On the morphology and taxonomy of the genera *Halys* and *Neohalys* (Heteroptera: Pentatomidae: Halyini)

К морфологии и систематике родов *Halys* и *Neohalys* (Heteroptera: Pentatomidae: Halyini)

D.A. Gapon
Д.А. Гапон

*Abstract.* The male and female terminalia of *Halys sulcatus* (Thunberg, 1783) and *H. magnus* Chopra, 1974, nom. resurr., are redescribed in detail, including the completely inflated aedeagi. The distribution of these taxa is analysed. It is shown that *H. sulcatus* is reliably recorded only from the southern regions of India and *H. magnus*, only from the northern regions; numerous published records of “*H. dentatus*” from the central regions of India cannot be reliably attributed to either of these taxa. It is shown that almost all characters of the terminalia previously used to distinguish between *H. sulcatus* and *H. magnus* are highly variable and do not have a hiatus in their variability. Furthermore, the specimens were examined which exhibited an intermediate type of paramere between those in the two taxa. The material examined (which is not very extensive) revealed only one character that can consistently differentiate between northern and southern populations: the shape of armament on the anterior margin of parameral hypophysis (i.e., the position of a denticle and the presence or absence of a carina proximal to its base). However, a lack of correlation between these characters and with other, even less significant characters, as well as published evidence of the variability of the paramere, raise doubts about whether *H. sulcatus* and *H. magnus* are distinct species. Hypotheses about the status of these taxa are considered. It is shown that the name *H. sulcatus* was applied to the taxon described as *H. magnus*, based on a variable character of the female terminalia, which has no diagnostic value in this case. Additionally, the type locality of *H. sulcatus* is in the southern regions of India, where no reliably identified specimens of *H. magnus* have been found so far. Therefore, in this article *H. sulcatus* is recognised as a senior synonym of *H. serriger* Westwood, 1837, syn. resurr., and the name *H. magnus* Chopra, 1974, nom. resurr., is resurrected to the taxon distributed in the north. In addition, a detailed redescription of the female terminalia of *Halys shaista* Ghauri, 1988 and the male and female terminalia of *Neohalys serricollis* (Westwood, 1837) is provided. A new species, *Halys brocchus* sp. nov. is described, distinguished from all congeners primarily by a unique character of its pygophore. An updated identification key for species of the genus *Halys* Fabricius, 1803 is given. The name *H. hyderabadiensis* Memon, Parveen, Ahmad et Shah, 2017, syn. nov. is recognised as a junior synonym of *H. magnus*. *Neohalys* Azim, 2002, syn. nov., is recognised as a junior subjective synonym and a junior homonym of *Neohalys* Ahmad et Perveen, 1982. The names *Neohalys acuticornis* Ahmad et Perveen, 1982, syn. nov., *N. longirostratus* Ahmad et Perveen, 1982, syn. nov., and *N. minirostratus* Ahmad et Perveen, 1982, syn. nov. are placed in synonymy with *N. serricollis*.

*Резюме.* Подробно переописаны терминалии самцов и самок *Halys sulcatus* (Thunberg, 1783) и *H. magnus* Chopra, 1974, nom. resurr., включая полностью раздутые эдеагусы. Проанализировано распространение этих таксонов. Показано, что *H. sulcatus* достоверно указан только из южных регионов Индии, а *H. magnus* – только из северных; многочисленные указания “*H. dentatus*” из

**Key words:** taxonomy, redescription, variability, male and female terminalia, completely inflated aedeagus, India, South Asia, Heteroptera, Pentatomidae, Halyini, new synonyms, new species

**Ключевые слова:** систематика, переописание, изменчивость, терминалы самцов и самок, полностью раздутый эдеагус, Индия, Южная Азия, Heteroptera, Pentatomidae, Halyini, новые синонимы, новый вид

**ZooBank Article LSID:** D5D3A6EF-5FF5-42CE-A82A-40FD5BD7C111

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**Introduction**

When describing a new genus and species of the tribe Halyini from Myanmar, I examined all specimens of the genera *Halys* Fabricius, 1803 and *Neohalys* Ahmad et Perveen, 1982 stored in the collection of the Zoological Institute of the Russian Academy of Sciences. Despite a recent revision of the genus *Halys* (Salini, 2019), the identification of some specimens belonging to this genus has proven difficult, and the status of two species has left me with some doubts. All existing descriptions of the terminalia of *Halys* and *Neohalys* species are not detailed enough, insufficient for meaningful comparison with other taxa, and take little into account the variability of these structures, which is particularly important for species in the genus *Halys*. This has served as the basis for the present work on these two genera and the reason why I have placed an emphasis on redescrbing the male and female terminalia using the terminology that I consider to be correct. In this work, I have also considered the variability observed in these structures. Based on the rather small amount of material I have on the genus *Halys*, my observations have revealed that the systematics of this genus is far from being as unambiguous and simple as it appears in the latest revision. The material I have does not allow one to resolve all the questions that have arisen before me, but these questions must be clearly formulated if we are ever to get answers to them. Moreo-
ver, among the material examined, there is a specimen that possesses a unique character; for this reason, I deemed it possible to describe it as a new species of Halys, despite the inherent variability within this genus.

**Material and methods**

Male and female terminalia were examined in wet preparations; the aedeagi were also examined in an entirely inflated condition in dry preparations made using the method of inflation by means of glass microcapillaries (Gapon, 2001). The pygophores and parameres are described in repose; the structures of the aedeagus are described according to its position in an inverted pygophore, i.e. in copula. The terminology for the parts of the endosoma is based on the topographic principle and follows Konstantinov & Gapon (2005); the terminology for the parts of the internal ectodermal genitalia of females follows Scudder (1959), Štys (1961), and Gapon (2008a, 2008b). To study the structure of the male terminalia, the abdomen of a pinned specimen was detached by applying downward pressure at the apex of the abdomen. Then the abdomen was boiled for about one minute in water; the pygophore was then removed and boiled for 2–3 minutes in a 15–20% KOH solution. Each female abdomen was boiled whole in a similar solution, whereupon the membrane between ventrites and connexivum was cut with a scalpel, and the abdominal dorsum was removed; if soft tissues remained around the gynatrium, boiling of the abdomen without tergites was repeated. If necessary, the gynatrial membranes were stained with methylene blue.

The material examined, including the holotype of the new species, is deposited at the Zoological Institute of the Russian Academy of Sciences, St Petersburg, Russia (ZISP).

For specimens of Halys sulcatus (Thunberg, 1783) and H. magnus Chopra, 1974, nom. resurr., whose terminalia were examined, three-symbol abbreviations were used in the descriptions of individual variability: a capital letter indicating location, a letter “m” or “f” indicating sex, and the specimen number. The correspondence of the abbreviations to the material examined is presented in Table 1.

**Results**

Family *Pentatomidae* Leach, 1815

Subfamily *Pentatominae* Leach, 1815

Tribe *Halyini* Amyot et Serville, 1843

Genus *Halys* Fabricius, 1803

**Composition.** In the revision of Halys, Ghauri (1988) excluded from the genus all previously included species except *H. serriger* Westwood, 1837, *H. serricollis* Westwood, 1837, *H. sulcatus* (Thunberg, 1783), and *H. shaista* Ghauri, 1988, and placed a number of names in synonymy: *H. magnus* Chopra, 1974, *H. qadrii* Ahmad et Abbasi, 1976 with *H. sulcatus*, and *H. parvus* Chopra, 1974 with *H. serricollis*. The species *H. neelgiriensis* Distant, 1893, *H. persa* Bergroth, 1919 and *H. rugosus* Distant, 1921, in his opinion, “should no longer be considered as belonging to the genus *Halys*”, however, he did not place them in any other genera, and they still remain incertae sedis. The Afrotropical species (including Madagascar and Arabia) *H. hedenborgi* Stål, 1865, *H. maculipennis* Stål, 1865, *H. simiplinervis* Bergroth, 1906, *H. clausnitzeri* Schumacher, 1913, and *H. jizanus* Linnavuori, 1986 were not considered in Ghauri (1988), and so to date, they also formally remain in the genus *Halys*. Ahmad et al. (1998) transferred *H. serricollis* to the genus *Neohalys* Ahmad et Perveen, 1982. In the last decade, several species of *Halys* from Pakistan and one species from India have been described. Recently Salini (2019) published a revision of the four Indian species of *Halys*. This article contained the redescriptions of *H. serriger* (sensu Ghauri, 1988), *H. sulcatus* (sensu Ghauri, 1988) and *H. shaista*, including the male terminalia and some structures of the female terminalia, and established new synonymies.

In the text below, I use the name *Halys sulcatus* (Thunberg, 1783) as a senior synonym of *Halys serriger* Westwood, 1837, *syn. resurr.* and a valid name, and the name *H. magnus* Chopra, 1974, *nom. resurr.* for the taxon considered by Ghauri (1988) and Salini (2019) under the name *H. sulcatus*. An explanation of this decision is given in note B after the redescription of the terminalia of these taxa.

**Distribution of the Asian species.** *Halys hyderabadiensis* is known from only one locality, Hyderabad, Pakistan, *H. mudigerensis* from India (Karnataka: Mudigere), and *H. shaista* also from India (Karnataka, Kerala, Tamil Nadu). Salini (2019, as *H. sulcatus*) writes about *H. magnus*, *nom. resurr.*: “This species is restricted to the northern region of India; the only record from southern India is the one by Chopra (1974) from Coimbatore (Tamil Nadu) (as *H. magnus*), but the determination is questionable and needs verification”. However, the type locality of *H. sulcatus* is “kust Coromandel”, i.e. today the southern states of Tamil Nadu and Andhra Pradesh (see below). Salini (2019) does not provide any information about the distribution of *H. sulcatus* (which is now considered to be a senior synonym of *H. serriger*), except for a list of the material she examined from the states of Andhra Pradesh and Tamil Nadu. From the large number of records in the literature, it seems that *H. sulcatus* is distributed throughout the Indian subcontinent from north to south, as reflected in the unpublished catalogue of David Rider, the corresponding part of which he kindly provided to me. In the vast majority of publications of the XIX and XX centuries, only one species under the name *H. dentatus* was reported for India, Afghanistan, Pakistan, and Bangladesh (not counting sporadic and dubious records of *H. neelgiriensis*), and even in the second half of the XX century, after the publication of articles by Chopra (1974) and Ghauri (1988), Indian faunists relied only on the outdated book of Distant (1902), who considered *H. serriger* and *H. sulcatus* (here considered as *H. magnus*, *nom. resurr.*) synonymous with *H. dentatus* (Dallas, 1851; Tennent, 1861; Walker, 1867; Stål, 1876; Atkinson, 1884; Paiva, 1907; Maxwell-Lefroy, 1909; A. Chandra, 1953; Ahmad et al., 1974; Ahmad, 1977; Pajni & Sidhu, 1982; Chakraborty et al., 1994; Biswas & Ghosh, 1995; Hegde, 1995; Ghosh et al., 1997; Chakraborty & Ghosh, 1998, 2003; K. Chandra & Rajan, 2004; Dhiman & Yadav, 2005, 2006, 2008; Biswas & Bal, 2007, 2010; K. Chandra, 2008, 2009; K. Chandra & Kushwaha, 2013; Biswas et al., 2014; Tembe et al., 2014; K. Chandra et al., 2012, 2014, 2015a, 2015b; Raina Surbhi & Kumari, 2015; Ahmed & Bajwa, 2016; Kandhro et al., 2016; Gupta & Pathania, 2017; Ullah et al., 2017; Gaikwad & Waghmare, 2018; etc.). *Halys dentatus* (Fabricius, 1775) is a junior homonym and should be replaced by the name *H. sulcatus* (see below). Therefore, now all of the records of *H. dentatus* should automatically pertain to *H. sulcatus*. Many faunistic works by Indian authors provide a diagnosis of *H. dentatus*, but unfortunately, these publications include only the characters of external structures, which are useless in distinguishing *H. sulcatus* and *H. magnus*. Reliable records of these species are provided only in taxonomic works that contained the descriptions and illustrations of the male and female terminalia (Chopra, 1974; Abbasi & Ahmad, 1976; Abbasi, 1986; Ghauri, 1988; Azim, 2002; Memon et al., 2002, 2006, 2016, 2017; Shaikh et al., 2011; Salini, 2019). These records are marked on the map (Fig. 1), and it was determined that *H. magnus* is known only from the northern regions of India (the states of Haryana and Uttar Pradesh, and Delhi Union Territory), as noted by Salini (2019, as *H. sulcatus*), and from Pakistan and Bangladesh, whereas *H. sulcatus* was recorded only from the southern regions of India and from Sri Lanka. The southernmost reliable record of *H. magnus* was noted by Ghauri (1988) from “Borbathor”, which probably corresponds to Porbandar (the state of Gujarat). According to Salini, Chopra (1974) recorded this species from Coimbatore (Tamil Nadu) by one female under the name *H. magnus*, but this article only reports material on this species from the states of Haryana and Punjab (indeed, one female from Chandigarh). Five females and five males of *H. magnus* from Coimbatore were recorded by Azim (2011), but this record is considered to be unreliable, since this article does not provide descriptions and/or images of the terminalia, and in the earlier article by the same author (Azim, 2002), a drawing of the paramere of “*H. magnus*” is more similar to the paramere of *H. sulcatus*. *Halys sulcatus* in India has been reliably recorded from the states of Karnataka, Andhra Pradesh, Kerala, and

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Tamil Nadu. The terminalia of specimens from central India have never been examined, and the records from the states of Madhya Pradesh, Maharashtra, Chhattisgarh, Jharkhand, Orissa, and West Bengal need to be reidentified (marked by white circles on the map, Fig. 1).

**Nomenclatural note.** In many publications, specific names that are adjectives in the nominative singular incorrectly agree in gender with the generic name. Kerzhner (2006) ascertained that the name *Halys* is derived from the ancient name of the Kizil Irmak River in Anatolia. This
**Table 1.** Abbreviations used for the specimens of *Halys sulcatus* (Thunberg, 1783) and *H. magnus* Chopra, 1974, *syn. resurr.*

<table>
<thead>
<tr>
<th>Northern part of the Indian subcontinent, <em>Halys magnus</em></th>
<th>Southern part of the Indian subcontinent, <em>Halys sulcatus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Af1</td>
<td>Afghanistan, Kabul Prov., Kabul</td>
</tr>
<tr>
<td>Bm1, Bm2, Bf1</td>
<td>Afghanistan, Laghman Prov.: Laghman valley</td>
</tr>
<tr>
<td>Cm1</td>
<td>Afghanistan, Laghman Prov.: upper Kabul River</td>
</tr>
<tr>
<td>Dm1, Df1, Df2</td>
<td>Afghanistan, Kunar Province, Asadabad</td>
</tr>
<tr>
<td>Em1, Ef1, Ef2</td>
<td>Afghanistan, Kunar Province, Dara-e-Pech</td>
</tr>
<tr>
<td>Fm1</td>
<td>Afghanistan, Nangarhar Prov., 40 km N of Jalalabad</td>
</tr>
<tr>
<td>Gf1</td>
<td>India, Delhi</td>
</tr>
<tr>
<td>Hm1</td>
<td>India, Uttarakhand, Dehradun</td>
</tr>
<tr>
<td>Im1, Im2</td>
<td>India, West Bengal, Kolkata</td>
</tr>
<tr>
<td>Jf1</td>
<td>India, Assam: Guwahati</td>
</tr>
<tr>
<td>Kf1</td>
<td>India, Assam: Jorhat</td>
</tr>
<tr>
<td>Lf1</td>
<td>India, Meghalaya, Shillong</td>
</tr>
</tbody>
</table>

is the Latinised ancient Greek word Ἅλυς. The names of all rivers in ancient Greek and Latin are of the masculine grammatical gender (except for Στύξ, Styx). Therefore, the corresponding specific names must agree with the masculine gender.

The ending of the name *H. serrigera* should also be changed. Firstly, Westwood (1837), considering the name *Halys* to be feminine, used only adjectives of the feminine gender and participles for specific epithets in this genus, rather than nouns. Secondly, Article 31.2.2 of the International Code of Zoological Nomenclature (ICZN) states that specific epithets that can be considered as nouns or adjectives should be treated as nouns in apposition. There are various dictionary forms of masculine nouns with the suffixes -ger and -fer (armiger, contiger, famiger, libriger, salutiger, tridentiger, anguifer, sagittifer, etc.), but I found only two examples of a feminine noun with the suffix -gera (cornigera, hind, horned cattle; lanigera, sheep) and two examples of such nouns with the suffix -fera. This is in contrast to numerous adjectives with these suffixes that decline according to gender. In other words, I believe that the word “serrigera” cannot be considered a noun.

**Note on terminology.** Chopra (1972, 1974) and Ghauri (1988) used the term “arcus” for the “two well developed sclerites” located on the wall of the gynatrium; Ghauri (op. cit.) notes that “Chopra did not differentiate the sclerotised rings in the arcus”. This term was first used by Verhoeff (1893) for a sclerite, which, in his opinion, was formed by the fusion of one of the pairs of “fibulae”, i.e. first or second rami. Verhoeff writes about this sclerite: “Von den Ov. p. [Ovipositoren post.]: sind noch zwei kleine Skelettstückchen übrig geblieben, welche bei Aelia und Stracchia getrennt, in der Bindehaut hinter dem Vaginalforamen liegen. Bei Pentatoma rückten sie dicht aneinander und bedeckten die Öffnung von der Hinterseite. Ihr Vorderrand wird bei allen drei Gatt, von einem V-förmigen Skelettstück umfasst. Da beide Paare von Fibulae verschwunden sind, so kann der Arcus (so bezeichnet ich die V-förmige Platte) nur durch Verwachsung eines Paares der Fibulae entstanden sein. Welches Paar aber diese Verschmelzung einging, dürfte nur ontogenetisch feststellbar sein”. Apparently, Chopra and Ghauri were misled by Verhoeff’s mention of “small skel-
et al. pieces” and the paired nature of the arcus. They did not use this term for “V-förmige Sce-
lettstück”, but instead they used this term for the two large lamellar sclerites connected to the ring
sclerites. Dupuis (1955) has homologised the arc-
cus with the second valvulae, and this view was
supported by Schaefer (1968), who specified that
the arcus is “a small, somewhat \-shaped, med-
dial sclerite posterior to the triangulin and near
the origin of the spermathecal duct”. I used the
term “gynatrial cone” for the complex of the two
sclerites that reinforce the opening of the sper-
mathecal duct and ensure its contact with the sec-
ondary gonopore of the vesica during copulation
(Gapon & Baena, 2005); the sclerite immediately
surrounding this opening I called the “annular sclerite”, and the sclerite located immediately an-
terior to it was called the “conoid sclerite” (Gapon,
2008a, 2008b). The paired sclerites located pos-
terior to the ring sclerites and usually fused with
them were called the “basal sclerites” (Gapon,
2008a, 2008b). It is these sclerites that were erro-
noeusly designated by Chopra and Ghauri as the
arcus. I think it is proper to retain this term for
the structure that it originally designated.

“Triangulum” is another term proposed by Ver-
hoeff (1893) for the large, more or less triangular
plate located under the gonocoxites I, which he
believed was formed by the fusion of the gonap-
ophostes I. His view was supported by many au-
thors, including Schaefer (1968) (for some reason
he called this structure the “triangulin”), who
gave arguments in favour of this hypothesis, and
only Scudder (1959) suggested that it may be a
new structure. Species of the genus Halys have
a pair of rather large lamellar membranous folds
with rounded margins, connected to each other
and located under the above-mentioned triangu-
lar plate. These folds may well be vestiges of the
gonapophyses I, so I think it is correct to retain
the term “triangulum” for the above-mentioned
triangular plate.

**Taxonomy.** Dallas (1851), Stål (1876) and Dis-
tant (1902) considered *Cimex sulcatus* Thunberg,
1783 as a synonym of *Halys dentatus* (Fabricius,
1775) based only on the external morphology.
Kirkaldy (1900) designated *H. dentatus* (Fabri-
cius, “1803”) as a type species of the genus. Lat-
er he (Kirkaldy, 1909) replaced this name, which
turned out to be a junior primary homonym of
*Cimex dentatus* De Geer, 1773 (junior synonym
of *Cimex interstinctus* Linnaeus, 1758), with
the name *H. sulcatus* (Thunberg, 1783). Chopra
(1974), accepting the synonymy established by
Dallas (1851), described the species *H. magnus.*
Ghauri (1988), having studied the types of *H. den-
tatus,* *H. serriger* and *H. sulcatus,* established the
conspecificity of *H. dentatus* and *H. serriger,* and
also placed *H. magnus* and *H. quadrii,* described by
Ahmad et al. (1974) from Bangladesh, in synonym-
y with *H. sulcatus.* Memon et al. (2002) res-
urrected *H. dentatus* from the synonymy with
*H. serriger* based on the characteristics of the ex-
ternal structure and some characters of the male
terminalia. They proposed *H. fabricii* Memon, Ah-
mad et Perveen, 2002 as a new replacement name
for *H. dentatus.* Salini (2019), having studied
photos of habitus and the dissected male genitalia
of the lectotype of *H. dentatus,* stored in the Nat-
ural History Museum of Denmark, synonymised
*H. fabricii* with *H. serriger.*

The external morphology (Fig. 2) of the ge-
nus, *H. sulcatus* and *H. magnus,* nom. resurr. was
described by Chopra (1974), Ghauri (1988), and
Salini (2019). The external characters in these
species are extremely variable with much overlap;
therefore, they were almost not used in the last re-
vision (Salini, 2019) and are not considered fur-
ther in this article.

According to Chopra (1974), *H. magnus,* nom. resurr. can be distinguished from *H. sulcatus* by
“the knob-like median lobe of the male pygophore
(vs. “indistinct median lobe”) and the paramere
which is “flattened and broad distally with outer
lateral extension with subapical tooth-like projec-
tion” (vs. “flattened and broad distally with outer
lateral extension bearing distal tooth-like projec-
tion”).

According to Ghauri (1988), “the tooth on the
external surface of paramere of *H. sulcatus* [here
considered as *H. magnus,* nom. resurr.] is located
on its disc – i. e. away from the margin of its head,
whereas in *H. serrigera* [syn. resurr., here as syn. of
*H. sulcatus*] this tooth occurs near the head of para-
mere”, “the ventral margin of pygophore is some-
what similar in these two species, but the dorsal
margin is quite different” – “gently wavy laterally
but with deep central depression formed by two
small lobes appearing slightly differently in vary-
ing views” in *H. magnus* (vs. “dorsal margin with a
small median emargination, lateral margins thick with thick growth of fine setae, gently concave” in *H. serriger* [here considered as *H. sulcatus*]); “the arcus of *H. sulcatus* is ‘broader’ than that of *H. serrigera* [here considered as *H. sulcatus*].

Salini (2019) writes that *H. sulcatus* (here considered as *H. magnus*, nom. resurr.) can be distinguished from *H. serriger* (syn. resurr., here as syn. of *H. sulcatus*) by “the short, spout-like median process on the infoldings of ventral rim of genital capsule” (vs. “the inverted U-shaped median process”), “parameral crown with two tooth, one situated apically and another medially towards ventrolateral margin of crown” (vs. “parameral crown with single tooth situated dorsolaterally near apical margin”), and “posterior margin of valvifers VIII convex to tooth situated dorsolaterally near apical margin”), and “posterior margin of valvifers VIII convex to tooth situated dorsolaterally near apical margin”), and “posterior margin of valvifers VIII convex to tooth situated dorsolaterally near apical margin”), and “posterior margin of valvifers VIII convex to tooth situated dorsolaterally near apical margin”).

A comparison of the descriptions of these genital characters considered by these three authors as diagnostic and based on the different study material, already exhibits significant variability in the listed structures. It will be shown below that all of these characters, except one, are quite variable and cannot be used to reliably distinguish the species. The absence of a clear correlation between the only distinguishing character and the states of other characters do not inspire confidence in the status of *H. sulcatus* and *H. magnus* as separate species. Therefore, below, I provide a common description of the terminalia and the variability of the more or less taxonomically important characters for these two taxa.

**Halys sulcatus** (Thunberg, 1783) and *Halys magnus* Chopra, 1974, nom. resurr., species inquirenda

(Figs. 2–9, 11, 12A–C, 13)

*Cimex sulcatus* Thunberg, 1783: 43.


*Cimex dentatus* Fabricius, 1775: 702 (junior primary homonym).


**Halys fabricii** Memon, Ahmad et Perveen, 2002: 51 (unnecessary new name for *C. dentatus* Fabricius, 1775; synonymised by Salini, 2019: 361, with *H. serriger*).


*Halys sindillus* Memon, Meier et Manan, 2006: 706 (synonymised by Salini, 2019: 367, with *H. sulcatus*).


*Halys mulberriensis* Memon, Parveen, Ahmad et Shaikh, 2016: 978 (synonymised by Salini, 2019: 367, with *H. sulcatus*).


*Halys noakoatensis* Memon, Parveen, Ahmad et Shah, 2017: 1304 (synonymised by Salini, 2019: 367, with *H. sulcatus*).


**Redescription of male terminalia.**

*Pygophore* (Fig. 3) about 1.15 times as wide as long, slightly flattened dorsoventrally. Its lateral walls in distal part only slightly divergent, almost

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parallel, sharply rounded at base; ventral wall in apical part with deep transverse rectangular depression having rather sharp basal margin; ventral wall of this depression weakly sclerotised, with rather large longitudinal median tubercle extending from base of depression, directed posteriorly. Posterolateral angles of pygophore rounded, not protruding laterally and caudally, forming rather short, longitudinal swellings, dorsal ends of which sharply rounded in caudal view, ventral ends passing into lateral parts of pygophoral posteroventral margin, being raised to level of posterolateral angles. These parts thick in caudal view, located obliquely in relation to sagittal plane of pygophore; in ventral view, their medial and caudal margins straight, located almost at right angle to each other (medial margins almost parallel to each other), medial angles rectangularly rounded. Median part of posteroventral margin smoothly concave, looking like continuation of ventrolateral infoldings, not connected with lateral parts of posteroventral margin. Posterodorsal margin of pygophore entirely smoothly concave, with small median notch located slightly below (anterior to) median part of posteroventral margin; each lateral end of posterior margin with a very small rounded notch near dorsal end of swellings of pygophoral posterolateral angles. Ventrolateral infoldings lamellar, rather narrow and long, located at same angle to dorsoventral and sagittal planes of pygophore, their medial margins more or less straight, oblique (converging basally), caudal margins straight, each with a narrow low transverse subrectangular carina on level of pygophoral posterolateral angle; angle formed by caudal and medial margins obtuse, not elongate. Dorsolateral infolding clearly differentiated into rather narrow median and wide lateral parts. Each lateral part of infolding, in turn, differentiated into two parts, outer and inner. Each outer part short, sloping basally from posterior margin of pygophore or vertical, almost parallel to its dorsal wall, with inner margin strongly sclerotised, most often bearing a small denticle in middle or more medially. Surface of each inner part very deeply depressed, normally sclerotised, with inner wall sharply elevated,
forming dorsolateral margin of genital opening. Median part of dorsolateral infolding trapezoidal, located in transverse plane, with slightly concave surface and wide ventral margin slightly elevated (not visible in dorsal view) and smoothly concave. Genital opening large, transverse, nearly diamond-shaped. Dorsal wall of pygophore with two small rounded membranous fenestrae on each side of median notch of posterodorsal margin; each dorsolateral wall with thin transverse desclerotised stripe near end of swelling of pygophoral posterolateral angle. Distal parts of ventral and lateral walls of pygophore densely covered with large dark brown punctures decreasing in size basally. Caudal surfaces of swellings and dorsal wall of pygophore not punctured. Ventrolateral infoldings, median tubercle of ventral wall, medial surfaces of swellings, posterodorsal margin of pygophore, inner lateral and medial parts of dorsolateral infolding covered with rather long setae. They directed medially on swellings and on lateral parts of dorsolateral infolding, in other areas they erect, longest on caudal margins of ventrolateral infoldings and on median part of posterodorsal margin. Caudal and lateral surfaces of swellings, dorsal surfaces of lateral parts of pygophoral posteroventral margin covered with short, sparse setae. Dorsal wall of pygophore distally covered with very short, sparse adpressed setae.

**Variability.** Median tubercle of ventral wall broad, more or less high, with rectangularly rounded apex (Fig. 3A) in Fm1, Mm1, Mm2, Mm3, and Nm1 (narrower and higher, with slightly concave apical margin in Nm1, lower in Fm1, Mm2, and Mm3); low, moderately narrow, with rectangularly rounded apex in Bm1 and Bm2; low, wide, with arcuate margin and deep narrow median notch in Mm5; narrow, with rounded apex (Fig. 3D) in Cm1, Dm1, Em1, Im1, Im2, Mm4, and Nm2 (long in Nm2, short in Dm1, Em1, Im1, and Im2, very short in Mm4, very short and extremely narrow in Hm1).

Lateral carina near caudal margin of each ventrolateral infolding (Fig. 3B, E) with rounded margin in Bm2, Hm1, Im1, Im2, Mm2, and Mm4; with triangular margin, lateral part of which longer than medial part in Mm1, Mm5, Nm1, and Nm2 or equal to medial part in Bm1, Cm1, Dm1, Em1, Fm1, and Mm3; in Bm1, Em1, and Fm1, lateral part with shallow notch; Mm5 and Nm1 with very low carina.

Median notch of pygophoral posterodorsal margin (Fig. 3B, E) very shallow, rather wide, tubercles on its sides strongly smooth in Mm3; notch rather shallow, rather wide, tubercles strongly smooth in Mm2 and Mm4; notch rather shallow, narrow, tubercles rather high in Mm5; notch quite deep, wide, tubercles quite high in Bm2, Mm1, Nm1, and Nm2; notch deep, wide, tubercles moderately high in Bm1, Cm1, and Nm1; notch deep, rather wide, tubercles high in Dm1, Hm1, and Im1; notch deep, rather narrow, tubercles high in Im2; notch deep, narrow, tubercles high in Em1; notch more or less V-shaped in nearly all specimens, trapezoidal in Mm4 and Nm1.

Each lateral outer part of dorsolateral infolding sharply elevated, almost vertical (Fig. 3C) in Mm1 and Mm5; more inclined in Bm1, Bm2, Fm1, Im1, Mm2, Mm3, and Nm1; almost horizontal, parallel to pygophoral dorsal wall (Fig. 3F) in Cm1, Dm1, Em1, Hm1, Im1, Mm4, and Nm2. Inner margin bearing sharp carina along entire width in Fm1, Mm1, Mm2, and Mm4; carina smooth in lateral part in Mm3, Mm5, and Nm1; barely noticeable carina, traced only laterally in Hm1 and Nm2; carina absent in Bm1, Bm2, Cm1, Dm1, Em1, Im1, and Im2.

Denticle located approximately in middle of lateral outer part of dorsolateral infolding (Fig. 3C) in Fm1, Mm1, Mm2, Mm3, Mm4, and Mm5; shifted medially (Fig. 3F) in Fm1, Bm2, Cm1, Dm1, Em1, Nm1, and Nm2. Hm1 completely without denticles. Im1 and Im2 with only medially located groups of four or five tiny denticles, one of which slightly larger (except for left side of infolding in Im1). Bm1 with medially located, rather broad tubercle directed ventrally and slightly medially, bearing a group of closely located, very small, sharp denticles, three on right and four on left side of infolding; several nearly obsolete denticles scattered dorsal and lateral to each tubercle. Bm2 with one small sharp main denticle on each side of infolding, directed ventrally and slightly laterally, and with one barely noticeable additional denticle dorsal to right of main one. In Cm1, main denticles slightly larger, slightly more inclined medially (with lateral margin longer that medial),
left one with truncated apex, right one with two tiny denticles on lateral margin. In Dm1 and Em1, main denticles very small, sharp, with equal margins, directed ventrally; in Dm1, one obsolete denticle located on either side, lateral to left main denticle and medial to right one; Em1 with only one such denticle medial to right main one. Fm1 with small sharp denticles located in middle on each side and larger denticle medial to it, both directed ventromedially, right medial denticle with two apices, left one with single apex, additional obsolete denticle located slightly lateral to left medial one. Mm1 with small main denticle on each side, having truncated apex, two obsolete denticles located medial to it, spaced away from it and from each other. Mm2 with rather large, broad main denticles, right one with sharp apex, very small denticle located immediately medial to it, left main denticle with rounded apex, small denticle next to it absent. In Mm3, main denticles smaller than in Mm2, right one with rounded apex, very small denticle located laterally, right medial additional denticle barely noticeable, left one absent. In Mm4, main denticles large, sharp, with serrate margins, two nearly obsolete denticles located medially at base of right main denticle. In Mm5, main denticles quite small, sharp, with smooth margins, one obsolete denticle located medial to left main one, carina medial to right main denticle rough, without distinct tiny denticle. In Mm1, Mm2, Mm3, Mm4, and Nm1, main denticles directed ventromedially, with lateral margins longer than median ones; in Mm5, main denticles directed almost ventrally, with equal margins. In Nm1 and Nm2, main denticle large, with rough median margin, additional minute denticles absent.

In Hm1, Im1, Im2, lateral walls of pygophore in distal part more convex (more widely turned medially) in caudal view than in other specimens.

**Paramere** (Figs 4–7). Basal plate large, oval, slightly longer than wide. Corpus of paramere moderately long and wide, trihedral in cross-section, strongly flattened laterally, with almost parallel or slightly divergent dorsal and ventral margins. Its medial wall concave; dorsal wall widening distally, bearing several long adpressed setae on distal part; lateral margin of dorsal wall and ventral margin of corpus rounded. Sensory tubercle absent. Hypophysis large, trihedral in cross-section, with short lamellar posterior margin, long, broad lamellar dorsal and anteromedial margins, lying at acute angle to sagittal plane and at obtuse angle to longitudinal axis of parameral corpus. Posterior margin of hypophysis passing into ventral margin of parameral corpus, anteromedial margin passing into short low carina on medial margin of its dorsal wall. Lateral wall of hypophysis parallel to lateral wall of parameral corpus, narrow, tapering apically, bearing one strongly sclerotised denticle on anterior margin; medial wall wide, oblique in relation sagittal plane of parameral corpus. Base of hypophysis dorsolaterally with tuft of rather long, raised setae with converging apices; its lateral and medial walls covered with very short, adpressed setae; posterior margin with longer raised setae.

**Variability. Magnus-type** (Figs 4, 6). Apical part of hypophysis long, anteromedial and posterior margins converging. Apex of hypophysis usually with narrow triangular denticle. Posterior margin of hypophysis wide in medial view (anterior denticle distant from it, visible against light). Posterior and anterior margins of hypophysis almost parallel basally. Denticle located at base of anterior margin, with distal margin continued into short, tapering carina covered with microsculpturing.

In medial view, posterior margin of hypophysis ranges from sharply arcuate convex in middle (in Hm1 and Im1) to almost straight (in Mm2 and Nm2), from rather deeply concave before apex (in Hm1 and Im1) to almost straight (in Bm1, Dm1, and Em1) or slightly convex (in Bm2 and Fm1). Anteroventral angle of hypophysis convex, broadly rounded (in Bm2, Em1, Hm1, and Im1) or obtusely rounded (in Cm1, Dm1, Mm2, and Mm3), or almost unpronounced (in Bm1, Fm1, and Im2);

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**Fig 3.** Pygophore of the specimens Mm1 (A–D) and Nm2 (E–F) in ventral (A, D), dorsal (B, E), and caudal (C, F) view. Abbreviations: i. l. p. – inner lateral part of dorsolateral infolding; l. p. – lateral parts of posteroventral margin; m. p. – median part of dorsolateral infolding; o. l. p. – outer lateral part of dorsolateral infolding; swl. – swellings of postero lateral angles; v-l. i. – ventrolateral infoldings. Blue arrow indicates a denticle in outer lateral part of dorsolateral infolding. Scale bar: 1 mm.
anterodorsal angle sharply obtusely rounded (in Dm1, Im1, and Im2) or smoothly obtusely rounded (in Cm1, Em1, and Hm1), or broadly obtusely rounded, almost unpronounced (in Bm1, Bm2, and Fm1). Anteromedial margin almost straight (in Dm1 and Fm1), slightly concave in middle (in Em1, Hm1, and Im1) or distal to middle (in Bm2 and Im2), or slightly convex (in Cm1 and Bm1). Dorsal margin almost straight (in Dm1, Im1, and Im2), or slightly concave near anterodorsal angle (in Bm2, Cm1, and Fm1), or slightly convex (in Bm1, Em1, and Hm1). Extreme apex of hypophy-

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**Fig. 4.** Parameres of the *magnus*-type. A–C, specimen Hm1; D–F, specimen Im1. Medial (A, D), ventral (B, E), and lateral (C, F) view. Abbreviations for hypophysis parts: ap. – apex; a. m. – anterior margin; a-d. a. – anterodorsal angle; a-m. m. – anteromedial margin; a-v. a. – anteroventral angle; d. m. – dorsal margin; p. m. – posterior margin. Scale bar: 0.5 mm.
sis shaped as long, narrow, sharp denticle (in Im1) or slightly less long (in Im2), or short (in Cm1, Dm1, Em1, and Hm1), or triangularly rounded (in Bm1, Bm2, and Fm1), with a very small sclerotised denticle curved to lateral side (in Bm2 and Fm1) or without such denticle (in Bm1).

*Sulcatus*-type (Figs 5A–C, 7C–G). Apical part of hypophysis short, its anteromedial and posterior margins almost parallel. Apex of hypophysis broadly smoothly rounded, always without denticle. Posterior margin of hypophysis narrow in medial view (anterior denticle close to it, vis-

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Fig. 6. Parameral hypophyses of the magnus-type in medial (A–G, H–J) and posterior (G) view. A, specimen Im1; B, specimen Hm1; C, specimen Im2; D, specimen Dm1; E, specimen Em1; F, specimen Cm1; G, H, specimen Fm1; I, specimen Bm2; J, specimen Bm1. Abbreviations: a-m. m. – anteromedial margin; d. m. – dorsal margin; p. m. – posterior margin. Scale bar: 0.5 mm.

Fig. 7. Parameral hypophyses of the intermediate (A, B) and the sulcatus-type type (D–F) in medial view. A, specimen Mm1; B, specimen Nm1; C, specimen Nm2; D, specimen Mm4; E, specimen Mm3; F, specimen Mm2; G, specimen Mm5. Abbreviations: a-m. m. – anteromedial margin; d. m. – dorsal margin; p. m. – posterior margin. Scale bar: 0.5 mm.
ible against light); anteromedial margin nearly straight; dorsal margin rather strongly concave near anterodorsal angle. Posterior and anterior margins of hypophysis converging basally. Base of anterior margin with short, rather high subrectangular carina covered with microsculpturing, denticle located on distal end of this carina, thus distant from base of hypophysis.

In medial view, posterior margin of hypophysis weakly, uniformly convex (in Mm3 and Mm5) or almost straight (in Mm2 and Nm2), or rather strongly convex before apex (in Mm4). Anteroventral angle obtusely rounded (in Mm2, Mm3, Mm5, and Nm2) or almost unpronounced (in Mm4); anterodorsal angle sharply obtusely rounded (in Mm2, Mm3, and Mm4) or smoothly obtusely rounded (in Mm5 and Nm2). Intermediate type (Figs 5D–F, 7A, B). Apical part of hypophysis quite long, its anteromedial and posterior margins converging. Apex of hypophysis with narrow triangular denticle (in Mm1 as in Im2; slightly wider in Nm1). Posterior margin of hypophysis weakly and uniformly arcuate convex in Mm1, weakly trapezoidal convex in Nm1, narrow in medial view (anteroventral denticle close to it, visible against light) in Mm1 or wider (dentine distant from it) in Nm1; anteromedial and dorsal margins almost straight. Anteroventral angle slightly convex, rounded in Mm1, almost unpronounced in Nm1; anterodorsal angle broadly obtuse (almost as in Bm1, Bm2 and Fm1). Posterior and anterior margins of hypophysis lateral wall converging basally. Base of anterior margin with short, rather high subrectangular carina covered with microsculpture, denticle located on distal end of this carina.

Aedeagus (Figs 8A, 9). Phallobase transverse; basal plates triangular in lateral view, with slightly elongate apices. Dorsal connectives moderately long. Capitate processes large, with short stalks and more or less triangularly rounded plates. Ventral processes broadly triangular, varying in length, often quite short.

Theca quite large, narrow at base, in ventral view rather strongly widening distally, reaching maximum width before apex, slightly tapering at extreme apex; ventral wall concave in middle of length, dorsal wall rather strongly convex throughout entire length. Ventral tubercles small, membranous. Apical opening quite large.

Conjunctiva. Ventrolateral lobes rather short, triangular, elongate at base along axis of aedeagus, swollen, each with short conical posterior tubercle near base of median penal plates; in anterior part (facing base of aedeagus), each lobe with long narrow branch adjacent to wall of theca, C-shaped, strongly curved medially, with narrowly rounded apices. Apex of conjunctiva short, wide, its base ventrally with narrow conical median tubercle directed ventrally. Apical lobes paired, very long, rather wide, directed dorsally, diverging or crossing, divided into two branches apically, varying in shape and length. Dorsal wall of conjunctiva with a pair of longitudinal, weakly sclerotised bands sharply converging basally, proximal ends of which more sclerotised, triangularly rounded, connected by short fold of conjunctival wall, slightly overlapping apical margin of theca. Ventral lobe rather long, narrow, directed towards base of aedeagus. Median penal plates, in ventral view, completely fused, their lateral margins converging at extreme base, then parallel. Apical processes large, more or less triangularly expanding distally, their posterior (ventral) margins widely divergent, anterior (dorsal) margins located very close to each other, converging, contiguous distally; each apical margin convex, with more or less deep notch, less often without it, rounded. Apical processes together forming broad spoon-shaped structure. Ventral lobe with small longitudinal membranous tubercle located between bases of apical processes at base of vesica. Vesica rather long, C-shaped at base, straight elsewhere, tapering apically, significantly protruding beyond posterior margins of apical processes.

Variability (Fig. 9). Apical lobes rather narrow, of more or less uniform width, crossing, with rather short conical lateral branch slightly deflected laterally and long medial branch deflected medially almost at right angles to axis of lobe (in Mm2, Mm4, Mm5, Nm2, Mm1*, and Mm3*); widened at base, not crossing, with lateral branches shaped as short triangular tubercles, lateral branches rather long, looking like continuations of lobes, long, narrowed at base and at apex, widened in middle, C-shaped, curved medially (in Bm1, Bm2, Cm1, and Fm1); significantly widened at base, not cross-

* Specimens whose conjunctiva was examined in a straightened, but not completely inflated state, in glycerol.
ing, with very short, vestigial lateral branches and rather long, broadly conical medial branches looking like continuations of lobes, slightly curved medially (in Hm1, and Nm1); widened at base, not crossing, with very close basally, diverging, very short and narrow lateral and medial branches, medial ones slightly shorter than lateral ones (in Dm1, Em1, and Im2*); shorter than in other specimens, widened at base, not crossing, with medial branches shaped as small triangular tubercles and lateral branch looking like rectangular tubercles (Im1).

Fig. 8. Completely inflated aedeagus (without phallobase). A, specimen Mf3; B, C, *Halys brockchus sp. nov.* Ventrolateral (A, B) and lateral (C) view. Abbreviations: a. br. – anterior branches of conjunctival ventrolateral lobes; a. l. – conjunctival apical lobes; a. pr. – apical processes of conjunctival ventral lobe; d. b. – sclerotised bands on conjunctival dorsal wall; p. t. – posterior tubercles of conjunctival ventrolateral lobes; ves. – vesica. Scale bar: 0.25 mm.
Fig. 9. Variability of the apical lobes of conjunctiva. A, specimen Mm2; B, specimen Cm1; C, D, specimen Nm1 (D, apex of lobe); E, specimen Cm1; F, specimen Im1; G, Halys brocchus sp. nov. Caudal (A–C) and lateral (E–G) view. Abbreviations: l. b. and m. b. – lateral and medial branches, respectively. Scale bar: 0.25 mm.

Fig. 10. Pygophore (A–C) and paramere (D–G) of Halys brocchus sp. nov. in dorsal (A), ventral (B), caudal (C), medial (D), anterior (E), ventral (F), and lateral (G) view. Abbreviations: a-m. m. – anteromedial margin; d. m. – dorsal margin; p. m. – posterior margin. Blue arrow indicates a denticle in outer lateral part of dorsolateral infolding. Scale bars: 1.0 mm (A–C) and 0.5 mm (D–G).
Apical margins of apical processes of ventral lobe with deep notch (in Em1, lm1, lm2, Nm1, and Nm2) or with shallow notch (in Bm1, Bm2, Hm1, Mm3, and Mm4), or with barely noticeable notch (in Dm1, Mm1, Mm2, and Mm5), or without notch (in Cm1 and Fm1).

Redescription of female terminalia (Figs 11–13). Gonocoxites I wider than long, their posterior margins sclerotised (not membranous), largely concave in medial part, convex in lateral part or almost straight throughout; medial margins more or less straight; lateral margins short, almost straight; anteromedial angles rectangularly rounded; posteromedial angles acute or rectangularly rounded; posterolateral angles rounded or truncated, with small plate curved dorsally; ventral surfaces rather weakly, uniformly convex (except for sometimes lamellar lateral areas of posterior margin), densely punctate, except for anterolateral and posterolateral areas, strongly darkened along posterior and medial margins, there densely covered with short thin setae directed posteriorly. Median plate (fused gonocoxites II) relatively long and wide or short and wide, with converging, slightly convex lateral margins, concave or straight posterior margin, and anterior margin straight or V-shaped, deeply concave in middle and convex laterally; ventral surface with very thin longitudinal median suture, punctured and covered with short thin setae, uniformly and weakly convex or almost flat in middle, with more or less convex rounded tubercles at anterolateral angles. Paratergites IX with slightly concave ventral surfaces, covered at posterior ends and along medial margins with short setae directed posteriorly, their lateral margins straight anteriorly, slightly convex posteriorly, medial margins straight, posterior ends sharply rounded, slightly protruding beyond posterior margin of proctiger. Paratergites VIII approximately 1.33 times as wide as long, not fused with each other, connected by narrow membrane with weakly sclerotised triangular median sclerite, their common posterior margin convex laterally and slightly concave medially, lateral angles rounded or truncated, ventral surfaces almost flat, densely punctured except areas along posterior margins. Second rami relatively long, extending from anterolateral angles of median plate obliquely anterolaterally, not quite reaching anterior margins of paratergites IX.

Triangulum large, with broadly or rectangularly rounded posterior margin, with or without small median notch, in middle part, weakly sclerotised entirely or with short membranous area along posterior margin, with large membranous areas on sides. Vestiges of gonapophyses I shaped as rather long transverse fold, posterior margin of which strongly convex laterally and concave medially or uniformly convex.

Gynatrial sac quite large, wide, located in anterior part of gynatrium, anterior to lateral apodemes of gonocoxites I, with two wide, rather long, slightly flattened dorsoventrally, triangular lateral pouches directed anteriorly and laterally, and with longer, more voluminous, broadly triangular median pouch. Dorsal wall of gynatrial sac with deep transverse fold near its posterior margin; lateral ends of this fold sharply bending anteriorly, reaching apices of lateral pouches; in middle, this fold sharply curved anteriorly and connected with dorsal margins of arcus. Arcus long, narrow, with posterior arms slightly diverging posteriorly, 1.26–1.86 times as long as wide. Annular sclerite located between posterior arms of arcus; in dorsal view, large, longitudinally oval or almost round; ventrally, looking as short wide papilla with sclerotised lateral and posterior walls and membranous anterior wall; openings of spermathecal duct located on anterior wall or over sclerotised apex.

Posterior margin of gynatrial sac broadly triangularly concave, extending from anterior ends of paratergites IX to posterior ends of arcus. Posterior wall of gynatrial sac forming transversal fold especially deep in middle. Ring sclerites located on ventral surface of this fold, rather large, transversely oval, with relatively thin margin, lying close to annular sclerite. Basal sclerites large, located horizontally on dorsal wall of gynatrium in its posterior part. Anterior margins of basal sclerites sharply curved dorsally, lying in fold of posterior wall of gynatrial sac and fused with anterior margins of ring sclerites. Anterior parts of basal sclerites rather long, wide, slightly wider than ring sclerites, tapering posteriorly, rather weakly sclerotised, except for strongly sclerotised band on lateral margin of each sclerite; anterolateral angles short, pointed, directed laterally and slightly posteriorly; anteromedial angles slightly or almost not protruding beyond margins of ring sclerites; lateral margins converging; medial mar-
gins convex anteriorly, sharply diverging, usually almost straight posteriorly. Posterior parts of basal sclerites short, shaped as pike pole: each lateral margin with narrow, long, triangular projection directed anterolaterally, extreme posterior ends of sclerites narrowly or widely rounded, directed posteriorly and slightly medially. Extreme posterior ends of basal sclerites representing flaps adpressed to dorsal wall of gynatrium.

Completely straightened proximal part of spermathecal duct, at most, extending beyond middle of ventrite VI or reaching its anterior margin; its distal end widening over long extent and comprising long posterior end of mediiodistal part of duct. Middle part of duct very long, having length (measured from posterior bend of mediiodistal part to its anterior end) from anterior margin of ventrite VII, at list, to anterior margin of ventrite IV, most often approximately to base of abdomen. Medioproximal part of duct wide, evenly widening from base and gradually tapering towards apex. Mediiodistal part of duct with long, very narrow posterior end curved at right or acute angle, gradually widening anteriorly, with parallel lateral walls in distal part, slightly widened at extreme anterior end. External distal part of duct 0.29–0.33 times as long as straight section of mediiodistal part. Pump quite large, its proximal flange smaller than distal one, margins of distal flange curved proximally. Capsule rather small, round, with two or three processes being sometimes branched.

Variability (Fig. 13). Posterior margins of gonocoxites I very strongly convex laterally and very strongly concave medially, posteromedial angles long in Lf1; margins quite strongly convex laterally and slightly concave medially, angles short in Mf1 and Mf2; margins very slightly convex laterally and rather strongly concave medially, angles rather long in Df1; margins rather slightly convex laterally and slightly concave medially, angles short in Mf3, Jf1, and Of1; margins same, but angles longer in Kf1; margins very slightly convex laterally and very slightly concave, almost straight medially, angles long in Gf1; margins

Fig. 11. External female terminalia of the specimen Kf1 in ventral view.
same, but angles shorter in Ef1 and Ef2; margins straight laterally and very slightly concave, almost straight medially, angles short in Df2; margins straight, angles quite long in Af1; margins very slightly convex in middle of width and very slightly concave medially, angles short in Bf1.

Fig. 12. Parts of female terminalia. A, gynatrial sclerites of the specimen Lf1, dorsal view; B, spermatheca of the specimen Lf1, dorsal view; C, magnified spermathecal pump and capsule of the specimen Lf1; D, gynatrial sclerites of Halys shaista Ghauri, 1988. Abbreviations: ann. s. – annular sclerite; arc. – arcus; b. s. – basal sclerites; pr. / mdl. – boundary between proximal and middle parts of spermathecal duct; r. s. – ring sclerites; IV–VII – corresponding abdominal ventrites. Scale bars: 0.50 mm (B), 0.25 mm (A, C, D).
Median plate quite long (in Df2, Kf1, Lf1, Mf1, and Mf2) or short (in Af1, Bf1, Df1, Ef1, Ef2, Jf1, Mf2, and Of1), relatively narrowly trapezoidal (in Df2, Gf1, Jf1, Kf1, Lf1, Mf1, and Mf3) or relatively wide trapezoidal (in Af1, Bf1, Ef1, Ef2, F7, Mf2, and Of1); its posterior margin concave (in Af1, Jf1, Kf1, Lf1, Mf1, and Mf3) or straight or almost straight (in Bf1, Df1, Df2, Ef1, Ef2, Gf1, and Mf2), or deeply V-shaped (Of1); tubercles on anterolateral angles strong (in Lf1) or medium-sized (in Df2, Ef1, Ef2, Mf1, and Mf2), or weak (in Af1, Bf1, Df1, Gf1, Jf1, Kf1, Mf3, and Of1). Apex of triangularum smoothly rounded (in Af1, Bf1, Df1, Ef1, Ef2, Gf1, Jf1, Lf1, Mf2, and Mf3) or trapezoidally rounded (in Df2, Mf2, and Of1), or triangularly rounded (in Kf1), with slightly wavy posterior margin (in Mf2) or with small median notch (in Kf1). Annular sclerite large, in dorsal view, diamond-shaped (in Lf1) or broadly oval (in Mf1 and Gf1), or transversely oval (in Mf2, Df1, Ef2, Df2, and Bf1), or round (in Af1, Ef1, Jf1, Kf1, and Mf3) with straight anterior margin (in Jf1) or narrowed anteriorly (in Af1, Ef1, and Mf3).

Anteromedial parts of basal sclerites long (in Af1, Bf1, Df2, Ef1, Ef2, Gf1, Jf1, Kf1, and Lf1) or relatively short (in Mf1, Df1, and Of1), or short (in Mf1 and Mf3), relatively wide (in Af1, Bf1, Df1, Df2, Ef1, Kf1, and Mf2) or relatively narrow (in Ef2, Gf1, Jf1, Lf1, Mf1, Mf3, and Of1); their medial margins widely rounded (in Af1, Bf1, Df1, Df2, Ef1, Ef2, Jf1, Kf1, Lf1, Mf2, and Of1) or broadly triangular (in Gf1 and Mf3), or acutangulum smoothly rounded (in Mf1), or straight, sharply diverging posteriorly (in Mf1); in Mf3, curved anterior margins of sclerites in medial part longer than in other specimens; posterior parts of basal sclerites converging sharply (in Mf1 and Af1) or moderately sharply (in Bf1, Df1, Df2, Ef1, Ef2, Gf1, Kf1, Lf1, Mf2, Mf3, and Of1), or weakly (in Jf1); their lateral processes quite wide (in Af1, Df2, Jf1, Lf1, Mf1, Mf3) or narrow (in Bf1, Ef1, Gf1, and Kf1), or very narrow (in Df1 and Mf2), or rather wide basally and strongly narrowed apically (in Ef1, Ef2, and Of1), lying very close to lateral margins of sclerites (Df1) or significantly distant from them (Bf1), in Ef1, Ef2, and Gf1, processes shorter than in other specimens.

Completely straightened proximal part of spermathecal duct not reaching anterior margin of ventrite VII (in Gf1) or only slightly extending beyond it (in Bf1, Df2, Ef2, Jf1, Mf3, and Of1), or almost reaching middle of ventrite VI (in Ef1, Kf1, Mf1, and Mf2), or reaching anterior margin of ventrite VI (in Lf1). Mediodistal part of duct (measured from bend to anterior end) extending from anterior margin of ventrite VII to anterior margin of ventrite III, i.e. to base of abdomen (in Df2, Gf1, Jf1, Kf1, and Lf1) or slightly not reaching it (in Af1, Df1, Mf1, and Mf2), or reaching anterior margin of ventrite IV (in Ef1 and Ef2), or extending beyond it, but slightly not reaching middle of ventrite III (in Bf1, Mf3, and Of1); in Jf1, its narrowed posterior end longer than in other specimens. In Ef1, Ef2 and Of1, external distal part of duct shorter than in other specimens. Spermathecal capsule with three long processes (in Gf1, Lf1, and Mf1), one of them with one short branch and one very short branch, third process with one long and one short branch (in Lf1), or only one of three processes with one very short branch (in Mf1), or capsule with two long and one short processes (in Af1, Bf1, Ef2, Mf2, and Of1), one long of them with two very short branches (in Bf1), or capsule with one long and two short processes (in Df1), or with two short and one very short process (in Jf1 and Kf1), or with two processes, short and long (Df2, Ef1), long one at apex with two very short branches (in Ef1).

Notes. (A) Examination of variability and analyses of geographical distribution have shown that the characters of the pygophore, aedeagus and female terminalia, even those previously given taxonomic significance, are too variable to consistently separate Halys sulcatus and H. magnus. However, it is possible to trace certain trends in their occurrence. For example, in the south of the common range, the specimens occur more often in which the tubercle of the pygophoral ventral wall is wide and rectangularly rounded, the median notch of the pygophoral posterodorsal margin is shallower, the tubercles on its sides are lower, the outer lateral parts of the dorsolateral infolding are carinate and have a denticle located in their middle; in the north, the specimens are more common in which the tubercle of the ventral infolding is narrow, with a rounded apex, the median notch of the posterodorsal margin is deeper, the tubercles on its sides are higher, the outer lateral parts of the dorsolateral infolding are without a carina, a denticle is located more medially or is absent. In
the north, all variants of the posterior margins of gonocoxites I are found, from strongly convex laterally and strongly concave medially to straight, from long posteromedial angles to short ones; in the south, in two specimens examined, these margins are quite strongly convex laterally and slightly concave medially, and in one more specimen, they are only slightly convex laterally and slightly concave medially; the posteromedial angles are short in all three specimens. It is worth noting that all examined males from the north have the paramere of the magnus-type, and it is highly unlikely that all the males from the north belong to one species, while females belong to two. In some cases, the variability is clearly local geographical, that is, for example, the differences in the structure of the apical lobes of the conjunctiva with only one deviation: the same lobes are found in two specimens from Uttar Pradesh and Tamil Nadu. The characters of the parameral hypophysis, which until now seemed to be the most reliable, given by all the authors who distinguished these two species, turn out to be not so unambiguous. In the north, all specimens examined have an elongate and narrowed apex of the hypophysis, bearing a denticle (very small in some specimens from Afghanistan; in one Afghan specimen, the denticle is absent); in the southern specimens, the hypophysis is short, with a broadly rounded apex that does not have a denticle. However, in the south, two specimens were found that have an elongate, tapering apex bearing a distinct denticle, but at the same time, these specimens have the same armament on the anterior margin of the hypophysis as the specimens from the south, i.e., their hypophysis is, as it were, an intermediate form between the hypophyses of H. sulcatus and H. magnus. These facts may have several explanations. (1) The specimens from the north and south belong to different species, and the intermediate type of paramere is a form of variability in the paramere of H. sulcatus. This hypothesis is contradicted by the absence of correlation between the state of the only character that may distinguish these species (the armament of the anterior margin of the hypophysis) and the states of other, even not very significant characters. (2) The specimens with the parameral hypophysis of the intermediate type are hybrids of two distinct species. If so, then it is difficult to explain the location of these specimens far from the northern border of the range of the southern species. (3) The specimens with the hypophysis of the intermediate type belong to a third species. The objection to this hypothesis is the same. For example, in the specimen from Madurai (Nm1), the apical lobes of the conjunctiva are the same as in the specimen from Uttar Pradesh, but in the specimen from Chennai (Mm1), they are completely different, the same as in the other specimens from this location and like in another specimen from Madurai. (4) H. sulcatus and H. magnus are a single species with highly variable characters, not only in the external structure, but also in the terminalia. It is also possible that there are two subspecies, corresponding to two opposite ends of the cline or separated by its distinct ledge. In the material examined, there are no specimens with intermediate or very similar states of the characters of the armament of the anterior margin of the hypophysis (position of the denticle, presence or absence of the carina). However, this hypothesis finds some support in the statement of Ghauri (1988) that several males of H. serriger (syn. resurr., here as syn. of H. sulcatus) from India have “the ridge of paramere less ‘high’”. An indirect confirmation of this hypothesis may also be the fact that in the 50 years since the differences between H. sulcatus and H. magnus were reported, one species was recorded only in the south and the other only in the north of the common range. Moreover, even among the extensive material from the southern regions of India examined by Salini (2019), not a single specimen of H. magnus was found.

Undoubtedly, this question may be resolved after having examined the terminalia of specimens from central India and as many specimens as possible.

(B) Thunberg (1783) described Cimex sulcatus based on the description of Caspar Stoll (1778) (and perhaps also from his material, since

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**Fig. 13.** Variability of the posterior margins of gonocoxites I; ventral view. A, specimen Lf1; B, specimen Mf1; C, specimen Df1; D, specimen Mf2; E, specimen Gf1; F, specimen Mf3; G, specimen Af1; H, specimen Bf1. Scale bars: 0.5 mm.
C.P. Thunberg was in Amsterdam in 1778 and 1779), who published it under the name “la Pu-naise à tête pointue”. The type locality of this species is “kust Coromandel (Côte de Coromandel)” by Stoll (op. cit.) and “India orientali, in Coromandelia & alibi” by Thunberg (op. cit.), Coromandel Coast, i.e. the coast between Point Calmere (Cape Calimere or Kodikkarai) near the Kaveri River delta north to the mouth of the Krishna River, today in the states of Tamil Nadu and Andhra Pradesh. Thunberg did not designate holotypes, but in this case the addition of the words “et alibi” [and elsewhere] to the type locality name suggests that he had more than one specimen. The addition of “et alibi” most likely means unlabelled specimens, since in other cases Thunberg indicated distribution in more detail (“Bengala”, “Ceilonia”, etc.), but this addition should not be considered as extending the type locality to East India, whole India, or even South Asia. Ghauri (1988) examined the female specimen with a handwritten label “sulcatus, Mus. Thunb.” from the Museum of Evolution at Uppsala University (UZIU) and used the term “type” for this specimen, which should be considered the designation of a lectotype in accordance with article 74.5 of the ICZN. He (op. cit.) resurrected the name H. sulcatus from the synonymy with H. dentatus (sensu Chopra, 1974), since “the arcus of H. sulcatus is ‘broader’ than that of H. serrigera [here considered as H. dentatus]”. There is no justification for resurrecting H. sulcatus and placing H. magnus in synonymy with it, since the basal sclerites (the “arcus” in interpretation of Ghauri) of the specimens I examined from both northern and southern India vary greatly in shape and do not show a hiatus between the aforementioned states of the character. Moreover, the type locality of H. sulcatus is in the southern part of India (tentatively indicated by the shading in Fig. 1), in the states where no reliably identified specimens of H. sulcatus sensu Ghauri have been found to date. Therefore, I consider H. sulcatus a senior subjective synonym of H. serriger, syn. resurr. For the northern species or subspecies, the name Halys magnus Chopra, 1974, nom. resurr. should be used, since it is based on a description of the structural characters of the paramere.

(C) Halys hyderabadiensis Memon, Parveen, Ahmad et Shah, 2017 was described based on four specimens from Hyderabad (Pakistan). In addition to the characters of external morphology, which vary significantly in all species of Halys, the authors have presented the following characters that distinguish this species from congeners: the second antennal segment is distinctly longer than the third, “blade [parameral hypophysis] with round apex and without apical spine, inner spine much prominent, outer margin at apex depressed, inner margin very much sinuated”, and “first gonocoxae with outer margin concave and with distinctly produced inner angle, spermathecal bulb with two fingerlike processes”. In addition, the description mentions “dorsoposterior margin with deep cavity, to some extent V-shaped, laterally sinuate and medially excavated” and the posteroventral margin “with shallow cavity, laterally smooth and with apically bifid median projection”. In the description of the species, only one numerical value is given for each antennal segment, without a range of values, which means that only one specimen was measured, most likely the holotype. The authors note that segments IV and V in the holotype and paratype are “mutilated,” which means probably that segment III could also be damaged, and this is most likely the reason that it is clearly shorter in the authors’ measurements than segment II. The listed characters of the shape of the parameral hypophysis have been found by me in the specimens of H. sulcatus from Afghanistan: the more or less rounded apex (in H2), the absence of a terminal denticle (in H1), the concave subapically posterior margin (in E8), and the more or less wavy dorsal margin (in F2, F8, H1, H2). Apparently, these states of the characters are expressed to varying degrees in various populations in the western part of the range of H. sulcatus. The shape of the posterior margin of gonocoxites I is not taxonomically significant, as shown above, and the shape reported for H. hyderabadiensis has also been found by me in the specimens from Afghanistan (D7). The number of processes of the spermathecal capsule, the shape of the median tubercle of the pygophoral ventral infolding, and the shape of a denticle on the anterior margin of the parameral hypophysis also cannot be considered as diagnostic characters. The amazing shape of the posterodorsal margin of the pygophore is most likely a mistake made by the illustrator, as are the incredibly long and thick legs in the total depiction of this species in the article. It is noteworthy that this unique
“character” is not given by the authors either in the key or in the comparison of the new species with congener species. Based on the above arguments, I consider *Halys hyderabadiensis*, syn. nov., a junior subjective synonym of *H. sulcatus*.

**Halys shaista** Ghauri, 1988  
(Fig. 12D)

**Halys shaista** Ghauri, 1988: 78.


Descriptions of the external structure and the male terminalia are given by Ghauri (1988) and Salini (2019). Here I provide a redescription of the female terminalia, which are described in those articles in insufficient detail.

**Redescription of female terminalia** (Fig. 12D). Posterior margins of gonocoxites I significantly concave medially, angularly convex laterally, part of margin between this convexity and posteromedial angle narrowly membranous; posteromedial angles short, rectangularly rounded; posterolateral angles distinct, obtuse; surfaces of gonocoxites uniformly, rather weakly convex, darkened in posteromedial half. Median plate rather short, broadly trapezoidal, without longitudinal suture, with concave anterior and posterior margins; its surface at anterolateral corners with small, sharply convex rounded tubercles. Lateral angles of paratergites VIII obtusely rounded. Surfaces of paratergites IX strongly concave in posterior part, slightly convex in anterior part; posterior angles acutely rounded, significantly protruding beyond posterior margin of proctiger, lateral and medial margins more or less straight. Triangulum more sclerotised in anterior part, with broadly rounded, slightly wavy (without median notch), weakly sclerotised posterior margin. Vestiges of gonapophyses I large, deeply divided, with rounded posterior margins. Second rami slightly not reaching anteromedial angles of paratergites IX.

Arcus narrow, 1.42 times as long as wide, with rather weakly diverging posterior arms. Annullar sclerite quite large, longitudinally oval, rectangularly rounded anteriorly in dorsal view, with membranous anterior wall and sclerotised lateral and posterior walls in ventral view; spermathecal duct opening in middle of anterior wall. Ring sclerites quite large, with rather wide margin. Basal sclerites relatively short and narrow. Anterior parts of basal sclerites generally strongly sclerotised, approximately as wide as ring sclerites; their anterolateral angles short, sharp; anteromedial angles indistinct; medial margins slightly obtusely convex anteriorly, slightly diverging posteriorly; lateral margins sharply converging anteriorly, almost parallel posteriorly. Anteromedial areas and posterior parts of basal sclerites less sclerotised. Posterior parts shaped as wide pike pole, with lateral processes directed anterolaterally at acute angle to lateral margins of sclerites; posterior ends of sclerites rather widely rounded, directed posteriorly.

Completely straightened proximal part of spermathecal duct extending significantly beyond middle of ventrite VI, but not reaching its anterior margin. Middle part of duct long, having length (measured from bend of mediodistal part to its anterior end) from anterior margin of ventrite VII to middle of ventrite III. Curved posterior end of mediodistal part of duct slightly shorter than in previous taxa. External distal part of duct damaged. Pump as in previous taxa. Capsule with two long unbranched processes.

**Halys brocchus** sp. nov.  
(Figs 8B, C, 9G, 10)


*Description. In characters of the external morphology, the holotype is almost identical to other species of the genus in the range of variability. This specimen is smaller than all other species of the genus, or some of its metric characters correspond to the lower values of variability of *H. sulcatus* and *H. magnus*, namely specimens from the northwestern part of the common range (Afghanistan) of these (sub)species.*

*Measurements [in mm; compared with males of *H. sulcatus* and *H. magnus*: original data / from Salini (2019)].* Body length 16.30 (vs. 16.50–19.89 / 18.96–20.63); head length 4.18 (vs. 4.18–5.10 / 4.56–5.27); head width 2.98 (vs. 2.88–3.60 / 3.22–3.51); synthlipsis 1.80 (vs. 1.80–2.25 / 1.92–2.09); ocular index 3.05 (vs. 2.94–3.33); lengths of antennal segments I–V 0.93 (vs. 0.93–1.15 / 0.87–
1.20) : 2.20 (es. 2.10–3.15 / 2.05–2.66) : 2.28 (es. 1.90–2.63 / 2.14–2.71) : 2.13 (es. 1.85–2.63 / 1.99–2.56) : segment V broken ; pronotum length 3.45 (es. 3.60–4.20 / 3.56–4.25); pronotum width 7.55 (es. 7.55–9.60 / 8.54–9.26); abdomen length 8.90 (es. 9.10–12.00); scutellum length 5.80 (es. 6.05–8.10 / 6.42–7.69); scutellum width 4.50 (es. 4.60–5.90 / 4.83–5.55).

Pygophore (Fig. 10A–C). Median tubercle on ventral wall large, trapezoidal, with shallow median notch. Carina near caudal margin of each lateral part of ventral infolding very low, barely visible. Posterodorsal margin of pygophore with small rounded medial notch and barely noticeable tubercles on its sides. Outer lateral parts of dorsolateral infolding short, not sclerotised, each with large triangular, strongly sclerotised denticle at lateral end, these denticles directed caudally and slightly ventrally, protruding beyond posterodorsal margin of pygophore in dorsal view (left denticle with very small additional denticle on medial margin).

The position, size, and direction of these paired denticles are unique characters that were not encountered within the range of variability of *H. sulcatus* and *H. magnus* (in which the denticles are small and located in the middle of the outer lateral parts of the dorsolateral infolding or shifted medially) in the specimens examined in this study and were not described in the publications of previous authors for any of the species of the genus.

Paramere (Fig. 10D–G) of sulcatus-type, differing from parameres of *Halys* taxa examined here and from those of other congeners, depicted by Salini (2019), in having following characters. Hypophysis short; its dorsal and posterior margins converging, apex broadly rounded, anterodorsal angle widely rounded, rather strongly projecting, anteromedial margin very short, dorsal margin long, very slightly concave, anteromedial and dorsal margins located almost at right angle to each other. Denticle of anterior margin of hypophysis located almost at extreme apex; in medial view, visible against light, denticle located at level of hypophysis posterior margin.

Aedeagus (Fig. 8B, C). Anterior branch of each ventrolateral lobe of conjunctiva shorter than that of specimens examined here and less strongly curved medially. Apical lobes diverging at base, with parallel apical parts, each with equal conical branches diverging at acute angle. Apical margins of apical processes of ventral lobe convex, without notch.

**Remark.** Some parameres of *H. serriger*, syn. resurr. (here as syn. of *H. sulcatus*) figured by Ghauri (1988: figs. 38, 39, 43; specimens from “Tinnevelly” [Tirunelveli] and Sri Lanka) are similar to the parameres of the new species, as far as these drawings allow us to judge the similarity. Unfortunately, Ghauri did not figure the pygophores of the corresponding specimens in a caudal view, and in his very brief descriptions of the terminalia, he did not pay attention to the position of the denticles on the outer lateral parts of the pygophoral dorsolateral infolding, but it is quite possible that the specimens from the extreme south of India and from Sri Lanka, examined by him and having such parameres belong to *H. brocchus* sp. nov. It is also worth noting that the pygophore of the Sri Lankan specimen figured by Ghauri (1988: fig. 30) has the same median tubercle of the ventral wall as in the new species, although the shape of this tubercle is variable and a concave or deeply notched apical margin of this tubercle is described here in the specimens Nm1 and Mm5.

**Etymology.** The specific name is a Latin adjective meaning “having projecting teeth, buck-toothed” that reflects the diagnostic character of the species, the denticles protruding beyond the dorsolateral margins of the pygophore.

**Key to the species of the genus Halys** (updated from Salini, 2019)

1(2). Anterolateral angles of pronotum strongly protruding beyond lateral margins of hemelytra; anterodorsal margin of pronotum rather sharply angularly concave. Apex of parameral hypophysis very short, rectangularly rounded; lateral surface of hypophysis with denticle located on its dorsal margin

H. mudigerensis

2(1). Anterolateral angles of pronotum slightly protruding beyond lateral margins of hemelytra (Fig. 2); anterodorsal margin of pronotum slightly concave. Apex of parameral hypophysis more or less elongated, tapering or widely rounded; lateral surface of hypophysis with denticle located on its anterior margin.

3(4). Ventral wall of pygophore without median tubercle near its posteroventral margin; lateral parts of posteroventral margin converging basally. Paramer-
eral hypophysis rather narrow, with pointed apex not bearing distinct denticle, anterodorsal angle of hypophysis not pronounced, anterior margin with denticle approximately in middle, without carina. Anterior parts of gynatrial basal sclerites rather narrow and short, with anterodorsal angles not protruding beyond margins of ring sclerites (Fig. 12D).

\textbf{H. shaista}

4(3). Ventral wall of pygophore with median tubercle near its posteroventral margin (Figs 3, 10A–C). Lateral parts of pygophoral posteroventral margin more or less rectangular. Parameral hypophysis rather wide, with broadly or narrowly rounded apex, sometimes bearing distinct denticle, anterodorsal angle of hypophysis more or less distinct, anterior margin with denticle at base or at distal end of subrectangular carina (Figs 4–7, 10). Anterior parts of gynatrial basal sclerites wide and rather long, with anterodorsal angles protruding beyond margins of ring sclerites (Fig. 12A).

5(6). Smaller, 16.30 mm. Each outer lateral part of pygophoral dorsolateral infolding with a strong denticle on extreme lateral end (Fig. 10C); denticle clearly visible in dorsal view (Fig. 10B). Anteromedial margin of parameral hypophysis short, located almost at right angle to dorsal margin (Fig. 10D).

................. \textbf{H. brocchus sp. nov.}

6(5). Larger, 16.50–20.63 mm. Each outer lateral part of pygophoral dorsolateral infolding with one or several small denticles (rarely without them) located in middle or medially (Fig. 3, F). Denticles not visible in dorsal view (Fig. 3B, E). Anteromedial margin of parameral hypophysis longer, located at obtuse angle to dorsal margin (Figs 4A, 5A, D, 6, 7).

7(8). Anterior margin of parameral hypophysis at base with short subrectangular longitudinal carina and denticle located at its distal end (Fig. 5C).

................. \textbf{H. sulcatus}

8(7). Anterior margin of parameral hypophysis at base with denticle having distal margin continued into very short, tapering carina (Fig. 4C, F).

\ldots \textbf{H. magnus, nom. resurr.}, species inquirenda

This genus was established by Ahmad & Perveen (1982) for three poorly distinguished species, \emph{N. acuticornis}, \emph{N. longirostratus}, and \emph{N. minirostratus}, described from Pakistan in the same article. Ahmad et al. (1998) transferred \emph{H. serricollis} from \emph{Halys} to this genus. The external morphology of \emph{H. serricollis} was redescribed by Chopra (1974) and Ghauri (1988), and that of the genus by Ahmad & Perveen (1982) and Ahmad et al. (1998). An updated diagnosis of the genus and a more detailed redescription of the male and female terminalia, and measurements of \emph{H. serricollis} are given below.

\textbf{Diagnosis.} \emph{Neohalys} can be distinguished from \emph{Halys} by each lateral margin of head without denticle (Fig. 14) \[vs. with denticle (Fig. 2A)]; pygophoral ventral wall without tubercle near posterior margin (Fig. 15) \[vs. with tubercle (Fig. 3), except for \emph{H. shaista}]; swellings of posterolateral angles of pygophore long in caudal view (Fig. 15C) \[vs. short (Figs 3C, F and 10C)], with ventral ends smoothly tapering \[vs. uniformly wide], dorsal ends broad, having sclerotised areas dorsally \[vs. narrower, without such areas], and medial surface bearing rather large denticle \[vs. smooth]; lateral parts of pygophoral posteroventral margin narrow in caudal view, oblique in ventral view \[vs. wide in caudal view, rectangular in ventral view, except for \emph{H. shaista}, according to photos by Salini (2019)]; posterodorsal margin of pygophore slightly convex, not notched in middle (Fig. 15B) \[vs. with median notch and tubercles on its sides, except for \emph{H. shaista} (?) (Figs 3B, E, 10B)], without notches at lateral ends \[vs. with notches]; margins of ventrolateral infoldings with denticles (Fig. 15A) \[vs. without denticles, except for \emph{H. mudigerensis}]; dorsolateral infolding not clearly differentiated into median and lateral parts \[vs. with such differentiation (Figs 3C, G, and 10C)], laterally not differentiated into oblique outer and deeply concave inner areas \[vs. with such differentiation in \emph{H. sulcatus}, \emph{H. magnus}, and \emph{H. brocchus sp. nov.}]; state of character unknown for \emph{H. mudigerensis} and \emph{H. shaista}, bearing sharp denticle ventrally at each side near paramere socket \[vs. without such denticle] and carina ventral to each of these denticles \[vs. without such carina]; ventral wall of pygophore without a pair of small membranous fenestrae near middle of posterodorsal margin \[vs. with such fenestrae].

\textbf{Genus} Neohalys Ahnmd et Perveen, 1982

\emph{Neohalys} Ahmad et Perveen, 1982: 1. Type species: \emph{N. acuticornis} Ahmad et Perveen, 1982, by original designation [junior subjective synonym of \emph{Halys serricollis} (Westwood, 1837), this article].

\emph{Neohalys} Azim, 2002: 43–44 (as subgenus of \emph{Halys}), \textbf{syn. nov.} Type species: \emph{Halys parvus} Chopra, 1974, by original designation. New junior subjective synonym and junior homonym.
Hypophysis of paramere small (Fig. 16) [vs. large (Figs 4, 5 and 10)], flattened laterally, without lamellar margins [vs. trihedral in cross-section, with broad lamellar anterior and dorsal margins]; medial surface of hypophysis convex [vs. flat]; denticle on anterior margin of hypophysis located very close to its apex [vs. more or less distant from apex in Halys, except for H. mudigerensis and H. broccus sp. nov.]; medial margin of dorsal wall of parameral corpus not continued on hypophysis [vs. shaped as carina extending into anteromedial margin of hypophysis]; basal plate small [vs. large].

Theca of aedeagus rather narrow (Fig. 17) [vs. wider (Fig. 8)]; anterior branches of conjunctival ventrolateral lobes short, not curved medially [vs. long, curved medially], posterior tubercles rounded, rather large [vs. conical, small]; apex of conjunctiva at base of ventral wall without median tubercle [vs. with tubercle]; apical lobes directed posteriorly, parallel, not branched [vs. directed dorsally, diverging or crossing, with two branches]; sclerotised bands on dorsal wall of conjunctiva almost parallel [vs. converging basally]; apical processes of ventral wall together forming tube-like structure [vs. spoon-shaped structure]; vesica not protruding beyond margins of apical processes [vs. clearly protruding].

Ventral surface of each gonocoxite I with transverse roof-shaped convexity (Fig. 18) [vs. uniformly weakly convex (Figs 11, 13)]; median plate short, without tubercles [vs. relatively long, with tubercles on anterolateral corners]; vestiges of gonapophyses I absent [vs. present]; anterior parts of gynatrial basal sclerites narrow (Fig. 19A) [vs. wide in H. magnus and H. sulcatus (Fig. 12A)]; medial margins straight anteriorly [vs. convex], posterior parts of basal sclerites long [vs. short]; middle part of spermathecal duct short (Fig. 19B), from anterior margin of ventrite VII to, at most, middle of ventrite IV [vs. long (Fig. 12D), to, at least, middle of ventrite III], posterior end of mediodistal part of duct straight or slightly curved, slightly elongated, not deeply entering proximal part of duct [vs. highly elongated, sharply curved, deeply extending into proximal part of duct], external distal part of duct short [vs. long].

**Neohalys serricollis** (Westwood, 1837) (Figs 14–19)

*Halys serricollis* Westwood, 1837: 23.
*Halys parvus* Chopra, 1974: 478.
*Neohalys acuticornis* Ahmad et Perveen, 1982: 3, syn. nov.
*Neohalys longirostratus* Ahmad et Perveen, 1982: 4, syn. nov.
*Neohalys minirostratus* Ahmad et Perveen, 1982: 5, syn. nov.

**Material examined.** India: Delhi, 29.IX.1957, Aleksandrov leg., 1 female; West Bengal, Kolkata, 4.II.1964, N. Borchsenius leg., 2 males, 2 females; Tamil Nadu, Mandapam, 14.I.1964, N. Borchsenius leg., 1 male.

**Measurements** (in mm). *Males*: body length 13.10–13.70; head length 3.60–3.88; head width 2.55–2.68; synthlipsis 1.55–1.60; ocular index 2.93–3.10; lengths of antennal segments I–V 0.70–0.83 : 1.63–1.88 : 1.68–1.80 : 1.80–1.90 : 1.45–1.50; pronotum length 2.70–2.85; pronotum width 6.05–6.45; abdomen length 6.90–7.50; scutellum length 4.55–4.85; scutellum width 3.65–3.90. *Females*: body length 15.20–16.10; head length 3.88–4.08; head width 2.80–2.90; synthlipsis 1.63–1.70; ocular index 2.88–2.89; lengths of antennal segments I–V 0.75–0.88 : 1.55–1.85 : 1.65–1.88 : 1.78 : 1.45; pronotum length 3.05–3.30; pronotum width 6.80–7.15; abdomen length 8.80–9.20; scutellum length 5.40–5.90; scutellum width 4.10–4.35.

**Redescription of male terminalia.**

**Pygophore** (Fig. 15) about 1.17 times as wide as long, slightly flattened dorsoventrally. Its lateral walls parallel distally, sharply rounded at base. Ventral wall in apical part with large shallow depression, its proximal margin widely rounded and smoothed; ventral wall of this depression horizontal, quite long, with widely parabolic, membranous median fenestra reaching base of depression, with smoothly concave, not notched posterior margin, without any tubercle. Posterolateral angles of pygophore rounded, not projecting laterally, slightly projecting caudally, with swellings, dorsal ends of which, in caudal view, widened, widely rounded, strongly sclerotised dorsally, each

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**Fig. 14. Neohalys serricollis** (Westwood, 1837), habitus of the male from Mandapam (A, B) and the female from Kolkata (C, D) in dorsal (A, C) and ventral (B, D) view.
with broad, strongly sclerotised denticle on medial surface, directed caudomedially, clearly visible in dorsal view; ventral ends, in caudal view, strongly tapering, passing into thin lateral parts of pygophoral posteroventral margin; caudal surfaces of swellings uniformly convex, inner walls vertical, almost parallel to outer ones. Lateral parts of posteroventral margin of pygophore located obliquely regarding sagittal plane; in ventral view, oblique, converging to base of depression of ventral wall. Median part of posteroventral margin smoothly concave, without median notch, looking like continuation of ventrolateral infoldings, not connected with lateral parts of posteroventral margin. Posterodorsal margin of pygophore located slightly above (posterior to) medial part of posteroventral margin, slightly convex laterally, with two wide, shallow concavities medially, separated by barely convex part. Ventrolateral infoldings lamellar, rather narrow and long, located at slight angle regarding to dorsoventral plane of pygophore, their medial margins oblique (converging basally), caudal margins short, without carinae near swellings; angle formed by caudal and medial margins, triangular, rather long and wide, directed caudomedially. Dorsal and lateral infoldings not delimited from each other. United dorsolateral infolding wide laterally, tapering medially, there rather narrow. Its area along genital opening strongly sclerotised, with clear outer margins and slightly depressed surfaces; ventral ends of this area long, each bearing one long, sharp, highly sclerotised denticle being almost adpressed, slightly elevated above transverse plane, directed laterally and slightly ventrally. Ventral to this denticle, transverse, highly sclerotised carina, reinforcing margin of paramere socket, and looking like broad, short denticle in dorsal view. Lateral areas of dorsolateral infolding normally sclerotised, smooth, each with shallow depression at level of aforemen-

**Fig. 15.** Pygophore of *Neohalys serricollis* (Westwood, 1837) (Kolkata) in ventral (A), dorsal (B), and caudal (C) view. Abbreviations: *d-l. i.* – united dorsolateral infolding; *l. p.* – lateral parts of posteroventral margin; *swl.* – swellings of posterolateral angles; *v-l. i.* – ventrolateral infoldings. Blue arrow indicates a denticle at the ventral end of dorsolateral infolding; red arrow shows a carina on the dorsal margin of the paramere socket. Scale bar: 1 mm.
tioned sharp denticle. Ventral margin of dorsolateral infolding raised, roof-shaped in medial part, looking like low, broad, triangular tubercle in dorsal view. Dorsolateral walls of pygophore near each swelling with very thin, transverse, weakly sclerotised area; dorsal wall without a pair of desclerotised fenestrae near middle of posterodorsal margin. Genital opening large, transverse, widely rounded in dorsal part. Distal areas of ventral and lateral walls of pygophore covered with rather large punctures, becoming smaller and sparser in basal direction, coalescing at depression of ventral wall; caudal surfaces of swellings of pygophoral posterolateral angles densely covered with rather large punctures; dorsal wall of pygophore covered only along posterior margin with small coalescing punctures and several scattered punctures on distolateral areas. Pygophoral posterovertrnal margin in its lateral parts, margins and ventral surfaces of distolateral infoldings, swellings, posterodorsal margin of pygophore, and inner part of dorsolateral infolding covered with setae. These setae short on lateral surfaces of swellings, long semierect, directed ventrally on their caudal surfaces, long erected, directed medially on medial surfaces; long, erected and dense on its lateral parts of posterovertrnal margin, on caudal margins of ventrolateral infoldings, on posterodorsal margin and inner area of dorsolateral infolding; shorter and sparse setae on surfaces and medial margins of ventrolateral infoldings. Distal part of pygophoral dorsal wall covered with very short, sparse, adpressed setae.

**Paramere** (Fig. 16). Basal plate rather small, narrowly diamond-shaped, strongly narrowed ventrally. Corpus of paramere moderately long and wide, strongly flattened laterally, with almost parallel dorsal and ventral margins. Its medial wall concave; dorsal wall with parallel margins, bearing several long adpressed setae at base and several raised setae in distal part at lateral margin. Medial margin of dorsal wall with long, rather high longitudinal carina, not extending on hypophysis; margin of this carina arcuate or trapezoidally rounded in ventral view. Sensory tubercle absent. Hypophysis short, flattened laterally, located in sagittal plane of parameral corpus at obtuse angle to its longitudinal axis. Posterior and anterior margins of hypophysis parallel, apex rounded. Posterior margin straight or slightly concave subapically. Anterior margin distally forming broad, short, highly sclerotised, flattened denticle directed slightly laterally. Lateral and anterior surfaces of denticle covered with microsculpture. Lateral wall of hypophysis covered with sparse, relatively short, semiraised setae directed ventrally; posterior or margin and medial surface covered with slightly shorter, raised setae.

**Aedeagus** (Fig. 17). Phallobase as in *Halys*. Theca narrower than in species of *Halys*, in ventral view, sharply widening from narrow base, reaching greatest width approximately in middle, slightly narrowing distally; ventral wall almost straight, slightly concave at base; dorsal wall convex at base and in middle, almost straight in distal part. Basal tubercles membranous, rather small.

Conjunctiva small. Ventrolateral lobes rather small, triangular, elongated at base along axis of aedeagus, swollen, each with rather large, widely rounded posterior tubercle near base of median penial plates; in anterior part (facing base of aedeagus), lobe with rather short, triangular branch directed anteriorly, adpressed to wall of theca, with small triangular, slightly sclerotised plate medially at extreme apex. Apex of conjunctiva short, rather wide, without median tubercle on ventral wall, with two long, thin, straight apical lobes directed posteriorly along axis of aedeagus; medial walls of lobes convex, contiguous in middle, apices strongly tapering, curved medially, not branched. Dorsal wall of conjunctiva with a pair of longitudinal, rather wide and strongly sclerotised, parallel bands, distal ends of which narrowing, weakly sclerotised, diverging, basal ends triangularly rounded, connected by short fold of conjunctival wall, slightly overlapping apical margin of theca. Ventral lobe narrow, rather long, directed ventrally and slightly towards base of aedeagus. Median penial plates, in posterovertrnal view, completely fused, their lateral walls almost parallel, converging at extreme base and slightly diverging distally. Apical processes long, widening distally, forming together tube-like structure, their posterior margins located close to each other, slightly diverging; dorsal margins contiguous at the base, slightly diverging only in extreme distal part; apical margins strongly convex, sharply curved laterally like infoldings, without notches. Ventral lobe without...
membranous tubercle at base of vesica. Vesica very thin, short, c-shaped throughout, with apex directed ventrally, not protruding beyond ventral margins of apical processes.

**Redescription of female terminalia** (Figs 18, 19). Gonocoxites I slightly wider than long, their posterior margins narrowly membranous except extreme lateral ends, slightly concave medially, more or less convex laterally, with lateral ends smoothly curved dorsally, most lateral part of margin straight; medial margins straight; lateral margins very short, slightly convex; antero- and posteromedial angles rectangularly rounded; posterolateral angles widely rounded; ventral surfaces strongly convex, roof-shaped posterior to middle of length, densely punctured in medial and posterior parts, with large dark area at posteromedial corner or entirely black except for extreme anterolateral areas, covered along posterior and medial margins with short thin setae being directed posteriorly. Median plate (fused gonocoxites II) short (shorter than what is typically seen in species of Halys), wide, with straight posterior margin; very slightly concave or straight posterior margin; smoothly converging, slightly convex lateral margins; sharply rounded anterolateral angles and widely rounded posterolateral ones; surface weakly and uniformly convex, punctate, covered with short, thin setae especially dense at anterior margin. Paratergites IX with ventral surfaces anteriorly slightly concave, covered with short setae directed posteriorly, with straight lateral and medial margins, acutely rounded posterior ends significantly protruding beyond posterior margin of proctiger. Paratergites VIII quite long, approximately 1.2 times as wide as long, not fused with each other, connected by narrow membrane with weakly sclerotised triangular median sclerite, their common posterior margin convex. Second rami short, narrow, extending obliquely anterolaterally from anterolateral angles of median plate, significantly not reaching anterior margins of paratergites IX. Triangulum large, with broadly trapezoidally rounded posterior margin having small notch in middle, weakly sclerotised in anterior part, with long membranous area along entire posterior margin. Vestiges of gonapophyses I absent.

Gynatrial sac of general structure as in Halys. Lateral pouches wide and long, contiguous, rounded anteriorly; median pouch absent; posterior margin almost straight, with lateral parts slight-
ly converging anteriorly. Arcus 1.00–1.18 times as long as wide, narrow anteriorly, with strongly diverging lamellar posterior arms, its lateral margins concave posteriorly. Annular sclerite, in dorsal view, rather small (smaller than in *Halys*), longitudinally oval, tapering anteriorly, slightly widened posterior to middle; ventrally, shaped as short papilla with sclerotised lateral and posterior walls and membranous anterior wall; opening of spermathecal duct located at its sclerotised apex. Ring sclerites smaller than in *Halys*, with thicker margins. Basal sclerites relatively long and narrow. Their anterior parts narrowly triangular, with anteromedial angles not pronounced, rectangular; anterolateral angles short, broadly acute, directed laterally; medial margins almost straight, parallel anteriorly, slightly diverging posteriorly; lateral margins sharply converging anteriorly, then

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**Fig. 17.** Completely inflated aedeagus (without phallobase) of *Neohalys serricollis* (Westwood, 1837) (Kolkata). Ventral (A), lateral (B), and dorsal (D) view. Abbreviations: a. br. – anterior branches of conjunctival ventrolateral lobes; a. l. – conjunctival apical lobes; a. pr. – apical processes of conjunctival ventral lobe; d. b. – sclerotised bands on conjunctival dorsal wall; p. t. – posterior tubercles of conjunctival ventrolateral lobes; ves. – vesica. Scale bar: 0.25 mm.
concave, c-shaped. Posterior parts of sclerites not reaching anterior margin of median plate, quite wide, shaped as pike pole, their lateral projections long and wide, pointed, directed anterolaterally, posterior ends of sclerites elongate, acute-angled. Completely straightened proximal part of spermathecal duct reaching middle of ventrite VI, slightly widened at extreme distal end. Middle part of duct short, having length from anterior margin of ventrite VII to anterior margin of ventrite V, beyond which slightly extending or reaching middle ventrite IV. Medioproximal part of duct smoothly widening anteriorly and gradually narrowing posteriorly. Mediodistal part of duct narrow, parallel-sided, with very narrow, straight or slightly curved posterior end slightly extending into proximal part of duct, and with widenings near posterior end and at extreme anterior end. External distal part of duct short, 0.21 times as long as mediiodistal part. Pump quite long, its proximal flange smaller than distal one, with straight margins, margins of distal flange slightly proximally curved. Capsule small, slightly longitudinally rounded, tapering basally, with two or three curved processes.

Variability. In a specimen from Delhi, posterior margins of gonocoxites I less convex laterally; anterior margin of median plate concave; arcus longer; parts of basal sclerites with longer and wider projections rounded apically and with medial margins concave near posterior ends; mediodistal part of spermathecal duct longer (to middle of ventrite IV), with elongate and slightly curved posterior end; spermathecal capsule with two long and one short processes. In a specimen from Kolkata, posterior margins of gonocoxites I more convex laterally; anterior margin of median plate straight; arcus as long as wide; posterior parts of basal sclerites with shorter and narrower projections pointed apically and with straight medial margins; mediiodistal part of spermathecal duct shorter (slightly extending beyond anterior margin of ventrite V),

Fig. 18. External female terminalia of Neohalys serricollis (Westwood, 1837) (Kolkata) in ventral view.
with shorter, straight posterior end; spermathecal capsule with two long processes.

Notes. (A) Ahmad & Perveen (1982) erected the genus Neohalys for three species, *N. acuticornis* (type species), *N. longirostratus* and *N. minirostratus*, all from Pakistan. *Halys serricollis* Westwood, 1837 was transferred to *Neohalys* by Ahmad et al. (1998). The first three species were described on the basis of highly variable characters, as can be seen in the nearest genus *Halys*: the length of the juga relative to clypeus; the ratio of the lengths of antennal segments II and III; the length of the labium relative to the abdominal segments; the length of hemelytra relative to the abdominal length; the connexivum well-exposed or only slightly exposed; the shape of the posterodorsal margin of pygophore (medially with wider conical projection or with bilobed projection); the shape of the posterior margin of parameral hypophysis (sinuate or notched in middle, or straight); the shape of the membranous conjunctival appendages (uniformly thin or with straight subacute apices, or with curved subacute apices); and the number and length of processes of the spermathecal capsule (two lateral processes of almost equal size or two lateral and one apical processes). The authors did not take into account the shape of the posterior margins of gonocoxites I and some other characters mentioned in the descriptions when comparing species and creating the key. This may be due

Fig. 19. Parts of the female terminalia of *Neohalys serricollis* (Westwood, 1837) (Kolkata). A, gynatrial sclerites, dorsal view; B, spermatheca, dorsal view; C, magnified spermathecal pump and capsule of specimen. Abbreviations: *ann. s.* – annular sclerite; *arc.* – arcus; *b. s.* – basal sclerites; *pr. / mdl.* – boundary between proximal and middle parts of spermathecal duct; *r. s.* – ring sclerites; *V–VII* – corresponding abdominal ventrites. Scale bars: 0.50 mm (B), 0.25 mm (A, C).
to the fact that the corresponding structures were not described quite reliably. The specimens examined in this study show much variability in most of the listed characters, not counting, of course, the shape of the parts of conjunctiva, which cannot be studied correctly from incompletely inflated aedeagi. The specimens examined in this study cannot be identified using the key provided by Ahmad et al. (1988) because they have a different combination of states of variable characters. For example, in these specimens, the juga are significantly shorter than the clypeus, coupled with antennal segment II shorter than segment III, and the connexivum nearly completely exposed; the jugae are slightly shorter than the clypeus, coupled with antennal segment II clearly longer than segment III; and the connexivum almost completely unexposed, coupled with the same ratio of segment lengths. Thus, it is impossible to pass even the first dichotomy of the key. The labium in the specimens examined in this study reaches the middle of ventrite VI or the anterior margin of ventrite VII, or nearly to it, or slightly extends beyond it, which corresponds to the states of the main diagnostic character of the two species, *N. minirostratus* (“labium reaching to 3/4 length of 6th abdominal sternum”) and *N. acuticornis* (“labium reaching to only slightly beyond the anterior margin of 7th abdominal sternum”). I have no doubt that the character of the third species, *N. longirostratus*, (“labium reaching to at least 1/2 length of the 7th abdominal sternum”) also fits within the variability of a single species. For the reasons mentioned above, I consider the names *Neohalys acuticornis* Ahmad et Perveen, 1982, *N. longirostratus* Ahmad et Perveen, 1982 and *N. minirostratus* Ahmad et Perveen, 1982 to be junior synonyms of *N. serricollis* (Westwood, 1837).

(B) In 2002, Azim established the monotypic subgenus *Neohalys* in the genus *Halys* with the type species *Halys parvus* Chopra, 1974 [junior synonym of *N. serricollis* (Westwood, 1837)]. *Neohalys* Azim, 2002 is a new junior homonym and a junior subjective synonym of *Neohalys* Ahmad et Perveen, 1982. Downgrading the rank of the taxon containing *N. serricollis* to a subgenus of *Halys* seems to be unfounded, since this taxon has very clear and significant differences from *Halys* in the structure of the pygophore, parameres, and spermatheca.

Acknowledgements

I am sincerely grateful to David Rider (North Dakota State University, USA), Peter Kment (National Museum, Czech Republic), David Redei (National Chung Hsing University, Taiwan), and Santhamma Salini (National Bureau of Agricultural Insect Resources, India), who took the time to read the manuscript. Their valuable advice and corrections were very helpful and contributed to improving this article. Also, David Rider provided valuable assistance by supplying copies of some hard-to-find publications and a part on *Halys* from his renowned but unpublished catalogue. And besides, I am very grateful to the editor of this article for his invaluable help in its publication.

The work was based on the taxonomic collection of ZISP and performed in the frames of the State Research Project No. 122031100272-3.

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Received 2 December 2023 / Accepted 30 December 2023. Editorial responsibility: A.A. Przhiboro