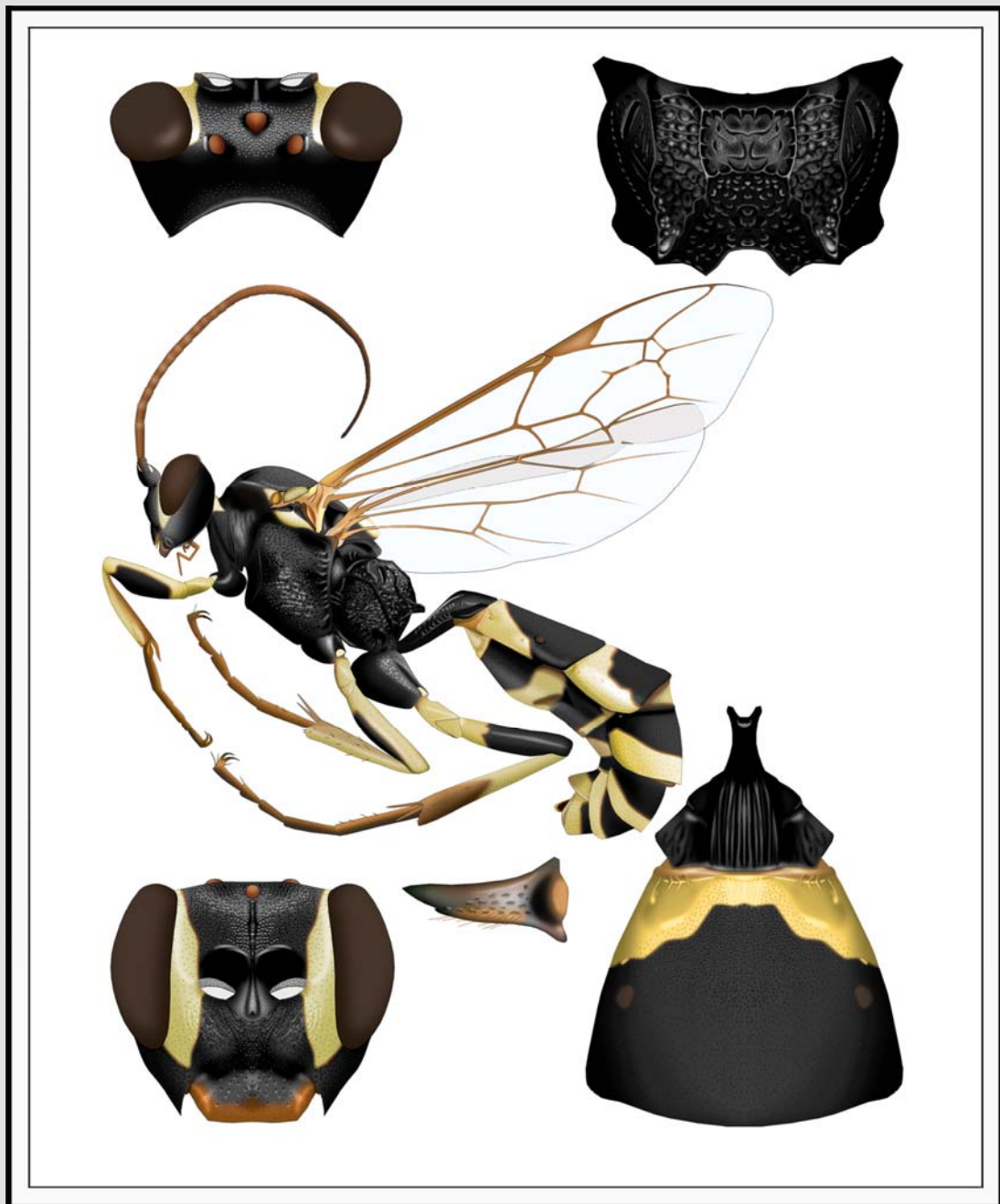# A.M. TERESHKIN

GUIDE TO PREPARING SCIENTIFIC ILLUSTRATIONS IN ENTOMOLOGY ON AN EXAMPLE OF ICHNEUMONIDAE (HYMENOPTERA)

A.M. Tereshkin

GUIDE
TO PREPARING SCIENTIFIC ILLUSTRATIONS IN ENTOMOLOGY ON AN EXAMPLE OF ICHNEUMONIDAE (HYMENOPTERA)

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Work is devoted to a technique of preparation of unified illustrations of zoological objects. In this work the methods of fulfillment of illustrations from completely manual up to performing the entire procedure in a graphics editor (Photoshop) are considered. The proposed technique enables fulfillment of scientific illustrations by specialists in concrete groups of organisms not necessarily possessing art skills. In the work main principles and approaches to fulfillment of scientific images of objects are stated. On an example of ichneumon flies of fam. Ichneumonidae, fulfillment of all actions necessary for creating illustrations, both of total object, and features of morphology of taxonomically significant parts of a body, is described in details and step by step. The sequence of actions from fulfillment of a contour of objects up to preparation of the final table of illustrations of a taxon in a color format is demonstrated. The possibilities of usage of intermediate layers of files with drawings as illustrations of characters for taxonomical analysis, and for revealing regularities of development of same or other characters and as illustrations in identification keys are considered. Principles, techniques and the sequence of operations developed for model group of insects can be used for preparation of the unified scientific illustrations of any objects of wildlife. All necessary operations are illustrated with 1315 drawings and the results with finished color plates. Finished color plates of representatives of all of the tribes of Ichneumoninae and genera of the tribe Platylabini to the extent of the world fauna as well as a number of palearctic genera are included in the work. Overall, color plates of representatives of 78 genera of Ichneumoninae are presented in the book. Every plate includes total color image of imago of ichneumon fly and its taxonomically significant body parts.

The guide is intended for scientists and graduate students specializing in taxonomy of any wildlife objects. It can be used in the practical training of students studying for biological specialties. The book may be useful to animal painters, designers who use computer graphics in their work, as well as to all nature lovers.

Ill. 691. Plates 86.

Amblyteles armatorius (FÖRSTER) plate is on the cover

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Introduction

Importance of a scientific illustration of objects of wildlife does not need additional argumentation. At the present time, in a time of increasingly growing access to global in-formation resources, the availability of unified scientific illustrations of taxa of different ranks is becoming more relevant.

The necessity of preparation of scientific illustrations in entomology is dictated by two circumstances. On the one hand, there are a lot of groups of insects the description of signs of which is a very difficult process and key couplets for such groups are presented by the texts of a considerable volume that makes identification of taxa of different ranks extremely difficult. Combination of alternatives is especially complex. For example, " … if petiole in the middle has approximately square cross-section, the same time on the border with postpetiole with knoll, or its lateral side is smooth and lower border is not edged (simultaneously …), or …" etc. (RASNITSYN 1981). A good example of such group is ichneumon flies subfamily Ichneumoninae (fam. Ichneumonidae). Their morphological diversity is generated not by a diversity of constant combinations of characters, but by a free, almost random combination of the same characters, that is related to character of group evolution, that leads to a plenty of closely related and difficult to distinguish species. Furthermore, the determination of superspecific taxa is more difficult than the determination of species (RASNITSYN 1978). According to G. HEINRICH (1967a), "…in a young subfamily, as the Ichneumoninae probably are, intermediate characters can be expected to be still in existence more frequently than in most other groups. Hence the genera can not be so sharply separated as our taxonomic mind would like….". One of the ways to make easier superspecific taxa identification is preparation of the tables of illustrations of typical or the most characteristic species of subfamily genera. One of the requirements of a successful solution of this problem, in our opinion, is a standard table preparation performed only by one author who specializes in investigation of the same particular group. All of the above served as the basis for preparation of this work.

On the other hand, at the description of new taxa, especially high ones, taxonomist must have typical or comparative material from different, often difficult to access collections. The solution of these problems is also seen in preparing maximally unified illustrations and descriptions of taxa and publishing them in the Internet for maximum ease of access to researchers. The availability of correctly prepared illustration of taxon by taxonomist, makes it possible to avoid the necessity of using typical material and representatives of relative taxa. In higher taxa of the subfamily, the above obtains special significance because of the mode of group evolution and morphologi-

cal definiteness of higher taxa being based, as a result, on a combination or conjunction of comparatively small number of taxonomic characters.

Fulfillment of a scientific illustration in entomology is quite a laborious occupation, re-quiring availability of specific skills and capabilities, and also considerable time ex-penses. According to the German researcher of botanical illustration C. Nissen (1951) "a combination of artist and researcher in one person is largely rare because the human life is short, and the power is too limited to achieve perfection in both fields". The present work is aimed at facilitating solving this problem as much as possible by using modern methods of digital processing of images.

The level of development of modern digital image processing allows to prepare a scien-tific illustration of taxon practically without resorting to "a pencil and paper". Moreover, with a certain amount of practice, it becomes accessible to a taxonomist who has no drawing skills. It is especially important, because the illustration which fulfilled by a professional artist not familiar with the significance of some or others taxonomic charac-ters, usually has, despite of qualitative fulfillment, low scientific value.

Thus, the illustrations prepared by the specialist on concrete group of insects are the most valuable and in this case scientific proficiency of the author has the decisive role.

Taxonomic research works should be illustrated only with illustrations fulfilled by the author of work, not photographs. The basic difference between scientific picture and a photograph, according to our opinion, is the following – a photograph is only image of object that is fulfilled with this or that degree of skill, whereas the picture is, first of all, graphic presentation of scientific knowledge about object at the given stage and author own concepts. Based on the above, in the process of preparing a total image, primary goal is the accentuation of taxonomic signs of object, both their graphic fulfillment and relocation of minor characters on "background scene" under the condition of preservation of a general view and features of object as a whole. Other important condition is the graphic fulfillment of illustrations of objects in unified fore-shortening, that is necessary for the comparative analysis.

The basic principle of a graphical representation of morphology of object is the maximum unification of images. **The given approach is vitally necessary for successful fulfillment of further researches, as well as for fulfillment of new descriptions of taxa of a different rank, and taxonomic generalizations.** These provisions have served as the preconditions for development of a methodology of preparation of illustrations and illustration plates.

Taxonomic illustration can be fulfilled in three ways – completely manually, using Indian ink and watercolor, or manually, with subsequent editing of figures in the graphic editor Photoshop (for entomologists having art skills), or completely in the Photoshop editor. In the **Plate I**, the pictures of imago of ichneumon fly, fulfilled both completely manually (1), and completely in the graphics editor (2) are shown. In all cases, irrespec-tive of chosen method, following a number of rules is necessary. Fulfillment of figures, both total and parts of a body, having basic taxonomic charac-

ters, should be performed in a unified scheme. One of the known schemes of graphical representation of Ichneumonidae was designed and offered by HENRY TOWNES (1969-1971).

By preparation of the table of illustrations mandatory observance of following conditions is necessary: 1 – arrangement of a figure of imago and parts of a body with basic taxonomical characters should have standard pattern in the table (for ichneumon flies, a standard position of legs, wings and flagellum must be followed), 2 – accuracy of detailed representation of taxonomical characters, 3 – accentuation of taxonomical characters and moving them out to "foreground", 4 – preservation of the general appearance of an object subject to accentuated basic taxonomical characters, 5 – fulfillment of figures in much greater scale, than sizes of objects in the final table, that allows to eliminate inaccuracies of images in the process of scale reduction.

The devices required for preparation of color images should be calibrated. The color image of an object on the monitor screen should match the color gamma on a hard copy. Therefore, calibration of devices is performed in correspondence of image on the screen by a type of ink of the ink-jet printer, and by a type of photographic paper. The printed out table of images is necessary for preparation it for printing in a publishing house, that is correspondence of image on screen of the file in the CMYK format and image of the finished product.

A mandatory condition, regardless of author abilities, is usage of a grid in a microscope for fulfillment of the contour of object. It is necessary for maintaining precise proportions of object drawing.One of the main merits of any taxonomic work is a possibility of using it in a comparative aspect to carry out subsequent investigations. The key to the solving this problem, in our opinion, is the maximal unification of both the taxa descriptions and their graphical presentation.

The foundation of unification of taxa description was laid by GERD HEINRICH (1962-1977), and unification of illustrative material, as already mentioned was laid by HENRY TOWNES (1969-1971).
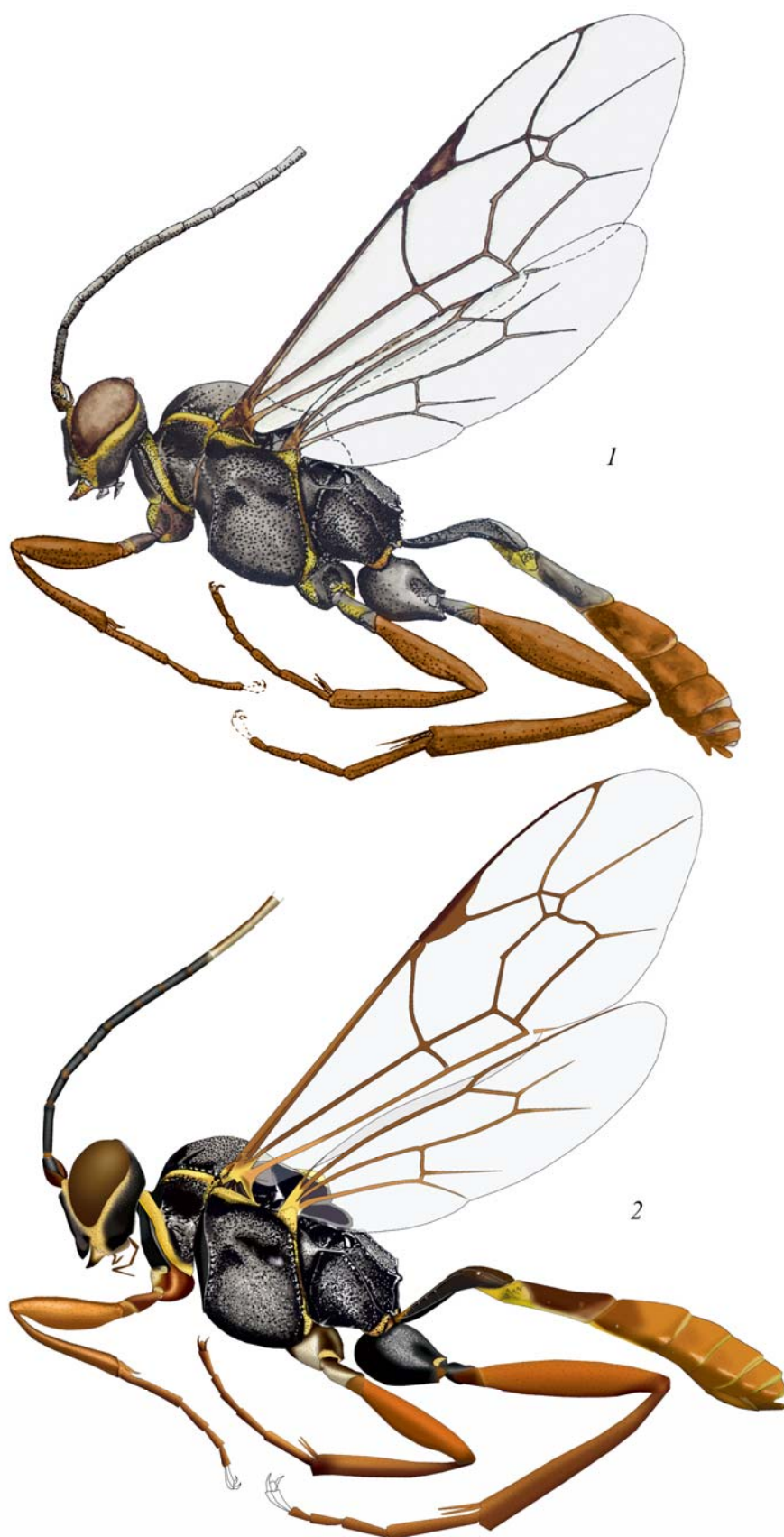
Plate I: : Comparison of *Hirtolabus alienoris* HEINRICH figures of imago, fulfilled by watercolor (**1**) and the same fully in a graphic editor (**2**) (according to TERESHKIN 2008).

We made an attempt to go further in those directions and strengthen and unite each of them. We consider a fundamental principle of the preparation of taxonomically most successful works to be simultaneous fulfillment in a unified scheme of the description and the graphic representation of taxa. It will subsequently facilitate the advancement of the study of the group and will allow fulfilling the descriptions of new taxa of various ranks without necessary of obligatory visual investigation of all its representatives. Modern digital technologies allow fulfilling the descriptions and graphical representation of taxa without trying to save space (as opposed to paper). It is necessary to maintain a strict sequence in the description of taxonomical characters, with indication of their presence or absence, if it is characteristic for at least one representative of the taxon of given rank, not being afraid of repetition. While maintaining the order of presentation of the body parts it is desirable to divide the descriptions of separate segments with full stop. Such scheme is more preferable both for further comparative analysis as well as during preparation of new descriptions. Descriptions of taxa are implemented following the principle of identification keys. If a character is present in at least in one taxon of the same rank, an indication on its absence is adduced in the description of all of the others taxa. For example, only in genus *Notoplatylabus* (tribe Platylabini) "pronotal base with angular projection above front coxae". In this case, it is necessary to indicate morphology of the pronotal base describing other genera of the tribe, e.g. "pronotal base gradually rounded", thus preserving an order of characters description (TERESHKIN 2009, 2011).

Thus, one of problems of the given work is popularization of idea of unified description of objects and their graphical representation and possibility publishing them in the Internet for an easy access by researchers.

Simultaneous presence of the unified description and the unified table of illustrations allows: 1 – to quickly master a morphological terminology and thereby concrete group of organisms to novice researchers, 2 – to discover presence of new, undescribed taxon of the given rank and 3 – to combine in separate tables contour drawings from intermediate layers from images of different taxa of one rank and to arrange them in such a manner, that to reveal the tendency of development of characters in a specific taxonomical group. Thus the latter point indicates that the given technique serves the research purposes as well.

In conclusion it is necessary to note that principles and methodology of fulfillment of a scientific illustration developed on an example of concrete group of hymenopterous in-sects can be modified and used without special work for fulfillment of scientific illustra-tions of any objects of wildlife.

Manual preparation of illustrations

Punctuate picture (peculiarities of technique and examples)

The punctuate drawing of a zoological (including entomological) object throughout long time was the basic for its graphic presentation, up to occurrence of graphic editors. The most demonstrative representation of tables with punctuate drawings of genera of Ich-neumonidae can be found in H. TOWNES works (1969-1971), numerous entomological publications, including "Fauna of the USSR" and lots of others. Tables with images of Ichneumoninae, fulfilled in a technique of punctuate drawings are presented in A. TERESHKIN works (1991-2007, 2004).

Basic provisions at punctuate drawing preparation are fulfillment of its contour with use of a grid of a binocular microscope on cross-section paper that allows to avoid distortion of proportions of separate body parts and fulfillment of drawing of object in the big for-mat considerably exceeding the final image in the publication.

Parts of a total insect body of imago – head, thorax, abdomen and separate segments of legs are fulfilled separately in one scale. Taxonomically significant parts of a body are fulfilled on cross-section paper in longitudinal section.

The prepared pencil images which fulfilled in one scale are replicated by means of blueprinting from the cross-section paper to a paper suitable for usage of Indian ink, using a lead pencil of the maximum hardness. The total image of imago is arranged compactly from separate parts of a body.

Images of taxonomically significant parts of a body that fulfilled in format 0,5 on cross-section paper, by means of blueprinting are fulfilled in a full-format.

A drawing is outlined and elaborated by points using rapidograph (0,18; 0,25 mm).

Usage of the given method at the present time is considerably facilitated by availability of computer and periphery (scanner).

Examples of illustrations of taxa, fulfilled in the technique of punctuate drawing are presented in tables in drawings 1-24.

With development of computer technology and emergence of graphic editors the present technique has lost the urgency.

Fig. 1-10: An example of punctuate drawing and an arrangement of parts of a body in a table of ***Baranisobas ridibundus*** (Gravenhorst **1829**) (according to Tereshkin 2002): (**1**) female, (**2**) head from above, (**3**) head from front, (**4**) pronotum from above, (**5**) scutellum, (**6**) propodeum, (**7**) segments 1-2 of abdomen, (**8**) mandible from front, (**9**) mandible of male from front, (**10**) mandible of male from below.
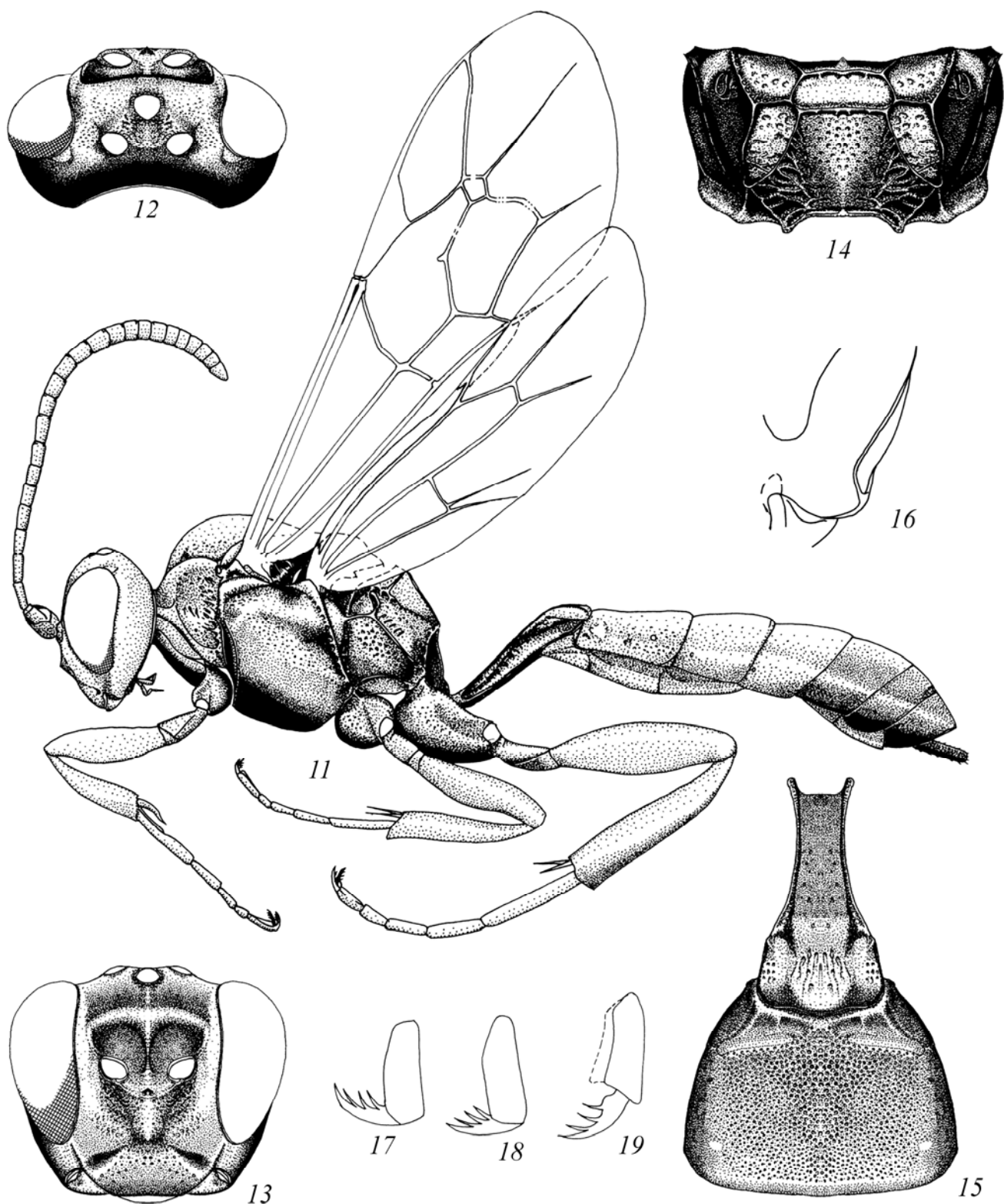
Fig. 11-19: An example of punctuate drawing and an arrangement of parts of a body in a table of *Deuterolabops pulchellatus* (**BRIGDMAN 1893**) (according to TERESHKIN 2004): (**11**) female, (**12**) head from above, (**13**) head from front, (**14**) propodeum, (**15**) segments 1-2 of abdomen; (**16**) gena, (**17-19**) claws of tarsi.
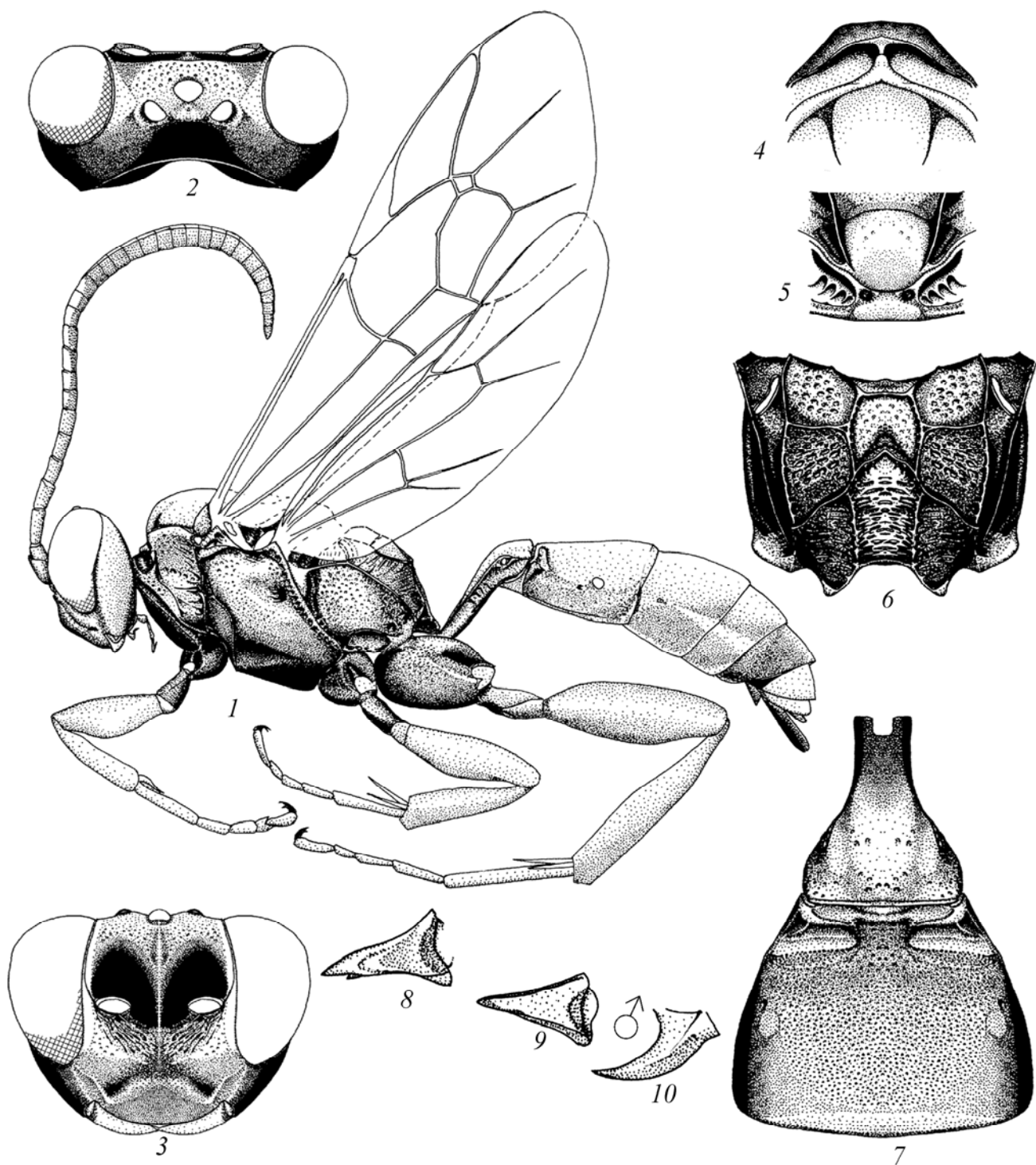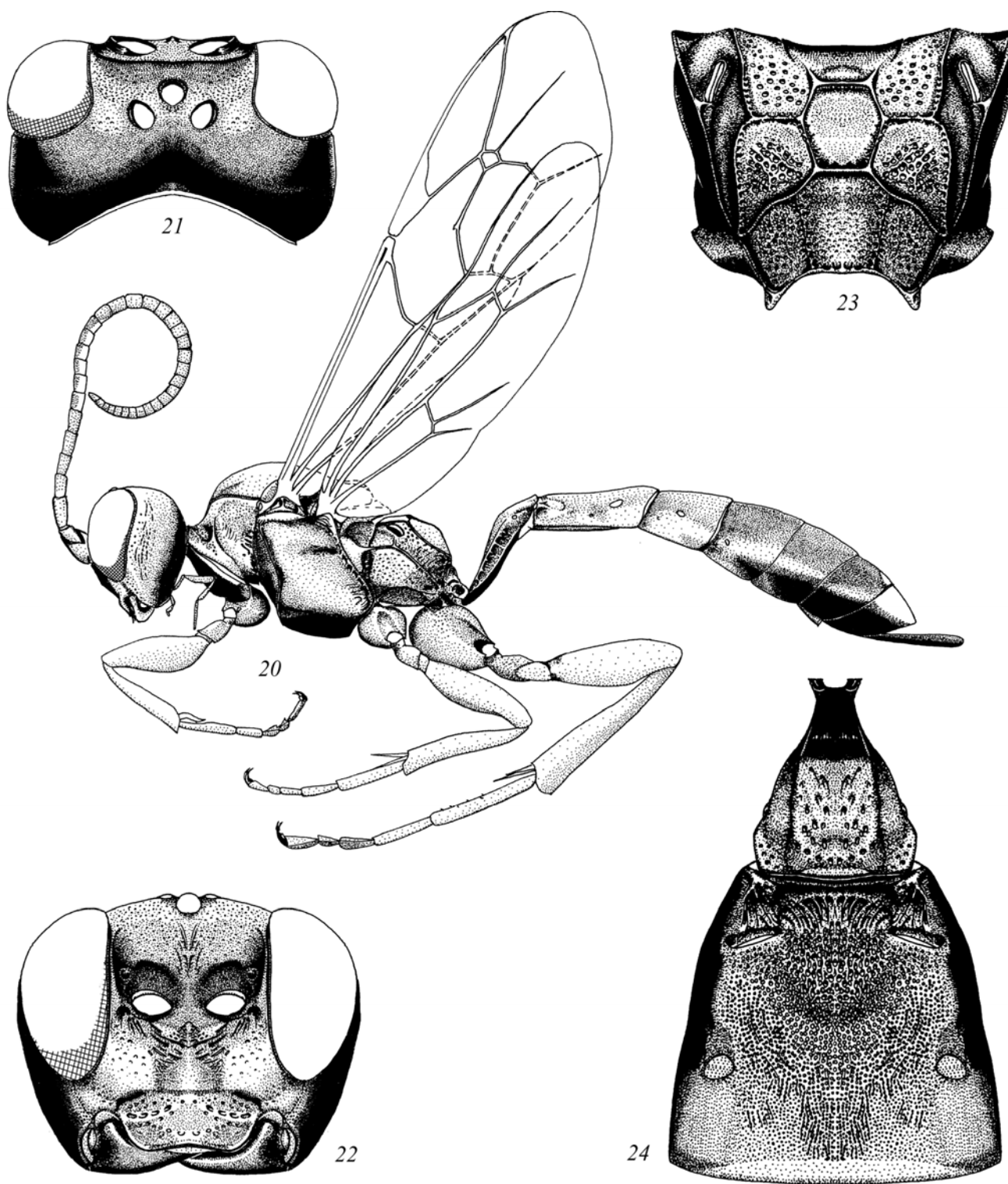
Fig. 20-24: An example of punctuate drawing and an arrangement of parts of a body in a table of *Eristicus clericus* (GRAVENHORST 1829) (according to TERESHKIN 2003): (**20**) female, (**21**) head from above, (**22**) head from front, (**23**) propodeum, (**24**) segments 1-2 of abdomen.

Manual preparation of illustrations and their finalization with graphic editor

If an entomologist specializing in the study of some group of insects has artistic abilities and skills then "manual" method of scientific illustration with the subsequent improve-ment using the graphics editor can be chosen. Very often, this method under specified conditions could be easier and more economical in terms of time than full preparation of a picture in graphics editor. The stages of preparing an illustration by the named above method are shown in the **Plate 2**, and an examples of a completely finished tables in the **Plates 9-45**.

The first step is fulfillment of pencil drawing of contours of separate segments of imago and parts of the body (0.5 in a longitudinal section) with basic taxonomical characters of the studied group on cross-section paper using a grid in the ocular of a binocular micro-scope. All parts of the future final table of images are being fulfilled in a much larger scale, because with decreasing of images various minor errors and irregularities of the lines will be eliminated. The outline of figures of wings and fla-gellum are fulfilled with a help of diascope or device for reading microfilms, as described below in detail. Then pencil contours are transferred to a paper suitable for usage at fulfillment of subsequent operations by means of the blueprinting technique.

Assembling of the contour of imago is performed in compliance with the standard arrangement of the body, flagellum, wings and legs during the process of blueprinting to the paper, that suitable for usage of Indian ink and watercolor. The most suitable density of paper for fulfillment of these operations, from our point of view, is density of utilized photographic paper (back side) and photographic paper for printers (back side). The con-tour is outlined by Indian ink, using a rapidograph (0.18, 0.25 mm). If the constituent elements have been fulfilled on a small scale drawings can be scanned with a subsequent increase, fulfillment of a contour in the editor, and then printing on a laser printer on the mentioned kinds of a paper.

The next stage is operation of giving volumetric appearance to table elements. It is done with black watercolor by a thin paintbrush. Detailing and punctuation of composite elements are performed with a help of rapidograph. These operations can be done using colored watercolor. However it requires considerable drawing skills and aptitudes.

At the following stage images are scanned and finalized with the graphics editor. For editing and deleting some irregularities of lines of an external contour of objects, lines limiting veins of the wing and etc, tools "Polygon Lasso" or "Eraser Tool" with the pressed Shift key are used. In the latter case in palette Brushes the maximum value of parameter of Hardness and minimum values parameter of Spacing should be specified. Also for elaboration of a contour, it is possible to use hard brush (Hardness – 100 %, Spacing – 1 %) with diameter 3px, while holding Shift key. The alternative method is outlining of necessary parts by the vectorial tool Line, as described in detail below. Color-ing the objects, pouring and coloring of an eye and ocelli, coloring a wing membrane are also done in the graphic editor in the sequence that is described in the corresponding sections below.
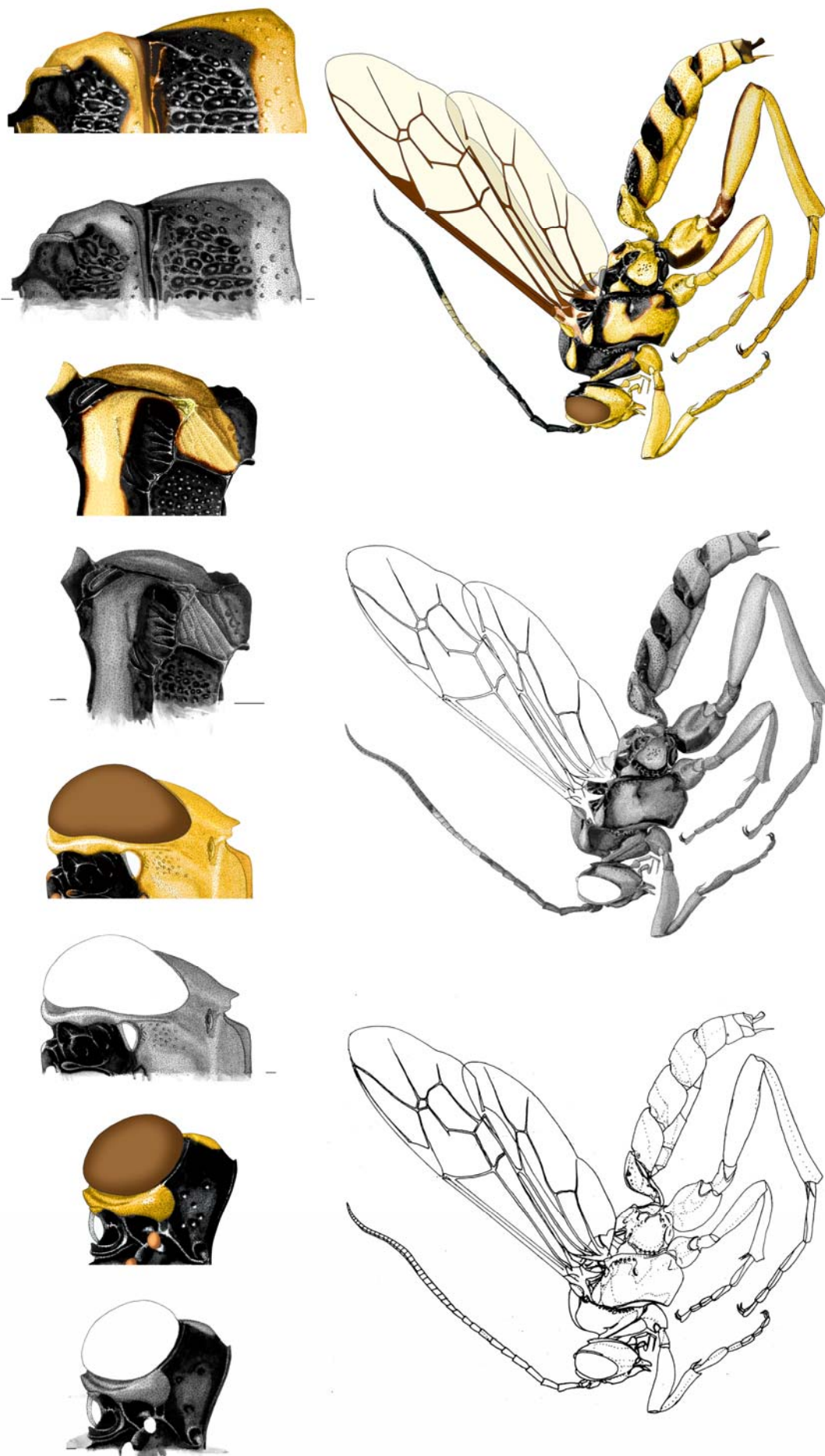
Plate 2: Stages of table preparation manually with subsequent improvement in a graphic editor (on example of *Abzaria latipetiolaris* CAMERON) (according to TERESHKIN 2008).

Complete preparation of a scientific illustration in the graphic editor (Basic Principles)

As mentioned above, the development of modern digital technologies allows preparing scientific illustration without recourse to "pencil and paper". Modern versions of Photoshop graphics editor open up the best possibilities for the preparation of scientific illustration of wildlife objects. Using of this editor makes it possible to solve the problem of preparing quality images of the objects, not only total ones, but of taxonomically important parts of a body and various structures characters that have a great importance in taxonomy separate groups of organisms as well.

It is the preparation of scientific illustration in Photoshop editor that makes it possible to specialists, specializing in research of specific groups of organisms to prepare qualitative unified illustrations without resorting to the services of professional artists. Illustrations of the objects and theirs characters, that are fulfilled by specialists on specific groups of organisms, as mentioned earlier, have undoubtedly incommensurably more scientific value.

Maximum use of tools of selection and facilities of using of parameter Feather in determining of the limits of selected area for giving to object the volumetric appearance and for elaboration (sculpturation) its structures, and also maximum use of the layers are the key in performing scientific illustrations in the Photoshop editor. Photoshop editor gives an ability to carry out all the operations in separate layers, like Wrinkles, Big and Small punctures, Cells with subsequent theirs clarification and contrasting in accordance with base layer (Pouring and volume). It allows choosing the best variant of final picture. Fulfillment of different structures (cells, wrinkles, punctures et al.) by mentioned manner in different layers makes it possible additionally to correct their shape and size, using different options of function Transform (Scale, Rotate, Warp et al.).

The key to obtaining high quality images in the editor is an accurate elaboration of the smallest details of the sculpture at high magnification. Details of elaboration may not be visible in the final image, but will give the image accuracy and "natural appearance". Therefore, size of the separate object in the editor should be several times larger than its image on the final plate with images. This proposition can be considered as the basic.

During preparation of the total image, drawings of segments should be fulfilled separately, on separate canvases (in separate files). It is necessary for subsequent "arrangement" of imago with a demanded (standard) locating of body segments and its processes.

During preparation of the images, each operation should be fulfilled in a separate layer: "Navigator", "Main lines", "Pouring and volume", "Sculpturation", "Puncturation" etc. In Preferences (Menu: Edit–Preferences) maximum number of commands (Preferences–History States=100) should be set. This is important for their withdrawal in case of need. All the layers used in the preparation of a concrete object

should be saved until the final image. This is necessary to correct the image in a case of need, and to illustrate the description of the individual structures, or in the preparation of identification keys and illustrations for taxonomic analysis of the group too. Using drawings from separate layers of taxa illustrations in concrete groups (high taxa) and theirs aggregation to the tables of drawings give additional facilities for taxonomic analysis and identification of trends in the development of various structures and characters.

When fulfillment of operation of sculpturation of an object, usage of instruments of selection with different values of parameter Feather should recognize as the most optimal (at pressed Shift-key for the same elements of sculpture). In the sequel, finished fragments are clarified, darkened and contrasted, achieving maximal similarity with object. During fulfillment of these operations, usage of a Pen Tablet is optimal.

Calibration of devices for correspondence of final image on screen to color gamma of object on photographic paper is a necessary condition. As mentioned above, calibration of devices is performed in correspondence of image on the screen to an image on printout, according to a brand of ink of the ink-jet printer, and brand of photographic paper. All digital images are fulfilled in CMYK mode in accordance of publishing houses requirements.

While fulfilling the images in Photoshop editor, composing the table of illustrations of taxon, fulfilling a number of the obligatory stages, which are saved in separate layers and in certain sequence, is necessary. It is fulfillment a contour of an object (a), pouring of a contour (b), shaping of volumetric appearance to object (c), sculpturation (or elaboration) (d) and object coloring (e). At a finishing stage, the final images are united in the table of illustrations of specific taxon. Tables of illustrations of taxa that completely performed in the graphic editor are presented in Color **Plates 46-86**.

Main operations

Preparing contour of an object

The fulfillment of a contour of an image is realized by two ways: or manually, using grid of binocular microscope and subsequent scanning and editing, using graphic editor capabilities, or completely in the graphic editor.

The first method is more convenient. pencil contour on cross-section paper is fulfilled, as a rule, on two sheets. On one sheet the parts of body of total image are fulfilled. Segments of a body for a final plate of images (0,5 in a longitudinal section) are fulfilled on another sheet. In a case with ichneumon flies, it is a head in two foreshortenings, propodeum and segments 1-2 of abdomen from above. After fulfillment of pencil contour on cross-section paper, a drawing is scanned with required resolution (600 dpi) (**Plate 3**, 1-9).

As mentioned above, for attain of image of maximal quality, size of the separate object in a separate file should be several times more than its image on the canvas in a

file with final plate of images. Therefore, for preservation of proportions, size of every primary table (on cross-section paper) is increased so, that size of image will considerably larger than its actual size in the final table. In Menu: Image–Image Size (Alt+Ctrl+I), or clicking by right mouse button to document window title in pop-up menu Image Size Width in % is set (more often 200 or more).

After general increasing of scanned sheets with pencil contours of the parts of total imago and taxonomically important parts of a body, every fragment is selected separately by instrument Polygonal Lasso Tool or Rectangular Marque Tool with parameter of Feather=0. Selected fragments are copied to separate files (Ctrl+C–Ctrl+N–Ctrl+V). Files with the parts of a body of total image of imago and files with taxonomically important parts of a body are put in different directories.

On the next stage, fulfilling of contour drawings of fragments in each separate file is started. Layer "Background" containing a pencil contour is duplicated having clicked on it in dialogue window Layers by the right button of the mouse. In a pop-up window a command Duplicate layer is chosen and for a new layer the name "Matrix" is inserted. After that in dialog box Layers layer "Background" is marked as the worker. After that a pencil contour in layer "Background" can be deleted (Ctrl+A–Del).

Pencil pattern (Matrix) is outlined with help of Line Tool instument with lines of necessary thickness (4–6px in accordance with a scale of image), having chosen color in the Swatches palette. At this stage file is in CMYK mode. Therefore, in case of need, the process of contour outlining is can be fulfilled with color lines, as presented on **Plate 3**, 10. Layer "Background" is made invisible, by clicking on the "eye" icon (Indicates Layer Visibility). After certain number of lines of a contour are fulfilled, they are merged periodically via menu command Layer–Merge Visible (Shift+Ctrl+E). During the operation the layer with pencil drawing (Matrix) is preliminary turned off (layer "Background" is already turned off) (fig. 279 from chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species"). Lines serving for orientation during fulfillment of following operations, are made dotted.

If the work was done in the Color mode, the image has to be converted into Grayscale mode. The layer, containing the contour, is marked as working layer, and minimum brightness is set via the menu command: Image–Adjustments–Brightness/Contrast).

To layer containing dotted lines, necessary for orientation when fulfillment of separate structures and color image, the name "Navigator" is entitled. Layer is duplicated, all lines which will not be present in final image are deleted and layer is entitled "Main lines". The file consists from four layers which situated from top to down in a following order: "Navigator", "Main lines", "Matrix" and "Background" and it is ready to fulfillment next stage.

The second variant of fulfillment of object contour is based on refusal from cross-section paper use and subsequent scanning. In this case it is necessary to use Menu function Show–Grid (Menu: View–Show–Grid). The function Snap To–Grid must to
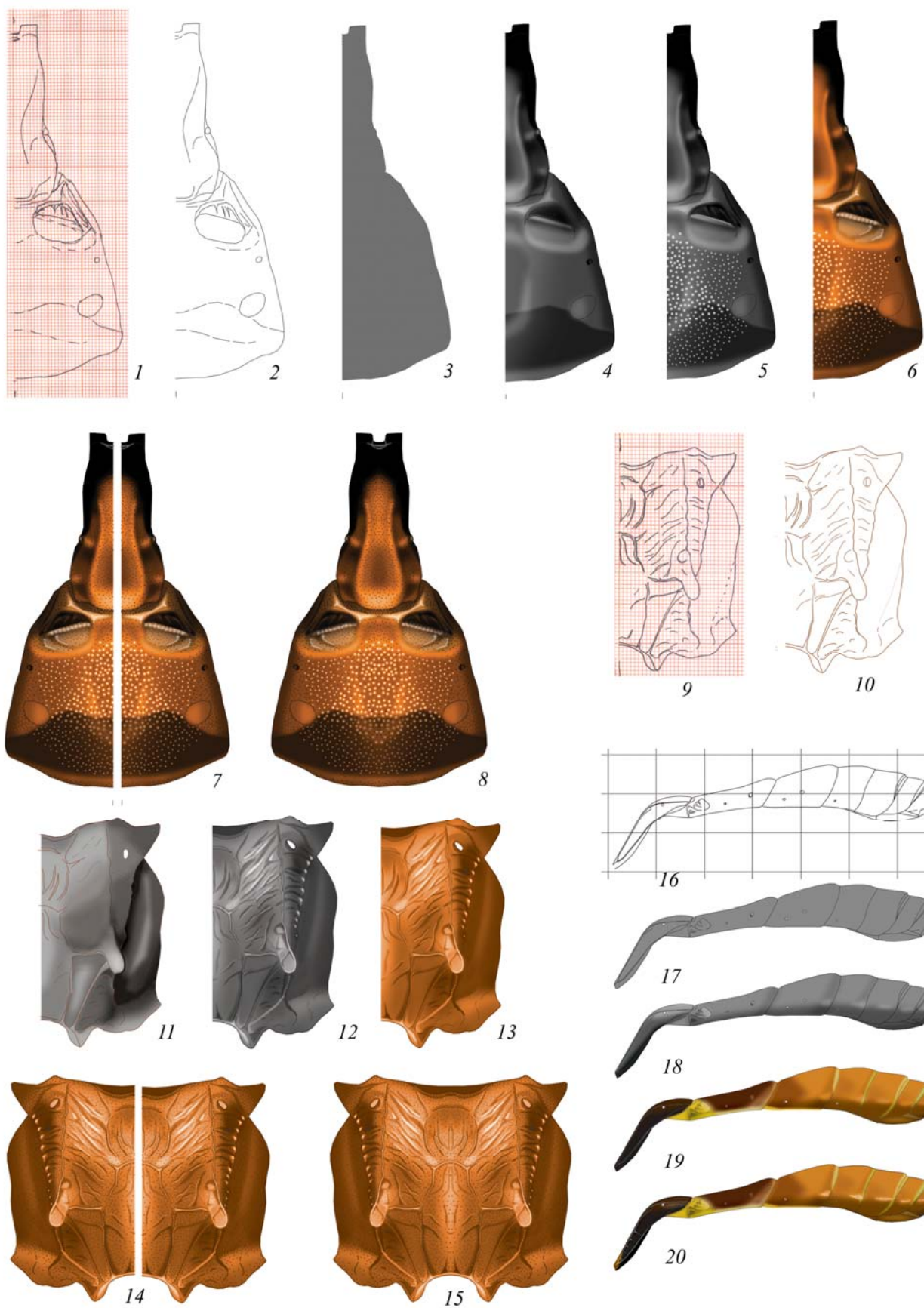
Plate 3: Simplified variants of preparation of images in the graphic editor (according to TERESHKIN 2008) (designations see Legends to color plates).

be switched off (Menu: View–Snap To–Grid). In this case fulfillment of lines by pen of Pen Tablet, or mouse will be arbitrary (**Plate 3**, 16).

The main conditions of image preparation are fulfillment of separate parts of a body in the same scale and copying them into separate layers to the same file. First variant of fulfillment of a contour (using pencil contour on cross-section paper) is more preferable.

Pouring of a contour

Pouring of a contour is necessary stage, preceding fulfillment of operations of shaping to the objects of volumetric appearance. A pouring is always fulfilled in separate layer or layers and it has own specificity for every fragment of a body. In details it is considered in the chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species" (see below). At the same time, an operation of pouring has a number of the common features. Before fulfillment of the stage, every file with a segment of a body or its part consists of four layers: "Navigator", "Main lines", "Matrix" and "Background". Operation is always fulfilled in separate layer "Pouring and volume". For layer creation, in palette Layers, layer "Main lines" is duplicated and in the pop-up menu the layer name (Pouring and volume) is entered. Then in a palette Layers a new layer is displaced by mouse cursor under a layer "Main lines". In the new layer "Pouring and volume" by means of instrument Polygonal Lasso Tool an area with all lines except of lines of an external contour is selected and then they are deleted having pressed key Del In the drawings with image of a head, borders of an external contour are internal borders of eye. All lines which need for following work are visible in the layer "Navigator". They are need for orientation in operations for shaping to the objects of volumetric appearance and sculpturation.

A pouring in the layer "Pouring and volume" is fulfilled by means of instrument Paint Bucket Tool with Mode – Normal, Opacity – 100%, Tolerance – 0. In palette Swatches Gray color of required saturation is chosen. An experience of drawings preparation has shown, Gray color 50-55% (55% Gray) is most suitable (**Plate 3**, 3,17). Usually, this operation is necessary to repeat 2-3 times to eliminate light border with black lines of a contour.

In preparing of the image of a head, an eye and the ocelli are poured only at the latest stage of work – "Coloration", in a separate upper layer. After operation of a pouring of contours of objects, a deletion of poured parts on antennal fossae and ocelli of head capsule, spiracles of thorax and segments 1-2 of abdomen is fulfilled. For this aim, a layer "Main lines" is marked as a working. Then, required parts are selected by instrument Magic Wand Tool at pressed key Shift (Tolerance=0). Then, without deselection, a layer "Pouring and volume" is marked as a working and by means of press key Del, the selected parts are erased.

After fulfillment of enumerated operations it is possible to pass to operation of Shaping of volumetric appearance of objects.

Shaping of volumetric appearance to an object

Volumetric image is fulfilled in layer "Pouring and volume". Above it the layers "Main lines" and "Navigator" (for orientation) are situated. At first stage, orientating by visible but not working layer (Navigator), a selection of main, most large parts of object (periphery) by means of instrument Polygonal Lasso Tool is fulfilled. Parameter of Feather is from 50 to 150px in depending on a shape of concrete object. Selection is begun from most convex area of object to its periphery. The area of selection always should transcend outside the limits of object. The external border of object should not be nearer than the middle of the selected area.

After that, the operation for darkening of selected area with using of command Menu: Image–Adjustments–Brightness/Contrast is fulfilled. Usually, during general darkening of object, area of selection is shifted periodically to periphery of an object. Every time, area of selection is darkened up to 10-20% in depending on the shape of an object. Periodically a general clarification of layer as a whole is fulfilled using the same command. It is possible also to use command Levels… (Ctrl+L) in Menu: Image–Adjustments–Levels, by moving cursor in channel Gray, or combining both methods.

On next stages separate parts of an object are being elaborated in detail. Maximum similarity to the real object is achieved by choosing of the value of the parameter of Feather for areas of selection and by means of performing shading, or clarification for the separate areas.

So-called mixed selection is convenient also. The different areas of object, or more dark, or contrary more light-colored are selected by instrument of selection with different values of parameter Feather at pressed key Shift simultaneously. Then a command Brightness/Contrast is fulfilled. However, perform of such operations demands a considerable experience.

Additional possibilities at fulfillment of operations of shaping of volumetric appearance to an object are given by presence of layers "Navigator" and "Main lines", which are situated above working layer "Pouring and volume". So, for example, when fulfillment a volumetric image of a head, the internal closed areas of borders of antennal fossae are selected in a layer "Main lines" with a help of instrument Magic Wand Tool. Not removing selection, a layer "Pouring and volume" is marked as a working. Then, theirs contrasting is fulfilled. It is more important for fulfillment thoracal part of imago body and propodeum separately. By selecting in the upper layers, by the described way of separate fields or segments, it is possible without deselection after sequential move to working layer "Pouring and volume" theirs darkening or clarification is fulfill. Moreover, having pressed Shift key and selecting value of Feather parameter it is possible to expand area of selection, smoothing thus its borders.

Detailed description of shaping to different objects of volumetric appearance is given in the part which devoted to single-step description of fulfillment of table of illustrations of taxon in the chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species" (fig. 284-287, 309-317, 381-401, 450-469, 493-516, 549-560, 617-640).

After finalization of all operations of shaping to object of volumetric appearance, layer "Pouring and volume" is duplicated for security. In palette Layers, layer "Pouring and volume" is marked as a working. By clicking right button of mouse to the layer, in pop-up menu a command "Duplicate Layer…" is chosen. At the finishing stage the file of any object consists of six layers: "Navigator", "Main lines", "Pouring and volume", "Pouring and volume" copy, "Matrix" and "Background". The number of layers when fulfillment of operations on elaboration (sculpturation) varies to a considerable degree and depends on peculiarities of concrete object (bodies fragment).

Now the object is ready to fulfillment of operations of elaboration of a sculpture of a surface.

Sculpturation (elaboration)

Sculpturation is the fourth stage of the preparation of picture of parts of a body. At this stage above a working layer, after fulfillment of works of shaping to object of volumetric appearance, two visible layers – "Navigator" and "Main lines" are situated. At the given stage of preparation of an illustration, the necessary device often is Pen Tablet. It is appropriate to repeat, that precise elaboration of small details at the big magnification is a guarantee of a "natural appearance" of object in final picture of lesser scale.

Elaboration or sculpturation of an object is the most difficult and labour-consuming operation from which the general perception of the image as natural depends completely.

The most usual way is a sculpturation of an object directly in the basic layer with its volumetric appearance. For sculpturation the various tools of selection along with function Brightness/Contrast, various types of brushes, including specially developed shapes are used. This way of sculpturation is the least suitable because of its complexity and frequently impossibility to correct already executed actions.

Long-term practice of preparation of illustrations has shown, that an optimum method of fulfillment of sculptural peculiarities of object is fulfillment of its details (punctures, wrinkles etc.) in separate layers with use of tools of selection. Most complex task before the beginning of fulfillment of operations of sculpturation of any parts of a body is formalization of groups of the same structures and, accordingly, creation of a set of layers which necessary for their fulfillment. So, for example, puncturation can be presented by punctures of different size, large, small, regular and irregular-shaped, smoothed or sharply expressed, with shining central part and so on. The same

is applied also to other structures, such as cells, wrinkles or carinae (keels). The quantity of the one-type structures defines quantity of the layers which necessary for their fulfillment. Usually number of layers for structures of one type is three. For example, at fulfillment of large puncturation, layers which are located in a following order can be used: "Light punctures" (clarification of internal parts of punctures), "Punctures" (punctures actually) and "Clarifications of interspaces" (between punctures).

Performance of work in separate layers allows correcting drawing easily in the subsequent, changing brightness, contrast, the form of structures and their scale.

At pressed Shift key, with a help of different tools of selection with the established parameter of Feather (more often 5-7px) contours of wrinkles, cells and other structures are being fulfilled. In the subsequent, a pouring by black color with corresponding level of a saturation (%) of all selected structures is fulfilled. It is necessary to notice, that all contours of structures of a fragment and fulfilling of pouring is necessary to fulfill simultaneously, because at addition of separate structures in the subsequent, them is necessary to fulfill already in a separate layer, to avoid theirs overlapping. After completion of pouring, a clarification or darkening of structures in according to a saturation of fragments of an underlying layer (Pouring and volume) is fulfilled. At following stage in an underlying layer (Pouring and volume), parts that will be clarified with use of function Brightness/Contrast are selected by means of analogous method. Another and a more preferable variant is creation of new underlying (lower) layer "Clarifications of interspaces". In this layer, by tools of selection, the most shining sites are performed and then they are simultaneously filled by more light grey color.

The elaboration of object structure is possible to fulfill with use of function of copying of separately fulfilled fragment (punctures, wrinkles etc.) (Ctrl+C) and its subsequent insert (Ctrl+V). Then the visible layers – the working layer and the layers with inserted fragments (all other layers are disconnected) are merged. This method is optimal for retouching of "seam" (suture) at merging of two symmetric halves of an object.

Further we will consider peculiarities of fulfillment of the basic types of sculptural formations: **puncturation**, **cellular sculpture of a surface**, **longitudinal wrinkles** and **microsculpture**.

Puncturation

As already it was marked earlier, puncturation can be presented by punctures of different size, by large, small, regular and irregular-shaped, smoothed or sharply expressed, by punctures with shining central part and so on. The type of punctures (morphology) of puncturation defines a method of theirs fulfillment. A fulfillment of puncturation in separate layer is a rule for any variant of punctures fulfillment.

Small punctures of regular shape, round or oblong to some extent are fulfilled by Brush Tool, selecting previously corresponding parameters. Puncturation is usually fulfilled by pen of Pen Tablet. For fulfilling of puncturation of such type, in palette

Swatches usually saturated black color is chosen. In the subsequent, puncturation is possible to clarified up to complete correspondence to an object, because it is situated in a separate layer. It is necessary to watch, that section Shape Dynamics has been disconnected (a tick in a window is removed). In palette Brushes in section Brush Tip Shape parameters of brush Angle, Roundness, Hardness in compliance with observed at object are selected. It is necessary to pay special attention to parameter Spacing. If puncturation is fulfilled by separate punctures, a considerable value of parameter Spacing (for example 200%) is necessary to set, for prevention of merging of points when fast puncturation. When puncturation by separate fragments, parameter Spacing should be selected in agreement with density of puncturation. After selection of parameter Spacing, a puncturation by fragments is fulfilled or by shading by the pen of a Pen Tablet, or placing a starting point and then at pressing Shift by clicking the right button of the mouse on a final point of a section.

Puncturation of the given type is usually used for elaboration of separate parts of total image of imago, especially tergites of abdomen. During fulfillment of puncturation one should not be afraid of points existing beyond external borders ("flaws or imperfections"). Imperfections are liquidated easily as follows. Layer "Navigator", or "Main lines", which situated from above is marked as the working. Then, by means of instrument Magic Wand Tool is clicked on free space outside of a contour. Contour is selected by an external border. Further, not removing selection, a layer in which puncturation was fulfilled (Punctures) is marked as the working. By having pressed Del key, all points which protruding behind external border of an object (imperfections) are being deleted (see fig. 652 from chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species").

Another variant of puncturation of peripheral areas of the segment is selection of its internal part by means of instrument Magic Wand Tool in the layer "Main lines". The borders of selected area do not allow punctures to go beyond it. This is particularly important when the puncturation is fulfilled with a help of Pen Tablet by the method of hatching.

Sometimes punctures of puncturation have shining central part. In this case, above the layer "Punctures" an additional empty layer "Light punctures" is created. In this layer the light small points opposite the central parts of the main punctures are fulfilled. If surface between punctures is polished, shining, under layer Punctures additional empty layer "Clarifications of interspaces" is created. In some cases, when punctures have shining borders, in this layer by means of points with the same parameters but light-gray color, analogous puncturation is fulfilled. Margins of light punctures go beyond the borders of basic punctures. Fulfillment of punctures in different layers allows to regulate separately brightness of every separate layer with using of command Brightness/Contrast up to obtain of maximal conformity to real object (see chapter **"The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species"**).

At fulfillment of puncturation presented by large punctures of regular or irregular shape, the usage of instruments of selection are optimal. One of the variants (most complete) of fulfillment of large puncturation is described below.

At fulfillment of structures of one type, a number of necessary layers with use of the tool of arbitrary selection usually makes 4.

At the first stage, it is necessary to create four the separate transparent layers, that necessary for fulfillment of eight operations in subsequent. So, at fulfillment of image of large puncturation, the following layers that arranged in strict hierarchy (from top to down) are used: 1 – "Light punctures", 2 – "Pouring of punctures" 3 – "Clarification of punctures margins", 4 – "Clarification of interspaces" (fig. 33). These layers in the subsequent will be used for pouring by black or grey color, their contrasting, their brightening or darkening before imparting to puncturation of a natural appearance.

At the first stage, by means of instrument Lasso Tool, several contours of experimental punctures are fulfilled to determine degree of blur of their margins. For this purpose, parameter of Feather is changed and periodically experimental pouring by black color is carried out, achieving necessary effect. Having discovered "necessary blurring of punctures margins", in empty layer by instrument of selection, all the contours of punctures of the given type are fulfilled at pressed key Shift (fig. 25). At a following stage, by means of the instrument Paint Bucket Tool, all selected contours of punctures are simultaneously poured by black color, (fig. 26). At the third stage, a clarification of the parts of punctures is carried out according to the chosen type of illumination of object. For this purpose, not removing selection, the all areas of selection are displaced, having pressed the right button of the mouse at switched on instrument Lasso Tool. Further, by means of function Brightness/Contrast the chosen areas are clarified, simultaneously for all punctures (fig. 27). At a following stage, a working layer is transparent layer "Clarification of margins", located under a layer with the already partially clarified points. The selected areas of punctures are remained till now. Again having pressed the right button of the mouse, at switched on instrument Lasso Tool, all areas of selection of punctures are displaced simultaneously aside opposite to the clarified area. The selected areas are must slightly go beyond of punctures margins (fig. 28). Then, in a working layer "Clarification of margins" simultaneous pouring of all selected areas by grey color of more light saturation than a surface of fragment is fulfilled (fig. 29). At the given stage the selections of punctures are deselected.

The lowermost transparent layer at fulfillment of puncturation of a surface of segment is "Clarification of interspaces". In the given layer, by the instrument Lasso Tool with greater than at selection of punctures size of parameter of Feather, arbitrary areas of selection are fulfilled (at pressed key Shift). Then simultaneous pouring of them by grey color is carried out (fig. 30-31). Last, uppermost layer is "Light punctures". Bright points are fulfilled by instrument Brash Tool of the proper diameter and blurriness of margins. At performance of operation with use of a Pen Tablet in a
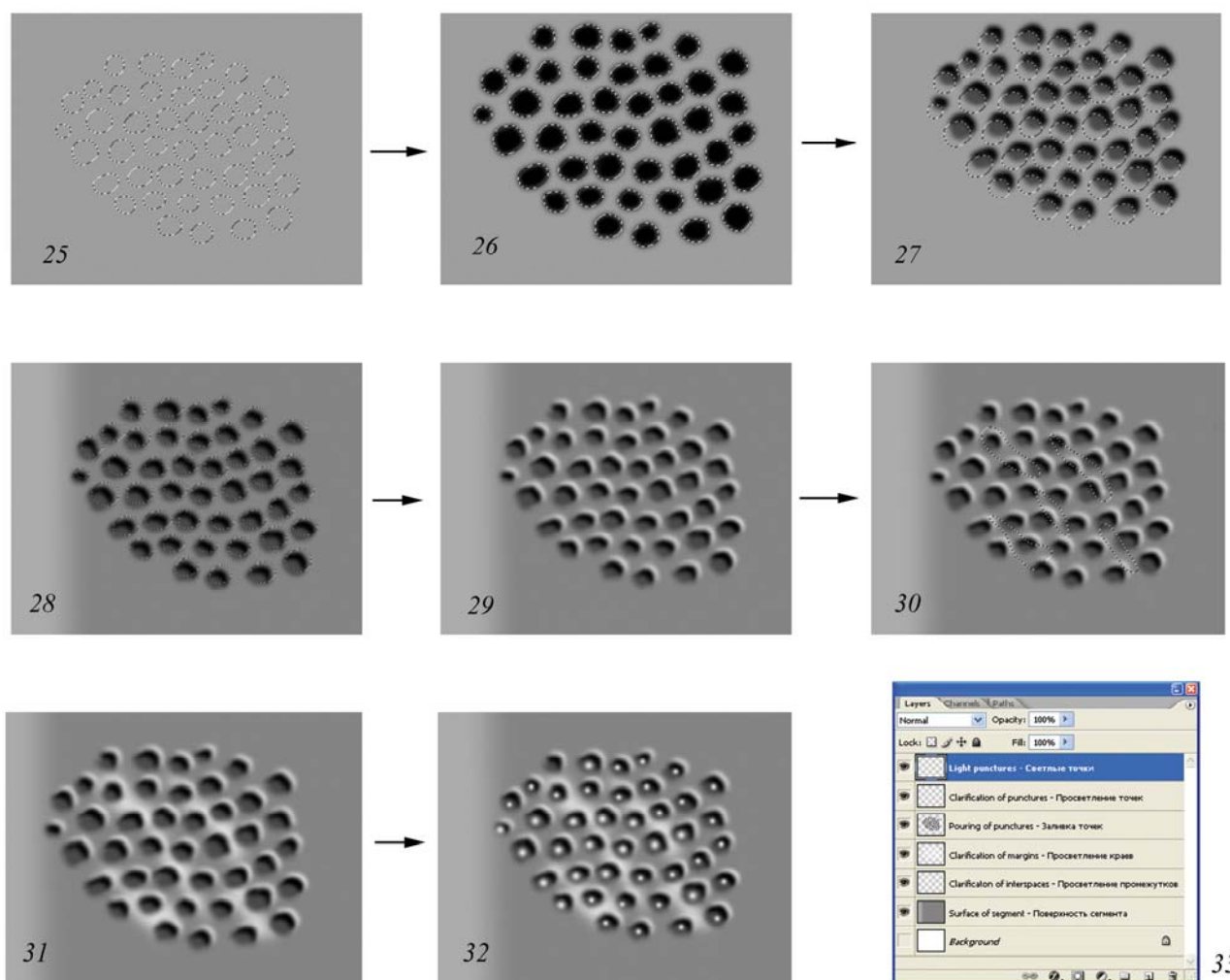
Fig. 25-33: Order of operations at fulfillment of image of homogeneous structure (large puncturation) (explanations in the text).

palette "Brushes" it is necessary to establish parameter "Spacing" not less than 300% for prevention of merging of punctures (fig. 32). In the subsequent, a selection of segment as a whole, with great value of parameter Feather is carried out. Then in each layer an operation "Brightness/Contrast" is fulfilled for achieving the maximum conformity of each class of structures to that which observed under a microscope and to the volumetric image of a segment, which located in the lower layer. After fulfillment of all listed operations, all other layers, except listed above are disconnected. Then merging of layers by command Merge Visible (Ctrl+Alt+E) is carried out.

Cellular sculpture of a surface

The cellular sculpture is characteristic more often to propodeum of ichneumon flies (**Plate 9**, **16**, **20**, **38**, **46**, **47**). Fulfillment of a cellular sculpture is similar to fulfillment of large puncturation. The given type of a sculpture is fulfilled by instruments of selection with use of several layers. As well as for large puncturation, a total ful-

fillment of all cells by instruments of selection, for their simultaneous pouring is necessary. The cellular sculpture can be peculiar to several fields of propodeum. In this case usage of several groups of layers or separate layers according to number of fields with a cellular sculpture will be expedient. As well as for big punctures of puncturation at fulfillment of this type of a sculpture, usage of four layers located from top to down in a following order: 1–"Light punctures"; 2–"Pouring of cells"; 3–"Clarification of margins"; 4–"Clarification of interspaces" is expediently. Cells have the diversified shape. Frequently cells are with the expressed corners. Therefore, the basic difference of procedure of their fulfillment from fulfillment of big punctures is usage first of all an instrument Polygonal Lasso Tool. At fulfillment of cellular strulpture by this tool in a layer "Pouring of cells", the size of parameter Feather has a great value. Before fulfillment of the bulk of cells, its size is determined by periodically fulfillment of selection and pouring of trial cells. After fulfillment of all the cells, or the cells of a concrete field, theirs simultaneous pouring by the black color is fulfilled. Further without deselection, the selected areas are shifted in accordance with light direction on a field of propodeum. Then, clarification of parts of cells is fulfilled using command Menu: Image–Adjustments–Brightness/Contrast in the same layer (Pouring of cells). However, more often area for giving to cells of volumetric appearance is fulfilled separately for each cell. Area is selected by instrument Lasso Tool at pressed key Shift and by use of the pen of Pen Tablet. Then, already after fulfillment of all areas of selection, simultaneously all cells of group are clarified, giving to them of volumetric appearance. The further procedures, in other layers are similar to procedures described above for big punctures (fig. 34,35).
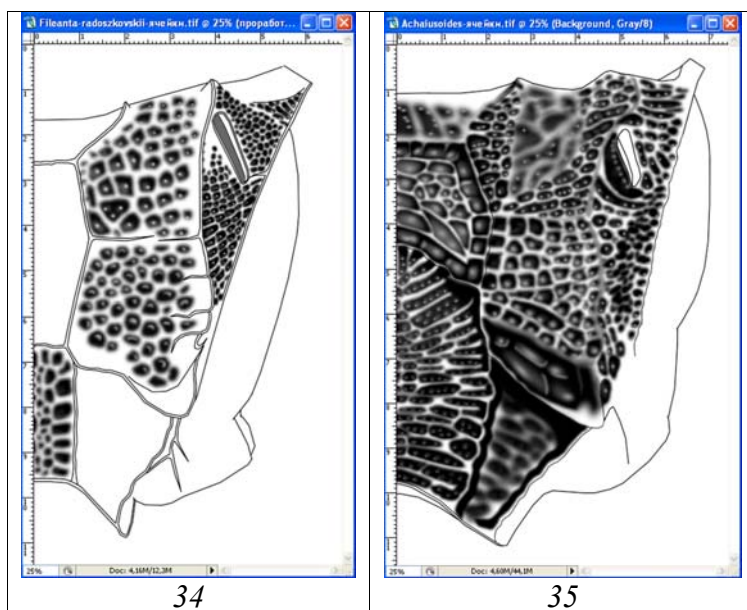

34   *35*

Fig. 34-35: General appearance of the layers with cells of propodeum: (**34**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**35**) *Achaiusoides epistomalis* TERESHKIN.

Fulfillment of such difficult structures as cells in a separate layer gives additional possibilities on their correction. It is not only the regulation of brightness and contrast of cells, allowing to achieve conformity to the basic layer (Pouring and volume), but also possibility of their modification. In a case, if some kind of group of cells not quite corresponds to real object already after their fulfillment, it is possible to modify their shape and the dimensions, using various variants of option Transform (Scale, Rotate, Warp, etc.).

So, if cells of all fields of propodeum were fulfilled in only one layer, a group of the cells which need modification is preliminary selected by instrument Polygonal Lasso Tool. In drawings 36 and 37 example of modification of already ready cells of 2nd lateral field of propodeum is shown. After selection of group of cells, the menu command: Edit–Transform–Warp (Scale, Rotate) is fulfilled, for achieving necessary conformity of the cellular sculpture, which is observed at object.
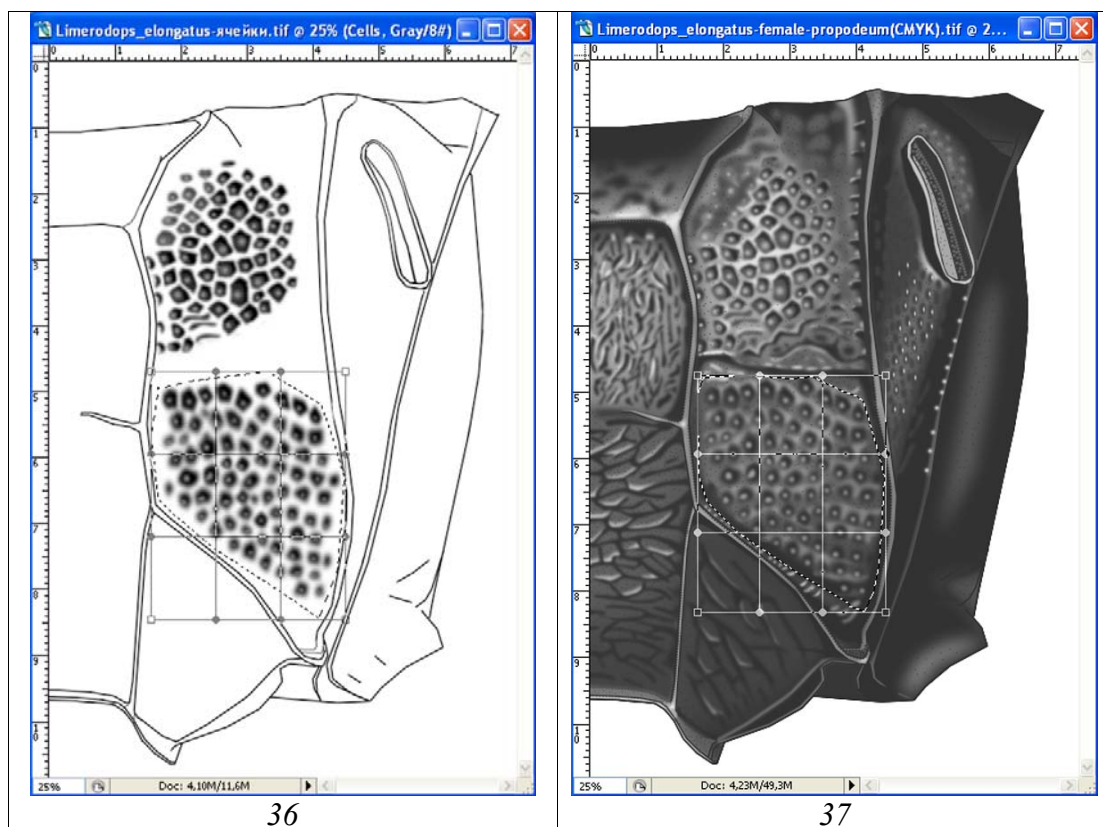

Fig. 36-37: Correction of shape and arrangement of cells fulfilled in a separate layer: (**36**) correction of cells of propodeum *Limerodops elongatus* (Brischke) in layer "Pouring of cells", (**37**) the same, at all switched on layers.

Wrinkled sculpture

Wrinkled or wrinkly-punctured sculpture is peculiar to many parts of a body. Process of detailed representation of wrinkles is similar to process of fulfillment of large punctures of puncturation. Unlike big punctures, wrinkles are usually fulfilled by in-

strument Polygonal Lasso Tool, previously having selected up experimentally a value of Feather parameter. Wrinkles are usually fulfilled in two layers – "Wrinkles" and "Clarification of interspaces". In a case when wrinkled sculpture has slanting or sinuous character, areas of clarification of intervals are selected separately, as well as the wrinkles actually. When fulfillment clarification of interspaces, it is possible to use and the basic layer with the volumetric image of object (Pouring and volume). In this case the basic layer should be duplicated (Pouring and volume copy). It is necessary for secure, in case of correction of errors in case of need.

L o n g i t u d i n a l   o r   p a r a l l e l   w r i n k l e s are more often peculiar to middle field of postpetiolus, for interval between gastrocoeli and middle part of second tergite of abdomen (**Plate 42**, **55**, **59**, **66-77**). Such longitudinal striation is usually fulfilled in two layers with instrument Polygonal Lasso Tool usage. As an example it is possible to give the description of a fulfillment of rugosity of an interval between gastrocoeli (fig. 38-44). At the first stage by a method of tests the value of parameter Feather is selected. In the given example the radius of selection was 10-15px. After that, at pressed Shift key, all longitudinal wrinkles of the interval are fulfilled by the instrument of selection and also their simultaneous pouring by black color by instrument Paint Bucket Tool is fulfilled (fig. 38).

After pouring, at the switched on tool of selection, all the areas of selection are moved by the mouse cursor (fig. 39).Then, already in an underlying layer "Clarification of interspaces", pouring by light gray color (10% Gray) is fulfilled (fig. 40-41). At following stages darkening or clarification in both layers for achieving conformity with an underlying layer with volumetric image is fulfilled. At first, from the centre to periphery area of wrinkles is selected with the considerable radius of Feather (90px). It is necessary to remember, that the central wrinkle should be, at least, in the centre of the selected area (the border of selection far falls outside the limits a canvas). After that, by command Menu: Image–Adjustments–Brightness/Contrast at first clarification of wrinkles (Brightness=+3%) is fulfilled (fig. 42), and then the same action is fulfilled in layer Clarification of interspaces (Brightness=+23%) (fig. 43). At last, at last stage, having selected similarly area of wrinkles from the centre to periphery, darkening (Brightness= –50%) is fulfilled (fig. 44).
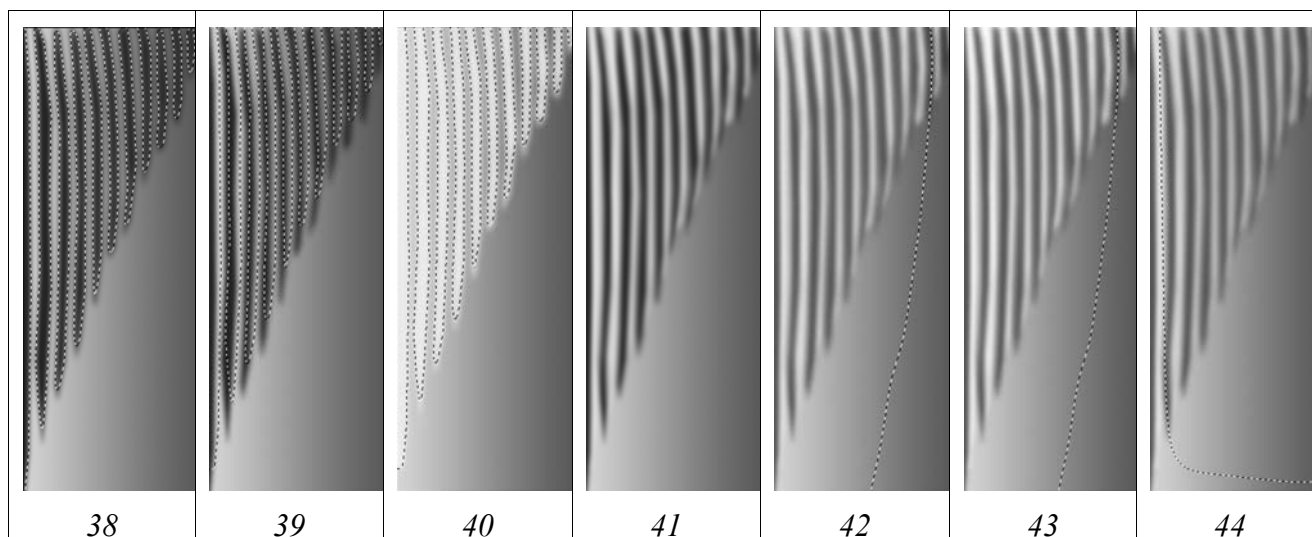

| *38* | *39* | *40* | *41* | *42* | *43* | *44* |

Fig. 38-44: Stages of fulfillment of longitudinal wrinkles: (**38**) selection and pouring of wrinkles, (**39**) shifting of areas of selection, (**40**) pouring by gray color in layer "Clarification of interspaces", (**41**) appearance of wrinkling at removed selection, (**42-43**) clarification in two layers, (**44**) darkening of clarifications in selected areas.

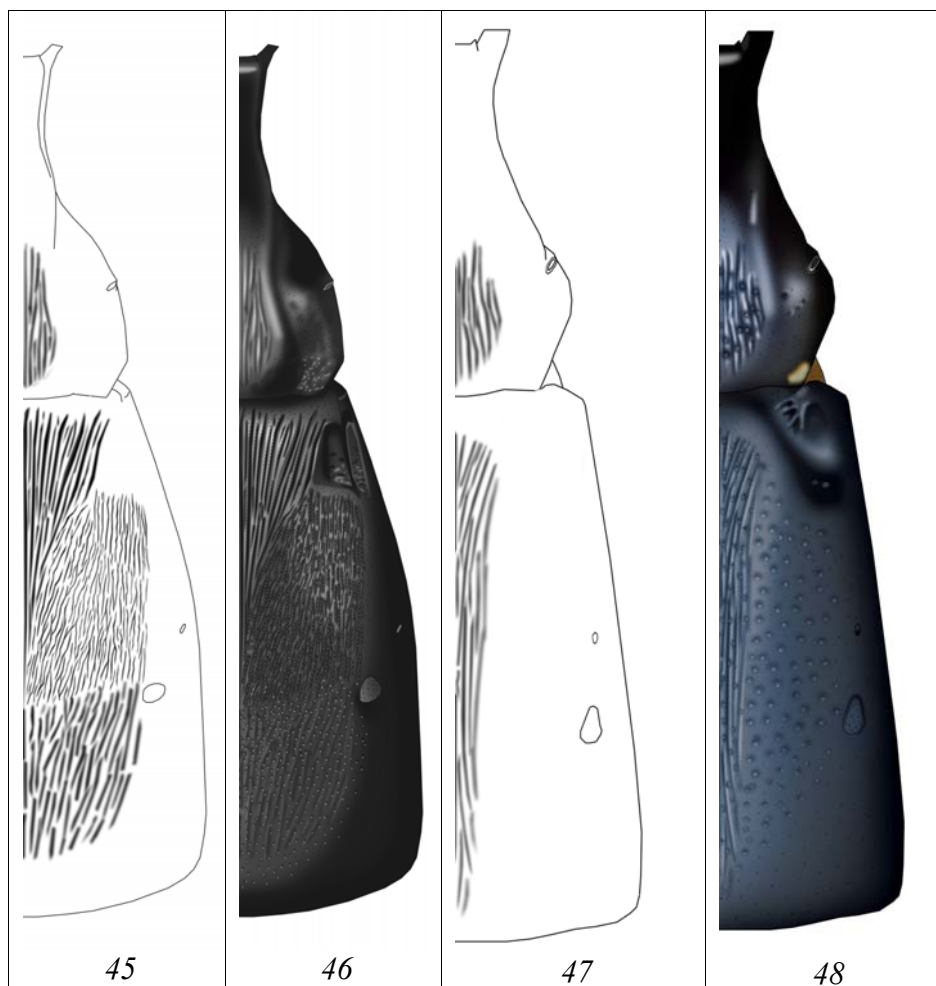Examples of fulfillment of wrinkles are resulted in drawings 45-48.

45   *46*   *47*   *48*

Fig. 45-48: Examples of fulfillment of wrinkling sculpture: (**45-46**) wrinkles and finished image of tergites 1-2 *Limerodops elongatus* (BRISCHKE), (**47-48**) the same *Limerodops violentus* TERESHKIN.

Microsculpture

For elaboration of a surface of a segment with a microsculpture, two layers are used. In one layer dark small points are fulfilled, in other – light ones (fig. 49-51).

For pictorial presentation of a surface of a segment with the expressed microsculpture, at the given stage, fulfillment of following operations are represented as optimal. At the first stage in one layer, uniform puncturation of not great fragment by dark points corresponding on the size and blur of a contour to area of a segment with microsculpture is fulfilled. In the second transparent layer, analogous puncturation by

light-colored points is executed. Further, in a layer with dark points a command select all (Ctrl+A) and then copy to the buffer (Ctrl+C) is performed. At a following stage the fragments are inserted from the buffer and displaced by instrument Move Tool (V) to all areas of a segment with microsculpture of a given type, forming hierarchy of layers. After an insert of all fragments, the command on merge of layers is fulfilled (Menu: Layer–Merge Visible, Shift+Ctrl+E). Then, the same sequence of operations is performed for light points. Further, merging of two layers with light and dark points is fulfilled, preliminary having selected in each layer their saturation and brightness (Brightness/Contrast) (fig. 49). Further, by instruments of selection with small rigidity of selection (Feather=50-90px), areas which are necessary to remove (dark areas of a segment on which the microsculpture is not looked through) are selected (fig. 50,51). Selected areas are deleted by Del key.
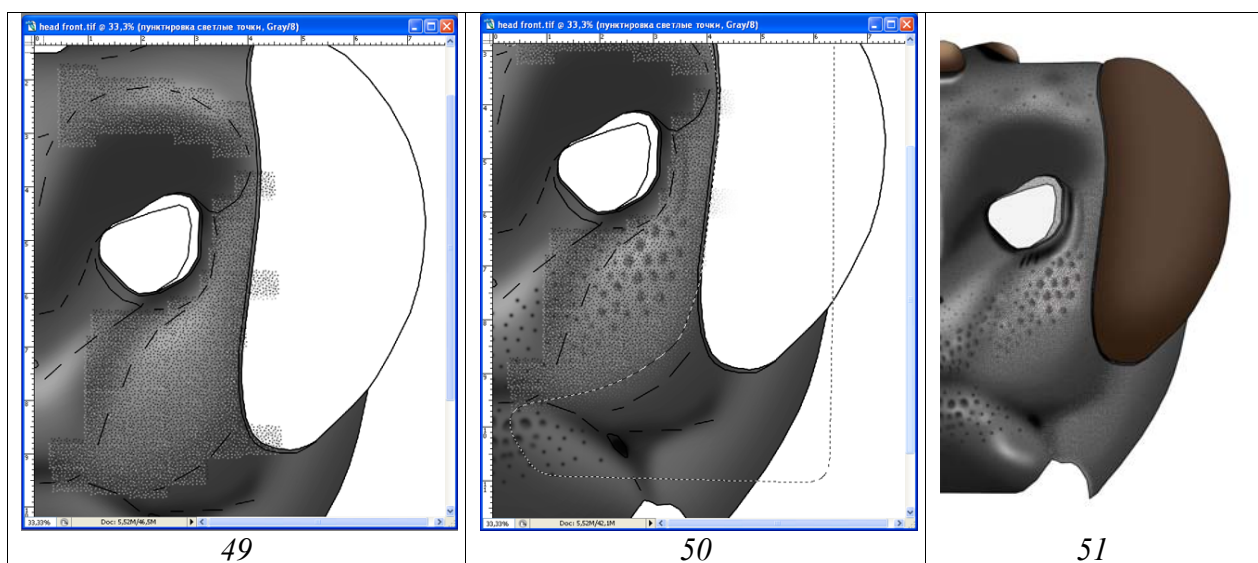

| *49* | *50* | *51* |

Fig. 49-51: Stages of fulfillment of head capsule of *Hybophorellus injucundus* (WESMAEL): (**49**) inserting of the areas with microsculpture from buffer, (**50**) deletion of superfluous areas after merging of layers, (**51**) result.

Pubescence

Unlike other structures, operation on fulfillment of pubescence is performed always in a separate and uppermost layer with use of the pen of Pen Tablet. Instrument Brush Tool, having selected a thickness of a line and having established obligatory parametres (Hardness=100% and Spacing=1%) is used. It is necessary to watch, that in palette Brushes in window Shape Dynamics, a tick has been established (fig. 52,53).

Fulfillment of pubescence in a separate layer is necessarily, first of all, because of peculiarities of coloring of the pubescence which are not coinciding usually with the basic coloring of a fragment of a body. After finishing of pubescence fulfillment and its coloration with use of standard procedures, the layers "Result" and "Pubescence" are merged (Shift+Ctrl+E), having disconnected preliminary all other layers, including "Background" (fig. 54).
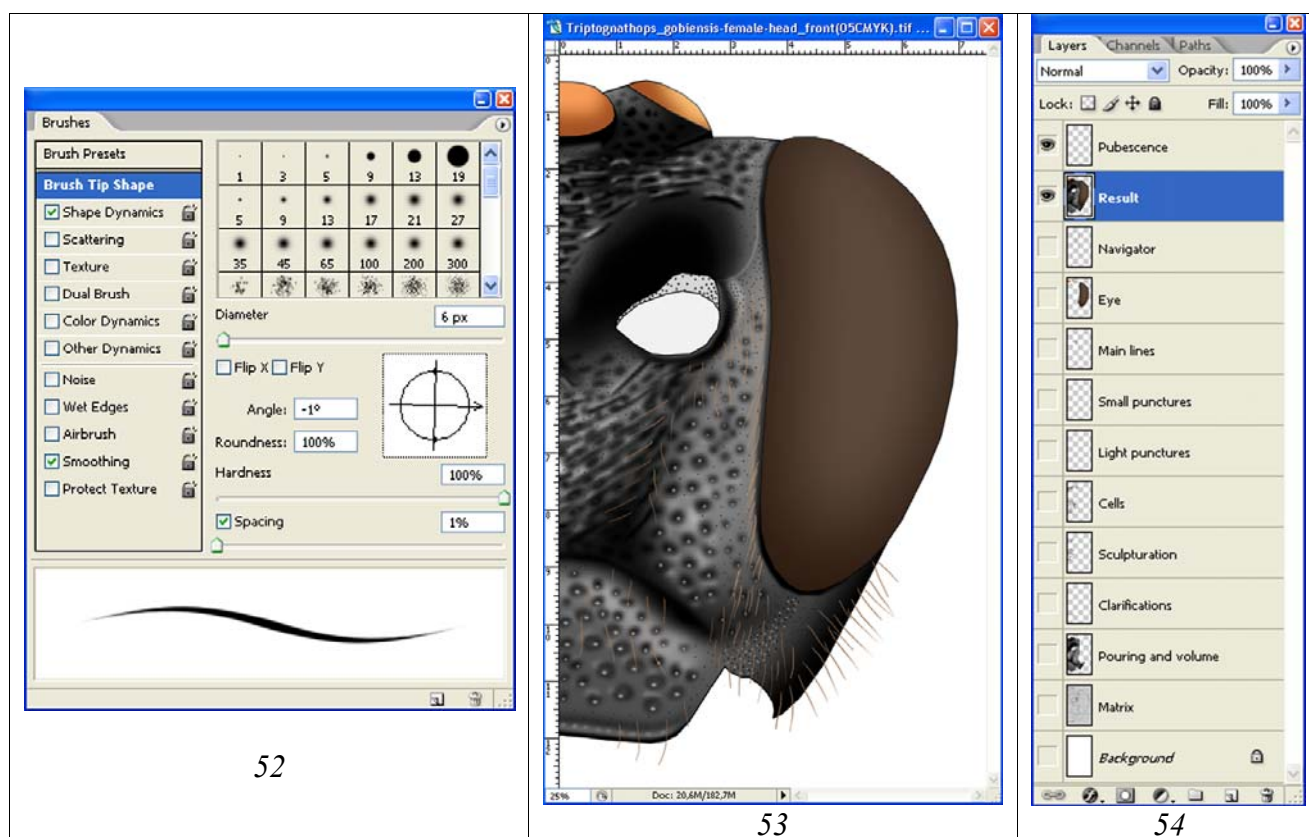
Fig. 52-54: Fulfillment of pubescence of head capsule of *Triptognathops gobiensis* TERESHKIN from front: (**52**) selection of parameters of Brush, (**53**) finished image, (**54**) hierarchy of layers before merging of layers "Result" and "Pubescence".

Coloring of an object

Graphic editor Photoshop allows to impart to entomological object a natural coloration without using watercolor and paintbrush, i.e. very labor consuming process which demands definite skills and capacities.

Object coloring is always fulfilled in the final layer "Result" which is formed as a result of merging of all layers in which all previous operations was performed. The exception is a head and a layer with pubescence, in case of its presence. If the object was fulfilled in Grayscale Mode, a file is translated to CMYK Mode (Menu: Image–Mode–CMYK Color). In a pop-up menu a command "Don't Flatten" is chosen, preserving all layers. At the first stage, the basic coloration of object entirely (part of a body, a segment or segments) is fulfilled. For example, the abdomen or 1-2nd its segments are of a reddish-brown coloration. At the first stage in palette Swatches the color of a stainable part, closest to the main is selected. Further, operation on coloring of the selected part is fulfilled: Menu: Image–Adjustments–Hue/Saturation (Ctrl+U). In a pop-up window Hue/Saturation by means of cursors (sliders) a color and a saturation of an object are selected. At operation fulfillment it is necessary to remember, that in window Colorize the flag should be set (see e.g. fig. 361,536 from chapter

"The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species").

For coloring of separate fragments, spots, strips, etc., theirs are selected preliminarily, usually with tool Polygonal Lasso Tool, having selected preliminarily parameter of Feather. Usually values of the parameter of Feather are small, more often 5-7px. After selection of necessary parts, theirs coloration is fulfilled as it is described above. It is necessary to note, that already in image that was performed in a Greyscale, the parts for coloring have been clarified to necessary level.

Special case of coloring is an imparting of hue to the certain parts of object (more often bluish or violet). For fulfillment of this, separate parts of a body, or separate segments are selected having established very much great values of parameter of Feather. More often it is 70-90px. Then, having selected in palette Swatches corresponding color, the menu command: Image–Adjustments–Hue/Saturation (Ctrl+U) is fulfilled. Usually, for achieving of necessary effect, it is enough to establish a flag in window Colorize, in pop-up dialogue window Hue/Saturation. In addition, it is possible to use sliders Hue and Saturation, achieving the maximum similarity of the image with object (**Plate 85**).

In the similar way, parts with a brownish shade on some parts of a body are colored also (**Plate 8**).

A constant control of object under the microscope is very important. A lamp with definite spectrum, for example, halogen lamp, is the best for lightening the object.

In detail all operations are described and illustrated in chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species".

Special features of preparation of separate elements of the table

As already it was spoken earlier, the table of images, illustrating concrete taxon, should consist of standard elements as much as possible completely illustrating features of its morphology. For model group of insects (species of family Ichneumonidae), the image of imago, head in two foreshortenings, propodeum and 1-2nd tergites of abdomen are obligatory. These elements give as much as possible complete representation about taxa of the given family. In case of need, the additional illustrations, characterizing concrete taxon can be included in the table. More often it is mandibles, segments of the male flagellum with tyloides and other parts of a body. Naturally, for each large systematic category of insects and any other organisms, own and most optimal scheme of graphic representation of taxa should be developed.

All enumerated elements of the table should have the unified representation, the sizes and an arrangement on a canvas.

Fulfillment of total image of imago

The main principle of fulfillment of the total image consists in separate fulfillment of its parts in uniform scale and their subsequent "mounting" in the whole image with a standard arrangement of parts of a body. Images of flagellum, head, thorax, legs, wings and abdomen are fulfilled separately.

Peculiarities of fulfillment of image of a flagellum

At preparation of image of imago, all segments of a body it is possible fulfill separately, practically up to final image. Flagellum frequently, along with wings remains at a stage of a contour till the period of imago "mounting" in the final image. It is connected with necessity of giving to flagellum standard position relative to a body of imago and correction of its size relative to a body and forward wing length. It is connected also with that fact, that the pencil drawing of flagellum is fulfilled separately, with use of projecting tools. It does not coincide by scale with contour drawings of other segments which are fulfilled in uniform scale with use of a grid of a microscope (see above).

As well as for all fragments or the segments of object, which are contained in separate files, all the operations are fulfilled in separate layers. Before fulfillment of all standard operations the file with image of flagellum is presented only by two layers – "Background" and "Matrix" with scanned pencil contour of flagellum. Usually, the file for preparation of flagellum image consists from six layers situated from top to down in a following order: "Navigator", "Small punctures" (shallow puncturation), "Main lines" (the basic lines), "Pouring and volume", "Matrix" (pencil contour) and "Background".

Contour drawing of flagellum, as well as all other parts of a body, is fulfilled by vectorial instrument Line Tool. Thickness of lines is selected proceeding from the dimensions of a pencil contour and the subsequent its reduction till the real dimension in the total image. After performance of certain number of lines, the layers with separate lines periodically are merged, preliminary having disconnected both lower layers (see fig. 279).

Shaping position and correction.

The contour of flagellum, fulfilled by means of vectorial instrument Line Tool is corrected on conformity of its dimensions concerning length of a body and its position concerning a front wing of imago. For correction of the dimension of the contour, length of flagellum measured under the binocular microscope is correlated relative to any segment of a body or length of flagellum from the base of a forward wing until any transversal vein of its apex. For correction of dimension of the contour of flagellum, an operation Menu: Edit–Transform–Scale (Rotate) is used. For example, the ready contour of flagellum exceeds an object body on the size. The length of flagellum, measured under a microscope corresponds on length to distance from the base of mesonotum up to hind margin of the third tergite of abdomen. In this case the follow-

ing sequence of operations is fulfilled. In a layer with a vectorial contour of flagellum an operation Menu: Edit–Transform–Rotate is fulfilled. The base of the first segment of selected flagellum is moved by the mouse on level of the base of mesonotum (having pressed and without releasing the left button of the mouse). A marker from the centre of selected area is moved to the same point. The cursor is placed on an inverse angle of selected area. Contour of flagellum is rotated up to coincidence of flagellum with a longitudinal axis of a body. Then transformation function is converted to regime Edit–Transform–Scale. Further having pressed and without releasing Shift key, the dimension of flagellum is decreased. Area of selection (flagellum) is decreased by dragging the cursor from an angle opposite to the base up to coincidence of flagellum apex with apex of the third tergite (see fig. 429, 431).

After correction of dimension of a contour of flagellum, the correction of its position concerning a body and forward wing of imago is begun.

At the first stage, function Menu: Edit–Transform–Rotate is used. Separate parts of a flagellum contour are turned, for giving of position concerning a body and a forward wing according to the standard of imago representation developed earlier (fig. 55). At a following stage already separate fragments of a contour of flagellum are corrected for correction of the shape and the dimensions of separate segments. Function Edit–Transform–Warp (fig. 56) is used for this purpose.
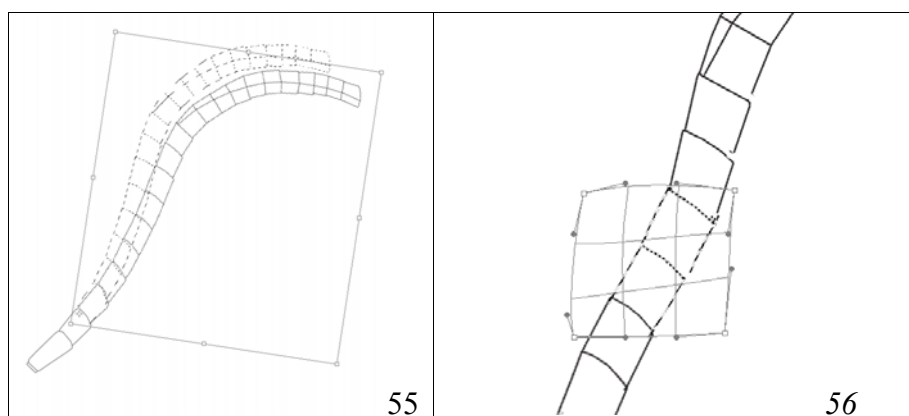

Fig. 55-56: Operations to transform the contour of the flagellum.

After finishing of contour drawing of flagellum, borders of a white annelus or any else additional details or borders are fulfilled by dotted lines. In palette Layers by the right button of the mouse, the layer with contour drawing is duplicated by three times. In pop-up window the names of new layers are entered. It is "Navigator", "Small punctures" and "Main lines". Initial layer with contour drawing is renamed to "Pouring and volume". Layer "Navigator", which used for orientation, is left unchanged. Contour drawing in layer Small punctures is completely deleted, reserving its empty (Ctrl–A+Del) for the subsequent puncturation. In layer "Main lines" the dotted lines serving for orientation are deleted retaining only the basic lines of a contour. In layer "Pouring and volume" the most part of the centre of flagellum is deleted, retaining only lines of an external contour. The usage of instrument of selection Polygonal Lasso Tool with parameter Feather=0 is most convenient.

At a following stage, p o u r i n g of a contour by instrument Paint Bucket Tool by grey color (55% is ordinary) is fulfilled, clicking some times by the left button of the mouse up to disappearance of light border with a contour.

Further, the v o l u m e t r i c   a p p e a r a n c e to flagellum is shaped. It is fulfilled by selecting and darkening of peripheral parts of flagellum, having selected certain rigidity of selection (fig. 265-267). Further, the central part of flagellum is selected and clarified (fig. 266). In the subsequent, separate sites of flagellar segments are selected with tool Lasso Tool and contrasted up to giving to flagellum the natural appearance (fig. 267). At a following stage in an empty upper layer (Small punctures) elaboration of segments by means of small points is fulfilled.

Ring (annelus) and ventral flattening.

At presence of white annellus or semiannelus on flagellum, a layer "Navigator" serves as for orientation when selections of area of annelus and for direct selection of flattened areas of segments too.

Annelus, or **semiannelus** in layer "Navigator" is marked by dotted lines, and flattened part of flagellum – by solid lines. After fulfillment of operations on giving to flagellum of volumetric appearance, according to layer "Navigator", area of annelus is selected by instrument Polygonal Lasso Tool, having chosen a correspond value of hardness of parameter of Feather (fig. 57). At a following stage, a working layer is the bottom layer – "Pouring and volume". In this layer operation of clarification of area of annelus or semiannelus is fulfilled (Menu: Image–Adjustments–Brightness/Contrast) (fig. 58). Then, not removing selection, layer "Main lines" is marked as working. After that clarification of the contour of flagellum in the area of annelus is fulfilled. Further, also not removing selection, layer "Small punctures" is marked as working. Layer "Small punctures" is clarified to necessary level.

At a following stage, at presence of **ventral flattening** of flagellum, the worker layer is again the top layer "Navigator". Having pressed and not releasing Shift key flattened parts of all segments of flagellum are selected by instrument Magic Wand Tool (W) (fig. 57). Not removing selection in palette Layers a layer "Pouring and volume" is marked by the cursor as working. Next, by function Brightness/Contrast, flattened area of flagellum is clarified (fig. 58).

Last operation on elaboration of the multilayered black-and-white image of flagellum is clarification of the lines of a contour in layer "Main lines". Separate areas of lines of a contour are selected by instrument Polygonal Lasso Tool at low, but not equal to 0 values of parameter Feather. The selected lines are clarified by command Menu: Image–Adjustments–Brightness/Contrast, achieving coincidence on a tonality with underlying layer "Pouring and volume".

At the closing stage layers "Background", "Matrix" and "Navigator" are disconnected and then operation on merging of rest layers (Merge Visible) is fulfilled. Merged layer is selected (Ctrl+A).The image is copied in the buffer (Ctrl+C). Then, by command Alt+Ctrl+Z all previous actions are abolished, and hierarchy of layers is

restored. Ready picture is inserted from the buffer over the layer Navigator by the command Ctrl+V. Layer is named "Result". At the given stage image of flagellum is ready to operation on giving to it coloration.

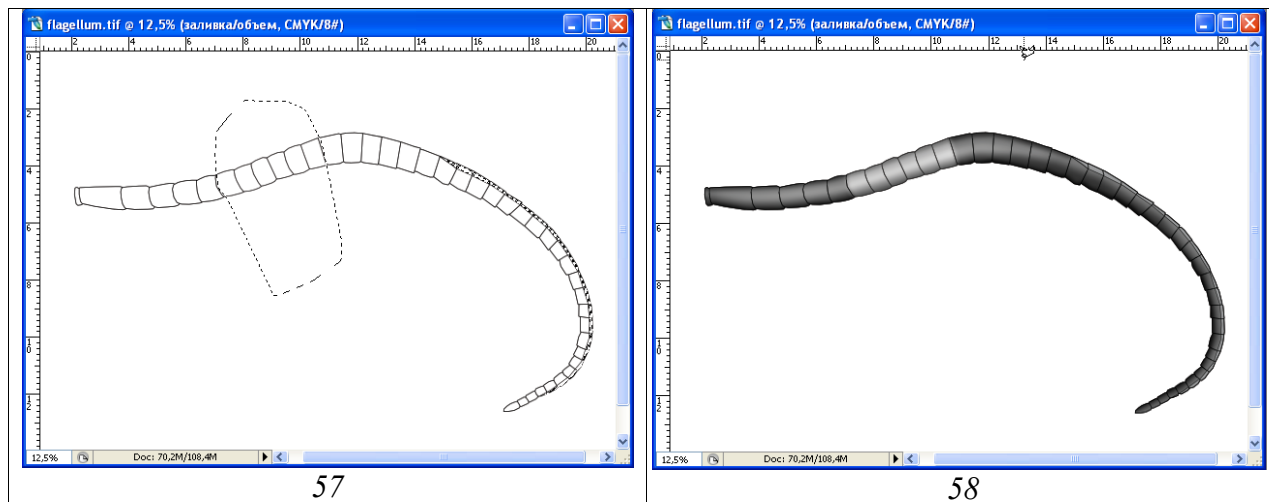Coloring of flagellum is fulfilled by means of the standard procedure described above.

Fig. 57-58: Clarification of region of white annulus and flattened area of segments of flagellum of *Eutanyacra crispatoria* (LINNAEUS): (**57**) selection of areas of a white annulus (Polygonal Lasso Tool) and flattened segments of flagellum (Magic Wand Tool), (**58**) result of clarification of selected areas in layer "Pouring and volume".

Flagellum of males possesses characteristic peculiarities. At some of species it can bear transverse ridges topped with short bristles on ventral side, segments ribbed ventrally to some extent and with characteristic for concrete group tyloides (**Plate 4**: 25,26, **17**,**23**: 6). Peculiarities of fulfillment of images of tyloides are in detail described more low in the section devoted to the detailed description of sequence of preparation of the table of images.

Various variants of Ichneumoninae flagellae and methods of their arrangement are presented in a color table (**Plate 4**).

Fulfillment of illustration of flagellae of species which possessing coiled flagellae at dry samples is particularly difficult. Even after maceration, straightening of flagellum even on microscope slide in a water drop, does not allow to achieve its linear arrangement (**Plate 4**: 22).

Plate 4: Variants of flagellum images and their positioning: females: (**1-24**), males: (**25-26**). (designations see Legends to color plates).

Peculiarities of fulfillment of image of a head

At fulfillment of contour drawing of a head capsule and processes, it is necessary to remember about importance of a choice of a thickness of a line of vectorial instrument Line Tool. As already it was told earlier, the scanned drawings of all parts of a body have been increased proportionally. Therefore, a thickness of lines at fulfillment of all parts of a body will be identical. It is necessary to remember that final picture of imago in the table will be considerably decreased. A thickness of lines of instrument Line Tool is selected proceeding from this. Many years experience of images fulfillment in the increased scale has shown that optimum thickness of a line is normally 5px.

Contour drawing of a head is fulfilled by vectorial instrument Line Tool, orientating to a pencil contour (Matrix). Periodically, having disconnected layers "Background" and "Matrix" merging of layers is fulfilled by command Menu: Layer–Merge Visible (Shift+Ctrl+E).

A main principle of fulfillment of a figure of a head is performance of its separate fragments in different layers such as "Head, pouring and volume", "Eye and ocelli", "Mandible" and "Maxillary palp" (fig. 60). Fulfillment of this condition is necessary as for giving of volumetric appearance for the separate elements, allowing avoiding of selection effect on adjacent parts at giving of volumetric appearance, and for their subsequent arrangement ("assemblage" of imago) too. In the finished contour, areas for orientation in the subsequent (for example colored areas) are marked by dotted lines. The finished contour drawing is duplicated according to quantity of the layers necessary for fulfillment of an image of a fragment, giving to them appropriate names. By right mouse button on a layer with a ready contour drawing in menu Layers is clicked. Then from a pop-up menu a command Duplicate Layer is selected. Further, layer name is entered.

Besides obligatory layers enumerated above, layers which necessary for sculpturation of a head capsule are added. In figures 59-61, layers necessary for fulfillment enough complex image of a head of ichneumon fly with a file consisting of 16 layers, arranged in obligatory hierarchy are presented.

P o u r i n g of a head contour is fulfilled by instrument Paint Bucket Tool (G) separately for a head capsule, scapus, maxillary palp and mandible. Further for each element which located in a separate layer, the operation on giving to them of volumetric appearance is performed with usage of the instrument of selection Polygonal Lasso Tool, using various values of parameter of Feather.

For e l a b o r a t i o n of a sculpture of surface of head capsule of ichneumon fly, various quantities of layers depending on complexity of sculpture of the object are used. The strict locating of layers over volumetric images of elements, i.e. their hierarchy is obligatory. More often at elaboration of a sculpture of a head following layers are used, located from top to down in a following order: small punctures, pubescence, light punctures, large punctures, wrinkles, clarification of interspaces, microsculpture, etc.
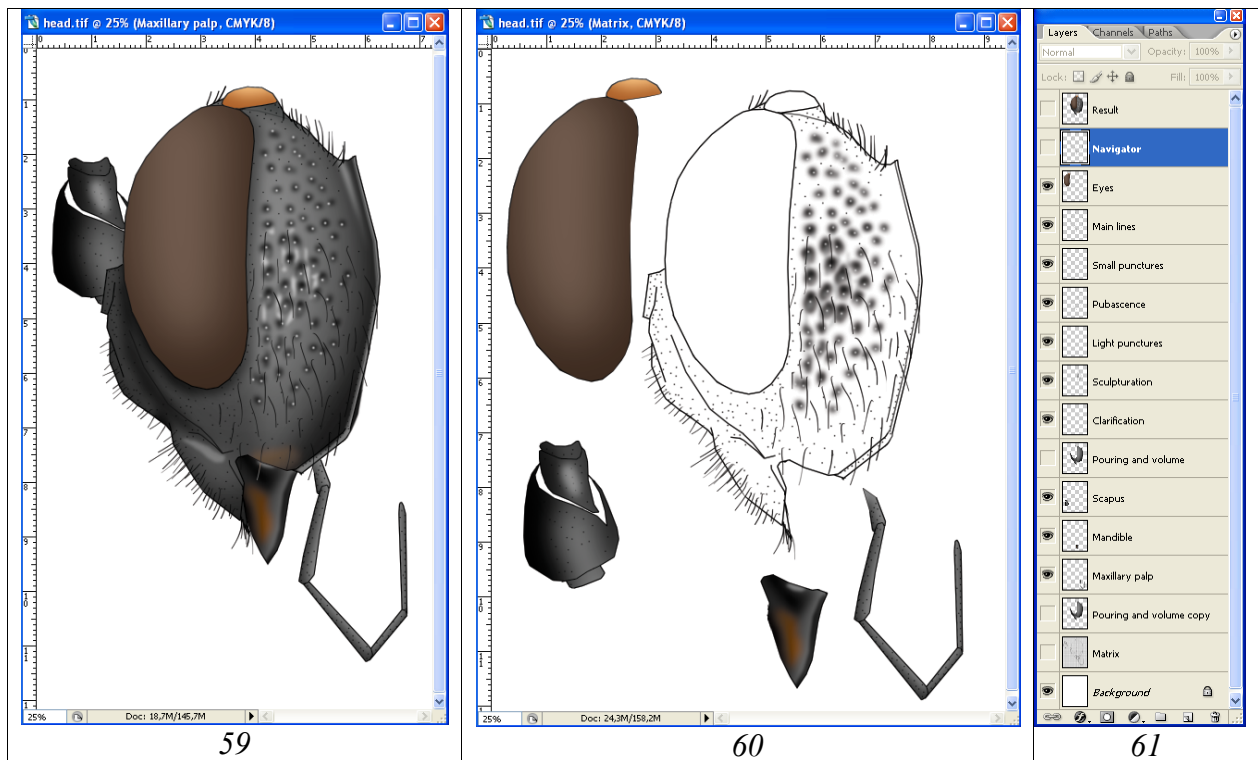
Fig. 59-61: Image of a head of ichneumon fly *Triptognathops gobiensis* TERESHKIN: (**59**) final result of fulfillment of operations (layer "Result"), (**60**) elements of a head fulfilling separately, (**61**) hierarchy of layers.

After elaboration of sculptural peculiarities, an operation of merging of layers with underlying layer "Pouring and volume" is fulfilled, separately for a head capsule and for its processes (Menu: Layer–Merge Visible, Shift+Ctrl+E).

After elaboration of sculpture of a surface and merging of layers, coloring of an object is started. If the previous operations were fulfilled in a file in a Grayscale, the file is necessary to translate in a color mode by command Menu: Image–Mode–CMYK Color. Operations on coloration of head capsule proper, scapus, mandible and palp are fulfilled separately. In case if a head or its processes have a light pattern, these areas are clarified, selecting their by instrument Polygonal Lasso Tool, according to a layer navigator preliminary having selected parameter of Feather.

As it was already spoken, eye and ocelli of a head of the ichneumon fly are in a separate upper layer. Coloration of eye and ocelli is started from selection of basic color in palette Swatches, orienting on the darkest area. After pouring by selected color by instrument Paint Bucket Tool, an internal part of an eye is selected by instrument Polygonal Lasso Tool with parameter of Feather more than 90-100px. Then selected area is clarified to necessary level bythe menu command: Image–Adjustments–Brightness/Contrast. Area of selection is chosen depending on the chosen illumination of object. Ocelli are clarified, having chosen small values of parameter Feather (for example 30px). In detail, coloring of eyes and ocelli is considered in section "Coloring the object" and in chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of one species (Stages of preparation of total image of imago)".

After fulfillment of operations on a coloring, the layer "Eye and ocelli" is merged (Merge Visible) with layer "Pouring and volume", preliminary having disconnected other layers.

Thus, at the final stage, in a file there are the following necessary for the further work on "integration" of imago, layers: "Result", "Scapus" and "Maxillary palp".

Various variants of final images of a head of total picture of imago are presented on a color **Plate 5**.

Peculiarities of fulfillment of image of a thorax

All pencil contours of parts of a body of imago are fulfilled in one scale and increased proportionally (see above). Therefore, at fulfillment of a contour of thorax, as well as other parts of total drawing by instrument Line Tool, a thickness of lines remains the same. Separate parts of thorax and the colored areas are fulfilled by the dotted lines which serving for orientation.

In palette Layers, by the right button of the mouse is clicked to layer with a contour. In pop-up menu, the command Duplicate Layer is chosen and name of a new layer is entered. At operation fulfillment on giving to object of volumetric appearance with use of tools of selection, separate elements of a thorax should located in separate layers to avoid influence of selected area on the next areas. Volumetric appearance of tegula, thorax proper and propleuron is fulfilled separately. Thus, before fulfillment of operations on pouring and giving of volumetric appearance, by means of duplication the following set of the layers which are located from top to down in a following order are generated: 1 – "Navigator", 2 – "Tegula", 3 – "Main lines", 4 – "External contour" and 5 – "Propleuron" (fig. 64). In a layer "Main lines" the dotted lines are deleted, reserving only lines which will be visible in final picture. In a layer "Pouring and volume" all lines, except the external ones are deleted.

P o u r i n g by Grey color (usually 55%) is fulfilled by instrument Paint Bucket Tool (G) in the layers "Tegula", "Pouring and volume" and "Propleuron".

In layers with pouring, by means of tools of selection, the operations on giving to fragments of volumetric appearance are fulfilled as in detail described in sections "Shaping of volumetric appearance to an objects" and "Stages of preparation of total image of imago".

Further it is started the most difficult stage – detailed sculpturation of thorax. By one variant, it is possible to use for operations of sculptoration the basic layer "Pouring and volume". However, long-term experience has shown that the optimal is fulfillment of separate classes of sculptures in separate layers. The quantity of layers depends on complexity of morphology of object. After separation of classes of the same structures peculiar to object, for example large and small punctures, cells, wrinkles etc., corresponding empty layers with certain names are created. In these layers by instruments of selection at pressed key Shift all the same structures are fulfilled simultaneously and theirs simultaneous pouring is performed. Fulfillment of the same structures in separate layers allows fulfilling their clarification or darkening up to

achieving the maximum similarity to the original (fig. 63). The quantity of separate layers with different types of sculptures can be considerable (fig. 64). At elaboration of a sculpture of object it is necessary to pay special attention on a relative positioning of layers (theirs hierarchy).
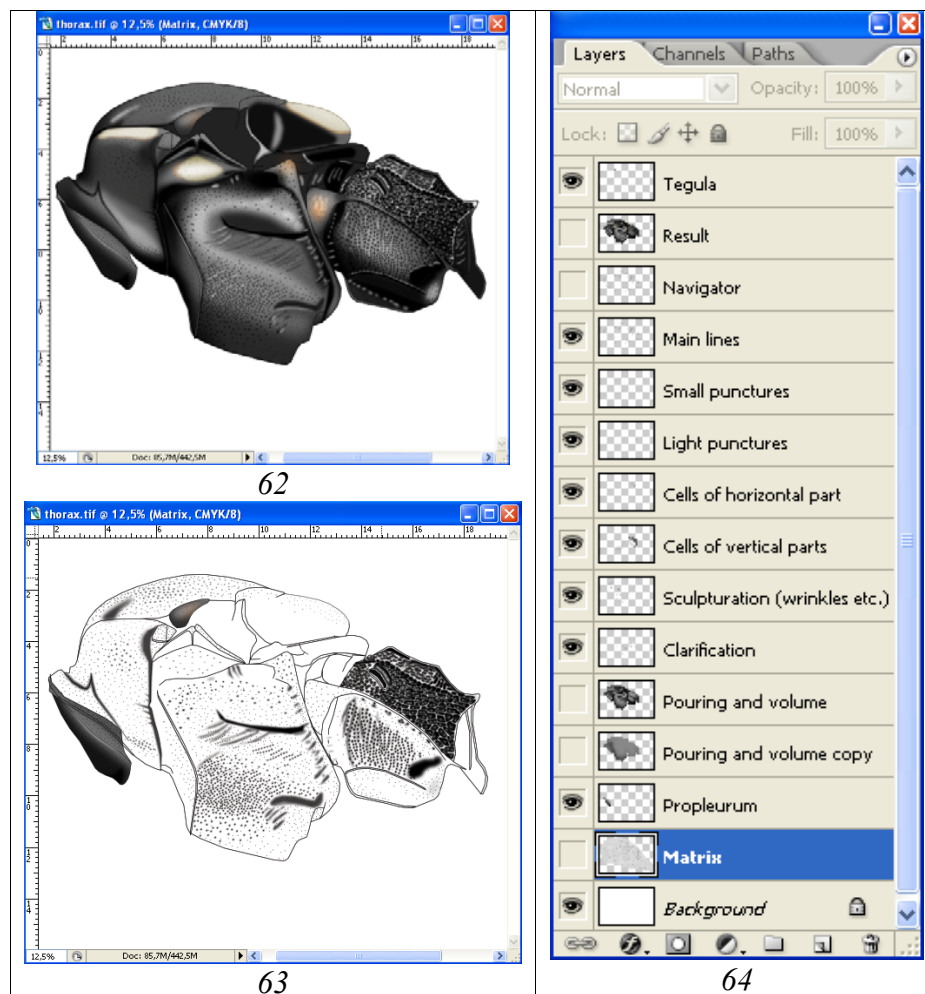

Fig. 62-64: Fulfillment of image of a thorax for total image of *Achaiusoides epistomalis* TERESHKIN: (**62**) final picture in layer "Result", (**63**) an image of thorax at disconnected layer "Pouring and volume", (**64**) hierarchy of layers.

At the final stage of elaboration of a sculpture, the separate lines in layer "Main lines" are clarified, up to achieving their correspondence to layer "Pouring and volume". After that, merging of necessary layers is fulfilled. As a result image of thorax is presented by two layers "Result" and "Tegula". The disposition of tegula in a separate layer is necessary for the subsequent "mounting" of total image and its position depends on the subsequent orientation of front wing of imago of ichneumon fly.

C o l o r i n g of thorax is begun with conversion of a file from mode Grayscale to mode CMYK: Menu: Image–Mode–CMYK Color. Having selected by instrument Polygonal Lasso Tool with the selected parameter of Feather equally colored areas, the menu command: Image–Adjustments–Hue/Saturation (Ctrl+U) is fulfilled (fig. 62). The sequence of actions is in detail described in sections "Coloring the object" and "Stages of preparation of total image of imago".

Pictures of a thorax of different degree of complexity are presented on **Plate 5**.

Image of wing

The most important taxonomic characters of a wing of ichneumon flies are an arrangement of veins and geometry of cells, to a lesser degree – coloration of veins and wing membrane. On this basis, the thickness of veins in the process of their representation can mismatch to proportions of object in favour of demonstrativeness of taxonomic characters. Coloration of veins and a membrane has to great extent conditional (schematical) character accordance with taxonomic characters.

The contour of a wing precisely reflecting a structure and an arrangement of veins and cells, it is possible to fulfill in editor Photoshop, not resorting to "a pencil and a paper" (the section "Preparing contour of an object" see). However, this way is labour-consuming and demands considerably more expenses of time, than combination of "manual work" and the further processing in the graphic editor.

There is a number of ways of preparation of drawing of wings, satisfying the above requirements. It is scanning of wing, digital photo and usage of slide projector or device for microfilms reading with the subsequent scanning of pencil drawing. The first method, frequently, demands a partition of an object and, thus, its damage that is unacceptable for a type material. The second demands precise smoothing of wing, that also not always probably and can lead to object damage. The most successful, in our opinion, last from three methods is. Mounted object is placed on foam plastic in front of an objective of a projector or the device for reading of microfilms under a necessary corner to perpendicularly ray of light and projected on a sheet of paper (format A4). After that, the contour of a wing and veins are outlined by pencil (the pencil contour can be outlined, if necessary, by rapidograph). The following stage is scanning of pencil drawing. Scanning usually is fulfilled in mode Gray at the maximum contrast.

At last, an outlining of a contour of a wing and elaboration of venation with observance resulted above regulations are begun. At this stage of work (in Gray mode), work with layers has ever greater importance. The drawing of wing for convenience of the subsequent actions is translated in Color mode (Image–Mode–Color). Transform of image to Color mode allows fulfilling outlining of wing by more demonstrable color lines. At the first stage, at obligatory control of object under the microscope, an outlining of a front wing is performed by following the procedure described more low. After finishing of outline of front wing, it is saved in a layer "wing-1", separately from fulfilled in the subsequent layers "wing-2" and "Background". In subsequent, from a layer "Background" the scanned pencil drawing is deleted, leaving only white background pouring (Ctrl+A–Del). Drawing is converted to Grayscale mode again. Then the layers containing the images of both wings by turns are darkened and contrasted as much as possible (Image–Adjustments–Brightness/Contrast). Thus, as a result there is a file in Gray mode with three layers – "wing-1", "wing-2" and "Background" with white background pouring.

Basic regulations at preparation of image of the wings are finalization of the wings base and coloration of membrane only at a stage of arrangement of the total image of imago. Besides, if front and hind wings were fulfilled in separate layers, before copying of wings in a file with the total image of imago, layers should be merged. It is necessary for proportional scaling of both wings concerning a body of imago of the ichneumon fly.

O u t l i n i n g . The optimal variant for outlining of veins is usage of vectorial instrument Line Tool. Periodically, it is necessary permanently to fulfill a command Megre visible (keyboard shortcut Shift+Ctrl+E), preliminary having disabled other layers (fig. 65). Generally, contour drawing of wing does not match the scale of the size of the wing on the final image of insect imago. Therefore, the line width of outlining should be selected proceeding from the subsequent reduction of the dimensions of a wing to necessary level.

C o l o r i n g   o f   v e i n s   o f   w i n g s . At the given stage, that is a stage when the wing image is in a separate file with three layers, coloring of veins is fulfilled. Pouring of membrane of wing is performed only after the general merging of all parts of a total picture of imago (see lower "Arrangement of the total image of imago"). The first step is file conversion from mode Grayscale to mode CMYK (Menu: Image–Mode–CMYK Color). The following step – color selection at the obligatory control of the object under a microscope and pouring of veins by the instrument Paint Backet Tool. At fulfillment of the given operation, it is necessary to watch to that the area of pouring has been closed, that is all lines limiting veins were continuous and had no breakes. In the wing base, it is necessary to close open parts of veins or temporarily, or by lines with color of the main color of pouring. Other and most rational method is limitation of an area of a wing with veins of an identical coloration (tonality) by means of selection. Thus an obligatory condition is maximum hardness of borders of selected area. It is necessary to install parameter Feather=0 and to click checkbox Anti-alias. At value of parameter Feather more than 0, it is possible to add gradient transition to open areas of veins in the wing base. It is not necessary to color an external contour of the veins which is presented by lines of black color as it will weaken "taxonomic demonstrativeness" of wing morphology. When performing the operation, it is necessary to remember that in the tool options bar, flag "smoothing" (Anti-alies) should be set. It is necessary for elimination of visible white border between the lines which limits veins and area of pouring. Also there should be clicked checkbox Contiguos in order to that only veins were filled, instead of all area of selection. Also, flag "All layers" should be removed.

After performing an operation of pouring, a correction of saturation of the areas of veins with less intensive coloration is begun. These are apical longitudinal veins and veins in the base, according to the object of description. Simultaneous visual control of object under a microscope is obligatory. For the operation fulfillment, usage of the menu command: Image–Adjustments–Brightness/Contrast is the most convenient. Preliminary, a necessary area of veins is selected, using instrument of selection, usually Polygonal Lasso Tool, if necessary, in a combination with Shift key. Selection is fulfilled at the installed parameter Feather> 0, usually 20 and more px (fig. 66). In

this case transition from dark areas of veins to light one will be smooth, that saves from necessity of additional retouching of transitive areas. The layer with an appropriate wing should be working, that is selected. During operation performance other two layers can be disconnected (the tick "Indicates layer visibility" in graphic palette Layers (F7) is removed).
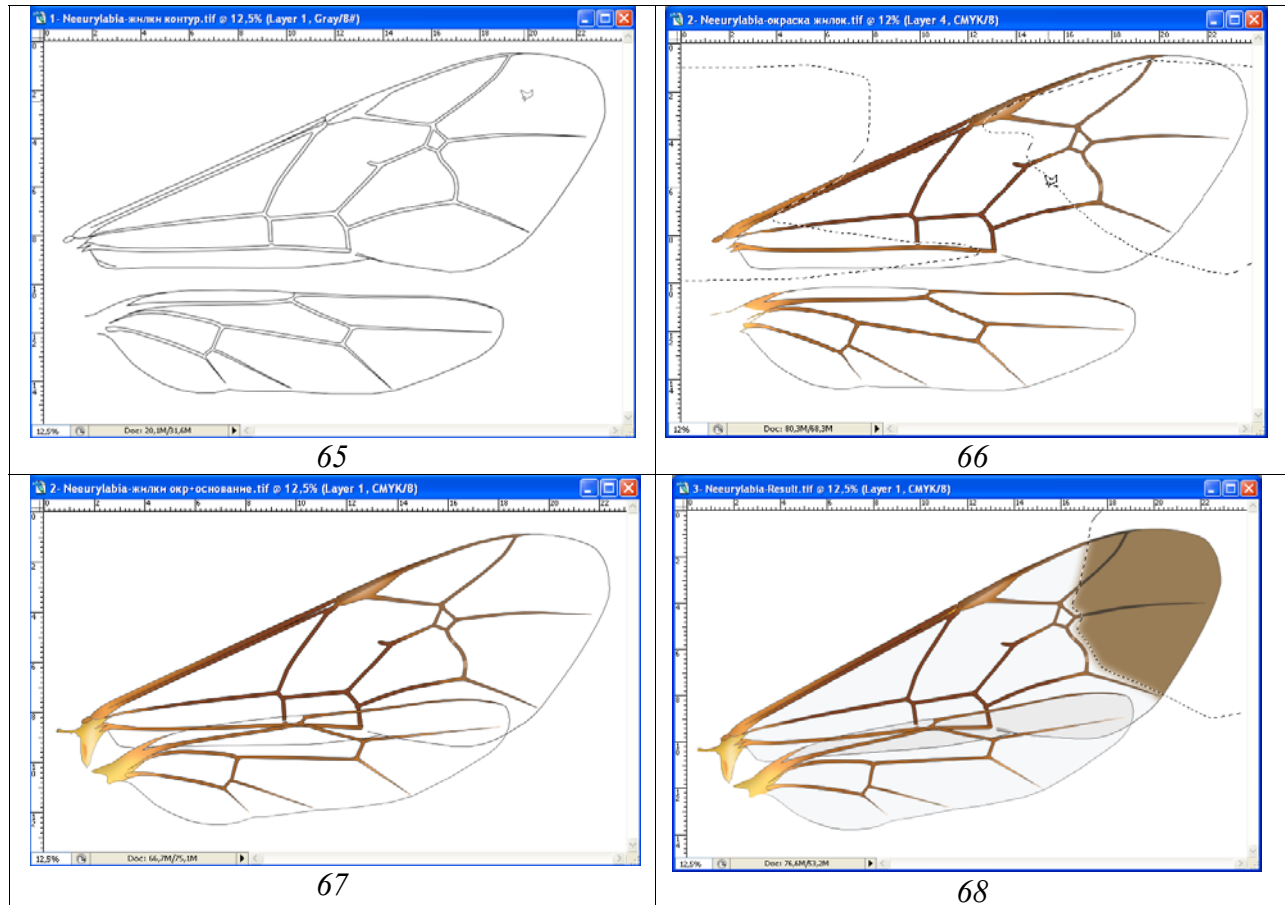

Fig. 65-68: Stages of fulfillment of wings images of *Neeurylabia spiloptera* (MORLEY): (**65**) contour drawing of wings in different layers, (**66**) coloration of veins of wings in different layers, (**67**) finalization of wing base in different layers, (**68**) coloring of wing membrane in merged layer.

After fulfillment of a coloration of veins of a front wing to a layer with a hind wing is passed and similar sequence of operations is fulfilled. Veins of a hind wing, as a rule are of lighter color. For a choice of a color of pouring of veins of a hind wing, in a front wing the most typical area of saturation is selected and, having initiated tool Paint Bucket Tool the cursor is brought to the selected area. With the Alt key held down (cursor should turn into eyedropper) one left-clicks on the chosen area selecting the necessary color. Then to a layer with a hind wing is passed. Pouring of veins and a clarification of apical areas and area of base are fulfilled, as it is described for a front wing (fig. 66).

Finalization of the wing's base and coloration of a membrane of a wing are fulfilled only at stage of imago "assemblage" from separate parts of a body (see lower). After

scaling of wings concerning a body size, forward and back wings are separated on separate layers. Wings are placed to the necessary position. The base each of wing according to position relative to the thorax is completed by instrument Line Tool, closing, thus, a wing contour. The bases of wings are colored and drew in details using tools of selection and menu command: Image–Adjustments–Brightness/Contrast (fig. 67).

C o l o r i n g   o f   w i n g   m e m b r a n e is fulfilled only after merging of all parts of a body of the ichneumon fly. At the majority of species a membrane of wing is hyaline. Therefore, normally pouring of wing is fulfilled by instrument Paint Bucket Tool, having chosen in palette Swatches the minimum value of Grey color (10% Gray). Any one of cells is poured by Gray color. Then, it is selected by instrument Magic Wand Tool and clarified by function Brightness/Contrast, achieving conformity with saturation, which is observed at object. Having directed the mouse cursor at a ready cell and having pressed key Alt (the cursor transform into eyedropper) necessary color is choosen. Then all nonoverlapping cells of both of wings are poured. It should to click by the mouse, as a rule some times on empty cell for disappearance of light border between the lines of a contour and a membrane. Overlapped cells of wings are poured by more dark color, usually by initial (10%) Grey color (fig. 68). Analogous procedures are fulfilled with more darkened, or colored, usually yellowish wings (**Plate 30**, **42**, **54**, **60**, **66**, **70**, **72**, **74, 76-79, 83, 85**).

Some of ichneumon species have wings with darkened areas (spots), more often with the darkened apices (**Plate 52**). For elaboration of such coloration the darkened areas of already "poured" wing are selected by instrument Polygonal Lasso Tool, having selected value of parameter Feather according to "blurriness" of the areas. Selected part is darkened by the menu command: Image–Adjustments–Brightness/Contrast. After that, operation on coloring of a selected area is fulfilled: Menu: Image–Adjustments–Hue/Saturation (Ctrl+U) or using the menu command: Image–Adjustments–Levels… (Ctrl+L) (fig. 68).

In detail the sequence of operations on finishing wing is described in the chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species".

Peculiarities of fulfillment of image of legs

Main principle of fulfillment of an image of legs for the total image of imago is the maximally possible fragmentation of each leg on parts and segments of tarsi. It allows arranging the legs as much as possible compactly during preparation of a total picture of imago.

Legs of the ichneumon fly are fulfilled in three separate files, according to number of pairs of legs. C o n t o u r   d r a w i n g of legs is fulfilled, as described above, by vectorial instrument Line Tool. Line width is identical with line width for an outline of other parts of a body (pencil drawing is increased proportionally for all parts of a

body). All fragments usually are fulfilled in same layer. The important condition is fulfillment of fragments of legs on considerable distance one from another. When giving volumetric appearance to separate fragments using selection tools, it is necessary to avoid impacts areas of selection on neighboring parts.

As well as at fulfillment of other fragments of a body, layer "Navigator" includes the dotted lines for orientation and for designation of limits of color pattern on legs. In layer "Main lines" dotted lines are deleted. Only lines, which necessary for a total image are retained. In layer "Pouring and volume" all lines except the external ones are deleted, selecting them by instrument Polygonal Lasso Tool (Feather=0) (fig. 69-71).

P o u r i n g by Grey color (55%) by instrument Paint Bucket Tool and giving of volumetric appearance with usage of tools of selection are fulfilled by the standard procedure described above. The named operations are fulfilled in layer "Pouring and volume".

Depending on morphological peculiarities of concrete species, empty layers are added for fulfillment of structures of different classes – punctures of different diameter, pubescence, spinules etc. It is necessary to remember about necessity of observing of strict hierarchy of layers.
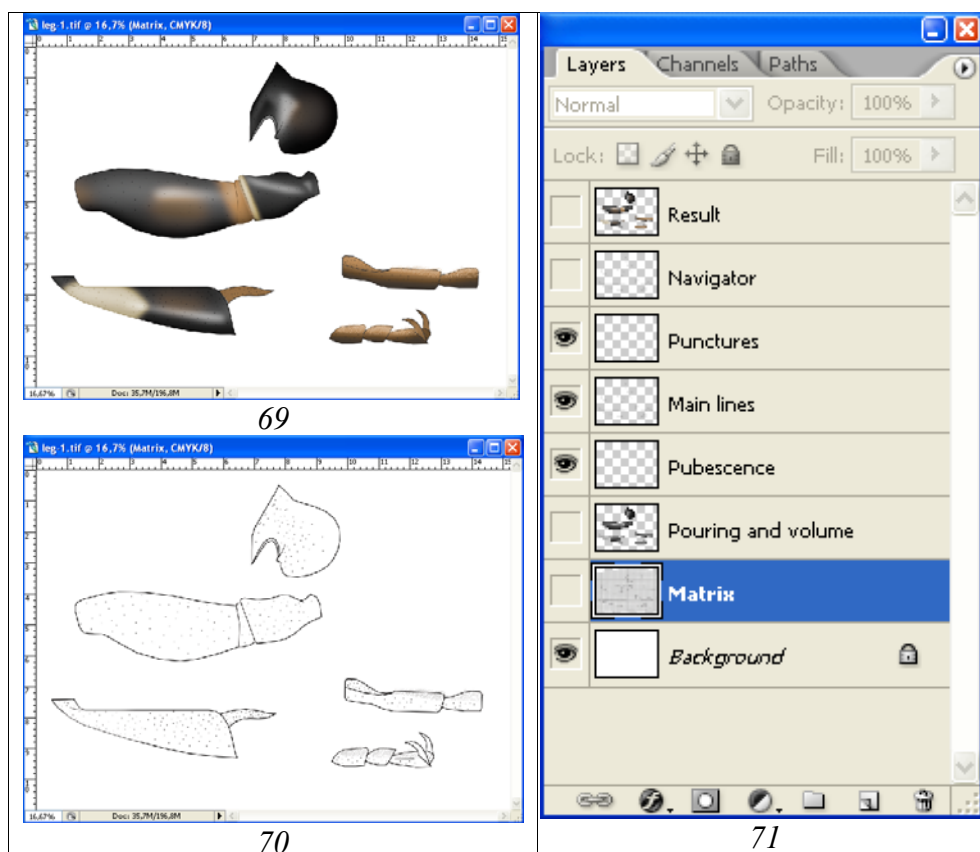
Fig. 69-71: Leg I of *Achaiusoides epistomalis* TERESHKIN: **(69)** layer "Result", **(70)** intermediate layers, opened in palette Layers, **(71)** hierarchy of layers.

At the finishing stages colored areas of legs in layers "Pouring and volume" and "Main lines" are clarified to necessary level.

In the palette Layers, the layers "Background", "Navigator", and "Matrix"are disconnected (an eye is removed). Then, merging of working layers is performed (Merge Visible, Shift+Ctrl+E). The combined layer is selected (Ctrl+A) and copied to the buffer (Ctrl+C). After that the layers are restored by means of cancellation of merging by command Shift+Ctrl+Z. An integrated image is inserted from the buffer into a top of graphic palette Layers (fig. 71). Layer is named "Result".

Before fulfillment of operation of c o l o r i n g of the object a file is transformed from mode Grayscale to mode CMYK by means the menu command: Image–Mode–CMYK Color. Having selected in a ready picture by instrument Polygonal Lasso Tool with the selected value of parameter Feather equally colored areas, the menu command: Image–Adjustments–Hue/Saturation (Ctrl+U) is fulfilled. In a pop-up window Hue/Saturation, by means of cursors (sliders), a color and saturation of selected area are selected (to establish a flag in window Colorize). Fulfillment of images of legs in the form of separate fragments allows in subsequent to copy their parts separately and to insert into the final file with a picture of imago, positioning them for achieving an optimal disposition of legs concerning a body.

Peculiarities of fulfillment of image of abdomen

The main condition of successful fulfillment of an image of abdomen at preparation of the total image of imago is performance of operations on giving of volumetric appearance separately for the first segment (layer "Sg-1, pouring and volume"), the others tergites of abdomen (layer "Tergites, pouring and volume") and sternites (layer "Sternites, pouring and volume") (fig. 72-74).

The d r a w i n g o f a c o n t o u r of abdomen is fulfilled by means of instrument Line Tool, as well as of all other segments with the same width of line, being oriented on the scanned pencil drawing (Matrix). In the layer "Navigator" separate structures and borders of the colored areas are marked by dotted lines. In subsequent, layer "Navigator" is duplicated for creating of separate layers for further operations. The layer "Main lines" contains all lines necessary for a final picture (dotted lines are being deleted). In layers "Sg-1, pouring and volume", "Tergites, pouring and volume" and "Sternites, pouring and volume" only external contour lines are saved.

After fulfilling of standard operations on p o u r i n g and giving of volumetric appearance in each of three listed layers, e l a b o r a t i o n of segments of abdomen is begun.

Depending on structure of a surface of abdomen of concrete species the necessary empty layers which situated in appropriate hierarchy – "Small punctures", "Light punctures", "Large punctures", "Wrinkles", "Clarification of interspaces" etc. are created. In each layer with a certain class of the same structures they are fulfilled by instruments of selection with the selected value of parameter of Feather at the pressed

Shift key. After performance of all structures in each layer, their simultaneous pouring by instrument Paint Bucket Tool is executed. Each layer is contrasted for achieving maximum correspondence with underlying layers "…, pouring and volume" for all three parts of abdomen.

At the final stage of elaboration, in the upper layer "Main lines", more light areas are selected and clarified according to underlying layers "…, pouring and volume".

After switching-off of all of "superfluous" layers (Background, Navigator, duplicating layers), the command on merging of layers Merge Visible (Shift+Ctrl+E) is fulfilled. Merged layers is selected by command Ctrl+A, and copied to the buffer (Ctrl+C). After that, by command Menu: Edit–Step Backward (Alt+Ctrl+Z) all previous actions are cancelled, returning into place all layers merged earlier. Further, by command Ctrl+V the merged image is inserted from the buffer under the name "Result" (fig. 74).
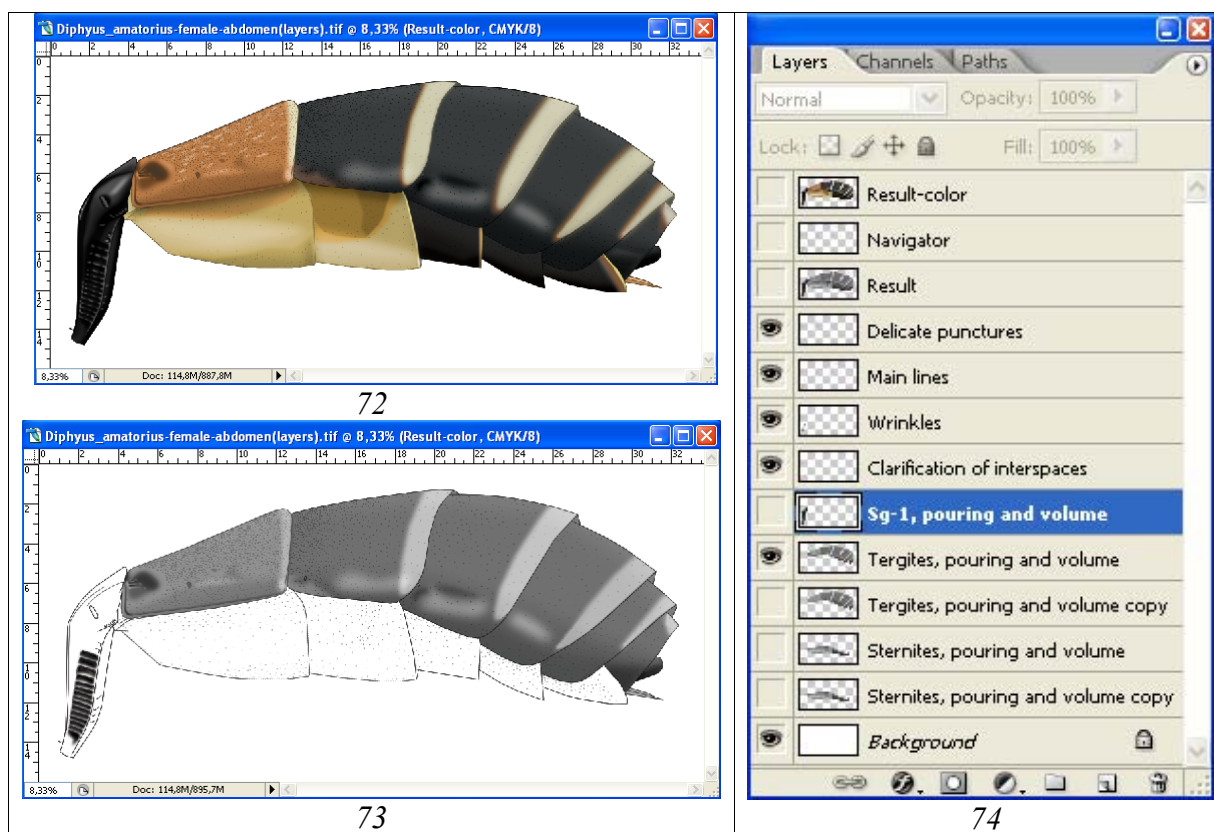
Fig. 72-74: Image of abdomen for total image of *Diphyus amatorius* (MÜLLER): (**72**) final layer "Result-color", (**73**) image of abdomen, at disconnected layers "Sg-1, pouring and volume" and "Sternites, pouring and volume", (**74**) hierarchy of layers.

At the final stage of fulfillment of image of abdomen for total image of imago, the operations on its coloration are performed. The first step is transformation of a file from regime Grayscale to regime CMYK: Menu: Image–Mode–CMYK Color. In the pop-up menu a command "Don't Flatten" is chosen.

The colored parts of abdomen are selected by instrument Polygonal Lasso Tool, having selected the appropriate value of parameter of Feather. Then standard command Menu: Image–Adjustments–Hue/Saturation (Ctrl+U) is executed (see above) (fig. 72).

Variants of ready images of abdomen are presented on **Plate 5** (31-34).

Arrangement of the total image of imago

In the process of preparation of the total image of an insect there is a whole set of ready files with images of separate parts of a body including also different number of layers. All parts of a body of ichneumon fly, except flagellum and wings, have been fulfilled in the same scale. Therefore, when creating of a final file in mode CMYK Color (600px) the dimension of a canvas is created proceeding from the summarized dimensions of separate parts of a body of insect. In subsequent, dimension of the image will be reduced till the dimensions of the total image in the final table. After file creation, the finished segments and their elements which containing in separate layers are copied into it. The strict hierarchy of layers in a final file is compulsory. The order of copying and arrangement of layers, excluding layer "Background", from below upwards normally is as following: 1 – abdomen, 2 – tarsus-3, 3 – tibia-3, 4 – trochanters+femur-3, 5 – coxa-3, 6 – tarsus-1, 7 – tibia-1, 8 – trochanters +femur-1, 9 – coxa-1, 10 – tarsus-2, 11 – tibia-2, 12 – trochanters +femur-2, 13 – coxa-2, 14 – thorax, 15 – maxillary palp, 16 – flagellum, 17 – scapus, 18 – head capsule, 19 – wings 1+2, 20 – tegula (see fig. 430). A fragment of the body from the top layer should overlap the base of fragment from the underlying layer. After scaling both of wings concerning a body length, front and hind wing normally are separated in independent layers. Thus, the minimum quantity of layers in a file by preparation of the total image of imago is 21. The quantity of layers can be more and depends on number separately fulfilled segments of insect tarsi. At the final stage of arrangement, layer "Background" is disconnected and a command on merging layers (Merge Visible, Shift+Ctrl+E) is performed. Merged layer is selected by command Ctrl+A and copied to the buffer by command Ctrl+C. After that, by command Alt+Ctrl+Z (Step Backward) a command on merging is cancelled and layers are restored. Then, from the buffer, by command Ctrl+V, merged image is inserted over the uppermost layer (Tegula). The layer is entitled "Result". In a final layer a coloration of wings and membranes in places of articulation is fulfilled.

The detailed illustrated description of all actions on arranging of insect imago is given in chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species" in section "Composing of total image of object from different files with different parts of a body".

Note: In certain cases arranging of insect imago is more convenient to fulfill in mode Grayscale and then having translated a file in mode CMYK Color, to perform operations on a coloration of insect. This method allows fulfilling simultaneously coloring of identically colored areas of object, having selected all of them with use of Shift key.

Plate 5: Variants of the image of different parts of imago body of ichneumon fly: **(1-24)** head, **(25-30)** thorax, **(31-34)** abdomen (designations see Legends to color plates).

Fulfillment of pictures of taxonomically important parts of a body

Most significant from taxonomical point of view parts of a body of ichneumon flies are a head in two foreshortenings, propodeum and 1-2nd tergites of abdomen. pencil contour of all parts of a body in a longitudinal section (0,5) is performed on graph paper with use of a grid of the binocular microscope (fig. 75).
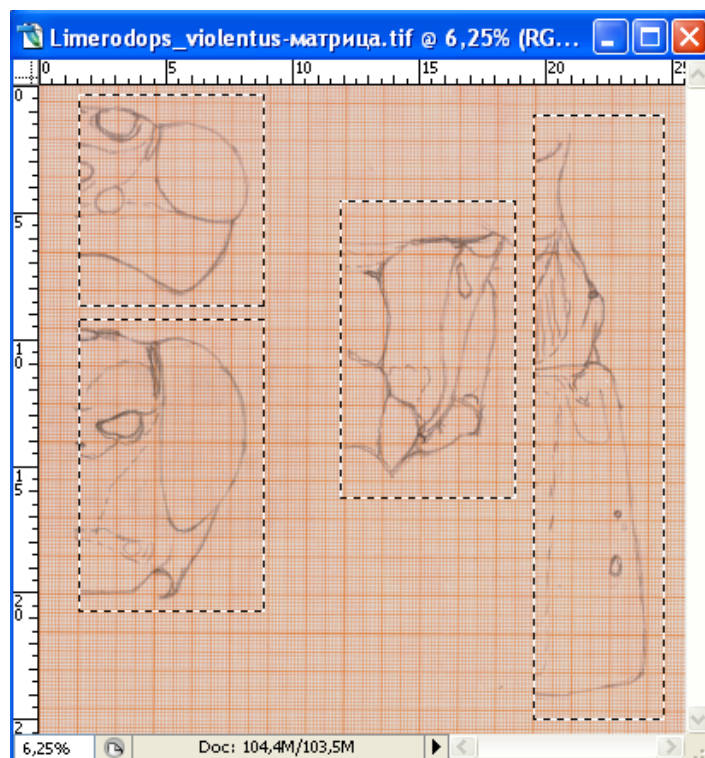
Fig. 75: Copying of outline drawings taxonomically significant parts of a body of ichneumon fly for creation of separate files.

As already it was told above, the dimension of the image when fulfilling object should exceed considerably the dimension of object in the final table. Normally width of a separate fragment in a complete format is 7-7,5 cm. Therefore before copying of each fragment in a separate file the whole of table with pencil contours is increased till the necessary size. For this purpose having clicked by the document window title with pencil contours of parts of a body by means of the right button of the mouse in a pop-up window in window Document Size a size of increasing of the image in per cent is established. Depending on the real dimensions of object, it is 150-200%. In window Resolution, the value 600px is being established. After magnification of the general canvas with pencil contours up to necessary size, each drawing is copied in separate file, preliminary having selected it by instrument Rectangular Marquee Tool (Ctrl+C–Ctrl+N–Enter–Ctrl+V),as it is shown in figure 75. As the result four files which necessary for the further work are obtained: "Head above", "Head front", "Propodeum" and "Sg 1-2".

Peculiarities of fulfillment of image of a head in different foreshortenings

Picture of a head of insect is fulfilled in separate files in two foreshortenings – from above and in front. The sequence of actions at fulfillment of images is identical.

At the first stage a contour drawing of a head by means of instrument Line Tool is performed, being guided on a layer with a pencil contour – "Matrix". At width of a head in a file equal 7-7,5 cm, the thickness of a line normally is 5-6px. The lines of a contour in the separate layers are merged periodically by the command Shift+Ctrl+E, preliminary having disconnected layers "Background" and "Matrix". Some areas which necessary for orientation – antennal cavities, spots, etc. are fulfilled by dotted lines.

After performance of a contour, the file contains three layers "Background", "Matrix" and "Navigator". Obligatory layers for fulfillment of picture of a head are "Navigator", used for the orientation, separate layer "Eye and ocelli" for fulfill of volumetric picture of eyes and ocelli, layer "Main lines", including all lines which will be visible on final picture and layer "Pouring and volume", containing only external lines of a contour and using for pouring and for giving to a head capsule of volumetric appearance. For generation of these layers, layer "Navigator" is duplicated some times. In layer "Eye and ocelli" all lines except a contour of eye and ocelli are deleted, having selected their by means of instrument Polygonal Lasso Tool (Feather=0) and having pressed key Del. In layer "Main lines" by the same way all dotted lines serving for orientation are deleted. In layer "Pouring and volume" all lines, except lines of an external contour are deleted.

Contours in the layers "Navigator" in both files should to be coordinated in dimensions and proportions of ocelli in both foreshortenings of a head. For this purpose, a layer "Navigator" from one file is copied in another one and proportions of separate elements of a head capsule is coordinated by means of the menu command: Edit–Transform–Scale (fig. 76). After fulfillment of operation, coordinated layer is copied, deleted and inserted into an initial file on a former place.
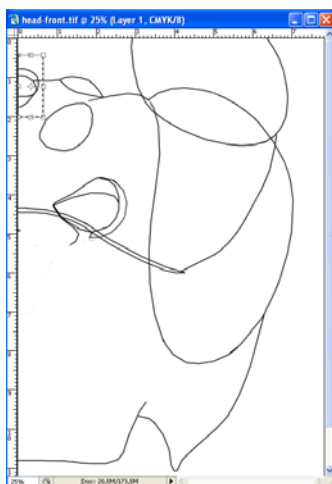

Fig. 76: Correction of sizes of ocelli in head contours in different foreshortenings.

Shaping for a head of volumetric appearance is begun from pouring by Grey color (Gray 10%) of a contour by means of instrument Paint Bucket Tool in layer "Pouring and volume". Operation on giving to a head of volumetric appearance is fulfilled in the same layer. For shaping of volumetric appearance, instruments of selection, first of all instrument Polygonal Lasso Tool is used. Choice of parameter Feather, determining degree of blur (rigidity) of border of selection area has a great value. At the first stages value of parameter Feather can reach 150px. Selection is begun from the highest (area of ocelli, a dorsal view) or the most projecting (middle field of face, the front view) areas of object to periphery. External borders of area of selection should leave more than twice behind external border of an object. Area of selection is darkened using the menu command: Image–Adjustments–Brightness/Contrast, using at the first stages small values of decreasing of brightness (10-30%). Selected areas gradually are shifted to object periphery (see section "Shaping of volumetric appearance to an object").

Sculpturation of surface of a head capsule is begun with selection of classes of sculptural formations of single-type – punctures, smoothed punctures, irregular punctures, wrinkles, microsculpture, etc. Depending on number of single-type of sculptures, certain quantity of the "empty" layers which necessary for fulfillment of these types of sculpture by means of tools of selection are created. In detail, peculiarities of fulfillment of structures of different type are considered in section "Sculpturation (elaboration)".

On the basis of layer "Navigator", all areas with light pattern are selected by instrument Polygonal Lasso Tool. Then all layers which should be merged are clarified up to necessary level. After merging of the elaborated layers, work on coloration of a head capsule is performed in merged layer "Result" and in the layer "Eye and ocelli" (fig. 81,86).

Coloring of head capsule actually and its color pattern are fulfilled under the standard scheme described in the appropriate section.

Examples of layers and their hierarchy that used by preparation of the image of a head in two foreshortenings are presented in figures 77-86.

Shaping of volumetric appearance and coloration of eyes and ocelli

Process of preparation of the color image of eyes and ocelli at preparation of the image of a head of ichneumon flies in different foreshortenings has a number of peculiarities. The first condition, as already mentioned is fulfillment of a coloration of eye and ocelli in a separate layer. It is connected with fulfillment of operation "volume" with use of function of selection with great values of parameter Feather. The areas of a head capsule neighboring to an eye can be affected when performance of operation Brightness/Contrast. The operations of coloring of eye and ocelli are fulfilled in separate layer "Eye and ocelli". After finishing of operations, merging of a layer with
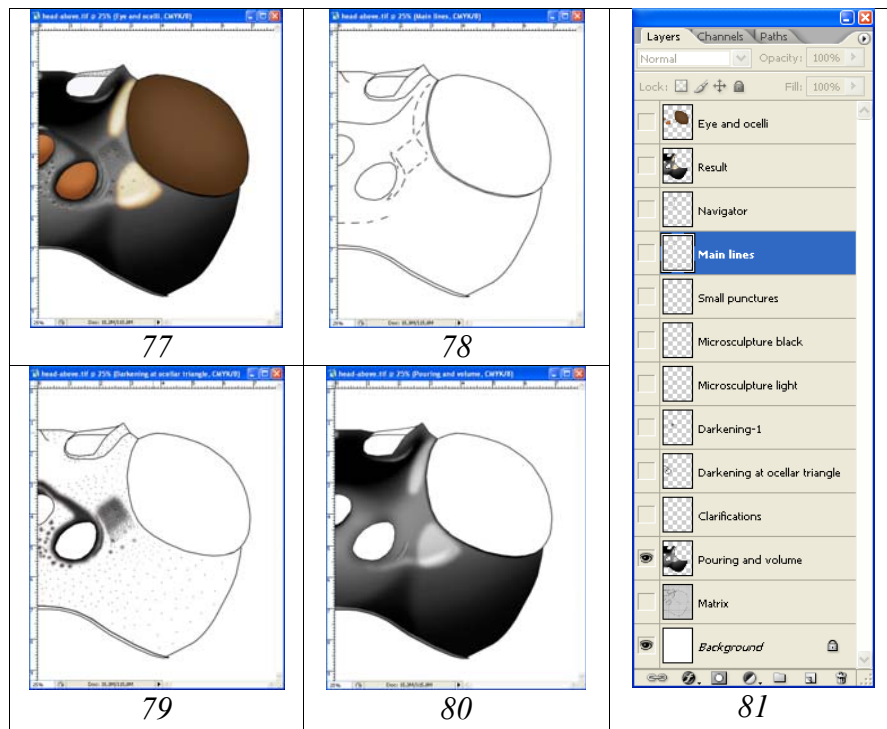
Fig. 77-81: Basic layers when fulfillment of head image (dorsal view) of ichneumon fly *Achaiusoides epistomalis* TERESHKIN: (**77**) merged layers "Result" and "Eye and ocelli", (**78**) layer "Navigator", (**79**) layer "Main lines" with layers of elaboration, (**80**) main layer "Pouring and volume", (**81**) hierarchy of layers.
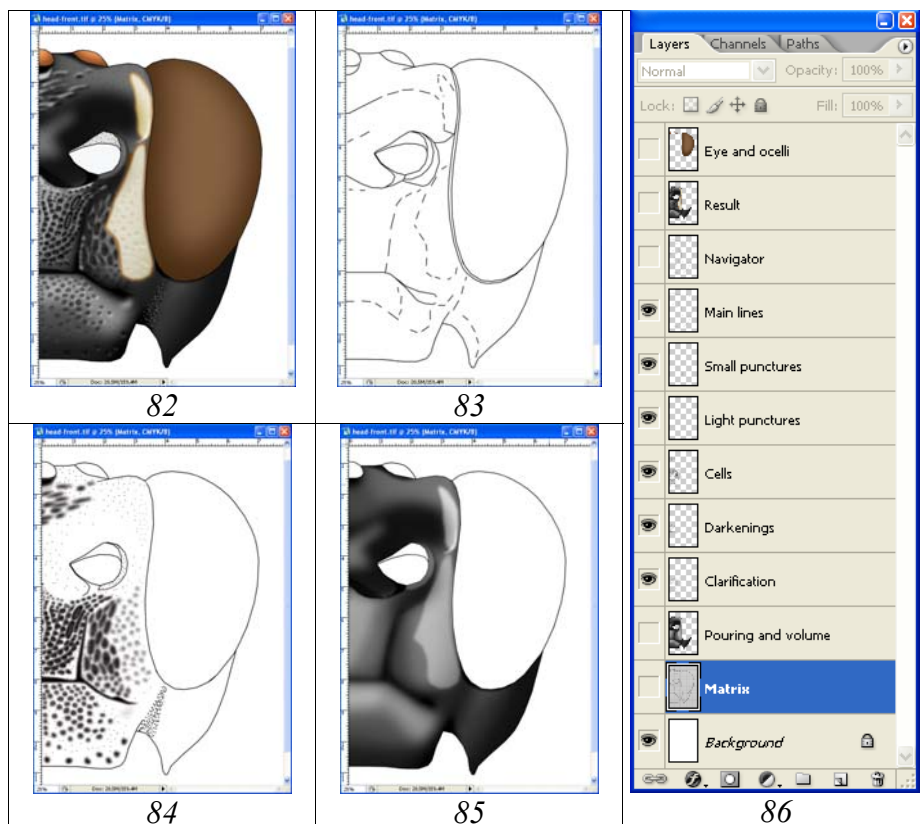

Fig. 82-86: Basic layers when fulfillment of head image (front view) of ichneumon fly *Achaiusoides epistomalis* TERESHKIN: (**82**) merged layers "Result" and "Eye and

ocelli", (**83**) layer "Navigator", (**84**) layer "Main lines" with layers of elaboration, (**85**) main layer "Pouring and volume", (**86**) hierarchy of layers.

picture of eye and ocelli with a layer containing the image of other part of a head capsule is being fulfilled.

Fulfillment of image of eye in color can be realized by two methods – by gradient pouring of a contour (fig. 88,90) and by clarification of the most convex part by means of "diffused" selection (fig. 87,89).

87 *88*

89 *90*
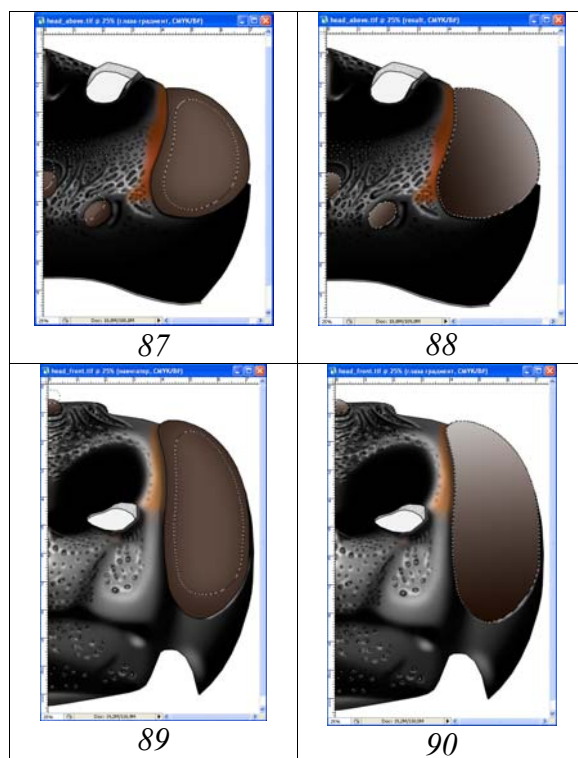
Fig. 87-90: Techniques of coloration and giving of volumetric appearance to eyes and ocelli of ichneumon fly *Spilichneumon occisor* (F.): (**87,89**) pouring with subsequent clarification; (**88,90**) gradient pouring.

Gradient pouring. Inner surface of an eye and ocelli is selected by instrument Magic Wand Tool. At selection by means of mentioned tool it is necessary to establish parameter Tolerance=255. After that, in a palette Swatches, a choice of color of pouring according to darkest area of an eye (the control of object under a microscope) is fulfilled. For performance of pouring in a palette of tools instrument Gradient Tool (G) is chosen, having pressed the corresponding button on the panel of tools. On the panel of parameters the sample of stretching (Linear Gradient) is chosen. Direction of pouring is chosen according to chosen lighting direction of object. After fulfillment of operation, brightness of area of gradient pouring of eye and ocelli is regulated up to achieving the maximum of conformity to object, at simultaneous control under a binocular microscope. Brightness and contrast of area of pouring are regulated by the

menu command: Image–Adjustments–Brightness/Contrast (fig. 88,90). Examples of gradient pouring are presented on **Plates 15**, **20-21**, **23**, **30, 34-35, 39, 44-45**.

The second method – **pouring with the subsequent clarification of the most convex part** with usage of "diffused" selection should recognize the most optimal. After a choice of color in graphic palette Swatches, corresponding to the darkest area of an eye or ocelli, areas of an eye and ocelli are poured by the selected color by instrument Paint Bucket Tool. It is necessary clicking some times by the mouse on area of pouring up to disappearance of light border with an external outline. The most convex area of a compound eye, taking into account lighting is selected by instrument Polygonal Lasso Tool. Value of parameter Feather usually exceeds 90px (fig. 87,89). Selected area is clarified by the menu command: Image–Adjustments–Brightness/Contrast. In some cases, depending on lighting, the area of selection can go beyond the limits of external contour. Clarification of ocelli is fulfilled similarly, but the value of parameter Feather does not exceed 30px (fig. 87,89).

After fulfillment of all operations there are two colored layers, which subject to merging. It is layers "Eye and ocelli" and "Result" (fig. 81,86). At some taxa an additional layer, "Pubescence", often differing on coloration from main color of a head capsule is present.

Peculiarities of fulfillment of an image of propodeum

Propodeum is the most difficult by sculpture for fulfillment of image part of body of ichneumon fly. The basis of performance of a qualitative image of a segment is usage of a maximum quantity of layers and usage of tools of selection as the instruments of drawing. After fulfillment of standard operations on preparation of a contour, pouring and volume, the file contains following standard layers: "Navigator", which used for orientation, the main lines of a contour (Main lines), which will be visible on the final image and a layer with the volumetric image of the object (Pouring and volume) containing only external lines of a contour.

At the first stages, the pouring by Grey color in layer "Pouring and volume" is fulfilled. Then, with usage of tools of selection, a volumetric appearance to propodeum is imparted, as it has been described above.

The next necessary step is formalization and determination of classes of sculptural formations of single-type, which determine a number of layers required for the elaboration of propodeum. Instruments of selection at Pen Tablet usage are the most convenient for fulfilling of sculptural formations of a surface of an object. Structures of the single-type are performed simultaneously at the pressed Shift key. Whereupon their simultaneous pouring by Grey color (more often 55%) by means of instrument Paint Bucket Tool is fulfilled. At elaboration of a surface with usage of layers, it is necessary to stick to theirs strict hierarchy. At a small number of layers with sculptural formations, a layer with the volumetric image is used for elaboration also, as it is shown in a figure 96. In case of fulfillment of operations of elaboration in layer

"Pouring and volume", it is necessary preliminary to duplicate it (fig. 97). This is necessary for the safety net in case of erroneous execution of some actions.
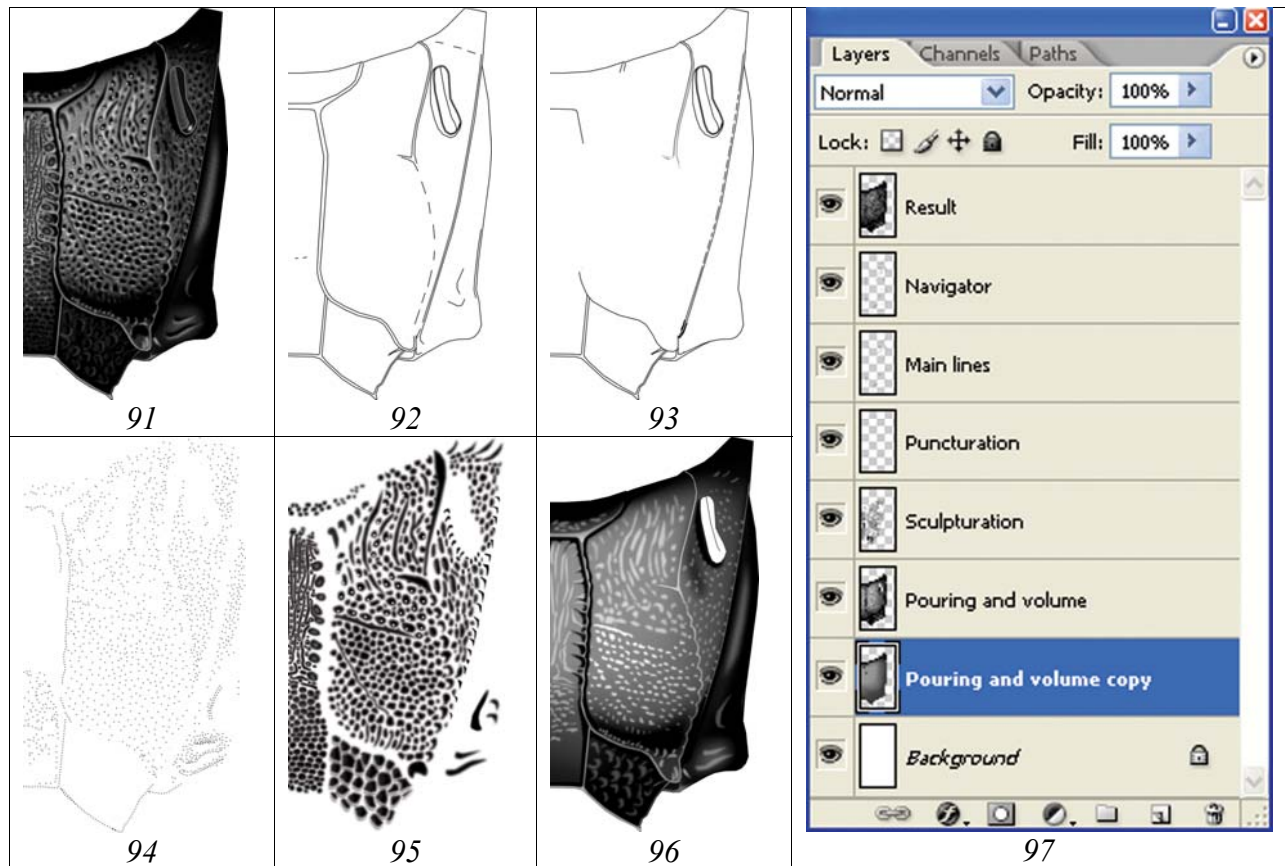

Fig. 91-97: Fulfillment of image of propodeum *Spilichneumon occisor* (FABRICIUS) at minimum number of layers: (**91**) layer "Result", (**92**) layer "Navigator", (**93**) layer "Main lines", (**94**) layer "Puncturation", (**95**) layer "Sculpturation", (**96**) layer "Pouring and volume", (**97**) hierarchy of layers.

Often sculpture of propodeum is of complex nature and includes the various classes of sculptural formations, characteristic for those or other fields. At fulfillment figure of propodeum of such type, a considerable number of layers are used, not only by separate groups of the sculptures, but also by the layers with different sculptural formations in separate fields (**Plate 6**). Propodeum can has simultaneously large and small punctures, large punctures of irregular and a regular shape including smoothed and sharply expressed punctures, cells of the various shape, wrinkles, keels and a number of other type of sculptures. Performance of structures in separate layers for each field is fulfilled by means instruments of selection with previously chosen value of parameter Feather. All single-type structures are perfomed simultaneously at the pressed Shift key. Then, theirs simultaneously are poured by black color by means of instrument Paint Bucket Tool. Large punctures and cells are clarified using instruments of selection according to the selected type of lighting, giving to them of volumetric appearance. As a rule, everyone sculptural group consist of three layers, upper,
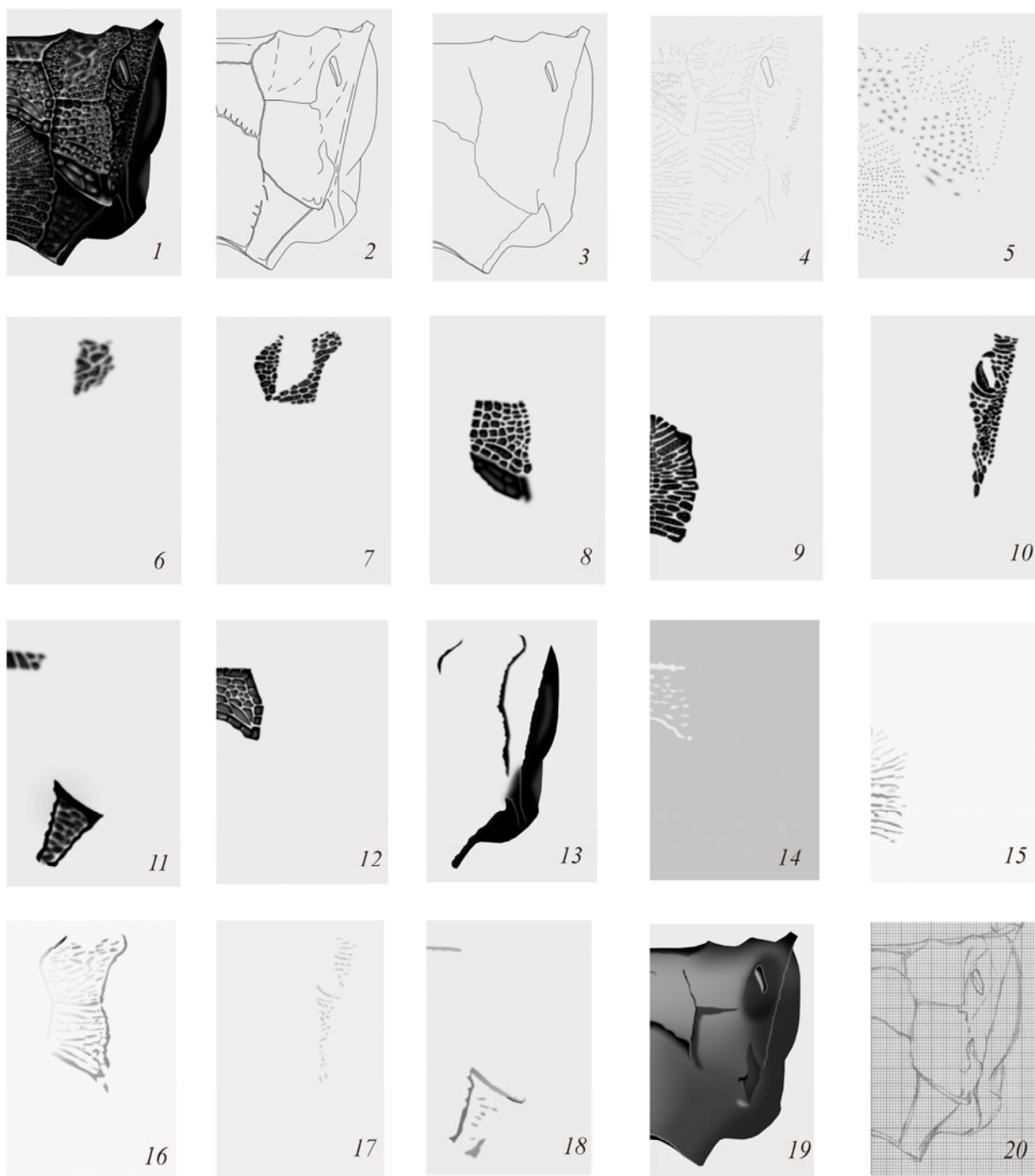
Plate 6: Layers and their hierarchy at image fulfillment of propodeum of *Achaiusoides epistomalis* TERESHKIN: (**1**) Result, (**2**) Navigator, (**3**) Main lines, (**4**) Small punctures (points), (**5**) Light punctures, (**6**) Elaboration of central part of 1st lateral area, (**7**) Elaboration of 1st lateral area, (**8**) Elaboration of 2nd lateral area, (**9**) Elaboration of apical area, (**10**) Elaboration of area spiraculifera, (**11**) Elaboration of others areas, (**12**) Elaboration of area superomedia, (**13**) Some lateral longitudinal carinae and lateral part of propodeum, (**14**) Clarifications in area superomedia, (**15**) Clarifications in apical area, (**16**) Clarifications in area dentipara, (**17**) Clarifications in area spiraculifera, (**18**) Clarifications in some other parts, (**19**) Basic volumetric image, (**20**) pencil drawing

with the light points showing a shining inner part of structure, a layer with structure and an underlying layer – "Clarification of interspaces". Normally, a layer "Light punctures (points)" which is situated over all layers with of sculptural formations and a layer "Clarification of interspaces", which is situated at the bottom level are the common for all layers with different sculpture.

After fulfillment of all layers their saturation are regulated according to the volumetric image of propodeum in layer "Pouring and volume". Separate parts of a segment are selected by diffused selection as at operation fulfillment on volume giving (see above section "Shaping of volumetric appearance to an object"). Without deselection, sequentially marking each layer as the working, the respective saturation is achieved, using the menu command: Image–Adjustments–Brightness/Contrast.

At the finishing stage all unnecessary layers, "Navigator", "Matrix", "Pouring and volume" copy and "Background" are disconnected and merging of layers is fulfilled. A merged layer is selected (Ctrl+A) and then it is copied to the buffer (Ctrl+C). Merged layers are restored, by cancellation of commands (Shift+Ctrl+Z). Merged image is inserted from the buffer as the uppermost layer. The layer is designated as "Result". On **Plate 6**, the images of 20 layers used at preparation of the image of propodeum of ichneumon fly *Achaiusoides epistomalis* Tereshkin, with a difficult sculpture of a surface of a segment are presented.

Before fulfillment of coloration of propodeum, a file is converted from regime Grayscale to regime CMYK: Menu: Image–Mode–CMYK Color. At first, by using of the menu command: Image–Adjustments–Hue/Saturation (Ctrl+U), general coloration is executed for the segment as a whole. Then, in case of presence of pattern on Propodeum, its coloration is fulfilled, preliminary having selected necessary areas by the tool Polygonal Lasso Tool. Parameter Feather for selection usually is about 5px. The operation description in detail is given in section "Coloring the object" and in the chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species".

Peculiarities of preparation of image of tergites 1-2 of abdomen

Order of fulfillment of images of 1-2nd tergites of abdomen is the same, as other parts of a body. The main difference is fulfillment of the first and the second tergites separately.

C o n t o u r of segments 1-2, as well as other parts of the body of imago is perfomed by using of vectorial instrument Line Tool with thickness of line 5-6px orientating on scanned pencil drawing "Matrix". Layer "Navigator", containing the dotted lines for orientation is duplicated. Having clicked the right button of the mouse on a layer in palette Layers, a command Duplicate Layer is chosen. In a pop-up window the name of a new layer "Main lines" is inscribed. All dotted lines of a contour which will not be present at the final image are being deleted from layer "Main lines".

At a following stage, already new layer "Main lines" is duplicated, creating two new layers – "Pouring and volume, 1st tergite" and "Pouring and volume, 2nd tergite". In

the named layers all lines except external lines of segments are deleted, having selected them by instrument Polygonal Lasso Tool (Feather=0) and having pressed key Del.

Contours of 1st and 2nd tergites are poured by grey by instrument Paint Bucket Tool, having chosen in palette Swatches of 55% Gray. Usually several left mouse button clicks are necessary up to disappearance the light border with contour lines.

Orientating on switched on layer "Navigator" and object control under a microscope, for each segment of volumetric appearance is shaped separately in different layers. The instrument of selection Polygonal Lasso Tool with different values of parameter Feather and the menu command: Image–Adjustments–Brightness/Contrast is used as it is in detail described in corresponding section.

After fulfillment of the volumetric image, layers with each segment are duplicated, creating the layers necessary for security and correction: "Pouring and volume, 1st tergite copy" and "Pouring and volume, 2nd tergite copy" (fig. 98-102).

E l a b o r a t i o n of a surface of segments is desirable to fulfill separately for each segment, observing strict hierarchy of layers (fig. 102). The quantity of necessary layers is defined proceeding from number of classes of sculptures of single-type, peculiar to each concrete species. After performance of elaboration, object is selected by instrument Polygonal Lasso Tool with great values of parameter Feather, as in operation on giving to object of volumetric appearance, in conformity with layer "Pouring and volume". Without deselection, brightness and contrast of each layer of elaboration are corrected by command Menu: Image–Adjustments–Brightness/Contrast, up to achieving complete conformity with underlying layer "Pouring and volume". Except layers with structures, brightness of lines of a contour in layer "Main lines" is corrected, also without deselection.

After finishing of elaboration of segments, the merging of necessary layers is being fulfilled, using standard procedure. In a considered example, in palette Layers, layers "Navigator", "Pouring and volume, copy" and layer "Background" are disconnected (remove an eye). Visible layers are merged by command Menu: Layer–Merge Visible (Shift+Ctrl+E). Merged layer is selected by command Ctrl+A. Then it is copied to the buffer (Ctrl+C). After recovery of merged layers by cancellation of commands (Menu: Edit–Step Backward (Alt+Ctrl+Z)), an integrated layer is inserted from the buffer (Ctrl+V) over layer "Navigator", having marked it preliminary as the working. Layer is named "Result".

Thus, at the given stage the file contains besides integrated layer, all intermediate layers. They can be used in the subsequent not only for the picture correction, but as for an illustration of the separate characters in the taxonomic keys and in the taxonomical analysis too.

Before fulfillment of coloring of segments, a file is converted to mode CMYK by command Menu: Image–Mode–CMYK Color (Don't flatten). Coloring of object is performed as it has been described above in section "Coloring of an object" and in

the chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species".
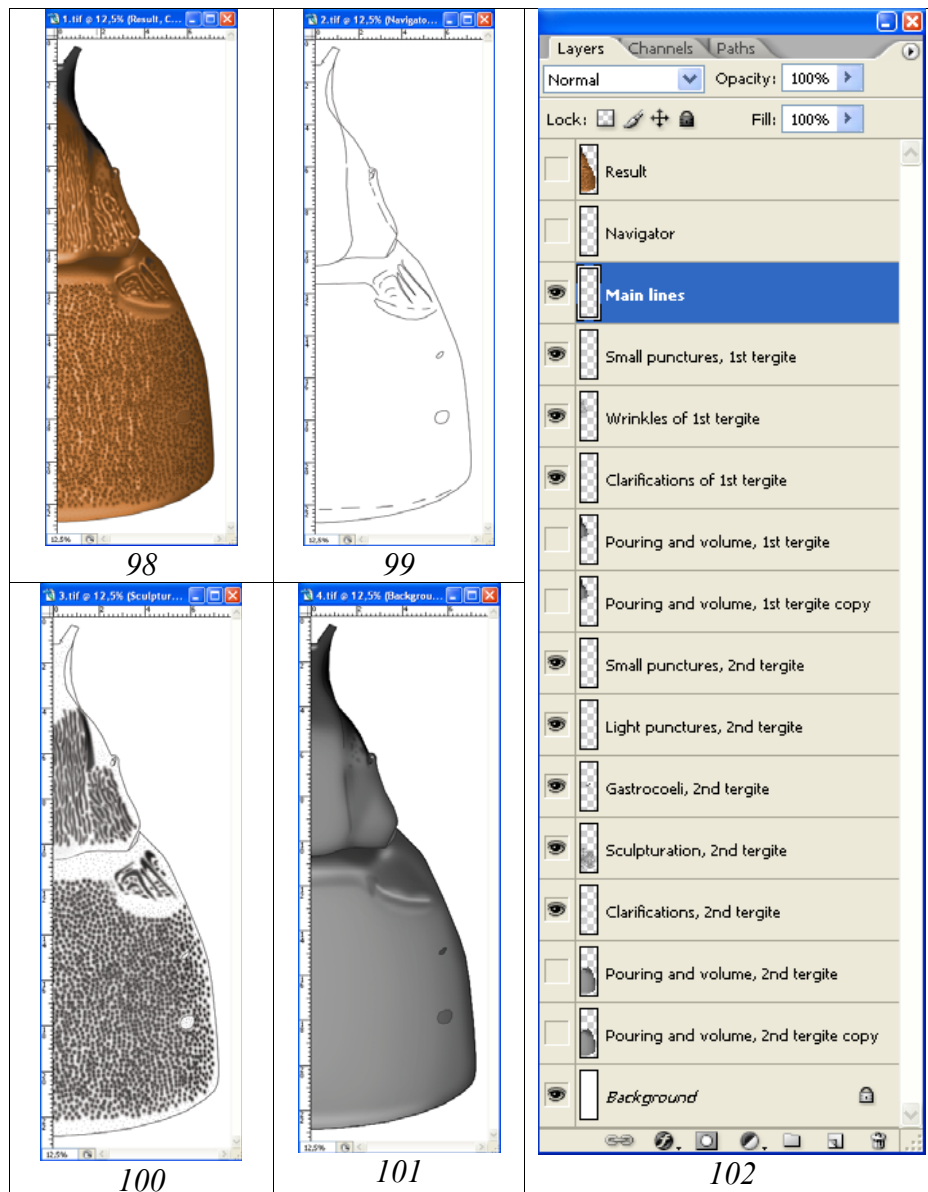

Fig. 98-102: Variant of set of layers at fulfillment of image of segments 1-2 of abdomen (*Hybophorellus injucundus* WESMAEL): (**98**) layer "Result", (**99**) layer "Navigator", (**100**) general appearance all switched on layers of elaboration of surface (see fig. 102), (**101**) general appearance of layer with volumetric image (layer "Pouring and volume"), (**102**) hierarchy of layers.

Merging of 50% fragments of object and retouching of a "suture"

All taxonomically significant parts of a body of object, head from above and in front, propodeum and tergites 1-2 of abdomen from above, were fulfilled in a format of 50% in a longitudinal section. Fulfillment of the images in a complete format for all parts of a body is implemented under the uniform scheme and it is finished by correction of "suture" between merged fragments.

Fulfillment of image in a complete format is begun from preparation of a canvas of corresponding size (Canvas Size). For fulfillment of an action, whole picture is selected by command Ctrl+A. Then layer "Background" is marked as the worker and a command to copy (Ctrl+C) is fulfilled.

The following step – creation of a new file with size of canvas, which will be increased twice. In Menu: File–New or by command Ctrl+N, a new file is created. In a pop-up window in window Width, the units of measure – cm and the dimension that increased twice are installed. The height of the canvas (Height) is left unchanged. Resultant file is saved under a title, which includes species name of the ichneumon fly and necessary attributes in the new directory "Result"..

Again to a file with 50% of the image are returned (selection is not removed yet). Layer "Result" with the colored image of a fragment is marked as working and a command to copy (Ctrl+C) is fulfilled. Further, already in the resultant file, the command of insertion (Ctrl+V) is performed.

At a following stage the menu command: Image–Rotate Canvas–Flip Horizontal is fulfilled. After that, by means instrument Move Tool (V), image is moved to the canvas left edge. A command of an insertion from the buffer (Ctrl+V) is fulfilled again. Further, both images are superimposed with the help of instrument Move Tool (V) and both layers are merged (Alt+Ctrl+Z), having disconnected layer "Background".

Last stage in preparation of the final image, it is so-called correction of "suture" between two halves of segment. For fulfillment of operation, the various tools – brushes of different diameter with various parameters, selection with the subsequent darkening or clarification of the areas and so on, can be used. However, a method of copying of adjacent, adjoining structures most similar on all parameters, with their subsequent insertion over area of suture should be recognized as the most optimal. Using the pen of a Pen Tablet, a suitable adjacent site is selected by means of instrument Lasso Tool, having picked up the corresponding parameter of Feather (usually 3-5px). The selected area is copied by command Ctrl+C and inserted by command Ctrl+V into the new layer located above the place of "suture" in the basic layer. After an insert, the copied areas are moved on place of "suture" with the help of instrument Move Tool. Actions on copying of adjoining areas and their inserts in a new layer are repeated before liquidation of all "imperfections". After finishing of operation, layer "Background" is disconnected and a command on merging of all layers Menu: Layer–Merge Visible (Shift+Ctrl+E) is being fulfilled.

The detailed illustrated description of all stages of operations on merging and correction of "suture" see in chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species" (fig. 540-542, 606-609).

Correction of ready picture, correction of errors

In that case when drawing of object is ready completely, including coloration, it can be found out, that some fragments do not correspond to those or other taxonomic

characters. It can occur in case of incorrect preparation of "Matrix" at usage of the grid, which is necessary for preservation of proportions of separate structures. In this case, it is necessary to avoid a manual correction of object as much as possible. So, for example, after final preparation of picture of 2nd tergite it is found out, that in final image, gastrocoelus is much longer than at real object. Manual correction will occupy very considerable time, let alone labor input. In this case, it is optimal to use the following possibilities of the editor. 1 – selection and copying of fragment to the buffer and its insert in a separate (top) layer and 2 – usage of function of transformation of the area which is copied in a separate layer. In the given example the sequence of actions can be following. In the final image of 2nd tergite, area of gastrocoeli (excluding thyridia, the form and sizes of which correspond to object, i.e. is correct) is selected by means of one of three tools of selection. Then the selected area is copied to the buffer (command Ctrl+C) and inserted into a separate layer (command Ctrl+V). After that, area of thyridia is selected and the same operation is fulfilled. It is necessary to watch over order of layers (theirs hierarchy). Further, a layer containing gastrocoelus is marked as a working and a command Select All (Ctrl+A) is fulfilled. Then gastrocoelus is shortened by means of function Menu: Edit–Transform (Scale, Rotate) or Free Transform. At a following stage thyridium (not transformed) is merged with transformed gastrocoelus (thyridium – a working layer). Both layers are merged by command Megre Visible (Shift+Ctrl+E) (others layers are not visible; eye is removed). Merged layer (gastrocoeli+thyridia) is edited. Then the basic layer is marked as visible and working. Adjoining areas are edited. This operation is fulfilled manually by instrument Brush Tool, or by copying and inserting fragments similar in structure. At the final stage all layers are merged (by command Megre Visible).

As it was repeatedly marked in all sections, the important condition at fulfillment of image of any fragment of a body is preservation in a file all intermediate layers. It gives additional possibilities of return to the concrete image and its subsequent correction in case of its necessity.

Preparation of the plate of illustrations of taxon

The table of illustrations of taxon always includes total drawing imago of object and the segments of a body with basic taxonomic characters, which have been fulfilled at considerable magnification. The set of pictures for different taxonomic groups may be different. The basic condition is a standard set of images with a standard arrangement of the objects which fulfilled in the same scale. The standard arrangement of objects in the table is a necessary condition at carrying out of comparative researches and fulfillment of descriptions of new taxa. Therefore, for each taxonomic group it is necessary to choose the standard of a set of illustrations and their arrangement in the table.

In the model group used by us as an example, the total image of imago, images of a head in two foreshortenings, propodeum and 1-2nd tergites of abdomen from above are obligatory. More often, the images of mandibles and segments of flagellum of

males, which necessary for a more complete characterization of the taxon are included into the plate of illustrations of Ichneumoninae additionally.

Indispensable condition is placing of the scanned image of labels of the specimen which was used as object of an illustration.

The original file contains in separate layers all images, the scanned label, a layer with numbering of drawings and a layer with the table name. The final file for the printing contains an integrated layer with pictures, layers with a label, numbering and the table name.

The illustrations of taxa completely fulfilled in the graphic editor are presented in the **Plates 46-86**.

Detailed, step-by-step fulfillment of the standard table of illustrations is described in chapter "The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species".

Preparation of additional illustrations for the high taxa

Images of separate morphological formations are used both additional characters for the characteristic of seniors taxa and as illustrations during taxonomical analysis and illustrations those or other tendencies in development of one or another group of organisms.

By preparation of tables of the illustrations, characterizing high taxa (genera or tribes) images of additional morphological formations and fragments of a body which are absent on the basic tabular fragments of a body are used. It is mandibles, peculiarities of morphology of scutellum, peculiarities of morphology of males flagellum, male genitals, palps, etc. Images of such type are fulfilled in the form of color or black-and-white volumetric illustrations (**Plate 8, 10, 22-23, 25-26, 28, 30, 36, 38-47, 49, 53, 55-56, 58, 60-68,70-80, 85-86**).

Order of fulfillment of image of the listed fragments is the same, as well as for the basic segments of a body of an insect, that described above. Having fulfilled contour drawing by using the pencil matrix (layer "Matrix"), received layer "Navigator" is duplicated. Unnecessary lines in layers "Main lines" and "Pouring and volume" are being deleted. To last layer, after pouring by the grey color, a volumetric appearance is imparted (fig. 106). In the additional layers, observing strict hierarchy, elaboration of sculpture is fulfilled. In case of presence of pubescence, it is executed in a separate layer. Layers "Result" and "Pubescence" are merged only after coloring of object (fig. 103-107).

Additional volumetric color illustrations of parts of a body for the characteristic of high taxa are presented more often by mandibles, rarely by peculiarities of scutellum morphology, still to a lesser degree by other fragments of an object (**Plate 7**). The parts of a body of Ichneumoninae, presented on a color Plate are used for additional illustration of taxa characters of generic and tribal level and not presented in the stan-

dard table of illustrations of taxon (a head in two foreshortening, propodeum, tergites 1-2 of abdomen and total image of imago).
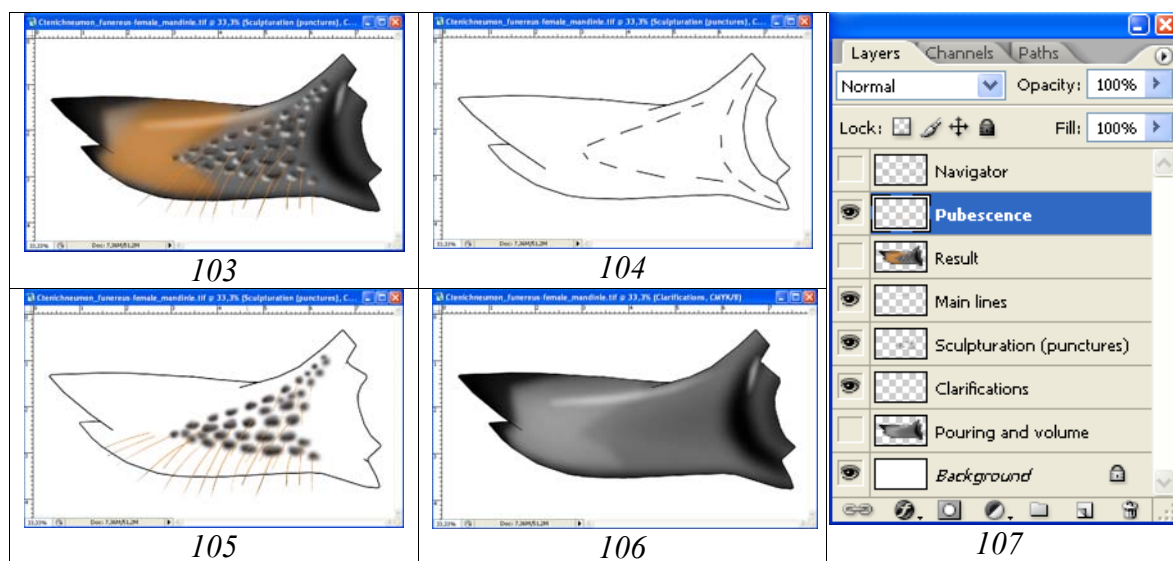
Fig. 103-107: Variant of layers set at fulfillment of picture of mandible *Ctenichneumon funereus* (GEOFFROY): (**103**) layer "Result", (**104**) layer "Navigator", (**105**) general appearance of all switched on layers of surface of elaboration (see fig. 107), (**106**) general appearance of layer with volumetric image ("Pouring and volume"), (**107**) hierarchy of layers.

Fulfillment of illustrations of separate characters and schematic images for taxonomic analysis and identification keys

A considerable array of illustrations it is the drawings which used in the taxonomical analysis of certain groups and as the illustrations for identification keys. Preparation of illustrations for these purposes is carried out by several paths: 1 – usage of the single-type fragments from ready tables for the comparative analysis, 2 – making of separate pictures of morphological formations of certain type in the volumetric image, 3 – fulfillment of schematic volumetric images of morphological formations of single-type, 4 – making tables of contour drawings with usage of the intermediate layers of components of tables of illustrations of taxa.

1. After finalization of the complete preparation of tables of illustrations of one or another taxon, higher then generic level, use of tables of fragments of one type, or segments of a body is seemed advisable for definition of tendencies of development of group or separation of groups of taxa (for example genera).

At fulfillment of all elements of the total table, the numerous layers had been used, that allows to copy separate elements as directly from layers, and also from ready images. In the latter case a necessary fragment is selected before copying by instrument Polygonal Lasso Tool with parameter Feather=0. Illustrations of tables of characters are fulfilled in mode Grayscale (Menu: Image–Mode–Grayscale).

Plate 7: Additional fragments of a body used for illustration of characters of high taxa of Ichneumoninae: (**1-38**) mandibles, (**39-40**) tyloides on flagellum of males, (**41-48**) scutellum from above and from side, (**49**) front part of a thorax from above, (**50**) apex of abdomen of female, (**51**) apex of abdomen and oedeagus of male, (**52-53**) claws of females tarsi. (designations see Legends to color plates).

As an example of such illustrations, morphology of 1st tergite of abdomen in genera of subtribe Amblytelina (fig. 108-123) can serve. After copying of all fragments to the ready table, fragments can be distributed according to the tendency of change of taxonomic character which under study. As the examples of such illustrations the table of variability of areolet in genera of tribe Platylabini (fig. 124-154) can serve.

2. The certain morphological characters which are not entering into standard tables of illustrations can have important taxonomical value, not only for model group, but also for the various circle of insects taxa. First of all it is peculiarities of genitals or adjoining structures. For example, for a number of groups of Ichneumoninae the morphology of males hypopygium has important taxonomical value. Preparation of volumetric detailed images of morphological formations is fulfilled under the described above scheme in a black-and-white variant.

The file with image of fragment of a body includes necessary number of layers for elaboration depending on complexity of a sculpture (fig. 155-160). Drawings are fulfilled in sagittal section and include all standard layers which located in strict hierarchy (fig. 159). All necessary layers at the final stage are merged and copied to the buffer. After fulfillment of command of cancellation of merging, it is inserted as the uppermost layer under name "Result". At fulfillment of parts of a body which have pubescence, it should be fulfilled obligatory in a separate layer.

After completion of drawings of hypopygium of representatives of all genera of group, they are copied in a separate file. Presence of all images in one file and in separate layers allows placing all images on one canvas in an order which defines the tendencies in variability of specific taxonomic characters. That is illustrations of fragments of a body allow not only to illustrate already known tendency in group development, but also to define the unknown earlier tendencies. In figures 161-173, males hypopygium of different genera of subtribe Amblytelina which collected in the integrated table are presented. Hypopygia are arranged according to the main tendency of group – lengthening towards apex of a central part of hypopygium of males.

Other successful example of fulfillment of separate structures for the decision of questions of taxonomy of concrete group is performance of drawings of spiracles of genera of tribe Platylabini and placement of drawings in the overall table. This allows you to identify the natural groups of genera and to employ established regularities for the preparation of an identification key of genera. As in the previous case, after preparation of the drawings of the spiracles of all genera, theirs are placed on a single canvas. Then, theirs are arranged by the groups in according to morphological features of the drawings and dimensional characteristics (fig. 174-197).

3. In some cases, for representation of tendencies of variability of some characters in different groups, the most demonstrative is fulfillment of images of structures of one type in a form of the schematic volumetric image of the fragment of a body of single-type. Example of tables of images of this type is variability of the shape of a process of metanotum, situated opposite of lateral longitudinal carinae of propodeum (fig. 198-203).
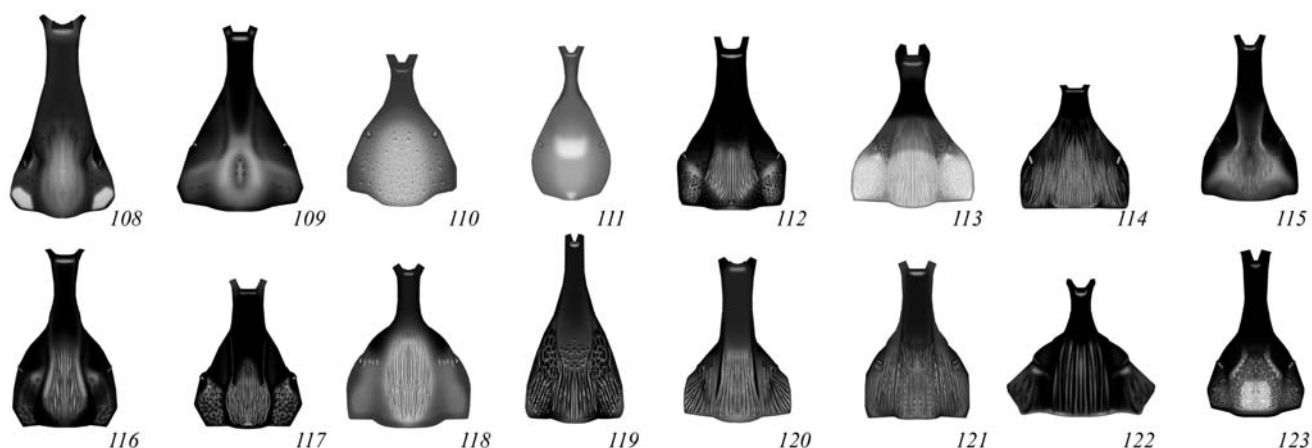
Fig. 108-123: First tergite of abdomen of Amblytelina genera (according to TERESHKIN 2011): (**108**) *Achaiusoides epistomalis* TERESHKIN, (**109**) *Hepiopelmus melanogaster* (GMELIN), (**110**) *Tricholabus strigatorius* (GRAVENHORST), (**111**) *Limerodes arctiventris* (BOIE), (**112**) *Diphyus amatorius* (MÜLLER), (**113**) *Eutanyacra crispatoria* (LINNAEUS), (**114**) *Bureschias subcylindricus* (GRAVENHORST), (**115**) *Spilichneumon occisor* (FABRICIUS), (**116**) *Limerodops elongatus* (BRISCHKE), (**117**) *Ctenichneumon funereus* (GEOFFROY), (**118**) *Obtusodonta equitatoria* (PANZER), (**119**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**120**) *Triptognathus uniguttatus* (GRAVENHORST), (**121**) *Triptognathops gobiensis* TERESHKIN, (**122**) *Amblyteles armatorius* (FÖRSTER), (**123**) *Achaius oratorius* (FABRICIUS).
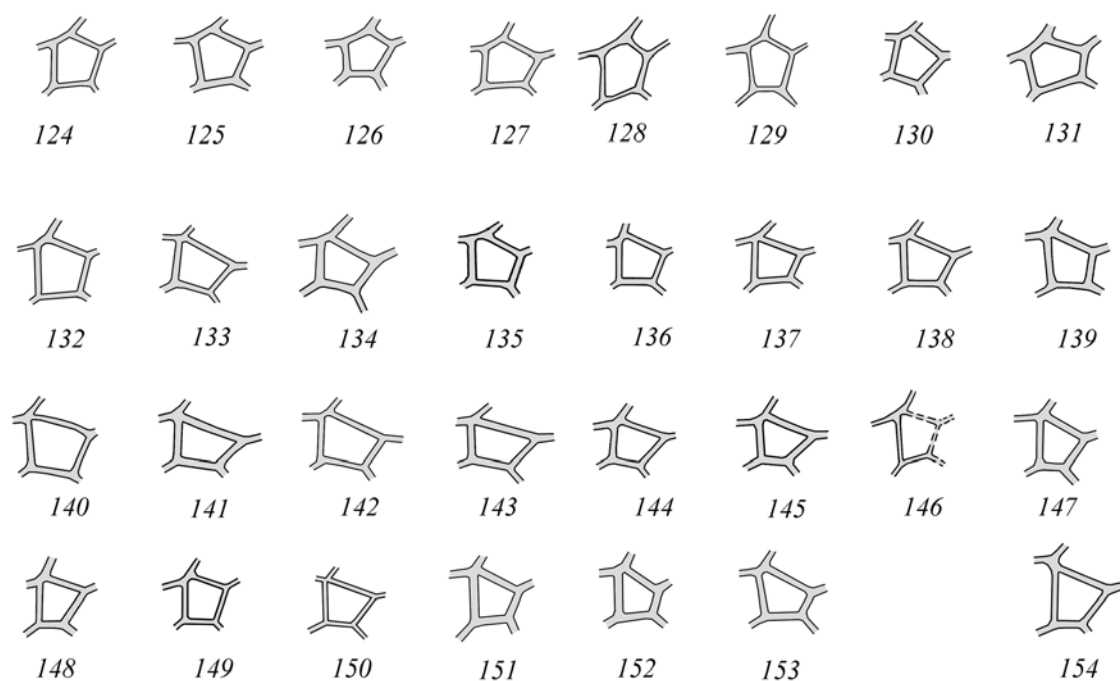
Fig. 124-154: Types of areolet of front wing in genera of Platylabini tribe (according to TERESHKIN 2009): pentagonal (**124–131**), quadrangular not petiolate (**132–153**), quadrangular petiolate (**154**).
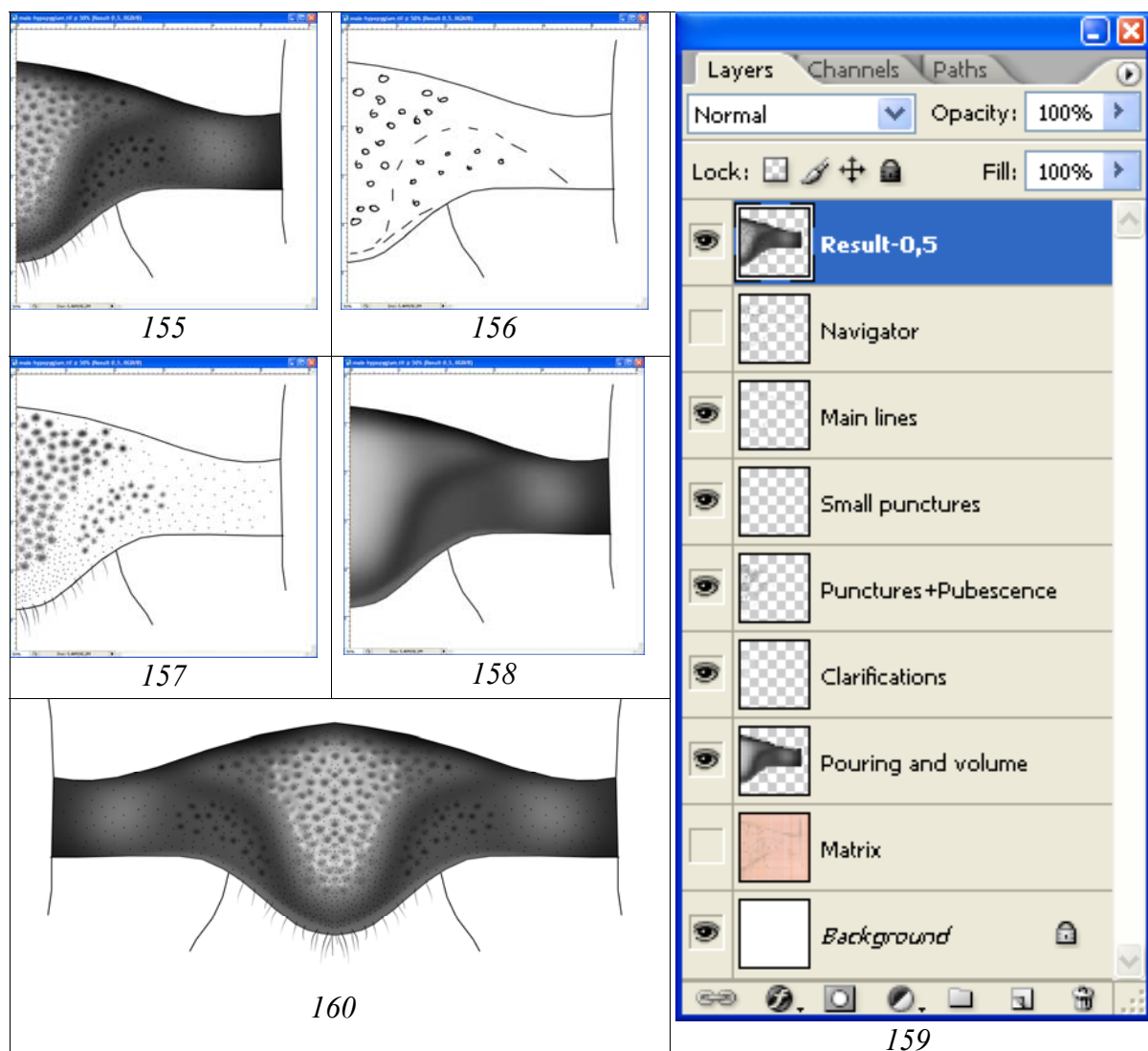
Fig. 155-160: Stages of fulfillment of picture of male hypopygium *Tricholabus strigatorius* (GRAVENHORST): (**155**) layer "Result", (**156**) layer "Navigator", (**157**) general appearance of all switched on layers of surface elaboration (see fig. 159), (**158**) general appearance of layer with volumetric image (layer "Pouring and volume"), (**159**) hierarchy of layers, (**160**) merged final picture.

4. As already has been repeated in all sections, the significant condition of preparation of the image of a fragment of a body of an insect is fulfillment of operations in separate layers. Moreover, after finishing of fulfillment of the image and merging of necessary layers (layer "Result"), all layers are restored and saved in the file. As it was already told, saving of all layers is necessary not only for the subsequent correction, in case of need, but also for usage of separate intermediate images for preparation of illustrations of different groups which necessary for the taxonomical analysis. More often for preparation of tables of illustrations, layers with contour drawings – "Navigator" and "Main lines" are used. For obviousness, lines of a contour can be contrasted, and the background of drawing can be poured by grey certain saturation by using of instrument Paint Bucket Tool.
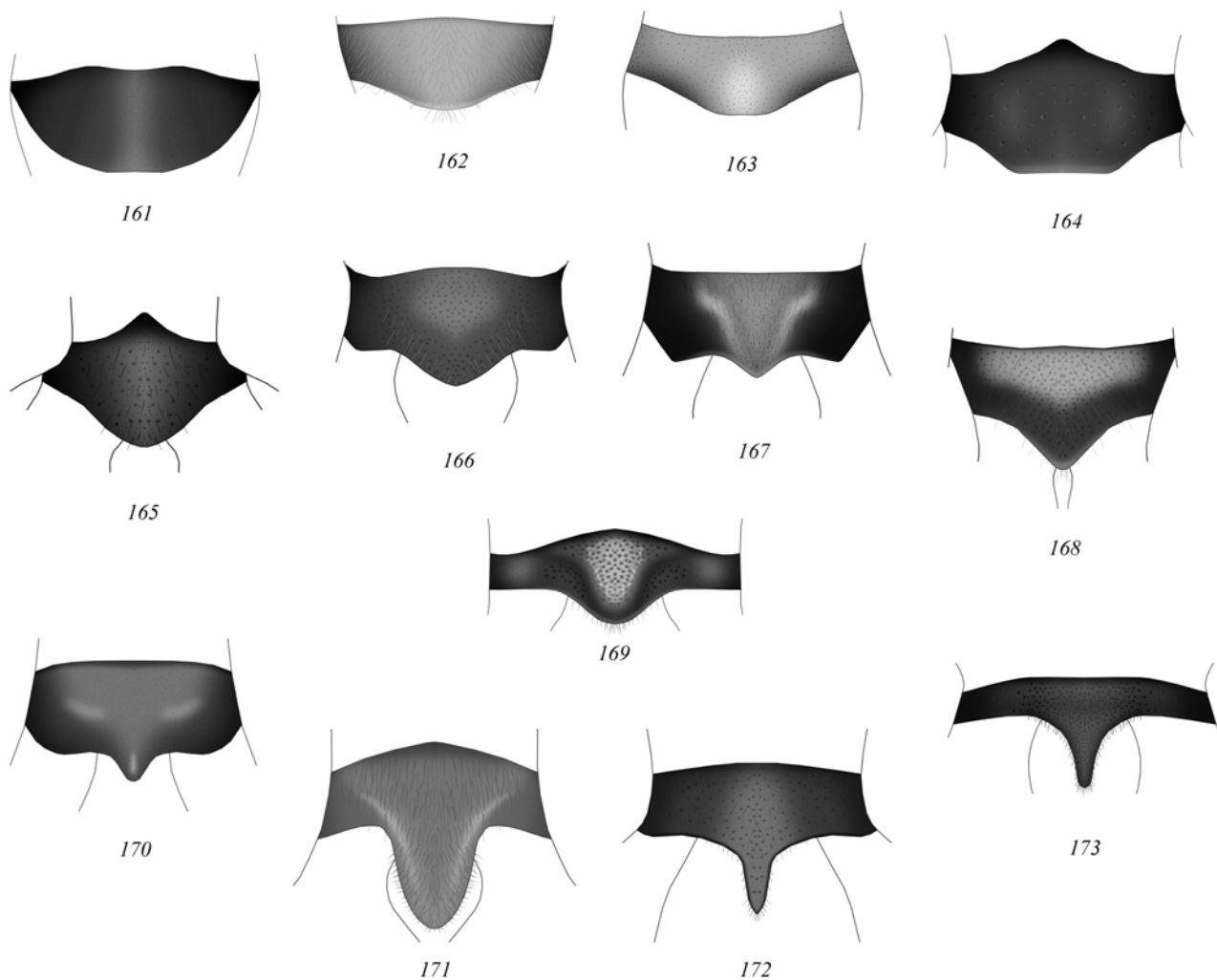
Fig. 161-173: Hypopygium of males of Amblytelina genera (according to TERESHKIN 2011): (**161**) *Ctenichneumon funereus* (GEOFFROY), (**162**) *Amblyteles armatorius* (FÖRSTER), (**163**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**164**) *Triptognathops gobiensis* TERESHKIN, (**165**) *Achaius oratorius* (FABRICIUS), (**166**) *Hepiopelmus melanogaster* (GMELIN), (**167**) *Limerodops elongatus* (BRISCHKE), (**168**) *Diphyus amatorius* (MÜLLER), (**169**) *Tricholabus strigatorius* (GRAVENHORST), (**170**) *Limerodes arctiventris* (BOIE), (**171**) *Eutanyacra crispatoria* (LINNAEUS), (**172**) *Spilichneumon occisor* (FABRICIUS), (**173**) *Triptognathus uniguttatus* (GRAVENHORST).

Tables with the contour drawings used for an illustration of characters when the taxonomical analyses of group (Amblytelina) are presented in figures 203-218, 219-234.
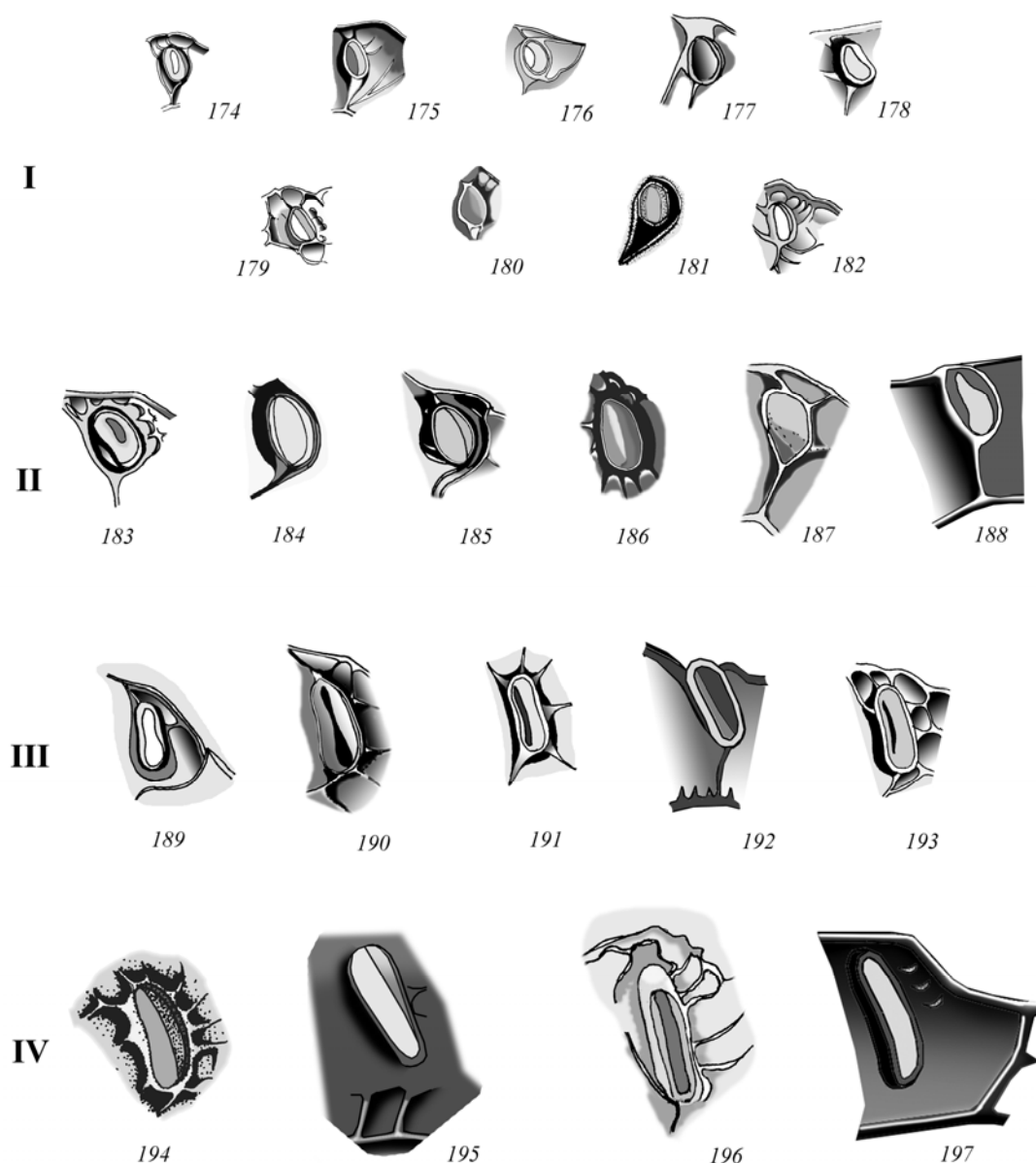
Fig. 174-197: Types of propodeum spiracles of Platylabini (according to TERESHKIN 2009): **I** – circular or roundish: (**174**) *Cyclolabellus pertenuis* HEINRICH, (**175**) *Cyclolabus nigricollis* (WESMAEL), (**176**) *Linycus exhortator* (FABRICIUS), (**177**) *Neolinycus michaelis* HEINRICH, (**178**) *Ectopius rubellus* (GMELIN), (**179**) *Apaeleticus bellicosus* WESMAEL, (**180**) *Ectopoides brevicornis* (KRIECHBAUMER), (**181**) *Notoplatylabus podolicus* HEINRICH, (**182**) *Carlsonia perturbator* (HEINRICH); **II** – longish-oval: (**183**) *Clypeolabus curtitarsis* HEINRICH, (**184**) *Hirtolabus alienoris* HEINRICH, (**185**) *Ambloplisus ornatus* (CRESSON), (**186**) *Rhyssolabus bassicus* (TISCHBEIN), (**187**) *Acantholabus malaisei* HEINRICH, (**188**) *Platybirmania acutinota* HEINRICH; **III** elongated: (**189**) *Cratolabus insulindicus* (HEINRICH), (**190**) *Poecilostictus cothurnatus* (GRAVENHORST), (**191**) *Hypomecus quadriannulatus* (GRAVENHORST), (**192**) *Dentilabus variegatus* (WESMAEL), (**193**) *Lissolaboides flavorufus* HEINRICH; **IV** – long to slit-shape: (**194**) *Spanophatnus bicinctorius* (THUNBERG), (**195**) *Abzaria latipetiolaris* CAMERON, (**196**) *Pachyjoppa tibialis* CAMERON, (**197**) *Lamprojoppa caerulea* CAMERON.
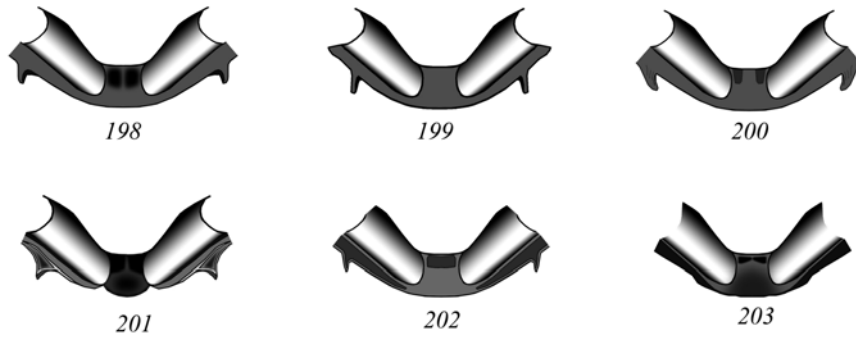
Fig. 198-203: Hind margin of metanotum of Platylabini (according to TERESHKIN 2009): (**198**) *Clypeolabus curtitarsis* HEINRICH, (**199**) *Ectopoides brevicornis* (KRIECHBAUMER), (**200**) *Hirtolabus alienoris* HEINRICH, (**201**) *Lamprojoppa caerulea* CAMERON, (**202**) *Platybirmania acutinota* HEINRICH, (**203**) *Abzaria latipetiolaris* CAMERON.
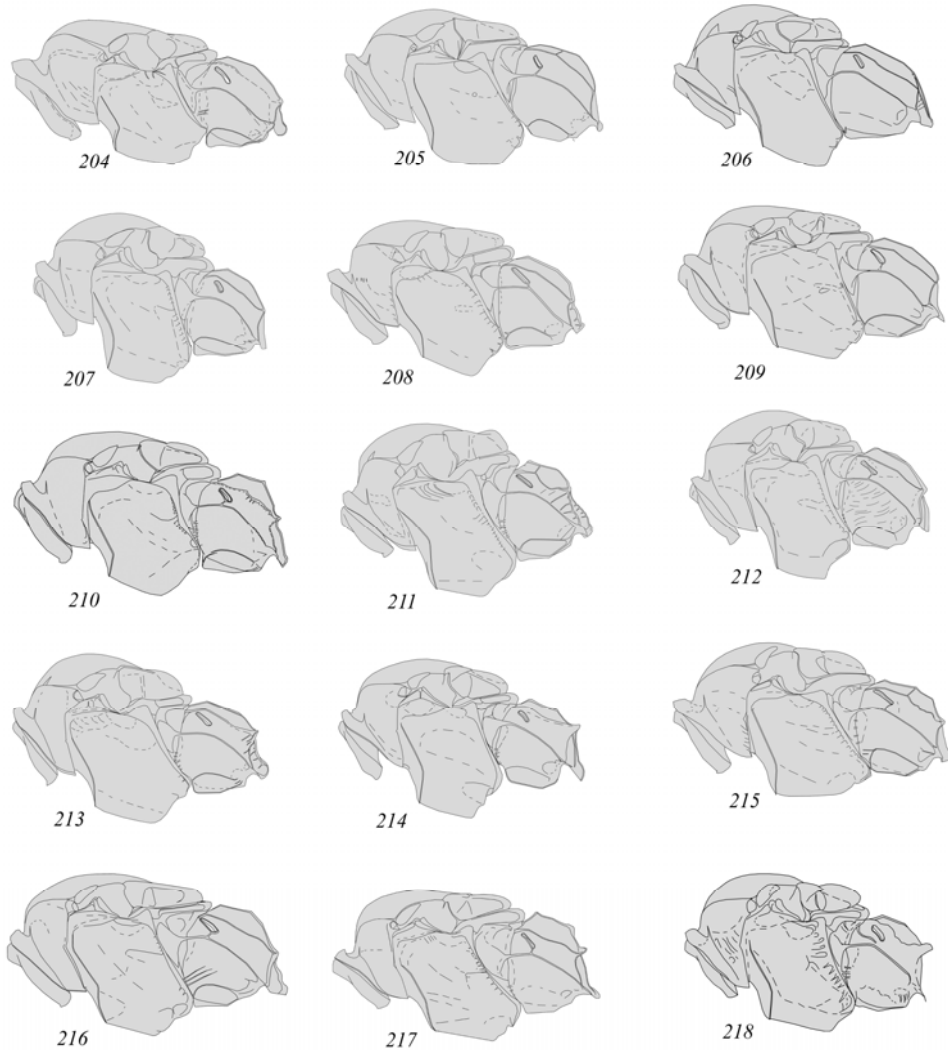
Fig. 204-218: Thorax of Amblytelina genera from lateral (according to TERESHKIN 2011): (**204**) *Spilichneumon occisor* (FABRICIUS), (**205**) *Limerodes arctiventris*

(BOIE), (**206**) *Tricholabus strigatorius* (GRAVENHORST), (**207**) *Ctenichneumon funereus* (GEOFFROY), (**208**) *Diphyus amatorius* (MÜLLER), (**209**) *Obtusodonta equitatoria* (PANZER), (**210**) *Eutanyacra crispatoria* (LINNAEUS), (**211**) *Hepiopelmus melanogaster* (GMELIN), (**212**) *Limerodops elongatus* (BRISCHKE), (**213**) *Achaius oratorius* (FABRICIUS), (**214**) *Achaiusoides epistomalis* TERESHKIN, (**215**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**216**) *Triptognathus uniguttatus* (GRAVENHORST), (**217**) *Triptognathops gobiensis* TERESHKIN, (**218**) *Amblyteles armatorius* (FABRICIUS).
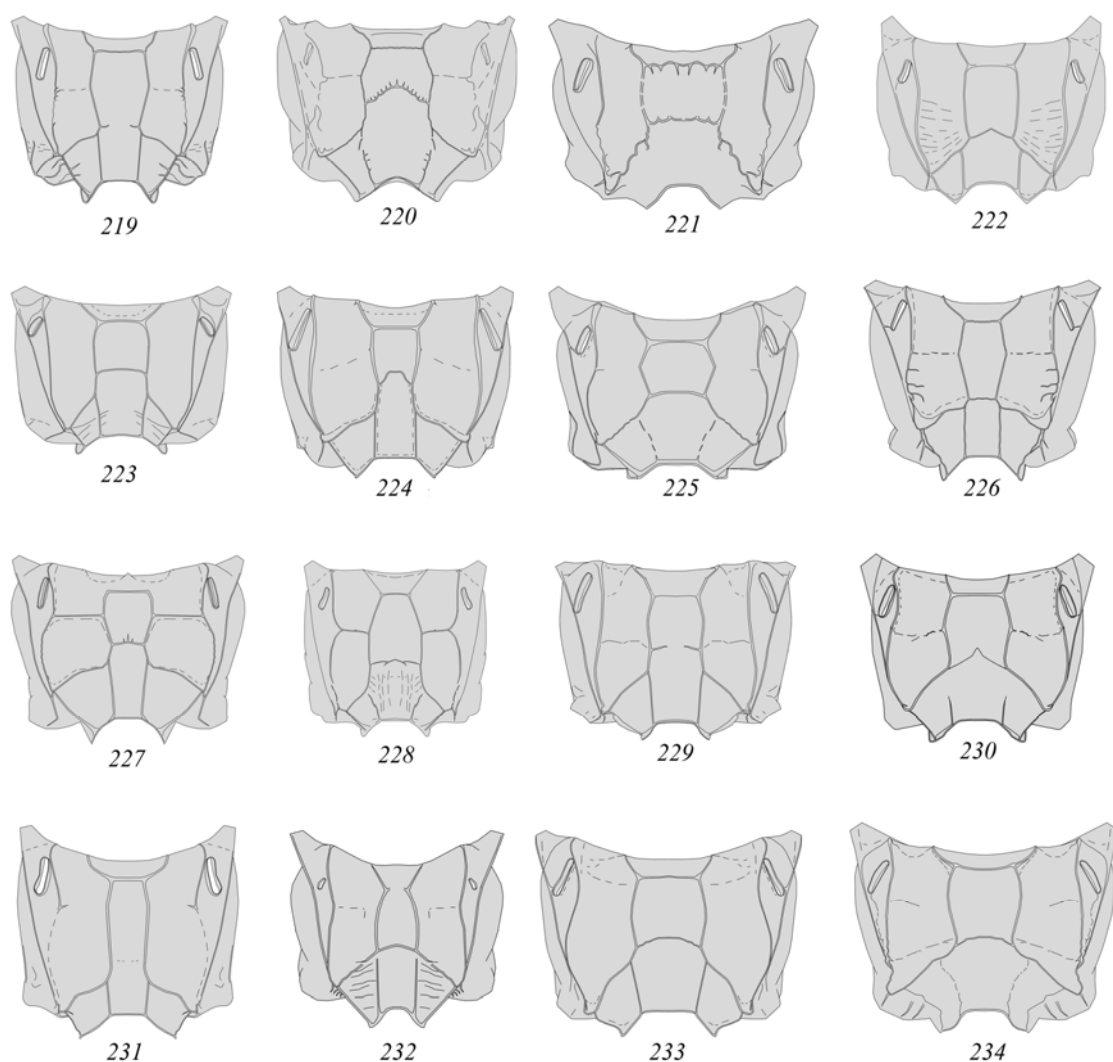
Fig. 219-234: Propodeum of Amblytelina (according to TERESHKIN 2011): (**219**) *Achaius oratorius* (FABRICIUS), (**220**) *Achaiusoides epistomalis* TERESHKIN, (**221**) *Amblyteles armatorius* (FABRICIUS), (**222**) *Bureschias subcylindricus* (GRAVENHORST), (**223**) *Ctenichneumon funereus* (GEOFFROY), (**224**) *Diphyus amatorius* (MÜLLER), (**225**) *Eutanyacra crispatoria* (LINNAEUS), (**226**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**227**) *Hepiopelmus melanogaster* (GMELIN), (**228**) *Limerodes arctiventris* (BOIE), (**229**) *Limerodops elongatus* (BRISCHKE), (**230**) *Obtusodonta equitatoria* (PANZER), (**231**) *Spilichneumon occisor* (FABRICIUS), (**232**) *Tricholabus strigatorius* (GRAVENHORST), (**233**) *Triptognathus uniguttatus* (GRAVENHORST), (**234**) *Triptognathops gobiensis* TERESHKIN.

The detailed description of sequence of operations at fulfillment of the table of illustrations on an example of single species

Stages of preparation of total image of imago

Sequence of operations

Preparation of matrix

Pencil contour of all parts of a body, with exception of flagellum and wings, is fulfilled in the unified scale by the method described above. Scanned tables of drawings are increased to a standard size. For example, the usual increase of pencil drawings, which fulfilled on graph paper, is 150-200%. On the document window title by right mouse button is clicked. Then, in pop-up menu, Image Size is selected. In the window that appears, the units "%" is set up instead of "cm" and a value of 150-200 is inserted, depending on the size of the original image. As a rule, the percentage of increasing is calculated from the length of the head in the final image of imago (4-5 cm). For example, the initial length of the head on pencil matrix is 2 cm. In this case the image size is increased up to 200% (fig. 235-236). Resolution required for further work is 600 pixels/inch.
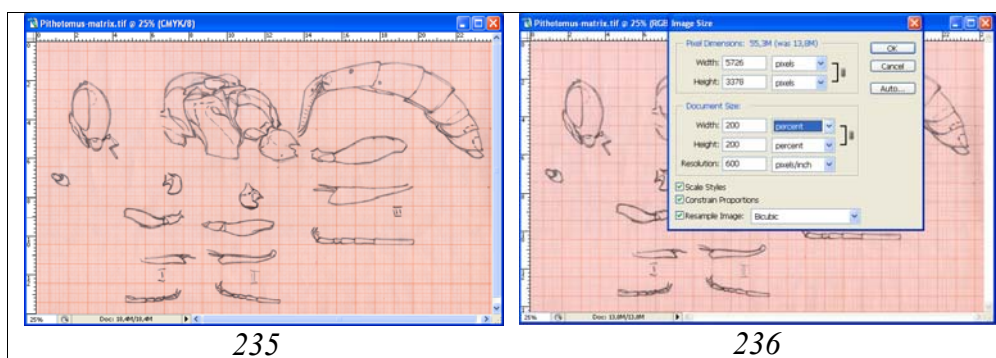
Fig. 235-236: Increasing the size of a pencil drawing of the contour to the desired of the working size: (**235**) matrix of initial size; (**236**) parameters of pop-up window at increasing of matrix.
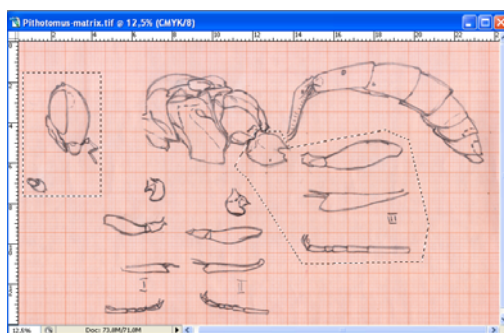
Fig. 237: Copying of parts of a body of ichneumon fly for creation of separate files.
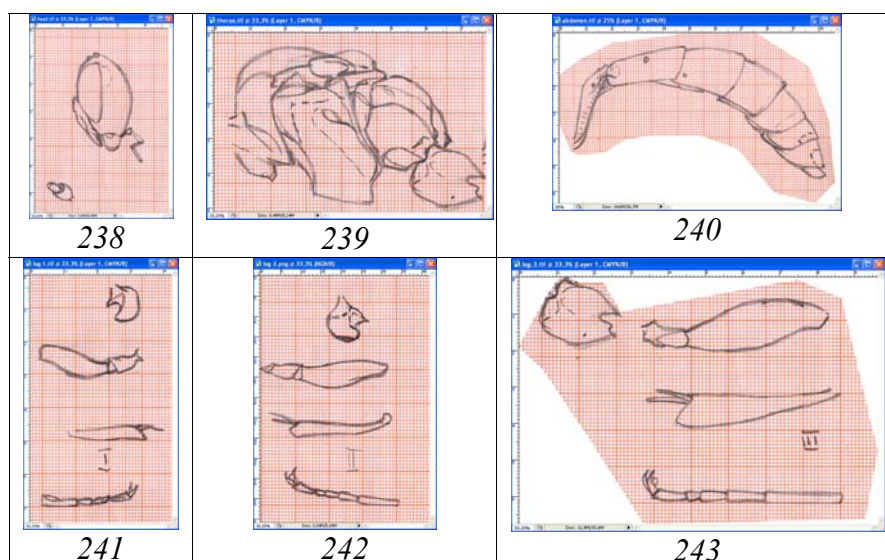
Fig. 238-243: Matrices of separate parts of a body of ichneumon fly prepared for operation in the six files: (**238**) head, (**239**) thorax, (**240**) abdomen, (**241**) leg-1, (**242**) leg-2, (**243**) leg-3.

Each part of a body is copied in a separate file for the subsequent processing. By means of tools of Rectangular Marquee or Polygonal Lasso Tool necessary fragment is selected. After that sequence of operations: Ctrl+C–Ctrl+N–Enter–Ctrl+V is performed. Operation is fulfilled with every parts of a body. Every part of a body is saved in a separate file. As the result, 6 files in mode CMYK, which needed for further processing: head, thorax, leg-1(2,3) and abdomen in a "TIFF" format are received (fig. 238-243).

All prepared files in CMYK mode consist of two layers "Background" and "Matrix" (with pencil contour). In the subsequent, operations of outlining of a pencil contour of each fragment by means of vectorial instrument Line Tool are carried out, on the assumption of obligatory control of object under the microscope.

Flagellum

As matrix for preparation of c o n t o u r   d r a w i n g of flagellum serves as pencil contour, prepared using the projecting devices, or digital photography, or scanned image. Fulfilment of matrix by means of enumerated methods is necessary for accurate representation of number of segments of flagellum and theirs proportions. By means of vectorial instrument Line Tool, with chosen previously the required thickness of lines (4-6px) depending on the size of the picture, an outlining of a contour is fulfilled. After finishing an operation of outlining of a contour, layer "Matrix" is switched off and merging of layers with separate lines is performed (Menu: Layer–Merge Visible, Shift+Ctrl+E). Then layer with Matrix is deleted (Ctrl+A–Del). The final file with a contour consists of two layers – "Contour" and "Background". If the contour of flagellum is fulfilled by colored lines, a file is converted to mode Gray and the lines of a contour are blacked out as much as possible (Menu: Image–Adjustments–Brightness/Contrast).

The subsequent actions are connected with correction of a contour – proportions of segments (fig. 244), position of flagellum relative to a body and wings of the ichneumon fly according to the chosen standard (fig. 245-262).
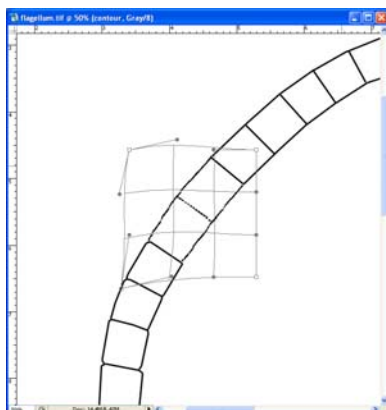
Fig. 244: Example of usage of function Warp for correction of proportions of separate segments of flagellum.
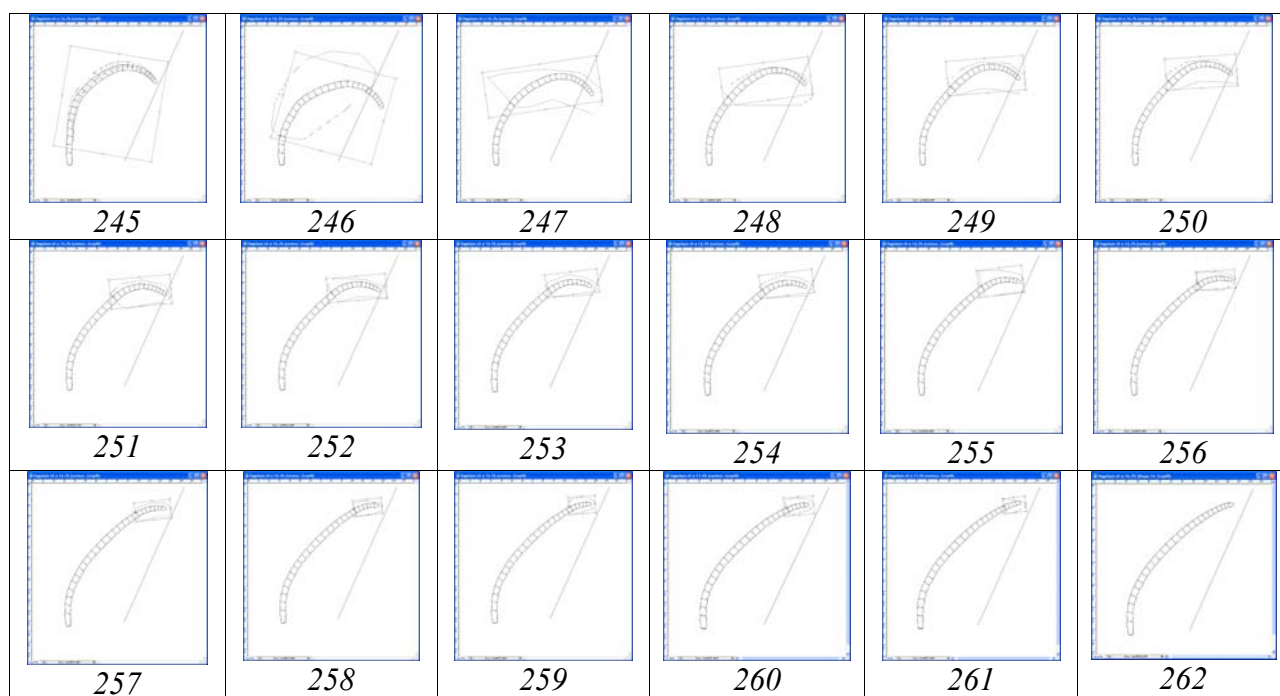
Fig. 245-262: Stages of modification of flagellum contour with usage of function Edit–Transform–Rotate, relative to front wing of imago.

Operations of this type are fulfilled with a help of functions of transformation (Edit–Transform–Scale, Rotate, Warp) already after "arranging" parts of imago in an integrated image. When correction of position of the flagellum relative to the front wing using the Rotate function, a center point of rotation is need to moved to the place of the contour of the flagellum, from which rotation will be carried out. After finishing operation on giving to flagellum the necessary position, the breaks is corrected or by the use of additional lines with a help of instrument Line Tool, or with a help of in-

strument Brush Tool with hard brush at pressed Shift key, up to the complete elimination of gaps in the contour of flagellum. At the final stage of this phase, file consists of two layers – "Navigator" and "Background".

The next phase of the flagellum image preparation is p o u r i n g. First step is duplication of layer "Navigator" and creating of two additional layers: "Main lines" and "Pouring and volume". Usually in layer "Navigator", borders of segments that flattened ventrally and borders of white annulus (characters which absent at this object) are marked by dotted lines. In the layer "Main lines" all lines of a contour, except dotted ones are presented. Brightness and Contrast of lines of this layer can be corrected in the sequel in accordance with underlying layer. Lower layer "Pouring and volume" is a base working layer for subsequent operations. Fulfilment of operation of pouring is carried out or by pouring of every separate segment by instrument Paint Bucket Tool (G), or of all contour of flagellum after its advance preparation. Second variant is preferential. The diameter of the instrument Eraser Tool (E) should not exceed the narrowest segment of the flagellum. In palette Brushes, in section Brash Tip Shape, diameter of the tool (Diameter) is selected. Maximum Hardness =100% and Spacing=1% are established. By pressing and holding down the Shift key, the central part of the contour of the flagellum in a layer of "Pouring and volume" is deleted (fig. 263-264).
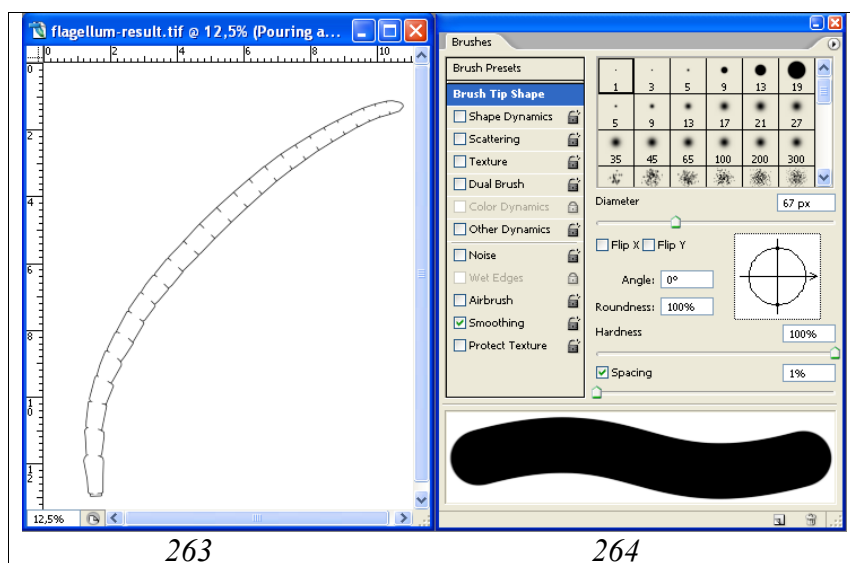
Fig. 263-264: Cleaning of central part of flagellum contour by instrument Eraser Tool (E) before "pouring", (**263**) deletion lines of central part by instrument Eraser Tool, (**264**) parameters of palette Brushes.

For deletion of central part of flagellum contour it is possible to use instrument Polygonal Lasso Tool (Feather=0). For pouring, instrument Paint Bucket Tool (G) is used. For fulfill of pouring, in palette Swatches Grey color, usually 55%, is chosen. During a process of contour pouring, it is necessary clicking some times by the mouse on area of pouring up to disappearance of light border with an external outline. On

this stage, the image of flagellum is ready for operation for giving to it of volumetric appearance.

The v o l u m e t r i c a p p e a r a n c e of flagellum is created with use of tools of selection (Polygonal Lasso Tool and Lasso Tool). At first stage, with use of Polygonal Lasso Tool a dorsal part of flagellum is selected as in the figure 265. The important point is the selection of parameter Feather. Usually "hardness" of selection is not more than 30px. Borders of selected area should overstep far of the limits of borders of flagellum. After finishing of selection, an operation for darkening of a dorsal part of flagellum is fulfilled (Menu: Image–Adjustments–Brightness/Contrast) (fig. 265). At a following stage (tool Polygonal Lasso Tool is turned on), area of selection is moved more close to margins of flagellum and operation on darkening is repeated. The same sequence of operations is fulfilled with ventral part of flagellum. Area of selection of a ventral part of flagellum should correspond to the direction of illumination of object that accepted earlier.

At a following stage, clarification of central part of flagellum is fulfilled. Central part of flagellum is selected by tool Polygonal Lasso Tool, as in the figure 266. Then, an operation of Brightness/Contrast is performed. Value of the parameter Feather is usually not more than 10px and depends on the size of the canvas.

| 265 | 266 | 267 |

Fig. 265-267: Giving to flagellum of volumetric appearance: (**265**) operation on darkening of dorsal part of flagellum, (**266**) clarification of a central part of flagellum, (**267**) finalization of separate segments of flagellum with usage of instrument Lasso Tool.

Improvement of volumetric image of flagellum is fulfilled with using of tool of free selection – Lasso Tool (L). In the given example, segments of the flagellum base are distinctly separated from each other (differentiated). For more well-defined representation of the given character, convex sites of segments of the base of flagellum are selected by tool Lasso Tool, having selected the corresponding parametre of Feather. Selected parts are contrasted with a help of function Brightness/Contrast (fig. 267). Operations of arbitrary selection are better to fulfill with using of Pen Tablet.

After deselection, the layers "Pouring and volume" and "Main lines" are contrasted separately with a help of function Brightness/Contrast up to giving flagellum necessary saturation.

At a finishing stage of operation "shaping volumetric appearance of flagellum" layer "Main lines" is marked as the working. More light-colored parts of a contour are selected by instrument Polygonal Lasso Tool (L), choosing value of parameter Feather. Then, areas of selection are contrasted by means of function Brightness/Contrast (fig. 268). Result of this stage is presented in figure 269. On this stage the layers "Main lines" and "Pouring and volume" do not yet merge (fig. 270).

268 *269* *270*
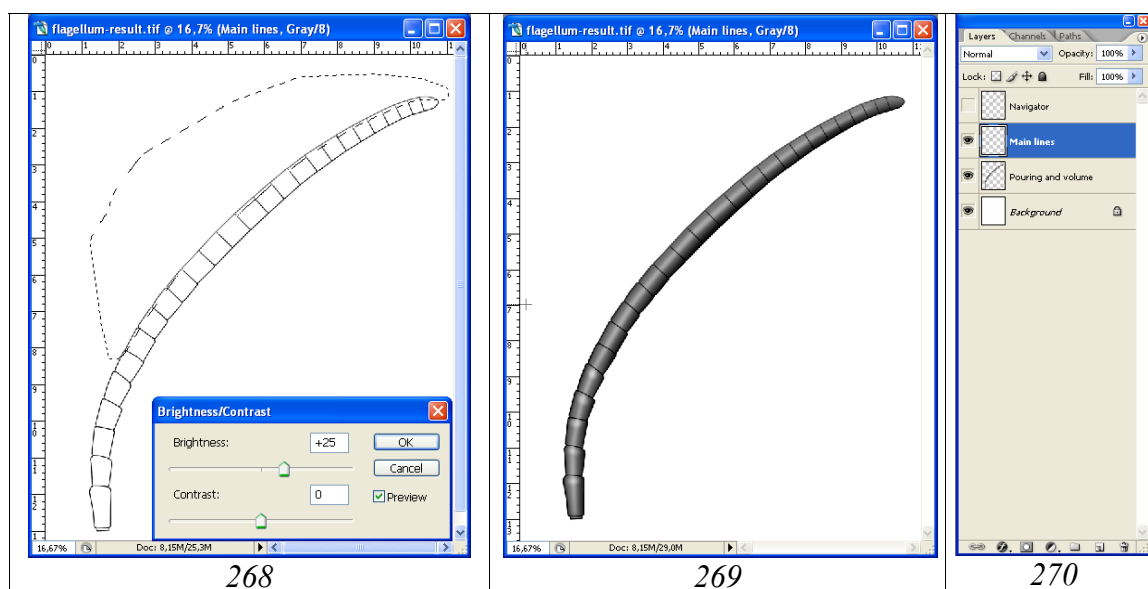
Fig. 268-270: Final operations on giving to flagellum of volumetric appearance: (**268**) clarification of contour in layer "Main lines", (**269**) result, (**270**) layers necessary for further operations fulfillment.

E l a b o r a t i o n of flagellum usually boils down to shading its volumetric appearance by means of small points and giving to him so-called "natural appearance".

At the first stage the separate empty layer, over a layer "Main lines" is necessary to create, having appropriated to him the name "Small punctures" (fig. 271). For layer creation in menu Layers the cursor is directed at layer Main lines, clicked on it the right button of the mouse. In the pop-up menu command Duplicate Layer is chosen. In the appeared window the layer name "Small punctures" is entered. Content of the duplicated layer is deleted by command Ctrl–A+Del.

For performance of small puncturation of flagellum, instrument Brush Tool is used. Operation is fulfilled in some stages. In palette Brushes in section Brush Tip Shape diameter of brush (Diameter) and its rigidity (Hardness) are selected depending on the sizes of the image (of canvas). It is need in order to the points were hardly appreciable in the final image of the whole insect (fig. 272). In the described example, when the size of a canvas is 110x130 mm, the size of flagellum in the final image will be re-

duced not less than twice. In this case diameter of brush 7px and its hardness of 25% are selected.
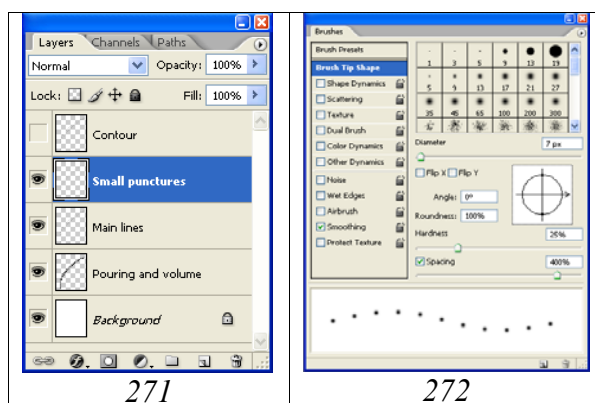
271 | *272*

Fig. 271-272: Hierarchy of layers in the resultant file and selection of parameters of Brush for shallow points: (**271**) hierarchy of layers, (**272**) parameters of palette Brushes.

At the first stage, puncturation of peripherial parts of flagellum is performed. A sparseness of puncturation is increased from border of segments up to central part of flagellum. Fulfillment of puncturation of peripherial parts is executed in a "semiautomatic" mode at pressed key Shift that allows evenly to puncturate the sites of big extent. Sparseness of puncturation from border to the centre was accordingly 200–250–300 and 400% (fig. 273).

Puncturation of the central part of flagellum is fulfilled in "random" mode (fig. 274). For performance of the given operation usage of Pen Tablet is desirable. Random puncturation also it is necessary to fulfill at great values of parameter Spacing, for prevention of arbitrary merging of points.

After fulfillment of operation of delicate puncturation of flagellum, a layer "Pouring and volume" is activated and the most light areas are selected by instrument Polygonal Lasso Tool (L). Then the small points are clarified according to a general view of flagellum (in layer "Pouring and volume") (fig. 275).

273 | *274* | *275*

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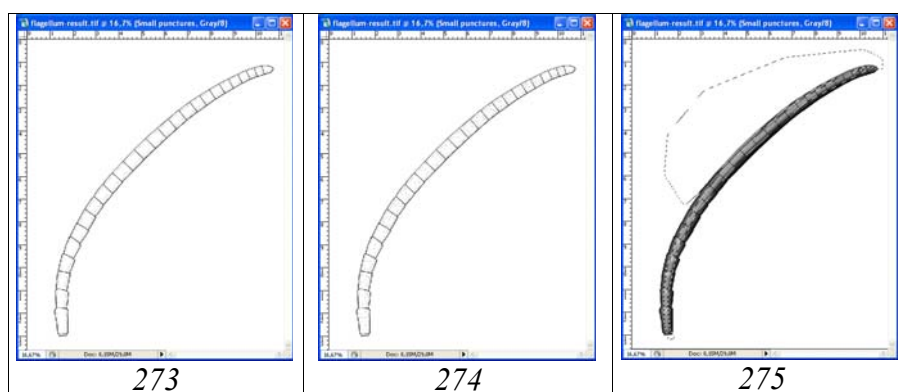
Fig. 273-275: Elaboration of flagellum by shallow points: (**273**) puncturation of peripheral areas with usage of Shift key, (**274**) completed puncturation, (**275**) clarification of shallow points.

Note: The clarification of points can be fulfilled and simultaneously with operation on giving to object of volumetric appearance. The order of performance of actions will then be somewhat different, and the number of operations less. However, it is necessary to notice, that it demands already certain skills.

Before beginning the operation on coloring of flagellum standard actions on merge of layers are fulfilled. At merging of layers in the file with image of flagellum "eyes" from layers "Contour" and "Background" are removed. Then command Merge Visible (Shift+Ctrl+E) is fulfilled. Merged layer is selected by command Ctrl+A. Then selected image is copied to the buffer (Ctrl+C). After that, by the menu command: Edit–Step Backward (Alt+Ctrl+Z) all previous actions are canceled, returning into place all layers that was merged earlier. Then, by command Ctrl+V, the merged image is inserted from the buffer under the name "Result".

C o l o r i n g

The first step is transform of a file from regime Grayscale to regime CMYK: Menu: Image–Mode–CMYK Color. In the pop-up menu a command "Don't Flatten" is selected, saving all layers. Flagellum of the given species is without white annelus and basically with dominance of a black coloration. Only the segments of the base have partially reddish-broun coloration (tint). For giving to flagellum the described features, the following actions are executed.

At the first stage by instrument of arbitrary selection Lasso Tool (L), at pushed Sift key, separate areas on segments of flagellum, having a reddish tint are selected (fig. 276). It is necessary to select value of parameter Feather by trial method. In our example it is 15-25px. For fulfillment of operation it is convenient to use the pen of Pen Tablet.

276

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278
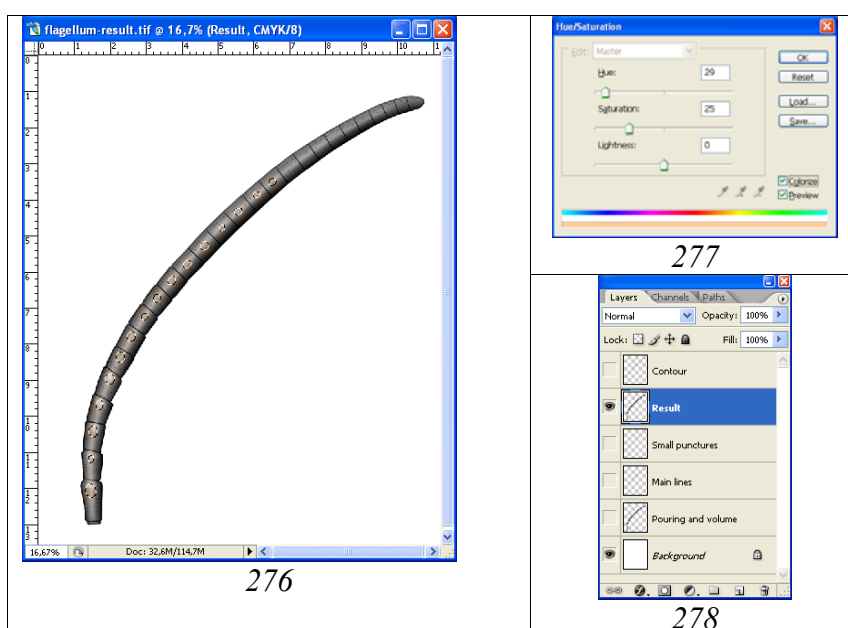
Fig. 276-278: Coloring of flagellum: (**276**) flagellum with selected areas, (**277**) dialog box Hue/Saturation, (**278**) final hierarchy of layers.

At a following stage, in menu Swatches, a basic color is chosen. In our case it is Darker Warm Brown. Then operation of coloring of selected areas (Menu: Image–Adjustments–Hue/Saturation (Ctrl+U)) is fulfilled. At the correct selection of value of parameter Feather and basic color it is enough to place a tick in window "Colorize" for obtaining of necessary effect (fig. 276-278).

Head

Head c o n t o u r, as well as and other parts of a body of imago is fulfilled with usage of vectorial instrument Line Tool. At real width of a head on a Matrix 2,5-3 cm, the thickness of a line normally is 5px. Color of a line is selected proceeding from convenience and obviousness (color of a pencil drawing – grey). New layers are merged periodically (Merge Visible), when disconnecting layers "Background" and "Matrix" (fig. 279).
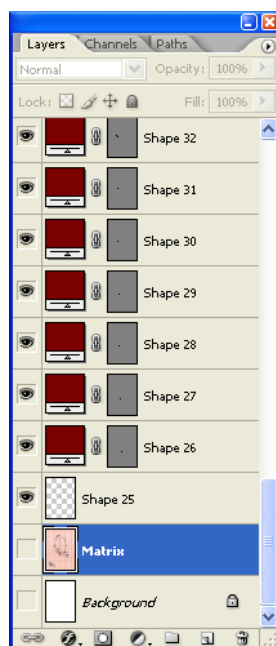
Fig. 279: Merging of layers when fulfillment of contour drawing of a head by instrument Line Tool.

Having finished operations of fulfillment of a contour of a head capsule and its processes, a layer with a pencil drawing (Matrix) is deleted. File is converted to regime Grayscale, without merging of layers (Image–Mode–Grayscale) (Don't flatten). Layer with contour ("Contour") is marked as the working and image is darkened as much as possible (Image–Adjustments–Brightness/Contrast). For the further fulfillment of the volumetric image of a head of imago and its processes presence of seven separate layers situated in the following order: "Navigator", "Main lines", "Eyes and ocelli", "Head capsule", "Mandible", "Scapus+palpi" and "Background" are necessary. For creation of layers the following sequence of actions is fulfilled. Layer "Contour" is

marked as the working and clicked on it by the right mouse button. In the opened pop up menu a command "Duplicate layer …" is selected and the titles of the layers named above are inserted.

Superfluous layer "Contour" is deleted. Then, all superfluous fragments are deleted from all layers, except upper layer (Navigator), using instrument Polygonal Lasso Tool (Feather =0) (fig. 280-282). At the given stage the file "head" is ready to the further operations on preparation of the volumetric image of a head of imago of ichneumon fly.

The layers which necessary for fulfillment of the subsequent operations are presented in figure 283.
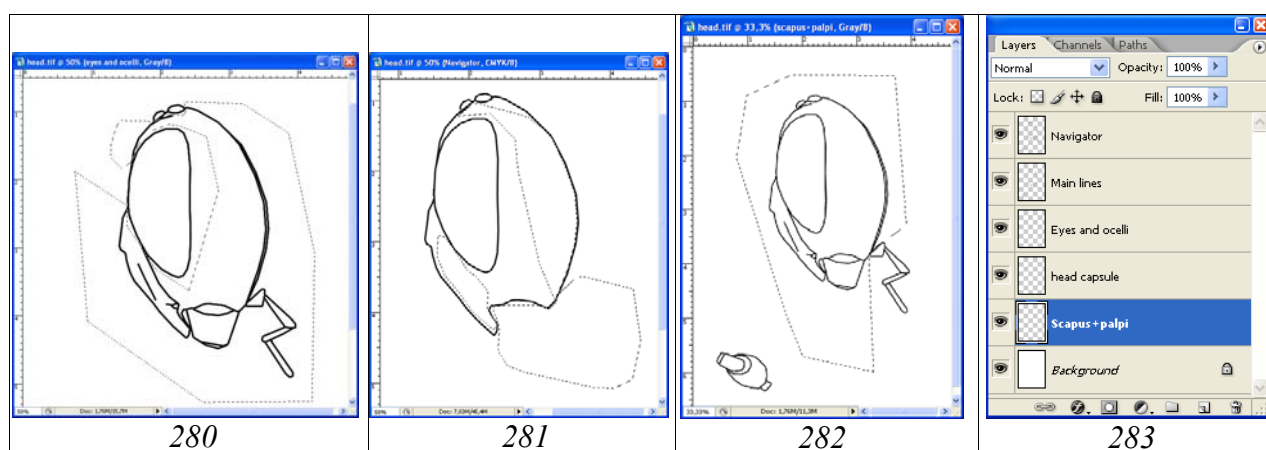
Fig. 280-283: Examples of elimination of superfluous fragments at creation of layers in a file "head": (**280**) "Eyes and ocelli", (**281**) "Head capsule", (**282**) "Scapus+palpi", (**283**) hierarchy of layers in menu Layers in a file with drawing of head contour of imago of ichneumon fly.

P o u r i n g   of a contour of a head is fulfilled by means of instrument Paint Bucket Tool (G) in the layers "Head capsule", "Mandible" and "Scapus+palpi". As well as at pouring of a flagellum contour, from palette Swatches Grey color of 55% is selected. Then, it is necessary clicking some times by the mouse on area of pouring up to disappearance of light border with an external outline. Pouring of eyes and ocelli is fulfilled after the full elaboration in detail of a head of imago and object conversion to regime CMYK Color.

A giving of v o l u m e t r i c   a p p e a r a n c e   to a head and its processes are fulfilled in 3 separate layers: "Head capsule", "Mandible" and "Scapus and palpi".

For giving to object of volumetric appearance, instrument Polygonal Lasso Tool is used. Selection is begun, as a rule, from peripheral areas, having installed very diffused border of selection (Feather 90-100px and more). It is essential, that at the first stages, the border of selected area should go far beyond the object borders. In process of reduction of the dimensions of areas of elaboration, hardness of borders of selected area is increased (value of parameter Feather is reduced). The basic function used for giving to object of volumetric appearance is Brightness/Contrast. At operation ful-

fillment, constant control of object under a microscope is necessary. After forming of volumetric appearance to a head capsule, towards layer "Navigator" or "Main lines" is moved, marking it as a working and by instrument Magic Wand Tool area of occipital carina is selected. At a following stage, without removing of selection, layer "Head capsule (Pouring+volume)" is marked as a working. In this layer selected area is clarified. Analogous operations are fulfilled in two remained layers –"Mandible" and "Scapus and palpi" (fig. 284-287).
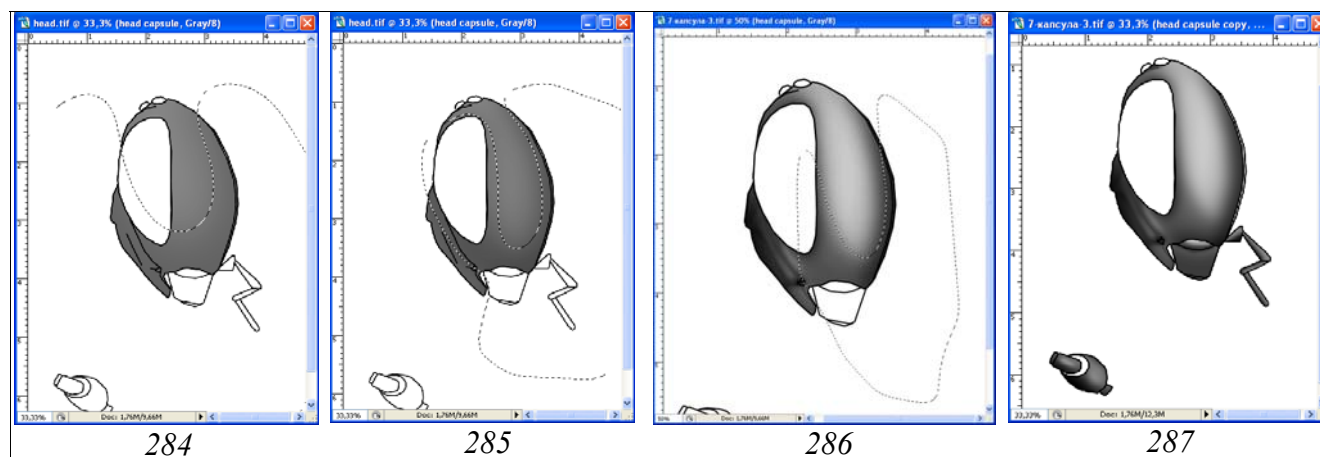
Fig. 284-287: Examples of operations on giving to head and its processes of volumetric appearance: (**284-286**) stages on giving of volumetric appearance to a head capsule, (**287**) final volumetric appearance of head and its processes.

E l a b o r a t i o n of the volumetric image of a head capsule of a concrete species is begun from the general assessment of sculptural peculiarities of a surface. It allows defining a choice of a method (strategy) for elaboration of sculptural peculiarities. Smoothed puncturation of temples with the approached, almost merging punctures, more large in the middle of temples is characteristic to object under consideration. Interspaces between punctures are without microsculpture, polished. Therefore, for representation of a sculpture of the given type instrument Brush Tool with the minimum parameter of Hardness is selected.

At the first stage it is necessary to create three separate empty layers, situated over layer "Head capsule (pouring+volume)". Standard procedure of generation of new layers is selection of an underlaying layer (in this case layer "Head capsule (pouring+volume)") and its duplication, with using of right mouse button (Duplicate Layer …) and insertion in the pop-up menu a title of a new layer. After layer duplication, its content is deleted by command Ctrl–A+Del. Operation is fulfilled three times. As a result three necessary layers, located over layer "Head capsule" in the following order are received: "Light punctures", "Punctures" and "Clarification of interspaces". In a considered example, in layer "Punctures" puncturation by the punctures of saturated black color is fulfilled. The shape of punctures is selected according to observable under a microscope. The appropriate parameters, "Angle" and "Roundness" are selected in palette Brushes (fig. 288). A dimension of punctures, according to observable under a microscope is reduced from centre of temples to periphery.
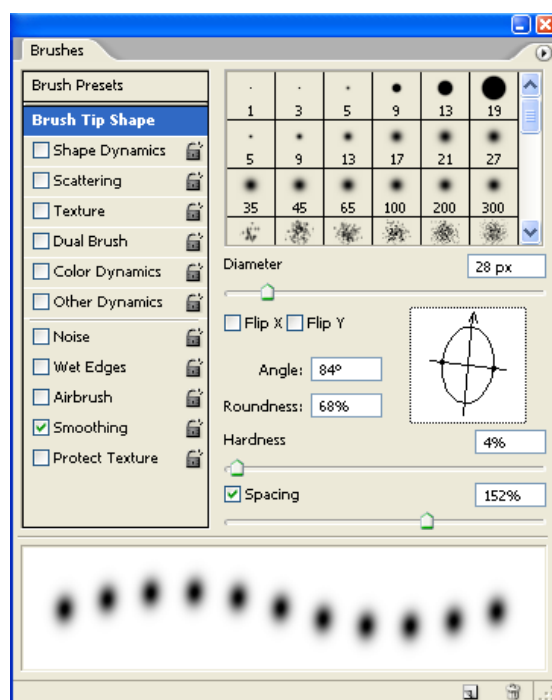
Fig. 288: Selection of parameters in palette Brushes for fulfillment of puncturation of temples.

In our example size of punctures was accordingly 16, 20 and 15px (fig. 289). At a following stage an operation of clarification of intervals between punctures is fulfilled. Working layer is "Clarification of interspaces". Operation is fulfilled by instrument Brush Tool with diameter and parameters corresponding to parameters of the brush, used for punctures. Saturation of white color is usually from 0 to 10%. In subsequent, brightness of the clarified areas can be regulated, as they are in a separate layer (fig. 290).

Operation is performed at switched on (visible) layers "Head capsule" and "Punctures". Further, an operation in the layer "Light punctures" which situated over layer "Punctures" is fulfilled by similar instruments. By instrument Brush Tool accordingly to the selected diameter and a saturation of the white color, the marginal or central areas of the black punctures are clarified (fig. 291). After finishing of all enumerated operations a most complex stage – contrasting of layers is started.

Fulfillment of puncturation in separate layers, as already it was spoken above, allows achieving a maximum correspondence of puncturation to observable under a microscope. For this purpose, the necessary areas of a surface are selected by means of instrument Polygonal Lasso Tool, having selected appropriate value of parameter Feather. Then sequentially various areas of all three layers are contrasted, using function Menu: Image–Adjustments–Brightness/Contrast and maximum correspondence of the object, to observable under a microscope (fig. 292,293) is achieved.

The object, that used as an example has the polished, glossy surface of temples. Therefore, for emphasis of this particularity, at the final stage of elaboration of a surface of a head, operation on clarification of the most shining areas is fulfilled. Per-

formance of operation is possible by two means. It is possible to create a separate empty layer over the layer "Head capsule (pouring+volume)" (it is situated under the rest of layers). In this layer, the most shining areas, according to the selected lighting of the object are selected by means of instrument Lasso Tool. In subsequent by means of instrument Pain Bucket Tool, pouring by grey color (for example 10%) is fulfilled. After pouring, brightness and contrast are regulated by standard function of Menu: Image–Adjustments–Brightness/Contrast up to achieving of necessary effect.

Other method used in our example, it is clarification of selected areas in the underlying (main) layer "Head capsule (pouring+volume)" directly, up to achieving the correspondence to observable under a microscope (fig. 293)
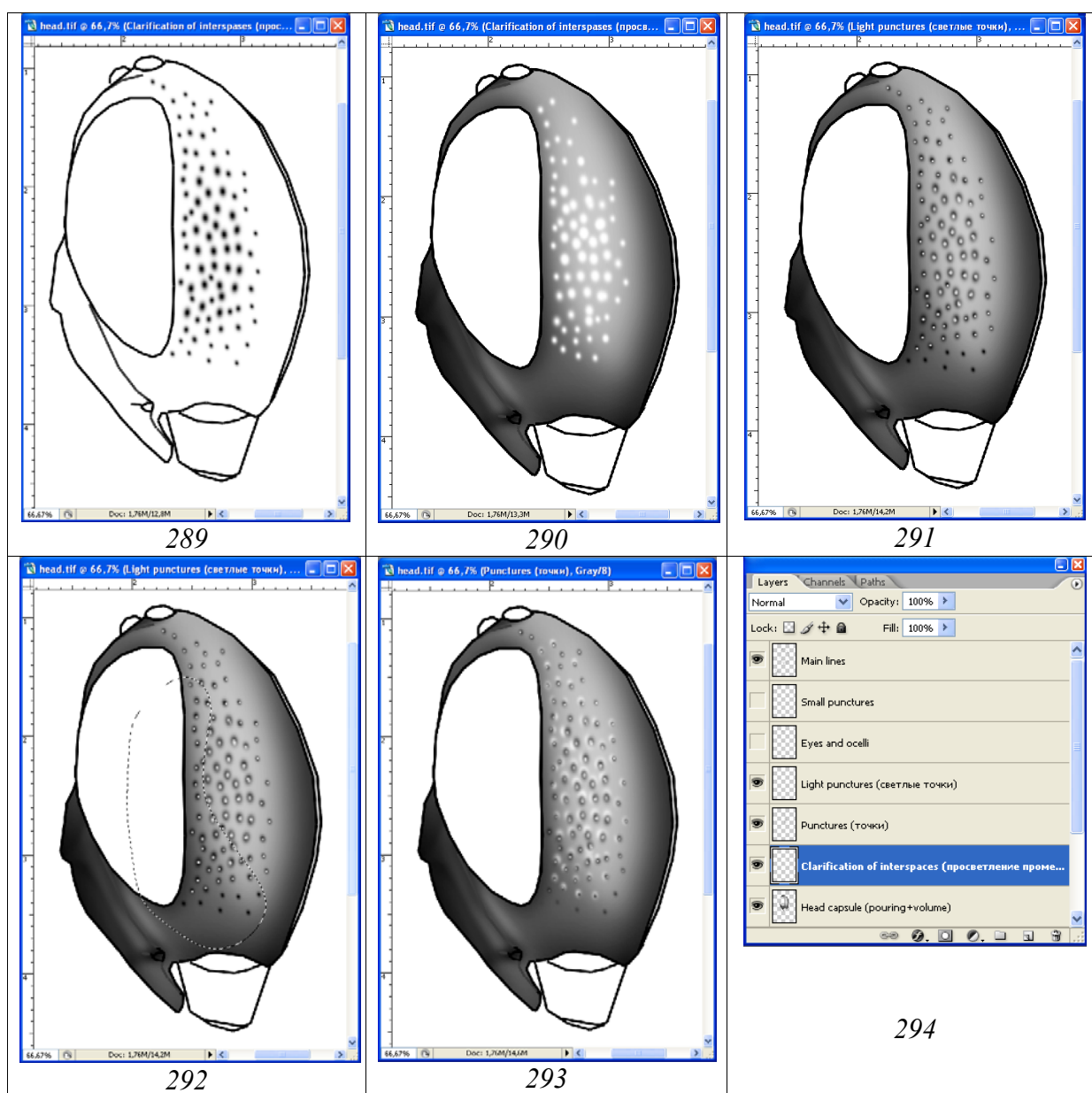
Fig. 289-294: Operations of fulfillment of puncturation of temples: (**289**) punctures; (**290**) clarification of interspaces; (**291**) light points; (**292**) contrasting of layers; (**293**) final result; (**294**) hierarchy of layers necessary for fulfillment of puncturation.

Elaboration is completed by fulfillment of shallow points in separate parts of a head capsule in separate layer "Small punctures" (fig. 294), as it is in detail described at elaboration of flagellum. Punctuation of palp and scapus are fulfilled directly in a layer "Scapus+palpi". At the given stage it is possible to start fulfillment of operations on giving to a head of imago of ichneumon fly appropriate coloration.

C o l o r i n g

At the given, stage initial quantity of layers reaches 12 (fig. 301). Fulfillment of the given operation demands periodic merging of layers, and at a final stage, also backspace to an initial state (initial composition of layers). In this connection, it is necessary to watch that in installations, a number of commands which could be cancelled was maximal (Menu: Edit–Preferences–History States).

Before beginning of operation on coloring of parts of a head, merging of some layers is fulfilled. Layers which should remain are made as invisible (eyes are removed). Layers "Head capsule (pouring+volume)", "Small punctures", "Main lines", "Light punctures", "Punctures", "Clarification of interspases" and "Gloss" necessary for coloring are merged. Layers, which necessary for fulfillment of the subsequent operations and their hierarchy are presented in figures 298, 302.

The object used as an example, has a rather monotonic coloration of a head. Primary color of head capsule is black. Head capsule of the given species is only with narrow light yellow (white) stripes in apical parts of external orbits and with weak tint of brown in the bottom of cheeks. In addition, palps and a tint of mandibles are dark-brown.

Before coloring of stripes in apical parts of temples, they are selected in a working layer by means instrument Polygonal Lasso Tool with hardness of borders of selection (Feather) about 5px. Then clarification of areas of stripes (Brightness/Contrast) is fulfilled (fig. 295). The following step is translation of a file from regime Grayscale to regime CMYK (Menu: Image–Mode–CMYK Color). After that, not removing selection, operation on a coloration of selected area is fulfilled. In palette Swatches color of selected area, in this case pale yellow, is chosen. Further, an operation on coloring of selected area (Menu: Image–Adjustments–Hue/Saturation (Ctrl+U)) is perfomed. In pop-up dialog box Hue/Saturation, by means of cursors (runners), Hue and Saturation of selected area are selected. At operation fulfillment it is necessary to remember, that in window Colorize the flag should be inserted (fig. 296, 297).

At a following stage in separate layer "Scapus+palpi", by similar way, a coloring of maxillary palp is fulfilled. Some parts, for example part of mandibles, the inferior part of cheeks possess a brown either brownish tint. For giving of a brown tint to the specified parts of a head, areas with a brownish tint are selected by instrument Polygonal Lasso Tool or Lasso Tool with diffused contour. In our example value of parameter Feather is 20px (fig. 296, 298). Further a command Hue/Saturation (Ctrl+U) is fulfilled, exposing a tick in window Colorize. Usually, if primary color in palette Swatches is chosen correctly, additional usage of sliders in a dialogue window is not required.

At the final stage, coloring of eye and ocelli is perfomed in separate layer "Eye and ocelli". As already it was spoken above, fulfillment of the image of eye and ocelli in a separate layer allows performing of operation on giving of volumetric appearance without influence of area of selection on adjacent areas of object. The first step is pouring the eye and ocelli by main color which has been selected in palette Swatches. Further according to the chosen technique, the parts of eye and ocelli are selected. In our example, according to the chosen lighting, by means of instrument Polygonal Lasso Tool (parameter Feather=90px), internal part of an eye is selected. The necessary result is achieved using standard function of Menu: Image–Adjustments–Brightness/Contrast up to reception of necessary effect. For ocelli the size of parameter Feather in our example is 20px (fig. 299).
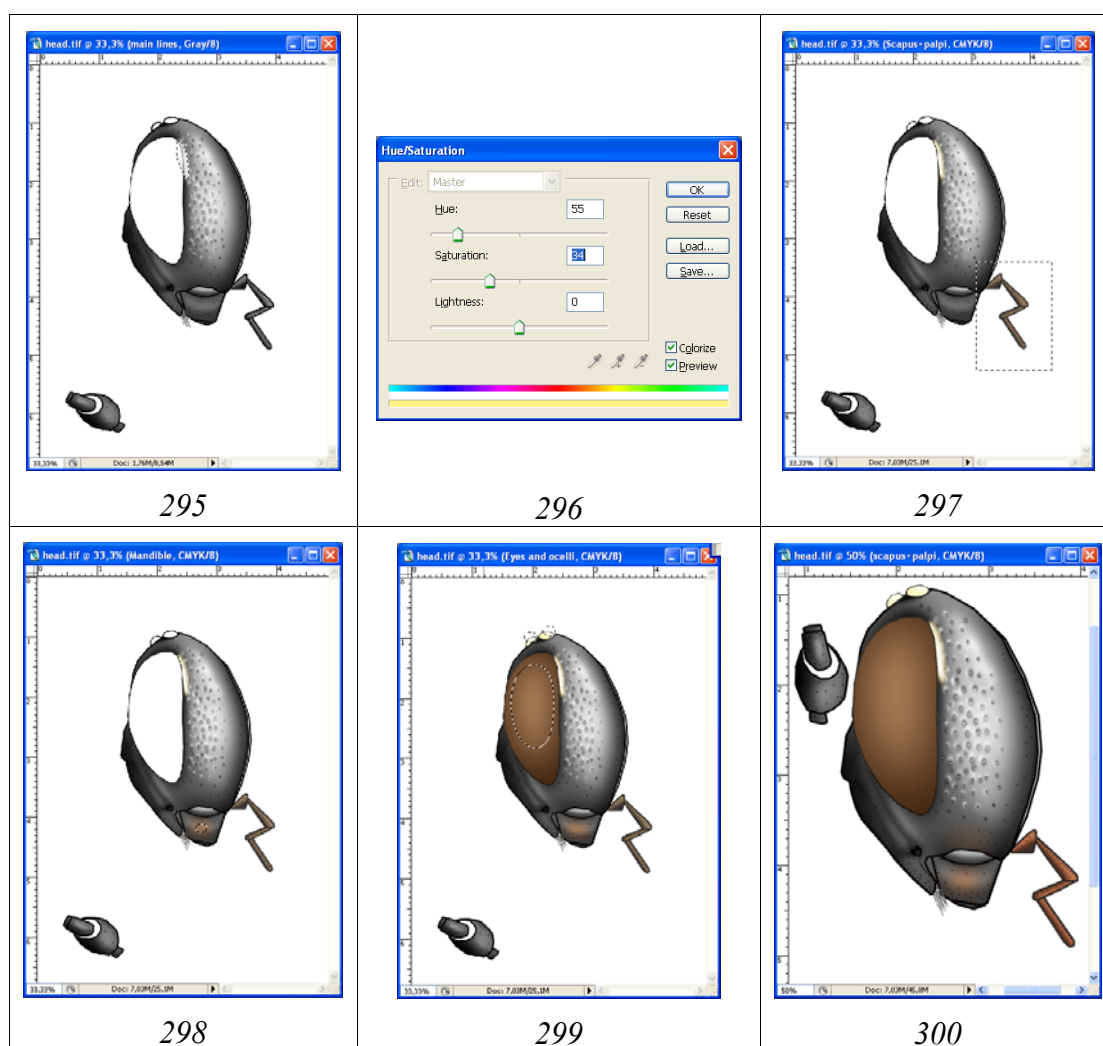
Fig. 295-300: Stages of coloration of a head of insect in graphics editor: (**295**) clarification of stripes on external orbits, (**296**) coloring of stripes with usage of function Hue/Saturation (CMYK); (**297**) coloring of maxillary palp; (**298**) giving of tint to mandible; (**299**) coloring of eye and ocelli; (**300**) final result of coloring of ichneumon fly head.

After fulfillment of all operations on coloring, a merging of layers is fulfilled. Layers "Eye and ocelli", "Head capsule (pouring+volume)" and "Mandible" are merged (fig. 302). Thereby all layers, except layers "Scapus+palpi" and "Backgroung" are merged.
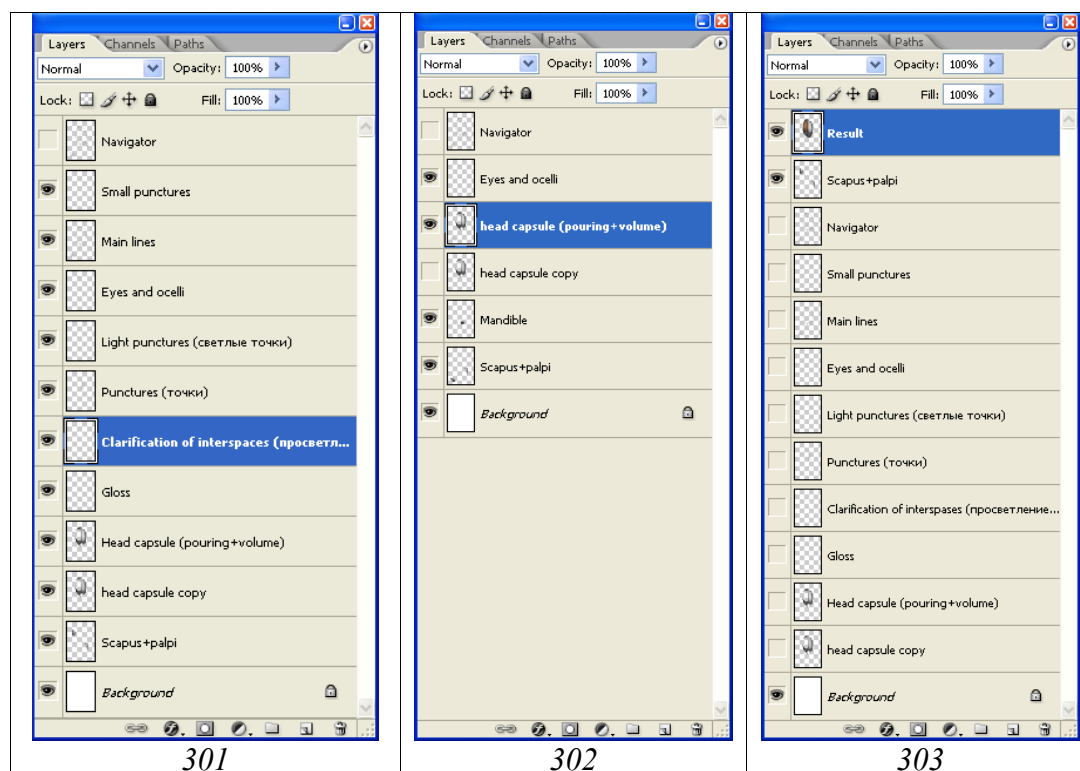
Fig. 301-303: Changes in hierarchy of layers in process of fulfillment of operations of coloration of head: (**301**) initial hierarchy of layers; (**302**) layers necessary for fulfillment of operations of coloration; (**303**) layers and their hierarchy in final file.

Maxillary palp and scapus should be in a separate layer that is necessary for final assemblage of total picture of imago. Merged layers (except "Scapus+palpi") are copied in the buffer by command Ctrl–A+Ctrl–C. Then, all previous actions are cancelled by means of the menu command: Edit–Step Backward (Alt+Ctrl+Z) or in palette History, restoring all layers that merged earlier. Restoration of layers is necessary for safety, in case of occurrence of necessity of correction of image in the subsequent. Besides, as already it was spoken earlier, contour drawings of separate parts can be used further at the analysis of morphology of group and for an illustration of characters in the identificational keys. After restoration of all layers, a layer "Scapus+palpi" is moved on upper level and color image of a head capsule is inserted from the buffer above it, having marked it as "Result". The hierarchy of layers in complete image of a head is presented in figure 303. For fulfillment of total image of imago of an insect in the subsequent, two top layers will be used.

Thorax

C o n t o u r of thorax is fulfilled, carrying out the same operations, as at preparation of a contour of a head with use of vectorial instrument Line Tool, at the same parame-

ters. After performance of a contour, the image is duplicated and 4 layers are created. Then superfluous lines are deleted by the way described above. From layer "Navigator" the dotted lines, serving as the reference points at elaboration of image are deleted. At preparation of layer "External contour", in the sequel serving for pouring, only the external lines are saved. The hierarchy of layers is presented in figures 304-308: 1 – "Navigator", 2 – "Tegula", 3 – "Main lines", 4 – "External contour" and 5 – "Propleuron".
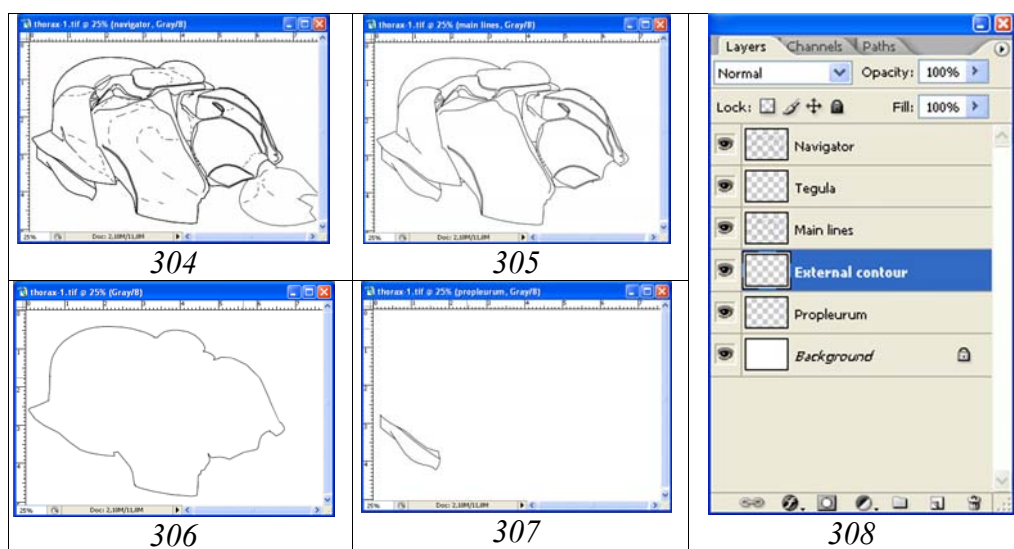
Fig. 304-308: Layers in a drawing of a thorax at finishing stage of fulfillment of a contour: (**304**) "Navigator", (**305**) "Main lines", (**306**) "External contour", (**307**) "Propleuron", (**308**) hierarchy of layers.

P o u r i n g of layers Tegula, External contour and Propleuron is fulfilled by means of instrument Paint Bucket Tool (G) having chosen in palette Swatches Grey color (55%). It is necessary clicking some times by the mouse on area of pouring up to disappearance of light border with an external outline. At the given stage, a drawing of thorax is ready to fulfillment of the subsequent operations.

For the layers "Tegula", "External contour" and "Propleuron", after operation performance of pouring, separately for everyone, a volumetric appearance is imparted.

The v o l u m e t r i c a p p e a r a n c e in the most complicated layer "External contour, pouring+volume" is formed as in all other cases with usage of instrument Polygonal Lasso Tool, starting from periphery of object (fig. 309-311). The layer "Navigator" is turned on (an eye is established). It is necessary for orientation when fulfillment of operations. The control of object under a microscope is necessary at perfomance of operation of detailed elaboration, at giving to an object the volumetric appearance. At the initial stages, the minimum hardness of border of selection (Feather=90-100px) is installed (fig. 309-310). The external borders of selected area should overstep far of the limits of borders of object.

The selected areas are darkened, with using function Brightness/Contrast. Usually level of darkening fluctuates in the range of 10-30%. At the subsequent operations, hardness of selection is increased gradually in process of detailed elaboration of various areas. In figure 311, a parameter of Feather already is 50%. Further, at more detailed elaboration of object and at lower values of parameter Feather, using function Brightness/Contrast, it is necessary not only to regulate brightness of an area, but also to reduce, or to improve its contrast. Necessity of the control of object under a microscope is obligatory. Simultaneous selection of different parts by means of instrument Polygonal Lasso Tool with different degree of hardness (different value of parameter Feather) at pressed key Shift (fig. 312) is also possible. But the given method cannot be considered as preferable.
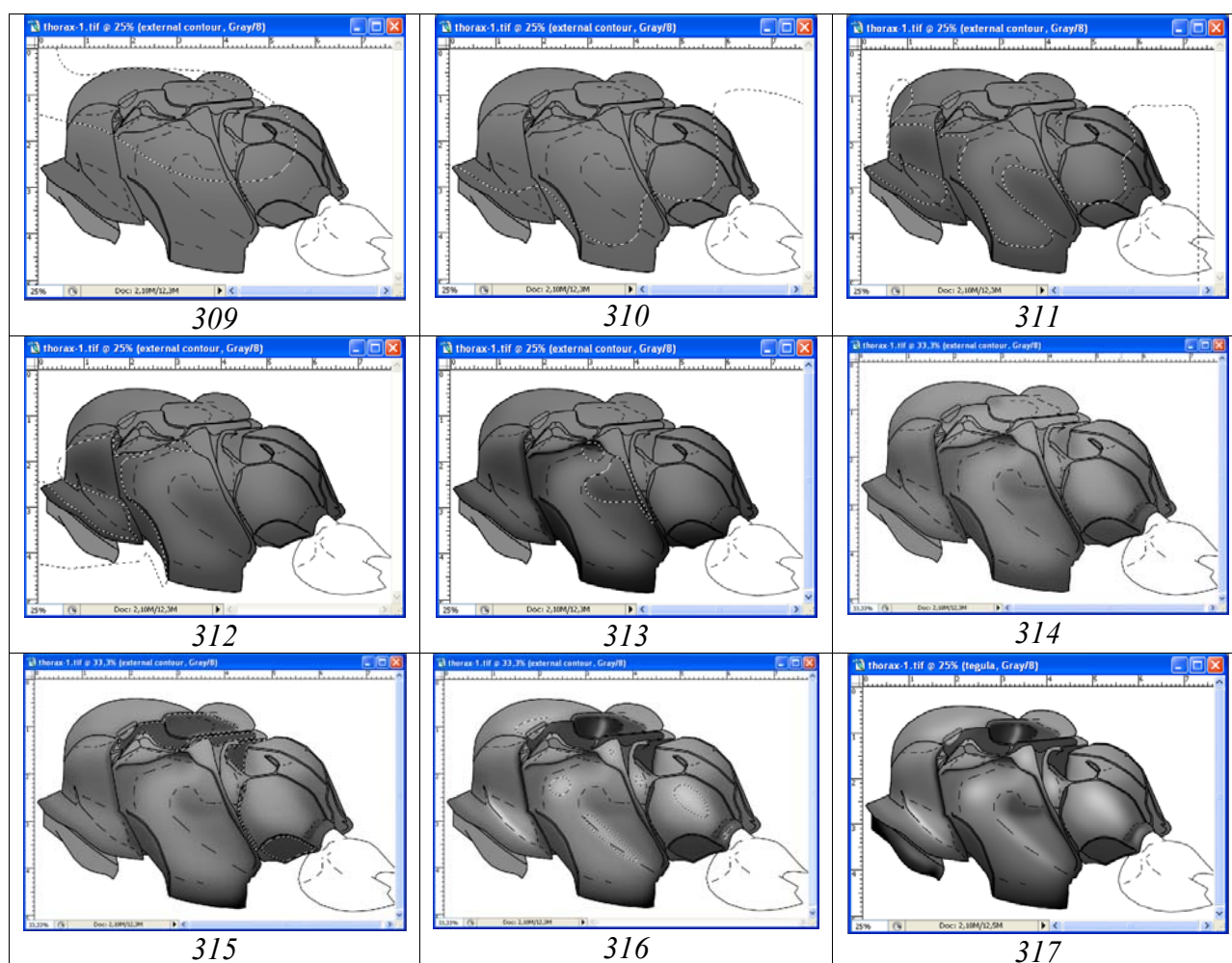
Fig. 309-317: Different stages of giving of volumetric appearance to thoracal part of imago, at visible (switched on) layer "Navigator" (explanations in the text).

After darkening and contrasting of the basic areas, the general clarification of the image is fulfilled (fig. 314). At perfomance of the given operation all selections are removed, and a working layer is the layer "External contour, pouring+volume". By using function Brightness/Contrast, image is clarified. In described case brightness has been increased by 30% (fig. 314). Periodical general clarification of the image facilitates the subsequent work not reducing its quality.

At a following stage of preparation of the volumetric image of thorax, the upper layers of a file are used. As a rule, maximally darkened areas on the final image of a thorax are axillary trough of mesonotum, an impression between propodeum and metanotum and sometimes coxal area of propodeum. These areas in a layer "Navigator" as a rule are closed by solid lines with the exception of axillary trough of mesonotum. Therefore in layer "Navigator", or "Main lines" these areas are selected by instrument Magic Wand Tool. The hind part of axillary trough of mesonotum is selected by instrument Polygonal Lasso Tool, having picked up corresponding value of parameter Feather. After selection in the named layers the listed areas, not removing selection, in palette Layers by the cursor as the working a layer "External contour, pouring+volume" is marked. The selected areas are darkened by means of function Brightness/Contrast. In described example value of parameter Brightness is –64, Contrast is –81 (fig. 315).

After darkening of the basic areas, a clarification of convex parts of thorax are fulfilled, using the same tools and functions (fig. 316).

Last stage of giving volumetric appearance to thorax is giving the volumetric appearance to tegula and to the propleurae. It is fulfilled by the same scheme in the separate layers (fig. 317). At giving of volumetric appearance to propleurae, the layers "Navigator" or "Main lines" are also used for selection. In subsequent, already in a working layer, contrasting of selected areas is perfomed. Clarification of some lines in a layer "Main lines" is fulfilled already after the complete fulfillment of volumetric appearance of object before completing merging of layers and depending on general appearance of an object.

At a final step of a stage, finished layer "External contour, pouring+volume" is duplicated. Duplicated layer is disconnected, doing its invisible. This layer is required for security against a risk at a stage of elaboration of thorax of insect. General appearance of thorax at a completing of fulfillment of stage and the hierarchy of layers are presented in figures 318-319.
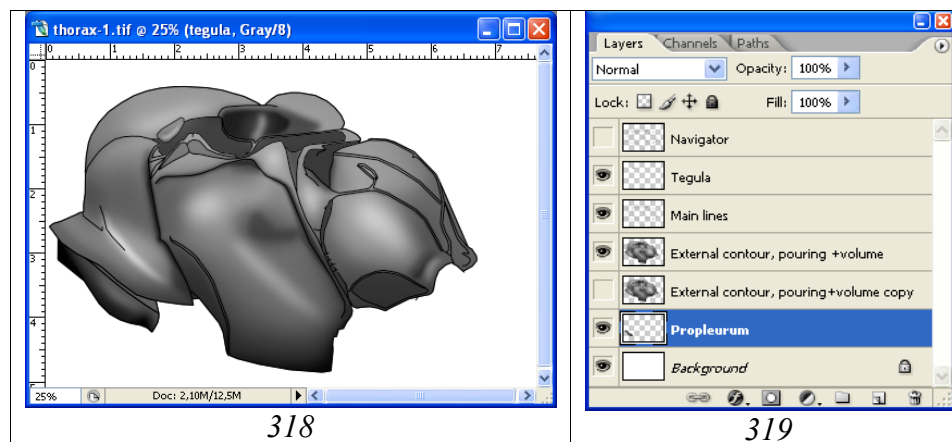
318   *319*

Fig. 318-319: Thoracal part of ichneumon fly in the final stage on giving to object of volumetric appearance: (**318**) general view of thoracal part at disconnected layer "Navigator", (**319**) hierarchy of layers.

Sculpturation (elaboration)

It is necessary to repeat that the essence of approach to fulfillment of operations of sculpturation (elaboration) consists in carefulness of execution of structural peculiarities at high-magnification of object. Often, the details of a sculpture that fulfilled at the high-magnification are not visible on the image of the final size. However, the similar approach has as the result, maximally possible natural image of an object.

A fulfillment of operation is begun, as it is described earlier, from creation of empty layers for operation: "Clarification of interspaces", "Punctures", "Wrinkles", "Light punctures" and "Small punctures", disposed in strict hierarchy, from bottom to top.

A choice of strategy of sculpturation

"…surface of pronotum in lower half smoothly-wrikled, in upper one with smoothed punctures, polished; ribs at hind border of pronotum practically not expressed".

Proceeding from features of sculpture of pronotum the methods of elaboration of its sculpture have the mixed character. At the first stage, the drawings of wrinkles are fulfilled by instrument Polygonal Lasso Tool with the selected parameter of Feather. Then, pouring of the selected wrinkles by means of instrument Paint Bucket Tool by black color in layer "Wrinkles" is fulfilled simultaneously (fig. 320). In the given example, a value of parameter Feather varied from 4 to 8px depending on relief of structures. Subsequently, all the wrinkles can be easily contrasted by selecting them and then using the function Brightness/Contrast, as they are in a separate layer.

After finishing of operation of pouring of the wrinkles, the puncturation of pronotum in a layer "Punctures" is fulfilled. The upper half of pronotum is punctured by means of brush with the selected shape and parameters Hardness and Spacing, as it is described in section on elaboration of a head of object. For the given operation it is convenient to use the pen of Pen Tablet. In our example, puncturation is fulfilled by the elongated punctures of 27px (parameter Hardness=0% and Spacing=100-300%). At a following stage the general clarification of punctures (Brightness/Contrast) is fulfilled and then of separate areas, as it is shown in frigure 321. The following stage is shading of punctures (giving to them of volumetric appearance) according to the chosen conditions of lighting of object. A shading of punctures can be fulfilled by two ways and it is perfomed in the same layer (Punctures). 1 – Color (saturation) of brush is selected by clicking by the mouse on area, adjacent to the puncture (at pressed Alt key). Then, by means of instrument Brush Tool with selected color, bottom part of the punctures is clarified in accordance with the selected lighting. Brush Tool parameters remain former, same as at puncturation of surfaces (see above). 2 – Other way is usage of instrument Eraser Tool. At usage of the named tool, in palette Brushes, the same parameters, as at fulfillment an operation in the layer "Punctures" are established (parameters: Angle=130º, Roundness=64%, Hardness=0% and Spacing=100-300%). At the same time, diameter of a brush is done a little smaller (for example 22px). The results of the described actions are presented in figures 322-323 at the disconnected layer "External contour, pouring+volume".

At a following stage an operation on clarification of interspaces (in layer "Clarification of interspaces") is fulfilled. Because a surface of pronotum is polished, method of

arbitrary selection (Lasso Tool) in the working layer ("Clarification of interspaces"), which situated under the darkened structures, is chosen. By means of instrument Lasso Tool with parameter of Feather=5-7px and at pressed key Shift (the usage of Pen Tablet is desirable) the most of shining sites are selected. Then, simultaneously, the selected areas with tool Paint Bucket Tool are poured by grey color (having chosen in palette Swatches value of Gray=10%) (fig. 324). The following step is contrasting of the clarified areas, depending on a direction of lighting and the volumetric shape of an object. For this purpose, the separate parts in a layer "Clarification ..." are selected by instrument Polygonal Lasso Tool with diffused contour (big value of Feather). Then, the selected areas are contrasted by means of function Brightness/Contrast, achieving necessary effect (fig. 325).

Following actions are directed on fulfillment of the small bright (central) points in a layer "Light punctures", located over a layer "Punctures". Operation is perfomed with instrument Brush Tool, having selected diameter and a minimum value of Hardness in palette Brushes. Setting of considerable value of parameter Spacing for prevention of merging of points is also desirable, especially at usage of Pen Tablet. The considerable value of this parameter is especially important in the cases, when fulfillment of plural puncturation is necessary. After fulfillment of operation, brightness of points is regulated in the same layer by function Brightness/Contrast, having selected preliminary, required areas by instrument Polygonal Lasso Tool with parameter of Feather of considerable size (for example 30px) (fig. 326).

The surface of pronotum is not ideally smooth. For elaboration of pronotum relief, separate areas of its surfaces are selected, having chosen parameter of Feather. Then, by means of function Brightness/Contrast, the separate areas are darkened or clarified in the basic layer "External contour, pouring +volume" (fig. 327). The separate elements of the fulfilled structures located in separate layers can go beyond the limits of borders of pronotum. For deletion of these sites, all parts of a thorax, adjacent with pronotum are selected by instrument Magic Wand Tool with parameter Feather=0 and at pressed key Shift, in layer "Main lines". After selection, in each of layers with sculptural formations, superfluous areas are deleted, by pressing key Del (fig. 328). The hierarchy of the layers necessary for fulfillment of operations on elaboration of thorax is presented in figure 329.

"...notauli not developed;...surface of mesonotum punctured by big smoothed punctures, polished; axillary tongue not developed;...".

For puncturation of mesonotum, an instrument Brush Tool is selected. Parameters of Brush Tool – Angle, Roundness and Hardness – are selected according to puncturation of mesonotum that observed at object. Operation is fulfilled in layer "Punctures". Parameter Spacing is selected in such manner that would to fulfill an automatic puncturation at pressed key Shift with usage of mouse. At puncturation of mesonotum, using of pen of Pen Tablet is preferably.

Separate parts of punctures usually can go beyond the limits of borders of mesonotum at puncturation of its dorsal part. For deletion of these areas it is necessary in layer Main lines (doing it as working) to click instrument Magic Wand Tool (Tolerance=0) on space outside of thorax, having selected it along external border.
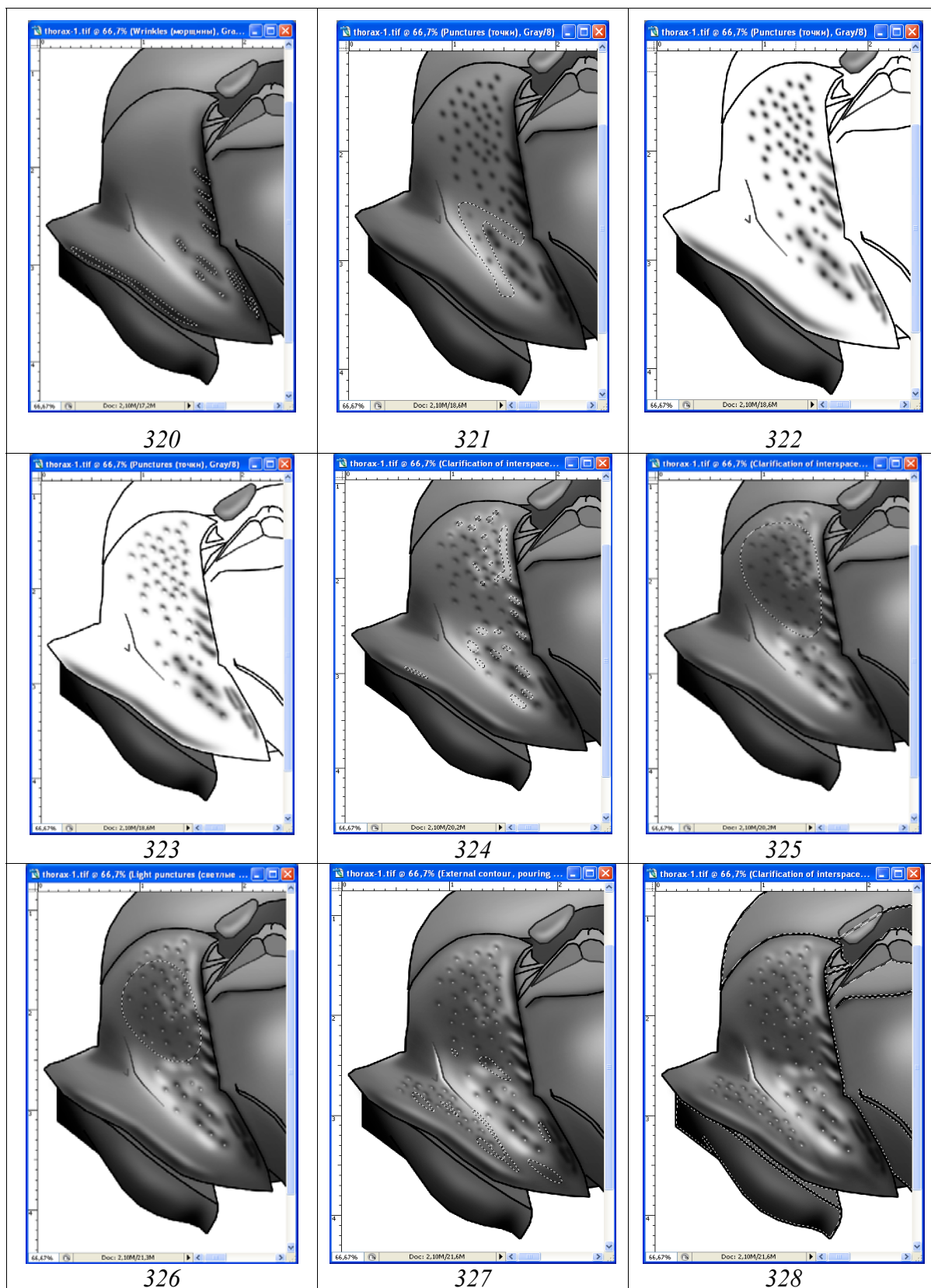
Fig. 320-328: Stages of elaboration of a sculpture of prothorax: (**320**) fulfillment of smoothed wrinkles, (**321**) puncturation of pronotum and its contrasting, (**322-323**) shading of punctures by instrument Eraser Tool, (**324**) clarification of interspaces, (**325**) contrasting of clarified areas, (**326**) regulation of brightness of light points, (**327**) elaboration of relief of surface of pronotum, (**328**) elimination of areas of the sculptural formations overstepping the limits of pronotum.
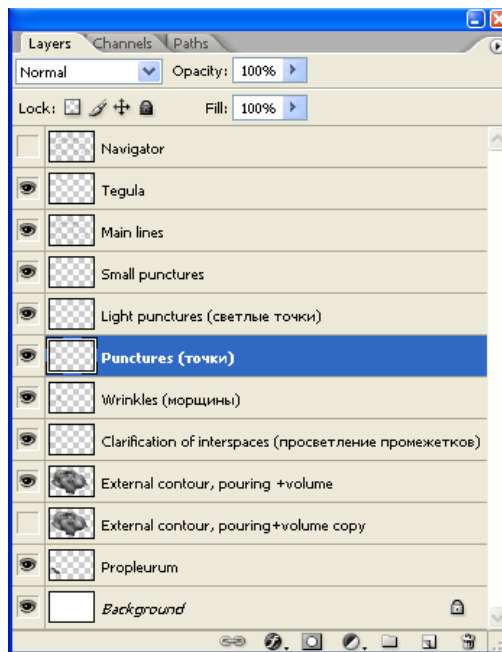
Fig. 329: Hierarchy of layers at elaboration of thorax.

Then layer "Punctures" is marked as the working and "flaws" are deleted by the key Del (fig. 330). Punctures are fulfilled as in detail described above at pronotum puncturation description. Surface of mesonotum in intervals between punctures is polished. Therefore, for representation of this character in layer "Clarification of interspaces", according to the volumetric appearance of a thorax, an area with parameter Feather approximately 30px is selected. Then, by means of instrument Paint Bucket Tool a pouring by grey color (10%) is fulfilled. Without deselection, poured area is contrasted by means of function Brightness/Contrast up to achieving a necessary effect (fig. 331).

> "…prepectal carina sharp, at apex only just reach front margin of mesopleurae; subalarum normal, high, not sharpened; speculum smooth, shining with sparse punctures; area of mesopleural fovea deeply and broadly impressed forms with mesopleural suture unit impression to hind margin of mesopleurae; mesopleural suture interrupted by weak ribs; lower part of mesopleurae not separated angularly; sternauli not expressed; upper part of mesopleurae densely punctured by smoothed only just merged oblonged punctures, lower one smoothly wrinkly-punctured; surface of mesopleurae shining, without microsculpture;…".

After that, by instrument Paint Bucket Tool, the simultaneous pouring by black of all selected areas by mouse double click (for the maximum darkening) is fulfilled (fig. 332). After pouring, without removing selection, all the selections are moved downwards at switched on instrument Lasso Tool, having pressed the left mouse button. The shift is fulfilled proceeding from the selected direction of illumination of an object. In subsequent, the lower parts of punctures are clarified by a function Brightness/Contrast, achieving necessary volumetric effect (fig. 333). The general contrasting of sculptural peculiarities of different areas of mesopleurae will be fulfilled after finishing of operations on their sculpturation.
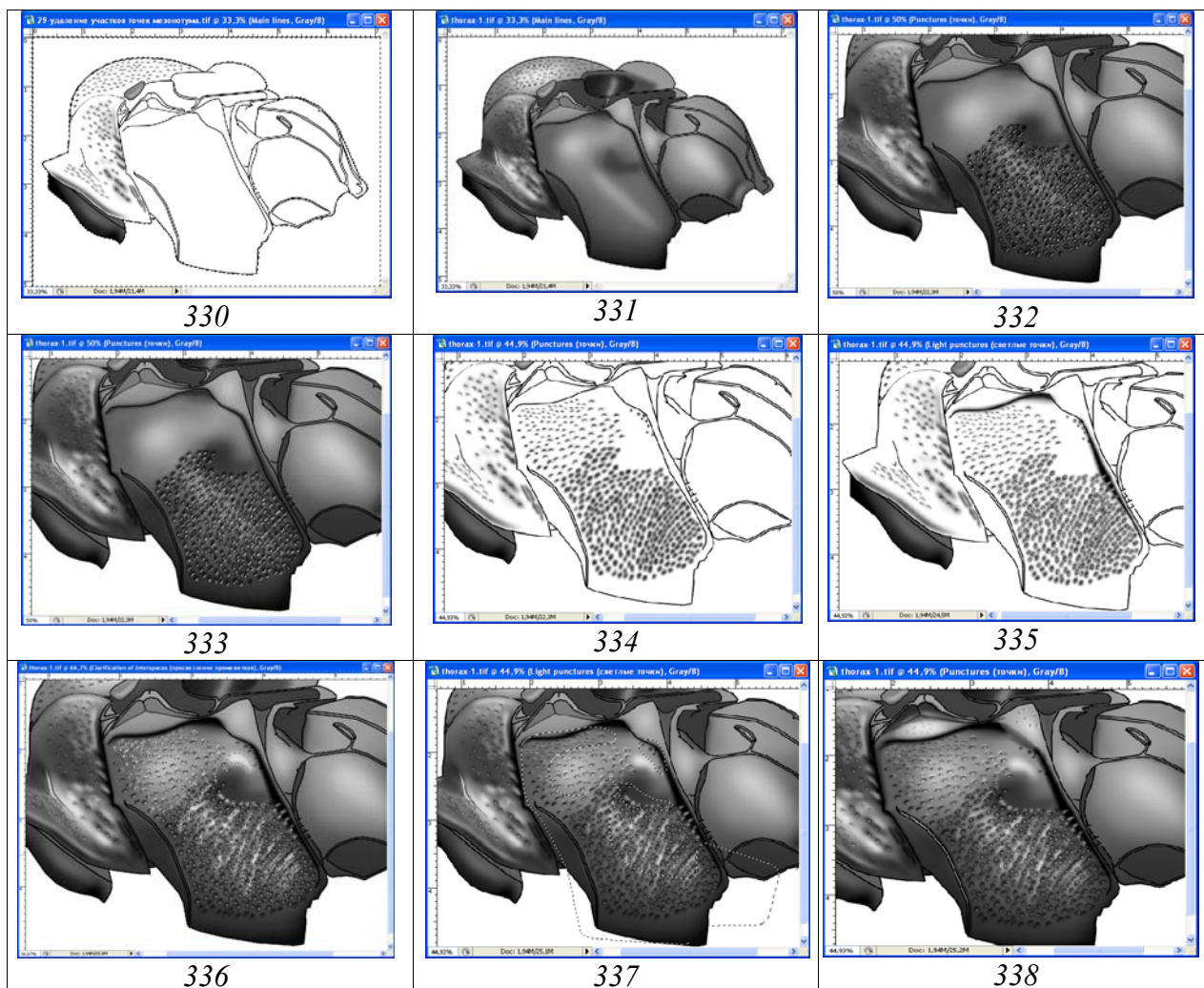
Fig. **330-338**: Sequence of operations on elaboration of mesothorax: (**330**) elimination of areas of punctures overstepping the limits of segment, (**331**) clarification of mesonotum, (**332**) fulfillment of puncturation by instrument Lasso Tool, (**333**) shifting of selected areas and contrasting of puncturation, (**334**) giving of volumetric appearance to punctures in upper half of mesopleurae by means of deletion of theirs lower parts by instrument Eraser Tool, (**335**) light points and elaboration of mesopleural suture, (**336**) operations on clarification of interspaces, (**337**) contrasting of the clarified interspaces, (**338**) result of elaboration of sculpture mesopleurae surface.

The upper half of mesopleurae and certain fields of the lower half are punctured with usage of instrument Brush Tool with parameters corresponding to the form and diameter of the punctures. It is necessary to mark especially, that the sequence of operations in one layer should be such: at first, puncturation by means of selection, thereafter puncturation by means of instrument Brush Tool. This order prevents the overlapping borders of fuzzy punctures, that were fulfilled by means of selection tools with the punctures, that fulfilled by Brush Tool. Puncturation of the upper half of mesopleurae is fulfilled by means of elongated points with diameter from 17 to 27px, having installed parameter Spacing=180% and Hardness=0. When performing of operation, the rotation angle of points (parameter Angle) is changed. The following step is

shaping of volumetric appearance to punctures by means of deletion of theirs inferior parts by means of instrument Eraser Tool with the parameters corresponding to parameters of Brush Tool that were used for fulfillment of puncturation (fig. 334). Following step is fulfillment of light points in layer "Light punctures" over the layer "Punctures" as it has been described when puncturation of pronotum.

In layer "Wrinkles" the structural peculiarities of the deep mesopleural suture interrupted by weak ribs are performed. Area of mesopleural suture is limited by instrument Polygonal Lasso Tool with parameter of Feather 5px, proceeding from peculiarities of morphology (see above). In the same way and area under subalarum is limited. After that, simultaneous pouring by black color by means of instrument Paint Bucket Tool is fulfilled. Weak ribs, which interrupt mesopleural suture are performed in the same layer by means of instrument Lasso Tool. Then they are clarified by means of function Brightness/Contrast. After that, without removing selection, layer "Main lines" is marked as the working and the complete deletion of superfluous lines is achieved by Del key press (fig. 335).

At the final stage of sculpturation of mesopleurae, the operations are fulfilled in a layer "Clarification of interspaces". Operations in this layer are necessary for underlining of the polished surface of mesopleurae. For the lower part of mesopleurae smoothly-wrinkled and for upper one – punctured sculpture are characteristic. Therefore, the selections in the mentioned working layer are performed by instrument Lasso Tool (at pressed Shift key). In the lower half, the selections are fulfilled in the form of longitudinal areas, and in upper half, in the form of roundish areas. Value of parameter Feather in a considered example varied in interval of 3-10px. The selections in areas of wrinkles are 5px, areas of punctures – 3px and of speculum – 10px (fig. 336). After finishing of operation of selection of all areas, their simultaneous pouring by grey color (10%) by instrument Paint Bucket Tool is fulfilled. Further, all light structures in the layers "Clarification of interspaces" and "Light punctures" are contrasted according to the volumetric image of a thorax (layer "External contour, pouring +volume") (fig. 337).

At the final stage of elaboration of mesopleurae, prepectal carina, subalarum, subalar tubercle and other parts of a segment are elaborated in detail additionally. Separate lines of a contour in a layer "Main lines" are contrasted. Correction is fulfilled in different layers and in the basic layer – "External contour, pouring +volume". At correction of prepectal carina, its inner part is selected by instrument Magic Wand Tool in a layer "Main lines". After that, without removing selection, as the working layer "External contour, pouring +volume" is marked. Then, inner part of prepectal carina is clarified by function Brightness/Contrast. The result of elaboration of mesopleurae (except shallow points) is presented in figure 338.

Propodeum is the most complicated for fulfillment by sculpture a part of body of ichneumon flies. At the same time, a species used as an example, has the least complex sculpture of surface of propodeum.

"Propodeum from lateral roundly slanted backwards; all carinae of propodeum developed; costulae weak; areae dentipara without teeth at apex, only with broadened transversal carina; lateral

longitudinal carina practically parallel to carina metapleuralis; spiracles long, 2,3 times longer than width along external contour. Surface of propodeum, from punctured in front from costulae by big smoothed punctures to wrinkly-punctured area dentipara and area posteromedia, shining; area basalis and area superomedia not sculptured; area spiraculifera from wrinkly-punctured behind spiracles to densely punctured by merged punctures in front of them; metapleurae punctured by big smoothed punctures, shining.".

Elaboration of propodeum is begun from darkening of the lower borders of carinae of propodeum. By means of instrument Polygonal Lasso Tool, with the selected value of parameter Feather, the areas destined for pouring are fulfilled in a layer "Wrinkles" according to the volumetric form of an object (selected lighting). The upper border of selected area should protrude beyond the lower border of the contour of carina. Simultaneously the areas of several carinae (see area spiraculifera) are selected. After selection of all fields (at pressed Shift key) simultaneous pouring of all selected areas by means of instrument Paint Bucket Tool by black color is fulfilled (fig. 339). The following step is deletion of superfluous darkened areas, overlapping an area of contour of carinae. In working layer "Main lines", all inner areas of contour of carinae are selected by instrument Magic Wand Tool by clicking mouse on theirs internal part. After selection, to a layer "Wrinkles" is moved, doing it as a working. Then, a key Del is pressed. Superfluous parts of the darkened areas are deleted, releasing central parts of carinae' contour (fig. 340). Further in layer "Main lines" an inner part of carinae contour is selected. Then to a layer "External contour, pouring volume" is moved and the selected areas are clarified by means of function Brightness/Contrast.

Surface of propodeum is sculptured generally by the punctures of different size, which often are merged in a hind half of horizontal part of Propodeum and on area spiraculifera and by large, sharp and smoothed on metapleurae punctures. Therefore, at a following stage, in a layer "Punctures" by means of instrument Lasso Tool with a help of pen of Pen Tablet the drawings of all punctures of a segment are fulfilled completely (at pressed Shift key). Parameter Feather is selected beforehand, trying different variants, depending on the size and a degree of a smoothness of punctures. After finalization of selection, all selected areas simultaneously are poured by black color by means of instrument Paint Bucket Tool (fig. 341). Further, fulfillment of operation on giving to punctures of volumetric appearance is begun. Without removing selection, on a toolbar again instrument Lasso Tool is activated. Then, having pressed the left mouse button all selected areas are shifted downwards. Further, by means of function Brightness/Contrast, the inferior parts of punctures are clarified, giving them of volumetric appearance (fig. 342). Operation on puncturation is completed by selection and contrasting of separate groups of punctures by means of function Brightness/Contrast in according to a general appearance of a segment.

The following stage is clarification of interspaces in a layer "Clarification of interspaces" which is situated under a layer "Punctures". Operation can be fulfilled by two paths. Selected previously areas are shifted upwards, controling a direction, depending on the chosen lighting. Then, at pressed Shift key, the additional areas for a clarification are drawn in details by means of instrument Lasso Tool. In other variant, the previous selections are removed and new ones are fulfilled according to observable

under a microscope. The selection is fulfilled manually for each point separately by means of instrument Lasso Tool. After finishing of selection of all necessary parts, all selected areas are poured by grey color (usually having chosen in window Swatches Gray=10%) by means of instrument Paint Bucket Tool (fig. 343). After fulfillment of pouring, the separate areas of a clarification are selected. Then theirs are contrasted by darkening or clarifying them by means of function Brightness/Contrast in accordance with general view of an object.
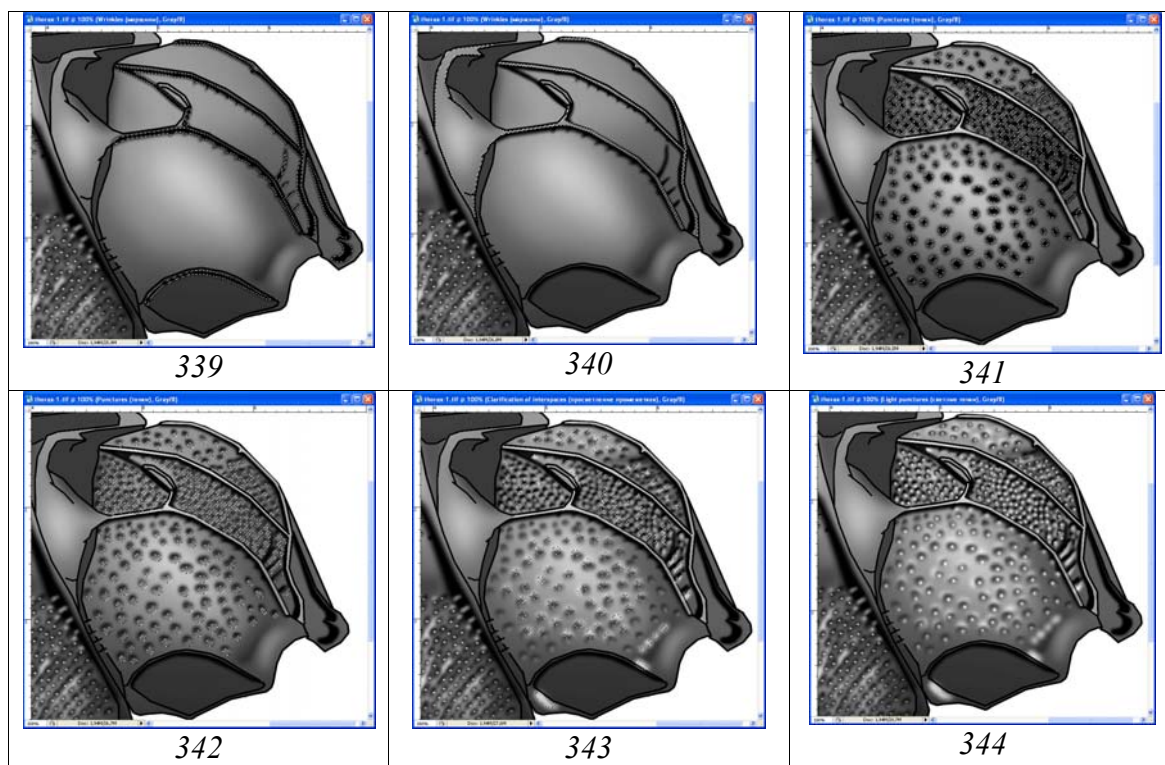
Fig. 339-344: Stages of elaboration of propodeum sculpture: (**339**) darkening of lower borders of carinae of propodeum, (**340**) removal of superfluous parts of darkened areas, which covered the areas of a contour of carinae, (**341**) fulfillment of puncturation of propodeum by instrument Lasso Tool, (**342**) giving to punctures of volumetric appearance, (**343**) clarification of interspaces, (**344**) fulfillment of light central points.

The following stage is fulfillment of light central points in a layer "Light punctures". In palette Brushes the necessary parameters of a brush (Diameter, Hardness) are selected. Considerable values of parameter Spacing for prevention of merging of points are installed and an operation is fulfilled by the pen of Pen Tablet. Usually in palette Swatches a value Gray=10 of % is chosen. After fulfillment of operation, the separate areas of light points are selected. Then, these areas are contrasted, darkening or clarifying them by means of function Brightness/Contrast, in accordance with general view of propodeum (fig. 344).

At the final stage, the remained parts of thorax – metanotum, carinal triangle, propleuron, scutellum, etc. are finished. Surface of thorax is not ideally smooth. Therefore,

separate structures are elaborated additionally by instrument of selection with use of function Brightness/Contrast in a basic layer "External contour, pouring+volume". In a layer "Main lines", parts of a contour with more light areas, for example scutellum, are selected and contrasted with use of function of Brightness/Contrast. And, at last, in a layer "Small punctures", by instrument Brush Tool, the image is completed by means of small points, giving to this part of a body of the ichneumon fly "natural appearance".

At the given stage a file with the image of thorax includes 13 layers (fig. 347).

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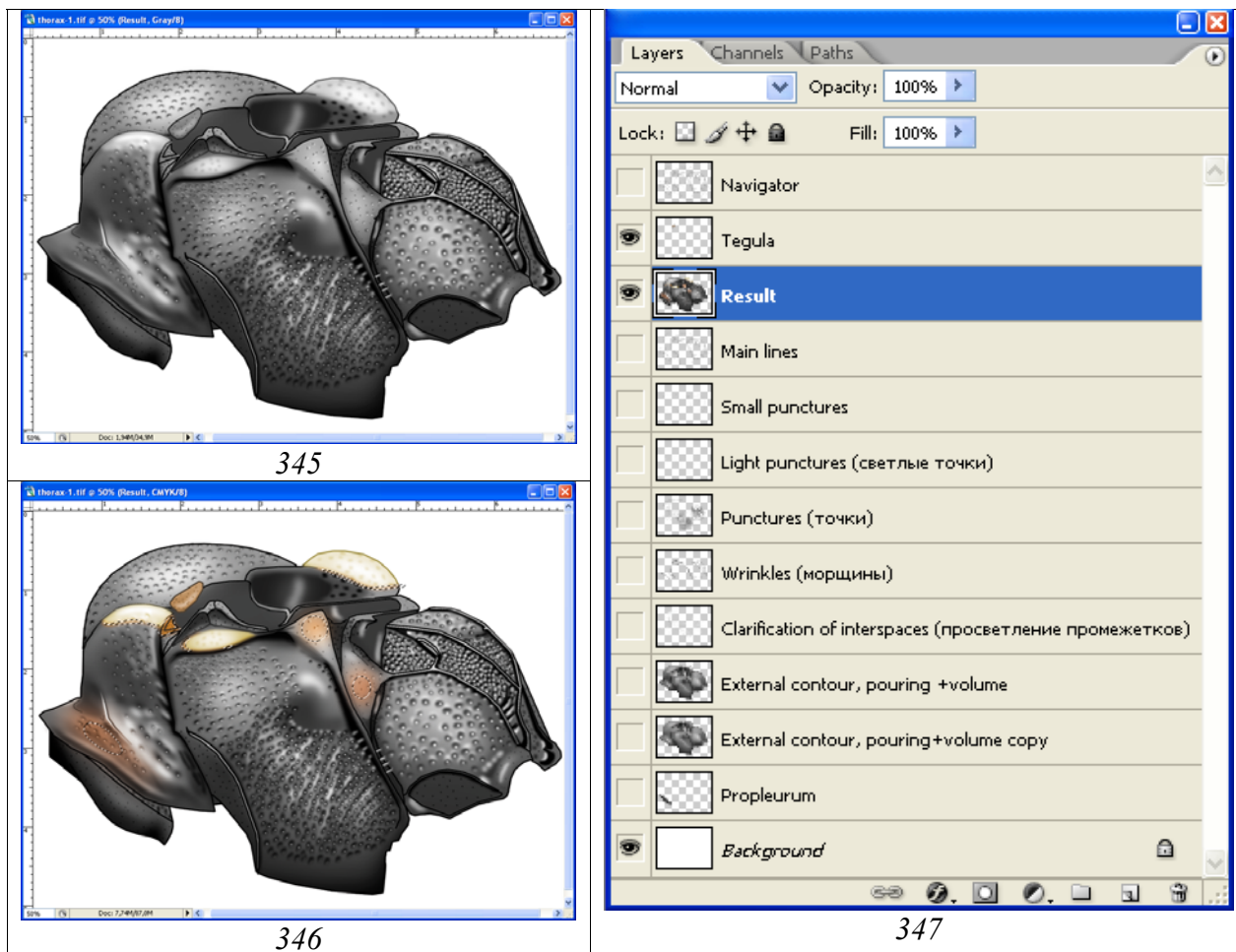
Fig. 345-347: Coloring of thoracal part of ichneumon fly imago: (**345**) initial image in format Grayscale, (**346**) result of fulfillment of operations of coloring of thorax, (**347**) hierarchy of layers in the final file "thorax.tif" (CMYK).

As mentioned in the introduction, you need to save the maximum possible number of layers. It is necessary not only for correction in the future, if such necessity arises, but also for usage of separate images (for example "Main lines" or "Navigator") for an illustration of characters in identification keys or for illustrations at the comparative analysis of features of morphology of different taxa.

At transition to a following stage – coloring of object – merging of some layers is necessary to fulfill. At merging of layers of thorax, in palette Layers "eye" in layers "Navigator", "Tegula", "External contour, pouring+volume copy" and in a layer

"Background" is removed. Then a command Merge Visible (Shift+Ctrl+E) is fulfilled. Merged layer is selected by command Ctrl+A. Then it is copied to the buffer (Ctrl+C). After that, as it is already described above, by the menu command: Edit-Step Backward (Alt+Ctrl+Z), all previous actions are canceled, returning into place all layers merged earlier. Then, merged image of a thorax is inserted from the buffer under a layer "Tegula" by command Ctrl+V. The layer is labeled as "Result" (fig. 347). In the resultant layer, by means of instrument Polygonal Lasso Tool with the selected parameter of Feather, areas with light coloring (an upper edge of pronotum, spot on subalarum and scutellum) are selected. Then they are clarified by means of function Brightness/Contrast (fig. 345). The file "thorax" is ready to fulfilment of operations of coloring.

C o l o r i n g

The first step is conversion of a file from regime Grayscale into regime CMYK (Menu: Image–Mode–CMYK Color).The main areas – upper margin of pronotum (pronotal rige), most part of subalarum and scutellum have pale yellow coloration. Some areas of thorax have brownish black shade. At first, having chosen value of parameter Feather, the areas of pale yellow coloration are selected. Then, not removing selection, operation on coloring of the selected areas is fulfilled. In palette Swatches pale yellow color is chosen. Further, an operation on coloring of the selected areas is performed: Image–Adjustments–Hue/Saturation (Ctrl+U). In pop-up dialogue window Hue/Saturation by means of cursors (sliders), color tone and a saturation of the selected parts are selected. At fulfillment of operation, it is necessary to remember, that in window Colorize, a tick should be put. At a following stage, brownish transitive zones between pale yellow spots and the basic part of thorax are selected with small value of parameter Feather. These transition zones are colored by the same method. Parts of a thorax with brownish shade (for example lower part of sides of pronotum) are selected, setting down great values of parameter Feather (diffused selection). Then, the selected areas are colored in the similar way (fig. 346).

Tegula of object is also of brown color. It is in a separate layer that is necessary for subsequent "assemblage" of imago. Therefore, operation on giving to it coloring is fulfilled separately, having removed selection and having marked a layer "Tegula" as working.

Legs

C o n t o u r d r a w i n g of legs is fulfilled by means of vectorial instrument Line Tool by the method described above. Peculiarity of preparation of contour drawing of legs is as much as possible complete division of leg on component parts. It is necessary for final "assemblage" of imago of insect and to giving to legs of standard position. Contour drawings of coxae, trochanters+femorae, tibiae and tarsi are usually fulfilled separately (fig. 348-350). Parts of legs are performed or in separate layers, or in one layer, but on considerable distance. It is necessary for prevention of influence of

diffused selection on the neighboring fragments in the process of operation on giving to the segments of legs of volumetric appearance.

After fulfillment of a contour of segments of legs, a layer "Matrix" is deleted. File is converted to mode Grayscale and the contour lines are darkened as much as possible. In a case if segments of legs are located compactly the size of a canvas is increased, or in the Menu: Image-Canvas Size, or having clicked the right button of the mouse on a top of document (document window title) and having chosen Canvas Size. After that, a segment is selected by instrument Polygonal Lasso Tool with parameter Feather=0. Then segment is moved to the necessary place of a canvas by means of instrument Move Tool (V) (fig. 348).

Working layer is duplicated. The final file with contour drawing of legs consists of three layers: "Navigator", "Main lines" and "Background". In layer "Main lines", all contour lines which will not be visible in final image are deleted. Layer "Main lines" is duplicated. One of the duplicated layers is used for pouring and giving to object of the volumetric appearance. The layer name is "Main lines … pouring … volume". Upper layer, "Main lines", in the subsequent is contrasted (to clarify) according to an underlaying layer "Main lines … pouring … volume" for giving to object the maximal definition. In a layer which serve for pouring, superfluous lines are selected by instrument Polygonal Lasso Tool (Feather=0) and deleted, leaving only an external contour.

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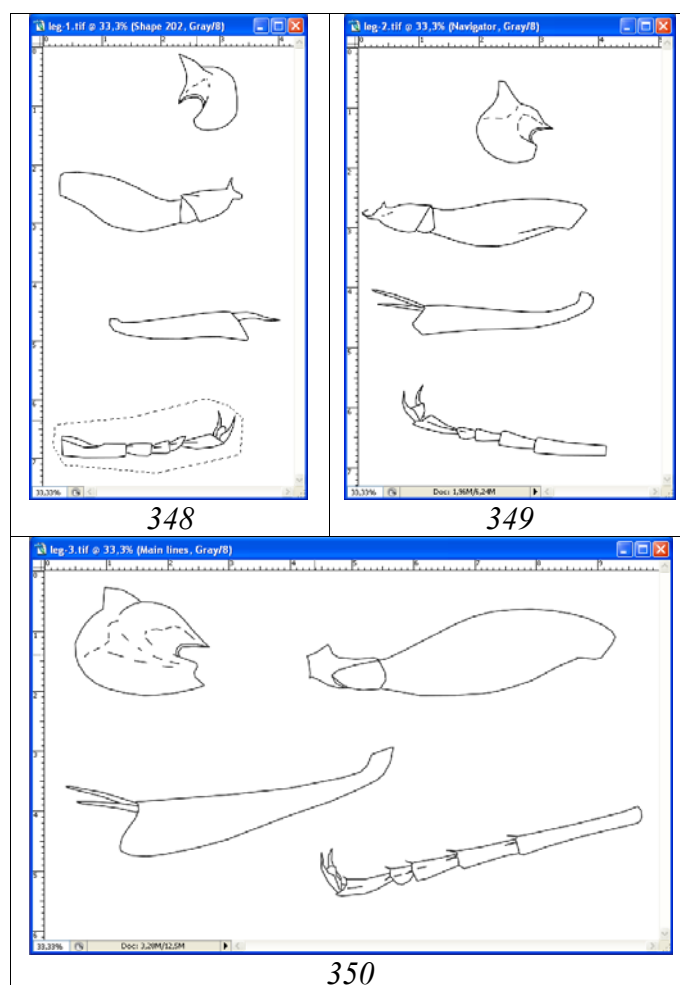
Fig. 348-350: Layer "Navigator" in files with a contour drawing of legs of imago: (**348**) leg-I, (**349**) leg-II, (**350**) leg-III.

P o u r i n g in a layer "Main lines … pouring … volume" is fulfilled by instrument Paint Bucket Tool (G) having chosen in palette Swatches Grey color (55%). It is necessary clicking some times by the mouse on area of pouring up to disappearance of light border with an external outline of each segment.

G i v i n g to legs of ichneumon fly of v o l u m e t r i c a p p e a r a n c e is fulfilled as it is described above for other parts of a body, with using instrument Polygonal Lasso Tool. Darkening of peripheral sites is begun with use of selection, with considerable values of parameter Feather (from 50px). An external border of area of selection as it is possible further transcends the borders of object. At the subsequent selections, hardness of selection is increased by reducing of values of parameter Feather in a process of displacement of zone of selection to the borders of object. At certain stages of operation fulfillment when the object becomes too dark, the general clarification of the whole of layer is performed (Brightness/Contrast). After all actions on darkening of peripheral areas, a clarification of the most convex parts of segments is fulfilled, having selected suitable value of parameter Feather. The saturation of coloration of separate segments of tarsi or trochanters is possible to change by means of operation Brightness/Contrast, pre-selecting them by means of instrument Magnetic Wand Tool in layers "Navigator" or "Main lines". In the subsequent, a saturation of separate segments is contrasted according to their coloration. Lines of the layer "Main lines" are contrasted also according to underlying layer with the volumetric image. At the final stage the legs of object are in three files, each of which includes 4 layers. The general view of result of the fulfilled operations and hierarchy of layers are presented in figures 351-354.
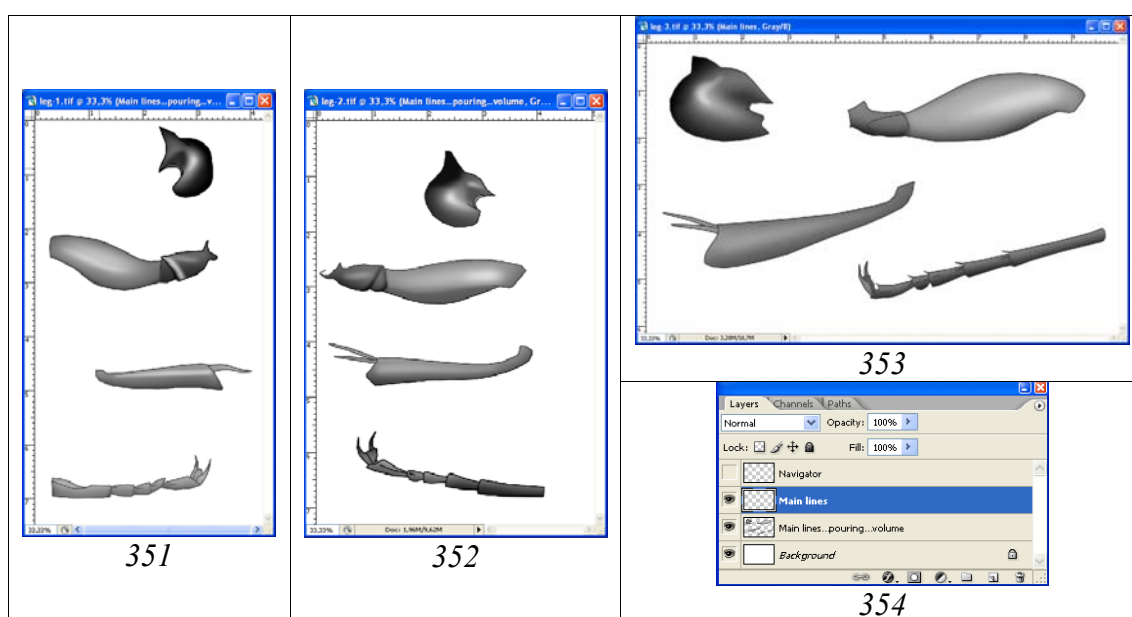
351   *352*   *353*

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At transition to a following stage – "Detailing", a layer "Main lines…pouring…volume" is duplicated for secure and stored in a layer "Main lines … pouring … volume copy".

Notes: A whole number of ichneumon flies possesses the legs with light rings or stripes on tibiae or tarsi. At such species at a stage of giving to object of volumetric appearance these peculiarities are drawn using the instrument of selection Polygonal Lasso Tool, having selected the appropriate parameter Feather. After clarification in a layer "… volume", selection is not removed. Then layer "Main lines" is marked as a worker. In this layer, the contour lines are clarified, changing their saturation.

E l a b o r a t i o n of the legs of ichneumon fly usually comes down to detailing of punctration of various sizes, spinules, in a case of their presence, etc. (fig. 355-357). The object that used as an example has only more or less noticeable puncturation of hind coxae and weak spinules on hind tibiae. Therefore, elaboration of legs of object is largely confined to shallow punctation and contrasting the external contour of legs in layer "Main lines". Proceeding from the real sizes of total image of imago (in this case 1:1 with the image in the table of format A4) following parameters of a brush for small punctures are chosen: Diameter=4px, Hardness=10px, Spacing=250%. At clarification of contour lines in a layer "Main lines" the most light parts are selected. Then they are clarified by means of function Brightness/Contrast up to reception of necessary effect. Results of operations are presented in figures 355-357.

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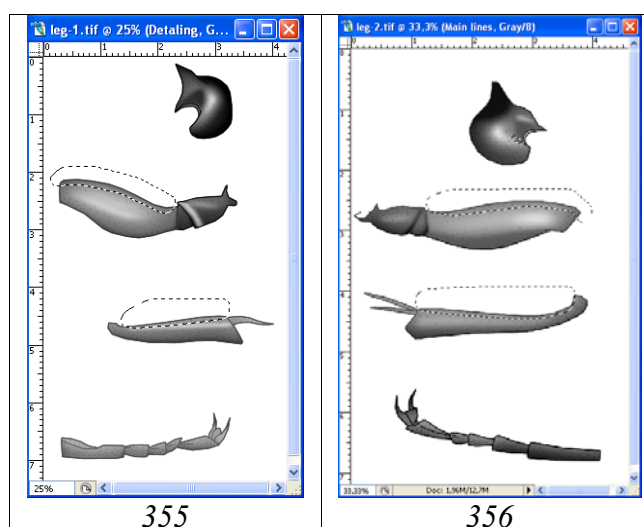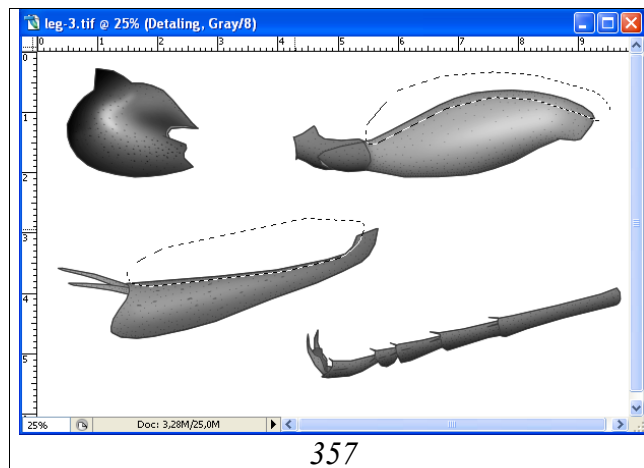
Fig. 355-357: Elaboration of details (puncturation and clarification of external contour): (**355**) leg-I, (356) leg-II, (**357**) leg-III.

Coloring

"Legs with the exception of coxae and trochanteres brown-red; front tibiae outside with a yellowish strip…".

Before the operation beginning on coloring, standard procedure on merging of layers with preservation of all intermediate layers is fulfilled. Layers "Navigator" and "Background" are disconnected. Then a command Merge Visible (Shift+Ctrl+E) is performed. Then a merged layer is selected and copied to the buffer (Ctrl+A–Ctrl+C). Thereafter all previous actions are canceled by command Menu: Edit–Step Backward (Alt+Ctrl+Z), returning into place all intermediate layers. Further, integrated image that is stored in the buffer is inserted over intermediate layers (Ctrl+V) having given to it a name "Result" (fig. 362).

File is converted from mode Grayscale to CMYK (Menu: Image–Mode–CMYK Color).

Before fulfillment of operation on coloring, parts of legs with identical coloration are selected by instrument Polygonal Lasso Tool (Feather=5px) (fig. 358-360).

Having chosen in palette Swatches primary color (for example Darker Red Orange) a coloring of the selected parts is begun (Menu: Image–Adjustments–Hue/Saturation; Ctrl+U). In dialogue window Hue/Saturation in window Colorize a tick is placed and a necessary coloration of the selected areas is achieved by movement runners (cursors) (fig. 361). Control of object under a microscope is obligatory.

The hierarchy of layers in a final file is presented in figure 362.
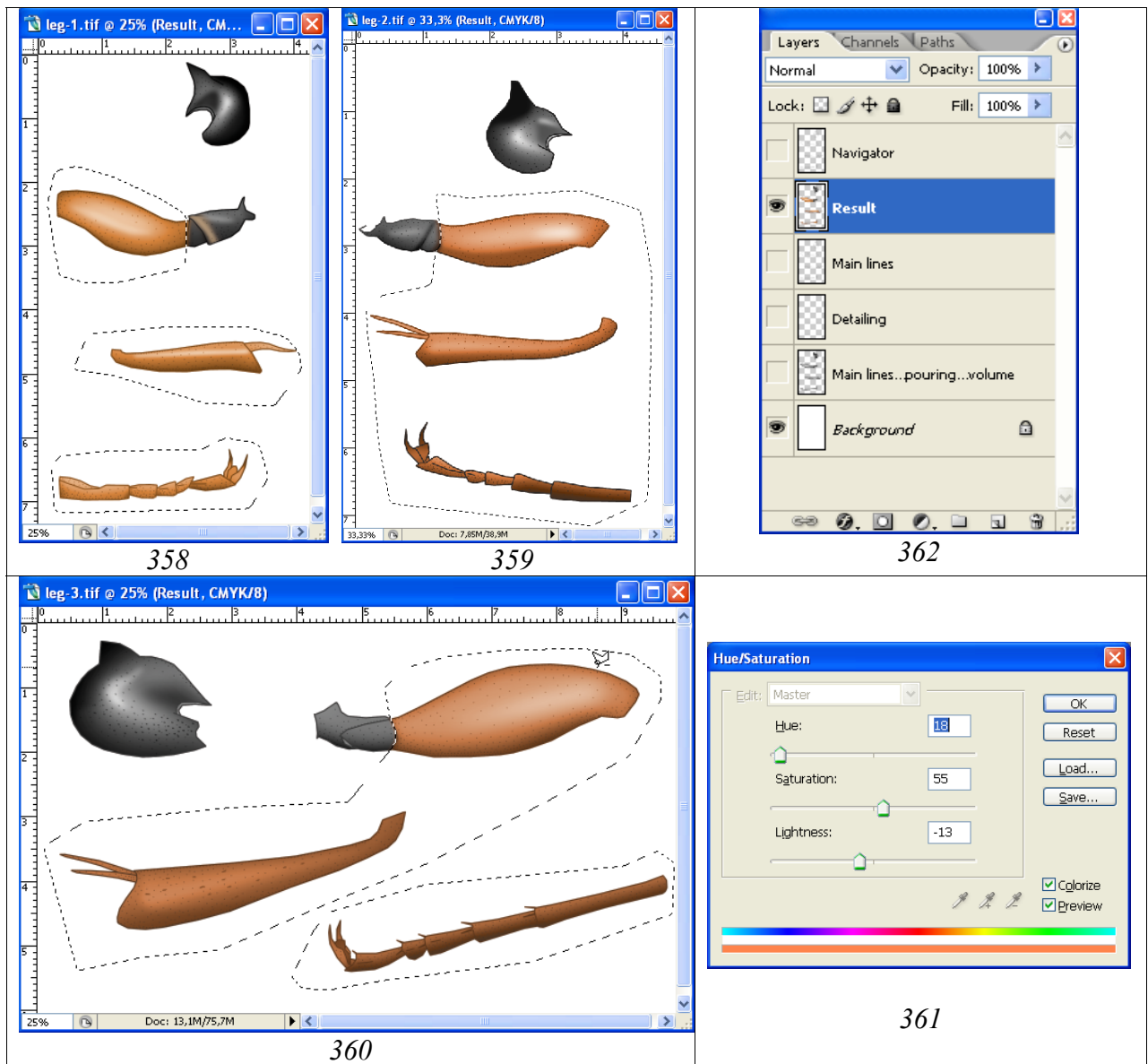
Fig. 358-362: Coloring of legs: (**358**) leg-I, (359) leg-II, (**360**) leg-III, (**361**) dialog box Hue/Saturation, (**362**) hierarchy of layers.

Wings

C o n t o u r of wings (a pencil contour) has been fulfilled on the basis of a matrix prepared by means of projecting tools, scanning, or the digital camera. At the first stage, the size that proportional to length of a body of final image is given to the matrix, increasing or reducing its picture. At the given stage front and hind wings are in one file and layer that is necessary for preservation of a real ratio of the sizes both of wings at changing of the sizes of matrix. After change of the sizes of wings up to a final one, front and hind wings are copied to separate files. Further, the matrix of every wing is outlined by means of vectorial instrument Line Tool in a separate layer, as it is described above. Obligatory condition of fulfillment of a final contour is the constant control of object under a microscope. For demonstrativeness (taxonomical),

the thickness of veins should be increased in comparison with real one as it is described in the first part of work. Color of vectorial lines is selected proceeding from color and brightness of underlying matrix (a file is in mode CMYK or RGB) (fig. 363-368).
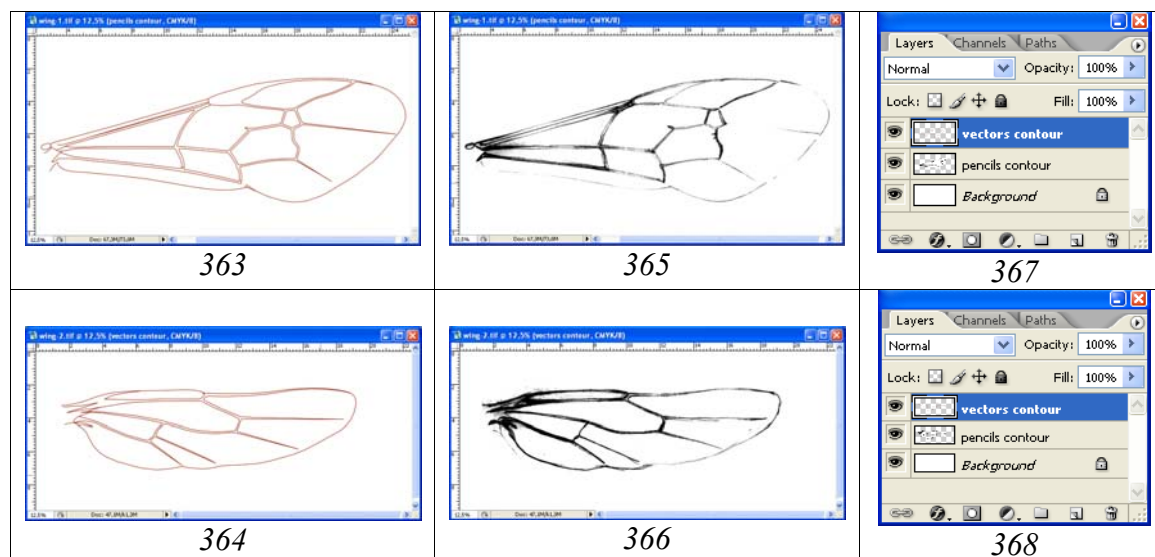
Fig. 363-368: Fulfillment of contour drawings of wings: (**363**, **364**) contour (vectorial) drawings of wings, (**365**, **366**) contour by pencil, (**367, 368**) hierarchy of layers.

The thickness of lines of outline (px) has considerable importance. It is chosen proceeding from the sizes of imago in the final table. If the wing contour is fulfilled by too thin lines, there is a danger of worsening of illustrativeness of image in the process of its considerable demagnification.

After fulfillment of all operations there are two files – "wing-1" and "wing-2", containing two layers, located one over another – "Contour" and "Matrix" (fig. 363-368).

At the final stage a layer "Matrix" (pencil contour) is deleted. The image is converted to mode Grayscale (Image–Mode–Grayscale). Then a contour drawing is darkened as much as possible (Image–Adjustments–Brigthness/Contrast).

E l a b o r a t i o n of wings is begun from converting of the files from mode of Grayscale to mode CMYK Color.

At first stage, a pouring of the veins of a forward wing by corresponding color is fulfilled. All veins before the beginning of works should be "closed". Therefore, first of all, the veins on absence of "ruptures" in the continuous lines are checked. Then, in palette Swatches, color the closest to most dark vein of object is chosen. Pouring of veins is fulfilled by means of instrument Paint Bucket Tool, having clicked some times by mouse by an internal part of veins up to disappearance of light border with contours lines (fig. 369).

The saturation of coloration of wings veins is different. Saturation of veins weakens backwards and towards the borders of wings. Saturation of veins coloration of the hind wings in a whole is weaker than of front ones. Therefore, following step is clarification of veins. Selection of areas of clarification is fulfilled by means of instrument Polygonal Lasso Tool. Parameter Feather is different for different areas of the wing. Value of parameter is selected by the method of tests. In figure 370, areas of selection with different values of parameter Feather are shown. Frontal part of costal vein – 15px, the central part of stigma – 30px and, at last, veins of a hind part of a wing – 60px. In figure 371 parameter Feather is varied on different areas from 5 to 25px. The selected areas are clarified by means of function Menu: Image–Brightness/Contrast up to achieving of necessary effect.

At the final stage, a hind margin of the wing which clarified in the previous operations is selected. Then, it is darkened by means of function Brightness/Contrast up to –100 (fig. 372).

Similarly, elaboration of a hind wing is being fulfilled. As already it was spoken above, veins of a hind wing are lighter. Therefore, the basic color of veins of a hind wing is selected from already prepared front wing. On the chosen area of front wing with selected color, the cursor in a form of instrument Paint Bucket Tool (at pressed Alt key) is directed. Necessary color is selected by clicking by the left button of the mouse. After that, by means of chosen color, "pouring" of veins of a hind wing is fulfilled.

After fulfillment of all operations, the ready image of a hind wing in a file "wing-2" is copied (Ctrl+A–Ctrl+C) and inserted into a file with the image of a forward wing "wing-1" (Ctrl+V). Then, the images of front and hind wings are united in one layer "wing 1+2" (Merge Visible, Shift+Ctrl+E) (fig. 373-374).

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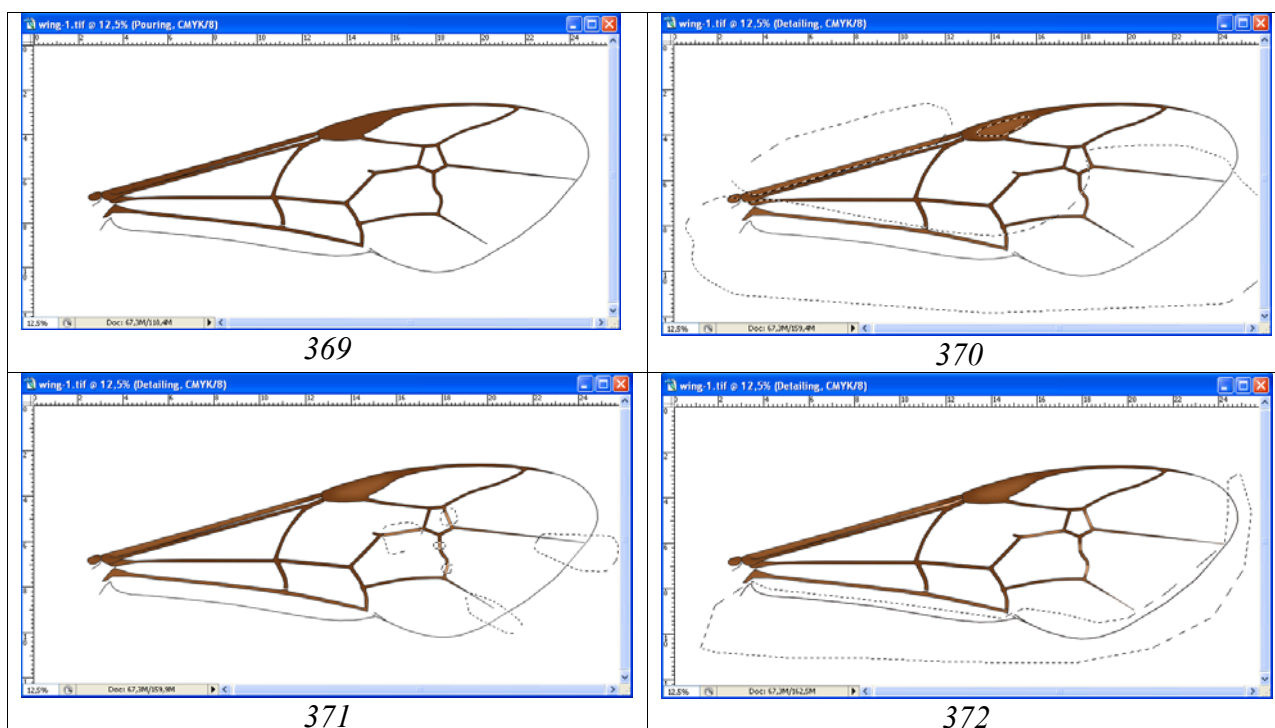
Fig. 369-372: Elaboration of veins of front wing: (**369**) pouring of veins; (**370-371**) clarification of different areas; (**372**) darkening of hind margin.

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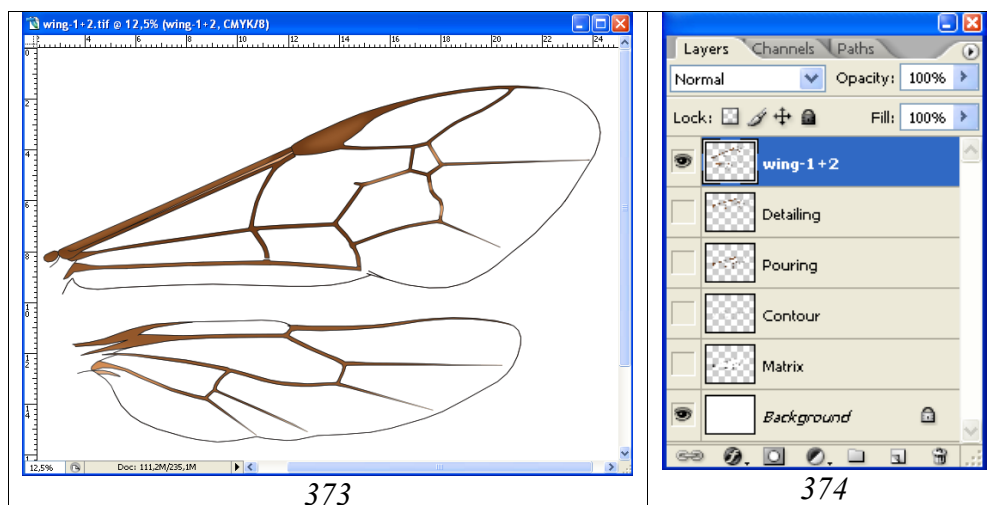
Fig. 373-374: Final result of elaboration of wings of ichneumon fly in separate file: (**373**) front and hind wings, (**374**) hierarchy of layers

The location of a front and hind wing in one layer is necessary for their simultaneous scaling at fulfillment of the total image of object. The wing's base in a final variant of a contour remains opened. Wing image, including "pouring of membrane" is finished only at a stage of final "assemblage" of imago.

Abdomen

C o n t o u r of abdomen is fulfilled by means of vectorial instrument Line Tool by way, described above, constantly controlling the process by object observation under a microscope. Borders of areas of an abdomen on a place of gastrocoeli, thyridia, of some other structures and also borders of spots and strips of certain coloring are designated on a final contour by dotted lines. Thus, after finishing of process of fulfillment of a contour, deletion of a layer with pencil drawing and drawing conversion to mode Grayscale we have two layers "Navigator" and a layer "Background".

For preparation of a contour for fulfillment of the subsequent operations, a layer with drawing of abdomen is duplicated three times. As the result, three working layers are created. Layers are located from top to down in a following order: "Navigator" (it is used only for orientation), "Main lines" (lines which will be saved in final drawing), "Sg-1 outline" (an external contour of a segment-1), "Tergites outline" (an external contour of tergites of abdomen), "Sternites outline" (an external contour of sternites) and "Background". In all working layers, the unnecessary fragments of a contour are deleted, using instrument Polygonal Lasso Tool (at value of parameter Feather=0). Layers in a final file are presented in figures 375-380.

Fulfillment of the listed fragments in separate layers allows avoiding difficulties at fulfillment of operations on giving to object of the volumetric appearance, after performance of operation "pouring".
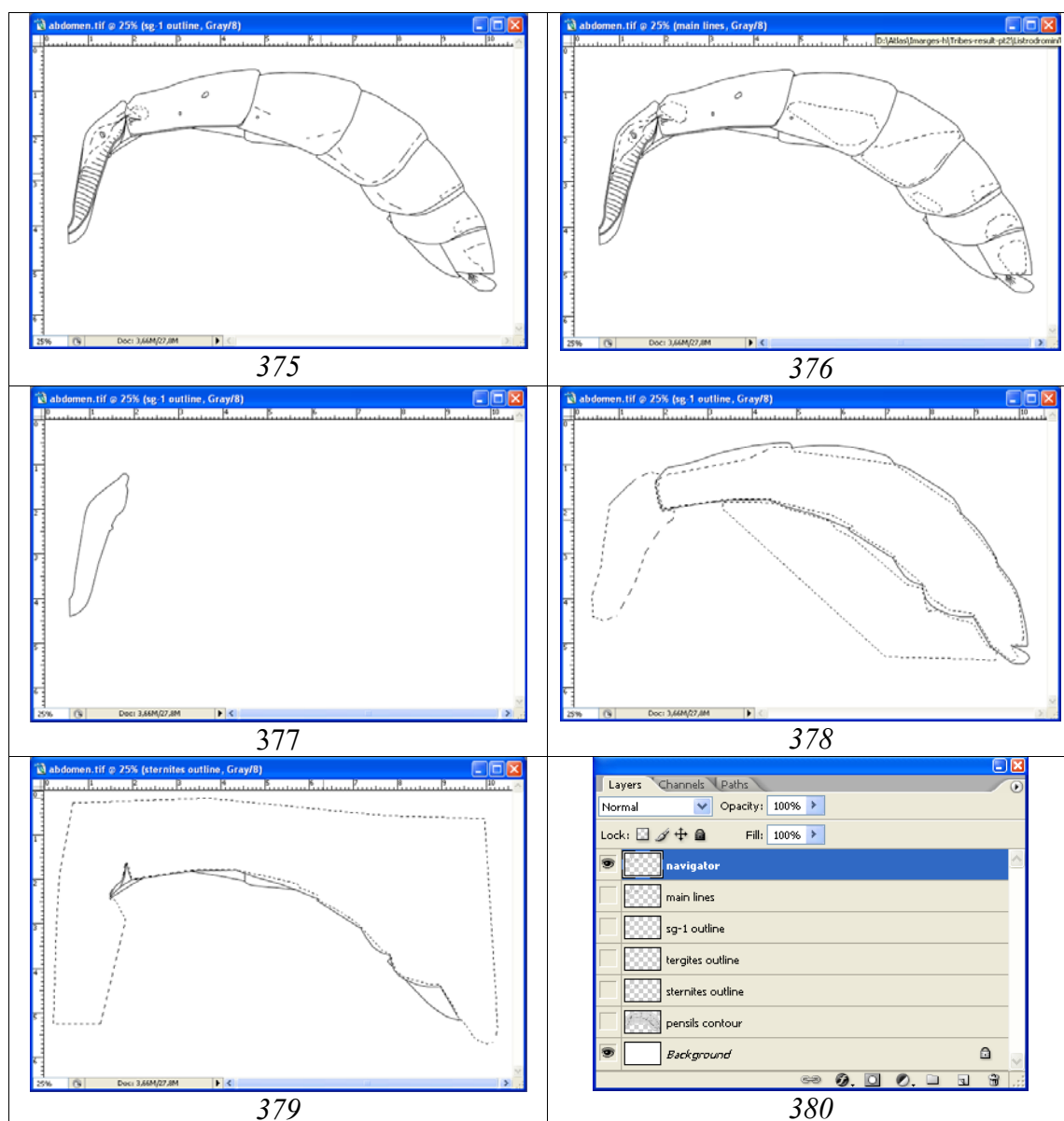
Fig. 375-380: Layers and their hierarchy in a file with a contour drawing of abdomen of imago of ichneumon fly: (**375**) layer "navigator", (**376**) layer "main lines", (**377**) layer first segment of abdomen ("sg-1 outline"), (**378**) layer "tergites outline", (**379**) layer "sternites outline", (**380**) hierarchy of layers.

P o u r i n g   of layers with first segment of abdomen ("Sg-1 outline pouring+volume"), tergites of abdomen ("Tergites outline pouring+volume") and sternites of abdomen ("Sternites outline pouring+volume") is fulfilled by instrument Paint Bucket Tool (G) having chosen in palette Swatches Grey color (55%) and having clicked some times by the left mouse button on area of pouring to complete disappearance of light border with an external contour (fig. 403).

Giving to abdomen of v o l u m e t r i c a p p e a r a n c e is fulfilled for the first segment, the others tergites of abdomen and its sternites in separate layers (fig. 381-401).
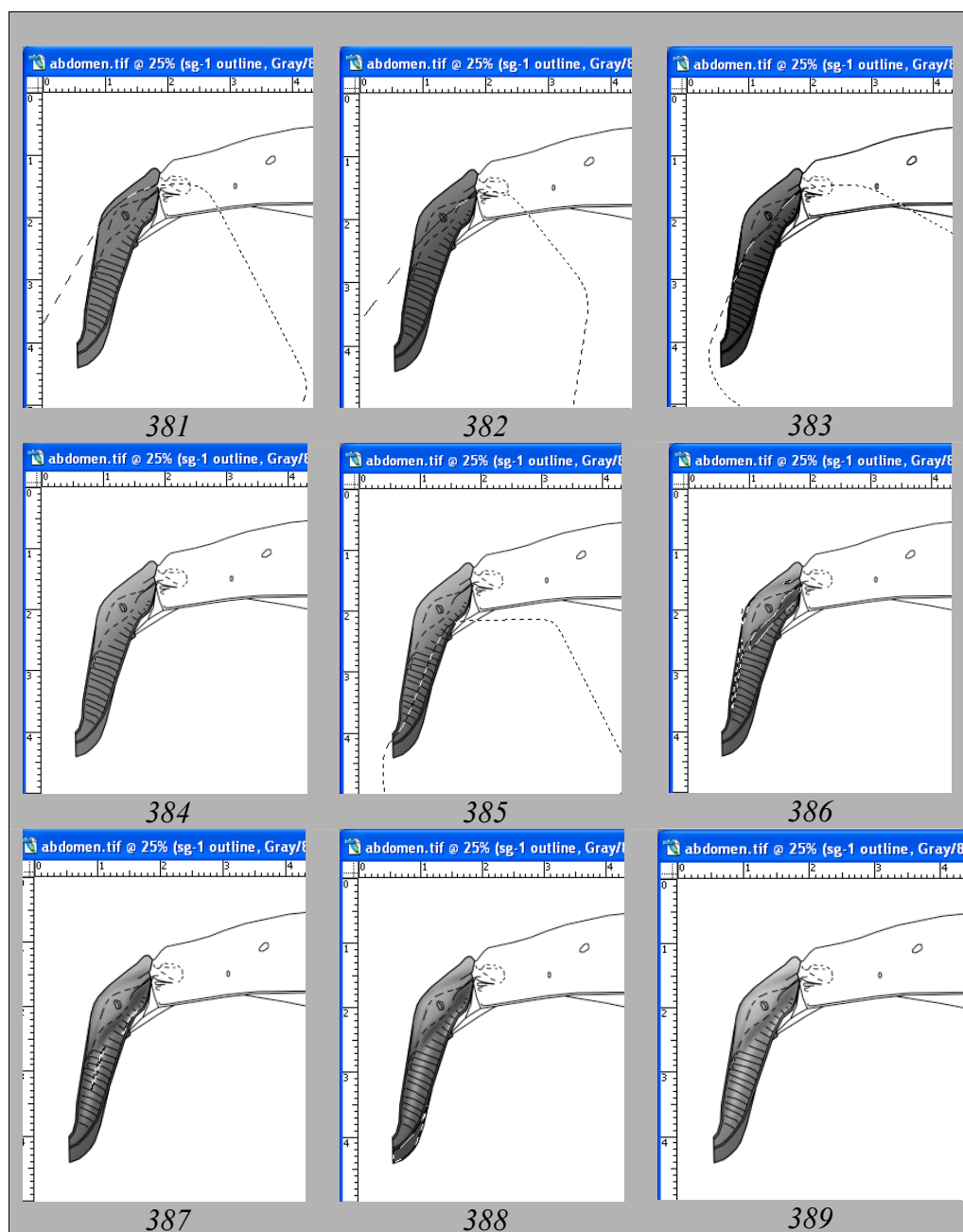
Fig. 381-389: Stages of fulfillment of operations on giving of volumetric appearance to segment 1 of abdomen at visible layer "Navigator": (**381-383**) general darkening of ventral parts of a segment, (**384**) general clarification of segment, (**385-386**) darkening of separate areas, (**387**) clarification of convex areas, (**388**) darkening of sternite of first segment, (**389**) general clarification of segment.

At giving of volumetric appearance to the first segment at the first stage, the general darkening of ventral parts of a segment is fulfilled selecting them by means of instrument Polygonal Lasso Tool with parameter Feather=50px. The external border of selected area should to go out far beyond the limits of segment (fig. 381-383). After fulfillment of darkening, a selection is removed and the general clarification of a seg-

ment is executed. In described example Brightness=60% (fig. 384). Further, a darkening of separate areas with narrower or more hard border of selected area (Feather=10%) are performed (fig. 386).

Convex areas are clarified (fig. 387). Sternite of the first segment is darkened, previously having selected it in layer "Navigator" (fig. 388). At the final stage the general clarification of segment entirely (30%) is fulfilled again (fig. 389).

Giving the volumetric appearance to tergites of abdomen is begun from selection of all tergites of abdomen by instrument Polygonal Lasso Tool with borders of selection that going out far beyond the limits of a canvas and with parameter Feather 90-100px and more. Borders of selection are selected according to the form of abdomen and its peculiarities.

In considered example parameter of Feather is 100px. The general volumetric appearance of abdomen is reached by shift of area of selection in some stages. Area of selection is shifted having pressed the left mouse button at switched on instrument Polygonal Lasso Tool. In process of shift of area of selection, constantly the operation Brightness/Contrast (Menu: Image–Brightness/Contrast) is fulfilled. In this example at each stage, brightness of selected area is reduced in the interval of 10-30% depending on peculiarities of morphology of selected area of abdomen (fig. 390-394).

In this case, darkening is fulfilled in 5 stages. On a final stage the whole of working layer is clarified (fig. 395). In the sequel, abdomen particularities are elaborated, using selection with more rigid border (20-30px) (fig. 396). In process of experience acquisition, it is possible to select simultaneously various areas of abdomen by instrument Polygonal Lasso Tool with different parameters Feather at pressed Shift key. In figure 397 a result of selection of different areas by instrument Polygonal Lasso Tool with parameters Feather=5, 10 and 20px is presented.

Results of operation of darkening can be corrected by function Contrast (Menu: Image–Brightness/Contrast) up to obtaining of acceptable result.

At following stage more small areas (for example area of gastrocoeli, base of second tergite) are selected and darkened. Further, separate segments are contrasted according to abdomen coloration, pre-selecting them in layer "Main lines" (fig. 398).

Spiracles and lunulae are selected by instrument Magic Wand Tool in layers "Navigator" or "Main lines", and then selected areas are contrasted in a working layer. Further, having selected value of parameter Feather, areas of the apical spots (or any other spots or bands with more light coloration at other species) are clarified (fig. 399). At a following stage in a layer "Main lines", areas of a contour of less saturated coloration in a final picture are selected and clarified (fig. 400). And, at last, at the final stage, fields with gleams are selected and clarified, having selected appropriate value of parameter Feather. The different areas are selected with different values parameter Feather when pressed Shift key (fig. 401).
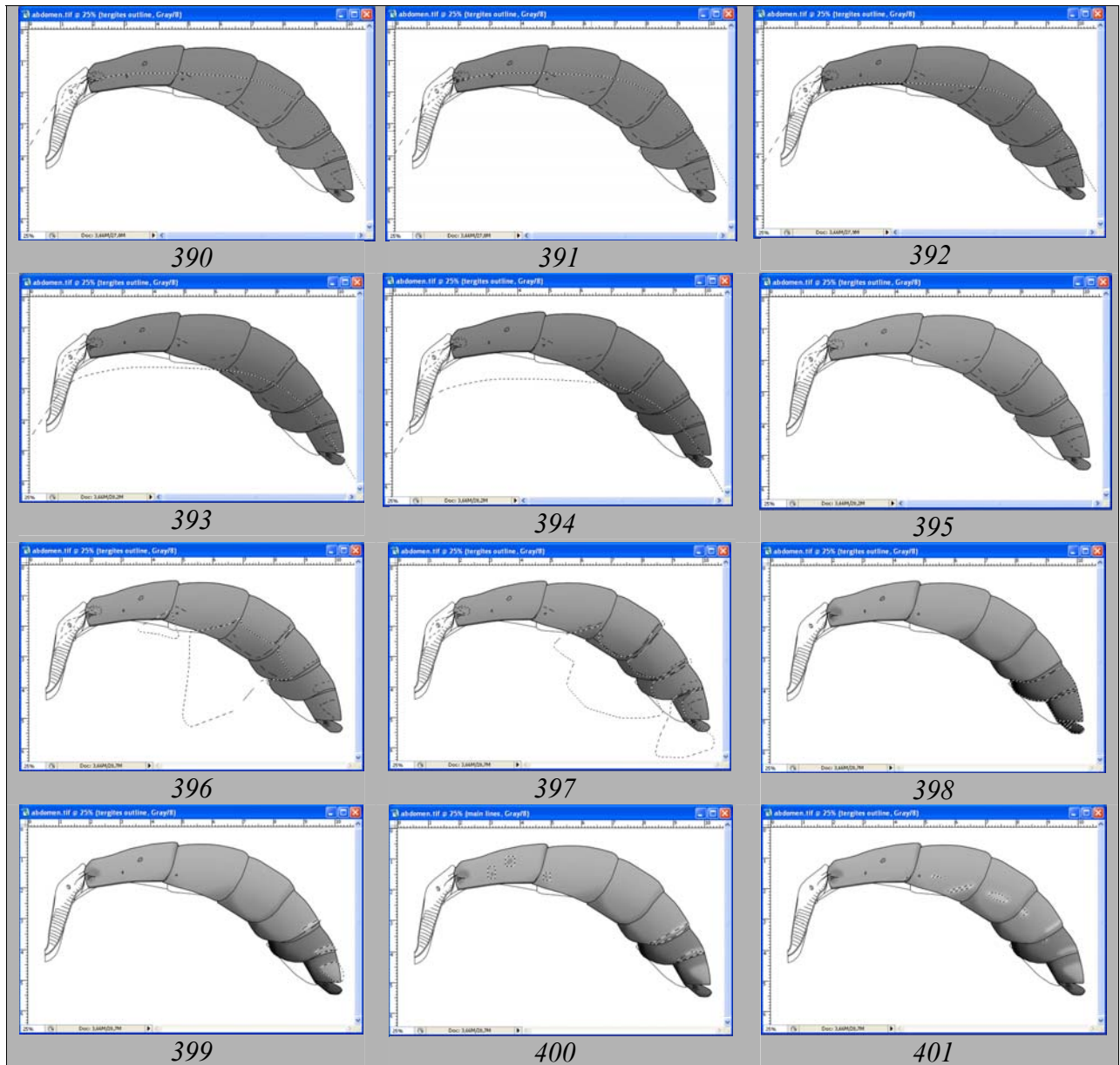
Fig. 390-401: Main operations on giving of volumetric appearance to tergites of abdomen: (**390-394**) general darkening of tergites of abdomen by shifting of area of selection, (**395**) general clarification of a layer, (**396-397**) darkening of separate areas of tergites, (**398**) darkening of apical tergites, (**399**) clarification of areas of lunulae, apical spots and bands, (**400**) clarification of the main lines in layer "Main lines", (**401**) clarification of shining areas of tergites.

At the finishing stage, the actions that analogous to the described above are fulfilled in a layer "Sternites". After fulfillment of the enumerated actions and transfer to a stage "Elaboration", a layer with the volumetric image of tergites is duplicated. It is necessary for "security" at fulfillment of operations of following stage.

General appearance of a file with the abdomen image at the final stage of fulfillment of operation "…volumetric appearance" and hierarchy of layers are presented in figures 402-403.
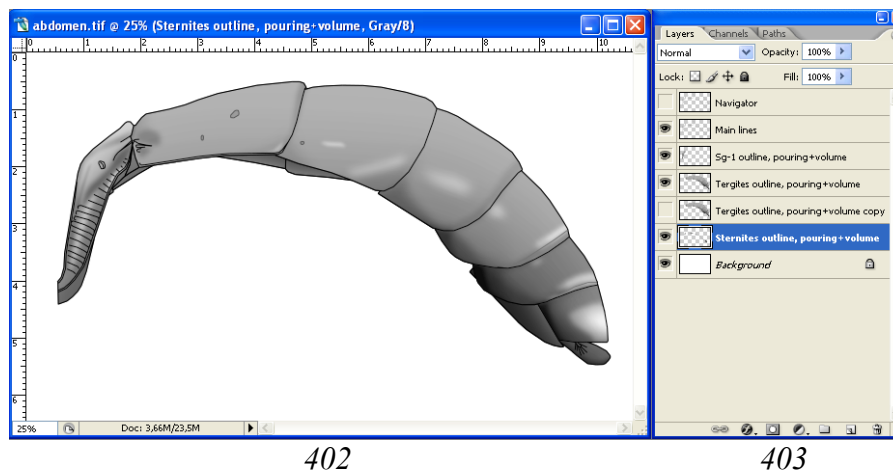
Fig. 402-403: Abdomen in the completing step of the stage "Volume": (**402**) general view of abdomen, (**403**) hierarchy of layers.

Sculpturation (elaboration)

Operation fulfillment is begun, as it is described earlier, from creation of empty layers: "Clarification of interspaces", "Punctures", "Wrinkles", "Light punctures" and "Small punctures" that are arranged in a strict hierarchy.

1st tergite.

> "…dorsomedian carinae visible only from base up to middle of tergite, dorsolateral carina weak, ventrolateral carina sharp; lateral surface of petiolus with distinct transversal ribs; petiolus from lateral with distinct but gradual transforming to postpetiolus, from above gradually broadened to postpetiolus; spiracles small …".

Sculpturation of tergite is begun from fulfillment of carinae and transversal ribs in a layer "Wrinkles". Fulfillment of structures is carried out by instrument Polygonal Lasso Tool (having pressing Shift key at passage to each subsequent sculpture) with the selected by method of tests value of parameter Feather. After fulfillment of all enumerated formations, the areas of selection simultaneously are poured by black color, by means of instrument Paint Bucket Tool (fig. 404). Contrasting of wrinkles is fulfilled after finishing of elaboration of a segment.

At a following stage in an underlaying layer "Clarification of interspaces", light (shining) areas are selected by instruments Polygonal Lasso Tool or Lasso Tool (having selected preliminarily a value of parameter Feather by method of tests) and having pressed Shift key. Values of parameter Feather can have different value for different areas. After selection of all areas they simultaneously are poured by grey (10%) by means of instrument Paint Bucket Tool (fig. 405). As well as in the previous case, contrasting of the clarified areas is fulfilled after finishing of elaboration of a segment.

Darkening of lateral carinae is fulfilled in a layer "Sg-1 outline, pouring+volume", pre-selecting them in a layer "Main lines" (fig. 406).

114

The following operation, it is deletion of superfluous lines in a layer "Main lines". Lines of transversal ribs are deleted, because the transversal ribs of lateral surfaces of the first tergite have distinct, but smoothed character. Area of lines of ribs is selected by instrument Polygonal Lasso Tool with parameter Feather=0 and then it is deleted by pressing Del key (fig. 407).

The first tergite of abdomen has a light coloration. Therefore, separate areas of an external contour of tergite are clarified by function Brightness/Contrast, pre-selecting them by means of instrument Polygonal Lasso Tool with considerable value of parameter Feather (10-30px). Areas of a contour are being clarified, seeking to achieve correspondence of their saturation to the volumetric image of a segment (fig. 408).

At the final stages, a contrasting of different areas in layers "Wrinkles" and "Clarification of interspaces" is fulfilled. Separate parts are selected by instrument Polygonal Lasso Tool with the selected value of parameter Feather (20px). Then selected areas are contrasted by means of function Brightness/Contrast to achieve maximum compliance to the object under a microscope (fig. 409,410). The final result of fulfillment of operations on elaboration of 1st segment of abdomen is presented in a figure 411.

404 *405* *406* *407*

408 *409* *410* *411*
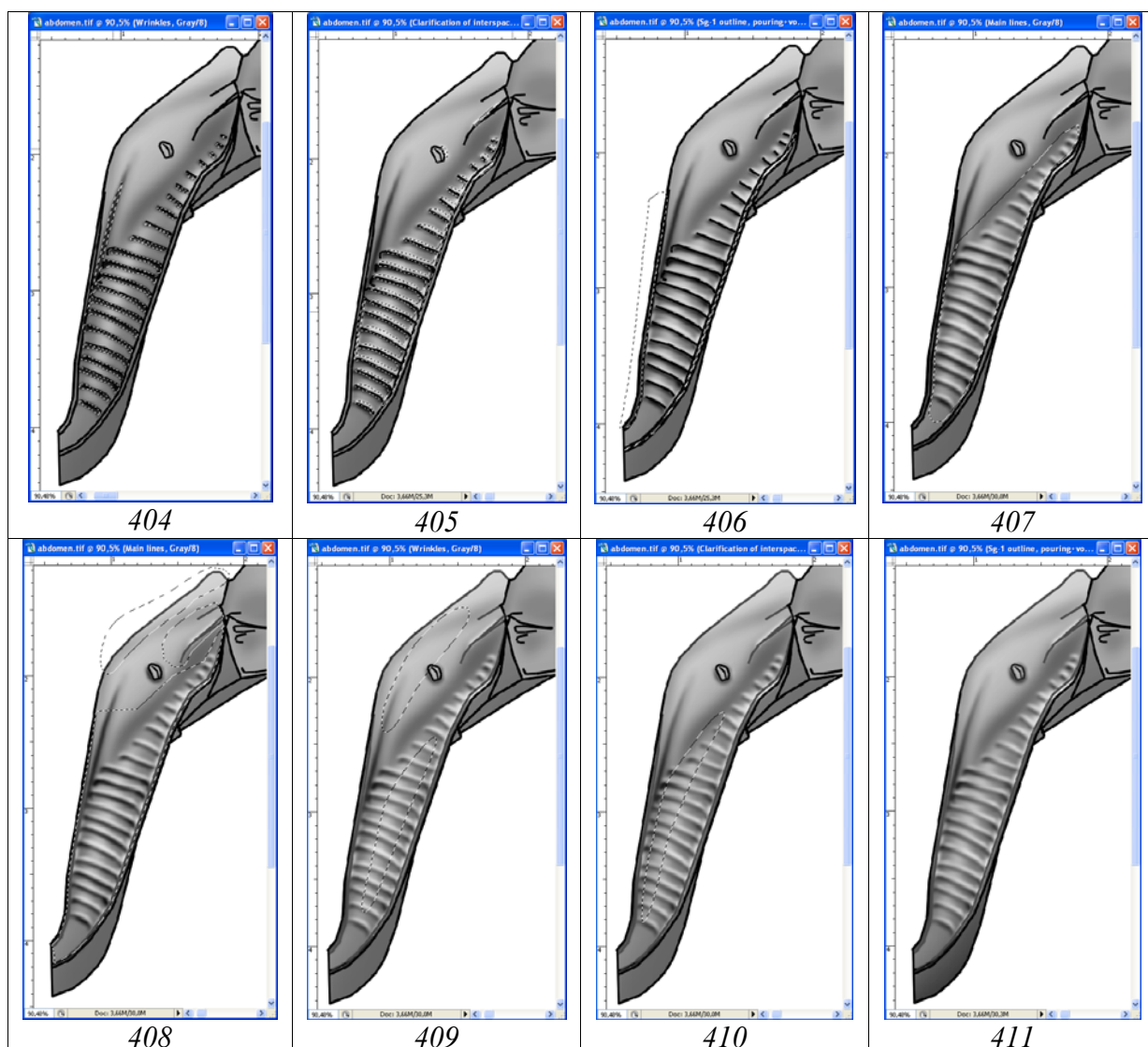
Fig. 404-411: Sequence of operations on elaboration of the first tergite of abdomen: (**404**) fulfillment of keels and transversal ribs, (**405**) clarification of shining areas, (**406**) darkening of lateral carinae, (**407**) elimination of superfluous lines (ribs) in layer "Main lines", (**408**) clarification of areas in layer "Main lines", (**409**) contrasting of ribs and carinae in layer "Wrinkles", (**410**) contrasting of clarified areas in layer "Clarification of interspaces", (**411**) final result of fulfillment of operations on elaboration.

Other tergites.

> "Gastrocoeli not big, slightly but distinctly impressed, many narrower than interval between them; thyridia absent; lunulae of moderate size in a form of more or less distinct impressions behind middle…".

The second tergite of abdomen is a most difficult segment for elaboration, with the greatest number taxonomically significant structures. Elaboration (sculpturation) can be fulfilled and in the main layer "Tergites outline, pouring+volume" (see above). However, the most optimal is performance of all structures in separate layers with usage of tools of selection that allows to correct appearance of structures. Such approach allows achieving a maximum resemblance to the object. Elaboration is begun from area of gastrocoeli and thyridia. Area of gastrocoeli is selected by instrument Polygonal Lasso Tool, having selected preliminarily value of parameter Feather. The area of selection may extend beyond the borders of segment. After pouring, superfluous parts can be easily deleted in the subsequent. Area of selection is poured by black color by means of instrument Paint Bucket Tool in a layer "Wrinkles". Poured area, not removing selection is contrasted by means of function Brightness/Contrast (fig. 412).

412 *413* *414*

415 *416*
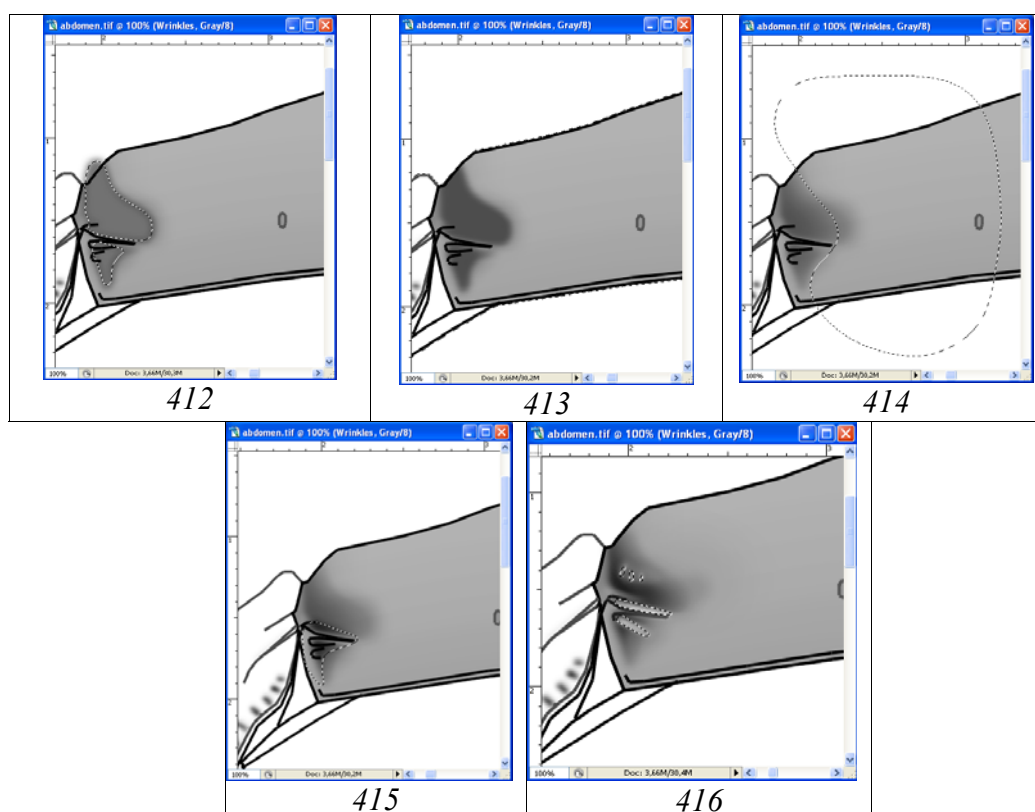
Fig. 412-416: Elaboration of area of gastrocoeli: (**412**) selection and pouring of area of gastrocoeli, (**413**) selection of external contour and elimination of "superfluous" areas, (**414**) clarification of hind parts of gastrocoeli, (**415**) darkening of front areas of gastrocoeli, (**416**) finalization of gastrocoeli by clarification in a layer "Wrinkles" and a layer "Clarification of interspaces".

At following stage, in a layer "Main lines" external contour of abdomen is selected, clicking by instrument Magic Wand Tool on area outside of the contour. A layer "Wrinkles" is marked as a working. Then, by pressing Del key, areas of pouring outside the borders of an object are removed (fig. 413).

Hind areas of gastrocoeli, according to peculiarities of morphology of the object (see above) are clarified by means of function Brightness/Contrast in a layer "Wrinkles". Similarly, front areas of the structure are darkened, also having selected value of parameter Feather (5px) (fig. 415).

Finalization of area of gastrocoelus is fulfilled by means of instruments of selection in layers "Wrinkles" and "Clarification of interspaces", contrasting those or other areas (fig. 416).

> "…surface of second tergite very densely punctured by smoothed irregular punctures, medially punctures more big and elongated, shining, without microsculpture; puncturation of tergites more delicate to apex of abdomen; abdomen polished…".

For puncturation of tergites of abdomen, usage of instrument Brush Tool is most handy. Parameters of Brushes (Angle, Roundness and Hardness) are selected in accordance with puncturation, which observe at object. Operation is fulfilled in a layer "Punctures" by superficial points, which are decreasing in diameter from 2nd to 5th tergite of abdomen. In the given example diameter of punctures decreases from 23 to 10px. Parametres of punctures at fulfillment operation on the second tergite: Roundness=60%, Hardness=0, Spacing=236-302% (fig. 417). On tergites with uniform puncturation (regular intervals between punctures) puncturation is convenient to fulfill by separate lines, using a pen of Pen Tablet. It substantially accelerates fulfillment of the given operation.

The following stage is contrasting of punctures for giving them an appearance maximally corresponding to the general saturation of object in layer "Tergites outline, pouring+volume" and accordingly to puncturation, observable under a microscope.

For this purpose, in a layer "Main lines", having marked it as working, by means of instrument Magic Wand Tool, punctured tergites are selected. Then, not removing selection, as the working the layer "Punctures" is marked. Further, an operation on contrasting of punctures is fulfilled. As well as in other cases, function Menu: Image-Brightness/Contrast is used, achieving the maximum conformity to observable at object. In our example parameter Brightness=63% (fig. 418).

The polished surface of tergites in intervals between punctures is stressed by operation on clarification of intervals. Operation is fulfilled in a working layer "Clarification of interspaces", having selected, usually by instrument Lasso Tool or Polygonal

Lasso Tool, most shining areas (having chosen parameter Feather and at pressed Shift key). After selection of all the areas, their simultaneously are poured by grey by instrument Paint Bucket Tool (G), having chosen in palette Swatches Grey color, usually 10%. In the subsequent, groups of the poured areas are selected by instrument Polygonal Lasso Tool and contrasted (Brightness/Contrast) for achieving the maximum conformity to smoothness of surface observable at object (fig. 419-420).

At the finishing stages of elaboration, it is necessary to fulfill a number of operations – contour clarification, removal of aberrations of elaboration and fulfillment of small puncturation.

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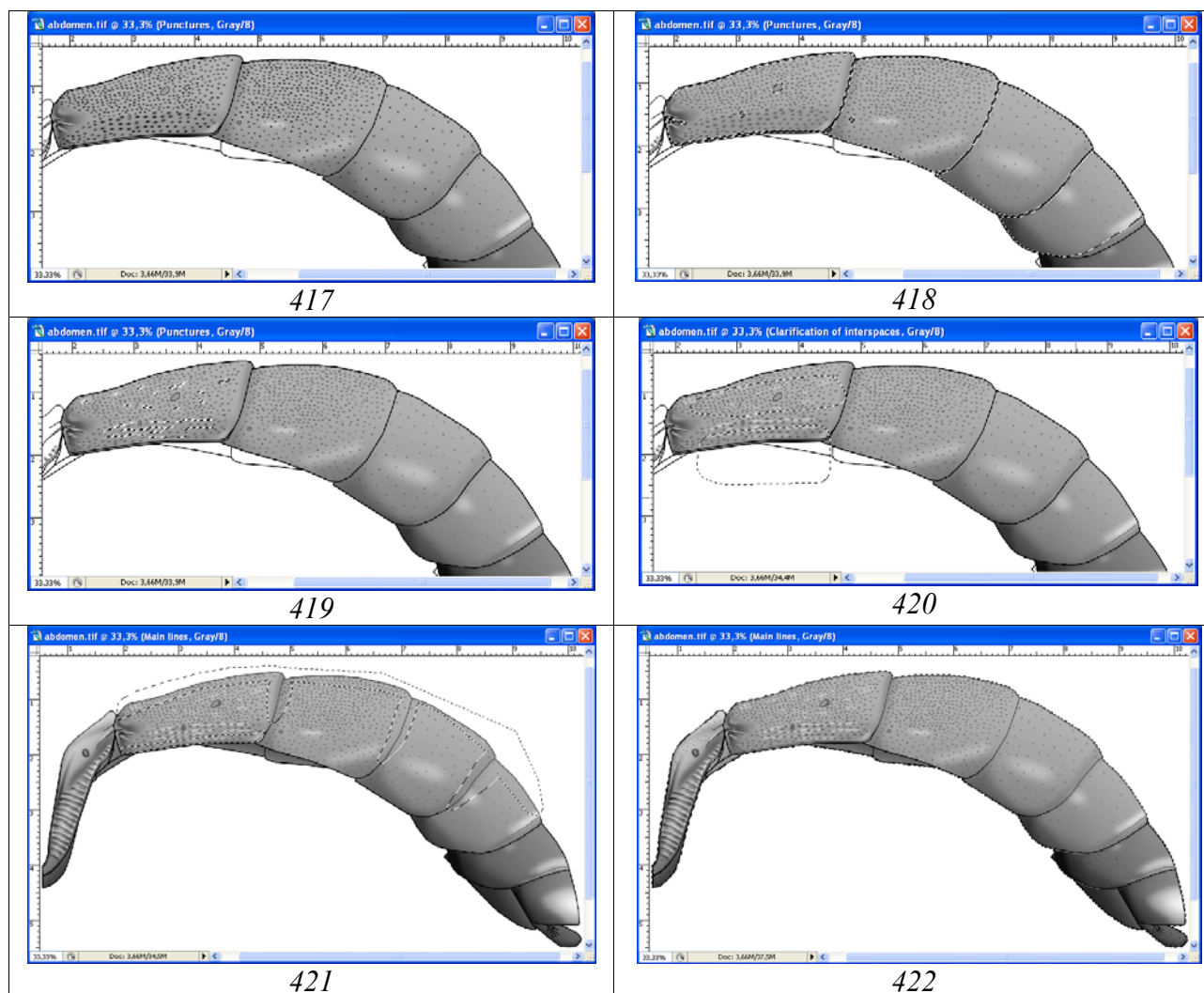
Fig. 417-422: Elaboration of tergites of abdomen: (**417**) puncturation of tergites by superficial punctures, (**418**) selection of punctured tergites in a layer "Main lines" and contrasting of punctures, (**419**) clarifications of interspaces, (**420**) contrasting of interspaces, (**421**) clarification of a contour in a layer "Main lines", (**422**) small puncturation, its contrasting and elimination of "inaccuracies" outside of a contour.

Contour clarification is fulfilled in the layer "Main lines", doing its as a working. By means of instrument Polygonal Lasso Tool, having selected value of parameter Feather, the most light areas of a contour are selected and contrasted by function

Menu: Image–Brightness/Contrast, achieving of maximal conformity to the underlying layer "Tergites outline, pouring+volume" (fig. 421).

In a layer "Small punctures", by instrument Brush Tool, a finalization of details of separate parts of abdomen is fulfilled. It is necessary to select parameters of brush correctly. Usually it is a diffused brush with diameter 5-7px with low, close to 0 values of parameter of Hardness. At use for puncturation a pen of Pen Tablet it is necessary to remember about selection of considerable value of parameter Sparcing, for prevention of merging of points in the process of puncturation. Separate parts of a body (group of punctures) are selected by instrument Polygonal Lasso Tool and contrasted by function Brightness/Contrast, achieving the maximal conformity to the underlying layer "Tergites outline, pouring+volume".

In the working layer "Main lines" clicking by instrument Magic Wand Tool on a space outside the object, its outer contour is selected. In the subsequent, passing down from one layer to another, all the "imperfections" that go beyond the outer contour of the object are removed by pressing Del key (fig. 421-422).

At finishing stage of sculpturation, the integrated layer "Result" is created. Layers "Navigator", "Background" and duplicating layer "Tergites outline, pouring+volume copy" are disconnected ("eye" is removed). Other layers are with turned on "eye". A command Merge Visible (Shift+Ctrl+E) is fulfilled. Merged layer is selected by command Ctrl+A. Then it is copied to the buffer (Ctrl+C). After that, by command Menu: Edit–Step Backward (Alt+Ctrl+Z) all previous actions are canceled, returning into place all layers that was merged earlier. The merged image of abdomen is inserted from the buffer under a layer "Navigator" by command Ctrl+V. Layer is designated as "Result" (fig. 422-423). The file "abdomen" is ready to fulfillment of operations on coloring.

C o l o r i n g (fig. 423-428)

"Abdomen red with darkened apex; white: apical stripes on tergites 5-6 and spot on tergite 7…".

As in other cases, the first step is transformation the file from regime Grayscale to CMYK (Menu: Image–Mode–CMYK Color). At first, having chosen a value of parameter Feather (5px), the basic red-brown part of abdomen – 1-5 tergites is selected. Then, not removing selection, an operation on coloring of the selected area is fulfilled. In palette Swatches one of variants of brown color (Darker Red Orange) is chosen. Further, an operation on coloring: Menu: Image–Adjustments–Hue/Saturation (Ctrl+U) is fulfilled. In pop-up dialog box Hue/Saturation by means of cursors (runners) a hue and a saturation of selected area are selected. At fulfillment of operation, it is necessary to remember, that in window Colorize, a tick should be inserted (fig. 424).
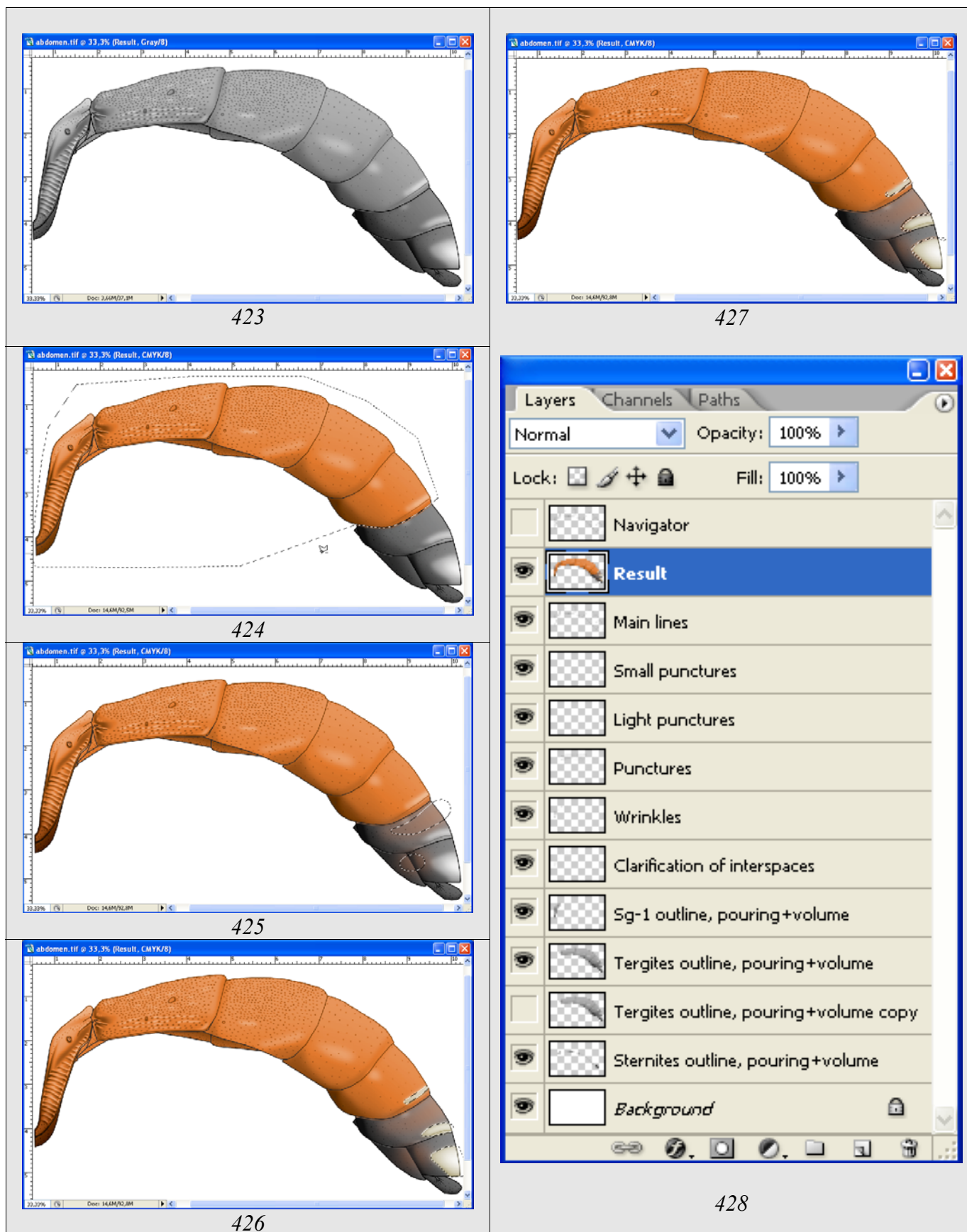
Fig. 423-428: Coloring of abdomen: (**423**) initial drawing in mode Gray, (**424**) basic coloration, (**425**) brown tint of apical tergites, (**426**) coloring of apical spots, (**427**) coloring of borders of apical spots, (**428**) hierarchy of layers in a file "abdomen".

Segments of apex of abdomen with the basic black coloration have partially brownish tint. For giving of a brown tint to the separate segments, parts of segments are selected by instrument Polygonal Lasso Tool or Lasso Tool, by so-called "diffused" selection. In our example parameter Feather=35px. Having chosen in palette Swatches one of variants of brown color, a command Ctrl+U is fulfilled. Usually, at correct selection of primary color in palette Swatches for achievement of necessary effect, a tick in window Colorize (fig. 425) is enough to insert.

Similarly coloring of white (yellowish) apical spots is fulfilled. Parameter Feather, as well as in the given example, usually is 5px (fig. 426).

Borders of apical spots have brownish in different degree transitional zone. For coloring, an area of transitional zone is selected by means of instrument Polygonal Lasso Tool with parameter Feather=5px. Then, it is colored as it was described above (fig. 427).

The apex of abdomen of ichneumon flies is often darkened. In final image or hard copy, the borders between segments in ventral part of apex of abdomen can be not visible. At the same time, this can have important taxonomical importance. Therefore, borders between segments are necessary to clarify by one or another way. In our example the borders narrowly are selected by means of instrument Polygonal Lasso Tool with parameter Feather=0-1px and then they are clarified by means of function Menu: Image–Brightness/Contrast, up to achieving a necessary effect. The border can also be fulfilled by means of thin brush (Hardness=100, Spacing =1%) in a combination with Shift key. Other method is clarification of the lower borders of the darkened apex of abdomen even before creation of layer "Result" (Grayscale). For this purpose, the necessary parts are selected. Then they are clarified in layer "Main lines", even before merging of layers.

"Composing" of total image of object from different files with different parts of a body

All parts of a body of object, with exception of flagellum and wings, are fulfilled in a same scale. Proceeding from the dimensions (total length of object) new file in CMYK mode with the resolution of 600 dpi is created.

To the created file all layers "Result" from all files of separate parts of a body of the total image of imago are copied. After an insert, each part of a body is moved on its place in a total image, by means of instrument Move Tool (V). Sequence of copying and insert of layers "Result" from files with separate parts of a body into the resultant file from below to upwards is usually following: 1 – Abdomen, 2 – Tarsus-3, 3 – Tibia-3, 4 – Trochanters+femur-3, 5 – Coxa-3, 6 – Tarsus-1, 7 – Tibia-1, 8 – Trochanters +femur-1, 9 – Coxa-1, 10 – Tarsus-2, 11 – Tibia-2, 12 – Trochanters +femur-2, 13 – Coxa-2, 14 – Thorax, 15 – Maxillary palp, 16 – Flagellum, 17 – Scapus, 18 – Head capsule, 19 – Wing 1+2, 20 – Tegula. The order of an arrangement of layers has a key importance (fig. 429-430). After copying of all elements in one file, association

of separate elements is fulfilled, up to achieving standard arrangement of parts of a body of ichneumon fly.
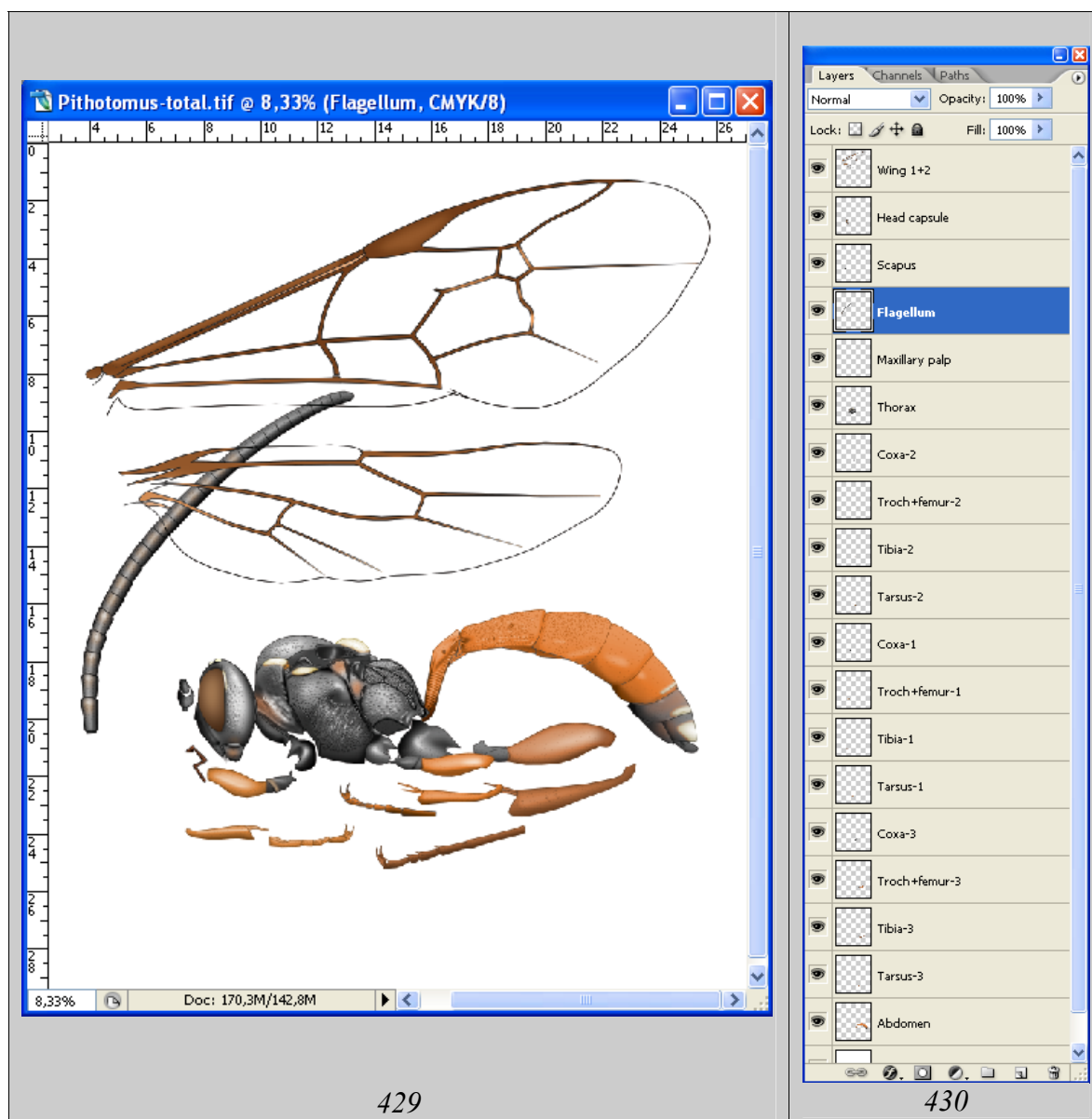
Fig. 429-430: Initial file with the total image of imago *Pithotomus*: (**429**) set of elements, (**430**) order of arrangement of layers.

At the first stage, the scaling of wings and flagellum of imago, according to other parts of a body, which already executed in uniform scale, is fulfilled. For scaling of the flagellum relatively to the body, its length is measured under microscope. Then, it is correlated with any part of a body.

For example, the real length of flagellum is equal to distance from spiracle of pronotum up to apex of gastrocoeli of the first tergite of abdomen. Layer containing the flagellum (Flagellum) is marked as a working. Then a command on transformation of flagellum Menu: Edit–Transform–Scale/Rotate is fulfilled. At first a command Rotate is perfomed. Flagellum is moved having pressed and not releasing the left button of

the mouse so that the basis of the first segment is coincided with spiracle of pronotum. The central point of rotation is moved by the mouse in the base of the first segment. Then flagellum is rotated having pulled for the top corner of the selected area, positioning it along an axis of a body of object. After that, in Menu: Edit–Transform, a command Scale is chosen. Having pressed and not releasing a key Shift, flagellum is scaled according to the chosen area of a body (fig. 431).

Further, wings of object are scaled by the similar way. It becomes clear, why wings of an insect have been united earlier in one layer. It is this that allows fulfilling their simultaneous proportional scaling.

The length of forward wing, measured under a microscope from tegula up to apex is comparable on length to distance from a front margin of mesonotum up to apex of the third tergite of abdomen. As well as in a case with flagellum, by command Ctrl+A the layer "Wing 1+2" is marked as a working and the menu command: Edit–Transform–Scale/Rotate is fulfilled (fig. 432).
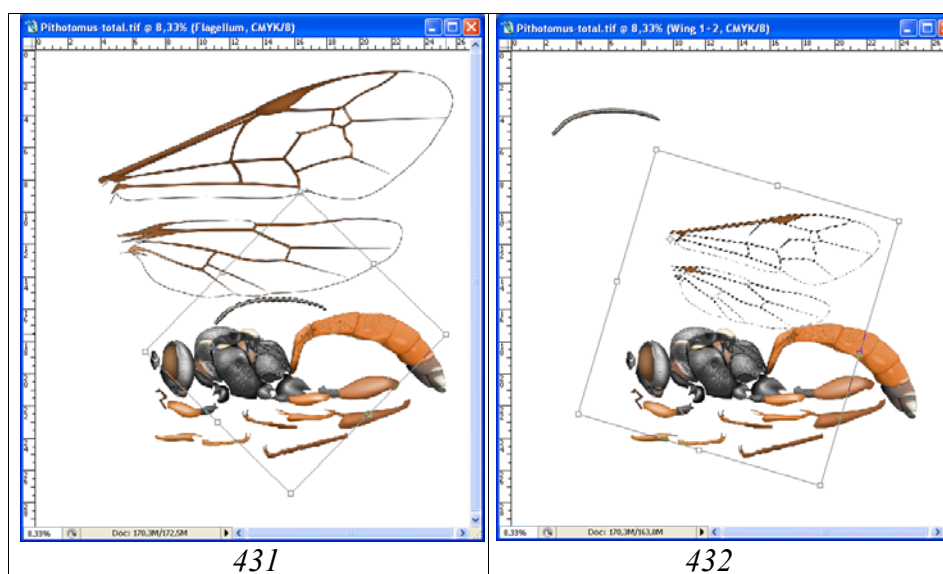
431 *432*

Fig. 431-432: Scaling of flagellum and wings: (**431**) scaling of flagellum, (**432**) scaling of wings.

After scaling of wings in a layer "Wing 1+2", the hind wing is selected by means of instrument Polygonal Lasso Tool with parameter Feather=0, and then cut out by command Ctrl+Z. After that it is inserted over a layer with a front wing by command Ctrl+V. The layer is labeled as "Wing 2". Thus, at the given stage, the file consists of 22 layers, including a layer "Background".

A r r a n g e m e n t   o f   p a r t s   o f   a   b o d y is begun from legs of an object. It is important to achieve not only standard and as much as possible compact arrangement of legs, but also theirs maximal illustrativeness, that is minimum overlapping of different parts of legs.

Operation is begun with the arrangement of middle legs. The first step is an arrangement and correction of shape of coxa ("Coxa-2"), in such a manner, that would femur

of middle leg in the minimum degree would overlap hind coxa. Command Menu: Edit–Transform–Scale/Rotate/Warp is used (fig. 433). Front coxa is modified in the similar way (fig. 436).

433 *434* *435*

436 *437* *438*
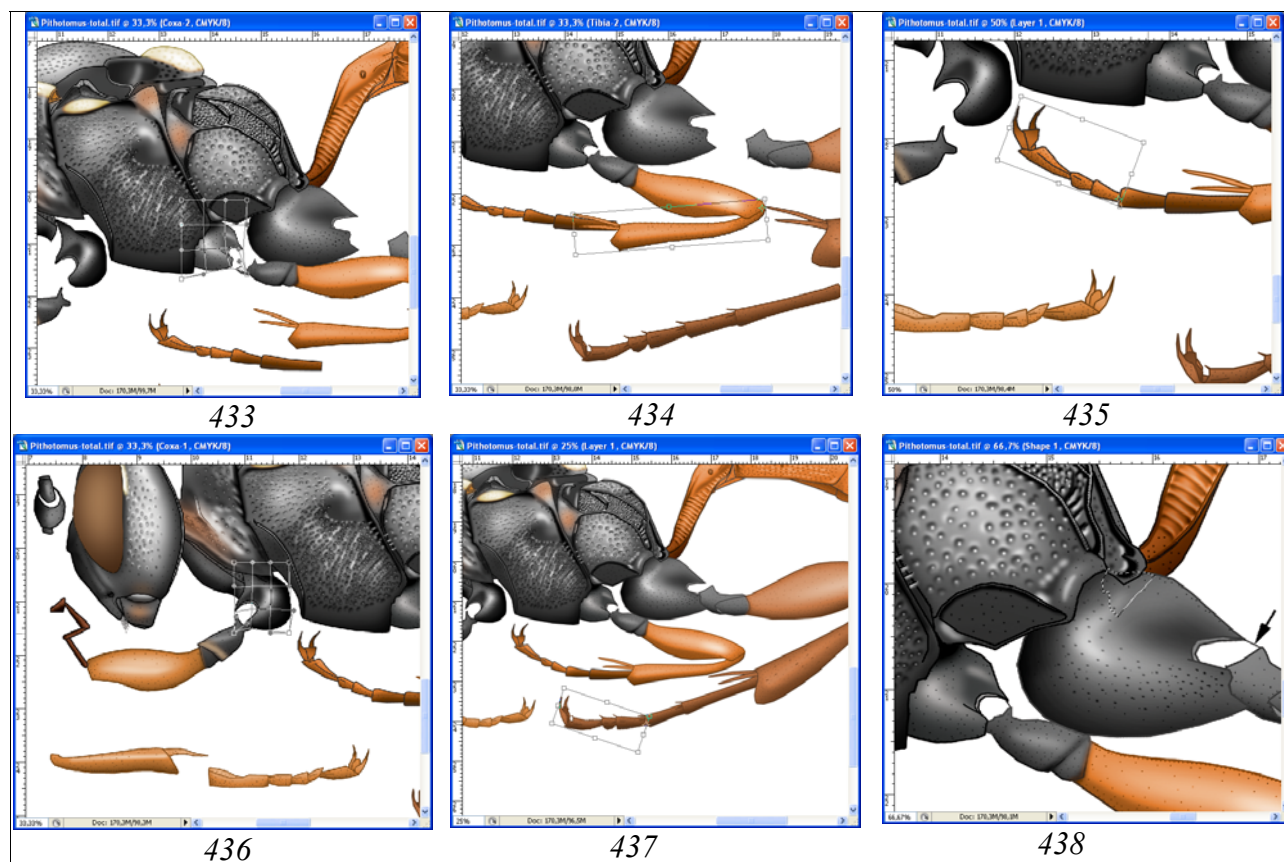
Fig. 433-438: Arranging of legs of object: (**433**) modification of middle coxa by function Warp, (**434**) giving to tibia of necessary position by function Rotate, (**435**) change of position of segments of middle tarsus, (**436**) modification of front coxa by function Warp, (**437**) change of position of segments of hind tarsus, (**438**) lines, closing the membranes on coxae of hind legs and a removal of superfluous parts of propodeum.

Further, by using the the menu command: Edit–Transform–Rotate, femur-2 is attached to the coxa, and to him the tibia (fig. 434). For more compact arrangement of a middle tarsus, three last segments of tarsus are selected by means of instrument Polygonal Lasso Tool (Feather=0). Then, a command Ctrl–X is fulfilled, "cutting out" them to the buffer. At a following stage, the segments are inserted from the buffer into a separate layer under the layer "Tarsus-2". Further by the menu command: Edit–Transform-Rotate, central point of area of selection is moved to the top of the second segment. Then, a necessary position is given to the apical segments of tarsus (fig. 435). After rotation of apical segments of the tarsus, "eyes" in palette Layers from all layers except a new layer and a layer "Tarsus-2" are removed, doing their invisible. Layer "Tarsus-2" is marked as the working. Then, for merging segments of tarsus 2, the command Merge Visible (Shift+Ctrl+E) is fulfilled. The same operations are performed for front and hind legs, up to achieving the compact and standard theirs ar-

rangement (fig. 437). At last stage the lines closing membranes on coxae of all the legs by tool Brush Tool at pressed key Shift are fulfilled. Superfluous parts of propodeum above hind coxa are deleted, selecting them by means of instrument Polygonal Lasso Tool (Feather=0) (fig. 438).

At a following stage, by means of instrument Move Tool, maxillary palp is moved to its place in layer with the same name (Maxillary palp). If maxillary palp overlaps any part of a body, it is modified as it is described for segments of tarsi (see above).

Arranging of antenna of object is begun from moving of scape by means of instrument Move Tool and transformation its up to necessary position by means of function Rotate. Flagellum of object is moved by the same way. In case of need, a place of joint of scape and flagellum is modified by means of function Menu: Edit–Transform–Warp.

The greatest amount of works at composing of total image of imago, it is finalization of wings of an insect. Front and hind wings of an insect are in separate layers between layers "Tegula" and "Thorax". After placing the wings on theirs place, a necessary position for tegula is imparted by means of function of transformation (Rotate). At a following stage the actions on finalization of the base of a front wing are fulfilled. The base of wing is closed, using vectorial instrument Line Tool, having chosen a corresponding thickness of lines. Vectorial lines are fulfilled being guided on a layer "Thorax". After finishing of fulfillment of contour of wing's base, "eyes" from all layers except a layer "Wing-1" and layers with separate lines are removed. Then, an operation of merging of visible layers (Merge Visible, Shift+Ctrl+E) is fulfilled. At performance of operation, a layer "Wing-1" is necessary to mark as the working. Further, similar actions are fulfilled with a hind wing of an object.

After performance of a contour of the base of wing, his pouring and coloring is fulfilled, controlling the process by means of object observation under a microscope. When coloring, the instrument Paint Bucket Tool is used, having chosen corresponding color in palette Swatches or in window Color Picker (fig. 439).

Before merging of layers, for demonstrativeness, a clarification of parts of thorax which are closed by wings are fulfilled. In a layer "Thorax" by means of instrument Polygonal Lasso Tool (Feather=0) areas of a thorax which covered by wings are selected. Then they are clarified by means of function Brightness/Contrast up to obtaining of necessary effect (fig. 440).

At the final stage layer Background is disconnected and a command on merging of layers (Merge Visible, Shift+Ctrl+E) is fulfilled. Merged layer is selected by command Ctrl+A and then it is copied to the buffer by command Ctrl+C. After that by command Alt+Ctrl+Z (Step Backward) or in palette History a command on merging is cancelled and layers are restored. Then from the buffer, by command Ctrl+V, merged image of imago is inserted above the uppermost layer (Tegula). Layer is labeled "Result".

In layer "Result" the final actions on performance of total picture of imago – coloring of a membrane of a wing, membranes in place of a joint of trochanters and coxae and membrane of scapus are fulfilled.

The membrane of wing of object is hyaline, not painted. Therefore, pouring of wing is fulfilled by means of instrument Paint Bucket Tool, having chosen in palette Swatches the minimum value of grey color (10% Gray). At the first stage, any cell of wing is poured, having clicked on it some times the mouse before disappearance of light border with veins. After that, a cell is selected by means of instrument Magic Wand Tool. Then, selected cell is clarified by means of function Brightness/Contrast, up to achieving conformity of her saturation to saturation of cells which is observed at object. In the given example brightness is +12%. After that, with the Alt key held down (cursor should turn into eyedropper) one left-clicks on the poured and clarified cell is fulfilled, selecting the necessary saturation. Further, by means of chosen color, the pouring of all other nonoverlapping cells of front and hind wings is executed. Areas of overlapping of front and hind wings are poured by more dark color (10% Gray).
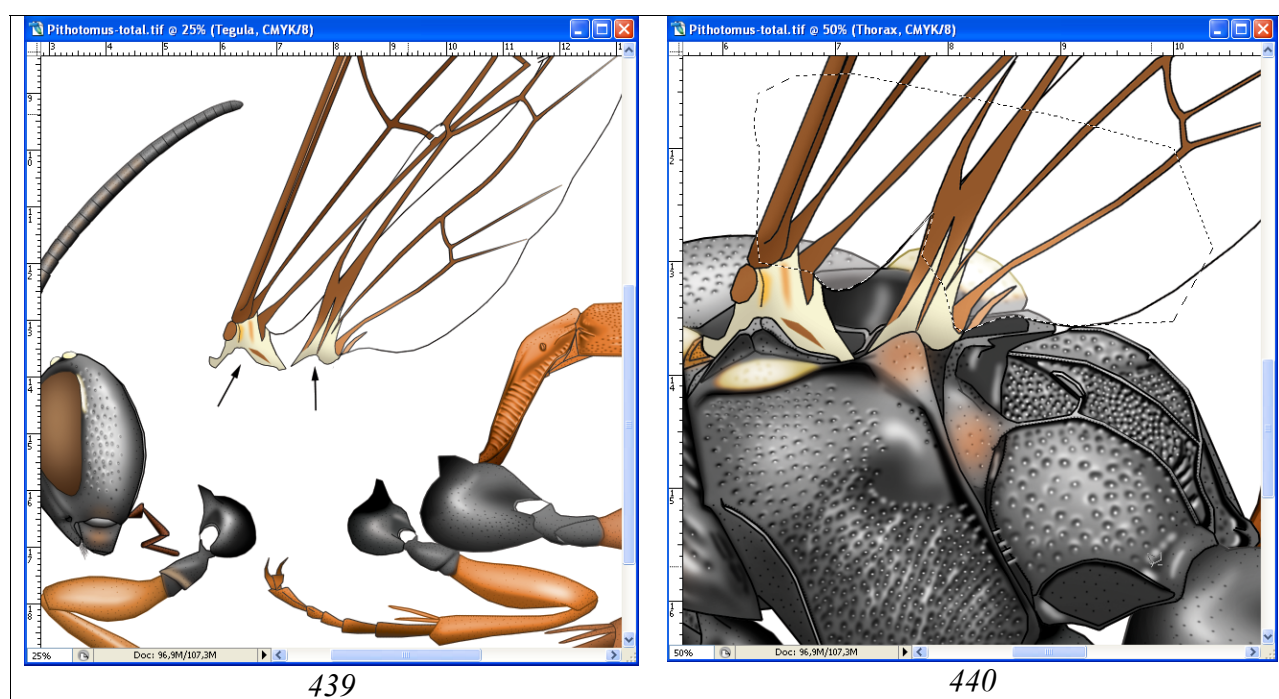
439   *440*

Fig. 439-440: Finalization of a base of a wing: (**439**) finalization of a wing's base in separate layers, (**440**) clarification of areas of thorax, closed by wings.

As in all previous cases, at preparation of separate parts of a body, in a final file with the image of imago of ichneumon fly, all layers are saved. The images, preserved in separate layers in the subsequent can be use in the taxonomical analysis of characters and their groups, or for an illustration of characters in identificational keys. Altogether a final file with the image of imago of ichneumon file contains 22 layers, without layer Background (fig. 442).

At the finishing stage, a file with the image of imago of ichneumon fly for preparation of the resultant table is created. In a final file, as the working, a layer under layer "Result" (in our case layer "Tegula") is marked. Then, having pressed and without releasing Shift key, the layer lying above layer "Background" (in our example layer "Abdomen") is marked. All the layers except "Result" and "Background" become marked (selected). Then one right-clicks the selected layers and selects the "Delete Layers" command from the pop-up menu. File is saved in directory "Result" with the name of species of ichneumon fly and attributes – "Pithotomus tschitscherini-female-total (CMYK)". The previous file including numerous layers remains without changes in directory "Total". Saving of file with all layers in an original format allows using, in case of need, elements in separate layers as additional illustrations and in addition, to make changes to drawing in case of need.
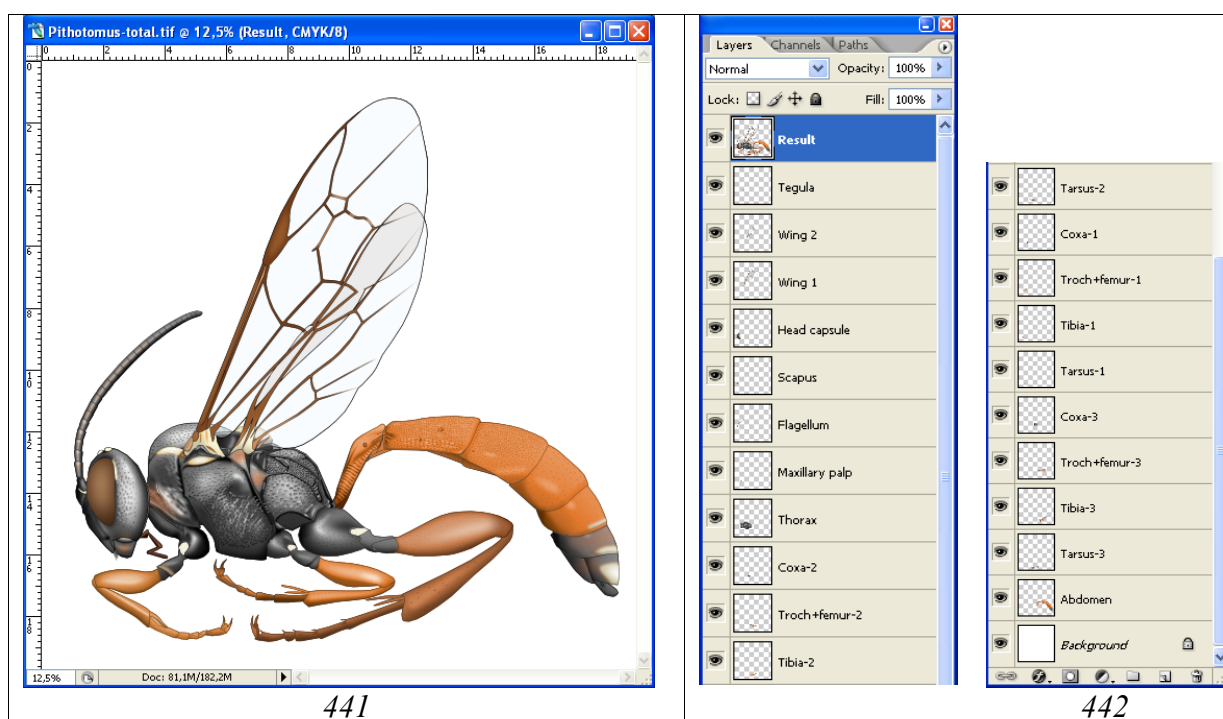
Fig. 441-442: Result of fulfillment of image of imago of ichneumon fly: (**441**) female with already painted wings, (**442**) hierarchy of layers in a final file with image of imago of ichneumon fly.

Stages of fulfillment of images of taxonomically important parts of a body

The overwhelming majority of the characters which characterise the species of fam. Ichneumonidae and have been not presented on lateral image of imago are concentrated on such segments and body parts as a head, propodeum and 1-2nd tergites of abdomen. Therefore, for inclusion in the table of the images characterising concrete taxon, images of a head of the ichneumon fly in two foreshortenings, propodeum (dorsal view) and 1-2nd tergites of abdomen (dorsal view) are obligatory. For a series of taxa the separate details of morphology of the object, such as mandibles, tyloides of

males flagellum and other details of morphology have an important taxonomical value and can additionally be included to the summary table.

As already it was spoken earlier, the object image in a working file should exceed con-siderably its size in the final table. As a rule, all pencil sketches of parts of a body of object are on one sheet of format A4 in a total scanned image (fig. 443). The image of 1/2 of a head in the "working" file is about 7 cm. Basis for contour fulfillment is the pencil contour of much smaller size in the total file with images of different parts of a body. Therefore, the total scanned image with pencil contours is increased till the sizes in "working" file. At the first stage in Menu: Image–Image Size (Alt+Ctrl+I), or having clicked the right button of the mouse on a document window title and having chosen in emerging window, Image Size, a width of the image in % is set. In de-scribed case, at width of a head in pencil drawing of 3,5 cm, width=200% in window is set. At a following stage, each part of a body from the increased table is copied to the separate files (see fig. 443). As a result, four files in a format "TIFF" and with the resolution 600 dpi are received: "head_above", "head_front", "propodeum" and "sg1-2". Each file consists of layer "Matrix" with 1/2 images of a fragment of a body and of layer "Background".
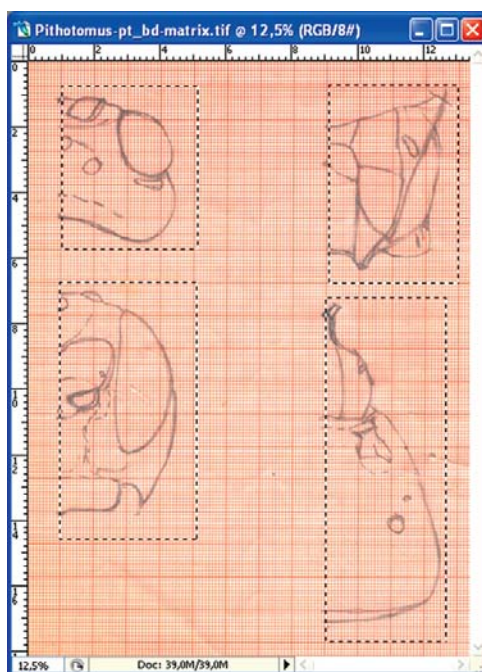
Fig. 443: Copying of fragments of a body of an insect from the table with pencil drawings for creation of separate files.

Head from above

"…temples behind eyes from above roundly swollen, width of a head at level of temples more than at level of eyes; from lateral temples long, 1,4 times longer than longitudinal di-ameter of eye at middle; occipital carina from above roundly concaved, far not reach level of eyes and hind ocelli; antennal cavities not big, deeply impressed, far not reach level of front ocellus and only just reach borders of eyes, laterally above antennal fossae with tu-

bercles and without of interantennal tubercle; frons some under front ocellus with broad impression; ocelli moderately convex, small, diameter of lateral ocellus 1,8 times less than distance from ocellus to eye…".

H e a d   c o n t o u r from above, as well as other parts of a body of imago is fulfilled with use of vectorial instrument Line Tool. At real width of a head on a matrix 7-7,5 cm, the thickness of line usually is 5-6px. Color of lines is chosen proceeding from convenience and demonstrativeness. If the file is in a Color mode, (not transformed to mode Grayscale), in a palette Swatches, the saturated black color (Black) is chosen. New layers with the separate lines are merged periodically (Merge Visible), having disconnected layers "Background" and "Matrix". As the result of outlining of a pencil contour by means of instrument Line Tool, the file with drawing consists of three layers – "Navigator", with a head contour, "Matrix" with a pencil contour and layer "Background" (fig. 444). If contour drawing was fulfilled proceeding from convenience by means of colored lines, a file is converted from a color mode to grey one (Menu: Image–Mode–Grayscale). Then, the lines of contour drawing are darkened maximally (Menu: Image–Adjustments–Brightness/Contrast).

444   *445*   *446*

447   *448*   *449*
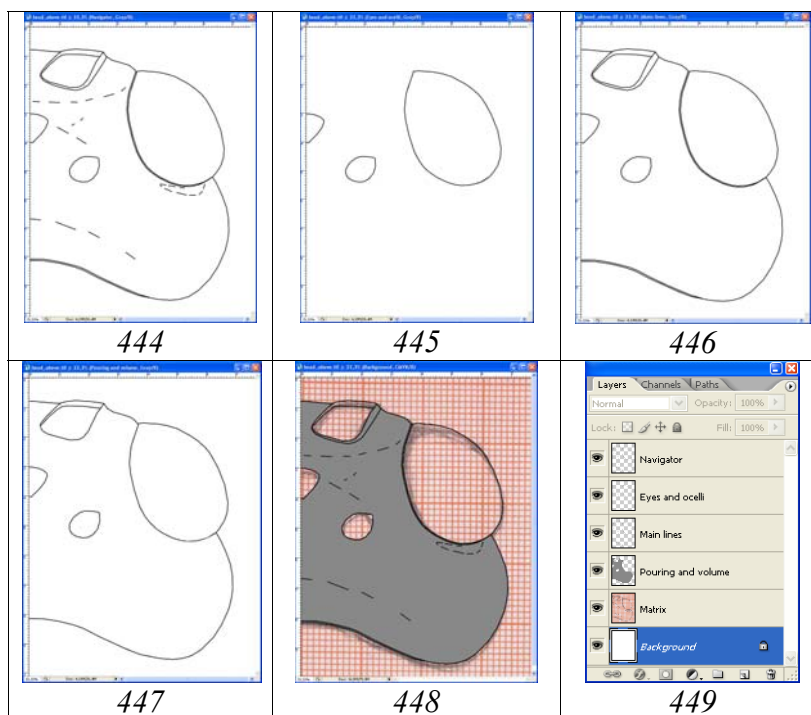
Fig. 444-449: Layers in a file "head above" at final stage of contour drawing: (**444**) layer for orientation "Navigator", (**445**) "Eyes and ocelli", (**446**) "Main lines", (**447**) layer for pouring ("Pouring and volume"), (**448**) final appearance of picture at the switched on layers, including layer "Pouring and volume", (**449**) hierarchy of layers.

At a following stage the layers necessary for fulfillment of pouring and volumetric drawing of a head are prepared. Layer "Navigator" is duplicated, for creating three additional layers – "Eye and ocelli", "Main lines" and "Pouring and volume". Layer

"Navigator" is duplicated, having clicked by the right button of the mouse on a layer in menu Layers and having chosen command Duplicate layer. In an emerging window the new name of a layer is entered. The layers are arranged as in figure 449. After fulfillment of the described actions, layer "Matrix" with pencil drawing is possible to remove, having clicked the right button of the mouse on a layer and having chosen in the emerging menu command Delete layer. Layer "Navigator", used for orientation is saved in initial state. In layer "Eyes and ocelli" all lines except contours lines of eye and ocelli are selected by instrument Polygonal Lasso Tool (Feather=0). Then, selected lines are deleted by having pressed Del key (Fig. 445). In layer "Main lines", the dotted lines serving for orientation are deleted. In layer "Pouring and volume" the external lines of the margins of antennal fossae, internal lines of occipital carina and the lines adjoining to an eye are deleted (fig. 447).

At the given stage a contour drawing is ready to pouring. P o u r i n g is fulfilled by means of instrument Paint Bucket Tool in layer "Pouring and volume", having chosen in palette Swatches Grey color 10% (fig. 448). Now drawing is ready for operation for giving to it of volumetric appearance.

V o l u m e t r i c i m a g e of a head is fulfilled in a layer "Pouring and volume".

For giving to object of volumetric appearance, an instrument Polygonal Lasso Tool is used. The layer "Navigator", serving for orientation is switched on. Proceeding from the form of a head capsule of the object, at the first stage all periphery of a head capsule is selected, reserving only area of ocelli, as the highest area. Border of selection is set up as very blured (Feather 90-100px and more). In described example it is 90px. It is necessary that at the initial stages, border of selected area went far beyond limits of object (for canvas limits). Brightness of selected parts of a head capsule (Menu: Image–Adjustments–Brightness/Contrast) at the initial stages are reduced as a rule on small values (20-30%.). At the first stage the parameter of brightness is reduced to – 32 (fig. 450).

At following stages, area of selection (Feather=90px) is shifted to periphery of a head capsule. Then head capsule is darkened by installing parameter Brightness= –16-20 (fig. 451-452). Area of vertex and temples is darkened by means of reducing parameter Brightness up to –32 (fig. 453).

After each operation on darkening of head capsule, having removed selection, correction of picture, by means of the general contrasting of object entirely is fulfilled, as a rule, by reducing contrast, up to liquidation of sharp borders between the darkened areas (fig. 454).

Area of antennal cavities is darkened in two stages. At the first stage, a composite selection is fulfilled. Antennal cavities properly are selected, selecting parameter Feather=30px. Having pressed and without releasing Shift key, a central part of frons (that divides antennal cavities) is selected having installed greater value of parameter Feather (50px) (fig. 455). Further, more in-depth parts of antennal cavities are darkened additionally even more by selecting their by instrument Polygonal Lasso Tool with parameter Feather=30px. Parameter Brightness is reduced to –20 (fig. 456).
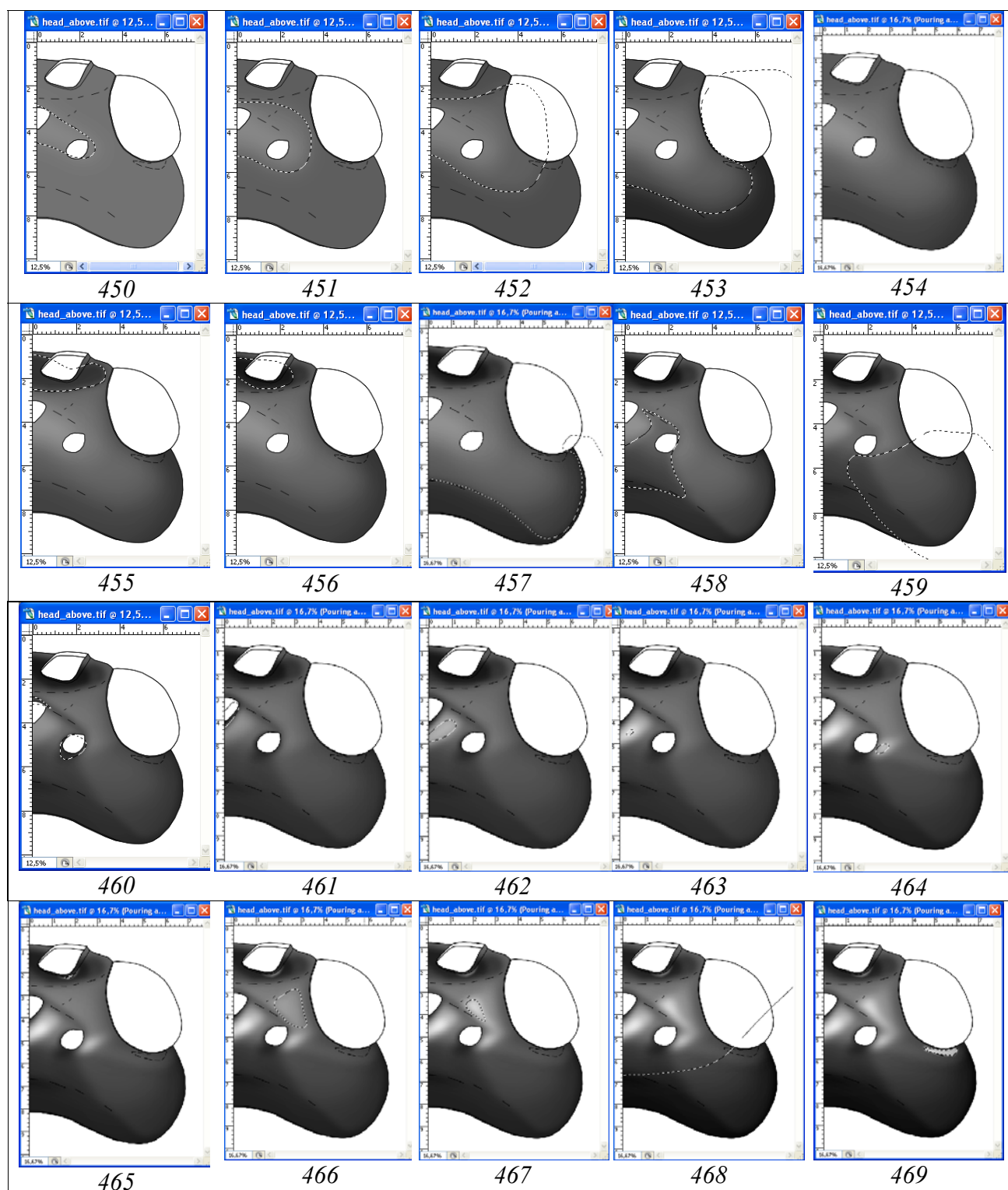
Fig. 450-469: Operations on giving of volumetric appearance to head capsule of ichneumon fly at switched on layer "Navigator": (**450**) first stage of darkening, (**451**) second stage of darkening, (**452**) third stage of darkening, (**453**) darkening of area of vertex and temples, (**454**) general clarification and contrasting of a head, (**455**) areas of mixed selection of antennal cavities, (**456**) additional darkening of deepest areas of antennal cavities, (**457**) darkening of periphery of vertex and temples, (**458**) darkening and contrasting upper part of vertex and ocellar triangle, (**459**) darkening and contrasting areas of temples, (**460**) combined darkening and contrasting of ocellar triangle, (**461**) darkening of area of front ocellus, (**462**)

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clarification of interval between ocelli, (**463**) additional clarification, (**464**) clarification of area adjoining to lateral ocellus, (**465**) clarification of area adjoining to antennal fossa, (**466**) clarification of area adjoining to ocellar triangle, (**467**) additional clarification of area adjoining to ocellar triangle, (**468**) diffused darkening of vertex and temples (–150px, Brightness= +76), (**469**) clarification of areas of white stripes on external orbits

At following stages, using instrument Polygonal Lasso Tool, separate parts of a head capsule are selected, using various values of parameter Feather. Separate areas are clarified, darkened or contrasted. Thus, the volumetric appearance of a head and first of all area of ocellar triangle is refined. At first, a periphery of vertex and temples (Feather=30px, Brightness= –18) is darkened (fig. 457). Then darkening and contrasting of the upper part of vertex and ocellar triangle (Feather=50px, Brightness= –29, Contrast= –29) (fig. 458) are fulfilled. After darkening and contrasting of area of temples, a combined darkening and contrasting of ocellar triangle are perfomed (fig.459).

Operation is fulfilled by means of instrument Polygonal Lasso Tool with parameters Feather=20,50px (Brightness= –38, Contrast= –61) (fig. 460). Area of a front ocellus is darkened similarly (Feather=30px, Brightness= –100, Contrast= +73) (fig. 461).

In the subsequent, using the same tools, the most shining areas of a head capsule are clarified and contrasted as it is shown in figures 462-467.

Stage on giving of volumetric appearance to a head capsule of object is completed by clarification and contrasting of areas of white spots in apices of external orbits.

In the given example, when selection of area of spots, parameter Feather=10px, values of Brightness= +70 and Contrast= +51 were used (fig. 469).

E l a b o r a t i o n   o f   a   h e a d (from above)

Elaboration is begun from the general estimation of sculptural features of a surface for a choice of strategy of elaboration. An area of ocellar triangle is sculptured by smoothed elongated almost merged punctures up to almost wrinkly-punctured surface on some areas. Surface of a head laterally from ocelli and on frons above antennal cavities is punctured by merged, round punctures. Area of vertex is polished. Area of frons from ocellar triangle up to an eye is with indistinct microsculpture.

Proceeding from the listed peculiarities, the methods of elaboration of sculptural peculiarities and accordingly quantity of new "empty" layers are chosen. For elaboration of area of ocellar triangle, detailed representation of punctures by means of instrument Lasso Tool and Polygonal Lasso Tool with selected parameter of Feather is optimal. For other parts, a diffused brush (Brush Tool) with the minimal parameter of Hardness is most suitable.

For fulfillment of operations on elaboration, six additional "empty" layers, located under layer "Main lines" in a following order from top to down are created: "Small punctures", "Light punctures", "Punctures", "Elongated punctures and wrinkles", "Clarification of interspaces" and "Microsculpture". For creation of "empty" layers, the layer "Pouring and volume" is duplicated with use of the right button of the mouse

(Duplicate Layer …) and the name of a new layer is entered in the pop-up menu, beginning from below of the list (Microsculpture). Then contents of a new layer is selected by command Ctrl+A and it is deleted (Del). Then this empty layer and everyone subsequent are duplicated in the similar way, inserting names of necessary layers: "Elongated punctures"–"Punctures"–"Light punctures"–"Small punctures". Each of layers in case of need it is possible to duplicate and to merge in subsequent. It allows avoiding of overlapping of the selected and poured areas at addition of those or other elements. So, for example, after fulfillment of the clarified (bright) areas in layer "Clarification of interspaces", a necessity in addition of similar elements is appearing. In this case, they should be performed in an additional "empty" layer and merge in the subsequent with the basic layer.

The elongated punctures and impressions in area of ocellar triangle are fulfilled simultaneously in a corresponding layer at pressed Shift key, having chosen by experimentally a value of parameter Feather (7-10px). For detailed elaboration of structures by means of instrument Lasso Tool, a pen of Pen Tablet is convenient to use.

Pouring of the selected areas is fulfilled by means of instrument Paint Bucket Tool, having chosen in palette Swatches the saturated black color and having clicked two times by the left button of the mouse by the allocated areas (fig. 470).

After fulfillment of operation of pouring, at the switched on instrument of selection, having pressed the left button of the mouse, all allocated areas are shifted. Then, the poured areas are clarified, giving to them of volumetric appearance (Brightness= +35, Contrast= +38) (fig. 471).

The following stage of elaboration of ocellar triangle is fulfilled in a layer "Light punctures". Light points are fulfilled by means of instrument Brush Tool, having chosen corresponding parameters of Spacing, Hardness, Roundness and orientation of the elongated points (Diameter=15-44px, Spacing=150%, Hardness=0%, Roundness=72%). Fulfillment of light points in a separate layer allows to clarify, to darken and to contrast their separate groups according to a volumetric appearance of object (fig. 472).

At following stage, the most shining areas of ocellar triangle are fulfilled in a layer "Clarification of interspaces". The areas for clarifying are selected by means of instrument Polygonal Lasso Tool (Feather=7px). Then, their pouring by grey color (10%) is performed by means of instrument Paint Bucket Tool. After pouring, the separate sites are contrasted by means of function Brightness/Contrast (fig. 473). In additional layer "Darkening", by analogous method, some impressed areas are darkened (fig. 474).

In separate layer "Punctures", the puncturation of a head is fulfilled, having chosen parameters of brush: Spacing, Hardness, Roundness and orientation of the elongated points. In our example diameter of the points varied from 53 to 72px. Parameter Hardness is fluctuated from 0 to 15%, parameter Roundness – from 0 to 64, and Angle – from 6 to –23° (fig. 475).
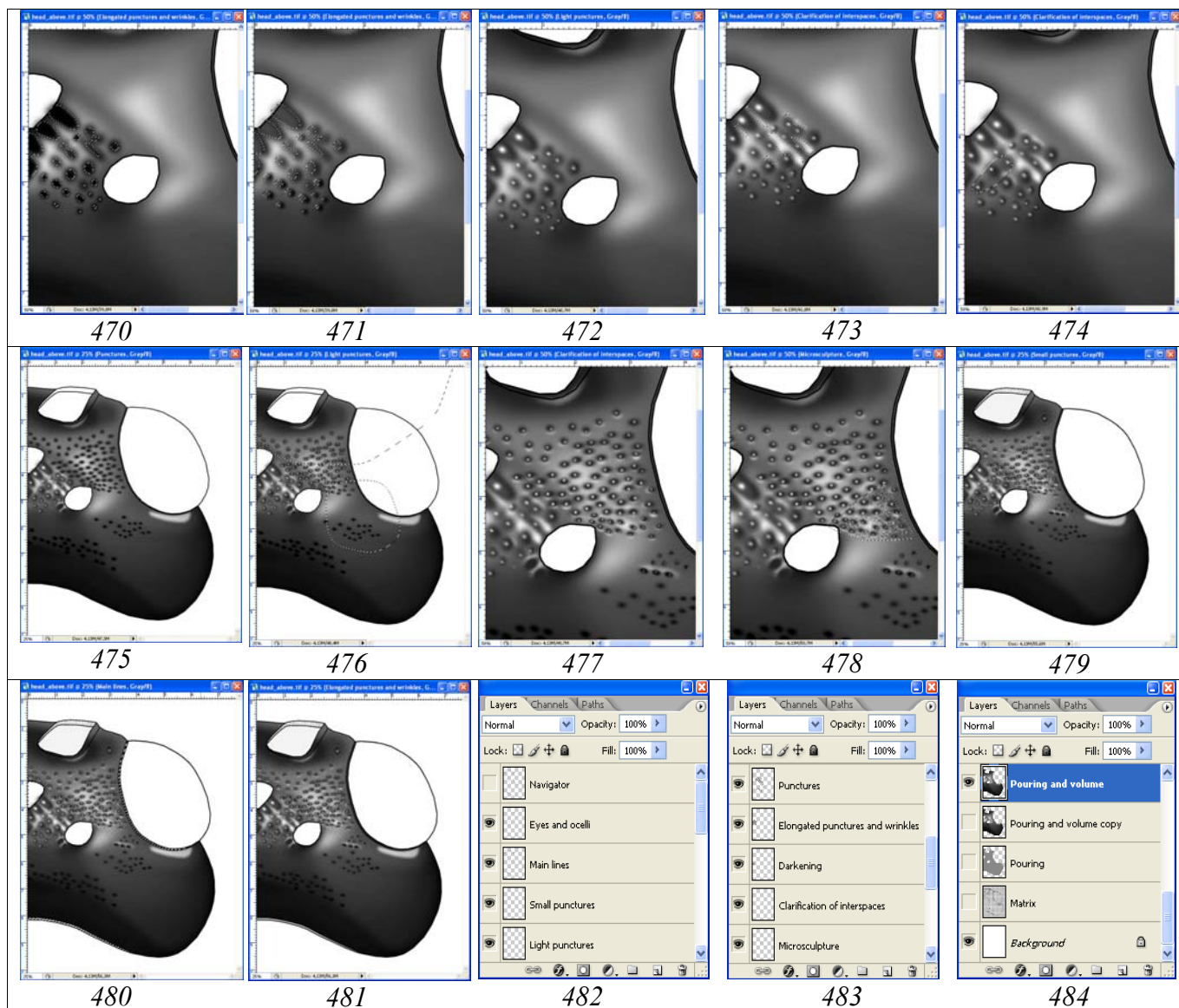
Fig. 470-484: Elaboration of head capsule of ichneumon fly (from above): (**470**) darkening of impressions in area of ocellar triangle, (**471**) shifting of areas of selection and clarification, (**472**) light points of 10% Gray, (**473**) clarification of intervals, (**474**) additional darkening, (**475**) puncturation, (**476**) light points 10% Gray (Diameter = 10-17px), (**477**) clarification of margins of punctures by instrument Brush Tool in layer "Clarification of interspaces", (**478**) elaboration of area with a microsculpture (layer "Microsculpture"), (**479**) small points in layer "Small punctures", (**480**) elimination of "imperfections" in area of front ocellus, impression around eye and area of occipital carina, (**481**) final result of operations on elaboration, (**482-484**) layers in final file.

Following step is the clarification of central parts of punctures. Operation is performed in layer "Light punctures". Accordingly, diameter and shape of light points are selected. Their saturation is regulated after finishing of fulfillment all of light points, by means of function Brightness/Contrast depending on an object general appearance (Feather=90px, Brightness= –100) (fig. 476).

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The gleams at the edges of punctures are fulfilled by instrument Brush Tool in layer "Clarification of interspaces", that is situated below. In the same layer the gleams of the most shining areas are performed with usage of instruments of selection and subsequent pouring of selected areas by grey color (10%) (fig. 477).

Area between an eye and ocellus with indistinct microsculpture is punctured by means of shallow dark and light points with diameter of brush 7px in layer "Microsculpture" (fig. 478).

At the last stages, a conditional darkening of antennal fossa is fulfilled. Internal part of hind margin of antennal fossa and the fossa proper are poured by grey color (10%). The fossa proper is selected by instrument Magic Wand Tool. Then, brightness is reduced on 10% by means of function Brightness/Contrast. In layer "Small punctures", an internal part of hind margin of antennal fossa is punctured schematically by means of shallow points. Some parts of a head capsule are punctured similarly, for giving to object more "natural appearance". Diameter of points at the given size of a picture is normally 5-7px. Hardness of a brush has been lowered. Parameter Spacing should have great values for preventing of coalescence of points at usage of a pen of Pen Tablet (fig. 479).

At the elaboration finishing stage in layer "Main lines", by means of instrument Magic Wand Tool, area of a front ocellus, impression around an eye and area of occipital carina are selected sequentially. In working layer "Elongated punctures and wrinkles" the parts of wrinkles which cover the area of an ocellus are deleted (to do it not obligatory because after coloration this area will be covered by an ocellus). In working layer "Pouring and volume", selected area of impression around an eye is darkened. Then, in the same way, an area of occipital carina selected in layer "Main lines" is clarified and contrasting (fig. 480). The final result is shown in figure 481.

In total, the final file at the given stage consists of 15 layers (fig. 482-484).

Operation on elaboration is completed by creation of layer "Result". Operation is fulfilled in the following order. In palette Layers, the layers "Navigator", "Eyes and ocelli", "Pouring and volume copy", "Pouring", "Matrix" and "Background" are disconnected (remove an eye) (fig. 482-484). After that operation of merging of layers (Menu: Layer–Merge Visible (Shift+Ctrl+E)) is performed. The image in the merged layer is selected by command Ctrl+A. Then, it is copied to the buffer (Ctrl+C). After that, the previous actions are cancelled (Menu: Edit-Step Backward (Alt+Ctrl+Z)), returning into place all layers merged previously. Layer "Main lines", that is situated under layer "Eyes and ocelli", is marked as the working and a command of insert (Menu: Edit-Paste (Ctrl+A)) is fulfilled. New layer is entitled "Result". By means of instrument Move Tool (V), layer "Result" is combined precisely with the underlaying layers and layer "Eyes and ocelli", which is situated over it.

C o l o r i n g of head (dorsal view) is begun from transformation of the image from mode Grayscale to mode CMYK – Menu: Image–Mode–CMYK Color (Don't flatten).

"Head black; white: narrow stripes at top of external orbits…".

Stripes at the top of external orbits are selected by instrument Polygonal Lasso Tool with parameter Feather=5px. From palette Swatches the palest yellow color (Pastel Yellow) is selected. Further, an operation on coloring of a selected area is fulfilled: Menu: Image–Adjustments–Hue/Saturation (Ctrl+U). In pop-up dialog box Hue/Saturation by means of cursors (runners) Hue and Saturation of selected area are selected. At fulfillment of operation, it is necessary to remember, that in window Colorize the flag should be inserted (fig. 488). The external border of yellowish strips has a brownish coloration. External border is selected by means of instrument Polygonal Lasso Tool also with parameter Feather=5px and similar operation is performed, having selected from palette Swatches brown color (fig. 485,486).
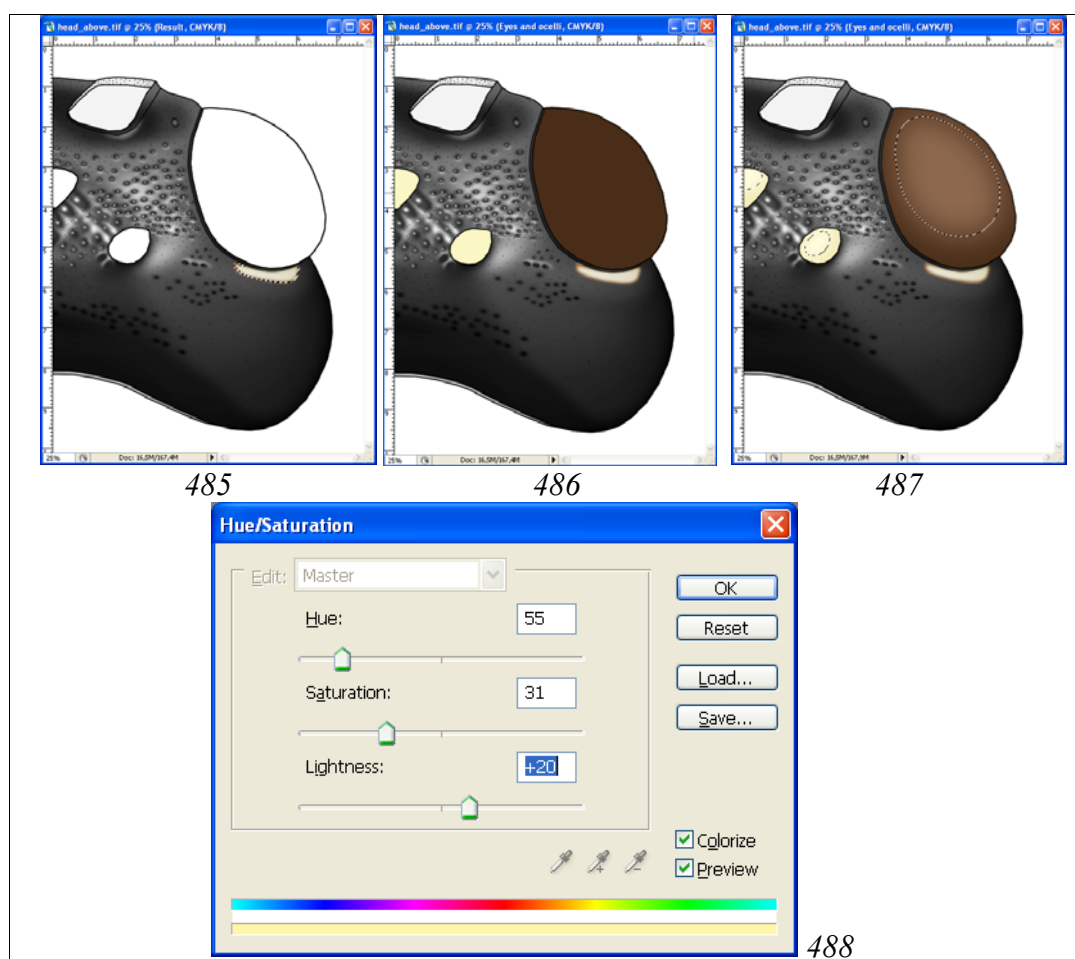
Fig. 485-488: Coloring of fragments of head capsule (from above): (**485**) coloring of stripes on external orbits, (**486**) pouring of eye and ocelli in layer "Eyes and ocelli", (**487**) giving to eye and ocelli of volumetric appearance in layer "Eyes and ocelli", (**488**) dialogue box Hue/Saturation at coloring of stripes on external orbits.

At the finishing stage, a coloration of eye and ocelli in separate layer "Eye and ocelli" is fulfilled. As already it was spoken above, performance of the image of eye and ocelli in a separate layer allows fulfilling an operation on giving of volumetric appearance, without influence of area of selection for the adjoining areas of a head capsule. The first step is pouring of eye and ocelli by primary color. Image of imago in

color mode to this point has already been fulfilled. Therefore, the file with image of imago it is necessary to open. Having switched on instrument Paint Bucket Tool (G), the cursor is moved to the most phaeochrous areas of eye and ocelli of colored image of imago. After that, having pressed Alt key (the cursor becomes eyedropper) it is necessary to click the left mouse button. Then, to the file "head_above" is moved. In the layer "Eye and ocelli" a pouring by the selected color at first of eye, then ocelli is fulfilled, having clicked some times by mouse on the chosen area up to disappearance of light border with lines of external contour (fig. 486).

Further, according to the selected mode of giving a volumetric appearance, a part of eye and ocelli is selected. In our example, according to the selected lighting, by means of instrument Polygonal Lasso Tool, with parameter Feather=90px, internal part of an eye is selected. A necessary effect is achieved, using standard function Menu: Image–Adjustments–Brightness/Contrast. For ocelli the value of parameter Feather in our example is 30px (fig. 487).

At the final stage layers "Result" and "Eyes and ocelli" are merged (Shift+Ctrl+E) (other layers are disconnected). Merged layer is selected by command Ctrl+A. Then it is copied to the buffer (Ctrl+C). After that the command of merging of layers is cancelled (Alt+Ctrl+Z). Uppermost layer "Navigator" is marked as the working and command of insert from the buffer (Ctrl+V) is fulfilled. A new layer containing a color image of a head on the scale of 0,5 is entitled "Result-1". Thus the final file with image of a head, on the scale of ½ includes 17 layers.

Fulfillment of an image of a head from above in complete format

Fulfillment of an image of a head in a complete format is started from preparation of a canvas of the appropriate dimension (Canvas Size). For fulfillment of operation, by command Ctrl+A, the entire image (scale 0.5) is selected. Then layer "Background" is marked as the working. After that, command to copy (Ctrl+C) is fulfilled.

The following step is creation of a new file with the size of the canvas that is increased two-fold. In Menu: File–New, or by command Ctrl+N, a new file is created. In a pop-up window the units in cm and width enlarged twice are put up. Thus, in the described example, instead of value of width equal 7,7 cm, value 15,4 is put down. The height of the canvas is left unchanged. The resulting file is saved under the name, which includes the specific name of the ichneumon fly and the necessary attributes, in directory "Result". In the given example it is "Pithotomus tschitscherini-female-head_above (CMYK)".

Again to a file "head_above" (selection is not removed) is returned. Layer "Result-1" is marked as the working and the command to copy (Ctrl+C) is performed. To the file "Pithotomus tschitscherini-female-head_above (CMYK)" is returned again and a command of insert (Ctrl+V) is fulfilled (fig. 489).

At a following stage the menu command: Image–Rotate Canvas–Flip Horizontal is performed. After that, by means of instrument Move Tool (V), the image is moved to

a canvas left margin (fig. 490). The command paste from the buffer (Ctrl+V) is fulfilled again (fig. 491). Further, by means of instrument Move Tool (V) both images are joined. Then both layers are merged (Alt+Ctrl+Z), having disconnected the layer Background (fig. 492).

489   *490*   *491*   *492*
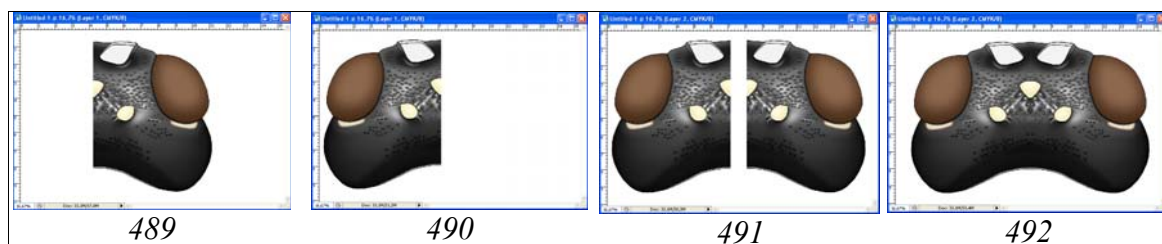
Fig. 489-492: Stages of fulfillment of image of a head in a complete format (see text).

The last stage in preparation of ready image is so-called correction of "seam (suture)" between two halves of a head capsule. In a described example a necessity in additional operations practically is absent. The best variant of correction is selection of analogous fragments on adjacent areas by means of instrument Lasso Tool , their copying and subsequent insert above area of "suture". Examples of correction of "seam" will be considered below at the description of fulfillment of images of other parts of a body of the ichneumon fly.

Head from front

H e a d c o n t o u r from front, as well as other parts of a body of imago is fulfilled with usage of vectorial instrument Line Tool with line width 5-6px.

> "Head contour from front slightly roundly narrowed downwards, rounded, with equal length and breadth; temples from front visible up to upper third of an eye; malar space 5 times shorter than height of an eye; eyes not great;... clypeus flat, transverse, 3,6 times wider than length…; antennal cavities not big, deeply impressed, far not reach level of front ocellus and only just reach borders of eyes…; ocelli moderately convex, small, diameter of lateral ocellus 1,8 times less than distance from ocellus to eye; …".

The sequence of operations had been described above. The layer "Navigator", received as a result of the outlining of the pencil drawing is duplicated, and three additional layers are created: "Eyes and ocelli", "Main lines" and "Pouring and volume". Layer is duplicated, having clicked on it by the right mouse button in menu Layers and having selected Duplicate layer command. In a pop-up window the new name of layer is entered and the layers are arranged as is shown in figure 449.

Layer "Navigator", used for orientation is saved in an initial state. In layer "Eyes and ocelli", all areas except an eye and ocelli are selected by instrument Polygonal Lasso Tool (Feather=0). Then they are deleted by keystroke Del. In layer "Main lines", the dotted lines used for orientation are deleted. In layer "Pouring and volume" lower lines of antennal fossae and structures of antennal cavities (tubercles) are deleted. At the given stage the contour drawing is ready to pouring. P o u r i n g is fulfilled by in-

strument Paint Bucket Tool in layer "Pouring and volume", having selected in palette Swatches Grey color of 10% (see fig. 448). Now the drawing is ready for operation on giving to object of volumetric appearance.

V o l u m e t r i c i m a g e of a head from front is fulfilled in a layer "Pouring and volume".

"…clypeus practically not separated from face (only by slight broad impression), of peculiar shape, with impressed, thinned apex with broad medial projection and enough distinct, but rounded lateral corners and slightly elevated lateral margins under clypeal foveae; clypeal foveae indistinct, only in a form of broad impressions between clypeus and lateral fields of face extended up to malar space; surface of face slightly differentiated, clypeus separated from lateral fields of face enough distinctly (unlike othe genera of tribe); middle field of face very slightly but distinctly expressed, 1,6 times wider than lateral fields in middle; antennal cavities not big, deeply impressed, far not reach level of front ocellus and only just reach borders of eyes, laterally above antennal fossae with tubercles and without of interantennal tubercle; margins of antennal fossae slightly elevated above face surface; frons some under front ocellus with broad impression; ocellar triangle not expressed, but area of a head at place of ocelli high elevated above upper level of eyes…".

For giving to object a volumetric appearance instrument Polygonal Lasso Tool is used. The layer "Navigator", which intended for orientation, is switched on. Proceeding from the form of a head capsule of the object, on the first step, the whole of periphery of a head capsule is selected. At first three stages, the very much diffused border of selection is set (150px in described example). It is necessary, that at the first stages, a border of selected area transcended far beyond borders of the object (beyond the canvas limits). Brightness of the selected parts of a head capsule (Menu: Image–Adjustments–Brightness/Contrast) is reduced at the initial stages usually on insignificant sizes – 10-30% (fig. 493-495). At the subsequent stages the separate areas of a head capsule are darkened, more and more detailing volumetric image of object (fig. 496-513). For detailed elaboration of object, the selections of areas by means of instrument Polygonal Lasso Tool with various values of parameter Feather are used. In some cases, a mixed selection, depending on morphology of the area of darkening is used. For example, a part of area is selected, using high values of Feather parameter (fuzzy selection), whereas other parts are selected (at the pressed Shift key) with low value of Feather parameter (hard selection). Thereafter, the operations on darkening and contrasting of a selected area are fulfilled (fig. 497,504,507,510).

Periodically the general clarification is fulfilled having selected value of parameter Brightness (fig. 498,514). Before fulfillment of operations on clarification of separate areas of a head, the general clarification of the object on +35% is performed.

At finishing stages of operation on giving of volumetric appearance, clarification and contrasting of the most convex or shining parts of the object are fulfilled. Sequentially, the areas, shown in figure 515 are selected and clarified. Narrow selection and clarification in the area of a front ocellus was fulfilled by selection with Feather=10px (Brightness= +90, Contrast= +40). Clarification on upper borders antennal cavities was fulfilled by selection with parameter Feather=40px (Brightness= +58, Contrast= +20). For clarification of upper parts of lateral fields under antennal

fossae, selection with parametre Feather=30px (Brightness= +40, Contrast=0) was used. Central part of the middle field of face was selected with parameter Feather=40px and clarified with parameters Brightness= +35 and Contrast=0. The gleams in the area of a clypeus were fulfilled in some stages with parameters Feather from 10 to 30px.

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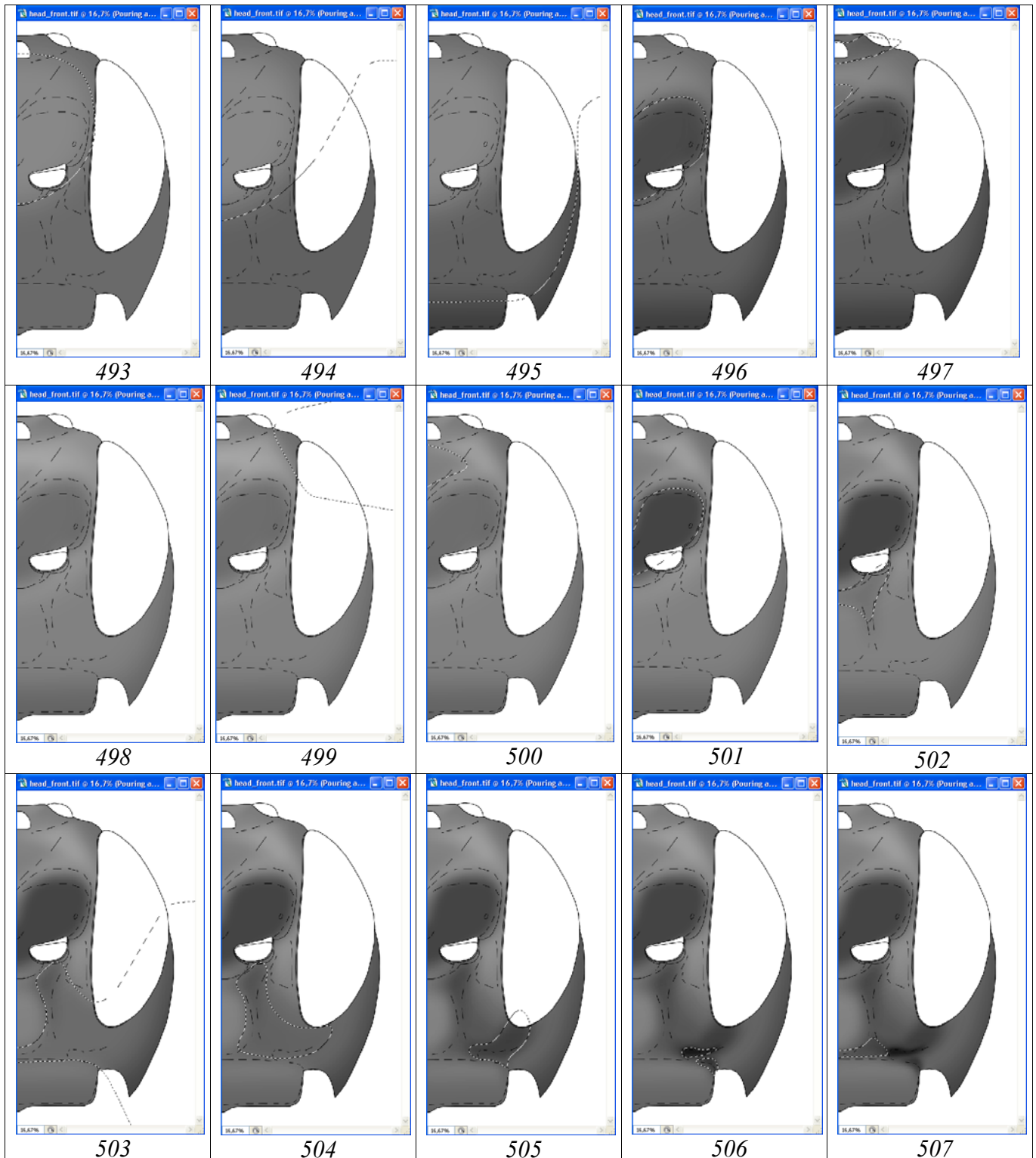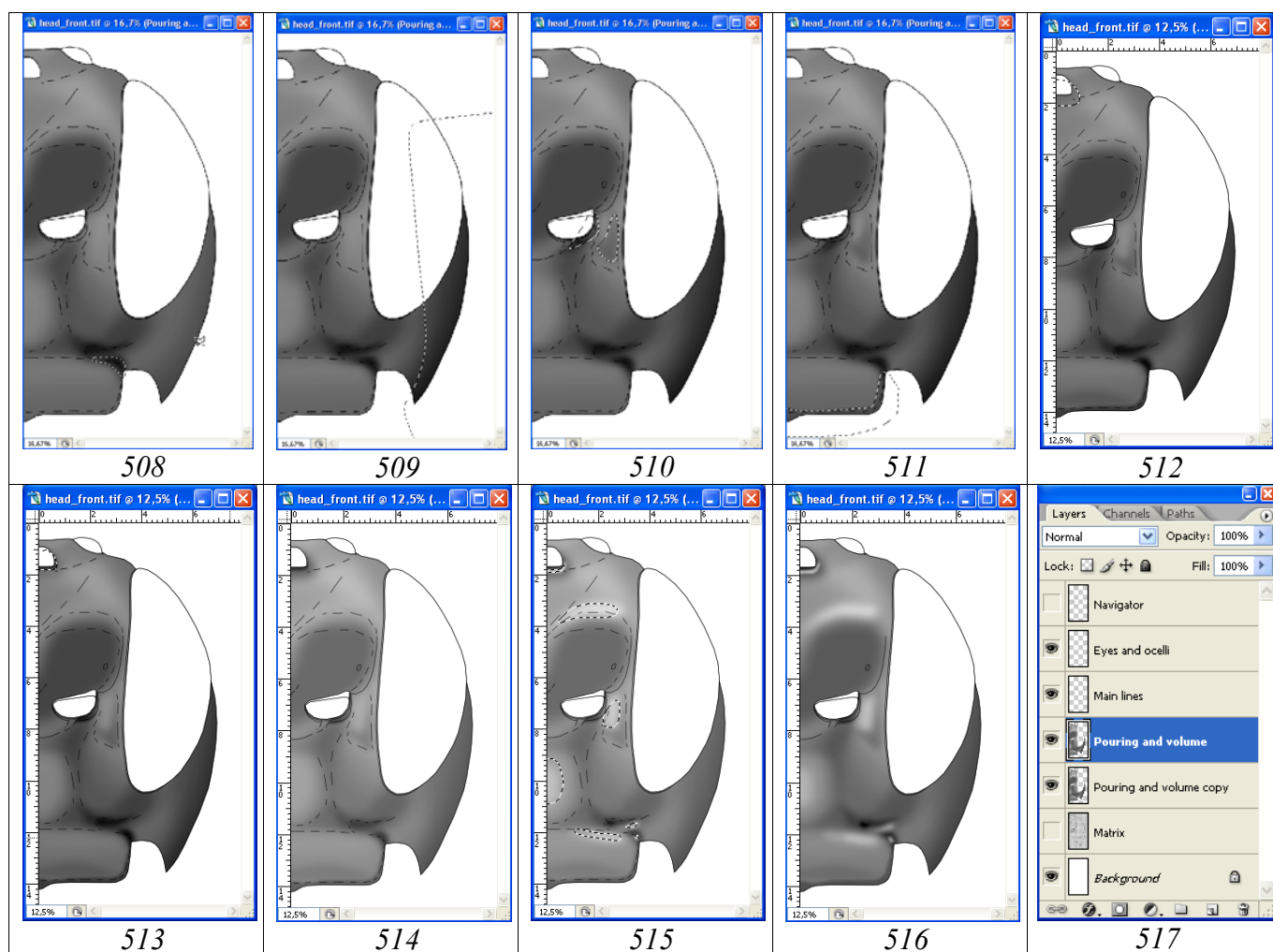
Fig. 493-517: Operations on giving of volumetric appearance to a head capsule of ichneumon fly: (**493**) first stage of darkening (–150px, Brightness= –30), (**494**) second stage of darkening (Feather=150px, Brightness= –10), (**495**) third stage of darkening (Feather=150px, Brightness= –30), (**496**) darkening of area of antennal cavities (Feather=90px, Brightness= –60), (**497**) mixed selection and darkening of area of frons (Feather=70,50,30px, Brightness= –20), (**498**) general clarification of head (Brightness= +33), (**499**) additional darkening of top of head (Feather=70px, Brightness= –31, Contrast= +2), (**500**) darkening of frons under forward ocellus (Feather=70px, Brightness= –32, Contrast= –81), (**501**) darkening of antennal cavities (Feather=50+70px, Brightness= –38, Contrast= –100), (**502**) darkening and contrasting of upper part of face (Feather=70px, Brightness= –27, Contrast= –65), (**503**) darkening and contrasting of lateral fields of face (Feather=70px, Brightness= –19, Contrast= +22), (**504**) additional darkening and contrasting of lateral fields of face with the mixed selection (Feather=70+90px, Brightness= –22, Contrast= +40), (**505**) darkening and contrasting of areas of clypeal fovea (Feather=50px, Brightness= –24, Contrast= –27), (**506**) additional darkening of clypeal fovea (Feather=20px, Brightness= –30, Contrast=0), (**507**) darkening area of epistomal suture (Feather=20+30px, Brightness= –16, Contrast= –44), (**508**) darkening and contrasting of lateral margin of clypeus (Feather=30px, Brightness= –25, Contrast= +10), (**509**) darkening of lateral part of head (Feather=70px, Brightness= –14, Contrast=0), (**510**) finalization of lateral field (Feather=10–30px, Brightness= –30,

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Contrast= +26), **(511)** darkening of front margin of clypeus (Feather=10px, Brightness= –22, Contrast=0), **(512)** additional darkening of area of front ocellus (Feather=30px, Brightness= –30, Contrast=0), **(513)** same, additional darkening of area of front ocellus (Feather=10px, Brightness= –50, Contrast=0), **(514)** general clarification of head (Brightness= +35), **(515)** clarifying areas (see text), **(516)** result of operations on giving of volumetric appearance (at switched off layer "Navigator" and the general darkening on –16%), **(517)** hierarchy of layers in the file on stage of giving to image a volume appearance.

For clarification, parametres Brightness were changed in limits from +30 to +75, and Contrast from 0 to +48% depending on observable at object under a microscope. In figure 516 volumetric appearance of a head at the final stage at disconnected layer "Navigator" and at general darkening on –16% is presented. After finalization of works on giving to the head of volumetric appearance, layer "Pouring and volume" is duplicated for security (fig. 517).

Elaboration of a head (from front)

Elaboration is begun from the general assessment of sculptural peculiarities of a surface for a choice of the strategy of elaboration.

> "…Clypeus in lower half smooth, shining, in upper one punctured by merged smoothed punctures; malar space with microsculpture in part; face very densely punctured, shining, without microsculpture, in place of borders between lateral and middle field big punctures practically merged forming smoothed wrinkling; temples punctured by smoothed punctures up to middle in longitudinal direction, polished…".

Proceeding from the enumerated peculiarities, the methods of elaboration of sculptural peculiarities and accordingly quantity of new "empty" layers are chosen. For fulfillment of operations of elaboration, the six additional "empty" layers are created, located under layer "Main lines" in a following order from top to down: "Small punctures", "Light punctures", "Punctures", "Darkenings", "Clarification of punctures margins", "Clarification of interspaces" and "Microsculpture". For creation of "empty" layers, a layer "Pouring and volume" is duplicated with usage of the right mouse button (Duplicate Layer …) and in a pop up menu the name of new layer is inserted starting from below of the list (Microsculpture). After that contents of a new layer is selected by command Ctrl+A, and it is deleted (Del). Then, this empty layer and each subsequent are duplicated by the same way, giving names to the new necessary layers: "Clarification of interspaces"–"Clarification of punctures margins"–"Darkenings"–"Punctures"–"Light punctures"–"Small punctures". Each of layers, if necessary, it is possible to duplicate and to merge in the subsequent. This avoids overlap selected and poured areas at addition of those or other elements. So, for example, after fulfillment of the clarified areas in the layer "Clarification of interspaces", the necessity in adding similar elements appears. In this case they should be fulfilled in additional "empty" layer. In subsequent, it will be merged with the basic layer.

Elaboration of structures of a head capsule is begun from fulfillment of the most mass sculpture – puncturation. The shape of punctures is from round to elongated. There-

fore, as the drawing tool, the instrument of random selection Lasso Tool (L) has been chosen. For the medial points, which located on a line of section, instrument Polygonal Lasso Tool was used for selection of theirs halfs. Depending on contrast of margins of punctures, parameter Feather was 7, 11 and 14px.

All punctures were selected simultaneously, at the pressed Shift key, in layer "Punctures". In connection with a considerable quantity of punctures, the operations of pouring and saving (Ctrl +S) of file are fulfilled periodically to be safe from computer crashes. The command in the subsequent is being cancelled (Ctrl+Alt+Z) and the selection of punctures is continued. In the case of a computer crash, a new layer "Punctures" should be created, and already in it, the puncturation is continued. In subsequent, the layers can be merged. Selected punctures are presented in a figure 518 against a background layer with a volumetric image of the head.

Pouring of selected areas of punctures, by saturated black color is fulfilled by instrument Paint Bucket Tool simultaneously, having selected in palette Swatches Black color.

At a following stage, a volumetric appearance for the punctures is shaped. For this purpose, not removing selections, in the same layer, at switched on instrument Lasso Tool, areas of selection are shifted according to the selected direction of lighting, by a mouse cursor (fig. 520). Further the selected parts of punctures are clarified by means of function Menu: Image–Adjustments–Brightness/Contrast. In a considered example the selected areas are clarified on +35%. Layer is renamed into "Punctures double pouring + shade" (fig. 531).

The following stage is clarification of the punctures edges. Areas of selection of punctures are shifted by the previously described method, a little below of lower border of punctures. Then in layer "Clarification of punctures margins" (a working layer), pouring by grey color (Gray 10%) is fulfilled. Maximum correspondence to the object, it is possible to achieve trying different variants of displacement of area of selection of punctures (fig. 521). In a figure 522 a final result of a clarification of margins of punctures, at the removed selection is shown. Both punctures and theirs margins, it is possible to contrast in subsequent, up to achieving the maximum resemblance to object.

At giving of volumetric appearance to the punctures by simultaneous shift of area of selection, some punctures may be not well elaborated. In this case they additionally are elaborated as follows. In a layer with punctures (Punctures double pouring + shade) the roundish selection, comparable on diameter with a puncture, with parameter Feather=5px is fulfilled. Area of selection is moved by means of cursor from one puncture to another and clarification is fulfilled, giving to them of volumetric appearance. Or simultaneously, at pressed Shift key, the areas of all not elaborated punctures are selected and their simultaneous clarification is fulfilled. At the finishing stage, a tonality of the punctures in a layer "Punctures … + shade" is corrected, or the entire layer as a whole, or separate groups of punctures. In described example brightness of volumetric punctures is increased by 21% (fig 523).

At the following stage an operation of clarification of central parts of volumetric punctures is fulfilled. Operation is performed in a layer "Light punctures" by instru-

ment Brush Tool. Depending on diameter of points, diameter of a paintbrush, and the appropriate parameters Hardness, Roundness and orientation of the elongated points are selected. Hardness of instrument Brush, as a rule, is minimal. Color of paintbrush is normally grey (10% Gray). In subsequent, saturation of light points on separate areas can be corrected by function Brightness/Contrast after theirs selection.

After fulfillment of light points in layer "Light punctures", impressions on a head surface are selected by diffused selection by means of instrument Polygonal Lasso Tool. In our example value of parameter Feather is 40px.

Selected areas are sequentially darkened in layers "Light punctures", "Punctures … + shade" and "Clarificatoins of margins", up to achieving the maximum resemblance to an object.

The surface of head capsule is not ideally smooth. Therefore, all additional structures and peculiarities are elaborated in the main layer "Pouring and volume" using tools of selection with the subsequent darkening or clarification by means of function Brightness/Contrast, and other tools, such as Brushes of different diameter and shape.

In a separate layer, "Darkenings", some most darkened areas are selected and then their pouring is fulfilled. In addition, some unnecessary lines in layer "Main lines" are deleted or their some parts are clarified (fig. 526).

Area with a microsculpture on a malar surface is fulfilled by puncturation by means of shallow light and dark points (7px). Area of fulfillment of microsculpture is limited by selection it by instrument Polygonal Lasso Tool (10px) (fig. 527).

Ring-shaped impression around eye is darkened preliminarily having selected it by instrument Magic Wand Tool in layer "Main lines". After that, it is darkened in working layer "Pouring and volume" by function Brightness/Contrast. Border of ring-shaped impression is contrasted by function Brightness/Contrast in layer "Main lines" preliminarily having selected it by instrument Polygonal Lasso Tool.

Area of antennal fossa is poured by grey color (10% Gray) and elaborated as described above in section "Head from above".

At penultimate stage of elaboration, some areas of a surface are completed by shallow points in layer "Small punctures", for giving to a head capsule of more natural appearance.

At finishing stage the most shining areas of object are clarified. Operation is fulfilled in separate layer "Clarification of interspaces" in several stages. Each area is selected separately by instrument Polygonal Lasso Tool, having selected for each area a value of parameter Feather. Selected area is poured by grey color (10% Gray). After that, without removing selection, by means of function Brightness/Contrast, the maximum resemblance with shining areas that observable at object under a microscope is achieved. Layer "Clarification of interspaces", in a case of separately fulfilling operations, is duplicated some times, to avoid of overlapping.

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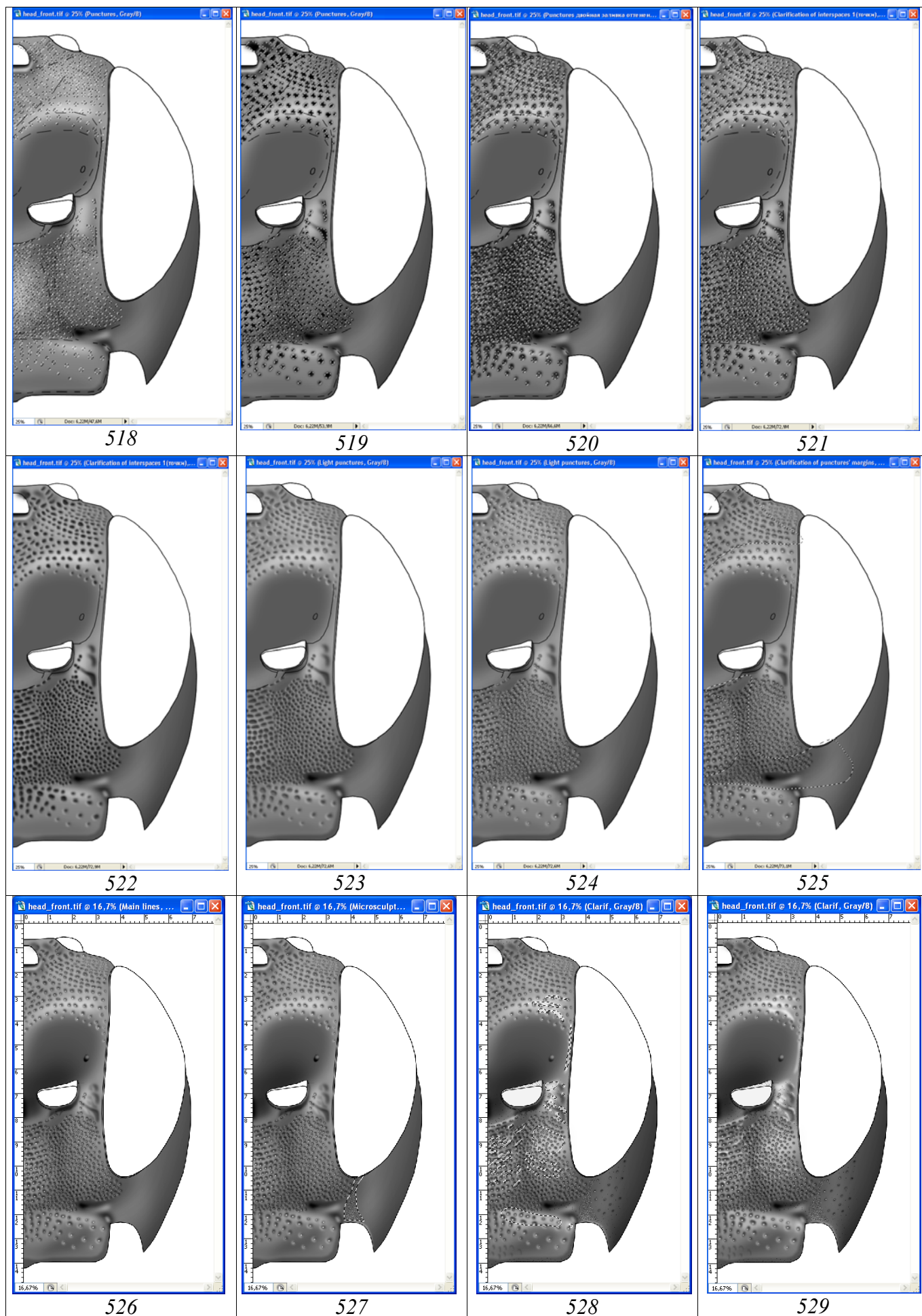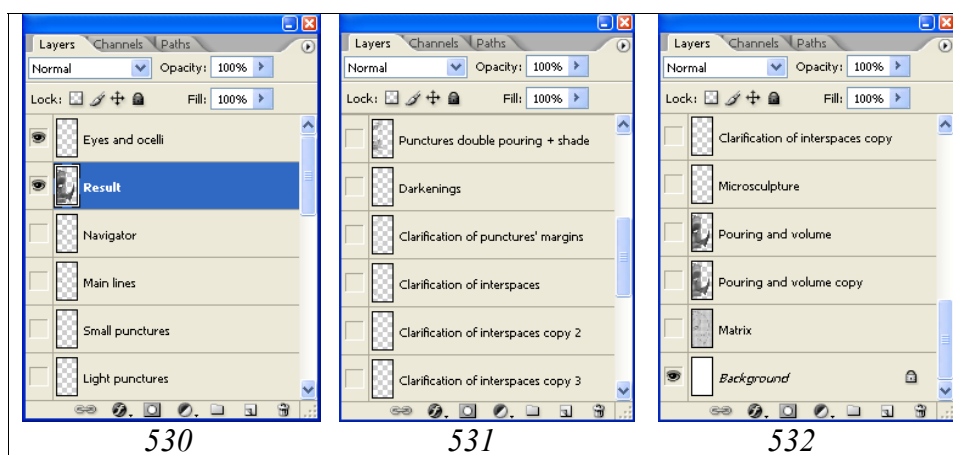
Fig. 518-532: Elaboration of head capsule of ichneumon fly (front view): (**518**) selection of punctures of puncturation (Feather=7,11,14px), (**519**) pouring of selected punctures (by black color), (**520**) clarification of punctures (giving of volumetric appearance), (**521**) clarification of margins of punctures (pouring by 10% Gray in layer "Clarification of punctures margins"), (**522**) result after deselection, (**523**) increase of brightness on 21% after finalization of volumetric appearance of punctures, (**524**) light points of 10% Gray (Diameter=10,17,20px), (**525**) contrasting of puncturation (darkening of light punctures –70%, darkening of volume punctures –12%, darkening of punctures margins –40%), (**526**) additional elaboration in basic layer and layer "Darkenings", (**527**) microsculpture of malar surface, (**528**) elaboration of antennal fossae and small puncturation, clarification of intervals between punctures, (**529**) final result of operations on elaboration, (**530-532**) hierarchy of layers in a final file.

The some areas of clarification are performed in different layers. In the subsequent all layers "Clarification …" can be merged. In figure 528 a scheme of selection of different areas of a head capsule is shown. In an operating time, groups of areas of clarification are fulfilled in different layers with different parameters of selection and contrasting. So, for example, for area of a clarification of base of clypeus, the instrument Polygonal Lasso Tool with parameter Feather=27px was used, and darkening after pouring was –68%. Clarification of the apical half of lateral fields was fulfilled by the same instrument, with parameter Feather=57px, and darkening after pouring was –41%. Clarifications of a median field and the lower part of lateral fields were fulfilled by means of instrument Lasso Tool at pressed key Shift. In different parts parameter Feather was changed from 7 to 17px. For a clarification of lateral margins of antennal cavities, the mixed selection by instrument Polygonal Lasso Tool with parameter Feather from 9 to 19px etc. was used. Areas of clarification are contrasted in the subsequent by selection of their separate areas and by using function Brightness/Contrast, to achieve the maximum conformity of the image to real object.

Elaboration of head capsule from front is finished with preparation of layer "Result", which is necessary for fulfillment of a stage of coloring of object. Operation is fulfilled in a following order. In palette Layers the layers "Navigator", "Eyes and ocelli", "Pouring and volume copy", "Matrix" and "Background" are disconnected (an eye is removed) (fig. 530-532). After that, an operation on merging of layers (Menu: Layer–

Merge Visible (Shift+Ctrl+E)) is fulfilled. The image in a merged layer is selected by command Ctrl+A. Then, it is copied to the buffer (Ctrl+C). After thereof, the previous actions are canceled (Menu: Edit–Step Backward (Alt+Ctrl+Z)), returning into place all layers that was merged earlier. Layer "Main lines", which located under layer "Eyes and ocelli" is marked as the working and a command of insert (Menu: Edit–Paste (Ctrl+A)) is fulfilled. New layer is entitled "Result". Layer "Result" is superimposed accurately with the underlying layers and with layer "Eyes and ocelli" by means of instrument Move Tool (V). Layer "Navigator" is moved by means of mouse cursor under the layer "Result". Altogether at the final stage of elaboration of the sculptural peculiarities of head from front, the file with image includes already 18 layers (fig. 530-532).

C o l o r i n g of head (front view) is begun from transformation of the image from mode Grayscale to mode CMYK – Menu: Image–Mode–CMYK Color (Don't flatten).

Head (from front) is black, with exception of colored eye and ocelli. Eye and ocelli are colored in a separate upper layer – "Eyes and ocelli". The first step is pouring of eye and ocelli by main color. Because head image from above is already ready, it is necessary to open already colored file. Having switched on instrument Paint Bucket Tool (G), the cursor is moved to the most phaeochrous areas of eyes and ocelli. After that, having pressed Alt key (the cursor becomes eyedropper) click the left mouse button on the chosen area. Then, to a file "head_front" is moved. In layer "Eyes and ocelli" a pouring, at first, an eye, and then of simple ocelli is fulfilled, having clicked some times by the mouse on the chosen area before disappearance of light border with an external contour (fig. 533).

Further, according to the chosen way of coloration, the parts of eye and ocelli are selected. In our example, according to the chosen lighting, by means of instrument Polygonal Lasso Tool, internal part of an eye is selected with parameter Feather=90px. Necessary effect is achieved using standard function Menu: Image–Adjustments–Brightness/Contrast up to reception of necessary effect. For ocelli, the value of parameter Feather in our example is 30px (fig. 534).

The head of this species, usually described as black, does not possess the homogeneously saturated black coloration. As a rule, separate fragments of a head capsule are of brownish shade. In described example, median field of face and clypeus of ichneumon fly are of brownish color. To achieve the maximum resemblance of an image with object, an operation on giving tint to the named parts of head capsule is used. For this purpose, separate parts of a head are selected by the extremely "diffused" selection. In our example, the value of parameter Feather is 200px. Further from palette Swatches the most suitable primary color is selected. In our example it is Darker Red Orange or Darker Warm Brown. Further, an operation on coloring of selected area is fulfilled (Menu: Image–Adjustments–Hue/Saturation (Ctrl+U)).

In pop-up dialog box Hue/Saturation, it is enough to expose a tick in window Colorize for obtaining of necessary effect (fig. 535,536). In case of need it is possible to resort

to correction Hue and Saturation of selected area by means of cursors (runners). Normally, additional actions on correction are unnecessary.
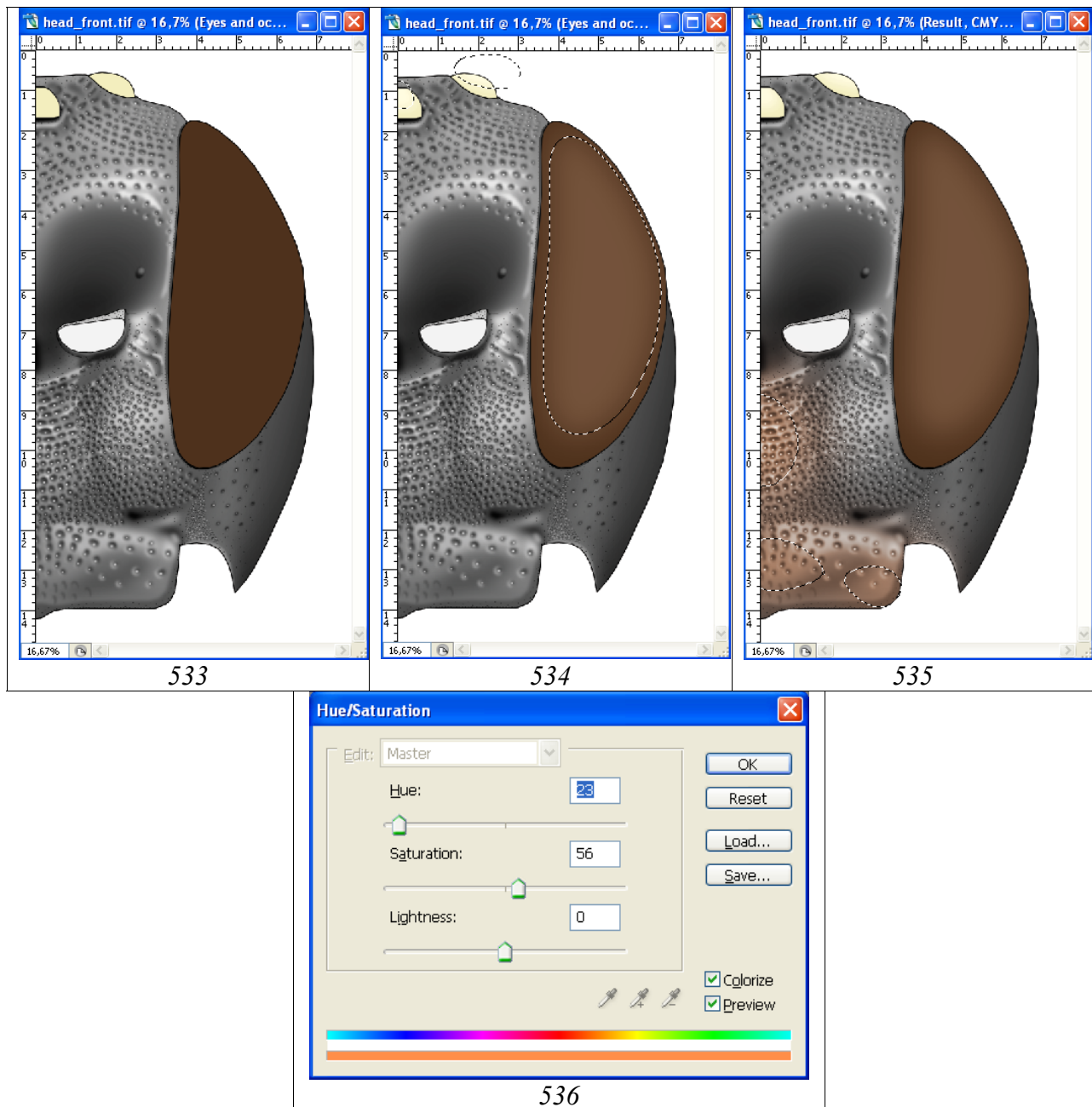
Fig. 533-536: Coloring of fragments of head capsule (front view): (**533**) pouring of eye and ocelli in layer "Eyes and ocelli", (**534**) giving to eye and ocelli of volumetric appearance in layer "Eyes and ocelli", (**535**) giving of tint to median field of face and clypeus with usage of fuzzy selection (Feather=200px), (**536**) dialog box Hue/Saturation at giving a tint to areas of head capsule.

At the final stage, layers "Result", "Eyes and ocelli" are merged (Shift+Ctrl+E) (the others layers are disconnected). The merged layer is selected by command Ctrl+A. Then it is copied to the buffer (Ctrl+C). After that a command of merging of layers is cancelled (Alt+Ctrl+Z). The uppermost layer "Navigator" is marked as the working and a command of an insert from the buffer (Ctrl+V) is fulfilled. New layer, contain-

ing a color picture of a head in a scale 0,5, is named "Result-1". Thus the resulting file with an image of a head, fulfilled in scale of 0,5 includes 19 layers.

Fulfillment of an image of a head from front in complete format

Fulfillment of an image of a head in a full format is begun from preparation of a canvas of the appropriate size (Canvas Size). For fulfillment of operation, by command Ctrl+A, an image as a whole is selected. Then layer "Background" is marked as the working and a command to copy (Ctrl+C) is fulfilled.

The following step is creation of a new file with the dimension of a canvas increased twice. In Menu: File–New or by command Ctrl+N a new file is created. In an emerging window units of measure – cm and Width – size increased twice are inserted. Thus, in the described example, instead of width 7.9 cm , value 16 is inserted. The height of the canvas (Height) is left unchanged. Final file is saved under the name, which includes the species name of ichneumon fly and the necessary attributes, in directory "Result". In the given example it is "Pithotomus tschitscherini-female-head_front (CMYK)".

Again to the file "head_front" is returned (selection is not removed yet). Layer "Result-1" is marked as the working and a command to copy (Ctrl+C) is fulfilled. Again to a final file is returned and an insertion command (Ctrl+V) is fulfilled (fig. 537).

| 537 | 538 | 539 | 540 |
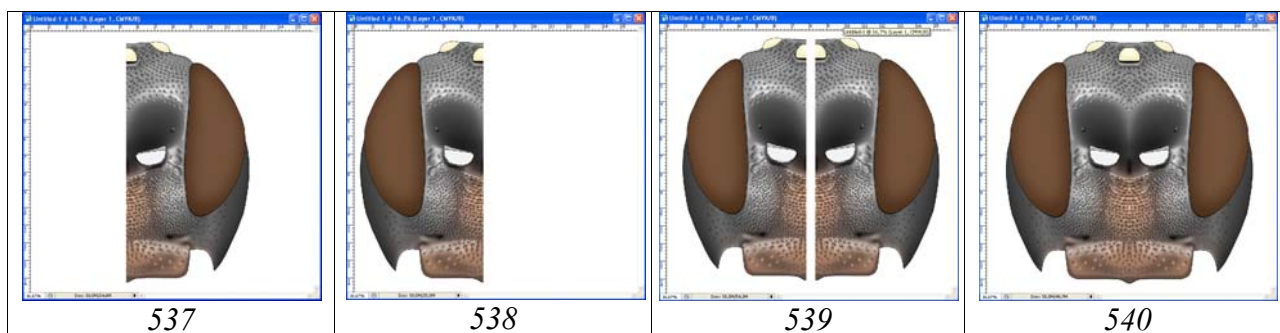
Fig. 537-540: Stages of fulfillment of image of head in complete format (see text).

At a following stage the menu command: Image–Rotate Canvas–Flip Horizontal is fulfilled. After that, by means of instrument Move Tool (V), an image is shifted to the left margin of canvas (fig. 538). A command of an insert from the buffer (Ctrl+V) is fulfilled again (fig. 539). Further, by means of instrument Move Tool (V) both images are superimposed and both layers are merged (Alt+Ctrl+Z), having disconnected layer Background (fig. 540).

Last stage in preparation of the ready image is so-called correction of "seam (suture)" between two halves of head capsule (fig. 541-543).

For fulfillment of operation, the various instruments – brushes of different diameter with various parameters, selection with the subsequent darkening or clarification of
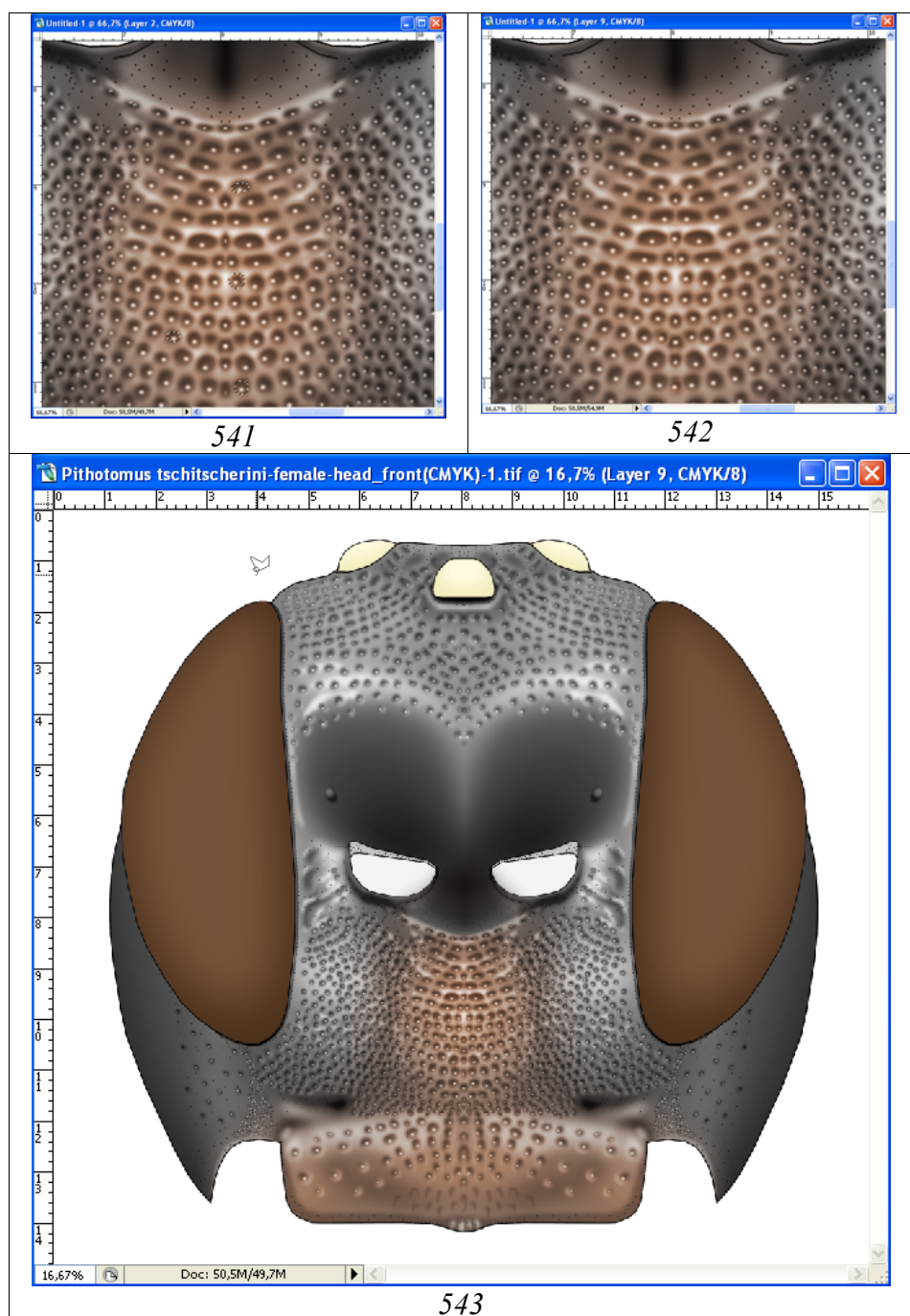
Fig. 541-543: Correction of "suture" at merging of two half of head capsule: (**541**) selection of punctures of adjacent areas of middle field of face, (**542**) result of relocation of the copied areas on "suture", (**543**) corrected image of head capsule.

areas, etc. are used. However, the optimal variant of correction is copying of analogous fragments on adjacent areas and their subsequent insert over area correcting. Having chosen suitable site on adjacent area, it is selected by instrument Lasso Tool with the appropriate parameter of Feather. Usually the size of parameter Feather is 3-5px. After selection of area, it is copied by command Ctrl+C and inserted by command Ctrl+V into the new layer located over the basic layer. After an insert, a copied

area is moved to place above correcting area by means of instrument Move Tool. Actions on copying of areas and their inserts in a new layer are repeated up to liquidation of all "imperfections". After finishing of operation, layer "Background" is disconnected. Then a command of merging of all layers (Menu: Layer–Merge Visible (Shift+Ctrl+E)) is fulfilled. In figure 541, the selected areas in the lower part of a head, which necessary for correction of "imperfections" are presented. Results of moving of the copied areas are shown in figure 542. The result of operation of correction is presented in figure 543.

Propodeum

C o n t o u r of propodeum, as and other parts of a body of imago is fulfilled with use of vectorial instrument Line Tool with thickness of line 5-6px.

> "…carinae of propodeum developed; basal area rather long, not impressed; area superomedia half-moon-shaped, transverse, 3,2 times shorter than breadth between costulae, costulae weak; area dentipara at apex without tooth, only with broadened transversal carina; spiracles long, along external contour 2,3 times longer than width…".

The sequence of operations has been described above. As the result of consecutive merging of layers with vectorial lines, the basic layer "Navigator" is formed Layer "Navigator" is duplicated, and two additional layers – "Main lines" and "External contour" are created. The layer is duplicated, having clicked by the right button of the mouse on a layer in palette Layers and having chosen command Duplicate Layer. In an emerging window the new name of a layer is entered and layers are arranged as is shown in figure 548. In layer "Main lines", the dotted lines serving for orientation are deleted (fig. 545). In layer "External contour" all lines except an external contour of propodeum are deleted (fig. 546).

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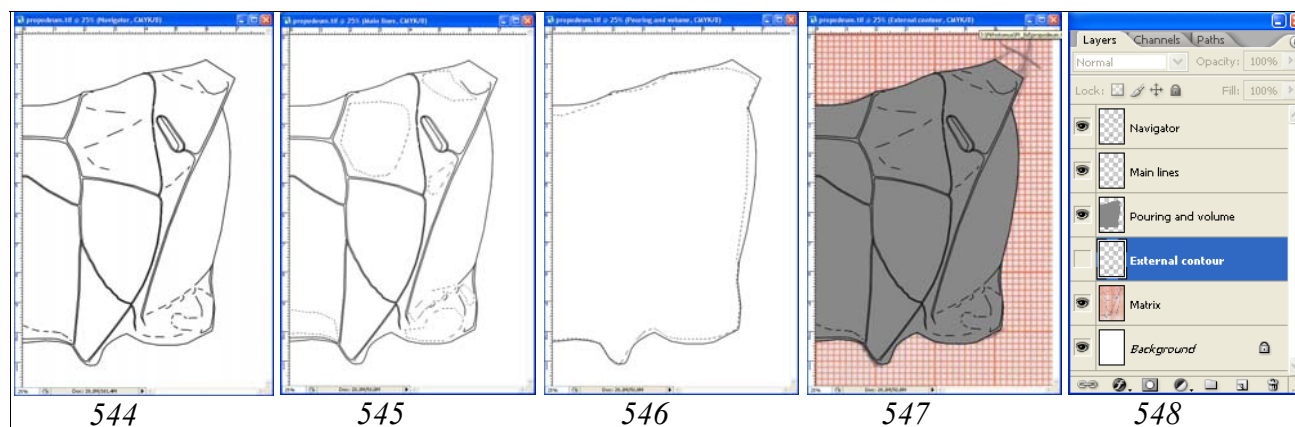
Fig. 544-548: Layers in a file "propodeum" at final stage of contour drawing preparation: (**544**) layer for orientation – "Navigator", (**545**) deletion of superfluous lines in layer "Main lines", (**546**) deletion of superfluous lines in layer "External contour", (**547**) final view of picture, at all switched on layers, (**548**) hierarchy of layers.

At a following stage layer "External contour" is duplicated or renamed into layer "Pouring and volume". P o u r i n g is fulfilled by means of instrument Paint Bucket Tool in layer "Pouring and volume", having chosen in palette Swatches Grey color of 10% (fig. 547). Now drawing is ready for operations on giving to object of volumetric appearance.

V o l u m e t r i c i m a g e of prppodeum is fulfilled in a layer "Pouring and volume".

> "…Propodeum roundly slanted backwards; horizontal part 2,3 times shorter than length of area posteromedia in middle;…".

For giving to object of volumetric appearance, an instrument Polygonal Lasso Tool is used (fig. 549-560). The layer "Navigator" serving for orientation is turned on (the eye is established). Proceeding from the shape of propodeum, a hardness of selection is chosen and object darkening is fulfilled. According to the form of object, parameter Feather in a described example is maximal – 150px. The general darkening of propodeum is fulfilled in six stages. Selection is begun from area of area superomedia, the highest part of propodeum. Borders of the selected area, as in previous examples, should go far beyond outside the limits of object. Area of selection at each stage is shifted to the object periphery. The selected area is darkened on 10% and at last stage on 20% (fig. 549-554). Then, the general clarification of propodeum is fulfilled, by setting parameter Brightness= +40 (fig. 555).

At following stages, the separate areas of periphery are darkened for achieving the maximum similarity to a general appearance of the object observable under a microscope (fig. 556-558).

In figure 559, variant of the mixed selection is presented. In layer "Main lines", apical and third lateral area are selected by instrument Magic Wand Tool (Feather=0).

Then, having pressed Shift key, the additional areas are selected by instrument Polygonal Lasso Tool (Feather=30). After that, already in a working layer "Pouring and volume" darkening on 10%, by means of function Brightness/Contrast is fulfilled.

At last stage, the most convex or shining areas are clarified and contrasted sequentially. Area of horizontal part of propodeum is selected by instrument Polygonal Lasso Tool (Feather=50). Selected area is clarified (Brightness= +38). Metapleurae are clarified and contrasted, having selected a most convex part with the same hardness of parameter of Feather. Parameters Brightness= +34 and Contrast= +12 are set (fig. 560).

After completion of all operations on giving to propodeum of ichneumon fly of volumetric appearance, layer "Pouring and volume" is duplicated for secure. Layer "Pouring and volume" in the Layers palette is right-clicked and Duplicate Layer command is selected from the pop-up menu.

Now propodeum is ready to fulfillment of operations on elaboration of sculpture of a surface.
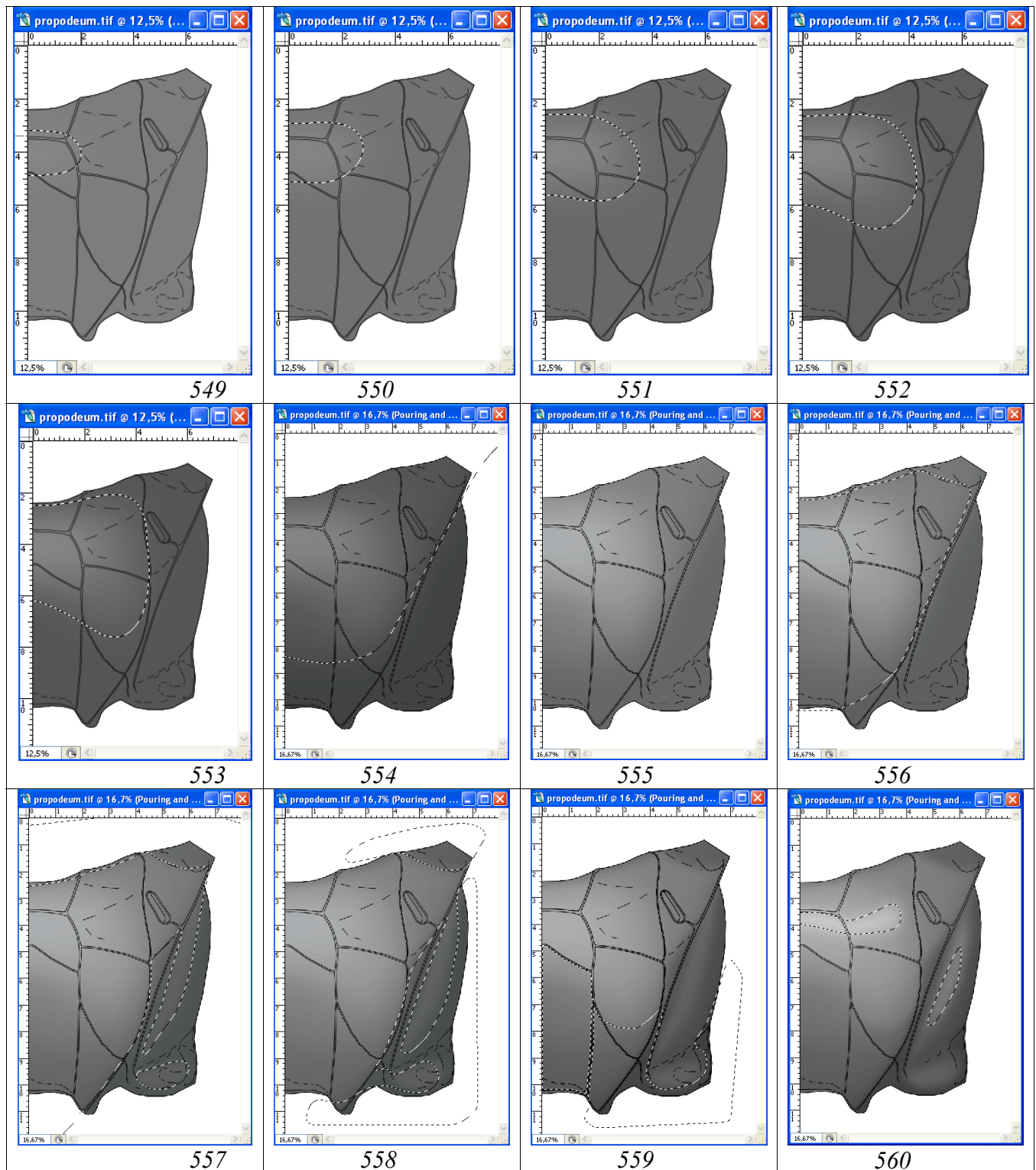
Fig. 549-560: Operations on giving of volumetric appearance to propodeum of ichneumon fly: (**549-553**) stages of darkening from centre to periphery (–150px, Brightness= –10), (**554**) sixth stage of darkening (Feather=150px, Brightness= –20), (**555**) general clarification of propodeum (Brightness= +40), (**556**) darkening of lateral parts of propodeum (Feather=50px, Brightness= –15, Contrast= –15), (**557**) darkening of lateral and front parts of propodeum (Feather=30px, Brightness= –15, Contrast=0), (**558**) darkening of lateral parts of propodeum by mixed selection (Feather=20+50px, Brightness= –5, Contrast= –5), (**559**) darkening of apical field

and lateral parts of propodeum by mixed selection (Feather=0 (apical field, see text) +50px, Brightness= –10, Contrast=0), (**560**) clarification and contrasting of parts of propodeum at disconnected layer "Navigator" (see text).

E l a b o r a t i o n of propodeum is begun, as for other parts of body, from formalization of the groups of structures of a same type and, accordingly, of creating of a set of layers necessary for their fulfillment.

> "…carinae of propodeum developed; basal area rather long, not impressed; area superomedia half-moon-shaped, transverse, 3,2 times shorter than breadth between costulae; area dentipara at apex without tooth, only with broadened transversal carina; spiracles long, along external contour 2,3 times longer than width. Surface of propodeum, from punctured in front from costulae by big smoothed punctures to wrinkly-punctured area dentipara and area posteromedia shining; area spiraculifera from wrinkly-punctured behind spiracles to densely punctured by merged punctures in front of them; metapleurae punctured by big smoothed punctures, shining".

The sculpture of propodeum surface includes such groups of sculptures, as punctures (puncturation), carinae and wrinkles. For fulfillment of **punctures**, the group of three layers is created. Layers are arranged from top to down in the next order: "Light punctures", "Punctures, shade" (punctures proper of volumetric appearance) and "Clarification of punctures margins". **Wrinkles**, **Keels** (**Carinae**) and **Darkenings** are fulfilled in separate layers. Below of listed layers, a layer **Clarification of interspaces** is created. For creation of "empty" layers the layer "Pouring and volume" is duplicated with usage of the right mouse button (Duplicate Layer …). In pop-up menu the name of a new layer is inserted. Creation of new layers is begun from below of the list. Then, contents of a new layer is selected with command Ctrl+A, and it is deleted (Del). Then, this empty layer and each subsequent is duplicated by a similar way, giving an appropriate title to each new layer.

Each of layers in case of need it is possible to duplicate and to merge in the subsequent. It allows to avoid an overlapping of the selected and poured areas when addition of those or other elements. In addition, under layer "Main lines", a layer "Small punctures" for giving to object of a "natural" appearance is added.

Basic element of propodeum sculpture is p u n c t u r a t i o n, presented by punctures of different diameter, often irregularly-shaped and almost merged. At the first stage, puncturation of the first lateral area and area dentipara was fulfilled. For fulfillment of puncturation the instrument of arbitrary selection Lasso Tool has been chosen. More large punctures were fulfilled with parameter Feather 7px, smaller ones – 5px. After fulfillment of all punctures by means of selection in the layer "Punctures, shade" in both areas, a pouring by black color by means of instrument Paint Bucket Tool was fulfilled (fig. 561). At a following stage, a clarification of internal parts of punctures was performed. In connection with peculiarities of morphology of propodeum, the method of shifting of all selections with the subsequent clarification, as at fulfillment of image of a head (see above), was not used. An internal part of each puncture was selected separately by means of instrument Lasso Tool (at pressed Shift key) with different values of parameter Feather, depending on the size of a puncture. Clarification

was fulfilled in the same layer by means of function Brightness/Contrast up to brightness of +46% (fig. 562).

In the same layer (Punctures, shade) the most convex part of propodeum was selected, using the maximum values of parameter Feather (200px). After that, the general clarification of punctures was fulfilled (Brightness= +45, Contrast= −10) (fig. 563). Puncturation of the lowest parts of propodeum also is selected with parameter Feather=100px. Then it is darkened on −20% according to volumetric appearance of propodeum in layer "Pouring and volume" (fig. 564).

At a following stage puncturation of metapleurae is fulfilled, also by using the instrument of arbitrary selection (fig. 565). Similarly a clarification of punctures is performed, giving them of volumetric appearance (fig. 566). Punctures on wrinkle-punctured area spiraculifera are fulfilled after performance of wrinkles.

The following stage – e l a b o r a t i o n o f c a r i n a e is performed in a layer "Keels" (Carinae). Area of carinae is selected with instrument Polygonal Lasso Tool with parameter Feather=10px. Areas of the main carinae are selected from two sides from the main lines of a contour of carinae (fig. 567). In subsequent, selected area is poured by means of instrument Paint Bucket Tool, having selected black color (Black) in palette Swatches (fig. 658). Further, in working layer "Main lines" an internal area of carinae is selected with instrument Magic Wand Tool. Then layer "Keels (Carinae)" is marked as the working and an internal part of the darkened area of carinae is deleted (Del) (fig. 569). In subsequent, without deselection, layer "Pouring and volume" is marked as the working. Additional clarification of an internal area of a contour of carinae on +45% is fulfilled (Menu: Image-Adjustments-Brightness/Contrast) (fig. 570).

External parts of the darkenings of carinae and lines of carinae contours are selected with instrument Polygonal Lasso Tool with parameter Feather=0px and they are contrasted, for achieving correspondence to the object. In a figure 571, a result of clarification of external areas of carinae in layers "Keels" (Carinae) (+42%) and "Main lines" (+44%) of 1st lateral area is presented. By similar method, brightness and saturation of the enumerated parts in other areas of propodeum are corrected.

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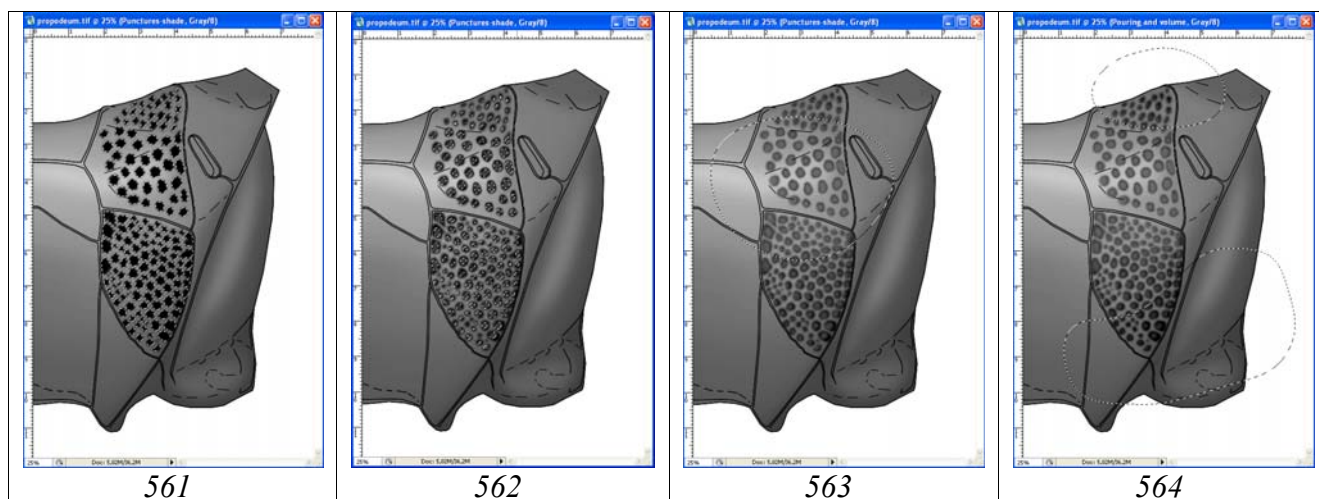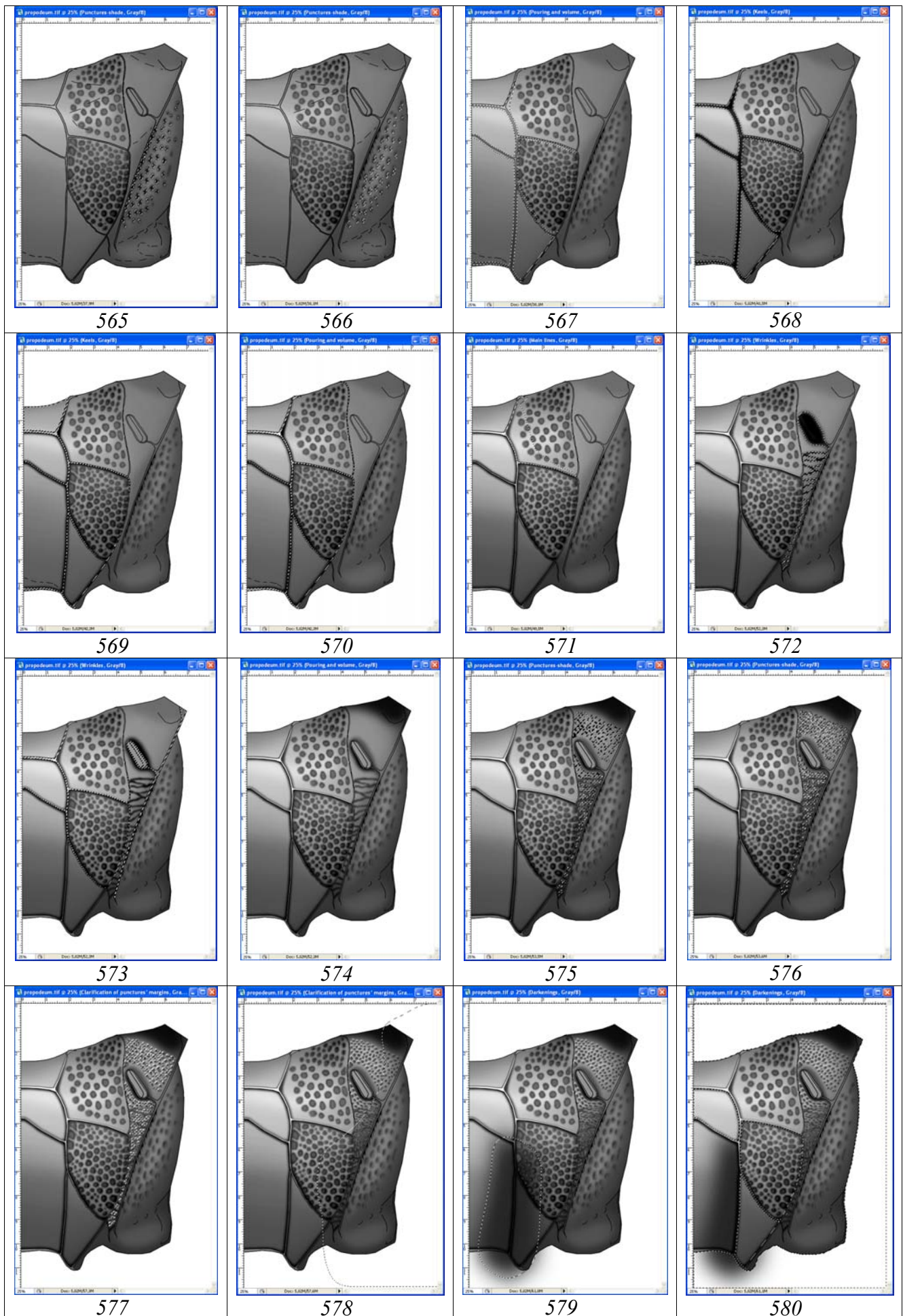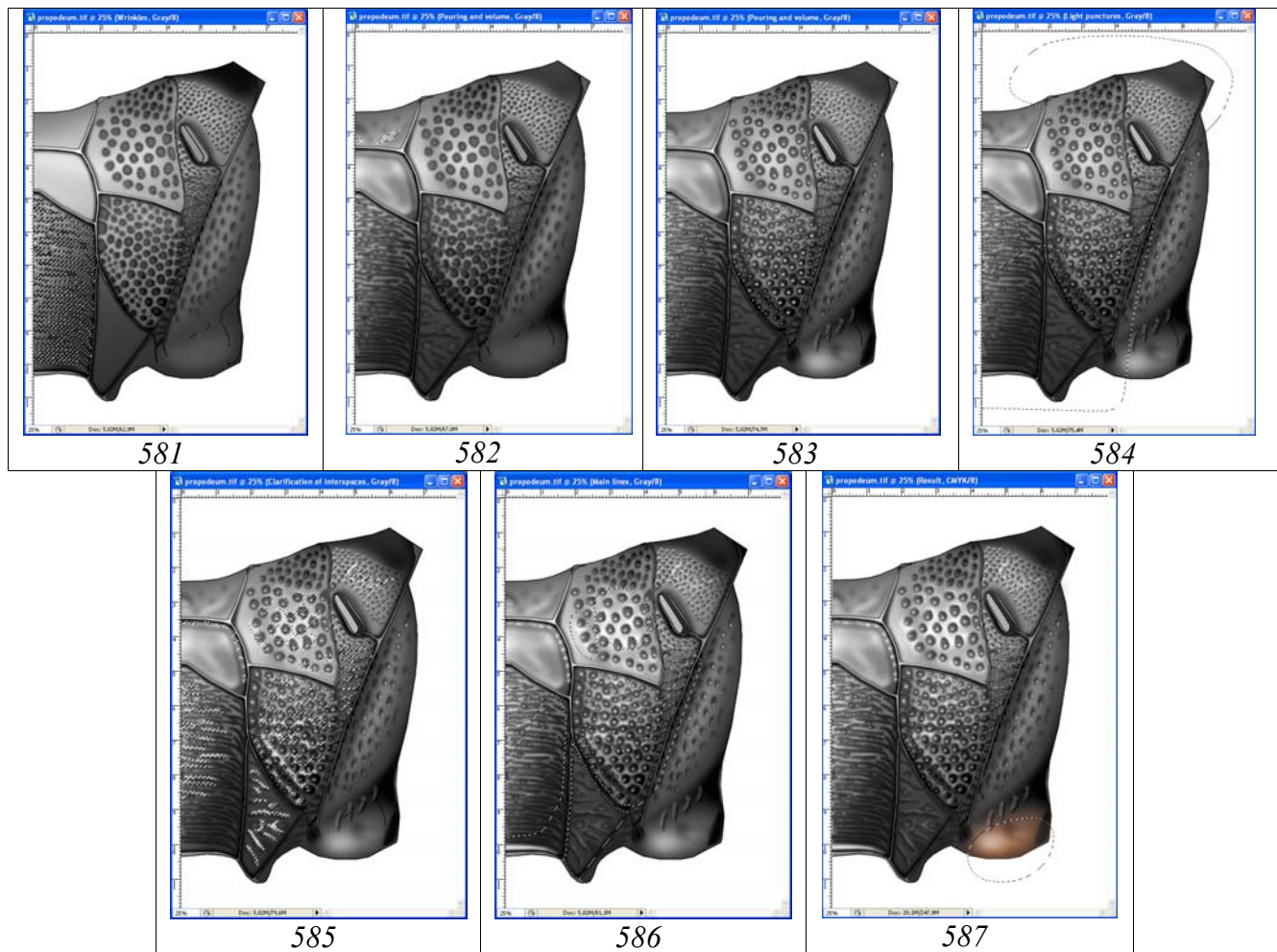
Fig. 561-587: Operations on elaboration of propodeum: (**561**) fulfillment of puncturation by selection and pouring of selected punctures by black color, (**562**) clarification of parts of punctures for giving to them of volumetric appearance, (**563**) general clarification of puncturation according to the form of propodeum, (**564**) darkening of peripheral punctures according to the form of propodeum, (**565**) fulfillment of puncturation of mesopleurae, (**566**) clarification of parts of punctures of mesopleurae for giving to them of volumetric appearance, (**567**) selection of area of carinae, (**568**) pouring of selected area of carinae, (**569**) deletion of internal part of darkened area of carinae, (**570**) additional clarification of carinae in layer "Pouring and volume", (**571**) additional clarification of external darkening and lines of contour of carinae, (**572**) pouring of wrinkles and area of spiracle, (**573**) deletion of superfluous areas after pouring, (**574**) clarification of part of carinae and area of spiracle, (**575**) fulfillment of puncturation of area spiraculifera by instruments of selection and its pouring by black, (**576**) clarification of parts of punctures for giving them of volumetric appearance by shifting of areas of selection, (**577**) clarification of margins of punctures, (**578**) darkening of clarifications of margins of punctures (Feather=90px) in two stages (Brightness= –100, Contrast= +25, Brightness= –75), (**579**) darkening of area posteromedia in layer "Darkenings", (**580**) deletion of superfluous areas of darkening by selection of external contour, (**581**) fulfillment of wrinkles of area posteromedia by selection (5px) and pouring them by black color, (**582**) elaboration of area superomedia and basal area in layer "Pouring and volume",

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(583) light points (10% Gray), **(584)** contrasting of light points, **(585)** clarification of interspaces, **(586)** contrasting of clarifications, **(587)** layer "Result-1" (CMYK).

Area spiraculifera behind spiracles has wrinky-punctured sculpture. Therefore, the method of fulfillment of wrinkles by instrument Polygonal Lasso Tool with parameter Feather=7px in layer "Wrinkles" has been selected. Darkening around spiracle is fulfilled by selection of an area with parameter Feather=17px and simultaneous pouring by black by means of instrument Paint Bucket Tool in the same layer (fig. 572). After pouring, it is visible that the wrinkles and darkenings are overlapped the spiracle and longitudinal carinae. To liquidate superfluous areas in layer "Main lines" or "Navigator" by instrument Magic Wand Tool (Feather=0) inner areas of carinae and spiracle are selected and, having moved to layer "Wrinkles", they are deleted having pressed Del key (fig. 573). Clarification of the parts of carinae and area of spiracles are fulfilled in the same layer. Necessary areas are selected and then, by using function Brightness/Contrast, a necessary similarity with an object under a microscope is achieved (fig. 574).

For detailed representation of punctures, the instrument of the arbitrary selection Lasso Tool (with parameter Feather=5px) was chosen. Fulfillment of puncturation is realized in some stages. At first, by means of instrument of selection, a drawing of all punctures of area spiraculifera is fulfilled in layer "Punctures, shade". After that, simultaneous pouring by instrument Paint Bucket Tool is fulfilled, having selected black color (Black) from palette Swatches (fig. 575). Not removing selection, in palette Tools instrument Lasso Tool is chosen again. Then all areas of selection are shifted in such manner that the volumetric appearance of punctures would correspond to object lighting. After that, clarification of punctures by means of function Menu: Image–Adjustments–Brightness/Contrast is fulfilled. In our example Brightness= +57, Contrast= +20 (fig. 576). At a following stage according to object lighting all areas of selection are shifted. Then, the layer "Clarification of punctures margins" is marked as the working. After that, simultaneous pouring by instrument Paint Bucket Tool is fulfilled, having selected Grey color in palette Swatches (fig. 577). In subsequent, the most darkened areas are selected. Then, clarifications are corrected by function Menu: Image–Adjustments–Brightness/Contrast. In our example, the parameter of Feather was 90px. At the first stage, the parameter Brightness is reduced on −100, and Contrast increased to +20%. At the second stage, in a hind half, brightness of area spiraculifera is reduced additionally to −75%.

Apical area of propodeum is impressed and transversally striated by smoothed wrinkles. For more pictorial presentation of "an impression" of the apical area, the darkenings of its lateral parts in the layer "Darkenings" are used. Lateral parts of the apical area (area posteromedia) were selected with diffused selection by means of instrument Polygonal Lasso Tool. Selected area should go out far beyond the limits of the area posteromedia. Parameter Feather is installed up to 150px and pouring by black by means of instrument Paint Bucket Tool is fulfilled (fig. 579). After pouring, the parts protruding outside the limits of the apical area were selected in the layer "Main lines". Having returned on layer "Darkenings", they are deleted by pressing Del key (fig.

580). Transversal wrinkling of the apical area is fulfilled by instrument Polygonal Lasso Tool in layer "Wrinkles", having selected value of parameter Feather (6-7px). After pouring by black color, by using of instrument Paint Bucket Tool, lateral parts of wrinkles are selected and darkened. Central part of the wrinkles, on the contrary, is clarified according to the general volumetric appearance of propodeum (fig. 581).

Area superomedia of propodeum, as well as area basalis, does not have ideally smooth surface. As a rule, they are with indistinct impressions, or convexities. For representation of these features, the concrete areas are selected by instruments of selection with parameter Feather from 10 to 25px. Then theirs are clarified or darkened in the main layer (Pouring and volume) (fig. 582).

On the final stage of elaboration of a segment, a clarification of punctures and interspaces between sculptural formations are fulfilled. Puncturation is the main sculpture of propodeum. Punctures of puncturation vary on size, shape and smoothness. The central part of punctures is usually shining. For clarification of the central part of punctures of puncturation, instrument Brush Tool is used. The brush size, its shape and hardness depend on peculiarities of each concrete group of punctures. Light points are fulfilled in separate layer "Light punctures". In palette Swatches 10% Gray color is selected. Fulfillment of operation in a separate layer allows later to contrast light points depending on general appearance of object, shading, or clarifying necessary areas (fig. 583,584). Operations on clarification of interspaces between sculptural formations are performed in separate layer "Clarification of interspaces", using instruments of selection Lasso Tool and Polygonal Lasso Tool. The most shining areas of a surface of the segment, which emphasize its sculptural peculiarities, are selected. Values of parameter of selection Feather are chosen experimentally, by trial. For pouring of selected areas, usually 10% Gray color from palette Swatches are chosen. Then, the selected areas are poured with usage instrument Paint Bucket Tool (fig. 585).

Poured areas are clarified and contrasted or conversely, darkened depending on the form and illumination of the object. For selection of areas, the considerable values of parameter Feather (70-90px) were used (fig. 586).

Practically finished black-and-white image is improved by fine puncturation in separate upper layer "Small punctures". In described example following parameters of Brush Tool were selected: Diameter=7px, Hardness=20% and Spacing=200%. Parameter Spacing is selected based on puncturation of the darkened sides of propodeum carinae and prevention of coalescence of points at usage of a pen of Pen Tablet. At first, margins of carinae from a side of darkenings are elaborated. Puncturation is performed at the pressed Shift key. With usage of this method, uniform puncturation at once of considerable parts of carinae is fulfilled. After performance of fine puncturation, the points are contrasted by means of function Brightness/Contrast. The points of one field can be selected preliminary or in the layer "Main lines" using of instrument Magic Wand Tool or directly in the layer of "Small punctures" by means of instrument Polygonal Lasso Tool.

Elaboration of propodeum is completed by preparation of layer Result, which is necessary for fulfillment of a stage of coloration of the object. Operation is fulfilled in the following order. In palette Layers, the layers "Navigator", "Pouring and volume copy", "Matrix" and "Background" are disconnected (eye is removed) (fig. 588-590). After that an operation on merging of layers (Menu: Layer–Merge Visible (Shift+Ctrl+E)) is fulfilled. The image in the merged layer is selected with command Ctrl+A. Then, it is copied to the buffer (Ctrl+C). After this, all previous actions are canceled (Menu: Edit–Step Backward (Alt+Ctrl+Z)), returning into place all layers that was merged earlier. Layer "Main lines is marked as the working and a command of insert (Menu: Edit–Paste (Ctrl+A)) is fulfilled. New layer is named as "Result". Layer is superposed precisely with underlaying layers by instrument Move Tool (V). Layer "Result" is duplicated under the name "Result-1". It is used for coloring of an object.

C o l o r i n g of propodeum is begun with conversion of the image from regime Grayscale to regime CMYK – Menu: Image–Mode–CMYK Color (Don't flatten). Propodeum of this ichneumon fly is black, only its apical part above hind coxae has brownish tint. For tint giving to apical part of propodeum, this site is selected with "diffused" selection. Further, from palette Swatches, the most suitable main color is selected. In our example it is Darker Red Orange or Darker Warm Brown. Further, an operation on coloring of selected area is fulfilled (Menu: Image–Adjustments–Hue/Saturation (Ctrl+U)). In pop-up dialog box Hue/Saturation in window Colorize a tick is established and color is corrected by means of cursors (runners) up to obtaining of necessary effect (fig. 587, 591).

In total at the finishing stage of elaboration of sculptural particularities of propodeum, the file with an image includes already 16 layers (fig. 588-602).

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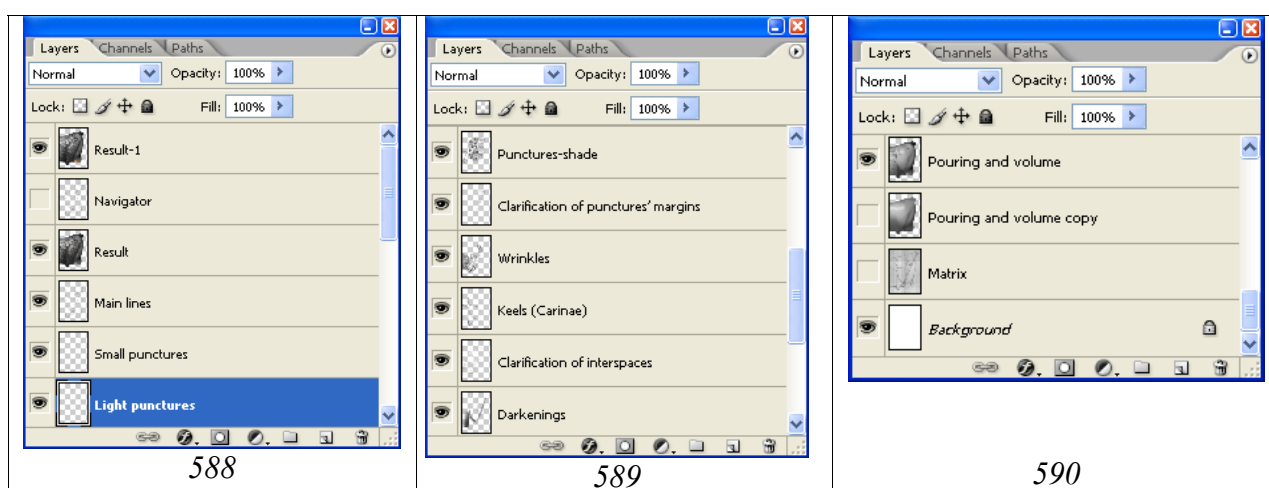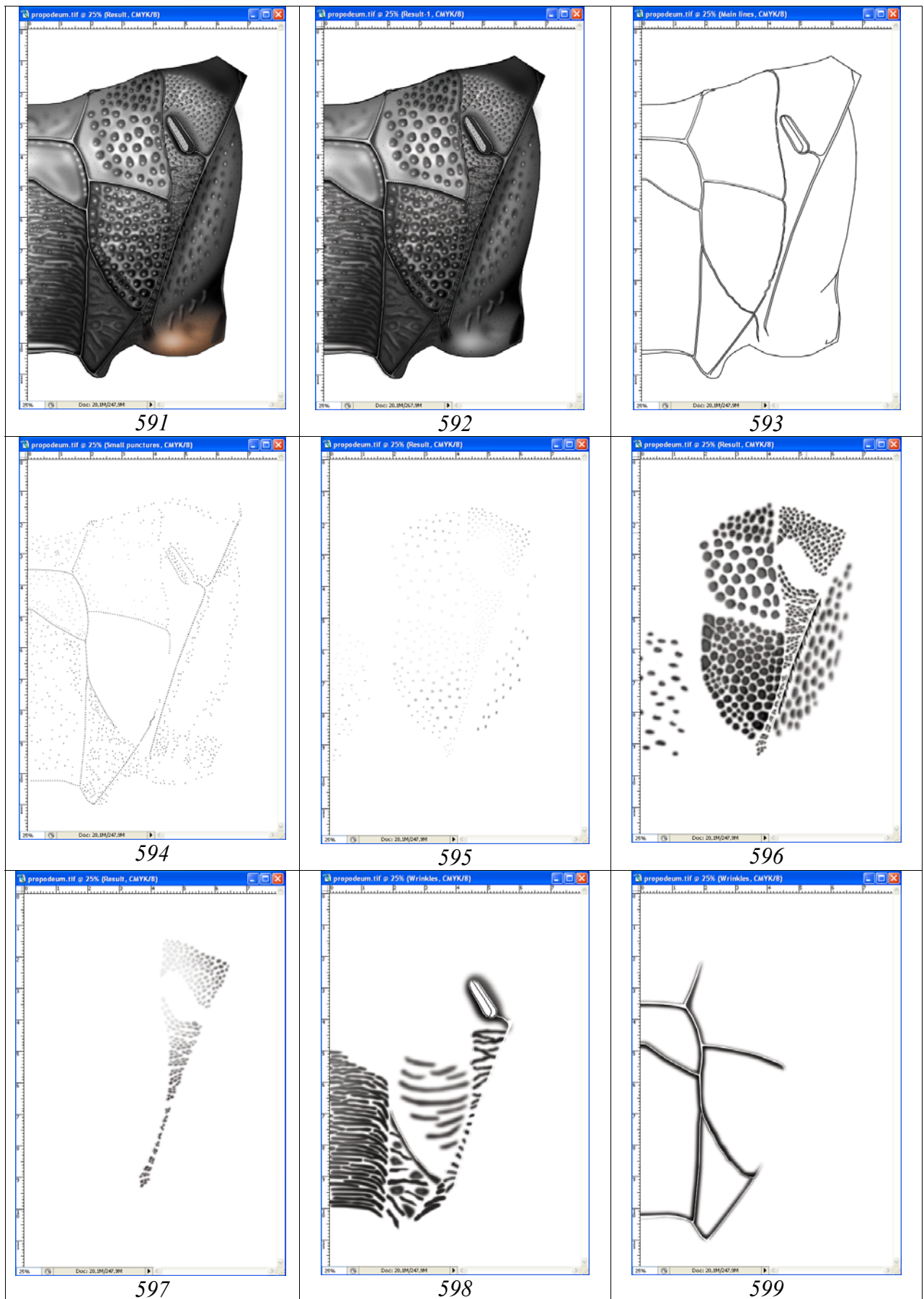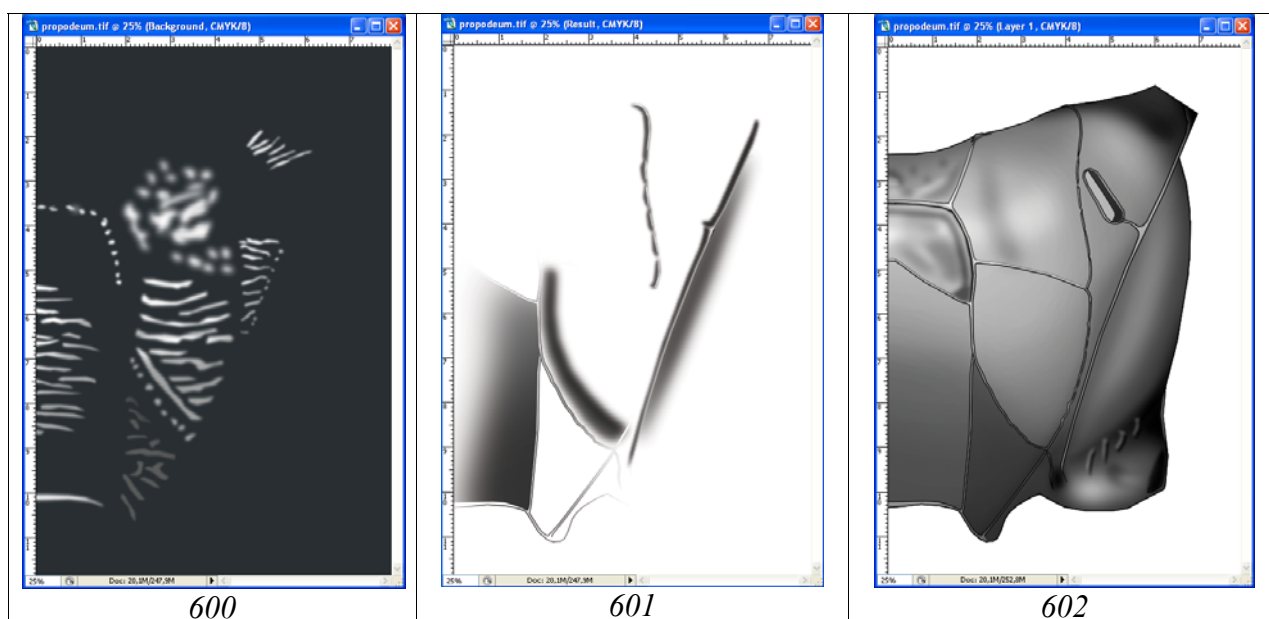
Fig. 588-602: Layers in file "propodeum": (**588-590**) hierarchy of layers, (**591**) colored image in layer "Result-1", (**592**) black-and-white image in layer "Result", (**593**) layer "Main lines", (**594**) layer of small points (layer "Small punctures"), (**595**) layer of light points (layer "Light punctures"), (**596**) layer of volumetric punctures (layer "Punctures, shade"), (**597**) layer "Clarifications of punctures margins", (**598**) layer "Wrinkles", (**599**) layer of shading of carinae (layer "Keels" (Carinae)), (**600**) layer of clarification of interspaces (layer "Clarification of interspaces"), (**601**) layer of darkening (layer "Darkenings"), (**602**) layer "Pouring and volume".

Fulfillment of image of propodeum in complete format is begun with preparation of a canvas of the appropriate size (Canvas Size). For fulfillment of operation, whole image is selected entirely by command Ctrl+A. Then layer "Background" is marked as the working and a command to copy (Ctrl+C) is fulfilled.

The following step is creation of a new file with the size of a canvas increased twice. In Menu: File–New or by command Ctrl+N, a new file is created. In a pop-up window measurement unit is set – cm and in window Width – the size increased twice. So, in a described example, instead of 7,95 cm, the width 16 cm is set. The height of the canvas is left unchanged. The resulting file is saved under the name, which includes the species name of the ichneumon fly and the necessary attributes, in directory "Result". In the given example it is "Pithotomus tschitscherini-female-propodeum (CMYK)".

Again to the file "propodeum" is returned (selection is not removed yet). Layer "Result-1" is marked as the working and a command to copy (Ctrl+C) is performed. Again to a final file are returned and an insertion command (Ctrl+V) is fulfilled (fig. 603).

At a following stage the menu command: Image–Rotate Canvas–Flip Horizontal is performed. After that by means of instrument Move Tool (V) image is shifted to the canvas left margin (fig. 604). Command of an insertion from the buffer (Ctrl+V) is fulfilled again (fig. 605). Further, by means of instrument Move Tool (V) both images

are superimposed and both layers are merged (Alt+Ctrl+Z), having disconnected layer Background (fig. 606).

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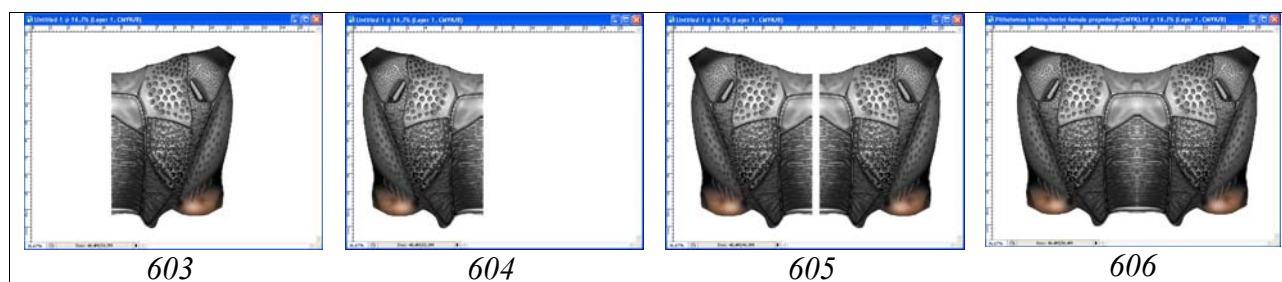
Fig. 603-606: Stages of fulfillment of image of propodeum in complete format (see text).

The last stage in preparation of the ready image is so-called **correction of "seam (suture)"** between two halves of propodeum (fig. 607-610).

For fulfillment of operation various instruments are used – brushes of different diameter with various parameters, selection with the subsequent darkening or clarification of areas, etc. However, the variant of correction, by copying of similar fragments on adjacent areas and their subsequent insert on correcting area should be recognized the most optimal. In our example only area posteromedia (apical area) needs in correction of "seam (suture)".

Having chosen suitable site on adjacent area, it is selected by instrument Lasso Tool with the appropriate parameter of Feather. Value of parameter Feather is 5px (fig. 607). After selection of area, it is copied by command Ctrl+C and inserted by command Ctrl+V into the new layer located over the basic layer. After an insert, a copied area is moved over area of correcting by means of instrument Move Tool. Actions on copying of areas and their inserts in a new layer are repeated up to liquidation of all "imperfections". After an insertion of every of copied area in a separate layer (fig. 608), it is corrected, if needed, by function Menu: Image–Adjustments–Brightness/Contrast. After finishing of operation, layer "Background" is disconnected and a command of merging of all layers (Menu: Layer–Merge Visible (Shift+Ctrl+E)) is fulfilled.

On other parts of propodeum only shallow points, of an appropriate saturation are added. Having installed the known size of Brush (7px) the cursor is moved to an adjacent point and having pressed Alt key (cursor turns into eyedropper) by clicking the left mouse button, a necessary saturation of the points is selected.

In a figure 609 results of correction of "seam" on apical area after merging of all layers of an insertion are shown. The ready image of propodeum is presented in a figure 610.
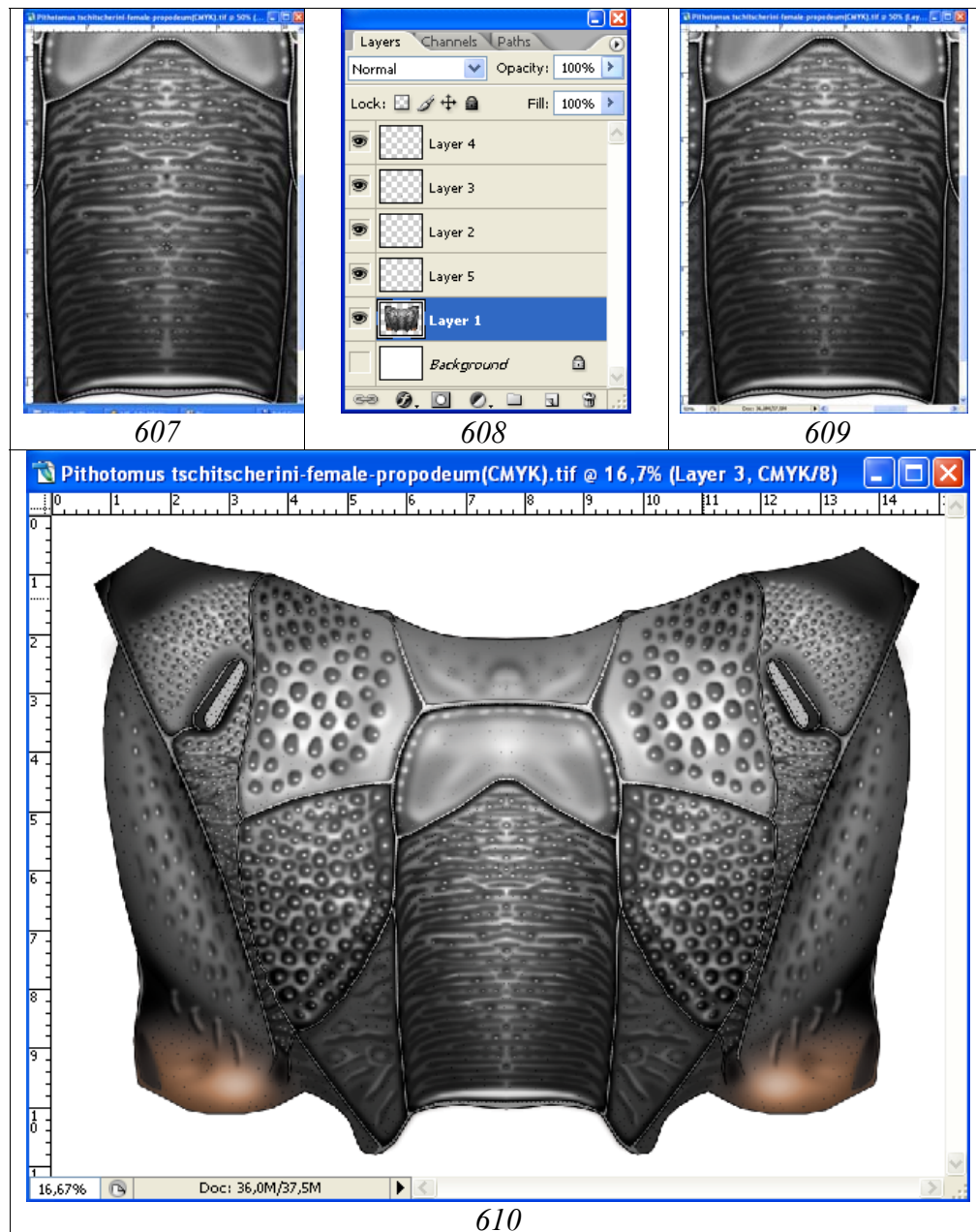
Fig. 607-610: Correction of "suture" at merging of two half of propodeum: (**607**) selection and copying of adjoining areas of surface, (**608**) layers at insert of copied areas, (**609**) result of moving of the copied areas on "flaws", (**610**) resultant image of propodeum.

Tergites 1-2 of abdomen

C o n t o u r of segments 1-2, as well as other parts of a body of imago is fulfilled with usage of vectorial instrument Line Tool with line width 5-6px.

"…middle field of postpetiolus only slightly elevated and not carinated, with distinct impression at level of spiracles. Gastrocoeli not big, slightly but distinctly impressed, many narrower

than interval between them; thyridia absent; lunulae in a form of more or less distinct impressions behind middle…".

The sequence of operations has been described above. Tergites 1 and 2 should be situated in separate layers that are necessary at operation fulfillment on giving to the object of volumetric appearance (see below). Layer "Navigator" is duplicated for creating three additional layers – "Main lines", "Segment-1 (External contour)" and "Segment-2 (External contour)". Layer is duplicated, having clicked by right mouse button on a layer in menu Layers and having selected Duplicate layer command. In a pop-up window a new name of layer is entered and layers are distributed as it is shown in a figure 616. Layer "Navigator" is left unchanged (fig. 611). In layer "Main lines", the dotted lines serving for orientation are deleted. In layer "Segment-1 (External contour)" all internal lines of a segment and a segment 2 are deleted (fig. 613). In layer "Segment-2 (External contour)" similarly all internal lines of a segment and a segment 1 are deleted (fig. 614). Layers "Segment-1 (External contour)" and "Segment-2 (External contour)" are duplicated or transformed to the layers "Segment-1 (Pouring and volume)" and "Segment-2 (Pouring and volume)". P o u r i n g of these layers is fulfilled by means of instrument Paint Bucket Tool in layer "Pouring and volume", having selected in graphic palette Swatches Grey color of 10% (fig. 615). Now the drawing is ready for operation on giving to him of volumetric appearance.
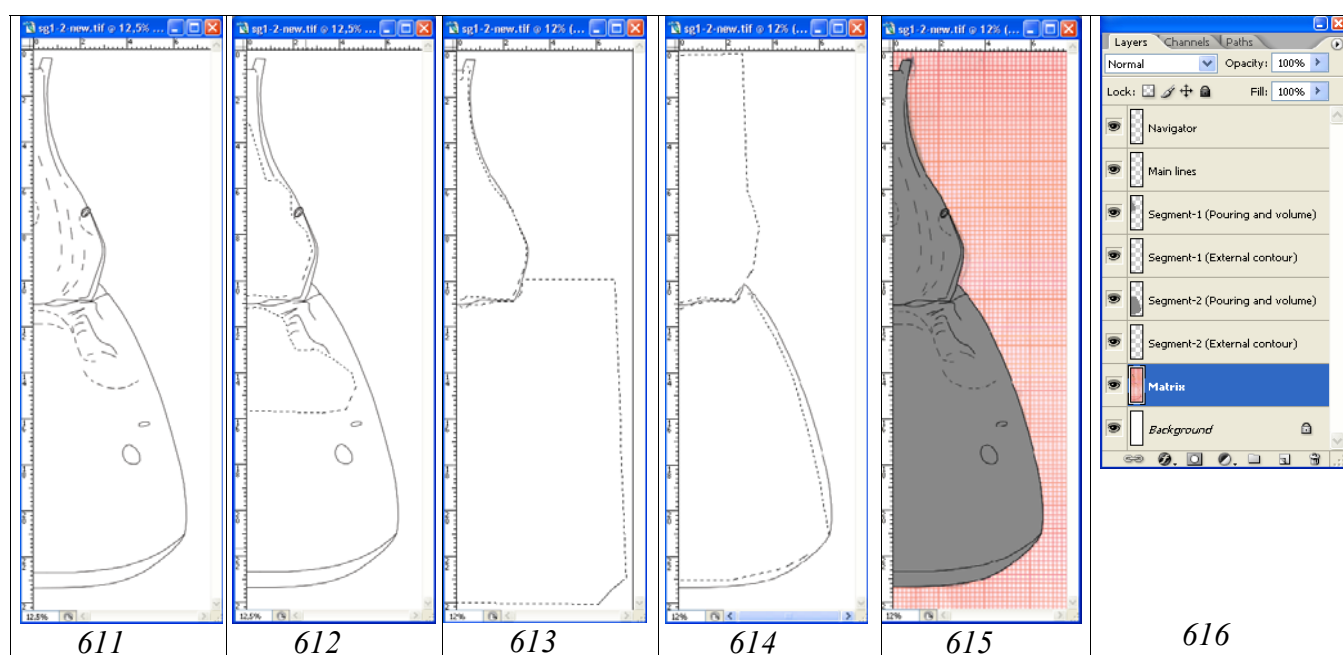
Fig. 611-616: Layers in file "Sg1-2" at the final stage of contour drawing: (**611**) layer for orientation "Navigator", (**612**) elimination of superfluous lines in layer "Main lines", (**613**) deletion of superfluous lines in layer "Tergite-1 (External contour)", (**614**) elimination of superfluous lines in layer "Tergite-2 (External contour)", (**615**) final view of image at all switched on layers, including layer "Pouring and volume", (**616**) hierarchy of layers.

V o l u m e t r i c   i m a g e of tergites 1-2 is fulfilled in the separate layers – "Segment-1 (Pouring and volume)" and "Segment-2 (Pouring and volume)". Performance of operations on giving to the tergites of volumetric appearance is necessary to do in separate layers, because this allows avoiding the overlapping when selection and darkening of separate areas of tergite. So, for example, borders of selected area during the general darkening of the first tergite, should always go beyond the limits of the borders of tergite. If the 1st and 2nd tergites are situated in the same layer, then during darkening of the first tergite, second tergite will be darkened inevitably. To correct consequences of this, it is extremely difficult in subsequent.

In layer "Segment-1 (Pouring and volume)" the operations on giving of volumetric appearance to the first tergite of abdomen are fulfilled (fig. 617-628). At the first stage, the general darkening, when borders of selected area go far beyond the limits of a segment is perfomed. Darkening is begun from the most convex area (middle field of postpetiolus). Then, a selection is shifted to the borders of segment. Value of Feather parameter during operation fulfillment in the given example varies from 100 to 150px, decreasing of brightness – from 10 to 20% (fig. 617-621).

In subsequent, the general clarification of a segment is fulfilled and then, having selected area of petiolus by means of diffused selection with parameter Feather=90px, it is darkened on 30% (fig. 622).

At following stages, the separate areas of a segment are selected and darkened, for achieving maximal resemblance to the object, which is observed under a microscope (fig. 623-626).

At the finishing stage, the most convex and shining areas are clarified and contrasted. In this case it is apex of middle field of postpetiolus (fig. 627-628).

After fulfillment of a volumetric image of the first tergite, to layer "Segment-2 (Pouring and volume)" is moved, marking its as a working. Then, the similar operations on giving to tergite of volumetric appearance are fulfilled (fig. 629-639).

At the first stage, the general darkening, when borders of selected area go far beyond the limits of a tergite is fulfilled. Darkening is begun from the most convex area (a middle of second tergite). Then, a selection is shifted to the borders of segment (fig. 629-634). Diffused selection, with parameter of Feather 100-150px is used. At the first stages, the value of parameter Brightness is reduced on 10% (fig. 629-632). On the final stages (lateral parts) brightness is redused on 20-30% (fig. 633-634). Then, the general clarification of a segment is fulfilled. In this case it is +35% (fig. 635).

Further area of gastrocoeli and the most impressed areas of a surface are selected and darkened, having selected appropriate values of parameter Feather and Brightness/Contrast (fig. 636-639).

Volumetric image of the second tergite is completed by clarifying of its most convex parts (fig. 639).

The general appearance of a volumetric image of the first and second tergites of abdomen is presented in a figure 640. Layers "Main lines", "Segment-1 (Pouring and

volume)" and "Segment-2 (Pouring and volume)" are switched on. Layer "Navigator" is disconnected. General clarification is +16%. After completion of work, layers with the volumetric images of segments are duplicated for secure. In palette Layers on each layer one right-click the selected layers and selects the "Duplicate Layer …" command from the pop-up menu.

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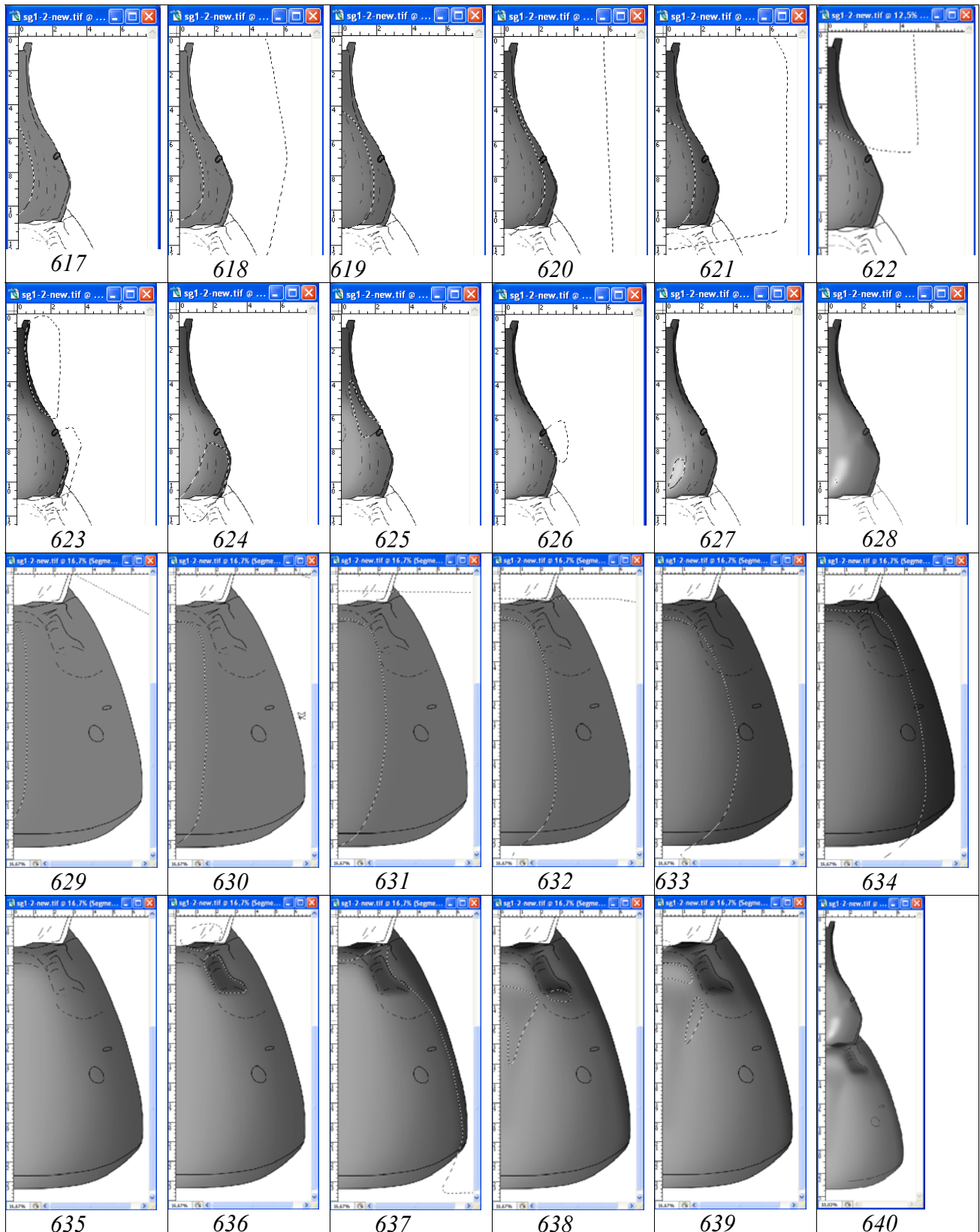
Fig. 617-640: Operations on giving of volumetric appearance to tergites 1-2 of abdomen of ichneumon fly. (**617-628**) 1st tergite: (**617**) first stage of darkening (Feather=150px, Brightness= –10), (**618**) second stage of darkenings (Feather=150px, Brightness= –10), (**619**) third stage of darkening (Feather=100px, Brightness= –20), (**620**) fourth stage of darkening (Feather=100px, Brightness= –20), (**621**) darkening and contrasting of tergite base and lateral fields of postpetiolus (Feather=100px, Brightness= –13, Contrast= –30), (**622**) general clarification + darkening of petiolus (Feather=90px, Brightness= –30, Contrast=0), (**623**) mixed selection and darkening of margins of tergite (Feather=10+30px, Brightness= –20, Contrast= –30), (**624**) darkening of lateral field (Feather=40px, Brightness= –10, Contrast= –30), (**625**) lateral darkening (Feather=30px, Brightness= –9, Contrast= –30), (**626**) darkening of area of spiracle (Feather=70px, Brightness= –30, Contrast=0), (**627**) clarification of middle field (Feather=40px, Brightness= +68, Contrast=0), (**628**) additional clarification of middle field, at switched off layer "Navigator" (Feather=30px, Brightness= +46, Contrast=0). (**629-639**) 2nd tergite: (**629**) basic darkening of tergite, 1st stage (Feather=150px, Brightness= –10, Contrast=0), (**630**) basic darkening of tergite, 2nd stage (Feather=100px, Brightness= –10, Contrast=0), (**631**) basic darkening of tergite, 3rd stage (Feather=100px, Brightness= –10, Contrast=0), (**632**) basic darkening of tergite, 4th stage (Feather=100px, Brightness= –10, Contrast=0), (**633**) basic darkening of tergite, 5th stage (Feather=150px, Brightness= –30, Contrast=0), (**634**) basic darkening of tergite, 6th stage (Feather=150px, Brightness= –20, Contrast=0), (**635**) general clarification of tergite (Brightness= –35, Contrast=0), (**636**) mixed selection and darkening area of gastrocoeli (Feather=30+50px, Brightness= –40, Contrast= –100), (**637**) mixed selection and darkening of tergite periphery (Feather=50+70px, Brightness= –6, Contrast=0), (**638**) darkening of central part of tergite (impression) (Feather=90px, Brightness= –35, Contrast=0), (**639**) mixed selection and clarification of convex areas (Feather=30-50px, Brightness= +10, Contrast=0). (**640**) segments 1-2 at finishing stage on giving of volumetric appearance, at disconnected layer "Navigator" and general clarification on 16%.

Now the images of segments 1-2 are ready to fulfillment of operations on detailed elaboration of a sculpture of a surface.

E l a b o r a t i o n of tergites 1-2 of abdomen is begun, as for other parts of the body, from formalization of the groups of structures of the same type and, accordingly, of creating of a set of layers necessary for their fulfillment.

> "…dorsomedian carina visible only from base up to middle of tergite, dorsolateral carina weak, ventrolateral carina sharp; lateral surface of petiolus with distinct transversal ribs; surface of middle field of postpetiolus smooth, or with only just visible longitudinal striation, shining, with distinct impression at level of spiracles; lateral fields punctured. Gastrocoeli not big, slightly but distinctly impressed, many narrower than interval between them; thyridia absent; lunulae in a form of more or less distinct impressions behind middle; interval between gastrocoeli with slight longitudinal wrinkling at base; surface of second tergite very densely punctured by smoothed irregular punctures, medially punctures more big and elongated, shining, without microsculpture; puncturation of tergites more delicate to apex of abdomen; abdomen polished…".

The sculpture of a surface of 1-2nd tergites includes such groups of sculptures, as punctures (puncturation), carinae and wrinkles. For fulfillment of **"Punctures"**, a group of three layers located from top to down in following order is prepared: "Light punctures" for punctures of lateral fields of 1st tergite and an interval between gastro-coeli of 2nd tergite, actually punctures (Punctures), punctures of volumetric appearance (Punctures-shade) and "Clarification of punctures margins". **"Wrinkles"** are fulfilled in separate layers. Below these layers, a layer "**Clarification of interspaces**" is disposed. For creation of "empty" layers, the layer "Segment-1 (Pouring and volume)" is duplicated with use of the right button of the mouse (Duplicate Layer …) and in the emerging menu a name of a new layer is entered, beginning from below of the list. Then, contents of a new layer is selected with command Ctrl+A, and after that it is deleted (Del). Then, this empty layer and everyone subsequent is duplicated in the similar way, giving names to the necessary layers. Each of layers in case of need it is possible to duplicate and to unite in subsequent. It allows avoiding of overlapping of the selected and poured areas in a process of addition of those or other elements. In addition under layer "Main lines" a layer "Small punctures" for giving to object of "natural" appearance is added. Sculptural peculiarities both 1st and 2nd tergites are fulfilled in the common layers, in spite of fact that their volumetric images are situated in the different ones.

Basic element of a sculpture of front tergites is **puncturation**, presented by punctures of different diameter, an irregular shape often of the elongated form and almost merging on the surface of second tergite medially. Punctures of puncturatuion laterally and in the base of 2nd tergite in the area of an interval are with shining central part unlike of other areas. For fulfillment of puncturation, two methods, fulfillment of punctures with the help of instruments of selection and puncturation with use of instrument Brush Tool with selected parameters of a brush have been chosen. Puncturation is fulfilled in two stages, separately on the first and on the second tergites.

Puncturation of lateral fields of postpetiolus of the first tergite and of the medial impression is fulfilled with use of instruments of selection in layer "Punctures-shade". Large punctures are selected with the instrument of free selection Lasso Tool (L) with parameter Feather=15px, smaller ones – 7px, at pressed Shift key. Medial impression is fulfilled by instrument Polygonal Lasso Tool with parameter Feather=50px. After fulfillment of all the selections, they are simultaneously poured by black color by instrument Paint Bucket Tool (fig. 641). After pouring, the different groups of punctures are selected and their clarification and contrasting are fulfilled (fig. 642).

At a following stage, a volumetric appearance to the punctures is given. In same layer "Punctures-shade", the areas of punctures are selected with instrument Lasso Tool (10px) depending on object illumination. Then, the selected areas are clarified by function Menu: Image–Adjustments–Brightness/Contrast. In this case the size of parameter Braightness was +30% (fig. 643).

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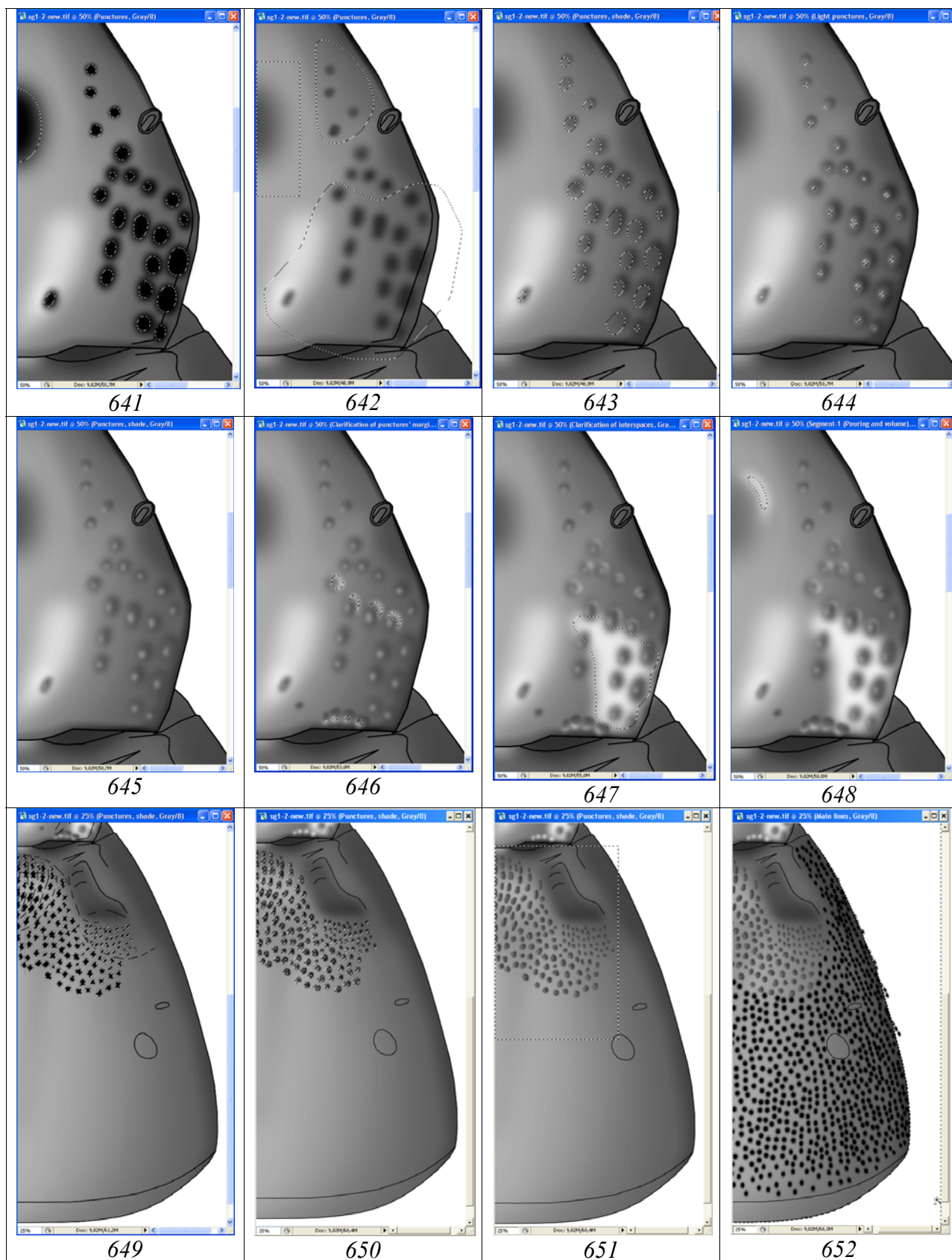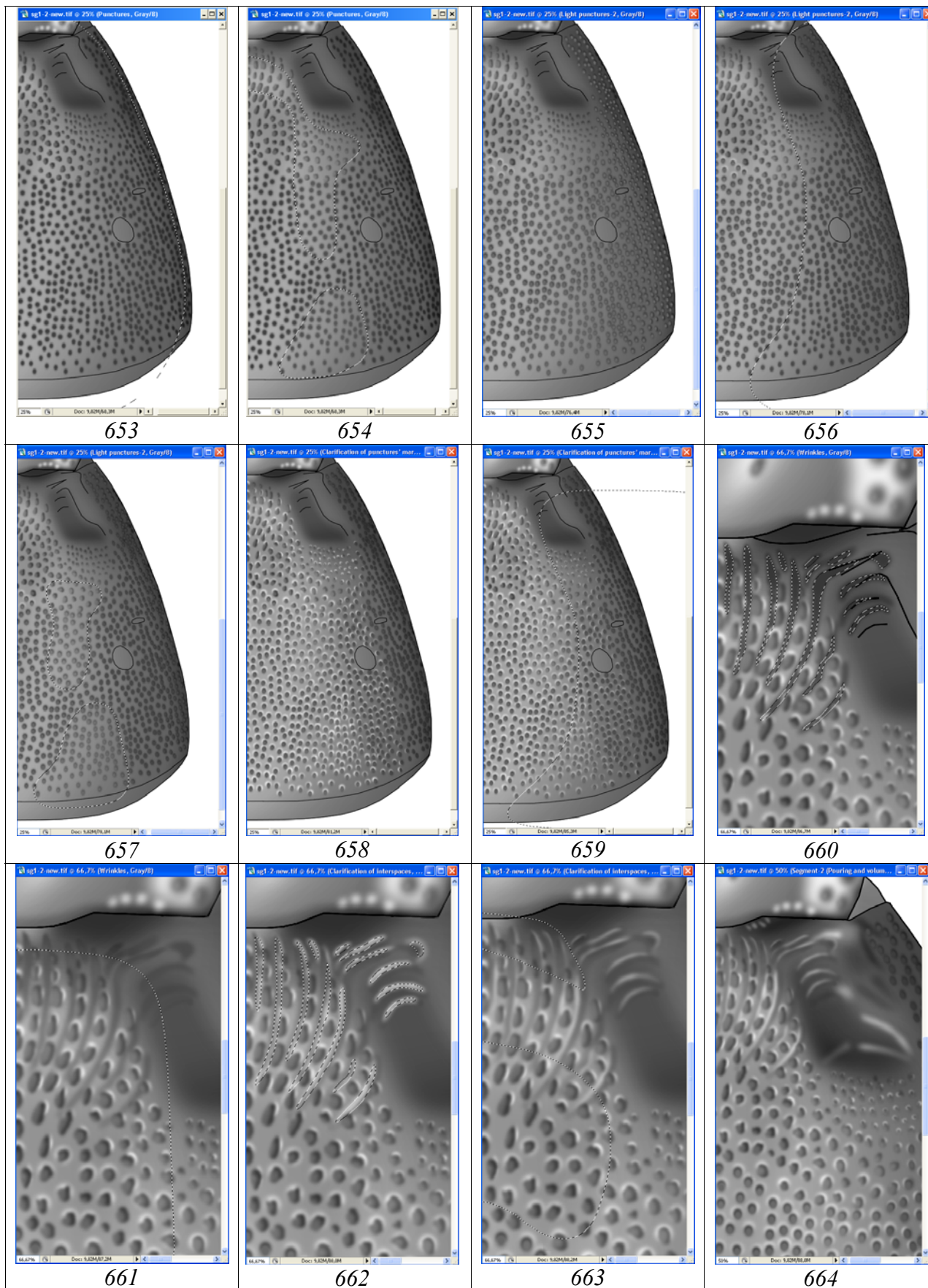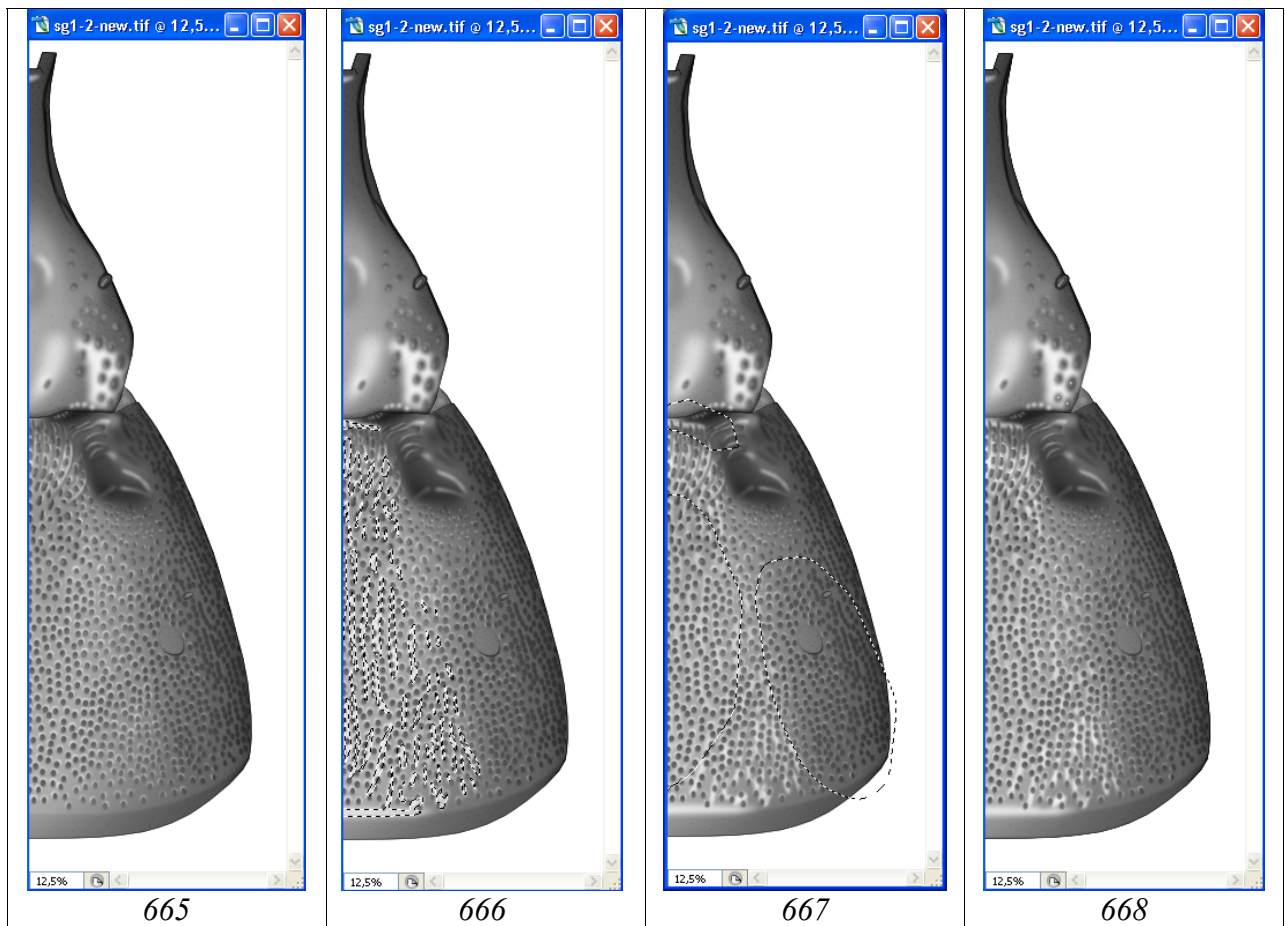
Fig. 641-668: Operations on elaboration of tergites 1-2 of abdomen. (**641-648**) postpetiolus of 1st tergite: (**641**) fulfillment of puncturation, medial impression and pouring of selected punctures by black color, (**642**) general clarification of poured areas, (**643**) clarification of parts of punctures for giving them of volumetric appearance (+30%), (**644**) simultaneous fulfillment of light points in layer "Light punctures-2", (**645**) general clarification of volumetric punctures in layer "Punctures-shade", (**646**) clarifications of margins of punctures in layer "Clarification of punctures margins", (**647**) clarification of interspaces in layer "Clarification of interspaces", (**648**) clarification of impression in main layer. (**649-659**) tergite 2: (**649**) selection and pouring of punctures in the base of tergite, (**650**) clarification of punctures of the base of tergite, (**651**) general clarification of punctures of the base of tergite, (**652**) puncturation by Brush Tool and elimination of "flaws" in layer "Punctures", (**653**) contrasting of puncturation, (**654**) clarification of punctures on convex areas of tergite, (**655**) clarification of puncturation and giving of volumetric appearance, (**656**) general darkening of clarifications, (**657**) clarification of punctures of convex areas, (**658**) clarification of margins of punctures in layer "Clarification of punctures margins", (**659**) contrasting of clarifications of margins of punctures according to volume image. (**660-664**) base of 2nd tergite: (**660**) selection and pouring of wrinkles, (**661**) clarification of wrinkles, (**662**) selection and pouring of clarifications of wrinkles, (**663**) contrasting of wrinkles depending on volumetric appearance of interval between gastrocoeli, (**664**) result of finishing of base of 2nd tergite in layer "Pouring and volume". (**665-668**) tergites 1-2: (**665**) result of finishing of tergites

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in main layer "Pouring and volume", (**666**) selection areas of clarifications and theirs pouring, (**667**) contrasting of clarifications, (**668**) layer "Result".

The following step is simultaneous their pouring by suitable on saturation Grey color (fig. 644). It is chosen in palette Swatches, by means of instrument Paint Bucket Tool.

In subsequent, a general clarification of volumetric punctures in layer "Punctures-shade" (Brightness= +18, Contrast= –55%) is fulfilled (fig. 645).

Surface of lateral fields of the first tergite is polished in interspaces between punctures. For accentuation of peculiarities of the polished surface, the clarifications of surface are fulfilled in layers "Clarification of punctures margins" and "Clarification of interspaces". Clarifications of the edges are performed by instrument Lasso Tool (Feather=10px). Then, they are poured by gray color of 10% (fig. 646). The poured areas in subsequent can be corrected, by selection and deletion of superfluous areas. Clarification of interspaces are fulfilled, selecting an area by instrument Polygonal Lasso Tool in the layer with the same name (Feather=20px). Then, the selected areas are poured by light grey color (10% Gray). In subsequent, a poured area is contrasted by function Brightness/Contrast, achieving necessary effect (fig. 647).

At the end of the basic actions on elaboration of postpetiolus of 1st tergite, in basic layer "Segment-1 (Pouring and volume)" a clarification of the margins of central impression is performed (fig. 648).

Puncturation of the second tergite of abdomen is fulfilled in the two layers. Large, more or less irregular punctures of a forward part of tergite were fulfilled by the instrument of selection Lasso Tool with parameter Feather=5-7px in a layer "Punctures-shade". After fulfillment of all punctures at pressed key Shift, they simultaneously are poured by black color by means of instrument Paint Bucket Tool, having chosen color in palette Swatches. After pouring, the punctures were clarified according to volumetric appearance (illumination) of the object. The clarification can be fulfilled by two ways. In the first case, without removing selection after pouring, all areas of selection at the switched on instrument of selection are shifted. Then, clarification (Brightness/Contrast) up to necessary level is fulfilled. In the second case, for more detailed elaboration of puncturation, an area of clarification of each puncture is selected separately and more carefully by instrument Lasso Tool at pressed Shift key, and then clarification to necessary level is performed. The completed punctures of volumetric appearance are contrasted by function Brightness/Contrast, achieving correspondence to the main layer with volumetric image of segment (Brightness= +32%) (fig. 649-650).

Area with punctures preliminarily is selected with the instrument Rectangular Marquee Tool (Feather=0) because the layer includes also elements of puncturation of 1st tergite (fig. 651).

More or less regular, roundish, or slightly elongated punctures of puncturation are fulfilled in a separate layer "Punctures", using instrument Brush Tool. Punctures of the central parts are larger, connivent, with distance between punctures considerably lesser, than diameter of a puncture. Puncturation of lateral parts is shallower and in

the most peripheral areas, the punctures are almost merged, especially behind spiracles. Density of puncturation is weaker towards apex of tergite. For fulfillment of puncturation of the central parts of the second tergite the following parameters of instrument Brush are selected by trial: Diameter=61px, Roundness=72%, Hardness=22%, Spacing=130%. Puncturation was fulfilled by a pen of Pen Tablet, allowing fulfilling puncturation both by method of hachures, fulfilling the whole groups of punctures, and by separate punctures. Diameter of punctures is decreased to some extent in a direction of lateral parts of tergite. At puncturation by the pen of Pen Tablet of marginal parts of tergite, a number of punctures go beyond a segment border (so-called "flaws"). For their liquidation to layer "Main lines" is moved, marking it as the working. Then instrument Magic Wand Tool (Tolerance=0) is selected and clicked the mouse on space around an outline, having selected it thereby. After that layer "Punctures" is marked as a working layer and "flaws" are deleted by pressing Del key (Fig. 652).

At a following stage contrasting of punctures by means of function Brightness/Contrast in a layer "Punctures" is fulfilled. It is necessary for achieving of correspondence of a saturation of punctures to the image of object in the layer "Pouring and volume" and in the layer "Punctures-shade". Operation can be fulfilled by two methods. 1 – In layer "Punctures", the general clarification of punctures up to achieving correspondence of volumetric punctures in the central part to the general tonality of a segment is need to fulfill. Then, the punctures of lateral parts of segment are selected by diffused selection (Feather=100-200px). After that, they are darkened up to achieving correspondence to the general volumetric appearance of object in the layer "Pouring and volume". 2 – Selection of puncturation by "diffused selection" (200px) from lateral margin of tergite and its subsequent clarification (to 49%). It is necessary to note, that in both cases the borders of area of selection should go far beyond the limits of image (fig. 653).

The surface of the tergite is not absolutely flat. Therefore, under certain lighting, some of the convex areas of a surface of tergite are more shining. These areas are selected with "diffused selection" (Feather=70px) and puncturation is clarified in both layers on the identical level of brightness (for example +21%) (fig. 654).

As already it was spoken earlier, the earnest of success at preparation of the image of the object is precise elaboration of small structures at high magnification. On the final image of object, with its real size, these details can be not visible, but representation about any class of structures becomes maximally real. Peculiarities of morphology of punctures of the second tergite of abdomen and their elaboration are an illustrative example of this approach.

Puncturation consisting from roundish punctures in a layer "Punctures" is presented at the object by enough flat punctures with impressed central part and with clearly enough darkened periphery. Interspaces between punctures are smooth, polished, shining. For fulfillment of puncturation, presented by punctures with the enumerated features, it is necessary to create three layers: "Light punctures-2" with the clarified part, "Punctures", with punctures in the restricted sense and "Clarification of punc-

tures margins" for separate punctures with shining front margin. Fulfillment of clarified central parts of punctures and theirs shining edges in separate layers allows to use the same instrument, brush, and also in subsequent to correct brightness and contrast on separate areas, for achieving maximum resemblance to the object. In a figure 669 with a fragment of puncturation of the second tergite of abdomen, the variants of fulfillment of punctures are presented.
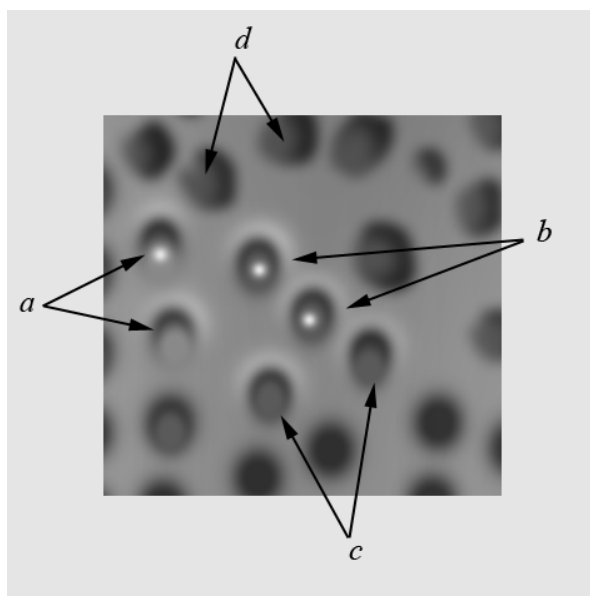
Fig. 669: Choosing type of punctures for puncturation of second tergite of abdomen (explanation in the text).

Punctures in figure 669a were fulfilled as follows. For giving to a puncture of volumetric appearance, in layer "Light punctures-2", which located over layer "Punctures", the lighter points of some smaller diameter in comparison with the main punctures are fulfilled. Parameters of Brush Tool for more light points are following: Diameter=56px, Roundness=80%, Hardness=24%. Brightness of a point in the given variant is chosen as follows. Cursor of mouse is moved to the area of the main layer adjoining to a point (instrument Brush Tool is switched on). Then, at pressed the Alt key (the cursor turns into eyedropper), mouse button is clicked. Hind margin of the volumetric punctures of the given type is indistinct. In a figure 669b, the volumetric punctures of other type, with more dark central part and sharper hind border are shown. Points of central part are of smaller diameter. Parameters of Brush Tool for these medial points are: Diameter=46px, Roundness=80%, Hardness=24%. Brightness of a point in the given variant is chosen similarly, but the cursor is moved to above the central part of already ready irregular punctures in layer "Punctures-shade" (fig. 669d).

Clarification of a front margin of punctures, if necessary, is fulfilled in layer "Clarification of punctures margins", using a circular Brush equal on diameter to the basic punctures. In the given example Brush parameters were the following: Diame-

ter=61px, Roundness=100%, Hardness=21%. For fulfillment of points for the clarification of a front margin, white color from graphic palette Swatches was selected.

Some punctures of puncturation can have a shine central part. For detailed representation of this peculiarity, shallow light points are fulfilled by means of Brush Tool in the layer "Light punctures" (fig. 669a, b).

From the enumerated variants of fulfillment of main part of puncturation of the second tergite of object, the second variant (fig. 669c) is the most suitable. It reflects the puncturation of second tergite most adequately. This variant has been used for further elaboration of puncturation of tergite.

At the first stage the main puncturation by black color by means of instrument Brush Tool with the parameters named above is fulfilled. Parameters Roundness and Angle are changed depending of that observed at the object and diameter of punctures is reduced in some extent towards periphery. Correct selection of parameter Spacing and usage of a pen of Pen Tablet allow to fulfill puncturation by groups of punctures by separate lines (hatching). After finishing of all puncturation, it is possible to see, that the part of punctures in layer "Punctures" goes beyond the borders of tergite, forming so-called "flaws". For their liquidation, in the working layer "Main lines" clicking by instrument Magic Wand Tool on a space outside the tergite, its outer contour is selected. After that layer "Punctures" is marked as the working and superfluous punctures are deleted by pressing Del key (fig. 652).

At a following stage, a contrasting of puncturation is fulfilled, for achieving correspondence to the volumetric image of a segment. At first, a segment, beginning from lateral margin to the middle of tergite is selected with diffused selection (Feather=100-200px). Limits of area of selection go far beyond limits of canvas. Then, a clarification of puncturation is fulfilled (fig. 653). Further the most convex and shining areas are selected with diffused selection (Feather=70px). Then, they are clarified additionally by function Brightness/Contrast up to correspondence to subjacent layer "Pouring and volume" (fig. 654).

The next step is giving to punctures of volumetric appearance. In layer "Light punctures-2", more light punctures are fulfilled with parameters of Brush Tool and saturation as has been described above. Each separate puncture of puncturation is elaborated individually (fig. 655). After fulfillment of all points of clarification, an operation on giving of correspondence theirs saturation to the general volumetric appearance of object is fulfilled. As well as in the previous operation, at first, the general darkening of more light points from the middle to periphery is fulfilled with using as much as possible diffused selection (borders of area of selection go far beyond lateral margin of tergite) (fig. 656). Then, clarifications of punctures on convex areas are fulfilled (fig. 657).

The last step of elaboration of basic puncturation of the second tergite, it is clarification of margins of punctures in layer "Clarification of punctures, margins" with usage of a round brush (Brush Tool) corresponding by diameter to the main punctures (see above). After fulfillment of all white points in the layer "Clarification of punctures, margins" (fig. 658), as in the previous cases, their contrasting is fulfilled. In conclu-

sion of this section about of elaboration of puncturation, more short cut of fulfillment of some operations should be marked. If all parts of all structures were fulfilled in different layers, then correction of brightness and contrast according to the general volumetric appearance, it is possible to fulfill in a final part of operation on elaboration. There is possible to fulfill just once diffused selection of a segment and one after another the correction of each layer to fulfill. However such approach demands presence of significant skills.

The following stage of elaboration of tergites is fulfillment of wrinkles in a layer with the same name. Rugosity of the second tergite of abdomen in the base and in area of gastrocoeli is only just expressed, the extremely weak and indistinct. For its detailed representation, instrument of selection Polygonal Lasso Tool was used. Wrinkling of an interspace between gastrocoeli is most pronounced on its front margin. Wrinkles become weaker backwards. Maximal value of parameter of Feather for fulfillment of wrinkles, at considerable image magnification was 8px. Therefore, for performance of this type of structures, the strategy of mixed selection has been chosen. A wrinkling along front margin is fulfilled having installed parameter Feather=5px having pressed and not releasing Shift key. More long parts of wrinkles, which become weaker on direction to apex are selected, having installed parameter Feather=8px and also having pressed and not releasing Shift key. Selected areas are poured simultaneously by instrument Paint Bucket Tool, having selected in graphic palette Swatches Black color. After pouring, without deselection, clarification of wrinkles by function Brightness/Contrast to level, corresponding to darkest area on the final image (+40%) is fulfilled (fig. 660). Next step is clarification of apical parts of the wrinkles which become weaker on direction of apex. Wrinkles are selected by diffused selection by means of instrument Polygonal Lasso Tool, starting from a front margin and far coming behind apices of wrinkles so that apices of wrinkles were in the middle of area of selection. After that selected areas are clarified and contrasted by means of function Brightness/Contrast up to level corresponding to observable at the object (fig. 661).

After finishing of fulfillment of darkened parts of wrinkles, an operation on theirs clarification is begun. [Note: In those cases when only longitudinal wrinkles are characteristic to object, selection in layer Wrinkles after pouring them by black color is not removed. Areas of selection are shifted by means of instrument of selection. Then, theirs are poured by white color already in layer "Clarification of interspaces".] Clarifications of wrinkles are fulfilled also by instrument Polygonal Lasso Tool at pressed Shift key, having selected the appropriate parameter Feather. Selected areas are poured by grey color (20% Gray) by means of instrument Paint Bucket Tool in layer "Crarification of interspaces" (fig. 662). At a following stage the clarifications of wrinkles are corrected, especially in area of gastrocoeli. Using instruments of selection, separate areas are darkened or clarified, superfluous fields are deleted etc., up to achieving maximum resemblance to the object. After that, the selections of separate parts of the clarifications on interspace between gastrocoeli are fulfilled. Then, the contrasting of the clarifications of wrinkles, darkening, or clarifying of certain areas depending on volumetric appearance of tergite is fulfilled (fig. 663). At the finishing stages of elaborations of wrinkles in area of gastrocoeli and an interspace between

them, the instruments of selection and function Brightness/Contrast are used, fulfilling a detailed elaboration in main layer "Pouring and volume" (fig. 664).

At the given stage, for finishing of elaboration of segments 1-2, detailing of structural peculiarities of the object is performed. Detailing of structural peculiarities is fulfilled in main layer "Pouring and volume". Generally, spiracles of segments and lunulae, the base of the first and apex of the second segment are elaborated. In subsequent if any details of elaboration will not meet the real object, they can be fulfilled anew, by copying an initial area from layer "Pouring and volume copy". For detailed elaboration, the small points in layer "Small punctures" are used also.

Superfluous lines in layer "Main lines" are deleted. Some lines of a contour are clarified, for bringing them into conformity with saturation of concrete areas (fig. 665).

At a final stage of elaboration, the clarifications between the structures that emphasize the polished character of segments are fulfilled. After pouring of the selected shining areas by grey color, theirs contrasting is performed. Areas of clarification of the less shining sites are selected by diffused selection (Feather=60px) and then they are darkened by means of function Brightness/Contrast to level corresponding to the object (fig. 666-667). And on the contrary, more convex and shining areas are clarified.

Usually punctures of puncturation of the majority of ichneumon flies have the shining central area (point). At this species only few punctures in angles of postpetiolus of the first tergite have this peculiarity, the rest of punctures are with flat central part and without shining central point. Separate shining points are fulfilled by instrument Brush Tool in layer "Light punctures", having selected appropriate parameters of Brush. Besides that some shining punctures are visible in the most convex part of an interval between gastrocoeli.

Elaboration of tergites of abdomen 1-2 is completed by preparation of layer "Result", which is necessary for fulfillment of a stage of coloring of object. Operation is performed, as in all other cases, in the following order. In palette Layers, the layers "Navigator", "Pouring and volume copy", "Matrix" and "Background" are disconnected (remove an eye). After that, an operation of merging of layers (Menu: Layer–Merge Visible (Shift+Ctrl+E)) is fulfilled. The image in the merged layer is selected by command Ctrl+A, and then, it is copied to the buffer (Ctrl+C). After that, the previous actions are cancelled (Menu: Edit-Step Backward (Alt+Ctrl+Z)), returning into place all layers merged previously. Layer "Main lines" is marked as the working and a command of insert (Menu: Edit–Paste (Ctrl+A)) is fulfilled. New layer is entitled "Result" (fig. 668,672). By means of instrument Move Tool (V), a layer "Result" is combined precisely with underlaying layers. Layer "Result" is duplicated, having named it as "Result-color" (fig. 671), using it for giving of coloration.

C o l o r i n g of tergites of abdomen is begun from transformation of the image from mode Grayscale to mode CMYK – Menu: Image–Mode–CMYK Color (Don't flatten). 1-2nd segments of abdomen of ichneumon fly are red-brown with slightly darkened base of tergite 1. In palette Swatches, the most suitable primary color is selected. In our example it is Darker Red Orange or Darker Warm Brown. If the colored image

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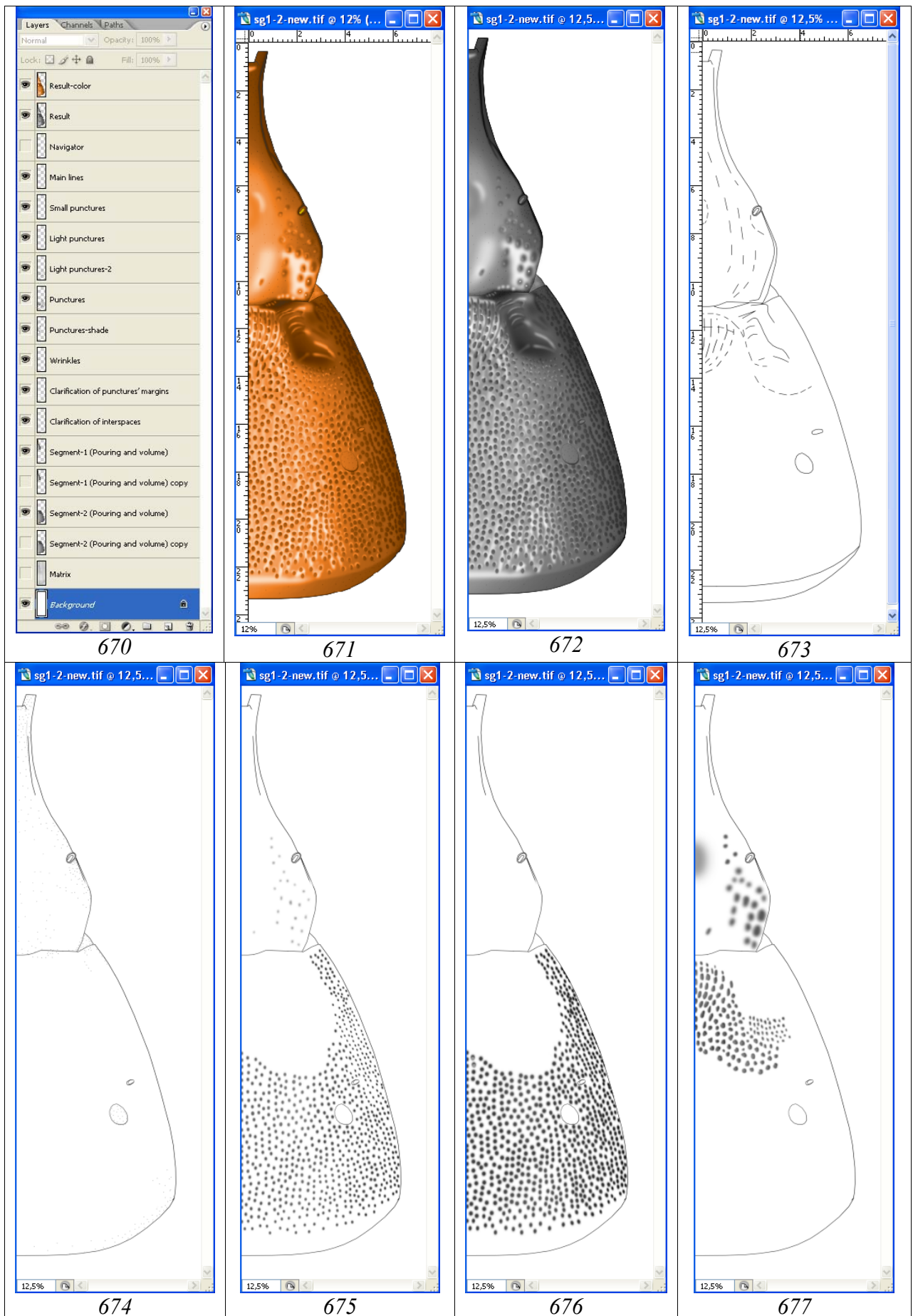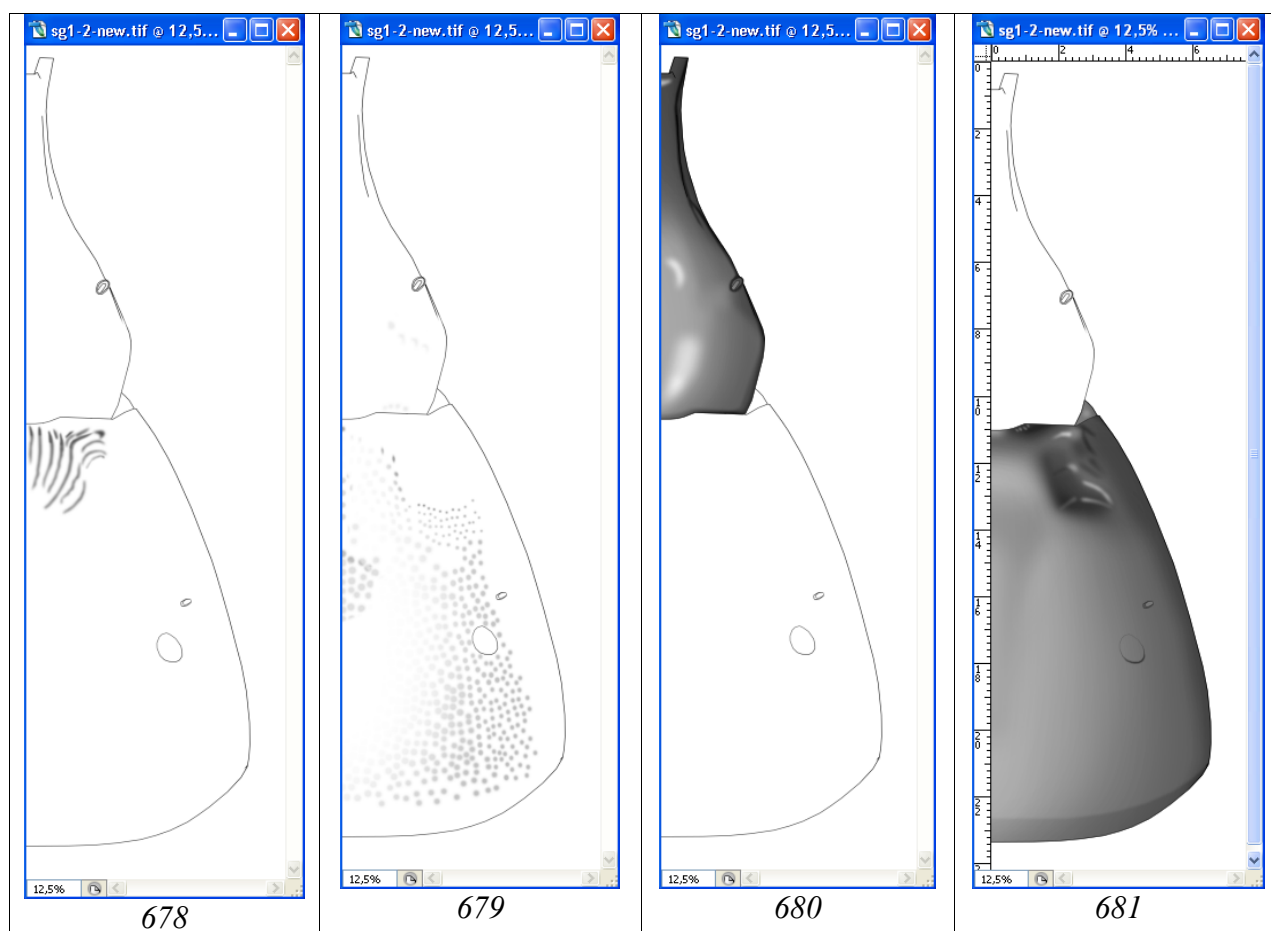
Fig. 670-681: Layers in a file "segment 1-2" (674-681 at switched on layer "Main lines"): (**670**) hierarchy of layers, (**671**) colored image in layer "Result-color", (**672**) black-and-white image in layer "Result", (**673**) layer for orientation "Navigator", (**674**) layer with fine points "Small punctures", (**675**) layer "Light punctures-2", (**676**) layer of punctures which were fulfilled by instrument Brush Tool ("Punctures"), (**677**) layer of volumetric punctures ("Punctures-shade"), (**678**) layer "Wrinkles", (**679**) layer "Clarifications of punctures margins", (**680**) layer "Segment-1 (Pouring and volume)", (**681**) layer "Segment-2 (Pouring and volume)".

of abdomen of the ichneumon fly is already fulfilled in process of preparation image of imago as in our event, it is necessary to open it in a separate window. Then the mouse cursor is moved to the most dark or characteristic area for front tergites and having pressed key Alt (the cursor turns to eyedropper), clicking on it by the left mouse button, necessary color is selected. Further, an operation on coloring (Menu: Image–Adjustments–Hue/Saturation (Ctrl+U)) is fulfilled. In pop-up dialog box Hue/Saturation in window Colorize a tick is established and color is corrected by means of cursors (runners) to obtaining of necessary effect (fig. 671). Altogether at the final stage of elaboration of sculptural peculiarities of tergites 1-2 of abdomen, the file with image includes already 18 layers (fig. 670-681).

Fulfillment of an image of tergites 1-2 of abdomen in a complete format is started from preparation of a canvas of the appropriate dimension (Canvas Size). For fulfillment of operation, the whole image is selected by command Ctrl+A. Then layer Background is marked as a working and a command to copy (Ctrl+C) is fulfilled.

The following step is creation of a new file with the doubling size of canvas. In Menu: File–New or by command Ctrl+N a new file is created. In emerging window units of measure – cm and width increased twice are put up. So, in a described example, instead of width of 7,59 cm, 15,2 cm is inserted. The height of the canvas (Height) is left unchanged. The final file is saved under the name, which includes the specific name of the ichneumon fly and the necessary attributes. In the given example it is "Pithotomus tschitscherini-female-sg1-2(CMYK)". It is saved in the directory "Result". Again to a file "segment 1-2" (selection is not removed) is moved. Layer "Result-color" is marked as the working and a command to copy (Ctrl+C) is performed. Again to a final file are returned and an insertion command (Ctrl+V) is fulfilled (fig. 682).

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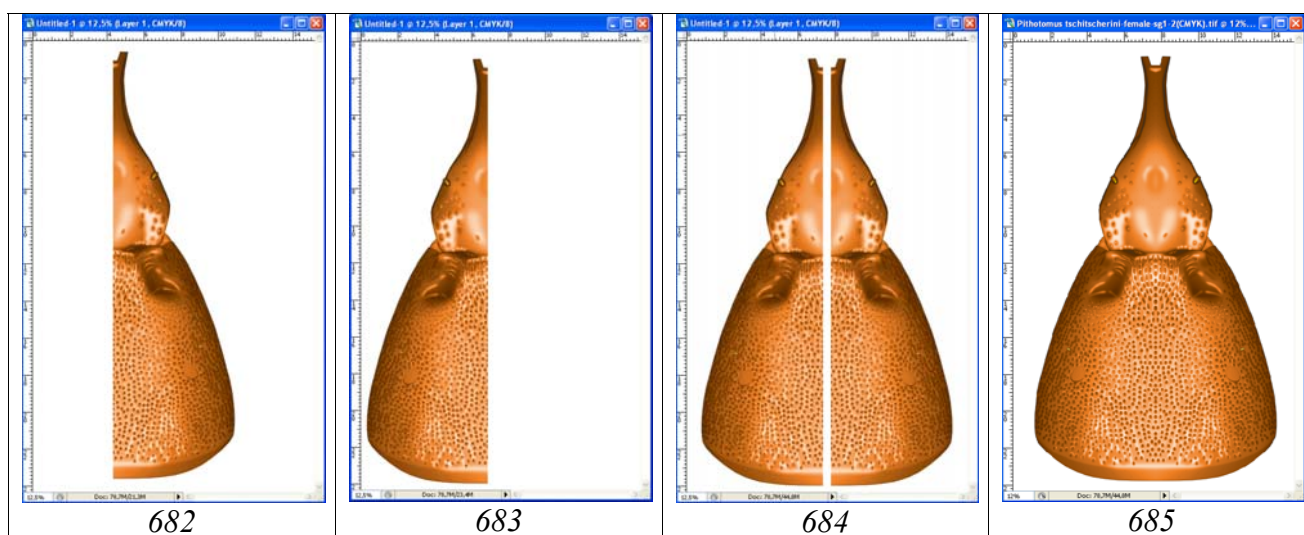
Fig. 682-685: Stages of fulfillment of image of tergites 1-2 in a complete format (see text).

At a following stage the menu command: Image–Rotate Canvas–Flip Horizontal is performed. After that, by instrument Move Tool (V), the image is moved to a canvas left margin (fig. 683). A command of an insertion from the buffer (Ctrl+V) is fulfilled again (fig. 684). Further, both of images are superposed with one another with use of instrument Move Tool (V), and both layers are merged (Alt+Ctrl+Z) having disconnected layer "Background" (fig. 685).

The last stage in preparation of the ready image is so-called c o r r e c t i o n   o f "s e a m   (s u t u r e)" between two halves of image.

Unlike to propodeum, correction of "seam"in this case was almost unnecessary. It was necessary only to add of several shallow points and to correct of 2-3 punctures on an

interval between gastrocoeli with using of instrument Brush Tool. In the enumerated examples color of a brush was installed by directing the cursor on a suitable place of adjoining area and by clicking mouse button at pressed Alt key.

Additional fragments

For the characteristic of higher taxa, or representatives of an opposite sex, images of some fragments of a body also can be included in the table additionally. More often it is mandibles or tyloides on flagellum of males, in case of their presence.

Mandibles

> "…mandibles wide and massive, sharply curved from above behind base almost at right angle, not narrowed to apex, parallelsided at most part and slightly swollen at apex, with two strong teeth separated by wide gape and situated in the same plane, upper tooth considerably longer than lower one…".

Drawing of mandibles is fulfilled with the same sequence, as segments of a body (head, propodeum, segments of abdomen, etc.).

The scanned pencil contour is increased till the necessary size, approximately 7 cm. A layer is entitled "Matrix". After that, an outlining of a contour is fulfilled, using instrument Line Tool. Merging of layers with separate lines is performed periodically. Further, as it is described earlier, all necessary layers (hierarchy is presented in figure 686) are created and all necessary actions are fulfilled.

After performance of images in all intermediate layers, the layers "Main lines", "Small punctures", "Punctures", "Clarification" and "Pouring and volume" are merged (Shift+Ctrl+E), having disconnected all others layers. Merged layers are copied to the buffer (Ctrl+A–Ctrl+C), the previous commands are cancelled (Ctrl+Alt+Z), returning into place all layers merged earlier. Then, merged image is inserted from the buffer over the layer "Navigator".

Layer "Pubescence", with hairs, characteristic for mandibles do not merge with other layers up to completion of operation on coloring of object. Coloring of mandible properly (layer "Result") and pubescence (layer "Pubescence") is fulfilled in separate layers. Image of mandible in a multilayer file is presented in drawing 687.
After completion an operation on coloring, all layers except layers "Pubescence", "Result" and "Background" are deleted. Further layers "Pubescence" and "Result" are merged (layer "Background" is disconnected). File is saved under the name, which includes the specific name of the ichneumon fly and the necessary attributes. In the given example it is "Pithotomus tschitscherini-female-mandible(CMYK)", in directory "Result". The file with all layers for fulfillment of image of mandible is saved under the former name.
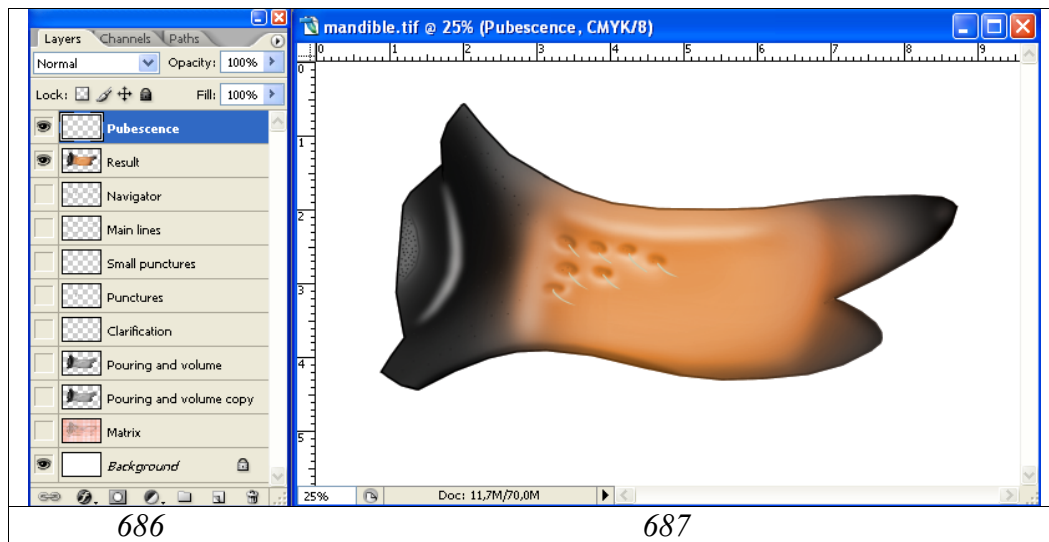
Fig. 686-687: Fulfillment of image of mandible: (**686**) hierarchy of layers, (**687**) mandible at switched off initial layers.

Tyloides of males flagellum

"Flagellum of males with 31 segments and broadly-oval tyloides on segments 7-21, tyloides on segments 10-17 very big, almost on all length of segments".

To fulfill the given structure is not difficult with usage of simplest methods and using a minimum number of layers. However, in our example the possibilities of layers are used in a maximal degree.

Drawing of segments of flagellum is fulfilled with the same sequence, as segments of a body (head, propodeum, segments of abdomen, etc.).

The scanned pencil contour is increased till the necessary size, approximately 7 cm. The layer is named "Matrix". After that, an outlining of a contour is fulfilled, using instrument Line Tool. Merging of layers with separate lines is performed periodically. Further, as it is described earlier, all necessary layers (hierarchy is presented in figure 688) are created and all necessary actions are fulfilled.

Number of layers in our example is maximal in connection with peculiarities of elaboration and coloring of object. Layer "Main lines" includes all lines of a contour of segments and tyloides. Layer "Pouring and volume" includes only lines of the external contour. Fulfillment of actions on giving of volumetric appearance to segments of flagellum and tyloides in different layers considerably simplifies the problem.

Small puncturation both by dark, and light points is fulfilled in separate empty layers for segments of flagellum (layers "Small punctures" and "Small light punctures") and also for tyloides (layers "Small punctures-tyloides" and "Small light punctures-tyloides"). Performance of small puncturation in separate layers allows fulfilling their contrasting independently, for achieving the maximum correspondence to the object.

After preparation of all layers, at the first stage, a pouring by instrument Paint Bucket Tool (55% Gray color) of segments of flagellum and tyloides in layers "Pouring and volume" and "Tyloides" is fulfilled. In the subsequent, a volumetric appearance to

segments of flagellum and to tyloides is formed in separate layers with use of tools of selection.

At a following stage, the dark and light puncturation, separately in all four layers is performed. Fulfilled puncturation is contrasted by function Brightness/Contrast with use of instruments of selection with big values of parameter Feather, up to achieving its maximum conformity with underlying volumetric images of segments and tyloides. At the same diffused selection, light punctures are darkened. Then, not removing selection, to the layer with dark punctures is moved and their clarification is fulfilled. At the given stage, all layers conform to an image of volumetric appearance of the fragment. Now, contrasting of the main lines of a contour, in the uppermost layer the "Main lines" is fulfilled. In the given layer, the lightest external lines of a contour of segments and tyloides are clarified, for achieving conformity with underling layers.

After performance of all operations on elaboration, fulfillment of operations on coloring of flagellum fragment is begun. Flagellum of this ichneumon fly is of black color with brown tint (brownish). To achieve similarity to the original, coloration is fulfilled directly on segments of flagellum. Tyloides are not colored. Therefore, merging of layers with tyloides and their puncturation and of segments directly and their puncturation are fulfilled separately. It becomes even more obvious, why for image fulfillment so many layers had been created. Standard procedures of merging of necessary layers (Shift+Ctrl+E), copying of merged layers to the buffer (Ctrl+A–Ctrl+C), of cancellation of the previous actions and of restoration of merged layers (Ctrl+Alt+Z) are fulfilled. Merged layers are inserted from the buffer under layer "Main lines" (Ctrl+V). The listed actions are described in detail in the previous sections. New layers before operation performance on giving of coloration are located in a following order: "Main lines", "Tyloides" and "Result-1" (fig. 688).

An operation on giving of brownish tint to segments of flagellum is fulfilled in layer "Result-1". The central part of segments is selected with diffused selection by means of instrument Polygonal Lasso Tool (Feather=70px). Then, in palette Swatches necessary color is chosen and an operation of coloring of the selected areas is fulfilled (Menu: Image–Adjustments–Hue/Saturation (Ctrl+U)). In pop-up dialog box Hue/Saturation in window Colorize a tick is established and color is corrected by means of cursors (runners) up to obtaining of necessary effect (fig. 689). Having switched off the lower layers, all three layers are merged and copied to the buffer. Then, all previous actions are cancelled and all merged layers are restored. An integrated image is inserted from the buffer over all other layers. The layer is labeled "Result-2" (fig. 688).

File with a full set of layers is saved (Ctrl+S). Then, in palette Layers, all layers except the upper and lower one are marked, having pressed Shift key, and deleted. Final file is saved under the name, which includes the specific name of the ichneumon fly and the necessary attributes. In the given example it is "Pithotomus tschitscherini-male-tyloides(CMYK)". This file is saved in directory "Result".
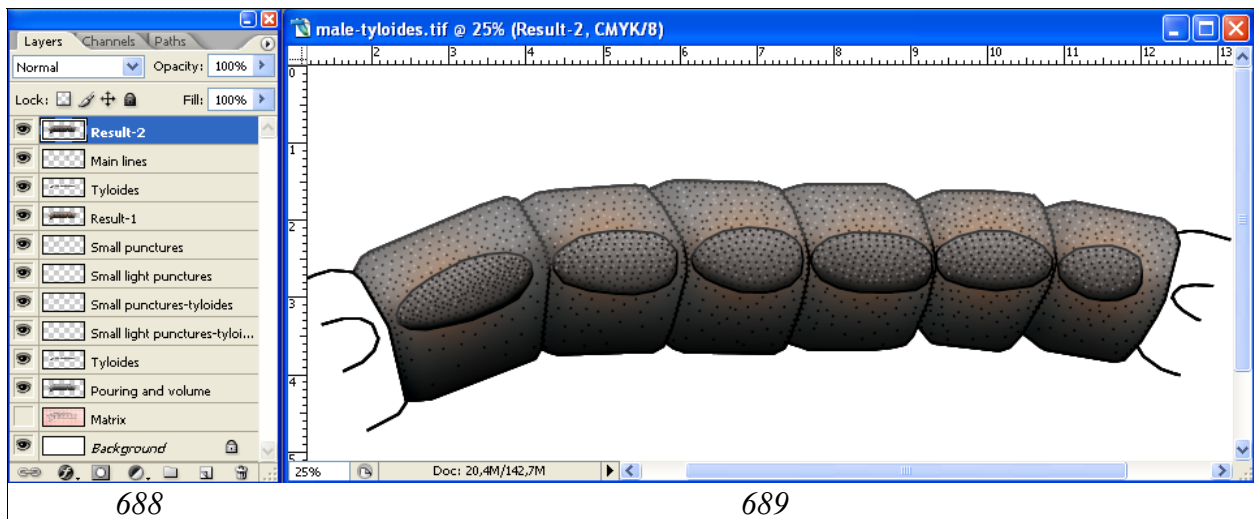
Fig. 688-689: Fulfillment of a fragment of flagellum of male with maximum number of layers: (**688**) hierarchy of layers, (**689**) tyloides on segments 13-18.

Preparation of the final table of taxon illustrations

At the given stage in directory "Result" there are 10 files from which it is necessary to prepare the total table: "Pithotomus tschitscherini-female-head_above(CMYK)", "Pithotomus tschitscherini-female-head_front(CMYK)", "Pithotomus tschitscherini-female-propodeum(CMYK)", "Pithotomus tschitscherini-female-sg1-2(CMYK)", "Pithotomus tschitscherini-female-total(CMYK)", "Pithotomus tschitscherini-female-mandible(CMYK)", "Pithotomus tschitscherini-male-tyloides(CMYK)" and three files with scanned labels of specimens which were used at preparation of pictures: "Pithotomus tschitscherini-female-lable(Holotype)", "Pithotomus tschitscherini-female-lable(orig)" and "Pithotomus tschitscherini-male-lable". All of enumerated files are in the format "TIFF".

For table preparation, a new file in format CMYK of the size A4 21x29 cm and the resolution 600 dpi, is created. In an active window, a ruler and a grid which necessary for positioning of separate segments (Menu: View–Rulers; Show–Grid) are switched on. File is named as "Pithotomus tschitscherini-female-table(CMYK-layers)" and it is saved in directory "Result".

Size of separate segments is selected proceeding from peculiarities of concrete taxonomic group. In our example (Ichneumonidae) the width of a head capsule of the ichneumon fly of 7,5 cm was as reference point for other components of a table. From files, listed above (from directory "Result") the images of segments are selected and copied (Ctrl+A–Ctrl+C). At first, image of head from above is copied and then, it is inserted into a file with the table by command Ctrl+V. After an insert of object, it is moved by the mouse cursor to the upper left angle of canvas and a command of Menu: Edit–Transform–Scale is chosen. Then, having pressed and not releasing key Shift, the image is scaled to the necessary size. Further, similarly, all other parts of a body are inserted and scaled by consistently. After an insert of images of segments, an

image of imago total is inserted. By the menu command: Edit–Transform–Scale (Rotate), the image of imago is positioned in the central part of the canvas (fig. 691). The images of mandible and fragment of flagellum of the male with tyloides are inserted the last.
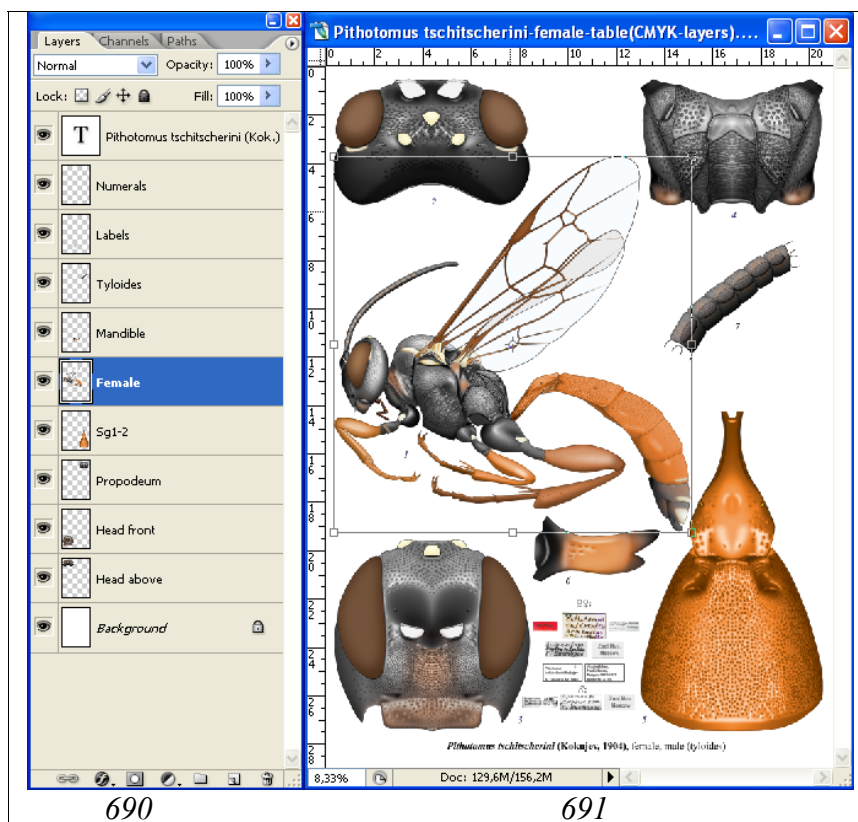
690 *691*

Fig. 690-691: Final plate with complete set of layers: (**690**) hierarchy of layers, (**691**) positioning of imago image in the table.

After inserting all the images in separate layers, scanned labels of the specimens which was used to fulfillment of a table are inserted. Further, the separate components of table are enumerated by selected font. Numbering is saved in a separate layer.

The scientific name of a taxon is fulfilled in a separate upper layer, having selected the conforming fonts and their size according to demands to the publication.

At the final stage all layers with drawings are merged and saved to a final file for the publication with layers: "Images", "Labels", "Numerals", "Species name" and "Background". File prepared for the publication is saved under new name "Pithotomus tschitscherini-table (CMYK-without layers)" in format "TIFF".

The unified description of a taxon and its conformity to graphic representation of characters

As it was already spoken in introduction, the purpose of the work is to advancement in the maximum degree of the unified system of the description of the taxa and graphic representation of theirs characters. At the closing stage of work we present as much as possible unified, from our point of view, a description of a taxon of a specific rank. For this species, in the previous sections, a stage-by-stage preparation of illustrations, both the most significant taxonomically parts of a body, and an imago were described. Practically all characters of a taxon in the description have graphic presentation in the table (**Plate 8**). In the scientific description of the object and in the table they are marked by numbers. Only descriptions of the front margin of pronotum and transverse furrow of pronotum interrupted by keel have no graphic representation. However, these signs are obvious enough and do not require additional illustrations.

Pithotomus tschitscherini (KOKUJEV) (**Plate 8**)

Anisobas tschitscherini KOKUJEV, 1904. . Rus. entom. obozr., **4**,2: 199, ♀.
Pithotomus rufiventris armenicus: HEINRICH, 1978. Вост. пал. Ichn.: 78, ♀.
Pithotomus rufiventris: HEINRICH, 1980. Spixiana, **3**,3: 225.
Pithotomus tschitscherini: RASNITSYN, 1984. Entomol. obozr., **63**,4: 794-796.

F e m a l e

F l a g e l l u m : Short, filiform, with 27 segments, without white annulus, slightly rufous, slightly widened and not flattened at the apical third (**1**); basal segments short, first segment 2 times longer than width at apex, segment 9 square from lateral. Flagellum 1,7 times shorter than the front wing and 2,3 times shorter than body length.

H e a d : Head contour from front slightly roundly narrowed downwards, rounded, with equal length and breadth; temples from front visible up to upper third of an eye (**2**); eyes not great; head from above stout, transverse, 1,6 times wider than length. Vertex from lateral roundly slanting down to occipital carina; (**3**); temples behind eyes from above roundly swollen (**4**), width of a head at level of temples more than at level of eyes; from lateral temples long, 1,4 times longer than longitudinal diameter of eye at middle (**5**), parallel to hind margin of an eye; occipital carina sharp all round, moderately high, from above roundly concaved, far not reach level of hind ocelli, and eyes (**6**) meeting with hypostomal carina on base of mandible (**7**); hypostomal carina not visible from lateral; malar space 1,5 times shorter than the mandible base width; mandibles wide and massive, sharply curved from above behind base almost at right angle, not narrowed to apex, parallelsided at most part and slightly swollen at apex, with two strong teeth separated by wide gape and situated in the same plane, upper tooth considerably longer than lower one (**8**); clypeus flat, transverse (**9**), 3,6 times wider than length, practically not separated from face (only by slight broad impression) (**10**), of peculiar shape, with impressed, thinned apex with broad medial projection (**11**) and enough distinct, but rounded lateral corners (**12**) and slightly elevated

lateral margins under clypeal foveae (**13**); clypeal foveae (**14**) indistinct, only in a form of broad impressions between clypeus and lateral fields of face extended up to malar space; labrum slightly protrude from under clypeus, short, roundly-triangular, narrower than front margin of clypeus; surface of face slightly differentiated, clypeus separated from lateral fields of face enough distinctly (unlike other genera of tribe); middle field of face very slightly but distinctly expressed (**15**), 1,6 times wider than lateral fields in middle (**16**); antennal cavities (**17**) not big, deeply impressed, far not reach level of front ocellus and only just reach borders of eyes, laterally above antennal fossae with distinct lateral tubercles (**18**) and without of interantennal tubercle; margins of antennal fossae (**19**) slightly elevated above face surface (**20**); frons some under front ocellus with broad impression (**21**); ocelli moderately convex, small (**22**) , diameter of lateral ocellus (**23**) 1,8 times less than distance from ocellus to eye; ocellar triangle not expressed, but area of a head at place of ocelli high elevated above upper level of eyes (**24**). Clypeus in lower half smooth, shining, in upper one punctured by merged smoothed punctures; malar space with microsculpture in part (**25**); face very densely punctured, shining, without microsculpture, in place of borders between lateral and middle field big punctures practically merged forming smoothed wrinkling; temples punctured by smoothed punctures up to middle in longitudinal direction, polished.

T h o r a x : Collar of pronotum long, front margin of pronotum straight from above; transverse furrow of pronotum shallow, broad, interrupted by keel; pronotal base only just sinuous, practically evenly curved (**26**), lower angle very sharp; pronotal ridge (**27**) thickened; epomiae sharp (**28**); surface of pronotum in lower half smoothly-wrikled, in upper one with smoothed punctures, polished; ribs at hind border of pronotum practically not expressed. Mesonotum (**29**) convex, only just longer than width; notauli not developed; lateral furrow of mesonotum deep in hind half; surface of mesonotum punctured by big smoothed punctures, polished; axillary tongue not developed; prepectus (**30**) behind front coxae deeply impressed; prepectal carina sharp (**31**), at apex only just reach front margin of mesopleurae; subalarum (**32**) normal, high, not sharpened; speculum (**33**) smooth, shining with sparse punctures; area of mesopleural fovea (**34**) deeply and broadly impressed, forms with mesopleural suture unit impression to hind margin of mesopleurae; mesopleural suture interrupted by weak ribs (**35**); lower part of mesopleurae not separated angularly (**36**); sternauli not expressed; upper part of mesopleurae densely punctured by smoothed only just merged oblonged punctures, lower one smoothly wrinkly-punctured; surface of mesopleurae shining, without microsculpture; scutellum from lateral roundly convex (**37**), high elevated above postscutelum (**38**), laterally not carinated, its surface with sparse big smoothed punctures, smooth, shining; scuto-scutellar groove broad and deep. Hind margin of metanotum with triangular projections opposite lateral longitudinal carinae (**39**). Propodeum from lateral roundly slanted backwards (**40**); horizontal part 3,2 times shorter than length of area posteromedia in middle; all carinae of propodeum developed; basal area (**41**) rather long, not impressed; area superomedia (**42**) half-moon-shaped, transverse, 3,2 times shorter than breadth between costulae, costulae (**43**) weak; area dentipara without tooth at apex (**44**), only with broadened transversal carina (**45**); lateral longitudinal carina (**46**) practically parallel to carina meta-

pleuralis (**47**); spiracles (**48**) long, 2,3 times longer than width along external contour. Surface of propodeum, from punctured in front from costulae by big smoothed punctures to wrinkly-punctured area dentipara and area posteromedia, shining; area basalis and area superomedia not sculptured; area spiraculifera from wrinkly-punctured behind spiracles (**49**) to densely punctured by merged punctures in front of them (**50**); metapleurae (**51**) punctured by big smoothed punctures, shining.

L e g s : Quite slender; hind coxae densely punctured by small punctures, shining, without scopa; claws smooth, smoothly and quite slightly and evenly curved, slightly widened at base (**52**).

W i n g s : Areolet (**53**) big, pentagonal, symmetrical, with wide base; radius almost straight (**54**), radial cell broad and long (**55**); nervulus (**56**) interstitial or only just visible postfurcal; ramulus (**57**) quite long; stigma (**58**) dark and quite broad and long; all veins of hind wing developed; membrane of wing hyaline, veins dark. Front wing 1,3 times shorter than body length.

A b d o m e n : Amblypygous, long, from above quite narrow with oblong apex; second tergite only just transversal, 1,1 times shorter than breadth at apex; tergites 2 and 3 quite strongly separated; tergites 6-7 projected on considerable length; sides of tergite 6 bending far onto the ventral side almost closing above hypopygium (as of some *Limerodops* HEINRICH); sheath of ovipositor from above only just protrude. Petiolus not flattened at base, dorsomedian carinae (**59**) visible only from base up to middle of tergite, dorsolateral carina (**60**) weak, ventrolateral carina (**61**) sharp; lateral surface of petiolus with distinct transversal ribs (**62**); petiolus from lateral with distinct but gradual transforming to postpetiolus (**63**), from above gradually broadened to postpetiolus (**64**); spiracles (**65**) small, distance between them 1,4 times more than distance from spiracles to apex of tergite; middle field (**66**) only slightly elevated and not carinated; its surface smooth, or sometimes with only just visible smoothed longitudinal striation, shining, with distinct impression at level of spiracles; lateral fields punctured (**67**). Gastrocoeli (**68**) not big, slightly but distinctly impressed, many narrower than interval between them (**69**); thyridia absent; lunulae (**70**) of moderate size in a form of more or less distinct impressions behind middle; interval between gastrocoeli (**69**) with slight longitudinal wrinkling at base; surface of second tergite very densely punctured by smoothed irregular punctures, medially punctures more big and elongated, shining, without microsculpture; puncturation of tergites more delicate to apex of abdomen; abdomen polished. Hypopygium (**71**) not compressed from sides with oblong apex, overlap slit of ovipositor, but not reach apex of ovipositor sheath. Sternites 2-4 strongly unsclerotized, with fold (**72**).

C o l o r a t i o n : Head and thorax black; white: narrow stripes at top of external orbits (**73**), pronotal ridge broadly (**27**), subalarum (**32**) and scutellum entirely (**37**). Abdomen red with darkened apex, white: apical stripes on tergites 5-6 (**74**) and spot on tergite 7 (**75**). Legs with exception of coxae and trochanters brownish-red; front tibiae with yellowish stripe outside.

S i z e : Body length – 8,5, flagellum – 3,7; front wing – 6,4 mm.
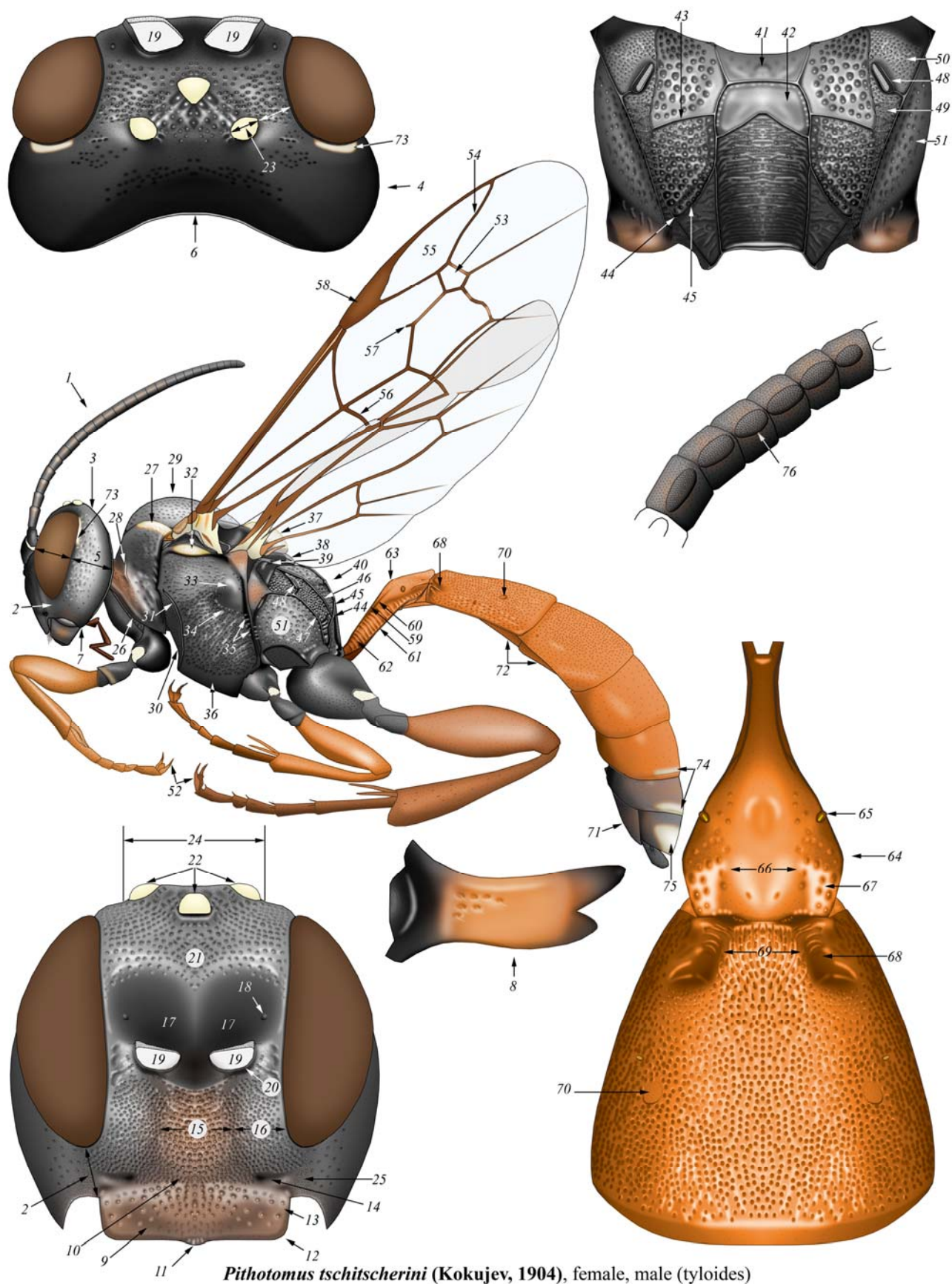
Plate 8: Complete table of pictures of species *Pithotomus tschitscherini* (KOKUJEV 1904) with numbering of characters (see description in the text)

M a l e

Flagellum of males with 31 segments and broadly-oval tyloides (**76**) on segments 7-21, tyloides on segments 10-17 very big, almost on all length of segments. Carinae of propodeum more sharp and high. Unlike of females broad white bands not only on tergites 5-6, but on tergite 4, and tergite 7 white entirely.

Conclusion

As a result of 25-years experience of preparation of scientific illustrations it is established that the scientific illustration that is fulfilled under a unified scheme is a necessary component of describing taxon, especially of high rank. Presence of the unified description of a taxon along with unified illustrations, allows describing new taxa without resorting to type material and avoiding research of the total volume of objects of its rank. A necessary condition of a successful result of investigation of any group of taxonomically defined objects is working out of the uniform, unified scheme of representation of their characters.

The major condition of valid scientific illustration of an object and its features it is fulfillment by specialist in taxonomy of a particular group of organisms, rather than a professional artist who is not familiar with taxonomic features.

The level of development of modern methods of digital image processing allows preparing a scientific illustration of taxon practically without resorting to a pencil and paper. And, with availability of certain skills, it becomes accessible to taxonomist who has no artistic aptitudes. Precise elaboration of small structures at high magnification and maximal using of layers possibilities are necessary conditions at fulfillment of illustrations. On the final image of object, with its real size, these details can be not visible, but representation about any class of structures becomes maximally real. The developed and proposed technique of fulfillment of the unified images of a taxon and its characters along with its unified description allows reaching the maximum effect in taxon representation.

The sequence of operations described above is suitable without modification for preparation of scientific illustrations of any taxa of hymenopterous insects (Hymenoptera).

While working out the necessary scheme, the proposed technique can be used to fulfill illustrations of any wildlife objects.

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Legends to color plates

Plate 3: Simplified variants of preparation of images in the graphic editor: (**1-8**) stages of preparation of image 1-2 tergites of abdomen *Clypeolabus curtitarsis* HEINRICH with use of a pencil contour, (**9-15**) stages of preparation of image of propodeum of *Afrectopius seyrigi* (HEINRICH), (**16-20**) stages of transformation of abdomen of imago *Hirtolabus alienoris* HEINRICH without use of a pencil matrix (according to TERESHKIN 2008).

Plate 4: Variants of flagellum images and their positioning: **Females**: (**1**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**2**) *Goedartia alboguttata* (GRAVENHORST), (**3**) *Hepiopelmus melanogaster* (GMELIN), (**4**) *Hoplismenus pica* WESMAEL, (**5**) *Limerodes arctiventris* (BOIE) (**6**) *Achaius oratorius* (FABRICIUS), (**7**) *Limerodops elongatus* (BRISCHKE), (**8**) *Neeurylabia spiloptera* (MORLEY), (**9**) *Callajoppa cirrogaster* (SCHRANK), (**10**) *Triptognathus uniguttatus* (GRAVENHORST), (**11**) *Trogus lapidator* (FABRICIUS), (**12**) *Achaiusoides epistomalis* TERESHKIN, (**13**) *Cratolaboides palpalis* TERESHKIN, (**14**) *Heinrichiellus hildegardae* (TERESHKIN), (**15**) *Ischnojoppa luteator* (FABRICIUS), (**16**) *Tricholabus strigatorius* (GRAVENHORST), (**17**) *Obtusodonta equitatoria* (PANZER), (**18**) *Bureschias subcylindricus* (GRAVENHORST), (**19**) *Coelichneumon torsor* (THUNBERG), (**20**) *Diphyus amatorius* (MÜLLER), (**21**) *Ichneumon extensorius* LINNAEUS, (**22**) *Protichneumon pisorius* (LINNAEUS), (**23**) *Spilichneumon occisor* (FABRICIUS), (**24**) *Heresiarches eudoxius* (WESMAEL). **Males**: (**25**) *Coelichneumon torsor* (THUNBERG), (**26**) *Pristiceros serrarius* GRAVENHORST.

Plate 5: Variants of the image of different parts of imago body of ichneumon fly: (**1-24**) **Head**: (**1**) *Pseudalomya praevara* TELENGA, (**2**) *Clypeodromus thyridialis* TERESHKIN, (**3**) *Cratolaboides palpalis* TERESHKIN, (**4**) *Neolevansa hirsuta* GAULD, (**5**) *Neeurylabia spiloptera* (MORLEY), (**6**) *Eurylabus torvus* WESMAEL, (**7**) *Cotiheresiarches dirus* (WESMAEL), (**8**) *Ceratojoppa cornuta* CAMERON, (**9**) *Ctenocalus schizoaspis* HEINRICH, (**10**) *Compsophorus verecundus angolae* (HEINRICH), (**11**) *Ischnojoppa luteator* (FABRICIUS), (**12**) *Listrodromus nycthemerus* (GRAVENHORST), (**13**) *Oedicephalus variegatus* (SZÉPLIGETTI), (**14**) *Eccoptosage brevispinosa* (TOSQUINET), (**15**) *Goedartia alboguttata* (GRAVENHORST), (**16**) *Cratichneumon unificatus* TERESHKIN, (**17**) *Ichneumon extensorius* LINNAEUS, (**18**) *Bureschias subcylindricus* (GRAVENHORST), (**19**) *Hoplismenus pica* WESMAEL, (**20**) *Heresiarches eudoxius* (WESMAEL), (**21**) *Protichneumon pisorius* (LINNAEUS), (**22**) *Apatetor blandus* SAUSSURE, (**23**) *Callajoppa cirrogaster* (SCHRANK), (**24**) *Trogus lapidator* (FABRICIUS). (**25-30**) **Thorax**: (**25**) *Callajoppa cirrogaster* (SCHRANK), (**26**) *Trogus lapidator* (FABRICIUS), (**27**) *Pagarenes erythropus* CAMERON, (**28**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**29**) *Spilichneumon occisor* (FABRICIUS), (**30**) *Diphyus amatorius* (MÜLLER). (**31-34**) **Abdomen**: (**31**) *Ctenocalus schizoaspis* HEINRICH, (**32**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**33**) *Obtusodonta equitatoria* (PANZER), (**34**) *Amblyteles armatorius* (FÖRSTER).

Plate 7: Additional fragments of a body used for illustration of characters of high taxa of Ichneumoninae: (**1-38**) **Mandibles**: (**1**) *Pseudalomya praevara* TELENGA, (**2**) *Clypeodromus thyridialis* TERESHKIN, (**3**) *Platybirmania acutinota* HEINRICH, (**4**) *Poecilostictus cothurnatus* (GRAVENHORST), (**5**) *Platylabus rufus* WESMAEL, (**6**) *Neeurylabia spiloptera* (MORLEY), (**7**) *Pyramidophorus flavoguttatus* TISCHBEIN, (**8**) *Eurylabus torvus* WESMAEL, (**9**) *Ceratojoppa cornuta* CAMERON, (**10**) *Ctenocalus schizoaspis* HEINRICH, (**11**) *Compsophorus verecundus angolae* (HEINRICH), (**12**) *Ischnojoppa luteator* (FABRICIUS), (**13**) *Listrodromus nycthemerus* (GRAVENHORST), (**14**) *Pithotomus tschitscherini* (KOKUJEV), (**15**) *Oedecephalus variegatus* (SZÉPLIGETTI), (**16**) *Eccoptosage brevispinosa* (TOSQUINET), (**17**) *Goedartia alboguttata* (GRAVENHORST), (**18**) *Hymenura nigra* (HEINRICH), (**19**) *Aethioplites madagascariensis* HEINRICH, (**20**) *Achaius oratorius* (FABRICIUS) (**21**) *Amblyteles armatorius* (FÖRSTER), (**22**) *Bureschias subcylindricus* (GRAVENHORST), (**23**) *Spilichneumon occisor* (FABRICIUS), (**24**) *Ctenich-*

neumon funereus (GEOFFROY), (**25**) *Diphyus amatorius* (MÜLLER), (**26**) *Eutanyacra crispatoria* (LINNAEUS), (**27**) *Hepiopelmus melanogaster* (GMELIN), (**28**) *Achaiusoides epistomalis* TERESHKIN, (**29**) *Fileanta radoszkowskii* (BERTHOUMIEU), (**30**) *Limerodes arctiventris* (BOIE), (**31**) *Limerodops elongatus* (BRISCHKE), (**32**) *Obtusodonta equitatoria* (PANZER), (**33**) *Tricholabus strigatorius* (GRAVENHORST), (**34**) *Triptognathops gobiensis* TERESHKIN, (**35**) *Triptognathus uniguttatus* (GRAVENHORST), (**36**) *Hoplismenus pica* WESMAEL, (**37**) *Hybophorellus injucundus* (WESMAEL), (**38**) *Heresiarches eudoxius* (WESMAEL). (**39-40**) **Tyloides on flagellum of males**: (**39**) *Poecilostictus cothurnatus* (GRAVENHORST), (**40**) *Hypomecus quadriannulatus* (GRAVENHORST). (**41-48**) **Scutellum from above and from side**: (**41**) *Ceratojoppa cornuta* CAMERON, (**42**) *Ctenocalus schizoaspis* HEINRICH, (**43**) *Compsophorus (Epijoppa) verecundus angolae* (HEINRICH), (**44,48**) *Goedartia alboguttata* (GRAVENHORST), (**45**) *Oedecephalus variegatus* (SZÉPLIGETTI), (**46**) *Callajoppa cirrogaster* (SCHRANK), (**47**) *Ttogus lapidator* (FABRICIUS). (**49**) **Front part of a thorax from above** *Clypeodromus thyridialis* TERESHKIN. (**50**) **Apex of abdomen of female** *Hymenura nigra* (HEINRICH). (**51**) **Apex of abdomen and oedeagus of male** *Tricholabus strigatorius* GRAVENHORST (**52-53**) **Claws of females tarsi**: (**52**) *Clypeodromus thyridialis* TERESHKIN, (**53**) *Pyramidophorus flavoguttatus* TISCHBEIN.

Plate 9–56: (**1**)) imago, (**2**) head from above, (**3**) head from front, (**4**) propodeum, (**5**) tergites 1-2 of abdomen, (**6**) tyloides on flagellum of male, (**7**) mandible, (**8**) mesonotum from above, (**9**) area superomedia of male, (**10**) scutellum from above, (**11**) scutellum from lateral, (**12**) collar of pronotum from lateral, (**13**) collar of pronotum from above, (**14**) apex of males abdomen (**15**) apex of abdomen from above, (**16**) claws of tarsi, (**17**) maxillary palp.

Examples of tables of illustrations of Ichneumoninae fulfilled manually and completed in the graphic editor
(according to TERESHKIN 2009)
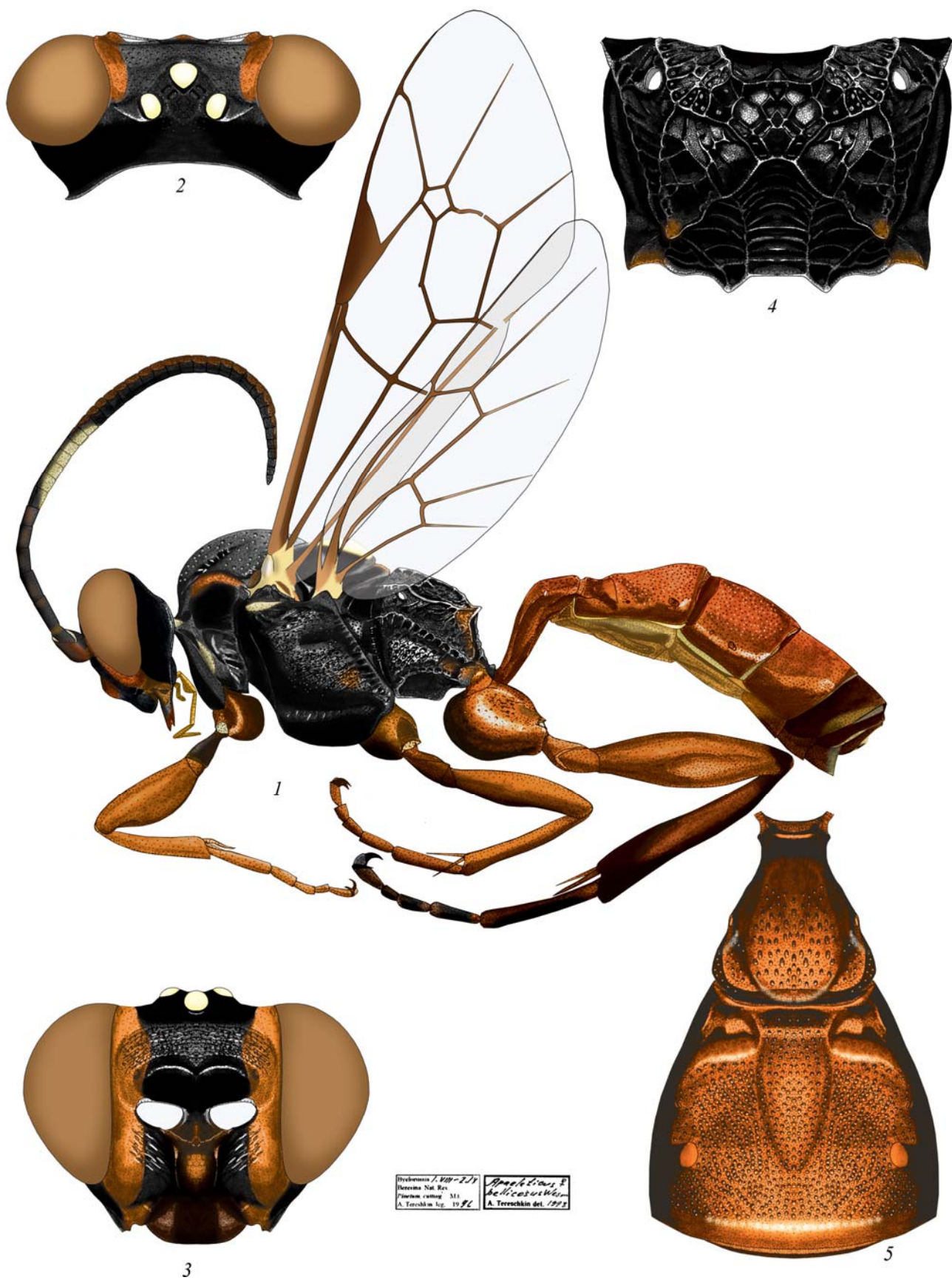
Plate 9: *Apaeleticus bellicosus* WESMAEL 1844, ♀ (Platylabini)

Plate 10: *Ectopius rubellus* (GMELIN 1790), ♀ ♂(6,9) (Platylabini)
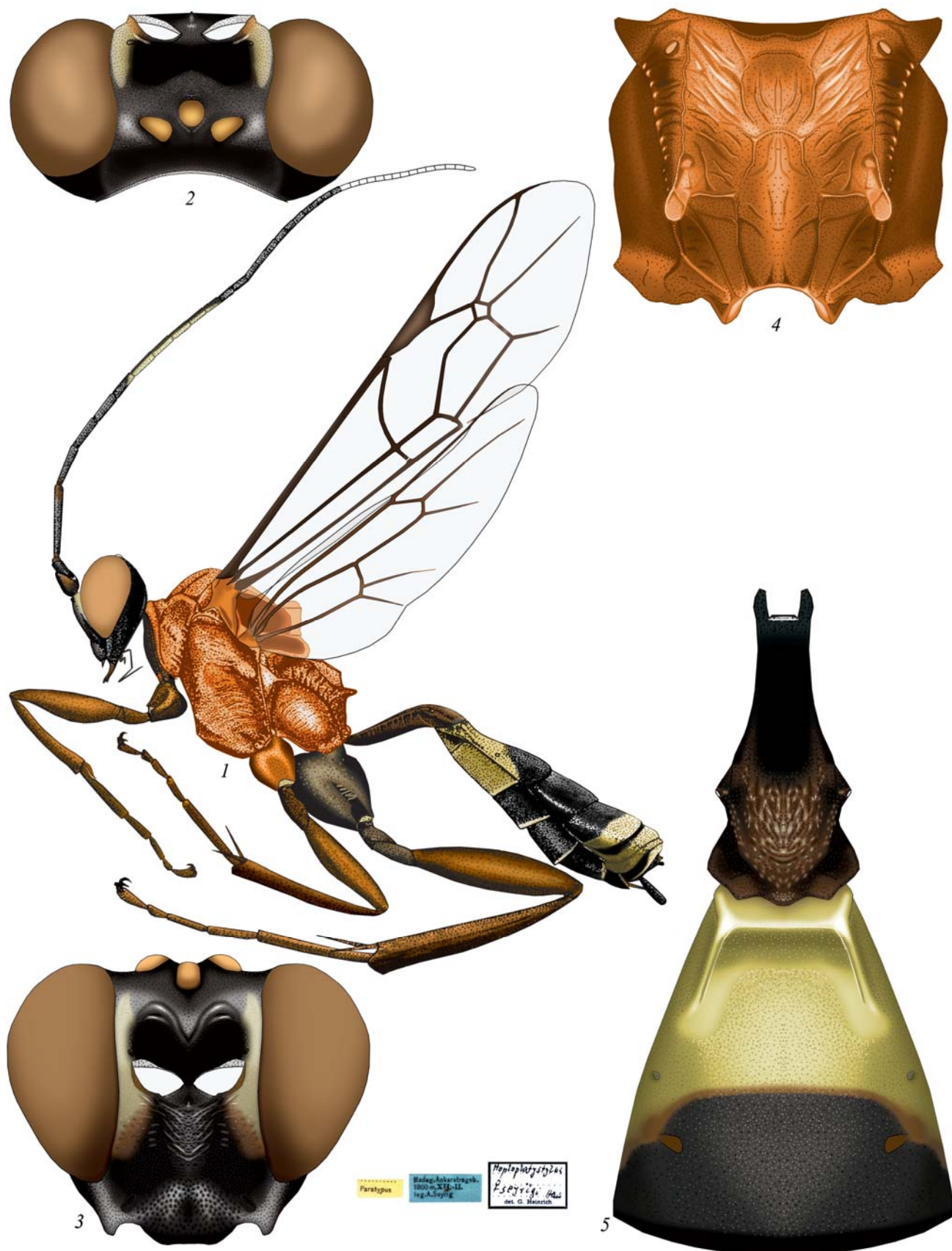
Plate 11: *Afrectopius seyrigi* (HEINRICH 1938), ♀ (Platylabini)

Plate 12: *Cyclolabus nigricollis* (WESMAEL 1844), ♀ (Platylabini)

Plate 13: *Cyclolabellus pertenuis* HEINRICH 1974, ♀ (Platylabini)

Plate 14: *Linycus exhortator* (Fabricius 1778), ♀ (Platylabini)

Text on specimen label:
Bistineau Park
near Doyline
Louisiana, USA
27.iy.-2.v.72
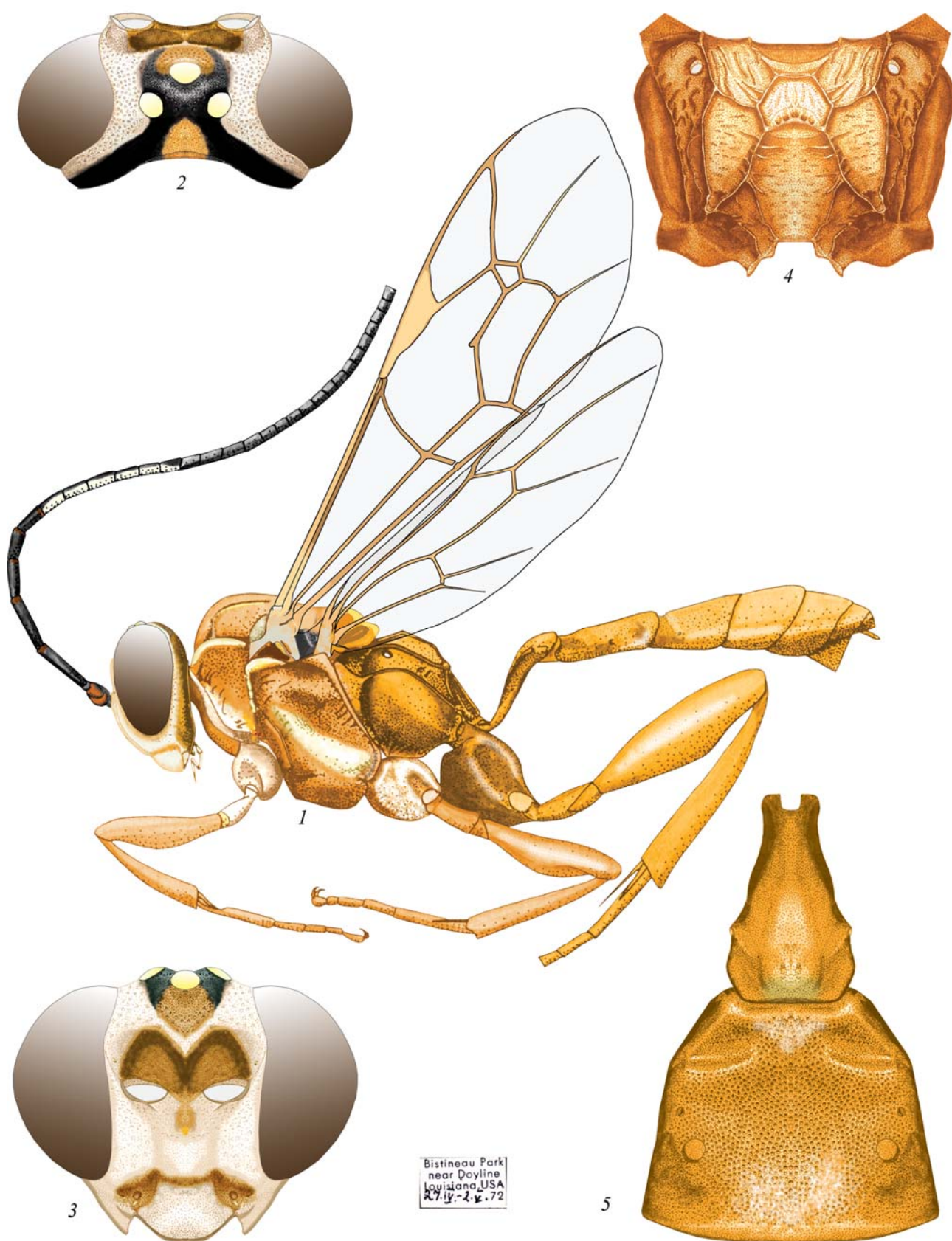
Plate 15: *Neolinycus michaelis* HEINRICH 1971, ♀ (Platylabini)
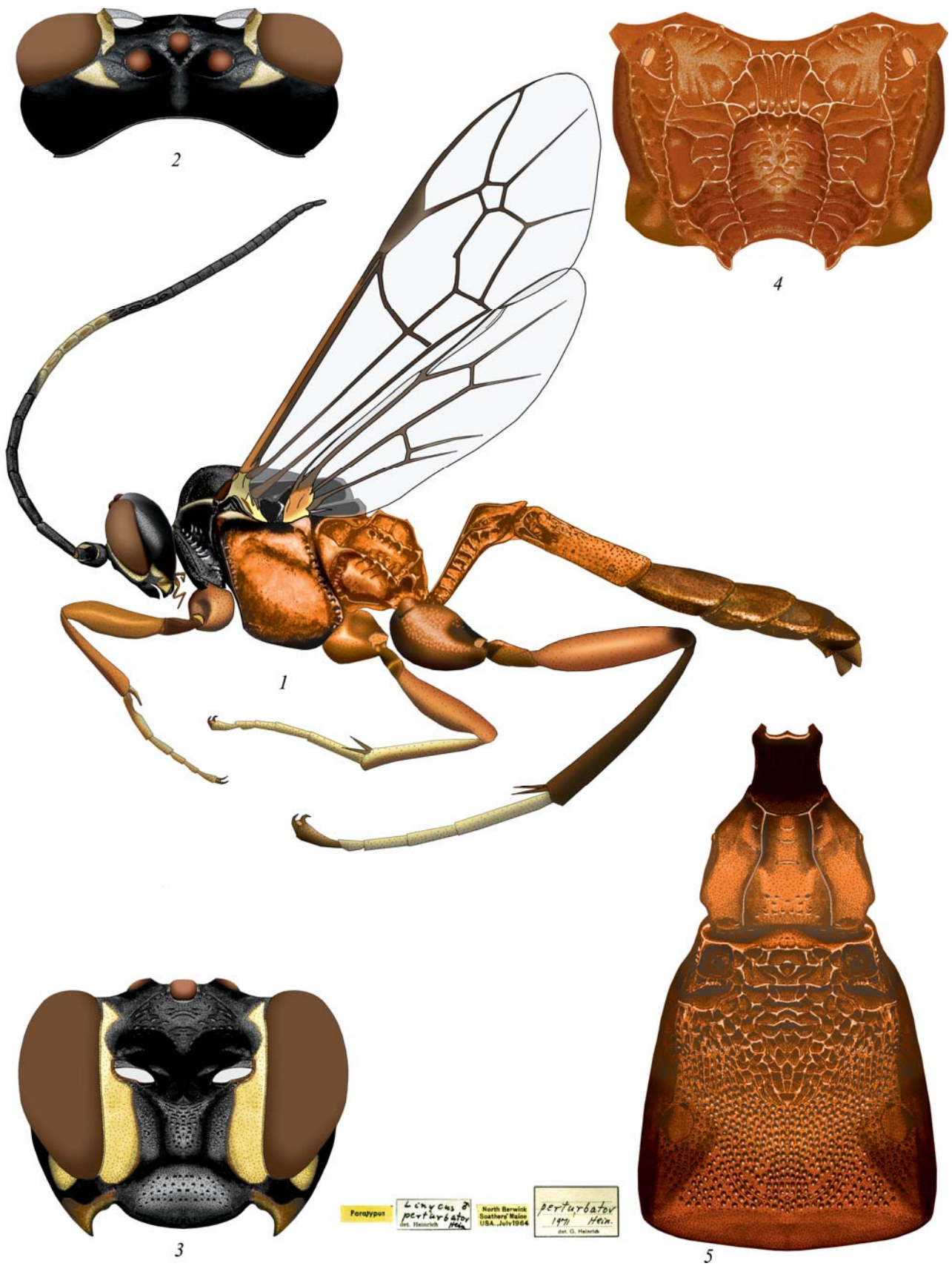
Plate 16: *Carlsonia perturbator* (HEINRICH 1971), ♂ (Platylabini)

Plate 17: *Notoplatylabus podolicus* HEINRICH 1934, ♀ (Platylabini)

Plate 18: *Clypeolabus curtitarsis* HEINRICH 1974, ♀ (Platylabini)

Plate 19: *Hirtolabus alienoris* HEINRICH 1974, ♀ (Platylabini)
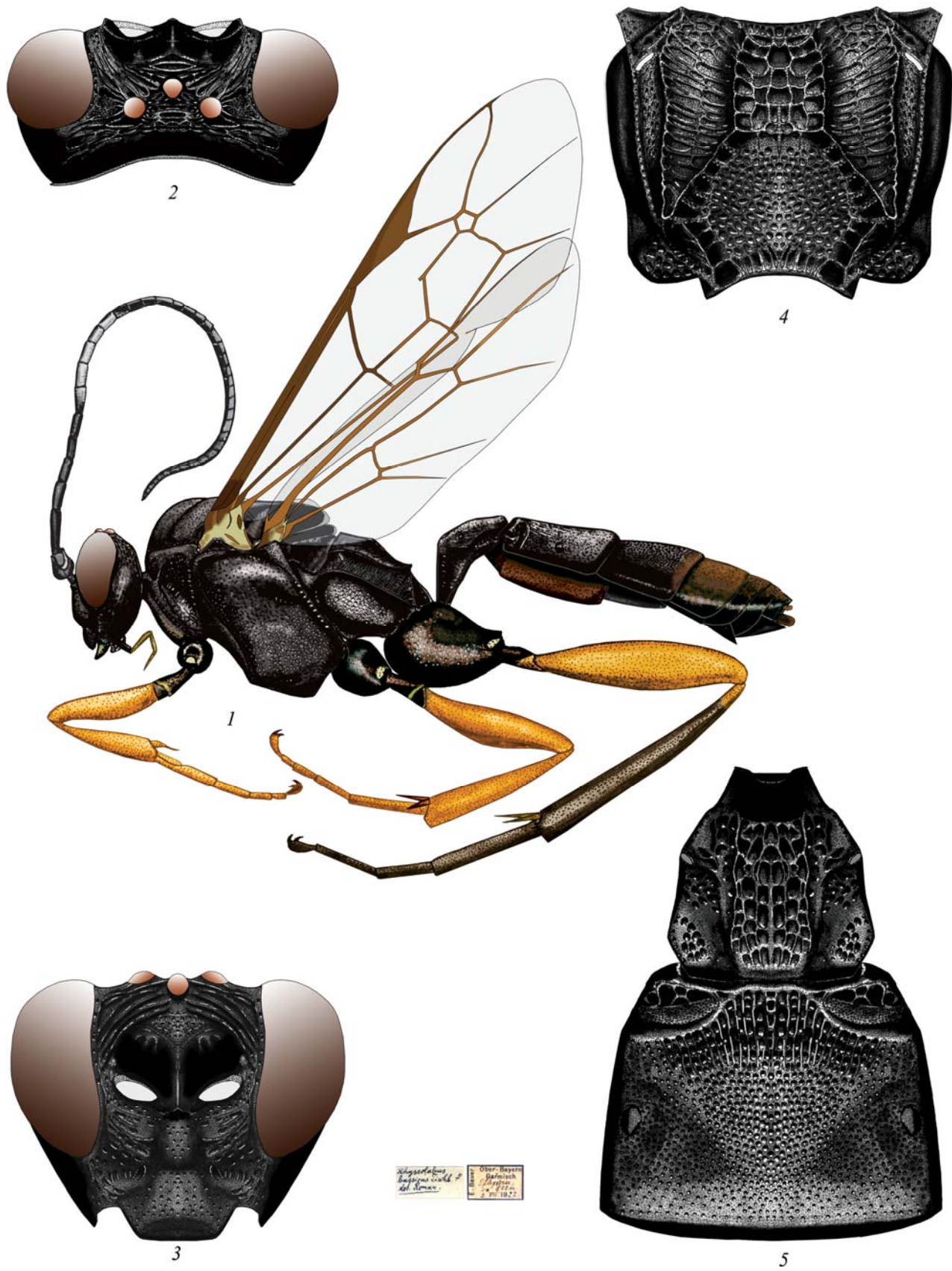
Plate 20: *Rhyssolabus bassicus* (TISCHBEIN 1868), ♀ (Platylabini)
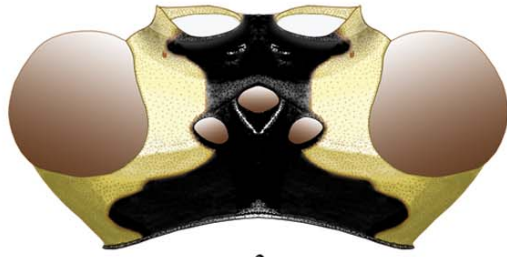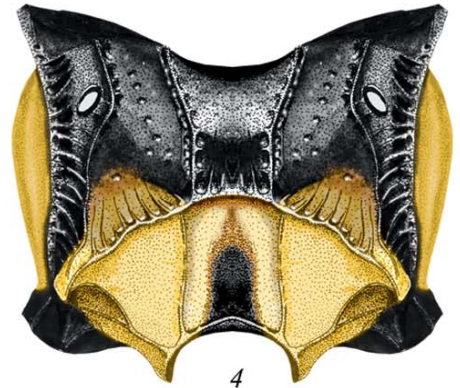
Plate 21: *Ambloplisus ornatus* (CRESSON 1868), ♀ (Platylabini)
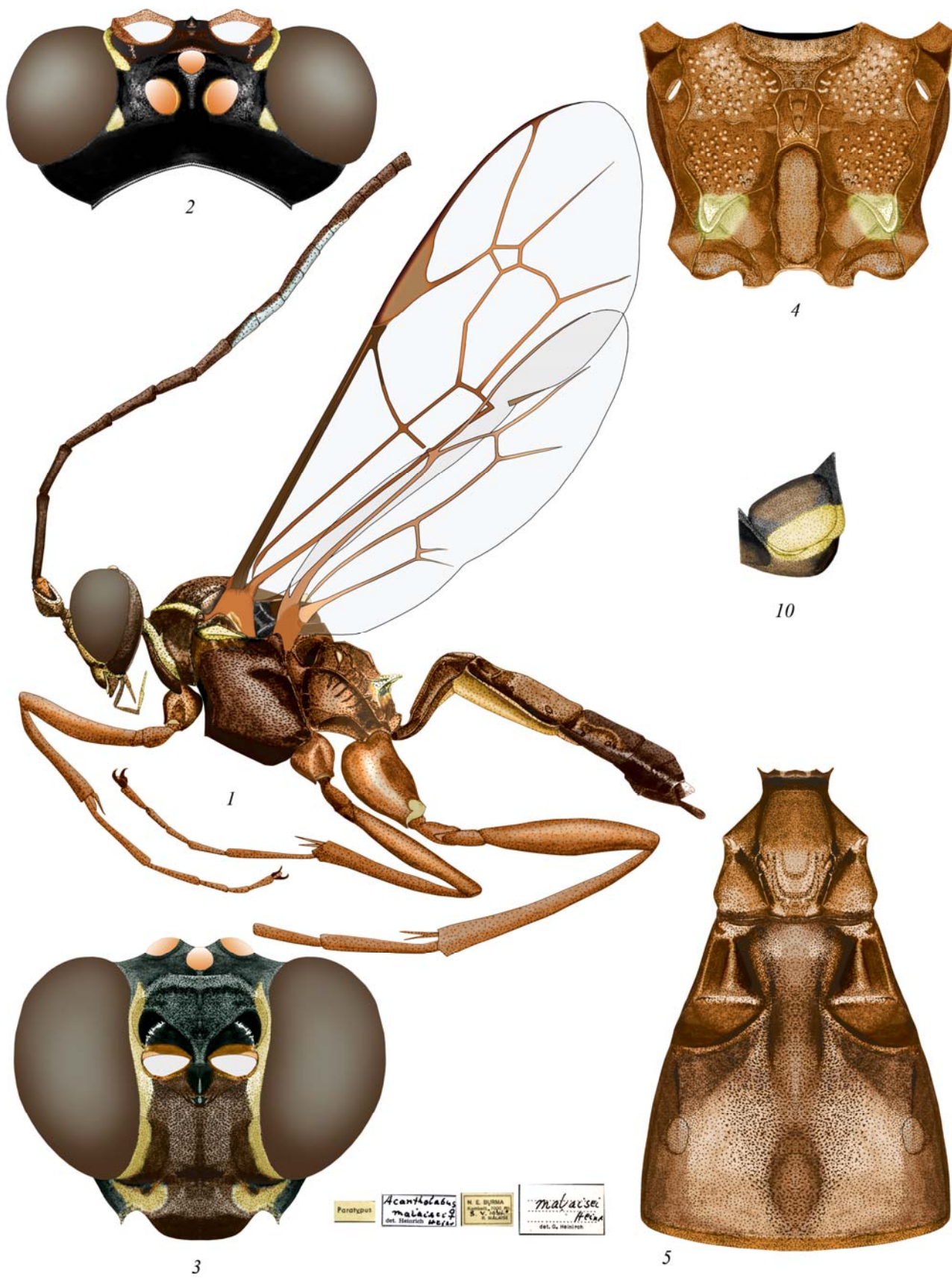
Plate 22: *Acantholabus malaisei* HEINRICH 1974, ♀ (Platylabini)
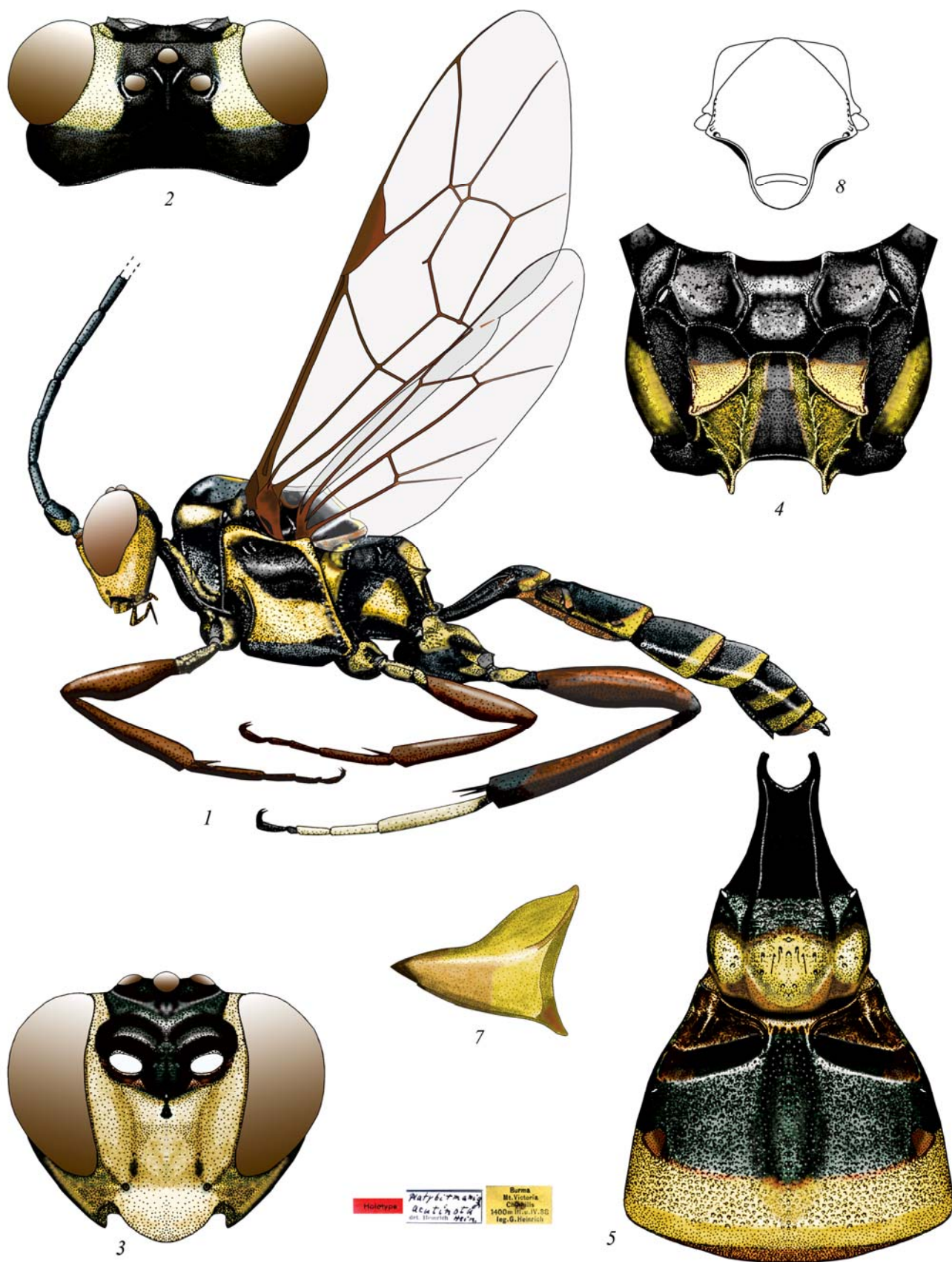
Plate 23: *Platybirmania acutinota* HEINRICH 1974, ♂ (Platylabini)

Plate 24: *Cratolabus insulindicus* (HEINRICH 1934), ♀ (Platylabini)

Plate 25: *Poecilostictus cothurnatus* (GRAVENHORST 1829), ♀ ♂(6) (Platylabini)
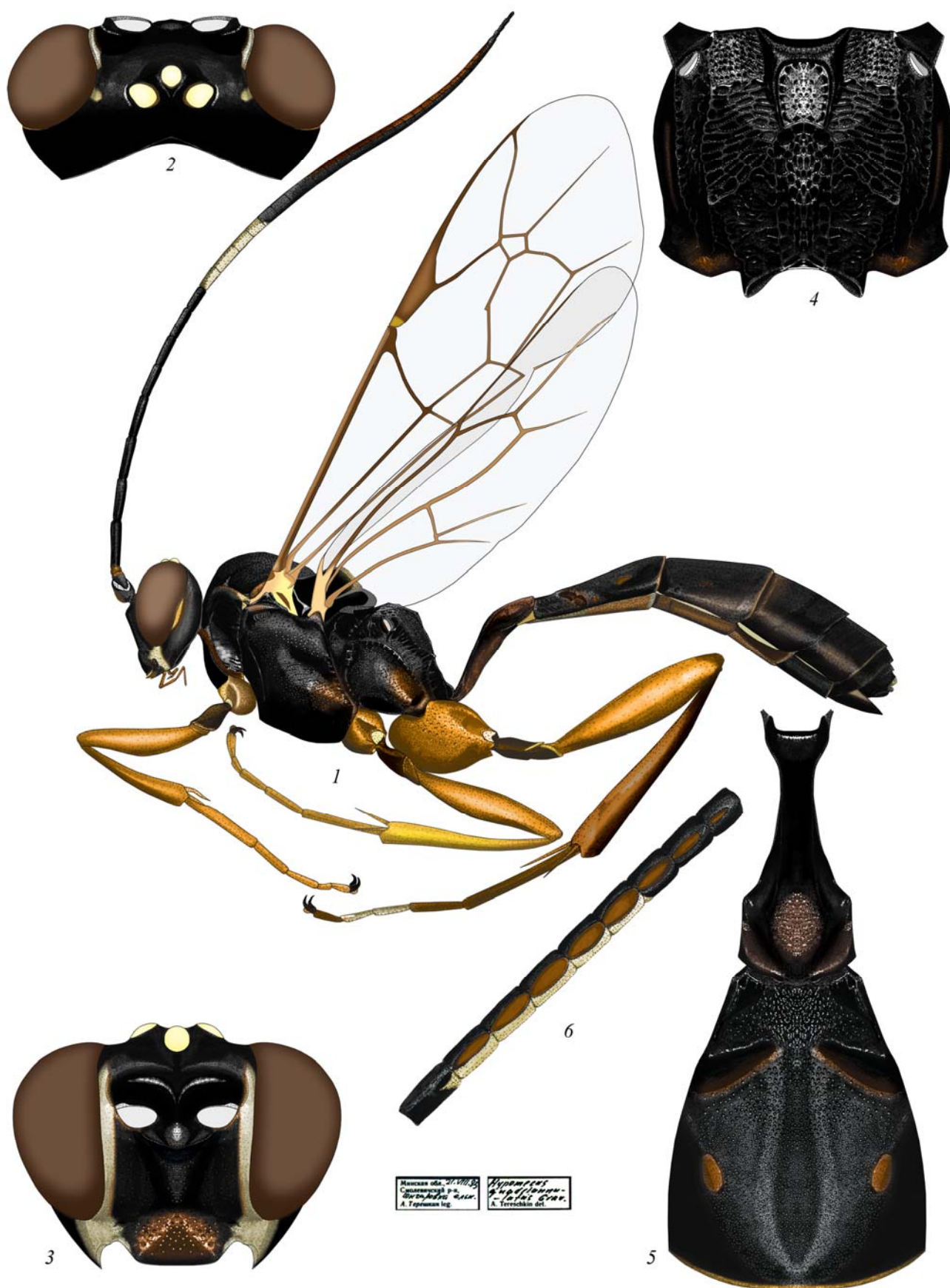
Plate 26: *Hypomecus quadriannulatus* (GRAVENHORST 1829), ♀ ♂(6) (Platylabini)
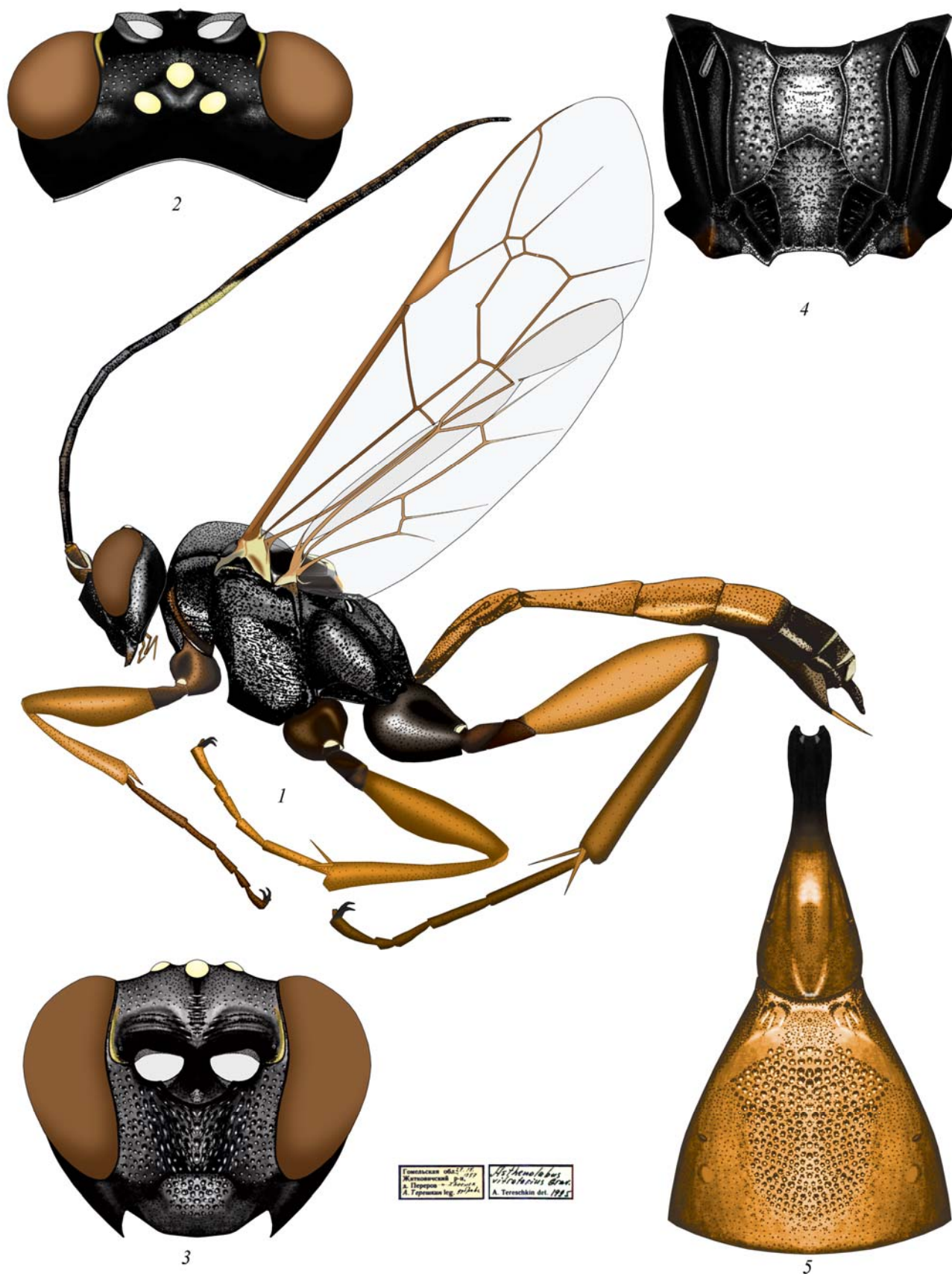
Plate 27: *Asthenolabus vitratorius* (GRAVENHORST 1829), ♀ (Platylabini)
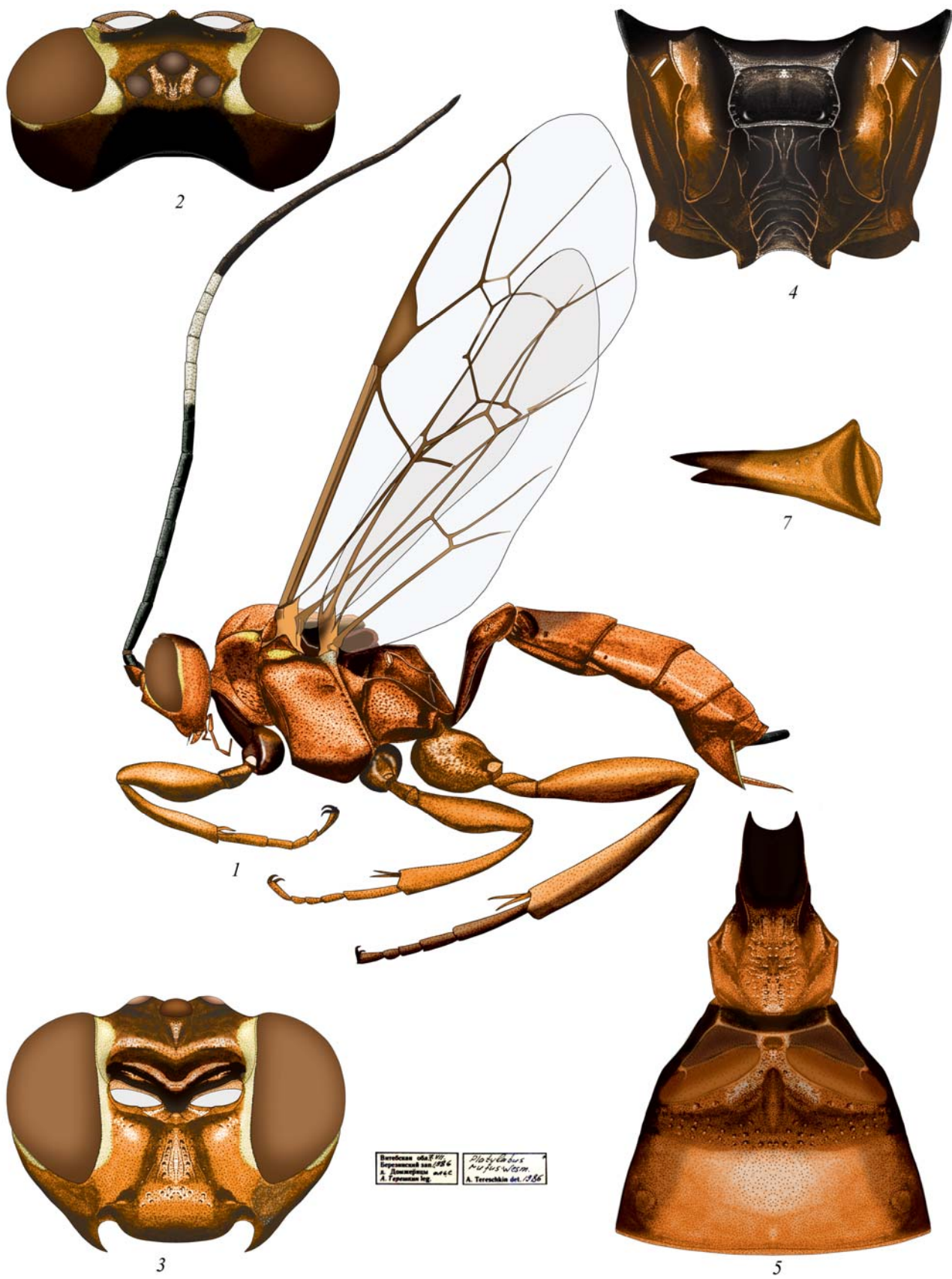
Plate 28: *Platylabus rufus* WESMAEL 1844, ♀ (Platylabini)
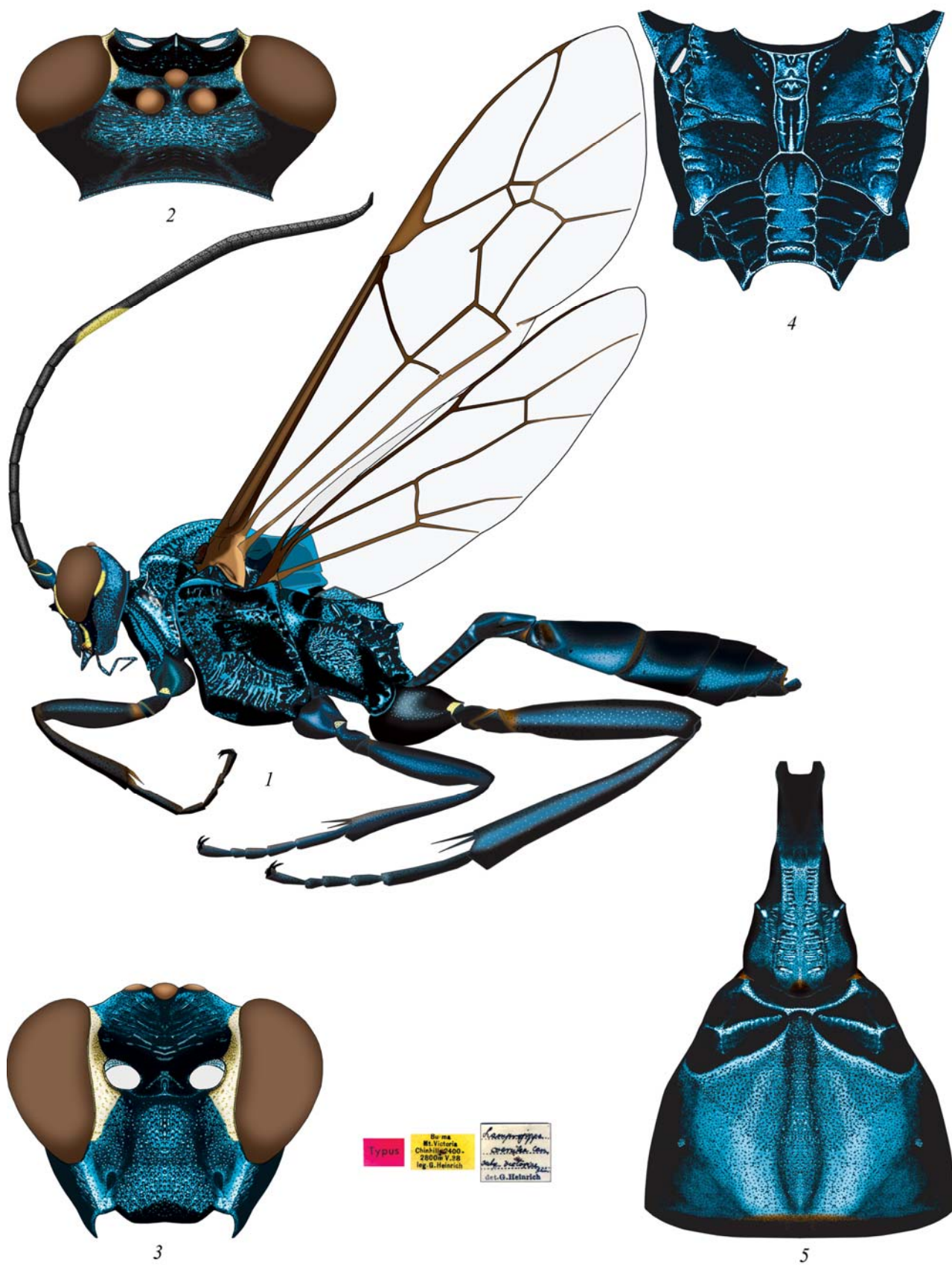
Plate 29: *Lamprojoppa caerulea* CAMERON 1901, ♀ (Platylabini)
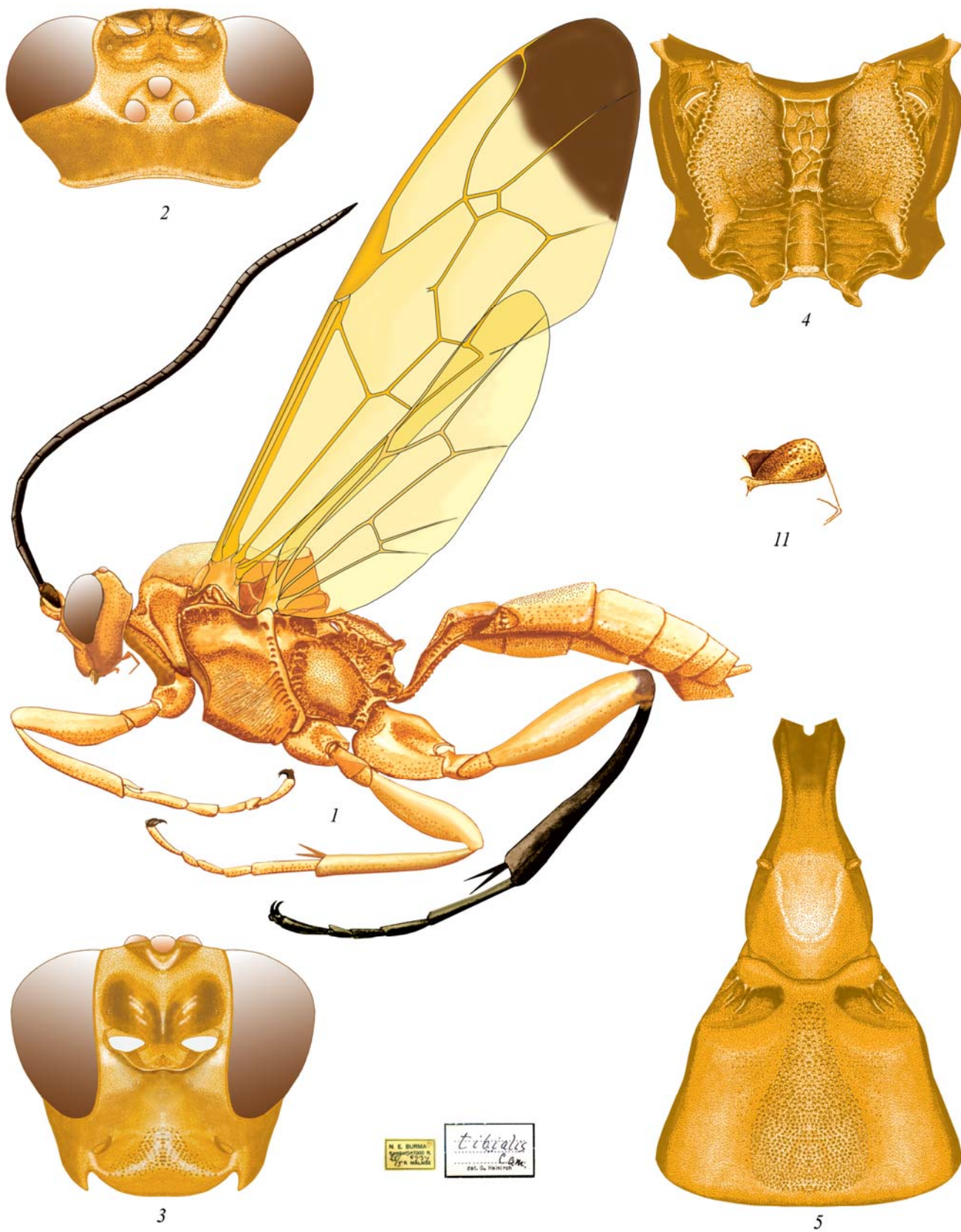
Plate 30: *Pachyjoppa tibialis* CAMERON 1901, ♀ (Platylabini)

Plate 31: *Pristicerops infractorius* (LINNAEUS 1761), ♀ ♂(6) (Platylabini)

Plate 32: *Pristiceros serrarius* GRAVENHORST 1829, ♂ (Platylabini)

Plate 33: *Dentilabus variegatus* (WESMAEL 1844), ♀ (Platylabini)

Plate 34: *Lissolaboides flavorufus* Heinrich 1974, ♀ (Platylabini)

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Grahamstown
X. 21-31. 70 S. Afr.
Fred Gess
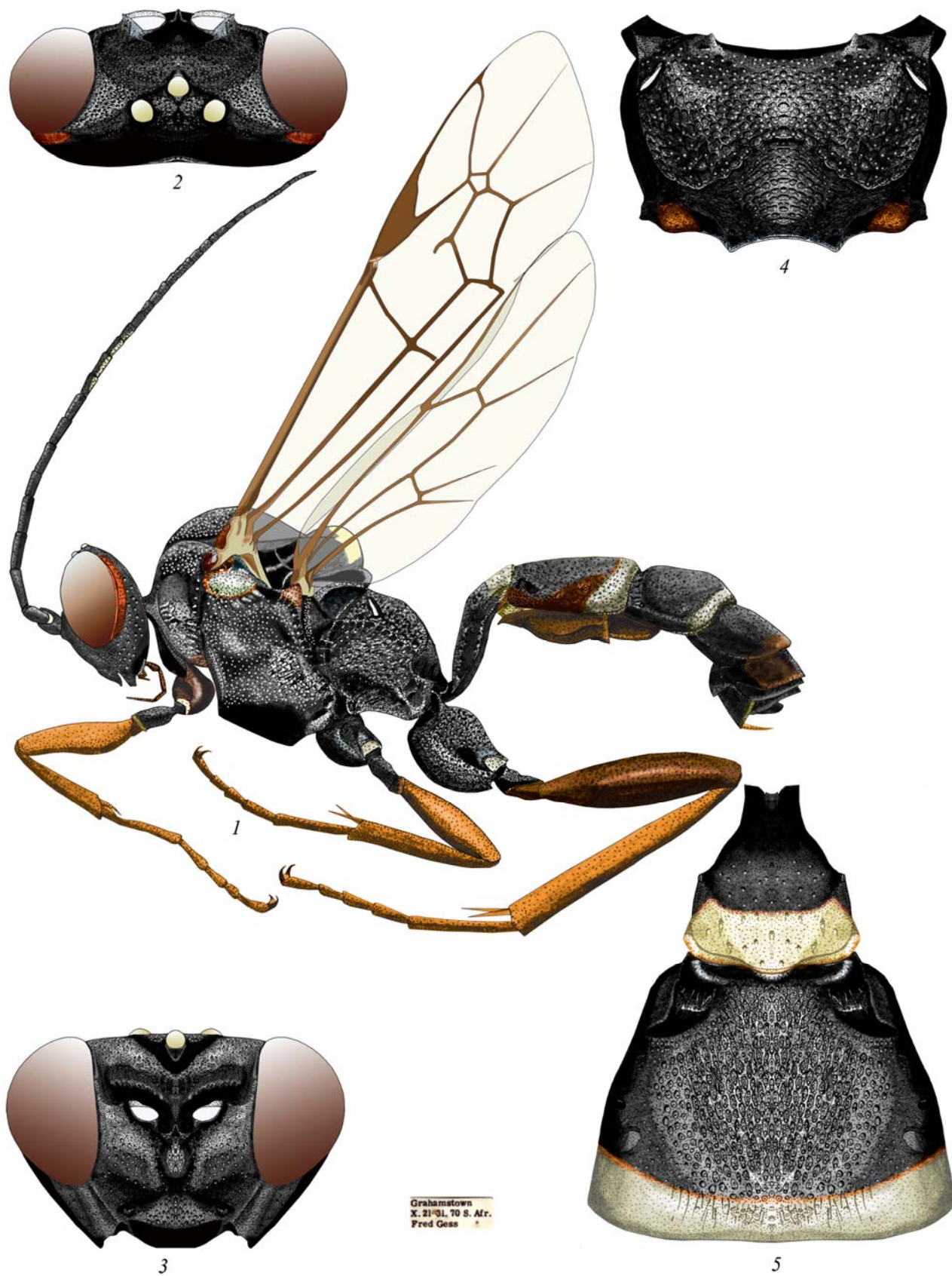
Plate 35: *Spanophatnus bicinctorius* (THUNBERG 1822), ♀ (Platylabini)

222
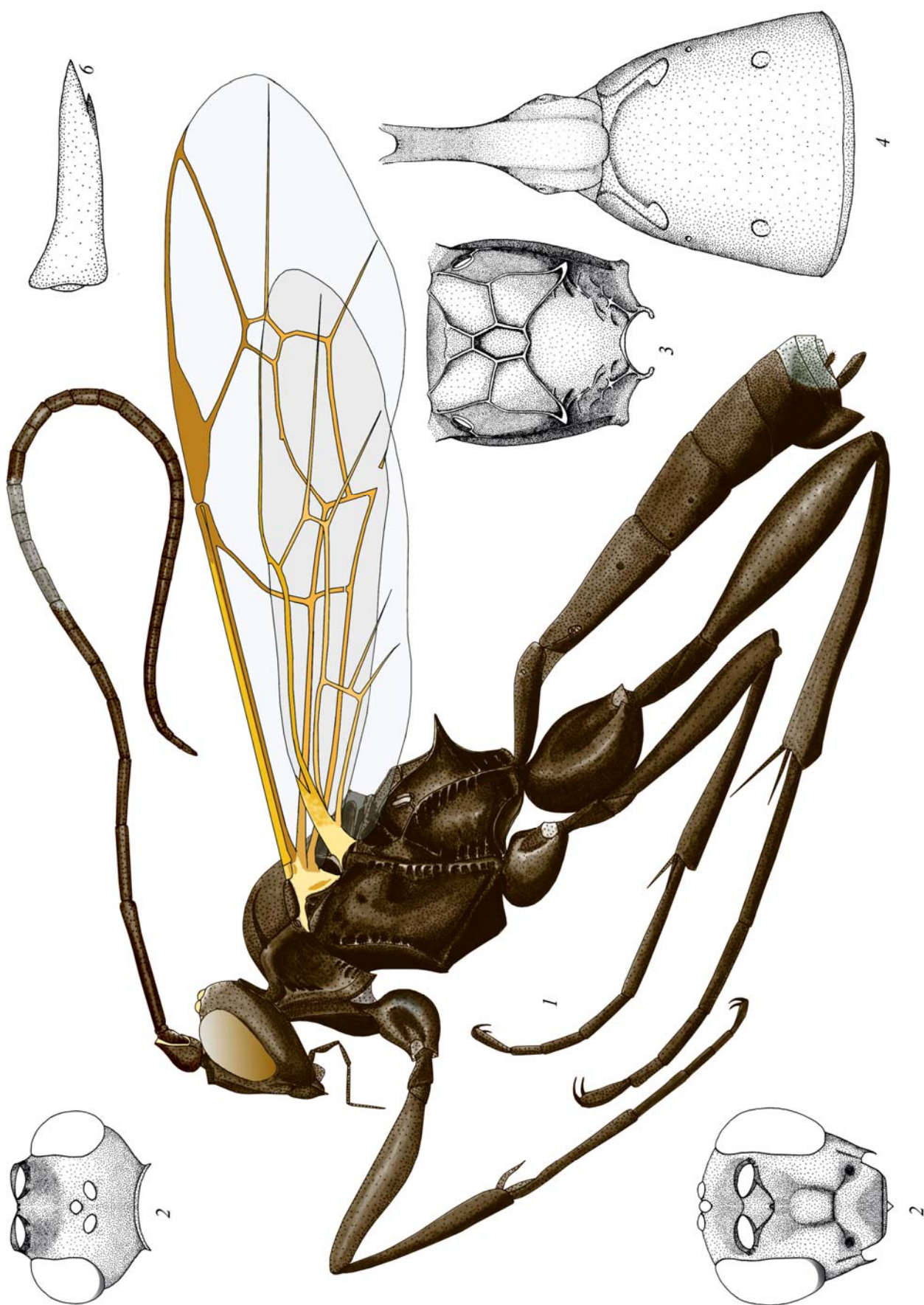
Plate 36: *Heinrichiellus hildegardae* (TERESHKIN 1996), ♀ (Platylabini)

Plate 37: *Abzaria latipetiolaris* CAMERON 1885, ♀ (Platylabini)

Plate 38: *Pyramidophorus flavoguttatus* TISCHBEIN 1882, ♀ (Platylabini)

225
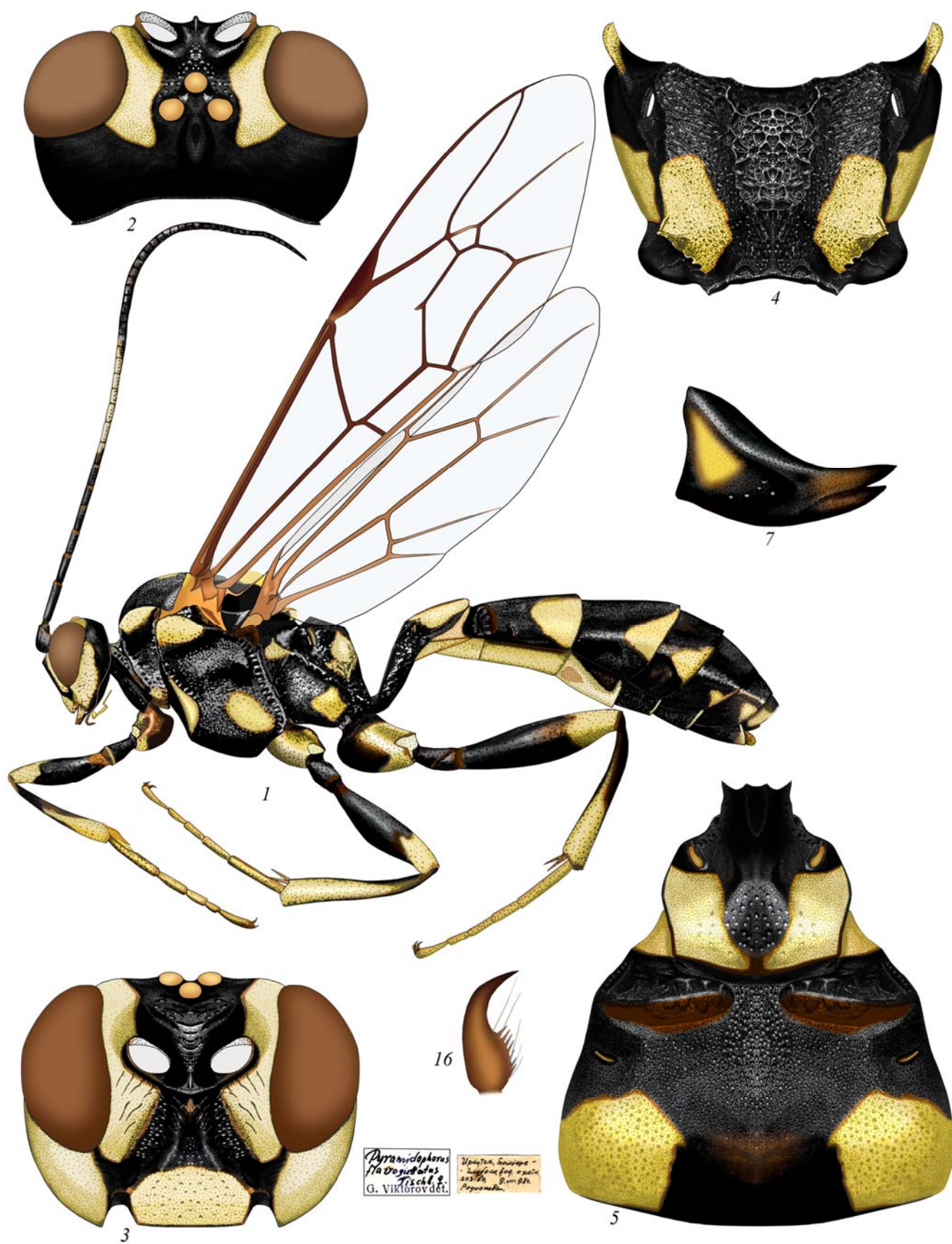
Plate 39: *Clypeodromus thyridialis* TERESHKIN 1992, ♀ ♂(6) (Clypeodromini)
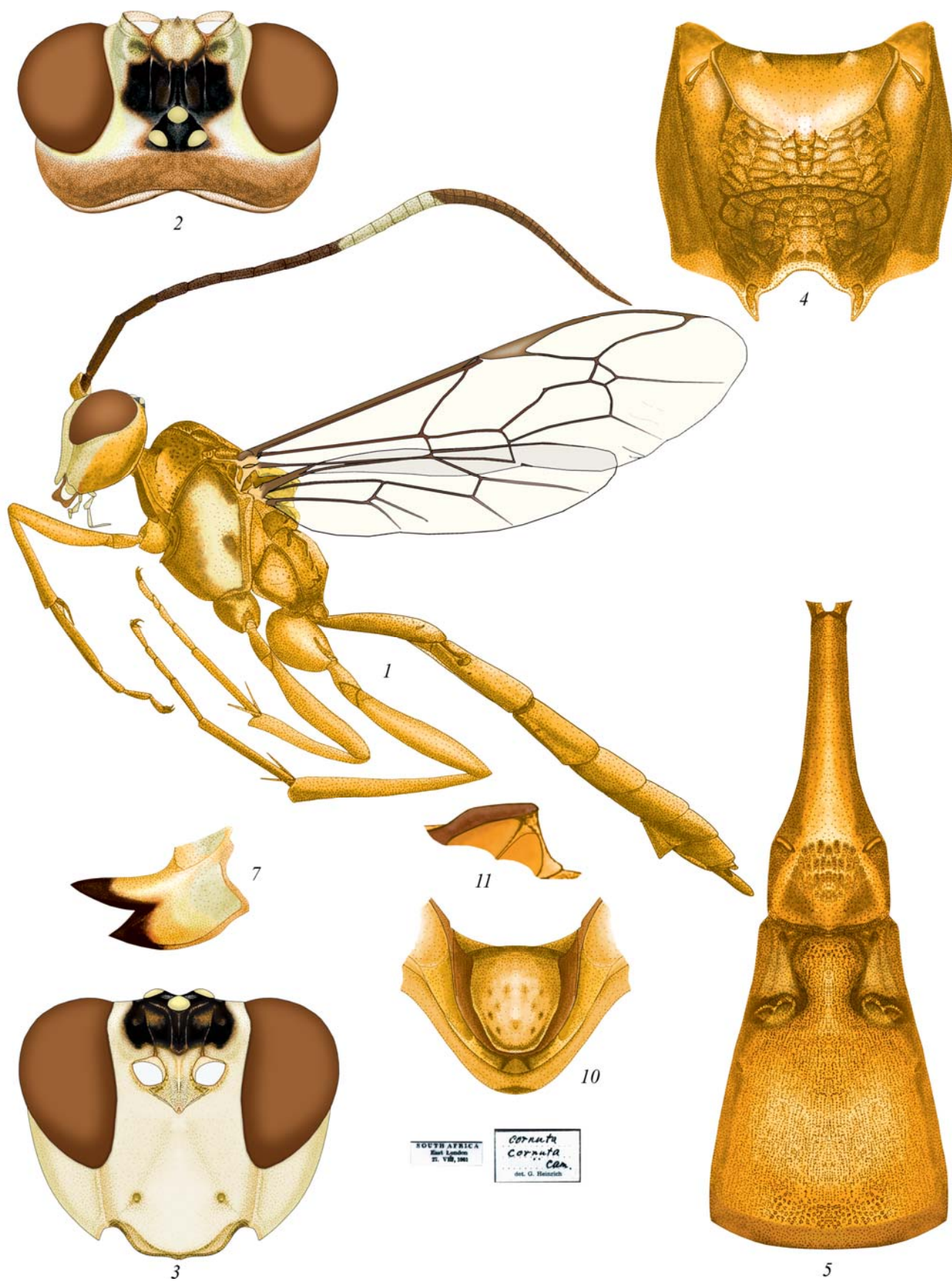
Plate 40: *Ceratojoppa cornuta* CAMERON 1905, ♀ (Ceratojoppini)

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Plate 41: *Ctenocalus schizoaspis* HEINRICH 1967, ♂ (Ctenocalini)

Plate 42: *Compsophorus* (*Epijoppa*) *verecundus angolae* (HEINRICH 1967), ♀
(Compsophorini)

Label text on image 1:
Celebes
Latimodjong geb Uru
800 m Aug/Sept.1930
G.Heinrich

Plate 43: *Ischnojoppa luteator* (FABRICIUS 1798), ♀ (Ischnojoppini)
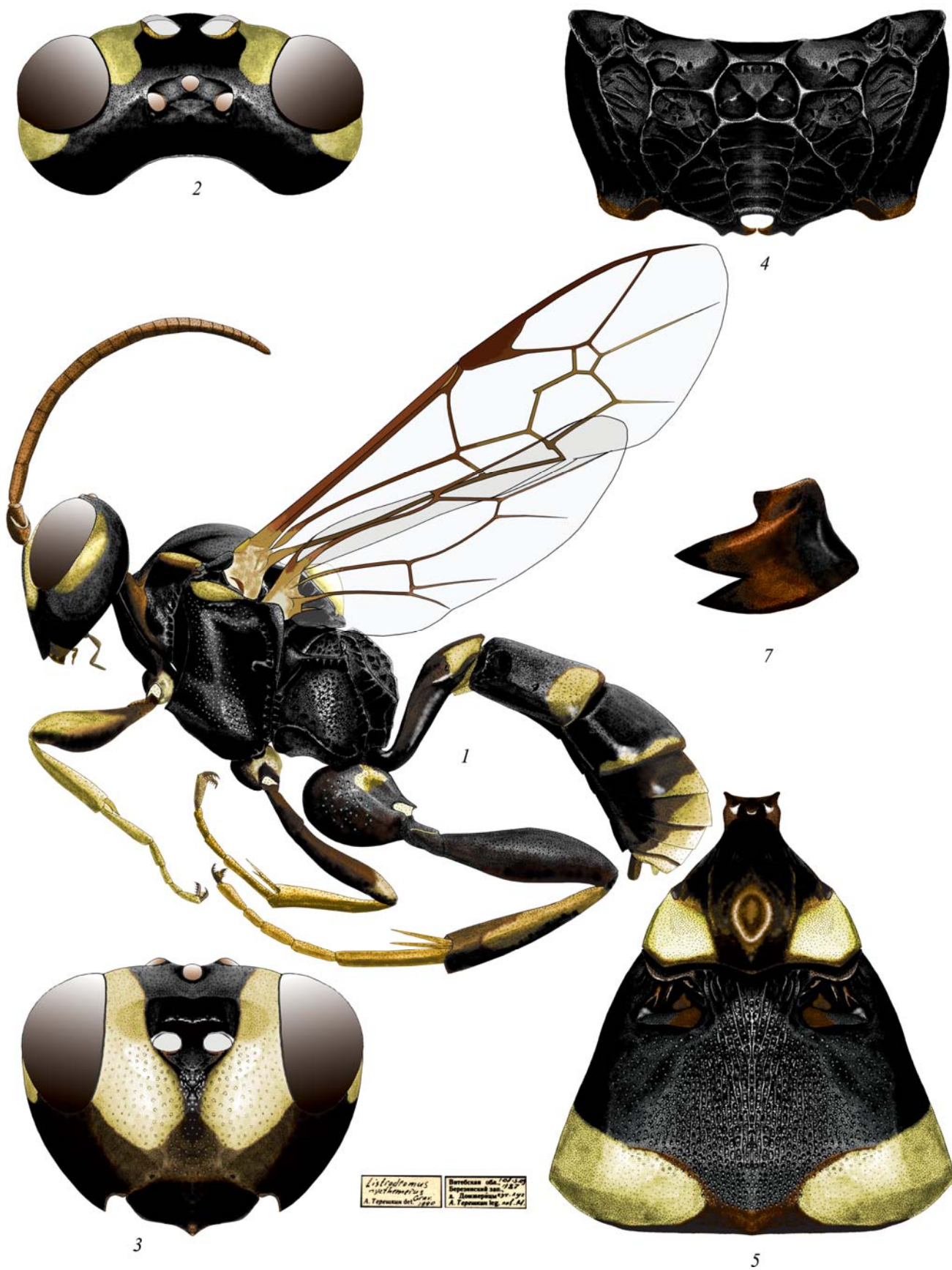
Plate 44: *Listrodromus nycthemerus* (GRAVENHORST 1820), ♀ (Listrodromini)
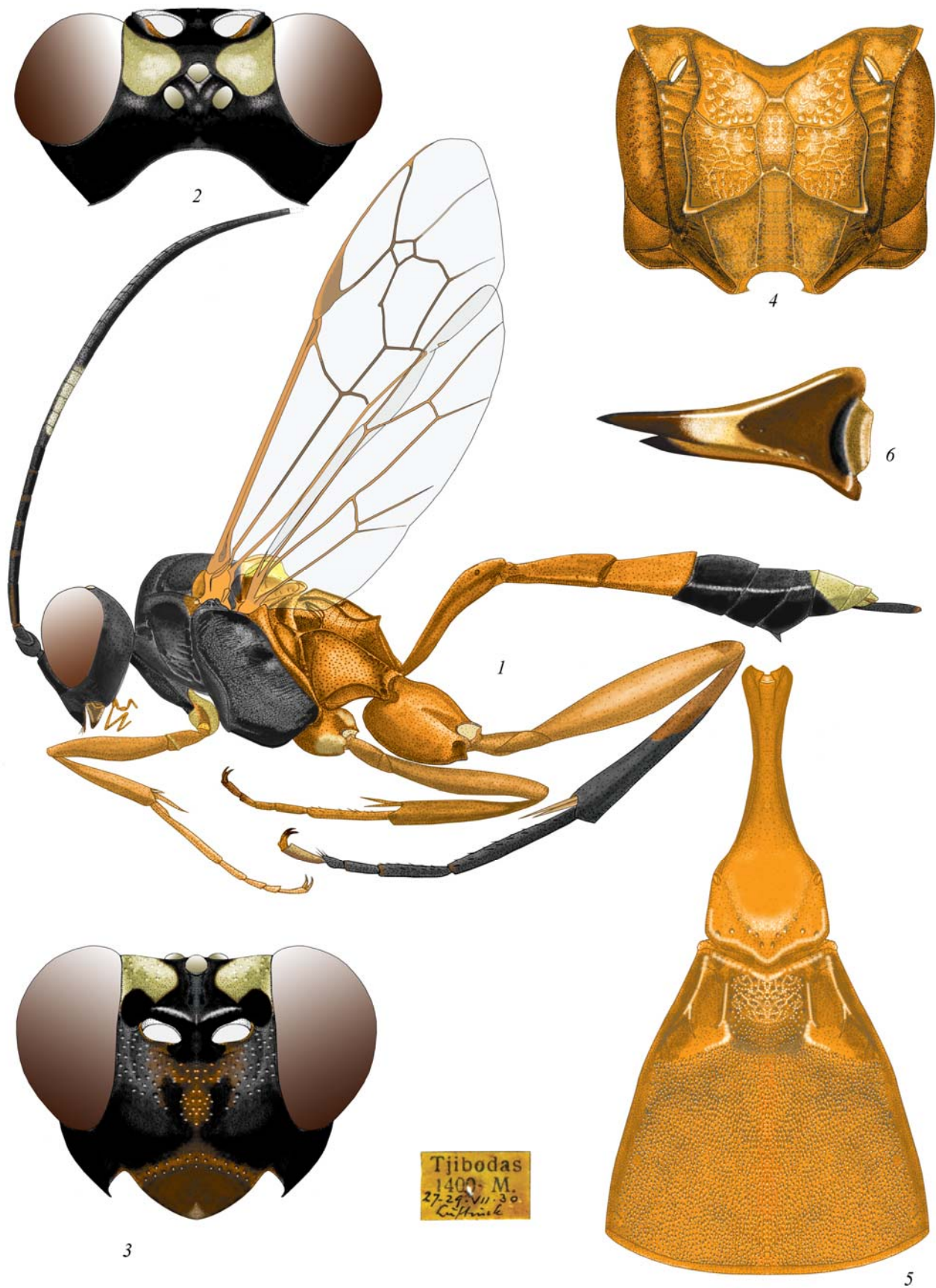
Plate 45: *Eccoptosage brevispinosa* (TOSQUINET 1903), ♀ (Joppocryptini)

Examples of tables of illustrations of Ichneumoninae completely fulfilled in the graphic editor

Label text on plate:

Russia, Primorskij
Kraj, Ussurijsk,
13.6.02
leg. A.Tereshkin
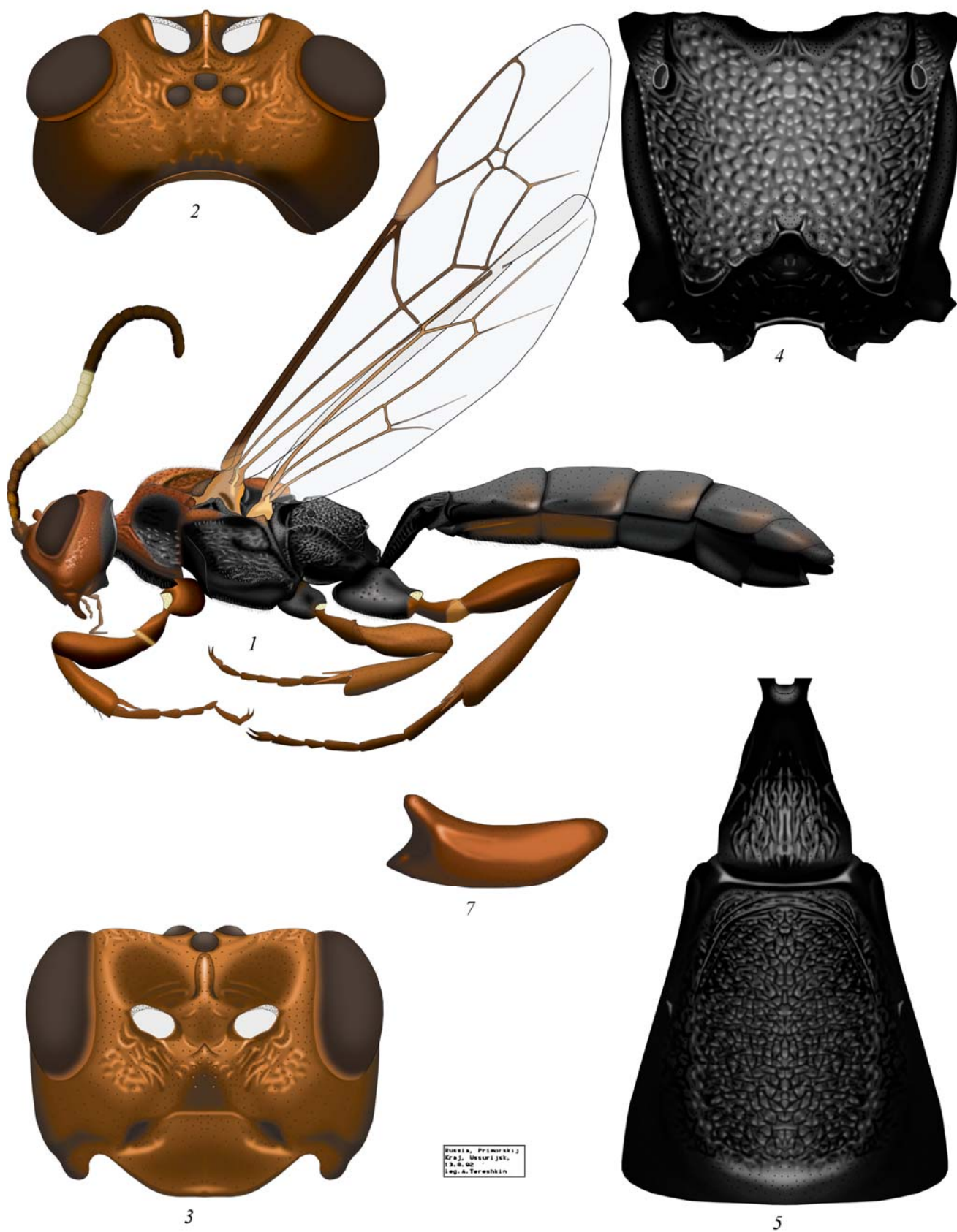
Plate 46: *Pseudalomya praevara* Telenga 1930, ♀ (Alomyini) (according to Tereshkin 2009)

The labels shown in the illustration read:

Paratypus
Notoplatylabus podolicus conterraneus Tereshkin

Russia, Far East
Ussurijsk
Kajmanovka   10.08.1992
A. Tereshkin leg.

Plate 47: *Notoplatylabus conterraneus* TERESHKIN 1993, ♂ (Platylabini) (according to TERESHKIN 2009)
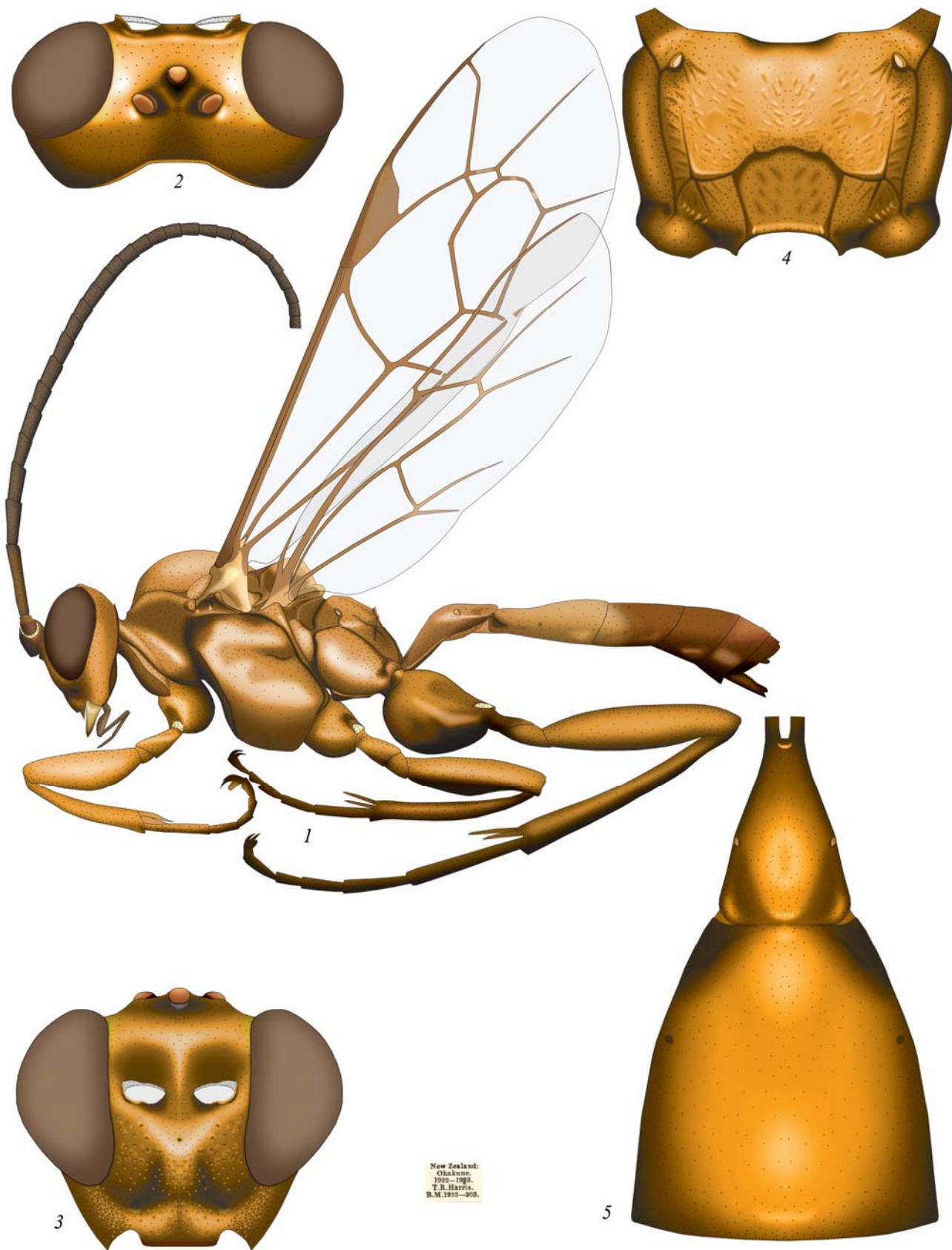
Plate 48: *Levansa decoratoria* (FABRICIUS 1775), ♀ (Platylabini) (according to
TERESHKIN 2009)

Plate 49: *Cratolaboides palpalis* Tereshkin 2009, ♀ (Platylabini) (according to Tereshkin 2009)

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Plate 50: *Pagarenes erythropus* CAMERON 1903, ♀ (Platylabini) (according to TERESHKIN 2009)
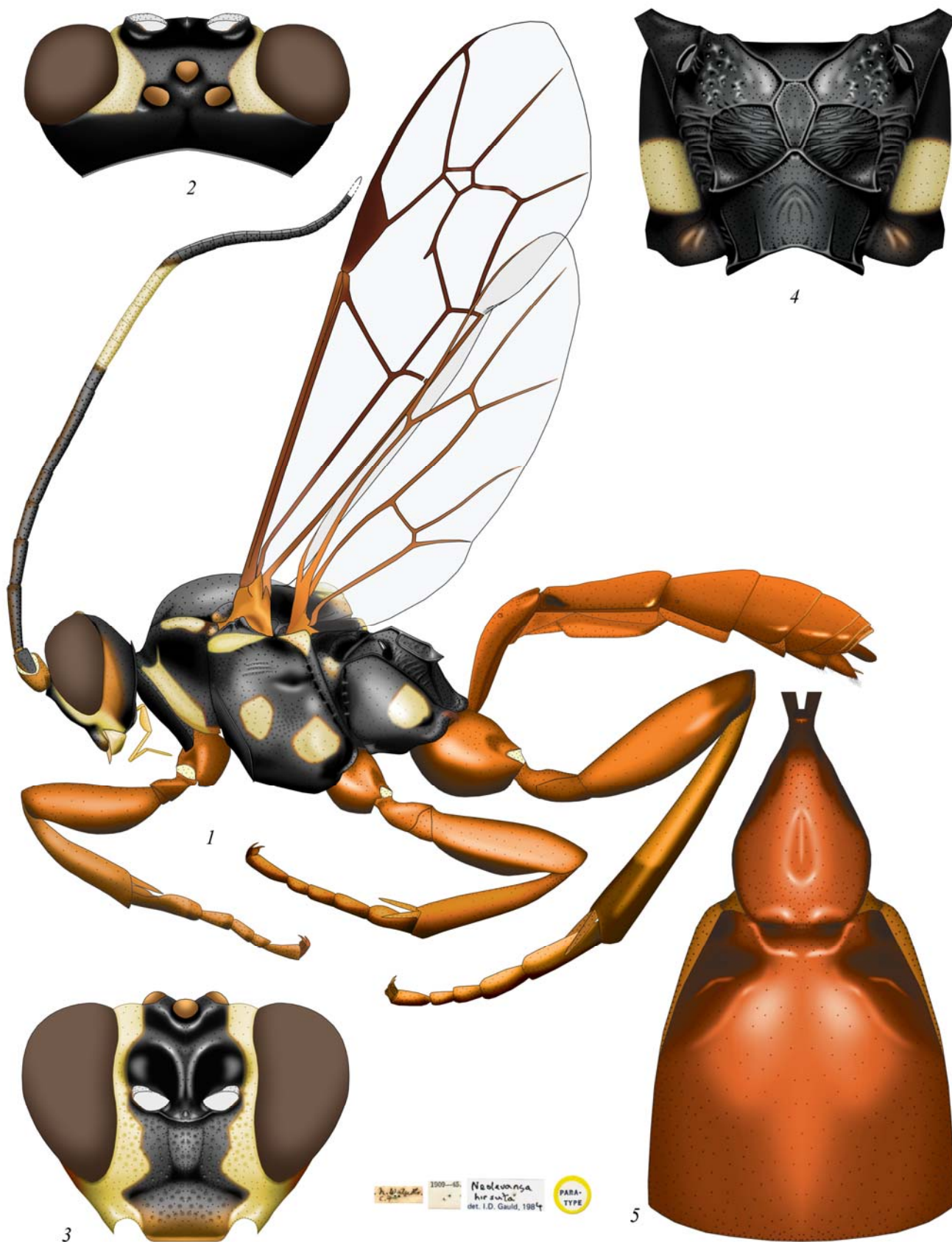
Plate 51: *Neolevansa hirsuta* GAULD 1884, ♀ (Platylabini) (according to TERESHKIN 2009)
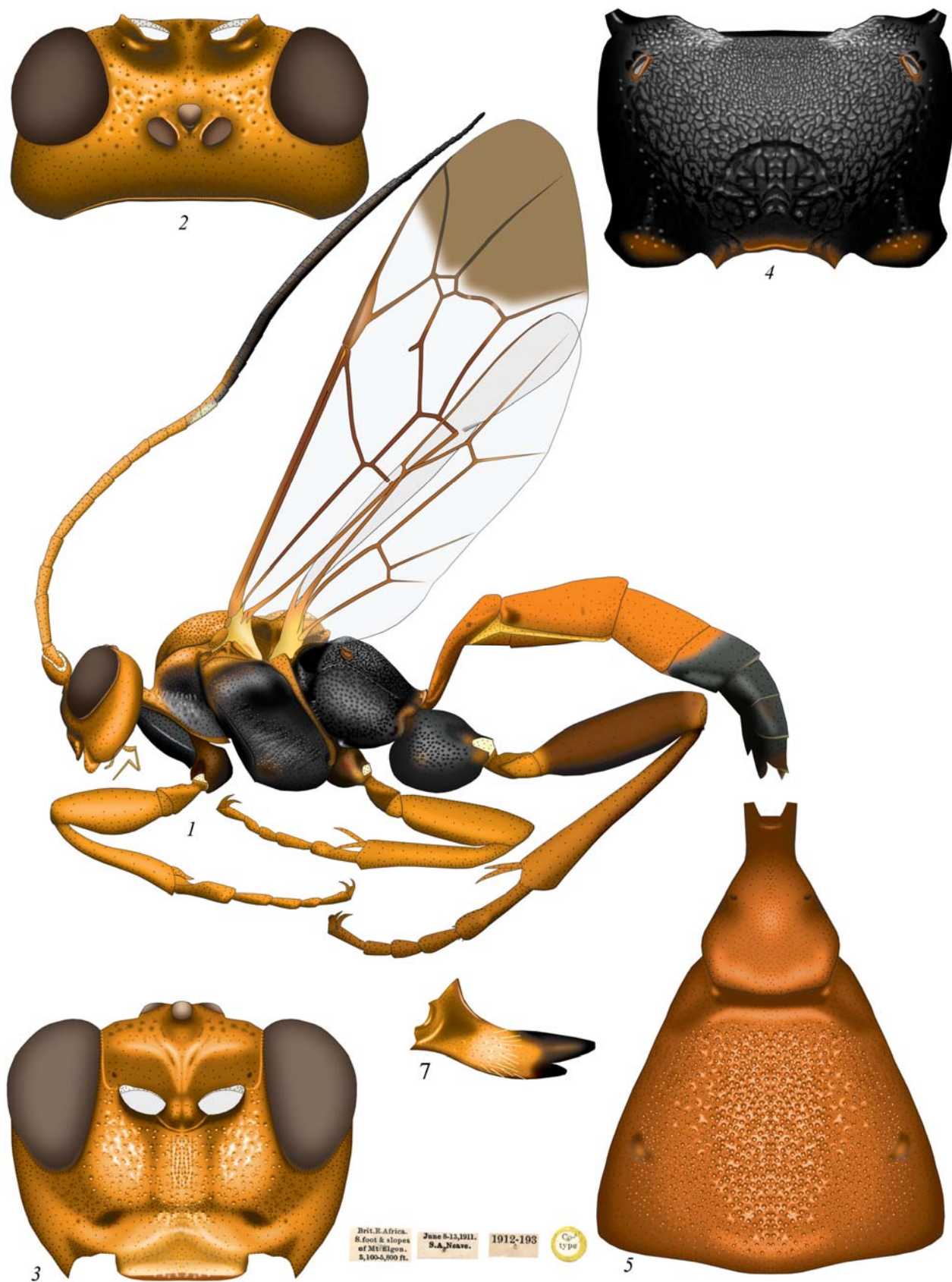
Plate 52: *Neeurylabia spiloptera* (MORLEY 1919), ♀ (Platylabini) (according to TERESHKIN 2009)

Plate 53: *Euylabus torvus* WESMAEL 1844, ♀ (Eurylabini) (according to TERESHKIN 2009)

Plate 54: *Cotiheresiarches dirus* (WESMAEL 1853), ♂ (Zimmeriini) (according to TERESHKIN 2009)

Plate 55: *Oedicephalus variegatus* (SZÉPLIGETTI 1903), ♀ (Oedicephalini) (according to TERESHKIN 2009)

Plate 56: *Goedartia alboguttata* (GRAVENHORST 1829), ♀ (Goedartiini) (according to
TERESHKIN 2009)

Plate 57: *Cratichneumon unificatus* TERESHKIN 2003, ♀ (Ichneumonini, Cratichneumonina) (according to TERESHKIN 2009)

Plate 58: *Hymenura nigra* (HEINRICH 1930), ♀ (Ichneumonini, Cratichneumonina) (according to TERESHKIN 2009)

Plate 59: *Ichneumon extensorius* LINNAEUS 1758, ♀ (Ichneumonini, Ichneumonina) (according to TERESHKIN 2009)
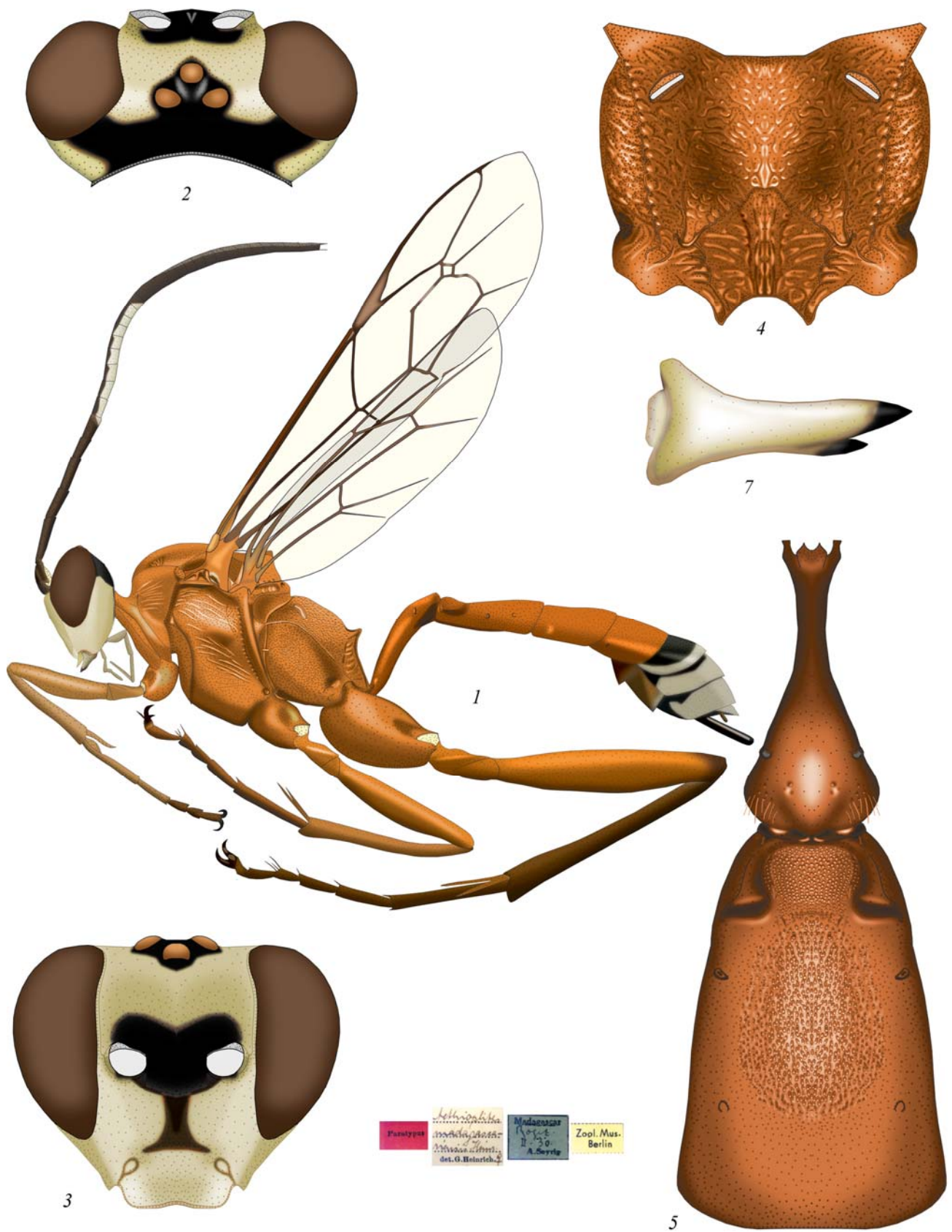
Plate 60: *Aethioplites madagascariensis* HEINRICH 1938, ♀ (Ichneumonini, Aethioplitinina) (according to TERESHKIN 2009)

Plate 61: *Limerodes arctiventris* (BOIE 1841), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)

Plate 62: *Tricholabus strigatorius* (GRAVENHORST 1829), ♀, ♂ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)

Plate 63: *Hepiopelmus melanogaster* (GMELIN 1790), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)

Plate 64: *Achaius oratorius* (FABRICIUS 1793), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)

Plate 65 markings on figure: 2, 4, 1, 3, 7, 5

Holotypus
Achaiusoides
epistomalis Tereshkin

Russia, Primorskij
Kraj, Kajmanovka at
Ussurijsk 29.07.1992
Tereshkin A. leg.

Plate 65: *Achaiusoides epistomalis* TERESHKIN 2011, ♀ (Ichneumonini, Amblytelina)
(according to TERESHKIN 2011)
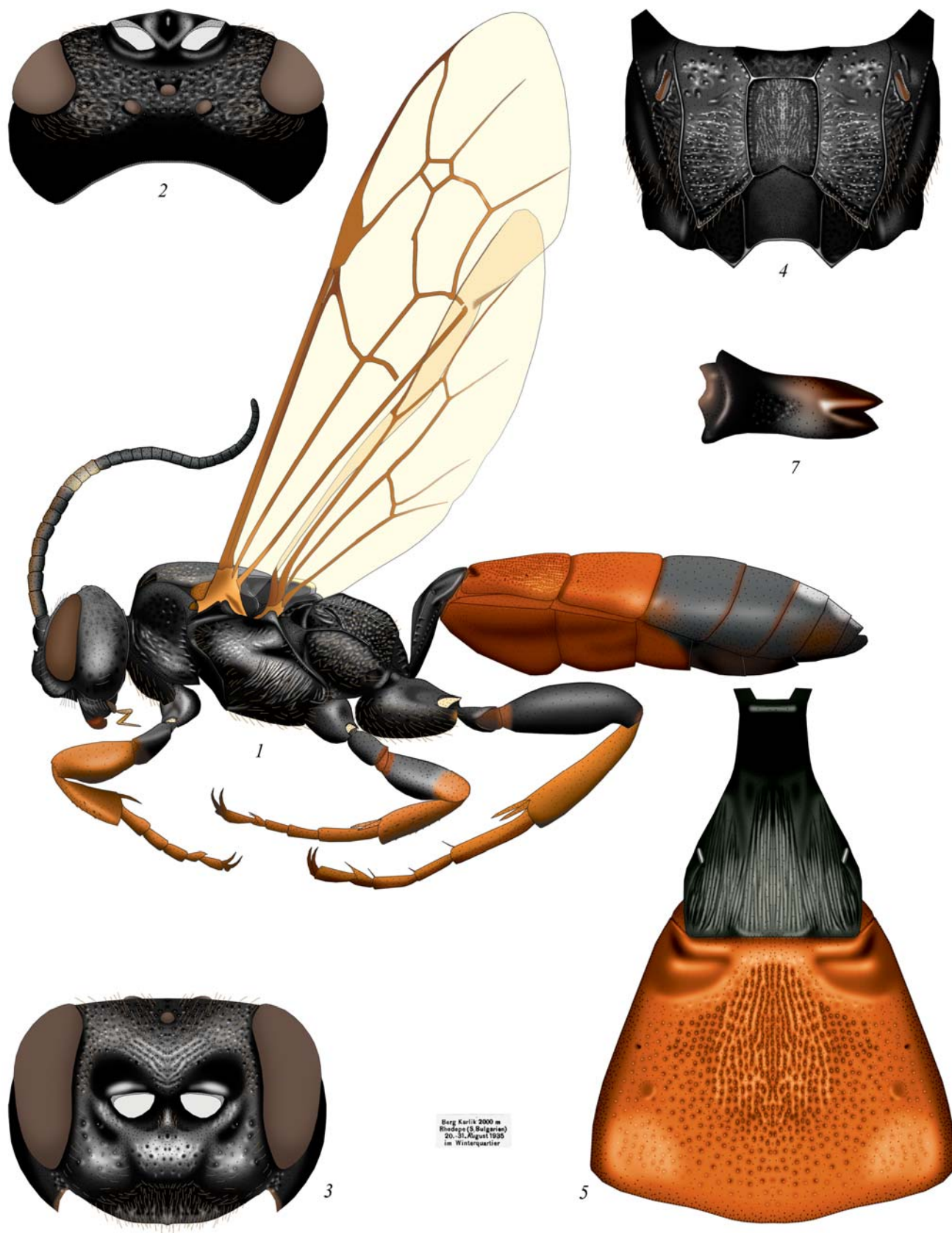
Plate 66: *Bureschias subcylindricus* (GRAVENHORST 1829), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)

Plate 67: *Spilichneumon occisor* (FABRICIUS 1791), ♀ (Ichneumonini, Amblytelina)
(according to TERESHKIN 2011)
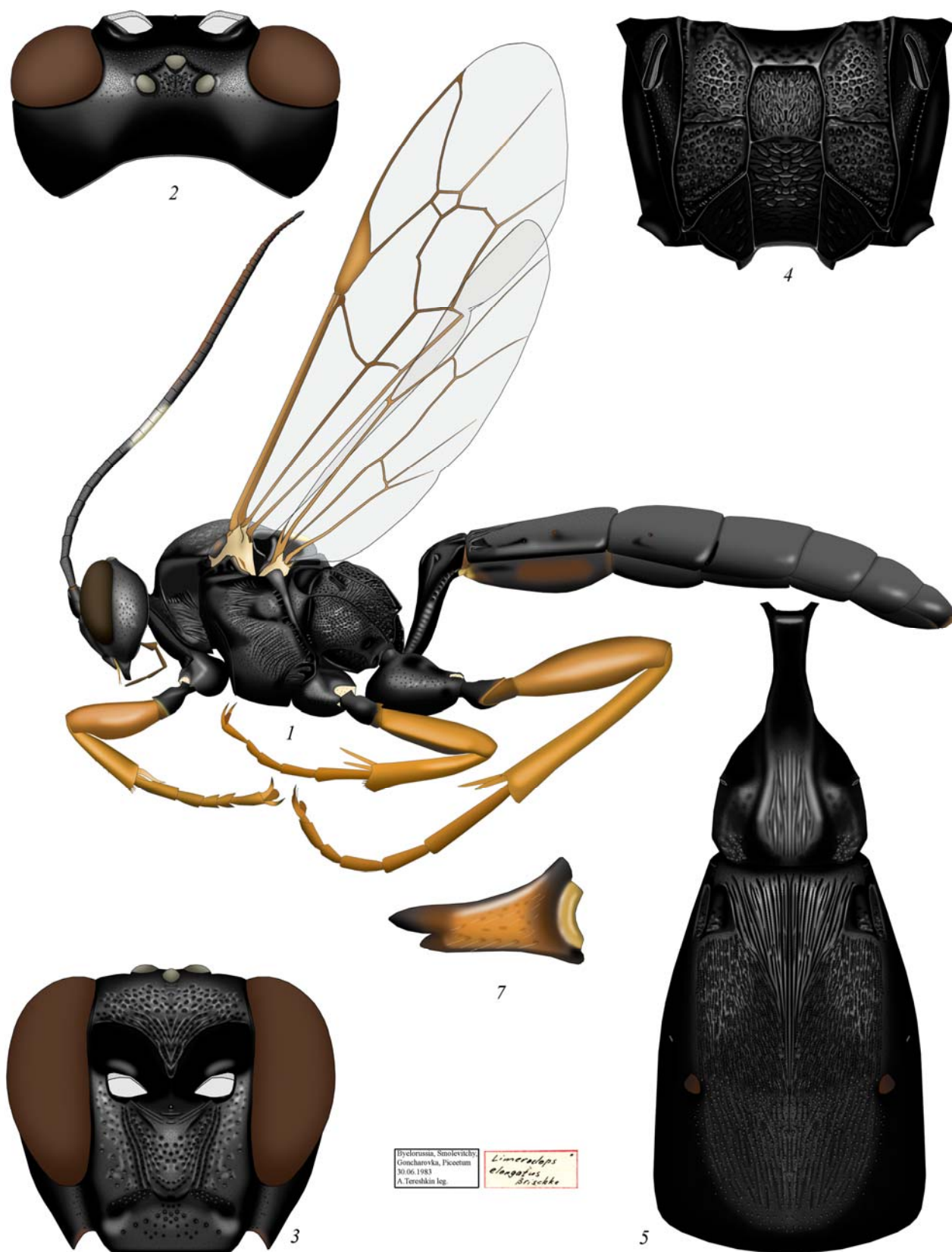
Plate 68: *Limerodops elongatus* (BRISCHKE), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)

Plate 69: *Limerodops violentus* TERESHKIN 2011, ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)
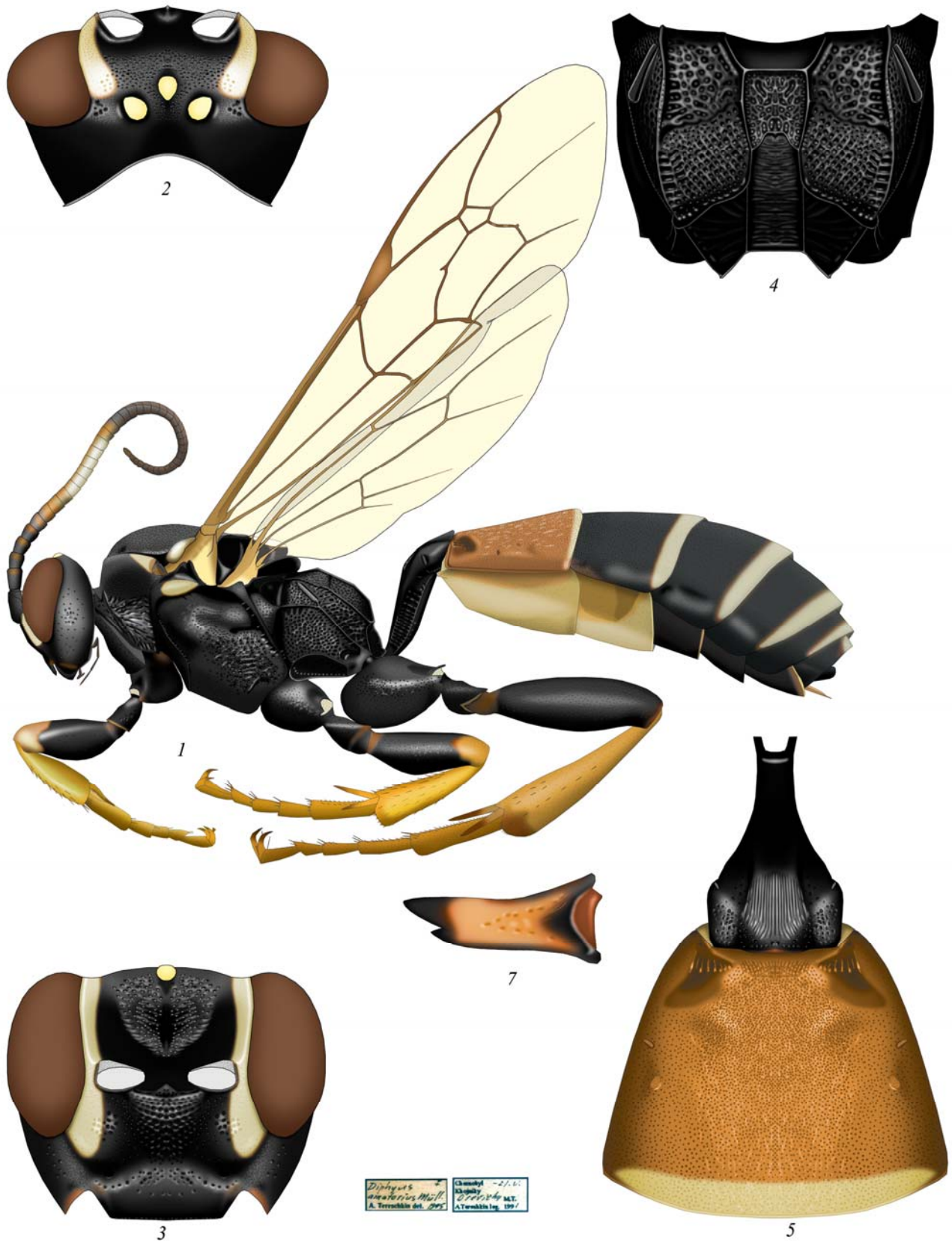
Plate 70: *Diphyus amatorius* (MÜLLER 1776), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)

Plate 71: *Ctenichneumon funereus* (GEOFFROY 1785), ♀ (Ichneumonini, Amblytelina)
(according to TERESHKIN 2011)
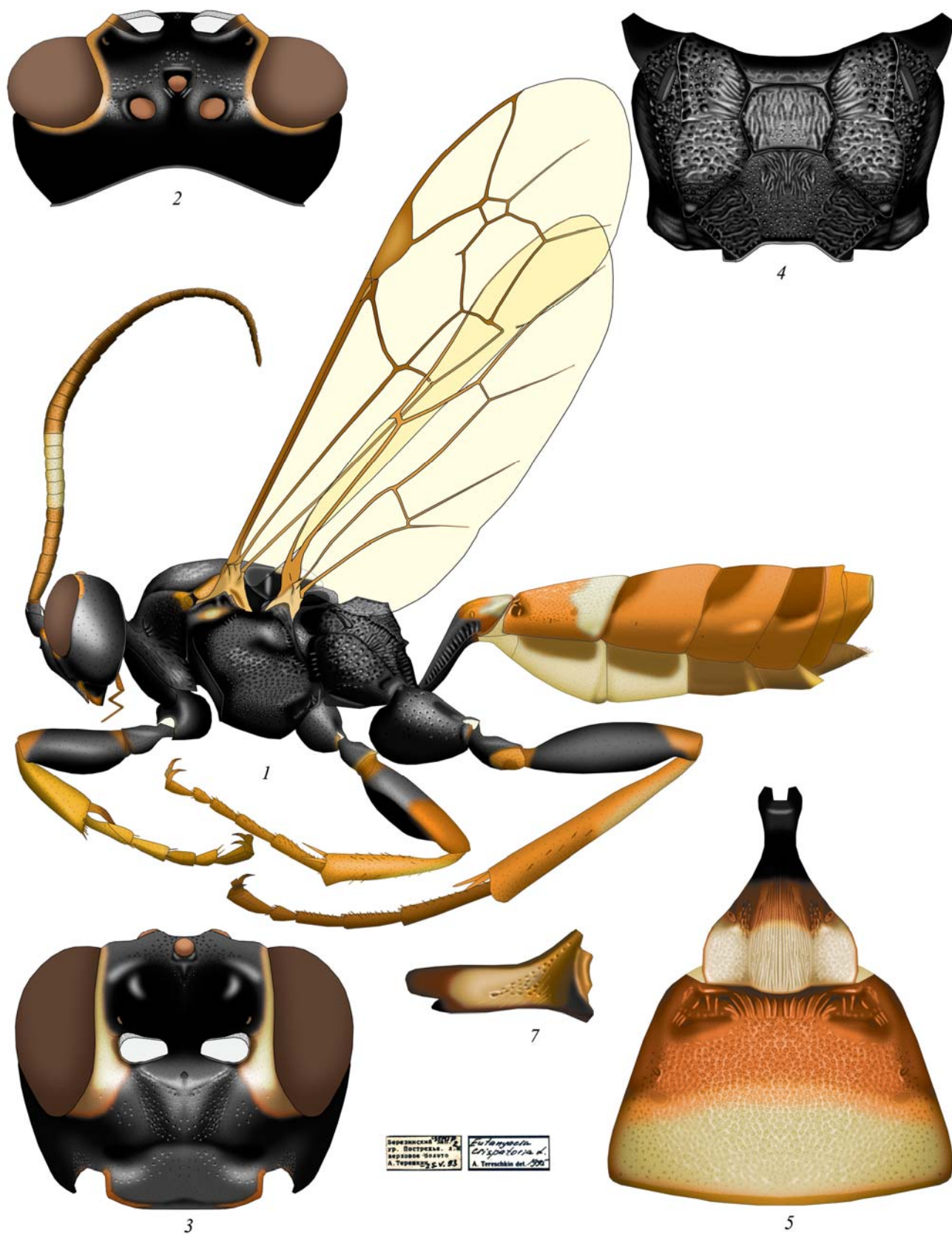
Plate 72: *Eutanyacra crispatoria* (LINNAEUS 1758), ♀ (Ichneumonini, Amblytelina)
(according to TERESHKIN 2011)

Plate 73: *Amblyteles armatorius* (FÖRSTER 1771), ♀ (Ichneumonini, Amblytelina)
(according to TERESHKIN 2011)

Plate 74: *Obtusodonta equitatoria* (PANZER 1786), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)
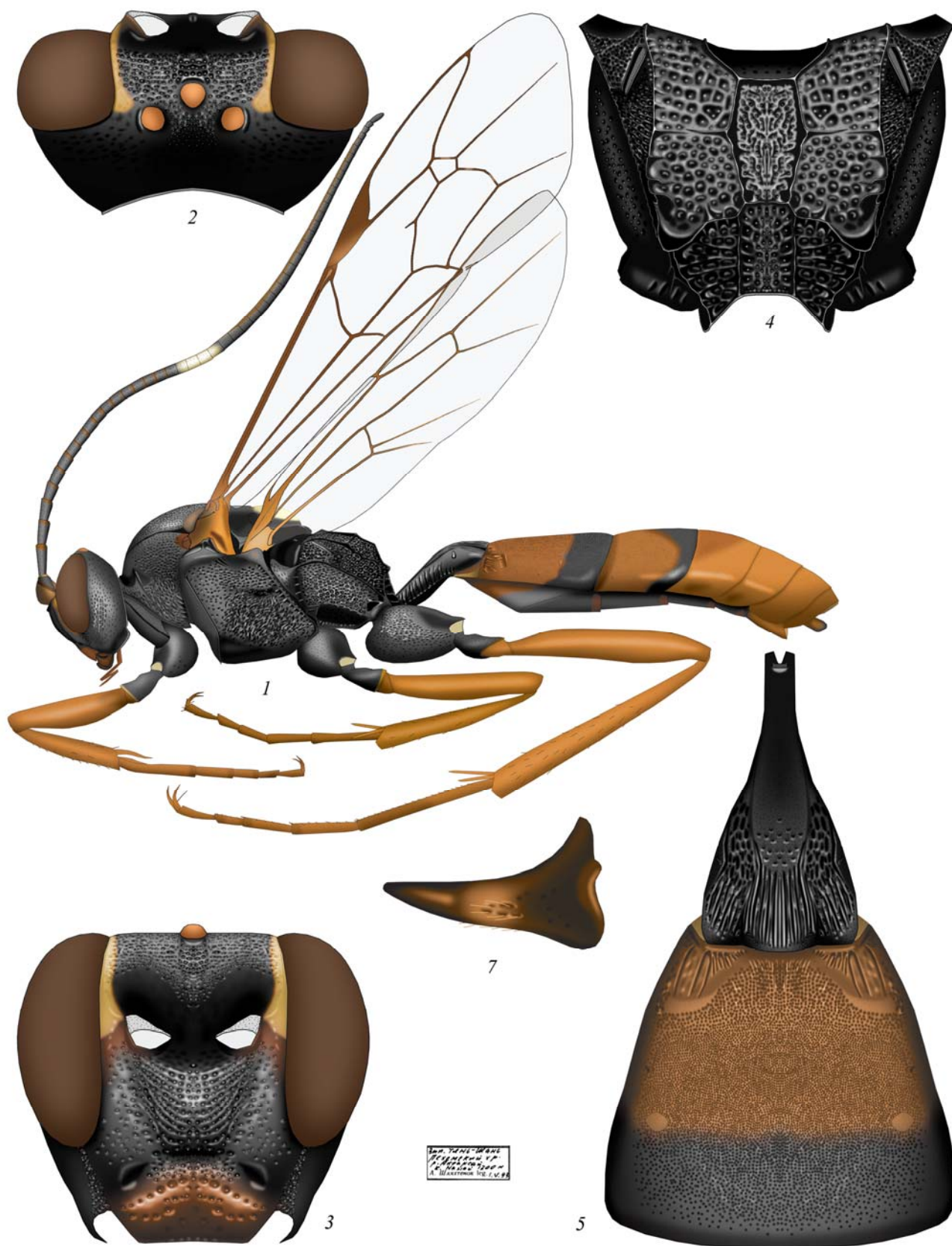
Plate 75: *Fileanta radoszkowskii* (BERTHOUMIEU 1892), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)

Plate 76: *Triptognathus uniguttatus* (GRAVENHORST), ♀ (Ichneumonini, Amblytelina) (according to TERESHKIN 2011)
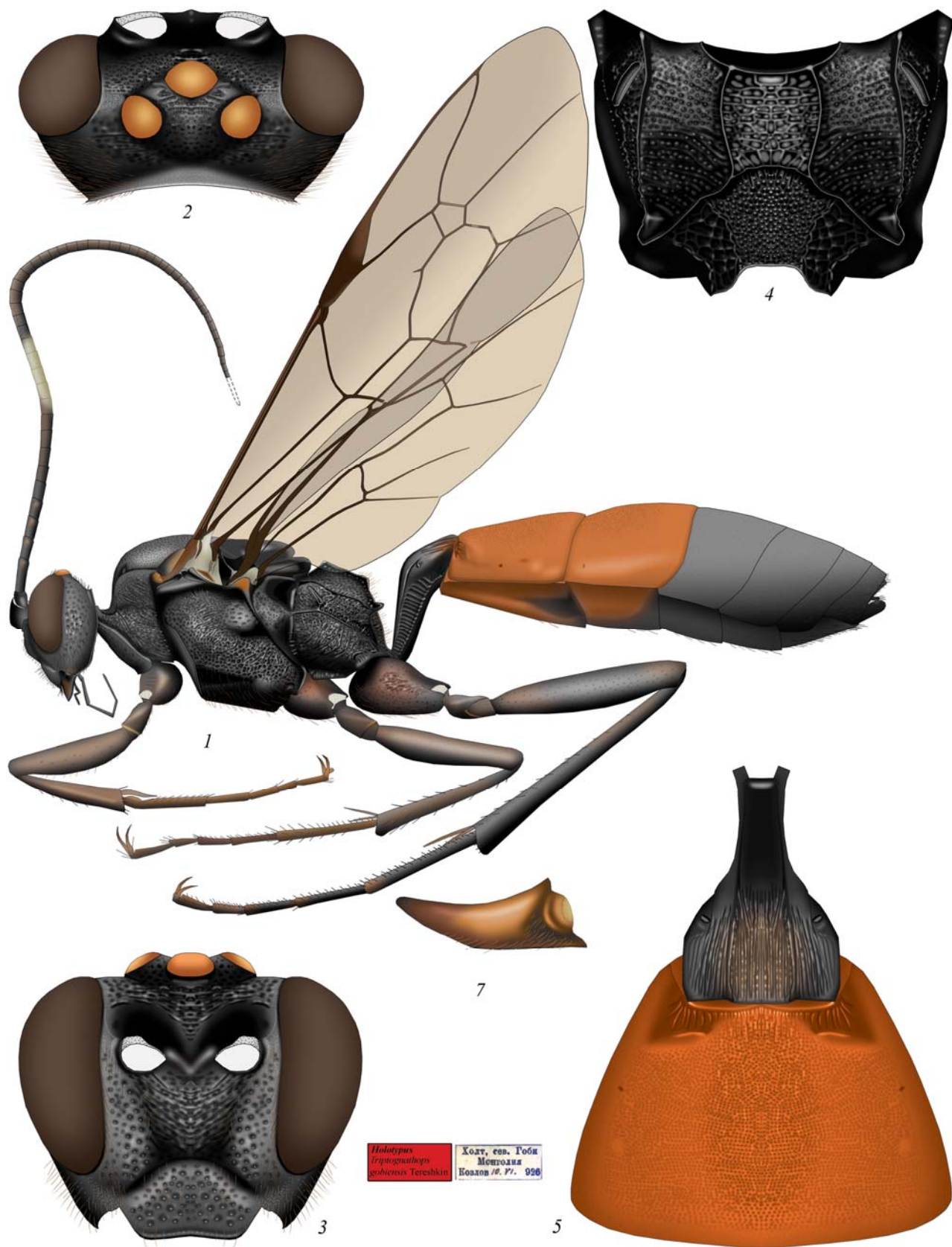
Plate 77: *Triptognathops gobiensis* TERESHKIN 2011, ♀ (Ichneumonini, Amblytelina)
(according to TERESHKIN 2011)

Plate 78: *Hoplismenus pica* WESMAEL 1855, ♀ (Ichneumonini, Hoplismenina)
(according to TERESHKIN 2009)

Plate 79: *Hybophorellus injucundus* (WESMAEL 1854) ♀ (Ichneumonini, Hoplismenina)
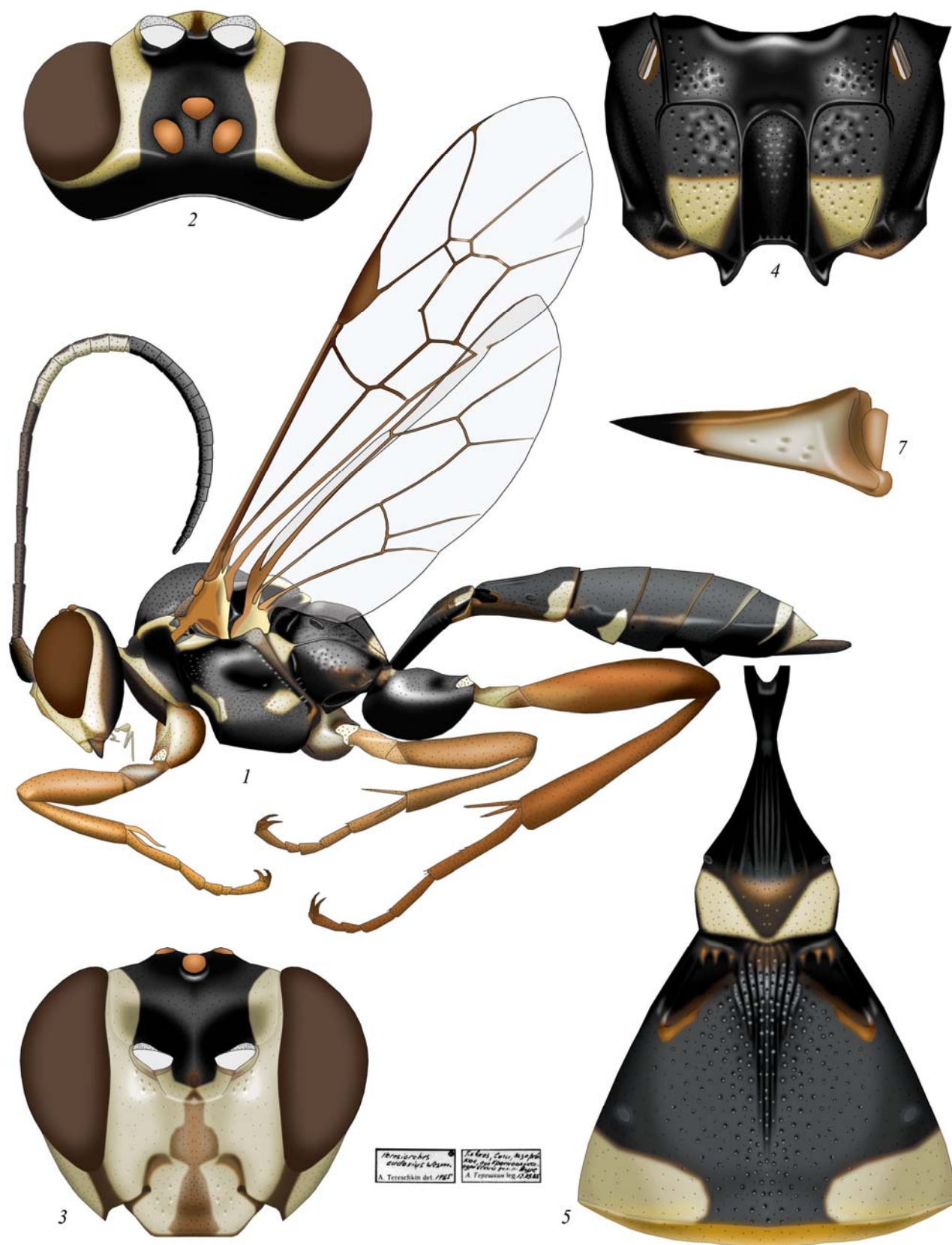
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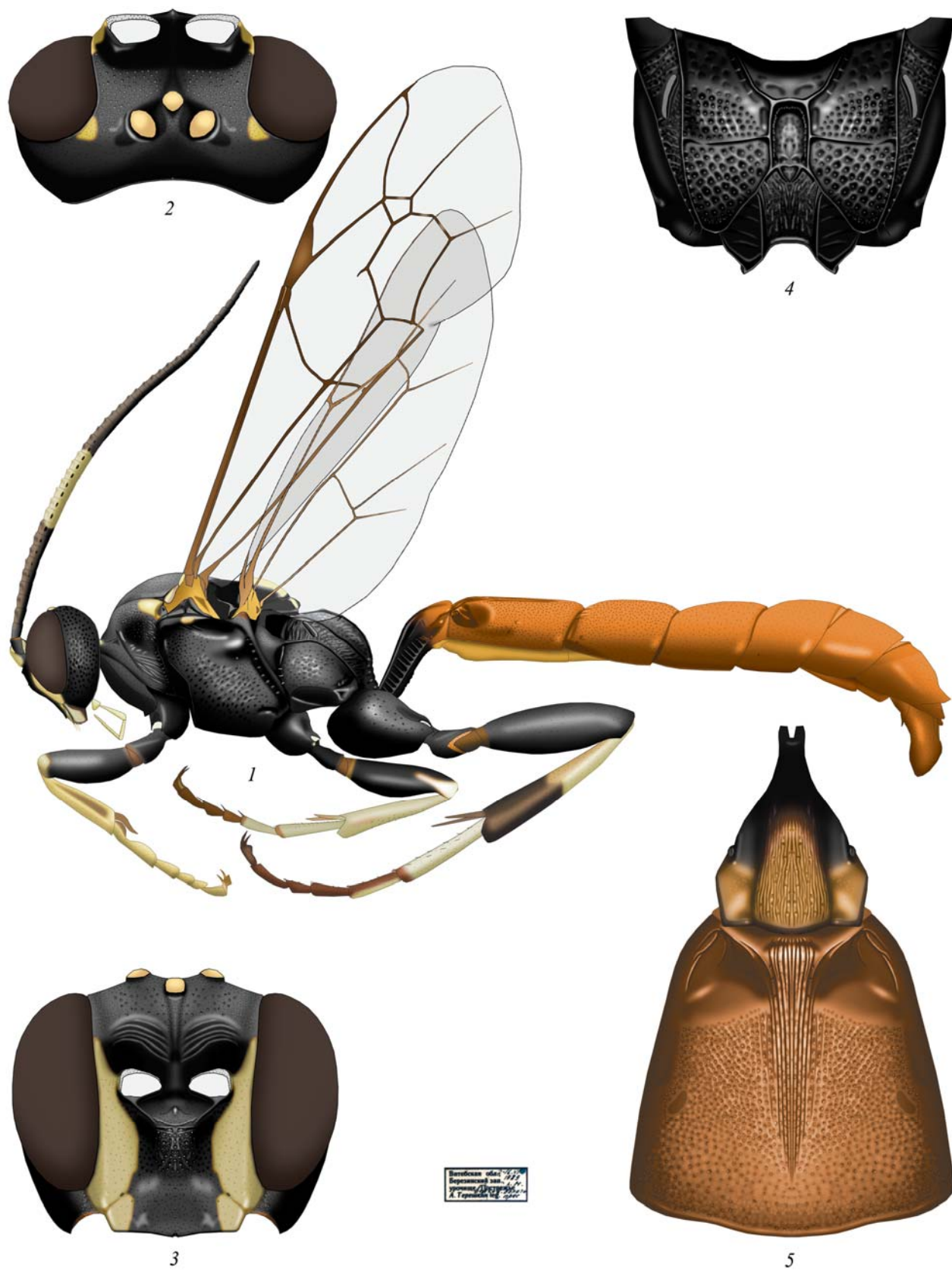
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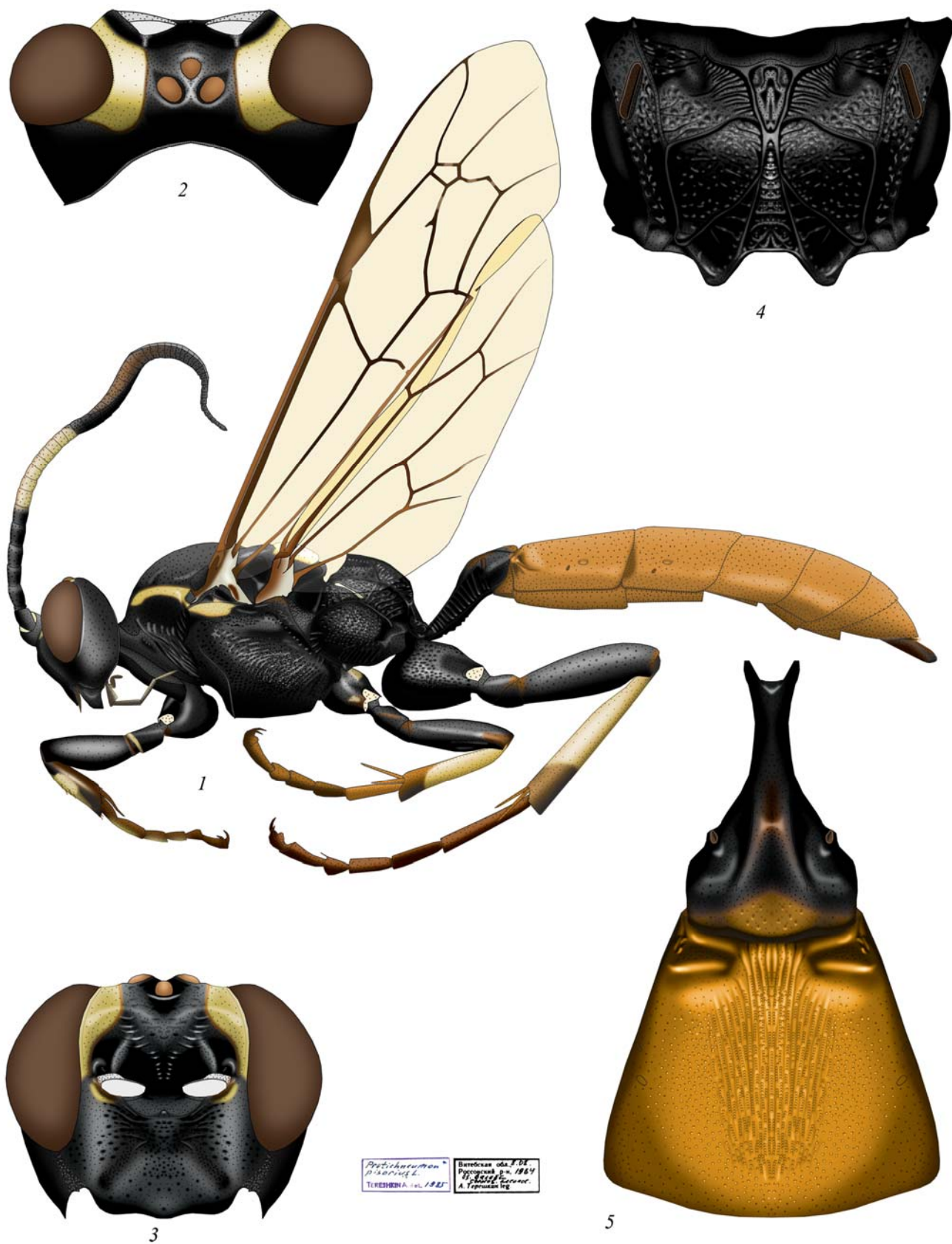
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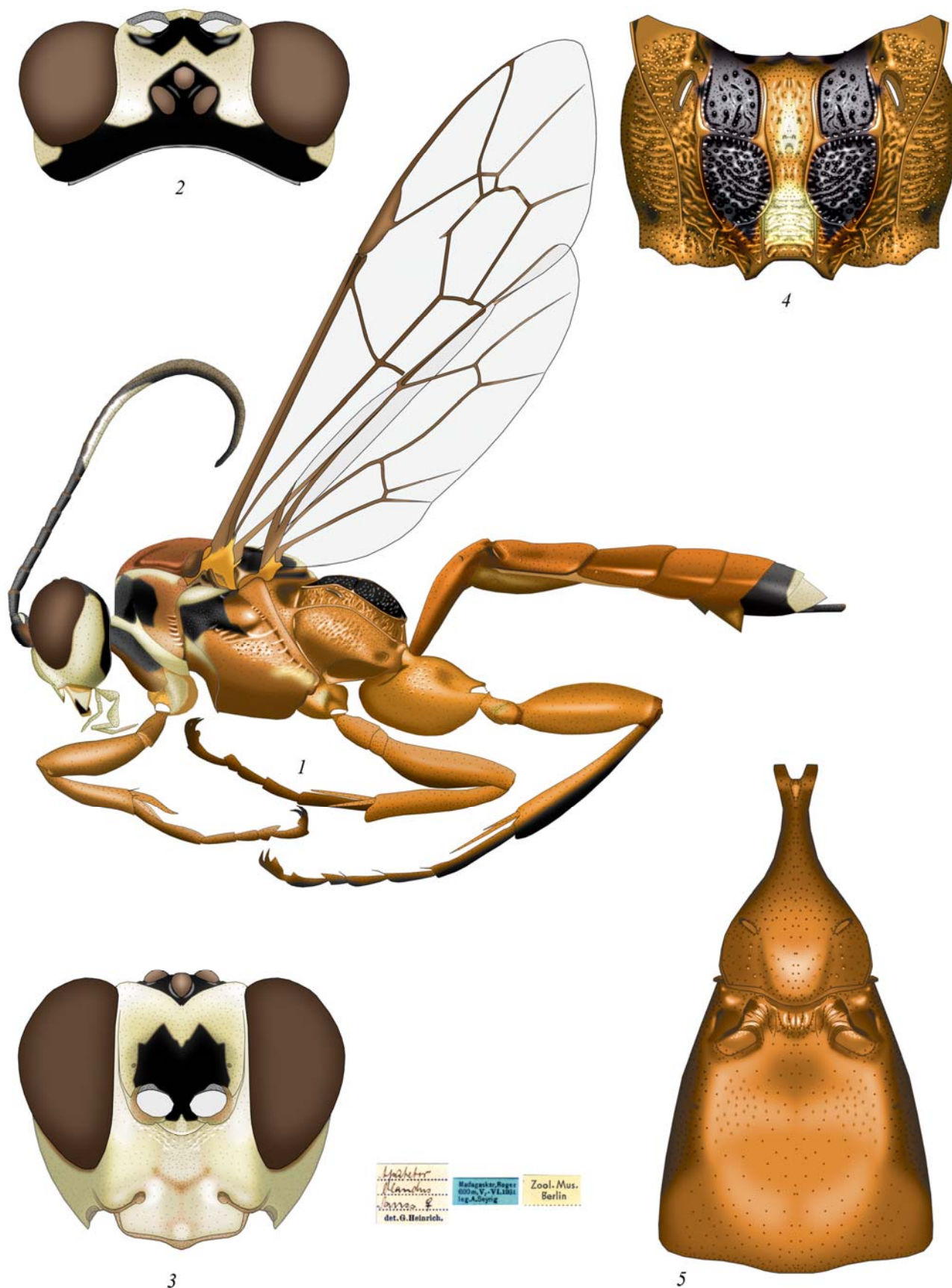
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(according to TERESHKIN 2009)

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Labels on specimen:

Russia   Altay region
Volchikha   17. VI. 1976
L. Litvinchuk leg.

Callajoppa
cirrogaster **Schrank** fem.
A. Tereshkin det.

ex pup.
Dilina tiliae **L.**
L. Litvinchuk leg.

Plate 85: *Callajoppa cirrogaster* (SCHRANK 1781), ♀ (Trogini, Callajoppina) (according to TERESHKIN 2009)
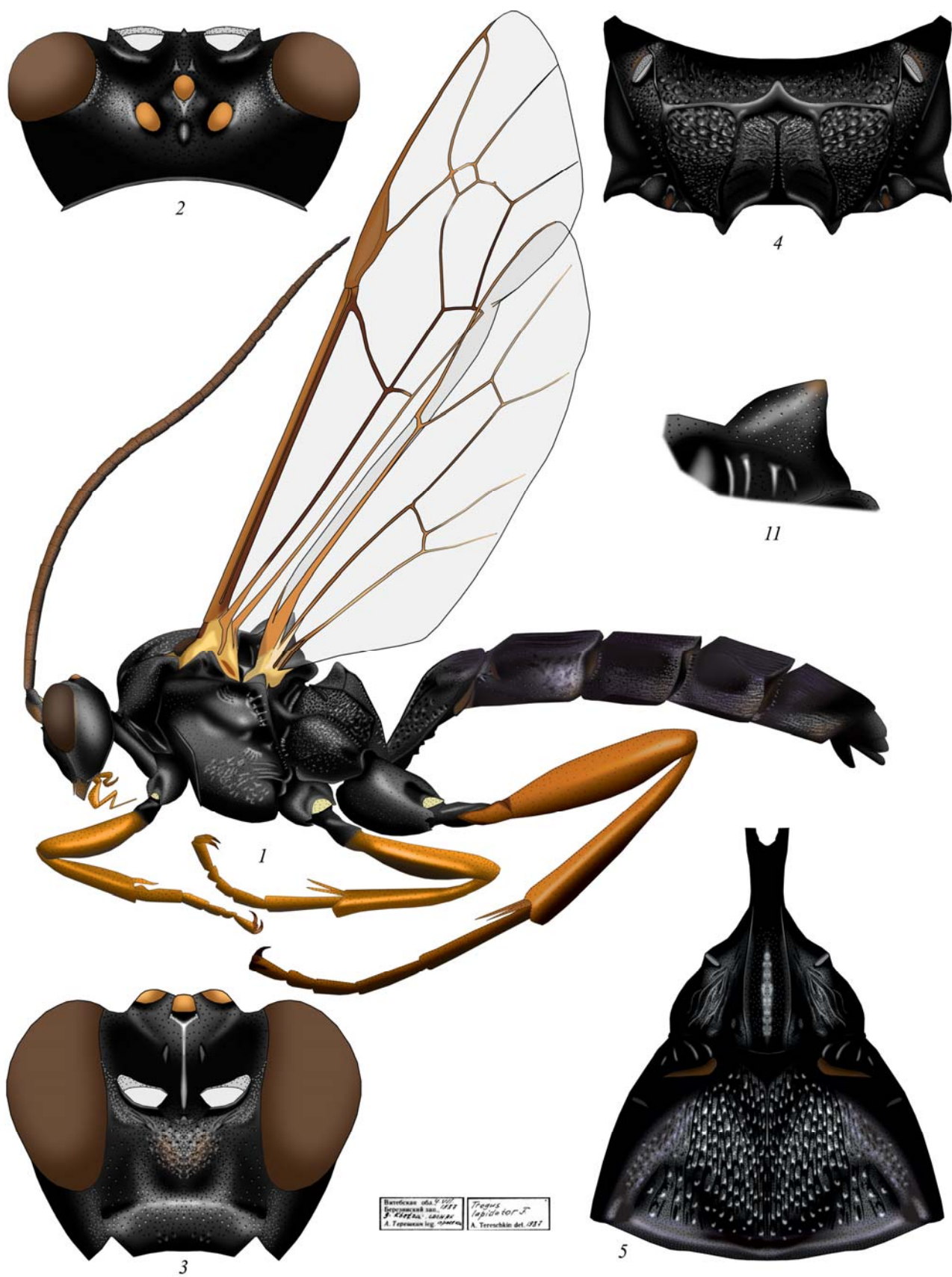
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Научное издание

Терешкин Александр Михайлович

Руководство по подготовке научных иллюстраций в энтомологии на примере наездников семейства Ichneumonidae (Hymenoptera)

В авторской редакции