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A GLOSSARY OF SURFACE SCULPTURING

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INTRODUCTION

Time spent in describing specimens or understanding descriptions is often substantially lengthened by tiresome searches for accurate terminology or for interpretive insight where confusion exists in the descriptive terminology. Consistent and correct use of descriptive terms is essential for efficient taxonomic work; synonymies abound where original descriptions have inadequately defined a specimen. The fault does not lie in a lack of suitable terms since there are descriptive terms for almost any imaginable structure. The problem lies in the misapplication of these terms when workers fail to acquaint themselves with the nomenclature or use terms too casually. Almost all the terms have been available since Smith published his *Glossary of Entomology* in 1906, but they have never been available in a convenient format. Smith weeded out a lot of synonyms but more have appeared through the years. Torre-Bueno (1937) felt all terms in current use should be included even if they were synonymized, for the benefit of workers in restricted areas. Unfortunately, he did not indicate any of these restricted areas in his glossary. For this reason many workers find it inconvenient to use his glossary. Further, the terms they seek are neither cross-referenced nor categorized.

A complete revision of the terminology is out of my grasp. Instead, I have revised one small area of terminology particularly in need of it. I have collected and revised descriptive terminology of surface sculpturing and presented it with SEM micrographs for reference. I hope this will standardize the use of specific terminology which will in turn increase accurate information transfer in descriptive and diagnostic work. The terms are indexed and synonymized and presented in related categories. Most of the terms are cross-referenced, though only to closely related terms since the categorical groupings serve a similar function at a broader level. The photo-reference section should be helpful in attaining a comprehensive understanding of these terms, and also provides a survey of the diverse surface sculpturing in the Hymenoptera.

DISCUSSION

Sources of Definitions. The primary source of the terms used was *A Glossary of Entomology* by Torre-Bueno (1937 and 1962). A few terms were gleaned from texts listed in the Literature Cited section and from several general entomology texts. Definitions were established by comparing the common use of the word in each source. Where there were significant differences in meaning, and this was rare, the definition closest to the Latin root meaning was used. All words were compared with their Latin roots. Many words have definitions very different from their Latin roots, but the derivation was always apparent and there was normally agreement upon current use in the texts consulted. Problems arose when the anglicized word had two or more definitions according to the discipline using it and the Latin root had two or more definitions also. The word "strigose" was the source of many problems. It has two very different current definitions and there are at least five Latin words with the same base word spelling. The correct Latin root has at least four

definitions. This word is further discussed below.

Torre-Bueno included Latin and anglicized forms in his glossary, but Latin forms are not currently used and were here placed in synonymy. Words without Latin roots were avoided, but a few have established themselves in the terminology and must remain.

There are three common anglicized endings to Latin roots; -ate, -eous, -ose. Some root words are established with more than one of these anglicizations and have a corresponding number of definitions. These synonyms arise when workers unfamiliar with terminology find a suitable Latin root and anglicize it before determining if the anglicized form already exists. It may also occur when the Latin base word is incorrectly established.

Another problem arises with words whose Latin root is in the diminutive. Workers have been known to make diminutives of already diminutive anglicized words. This is redundant and adds to synonymy. A few words found had definitions in the positive form (the uncompared form) very different from the diminutive form. This is apparently a result of early misapplication of terms, but most are now firmly established in the nomenclature. For this reason, a worker cannot assume that a diminutive form of a term is necessarily defined as such. When going from diminutive to positive, or conversely, the definitions should be checked. If it is necessary to describe a surface sculpture in the diminutive and no such term exists, a modifier such as minutely, finely, coarsely, etc., can be used.

Obsolete, Vague, and Inaccurate Terms. Workers may find it difficult to accept some changes here proposed in terminology. Students of specialized groups, for example Hymenoptera, use favorite terms such as "shagreened" and "coriaceous." "Shagreened" has come to have a range of meanings, from imbricate to rugose, but its actual definition is closest to scabriculous. The term "coriaceous" refers to a texture which *feels* leathery, tough, and rigid. Yet this word is often used to describe a surface which only *appears* leathery. The correct term is "coriarious." There is little need, in a diagnosis or description, for terms with a range of definitions or for terms which cannot be correctly applied to the material at hand.

Many of the synonyms encountered were obviously the result of attempts to modify the meaning of an otherwise correct descriptive term that did not quite fit the surface observed. In some cases, the result was a word homonymous with a word that had a correct definition. Now it has two. An example is the ubiquitous "strigose." Eady (1968), in an attempt to clarify some descriptive terminology, used "strigose" to define a surface sculpture. "Strigose" means ". . . covered with strigae or parallel grooves . . ." in zoological use but means ". . . covered with short, dense, bristles; hispid . . ." in entomological and botanical use. The surface he was describing was covered with fine, transverse, subparallel lineations. He could have correctly called it "substrigate" or he could have described it as I have. He was correct in a zoological sense, but publishing in an entomological journal, he was in error.

If a researcher is multidisciplined, he must use terminology consonant with the discipline in which he plans to publish. The definitions used in this glossary apply only to the surface sculpturing of Insecta. The same word may have a very different meaning in the botanical or zoological sense or even in other entomological applications.

Singular structures such as a papillule or a sulcus are not included. Neither are general body shapes or surface coverings such as hair or dust unless these terms are commonly misused to describe surface sculpturing.

Absolute vs. Relative Size of Sculptures. The question of magnification and absolute versus relative size of specific sculpturing presents a few problems. Many descriptive terms exist with diminutive or superlative forms. If we consider a specific sculpturing to have an absolute value, then the magnification at which we view the specimen and the actual size of the specimen will be irrelevant to the type of sculpturing present. This may seem desirable at first, but consider that a chalcid with a dozen deep punctures on its scutum would be described the same as a large vespid with several hundred of the same size punctures. This does not seem suitable. Terminology would be more consistent if specimens that have the same number and arrangement of impressions or excrescences per unit of body area are described the same, regardless of specimen and sculpture size. In other words, the specimen should be described only in its own context; particular structures should be viewed only in relation to the whole specimen, not individually. Comparative size should be considered independently. If two specimens are identical, except for size, then their sculpturing, though differing in absolute size, is described as identical because the relationship of the structure to the body region remains constant.

Magnification. Some sculpturing is visible only at magnifications over 100X, which is the approximate useful limit of most dissecting microscopes. Recent widespread use of the scanning electron microscope for descriptive purposes has made this type of microsculpturing important in distinguishing very small specimens and specimens identical at the macro level. Terminology may be modified for this type of sculpturing by attaching the prefix "micro-" to the same descriptive terms used for macrosculpture. This is workable for most of the terms, but a few will present problems. Terms that have diminutives or superlatives will be confusing because at one magnification one form of the term will apply, but at a lower or higher magnification another form of the term will be more appropriate. This is basically the same problem as with macrosculpturing, but now what is punctate at 150X, will be foveate or foveolate at 500X. Unfortunately, we cannot use the same solution used for macrosculpturing where the sculpturing is viewed relative to the body region it occupies, because at the micro level, each body region will be enormous relative to the sculpturing. One remedy is to use only the diminutive form of the descriptive term when describing microsculpture. Sculpturing visible at 100X or less will have the full range of descriptive terms available to it. Sculpturing visible only at magnifications greater

than 100X must be described in the diminutive whenever possible (since not all terms have diminutive forms) and must be prefixed by micro.

Intergraded Sculpturing and Compound Terminology. When sculpturing of one type gives way to another, there is often an area of compound or intergraded sculpturing. Compound sculpturing over an entire body region also occurs. This type of sculpturing can be very confusing and difficult to describe. Contracted or hyphenated forms of the two (rarely more) descriptive components are the common solutions, but neither has been consistently applied. The contracted forms suffer from numerous arbitrary spellings since there are no guidelines or preferred methods to determine the linking vowel. Their use would eventually increase the number of descriptive terms by several hundred. Hyphenated forms are easier to use and add no new terms to our present vocabulary. At the same time, they offer as many new definitions as contracted forms.

When using hyphenated forms, the dominant component sculpturing should be named first. When the two component sculptures are equally represented, the descriptive term should be preceded by the word "equally."

Synonyms and the Arbitrary Creation of Words. Synonyms:

> ". . . Words of like implication throughout, their differences appearing only in certain collocation—words which express essentially the same idea, but which differ from one another in some shade of meaning or emphasis, or (esp.) in their connotations. A thorough analysis of synonyms will in most cases show that the words have clearly distinguishable differences of meaning and are interchangeable only when the differences in meaning do not affect the speaker's meaning in a given context." (Neilson, 1951.)

In this work, there are no new terms created, for rather than being short on descriptive terms, the entomological field is plagued by synonyms. Almost half of the words investigated were functional synonyms of words in the remaining half. Many of the words left in the list are synonyms (*sens. str.*) of other words in the list. However, they differ enough in nuance or connotation to warrant separate listing; they had differences that set them slightly apart. Others may disagree on these remaining synonyms. If the list of available terms is further reduced the use of modified or hyphenated terms will be correspondingly increased. For this reason, I see no advantage in further substantial reductions in the lists of words presented here. If, on the other hand, it is found that some areas are not adequately covered, the list may certainly be expanded at any time. If this is the case, workers should be as careful as possible in the selection or creation of their terms. The guidelines of Brown (1954) (paraphrased) seem appropriate:

1. Is the word really necessary?
2. Are the combined elements pure and euphonius, not hybrid and awkward?
3. Is the connective vowel necessary, proper, and appropriate?
4. Is the transliteration, if necessary, correct?
5. Is the spelling and gender correct, especially in the case of binomials?

6. Is the word already in the dictionaries or preoccupied in the taxonomic catalogues?
7. Has the etymology of the word been stated correctly?

Materials and Methods (for photo section). Specimens used in SEM work were provided by the curator of the entomology museum at the Davis campus of the University of California. Specimens were taken only from well represented and determined groups. The entire Hymenoptera collection was scanned for obvious sculpturing, several genera were examined in depth. All specimens were first examined under a dissecting microscope and then cleaned with an air jet or, if the specimen was particularly dirty, it was soaked in a solvent (EtOH or xylene) and cleaned in a sonicator for 10 to 20 seconds. The air jet was also very efficient at removing hairs.

Specimens were mounted on stubs with liquid polyvinylchloride and prepared for SEM viewing by sputter coating in a Technics Hummer II with about 30 nm of gold/palladium. They were viewed on an ETEC Autoscan scanning electron microscope at 8 to 24 mm. The longer distance was most often used because of its greater depth of field. Photos were made with a Polaroid model 405 pack film holder on Polaroid type 105 positive/negative film.

Magnifications of photos in the photo-reference section are not indicated because the photos are reproduced at relative magnifications. That is, any sculpturing that will change with magnification is reproduced at a magnification commensurate to its relationship with superlative or diminutive forms (i.e., foveate is reproduced larger than punctate which in turn is reproduced larger than puncticulate or punctulate).

GLOSSARY

The Word Index and Glossary. The word index and glossary consists of three sections. The first is an alphabetical checklist of terms and synonyms. A quick check in the index will tell you in which section of the glossary an unfamiliar term is defined. Also the index will refer to the preferred synonyms. Words in capitals are preferred, those in lower case are synonyms.

The next section lists 10 areas of surface sculpturing covered by the glossary. If in describing a specimen there is a need to accurately label a specific surface sculpturing, look down this list to find the category of sculpturing to be described. It will refer to the appropriate section of the glossary. At this point, it will be necessary to read through the section to find a word which approaches the kind of sculpturing to be described. Most words are cross-indexed to similar words.

The final section is the glossary. The glossary consists of 10 categories of words and their definitions. The words are listed alphabetically and each entry is followed by its antonyms (ant.), diminutives (dim.), and synonyms and less related terms (cf.). Several terms are preceded by an asterisk (*). This indicates that though the word is otherwise correct, it is not a preferred term for surface sculpture. There may be several

reasons for this, but the most common objections are that the term is either too vague or has two or more common meanings, one in the broad sense (*sensu lato*) and one in the strict sense (*sensu stricto*). Their use should be avoided whenever possible.

All words were checked in all sources listed in the reference section. The letters in brackets following each definition refer to the primary source or sources of the definition. Note that many of the definitions refer to more than one source. The sources indicated in brackets are as follows:

(B), Brown, 1954.
(C), Cassell's (see Marchant, et al), 1952.
(E&B), Emery and Brewster, 1959.
(FW), Funk, 1949.
(H&D), Harrington and Durrell, 1957.
(J), Jaeger, 1950.
(M), Munz, 1968.
(S), Stearn, 1966.
(T-B), Torre-Bueno, 1937, 1962 [Includes Tulloch, 1960].

Word Index and Synonymy. The following index is an alphabetical checklist of the descriptive terms covered in this paper. Words written in capitals are defined in one of the 10 succeeding sections as indicated by the Roman numeral after each entry. A word in lower case letters is a functional synonym of the capitalized word following it. Refer to the preceding section for the definition of a synonym.

A-II
AB-II
ACICULATE VI
Aciculatus: ACICULATE VI
ACINOSE V
Acinous: ACINOSE V
Acuductate: ACICULATE VI
Acupunctate: PUNCTATE IV
ADSPERSE IV
Adspersus: ADSPERSE IV
ALUTACEOUS VII
Alutaceus: ALUTACEOUS VII
ALVEOLATE VII
Alveolatus: ALVEOLATE VII
AREATE VII
AREOLATE VI, VII
Asperate: ASPEROUS VI
Asperatus: ASPEROUS VI
ASPEROUS VI
ATOMARIUS IV
Bullate: PUSTULATE V
Bullatus: PUSTULATE V
CAELATE VI
Caelatus: CAELATE VI
CANALICULATE X
CANCELLATE VII
Cancellatus: CANCELLATE VII
CARINATE IX
Carinatus: CARINATE IX
CARINULATE IX
Carinulatus: CARINULATE IX
CARIOSE IV
Cariosus: CARIOSE IV
Carious: CARIOSE IV
CATAPHRACTED VII
Cataphractus: CATAPHRACTED VII
CATENATE VII
Catenatus: CATENATE VII
Cateniform: CATENULATE VII
CATENULATE VII
Catenulatus: CATENULATE VII
Chagrined: SHAGREENED VI
CHANNELLED X
CICATROSE IV
Cicatrosus: CICATROSE IV
CLATHRATE VII
Clathratus: CLATHRATE VII

Clathrose: CLATHRATE VII
Clathrosus: CLATHRATE VII
COLLICULATE V
CONFLECTED II
CONFUSED II
CONSUTE VII
CORIACEOUS VII
Coriaceus: CORIACEOUS VII
CORIARIOUS VII
CORRUGATED VIII
CORTICINUS IV, VI
COSTATE IX
Costatus: COSTATE IX
COSTULATE IX
Costulatus: COSTULATE IX
CRENATE VII
CRENULATE VII
Cribrate: PUNCTATE IV
Cribratus: PUNCTATE IV
CRISTATE IX
Cristatus: CRISTATE IX
CRISTULATE IX
DENUDATE III
Denuded: DENUDATE III
DESTITUTE III
Destitutus: DESTITUTE III
DISPERSED II
E-II
ECARINATE III
ECHINATE V
Echinatus: ECHINATE V
ECHINULATE V
ELUTE II
Elutus: ELUTE II
EMBOSSED I
Engraved: EXSCULPTATE IV
EX-II
EXARATE IV
Exaratus: EXARATE IV
Exasperate: ASPERATE VI
Exasperatus: ASPERATE VI
EXCAVATED IV
Excavatus: EXCAVATED IV
EXPLICATE III
EXSCULPTATE IV
FARINACEOUS VI
Farinaceus: FARINACEOUS VI
FARINOSE VI
Farinosus: FARINOSE VI
FATISCENT IV, VI
Faveolate: ALVEOLATE VII
Favose: ALVEOLATE VII
Favosus: ALVEOLATE VII
Favous: ALVEOLATE VII
FENESTRATE IV
FISSATE IV, VI
FLUTED X
FOSSULATE IV
FOVEATE IV
FOVEOLATE IV
Glaber: GLABROUS III
GLABRATE III
GLABROUS III
GOFFERED VII
Granular: GRANULATE V
GRANULATE V
Granulatus: GRANULATE V
Granulose: GRANULATE V
HATCHED VI
Helcodermatus: CARIOSE IV
IMBRICATE VII
Imbricatus: IMBRICATE VII
IMACULATE III
IMPRESSED IV
Impressus: IMPRESSED IV
IMPUNCTATE III
Impunctatus: IMPUNCTATE III
INERMIS III
INNOTATE III
INSTITIA X
INTERSTICE I
INTERVAL I
INTRICATE II
INVESTITUS III
IRRORATE IV
Lacunate: LACUNOSE IV
LACUNOSE IV
Laevis: LEVIGATE III
Laevigatus: LEVIGATE III
Latticed: CLATHRATE VII
LEVIGATE III
LINEATE VIII
Lineatus: LINEATE VIII
LINEOLATE VIII
MACULATE IV
MACULATION I
Maculose: MACULATE IV
Mammillate: PAPILLATE V

Mammillatus: PAPILLATE V
Mealy: FARINOSE VI
MICANS III
Multiplicate: PLICATE VIII
MUNITE V
Munitus: MUNITE V
Muricate: SCABROUS VI
Muricatus: SCABROUS VI
MURICULATE VI
MUTIC III
NITID III
Nitidus: NITID III
Nodular: NODULATE V
NODULATE V
Nodulose: NODULATE V
Nodulosus: NODULATE V
Nodulous: NODULATE V
NOTATE IV
Notatus: NOTATE IV
NUDE III
OBSCURE II
Obscurus: OBSCURE II
ORDINATE II
Ordinatus: ORDINATE II
PAPILLATE V
Papillatus: PAPILLATE V
Papillose: PAPILLATE V
Papillosus: PAPILLATE V
Papillous: PAPILLATE V
PAPILLULATE V
PERLATE V
Phalerated: PERLATE V
Phaleratus: PERLATE V
Plaited: PLICATE VIII, X
PLICATE VIII, X
Plicatus: PLICATE VIII, X
POLITUS III
POLLINOSE VI
Pollinosus: POLLINOSE VI
PORCATE IX, X
Porcatus: PORCATE IX, X
Poriferous: PUNCTATE IV
POROSE IV
PROMINENT I
PROTUBERANCE I
PRUINOSE VI
Pruinosus: PRUINOSE VI
Pruinous: PRUINOSE VI
PULVERULENT VI
PUNCTATE IV
Punctatus: PUNCTATE IV
PUNCTICULATE IV
PUNCTULATE IV
Punctulatus: PUNCTULATE IV
Punctured: PUNCTATE IV
PUSTULATE V
Pustulose: PUSTULATE V
Pustulosus: PUSTULATE V
Pustulous: PUSTULATE V
RASTRATE VI
Rastratus: RASTRATE VI
Reticious: RETICULATE VII
RETICULATE VII
Reticulatus: RETICULATE VII
Reticulose: RETICULATE VII
Reticulosus: RETICULATE VII
Reticulous: RETICULATE VII
RIMOSE IV, VI
Rimosus: RIMOSE IV, VI
Rimous: RIMOSE IV, VI
RIMULOSE IV, VI
RIVOSE VI
Rivosus: RIVOSE VI
Rivous: RIVOSE VI
RIVULOSE VI
RORULENT VI
Rorulentus: RORULENT VI
RUGOSE VI
Rugosus: RUGOSE VI
Rugous: RUGOSE VI
RUGULOSE VI
Rugulosus: RUGULOSE VI
SALEBROSE VI
Salebrosus: SALEBROSE VI
Salebrous: SALEBROSE VI
Scaber: SCABROUS VI
Scaberulous: SCABRICULOUS VI, VII
SCABRICULOUS VI, VII
SCABRID VI
Scabridulous: SCABRICULOUS VI, VII
Scabrose: SCABROUS VI
Scabrosus: SCABROUS VI
SCABROUS VI
Scalloped: CRENATE VII
SCARIFIED VI
SCROBICULATE IV, VII

SCULPTURE I
SCULPTURED I
SCUTATE VII
Scutatus: SCUTATE VII
SCUTELLATE VII
Scutellatus: SCUTELLATE VII
Scutiform: SCUTATE VII
SERIATIONS VIII
SHAGREENED VI
Sparsate: SPARSE II
SPARSE II
Sparsus: SPARSE II
SPHERULATE V
Spined: SPINOSE V
SPINOSE V
Spinosus: SPINOSE V
Spinous: SPINOSE V
SPINULATE V
Spinulose: SPINULATE V
Spinulosus: SPINULATE V
SQUAMATE VII
Squamose: SQUAMATE VII
SQUARROSE VI
STRIATE X
Striatus: STRIATE X
STRIGATE IX, X
STRIGULATE IX, X
STRIOLATE X
SUB-II
SULCATE X
TAENIATE VIII
Taeniatus: TAENIATE VIII
TESSELLATE VII
Tessellatus: TESSELLATE VII
TOROSE V
Torosus: TOROSE V
Torous: TOROSE V
TORULOSE V
TUBERCULATE V
Tuberculose: TUBERCULATE V
Tuberculouse: TUBERCULATE V
UNDOSE IV, VI
Undosus: UNDOSE IV, VI
VARIOLATE IV
VENOSE VI
Venosus VENOSE VI
Venous: VENOSE VI
VERMICULAR VI
VERMICULATE VI
Vermiculatus: VERMICULATE VI
Verrucate: VERRUCOSE V
VERRUCOSE V
Verrucous: VERRUCOSE V
Verruculous: VERRUCOSE V
Verruculosus: VERRUCOSE V
VITTATE VIII
Vittatus: VITTATE VIII
Wrinkled: RUGOSE VI
Writhled: RUGOSE VI

Word Guide by Sections.

Page

I. *General Terminology:* Some important terms for correctly understanding a discussion of descriptive terminology 11

II. *Modifiers:* Words used to modify the meaning of a descriptive term. Also, prefixes 11

III. *Unsculptured Surfaces* 12

IV. *Superficial and Impressed Nonparallel Sculpturing:* Spots, punctures, excavations, and cracks 13

V. *Protuberant Nonparallel Sculpturing:* Bumps, knobs, and spines 14

VI. *Irregular and Nonparallel Sculpturing:* Wrinkles, roughness, scratches, mealiness 16

VII. *Regular and Nonparallel Sculptured Patterns:* Reticulations, imbrications 18

VIII. *Parallel Lineations:* General terms for sculptured lineations, whether raised, impressed, or superficial 19

IX. *Raised Parallel Lineations* 19

X. *Impressed Parallel Lineations* 20

Definitions by Sections

I. *General Terminology:* Some important terms for correctly understanding a discussion of descriptive terminology.

embossed, ornamented with raised sculpturing (T-B).
cf., sculptured.

interstice, a space between two lines, whether striate or punctate (T-B).
cf., interval.

interval, the space between two structures or sculptures (T-B).
cf., interstice.

maculation, the pattern of marks or spots on a surface (T-B)(C)(B).
cf., sculpture.

prominent, raised or produced above the surface or beyond the margin; standing out in relief; conspicuous by position (T-B).
cf., protuberance.

protuberance, any excrescence above the surface; a prominence (T-B)(FW).
cf., prominent.

sculpture, the markings or pattern of impressions or elevations on a surface (T-B).
cf., maculation.

sculptured, superficially marked with elevations or depressions or both, arranged in some definable manner (T-B).
cf., embossed.

II. *Modifiers:* Words used to modify the meaning of a descriptive term. Also, prefixes.

a-, wanting or without (T-B).

ab-, off; away from (T-B).

conflected, crowded; thickly clustered (T-B)(J).
ant., sparse.

confused (fig. 17), markings with indefinite outlines or run together as lines or spots without definite pattern (T-B).
cf., intricate, obscure.

dispersed, with scattered markings or small sculptures (T-B).
cf., sparse.

e-, without (T-B).

elute, with scarcely distinct markings (T-B).

ex-, out of; proceeding from (T-B).

intricate, confused; markings, whether elevated or depressed, so run into each other as to be difficult to see (T-B).
cf., confused, obscure.

obscure, dark; not readily seen; not well defined (T-B).
cf., confused, intricate.

ordinate, spots or sculpturing arranged in rows or regularly arranged (T-B)(B).
cf., perlate V.

sparse, scattered; spread irregularly and some distance apart; thin; eg., pile or hairs (T-B).
cf., dispersed.
ant., conflected.

sub-, under, slightly less than, or not quite so (T-B).

III. ***Unsculptured Surfaces:***

* ***denudate,*** without hairs or scales (*sens. str.*); without vestiture of any kind (*sens. lat.*) (T-B)(B)(C).
cf., glabrous, immaculate, investitus, nude.

destitute, lacking or devoid of something specified; being entirely without (used to contrast) (T-B) (E&B).

ecarinate, without or deprived of a keel or a carina (used to contrast carinate) (T-B).
ant., carinate IX.

explicate, unfolded or open; also, without folds or plicae (T-B).
ant., plicate VIII, X.

glabrate, almost glabrous (M)(FW).

glabrous, smooth, devoid of pubescence (*sens. str.*); devoid of any sculpturing (*sens. lat.*) (T-B)(FW)(C).
cf., denudate, immaculate, investitus, nude.

immaculate, destitute of spots, marks, or sculpturing (*sens. lat.*); destitute of spots or marks (*sens. str.*) (T-B)(S).
cf., denudate, glabrous, investitus, nude.
ant., maculate IV.

impunctate, not punctate or marked with punctures (used to contrast punctate) (T-B).
ant., punctate IV.

inermis, unarmed; without striae, spines, or any other sharp processes (T-B)(B).
cf., mutic.
ant., munite V.

* ***innotate,*** without markings (T-B).
ant., notate IV.

* ***investitus,*** unclothed; without scales or hair (T-B).
cf., denudate, glabrous, immaculate, nude.

* ***levigate,*** a smooth surface, sometimes somewhat shiny or polished; without elevations or depressions (T-B)(B)(C)(FW).
cf., glabrous, micans, nitid, politus.

micans, shining or twinkling, in part or altogether (B)(T-B).
cf., glabrous, nitid, politus.

mutic, unarmed; lacking processes where such usually occur (T-B).
cf., inermis.

nitid, shiny or glossy; reflecting light (T-B).
cf., politus.

nude, naked; devoid of hair, scales or other surface vestiture (T-B).
cf., denudate, glabrous, immaculate, investitus.

* ***politus,*** polished; smooth shiny (B)(C)(T-B).
cf., glabrous, micans, nitid.

IV. ***Superficial and Impressed Nonparallel Sculpturing:*** Spots, punctures, excavations, and cracks.

* ***adsperse,*** marked with closely crowded, small spots (T-B).
cf., atomarius, irrorate, maculate.

* ***atomarius,*** with minute dots or points (T-B).
cf., adsperse, irrorate, maculate.

cariose, corroded; appearing worm eaten; with cavities or ulcerations (T-B)(FW).
cf., vermicular VI, vermiculate VI.

* ***cicatrose,*** a surface having scars with elevated margins like those of small pox (T-B).
cf., impressed, lacunose, variolate.

* ***corticinus,*** bark-like sculpturing or texture (T-B).
cf., fatiscent, fissate, rimose.

* ***exarate,*** ploughed; sculpted; furrowed; sulcated; an excavated surface in general (T-B)(B)(FW).
cf., impressed.

* ***excavated,*** with a scooped out depression; superficially, with a hollowed out area (FW)(C).
cf., lacunose.

* ***exsculptate,*** with irregular, more or less longitudinal depressions, as if carved or scooped out (T-B)(C).
cf., fossulate, scrobiculate.

fatiscent, with superficial cracks, crevices, or similar openings (T-B)(C).
cf., corticinus, fissate, rimose.

* ***fenestrate,*** with transparent areas or window-like openings (fenestrae) as in the wings of some Lepidoptera (M)(T-B).

fissate, with fissures or cracks (*sens. lat.*); divided or cleft (*sens. str.*) (C)(T-B).
cf., corticinus, fatiscent, rimose.

fossulate, with oblong depressions (fossulae) more elongate or furrow-like than scrobiculate (T-B)(B).
cf., exsculptate, lacunose, scrobiculate.

foveate (fig. 27), pitted; with numerous, regular, depressions or pits (foveae) (B)(C)(T-B).
dim., foveolate.
cf., lacunose, punctate.

foveolate (figs. 29, 32, 34, 35, 36), with small deep pits; finely pitted (B)(C).
dim., punctate.
cf., foveate.

* ***impressed,*** having shallow, depressed areas or markings (T-B).
cf., cicatrose, lacunose, variolate.

irrorate, freckled or speckled; covered with minute spots or granules (T-B)(B).

cf., adsperse, atomarius, farinose VI, maculate.

lacunose (fig. 20), full of hollows or cavities; with scattered and irregular broad, shallow cavities (C)(B)(T-B).
cf., excavated, foveate, impressed, variolate.

* ***maculate,*** spotted; with many superficial marks or spots (T-B)(FW).
ant., immaculate III.
cf., adsperse, atomarius, irrorate.

* ***notate,*** marked by spots (*sens. str.*); with a series of depressed marks as a sculpture (*sens. lat.*) (T-B).
ant., innotate III.
cf., impressed, maculate, ordinate II.

porose, having pores (T-B).

punctate (figs., 23, 30, 31, 32, 35, 37, 38), set with fine, impressed points or punctures appearing as pin-pricks (T-B)(B)(C).
ant., impunctate III.
dim., punticulate, punctulate.
cf., foveate, foveolate.

puncticulate (figs. 33, 36), sparsely punctate with very fine, widely spaced punctures (S)(M).
cf., punctulate.

punctulate (fig. 30), finely punctate; with numerous minute and close set punctures (S)(C)(T-B).
cf., puncticulate.

rimose, with minute, narrow and nearly parallel excavations (rimae) running into each other; chinky; resembling the cracked bark of a tree (C)(B)(J)(T-B).
dim., rimulose.
cf., corticinus, fatiscent, fissate, rivose VI, undose.

rimulose, minutely rimose; with minute cracks or fissure-like openings with sharp edges (B).

scrobiculate (fig. 28), uniformly covered with short, oblong or trench-like hollows (B)(J)(T-B).
cf., exsculptate, fossulate.

undose, with undulating, broad, nearly parallel depressions running more or less into each other; wavy, resembling ripple-marks on a sandy beach (T-B).
cf., vermiculate VI.

variolate (fig. 42), pitted as if by small pox; full of irregular indentations (varioles) (B)(T-B).
cf., cicatrose, impressed, lacunose.

V. ***Protuberant Nonparallel Sculpturing:*** Bumps, knobs, and spines.

acinose, continuously set with granulations like those on a blackberry (T-B).
cf., colliculate, granulate, papillate.

colliculate (fig. 43), continuously covered with low, rounded

elevations, not as pronounced as acinose (B) (S).
cf., acinose, granulate, papillate.

echinate, thickly set or armed with short, stout spines or prickles; spiny like a hedgehog (FW) (T-B).
dim., echinulate.

echinulate, with very small prickles; minutely echinate (C).

granulate, covered with or made up of very small grains or granules. Also, minutely and densely verrucose or minutely farinose (T-B) (M) (S).
cf., acinose, farinose VI.

munite, a surface armed with spines or other excrescences (T-B) (C).
ant., inermis III.

nodulate, a surface sculpturing of small knots or swellings (T-B).
cf., acinose, colliculate, torulose, tuberculate, verrucose.

papillate, covered with small, nipple-like surface elevations, often porous at the tip (B) (H&D) (T-B).
cf., acinose, colliculate, papillulate, pustulate.

papillulate, beset with depressions or elevations with a small elevation in the center (a papillule) (T-B).
cf., papillate.

* ***perlate,*** beaded (*sens. lat.*); bearing relieved, rounded points in series (*sens. str.*) (T-B).
cf., ordinate II.

pustulate, covered with small, blister-like swellings larger than papillae and never with a terminal pore (T-B) (S).
cf., acinose, colliculate, papillate.

spherulate, provided with one or more rows of minute tubercles (T-B) (B).
cf., perlate, tuberculate.

spinose, armed with thorny spines, more elongate that echinate (B) (T-B).
dim., spinulate.
cf., echinate.

spinulate, set with numerous small, thorny spines; minutely spinose (B) (T-B).
cf., echinulate.

torose, superficially swelling in knots, knobs, or protuberances; knobby (*sens. lat.*). In general form, swollen or with a knobby or knotted shape (*sens. str.*) (T-B) (B) (C).
dim., torulose.
cf., nodulate, tuberculate, verrucose.

torulose, minutely torose; with numerous small knobs or knots (*sens. lat.*) (T-B) (B).
cf., torose

tuberculate, covered or furnished with rounded, projecting lobes; more projecting than granulate, papillate, or pustulate (S) (J) (B) (T-B).

cf., nodulate, torose, verrucose.

verrucose (fig. 44), covered with irregularly shaped lobes or wart-like protuberances (S) (T-B).
cf., nodulate, torose, tuberculate.

VI. ***Irregular and Nonparallel Sculpturing:*** Wrinkles, roughness, scratches, mealiness.

aciculate, appearing as if irregularly scratched with a needle (T-B).
cf., rastrate, scarified.

areolate (figs. 19, 21, 22, 23, 26), divided into a number of small, irregular spaces (S) (B).
cf., alveolate VII, goffered VII, reticulate VII.

asperous, rough and uneven (T-B).
cf., salebrose, scabrous, squarrose.

caelate, with superficial plane elevations of varying form (T-B) (B).

* ***corticinus,*** bark-like sculpturing or texture (T-B).
cf., fatiscent, fissate, rimose.

farinaceous, mealy or powdery looking; applied to surfaces or wings (T-B) (C).
cf., farinose, pollinose, pruinose, pulverulent, rorulent.

farinose, dotted with many single flour-like spots; mealy (T-B).
cf., farinaceous, pollinose, pruinose, pulverulent, rorulent.

fatiscent, with cracks, crevices, or similar openings (T-B) (C).
cf., corticinus, fissate, rimose.

fissate, with fissures or cracks (*sens. lat.*); divided or cleft (*sens. str.*) (C) (T-B).
cf., corticinus, fatiscent, rimose.

* ***hatched,*** closely marked with numerous short, transverse lines (T-B).
cf., strigate IX, X.

muriculate, with a coverning of fine, short, sharp, thick excrescences; irregularly scabriculous (M).

* ***pollinose,*** covered with a loose, mealy, often yellow dust like the pollen of flowers; fine meal (T-B) (B) (J).
cf., farinaceous, farinose, pruinose, pulverulent, rorulent.

pruinose, appearing covered with a fine dust or coarse powder, but which cannot be rubbed off; the brightness of the surface somewhat obscured by the appearance of a bloom like that of a plum (T-B) (M).
cf., farinaceous, farinose, pollinose, pulverulent, rorulent.

pulverulent, powdery or dusty. Also, covered with very minute, powder-like scales (T-B) (M).
cf., farinaceous, farinose, pollinose, pruinose, rorulent, squarrose.

rastrate, covered as if with longitudinal scratches (T-B) (J).
cf., aciculate, scarified.

rimose, with minute, narrow and nearly parallel excavations

(rimae) running into each other; chinky; resembling the cracked bark of a tree (C) (B) (J) (T-B).
dim., rimulose.
cf., corticinus, fatiscent, fissate, rivose.

rimulose, minutely rimose; with minute cracks or fissure-like openings with sharp edges (B).

rivose, marked with sinuate furrows, like rivulets, not running in a parallel direction (C) (S) (B).
dim., rivulose.
cf., rimose, venose.

rivulose, minutely rivose; with very small or fine sinuate furrows, like rivulets, which are not parallel (B) (C).

rorulent, covered with a bloom of fine dust that can be rubbed off (T-B) (C) (S).
cf., farinaceous, farinose, pollinose, pruinose, pulverulent.

rugose, (figs. 12, 15, 16, 21, 22), wrinkled (T-B) (C) (B).
dim., rugulose.
cf., salebrose, scabrous.

rugulose, (figs. 17, 18, 19, 20, 23), minutely rugose; minutely wrinkled (J) (T-B).
cf., scabriculous.

* ***salebrose,*** rough, rugged, or uneven (C) (T-B).
cf., asperous, rugose, scabrous, squarrose.

scabriculous, (figs. 13, 19), finely scabrous; with fine and regular short, sharp, wrinkles and/or projections (M) (T-B).
cf., muriculate, shagreened.

scabrid, sparsely scabrous (S) (M).

scabrous, (fig. 14), rough; irregularly and roughly rugose; possessing short, sharp projections or wrinkles (B) (T-B).
dim., scabriculous.
cf., rugose, salebrose, squarrose.

scarified, appearing clawed or scratched; furnished with fine, irregular grooves, coarser than aciculate (T-B) (B).
cf., aciculate, rastrate.

* ***shagreened,*** covered with a closely set roughness, like the rough-surfaced horse leather termed shagreened; like shark leather (T-B).
cf., scabriculous.

squarrose, rough with elevations; scurfy; rough with loose scales differing in direction or not parallel in direction (C) (J) (S) (T-B).
cf., pulverulent, rugose, salebrose, scabrous.

undose, with undulating, broad, nearly parallel depressions running more or less into each other; wavy; resembling ripple-marks on a sandy beach (T-B)
cf., vermiculate.

* ***venose,*** furnished with veins or vein-like marking; of or pertaining to veins (T-B).

* ***vermicular,*** worm-shaped or worm-like in general body form (M) (S).
cf., cariose IV, undose, vermiculate.

vermiculate, with superficial, tortuous markings resembling the tracks of a worm (T-B) (S).
cf., cariose IV, undose, vermicular.

VII. ***Regular and Nonparallel Sculptured Patterns:*** Reticulations, imbrications.

* ***alutaceous,*** rather pale leather-brown; covered with minute cracks like the human skin and leathery in texture (T-B)
cf., coriaceous, coriarious.

alveolate, (fig. 25), honeycombed; with regular, deep, angular cavities (alveolie) separated by thin partitions. Furnished with cells or alveoli (T-B) (J).
cf., areolate, goffered, reticulate.

* ***areate,*** furnished with open areas or with areas defined on the surface (T-B) (M).
cf., areolate.

areolate, (figs. 19, 21, 22, 23, 24, 26), divided into a number of small, irregular spaces (S) (B).
cf., alveolate, areate, reticulate.

* ***cancellate,*** a lattice-work or grid; a series of enclosed cells or chambers (B) (C) (FW).
cf., clathrate, reticulate.

* ***cataphracted,*** clad in closely set scales (C) (T-B).
cf., imbricate, scutate, squamate.

catenate, with longitudinal, connected elevations like links in a chain (T-B).
dim., catenulate.
cf., consute.

catenulate, chain-like, with smaller links than catenate (T-B).

clathrate, latticed; elevated ridges decussing at right angles (T-B).
cf., cancellate, reticulate.

consute, with very minute elevations in series, some distance apart, and of a different color from the general surface, which resemble stitching somewhat (T-B).
cf., catenate.

* ***coriaceous,*** leather-like in texture, with minute cracks like human skin (T-B).
cf., alutaceous, coriarious.

coriarious (fig. 38), leather-like in sculpture; with minute cracks like the human skin (T-B) (B).
cf., alutaceous, coriaceous.

crenate, having the margin evenly notched with rounded teeth (B) (T-B).
dim., crenulate.

crenulate, having the margin finely notched with small, rounded teeth (T-B) (B) (M).

** goffered,* with regular impressions, closely set, and separated by narrow ridges; waffling or honeycombs (E&B) (T-B).
cf., alveolate, areolate, cancellate, clathrate, reticulate.

imbricate (figs. 37, 39, 40, 41), partly overlapping and appearing like shingles on a roof or scales on a fish (T-B) (M) (H&D).
cf., cataphracted, scutate, squamate.

reticulate (figs. 27, 30), superficially net-like or made up of a network of lines; meshed; netted (T-B) (C) (S).
cf., alveolate, areolate, cancellate, clathrate, goffered.

scabriculous, (figs. 13, 19), finely scabrous; with fine and regular short, sharp, wrinkles and/or projections (M) (T-B).
cf., muriculate VI, shagreened VI.

scrobiculate, uniformly covered with short, oblong or trench-like hollows (B) (J) (T-B).
cf., exsculptate IV, fossulate IV.

scutate, covered with large, flat, scales. Also, having a scutum; shield-shaped; scutiform (T-B).
dim., scutellate.
cf., cataphracted, imbricate, squamate.

** scutellate,* divided into surfaces like small plates, minutely scutate (T-B).
cf., cataphracted, imbricate, squamate.

** squamate,* scaly; covered with scales (B) (T-B).
cf., cataphracted, imbricate, scutate.

tessellate, made up of squares like a chess board, either in sculpturing or in color (C) (M).
cf., cancellate, clathrate.

VIII. *Parallel Lineations:* General terms for sculptured lineations, whether raised or impressed or superficial.

** corrugated,* wrinkled into furrows; with alternate ridges and channels (T-B) (E&B).

lineate, longitudinally marked with raised or depressed parallel lines; with linear marks (T-B) (M).
dim., lineolate.

lineolate, finely lineate, longitudinally marked with very fine raised or depressed lines (C).

plicate, folded; with folds; impressed with striae to produce the appearance of having been folded or pleated (T-B).
ant., explicate III.

** seriations,* lines arranged in parallel series, either in sculpture or in color, as in the Corixidae of the Heteroptera (T-B).

taeniate, with broad, longitudinal bands or ribbon-like markings (*sens. lat.*); shaped like a tapeworm (*sens. str.*) (B) (C) (T-B).

** vittate,* striped; longitudinally striped or plaited (T-B).

IX. *Raised Parallel Lineations.*

carinate (figs. 11, 16), keeled; having keels or carinae; with one, or several, but usually few longitudinal narrow raised ridges (T-B).

ant., ecarinate III.
dim., carinulate.
cf., costate, cristate, porcate.

carinulate, with several small, elevated, longitudinal ridges or carinae (T-B).
cf., costulate, cristulate.

costate (figs. 8, 9), furnished with longitudinal raised ribs or ridges (costae), much coarser than carinate (T-B).
dim., costulate.
cf., carinate, cristate, porcate.

costulate (figs. 4, 6, 7), with less prominent ribs or ridges than costate (T-B).

cristate, with a prominent carina or crest on the upper surface; crested (T-B).
dim., cristulate.
cf., carinate, costate, porcate.

cristulate, with several, small, crescent-like ridges or crests (T-B).
cf., carinulate.

porcate (fig. 10), with several parallel, longitudinal ridges with deep, broad sulcations (T-B).
cf., carinate, costate, cristate.

strigate (figs. 4, 5, 6, 12), having narrow, transverse lines or streaks, either raised or impressed; composed of fine, short lines (T-B).
dim., strigualte.
cf., hatched VI, striate X.

strigulate (figs. 1, 2, 3), finely or minutely strigate; with numerous short and fine transverse lines, either raised or impressed (T-B) (B).
cf., striolate X.

X. *Impressed Parallel Lineations.*

* ***canaliculate,*** channelled or furrowed; longitudinally grooved (*sens. lat.*). In general body form, long and concave so as to resemble a gutter or channel (*sens. str.*) (T-B) (S).
cf., porcate, sulcate.

* ***channelled*** (fig. 11), having deep grooves or channels (T-B).
cf., canaliculate, fluted, striate, strigate.

* ***fluted,*** having parallel grooves or flutes; channelled (FW) (T-B).
cf., canaliculate, channelled.

institia, striae or furrows of equal width throughout (T-B).

plicate folded; with folds; impressed with striae to produce the appearance of having been folded or pleated (T-B).
ant., explicate III.
cf., striate.

porcate (fig. 10), with several parallel, longitudinal ridges with deep, broad sulcations (T-B).

cf., canaliculate, striate, sulcate.

striate, marked with parallel, fine, longitudinal impressed lines or furrows (T-B) (M) (C) (J) (B).
dim., striolate.
cf., strigate.

strigate (figs. 4, 5, 6, 12), having narrow, transverse lines or streaks, either raised or impressed; composed of fine, short lines (B) (T-B).
dim., strigulate.
cf., hatched VI, striate.

strigulate (figs. 1, 2, 3), finely or minutely strigate; with numerous short and fine transverse lines, either raised or impressed (T-B) (B).
cf., striolate.

striolate, minutely or finely striate; with numerous parallel and very fine longitudinal impressed lines or furrows (T-B) (B).
cf., strigulate.

sulcate, deeply furrowed or grooved (T-B).
cf., canaliculate, porcate.

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SPECIES AND BODY REGIONS PHOTOGRAPHED FOR FIGURES

1. *Sphaerophthalma amphion* (Fox): base of gaster.
2. *Sphaerophthalma amphion* (Fox): tergite 3.
3. *Sphaerophthalma amphion* (Fox): tergite 3.
4. *Ammophila wrighti* (Cresson): thorax.
5. *Ammophila aphrodite* (Menke): propodeal enclosure.
6. *Ammophila wrighti* (Cresson): propodeal enclosure.
7. *Pogonomyrmex barbatus rugosus* Emery: head.
8. *Novomessor cockerelli* (Andre): head.
9. *Pogonomyrmex californicus* (Buckley): thorax.
10. *Pogonomyrmex barbatus rugosus* Emery: thorax.
11. *Ibalia ensiger* Norton: scutum.
12. *Ammophila stangei* (Menke): propodeal enclosure.
13. *Andrena* (*Onagrandrena*) sp.: propodeum.
14. *Ibalia ensiger* Norton: mesonotum.
15. *Veromessor andrei* (Mayr): thorax.
16. *Ceropales maculata fraterna* Smith: pronotal collar.
17. *Aulacostethus rufitarsus* (Cresson): lateral on propodeum.
18. *Pseudosibrachium occidentale* Evans: propodeum.
19. *Nomada crotchii* (Cresson): dorsal on ponotum.
20. *Sphaerophthalma edwardsii* (Cresson): scutum.
21. *Sphecodes* sp.: metanotum.
22. *Sphecodes* sp.: lateral on propodeum.
23. *Pseudomethoca harpalyce* (Fox): thorax.
24. *Sphaerophthalma amphion* (Fox): lateral on thorax.
25. *Habrocytis analis* (Ashmead): just below tegula.
26. *Odontophotopsis cookii* Baker: propodeum.
27. *Eulonchopria punctatissima* Michener: thorax.
28. *Discoelius strandei* Zavatarri: tergite 2.
29. *Nomada texana* Cresson: scutum.
30. *Eulonchopria punctatissima* Michener: tergite 2.
31. *Nomada texana* Cresson: tergite 1.
32. *Discoelius strandei* Zavatarri: tergite 1.
33. *Brachygastra azteca.*
34. *Scolia otomita* Saussure: thorax.
35. *Scolia ardens* Smith: tergite 4.
36. *Sphecodes* sp.: lateral on tergite 1.
37. *Andrena* (*Onagrandrena*) sp.: pronotum.
38. *Nomada citrina* Cresson: lateral on tergite 2.
39. *Nomada crotchii* (Cresson): lateral on sternite 2.

40. *Chenosmia exigua* (Cresson): sternite 7.
41. *Habrocytis analis* (Ashmead): lateral on tergite 2.
42. *Eurytoma californica* Ashmead: lateral on tergite.
43. *Auplopus nigrellus* (Banks): scutellum.
44. *Auplopus nigrellus* (Banks): ventrolateral on propodeum.

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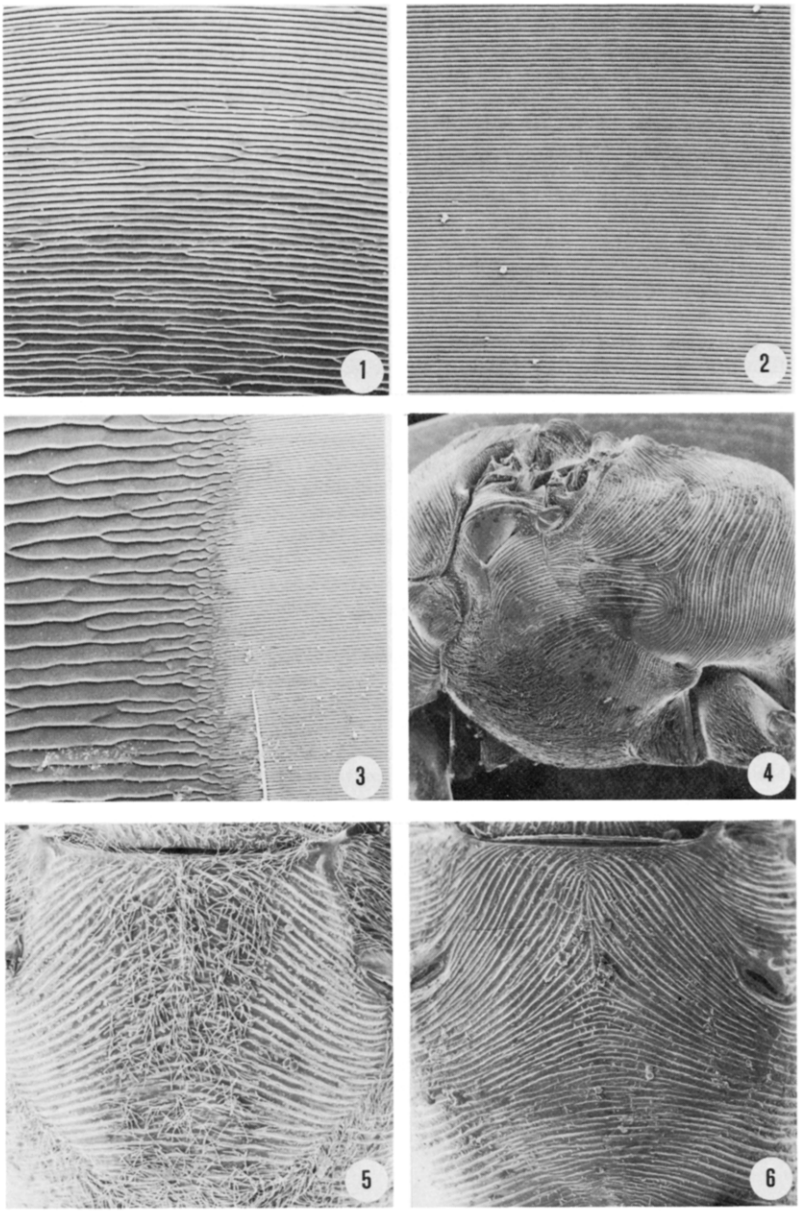
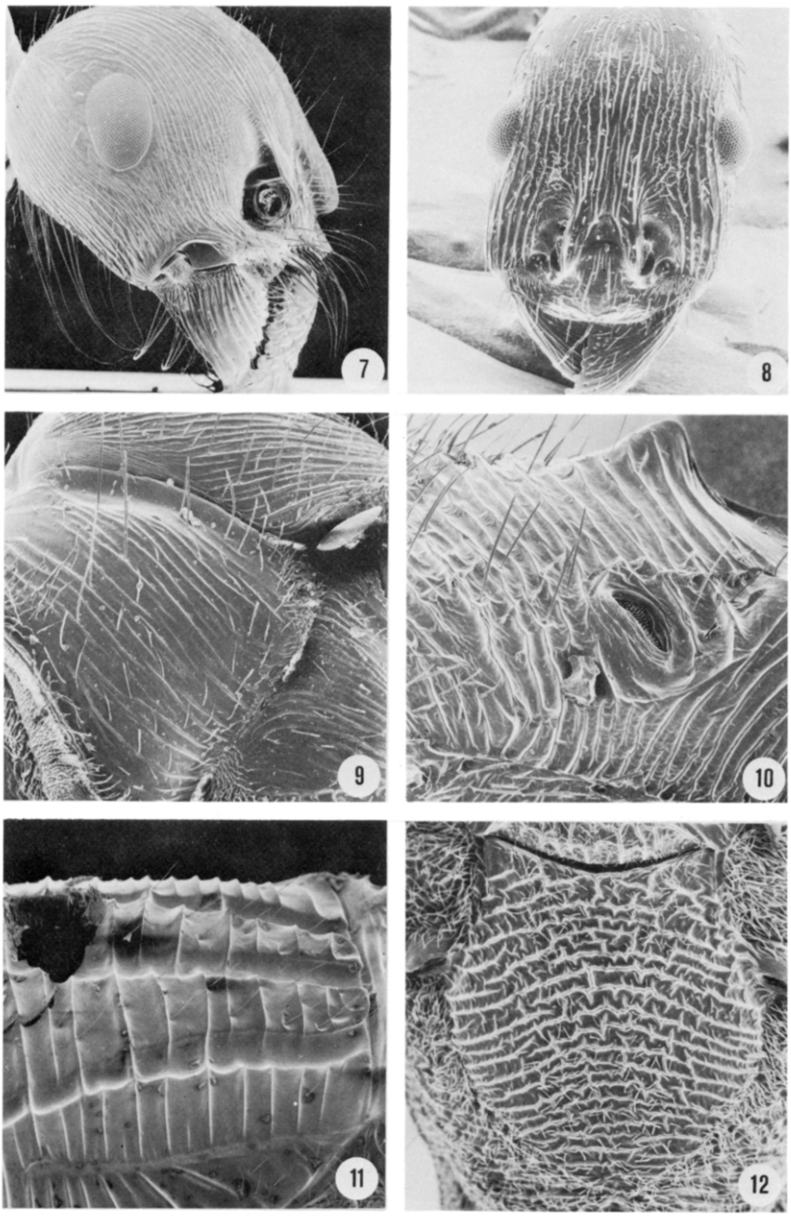
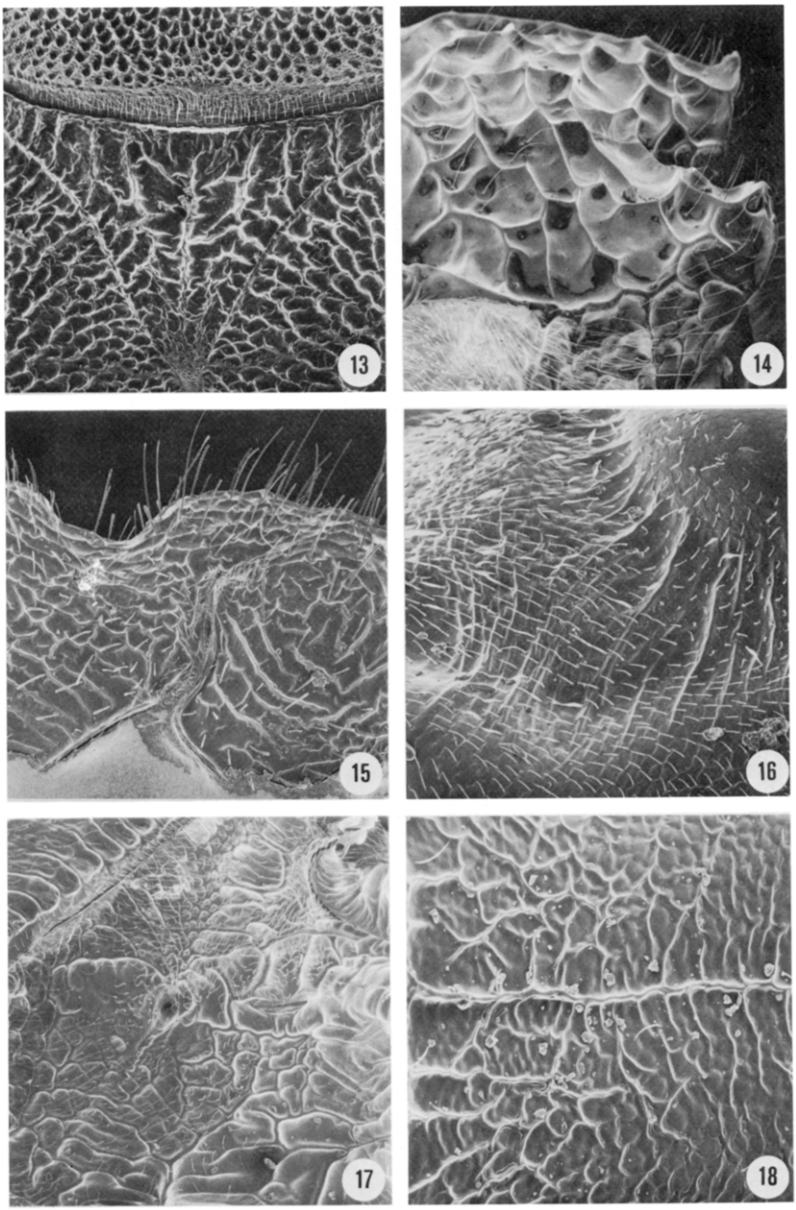


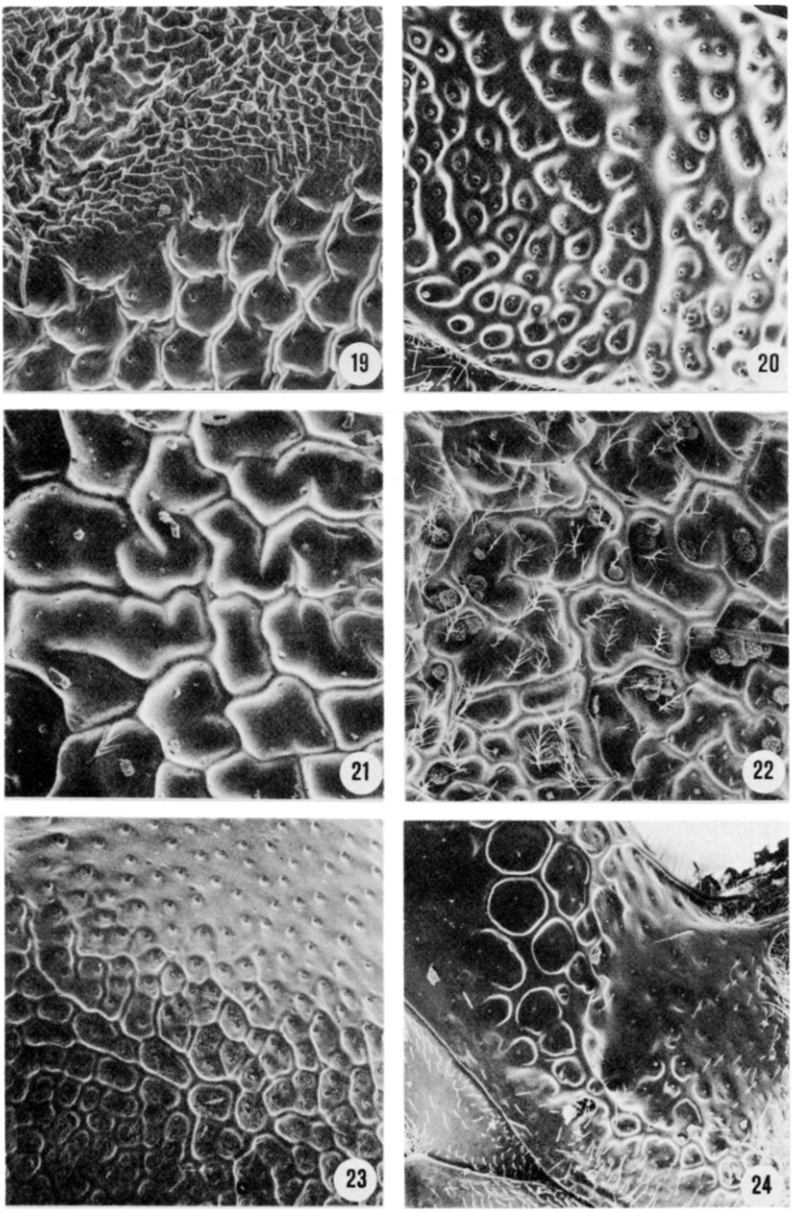
Figures 1–6: Fig. 1, Substrigulate. Fig. 2, Finely Strigulate. Fig. 3, Substrigulate to Finely Strigulate. Fig. 4, Strigate or Costulate. Fig. 5, Strigate. Fig. 6, Strigate or Costulate.



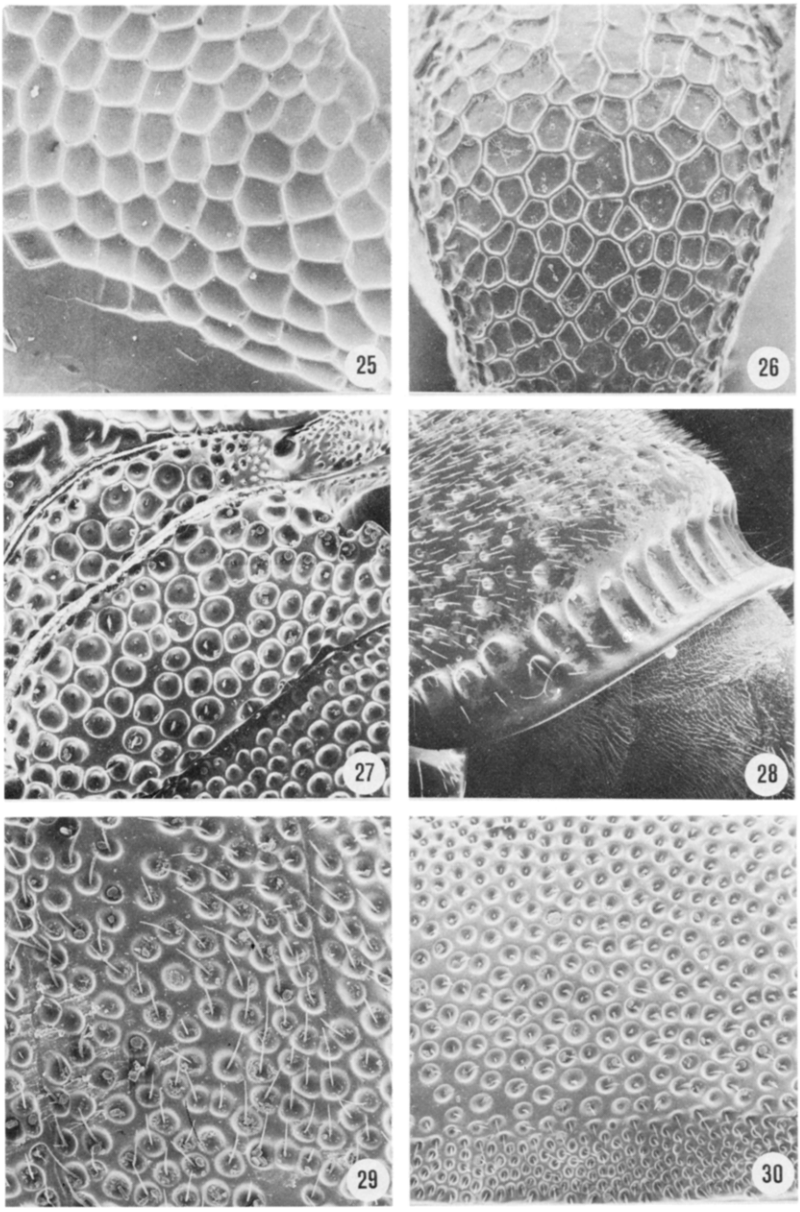
Figures 7–12: Fig. 7, Costulate. Fig. 8, Costate. Fig. 9, Costate. Fig. 10, Porcate. Fig. 11, Broadly Strigate (or Tranversely Carinate) and Axially Sulcate. Fig. 12, Strigate-Rugose.



Figures 13–18: Fig. 13, Scabriculous. Fig. 14, Scabrous. Fig. 15, Rugose. Fig. 16, Carinate-Rugose. Fig. 17, Confused-Rugulose. Fig. 18, Rugulose.



Figures 19–24: Fig. 19, Scabriculous to Areolate. Fig. 20, Rugulose-Lacunose. Fig. 21, Areolate-Rugose. Fig. 22, Areolate-Rugose. Fig. 23, Areolate-Rugulose to Punctate. Fig. 24, Areolate.



Figures 25–30: Fig. 25, Alveolate. Fig. 26, Areolate. Fig. 27, Foveate-Reticulate. Fig. 28, Scrobiculate. Fig. 29, Densely Foveolate. Fig. 30, Punctate-Recticulate above, Punctulate-Reticulate below.