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The *Chrysis ignita* group considered in a British context

Michael E. Archer

David Baldock has asked me to comment on the translation of Kunz's text on the *Chrysis ignita* group. I am responsible for the eventual mapping of the species in this group so it is necessary to make some decisions, before the records are collected for mapping purposes.

First we must thank Margarete Earle for carrying out the translation and Robin Williams for typing out the translation.

Morgan (1984) is the standard reference for the British chrysids and he differentiates ten species in the *Chrysis ignita* group: *Chrysis fulgida, C. pseudobrevitarsis, C. mediata, C. ignita, C. impressa, C. schenki, C. angustula, C. rutiliventris, C. ruddii, C. longula.* Kunz's (1994) recognises four species: *Chrysis fulgida, C. pseudobrevitarsis, C. mediata, C. ignita.* Thus seven of Morgan's species are included within *C. ignita*, although Kunz allows *ruddii* and *longula* as varieties within *C. ignita*. Linsenmaier (1977) recognises eight species of Morgan's ten with *C. impressa* and *C. schenki* included within *C. ignita*. It would be good to have a translation of the relevant part of Linsenmaier's key. Kimsey & Bohart (1990) is mainly concerned with a generic revision of the world genera of the chrysids but does list the species of each genus. Kimsey & Bohart list eight species as per Linsenmaier (1997). Thus there is a range of opinions by the various authors. I would be grateful of any discussion to help me come to a working solution that will be needed before the species can be mapped.

The problem is, therefore, to decide between Morgan's ten species and Kunz's four species or accept some intermediate number of species. I think difficulties may arise because some specimens fall between two of Morgan's species, e.g. *ignita* and *impressa*, *impressa* and *angustula*, *rutiliventris* and *impressa*. I would welcome your argued opinions on this problem particularly if published in the Newsletter.

I have been studying specimens that has been identified by G.M. Spooner (who, by the way, recognised a further two species, so Morgan's ten species becomes 12 species) and D. Morgan. Certainly the ten species of Morgan can be recognised although my experience of *C. schenki* is limited and the concept of *C. rutiliventris* I sometimes find difficult to grasp. I have found that my concept of *C. rutiliventris* does not agree with that of Linsenmaier! I am trying to define each of Morgan's ten species so that the recognition of the intermediates, if they exist, can be assessed with some confidence. If the intermediates can be established then a case can be made to reduce the number of Morgan's ten species. Of course, you may consider that Kunz (1994) has already carried out this research. Certainly the translation is to be welcomed as it should concentrate our thoughts on the problem.

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Translation from, **Die Goldwespen Baden-Württembergs by Peter X. Kunz**
Translated by Margarete Earle and typed by Robin Williams

[The book is available for £12 + p&p from Ian Johnson (Pemberley Books) P.O. Box 334, Hayes, Middlesex UB4 0XX Tel/fax: 0181 561 5494 email: ij@pembooks.demon.co.uk and is excellent value for money - Editor]

3.7, The *Chrysis ignita* Group

(P.25) Linné described *Chrysis ignita* in 1761. Probably as early as some decades later, problems developed which even today have not been finally resolved. According to LINSENMAIER'S system, about 16-18(!) species and sub-species in Germany are closely related to *ignita* and even LINSENMAIER himself does not wish to commit himself as to the status of many forms. Added to this, in the 'wider' *ignita* group, are the species *Chrysis indigotea, C. iris, C. fulgida, C. immaculata*, which can be differentiated from the closer *ignita* group by their colouring but which, on the evidence of their morphological characteristics and biology show a great family similarity.

(P.26) -3, 7, 1, Differences in colour distribution.

Colour patterns which are clearly recognisable and which deviate from the typical *ignita* colouring, are the completely blue-green colouring of *C. iris* and *C. indigotea*, as well as the colouring of *C. fulgida* and *C. immaculata*, with their blue-green first tergite. These constant colours on the tergites allow us to determine these forms, and, as at present we have to content ourselves with being able to determine a morphospecies, those species that can be determined this way should be allowed to keep their status.

 The red or green-golden bands on the thorax or sternites of some species are useless characteristics for determination, as they vary considerably in extent as well as colour-shade. The red patches on the legs of *C. ruddii* are, although very striking, only a weak criterion for determining the species. Firstly this extreme colouring is not always present, less extensive red colouring of the legs and sternites is not rare in *C. ignita* while secondly an interesting experiment can be reported. When soaking *C. ignita* specimens in a water-bath for preparation of the hidden segments, on several occasions a specific phenomenon was seen. Because of the effect of the warm water, previously normally green-coloured *C. ignita* specimens turned a brilliant metallic red, especially on their legs and faces, as well as showing red patches on the thorax. When viewed from below, they looked like *C. ruddii*. On drying out the red colouring disappeared. The specimens which underwent this colour change were in a minority; in most cases only a darkening of existing colours could be observed in the damp state. Nevertheless this chance observation sheds a new light on the characteristics of the red legs of *C. ruddii*. If, as it appears, such red patches are dependent on the water content at a given moment, that is to say on the capacity of the refractory layers of the cuticle to expand, the obvious explanation , they can at best only be taken into account of in the living insect. And even here there is a counter argument! For example, in *C. bicolor* there is also strong variability in the extent of the red patches on the legs which does not correspond with the present separation into *C. bicolor* and *C. hellenii* and, very wisely, has not been used as a determining criterion in the literature. The red legs of *C. ruddii* must therefore be put into doubt as a characteristic of the species.

3, 7. 2 Punctuations

It is now certain that punctuations are no safe criterion for determination in the *C. ignita* group. If one looks at the various forms, in large numbers, without preconceived ideas, one has to state that all imaginable variants between the described extremes exist. This applies to the abdomen as well as the thorax. *C. ruddii*, with its characteristically dense punctuations on the tergites, is also connected to *C. ignita* via transitional forms (*C. rutiliventris*). The punctuations cannot be recorded by measuring and counting techniques, as in every specimen, in addition to the large clearly visible punctuations, considerably smaller to tiny impressions can be found, where one cannot determine from what size upwards they are to be counted as punctuations.

(P.28) 3, 7,3 Length of Tarsi and Spurs.

Up to now, the two species*, C. brevitarsis* and *C. pseudobrevitarsis,* have been determined on the basis of their short tarsi and the spurs of the middle legs, which are of equal length. But closer observation leads me to conclude that the two spurs of the middle leg of *C. brevitarsis* and *C. pseudobrevitarsis* are never really equally long (according to the material available to me). The front spur is always slightly shorter and somewhat thinner than the hind spur. In addition, in the *C. ignita* group, there are front spurs present which are only half as long as the hind spurs. The length of the spurs cannot be unequivocally ascribed to the described taxa.

The claimed different lengths of the leg segments of some forms and species turned out to be an optical illusion when actual measurement took place. As an example, Diagram 15 (P.28) shows the result of measuring the hind tibiae. Even *C. brevitarsis* is exactly on the regression line which can be drawn through the proportions of the whole genus of *Chrysis*. A mistake in determining the specimens can be excluded, as the species can be accurately determined by the look of the mandible and the wider ovipositor of the ♀.

3, 7, 4. Further Body Proportions.

The clearest proof that the body proportions do not lend themselves to a clear separation is the dendogram of Diagram 14 (P.26), which compares the correlation coefficients of all 21 measurments between 42 measured specimens from 15 different species or forms (including specimens of species outside the *C. ignita* group) and in which a total correlation of more than 98% **(P.29)** is calculated. This means that all measurements, including all measured characteristics published for the *C. ignita* group, are unsuitable for separation of the species. At least the systematically more distantly related species *C. radians* or *Pseudospinola neglecta* stand out from the mass of data if one looks at the correlation of the distance of the eyes/to width of the head and height/length of the discoidal cell (Diagram 19, P. 30 and 18, P.30)). These are the two species which the computer shows somewhat further away from the other species on the dendogram (Diagram 14, P.27)). But this **(P30)** separation is not statistically valid either, as the bifurcation is at a difference of the correlation coefficients of less than 0.020. The significant threshold for an error probability of 1% is at least 0.3932 (value from CAVALLI-SPAZA 1969), which, transferred to an A-4 format is more than 2 metres to the right of the margin of a piece of paper.

(P.31) -One reason why I classify the two forms, *C. longula* and *C. ruddii*, as variations and not as synonyms is that I do not wish to just pass over certain morphological characteristics, even though they are too weak as criteria for separating species. These are, for example, the distance between the ocelli and between the ocelli and the eyes (see Diagram 20, P.31).

According to the range of data calculated by the computer (prediction probability of 95%, marked with little strokes in the Diagram 20, P.31) and named *ignita, longula* and *ruddii*), *C. longula* has a larger distance between the hind ocelli, compared with the distance from hind ocelli to eyes, than *C. ignita*; while *C. ruddii* has about the same ocelli-ocelli distance, but a greater ocelli-eye distance than *C. ignita*. However the range of tolerance (+-2 units in each case) which is shown in the lowest *C. ruddii* data shows that the distance of the calculated punctuation clouds (ovals) for the three forms is smaller than the tolerance range (refers to diagram 20, P. 31)**,** which makes a separation into species on the basis of these proportions untenable, especially as the values for *C. rutiliventris vanlithi* (shown in Diagram 20, P.31, as empty quadrats) link the two ovals surrounding the plots for *C. longuli* and *C. ruddii*.

3, 7, 5. Sexual Appendages.

There has been little knowledge to date of male sexual appendages and ovipositors. Such examinations are time-consuming and carry the risk of losing collection specimens, so that hardly any curator or private collector is prepared to carry them out on a large scale. LORENCOWA (1962) and NOSKIEWICZ & LORENCOWA (1963) have published some drawings of the hidden segments of Chrysids. Their drawings have been the basis for my own examinations of the hidden segments of some forms. These examination confirm the diagrams of the above-named authors to a large degree, even though I think some of their conclusions over-emphasise slight deviations between some forms.

Females (♀)

The variability of the hidden segments lies to a great extent in the different degree of their sclerotisation, which fluctuates individually within the various forms. This makes it difficult to compare lobes, indentations or hairs of the segments. On the whole, the outlines within a form are constant. In a small series of *C. ignita* ♀ from one location which I examined, the segments were identical. When these were compared with specimens from other locations, insofar as they could be determined externally as *C. ignita* from the key presented here, they were only insubstantially or not at all different either. However the shapes of segments vary between the species. For example *C. fulgida* has, compared with *C. ignita*, slightly wider and more obtuse segments, which are in between those of *C. ignita* and *C. mediator* or *C. brevitarsis* and others. On the other hand, in *C. brevitarsis* ♀ (Diagram 330, P.172) and *C. pseudobrevitarsis* (Diagram 331 P.172), these segments are clearly different from *C. ignita*, though *C. pseudobrevitarsis*, when viewed externally, seems to be positioned between *C. ignita* and *C. brevitarsis* and in some cases cannot be determined without preparation of the genitalia.

The wider and darker segments of ♀ *C. mediata* (Diagram 141, P.63, & 325, P.169) are rather striking and can be recognised from the outside, even if the ovipositor is only moderately extended. These, in addition to specialisation in certain species of *Odynerus*, are an acceptable argument to consider *C. mediata* as a separate species. However *C. obtusidens, C. indigotea* (Diagram 329) and *C. valida* also have wider ovipositors. The difference in ovipositors between these species cannot be recognised without preparation. Transitional forms e.g. with the exterior appearance of *C. ignita* and 'segments which are half the width' could not be found. This is why I consider the wider ovipositor to be a good criterion to differentiate the species in the *C. ignita* group. In the case of *C. ruddii*, I cannot confirm the statements made by NOSKIEWICZ & LORENCOWA (1963). These authors believe that *C. ruddii* must be attributed to a different group which is closely related to the *C. ignita* group. Their main argument is the frontal lobe on the fifth tergite which is divided into two parts (Diagram 21e, P.32, see arrow). I examined 6 ♀ *C. ruddii* randomly selected from different locations (examples are Diagram 21, P.32, & 326, P.170) and could not find clear differences from *C. ignita* on any of the segments.

Males (♂).

Dealing with ♂, the first difficulty is to determine some forms at all. Viewed externally, in many instances there is no clear difference between *C. ignita, C. mediata, C. pseudobrevitarsis, C. longula* and others. Observation of ♀ and ♂ flying together does not supply the desired evidence either, because, as explained further on, several *C. ignita* forms may fly in the same habitat at the same time. With this in mind, the drawings of the male genitalia segments published by NOSKIEWICZ & LORENCOWA (1963) are to be treated with reservations as far as determination is concerned. However one thing is clear from the drawings, which my observations have confirmed; the differences in the hidden segments of the ♂ are restricted to the 8th sternite and even there they are small and open to interpretation, so that these examinations do not provide safe criteria for separating the species.

A comparison (Diagram 22) between the drawings of NOSKIEWICZ & LORENCOWA (1963) and the segments I prepared, clearly shows how unsafe systematic statements on the basis of male genital segments are at present.

(P.34) -For the two *C. mediata* ♂ which I prepared, there are ♀ caught at the same time, here the probability is great that the determination is correct. For the *C. pseudobrevitarsis* ♂ there are no such ♀ available and there is only a probability that the determination is correct.

The most important determining characteristic is, I repeat emphatically, the shape of segments 5 & 6 in the ♀. On this basis the specimens can be divided into two main groups: on the one hand species with a narrow ovipositor, such as *C. ignita*, and, on the other hand, specimens with a wide ovipositor similar to *C. mediata*; *C. fulgida* should be included in this group. The larger number of species belong to the second group and in this group little is known about the biology of the species apart from *C. mediata.* In the group of forms with a narrow ovipositor, the state of knowledge is somewhat better. It has become evident that most of the described species, including *C. ruddii*, belong to the *C. ignita* species. Not enough is known about *C. iris*, which continues to be treated as a separate species, as it can be determined safely. Table 1, P.35, is a survey of the most important morphological characteristics of the forms of the *C. ignita* group which can be represented +- dichotomously.

3, 7, 6, Way of Life.

It has become evident that research into ecological differences is more important and more promising than further search for morphological characteristics, ecological knowledge being a basic pre-condition for a realistic evaluation of morphological characteristics.

Are the various *C. ignita* forms separated by the preference for certain climatic or landscape conditions? This could at the most be valid for *C. valida*, which is stated to be an Alpine species, but for which no other safe data are available. For all the other forms such **(P.35)** a separation is impossible. This becomes clear from two examples selected from the collected material at my disposal:

a) On 20/6/1943, HOHNDORF caught, at the location Küaberg/Wiesental (which have identical location labels),
C. obtusidens ♀ X 1
C. mediadentata ♀ X 1 (det. LINSENMAIER)
C. longula ♀ X 1
C. impressa ♀ X 1 (det. LINSENMAIER)
C. ignita, several ♂ & ♀

C. impressa ♀ X 1 (det. LINSENMAIER)

only a few days before and afterwards, other specimens caught by the same collector were recorded from the same location:

C. schencki ♀ X 1 (det. LINSENMAIER)

C. angustula, several specimens

C. mediata, several specimens

C. fulgida, very many specimens

C. ruddii. several specimens

b) in the wider Wachtental area (about 20 X 20 km), nearly all forms of the C. ignita group were caught - in the course of several years:

C. angustula

C. fulgida

C. ignita

C. indigotea

C. iris

C. longula

C. mediata

C. obtusidens

C. pseudobrevitarsis

C. ruddii

According to all observations so far, most forms are parasites of solitary wasps (*Eumenidae*) living in stems, they are also found in some *Eumenidae* which live in other hollows apart from stems.

Only the following should be singled out:

C. mediata which appears to parasitise exclusively the endogenous 'chimney-forming' *Odynerus spinipes* and *O. reniformis*. It has been reported that SANDERS in Holland raised *C. mediata* from *Allodynerus delphinalis*, which nests in stems (quoted from LINSENMAIER 1968). As, so far, the wide ovipositor has not been clearly publicised as a decisive criterion, a wrong determination by SANDERS is possible, as the punctuations are sometimes misleading. But if clearly identified *C. mediata* ♀ hatch from nests in stems, the discussion about the species will be re-opened.

It is to be assumed that *C. ruddii* hatches mainly from nests in mortar, but an exclusive restriction to such nests has not yet been proved due to the small number of reared specimens recorded. *C. impressa* has also been raised from an *Ancistrocerus oviventris* nest (LITH 1953). An ecological separation of *C. ruddii* and *C. ignita* by this criterion can therefore not be recognised. A comparison of distribution maps of host and parasite in Baden-Württemberg do not get us any further either. (Maps for *Eumenidae* can be found in SCHMIDT & SCHMITT-EGGES 1991). A proper evaluation is not possible because of the gaps in the records which still exist.

So far I have been fortunate to obtain, on two occasions, specimens of different forms raised from the same nest. In the first case (SCHRAMEYER), *C. sublongula* ♂ hatched from the same *Rubus* stem, which leads us to conclude that both belong to the same species and are possibly even descended from the same ♀, one being a 'starvation' specimen. In the second case (BRECHTEL), *C. longula* ♀ and *C. angustula* ♂ hatched from a single artificial nest on the same day. A mixed nest could of course be assumed, as the host insect is not known, but I have very many identical data available for *C. longula* and *C. angustula* which makes this hatching more than a coincidence.

DIAGRAM HEADINGS & EXPLANATIONS.

Diagram 14, P.27, Dendogram of the measured ♀ of the C. ignita group and comparison specimens of closely and distantly related groups. The explanations given on P.25 for Diagram 13, P.25, apply here as well. The largest calculated difference (which corresponds to the distance of the bifurcation point to the 0.000 -marker) of the correlation coefficients is, in the diagram on the next page, smaller than 0.020. This means that all the measured specimens have a mutual similarity greater than 98%.

P.28,29 Diagrams 15-17. Regression calculations with different measurements each in relation to body size.
    15 length of hind tibia,
    16 width of first tergite,
    17 width of pronotum.

The normal distribution of the data of all measurements used in diagram 15-19 was confirmed by the chi-quadra-test.
- 25 units = 1mm on the specimen.

Diagram 15 (P.28)
length of hind tibia

Body size

Diagram 16 (P.29)

width of first tergite

Body size

Diagram 17 (P.29)

Width of pronotum

Body size

Diagram 18 (P.30)

Length of discoidal cell

Height of discoidal cell

Diagram 19 (P.30)

Distance of ?(between) eyes

Width of head

Diagram 20. (P.31). The distance between the hind ocelli in comparison with the distances between hind ocelli & eyes in some *C. ignita* forms. Above left in the diagram is the tolerance of both measurements. - 100 units=1mm.

Diagram 21. (P.32). Comparison of some characteristic female segments of the *C. ignita* group. The scale below each specimen = 1mm. Drawing **b** is from MORGAN (1984), Drawing **e** from NOSKIEWICZ & LORENCOWA (1963).

Diagram 22. (P.34). 8th sternite of some ♂ of the *C. ignita* group. The drawings with * have been taken from NOSKIEWICZ & LORENCOWA (1963).

Table 1. (P.35). Distribution of characteristics in the *C. ignita* group.

The symbols mean:

- + applies
- ++ applies in a very special way
- - does not apply
- -- is only used in the abdomen spots and means especially fine spots
- If a characteristic for a species is unspecific or too variable, no symbol is marked.

Characteristics:
1. Ovipositor widened
2. segments of the antennae knotty
3. Spurs of middle tibiae nearly the same length
4. Mandible with two teeth of equal length?
5. Hind tibiae wide in comparison with length
6. Punctuations on thorax strikingly dispersed
7. Punctuations on front of tergite 2 rough (course?)(+) or fine (-)
8. Top of abdomen completely green
9. Top of abdomen bicoloured

10. Sternites red

11. Legs strongly coloured red

12. Terminal segments of antennae short

13. Middle section of mesonotum darker than side sections.

KEYS. (P.63)

35. Both spurs of the middle tibia are practically of equal length. 3rd tergite in ♀ in profile varies from a small saddle up to fully convex similar to male. Ovipositor of ♀ wide (in small specimens difficult to recognise without preparation). Antennae +- up to clearly knotty (Diagram 134, P. 62). Mandibles in *C. brevitarsis* with two teeth of nearly equal length at their tip (Diagram 135. P.62), in *C. pseudobrevitarsis* with a simple tip   **36**

• Spurs +- clearly up to very clearly of different length. 3rd tergite of ♀ with a saddle. The ovipositor can be narrow (Diagram 140, P.63) as well as wider (Diagram 141, P.63). Antennae not knotty (Diagrams 136 & 137, P.62). If there is a tooth next to the mandible tip, then it is much smaller than the tip itself **37**

36. (P.64). In both sexes, mandibles clearly have two front teeth, the tips about equally long (Diagram 135, P.62). Punctuations on mesothorax and cuticle strikingly dispersed, with large smooth surfaces between the punctuations. Antennae relatively thick and knotty (Diagram 134, P.62). Hind tarsi relatively wide in relation to their length (Diagram 142d, P.63). Very rare, on *Discoelius*. 5-10mm (P.107)
....*C. brevitarsis*, THS.

• Mandibles simple. Antennae not so clearly knobbly. Punctuations on the thorax somewhat denser. Punctuations at the base of the 2nd tergite rough (course?). Hind tarsi somewhat slimmer (Diagram 142c, P. 63). Not rare. 5-10mm (P.130)...
....*C. pseudobrevitarsis*, LINS

37. The middle section of the mesonotum clearly darker (up to nearly black) and duller than the lightly coloured metallic mesonotum side sections. Punctuations on 2nd tergite fine. Hidden segments of ♀ wide and dark (similar to *C. mediata*, Diagram 141, P.63). The black patches on the sternites hardly separated in the middle. The last segments of the antennae not longer than wide (Diagram 136, P.62). 6-10mm. P.129
....*C. obtusidens*, DUF.& PER.

• Mesonotum with colour and brilliance similar to the side sections (mostly metallic blue-green); in *C. valida* the whole thorax is nearly black...**38**

38. Big robust form of very dark colouring; head and thorax, especially in ♀, nearly black. ♀ ovipositor wider (similar to Diagram 141, P.63). Punctuations at base of 2nd tergite rough (coarse), but shallow. Alpine area, very rare. 7-11mm. P.140
....*C. valida*, MOCS.

• Lighter coloured forms...**39**

39. Even at the base, punctuations on 2nd tergite very much finer than on 1st tergite (but compare '*angustula gracilis*', Diagram 144 and Couplet 41)..**40**

• Punctuations at base of 2nd tergite not clearly fine, as on 1st tergite (except on '*angustula gracilis*', Diagram 144, P.65), often even larger and wrinkly **41**

40. Legs green-blue. ♀ ovipositor wider and mostly very dark coloured (Diagram 141, P.63). Can mostly be found on colonies of *Odynerus spinipes* and *O. reniformis*. 6-10mm. P.128.

....*C. mediata*, LINS.

• Legs, especially the hind ones, strikingly and extensively copper coloured (usually visible with the naked eye). Sternites also red. Punctuations on tergite 3 extremely dense. ♂ appears as in Diagram 145, P.65. Typically on mortar nests of *Eumenidae*. 6-10mm. P.122.

....*C. ignita* var. *ruddii*, SCHUCK.

41. Hind tibia green-blue. Punctuations at base of tergite 2 rough and wrinkly. The largest punctuations larger than those on the mesonotum. Appearance as in Diagram 143, P.65. Sternites predominantly metallic red. This variation also appears as smaller specimens (< 10mm '*sublongula*'). 10-13mm. P.122.

....*C. ignita* var. **longula,** AB.

• Hind tibia green-blue, in some specimens copper-coloured spots appear on coxae and femora which are not, however, as extensive as *C. ruddii*. Punctuations at base of tergite 2 not as rough and wrinkly as in '*longula*', frequently towards the end of tergite 2 already relatively dispersed, but there are forms with punctuations all over. In small slim forms the punctuations can be finely dispersed, even at the base (Diagram 144, P.65, '*angustula gracilis*'). The latter can be differentiated from *C. mediata* by the narrow ovipositor of the ♀. Transitional forms exist with the appearance and punctuations of '*ruddii*' (Diagram 146, P.65, '*rutiliventris*'). One has to observe the sexes flying together to differentiate ♂ *C. ignita* from ♂ *C. mediata*. 5-10mm. P.120

....*C. ignita*, L.

(P. 36) 3.7.7. Bischoff's Theory of 'Ecological Races'.

BISCHOFF (1934) also thought about the 'ecological races in *Chrysis ignita*'. He believes that splitting up of such forms is possible without separating them geographically. According to him, the hatching parasite is already impregnated with the specific odour of the host which decides its later preference for sexual partners and host nests of the same odour. However we do not know to what extent Chrysididae can register different odours. We do not even know exactly which senses lead them to a host, apart from the visual senses. Nevertheless this theory is, at least partly and in connection with the possibility of local inbreeding mentioned on P. 18, a possible explanation for a partly sympatric separation of forms, but probably not for a sympatric genesis of species within the *ignita*-group.

BISCHOFF also thought of anatomical-mechanical problems. Large *ignita*-forms cannot get into nesting corridors which are too narrow. I am sure this is true, but I doubt the supposition that larger nests put up too much resistance for small forms. It is now known that Chrysididae living in stems, to which most species in the *ignita* family belong, lay their eggs into a cell which is not yet closed (see P.159). So the thickness of the later cell occlusions does not present any obstacles to smaller forms. If the egg has been laid into a cell of a large host species, where there is plentiful food, a larger *Chrysis* can develop for which hatching is no more difficult than for the descendants of the host.

(P.37) 3, 7, 8. Conclusion.

The morphological variability within the *ignita*-group is a remarkable phenomenon, but similar problems can be found in other families, although not concerning such a large group. The ignita-group is relatively limited in the selection of its biotope and hosts which are apparently largely, but not exclusively, solitary Eumenidae. On the basis of this great similarity in the ecological demands, it can be assumed that the number of authentic species in the closest *ignita*-family is much lower than the present system allows.

Up to now, there have been problems with the closest *ignita*-group, that is all forms which cannot be separated even by the female ovipositor. If all data about these forms are summarised, they only make sense if most of the forms are united under *Chrysis ignita*.

The following facts then fit together:

• The morphological characteristics do not allow a clear separation between *ignita* and its subspecies as well as *longula, angustula, ruddii* and *rutiliventris*.

• The red patches on the legs of *Chrysis ruddii* can be produced by the effect of warm water in some *ignita* individuals with originally green legs. Also such patches are, although not extensive, not rare in freshly caught *ignita*-individuals, and in other *Chrysis* species (e.g. *bicolor*) comparable fluctuations can be found which cannot be regarded as a criterion for the species.

- *Chrysis ruddii* is not the only form which occurs in mortar nests. *Chrysis ignita impressa* has also been proved to have been from *Ancistrocerus oviventris*-nests; with *rutiliventris* this host can also be assumed. (c.f. Chapter 5.1. Connected Species List)

- *Chrysis longula, sublongula* and *angustula* evidently belong to the same species, as two of each of them have bred from the same nest. If the largest and the smallest forms have been united, the conclusion that the middle form, *Chrysis ignita*, which up to now has been determined by the exclusion-principle (that is everything that cannot be determined any other way is called '*ignita*') also forms part of the same species.

- *Chrysis longula* and *ruddii* are represented in the known collections by at least the power of ten less frequently than *ignita*. One interpretation is that they are only extreme forms, not separate species.

Chrysis mediata is to be singled out as a separate species on the basis of its ecology together with the morphological characteristic of the widened hidden segments (especially in the ♀). The described subspecies, in as far as they also show these characteristics are part of that species. If a subspecies of *mediata* is fundamentally different in just one characteristic (e.g. if it is bred from a stem), its separateness as a species has to be discussed again.

Chrysis brevitarsis is a species which is very difficult to judge. The morphological characteristics together with the specific host, *Discoelius*, which is clearly different from the other Eumenids and which is in a separate subfamily (BLÜTHGEN 1961), point to a status for *brevitarsis* as a separate species.

So the number of separate taxa within the *ignita*-group shrinks considerably:

- As good species remain:
  Chrysis ignita, including the variations *longula* and *ruddii.*
  Chrysis mediata, including *mediadentata* and *fenniensis*
  Chrysis valida?

- Up to now the only morphospecies are:
  Chrysis iris
  Chrysis indigotea
  Chrysis fulgida
  Chrysis immaculata
  Chrysis pseudobrevitarsis
  Chrysis obtusidens

- I treat the following as conspecific with *ignita*:
  Chrysis angustula
  Chrysis impressa
  Chrysis longula, including *sublongula* and *subcoriacea*
  Chrysis ruddii
  Chrysis rutiliventris, including *vanlithi*
  Chrysis schencki
  Chrysis sculpturata

In Diagram 23 (P. 38) the morphological relationships of the forms in the key are represented graphically. The connection lines are not to be regarded as lines of descendancy, they only represent the lines of greatest similarity found between the forms, the similarity to *ignita* which is taken as the point of departure lessens from left to right. Species which are close together in the diagram, vertically and horizontally, are systematically closer than the species placed further apart. The most important point of separation is the widened female ovipositor.
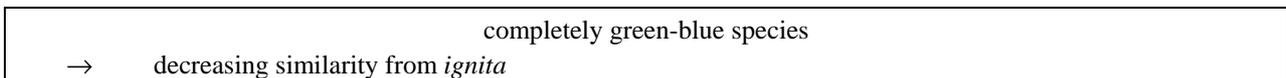
completely green-blue species
→   decreasing similarity from *ignita*

Diagram 23. Family Relationships in the *ignita*-group.

The green colouring of the first tergite in *fulgida* and *immaculata* can be regarded as a transition to the total green colouring of the abdomen, however I do not postulate a phylogenetic sequence. Both green species have relatively little in common apart from the colour. Whilst *iris* is probably closely to very closely related to *ignita* via *longula*, *indigotea* shows greater relationship with *obtusidens* than with *iris.*