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Of the subgenus *Serviformica* For., genus *Formica* L., three species have been known as belonging to the Norwegian fauna, namely the common *F. fusca* L. (with one variety, var. *lemani* Bondr.), *F. rufibarbis* F., and *F. picea* Nyl., and quite recently (Holgersen 1942, see bibliography) a fourth species, *F. gagatoides* Ruzsky, has been introduced into the Norwegian list.

As this last species seems to be very incompletely known by myrmecologists, at least outside Soviet-Russia, I am going to deal with its characteristics and connection with the closely related species, and give an account of its discovery in Norway and distribution in this country, as it is known at present.

As it will be remembered, there has been a good deal of confusion about what may be called the *picea-gagates*-question, and usually the true *Formica picea* Nyl. has been called *gagates* Latr.

A very thorough discussion on these two species has been given by BÖNNER (1914).

F. picea was originally described from Finland by NYLANDER (1846), whilst *gagates* was unknown from Fenno-Scandia until ADLERZ (1886) reported its capture on Öland (Sweden) and Dovre (central Norway). On p. 307 he says that LINDMAN found *gagates* at Kongsvoll, Dovre, at a height of 2900 ft. In 1914 Adlerz gave information on *F. picea* in Sweden, and in the same year Bönner published his work (see above) on the species, which he had found near Copenhagen. In this paper (p. 75) Bönner suggests that Adlerz' *gagates* from Dovre must be *picea* Nyl., and in a following publication (1915) he says (p. 75) that Adlerz in a letter to him has stated this suggestion.

Several authors emphasize *gagates* Latr. as a south-western species, in northern and north-eastern Europe replaced by *picea* Nyl. For instance KARAWAIEW (1926 p. 197) says that *F. gagates* Latr. has a southern and western distribution, occurring in southern France, Italy, southern Germany, the Balkans, the Crimea

and Asia Minor: most of Ruzsky's *gagates* must be *picea Nyl.; gagates* Latr. doesn't occur in northern Russia nor anywhere in northern Europe, whilst *picea* Nyl. is characteristic for the north and east of Europe.

In 1931 Karawaiew mentions *F. picea* Nyl., but not *gagates* Latr., as belonging to the Swedish fauna, supposing (p. 215) Adlerz' *gagates* to be *picea* Nyl. Bönner and Adlerz have earlier (1914) pointed out that *gagates* Latr. from Jutland and Österbotten are *picea* Nyl. JANSSON (1934 p. 295) still regards the species found in Öland and Gotland as *gagates* Latr., and reports it from Östergötland too.

In the spring of 1938 I asked my friend the coleopterologist A. STRAND, Oslo, to collect some ants for me on Dovre, where he has a summer residence, as I hoped to be furnished with material of *F. gagates* Latr., which I then supposed the species to be — as I knew only the work of Adlerz (1886) and none of Bönner's publications (1914—15). In my collection I had neither *picea* nor *gagates,* nor were they represented in the collections of the Zoological Museum in Oslo.

Strand brought several ☿☿ of the supposed *gagates* (and other species too), and when I a short time later began a revision of the Formicidae in the Zool. Museum (Oslo), I discovered that several specimens of «*F. fusca* L.» were identical with *gagates* from Dovre (Vålåsjø, A. Strand leg.). I had no doubt that I here had the same species which Adlerz has published from Kongsvoll.

In July 1940 I found the species myself in the mountains of Suldal (south-western Norway, county of Rogaland), and my colleague cand. real. Y. HAGEN who at my request collected some ants at Ustaoset (Hardangervidda, central Norway) a couple of weeks later, found it there and sent me ☿☿ and some ♂♂. I myself had found ☿☿ and deälated ♀♀ (queens).

Studying the specimens more closely, I soon saw that they did not quite agree with the description of *gagates* Latr. Epinotum was not rounded as in this species, but like epinotum of *picea* Nyl., of which in the meanwhile a ♀ and many ☿☿ had been sent me by Mr. A. JANSSON, Örebro (Sweden). The differences between our species and *picea* Nyl. were rather striking.

I then wrote to Deutsches Ent. Institut, Berlin-Dahlem, and asked for specimens of *gagates* Latr. for comparison. Director Dr. H. SACHTLEBEN generously gave me 2 ☿☿ and lent me a ♀. And now I could state that I here had three species, distinctly different, *F. picea* Nyl. (Swedish specimens), *F. gagates* Latr. (Italian specimens), and a third species (Norwegian specimens), by Adlerz (1886) called *gagates,* later *picea* (Bönner 1915), and by myself once called *fusca* (1938 p. 78 partim). As I have recently shown (1942), SPARRE SCHNEIDER too (1909 p. 78) and SOOTRYEN (1925 p. 9) have made the same mistake (in some cases, not always). SIEBKE's *fusca* from Fokstua and Hjerkinn (Siebke 1863 p. 139) also belong to this strange species.

This form unknown to me might perhaps be one of the varieties of *fusca,* var. *lemani* Bondr., or var. *gagatoides* Ruzsky.

The description of var. *lemani* — kindly sent me by Dr. Sachtleben, Berlin-Dahlem — showed that it could not possibly be this form, and then only var. *gagatoides* remained for consideration.

F. fusca L. var. *gagatoides* Ruzsky is by EMERY (1909, 1925) and STITZ (1939) regarded as a variety of *picea* Nyl., and by the former described as «Eine Übergangsform von *fusca* zu *picea* in Nordeuropa» (1909 p. 195).

In his monograph on the genus *Formica,* WHEELER (1913) described it briefly as follows: «Intermediate in its characters between *picea* and *fusca.* Northern Europe.» — Stitz (1939 p. 368) gives a better description, cited from Ruzsky (1904 and 1905—07):

> «☿ (nach RUZSKY). Vorderfläche des Kopfes und des Thorax matt wie bei *F. fusca,* Gaster glänzend wie bei *F. gagates.* — Pubescenz spärlich, auf der Oberseite und Unterseite der Gaster fehlend.
> ♀ (nach RUZSKY). Von *F. gagates* unterschieden durch den matten Thorax.
> Vorkommen: Nordeuropa.»

It seems clear enough that none of these authors has seen specimens of *gagatoides,* and the original description given by Ruzsky, has evidently been rather short and incomplete.

As I knew that at least parts of Ruzsky's collection were deposed at the Zoological Museum in Leningrad, I wrote to the museum and asked for specimens of this form.

From prof. dr. VLADIMIR B. POPOV I very soon received 2 ☿☿ and 1 ♀. One of the ☿☿ (bank of the river Tjung, 65°45' N. —118°56' O, 6/VIII 1926, GRIGORJEV) was identified by Karawaiew as «*For. picea Nyl.* v. *gagatoides* Ruz.»; it has the scale of the petiole straight cut at apex, but otherwise it agrees well with those of my specimens which differ from the average in respect to the shape of the scale (see the following description).

The second ☿ (Ura, western part of the Murman coast, ILJIN 8/VI 1900) is identified by Ruzsky himself and bears his label: «*For. fusca* L. v. *gagatoides* R. M. Ruzskij det.» This specimen agrees in all respects with the majority of my specimens, in shape of head, colour, pubescence, bristles, and scale.

The ♀ (Ura, «*For. fusca* L. ad v. *gagatoides* interm. M. Ruzskij det.») is — as indicated by Ruzsky — not quite typical. Its pubescence is a little more dense, and thus the body is less shiny than in most of my specimens, but the gaster is shiny and the scale emarginate as in mine. It does not differ more from the average (as deduced from a small number of ♀♀ it must be admitted) than some of my ☿☿ do from specimens within the same nest.

In May 1941 I returned the specimens and let some Norwegian ones follow, together with a ♂, asking for comparison with male specimens in the Leningrad collection, if such were present. The ♂♂ seem to be rather characteristic. Shortly afterwards our correspondence was, however, interrupted.

Information in the literature on *gagatoides* Ruzs. is very sparse. Apart from Ruzsky's description (which I have not seen) and the above mentioned short notes by Emery, Stitz, and Wheeler, I know only one paper, where the species is dealt with, namely Karawaiew's from 1931 (b).

I prefer to cite all that he writes on *gagatoides* and *picea*, although it is rather detailed:

P. 111: «*Formica (Serviformica) picea Nyl. und var. gagatoides Ruz.*

..... Die var. gagatoides Ruz. stellt eine Übergangsform von picea zu fusca dar. Sie wurde von Ruzsky für den Norden von Europäisch-Russland beschrieben, nämlich für das Gouv.

Archangelsk, die Kola-Halbinsel, ausserdem Murman (daselbst auch von mir 1929 gesammelt) und das Gouv. Perm. Wie aus dem Folgenden zu sehen ist, ist diese Varietät auch in Jakutien vorhanden, woselbst sie, auf Grund des vorhandenen Material beurteilt, gemein ist. Die Varietät gagatoides ist unbeständig, und es kommen zahlreiche Übergangsformen zum Typus vor. Die Exemplare aus Jakutien, die ich untersucht habe, kann man in drei Kategorien einteilen. Zu der ersten gehören Exemplare die besonders typische picea sind. Das Stirnfeld ist bei ihnen sehr glatt und glänzend, und die Pubescenz ist auf dem Körper und besonders auf der Gaster sehr schwach entwickelt, wodurch die letztere besonders glatt und glänzend erscheint. Zu der zweiten Kategorie rechne ich Exemplare, bei denen diese Merkmale nicht so scharf ausgeprägt sind. Zur dritten Kategorie rechne ich Exemplare, die mehr oder weniger einen Übergang zu fusca zeigen und damit als zu var. gagatoides gehörend bezeichnet werden können. Das Stirnfeld ist bei ihnen etwas gerunzelt und dadurch kaum glänzend und die Pubeszenz bedeutend mehr entwickelt, besonders auf dem Thorax, die Gaster weniger glänzend. Selbstverständlich ist diese Einteilung künstlich, und unter den Exemplaren, die ich zu der einen oder anderen Kategorie rechne, sind solche vorhanden, welche mit einem gewissen Zögern eben zu der betreffenden Kategorie gestellt sind. Es tut mir leid, dass die Hauptmasse des gesammelten Materials einzeln gefangene Exemplare darstellt und dass ökologische Angaben fast gänzlich fehlen, so dass die Variabilität in dieser Hinsicht nicht ausgenützt werden kann. Unter dem gesammelten Material befanden sich auch zahlreiche einzeln gefangene Geflügelte, ich zögere aber, dieselben mit Sicherheit unter picea und fusca einzuteilen.»

Then follow detailed lists of captures of specimens of the three categories, where Karawaiew as «typische var. gagatoides Ruz.» mentions 8 ☿☿ from Tjung (6/VIII 1926, GRIGORJEV), of which I have seen one specimen.

On p. 113 he goes on:

«Aus dem oben angeführten ist zu sehen, dass beim Dorf

Namskoje, an der Bucht Tjunge-törde und in der Umgegend von Jakutsk sowohl typische picea als auch Übergänge zu var. gagatoides gefunden wurden.»

Karawaiew thus regards *gagatoides* as belonging to the species *picea* Nyl. Ruzsky described it as a variety of *fusca* L., and it seems more likely that it must be more closely related to this, and not to *picea,* a species well known to Ruzsky, yet he called it *gagates* (Karawaiew 1926 p. 197). Since Ruzsky gave the name *gagatoides* to a variety of *fusca,* it must be because it was more shiny, i. e. had more sparse pubescence, than *fusca,* thus resembling *gagates*≠*picea.*

The differences between *picea* and Norwegian *gagatoides* (♀♀) are rather great, in respect to the shape of the scale (Figs. 2 and 3) and the bristles on thorax and gaster, whilst *gagatoides* and *fusca* are alike as regards the bristles on thorax, usually missing in both species (only in few specimens have I seen a few bristles on pronotum, in most cases there are none), but the pubescence is very differently developed in the species, especially on the gaster (for further differences, see description).

The Norwegian specimens fully agree with specimens from Northern Russia (and Siberia, see above), and thus no doubt must be Ruzsky's *gagatoides.*

In his description, Ruzsky evidently has drawn attention to only one difference between *gagatoides* and *fusca,* saying that the first had a more shiny gaster. Later authors have cited Ruzsky without having seen any specimens of *gagatoides* themselves, and finally *gagatoides* has been transferred to *picea* Nyl., as a variety of this species.

As Karawaiew indicates, he has only regarded the pubescence and the frontal area, and does not show any interest in bristles or scale, and — besides — he has only used ♀♀ for his classifications. Personally I have the pleasure of possessing several ♂♂ taken in nests together with ♀♀, and as will be seen from the following description, the males are perhaps still more characteristic than the ♀♀, and differ distincly from the males of *fusca* and — especially — *picea.* Thus the ♂♂ highly support my conviction that *gagatoides* is a good species, and not so closely related to *picea* as some authors have previously supposed.

At least in this country, *gagatoides* is a very distinct species, and specimens from Murman and Jakutien, which I have had for comparison, have been as much or nearly as characteristic. If intermediate forms between *picea* and *gagatoides* should exist, they must be intermediate in other characters than pubescence only. The transition must take place gradually and comprise all characters.

I am not convinced of the existence of such intermediate forms, and — as mentioned above — I am not inclined to regard *gagatoides* as a form of *picea.*

If *gagatoides* were a simple variety of *picea,* one might suppose them both to be found and about equally common for instance in Norway. If *picea* inhabits this country — which is most likely — it is no doubt rather rare, at least not as common as *gagatoides.*

But at present only *gagatoides* is known to occur in Norway, and where I have had the occasion of seeing it myself in nature, it has been a xerophilous species, whilst *picea* is one of the most hygrophilous species known! (See e. g. Adlerz 1914, Bönner 1914—15).

One might suppose that *picea* and *gagatoides* with intermediate forms could live beside each other, e. g. in the central parts of *picea*'s area of distribution, and towards the periphery one of them might change habits, so that the extreme *gagatoides* here got an ecological race living on dry ground, the extreme *picea* a race living in sphagnum bogs, the intermediate forms dissappearing.

But this seems little evident. *F.picea* is found in moors in Russia, Finland, Denmark, Sweden, Great Britain, Germany etc, thus showing the same habits not only in a center, but wherever it lives, and it occurs no doubt under the same circumstances in Norway too.

Karawaiew remarks that his material from Jakutien consists of singly captured specimens without notes of ecological kind. Thus it is quite possible that *picea* and *gagatoides* in this material may have been taken in different spots, on damp and dry localities respectively.

I am convinced that we have here 2 species, one of them — *gagatoides* Ruzsky — being closely related to *fusca,* but having the little developed pubescence of the other species, *picea* Nyl. In Siberia they live, at least in certain districts, beside each other. Whether they here live in the same surroundings or not, is an open

question, and if they live beside each other in other parts of the continents, is likewise unknown owing to lack of investigations. Evidently they may both be found in Norway, in the northern parts of Sweden, Finland, and Russia, and in Siberia, probably in other countries too, but I think they will everywhere inhabit different biotopes, *gagatoides* preferring dry ground, *picea* damp or wet.

Karawaiew's material from Jakutien has evidently been composed of *picea* and *gagatoides*. Of the last one, some specimens have looked more opaque (as some of my Norwegian specimens do*) than *gagatoides* usually does, and Karawaiew has regarded these as transitional forms, paying attention only to pubescense (and frontal area, this is, however, of less interest), not to all characters.

If the material from Jakutien still exists, it ought to be submitted to renewed investigations, and the same is true of the material of *gagatoides* from northern Russia.

It would also be of interest to carry out exact investigations of the genitalia in the ♂♂ of *gagatoides, picea* and *gagates,* as CLAUSEN (1938 p. 88) has done with *F. fusca.*

As *F. gagatoides* has been so incompletely described in the literature, and as the male has hitherto been unknown, I take the opportunity to give the characteristics of the species as well as some sketches, showing parts of the body of *gagatoides* and allied species.

♀ Mandibles toothed, the terminal border bearing 7—8 teeth. Clypeus distincly, but slightly carinate. Frontal area slightly shagreened. Head about as broad as long, rounded posteriorly. Epinotum seen in profile, distinctly angled.

Scale broad, heart-shaped, usually and often deeply excised at apex (Fig. 2). Head, thorax, scale and abdomen black, mandibles brown or brownish black, antennae and legs brown.

Head and thorax dullish, gaster shiny. Pubescence very sparse. Head and thorax now and then with a few short bristles. Gaster with short bristles at posterior border of the segments.

Length 4,2—6 mm.

*) This opaque appearance (on the gaster especially) may sometimes come from grease and adhering fine dust, as I have seen in some specimens; it will often be the case with old material.

It differs from *F. fusca* L. in having a very shining gaster. Thorax and head (with frontal area) too are shiny compared with *fusca*. It is easily distinguished from *F. gagates* Latr. by its angled epinotum (Fig. 1, see also photographical illustrations by Bönner 1914 p. 64). The gaster has more sparse pubescence and fewer bristles than in *gagates*.

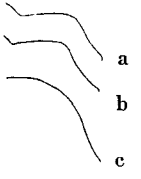

Fig. 1. Epinotum seen in profile.
a) *F. gagatoides* Ruzs. (☿)
b) *F. picea* Nyl. (☿)
c) *F. gagates* Latr. (☿ major).

It resembles *fusca* in habitus (especially when alive, it must be admitted that I have not seen living specimens of *picea),* in a smaller degree *picea,* from which it differs in usually having a more shining body, and it hasn't the long and numerous bristles of *picea* on thorax (pro- and mesonotum) and gaster. The colour is black, not brown or brownish black as in most of my specimens of *picea.*

In respect to the scale, the shape of this separates *gagatoides* from *fusca, picea,* and *gagates* (Figs. 2, 3, 4).

Fig. 2. Types of scale forms in *F. gagatoides* Ruzs.
a) ♂ b) ♀ c—g) ☿☿
c) drawn to a smaller scale than the rest.
g) The common type.

Fig. 3. Scales of *F. gagates* Latr. (upper) and *F. picea* Nyl. (lower), ♀ (left) and ☿ (right). All drawn to the same scale.

Fig. 4. Scale of *F. fusca* L., ☿.

♀ (deälated). The most important characters as in the ☿. — Length 7—8 mm.

More difficult than the ☿☿ to separate from the allied species. It may be recognized by the shining gaster and the broad, heart-shaped

and emarginate scale. Head, thorax and gaster have not by far so many bristles as *picea*. Norwegian specimens do not quite agree with a specimen from Murman (see above), have broader and more excised scale, are darker and have more shining and less pubescent abdomen.

Thorax is slightly broader than the head. The shiny gaster and usually also the scale separate it from *fusca*.

The frontal area of ☿☿ and ♀♀ of *gagatoides* is shining, only slightly shagreened. It is transversely striate, in about the same degree as in *picea*, i. e. far less than in *fusca*.

Fig. 5. *F. gagatoides* Ruzs., ☿. Clypeus seen in profile (left), and scale seen from the side (right).

Fig. 6. Subgenital lamina (☿) of *F. gagatoides* Ruzs. (upper), and *F. fusca* L. (the lower), from Clausen 1938. Drawn to different scales.

☿ Terminal border of mandibles not denticulate. Clypeus not carinate, with two transverse impressions (Fig. 5 left) (this character does not, however, seem to be constantly developed in all specimens). Frontal furrow distinct. Head and thorax finely punctured, scutellum and epinotum more shiny. Frontal area shagreened.

On the head 7—8 bristles round ocelli. Thorax with a few bristles on pronotum, mesonotum quite densely, but shortly haired. Abdomen with few erect hairs on segmental borders, pubescence decumbent and greyish. Scale thick (Fig. 5, right), broadest and slightly emarginate at apex (Fig. 2 b), some very few and short hairs along apical border.

Colour black, legs (apart from the foot) and outer genitalia light brownish yellow. Femura of the same light colour as the rest of the legs. Wings clear, with a slight, yellowish tinge, pterostigma light brown.

Length 6—7 mm.

The ♂ of gagatoides is rather small and usually easily distinguished from *fusca* as well as from *picea* (I have not seen *gagates*- ♂ in reliably determined specimens).

The pubescence of abdomen is slightly developed, less than in *fusca,* thus giving the gaster a more shiny appearance than in *fusca,* but it is not by far so shiny as the gaster of *picea.* The abdomen is more oblong oval, not long and cylindrical as in *fusca* and *picea.*

The head bears only few bristles. In this respect *gagatoides* resembles *fusca,* but differs from *picea.* Thorax is less haired than in *fusca,* the erect hairs being short, not long and strong as in *picea,* and not by far so numerous.

The thorax is more shiny than in *fusca,* yet slightly shagreened. The *picea*- ♂ has numerous hairs and strong bristles on thorax, the thorax itself being opaque, strongly shagreened, nearly rugose.

The scale resembles that of *picea,* is thick and broad and emarginate at apex, but it wears only few erect hairs, whilst the scale of *picea* is densely haired on the frontal side.

The mandibles are not toothed, as they are in a Danish specimen of *picea* in my collection. Stitz (1939 p. 365) says that *picea* has not toothed mandibles; this character is no doubt subject to variation, as it is in *fusca* (see e. g. DONISTHORPE 1927, p. 354). It is quite possible that some *gagatoides*- ♂♂ too may have toothed mandibles, but I have not seen such specimens.

The size is probably variable, as it varies in *fusca* as well as in *picea.* My specimens are all of about the same size, much smaller than most of my *fusca* specimens (I have only one *fusca*- ♂ of nearly the same size as *gagatoides,* measuring only 8 mm. in length, but this is exceptional for Norwegian *fusca,* as far as I have seen). Stitz gives as size of *picea*- ♂ 7—10 mm.

The scale of the ☿☿ varies in shape, as shown in Fig. 2 c—g: Only in 13 of my 140 mounted specimens is the emargination at the apex missing, and in only 1 of these has the scale a shape as in *fusca* (Fig. 4).

On the whole, the species seems to be very constant in characters, judging from the Norwegian material.

Distribution of *F. gagatoides* Ruzsky:

Norway, Kola with Murman, Archangel, Perm, Jakutien. It no doubt occurs also in Sweden and Finland.

According to Emery (1925) *gagatoides* has been found in Thibet too, but this occurrence has been dropped by Stitz (1939).

Distribution in Norway:

Southern Norway: On, Hjerkinn, Dovre (1853, Siebke)
» Dovre, (1843, Siebke)
» Dovre (Munster)
» Vålåsjø, Dovre (1938, A. Strand)
» Storhøliseter (Munster)
Bv, Ustaoset (1940, Y. Hagen)
Ri, Jonstøl, Suldal (2 colonies, 1940, Holgersen)
» Bleskestadmoen, Suldal (some 10 col., 1940—42, Holgersen)
STi, Kongsvoll, Dovre (Lindman acc. to Adlerz)

Northern Norway: Nsi, Grønlidalen, Rana (1931, Fr. Jensen)
TRi, Målselv (1916, Natvig)
» Nordmo, Målselv, (1906 Sparre Schneider)
» Tabmokdal, Balsfj. (1922, Soot-Ryen)
TRy, Tromsø (Sparre Schneider)
» Ramfjord (1924, Soot-Ryen)
Fv, Hammerfest, (Munster)
Fi, Alta, (1924, A. Strand)
» Vina, Alta (1924, A. Strand)
Fn, Kolvik (1908, Sparre Schneider)
» Lakselv, Porsanger (1907—08, Sparre Schneider)
» Stabburselv (1931, Fr. Jensen)
» Børselv (W. M. Schøyen)
» Skoganvarre (1931, Fr. Jensen)

I have seen specimens from all these Norwegian localities except from Kongsvoll.

Summary.

In studying a material (some 160 ☿☿, about 20 ♀♀ and ♂♂) of a *Formica (Serviformica)* sp. found in Norway, the author has come to the conclusion that it is *F. gagatoides* Ruzsky, originally described as a variety of *F. fusca* L., and later regarded as a variety of *F. picea* Nyl.

F. gagatoides Ruzsky seems to be a good species, the ☿☿, ♀♀ and the hitherto unknown ♂♂ differing well from the related species *fusca* L., *picea* Nyl., and *gagates* Latr.

In Norway, *F. gagatoides* has been found in many places, from 1843 to 1940, living in southern Norway only in the mountains in elevations from 2400 ft. to at least 2900, in northern Norway also at sea level.

In southern Norway it prefers open country above or in the upper parts of the low birch wood, nesting on dry ground. The nests are situated similarly to those of fusca, sometimes in birch stumps and roots.

From the captures in northern Norway, no ecological information can be given.

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Bleskestadmoen, Suldal, + 2400 ft. (= 720 m).

Bleskestadmoen, Suldal. Nesting ground for several colonies of **Form. gagatoides** Ruzsky.