subsequently described as *sanfordi*, but on studying the description of the latter it is impossible to discover a single harmonizing character to bear out the surmise, and I therefore attach to it another name as above; it is the only species of the present group known to me as occurring on the eastern side of the central valley, although the exact locality of a number of the species described in the table is unknown. *Sanfordi*, by its published dimensions, must be included in the *abdominalis* group, where, however, it is wholly isolated as before intimated. The small species of the second section of the table are distinguishable, as a group, by the peculiar segregation of the elytral punctures into broad uneven longitudinal areas lying between the narrower and usually somewhat elevated smooth lines; they might even be considered a distinct group by themselves.

Group IV. — Type *cuneata*.

In reality this group is only a continuation of the preceding, but, as the cuneiform outline of its few known members is a rather striking character common to both sexes, though much more feebly developed in the female, it may therefore be considered distinct for convenience in identification. The three known species are the following:—

- Body deep black in color, more or less shining.....2
- Body dark piceous in color, dull and densely alutaceous, more southern in habitat..... .3

2 — Form cuneate, widest anteriorly, the male shorter and more strongly cuneiform, convex, moderately elongate, highly polished and deep black throughout, glabrous; head somewhat coarsely, moderately closely punctate throughout, the sinus unusually deep, rather narrow, the anterior canthus rather full, rounded, fully as prominent as the posterior; prothorax one-half wider than long, the sides evenly rounded and rather strongly convergent apically,

true male of *elongata*, and some of the others also represent distinct species in all probability, but I will leave this discussion for a future occasion. Perhaps after all, the margination of the prosternal lobe may not be so unstable a character in this group as I surmised on concluding the table of its species, but it should be stated that, under the circumstances, it was deemed best to distinguish by name only those forms markedly isolated in general habitus and therefore assumably having the status of true species or subspecies.

becoming parallel and straighter in about basal half, the apex moderately sinuate in circular arc, two-thirds as wide as the base, the angles right and only narrowly rounded; surface finely and sparsely but distinctly punctate, decidedly coarsely, very deeply and much more closely so toward the sides, the marginal bead rather thick, perfectly straight to the apex of the basal angles; scutellum well developed, transversely triangular; elytra one-half longer than wide (♀) or less (♂), the sides feebly converging from the base and nearly straight almost to apical third, then strongly rounded and converging to the obtusely ogival tip; surface nearly smooth or with a suspicion of broadly tumescent lines, not coarsely but very strongly, sparsely punctured, decidedly more coarsely and less sparsely toward the sides; prosternum minutely, sparsely punctate, polished, the process moderately wide, feebly dilated and rounded apically, with a continuous beaded edge (♂, ♀); hind femora and abdomen finely, remotely punctate. Length 11.0–11.7 mm.; width 5.18–5.3 mm. California (Humboldt Co., — Hoopa Valley) *atronitens* n. sp.

Form nearly similar, smaller in size, convex, glabrous, the legs piceous distally; surface scarcely at all alutaceous; head finely, not densely punctate, the sinus very much broader and relatively shallower than in the preceding, the sides more oblique, the anterior canthus much less prominent than the posterior and coming to an obtuse point at the eye; prothorax shorter, fully three-fifths wider than long, similar in general form, the apex moderately sinuate, fully three-fifths as wide as the base, the angles right and only slightly blunt; surface sparsely, excessively minutely and scarcely visibly punctulate, more visibly but still sparsely and very finely toward the sides, where the bead is finer than in *atronitens* though bordered internally by a broader groove; scutellum somewhat smaller; elytra one-half longer than wide (♂), the sides more converging from the base to apical third than in *atronitens* (♂), straight, more gradually converging and acutely ogival at apex; surface nearly smooth, very sparsely and finely punctate, somewhat more strongly and less remotely toward the sides; prosternum minutely, rather sparsely punctate, the process a little broader, more dilated, convex and obtusely angulate at apex, finely margined and only along the coxæ; hind femora finely but less sparsely punctate, the abdomen excessively minutely, remotely so. Length 10.3 mm.; width 4.6 mm. California (locality unrecorded)... *sparsa* n. sp.

3 — Form broader, less convex, strongly cuneiform; under surface, legs and base and apex of the antennæ rufescent, subglabrous, the setæ extremely minute though visible; head very finely but strongly, evenly and rather closely punctate, the sinus moderately broad and deep, parabolic, the oblique sides rounded evenly from the obtusely pointed canthus at the eye, much less prominent than the posterior, to the apical lobes, which are rather angulate; prothorax fully two-thirds wider than long, the sides evenly round-

ing and converging before basal third, straight and posteriorly converging behind basal third and continuous in direction with the straight and converging sides of the elytra; apex moderately sinuate, nearly two-thirds as wide as the base, the curve of the sinus becoming anteriorly arcuate and confused with the rounded angles laterally; base almost truncate, the sinuses subobsolete; surface sparsely, extremely minutely punctate, more evidently but still finely and very sparsely toward the sides, the bead fine though attended by a distinct narrow internal gutter; scutellum rather small; elytra relatively small, much narrower than the widest part of the prothorax near basal two-fifths of the latter and barely twice as long, gradually rounding and rather acutely ogival behind; surface nearly smooth, very finely, sparsely punctate, but little more closely or coarsely so laterally, where the margins are rather less narrowly reflexed than in the two preceding; prosternum finely but strongly, not very sparsely punctate, the process wide, strongly dilated and obtusely angulate at apex, strongly beaded but only along the coxæ; hind femora rather strongly but sparsely punctate, the abdomen minutely. Length 10.8 mm.; width 5.3 mm. California (San Diego), — G. W. Dunn.

cuneata n. sp.

The last of the above species is one of the more distinct of the genus and differs from the first two, which are northern forms, in being evenly narrowed posteriorly from behind the middle of the prothorax and not solely from the base of the elytra; it is represented in my cabinet by a single male specimen.

Group V. — Type *subpubescens*.

This is probably not a perfectly natural group, as it comprises a few species from nearly all the zoölogical regions of California, differing a good deal among themselves in facies. It is, in general, characterized by a less convex form of body than usual in the genus, although the latter may be stout or as elongate as in *viatica*, but the surface is generally dull and alutaceous and always distinctly, though more or less sparsely, pubescent, with the hairs decumbent and not erect and bristling as in the *setosa* group. In some species, as for example *montana*, the male is distinctly cuneiform as in the *cuneata* group preceding, but I have not noticed this character as pertaining to both sexes as it does there. The elytral punctures are more or less small in size and the surface never so rugose as in the *eschsoltzi* group. The seven species at present known may be differentiated very clearly as follows: —

- Body larger, always over 10.0 mm. in length, the head well developed 2
- Body small, always much under 10.0 mm. in length, more oblong-oval in form, the head small.....7
- 2 — Hind femora minutely and remotely punctate.....3
- Hind femora coarsely, more closely and conspicuously punctured, at least toward base6
- 3 — Sides of the head before the eyes more or less broadly rounded and as prominent as the posterior canthus or nearly so; body broader in form.....4
- Sides more oblique, coming to a more point-like canthus, which is much less prominent than the posterior; body narrower.....5
- 4 — Body oblong, stout and parallel (♀) or feebly cuneiform and much narrower (♂), moderately convex, strongly alutaceous above, black, the tarsi and antennal apex rufescent; pubescence sparse, long, fulvous in color; head coarsely, very deeply but not densely punctate, the sinus moderate, rather deep, triangular; anterior canthus a little less prominent than the posterior; prothorax transverse, two-thirds wider than long, the sides broadly rounded and converging anteriorly, becoming parallel and straight or feebly arcuate in about basal half; apex moderately sinuate, three-fourths as wide as the base, the angles slightly obtuse but not much rounded; surface very finely and remotely punctate medially, becoming notably coarsely, deeply and much more closely so toward the sides, the marginal bead moderately strong; scutellum well developed, only moderately transverse, evenly triangular; elytra two and one-half times as long as the prothorax, the sides parallel or feebly converging and nearly straight to a little behind the middle, then unusually gradually converging, becoming straight to the acute apex; surface nearly smooth, with some obsolescent irregular grooves, the punctures moderately coarse, deep and very sparse, becoming not much larger but closer laterally; prosternum with moderate, perforate, more close-set punctures, the process convex, margined except at the middle of the apex; abdomen very finely but distinctly, sparsely punctate. Length 10.8–13.0 mm.; width 4.9–6.2 mm. California (Lake Tahoe). Collected only by the writer so far as known.

montana Csy.

Body oblong, still less convex, somewhat piceous-black, the tarsi and entire antennæ ferruginous; upper surface alutaceous, the hairs rather long, more close-set and conspicuous on the elytra than in *montana*; head coarsely, loosely punctate, more finely and more densely on the base of the vertex, the parabolic sinus rather deep, the anterior canthus very broadly rounded, fully as prominent as the posterior; prothorax formed as in *montana* but with the hind angles slightly more posteriorly prominent; surface less finely, more closely and very distinctly punctate medially, becoming coarsely and still more closely so laterally, the lateral bead simi-

lar; scutellum more transversely triangular; elytra parallel and straight at the sides in almost basal two-thirds (♀), more rapidly and arcuately narrowed to the more obtuse tip; surface broadly undulato-rugose, strongly so apically, the punctures rather fine but deep, much more close-set than in *montana*, but little closer though sensibly coarser laterally; prosternum rather coarsely and closely punctate, the process rounded behind, moderately strongly margined throughout; abdomen not very finely, rather sparsely but conspicuously punctate medially, more minutely and remotely laterally. Length 10.8 mm.; width 4.75 mm. (♀). California (Marin Co.). [San José, — LeConte; the original type, 9.2 × 4.3 mm., is probably a male, being smaller and more slender than my female representative; the locality "San Diego" under the original description is an error, a different species being involved].

subpubescens Lec.

5 — Form elongate, very moderately convex, parallel, alutaceous, the elytra more feebly so, deep black; hairs rather short, very sparse, fulvous but less conspicuous than in the two preceding; head rather coarsely, deeply and sparsely punctate, more closely toward the suture, the sinus not very broad, deep and angular; prothorax more elongate, distinctly less than one-half wider than long, the sides parallel and nearly straight fully to apical two-fifths, gradually rounding and converging thence to the apex, which is broadly sinuate and three-fourths as wide as the base, the angles right and only slightly blunt; base rather strongly bisinuate; surface somewhat finely and sparsely but strongly punctate, becoming coarsely, conspicuously and somewhat less sparsely so laterally, the bead moderate, a median line subimpunctate; scutellum moderate; elytra not quite two and one-half times as long as the prothorax, the sides straight and parallel, gradually arcuately converging in apical two-fifths to the rather acutely ogival tip; surface nearly smooth, rugulose apically, sparsely but strongly punctate, more coarsely so laterally and apically; prosternum rather finely but strongly, moderately closely punctate, the process margined throughout; abdomen minutely, rather sparsely punctate. Length 11.25 mm.; width 4.9 mm. California (Hermitage, Mendocino Co.). A single specimen taken by the writer. **parallela** Csy.

6 — Form, lustre, coloration and pubescence nearly as in *montana* but narrower; head coarsely, deeply, somewhat closely punctate, the sinus rather deep and angulate, not very broad, the anterior canthus rounded and rather full, just visibly less prominent than the posterior; prothorax nearly as in *montana* but not so transverse, three-fifths wider than long, the base more broadly and strongly bisinuate, the punctures medially sparse but not so minute, very distinct, coarse, close and very conspicuous laterally, the bead moderately thick; scutellum rather small, sharply triangular, not much wider than long; elytra more than two and one-half times as long as the prothorax in the apparently female type, the sides

straight and parallel to apical two-fifths, then gradually arcuate and converging to the rather acutely ogival tip; surface nearly as in *montana*, the strong and moderately large punctures less sparse, becoming somewhat close-set and coarse laterally; prosternum rather coarsely but sparsely punctate, the process dilated and rounded behind the coxæ, the marginal bead rather feeble but entire; abdomen rather finely but very distinctly, sparsely punctate; hind femora strongly, conspicuously, evenly but not very closely punctate throughout. Length 12.2 mm.; width 5.2 mm. California. Cab. Levette **canonica** n. sp.

Form much broader, more oblong-oval, only moderately convex, deep black, the tarsi and antennæ picescent, the upper surface dull and strongly alutaceous, the hairs rather long, moderately sparse, fulvous and distinct; head strongly, rather sparsely, not very coarsely punctate, the sinus narrow, deeply angular; anterior canthus full and broadly rounded, as prominent as the posterior; prothorax as in *montana* but more narrowed anteriorly, the apex more deeply sinuate and only three-fifths as wide as the base, the base rather more strongly and more broadly sinuate laterally, the punctures and lateral bead nearly as in *canonica*; scutellum as in the latter; elytra shorter, less than one-half longer than wide, the sides parallel and straight to apical two-fifths, then moderately rapidly converging and arcuate to the subparabolic apex; surface smooth, feebly undulato-rugose posteriorly, rather finely but distinctly, sparsely punctate, more coarsely though still not very deeply and but little less sparsely laterally; prosternum strongly, moderately closely punctate, the process feebly dilated and rounded behind the coxæ, convex, the beaded margin obsolescent at apex; hind femora strongly and rather closely punctured toward base but sparsely and less coarsely so thence distally; abdomen finely, feebly and sparsely punctulate. Length 11.7 mm.; width 5.8 mm. California (South Fork of the Kaweah River).

perspicua n. sp.

7—Body oblong-suboval, moderately convex, dull and alutaceous, rather grayish-black, the legs, antennæ, mouth-parts and clypeus rufescent; pubescence coarse, moderately long, fulvous and distinct though rather sparse; head somewhat coarsely and closely perforato-punctate, the sinus moderately narrow and parabolic, the anterior canthus narrowly rounded, about as prominent as the posterior; prothorax one-half wider than long, the sides broadly rounded, strongly converging apically, becoming nearly parallel toward base, the apex deeply sinuate, barely three-fifths as wide as the base, the angles right and scarcely even blunt, very distinct; surface rather sparsely but strongly punctate, coarsely and less sparsely so laterally, the marginal bead fine, arcuate near the base; scutellum moderate, picescent; elytra about two and a third times as long as the prothorax, rather obtusely ogival with strongly arcuate sides in apical two-fifths, parallel thence to the base; surface nearly smooth, undulato-rugose apically, strongly, somewhat

sparsely punctate, becoming moderately coarsely and rather less sparsely so laterally; under surface and hind femora finely, sparsely punctulate, the prosternum more strongly, with the process unmarginated except feebly along the coxæ; tarsi unusually slender. Length 7.0-8.0 mm.; width 3.4-3.9 mm. California (San Diego). Two specimens taken by the author and one subsequently received, the latter having the scutellum much more transversely triangular and the body a little more convex.

parviceps Csy.

Body somewhat less cylindrical, oblong-oval, distinctly more depressed, nearly similar in coloration, lustre and pubescence; head even smaller and less developed than in any other species, less coarsely but strongly, rather closely punctate, the sinus rather broader, the anterior canthus more obliquely pointed, as prominent as the posterior; prothorax much shorter but otherwise nearly similar, two-thirds wider than long, the deep apical sinus parabolic, almost similarly sculptured but not quite so coarsely, the marginal bead fine, arcuate at base; scutellum rather small, similar, only feebly transverse and sharply triangular; elytra about two and one-half times as long as the prothorax, less than one-half longer than wide, more gradually and acutely ogival in apical two-fifths; surface more strongly undulato-rugulose, especially behind, with a medial vaguely eroded line on each, the punctures rather smaller and less sparse than in *parviceps*; prosternum rather strongly, moderately closely punctured, the process strongly margined, obsolescently so around the broadly arcuate apex; hind femora and abdomen finely and rather sparsely but strongly and distinctly punctate. Length 7.8 mm.; width 3.7 mm. California (Poway, San Diego Co.).....**filiola** n. sp.

The last two species of the table form a rather isolated type, peculiar to the Sonoran regions of California.

Group VI. — Type *setosa*.

The following five species form a natural group leading to *eschsoltzi* and allies, having the same rather stout and oblong convex body, but with the elytral sculpture comparatively fine and always less coarse or rugose and the more or less conspicuous vestiture erect and bristling on the elytra; they have a geographic distribution differing greatly from that of the *eschsoltzi* group but coincident with that of the *ovalis* group and may be thus defined: —

- Prosternal process not or but feebly dilated behind the coxæ.....2
- Prosternal process more constricted at the coxæ and always more or less strongly dilated apically.....5
- 2 — Elytral vestiture short.....3

Elytral vestiture long, shaggy and very conspicuous.....4

3 — Body rather narrowly oblong or subelongate, convex, deep black, the antennæ black, the legs piceous distally; surface rather shining, the elytral setæ small and not very conspicuous; head well developed, rather finely and sparsely punctate, the sinus rather deep, sharply parabolic, the lobes broadly rounded, the anterior canthus angularly rounded, as prominent as the posterior; prothorax transverse, nearly three-fourths wider than long, the sides broadly rounded, more converging anteriorly, becoming almost parallel toward base, the apex moderately sinuate, fully three-fifths as wide as the base, with the angles evidently rounded; surface very finely, sparsely punctate, becoming gradually rather coarsely and closely so laterally, the bead rather fine; scutellum moderate; elytra one-half longer than wide, parallel, very obtusely and broadly, parabolically rounded behind, generally almost smooth but sometimes rugose, with obsolete indications of longitudinal tumescent lines occasionally, strongly, rather closely punctate, more coarsely and still more closely so laterally and also apically, where the surface is more opaque; prosternum finely, rugosely sculptured, the process polished and more sparsely and strongly punctate, strongly margined at the sides but immarginate at tip; hind femora strongly though very sparsely punctate, the abdomen minutely, remotely so, more strongly toward the sides; tarsi slender. Length 10.0–10.3 mm.; width 4.8–5.0 mm. Idaho (Cœur d'Alene). One specimen is labeled "Cal." but probably in error.....**setosa** Csy.

Body somewhat stouter and more abbreviated, deep black, moderately shining, the bristling vestiture distinct, fulvous; head rather coarsely and densely punctured toward the suture, coarsely apically and sparsely and finely from before the eyes to the base, the sinus broad, parabolic, the anterior canthus rather obtusely pointed, much less prominent than the posterior; oblique sides feebly emarginate at the ends of the oblique sutures; prothorax more transverse, nearly four-fifths wider than long, the sides subevenly and moderately arcuate throughout, becoming parallel only near the base; apex broadly sinuate, two-thirds as wide as the base, with the angles right and but slightly blunt; surface finely, sparsely punctate, becoming broadly rather coarsely but not much more closely so toward the sides, the bead rather fine, the base broadly, evenly bisinuate; scutellum rather small, transversely triangular; elytra parallel, very broadly and obtusely rounded in apical third, two-fifths longer than wide, nearly smooth, finely, remotely punctate, more coarsely but shallowly and not much less sparsely so toward the sides, subopaque posteriorly; prosternum rather strongly punctate, the process broad, subparallel, unmarginated except finely along the coxæ; hind femora and abdomen rather finely but more or less strongly, sparsely punctate. Length 10.0 mm.; width 5.2 mm. Utah (Clear Lake),—H. F. Wickham.....**obtusa** n. sp.

- 4 — Form still stouter, oblong-oval, convex, deep black, somewhat alutaceous, the elytra more shining; head rather finely, very sparsely punctate, more closely so near the transverse suture, the sinus moderately broad, deeply subangulate, the anterior canthus full, somewhat less prominent than the posterior; prothorax three-fourths wider than long, the sides very feebly converging and almost straight, or with a feeble ante-basal sinus, from the base about to the middle, then rounding, becoming strongly converging and just visibly arcuate to the apex, which is broadly sinuate and two-thirds as wide as the base, the angles right and rather narrowly rounded; surface very minutely, sparsely punctate, becoming broadly somewhat coarsely but not very closely so laterally; base somewhat more strongly bisinuate than in *obtusa*; scutellum small, transversely triangular; elytra as in *obtusa* but barely a third longer than wide, nearly smooth, subopaque posteriorly, having numerous fine and generally subtransverse, anastomosing creases throughout, the punctures sparse but rather strong, becoming quite close-set and subrugulose or with transversely sublineate extensions laterally; prosternum rather finely but strongly punctate, the process long, the post-coxal part oblong with but feebly arcuate sides and rounded tip, broadly constricted at the coxæ, unmargined except finely along the coxæ; hind femora and abdomen very sparsely punctate. Length 10.8 mm.; width 5.75 mm. Nevada (Carson City),—H. F. Wickham.

lanuginosa n. sp.

- 5 — Body oblong, deep black, the tarsi piceous; upper surface alutaceous, the elytra more shining though posteriorly opaque, head rather sparsely but somewhat strongly punctured, finely toward base, the sinus nearly as in the preceding, the anterior canthus rather broadly rounded and almost as prominent as the posterior; prothorax two-thirds wider than long, the sides subevenly and moderately arcuate throughout, not quite becoming parallel even at base, the apex rather deeply sinuate, scarcely more than three-fifths as wide as the base, the angles right and very distinct, scarcely at all blunt; surface sparsely, extremely minutely punctate, becoming broadly quite coarsely but scarcely less sparsely so laterally; base rather strongly sinuate near each side; scutellum small; elytra not quite one-half longer than wide, parallel, obliquely and rapidly narrowed in posterior third to the apex, which is much more angulate than in the preceding, the pubescence very conspicuous, fulvous; surface nearly smooth, the anastomosing fine creases only distinct posteriorly, finely, remotely punctate, more strongly and less sparsely so laterally but still comparatively finely; prosternum rather strongly punctate, unmargined except finely along the coxæ; hind femora and abdomen rather finely but unusually distinctly, though remotely, punctate; tarsi moderately slender. Length 10.9–11.5 mm.; width 5.7–5.85 mm. Utah (Marysvale),—H. F. Wickham.

wickhami n. sp.

Body nearly similar in form, rather strongly shining throughout, pale piceo-rufous, the elytra, under surface, legs and antennæ still paler, ferruginous — possibly partially owing to immaturity; — pubescence abundant and conspicuous posteriorly though only moderate in length as in *wickhami*; head somewhat coarsely and closely punctate throughout, the sinus broadly angulate, the lobes rounded, impressed; anterior canthus rather broadly rounded, visibly less prominent than the posterior; prothorax fully three-fourths wider than long, the sides broadly rounded and strongly converging anteriorly, becoming parallel and nearly straight in about basal half, the apex rather shallowly sinuate, fully two-thirds as wide as the base, the angles right and only slightly blunt; surface very finely, rather closely punctate, becoming coarsely and unusually densely so very broadly toward the sides, the bead fine; basal angles slightly prolonged, right; scutellum moderate; elytra one-half longer than wide, the sides gradually converging and broadly, evenly arcuate from slightly behind the middle to the narrowly parabolic apex, nearly smooth, finely, rather sparsely, submuricately punctate, becoming rather coarsely, densely, muricately so, with the punctures transversely subconfluent, laterally; prosternum strongly, closely punctate, the process nearly circular in form behind the very strong intercoxal constriction, unmarginated except moderately along the coxæ; femora and abdomen as in *wickhami* but less strongly punctured. Length 11.2 mm.; width 5.4 mm. Washington State **pubifera** n. sp.

Wickhami is a larger species than *obtusa*, with much less transverse prothorax and angulate, and not broadly rounded, elytral apex; the posterior part of the elytra in *pubifera* differs again from anything else known in the group, and this is an unusually well differentiated species, in which the pale coloration is in all probability not entirely due to immaturity, a parallel case being *farallonica*, of the following group.

Group VII. — Type *cschscholtzi*.

This is one of the larger groups of the genus, and, at the same time, one of the most restricted in habitat. It occurs exclusively in the coast regions from San Francisco Bay probably through Oregon, being geographically coincident with the *viatica* group; to the northward and eastward of this region it is replaced by the *setosa* and *ovalis* groups, and, to the southward, by the *abdominalis* group. The species are oblong or oblong-suboval, usually strongly convex in form and generally have very coarse and deep elytral punctures, separated by convex interspaces, giving to the surface a more or less pro-

nounced rugosity. Pubescence is frequently noticeable but is always very short, sparse and decumbent and never so conspicuous as in the two preceding groups. The various forms in my collection may be known by the following characters:—

- Elytral punctures bearing short decumbent and evident, though more or less inconspicuous hairs 2
- Elytral punctures virtually nude or bearing very minute setæ, usually not projecting beyond their limits..... 17
- 2 — Larger and strongly convex species, seldom less than 11.0 mm. in length..... 3
- Smaller, less convex species, though rather more convex than in *subpubescens* and allies, never much more than 10.0 mm. in length and generally very much less 13
- 3 — Species occurring in California, probably in all cases near San Francisco Bay; prosternal process strongly beaded throughout the periphery in all the specimens at hand; anterior canthus fully as prominent as the posterior 4
- Species of Oregon; prosternal process margined feebly at the sides but not at apex; anterior canthus less prominent than the posterior..... 12
- 4 — Sides of the prothorax rounding and strongly converging anteriorly, becoming parallel and almost straight in about basal half... 5
- Sides of the prothorax evenly and moderately or subevenly arcuate from base to apex 10
- 5 — Clypeal sinus only moderate in width, deep and parabolic..... 6
- Clypeal sinus broad, very shallow, evenly rounded in circular arc... 9
- 6 — Prosternal process broadly and rather abruptly arcuato-truncate at apex 7
- Prosternal process narrower and evenly, semicircularly rounded at apex 8
- 7 — Form very broadly oblong, deep black, moderately shining, the anterior parts alutaceous; head strongly but somewhat loosely and irregularly punctured, the anterior canthus rounded though not very broadly; antennæ slender, rufescent at tip as usual; prothorax short, nearly four-fifths wider than long, the apex moderately sinuate, two-thirds as wide as the base, the angles somewhat obtuse and well rounded, the base transverse, not medially lobed, becoming very feebly and posteriorly sinuato-oblique laterally; surface finely but strongly, sparsely and somewhat unevenly punctate, gradually quite coarsely and more closely so laterally, the bead coarse and polished; scutellum large, very transversely triangular; elytra barely one-half longer than wide, parallel, the sides very evenly rounded and converging in posterior two-fifths, the apex obtusely ogival; surface very coarsely, moderately closely punctate and rugulose; prosternum strongly but rather sparsely

punctate and with short pubescence, the process wide, subparallel; hind femora rather strongly but sparsely, the abdomen minutely and remotely, punctate. Length 14.2 mm.; width 6.4 mm. (♀). San Francisco Co.,—Chas. Fuchs....*expansa* n. sp.

Form much narrower and relatively more convex, polished throughout and very much more shining, deep black; head rather finely but strongly, moderately closely punctate, the anterior canthus rather narrowly rounded though not at all pointed; prothorax much less transverse, but little more than one-half wider than long, the apex moderately deeply sinuate, nearly two-thirds as wide as the base, the angles obtuse but rather narrowly rounded, the base broadly arcuate medially, just visibly and transversely sinuate laterally; surface finely, rather distinctly but sparsely punctate, rather strongly though not coarsely, sparsely so laterally, the bead moderately thick; elytra of peculiar form, fully one-half longer than wide, the sides gradually evenly arcuate and converging posteriorly to the acutely ogival apex, becoming parallel only toward base, very coarsely but rather sparsely punctured, densely so apically, the surface rugose; prosternum polished, very minutely, remotely and inconspicuously punctate, the process more constricted intercoxally than in *expansa* and with the apical angles more rounded; hind femora and abdomen very finely, sparsely punctate. Length 12.7 mm.; width 5.7 mm. San Francisco. A single specimen taken by the author in the suburbs.....*franciscana* n. sp.

8 — Body very broadly oblong, rather strongly convex, deep black, polished, the anterior parts somewhat alutaceous; head with rather small but strong, moderately close punctures, the anterior canthus rather narrowly rounded; prothorax short, fully three-fourths wider than long, the sides more evenly rounded anteriorly than in *expansa*, the apex similar but with less thickened bead laterally, three-fifths as wide as the base, the latter similarly truncate but less prolonged backward laterally, being very feebly, transversely sinuate toward the sides; surface finely, sparsely punctate, becoming strongly and somewhat coarsely though still sparsely so laterally, the marginal bead rather fine; scutellum smaller, much less transversely triangular; elytra nearly as in *expansa* but with the sides becoming arcuately convergent behind at about basal third and with the apex more acutely ogival, the punctures similarly very coarse and the surface rugose; prosternum very minutely, sparsely and inconspicuously punctate, the process but feebly constricted intercoxally; hind femora and abdomen very finely, remotely punctate. Length 12.4 mm.; width 5.8 mm. Near San Francisco, — G. W. Dunn*truncata* n. sp.

Body much narrower and more elongate, parallel, similarly convex, deep black, strongly shining, the anterior parts slightly alutaceous; head similarly though much more sparsely punctate, the anterior canthus more rounded and less oblique; antennæ not very slender, the outer joints not much enlarged; prothorax not more than one-

half wider than long, the anterior sinus moderately shallow, nearly three-fourths as wide as the base, the angles obtusely rounded, the base transverse, just visibly and very broadly bisinuate; surface minutely, very remotely punctate, more strongly but still comparatively finely and sparsely so laterally, the bead rather fine; scutellum moderate, transversely triangular; elytra fully one-half longer than wide, the sides parallel and straight to well behind the middle, then gradually rounded and converging to the rather acutely ogival apex; surface of each with a few remote and feebly tumescent lines, of which one margins the suture, the punctures coarse but unusually sparse, with less convex interspaces, denser and more rugose posteriorly; prosternum sparsely pubescent, finely but rather strongly, sparsely punctate, the process broader than in *truncata*, feebly constricted intercoxally; hind femora and abdomen very finely, remotely punctate. Length 13.0 mm.; width 5.7 mm. (♂). Cab. Levette..... **suturalis** n. sp.

9 — Form moderately stout, convex, alutaceous, the elytra much more shining, deep black; head rather finely and sparsely but strongly punctate, the anterior canthus obliquely and obtusely pointed; antennæ rather slender; prothorax three-fifths wider than long, the apex shallowly sinuate, two-thirds as wide as the base, the angles obtuse and rather broadly rounded, the base very broadly and feebly bisinuate; surface rather sparsely but not very finely, strongly punctate, becoming somewhat coarsely and less sparsely so laterally, the bead moderately fine; scutellum moderate, sharply triangular, not very transverse; elytra one-half longer than wide, the sides gradually rounding and converging from rather before the middle posteriorly, the apex acutely ogival; surface coarsely but not very closely punctate, the interspaces not notably convex, except apically, where they are narrower; prosternum very finely, sparsely punctate, the process almost impunctate and subparallel, broadly rounded at tip; hind femora and abdomen minutely, remotely and very inconspicuously punctate. Length 11.0 mm.; width 4.9 mm. Cab. Levette..... **audax** n. sp.

10 — Tarsi unusually slender. Form oblong-oval, rather shining throughout, deep black; head somewhat coarsely punctate, very sparsely posteriorly, moderately closely anteriorly, the sinus not very broad, deeply parabolic; anterior canthus oblique and rather pointed but blunt; prothorax shorter than in the three following, three-fifths wider than long, the apex only very moderately sinuate, three-fifths as wide as the base, with the angles obtusely rounded; sides unusually converging from base to apex, broadly arcuate; base rectilinearly truncate, becoming conspicuously oblique posteriorly at the sides; surface very sparsely but somewhat strongly punctate, more coarsely but still sparsely so laterally, the bead moderately thick, curving strongly at base entirely about the hind angles; scutellum very transversely triangular, rather large; elytra as wide as the prothorax, one-half longer than wide, the sides strongly rounding behind the middle, the apex obtusely ogival;

surface very coarsely punctate and rugulose, the punctures well separated except apically; prosternum finely, sparsely punctate, the process rather wide, only very feebly constricted at the coxæ, semicircularly rounded at apex; hind femora and abdomen very finely, remotely punctate. Length 11.3 mm.; width 5.2 mm. (♂). Precise locality not recorded.....**convergens** n. sp.

Tarsi moderately stout as usual; prothorax less transverse.....11

11 — Form evenly elongate-elliptical, strongly convex, deep black, alutaceous, the elytra polished; head large, nearly half as wide as the prothorax, strongly, rather closely punctate, the sinus only moderately deep and wide, broadly parabolic, the lobes broadly rounded, the anterior canthus narrowly rounded, very prominent, somewhat more so than the posterior; prothorax unusually elongate, less than one-half wider than long, the sides evenly converging from base to apex, evenly and moderately arcuate, the apex shallowly sinuate, fully two-thirds as wide as the base, the angles right and narrowly rounded or blunt, the base broadly, evenly, very feebly bisinuate; surface finely and sparsely but rather strongly punctate, somewhat coarsely and less sparsely so laterally, the bead rather coarse, perfectly straight to the basal angles; scutellum moderate, sharply triangular, not very transverse; elytra less than one-half longer than wide, scarcely more than twice as long as the prothorax, the sides becoming rounded behind the middle, the apex very obtuse from above; surface very declivous posteriorly, very coarsely, moderately closely punctate and rugose; prosternum very finely, sparsely punctate, the process wide, broadly rounded at tip, feebly constricted; hind femora finely but distinctly, remotely, the abdomen minutely, punctate. Length 12.0 mm.; width 5.75 mm. San Francisco. A single specimen, apparently female, from the suburbs, collected by the writer**symmetrica** n. sp.

Form somewhat more oblong and scarcely so convex, deep black, polished throughout; head smaller, distinctly less than half as wide as the prothorax, less coarsely, more sparsely punctate, the sinus narrower and deeper, parabolic, the lobes less broadly rounded, the anterior canthus similarly oblique and narrowly rounded and very prominent though not more so than the posterior; prothorax nearly as elongate, barely one-half wider than long, nearly similar but more narrowed from base to apex, the latter similar but only three-fifths as wide as the base, with the angles more broadly rounded, the sides of the base more posteriorly oblique; surface very sparsely, rather finely but strongly punctate, gradually rather coarsely and less sparsely so laterally though becoming dense near the hind angles, the bead similar but rather less coarse; scutellum nearly similar; elytra longer, one-half longer than wide, more ogival at tip from above; surface less declivous posteriorly, a little less coarsely but otherwise similarly punctate and rugose; prosternum minutely, sparsely punctate, the process semicircularly rounded at tip, moderately con-

stricted; hind femora rather coarsely, closely and conspicuously punctured basally, more remotely thence to the apex, the abdomen very minutely and remotely; hind tarsi much shorter than in *symmetrica*. Length 10.8 mm.; width 5.3 mm. (♂). Exact locality unrecorded.....**anxia** n. sp.

Form moderately stout, oblong, convex, alutaceous, the elytra polished, deep black; head not very coarsely but strongly, rather sparsely punctate, the sinus broad, moderately deep, parabolic, the lobes obtuse though rather narrowly rounded, the anterior canthus nearly as in *anxia* but more obtusely rounded; prothorax shorter, a little more than one-half wider than long, the sides subevenly and much more strongly arcuate, becoming parallel near the base, strongly converging anteriorly, the apex shallowly sinuate, fully three-fifths as wide as the base, the angles right and moderately rounded, a good deal deflexed, the base broadly, feebly bisinuate; surface sparsely, very finely punctate, gradually strongly, moderately sparsely to rather closely and coarsely so toward the sides, the bead moderately thick, straight to the base; scutellum as in the two preceding; elytra as in *anxia* though still a little more acutely ogival at apex, the punctures similarly very coarse but well separated and the surface rugose; prosternum similar, the process subparallel (♀), semicircularly rounded at tip; hind femora strongly and conspicuously punctured toward base, the abdomen with small but distinct, sparse punctulation. Length 11.5–13.0 mm.; width 5.4–6.1 mm. Exact locality unrecorded. [Benicia, — LeConte]..... **affinis** Lec.

A — Nearly as in *affinis* but more narrowly elongate-suboval in form, the punctures toward the sides of the prothorax much sparser and less coarse, the sides of the latter less strongly and more unevenly arcuate, being relatively more strongly arcuate apically, the setæ of the elytral punctures altogether inconspicuous except apically, where they are much shorter, passing but little beyond the confines of the punctures; under surface nearly similar, except that the hind femora are minutely, sparsely and inconspicuously punctate throughout. Length 12.0 mm.; width 5.78 mm. (♀). “Cal.”..... **patruelis** n. subsp.

12 — Body oblong, convex, deep black throughout, the antennæ scarcely even picescent apically, stout; surface feebly alutaceous anteriorly, the elytra more shining; head coarsely but loosely punctate, the sinus wide, rather deep, parabolic, the anterior canthus oblique, subacute, scarcely prominent; prothorax one-half wider than long, the sides rounded and convergent anteriorly, becoming faintly sinuate and parallel in basal three-fifths, the apex shallowly sinuate, two-thirds as wide as the base, the latter broadly and rather strongly bisinuate, the basal angles unusually prolonged posteriorly and rather acute, the anterior obtuse though not very broadly rounded; surface sparsely but strongly punctate, unusually coarsely, moderately closely and somewhat unevenly

so laterally, the bead moderately coarse, not at all curved at base; scutellum moderate, not very transverse, convexly declivous anteriorly; elytra scarcely one-half longer than wide, parallel, the sides rounding rather abruptly near apical third, thence obliquely converging and less arcuate to the ogival apex; surface very coarsely, deeply but not very closely punctate, the interspaces not notably convex, rugose apically; prosternum coarsely, strongly, very closely and conspicuously punctate throughout, pubescent, the process but feebly constricted, strongly rounded at apex; hind femora strongly, closely punctate basally, more sparsely elsewhere, the abdomen not very finely and unusually strongly so. Length 11.0 mm.; width 5.3 mm. (♂). Oregon (Albany), — H. F. Wickham.....**oregona** n. sp.

13 — Base of the prothorax abruptly posteriorly oblique at the sides, the angles obviously prominent posteriorly..... 14

Base of the prothorax broadly, subevenly bisinuate, not abruptly oblique laterally, the angles barely at all prominent posteriorly; antennæ notably slender, the joints much elongated; size very small..... 16

14 — Head very sparsely but unevenly punctate. Body oblong-oval, moderately convex, subalutaceous, not very deep black, the legs and antennæ rufescent; pubescence sparse, fulvous; head moderately large, the punctures somewhat coarse, more aggregated near the transverse suture, very sparse elsewhere, the sinus rather narrow, deeply parabolic, the anterior canthus broadly rounded, about as prominent as the posterior; antennæ rather slender, the joints moderately elongate; prothorax one-half wider than long, the sides rounded and converging anteriorly, becoming gradually very feebly arcuate and almost but not quite parallel through basal three-fifths; apex rather shallowly sinuate, almost two-thirds as wide as the base, with the angles right and only slightly blunt; surface rather finely but strongly, remotely and unevenly punctate, with a rather pronounced median impunctate line, gradually rather strongly but still not closely punctate toward the sides, the bead rather fine, not curved at base; scutellum moderate, transversely and sharply triangular; elytra less than one-half longer than wide, rounding at the sides behind the middle, the apex moderately obtusely ogival; surface only moderately coarsely, rather sparsely punctate, strongly rugose posteriorly; prosternum finely but strongly, perforately and not very closely punctate, the process strongly rounded at tip, not margined except feebly toward its base; hind femora very minutely, remotely punctate, the abdomen somewhat more strongly though very finely. Length 10.5 mm.; width 4.75 mm. (♀). "Cal."

extricata n. sp.

Head more closely, subevenly punctate throughout..... 15

15 — Form nearly as in *extricata*, somewhat brownish-black, the tarsi and antennæ rufescent; lustre rather shining, the pubescence very obvious, fulvous; head with the sinus moderately wide, not very

deep, broadly parabolic, the anterior canthus oblique, subacute, as prominent as the posterior; antennæ slender, the joints notably elongate; prothorax as in *extricata* but shorter, fully three-fifths wider than long, the punctures similar but much more close-set throughout and without median impunctate line; scutellum similar; elytra as in *extricata* but narrower and more nearly one-half longer than wide, more gradually acute at apex, still less coarsely and more sparsely punctate, similarly rugose posteriorly; prosternum finely but very strongly, moderately closely punctate and puberulent, the process very strongly beaded along the sides to the apex but not around the latter; hind femora excessively minutely and remotely punctulate throughout, the abdomen not very finely though sparsely, strongly and conspicuously punctate. Length 9.5 mm.; width 4.35 mm. (♀). San Francisco Co.

marginata n. sp.

Form narrower and more elongate, moderately convex, alutaceous, the elytra polished, somewhat piceous black, the tarsi piceous and the antennal apex rufous; head moderate in size, strongly, rather closely punctate, sparsely pubescent, the sinus moderately narrow and deep, parabolic, the lobes broadly rounded, the anterior canthus oblique though obtusely rounded, as prominent as the posterior; prothorax three-fifths wider than long, the sides rounding and convergent anteriorly, becoming subparallel and straight or sometimes with a feeble sinus in more than basal half, the apex rather shallowly sinuate, two-thirds as wide as the base, the angles slightly obtuse but only narrowly rounded; surface finely though strongly, only moderately sparsely punctate, strongly but not much more closely toward the sides, the bead not very thick though prominent, slightly curving inward at base; scutellum moderate, transversely triangular; elytra one-half longer than wide and somewhat gradually acutely ogival behind (♀), or two-fifths longer than wide and more obtusely parabolic at apex (♂), rugose posteriorly, the punctures rather coarse and well separated, notably unequal; prosternum finely, sparsely punctate, puberulent, the process rather narrow, somewhat strongly margined to, but scarcely about, the rounded apex (♀), or a little wider and finely margined and only at its base (♂); hind femora and abdomen minutely, sparsely and more or less inconspicuously punctate. Length 7.7-9.0 mm.; width 3.5-4.0 mm. San Francisco. Taken in the suburbs rather plentifully by the writer and also received from the County, collected by Mr. Fuchs.

nemoralis Esch.

Form rather shorter than in *nemoralis*, still smaller in size, similar in coloration and lustre; head rather small, strongly, somewhat closely punctate, the sinus moderately wide and deep, circularly rounded, the anterior canthus oblique, subacute, less prominent than the posterior; antennæ notably thick, the joints only moderately elongate; prothorax large, nearly three-fifths wider than long, the sides broadly arcuate, more strongly so and very con-

vergent anteriorly, slightly wider near the middle than at base, the apex not more than three-fifths as wide as the base, the angles obtuse and broadly rounded, more deflexed than usual; surface very finely, rather sparsely punctate, more strongly but still not coarsely and almost equally sparsely so toward the sides, the bead rather fine, slightly curving at base; scutellum and elytra nearly as in *nemoralis*, the latter scarcely one-half longer than wide, gradually arcuately narrowed behind the middle, the apex ogival, though narrowly obtuse; surface and punctures uneven, nearly as in *nemoralis*; under surface nearly similar. Length 7.25 mm.; width 3.3 mm. "Cal.".....**parva** n. sp.

- 16 — Body oblong, rather stout, very small in size, similar to the preceding in coloration but more shining, the anterior parts not at all alutaceous; head moderately large, strongly, subevenly but not very closely punctate, the sinus nearly as in *parva*, the anterior canthus much more obtusely rounded and scarcely at all less prominent than the posterior; prothorax fully three-fifths wider than long, nearly as in *nemoralis*, the apex more than two-thirds as wide as the base; surface finely but distinctly, sparsely punctate, more strongly and less sparsely toward the sides, the bead moderate, curving very slightly at base, the basal angles very blunt; scutellum rather small; elytra short, two-fifths longer than wide, otherwise nearly as in *parva* though smoother, rugulose apically, the punctures not coarse but strong, well separated and rather unequally distributed; prosternum finely but strongly, sparsely punctate, the process rather narrow, evenly and strongly convex longitudinally, margined only at base; hind femora and abdomen very minutely, sparsely and inconspicuously punctulate. Length 6.7 mm.; width 3.1 mm. (♂). San Francisco Co.,—Chas. Fuchs.....**minuta** n. sp.
- 17 — Body deep black in color throughout, inhabiting the mainland exclusively.....18
- Body piceous to pale testaceous in color; habitat insular.....26
- 18 — Elytral punctures only moderately coarse, relatively fine for the present group..... 19
- Elytral punctures very coarse and generally deep.....23
- 19 — Small species, never as much as 10.0 mm. in length.....20
- Larger species never less than 10.0 mm. in length.....21
- 20 — Elytra unequally punctate, very remotely so, with the surface nearly smooth, becoming more coarsely and closely with the surface very rugose apically. Body oblong-oval, moderately convex, deep black, the tarsi and antennal base and apex piceo-rufous, very highly polished throughout; head strongly but sparsely punctate, the sinus only moderate in width, deep and parabolic, the anterior canthus obliquely rounded, as prominent as the posterior; antennæ moderately thick; prothorax fully two-thirds wider than long, the sides broadly rounded and converging before the middle, becom-

ing feebly diverging and almost straight thence to the base, the apex shallowly sinuate, three-fifths as wide as the base, the angles right and only slightly blunt; surface rather finely but strongly, remotely punctate, becoming coarsely and much less sparsely so laterally, the bead thick, much thickened apically, curving but little at base; scutellum moderate, transversely triangular; elytra not quite one-half longer than wide, rounded at the sides and narrowed to the obtusely ogival apex in posterior two-fifths, the punctures deep but uneven in size; prosternum strongly, rather closely punctate, the process unmarginated except feebly at base; hind femora minutely, sparsely, the abdomen rather strongly, somewhat less sparsely, punctate. Length 9.2 mm.; width 4.25 mm. "Cal."

perpolita n. sp.

Elytra almost equally and much less sparsely punctate, less smooth though almost similarly rugose behind. Body more elongate, similarly convex, less shining, the anterior parts sometimes faintly alutaceous, deep black, the antennæ and distal parts of the legs picescent or rufous; head strongly but loosely, unequally punctate, the sinus moderately deep, not wide, the anterior canthus obliquely subangulate or obtuse, fully as prominent as the posterior; antennæ moderate; prothorax one-half wider than long, formed as in *perpolita* but less narrowed at the shallowly sinuate apex, the latter two-thirds as wide as the base, the sides of which are more abruptly oblique, with the hind angles not more produced posteriorly but more narrowly and abruptly so; bead not so thick and not thickened apically; punctures much finer and a little closer throughout in the same relative parts of the surface; scutellum and elytra nearly similar, the latter somewhat less rapidly narrowed behind; punctures strong, somewhat uneven, each with a small yellowish-silvery seta, more distinct posteriorly but not sufficiently long to constitute pubescence; under surface similar throughout, except that the abdomen is much more minutely, sparsely punctulate. Length 8.6-9.7 mm.; width 4.0-4.6 mm. (♂, ♀). San Francisco. Two specimens taken by the writer in the suburbs, one example from the County, taken by Mr. Fuchs, and several from the Levette cabinet.....**pudica** n. sp.

21 — Sides of the prothorax subangulate though rounded at the middle. Form oblong-elongate, convex, deep black throughout, alutaceous, the elytra rather strongly shining; head very finely, rather sparsely, subevenly punctulate, the sinus rather small but deep, subangular, the lobes obtuse, the anterior canthus obtuse, very nearly as prominent as the posterior; antennæ moderately thick; prothorax almost four-fifths wider than long, the sides strongly converging though only slightly arcuate anteriorly, parallel and straight in about basal half, the apex moderately sinuate, even less than three-fifths as wide as the base, the angles obtuse but narrowly rounded, the base moderately and rather narrowly, evenly sinuate at each side; surface remotely, very minutely punctulate, with an impunctate medial linear area, the punctures gradually stronger and closer

but still rather small laterally, the bead fine, straight at base; scutellum large, transversely triangular; elytra somewhat more than one-half longer than wide, parallel, rather strongly rounded and narrowed to the ogival apex in barely apical two-fifths, the oblique sides becoming nearly straight, the base not quite as wide as the thoracic base, the surface somewhat uneven, deeply and somewhat finely, densely rugose on the declivity, the punctures small, moderately close-set, coarser posteriorly, the setæ very minute and inconspicuous; prosternum smooth, minutely, sparsely punctate, the process large, much constricted intercoxally, margined throughout; hind femora and abdomen very minutely, sparsely punctulate. Length 12.0 mm.; width 5.68 mm. Locality not recorded but probably from northern California.....**callida** n. sp.

Sides of the prothorax subevenly rounded from base to apex.....22

22 — Body oblong-suboval, rather strongly shining and deep black throughout; head finely, somewhat closely punctate, the sinus moderately wide, rather deeply parabolic, the lobes broadly rounded, the anterior canthus evenly rounded, fully as prominent as the posterior; prothorax almost four-fifths wider than long, the sides broadly rounded and more converging apically, becoming a little less rounded and almost parallel basally, the apex moderately sinuate, two-thirds as wide as the base, with the bead strong laterally, the angles right and moderately rounded; base rather strongly sinuate laterally, broadly lobed; surface very finely, rather sparsely punctate, subimpunctate along the middle, more strongly but not very closely or coarsely laterally, the bead rather fine, not arcuate at base; scutellum small; elytra not quite one-half longer than wide, the sides converging and rounded behind the middle to the acutely ogival apex; surface with two or three narrow faint ridges on each, rather smooth, rugose posteriorly, somewhat finely but strongly, rather sparsely punctate, more coarsely so toward the apex and a little closer laterally; prosternum strongly, somewhat closely punctate, the process minutely and sparsely so, very feebly constricted, rounded at tip and margined throughout, the bead occasionally obsolete apically; hind femora and abdomen minutely, sparsely punctulate, the latter very feebly rugulose. Length 10.0–12.0 mm.; width 4.6–5.75 mm. (♀). Siskiyou Co., — Albert Koebele.....**shastanica** n. sp.

Body larger than in *shastanica*, more broadly oblong and rather less convex, dull in lustre, the elytra rather less pronouncedly deep black; head rather finely, closely and subevenly punctate, the sinus small, very deeply subangulate, the lobes broadly rounded, the anterior canthus rounded but not very broadly, about as prominent as the posterior; antennæ rather thick; prothorax very transverse, slightly less than twice as wide as long, the sides rounded and converging from base to apex, rather more so anteriorly, subparallel toward base, the apex unevenly sinuate, being more transverse medially, two-thirds as wide as the base, the latter broadly,

evenly bisinuate, with the angles rather acute and posteriorly produced, the apical angles moderately rounded, right; surface finely, not very sparsely punctate, becoming strongly and unusually closely so laterally, the bead moderately fine: scutellum rather small, not very transversely triangular; elytra one-half longer than wide, much less gradually rounded and narrowed behind than in *shastanica*, obtusely ogival at tip; surface nearly smooth, with noticeably small and unusually close punctures, but strongly rugose and more coarsely punctate on the declivity, where each puncture has a very minute silvery seta entirely enclosed within it; prosternum nearly as in *shastanica* but with the process more elongate, more constricted, strongly margined except at the rounded apex, which is unmargined; hind femora and abdomen finely, sparsely and inconspicuously punctate. Length 12.3 mm.; width 5.9 mm. Siskiyou Co. (Sisson), — H. F. Wickham.....**conferta** n. sp.

23 — Prothorax large, a little wider than the elytra.....24

Prothorax not at all wider than the elytra.....25

24 — Form oblong-elongate, very convex and strongly shining throughout, very deep black, the elytral punctures with setæ so minute as only to be observed under rather high power; head somewhat finely but strongly, moderately sparsely punctured, the sinus rather wide and shallow, the anterior canthus broadly rounded, even a little more prominent than the posterior; prothorax nearly four-fifths wider than long, the sides subparallel and feebly arcuate, rounding and strongly converging anteriorly, the apex broadly sinuate, three-fifths as wide as the base or a little more (♂), the angles obtuse and rounded; base subtransverse, with the angles but feebly and gradually produced and rounded; surface excessively minutely and remotely punctulate, more visibly but still very finely and remotely so laterally, the sides narrowly explanate and with a rather coarse bead; scutellum rather large, transversely and obtusely triangular; elytra two-thirds longer than wide, straight and parallel at the sides, very gradually narrowed and somewhat acutely produced at apex, nearly smooth, very coarsely and sparsely punctate, more closely so but only slightly rugose on the declivity; prosternal process but feebly constricted, strongly margined at the sides but unmargined at apex; abdomen extremely minutely, remotely punctulate, the hind femora with sparse but rather strong — though small — punctures. Length 11.7–13.5 mm.; width 5.4–6.1 mm. San Francisco. [= *inaequalis* Csy.].

eschscholtzi Mann.

Form narrower, deep black, less shining, the elytral punctures posteriorly each with a very small but more visible seta; head very finely, rather sparsely punctate, the sinus broad but rather deep, parabolic, the lobes less obtuse, the anterior canthus oblique and much less rounded, obtusely subangulate, as prominent as the posterior; prothorax less transverse, nearly three-fourths wider than long, the sides more evenly rounded, gradually more con-

verging anteriorly, becoming parallel and nearly straight toward base, the apex shallowly sinuate, nearly two-thirds as wide as the base, the angles rather deflexed, moderately rounded; base very broadly and feebly bisinuate, the hind angles right, not more than slightly blunt; surface very minutely, not very sparsely punctulate, the punctures becoming decidedly strong and closer but still noticeably fine laterally, the margins not at all reflexed and with a moderately fine bead; scutellum less obtuse though transversely triangular; elytra but little more than one-half longer than wide, the sides broadly, subevenly rounded and converging from near basal third to the more obtusely ogival apex, scarcely visibly narrower than the prothorax; surface coarsely, less sparsely and less strongly punctate, but more densely and more rugose on the declivity; prosternum sparsely and very minutely punctulate, the process unusually short, broadly rounded, very feebly constricted, margined throughout; hind femora and abdomen minutely, sparsely and inconspicuously punctate. Length 10.7 mm.; width 4.9 mm. (♂). "Cal." **pagana** n. sp.

- 25 — Body oblong-oval, strongly convex, black and moderately shining throughout, the anterior parts slightly alutaceous; head rather coarsely and closely punctured anteriorly, finely and sparsely toward base, the sinus moderately wide, deep, evenly rounded, the anterior canthus obtusely oblique, much more prominent than the posterior; prothorax not more than one-half wider than long, the sides converging and progressively more rounded from base to apex, the latter shallowly emarginate, nearly two-thirds as wide as the base, the angles much deflexed and broadly rounded; base very feebly bisinuate, the angles but slightly projecting; surface extremely minutely, sparsely punctulate, becoming somewhat coarsely but sparsely so toward the sides, the margin not reflexed and not very thickly beaded; scutellum very transversely triangular; elytra visibly less than one-half longer than wide, slightly wider than the prothorax, the sides parallel and nearly straight, arcuately converging at base, rapidly rounded and converging in apical two-fifths, the apex very broadly ogival; surface very coarsely but not closely punctate, rugose, densely and strongly so posteriorly; prosternum minutely, sparsely punctate, the process short, impressed along the middle, rounded at tip, barely at all constricted, very strongly margined throughout; hind femora and abdomen minutely, remotely punctulate. Length 10.5 mm.; width 5.18 mm. (♀). California..... **inornata** n. sp.

Body oblong-oval, very stout, strongly convex, very deep black and strongly shining throughout, the elytra with very minute and inconspicuous setæ posteriorly; head finely, sparsely punctate, the sinus moderately wide, rather deep and parabolic, the lobes very widely rounded, the anterior canthus obliquely subacute, fully as prominent as the posterior; prothorax three-fifths wider than long, the sides broadly rounded and converging anteriorly, becoming nearly straight and almost parallel in about basal half, the apex

shallowly sinuate, two-thirds as wide as the base, with broadly rounded angles; base very broadly and feebly bisinuate; surface very sparsely, extremely minutely punctulate, becoming more distinctly but still finely, sparsely so laterally, the bead moderate; scutellum transverse, sharply triangular; elytra inflated, very distinctly wider than the prothorax, the sides parallel and broadly arcuate, strongly rounding and converging behind the middle, a little less than one-half longer than wide, the apex ogival; surface almost smooth, moderately rugose posteriorly, the punctures coarse though much less coarse and sparser than in *inornata*; prosternum very minutely, sparsely punctate, the process well developed, moderately constricted, very strongly margined throughout, not impressed; hind femora finely and sparsely but rather strongly punctate, the abdomen extremely minutely, remotely and almost imperceptibly so. Length 11.8 mm.; width 6.0 mm. (♀). California. Cab. Levette.....**congesta** n. sp.

Body oblong-elongate, more parallel and less convex than in the two preceding, rather shining, the elytra with small but visible setæ posteriorly; head rather coarsely, sparsely and unevenly punctate throughout, the sinus moderately wide, rather deeply parabolic, the lobes rounded, the anterior canthus obtusely rounded, more prominent than the posterior; prothorax barely one-half wider than long, the sides converging and feebly arcuate from the base, more strongly near the apex, which is evenly and moderately sinuate and fully three-fifths as wide as the base, the angles deflexed, obtuse and moderately rounded; base broadly, very feebly and evenly bisinuate; surface finely and sparsely though distinctly punctate, becoming rather coarsely and more closely so laterally, the bead moderate; scutellum moderate, not very transverse, obtusely triangular; elytra fully one-half longer than wide, equal in width to the prothorax, the sides parallel, rounding and converging behind the middle to the broadly ogival apex; surface not rugose, moderately coarsely, very sparsely punctate, the punctures coarser and denser, with the surface rugose, on the declivity; prosternum with strong and only moderately sparse punctures, the process less abbreviated than in *inornata*, margined throughout but less strongly, not impressed; hind femora and abdomen finely but rather strongly, sparsely punctate. Length 12.3 mm.; width 5.83. California. Cab. Levette**agrestis** n. sp.

26 — Form oblong-suboval, strongly convex, shining throughout, the elytra with small hairs only noticeable posteriorly; head very coarsely, more or less densely and unevenly punctate, the sinus moderately wide, rather shallow, the lobes not much rounded, the anterior canthus obtusely rounded, more prominent than the posterior but not more so than the unusually convex eyes; prothorax nearly four-fifths wider than long, the sides converging and nearly straight about to apical third, then strongly rounded and more converging to the apex, which is shallowly sinuate and two-thirds as wide as the base, the latter broadly, feebly bisinuate, the an-

terior angles broadly rounded; surface sparsely but rather coarsely, unevenly punctate medially, becoming unusually coarsely so and less sparsely toward the sides, the bead thick; scutellum moderate, transversely triangular; elytra one-half longer than wide to rather more, rapidly narrowed and with strongly rounding sides in apical two-fifths, the apex broadly ogival; surface with more or less feeble evidence of a few longitudinal costæ, rugose behind, nearly smooth anteriorly, coarsely and more or less closely but unevenly punctate; prosternum strongly, closely punctate, the process rather narrow, moderately constricted, longitudinally convex, rounded at tip, not margined except at the sides toward base; hind femora and abdomen with sparse but unusually strong, even punctures throughout. Length 10.2–12.2 mm.; width 4.75–5.9 mm. Farallon Islands.....**farallonica** Csy.

Some of the species allied to *nemoralis* might almost as naturally fall near *subpubescens* in the preceding group, but the form is a little more convex and the sculpture stronger, giving them on the whole more nearly the general habitus of the present group. There are evidences of some natural geographic subdivisions of this group, *oregona* and *farallonica*, for example, being widely different from each other and from the usual type and the series of northern species from *callida* to *conferta* also hold together very consistently, departing widely in general sculpture from the others. It is quite obvious that the species formerly described by me under the name *inæqualis*, a remarkably isolated form by reason of the sharply acute elytral apex and in having the prothorax wider than the elytra, with narrowly subexplanate sides, is, by reason of the virtual absence of elytral setæ and because of the very feeble punctuation of the anterior parts, the species held by LeConte and Horn to represent the true *eschsoltzi*; *affinis* is therefore a valid species, being one of a considerable number of more or less closely allied forms as noted above.

Group VIII. — Type *ovalis*.

The rather numerous species falling under this head replace the allies of *eschsoltzi* in the northern Pacific coast and Rocky mountain regions, and are distributed thence southwardly to the eastern foothills in central Colorado, and, to the westward, through Utah to western Nevada, this extended range being nearly coincident with that of the *setosa* group. The body is always

strongly convex, comparatively coarsely sculptured and is more oval than in the *eschscholtzi* group, but otherwise resembles the prevailing form in the latter, except that it is more completely glabrous, no species being known to me having more than very minute setæ virtually wholly enclosed within the punctures; they may be known by the following characters:—

Elytral punctures more or less coarse and very conspicuous, the integuments deep black throughout and strongly shining; habitat near the coast.....2

Elytral punctures smaller and less conspicuous though invariably distinct, the integuments always deep black but frequently alutaceous; habitat further removed from the coast.....6

2 — Sides of the prothorax strongly rounded and converging anteriorly, becoming straight and parallel in rather more than basal half. Form more oblong than usual, parallel, strongly shining; head strongly, rather closely punctate anteriorly, more sparsely toward base, the sinus rather broad, moderately deep, subangular, the lobes broadly rounded, not impressed, the anterior canthus broadly rounded, more prominent than the posterior; prothorax short, fully four-fifths wider than long, the apex moderately sinuate, barely three-fifths as wide as the base, the angles deflexed and slightly obtuse but only narrowly rounded; base transverse, feebly oblique at the sides; surface finely, rather closely and distinctly punctate, becoming somewhat coarsely so, though not much more closely, toward the sides, the bead rather fine; scutellum small; elytra one-half longer than wide, barely as wide as the prothorax, the sides gradually converging and broadly rounded behind from about basal third, the apex rather acutely ogival; surface rugose, especially behind, coarsely and closely punctate; prosternum strongly and closely punctured throughout, the process well developed, very feebly constricted, circularly rounded at tip, very strongly margined throughout; hind femora rather coarsely, moderately closely and conspicuously punctate, the abdomen strongly and unusually closely so. Length 11.0 mm.; width 5.45 mm. (♀). Probably near Puget's Sound...**breviuscula** n. sp.

Sides of the prothorax strongly, subevenly rounded throughout, strongly converging anteriorly, becoming parallel and less arcuate toward base. Form oblong-oval, much more longitudinally convex; head not very coarsely but strongly punctured, densely toward the suture, more sparsely elsewhere, the sinus broad and unusually shallow, circularly rounded, the lobes broadly rounded, impressed near the margin, the anterior canthus evenly and broadly rounded, more prominent than the posterior; prothorax more than three-fourths wider than long, the apex rather deeply sinuate, three-fifths as wide as the base, the angles moderately deflexed, slightly obtuse and well rounded; base broadly bisinuate, the angles rather

strongly produced; surface strongly convex, sparsely but unusually coarsely punctate, gradually closely though unequally and still more coarsely so laterally, the bead moderately thick; scutellum moderate; elytra scarcely one-half longer than wide, equal in width to the prothorax, the sides straight and parallel, rather rapidly converging and rounded in apical two-fifths, oblique and straighter toward the rather acute tip; surface very coarsely, deeply and rather closely punctate and very strongly rugose throughout; prosternum rather strongly, closely punctate, the process finely so, distinctly constricted, rather acutely rounded at apex and unmarginated; hind femora rather coarsely and conspicuously, though somewhat sparsely, punctured, the abdomen but little less coarsely and sparsely, strongly so. Length 9.4 mm.; width 5.0 mm. (♂). Washington State,—exact locality unrecorded.

sculptipennis n. sp.

- Sides of the prothorax converging from the base..3
 3 — Prosternal process margined throughout..4
 Prosternal process not margined, except feebly toward base.....5
 4 — Body very evenly subelliptic in form, convex, shining; head strongly, rather loosely punctate, the sinus moderate in width, unusually deep, angulate, the lobes broadly rounded, more or less strongly impressed within the margin, the anterior canthus obliquely and somewhat narrowly rounded, a little more prominent than the posterior; prothorax fully three-fourths wider than long, the sides almost evenly and broadly rounded from base to apex, the latter rather shallowly sinuate, with the bottom of the sinus transverse, barely three-fifths as wide as the base, the angles deflexed and somewhat obtuse but only very narrowly rounded; base broadly bisinuate, the angles somewhat produced and acute; surface rather finely and sparsely though very distinctly punctate, gradually coarsely and rather closely so laterally, the bead fine; scutellum rather small, not very transverse, sharply triangular; elytra as wide as the prothorax, fully one-half longer than wide, the sides parallel and just visibly arcuate, rounding and converging in apical two-fifths, the sides becoming nearly straight toward the rather acutely angular tip; surface rugose to nearly smooth, moderately coarsely, rather sparsely punctate; prosternum polished, strongly, rather closely punctate, the process distinctly constricted, the marginal bead strong throughout; hind femora with moderate and rather strong but sparse punctures, those of the abdomen similar though closer. Length 11.0–11.2 mm.; width 5.7 mm. Washington State (Leavenworth), — H. F. Wickham.

regularis n. sp.

Body less evenly elliptic, oblong-oval, sometimes feebly inflated posteriorly, shining; head rather coarsely and closely punctate, the sinus nearly as in *regularis*, the lobes more narrowly rounded, more broadly and less linearly impressed, the anterior canthus nearly similar but more rounded; prothorax barely three-fourths

wider than long, the sides feebly converging and nearly straight from the base to beyond the middle, there becoming rounded and more converging, the apex more evenly sinuate, two-thirds as wide as the base, the angles, base and basal angles nearly as in *regularis*; surface rather coarsely, not very sparsely punctate, becoming unusually coarsely and densely so laterally, the bead moderately coarse, arcuate about the basal angles; scutellum more transverse, with rather rounded sides and more obtuse apex; elytra fully one-half longer than wide, near the middle a little wider than the prothorax, the sides parallel and sensibly arcuate, rounding in posterior third, becoming straight to the acutely angulate apex; surface rugose, polished, very coarsely but rather sparsely punctured; prosternum moderately shining, strongly, rather closely punctate, the process a little wider, constricted, strongly rounded at tip, feebly margined and somewhat uncertainly so near the apex; abdomen polished though feebly rugulose, with fine and rather sparse but very strong punctures. Length 10.7 mm.; width 5.55 mm. Probably from the neighborhood of Puget's Sound..... **punctata** n. sp.

- 5 — Form oblong-oval, rather elongate, strongly convex, alutaceous anteriorly, the elytra polished; head rather finely but strongly, sparsely punctate, the sinus rather narrow, deep, angular, the lobes rounded, broadly impressed, the anterior canthus nearly as in *punctata*; prothorax similar but much less coarsely punctured and less closely so toward the sides, the bead finer and more feebly hooked at base, not entirely surrounding the basal angles; scutellum small, similar in form; elytra similar in form but not inflated and with the parallel sides nearly straight, the surface similarly rugose though with the rather sparse punctures not quite so coarse; prosternum subopaque, moderately punctured and with very short fulvescent setæ, the process well developed, very feebly constricted, angularly rounded at apex, somewhat feebly margined along the sides, the apex unmargined; hind femora and abdomen sparsely and finely but somewhat strongly punctured. Length 11.3 mm.; width 5.75 mm. Vancouver Island **parilis** n. sp.

Form much more abbreviated and more evenly elliptic, convex, strongly shining throughout; head with moderately small, perforate and somewhat close-set punctures, the sinus a little wider and less deep, angulate, the lobes rounded, strongly impressed, the anterior canthus still more broadly rounded, much more prominent than the posterior; prothorax much shorter, nearly four-fifths wider than long, the sides more strongly converging and nearly straight to before the middle, then rounding, strongly converging at apex, the latter barely three-fifths as wide as the base, more deeply and subevenly sinuate, the angles more deflexed and much more broadly rounded, the base and the produced angles similar; surface with larger, strong and rather sparse punctures and a broader impunctate line, the punctures relatively less enlarged, sparser,

equally coarse and still more unevenly distributed laterally, the bead moderately fine, almost straight, not curved at base; scutellum smaller than in any other species observed; elytra much less than one-half longer than wide, more oval, the sides rounding and converging behind the middle to the more obtusely angulate apex, the surface similarly rugose but still less coarsely, sparsely punctate; prosternum opaque, finely, not conspicuously punctate, the process abnormally short, broadly rounded, moderately constricted, very sparsely punctate, unmargined except very finely at the sides toward base; hind femora rather closely, somewhat strongly punctured, the abdomen unusually closely and strongly so. Length 9.8 mm; width 5.3 mm. Vancouver Island, —H. F. Wickham..... **vancouveri** n. sp.

- 6 — Prosternal process margined throughout7
 Prosternal process not margined at apex but with an unusually broad, though flat, margin at the sides.....13
 7 — Species of the Rocky mountain system.....8
 Species of the eastern foothills of the Sierras12
 8 — Anterior canthus about as prominent as the posterior.....9
 Anterior canthus much less prominent than the posterior.....11
 9 — Body oblong in form, convex, polished throughout, deep black; head rather finely, subevenly and loosely punctate, the sinus rather deeply parabolic, the lobes rounded, unimpressed, the anterior canthus strongly rounded, a little more prominent than the posterior; prothorax four-fifths wider than long, the sides broadly rounded and moderately converging anteriorly, becoming nearly parallel toward base, the apex evenly and moderately sinuate, two-thirds as wide as the base, the angles deflexed, right and but little rounded, the base broadly, feebly bisinuate, with the angles rather abruptly and moderately produced; surface very finely, sparsely punctate, becoming moderately coarsely, not very closely so laterally, except anteriorly where they are still rather fine and sparse, the bead fine; scutellum not very transverse, moderate, somewhat obtusely angulate; elytra one-half longer than wide, the sides parallel and nearly straight to apical two-fifths, then strongly rounded, becoming straight to the obtusely angulate and prominent tip; surface smooth, finely, densely rugose behind, the punctures moderately fine, rather sparse; prosternum densely punctate and rugulose, the process polished and sparsely punctulate, rounded at tip, strongly constricted; hind femora and abdomen strongly but not very coarsely punctate, the latter the more closely. Length 9.2 mm.; width 4.8 mm. Utah (Nephi), — H. F. Wickham..... **utana** n. sp.
 Body more evenly elliptic in outline10
 10 — Form rather narrowly elliptic, polished, only moderately convex, deep black; head very finely, sparsely punctate, the sinus only moderately deep, broadly parabolic, the lobes broadly rounded,

scarcely impressed, the anterior canthus broadly rounded, coprominent with the posterior; prothorax two-thirds wider than long, the sides strongly converging from base to apex, subequally and rather strongly arcuate, more so at apex, the latter evenly sinuate and but little more than half as wide as the base, the angles deflexed, right and rather distinctly rounded; base broadly bisinuate, the angles but little produced; surface minutely, sparsely punctulate, becoming strongly but not very coarsely and still sparsely punctate laterally, the bead fine, perfectly straight and unmodified at the basal angles; scutellum moderate, obtuse; elytra two-fifths longer than wide, the sides rounding and converging posteriorly to the regularly ogival tip, becoming parallel only toward base, the surface smooth, rather finely rugose posteriorly, strongly and sparsely but not very coarsely punctured, more coarsely and densely behind; prosternum nearly as in *uteana* but with the process narrower, less constricted and more acutely rounded at apex; hind femora with rather small but strong and remote punctures, the abdomen minutely, sparsely and inconspicuously punctulate. Length 9.0 mm.; width 4.5 mm. (♂). Colorado (Salida), — H. F. Wickham.....**inepta** n. sp.

Form more broadly elliptic and more convex, much larger, not quite so shining, black; head finely, sparsely punctate, the sinus rather deep, subangular, the lobes not very broadly rounded, unimpressed, the anterior canthus similar; prothorax three-fourths wider than long, the sides as in *inepta*, the apex also nearly similar but three-fifths as wide as the base; base rather strongly bisinuate, the angles moderately and gradually produced; surface minutely, sparsely punctulate, gradually more strongly but still rather finely and only moderately closely toward the sides, the bead rather fine; scutellum rather small; elytra formed nearly as in *inepta* but with the sides becoming parallel in about basal half; surface rugose throughout to nearly smooth, always more strongly and deeply rugose on the declivity, the punctures rather small but strong, sparse, larger and close posteriorly; prosternum as in *inepta*, somewhat shining, closely and somewhat asperately punctate, the process similarly rather narrow and elongate, smooth and moderately constricted but more broadly and evenly rounded at tip, the abdomen and hind femora finely, sparsely and rather inconspicuously punctate. Length 10.2–11.5 mm.; width 5.1–5.6 mm. Probably from northern Idaho..... **oblita** n. sp.

Form more elongate, convex, alutaceous, the elytra more shining, deep black; head finely, sparsely punctured, the sinus rather narrow, moderately deep, parabolic, the lobes broadly rounded, obsolete impressed, the anterior canthus strongly rounded, a little more prominent than the posterior; prothorax three-fifths wider than long, the sides sensibly converging and more or less nearly straight to beyond the middle, then more strongly rounded and converging to the apex, the latter moderately sinuate and fully two-thirds as wide as the base, the apical and basal angles nearly as in *uteana*, Proc. Wash. Acad. Sci., April, 1908.

the former only narrowly rounded; surface finely but distinctly, rather sparsely punctate, becoming more closely and strongly so toward the sides though still not coarsely so, the bead rather fine, straight to the base; elytra one-half longer than wide, with the sides nearly straight and parallel, rounding gradually behind to the acutely ogival and prominent tip; surface rather finely, sparsely punctured, nearly smooth, moderately rugose posteriorly; prosternum, legs and abdomen nearly as in *oblita*. Length 10.3 mm.; width 5.2 mm. (♀). Utah (southwestern),—C. J. Weidt.

arida n. sp.

Form stouter and differing greatly in being inflated posteriorly, black, alutaceous, the elytra rather shining; head somewhat coarsely, loosely punctate, the sinus broad, not very deep, parabolic, the lobes broadly rounded, unimpressed, the anterior canthus rounded, coprominent with the posterior; prothorax three-fourths wider than long, in outline as in the preceding but more strongly narrowed at apex, the latter rather more deeply sinuate and barely three-fifths as wide as the base, which is more strongly bisinuate than in *arida*, with the sides more gradually and feebly oblique; apical angles but slightly rounded; surface punctured nearly as in *arida* but more strongly and more coarsely and much more closely so toward the sides; scutellum much smaller; elytra barely a third longer than wide, behind the middle evidently wider than the prothorax, the sides broadly rounded, rapidly rounded to the very obtusely subangulate apex; surface nearly smooth, rather finely and closely punctate, densely rugose and more coarsely punctate on the declivity; prosternum differing greatly, being somewhat coarsely and very closely punctate even on the process, which is shorter and broader, rounded at tip and moderately constricted; abdomen and hind femora rather finely but strongly, sparsely punctate. Length 11.1 mm.; width 5.6 mm. (♀). Utah (southwestern),—C. J. Weidt *weidti* n. sp.

11 — Form oblong-oval, moderately convex, deep black, rather shining; head rather strongly, unevenly punctate, the sinus rather broad, not very deep, parabolic, the lobes unusually broadly rounded, unimpressed, the anterior canthus somewhat oblique and narrowly rounded; prothorax four-fifths wider than long to a little less, the sides converging from the base and feebly arcuate, becoming strongly rounded and converging anteriorly, the apex moderately sinuate, three-fifths as wide as the base, which is very feebly bisinuate, the angles but slightly produced, the anterior angles deflexed and moderately rounded; surface rather strongly and unusually closely punctate, becoming decidedly coarsely but not materially more closely so laterally, the bead moderate, straight at base; scutellum well developed; elytra evidently less than one-half longer than wide, as wide as the prothorax, the sides parallel and nearly straight, rather rapidly rounding in apical two-fifths to the moderately obtusely ogival tip; surface slightly uneven, strongly and somewhat sparsely punctate, rugose posteriorly; pro-

sternum shining medially, with strong and moderately separated punctures, the process only moderate in width, rounded at tip, moderately constricted; abdomen unusually strongly and closely punctate, the hind femora more sparsely. Length 10.2-11.0 mm.; width 5.2-5.6 mm. Montana (Bitter Root Mts.)...*acerba* n. sp.

Form more oval and convex, polished, deep black, the punctures posteriorly with very small silvery setæ; head rather finely but strongly, not very closely punctate, the sinus moderately narrow, deep and subangulate, the lobes much less broadly rounded, even, the anterior canthus broadly rounded; prothorax from less to more than four-fifths wider than long, in outline nearly as in *acerba* throughout, the base similar; surface finely though rather strongly, not very sparsely punctate, gradually coarsely and much more closely so laterally, the bead moderately fine, straight to the base; scutellum rather small, transversely and obtusely triangular; elytra nearly as in *acerba* but rather more gradually and acutely angulate at tip, the sides parallel and very feebly arcuate; surface slightly uneven, rugose behind, the punctures strong though not very coarse, closer and coarse posteriorly; prosternum shining though strongly and densely punctured, the process less closely so, moderately broad, rounded behind and distinctly constricted; hind femora and abdomen finely and strongly punctured, the latter more closely. Length 9.0-10.5 mm.; width 4.4-5.5 mm. Colorado (Boulder Co.), — Mrs. F. Y. Parker*anita* n. sp.

12 — Body stout, convex, oblong-oval, dull and alutaceous, deep black, the elytral punctures with minute silvery setæ; head finely but strongly, moderately closely punctate, the sinus moderately narrow, deep and bluntly angulate, the lobes rounded and feebly impressed, the anterior canthus narrowly rounded, much more prominent than the posterior; prothorax three-fourths wider than long, the sides rounded and converging anteriorly, less arcuate and more or less nearly parallel toward base, the apex deeply sinuate, two-thirds as wide as the base, the angles not much deflexed and well rounded; base broadly, feebly sinuate toward the sides; surface finely, rather sparsely punctate, with a more or less evident impunctate line, becoming strongly and closely but not very coarsely so laterally, the bead fine, straight to the base; scutellum small; elytra parallel, one-half longer than wide to a little less, angulate in apical two-fifths; surface nearly smooth, strongly but not very coarsely, rather closely punctate, strongly rugose and coarsely, closely punctured posteriorly; prosternum strongly, densely and submuricately punctate, the process nearly smooth and very sparsely, simply punctate, broadly rounded, strongly constricted; hind femora and abdomen strongly and moderately, equally sparsely punctate. Length 8.8-10.7 mm.; width 4.7-5.1 mm. Nevada (Reno). A moderate series taken by the writer along the Truckee River.....*alutacea* Csy.

13 — Body narrower, oblong-oval, convex, deep black and alutaceous,

the elytra shining, with very minute setæ within the punctures; head finely, deeply and closely punctate, the sinus moderately narrow, deep, angulate, the lobes not broadly rounded, unimpressed, the anterior canthus obliquely rounded, sensibly more prominent than the posterior; prothorax three-fourths wider than long, the sides strongly and almost evenly rounded, strongly converging apically, becoming parallel basally, the apex rather shallowly sinuate, fully three-fifths as wide as the base, the angles deflexed and obtuse but rather narrowly rounded, the base feebly sinuate laterally; surface somewhat finely and sparsely though very strongly punctate, becoming coarsely but loosely so laterally, the bead rather fine, slightly curving at base; scutellum small; elytra barely two-fifths longer than wide, toward base narrower than the prothorax, the sides parallel and rounded, becoming more converging but rounded posteriorly to the ogival apex; surface slightly uneven, rugose posteriorly, strongly, rather sparsely punctate; prosternum medially finely but strongly, not densely punctate, opaque anteriorly, the process rather narrow, moderately constricted, the broad flat lateral margin differing from anything else observed in the genus; hind femora and abdomen finely, sparsely punctate. Length 9.25 mm.; width 4.75 mm. Colorado (Boulder Co.)**corvina** n. sp.

Form oval, rather abbreviated, posteriorly subacute, black, shining; prothorax shorter than wide, less finely punctate than in *affinis*, the anterior angles strongly deflexed, the sides very finely margined, the posterior angles produced, acute; elytra densely, rugosely punctate. Length 10.25 mm.; width 5.5 mm. Oregon.
ovalis Lec.

The species described by LeConte under the name *ovalis*, was probably collected at some point in the Willamette Valley, and will prove to be different from any at present represented before me; the original description is given above.

Subgenus **Crypticomorpha** nov.

Form elongate-oval, rather depressed, piceous, the under surface, legs and antennæ more or less pale and rufescent; integuments rather shining, clothed thinly with fine decumbent pubescence; head moderate, rather finely, not densely punctate, the sinus moderate in width, broadly rounded, the lobes obtuse but not very broadly rounded, the oblique sides arcuate, less prominent than the unusually convex and subentire eyes; antennæ long, very slender; prothorax nearly three-fifths wider than long, somewhat wider behind the middle than at base, the sides subevenly and rather strongly arcuate, converging anteriorly, becoming parallel basally, the apex moderately and evenly sinuate, three-fifths as wide as the base,

the angles right and narrowly rounded, the base broadly bisinuate, with the angles but slightly produced; surface minutely, sparsely punctate, becoming but slightly more strongly or less sparsely so laterally, the bead extremely fine; scutellum rather small, but slightly transverse, sharply triangular; elytra equal in width to the prothorax, rather more than one-half longer than wide, the sides parallel and straight, gradually strongly rounded in about apical two-fifths to the somewhat sharply ogival tip; surface smooth throughout, alutaceous posteriorly, very finely, evenly and not densely punctate; prosternum extremely minutely punctulate, the process unmarginated, moderately constricted, long, rounded at tip; femora and abdomen minutely, sparsely, inconspicuously punctate; tarsi long and very slender. Length 6.7 mm.; width 2.9 mm. (♂). California,—the exact locality unrecorded, — J. J. Rivers..... *tenuis* n. sp.

Subgenus **Brachyontis** nov.

Form extremely short and stout, very convex, feebly shining, black, the legs rufous, the antennæ piceous; upper surface clothed rather thinly with coarse decumbent fulvous hairs; head moderate, rufescent anteriorly, rather finely, loosely punctate, the sinus moderate, broadly rounded, the lobes obtuse, not very broadly rounded, the anterior canthus rounded, less prominent than the posterior; antennæ rather short, thick; prothorax fully four-fifths wider than long, the sides almost evenly rounded, more converging anteriorly, becoming parallel near the base, the apex strongly sinuate, two-thirds as wide as the base, the angles much deflexed, obtuse but not broadly rounded, the base transverse, straight, feebly curved posteriorly toward the sides, the hind angles rounded; surface finely, closely punctate, more strongly and still more closely so toward the sides, the bead fine, curving inwardly at base; scutellum moderate, polished, obtuse; elytra not longer than wide, very strongly declivous behind, at the middle a little wider than the prothorax, the sides parallel and broadly arcuate, the apex very broadly obtuse; surface smooth even posteriorly, minutely, rather sparsely punctate; prosternum finely, closely punctate, the process short, moderately constricted, rounded and convex apically, not margined except feebly at the sides basally; abdomen almost impunctate. Length 6.4-6.5 mm.; width 3.7-4.22 mm. California (Tahichipi Pass)..... *globulina* Csy

It should be borne in mind that the groups into which the genus *Coniontis* is divided above, are, in considerable measure, arbitrary and intended more to facilitate identification than anything else; the *abdominalis*, *opaca* and *subpubescens* groups are perhaps the least natural aggregates, while the *viatica*, *setosa*, *cschscholtzi* and *ovalis* groups are more in the nature of quasi-subgeneric geographic sections of the genus, more sharply circumscribed in general habitus and are more homogeneous.

Coniontellus Csy.

The small convex species constituting this genus have a facies very similar to that of *Coniontis*, but, besides the completely divided eyes, they differ in their shorter legs and smaller antennæ. They are divisible into two clearly separated groups, the first, having stiff hispid vestiture, being confined as far as known to the eastern slopes of the central Sierras, all that I have seen having been taken in the valley of the Truckee River; the other group, smaller and glabrous or virtually so, are very widely distributed, but, unlike *Coniontis*, are entire strangers to the fauna of the coast regions. The eight species in my collection may be described as follows:—

Elytra bristling, more especially toward the sides and tip, with stiff erect fulvous setæ.....2

Elytra glabrous, or at most with very minute, decumbent and inconspicuous hairs.....5

2 — Integuments castaneous in color.....3

Integuments black4

3 — Body oblong, convex, rather shining, coarsely sculptured; head strongly but not coarsely, loosely punctate, more finely and densely so before the suture, the sinus deep, angulate, the lobes broadly rounded; prothorax more than four-fifths wider than long, the sides broadly rounded and converging before the middle, becoming parallel or nearly so and straighter thence to the base, the apex strongly sinuate, fully two-thirds as wide as the base, the latter transversely truncate, gradually curved posteriorly at the sides, the apical angles deflexed, right and narrowly rounded, the basal but slightly produced and blunt; surface finely, sparsely punctured, becoming coarsely, closely so and with the punctures elongate laterally, the head fine; scutellum moderate, not much wider than long, triangular; elytra less than one-half longer than wide, not inflated apparently in either sex, the sides parallel and straight, abruptly rounding in apical third to the obtuse tip; surface almost vertically declivous behind, slightly uneven, coarsely, very deeply, evenly and closely punctate throughout; prosternum and process strongly and closely punctate, the latter margined at the sides but not at the rounded apex; abdomen rather finely, strongly, somewhat sparsely punctate. Length 7.2–7.7 mm.; width 3.6–3.9 mm. Nevada (near Reno),—H. F. Wickham**hystrix** n. sp.

Body oblong, more elongate, larger in size, shining, less strongly sculptured; head rather finely and closely, strongly and subevenly punctured throughout, the sinus nearly similar, the lobes still more broadly rounded, the sides more broadly rounded before the eyes; prothorax twice as wide as the median length or nearly so, formed

otherwise nearly as in *hystrix*, but with the coarse punctures near the sides not elongate and with the narrow interspaces less smooth, and also differing in having the sloping flanks somewhat subexplanate basally and the marginal bead coarser; scutellum similar though a little larger; elytra much more elongate, fully one-half longer than wide, nearly three times as long as the median line of the prothorax, less declivous posteriorly, rounded in apical third, the apex feebly produced, the sides parallel and straight (♂) or feebly arcuate and somewhat inflated posteriorly (♀); surface very smooth, the punctures smaller, only moderately coarse but perforate and much more widely separated; prosternum similarly strongly, closely punctate, the process larger, more constricted, the lateral beading much finer; abdomen with rather small but strong, moderately sparse punctures. Length 7.8–8.2 mm.; width 3.8–4.6 mm. Nevada (near Reno), — H. F. Wickham.

longipennis n. sp.

- 4 — Form stout, convex, deep black, somewhat alutaceous in lustre; head punctured nearly as in *hystrix*, the sinus rather small, moderately deep, broadly angular, the lobes broadly rounded; sides obtusely prominent before the eyes; prothorax four-fifths wider than long, the sides very moderately rounded and not very strongly converging anteriorly, becoming parallel and straighter posteriorly, the strongly sinuate apex three-fourths as wide as the base, the angles and base as in the preceding species; surface not coarsely but strongly, sparsely punctured, the punctures becoming coarse, dense and slightly elongated laterally, the bead fine, the hind angles more narrowly produced and more acute than in the preceding; scutellum very small; elytra feebly inflated posteriorly (♂) or strongly so (♀), the sides broadly arcuate at or behind the middle, distinctly wider than the prothorax, the apex obtusely ogival and somewhat prolonged; surface coarsely and deeply but rather sparsely punctate, much more finely so on the opaque posterior declivity; prosternum coarsely, rather closely punctate, the process longitudinally and strongly convex; abdomen sparsely but strongly punctate, polished. Length 6.6–7.0 mm.; width 3.25–3.75 mm. Nevada (Reno). A small series taken by the writer on the banks of the Truckee, in the suburbs of the town.

inflatus Csy.

- Form still stouter, less convex, oblong, black, moderately shining, larger in size; head finely but strongly, subevenly and closely punctate, the sinus moderate, deep, subangular, the lobes broadly rounded; prothorax twice as wide as its median length, inflated, much wider just behind the middle than at base, the sides strongly, subevenly rounded, more converging anteriorly, the apex strongly sinuate, fully two-thirds as wide as the base, the angles right, rather narrowly rounded, the basal rather narrowly but abruptly and moderately produced and acute; surface finely and sparsely punctate, becoming coarsely and densely so, with the punctures just visibly elongate, laterally, the bead rather fine; scutellum very small, as

in *inflatus*, almost equilatero-triangular; elytra evidently less than one-half longer than wide, not at all wider than the prothorax, the sides parallel and but very feebly arcuate, the apex very obtusely rounded, the tip angular; surface with moderate, deep and perforate, rather sparse punctures, which are not notably smaller on the posterior declivity, the latter not differing in lustre, shining; prosternum deep black, strongly punctured, the process rather short and somewhat strongly constricted, rounded, not margined even at the sides; abdomen rather finely and sparsely though strongly punctate. Length 8.0 mm.; width 4.2 mm. Nevada (near Reno), — H. F. Wickham..... **ampliatus** n. sp.

- 5 — Elytra with very small hairs observable posteriorly. Body oblong, stout, convex, deep black, the legs and antennæ dark rufous, the surface only feebly shining; head finely, closely punctate, especially anteriorly, the sinus moderately deep, broadly angular, the lobes broadly rounded; prothorax twice as wide as its median length, the sides evenly rounded and converging anteriorly, becoming parallel in about basal half, the apex deeply and evenly sinuate, three-fourths as wide as the base, the angles deflexed, right and not rounded; base transversely rectilinear, curving rather abruptly to the rear near the sides, the angles rather prominent posteriorly and not blunt; surface strongly and closely punctate, becoming more coarsely and still more closely so laterally, the bead very fine; scutellum moderate, sharply equilatero-triangular; elytra less than a third longer than wide, equal in width to the prothorax, the sides parallel and straight, rounding to the very acutely ogival tip in apical two-fifths; surface but slightly uneven, rather coarsely, deeply, moderately closely and conspicuously punctate, the punctures very close laterally, becoming smaller only very near the acute tip; prosternum strongly but not densely punctate, the process unmarginated; abdomen not coarsely but strongly, somewhat closely punctured. Length 6.6 mm.; width 3.1 mm. Colorado (central). [= *Coniontis obesa* Lec.]..... **obesus** Lec.

Elytra completely glabrous, the setæ so minute as to be invisible under moderate power.....6

- 6 — Form oblong, rather more elongate than in *obesus*, similar in coloration and slightly more shining; head similarly punctured and almost equally short and transverse, the sinus smaller and still feebler, the lobes very broadly rounding and scarcely differentiated from the rounded sides, similarly with a very faint emargination at the ends of the oblique sutures; prothorax similar but less transverse, not more than four-fifths wider than long, similarly punctured and even more closely toward the sides; scutellum similar though notably smaller; elytra similar though a little more elongate, the punctures sensibly less close-set and decidedly less coarse; under surface nearly similar throughout. Length 5.8–6.75 mm.; width 2.8–3.2 mm. Montana (Helena)..... **subglaber** Csy.

Form similar to that of *subglaber*, deep black, more or less alutaceous,

the legs and antennæ piceo-rufous; head nearly similar, the sinus broader, moderately deep, angular, the lobes broadly rounded; prothorax almost exactly as in *subglaber*, the deflexed anterior angles blunt and by no means so sharply defined as in *obesus*, the punctures very fine and rather sparse but almost similarly strong and close-set laterally, the hind angles a little less prolonged and blunter; scutellum similar, the elytra still more elongate, parallel in both sexes, nearly one-half longer than wide, shorter in the male, the punctures fine and sparse though distinct throughout; prosternum strongly, rather closely punctate, the process sometimes feebly margined at the sides but never at tip; abdomen finely, sparsely punctate, a little more coarsely but still sparsely so toward the sides (♀) or closely and more coarsely so (♂). Length 6.2–7.0 mm.; width 3.15–3.35 mm. California (Bodie, — elevation 8475 feet).....**argutus** n. sp.

Form nearly similar but more convex and with the elytra inflated, probably more or less in both sexes, polished, deep black, the legs and antennæ rufo-piceous; head nearly as in the preceding species, strongly and closely punctured; prothorax as in *argutus*, the deflexed anterior angles right and blunt; surface rather finely but strongly, not very closely punctate, strongly and closely so laterally; scutellum a little larger, similarly equilatero-triangular; elytra at the middle much wider than the prothorax, not a third longer than wide, the sides parallel, evenly and rather strongly arcuate, very rapidly rounding behind to the ogival but less prominent tip; surface smooth, very finely, sparsely punctured; under surface nearly as in the preceding species, the abdomen strongly, moderately sparsely punctured, more coarsely so laterally. Length 6.5 mm.; width 3.45 mm. Colorado (Buena Vista, — elevation about 8000 feet), — H. F. Wickham.....**micans** n. sp.

Some time ago I suppressed *subglaber*, as a synonym of *obesus*, but more careful study shows that this course was premature; they are not by any means the same species. Mr. Warren Knaus kindly sent me a specimen of the species named *argutus* above, and I had also previously secured a series of four specimens from Mr. Wickham, giving a sufficiently complete succession of individuals for study; there is very little variation, but the male is notably less elongate than the female, sometimes having a more shining surface and stronger abdominal punctures. It is interesting to note that the inflation of the elytra is not necessarily a sexual character, though, when it occurs in both sexes, it is more pronounced in the female, and also to observe that some species in both groups of the genus, otherwise closely allied, may have the elytra inflated or without trace of inflation even in the female.

Conisattus Csy.

While the general organization of this genus is essentially similar to that of *Coniontis*, there are some characters that recall the Eusatti, such as the reflexed margin of the head, narrowly explanate sides of the pronotum and feebly prominent, though obtuse, external apical angle of the anterior tibiæ. It differs from the Eusatti, and is more closely affiliated with *Coniontis*, in the unproduced basal angles of the prothorax and well developed, sharply triangular scutellum. In the simple and filiform anterior tarsi, with the first four joints subequal and but slightly longer than wide, shorter basal joint of the posterior tarsi and almost wholly unimpressed mesosternum, it is however peculiar, proving it to be an isolated type of the subfamily; there is but a single species as follows:—

Form oblong, convex, subalutaceous, rufo-piceous, the legs dark rufous and the antennæ pale ferruginous, glabrous, with a few short hairs on the hypomera and some longer bristling setæ at the sides of the epipleuræ toward base; head finely punctured, sparsely behind, more closely before, the suture, the sinus moderately wide, rather shallow and parabolic, the margin of the oblique, rounded and medially emarginate sides moderately reflexed; antennæ long and very slender; prothorax fully twice as wide as long, widest behind the middle, subparallel, the sides subevenly arcuate, somewhat more converging anteriorly, the apex broadly and strongly sinuate, nearly three-fourths as wide as the base, the angles not deflexed and evidently rounded; base transverse; surface rather finely and sparsely but strongly punctate, becoming strongly and more coarsely but not densely so laterally, the margins narrowly and equally explanate throughout the length, the bead very fine, the basal angles very feebly produced, right and not rounded; scutellum but slightly wider than long; elytra scarcely as wide as the prothorax, parallel and very feebly arcuate at the sides, arcuately and gradually narrowed in apical two-fifths, the tip narrowly and slightly prolonged and rather acute; surface nearly smooth, finely, feebly, submuricately and sparsely punctured, more closely but not at all more coarsely toward the sides; prosternum moderately finely, submuricately punctate, the process not margined; abdomen rather gradually acute posteriorly, shining, finely and sparsely punctate and sparsely puberulent; tarsi long and very slender. Length 6.5 mm.; width 3.25 mm. Oregon (northwestern).

rectus Csy.

A few examples were taken by Mr. Schwarz at Squally Hill, which seems to be in the neighborhood of Astoria. The epi-

pleuræ are more narrowed toward apex than in *Coniontis* and are concave toward base; they are very finely, feebly and sparsely punctate.

Cœlotaxis Horn.

This genus is a development from the archetypes of *Coniontis*, by reason of isolation on the solitary Island of Guadalupe, probably during the time elapsing between some epoch in the late Tertiary and the present time; it is in fact simply *Coniontis* with feebly ciliate sides of the body, shallow and submuricate punctuation, subexplanate sides of the pronotum, rather more developed and more obliquely truncate basal joint of the anterior tarsi, somewhat less elongate basal joint of the hind tarsi, less impressed mesosternum and extremely minute scutellum, the last being the most important and striking differential feature. It is scarcely more closely allied to *Calus* than is *Coniontis* itself, any apparent resemblances, such as the ciliate sides of the body, being merely superficial or directly due to some similarity in habits. It is rather remarkable, when we consider the very circumscribed habitat of the genus, that several species, more or less closely allied it is true, should have been gradually evolved; these as represented in my cabinet by large series, in all except two of the species, may be defined as follows:—

- Epistomal sinus larger, in the neighborhood of a third as wide as the maximum width of the head; anterior angles of the prothorax somewhat deflexed, the lateral bead more or less fine.....2
- Epistomal sinus very small, barely a fifth as wide as the head and very shallow, the lobes broadly rounded; anterior thoracic angles not deflexed, the lateral bead unusually thick.....6
- 2—Elytra shining, rather sparsely and much less conspicuously punctured, the pubescence shorter and barely visible. Form broadly oblong-oval, strongly convex, dark blackish-brown, the under surface, legs and antennæ paler; head coarsely, densely punctate, broadly rounded, the sinus moderately shallow, subangular, the sides broadly rounded, very much more prominent than the eyes or the posterior canthus; antennæ long and very slender, the third joint much longer than the fourth; prothorax slightly more than twice as wide as its median length, the sides broadly, subevenly rounded and converging from base to apex, a little more strongly so toward the apex, which is three-fifths as wide as the base, deeply and evenly sinuate, the angles but little deflexed and merely somewhat

blunt; base transversely truncate, the angles very feebly prolonged backward and blunt; surface coarsely, deeply and closely punctate, more densely so sublaterally and again more finely and sparsely near the sides, where it becomes rather broadly subexplanate posteriorly, though narrowly so anteriorly, the bead not very thick, strongly elevated; elytra about a fourth longer than wide, the sides subparallel and very feebly arcuate, rounding a little at base, strongly rounding posteriorly to the broadly ogival tip, the surface nearly smooth, the punctures rather small and feeble, varying but little in size, becoming faintly muricate laterally and smaller apically, much smaller and less deep than those of the pronotum; prosternum strongly, rather closely punctate, the process well developed, not margined at apex; hind femora coarsely and conspicuously, though very remotely, punctate, the abdomen finely, sparsely so medially, more coarsely and closely, muricately so laterally. Length 8.8–11.2 mm.; width 4.6–5.9 mm.

punctulata Horn

Elytra densely dull, unevenly and closely punctured, the pubescence coarser and more conspicuous, though almost equally thinly distributed, the moderately long erect fulvous setæ along the sides of the body more developed.....3

3 — Body broadly oblong-oval.....4

Body narrowly oblong, with the sides more parallel.....5

4 — Form very broad, moderately convex, dark castaneous, the under surface, legs and antennæ paler, dark rufo-ferruginous; head less coarsely, very deeply and unequally punctate, very densely so centrally, much less densely before the suture, nearly as in *punctulata* in outline but less broadly rounded and less prominent at the sides before the eyes; antennæ similar; prothorax similar throughout, except that it is a little shorter and much more than twice as wide as long, with the apical sinus rather less deep, the almost equally coarse and perforate punctures still denser; elytra similar but with the parallel sides very slightly more arcuate, the punctures about as large as those of the pronotum but not so deep and intermixed with smaller punctures, very close-set and muricate throughout; under surface nearly similar, except that the coarse and very conspicuous punctures of the hind femora are generally less sparse, the basal joint of the anterior tarsi very slightly less stout and somewhat less obliquely sinuato-truncate at tip. Length 8.2–10.7 mm.; width 4.4–5.7 mm.

muricata Horn

Form rather less broad and more evenly elliptic, more convex, blackish-brown in color, the legs piccons-black, the abdomen still blacker, the sterna and antennæ paler, rufo-ferruginous; head as in *muricata* and similarly punctate but more broadly and less obliquely rounded at the sides, the antennæ similar; prothorax less transverse, barely twice as wide as its median length, the sides much less converging from the base and more narrowly and more feebly

subexplanate, the bead finer, otherwise similar in outline and in its very dense and perforate punctuation; elytra more elongate, more gradually and acutely ogival at tip, fully a third longer than wide, the punctures similarly muricate and uneven in size but not quite so dense; prosternum less coarsely and more sparsely punctate, the process narrower, the abdomen similar, the coarse punctures of the hind femora remote, the basal joint of the anterior tarsi stout and nearly as in *punctulata*. Length 11.0 mm.; width 5.65 mm.....**densa** n. sp.

5 — Body narrow and parallel, strongly convex, blackish-brown or paler, the under surface, legs and antennæ rufous; head strongly and densely, moderately coarsely punctured, nearly as in *muricata* but with the sinus broader and deeper, parabolic, the sides before the eyes only moderately prominent, obliquely rounded, the antennæ nearly similar; prothorax twice as wide as long to very slightly more, formed as in *densa* and likewise very narrowly subexplanate at the sides, coarsely, very deeply and densely punctate, the punctures at the sides sparse and mingled with smaller punctures; elytra nearly a third longer than wide, the sides parallel and very feebly arcuate, not rounding at base, gradually and arcuately narrowed posteriorly to the obtusely ogival tip, the surface smooth, with the close-set, muricate and unequal punctures of the preceding species; prosternum strongly, closely punctured, the hind femora coarsely and sparsely, the abdomen finely but strongly, sparsely so and with the punctures scarcely larger or denser toward the sides. Length 7.6-9.7 mm.; width 3.75-5.0 mm.....**angustula** Csy.

6 — Form narrower, more elongate and more convex than in *punctulata* or *muricata*, rather less narrow and more elliptic than in *angustula*, brownish-black, the legs and antennæ more or less rufo-picescent, dull in lustre above; head broadly rounded at apex, coarsely, densely punctate, especially toward the subobsolete transverse impression, the sides more broadly rounded than in any other species except *densa*, much more prominent than the eyes; prothorax scarcely more than twice as wide as its median length, the sides subevenly and distinctly converging and broadly arcuate from base to apex, the apical angles prominent, very narrowly blunt, the surface more coarsely and densely punctate than in any other species, with a partial elevated impunctate line along the middle, the sides narrowly concavo-explanate and obsoletely so at base as usual; elytra fully a fourth longer than wide, the sides rounding and converging to the rather obtusely ogival tip behind the middle, rather rough, with feeble traces of a ridge near and oblique to the suture, not extending to base or apex, the surface more coarsely muricate than in *densa* or *muricata* and equally closely, with numerous small, suberoded and more opaque areas; under surface punctured as usual but more strongly; pubescence and lateral fimbriæ as in *muricata*, sparser and less fulvous than in *angustula*. Length 11.0 mm.; width 5.4 mm.

frontalis n. sp.

The series of *punctulata* and *muricata* before me are composed of twelve and nineteen specimens respectively, that of *angustula* consisting of seven specimens, rendering the differences alluded to above patent at a glance; the types of *densa* and *frontalis* are still unique. In his original description of *Cælotaxis* (Trans. Am. Ent. Soc., V, 1876, p. 200), Dr. Horn makes no mention of its most conspicuous distinguishing character, which is the minute and subobsolete scutellum, and, in the accompanying table, interposes *Cælus* between *Cælotaxis* and *Eusattus*. It is true that the very great obliquity of truncature of the basal anterior tarsal joint, which varies but little throughout the genus, gives rise to the appearance of a short spur-like process homologous with the long process of *Cælus*, but this is simply a variation of the structure of this joint characterizing *Coniontis*, due to the more developed burrowing habits of *Cælotaxis*, as shown by the fimbriate margins of the body in the latter genus. At the same time, the long spur of *Cælus* is merely a still further development of this character, surviving in more or less developed form from the common archetypes of the subfamily Coniontinæ, wholly lost in *Eusattus* and allies and most developed in the burrowing types, such as *Cælus*. It simply proves that *Cælus* and *Coniontis* are descended from the same ancestors, the remoteness of which can only be conceived on considering the very radical antennal differences, which must have taken untold ages to develop, and of which no trace of any surviving intermediate form has yet come to light.

Tribe CÆLINI.

In proposing a separate tribe based upon virtually a single structural character, such as obtains in the case of *Cælus* with one or two allied genera, much should depend upon the nature of this differential feature, its degree of development and its constancy or consistency. The antennæ throughout the series of genera discussed hitherto in this paper, constituting the Coniontini, are greatly developed, long and generally slender, while in *Cælus* and allies these organs assume a totally different form, being very small, thicker and more compact. If there were any intermediate living forms, and I cannot regard the

case of certain far-distant exotics of the Praocini mentioned by Lacordaire as being a case in point, there might be ground for believing that these two groups of genera should not be tribally separated, but there is no evidence whatever of such intermediates and the proper course would therefore appear to be the tribal separation here suggested. It is of course possible to surmise that this very great reduction of the antennæ in *Cælus*, and especially *Cælomorpha*, may be due simply to their burrowing habits, but that this is not wholly true is proved by the fact that in *Cælotaxis*, which, as shown by the lateral fimbriæ and by the more extended inner angles of the basal anterior tarsal joint, has at least some burrowing propensity, there is no tendency whatever to a shortening of the antennæ, they being even longer and more slender than in the prevailing type of *Coniontis*. At the same time, there is undoubtedly an unusually strong bond of affinity between the Coniontini and Cœlini in the modification of the basal anterior tarsal joint, proving beyond question a common origin, but the elimination of all intermediates in antennal structure decisively isolates the Cœlini at the present epoch of their history, and this is the only point to consider in delimiting genera, tribes and other higher groups. There are two genera of Cœlini as follows: —

Body briefly oblong-oval, very convex, ciliate at the sides, the basal angles of the prothorax obtuse but not much rounded; antennæ 11-jointed, the basal joint very long, arcuate, two-thirds as long as the remainder; submentum well developed; eyes transversely reniform, emarginate anteriorly; process of the basal anterior tarsal joint very long and stout. [Type *C. ciliatus* Esch.].

Cælus

Body nearly similar in form but much smaller, similarly ciliate at the sides, the basal angles of the prothorax well rounded; antennæ 10-jointed, the basal joint much smaller, barely a third as long as the remainder; submentum not distinct; eyes less transverse, not emarginate anteriorly; process of the anterior tarsus much smaller. [Type *Cælomorpha maritima* Csy.].....**Cælomorpha**

The members of these genera are very abundant individually, and are only found on or near the ocean beaches burrowing into loose sand.

Cœlus Esch.

In this genus the body is oval to oblong-oval and always strongly convex in form, with a dense fringe of erect fulvous setæ along the sides and with bristling hairs of the same nature on the legs, along the anterior margin of the pronotum and on the head behind the suture, but otherwise subglabrous. The head is sinuate anteriorly, with a deep transverse suture delimiting the epistoma, and the sides project laterally far beyond the eyes, which are basal and more or less concealed by the prothorax, the latter transverse, narrowed at the apex, which is deeply sinuate, the base truncate and having a fine coriaceous margin and the hind angles not at all produced posteriorly. The scutellum is minute and triangular, being occasionally obsolete and the elytra are rounded, feebly embracing the sides of the body beneath, with the epipleuræ narrow, gradually wider and more or less concave basally. The legs are short and stout, all the tibiæ subequally dilated externally at tip, the terminal spurs long and hollowed or flattened on their under surface, the tarsi very slender, moderately long, with the joints swollen distally and bearing each a terminal corona of stiff fulvous setæ, the hind coxæ narrowly separated as in *Coniontis*. The species are rather numerous, and, so far as known, may be defined as follows: —

- Elytral punctures strongly muricate; species inhabiting the mainland of central and southern California exclusively. [**Cœlus** in sp.]...2
- Elytral punctures simple, not muricate, the lateral fimbriæ less developed; species confined to the islands off the coast of southern California. [**Pseudocœlus** n. subgen.]..12
- 2 — Epistoma very deeply sinuate3
- Epistoma more broadly and less deeply, though conspicuously, sinuate, the sinus trapezoidal in form, the bottom narrowly transverse; species more northern in habitat.....5
- Epistoma broadly and very feebly sinuate, the sinus generally subevenly rounded7
- 3 — Pronotum subevenly punctured throughout. Body broadly oblong-oval, black to piceous in color, polished, moderately small in size; head strongly and densely punctate, with a median impunctate area at base as usual; antennæ rufous, having a compact fusiform club of about three joints; prothorax two and three-fourths times as wide as its median length, the sides rather strongly converging from base to apex and broadly rounded, more strongly so basally,

the apical sinus very deep, the angles not deflexed, rounded; surface coarsely, deeply and closely punctured throughout, not differing much near the sides, which are explanate, the bead fine and feeble; elytra but just visibly longer than wide, rounded at the sides and obtuse behind, the immediate apex sharply ogival, the sides becoming parallel toward base; surface vertically declivous and then slightly inflexed behind in profile, the punctures strong, moderately separated, muricate, becoming granular posteriorly; prosternum densely punctato-rugose, the process moderately constricted between the coxæ; abdomen finely but strongly, more or less closely punctate. Length 5.8-7.8 mm.; width 3.7-4.9 mm. San Diego.....**globosus** Lec.

Pronotum very unevenly punctate, with large patches devoid of punctures.4

4 — Body large in size, oblong-ovoidal, blackish-castaneous to rufopiceous in color, shining; head rather coarsely, deeply and densely punctate, with the usual basal impunctate area; antennal club fusoid, of about four joints; prothorax scarcely two and one-half times as wide as the median length, the sides much more parallel, broadly rounded, more converging anteriorly, the apical sinus very deep as usual, the angles more broadly rounded than in *globosus*; surface sparsely and rather finely but very deeply punctate, the punctures becoming close and mingled with larger punctures on the explanate lateral part, the bead rather coarse though only feebly elevated and distantly punctured; elytra but little longer than wide, at the middle evidently wider than the prothorax, the sides parallel and broadly arcuate, rapidly converging and rounded behind, the surface nearly as in *globosus* but more rugose, the punctures strongly muricate, rather sparse, less sparse and granulo-se posteriorly as usual; pubescence long, subdecumbent and conspicuous toward the sides posteriorly and much more conspicuously so than in *globosus*; prosternal process only moderately constricted between the coxæ; abdomen rather sparsely but distinctly punctate. Length 11.0-12.0 mm.; width 6.4-7.0 mm. Probably San Pedro, — G. W. Dunn.....**grossus** Csy.

Body similar to the preceding in general characters but uniformly smaller and relatively narrower, polished, castaneous in color; head notably smaller in size but otherwise similar; prothorax a little shorter and more narrowed at apex but otherwise similar; elytra as in *grossus*, except that they are less inflated and never more than just visibly wider than the prothorax, the sculpture somewhat less coarse and notably less close; under surface nearly similar, except that the prosternal process is less abbreviated and with the punctuation less coarse, the metasternum, especially, more sparsely and much less conspicuously so. Length 9.4-10.7 mm.; width 5.5-6.0 mm. Sta. Barbara, — G. W. Dunn.....**solidus** n. sp.

Body shorter, broader and more evenly oblong-oval in form than in *grossus* and smaller in size, though unusually large for the genus, Proc. Wash. Acad. Sci., April, 1908.

deep black throughout, the antennæ piceous with a testaceous fusoid club of about three joints; head densely but less coarsely punctate; prothorax nearly two and three-fourths times as wide as long, the sides rounded and converging anteriorly, becoming parallel, though rounded, toward base and converging toward the very obtuse basal angles as usual, the apical angles less broadly rounded than in *grossus*; surface more coarsely and much more closely punctured, scarcely differing on the explanate lateral part, the bead fine but well defined, not punctate; elytra about as wide as long, not wider than the prothorax, formed nearly as in *globosus* and similarly sculptured, sparsely pubescent toward the sides posteriorly; prosternal process strongly constricted, its neck generally but little more than half as wide as the dilated posterior portion; abdomen polished as usual, not coarsely but strongly, rather sparsely punctate. Length 7.6–9.6 mm.; width 5.0–6.0 mm. Redondo Beach.....**saginitus** n. sp.

- 5 — Head well developed, very nearly half as wide as the prothorax. Body oblong-oval, more elongate than usual, strongly convex, polished, black, with the under surface piceous to piceous-brown throughout; head coarsely punctured behind, more finely and sparsely before, the transverse groove, which is coarser and deeper than in the preceding species, the epistoma more swollen transversely toward the middle and more impressed or flattened at the lobes; antennal club fusiform as usual, of about four joints; prothorax rather less than two and one-half times as wide as long, the sides moderately and subevenly converging from base to apex and subevenly, moderately arcuate, the angles not more than blunt, very much less rounded than in the four preceding; surface rather finely, very sparsely punctate, the punctures unequally distributed, having occasional vacant areas, rapidly declivous laterally and only narrowly explanate at the sides, where there are some scattered coarser punctures in addition, the bead fine and feeble; elytra but very slightly longer than wide, rounded at the sides, becoming parallel only basally, only just visibly wider than the prothorax, obtuse and vertically declivous posteriorly, coarsely, sparsely punctate-muricate, more closely and finely granulate posteriorly, the fulvous pubescence conspicuous near the apex; prosternal process strongly constricted; abdomen very finely and remotely punctate, the last segment more coarsely and closely so as usual. Length 5.5–7.5 mm.; width 3.2–4.4 mm. San Francisco,—found only on the sea-beaches.....**ciliatus** Esch.

- A — Similar in general to *ciliatus* but with the body materially larger and notably more elongate, the elytra much longer than wide; prosternal process even somewhat more strongly constricted, the hind femora more coarsely and conspicuously punctured. Length 8.0 mm.; width 4.7 mm. San Francisco.
longulus n. subsp.

Head much smaller, very evidently less than half as wide as the prothorax.....6

6 — Form nearly as in *ciliatus* but much smaller in size, blackish-castaneous to much paler piceo-testaceous, polished; head similar though less coarsely, densely punctured behind the suture and more finely, rather more closely before the latter; prothorax similar in form and sculpture but somewhat more finely and densely punctate toward the sides; elytra similar in general form but rather less coarsely and more closely punctato-muricate and still more finely and closely granose posteriorly; under surface nearly similar, the prosternal process equally strongly constricted. Length 4.8–5.8 mm.; width 2.8–3.4 mm. San Francisco,— found burrowing in loose sand on Blue Mt., near the ocean beach.

debilis n. sp.

Form very much more dilated than in either of the preceding, oblong-oval, polished, black, the under surface and legs piceo-rufous, the antennæ yellow-brown; head small, rough and punctate behind, and at the sides before, the suture, subimpunctate medially before the suture, the epistoma much less tumid medially than in *ciliatus*; prothorax shorter and more transverse, the sides more strongly converging and more strongly arcuate from base to apex, the anterior angles rather more deflexed and more rounded; surface similar and almost similarly finely and remotely, though less unequally, punctured; elytra not longer than wide, not at all wider than the prothorax, the sides feebly converging and feebly arcuate from the base, rapidly and obtusely rounded at apex, sculptured as in *ciliatus*; under surface nearly similar, except that the prosternal process is less strongly constricted. Length 5.25 mm.; width 3.35 mm. Near San Francisco.....*curtulus* Csy.

7 — Punctures of the pronotum unequally distributed, leaving large areas devoid of punctuation.....8

Punctures of the pronotum almost evenly distributed9

8 — Body rather broadly oblong-oval, polished, blackish, the elytra dark red-brown, the under surface and legs rufo-piceous, the antennæ paler and more flavate as usual; head coarsely and densely punctate behind and with a mixture of large and small punctures, sparse medially before the suture, the entire basal region impunctate, the epistoma moderately convex medially, flat laterally; antennæ gradually clavate distally as usual; prothorax two and one-half times as wide as long, the sides strongly converging from base to apex and broadly arcuate, gradually more rounded basally, the apical angles very evidently rounded; surface sparsely and very strongly, but not very coarsely punctured, the punctures closer and mingled with some much coarser punctures laterally, the sides not very widely declivo-explanate, the bead rather strong, especially around the apical angles; elytra scarcely at all longer than wide, not at all wider than the prothorax, the sides parallel and broadly arcuate, rounding to the obtuse apex in scarcely apical two-fifths, the immediate tip sharply ogival as usual; surface with the usual strong, sparse and muricate punctures, becoming finer

and closer granules on the alutaceous posterior declivity; prosternal process only moderately constricted between the coxæ; abdomen finely but strongly, sparsely punctate, more coarsely, densely so on the last segment. Length 8.4 mm.; width 5.1 mm. California (San Pedro).....**arenarius** Csy.

Body more narrowly elongate-elliptic, strongly convex, polished, black to rufo-piceous in color, the under surface and legs always somewhat paler; head nearly as in *arenarius*, very coarsely, densely punctate behind the suture, more finely, clearly and densely so on the flattened apical lobes, the median tumescent part of the epistoma rugosely but less densely punctate; prothorax less abbreviated, the sides less strongly converging, broadly and subevenly arcuate from base to apex, the apical angles more distinct and less rounded; surface similarly very sparsely punctate, the larger lateral punctures less coarse and the sides more broadly declivexplanate, the head similar; elytra not at all wider than the prothorax, very slightly longer than wide, the sides converging and rounding from before the middle, the apex obtusely and evenly rounding from above, the surface inflexed near the apex, the apical angle sharply ogival as usual, the sculpture somewhat less coarse than in *arenarius*; prosternal process very strongly constricted between the coxæ, the neck scarcely more than half as wide as the dilated and rounded posterior part; abdomen almost similarly punctate, the last segment relatively less densely. Length 8.0-8.6 mm.; width 4.7-4.85 mm. Sta. Barbara, — G. W. Dunn.

sternalis n. sp.

9 — Body evenly elliptic in form, the prothorax not at all wider than the elytral base 10

Body broadly oblong-suboval, the prothorax more swollen basally, and, at a short distance before the base, distinctly wider than the base of the elytra 11

10 — Form rather elongate, black, the antennæ and tarsi paler; head with irregular, dense, mingled coarse and finer punctures behind the suture, the epistoma but feebly tumid medially, more or less sparsely punctured; prothorax two and one-half times as wide as long, the sides strongly converging, strongly and very evenly arcuate from base to apex, the angles only very narrowly rounded; surface rather finely but strongly, sparsely punctate, more coarsely and with admixture of smaller close-set punctures laterally, the sides rather narrowly, subequally explanate, the head very fine throughout; elytra scarcely visibly longer than wide, evenly rounded behind from above, the sides becoming parallel only toward base, the punctures as usual, the posterior fulvous pubescence conspicuous; prosternal process moderately constricted, the neck fully two-thirds as wide as the dilated posterior part; abdomen finely, sparsely punctate, more strongly and densely on the last segment as usual. Length 6.9 mm.; width 4.15 mm. Los Angeles Co **obscurus** n. sp.

Form relatively a little broader, castaneous in color, the anterior parts more blackish; head nearly similar though notably smaller, barely two-fifths as wide as the prothorax, the antennæ only moderately enlarged distally; prothorax similar though a trifle more transverse and similarly sparsely and strongly, though not coarsely, punctate, more sparsely so laterally and with much less difference in the size of the larger and smaller punctures, the sides less abruptly, more declivously and somewhat more broadly explanate; elytra similar though not at all longer than wide, the punctures throughout similarly sparse but not quite so coarse; prosternal process slightly more strongly constricted. Length 5.6–6.5 mm.; width 3.6–4.1 mm. Redondo.....**scolopax** n. sp.

11 — Body stout, oblong, but little longer than wide, dark picco-testaceous throughout; head small, scarcely more than a third as wide as the prothorax, densely punctate throughout, more coarsely behind, more transversely rugose and medially swollen before, the transverse suture; antennæ relatively more dilated apically or slender basally than usual; prothorax fully two and three-fourths times as wide as its median length, inflated and with strongly rounded sides basally, the sides very strongly converging and less arcuate thence to the apex, the angles narrowly rounded; surface closely, rather coarsely punctate, the latter not differing in density but composed of mingled coarse and finer punctures laterally, broadly declivo-explanate at the sides, the bead fine but strong; elytra barely as long as wide, very broadly rounded behind from above, the sides becoming subparallel and broadly arcuate in about basal half, the sculpture more coarsely and closely muricate than in the two preceding species, granulose and smaller posteriorly but having the surface between the granules not at all alutaceous; prosternum coarsely and densely punctured, the process strongly constricted; abdomen finely and sparsely punctured medially. Length 4.9–7.0 mm.; width 3.0–4.5 mm. San Diego, — G. W. Dunn.
amplicollis n. sp.

Body similarly very stout and subquadrate, larger in size, deep black in color, the antennæ pale, the legs piceous, similarly polished throughout; head larger, fully two-fifths as wide as the prothorax, similarly densely sculptured, coarsely behind the suture, rather more loosely so and finely rugose before the latter, the antennæ nearly similar; prothorax a little less transverse, the sides similarly inflated posteriorly but less converging anteriorly, the angles distinctly though not very broadly rounded; surface similarly coarsely and closely, though a little more loosely, punctate, less abruptly and rather less widely declivo-explanate laterally, the bead similarly strong but not so elevated; elytra similar, scarcely as long as wide, the sides becoming parallel and more feebly arcuate before the middle, the very coarse sculpture almost similar; prosternal process somewhat less strongly constricted, the neck about two-thirds as wide as the rounded and dilated posterior portion;

abdomen rather strongly, moderately sparsely punctate, the last segment densely. Length 7.6 mm.; width 5.0 mm. San Diego. Taken by the writer on the ocean beach.....**latus** Csy.

- 12 — Body broadly oblong-elliptical, moderately convex, piceous-black, the surface polished; epistoma broadly sinuate; antennæ with a 3-jointed club; prothorax equal in width to the elytra, a little more than twice as wide as its median length, widest immediately before the base, the sides rather feebly arcuate and strongly convergent, moderately densely, evenly punctate throughout; elytra twice as long as the median line of the prothorax, not longer than wide, equally densely but more finely punctate than the pronotum, the punctures not in the least asperate on the disk and only very feebly so on the declivity and along the lateral margin; process of the first anterior tarsal joint extending under the next three; marginal fringe of the prothorax noticeably shorter and finer than in any of the foregoing species. Length 7.0 mm.; width 5.0 mm. Island of San Nicolas.....**pacificus** Fall

Body very convex, piceous-black, the legs and elytra brown; epistoma broadly sinuate; antennal club 4-jointed; prothorax similar in outline to that of *pacificus* but shorter, the surface subopaque, densely and coarsely punctate; elytra shining, finely, densely punctate, without trace of asperity; process of the first anterior tarsal joint extending beneath the next two; marginal fringe longer than in *pacificus* but thinner than usual. Length 6.5–7.0 mm.; width 4.0–4.5 mm. Island of San Clemente.... ..**remotus** Fall

Seven of the above species are represented by large and very complete series, showing with unmistakable clearness that they are truly delimited from each other and in scarcely any way opinionative; intermediate individuals are in fact wholly wanting. The laws of intraspecific variation can be observed so readily from these series, furthermore, that there can be little or no doubt concerning the specific validity of those at present represented by one or two specimens. Some of the species vary prodigiously in the size of the body, to an exceptional degree indeed, even among the Coniöntinæ, and there is a very remarkable inconstancy in the development of the scutellum, which varies from quite distinct to wholly obsolete within the limits of probably all the species; Lacordaire records a corresponding inconstancy in one species of the Praocini (Gen. Col. V, p. 216). In fact the scutellum is not very constant anywhere in the Coniöntinæ, except in *Calotaxis*, where it is never more than vestigial or very minute, and that in a group of genera where, elsewhere, it has its maximum development, giving

Cælotaxis a notable isolation among the genera more closely affiliated with *Coniontis*. It would appear almost certain that the radically different elytral sculpture of the last two species of the table, taken in connection with the more feebly developed burrowing habits, as recorded by Mr. Fall (Can. Ent., 1897, p. 242), is an ample reason for considering them at least subgenerically removed from the normal forms.

Cælomorpha Csy.

This genus, while allied rather closely to *Cælus*, differs in a number of important structural characters, such as the 10-jointed antennæ with more abbreviated basal joint, in the less transverse and virtually unemarginate eyes, which are similarly very coarsely faceted, in the very feeble transverse epistomal suture, in certain features of the prothorax, which, though possessing the coriaceous basal margin of *Cælus*, has the basal angles rounded and the side margins without vestige of a beaded edge, and in its more slender legs, all the tibiæ, however, being similarly dilated at apex. The process of the first anterior tarsal joint is small, though slender, and very much less developed than in *Cælus*. The scutellum is very minute and similarly triangular. The species, which are the smallest of the subfamily Coniontinæ, resemble *Cælus* altogether in habits and facies and may be described as follows:—

Form oblong-oval, strongly convex, rather shining, black to dark rufo-testaceous, the sides of the body bristling with coarse and erect but only moderately dense fusco-flavate setæ; head quite evidently less than half as wide as the prothorax, rather closely, finely and very muricately punctate, not transversely impressed at the suture, the epistoma not tumid, the emargination rather deep and abruptly formed, circularly rounded, the surface bristling throughout with stiff erect setæ; prothorax two and two-thirds times as wide as its median length, the sides subevenly and moderately rounded, a little more converging apically, the apex very deeply sinuate, with the angles narrowly rounded; base broadly, evenly and feebly arcuate, the angles very broadly rounded; surface with a few scattered punctures, almost wholly impunctate before the middle medially, more closely, asperately punctate, broadly declivo-explanate and bristling with stiff erect setæ laterally; elytra just visibly longer than wide, at the middle about a fifth wider than the prothorax, very broadly rounded behind from above, the sides parallel and broadly arcuate; surface as in *Cælus* but with the sculpture very

feeble, sparse and faintly muricate, more granuliform on the declivity though still feeble; epipleuræ broader medially than at base, rapidly becoming narrow posteriorly; prosternal process moderately constricted; abdomen finely, sparsely punctate, the last segment not at all more coarsely or closely so; basal joint of the hind tarsi but little longer than the next two combined. Length 2.8-3.4 mm.; width 1.65-1.85 mm. (♂, ♀). Lower California.
maritima Csy.

Form more broadly and more regularly subelliptic, less oblong, larger in size, shining, pale flavo-testaceous in color, similar in pubescence and in the bristling setæ of the head and sides of the body; head relatively a little smaller, otherwise nearly similar; prothorax almost three times as wide as its median length, the lateral length exceeding the median much more markedly than in *maritima*, the sides evenly and rather strongly arcuate, more converging from near the base to the apex than in the preceding, the surface almost similarly sculptured; elytra at basal third fully a sixth wider than the prothorax, inflated basally, more narrowed thence posteriorly and more narrowly rounded apically than in *maritima*, the sides more arcuate; surface nearly similar though somewhat more strongly muricate, approaching more closely the sculpture of *Cælus*; under surface and legs similar, the anterior tibiæ with very long erect setæ internally, the posterior with shorter but more numerous and very stiff erect setæ externally and a few much less conspicuous internally. Length 3.8 mm.; width 2.2 mm. (♀). Lower California..... **pallens** n. sp.

The material serving for the above descriptions was collected by Mr. G. W. Dunn in various unrecorded parts of Lower California.

The species above defined, as well as those of *Cælus*, *Coni-ontis* and in fact quite generally throughout the subfamily, differ from each other not so much by reason of any clearly defined peculiarities of structure, as in a certain characteristic habitus due to the summation of many minor features, such as general form and outline, size, sculpture and vestiture. The study of large series, where available, shows that this composite facies is as persistent as elsewhere in the Coleoptera, and, in my opinion, the various described forms are constant and true-breeding, conforming to the usual definition of a species.

ADDENDA.

I.

Having recently received a number of species of Praocini and Nycteliini from Mr. Rolle, it becomes evident, even upon cursory examination, that the subfamily Coniontinæ should include both of these tribes and that the definition of the subfamily previously given must be so generalized as to receive them. The hind coxæ, for example, very extended, oblique and comparatively slender in the North American tribes, become much more abbreviated, subtransverse and ovoidal in the South American groups, having there very nearly the prevailing form of the Asidinæ. The isolation of the Coniontinæ as a subfamily will therefore depend, as in so many other subdivisions of the Tenebrionidæ, upon the peculiar combination of a number of characters, no one of which is absolutely constant but together constituting a characteristic facies or habitus. Among the more salient of these subfamily features may be mentioned antennal structure, prolongation backward of the posterior thoracic angles, porrect prosternal process, more or less pronounced obliquity of the hind coxæ, sparsely spinulose tarsi, rather small, emarginate and obtapezoidal mentum, generally exposed and densely chitinized emarginate ligula, bifid mandibles, sinuate clypeus and exposed emarginate labrum, well developed tibial spurs and frequent basal dilation of the epipleuræ. I would propose the following arrangement of such tribes as are represented by the material in my collection:—

Antennæ long and slender, with or without a loose 3-jointed club...2

Antennæ very small, compact, with a feeble, compact and fusoid club,
the basal joint unusually developed.....5

2 — Ligula wholly concealed; gular sutures united and forming a single furrow for a considerable distance behind the mentum; legs long; posterior coxæ nearly as in *Asida*, widely separated and subtransversely oval; antennæ peculiarly hispid, not clavate, the last joint smaller, oval, pointed; elytra widely embracing the body, the epipleuræ dilated basally. Southern South America.

***Nycteliini**

Ligula largely exposed, densely chitinized; legs much shorter.....3

- 3 — Gular sutures uniting anteriorly, forming a single groove for a short distance behind the mentum; hind coxæ feebly oblique, long and cuneiform, distinctly separated, the abdominal process truncate; antennæ with a 3-jointed club; elytra widely embracing the body, the epipleuræ abruptly dilated at base. Tropical Atlantic North America.....**Branchini**
- Gular sutures rapidly diverging apically, delimiting a transverse piece at the base of the mentum.....4
- 4 — Hind coxæ oval, subtransverse, distinctly separated though very moderately, the abdominal process truncate to rounded; elytra rather widely embracing the sides of the body, the epipleuræ rapidly dilated at base; antennæ with a 3-jointed club. Peru and Chile.....***Praocini**
- Hind coxæ slender, much longer, strongly oblique and cuneiform, narrowly separated, the abdominal process acute or narrowly rounded; elytra widely to very narrowly embracing the sides of the body, the epipleuræ sometimes abruptly dilated at base; antennæ with a 3-jointed club.¹ Western temperate North America.
Coniontini
- 5 — Ligula and gular sutures nearly as in Coniontini, the hind coxæ also similar; fourth abdominal segment relatively much less abbreviated, somewhat as in *Praocis*; pronotum differing from any of the preceding tribes in having a coriaceous basal margin; elytra narrowly embracing the sides of the body, never acutely margined at the sides, resembling in this way only certain of the subtribe Eusatti of the Coniontini; legs rather short. Seabeaches of Southern California.....**Cœlini**

The gular sutures in Coniontini are rather inconstant, sometimes being very distinct behind the mentum and sometimes wholly obsolete; it was this inconstancy that occupied my attention when on page 54 (ante), I stated that these gular characters seemed to be rather equivocal in separating the Coniontini and Branchini, but I am now convinced that they will serve this purpose as suggested by LeConte. The tribe Nycteliini, as outlined above, will comprise at least two genera which may be defined as follows: —

¹ In the Coniontini the antennal club becomes a very variable feature. In the subtribe Coniontes the antennæ have an obvious, though feebly enlarged, 3-jointed club. In the Eusatti, however, the character is very inconstant, *Discodemus* and *Megasattus* having no trace of a terminal club any more than in *Nyctelia*; *Nesostes* and *Sphæriontis* have a feeble 3-jointed club, but *Eusattus* is composite, *dubius* having an obvious club of three joints, while the species from *productus* to the end of the genus have no trace of an apical enlargement. I think therefore that the genus *Conipinus*, for *dubius*, *nanus* and *oblongulus* may have to be maintained.

Form oval, the hind body not inflated, the elytra deeply striate, the sides of the prothorax fimbriate; habits fossorial. Atlantic Argentina. [Type *Zophosis nodosa* Germ.].....***Nyctelia**

Form ovoidal, the hind body much inflated, the elytra not striate; sides of the prothorax not fimbriate; habits non-fossorial. Southern Andes. [Type *N. explanata* n. sp.].....***Nyctelioma**

The body in *Nyctelia* Latr., is smaller than in *Nyctelioma* and there can be but little doubt that the habits are fossorial as in *Calus* and other fimbriate species, including certain Praocids. The type of *Nyctelioma* (n. gen.) may be described as follows:

Form convex, deep black, glabrous, rather strongly shining; head with some scattered coarse punctures laterally, the surface broadly impressed along the sides; prothorax a little more than twice as wide as its median length, densely aureo-fimbriate at apex and base, the sides parallel and almost straight nearly to the middle, then broadly rounding, becoming strongly converging and straight anteriorly, the apical sinus transverse at the bottom, the angles porrect, acute and well defined; base strongly, evenly bisinuate, the surface gradually and feebly convex medially, with some sparsely scattered punctures apically and broadly toward the sides, the marginal bead fine, obliterated behind the middle; scutellum wholly obsolete; elytra dilated, oval, at the middle nearly a third wider than the prothorax, a little longer than wide, produced at tip, evenly convex, gradually and rather broadly explanate at the sides before the middle, the margin thickened and rugose; surface smooth, even, with some small and widely scattered granules which become lineate in arrangement suturally and apically; hypomera with some minute, sparse, setigerous granules, smooth and polished, the prosternum smooth, becoming rugose medially and throughout the process, the latter rounded and thickly though feebly beaded about its entire contour. Length 17.5 mm.; width 11.2 mm. Argentina (Mendoza).....***explanata** n. sp.

The above species is allied to *latissima* Bl., but differs in having no trace of undulation along the sides of the elytra. Of a species called *latissima* Bl., Mr. Rolle sent me a considerable number of examples which differ among themselves in very confusing manner, showing that the delimitation of species in this genus is fully as difficult as in any part of *Coniontis*.

II.

Dr. Georg Seidlitz (Ber. wiss. Leist. Ent., 1905, p. 162), finds some fault with my recent papers because of the omission

of bibliographic references, in contrariety with usual custom in systematic works of this character. I can only state, in reply to this, that those who are engaged in observing and recording new facts in the vast and inexhaustible realm of nature in which we find ourselves, have but little time for finding out what others have done, except enough to avoid the duplication of names or to point out an occasional error, for it seems to be far more incumbent upon us—that is many of us, to correct the errors of our esteemed coworkers than to allude to anything good that they may be guilty of, leaving the recording of what has been accomplished to those having special aptitude and taste for such matters. The vocation of the bibliographer, of whom the late H. Carrington Bolton was one of the highest types, is a most important and useful one, and we all hail with delight every new catalogue giving dates and references to places of publication. But bibliography is becoming a specialty, like everything else, and it is doubtful if any careful bibliographer would accept the references and dates published by a taxonomic specialist, but would go to original sources for such data, so that work of this kind performed with considerable loss of time by the searcher for basic facts, would have to be reduplicated in any event.

In this connection it would evidently be better if figures could be given of every described species, but these, in order to be useful, must be rigorously exact and, as the original investigator cannot as a rule spare the time and extra tax upon the eyes to do this work, it must also be done by another very helpful specialist, known as the biologic artist or draftsman, and it becomes simply a question of halting all original scientific inquiry or publishing without illustrations, for entomological artists are almost as rare as the proverbial *dentes gallinarum*, and those that we have in this country are continuously employed in museums at fixed salaries and consequently inaccessible to the amateur, to whom scientific advancement has hitherto been in large part due.

While referring to the subject of type figures, it should be added that some Zoölogical Congresses have gone so far as to state that descriptions of new species, more especially con-

chological, unaccompanied by an illustrative drawing, shall not be considered valid, — a wholly impossible and illogical dictum, as a good description in words is not increased a particle in value by a poor figure, and the degree of excellence which the figure must possess is not stated definitely in the edicts of the congress. Another congressional dictum, to the effect that no description of a new species, more especially botanical, can be considered valid that does not involve at least a short Latin diagnosis, is equally illogical and absurd. A description following a name properly formed and printed in Roman characters, written wholly in Japanese or in any other decipherable language, would be perfectly valid. This might be very inconvenient for European taxonomists, it is true, tending to halt scientific progress until the descriptions could be translated, but it cannot properly be assumed that every investigator of nature must be familiar with some particular language as a condition for the recognition and acceptance of his work, and, furthermore, to be of any real value a description must extend beyond the few words of the old-fashioned diagnosis.

III.

REMARKS AND CORRECTIONS RELATING TO THE REVISION OF THE TENTYRIINÆ IN THE PRECEDING VOLUME OF THESE PROCEEDINGS.

- Page 289 — The genus *Ditaphronotus* was added to the table after the latter had been drawn up and was inadvertently given an erroneous position. It should come immediately after *Hylocrinus*, under the number "10" and referred to previously under "7 — Surface glabrous."
- Page 365 — The original type of *Auchmobius lævis* Lec., was lost at sea, together with the original type of *Cryptadius inflatus* and some other species, while being sent by LeConte to Lacordaire for study.
- Page 395 — The word "female" in the first line of the description of *plumbeus* should read *male*. It was the impression of LeConte that the two thoracic ridges of *Epitragus* (*Bothrotus*) pertain to the male and that the pronotum of the female was even in convexity. The facts are the reverse of this, but I

neglected to change the language of the original description in that respect.

Page 463 — For “*reticulatus*,” in the 7th line, read *nodulosus*.

Page 499 — For “delapidated,” in the 20th line, read *dilapidated*.

Page 522 — For “W. F. Rainbow,” in the 2d line under IV, read
W. I. Rainbow.

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THE SPERM-RECEPTACLE IN THE CRAYFISHES,
CAMBARUS CUBENSIS AND C. PARADOXUS.

BY E. A. ANDREWS.

IN some of the crustacea all of the sperm that is to fertilize the eggs is left by the male on the outside of the female and in some others it is deposited in external receptacles. Both these exceptional modes of transferring the sperm are met with in the crayfishes and lobsters.

As far as known in all the crayfishes of the world, except those of North America east of the Rocky Mountains, the male deposits the sperm on the outside of the shell of the female, and not in any receptacle. But in the above crayfishes of the central and eastern parts of North America the sperm is deposited in special receptacles in the shells of the females, and the same is true for the American lobster.

Before describing the sperm-receptacle in a Cuban and a Mexican crayfish in which it was necessary to find it in order to prove its general occurrence in all members of the genus *Cambarus*, we will make a comparison of the receptacles in the crayfish and lobster.

In both animals there is but one receptacle on each female and this lies on the under side of the body, between the fourth and the fifth pairs of legs.

The under side of the shell of the thorax of these animals may be thought of as made of more or less fused plates, one on each side and one on the middle of each somite. In the somites of the first, second and third legs the imagined plates

are all fused into one mass, forming a groove, with the middle plates as the bottom and the side plates as the elevated edges to which the legs join. But between the fourth legs the middle plate is recognizable as a distinct part of the sternal skeleton and we will call it the annular plate as in the female crayfish of the genus *Cambarus* it is specialized as the so-called *annulus ventralis*, that contains the sperm-receptacle. In the next somite, which bears the fifth legs, the middle plate is separate and often spine-like while the side plates stand up on edge as diagonal wings.

While the receptacle in *Cambarus* is contained within a single middle plate, in the lobster it is formed by three plates, one middle plate and two side plates, and thus though it has the same position and the same physiological value it has not the same morphological value. This will be more evident after a description of the receptacle in the lobster, where it was first recognized by Bumpus in 1897 (J. M., Vol. V). This organ is made by two side wings or plates of the fourth leg-bearing somite together with a wedge-like middle piece. These three plates surround a middle space which is several mm. long, somewhat less in width and more in depth. Bumpus states that it may be filled, in part, by a mass of sperm and largely by a wax-like substance.

In the lobster the legs are inserted so close to the middle line that the side plates come into contact at the middle line between the fourth legs, but passing diagonally backwards flare apart so that the middle or wedge-plate pushes in between them. The receptacle is just above the wedge-plate which underlies it and shuts it off from the exterior, as it runs forward like a slanting shelf from its broad posterior base to its small, free tip. The receptacular space would thus be entirely shut off and inaccessible were it not for the fact that the two side plates in front of the tip of the wedge may easily be forced apart by inserting between them the hard, spatula-like tips of the male stylets, or first abdominal appendages, which are very well fitted for this purpose. Once inserted these organs are not readily removed since the special ridge each bears, catches on the face of the lateral plate. The lateral plates are normally

kept close together by the elasticity of the soft cushions formed by the thin inner face of each plate. While the wedge-plate is especially well calcified, the walls of the side plates, or wings, remain membranous over most of their inner faces, so that much of the lining of the receptacle, as well as the entrance to it, is not brittle shell, but thin chitinous material.

Looked at from the inside of the body the protruding plates of the under surface of the body are not solid thickenings of the shell, but hollow protuberances, and from this standpoint the receptacle may be described as an external space embraced on the sides by two pouches of the shell, the right and the left wing, and by a middle floor, a long, pointed pouch, the wedge.

It should be emphasized that the receptacle is merely an enclosed region outside the body of the lobster, and that, as far as known, it has no communication with any internal structure.

To determine the homology of this organ it is important to know if all its parts belong to one somite or not. At first sight the wedge-plate seems to belong to the somite bearing the fifth pair of legs, as it sticks forward from the sternal ridge joining these legs, while the side wings belong to the somite bearing the fourth legs. But there are some reasons for holding that the wedge belongs to the somite bearing the fourth legs, though Herrick (*The American Lobster*, 1895), from a study of several stages in the formation of the receptacle in young lobsters, concluded that the wedge-plate belonged to the somite of the fifth legs. However, an examination of his Fig. 5, Plate 33, suggests that the cross line between the fourth and the fifth legs is homologous with the similar line, which we have shown to be the boundary of the annulus in young crayfishes (*Biol. Bull.*, 1906), and as the annulus seems to belong to the somite of the fourth legs, it may be that Herrick was in error in assigning the wedge to the somite of the fifth legs. Again, in the series of middle and side plates, the middle plate stands a little posterior to the line joining the side plates of its somite, as far as one can judge from the adult condition, so that a recession of the middle plate from its side plates is what is to be expected, while the existence of a middle plate in advance of the side plates would be exceptional. Thus there is a middle plate posterior to the

wings of the fifth legs, and there should be a middle plate posterior to the wings of the fourth legs, and as such a plate we may assume the wedge that projects forward from the line joining the fifth wings.

In the male lobster the wedge of the female is represented by a flat plate that is somewhat grooved along the middle. This plate of the male may very readily be regarded as a middle plate of the fourth leg region shoved back onto the somite of the fifth legs.

Another mode of judging of the homology of the wedge and its morphological position is a study of the internal skeleton, or endophragmal system. In the crayfish there are transverse ridges on the inside of the shell, between the side wings and the middle plates, and from these arise the long internal bars, or endosternites, that run up into the interior of the body, one on the right and one on the left. In the male it is easily seen that the endosternites come in between the wing plates and the middle plate of the somite bearing the fourth legs and also between the wings and middle plate of the somite of the fifth legs. In the female the same is true except that the wide annulus takes the place of the narrow annular plate of the male.

The endosternites cannot be taken as exact bounds of the somites, else the middle plate of the last thoracic somite would be reckoned as on the abdomen, which the general conformation renders unlikely.

In the lobster the extreme narrowness of the sterna brings the endosternites close together at the middle line: but in the male one can see that there is a pair of endosternites between the middle plate and the wings in front of it on the last somite and also between the hollowed out wings of the somite bearing the fourth legs and a middle plate which may be regarded as the annular plate. In the female the only difference is that the peculiar development of the wings and the wedge raises the endosternites of the boundary between these plates up onto the top of the seminal receptacle, where they were noticed by Herrick as parts of the endophragmal system.

It should also be noted that in the male lobster the receptacle is represented by a triangular pit, some two mm. wide, deep

and long, between the wings of the fourth legs and a rather flat plate that may be regarded as belonging to that same somite.

Deciding that the wedge-plate really belongs to the somite of the fourth legs we find no difficulty in homologizing it with the annulus of the crayfish. We will call the wedge-plate an annular plate. The only reason that this is not self-evident is that the annular plate of the lobster is secondarily pushed far back and fused to the sternal skeleton of the fifth leg somite. Even in the crayfishes there is a marked recession of the annular plate and in the lobster which has not the freedom of motion between the fifth and fourth somites that is found in the crayfish, the backward migration and fusion could take place to a greater extent.

However, to establish the homology of the wedge with the annular plate it is not necessary to show that they are on the fourth leg somite, but only that they are on the same somite: so that if the endosternites be taken as the exact bounds of the somites both the annulus and the wedge would belong to the somite of the fifth legs, but still be homologous.

While the receptacle of the lobster is a space between the side plates and an annular plate the receptacle of crayfishes is entirely within the annular plate itself: hence the two receptacles are not homologous, though one element of each is the same, the annular plate.

The general facts regarding the receptacle of the crayfish are as follows: In the crayfishes of Europe, which are all of the genus *Astacus*, it is said that the sperm is scattered over the posterior part of the sternum of the thorax of the female, enclosed in tubes of paste-like material, the spermatophores. Yet there is, in both sexes, an annular plate, slightly marked off from the great fused sternal mass that ends between the fourth legs. The same is presumed to be true of all the crayfishes of Asia and of North America, west of the Rocky Mountains as they are all of the same genus, *Astacus*. On the other hand in the three score and more crayfishes of the genus *Cambarus*, found east of these mountains the annular plate is variously sculptured and provided with a suture. Hagen, who discovered this annular plate (Monograph N. A. Astacidæ, 1870), supposed it had some gland-

ular function, but he recognized that it was a good aid in describing species of *Cambarus* and called it the *annulus ventralis*. Since then it has been constantly made use of as a specific character. In 1895 we showed that the male of *Cambarus affinis* deposits the sperm within a cavity in the annulus and subsequently we described the seminal receptacle in several species of *Cambarus* as a narrow pocket in the wall of the annular plate, which arose in the young female as a shallow epidermal pit that later deepened as a zigzag pocket.

In all crayfishes except *Cambarus* no receptacle is known and no specialization of the annular plate is known outside of the females of *Cambarus* and of the American lobster. Yet some sort of receptacle may yet be found in other crayfishes. Thus the crayfishes of eastern Asia have the annular plate hollowed out posteriorly, the male stylets armed with complex points and the legs provided with hooks, all of which leads one to predict that a renewed search will discover some kind of sperm-receptacle in these crayfishes. In that event the resemblances that led Faxon to call these crayfishes *Cambaroides*, as being like *Cambarus*, would be strengthened in a way that might add to the puzzling nature of the problem here presented of close resemblances between animals in the eastern and western areas of the continents, North America and Eurasia along with generic differences between the east and west of each continent.

Having shown that in *Cambarus affinis* the sperm put by the male into the annulus will remain alive all winter and that the eggs laid in the spring will develop if this sperm is present till then, though they did not develop when the annulus was removed, it was concluded that the sperm-pocket of the annulus was an essential link in the chain of reproductive organs, without which Cambari would come to an end.

To make way for a consideration of the possible mode of origination of this peculiar organ, which seems to have no exact homologue in other crustacea nor in other animals, as it is an unpaired, ventral, and not segmentally repeated organ, used only for the storage of sperm, it seemed important to make more sure that the annulus in all kinds of Cambari contained a sperm-receptacle of the same nature.

Ortmann having shown that the genus *Cambarus* (Proc. Wash. Acad. Sci., 1906) could be divided into six subgenera; the existence of the sperm-pocket in random members of all subgenera would approximately establish its presence in all the members of the genus. The annulus was found to contain a sperm-pocket of the same fundamental structure (but with specific differences) in species of the subgenera, *Faxonius*, *Bartonius* and *Cambarus* (Proc. Boston Soc. Nat. Hist., 1906) and later the same was found true for a species of the subgenus *Cambarellus* (Biol. Bull., 1908).

In the present paper the annulus is described in crayfish of the two remaining subgenera, *Procambarus* and *Paracambarus*, and the same sperm-pocket found in all.

Owing to the kindness of Dr. Ortmann, I have been able to study the annulus in six specimens of *Cambarus* (*Procambarus*) *cubensis* Erichs., and in one of his type specimens of *Cambarus* (*Paracambarus*) *paradoxus* Ortm. The former came to him from the Rio Almendares, Calabazar, Prov. Habana, Cuba, and the latter from the state of Puebla, Mexico, through the Paris Museum. These specimens of *Procambarus* had so many lost and regenerating limbs that this species would seem to be an especially favorable one for the study of regeneration.

In this Cuban crayfish the annulus is known from a description of Faxon (Revision Astacidæ, 1885) to be "composed of a larger anterior, bilobed tubercle and a smaller posterior tubercle" and Ortmann found that it showed an S-shaped fissure on the posterior tubercle. This fact and the figure given by Ortmann left little doubt that, when looked for, a sperm-pocket would be found within this annulus. However there was doubt as to what should be regarded as the real annulus since Faxon gave the name to all three tubercles, while Ortmann stated that it seemed to him only the posterior tubercle ought to be regarded as the annulus.

The following illustrations, in the light of the above considerations as to the morphology of the annular plate, will show that although the receptacle is all within the posterior tubercle, yet that alone is not the annulus, but all three tubercles together form the annulus.

The width of the whole set of tubercles is about 2 mm. in a female 48 mm. long, say 3 per cent. to 4 per cent. of the length, which is the usual proportion of annulus to body length. But the posterior tubercle, or "subannulus," as it might be called,

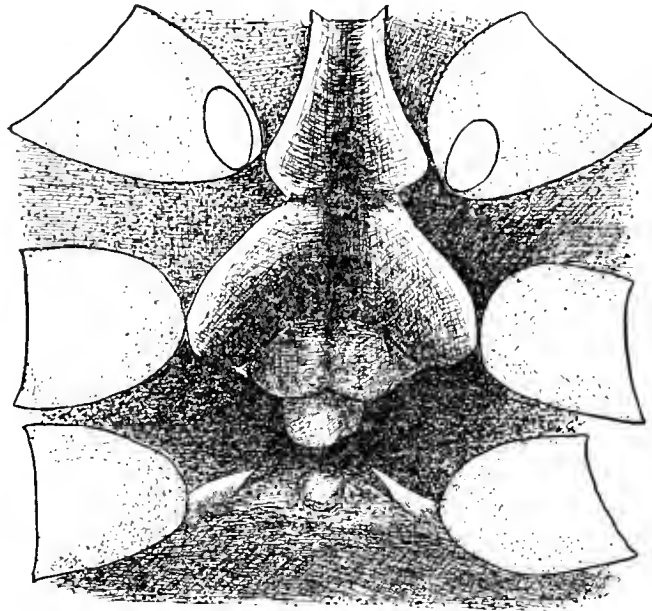


FIG. 1. Ventral view annulus and neighboring region of female 50 mm. long, $2a_0$.

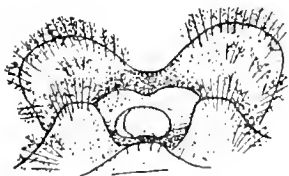


FIG. 2. Posterior view annulus and neighboring organs of a female 35 mm. long, right handed, $2a_0$.

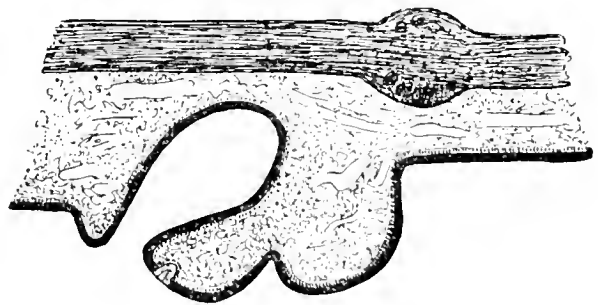


FIG. 3. Median lengthwise section of annulus and neighboring organs. Same specimen as in Fig. 2. 2.90 mm., A .

is only .75 mm. wide and .5 mm. long and thus not the right size for an annulus.

Fig. 1 shows, right and left, the basal segments of the third, fourth and fifth legs with the elliptical openings of the oviducts

on the third legs. Between the fourth legs are the flaring side or wing plates, and between the fifth legs are two similar plates which being set on edge show better from a posterior view, Fig. 2. Between the fourth and the fifth legs is the mass of three tubercles, shown enlarged in Fig. 4. Between the fifth legs there is a small tubercle serially homologous with the above set of three that form the annular plate.

The structures indicated in Fig. 1 are fringed with setæ but these are represented only in Fig. 2, which is a view from behind. These setæ add to the difficulty mentioned by Faxon and by Ortmann, of finding the annulus.

Fig. 2 shows in the foreground the low middle plate, or spine, of the sternum of the fifth legs and right and left of the

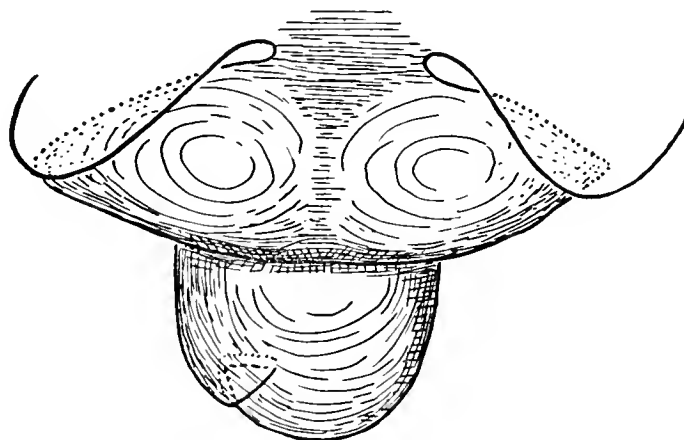


FIG. 4. Ventral view of annulus of female 38 mm. long, 2.90 mm., *A*.

the side wings of the same somite. In the background are the larger wings of the fourth leg somite and at the center the tubercles. The posterior tubercle stands out free, attached only along its contact with the paired tubercles, so that it can be moved up and down, while the anterior tubercles are pretty firmly soldered to the fused sternal mass anterior to them. The sides of the anterior tubercles reach under the flaring wing plates, as seen in Fig. 4, so that the entire set of tubercles has the proper form and connections for an annular plate. The peculiarity is that the posterior part of the annulus is set off as a rounded tubercle, which is not known to be the case in any other crayfish. As the posterior lobe is found to contain the

sperm-pocket it is not a new formation, fundamentally, but only a specialization of the posterior part of an annular plate. The two other tubercles seem to correspond to the paired elevations met with on the anterior part of the annuli of some of the higher Cambari.

In a median, lengthwise section, Fig. 3, the posterior lobe of the annulus is seen to stand out from the rest of the annulus like a fungus from a tree, forming a rounded shelf. Dorsal to this shelf there is a large space and the black line that represents the shell coming from the head, toward the right of the observer, rises up over the protuberant anterior part of the annulus, between the anterior tubercles, and sweeps around a deep cavity, to

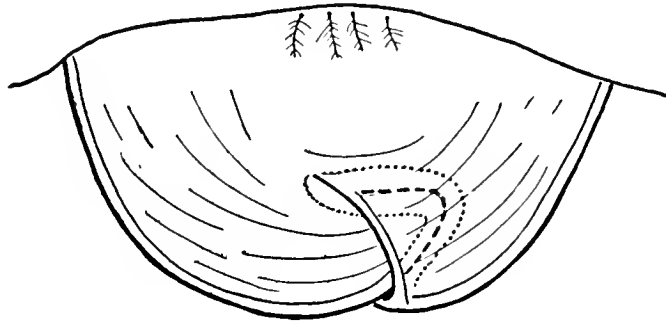


FIG. 5. Ventral view of posterior lobe of annulus of female 45 mm. long, left handed, 2A.

finally emerge over the summit of the small spine of the somite of the fifth legs. This figure also shows the epidermis that lines the shell and the vascular, sponge-work tissue that fills out the annulus and all the adjacent region up to the nerve cord, on which is represented the ganglion of the somite that bears the fourth pair of legs.

The peculiarity of this annulus is that it contains the essential, sperm-receptacle in the projecting posterior lobe.

This receptacle agrees so closely in structure with the pockets that contain sperm in the higher species of *Cambarus* that there is no doubt that it is used as a sperm-receptacle, though no sperm was found in it in the five females examined. The appearance of the pocket as seen in the posterior lobe of the annulus made translucent, is represented in Fig. 5. The pocket is an oblique slit that leads off to the observer's right as far as

the broken line, which represents its bottom. It is a very narrow and not very deep pocket. The dotted lines indicate the walls of the pocket and these are the continuations of the thick shell, running in to line the pocket.

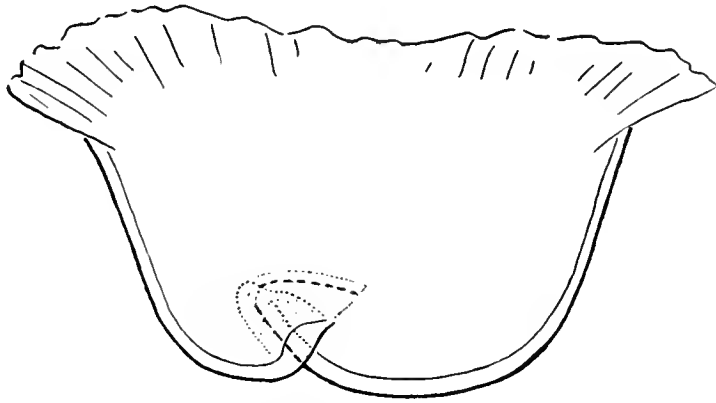


FIG. 6. Dorsal view of same specimen, 2A.

As shown in Fig. 6, this pocket comes to an end on the dorsal face of the posterior lobe of the annulus, after curving around the posterior face. Coming up from the left of the observer the mouth of the pocket runs a very short distance and the part of the pocket directly at this end is very short, but

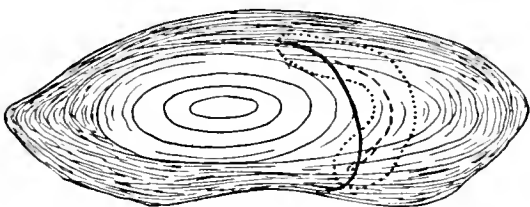


FIG. 7. Posterior face of posterior lobe of annulus of the same specimen, 2A.

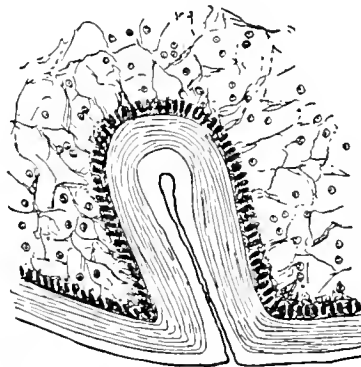


FIG. 8. Section of part of posterior lobe of annulus of left-handed female 30 mm. long, 2D.

through the thickness of the annulus the other, or ventral end of the pocket, is seen above and to the right of the figure. This becomes easy of comprehension when the sperm-pocket is viewed directly from the rear, as in Fig. 7. From this view the

posterior lobe of the annulus is seen to have a convex ventral surface, a somewhat concave dorsal surface and rather sharp edges, right and left. The mouth of the sperm-pocket is the somewhat crescentric narrow cleft, represented by the black line. The bottom of the pocket is represented by the broken line and the walls by the dotted lines. The pocket thus passes in obliquely to the right, and its ends where they pass over onto the top and bottom are bent towards the middle plane.

The sperm-pocket here is more simple in its curves and more easily seen to be a simple flat pocket than in any of the higher Cambari yet studied.

In more highly magnified sections, as in the coronal section, of which part is seen in Fig. 8, the sperm-pocket is seen to be made by an invagination of the simple epidermis, but the cavity of this pouch is largely filled in by the thick shell which the epidermis has made and which is continued in from the thick shell covering the rest of the annulus. The shell keeps its usual character, having a thick, laminated inner part near the epidermis, a much thinner outer part that is represented as clear in the figure, and an outermost cuticle that is indicated by the bounding line of the figure. The cavity lined by this shell is very narrow and but slightly dilated at the bottom, yet it is ample to contain innumerable sperms. It is probable that in life, before the action of reagents, the two sides of the pocket are so firmly in contact that the cuticular layer on each side may allow no water to pass into the receptacle.

The sperm-receptacle of this crayfish is thus both very simple and restricted to a small part of even the posterior lobe of the annulus. In Fig. 3 the small area actually occupied by the pocket is indicated by the little impitting in the posterior face of the posterior lobe of the annulus, though in an exactly median section this invagination would not show, as it is a little to one side of the middle on the posterior edge, Fig. 7.

The great bulk of the interior of the annulus is filled with areolated, spongy tissue represented in Figs. 3 and 8, and this is full of blood and scattered corpuscles, as indicated in Fig. 8. No glandular nor muscular tissues were found and no nerves, though special search should show nerves for the few setæ found on the ventral surface of the annulus, Fig. 5.

One unexpected feature of the annulus of the genus *Cambarus* is the fact that it enables one to recognize a dimorphism amongst the females of some, if not all, the species. The females are either right handed or left handed in the sense that the sperm-pockets are so placed and bent that some females have sperm-pockets which are the mirror images of the pockets of the other females of the same species. Indications are that about one half are of one kind and one half of the other.

Though the sperm-receptacle is, in general terms, a median structure it never lies entirely along the exact middle plane nor is it exactly balanced, right and left, as are so many organs in the anthropods.

In this Cuban *Cambarus* we find another illustration of this dimorphism expressed in the annulus of the females. Of the six specimens studied, four were left and two right handed. The lengths of the right-handed ones were 35 and 38 mm.; of the left handed 30, 45, 45, 48. Thus the dimorphism is probably not a matter of age nor something that alternates in successive periods of the same female as does the dimorphism, so-called, of the males of the other Cambari. The differences between the two forms of females are as follows: In the left-handed females the sperm-pocket lies a little to the animal's left of the middle of the body, Figs. 1, 5, 6, 7. In the right-handed female it lies to the right, Figs. 2, 4. Moreover in the two cases the pockets slope in opposite directions, so that the right-handed pocket is the mirror image of the left-handed one shown in Fig. 7; that is, it looks like that one seen through the paper from the other side. The crescent-like mouths of the receptacles in the left-handed females open to the right and those of the other to the left, so that they are to one another as new moon and old moon.

The entire posterior lobe of the annulus is also right or left handed, that is to say, in the left-handed females the most prominent part of the posterior face of the annulus is slightly to the right of the middle and the right side is the bigger, Figs. 1, 5, 6, 7. In the right-handed females the more protuberant part is on the animal's left, as in Fig. 4.

Thus taking the species as a unit there exists a symmetrical

pair of sperm-pockets: each female possessing but one of a symmetrical pair, while its mirror image is to be found upon some other female.

The sperm-pocket of this species of crayfish, representing the subgenus *Procambarus*, is thus fundamentally identical with the sperm-pockets in all the other Cambari, thus far studied.

Turning now to the only specimen of the subgenus *Paracambarus* as yet examined with reference to the sperm-pocket

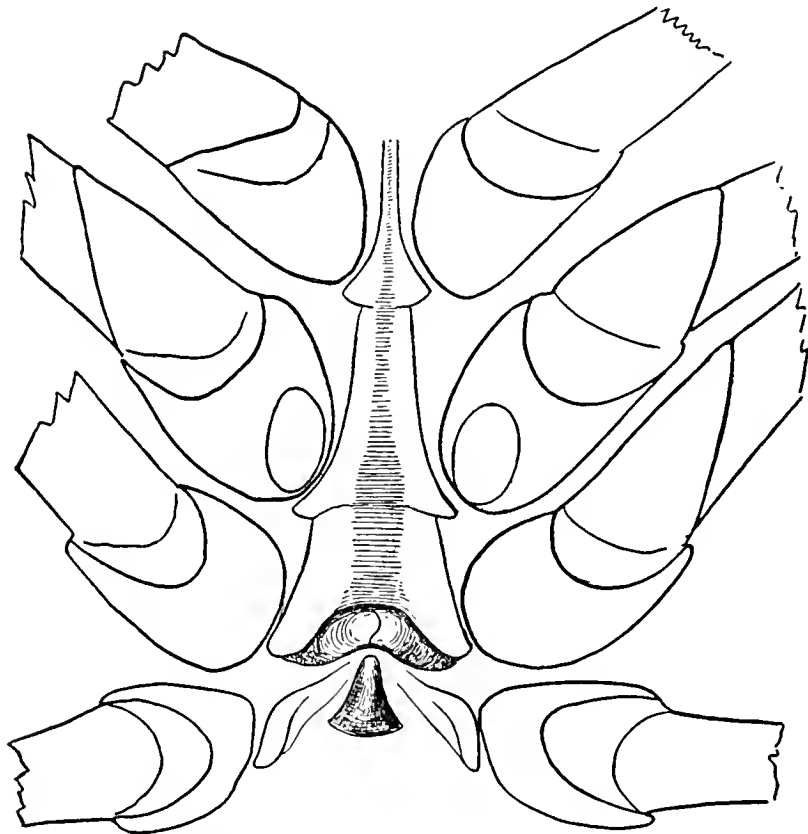


FIG. 9. Ventral view of annulus and neighboring organs of female 45 mm. long, 2 α_0 .

within the annulus we find the general appearances indicated in Fig. 9. The annulus itself is not so remarkable but the spine between the fifth legs attains a height not elsewhere known. The figure shows the bases of the second to fifth legs inclusive and the grooved sternal mass that ends between the fourth legs with flaring wing plates and a concave middle plate. In the concavity so formed lies the annulus, which differs from the usual form chiefly in rising up rather more in the middle

and in being decidedly concave on the posterior face. When isolated it has the form indicated in Fig. 11, with the mouth of the sperm-pocket lengthwise along its high middle part.

Posterior to this annulus the middle plate between the fifth legs is developed as a very high spine, which is shown in its true proportions and relations to other adjacent organs in Fig. 10. In this side view, with one half of the body cut away, the tall, conical, or somewhat flattened spine juts forward to overhang the annulus, which in turn stands up above the general level of the mid-region of the sternum. The spine bears at its apex several long and sparsely plumose setæ and a scant fringe of much shorter setæ is found along the edges of the wing plates of the fourth and fifth legs. In the background of the figure are the bases of the fourth and fifth legs. The side plates are here seen in their true elevation, while in Fig. 9 they are seen on edge.

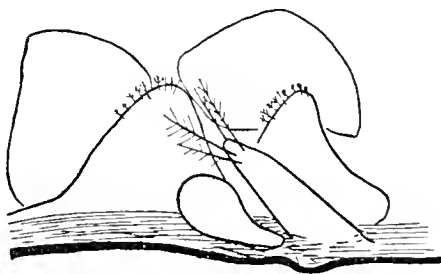


FIG. 10. Side view of annulus and post-annular spine, left half of body removed, $2a_0$.

In crayfishes the last thoracic somite is movable and the hard middle plate or spine of this somite may be readily shoved against the hind edge of the annulus. In *Cambarus affinis* there is reason to believe that the female so shoves the middle plate against the annulus as to liberate the sperms when they are needed to fertilize the eggs, as these glide out of the openings on the third legs and thence back over the annulus. In *Procambarus cubensis* the low simple spine, Figs. 1, 2, 3, may thus act against the low posterior face of this annulus and, on the other hand, in *Paracambarus paradoxus* the very tall spine may be useful against the unusually high annulus, which is concave on its posterior face, as if to receive the spine. While the very tall spine may thus find its use in connection with a very high annulus, as yet no use has actually been demonstrated, and the great development of the spine in this *Paracambarus* may not have any value. The spine is a specialization of the middle plate of the last thoracic somite and as such is to be regarded as homologous with the annulus, so that the

unusual height of the spine may be correlated with the height of the annulus as variations of serially homologous structures, whether there is any use for the spine or not. Returning to the annulus we find in it the usual sperm-receptacle, of much the same character as in the higher species and more complex than in *Cambarus cubensis*. The mouth of the pocket is a sinuous groove between elevated lips running across the convex ventral face and extending a little distance onto the anterior and posterior faces. Beginning on the anterior face, Fig. 11, the narrow mouth passes back from the middle line toward the left of the

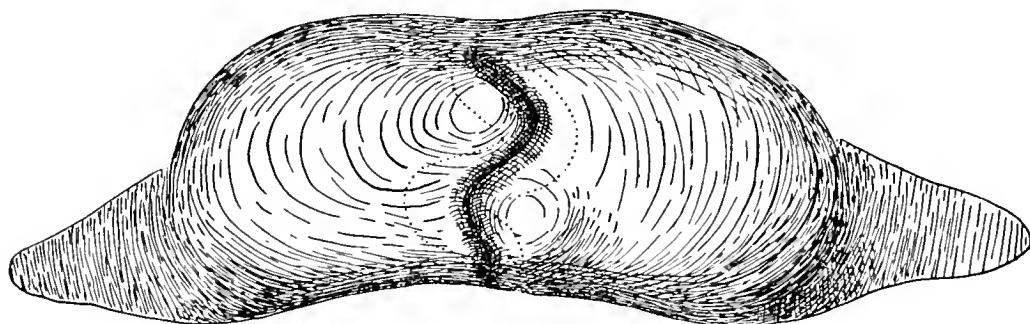


FIG. 11. Ventral face of annulus, 2A.

animal under the edge of a high, rounded tubercle. When the annulus is seen from the front this tubercle is the highest point of the annulus and from it the annulus slopes right and left more steeply than is indicated in Fig. 11.

On the convex ventral face the mouth makes a U-shaped curve to the animal's left and then a like one to the animal's right, to finally pass onto the posterior face. Embraced in the second curve is a second tubercle, less elevated than the anterior one and on the opposite side of the mouth. On the posterior face the mouth is seen as a short curved line coming down over the edge about on the middle line and with quite an elevation on the observer's right, close to the mouth.

As is faintly outlined in Fig. 11 the pocket into which this doubly bent mouth opens lies below it and not off to one side as much as in *C. cubensis*, yet a more careful sketch, Fig. 12, shows that the plane leading from the mouth to the bottom of the pocket does slant somewhat and is not at right angles to the surface of the annulus. Fig. 12 represents the sperm-pocket as

seen in a specimen made transparent; the broken line stands for the bottom of the pocket and the parallel rulings indicate the cavity of the pocket, which is about the same thing as a plane passed from the mouth to the bottom, since the width of the pocket is so little. It will be seen that the cavity of the pocket inclines first to the right, then to the left and again somewhat to the right, nearest to the observer. The bottom is thus more sinuous than the mouth; the broken line in the figure more bent than the continuous line that represents the mouth. Such inclination of the sperm-pocket is the rule and the S-shaped curve is common in the higher species. In another point this sperm-pocket suggests the complex conditions in the annuli of *C. virilis* and *C. affinis*, and that is, the conformation of the posterior part of the pocket. The bottom of the pocket is not coextensive with the mouth, so that the mouth runs along the surface beyond the limits of the bottom, both at the anterior and the posterior ends. At the posterior end the connection of the mouth with the bottom is by an inclined passage, sloping from the surface forward. This passage is slightly dilated right and left, as indicated in Fig. 12. This little

chamber so formed is quite near the surface and farther from the bottom of the pocket. It seems to be the same thing as the "recess" in which the sperm remains longer than elsewhere in the annulus of *C. affinis*. But this chamber is easily understood in this species, while in *C. affinis* it is obscure at first view.

The thick shell walls of the pocket are indicated in the figure by the dotted lines; the shell that lines the pocket was removed, in preparation, from the epidermis and then it was seen that the epidermis that had formed this pocket was an S-shaped, deep groove, out of which the S-shaped shell represented by the dotted

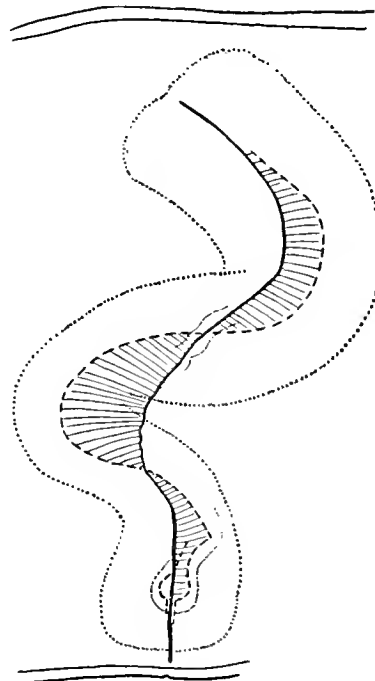


FIG. 12. Ventral view of sperm-pocket, as translucent object, 4A.

lines, had been pulled. Thus, here, as elsewhere the shell-pocket shown in Fig. 12 is cast in an epidermal mould of like form, a mould that exists as an epidermal groove. The epidermal groove secreted so thick a shell as to fill up the groove, all but a narrow slit, and it is this narrow cavity that doubtless is filled with sperm by the male, though in this single specimen no evidence of sperm was found.

A cross-section of this sperm-pocket would be essentially like Fig. 8.

From this one female it is impossible to say whether this species is dimorphic or not, but one may confidently predict that an examination of many specimens would show that there are both right- and left-handed forms. Some would have the sperm-pocket the mirror image of that shown in Fig. 12, so that these females would have the suture reversed and the pocket inclining the opposite way at each turn, as compares with Fig. 12.

We have thus demonstrated that the same sort of sperm-pocket is found in these two crayfishes, *Cambarus cubensis* and *Cambarus paradoxus*, as in all other species of *Cambarus* yet examined and have now found the same essential structure in the annuli of representatives of all the six subgenera of *Cambarus*, so that the sperm-pocket may be regarded as the fundamental feature of the annulus of all the Cambari.

SUMMARY.

The sperm-receptacles found on the ventral surface of the lobster and of the crayfish of the genus *Cambarus* are not homologous with one another, though they have the same use and location. In the lobster the receptacle is an external space covered over by the annular plate of the seventh thoracic somite; in *Cambarus* the receptacle is a narrow pocket invaginated into that same annular plate.

It is shown that in each of the six subgenera of *Cambarus* the annular plate contains the same sort of pocket and hence it is most probable that sperm is stored up in such pockets in all species of Cambari.

The middle plate of the eighth thoracic somite is homologous with the annulus and is variously modified as a hard plate or spine that may be pushed against the annulus. Probably the female brings about the discharge of the sperm from the annulus by use of this plate or spine, when the eggs are being laid.

BALTIMORE, March 21, 1908.

EXPLANATION OF FIGURES.

Drawn with camera and the Zeiss lenses indicated, reduced $\frac{1}{2}$ diameters.

Figures 1-8, *Cambarus (Procambarus) cubensis*.

Figures 9-12, *Cambarus (Paracambarus) paradoxus*.

PROCEEDINGS
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NOTICES OF DECEASED MEMBERS.

William Harris Ashmead.

1855-1908.

WILLIAM HARRIS ASHMEAD, Assistant Curator Division of Insects, United States National Museum, one of the foremost American workers in systematic entomology, died in Washington October 17, 1908, after a lingering illness. Although his death had been expected for some months, owing to the character of the malady that laid him low, it was none the less a great shock to his wide circle of friends among the scientific community of Washington and to the members of the Washington Academy of Sciences, of which he was a charter member, and of which he had been on several occasions Vice-President from the Entomological Society of Washington.

Doctor Ashmead was born in Philadelphia September 19, 1855. He was the son of Captain Albert Ashmead and Elizabeth (Graham) Ashmead, and came of fine old colonial ancestry on both sides. He was educated in the private and public schools of Philadelphia, and early in life entered the publishing house of J. B. Lippincott Company, of that city. Some years later he went to Jacksonville, Fla., and with his brother established a printing house for the publication of agricultural books and other matter. He founded an agricultural weekly, and a daily entitled *The Florida Dispatch*. He edited the scientific department of the weekly, devoting himself chiefly to

the investigation of injurious insects. Through his interest in this field, which became very great, he gradually built up a large collection of insects; and, experiencing great difficulty in securing determinations, began the study of systematic entomology. From the very first he was a tremendous worker and produced results with astonishing rapidity. His contributions to the scientific journals began in 1879, and from that date until the time of his final collapse he produced a long series of contributions to science, comprising more than 250 titles and including many papers of great systematic value.

In 1887 he received an appointment as Special Field Entomologist to the Division of Entomology of the United States Department of Agriculture, for the investigation of certain Florida problems. In 1888 he was appointed Entomologist to the State Agricultural College and Experiment Station at Lake City, Fla., and while holding that position, published one of the very first bulletins produced by an entomologist of an agricultural experiment station under the Hatch Act. It was entitled "Notes on Various Injurious Insects." In 1889 he was made an assistant entomologist and investigator of the Division of Entomology of the United States Department of Agriculture. During the winter of 1889-90, on leave of absence, he went abroad and studied for several months in Berlin. On his return he continued his work under the Division of Entomology, and in 1895 was appointed Assistant Curator of the Division of Insects, United States National Museum, which position he held until a few months before his death. He donated his large private collection to the Museum about 1898.

As a worker Doctor Ashmead was possessed of an enthusiasm and of an industry that has rarely been equaled. For many years he allowed himself but five hours, or a little more, sleep, devoting the remainder of his time, with the exception of that needed for eating, to an incessant study of the forms in which he was for the time interested. The amount of work thus accomplished was enormous. Either of his two main works, namely, his Monograph of the North American Proctotrypidæ, published as Bulletin 45 of the United States National Museum, a work covering some 500 pages, or his Classification of the

Chalcid Flies or the Superfamily Chalcidoidea, published by the Carnegie Museum, Serial No. 21, a quarto volume of 335 pages, would have been enough to have monopolized the working part of the lifetime of any one ordinary man. But aside from these he left nearly ready for publication a great monograph of the Braconidæ, and he had published very many smaller classificatory papers of high standing.

Doctor Ashmead was given the degree of Master of Science by the Florida State Agricultural College, and in 1904 was made a Doctor of Philosophy by the Western University of Pennsylvania, the Monograph of the Chalcidoidea just mentioned having been submitted as his thesis. He was prominent in scientific circles. He was a fellow of the American Association for the Advancement of Science, and a corresponding member of the American Entomological Society of Philadelphia. He had been Vice-President of the Biological Society of Washington, President of the Cambridge Entomological Society (1894), President of the Entomological Society of Washington (1894-5), Vice-President of the Washington Academy of Sciences (1888, 1893, 1894), honorary member of the Entomological Society of Ontario, and Vice-President of the Association of Economic Entomologists (1892). He married in Philadelphia in 1878, Harriet, the daughter of Thomas O. Holmes. He leaves a widow and one married daughter. He was a member of the Cosmos Club, of Washington, and of its very important committee on admissions.

When he came to Washington he was a man of large property, which however, was greatly reduced by the disastrous Jacksonville fire. This, however, did not appear to prey upon his mind and he remained until the end the same cheerful, tireless worker in the field of pure science. Like so many indefatigable workers in science, Dr. Ashmead was most helpful to his fellow workers. His knowledge and his time were always at the disposal of other workers, and he was noted for his helpful attitude towards younger investigators. He had the kindest of hearts, and will always be remembered by those who knew him.

L. O. HOWARD.

George W. Atherton.

1837-1906.

GEORGE W. ATHERTON, president of The Pennsylvania State College, died at State College, Pa., on July 24, 1906.

He was born at Boxford, Mass., on June 20, 1837, coming of good New England stock. Left fatherless at the age of 12, he supported himself and aided his mother and sisters by work in a cotton mill and later, on the farm and by teaching. He worked his way through Philips Academy, Exeter, N. H., and in 1860 entered the sophomore class at Yale. At the outbreak of the Civil War he responded to the call to arms, and on recommendation of President Woolsey was commissioned First Lieutenant in the Tenth Connecticut Volunteers. He took part in Burnside's North Carolina expedition, where he served with conspicuous bravery and efficiency, and was promoted to a captaincy.

Leaving the army in 1863 on account of failing health, he was graduated from Yale with his class, and on Christmas of the same year was married to Frances D. W. Washburn, who, with two sons and two daughters, survives him. For the next four years he was a professor in the Albany Boys' Academy, of Albany, N. Y. and for the succeeding year a professor, and during most of the year, acting principal, of St. John's College at Annapolis, Md.

In 1868, he was called to the newly established Illinois Industrial University — since become the University of Illinois — and took part in the organization of that institution, being closely associated with its first president, Dr. Gregory. After a single year's activity there, however, he accepted a very flattering offer from Rutgers College, and for the succeeding fourteen years filled the chair of political economy at that institution.

In 1873 he served as a member of the Board of Visitors to the United States Naval Academy. In 1875 he was a member of the commission to investigate the charges of corruption at

the Red Cloud Indian Agency preferred by Prof. O. C. Marsh, of Yale, having been added along with the Hon. Timothy Howe, of Michigan, by personal action of President Grant, to a commission of three, previously appointed by the Secretary of the Interior. In 1876, much against his wish, he was made the Republican candidate for Congress for his district. Although the district was hopelessly Democratic, he threw himself into the contest with characteristic energy and, while not elected, ran considerably ahead of the Presidential ticket. In 1878 he was appointed chairman of a commission to prepare and present to the legislature of New Jersey a digest and revision of the State system of taxation. While engaged in this work he found time to study law, and was admitted to the New Jersey bar while still carrying on his college work.

Both his studies in economics and his activity in public affairs naturally led him to interest himself in the development of industrial education, which occupied so large a share of educational thought during those years, particularly in connection with the land-grant act of 1862. In 1873 he presented an elaborate paper before the National Educational Association upon the subject "The Relation of the General Government to Education." In the course of this paper he traced in considerable detail the history and development of the land-grant colleges up to that time and emphasized those broad conceptions of their functions in our educational system and of the importance of the type of education which they were designed to give, to the concrete development of which he was to contribute so largely.

In 1882 he accepted the presidency of The Pennsylvania State College and began that work for which his previous life had been the unconscious preparation.

This institution was one of the first fruits of that revolution in the subject-matter and methods of education which characterized the middle years of the nineteenth century. Its foundation was so closely synchronous with that of the Michigan and Maryland agricultural colleges that the degree of priority is largely a question of definition. Chartered in 1855 and opened to students in 1859, its first five years gave promise of a successful

career; but later, through official neglect and public indifference, its affairs had reached a low ebb, and at the time when Dr. Atherton was elected president the entire work of the college was carried on in a single building, which also served to shelter the families of several professors, and the total assured income of the institution was \$30,000 per year from the Morrill fund. For the following college year, 1882-3, the number of collegiate students dropped to 34 and the total enrollment to 87, while the graduating class numbered 5.

The growth of the college in numbers and in material equipment in the twenty-four years of Dr. Atherton's administration was nothing short of marvelous. The enrollment of 87 in 1882-3 became 800 in 1905-6; the graduating class, on whom he conferred their degrees at his last official act, numbering 86. The faculty increased in the same period from 16 to 66, besides 20 "assistants in administration." The work which in 1882 was carried on in a single building was, at the close of his administration, distributed among fourteen, the cost of the new buildings erected having been nearly \$1,000,000, this including the magnificent Schwab Auditorium and Carnegie Library. The total of the State appropriations to the college during his presidency was nearly \$1,500,000, as compared with \$183,000 during all its previous history.

Despite the demands of his college work, Dr. Atherton found time and energy for other notable public activities. He was a leading spirit in the activities which resulted in the passage in 1887 of the Hatch act providing for the establishment of agricultural experiment stations, and also in 1890 of the second Morrill act providing further endowment for the colleges of agriculture and mechanic arts. He was largely instrumental in organizing the Association of American Agricultural Colleges and Experiment Stations and served two years as its first president. In 1887 he was appointed by Governor Beaver chairman of a commission of five, appointed under a joint resolution of the legislature, "to make inquiry and report to the next legislature . . . respecting the subject of industrial education." Special reference was had in the resolution to the question of the incorporation of industrial training into the existing system

of public education, and to the training of teachers for this purpose. The report of this commission, which was largely his work, was recognized as the most comprehensive and thorough treatment of the subject up to that time. In 1891 he was for the second time appointed on the Board of visitors to the United States Naval Academy and in 1895 he was appointed a member of the College and University Council of Pennsylvania, of which he continued a member until his death.

Dr. Atherton was an indefatigable worker, never sparing himself in the service of the college or of the larger public, and he inspired his associates with like zeal. He had the courage and poise of the born leader of men. Never dismayed or disconcerted by opposition or attack, accepting defeat as the stepping stone to future success, with an open mind welcoming every suggestion from others yet with supreme confidence in his own carefully considered conclusions, he bore his great responsibilities with a quietness and simplicity which were an inspiration to his associates. He was an optimist in the best sense, believing profoundly that right is stronger than wrong and that high and worthy ideals must ultimately triumph, and he showed his faith by his works.

HENRY PRENTISS ARMSBY.

Wilbur Olin Atwater.

1844-1907.

PROF. WILBUR OLIN ATWATER, whose death occurred September 22, 1907, at his home in Middletown, Conn., after an illness of nearly three years, was the son of a Methodist clergyman well known in New England, and was born in Johnsbury, N. Y., May 3, 1844.

He received his academic training at the University of Vermont and at Wesleyan University, Middletown, Conn., graduating from the latter institution in 1865. During a period of postgraduate study at Yale University, which led to the doctor's degree in 1869, he was associated with Professors S. W. Johnson and W. H. Brewer and had his attention called to agricultural chemistry and the great possibilities this subject offered to investigators. With an insight which characterized him throughout his career, he recognized the future possibilities of such work and from 1869 to 1871 he studied agricultural and physiological chemistry in the Universities of Berlin and Leipsic and acquainted himself with the European agricultural experiment station movement. His career as a college teacher began immediately after his return from Europe at the University of Tennessee and at the Maine State College, and he was thus brought into close touch with the movement for agricultural education and research which was at this time taking shape in the United States. He was called to Wesleyan University in 1873, where he held a professorship of chemistry for over thirty years and at his death was head of the chemical department in that institution.

The first agricultural experiment station in the United States was organized in Connecticut in 1875 largely through Professor Atwater's efforts, and he was made its first director. Interest in the experiment station movement spread rapidly and the passage by Congress in 1887 of the Hatch act made possible the establishment of such a station in every state and territory. In

Connecticut the funds were divided between two experiment stations and Professor Atwater was made director of the Storrs Station and retained this position for fourteen years. During this period a relatively large amount of scientific work along chemical lines and other lines related to agriculture was carried on by the station. Of especial interest were Professor Atwater's studies on the acquisition of atmospheric nitrogen by plants, begun several years prior to the establishment of the Storrs Station and continued as a part of the work of that station from 1888 to 1892.

On the invitation of Commissioner Colman, of the United States Department of Agriculture, Professor Atwater consented to become the first director of the Office of Experiment Stations, established in the Department of Agriculture for the general direction of the agricultural experiment station movement, accepting this position on the condition that he be permitted to retain the directorship of the Connecticut Storrs Station and his college professorship at Wesleyan University. That this Bureau has in later years followed with great success the general policies laid down by Professor Atwater is a proof of his wisdom and foresight in establishing this work.

A long list of articles in scientific and popular journals, in publications of the Connecticut Storrs Experiment Station and United States Department of Agriculture, etc., shows the contributions which Professor Atwater has made to the development of agricultural chemistry and agricultural education. Especially noteworthy is the establishment of the series of farmers' bulletins in 1889 under his advice and direction, a class of publications which has become of the greatest importance for the dissemination of information along agricultural lines. He was also founder of the Experiment Station Record, an abstract journal published in the Office of Experiment Stations, of which the first volume appeared in 1889. This journal covers the field of agriculture and related sciences and its circulation among students and investigators is world wide.

The influence of Professor Atwater on the development of agricultural research in the United States has been greatly broadened through the men who came into direct association

with him as students or co-workers and who have since become directors of agricultural experiment stations, professors in agricultural colleges, and influential in other capacities in the movement for agricultural education and research.

Parallel with his studies in agricultural chemistry, including animal nutrition, Professor Atwater began early in his career to carry on investigations in physiological chemistry with special reference to problems in human nutrition. Between 1879 and 1883 he made extensive studies of the chemical composition and nutritive value of American food fishes and invertebrates for the United States Commissioner of Fish and Fisheries and carried on work along similar lines for the Smithsonian Institution. Studies of the dietaries of people in Massachusetts and Canada were also made for the Massachusetts Bureau of Statistics of Labor and published in 1886. Nutrition investigations were also carried on during this period as part of the regular work of the Connecticut Storrs Experiment Station.

In 1893, Congress made an appropriation for investigations in human nutrition in coöperation with the agricultural experiment stations, assigning the supervision of this enterprise to the Department of Agriculture where it was made a part of the work of the Office of Experiment Stations. Headquarters for this enterprise were established at Middletown, Conn., and Professor Atwater was made its official chief. The work was broadly planned and steadily developed until it became the most comprehensive investigation on this subject ever undertaken. The coöperation of universities, colleges, and schools, experiment stations, public institutions, and private organizations of various kinds was secured in different parts of the country. Hundreds of dietary studies of people of different occupations were made and the results of similar studies throughout the world were collated. Numerous digestion experiments with men were carried on and special studies were made of the nutritive value of different cereals, meats, vegetables, fruits, and nuts, the effects of cooking and other forms of preparation on nutritive value, and other important food problems. Special efforts were made to improve methods and apparatus for such work.

In 1882-3, Professor Atwater devoted considerable time at

the Universities of Munich and Heidelberg in familiarizing himself with the German methods of studying nutrition problems, and familiarity with the Pettenkofer-Voit respiration apparatus, gained during this period, led him to undertake the construction of a similar device which should, however, include the measurement of the income and outgo of energy in addition to the income and outgo of matter. The respiration calorimeter, which was eventually developed by him and his associates is unrivaled in its class as an instrument of precision, useful for the study of a very large variety of problems connected with the physiology and nutrition of man and animals. The bomb calorimeter and the methods of its use were also materially improved under his direction.

The studies in human nutrition already made with the Atwater-Rosa-Benedict respiration calorimeter have been very important and promise to be still more so. Direct evidence has been obtained that the law of the conservation of energy holds good in the utilization of food in the human body; important data have also been obtained regarding the actual nutritive value of different foods and the relations of food to muscular energy and mental work.

As the Chief of Nutrition Investigations in the Office of Experiment Stations, Professor Atwater planned and supervised investigations which were carried on in about twenty States. The results of this work are embodied in about one hundred technical and popular publications issued by the United States Department of Agriculture and the Storrs Experiment Station.

In the judgment of competent experts, the nutrition investigations conducted under Professor Atwater's direction were more thorough in their scientific methods, more extended in the scope and amount of investigation, and more useful in the distribution and practical application of their results than any other inquiry of the kind ever undertaken in this country or in Europe.

Professor Atwater's aid was often sought in the study of nutrition problems. As instances may be mentioned the extended investigations of dietetic problems undertaken for the New York State Commission in Lunacy, studies of the nutritive value of alcohol carried on for the Committee of Fifty to

Investigate the Liquor Problem, and the series of investigations undertaken for the Carnegie Institution of Washington.

Professor Atwater's career as a teacher was markedly successful as is evidenced by the large number of his students and associates who are carrying on work in this and other countries of which he was in very large measure the inspiration.

As a public official working in a wide way in the organization and management of enterprises for the general good, Professor Atwater has earned the lasting gratitude of his countrymen, especially by what he did in connection with the agricultural experiment stations and the nutrition investigations. To this work he brought a well trained mind and a true scientific purpose. He had the enthusiasm and persistence necessary to impress other men with the importance of his enterprises and to carry him successfully over periods of opposition and discouragement. He had unusual ability in the conception and formulation of broad lines of work, and in attracting and holding men competent to give him such aid as he needed to complete these plans, put them into successful operation, and secure substantial results.

Professor Atwater was a member of many learned societies and received many honors in the United States and Europe. His influence on the development of agricultural education and research in this country and on the study of human nutrition has been of very great and prominent value.

A. C. TRUE.

Swan Moses Burnett.

1847-1906.

SWAN MOSES BURNETT was born in New Market, Tennessee, March 16, 1847, and died in Washington, D.C., January 18, 1906.

He graduated in medicine from Bellevue Hospital Medical College, New York City, now the Medical Department of New York University, in 1870, and first settled in Knoxville, Tennessee, where he was engaged in practice for 5 years. In 1873 he married Miss Frances Hodgson. In 1875 he removed to the District of Columbia, and soon attained prominence as a specialist in ophthalmology and otology, as well as in literary and art circles. He is the author of a Treatise on Astigmatism, a Treatise on Refraction of the Human Eye, and over 64 distinct articles on diseases of the eye and ear, and chapters in text-books. He was associated with Dr. John S. Billings in the production of the National Medical Dictionary, and with Doctors Norris and Oliver in that of the "System of Ophthalmology." He also wrote a number of magazine articles and public addresses.

In 1878 he was appointed lecturer on ophthalmology and otology in the School of Medicine, Georgetown University, continuing in this capacity until 1883, when he became clinical professor, which position he filled until 1889, since which time until his death he was professor in those branches. In 1879 he established a post-graduate course in ophthalmology and otology, in connection with his hospital and private practice, and rendered most distinguished services as an author, teacher and clinician.

He was president of the attending staff of the Central Dispensary and Emergency Hospital, to which institution he gave much of his time and skill. He founded and equipped in said hospital the "Lionel laboratory" in memory of one of his sons, "Little Lord Fauntleroy." This laboratory was the first to be

established in connection with a hospital for clinical, bacteriological and pathological research in the City of Washington.

He was for many years the ophthalmologist and otologist of the Children's and Providence Hospitals, and also a member of the consulting staff of the Episcopal Eye, Ear and Throat Hospital. In 1889 he was elected president of the Medical Society of the District of Columbia, and was a member of the Washington Academy of Sciences, Philosophical Society, Anthropological Society, Historical Society, the American Ophthalmological and Otological Society. In 1896 he was elected to the presidency of the Cosmos Club of Washington, of which he was one of the founders.

His degree of Doctor of Philosophy was bestowed by the University of Georgetown in 1890. During his service extending over 25 years in the cause of higher medical education, he was distinguished for his devotion to his calling and was unexcelled as a teacher, scholar and gentleman. His kind, open and earnest manner, his clear, concise and comprehensive lectures could not fail to impress his students, while his shining example always upheld the ethics of the profession and the dignity of the physician and teacher.

Doctor Burnett died of chronic myocarditis, at his residence 916 Farragut Square, Washington. His second wife and his son Vivian survive him.

Among his literary contributions and important writings are the following: Translation of Edmond Landolt's Manual of examination of the eyes. A course of lectures delivered at the École Pratique, Rev. Edit., VII, 9-312 pp., 1 ch., 1 table, 8°, Phila., 1879. A theoretical and practical treatise on astigmatism, VIII, 245 pp., 8°, St. Louis, 1882.

The principles of refraction in the human eye based on the laws of conjugate foci. 67 pp., 8°, Phila., 1904.

Study of refraction from a new viewpoint. Phila., 1905.

See also Billings, J. S. The National Medical Dictionary. Roy. 8°, Phila., 1890. — Landolt, E. The introduction of the metrical system into ophthalmology. 8°, London, 1876. Diseases of the conjunctiva and sclera. 82 pp., 2 pl., 8°, Phila., 1898, contained in Vol. II of Syst. Dis. Eye (Norris & Oliver).

Of the 64 distinct contributions to medical literature the following are mentioned :

A case of diplacusis binauralis with remarks. 10 pp., 8°, New York, 1877. Repr. from Arch. Ophth. & Otol., N. Y., 1876.

A case of choroiditis exsudativa. 11 pp., 8°, New York. Repr. from Arch. Ophth. & Otol., N. Y., 1877, 8°, VI.

Double optic neuritis (choked disc) and sloughing of the right cornea accompanying a sarcomatous tumor on the right side of the brain. 10 pp., 8°, New York. Repr. from Arch. Ophth. & Otol., N. Y., 1877, 8°, VI.

Results of an examination of the color sense of 3,040 children in the colored schools of the District of Columbia. 9 pp., 8°, New York. Repr. from Arch. Ophth., N. Y., 1879, VIII.

A systematic method for the education of the color sense in children. 4 pp., 8°, Washington, 1879. Repr. from Arch. Ophth., N. Y., 1879.

A case of acute chemosis. 3 pp., 8°, New York, 1880. Repr. from Arch. Ophth., N. Y., 1880, IX.

A case of primary external inflammation of the mastoid. Repr. from Arch. Otol., N. Y., 1880, IX.

Objective aural sounds produced by voluntary contraction of the tubal muscles. 3 pp. Repr. from Arch. Otol. N. Y., 1879, VIII.

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The comparative frequency of eye diseases in the white and colored races in the United States. Repr. Arch. Ophth. and Otol., N. Y., XII.

A nomenclature of ophthalmology. Repr. from Am. Jour. Ophth., St. Louis, 1884, I.

Theories of color perception. Repr. from Am. J. M. Sc., Phila., 1884, LXXXVIII.

Clinical contributions to the study of ringscotoma. Repr. Tr. Am. Ophth. Soc., Boston, 1887, IV.

An analysis of the refraction of 576 healthy human corneas examined with the ophthalmometer of Javal and Schlötz. Repr. from Tr. Am. Ophth. Soc., Hartford, 1888-90, V.

Reciprocal responsibilities. An address. 15 pp., 8°, Wash., D. C.

The physician as a man and citizen. 24 pp., 8°. Repr. from J. A. M. Assoc., Chicago, 1891, XVI.

Contributions to clinical ophthalmology. Rep. from Arch. Ophth., N. Y., 1892, XXI.

The general form of the human cornea and its relations to the refraction of the eye and visual acuteness. Repr. from Tr. Am. Ophth. Soc., 1894-6.

Some exceptional features in cataract extraction. Repr. from Va. Med. Monthly, Richmond, 1895-6, XXII.

The racial and geographic distribution of trachoma in the United States of America. Repr. from Am. Ophth., St. Louis, 1896.

A study of ocular coloboma. Repr. from Am. J. Ophth., St. Louis, 1898.

Gangrenous ulceration affecting the face including the lids of both eyes and destroying the eyeballs, the results of bites by a man. Repr. from J. Am. M. Assoc., Chicago, 1899.

Removal for relief of persistent headache of an ounce rifle bullet imbedded in the bones of the right temporal fossa, where it had lain unsuspected for 34 years. Repr. from J. Am. M. Assoc., Chicago, 1899.

A case of obstructed retinal circulation with a series of pictures showing the changes in the vascular system during its reestablishment of new vessels in the retina. Repr. from Ophth. Rec., Nashville, 1899.

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The position of ophthalmology in the curriculum of the

modern medical school, etc. Repr. from Am. J. Ophth., St. Louis, 1901, Febr.

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Appearance simulating optic neuritis due to unsuspected irregular corneal astigmia. Repr. from Am. J. Ophth., St. Louis, 1904.

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GEORGE M. KOBER.

James Carroll

1854-1907

JAMES CARROLL, the second in command on the Yellow Fever Commission, United States Army, was an Englishman, born at Woolwich, on June 5, 1854. His early years, like those of many men whose maturity is spent in a country not their own by birth, are little known, especially as his entire lack of egotism prevented his dwelling upon them. He was educated at a private school, Albion House, with a view to his entering the British Navy as an engineer student, but shortly before the time came for his admission, he emigrated to Canada. For some time after he reached Canada his life was that of a farmer in the backwoods, until, in course of time he came to the States, and in January, 1874, he enlisted in the United States Army.

Upon enlisting he was ordered to the far west, and while serving in Montana as a hospital steward he became interested in the study of medicine. After some difficulty he obtained permission to attend medical lectures at St. Paul, Minnesota, and from this time on he pursued his medical education as he could and where he could, until, on his return to the east he finally completed it at the University of the City of New York and the University of Maryland, receiving his degree of M.D. from the latter institution in 1891. He became intensely interested in the new science of bacteriology, then beginning to develop in this country, and availed himself of the graduate classes just opened at Johns Hopkins Hospital to prosecute this line of work. In 1895 he was assigned to duty in the Army Medical Museum at Washington, where Walter Reed was Curator, and from this time forward these two men were constantly associated as co-laborers. In 1899 Reed and Carroll were appointed by Surgeon-General Sternberg to investigate the true nature of the *Bacillus icteroides*, which Sanarelli had just declared to be the specific agent of yellow fever. Their work on this subject naturally associated their names prominently with

the great yellow fever question; and thus when, in 1900, an Army Medical Commission was appointed to go to Cuba and investigate the nature and transmission of this scourge of centuries, Reed was made Chairman with Carroll as second in command.

Carroll arrived in Cuba on June 25, 1900, and shortly afterward the preliminary experiments were begun. Early in the course of the work it became evident to the members of the Commission that the proposed line of work could not be carried on without experiments upon human beings and they agreed that the initial experiment must be made upon one of themselves. Carroll volunteered for this service, and he always said that the proudest circumstance of his life was that he was the first person to succumb to mosquito inoculation. He had a severe attack of the disease, during which his life was despaired of, and although he recovered, it was with an organic heart lesion which ultimately caused his death.

Carroll's services upon the Yellow Fever Commission, apart from the inestimable act of self-sacrifice just mentioned, were of the most essential character, and it is not at all too much to say that without his native force and perseverance, guided by his scientific knowledge and training, the work of the Commission could scarcely have been carried to a conclusion. Circumstances obliged Dr. Reed to leave Carroll in charge of the preliminary experiments while he himself returned to the United States on business connected with them, and it was entirely through Carroll's exertions at this time that they were brought to a satisfactory conclusion and the demonstration completed by the time Dr. Reed was again in Cuba. Again, in February, 1901, when the fact that yellow fever is transmitted by the *Stegomyia calopus* was definitely proved, and Reed went home, Carroll remained behind for several weeks to determine one or two additional points necessary to the perfect completion of their experiments. His most valuable, as well as his most independent service, of this description, however, was rendered in the following summer, when he returned to Cuba in order to undertake another line of experiments, intended to determine whether the specific agent of yellow fever is contained in the

blood. He encountered most serious difficulties before he could achieve his end, but it was finally accomplished, and without it the yellow fever experiments would undoubtedly have been far less useful to mankind. The points which were established by Carroll's individual efforts during this visit are:

1. That the specific agent of yellow fever is present in the blood during at least the first, second, and third days of the disease.

2. That the specific agent is destroyed, or at any rate attenuated by heating up to 55° C. for ten minutes.

3. That yellow fever can be produced by the injection of a small quantity of diluted serum taken directly from a patient and passed through a Berkefeld filter.

4. That, as the specific agent is capable of passing through a Berkefeld filter, it must belong to the class of organisms known as *ultra-microscopic*.

Yellow fever was not the only disease which Carroll employed his knowledge of bacteriology to investigate. In 1898 he was sent to Camp Alger to study the blood of the fever patients there and it was he who first showed that the illness prevailing among the troops there was typhoid fever and not malaria. On several other occasions he was employed to investigate typhoid fever.

After his return to the United States in 1901, Carroll continued to disseminate the valuable knowledge which he had acquired on the subject of yellow fever through the medium of the medical press. The first paper which he published independently, on "The Treatment of Yellow Fever," is the first contribution to the therapeutics of the disease after its mode of transmission became known; his last is the section on yellow fever in the second volume of Osler's "System of Medicine."

For some years Carroll's services received no official recognition, but during the last year of his life honors began to come to him in which he took a manly and justifiable pleasure. He was promoted from the rank of Lieutenant to that of Major, and two universities, the University of Nebraska and the University of Maryland, conferred upon him the honorary degree of LL.D. In the summer of 1907 the heart lesion, which originated in his

attack of experimental yellow fever, asserted itself and his health began to fail. He died at his Home at Washington on September 16, 1907.

In reviewing the facts of Carroll's life it is plain that he had the elements of success in him from the first. He was the typical *vir tenax propositi*, and this quality in his nature manifested itself in a persistence which, if not a necessary element of genius, is at least its closest ally and is often, pardonably, mistaken for it. His personal character was one which commanded respect and inspired the warmest affection. He was, as his former student, Dr. Donally, said of him, "a good man and a square," true and just in all his dealings, faithful in all his relations to those in authority over him, kindly and considerate to those under his command. Whatever his hand found to do he did it with his might, measuring the extent of his exertions by his duties and responsibilities, not by the value to himself of success achieved. He was modest almost to a fault and one of his most striking characteristics was a singular simplicity and trustfulness. He had an abiding sense of justice, his trust in human nature causing him always to believe that this sense was as strong in others as himself, while his belief in the final ordering of all things for good was the simple confidence of a child which trusts implicitly in higher powers whose failure to do right it cannot conceive.

HOWARD A. KELLEY.

Emil Alexander de Schweinitz.

1864-1904.

EMIL ALEXANDER DE SCHWEINITZ was born in Salem, North Carolina, in the year 1864. He was a son of Bishop de Schweinitz of the Moravian church, and a grandson of the Rev. Lewis David de Schweinitz, who is well known on account of his many additions to the knowledge of fungi and other plants in the United States. Emil Alexander de Schweinitz received his early education at the Nazareth Hall High School and the Moravian College of Bethlehem, Pennsylvania, and subsequently entered the University of North Carolina from which he received the degree of Doctor of Philosophy. From the University of North Carolina he went to the University of Berlin, and later entered the University of Göttingen, receiving from the last-named institution the degree of Doctor of Philosophy.

During the time spent in Germany the greater part of his labors was devoted to the study of chemistry and allied subjects. Upon returning to the United States he was engaged to teach chemistry in Tufts College, Massachusetts, and after a short while was made Professor of Chemistry in the Agricultural and Mechanical College of Kentucky. In 1888 he received an appointment as an assistant in the Division of Chemistry of the United States Department of Agriculture. On January 1, 1890, he was transferred from the Division of Chemistry to the Bureau of Animal Industry in the Department of Agriculture, and was placed in charge of the biochemical researches which were begun by the last named bureau on that date. The work along these lines increased so rapidly that a separate Division of Biochemistry in the Bureau of Animal Industry was created and Dr. de Schweinitz was placed at its head. This position he occupied until the day of his death.

After entering the Bureau of Animal Industry his labors were confined almost entirely to research work concerning the metabolic products of disease-producing bacteria, the chemical com-

position of the bodies of these bacteria and the production of immunity therefrom. Owing to the special interest of the Bureau of Animal Industry in those diseases which attack the domesticated animals, his attention was directed in great part to the study of the etiology, the treatment, and the methods of protection from such animal scourges as tuberculosis, hog cholera, swine plague and glanders. His most important contributions to science were probably those which dealt with the production of immunity from tuberculosis. While not the first to note a successful vaccination of laboratory animals against this disease, he was the first to record the use of attenuated human tubercle bacilli for the production of immunity from tuberculosis in cattle.

In the later years of his life he had given much time and energy to the production of a suitable vaccine for hog cholera. At the time of his death he had almost completed several extensive experiments dealing with the intertransmissibility of human and bovine tuberculosis. These experiments which have since been published, are generally recognized as important additions to our knowledge of this subject.

Dr. de Schweinitz was elected to membership in the American Public Health Association in 1896 and was also a member of the Section of Bacteriology and Chemistry from the time of its organization, having served on the council and various committees of the section. He was several times vice-president of international congresses on tuberculosis and hygiene which were held in Paris and Berlin, and his research work was well known and highly regarded abroad as well as in the United States.

In addition to the duties Dr. de Schweinitz performed as Chief of the Biochemic Division of the Bureau of Animal Industry, he was also Dean of the Medical School and Professor of Chemistry and Toxicology in that department of the Columbian University. In 1895 that institution conferred upon him an honorary degree of doctor of medicine. A complete bibliography of his writings has been prepared by Dr. Charles Wardell Stiles and may be found in *The Columbian University Bulletin*, No. 1.

His death, which was caused by uræmia, took place on

February 15, 1904, and came as the greatest shock to his co-laborers and friends. The Bureau of Animal Industry has lost a faithful and highly honored official and medical science has lost an investigator who did much toward clearing up the little-known paths of chemical pathology. We honored him for his scholarly achievements, and mourn his loss as that of a friend and an investigator who was cut off in the midst of his labors. As brilliant as was his past work, the future promised even greater achievements.

M. DORSET.

Daniel Coit Gilman.

1831-1908.

DANIEL COIT GILMAN was born in Norwich, Connecticut, July 6, 1831. In 1848, at the age of seventeen, he was admitted to Yale College and was graduated B.A. in 1852. His residence in New Haven was in the family of his uncle, Professor James L. Kingsley, whose varied learning, accurate scholarship and keen perceptions were stimulating and inspiring. In college he took a highly honorable position in scholarship, was president of the Linnæan Society, one of the editors of the *Yale Literary Magazine*, a member of Delta Kappa, of Alpha Delta Phi, and of the Beethoven Society, the Atalanta Boat Club, of Skull and Bones, and of Phi Beta Kappa. In the year following his graduation he was engaged in private teaching and literary work at New Haven, continuing at the same time his own studies, and was entered for some months as a resident graduate at Harvard College, where his home was with Professor Arnold Guyot.

In December, 1853, he and his life-long friend, Andrew Dickson White, sailed for Europe as attachés of the American Legation at St. Petersburg, under Ex-Governor Thomas H. Seymour, minister-plenipotentiary. Pending the arrival of Governor Seymour, whom he preceded by a few weeks, he traveled in England; and when he was not yet twenty-three years old, under the auspices of Mr. Richard Cobden and Mr. John Bright, at a large meeting of the National Public Association at Manchester, he delivered an address on "Common School Education in America," which was enthusiastically received. His connection with the legation at St. Petersburg afforded unusual facilities for observing the work of the great library and other institutions of learning, of technical schools, and reformatories, particularly for children of the Imperial Court, and of the great fortifications at Cronstadt during the French-English-Russian war. As a correspondent of the New York

Journal of Commerce, the *Independent*, and the *Tribune*, and as an occasional contributor to other periodicals, his letters, before the days of ocean telegraphs, not only from Russia but also from Berlin some months later, when he was a student in the university, were interesting and instructive. During his residence in Berlin he established lasting friendship with many distinguished scholars, among whom were Professor Perts, the historian and royal librarian, and, in the department of physical and political geography in which he was specially interested, with the eminent Karl Ritter and F. Adolph Trendelenburg. In 1855 he was appointed commissioner from the state of Connecticut to the Universal Exposition at Paris, where he became secretary of the Board of Associated Commissioners.

Returning to New Haven at the close of 1855 he was made assistant librarian of Yale College in 1856, and becoming librarian in 1858, he held that position until he resigned it in 1865. He was appointed secretary of the State Board of Education, was associated with the Honorable Henry Barnard in the publication of the *Connecticut Common School Journal*, and coöperating with Professor Arnold Guyot, prepared a series of school geographies and maps. He was also a contributor to Appleton's *American Encyclopedia* under the editorship of Charles A. Dana, and with Professor William D. Whitney and others, assisted Professor Noah Porter in the revision of Webster's Dictionary.

After resigning the office of librarian in 1865 he devoted himself more directly to his duties as professor of physical and political geography in the Sheffield Scientific School, to which office he had been appointed by the corporation of Yale College in 1863. Associated with Professor George J. Brush and others, he was efficient in extending and developing the work of the school of which he became practically the chief executive, securing for it large subscriptions for its permanent endowment, especially in connection with the munificent gifts of Joseph E. Sheffield, and Oliver S. Winchester and the family of Mrs. Cornelia L. Hillhouse, for an astronomical observatory. In 1870 he was elected President of the University of California, but declined the office, which, however, he assumed on his re-

election in 1872. Continuing in that position for three years he reorganized and greatly enlarged the work of the university and was successful in establishing it on the firm foundation where it has continued to grow and prosper.

Called to the presidency of the newly founded Johns Hopkins University at Baltimore in 1875, before a brick or stone had been laid, or a teacher or student enrolled, he devoted himself heart and soul to its organization and upbuilding, and at the end of a quarter of a century resigned the office, leaving behind him in the University and in the Johns Hopkins Hospital of which he was the first superintendent, and in the medical school of the University, enduring monuments of his genius as an organizer and administrator, of his inspiring influence with his colleagues and students as an educator, and of his wise discrimination in assembling a permanent staff of brilliant instructors and eminent scholars and scientists of Europe and America as occasional lecturers. From the beginning his motto was Men before Buildings.

He was a frequent contributor to newspapers and periodicals in regard to social science, civil service reform, charity organization, general education and scientific research. He delivered many academic discourses some of which were collated under the titles "University Problems" and "Launching of a University."

He was the biographer of James Monroe, in the Statesmen's Series, and of Professor James D. Dana of Yale College; was editor of the works of Doctor Francis Lieber and of Doctor Joseph P. Thompson, and of a new edition of De Tocqueville's Democracy in America. He was a contributor to Johnson's Universal Cyclopædia and was editor-in-chief of the New International Encyclopædia. He was chairman of the Committee on Awards at the Atlanta Exposition of 1895. He rendered efficient service as a member of the Venezuelan Commission in 1896, under appointment by President Cleveland. He was president of the American Bible Society; president of the American Oriental Society; one of the commission to draft a charter for the city of Baltimore, especially in the sections of Education and Charities; president of the Civil Service Reform

Association; president of the board of trustees of the John F. Slater Fund; vice-president of the Peabody Education Fund; an incorporator of the General Education Board, was for three years president of the Carnegie Institution, and became later a trustee of the Russell Sage Foundation. He received the honorary degree of Doctor of Laws from Harvard University and from St. John's College, Maryland, in 1876; from Columbia University in 1867; from Yale University and from the University of North Carolina in 1889; from Princeton in 1896; from the University of Toronto in 1903; from the University of Wisconsin in 1904; from William and Mary College and from Clark University in 1905.

In his multifarious and important duties he never sought political preferment, personal fame, or pecuniary reward, but through a life of great activity "held his rudder true" with an unswerving purpose to acquire and impart useful knowledge, and by his voice and pen and personal influence to realize the hopes of his youth in promoting and advancing sound education in all departments from primary and technical schools to the highest institutions of learning.

Between 1853 and 1908 he made ten voyages to Europe extending his travels to Algiers, Egypt and Jerusalem. The summer of 1908 was spent for the most part in southern Europe. He returned on October 7, seemingly in improved health, and after brief visits to his daughter and to relatives in Newport he went to the home of his sisters in Norwich, Connecticut, where he died suddenly on Tuesday afternoon, October 13, 1908.

He married in 1861, Mary Keycham, daughter of Tredwell Keycham, of New York. She died in 1869, leaving two daughters who survive their father.

In 1877 he married Elizabeth Dwight Woolsey, daughter of John M. Woolsey of Cleveland, Ohio, and niece of President Theodore Dwight Woolsey, of Yale University.

His domestic relations were of the happiest, and during his long official career the liberal and gracious hospitality of his household to all sorts and conditions of men, from youthful students to eminent scholars of world-wide distinction, contributed not a little to the promotion of the interests which were dear to his heart.

WILLIAM C. GILMAN.

William Rainey Harper.

1856-1906.

WILLIAM RAINEY HARPER died in Chicago, Illinois, January 10, 1906. He was born in New Concord, Muskingum County, Ohio, July 26, 1856, of Scotch Irish ancestors. He was born with fine mental faculties and a genius for constructive work. At the early age of eight years he entered the preparatory department of Muskingum College, a small denominational school in New Concord, and two years later he entered upon his collegiate course, completing it with honors and was graduated with the degree of Bachelor of Arts at the age of fourteen. He early developed a love for the Hebrew language and literature and delivered his commencement oration in that language on the day of his graduation. For three years after his graduation he pursued his studies without the aid of a master, holding closely and intently to his work, and at seventeen entered Yale University as a graduate student, receiving from that institution the degree of Doctor of Philosophy at the age of nineteen. Thus early did he discipline his fine intellect and bring his mental faculties under subjection to that tremendous will-power that was characteristic of him through all his brilliant career. He married the daughter of Rev. David Paul, President of Muskingum College, and spent a year as principal of the Masonic College at Macon, Tennessee. In the fall of 1876 he accepted an appointment as tutor in the preparatory department of Dennison University, and immediately his constructive and organizing power manifested itself in a plan for the development of Granville Academy. Before this work was commenced, however, he was called to the chair of Hebrew at the Baptist Union Theological Seminary in Chicago. While occupying this position he perfected a system of teaching Hebrew by correspondence, published text-books for the study of Hebrew, established two periodicals called the Hebrew Student and Hebraic, and started summer schools in Hebrew. He

became principal of the Chautauqua College of Liberal Arts and later of the entire Chautauqua system.

In 1886 he was appointed Professor of Semitic Languages in the graduate faculty of Yale University and in 1889 was appointed to the Woolsey Professorship of Biblical Literature in the same institution. September 18, 1890, he was elected President of the new University of Chicago. His letter of acceptance bears date February 16, 1891, and he entered upon his duties July 1 of that year. Beginning with a general outline of what the institution should become, he obtained funds to purchase about ten acres of ground for a site and secured one million dollars in money and pledges. With this beginning the Chicago University opened its doors in 1892. It is impossible in this brief statement even to sketch the marvelous growth of the university under his leadership. At the time of his death the university had over sixty acres of ground in a great city, forty buildings, fifteen millions of dollars in endowment and property, a faculty of three hundred and fifty professors and teachers, and over three thousand students. This result staggers belief and when one approaches the subject more closely and considers the infinite details of the work in securing the enormous contributions, in planning the buildings, in organizing the educational work, in securing the teaching staff, among whom were so many distinguished educators, and in turning to this institution such a large body of students, the mind and energy and consummate leadership of the man appear in their fullness and glory. It is not extravagant to say that history does not give a precedent or parallel of such an achievement.

But this was not all. In addition to this administrative and constructive work he was a great teacher and a productive writer.

The work he loved most was teaching. He was a master of his subject and he possessed the indefinable quality, common to all great teachers, that aroused the student to the greatest possible interest in his subject and compelled the student to zealous work. There was an influence which ran along the channel of his words that no words can interpret, which was an inspiration to everyone who listened to him. He did not seek so much

to make his students believe what he believed, but he taught them to think for themselves and reach rational conclusions. He brought them a feast of knowledge which they were to make their own by assimilation. He was both exacting and sympathetic with his students but he had no place for the man who would not make honest endeavor.

As a lecturer he won a brilliant place. Under his inspiring and enlightening treatment the plainest themes became alive with interest to almost any audience. As editor of the journals which he founded there was one purpose running through all of his work, and that was to popularize bible study and make higher education attractive. He wrote extensively for these journals during his life at Yale and Chicago. The list of books which he published upon his chosen and allied subjects and the important articles which he published in magazines are far too numerous to enumerate here. All this was done while he was planning for and bearing the heavy administrative duties of the great university. To those who knew him intimately he will always be remembered as the scholar and teacher, while to the world at large his creative genius in the establishment of the university will be his immortality.

The attractiveness and power of sincerity were well illustrated in his life. Although he did not possess the arts of oratory or brilliancy of style, thousands listened to him with intense interest and followed his leadership with enthusiasm.

Dr. Harper was a man of great faith. He believed in things not seen. He accepted faith as the evidence of things hoped for, and without doubting laid his plans and worked with tremendous energy to realize his hopes and justify his faith. He did not believe that anything worth having came by chance. He trained his mind, disciplined his will and believed in miracles wrought by human patience and toil. Only those who knew him intimately had any conception of his power of continuous application, of his endurance, and of the great multiplicity of labors which he performed. As a student and author he did a full man's part and his life would have been successful if he had done nothing more. As a teacher he bore his daily part and, judged by years of service and the quality of his work, he

measured up to the full requirements of ordinary life. In the organization, establishment and administration of the great university he accomplished in sixteen years what might well have been the labor of two generations of men. Not all that he planned and did will remain, but there is so much that will endure that there can be little room for regrets.

“By their fruits ye shall know them,” is the divine test and measuring-rod that is ultimately applied to every man. Thus tested and measured, Dr. Harper stands pre-eminent. He died without worldly estate, but the historian will administer upon his possessions and find riches that neither time nor rust can corrupt nor the vicissitudes of human events diminish or take away. He belonged to the elite who are born into the world to do quickly some great work. These have little time for what the world calls pleasures. They begin with almost super-human faith. They labor with masterful energy and take a direct line to the cross. But in the final accounting it is found that the world is vastly richer, that humanity has new aims and new impulses, and God and truth are more clearly apprehended because these men with dynamic souls have lived for a few years.

CHARLES WILLIS NEEDHAM.

Samuel Pierpont Langley.

1834-1906.

SAMUEL PIERPONT LANGLEY, the third Secretary of the Smithsonian Institution, astronomer and physicist, was born at Roxbury, Massachusetts, August 22, 1834, and died at Aiken, South Carolina, February 27, 1906.

He was educated in various private schools and the Boston Latin and High Schools, but owing to circumstances, he was prevented from adding to this the advantage of a college education. Nevertheless, he was a life-long student, was well grounded in literature and the fine arts, in modern languages and mathematics, and was altogether, aside from his scientific eminence, a broadly cultivated man. After leaving school, he devoted himself to architecture and engineering, and at the age of 23 went westward and spent the next seven years in Chicago and St. Louis, devoting his time to his profession, through which he gained a modest competence. In 1864 he abandoned what he had thought his life work and returned to New England, spending some time constructing a telescope, and later in European travel. Upon his return to Boston, the director of the Harvard College Observatory, Professor Joseph Winlock, invited him to become an assistant in that observatory, an offer which he accepted, and from that time he dated his scientific career.

In 1866, Mr. Langley became Assistant Professor of Mathematics in the United States Naval Academy at Annapolis where he reorganized the small observatory, the work of which had been interrupted by the Civil War. The following year he became associated with the Western University of Pennsylvania as Professor of Astronomy and Director of the Allegheny Observatory, where he remained for a period of twenty years. By his inventions and his original work on the solar spectrum, he gained that eminence which easily ranked him among the foremost scientific men of his day. His turn for business affairs

was shown when he secured a large portion of the money required for the equipment of the observatory by "selling time" to the railroads, a plan which resulted in great practical comfort to travellers by establishing a uniform time system, and finally by the standardization of time throughout the United States.

Mr. Langley's studies were largely directed to the sun, more especially to that part of the sun's energy known as the infra-red, for the investigation of which he invented a delicate instrument, the bolometer, now universally employed by astronomers. He aided and conducted numerous expeditions to observe the eclipses of the sun, the study of the corona and other phenomena, and in every case he secured successful results. Having great charm as a popular lecturer and possessing a singularly clear and beautiful literary style, he popularized the modern investigation of the sun and the science of astrophysics in his work "The New Astronomy," probably the most distinguished scientific memoir, from the literary point of view, ever produced by an American.

While still at Allegheny, Mr. Langley conducted a series of experiments which led to his further work in Washington in the solution of the problem of flying machines, or aerodromes, as he called them. After numerous experiments he succeeded, in 1896, in causing a steam driven machine, many times heavier than the air, to make a free flight of over three-fourths of a mile, and this was followed by another successful flight. These performances were afterwards repeated many times with aerodromes propelled by both steam and gas driven engines, so that to Mr. Langley will forever belong the credit of being the first to successfully maintain in the air a mechanical device many times heavier than the atmosphere, thus practically demonstrating the possibility of artificial flight. He later constructed a large aerodrome, capable of carrying a man, actuated by a 52 horse-power gasoline engine, which unfortunately on two occasions failed to be successfully launched.

After serving for a short time as Assistant Secretary of the Smithsonian Institution, in 1887 Mr. Langley succeeded Spencer F. Baird in his office as Secretary. During his administration the one large addition to the fund, since the foundation of the

Institution, was secured, and, largely through his personal efforts, two new branches, the Astrophysical Observatory and the National Zoölogical Park, were added to it.

The tributes in recognition of his work are almost too numerous to recite. He received the degree of D.C.L. from Oxford, D.Sc. from Cambridge, and, among numerous others, the degree of LL.D. from the universities of Harvard, Princeton, Michigan, and Wisconsin. He was awarded the Henry Draper medal by the National Academy of Sciences, the Rumford medal by the Royal Society of London, and the Rumford medal by the American Academy of Arts and Sciences, as well as the Janssen medal from the Institute of France, and the medal of the Astronomical Society of France. He was a foreign member of the Royal Society of London, a correspondent of the Institute of France, a fellow of the Royal Astronomical Society of London, member of the Royal Institution of London, member of the Academia dei Lincei, of Rome, of the National Academy of Sciences, and of many others.

He was also President of the American Association for the Advancement of Science, Vice-President of the American Philosophical Society, member of the Council of the National Academy of Sciences, and a Trustee of the Carnegie Institution. He was a man of a singularly retiring disposition and of a depth of affection which only those who knew him most intimately ever fathomed.

CYRUS ADLER.

Adolph Lindenkohl.

1833-1904.

ADOLPH LINDENKOHL was born at Niederkaufungen, Hesse Cassel, Germany, on March 6, 1833, and died in Washington, D. C., June 22, 1904. He graduated from the Polytechnische Schule, Cassel, in 1852. He came to the United States the same year, and in 1857 was admitted to American citizenship. He was employed in teaching for two years after coming to this country, and on July 1, 1854 was appointed to a position in the cartographic work of the Coast Survey, where he remained until his death, a remarkable record of fifty years of valuable service.

During the first year of this duty, James A. Whistler was a fellow employe for about three months. It was found to be a matter of difficulty to get the future distinguished artist to come to the office with that regularity expected by the government, or when there to devote himself to topographic drawing or to etching views for the charts, as he preferred to sketch heads and figures on the edge of the plates. Lindenkohl told of a personal effort to assist the young artist in punctuality, when he went one morning to his room, the walls of which were found to be covered with sketches on the plaster; the young artist was still in bed and so interested Lindenkohl in telling of his work that the only result was that neither got to the office that morning. In the last month of his service Whistler was credited with only six and one half days' work at one dollar and a half a day and the experiment of his employment was terminated without ill feeling on either side.

With others from the Coast Survey, Lindenkohl was assigned to duty with the army during a portion of the Civil War from 1862 to 1864. He assisted in a topographic survey on the Potomac River, and served as a topographer on the defenses of Baltimore. He also assisted in the compilation of data for various maps for the department of West Virginia.

In his regular duties in the office of the Coast Survey, Lin-

denkohl was engaged mainly in the compilation of data for charts and the preparation of charts for publication, and he was known particularly for the extensive store of information which he acquired as to the material available for the charts, as well as for the rapidity with which he worked; for instance in putting hachures or hill shading on charts he had both great speed and unusual skill.

He gave much attention both in connection with and outside of his official duties, to studies on subjects related to geography and the physics of the sea, particularly deep-sea temperatures, densities and currents. He wrote a number of articles on these and similar subjects, which were published in the Reports of the Coast and Geodetic Survey, *Petermann's Mittheilungen*, the *American Journal of Science*, and elsewhere.

In 1884, in a paper on the "Geology of the Sea-bottom in the Approaches to New York," he dealt largely with the submarine channel of the Hudson River. In a paper in 1895 on the Gulf Stream and circulation of the Gulf of Mexico he discussed the evaporation, precipitation and influx from rivers and currents, the variations of temperature and density in the Gulf waters, and the relation of these phenomena to the Gulf Stream. In 1897 he published the results of an investigation of the salinity and temperature of the North Pacific Ocean.

His inquiries along such lines are the more interesting because owing to the natural obstacles to investigations of the sea, in the present distribution of scientific effort the oceanographic problems are receiving less attention than their importance warrants.

At the time of his death Mr. Lindenkohl was the senior draftsman in the Coast and Geodetic Survey, having been rewarded by promotion through all the grades of his branch of the service. He was of a kindly and unassuming disposition, which endeared him to all with whom he came in contact.

G. R. PUTNAM.

Henri Louis Francois Marindin.

1843-1904.

MR. MARINDIN was born at Lausanne, Switzerland, July 2, 1843, and received his early education in the Swiss schools. He came to the United States before attaining manhood, and finished his scholastic education in the Owego Academy at Owego, New York, 1860-1863.

He entered the Coast Survey as aid on November 26, 1863, and was soon assigned to duty in a party engaged in the survey of Roanoke River, North Carolina, made at the special request of Admiral S. P. Lee, flag officer of the North Atlantic blockading squadron, the party being quartered on the gunboat Seymour for that purpose. In 1864 he served in a topographic party at work in the vicinity of Bermuda Hundred, Virginia, under the orders of Major General Butler, with Brigadier General Weitzel in immediate charge of the work, and later in the same year, and in January, 1865, he served in a topographic party engaged in work along the Potomac River under the direction of Major C. S. Stewart. He thus began his service to the nation of his adoption by aiding in the perpetuation of the Union, and continued to serve his country faithfully until death ended his long and honorable career.

In 1865 he was engaged in special surveys for a canal route through Nicaragua, and in 1870 he was engaged in similar work on the Isthmus of Darien.

His special work in the Coast Survey was in the field of physical hydrography, and many important features in the currents and in the development of harbors and bars along the Atlantic and Gulf coasts of the United States have been made known to commerce as the result of his systematic and careful investigation of the complex problems presented as the result of the action of winds and tides on the waters of the sea. He spent more than eighteen years in command of vessels of the Survey while engaged in this work.

On March 24, 1897, he was appointed by President McKinley to represent the Coast and Geodetic Survey on the Mississippi River Commission, and after that date devoted much time and attention to the duties thus imposed upon him, but continued his regular work on the Survey whenever it was possible to do so. His particular ability was recognized by numerous special assignments to duty in connection with harbor boards to establish harbor lines, and in the establishment of speed trial courses for vessels of the navy, and is shown in several scientific discussions of various physical problems relating to hydrography which have appeared from time to time as appendices to the annual report of the superintendent.

His death took place March 24, 1904.

ISAAC WINSTON.

Herbert Gouverneur Ogden.

1846-1906.

HERBERT GOUVERNEUR OGDEN was born in New York April 4, 1846. He descended from Revolutionary stock, Francis Lewis, a signer of the Declaration of Independence, being one of his ancestors.

His career in the Coast Survey commenced in 1863, when the Civil War was at its height. In common with a number of his brother officers, he was assigned to duty with the army and then with the navy, participating in the dangers and vicissitudes of active warfare.

In 1865 he served as a topographer on the Nicaragua Expedition.

In 1870 he was a member of the first naval exploring expedition to the Isthmus of Darien.

In 1893 he had charge of a section of the exploratory surveys for locating the international boundary between Alaska and British Columbia.

He was appointed by the President one of the original members of the Board on Geographic Names, and continued a member until the time of his death.

These were special assignments. In the regular course of his duties in the Survey, as his experience increased with length of service, he showed his versatility by engaging in and eventually directing nearly every one of the many branches of the work.

In 1880 he was placed in charge of the Engraving Division of the office. This position did not, as its name would imply, consist solely of superintending the work of expert engravers. It involved a knowledge of the whole range of chart construction and publication from the surveying operations in the field to the final verification of the chart from the press. It required an encyclopædic memory for details both of methods and locali-

ties, since the accuracy of the finished product depended in a large degree on his decision.

In 1898 he was appointed Inspector of Hydrography and Topography. His new duties were rendered the more difficult from the fact that a change was being made in the organization of the Survey, and also on account of the rapid expansion of the field of work, due to the development of Alaska, the acquisition of Porto Rico and the Philippine Islands.

In this position it came within the scope of his duties to formulate a general plan for hydrographic and topographic surveys; to make field inspections of the work; also of the ships, and to supervise their repairs and maintenance. Only those engaged in the same lines of work can fully appreciate the importance and value of what Mr. Ogden accomplished. Of the many thousands who traverse our coasts in ships, there are few indeed who are aware to what extent they are indebted to him for the integrity and completeness of the charts on which their safety depends.

The leading trait of Mr. Ogden's character — the one which endeared him most to his associates, both old and young — was his unfailing interest in their welfare. His ever ready sympathy attracted the confidences of his juniors, and his advice and assistance was ever constantly sought by them. At the same time his loyalty to the service never allowed his kindly feelings to override his high sense of duty. Decided in his convictions, he was firm in refusing ill-considered or improper requests, but he could deny in such a tactful and considerate manner as rarely to wound the most sensitive.

Having a genial and sanguine disposition — a man of simple habits — his friends hoped and expected that there were many years of activity and usefulness before him.

It was ordained otherwise, and he died suddenly February 25, 1906.

D. B. WAINWRIGHT.

William Bramwell Powell.

1836-1904.

WILLIAM BRAMWELL POWELL was born at Castile, N. Y., on December 22, 1836. He was of English ancestry, being the fifth child of Joseph and Mary Dean Powell who emigrated from England to New York in 1830.

From his parents, who were persons of far more than ordinary force of character and intelligence, he inherited many of the qualities that distinguished him in life. Joseph Powell, his father, had a strong will, deep earnestness, and indomitable courage, while his mother, Mary Dean, with similar traits possessed also remarkable tact and practicality. Both were English born, the mother well educated, and they were always leaders in the social and educational life of every community where they dwelt. Especially were they prominent in religious circles, the father being a licensed exhorter in the Methodist Episcopal Church. Both were intensely American in their love and admiration of the civil institutions of the United States and both were strenuously opposed to slavery, which was flourishing in America when they arrived in 1830. For a time they remained in New York City and then removed to western New York, finally locating in the village of Castile, where, as before stated, William Bramwell was born. Because of the slavery question Joseph Powell left the Methodist Episcopal Church on the organization of the Wesleyan Methodist Church and became a regularly ordained preacher in the latter. It was in this atmosphere of social, educational, political and religious fervor that the future school superintendent grew up. When he was three years old the family moved to Jackson, Ohio, and then, in 1846, went on westward to South Grove, Walworth County, Wisconsin, where a farm was purchased. They were in prosperous circumstances, and the boy was active in the management of affairs, early exhibiting his trait for doing things well.

His early education was such as the country schools afforded but his parents ever held before him the importance of achieving the highest education possible.

In 1851 his family removed to Bonus Prairie, Boone County, Illinois, where a larger farm had been purchased. About 1853 the Wesleyan College was established at Wheaton, Illinois, and the family removed there in order to take advantage of the opportunities afforded. The father became one of the trustees and young Powell entered the preparatory classes. With intervals of teaching he continued in the college till 1855, when he entered the preparatory department of Illinois College at Jacksonville, Illinois. Here he continued a year, leaving to enter Oberlin College, Ohio. In 1858 he returned to Wheaton College and entered the Junior year. Leaving in 1859 to engage in his chosen profession of teaching, he was not graduated; but in 1865 Lombard University, Illinois, conferred on him the degree of A.M.

Mr. Powell's services as teacher and school superintendent extended over nearly half a century. He was principal of a school in Sharon, Wisconsin, for some time between 1854 and 1861; in 1861-2, principal of the Hennepin (Illinois) school; 1863 to 1870, Superintendent of the Peru (Illinois) schools; 1871-1885, Superintendent Aurora (Illinois) schools; 1885-1900, Superintendent of Washington Public (white) schools. In 1901 he visited the Hawaiian and Philippine Islands and Japan to investigate the schools and text-book needs of these countries.

Mr. Powell was a member of the National Geographic Society, Washington Academy of Sciences, National Academy of Political and Social Science, Anthropological Society of Washington and the National Educational Association. He was the author of a number of school books which have been extensively used in the public schools of the country. The chief of these are: "How to See, How to Talk and How to Write," published in 1880; and a "History of the United States for Beginners," published in 1900. He was also joint author of the "Normal Series of Readers" published in 1887, and a "Rational Grammar of the English Language," published in 1900.

The following estimate of Mr. Powell's character and work as a school superintendent is quoted from an article in a Chicago journal of education (*Intelligencer*, April 1, 1904.)

“During his forty years of service Mr. Powell labored unceasingly and untiringly to improve the public school system. In his chosen profession he felt the most profound devotion, the greatest pride and pleasure. He was an advanced thinker, a prophet, and as such was often in advance of his time in the scope and grandeur of his ideals. His interests were centered in the welfare of the children, believing that the proper educational training is that which best prepares for life, not merely from the standpoint of earning a livelihood, but that education which elevates above sordid, material views; that which makes the brain and heart capable of appreciating the good and beautiful, susceptible to the allurements of the larger life.

“He felt it to be the child's birthright to have the best in education that human effort can give. Influenced by these ideals, he was a pioneer in methods of object teaching, of training by seeing and doing. Believing that all education is based upon experience, and that only through the child's own experience can he be held to understand and appreciate the experiences of others as found in books, he strove to give the child such experiences as lead to the interpretation of the natural world and to an understanding of the social whole. To provide for these experiences he early introduced into his course the study of nature and the study of institutional life. He collected libraries that the children might broaden their text-book knowledge with a knowledge of and a sympathy with life.”

The following passage from the same article does some justice to Mr. Powell's work in securing manual and industrial training in the public school system under his charge:

“A firm believer in the value of hand work, he was among the first to prepare a way for and to establish manual training and domestic science schools. Music, drawing and physical training also became part of the regular course in his schools; all of this before most schools had advanced beyond the three R's. In the Washington schools he strove as strenuously to provide the best facilities in manual training, in cooking and in

cutting and fitting as he did to provide the best of book instruction, thus giving to these new elements in education their proper standing. To him the genius of American civilization demands work — work of hand, heart and brain. He contended that getting knowledge by rational methods gives to the child mental and physical delight.”

He was married in 1865 to Miss Minnie Paul, of Peru, Illinois, who with two children, Miss Maud Powell, the violinist, and Mr. William Paul Powell, of Mount Vernon, New York, survives him. His death occurred after a short illness at Mount Vernon, New York, on February 4, 1904.

PREPARED BY U. S. BUREAU OF EDUCATION.

Nicholas Senn.

1844-1908.

NICHOLAS SENN was born in Buchs, Canton of St. Gall, Switzerland, October 31, 1844, and died, at his home in Chicago, January 2, 1908.

He came to this country with his parents in 1852 and settled at Ashford, Wis. He was graduated from the Fond du Lac high school in 1864, after which he taught school himself and began the study of medicine with Dr. E. Munk, of Fond du Lac. He entered the Chicago Medical College in 1865 and graduated in 1868. In 1869 he married Miss Aurelia S. Muehlhauser, of La Crosse, and began the practice of medicine in Ashford. In 1874 he moved to Milwaukee and became an attending physician of the Milwaukee hospital. Returning to Europe in 1877, he studied at the University of Munich and received the medical degree in 1878. He then resumed practice in Milwaukee until 1893, when he moved to Chicago where he remained until his death.

During the comparatively brief period of thirty years—the period of his active professional life, from the time of his graduation in Munich until the date of his decease in 1908—few men in any profession have performed more productive and excellent work, and certainly but few, if any, have received more honors in recognition of their distinguished service to humanity in the domain of medical science and practical surgery, than Dr. Senn.

In every sphere of professional activity, alike in his chosen field of operative surgery, as in the rôle of teacher and author; in his patriotic duties as a military surgeon; and in works of charity and benevolence, Dr. Senn “acted well his part.”

His hospital work began as interne in the Cook County Hospital of Chicago. Then he became a member of the staff of the Milwaukee Hospital; and later Surgeon-in-Chief to the St.

Joseph's Hospital and Presbyterian Hospital, Chicago; and Surgeon to the Passavant and Polyclinic Hospital.

He was always deeply interested in military matters and military surgery. He was made Surgeon-General of Wisconsin in 1888 and retained the position until he left that State. In 1892 he was commissioned by Governor Altgeld Surgeon-General of Illinois and retained this position until his death.

At the outbreak of the Spanish-American War he assumed charge of the mobilization camp at Springfield and ably directed the physical examination of recruits. He was commissioned Lieutenant-Colonel and chief Surgeon, U. S. Volunteers, May 13, 1898, and was assigned to duty with the Sixth Army Corps. He went with the expedition under command of Brigadier-General Guy V. Henry, U. S. Volunteers, to Santiago, Cuba, and was assigned to duty as chief surgeon of the operating staff with troops in the field. He resigned September 6, and was honorably discharged September 17. In general orders from the Adjutant-General's office, dated February 13, 1900, Lieutenant-Colonel Senn was commended for his surgical work during the Cuban campaign and for making a scientific study of typhoid fever among the troops.

His work as a teacher of medicine began in 1884 when he was appointed Professor of the Principles and Practice of Surgery in the College of Physicians and Surgeons, Chicago. Four years later he became Professor of the Principles of Surgery and Surgical Pathology in the Rush Medical College, and later Professor of Military Surgery in the University of Chicago. He was also Professor of Surgery in the Chicago Polyclinic.

His lectures — always without notes — were eloquent, dramatic and attractive.

His contributions to American medical literature comprised something over three hundred titles, twelve of these being printed volumes, varying in size, but all of them replete with original matter. Many of them are used as text-books and standard works of reference in most American medical schools, and a good number have been translated into foreign languages. Chief among them may be mentioned his text-books on: "The Principles of Surgery," "Surgical Bacteriology," "Experi-

mental Surgery," "Pathology and Surgical Treatment of Tumors," "Intestinal Surgery," "Tuberculosis of Bones and Joints," and "Practical Surgery." He also wrote on the surgery of the pancreas, stomach and gall-bladder; as well as contributing several books of travel in which he gives his observation of diseases, physicians and hospitals in foreign countries.

In 1897 Dr. Senn was elected President of the American Medical Association. He was a member of the Philadelphia College of Physicians, the American Surgical Society, the American National Red Cross, the Norwegian Medical Society, the Swedish Medical Society, and others.

Also an honorary member of the D. Hayes Agnew Surgical Society, the Philadelphia Academy of Surgery, National Association of Railway Surgeons, Academy of Medicine of Mexico, Glasgow Academy of Medicine, Manila Medical Society, the Imperial-Royal Medical Society of Vienna, and the Royal Medical Society of Budapest. He also received the Order of Merit of the Japanese Society of the Red Cross by the sanction of the Emperor of Japan.

While it was not the privilege of the writer to enjoy any personal intimacy with Dr. Senn, those who were more fortunate in this respect speak of him as a truly great man; "master of his profession; always ready to sacrifice his personal interest and comfort for the service of his adopted country; intensely loyal in his friendships; generous to a fault; and too honest to harbor suspicions." "His greatest glory was in his extraordinary capacity for work, which he held as a duty, and that work entirely for the benefit of his fellow-men."

Among the substantial evidences of his generosity may be mentioned his endowment of two rooms in the St. Joseph's Hospital, Chicago; his donation to Rush Medical College of the Senn Clinical Building, and his presentation to the Crerar Library of a valuable collection of books, including the entire library of Dubois-Raymond and that of the late Dr. William Baum, Professor of Surgery in the University of Göttingen.

Taking him for all in all, it may truly be said: the world is better for his having lived.

A. F. A. KING.

Samuel Edwin Solly.

1845-1906.

DR. SOLLY was born in London, England, May 5, 1845, and died at Colorado Springs, Colorado, November 19, 1906. He received his early education in the best schools of his native land, and, following the footsteps of his distinguished father, he took up a medical career. Owing to a physical breakdown in his early career, his attention was naturally directed along climatological lines. Through his father, he was brought into intimate association with many of the distinguished practitioners of London. In this way, he became acquainted with the late Sir Morell Mackenzie, from whom he acquired his insight into laryngology and rhinology. In his thirtieth year he found it impracticable, from a physical point of view, to longer reside in London, so he turned his face toward the setting sun. We next find him in Manitou, Colorado, where he resided for some years, being the inspiration of the English colony at this place. While at Manitou he made an investigation of the mineral springs of that place. Shortly after the establishment of the city of Colorado Springs, he removed to that inviting and thriving town. His great life work was done at Colorado Springs. He never tired of singing its praises or writing of its glories. Several years ago he was very much interested in a movement started by the civic body of Colorado Springs in sending out the secretary of that organization on a tour of the principal cities of the country to proclaim the attractions of Colorado Springs as a sanitarium. Though much interested in all projects of a civic character that redounded to the benefit of his home city, he was much more interested in those projects which had for their purpose the recognition of the fact that it was the world's great sanitarium for those afflicted with tubercular affection. The Cragmoor Sanitarium was his ruling passion during the last few years of his life. This institution

was modeled on a most comprehensive system, as only the master hand of Solly could have formulated.

Dr. Solly was a man of remarkable attainments — a representative of the highest type of the intellectual Englishman; in medicine, he was a scholar with an investigative turn of mind; an executive of remarkable ability; a public-spirited citizen of the highest grade; and a writer upon climatological subjects whose fame and name are co-extensive with the realms of modern medicine. His personality was the most delightful that the writer of this article has ever known. He possessed a quiet and dignified bearing, a modest temperament, a genial disposition, kindness of thought and action, a courtesy of manner that never was at fault, a ready wit that never lent itself to sarcasm, a perfect host, a most welcome guest, strong intellectually, with high moral ideals, and the courage of his convictions — such was the character of the lovable man of whom we write and who won his way into the hearts of all who came within his presence.

CHARLES W. RICHARDSON.

Ainsworth Rand Spofford.

1825-1908.

AINSWORTH RAND SPOFFORD at the time of his death, which occurred at Holderness, New Hampshire, August 11, 1908, was Chief Assistant Librarian of Congress. He was born at Gilmanton, New Hampshire, September 12, 1825, and was the son of the Reverend L. A. and Grata (Rand) Spofford.

He was prepared for college by private tutors, but his health failing, he went west at this time, 1844, and located in Cincinnati. His fondness for books soon decided his career; for he soon entered upon the duties of a book seller and publisher and spent his leisure moments in the study of literature and modern languages. In 1850, he was one of the founders of the Literary Club, of Cincinnati, a vigorous and intellectual organization. In 1852 he married Sarah P. Partridge, who died in 1892.

His coming to Washington, D. C., was in 1861, when he was appointed by President Lincoln Assistant Librarian to Congress. For several years previous to this, he was Assistant Editor, 1859-1861, of the *Cincinnati Daily Commercial*. His great fitness for the position of librarian was soon recognized and in 1864 he was made Librarian-in-Chief, holding that position until 1897, when he was relieved of the executive burden and made Chief Assistant Librarian. He saw the Library of Congress grow from a collection of 70,000 volumes to that of 2,500,000 volumes. He was the first to suggest the need of a separate building for the Library and when Congress was slow to act, he kept the matter before it not only in his formal reports, but by a systematic disorder in the overcrowded old quarters—the library, that filled every space with books, boxes, maps, bundles, etc., leaving thus but little room for the visiting Congressmen.

As a librarian he was widely known for his comprehensive knowledge of books and their contents and was to public men

and students a veritable catalogue. It was a tradition among the guides that Mr. Spofford read every book that came to the library and that he knew the position of every book. A question or two addressed to him would save hours of laborious research. The writer, a year ago, had occasion to look up the subject of medicine versus superstition and going to Mr. Spofford asked if he would pick out several of the best books on the subject. Mr. Spofford, taking a pencil, wrote offhand from memory the title, the author, in some cases the chapter, of eleven books of reference on the desired subject. When General Lew Wallace was writing "Ben Hur," he appealed to Mr. Spofford to help him in proper material for the local color and literary atmosphere. Mr. Spofford proposed and exhibited book after book from the Congressional Library without satisfying General Wallace, and finally told the General that he would find what he wanted in the Harvard Library in such a room and such a shelf, situated "sixth from the south end."

He contributed to many newspapers, magazines and encyclopedias. He was editor of Catalogues of the Library of Congress, and of the Annual American Almanac from 1878 to 1889; edited with others, Library of Choice Literature (10 vols.), Library of Historic Characters and Famous Events (10 vols.), Library of Wit and Humor (5 vols.). He was the author of Practical Manual of Parliamentary Rules, 1884; and A Book for all Readers, etc.

Many of his writings dealt with the early history of our country and especially with the history of the Federal city. He was a firm believer in the "instinctive genius" of the French engineer, Major L'Enfant, who planned the city of Washington, and in endorsing a bill, February 11, 1905, presented to Congress, speaks of him as "the undisputed author of the grand scheme which was ultimately adopted."

He was a charter member and Vice-President of the Columbia Historical Society from its organization in 1894 to the date of his death. Among some of the papers he contributed were:

"The Methods and Aims of Historical Inquiry," May 7, 1894.

"Life and Labors of Peter Force, Mayor of Washington," June 8, 1897.

“Washington City in Literature,” February 10, 1902.

“The Lyric Element in American History,” December 14, 1903.

“The Eloquence of Congress: Historic Notes,” November 13, 1905.

“Virginia, 300 Years Ago,” April 8, 1907.

Mr. Spofford was a man of kindly and charitable disposition and of a temperament which once known, was as peaceful and attractive as the cooling rivulet on a summer day. Absolutely unconscious of his distinction and never courting notoriety, he came and mingled with us all, giving help, advice and encouragement to those who would drink of the Pierian spring.

JAMES DUDLEY MORGAN.

R. Stansbury Sutton.

1841-1906.

DR. SUTTON was born in Indiana, Pennsylvania, in 1841 and died suddenly at Pittsburg, Pa., April 21, 1906. He studied medicine in Philadelphia and graduated with honor from the University of Pennsylvania in the class of 1865. He soon settled in Pittsburg where he practised his profession with great success up to the day of his death. He had his wish, to die with his harness on, and not to linger long with a distressing illness, a burden to himself and an anxiety to his many friends.

He was happily married and was a devoted father and a most useful neighbor and friend. Though a successful general surgeon he was among the first of his confrères to adopt the specialty of gynecology and abdominal surgery. He was actually a pioneer in his work and fitted himself more particularly for its delicate and responsible duties by special studies and training in our large cities and by instruction in the clinics and hospitals abroad, to which he frequently returned for new ideas and a study of their especial technique.

In 1905, Dr. Sutton was appointed a delegate to the Madrid International Congress of Gynecology.

In order more successfully to conduct the special work to which he had dedicated his talents, he established, in 1883, one of the first private hospitals in the country, and devoted it to gynecology and abdominal surgery. He named it the Terrace Bank Hospital for Women, and conducted it for twenty years. During the recent Spanish war his ardent patriotism led him to offer his services to the government and he was appointed Chief Surgeon to the Second Brigade, Third Division of the First Army Corps.

Dr. Sutton was a frequent contributor to the medical journals and societies and was the author of a book on abdominal surgery, which was chiefly a history of his own special work. He was twice elected Vice-President of the American Gynecological

Society. He served as President of the American Academy of Medicine, and also of the Mississippi Valley Medical Association, and the Pittsburg Obstetrical and Gynecological Society. In 1884 he was elected Chairman of the Obstetrical and Gynecological Section of the American Medical Association. He was also a member of the British Medical and Gynecological Associations.

JOSEPH TABER JOHNSON.

Robert Bowne Warder.

1848-1905.

ROBERT BOWNE WARDER died at his home in Washington, July 23, 1905, after an illness extending over nearly a year.

Professor Warder was born in Cincinnati, O., March 28, 1848, and spent his early life in the country home at "Aston," North Bend, Ohio. His character was formed under the influence of the Society of Friends and this faith remained the dominant feature of his life. From childhood he showed the effect of his parents' training and example, in a broad and catholic view of the ethics of life, and in a love of truth and scientific investigation. This devotion to truth was an especial characteristic and governed his life and actions throughout.

He was graduated from a Friends' institution, Earlham College, at Richmond, Ind., in 1866, and afterwards spent some time at the Illinois State University, at Champaign, where he was instructor in chemistry and natural philosophy. This work of teaching seemed to show Professor Warder his natural bent, and his energy was thenceforth devoted to studying the broad principles underlying all natural science. He spent some years in traveling, chiefly in the western half of the United States, in connection with the different State geological surveys. In 1873 he went to Harvard, where he was graduated as B.S. in chemistry in 1874.

After graduating at Harvard he spent a year traveling in Germany, studying at Giessen under Heinrich Will, and at Berlin under Hofmann. His attention was, however, especially devoted to methods of teaching chemistry in the German universities, and the application of theoretical chemistry to the practical sciences. His chief aim was to fit himself in the broadest sense for his work of teaching. This was his main desire throughout life, to help others, and he never faltered. On returning to this country he was associated with Prof. F. W. Clarke at the University of Cincinnati from 1875 to 1879 as

professor of chemistry and physics. Professor Warder early saw the close relation between these then distinct branches of natural science, and his papers on "The Speed of Saponification of Ethyl Acetate" and "Evidence of Atomic Motion within Liquid Molecules" were pioneer investigations in the field of physical chemistry of to-day.

He was engaged in this line of research from 1879 to 1883 when he accepted the chair of chemistry at Purdue University, where he remained until 1887. This position carried with it the duties of State Chemist, work of a commercial character rather foreign to his natural tastes, but to which he gave the same painstaking devotion that characterized all his work. Even these routine analyses were made to pay tribute to physical chemistry, as is shown by papers on "Influence of Time in Fertilizer Analysis," "Speed of Dissociation of Brass," etc.

In 1884 he married Gulielma M. Dorland, who also belonged to the Society of Friends, and like himself was interested in evangelical work. Their life together was one of perfect harmony.

It was probably about this time that Professor Warder felt more keenly than ever the call to help others in another field than chemistry. His philanthropic and evangelical work had always been foremost in his mind and labors, and in 1887 he accepted the professorship of chemistry at Howard University in Washington. Here he labored until he died, teaching chemistry and physics, but above all setting an example and teaching the principles of a Christian life with an unselfish devotion.

In spite of lack of facilities, his work at this period on "Dynamical Theory of Albumenoid Ammonia," "Recent Theories of Geometric Isomerism," "Cross Fertilization of the Sciences," and "The Major Premise in Physical Chemistry" showed his natural inclination to this phase of chemistry.

Professor Warder's later papers were chiefly devoted to applying the laws of mass action to and showing the speed of chemical reactions for the analytical data obtained by other investigators.

He was essentially a critic and his devotion to truth caused him to scrutinize the investigations of others with the same

zealous care with which he looked for flaws in his own work. This high standard, coupled with an unusual modesty, often caused a hesitation which sometimes obscured his really profound knowledge.

No one went to Professor Warder for aid and was turned away empty-handed. What he had was given freely, and he seemed to feel that no labor was too great in his fundamental desire to help others.

S. S. VOORHEES.

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