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A REVISION OF THE NORTH AMERICAN VARIANTS OF THE ANT *FORMICA RUFA*

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The many subspecies of *Formica rufa* which occur throughout North America offer particularly attractive material for those interested in the study of geographical races. That so little work has been done with most of these variants is unquestionably the result of the difficulty of recognizing them either in the field or laboratory. The entire complex has suffered from the seemingly endless, transatlantic controversy which developed around what may be called the *obscuripes-aggerans* question. I propose to review this involved situation because it is apparent that the student of these forms can scarcely avoid errors in view of the intricate nature of the existing taxonomy. The name *aggerans* has been applied to at least four distinct forms. In addition to

this difficulty there is a further factor for confusion in the difference of opinion concerning the status of *truncorum*. European myrmecologists have generally refused to accede to Wheeler's plan which gives *truncorum* specific rank. Add to these the fact that almost half of the recognizable variants are either unkeyed or undescribed and the forbidding character of the complex becomes even more apparent. I propose to take up these problems in the order given but before doing so it seems advisable to append a list of the previously recognized North American variants of *rufa* together with those described in this paper. Following a suggestion made in a former publication I have given all these variants subspecific rank.

LIST OF THE NORTH AMERICAN SUBSPECIES OF *FORMICA RUFA*

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|---|--|
| 1. Subsp. <i>clivia</i> , new subsp. = <i>aggerans</i>
Wheeler (1917) | 13. Subsp. <i>propinqua</i> Wheeler (1917) |
| 2. " <i>coloradensis</i> Wheeler (1913) | 14. " <i>ravida</i> Wheeler (1913) |
| 3. " <i>gymnomma</i> Wheeler (1905) | 15. " <i>subcaviceps</i> Wheeler (1917) |
| 4. " <i>haemorrhoidalis</i> Emery (1893) | 16. " <i>subfasciata</i> Wheeler (1917) |
| 5. " <i>integra</i> Nylander (1856) | 17. " <i>subnitens</i> , new subsp. |
| 6. " <i>integroides</i> Emery (1893) | 18. " <i>tahoensis</i> Wheeler (1917) |
| 7. " <i>laeviceps</i> , new subsp. | |
| 8. " <i>melanotica</i> Emery (1893) | |
| 9. " <i>mucescens</i> Wheeler (1913) | |
| 10. " <i>obscuripes</i> Forel (1886) = <i>aggerans</i>
Emery (1893) and Wheeler (1913) | |
| 11. " <i>obscuriventris</i> Mayr (1870) | |
| 12. " <i>planipilis</i> , new subsp. | |

The variant *whymperi*, described by Forel in 1904 as a variety of *obscuripes*, was subsequently shown by Wheeler to be the same as the latter's *adamsi*. Emery was apparently unaware of this synonymy since he included *whymperi* as a variant of *rufa* in the "Genera Insectorum."

THE *OBSCURIPES-AGGERANS* QUESTION

The problem involving the varieties *aggerans* and *obscuripes* was first raised by Wheeler when he monographed the genus *Formica* in 1913. In subsequent years it reappeared several times in the literature since none of the proposals made by

Wheeler or Forel offered a generally acceptable solution. Because the writer has been able to examine authentic material of *aggerans* which was not seen by either of the above investigators it is my belief that we may be able to reach a final settle-

ment of this troublesome question. A proper appreciation of this curious tangle cannot be secured without some mention of the steps by which it evolved. I have, therefore, prefaced my own observations on *aggerans* with a review of the *obscuripes-aggerans* controversy.

In 1886 Forel described a new variety of *rufa*, which he called *obscuripes*, from a series of specimens taken by Scudder at Green River, Wyoming. In this description Forel cited six characteristics which distinguish *obscuripes* from the European *rufa*. Regardless of subsequent developments it must be admitted that, in this description, Forel presented an adequate and accurate account of *obscuripes*. Its value was, unfortunately, lessened when Forel again referred to *obscuripes* in 1904. At this time he compared *obscuripes* to *obscuriventris*. In this comparison Forel noted that the erect hairs on the body of *obscuripes* are less numerous than those of *obscuriventris* and that *obscuripes* lacks entirely the small, erect tibial hairs which are present in *obscuriventris*. It is hard to explain what Forel had in mind here. Ten years later he himself admitted that he had been incorrect in both statements. Following the 1904 publication, however, it was natural for other myrmecologists to include with the original characterization of *obscuripes*, the additional features of sparse body hairs and hairless tibiae.

This misconception was particularly unfortunate in that meanwhile (1893) Emery had described another variety, *rubiginosa*, based on material coming from Colorado, Nebraska and South Dakota. At the time when he described *rubiginosa* Emery possessed cotypes of *obscuripes*, a fact which was to play an important part in later developments. The original description of *rubiginosa* consists of a very brief comparison of the new variety with *obscuriventris*. After noting the differences Emery stated that the pilosity and pubescence of the two forms are the same. The pilosity of *obscuriventris* is abundant, like that of *obscuripes*, but the gastric pubescence of the two forms is wholly unlike. There would seem to be little likelihood of con-

fusing *rubiginosa* and *obscuripes* if the matter of pubescence were kept in mind. Yet this is precisely what occurred. The name *rubiginosa* was replaced by *aggerans* in 1912 when Wheeler pointed out that Latrille, in 1804, had described a *Formica rubiginosa* whose status has never been satisfactorily determined.

When Wheeler monographed the genus *Formica* in 1913 he had no types of *aggerans* or *obscuripes*. He was, in consequence, forced to use descriptions as a basis for recognizing the two variants. The results were far from happy, for he was dealing with an inadequate description in the case of *aggerans* and a false one in the case of *obscuripes*. His 1913 *aggerans* was actually *obscuripes* while the specimens which he assigned to the "imperfectly known *obscuripes*" were merely worn and slightly darker representatives of the same variant. Wheeler was admittedly far from satisfied with the arrangement and suggested that *aggerans* and *obscuripes* might be synonyms. This brought a reply from Forel in the following year (1914) in which he negated the observations on *obscuripes* which he had published in 1904. The types of *obscuripes*, he said, had abundant erect hairs on the tibiae and were the same as the insect which Wheeler had described as *aggerans*. In his embarrassment at his mistake Forel failed to consider that Wheeler's *aggerans* was not necessarily the same insect that Emery had originally described. He thus laid himself open to further criticism by suggesting that *aggerans* be synonymized with *obscuripes*.

In 1917 Wheeler returned to the attack fortified with two cotypes of *obscuripes* which he had found in the collection of the National Museum. Guided by these Wheeler was in a position to rectify his error concerning *aggerans* but he was no longer willing to sink the form as Forel suggested. Wheeler argued that, while he had erroneously applied the name *aggerans* to material subsequently shown to be *obscuripes*, it did not follow that the true *aggerans* was a synonym of the latter form. Emery's original description of *aggerans* was made with the cotypes of

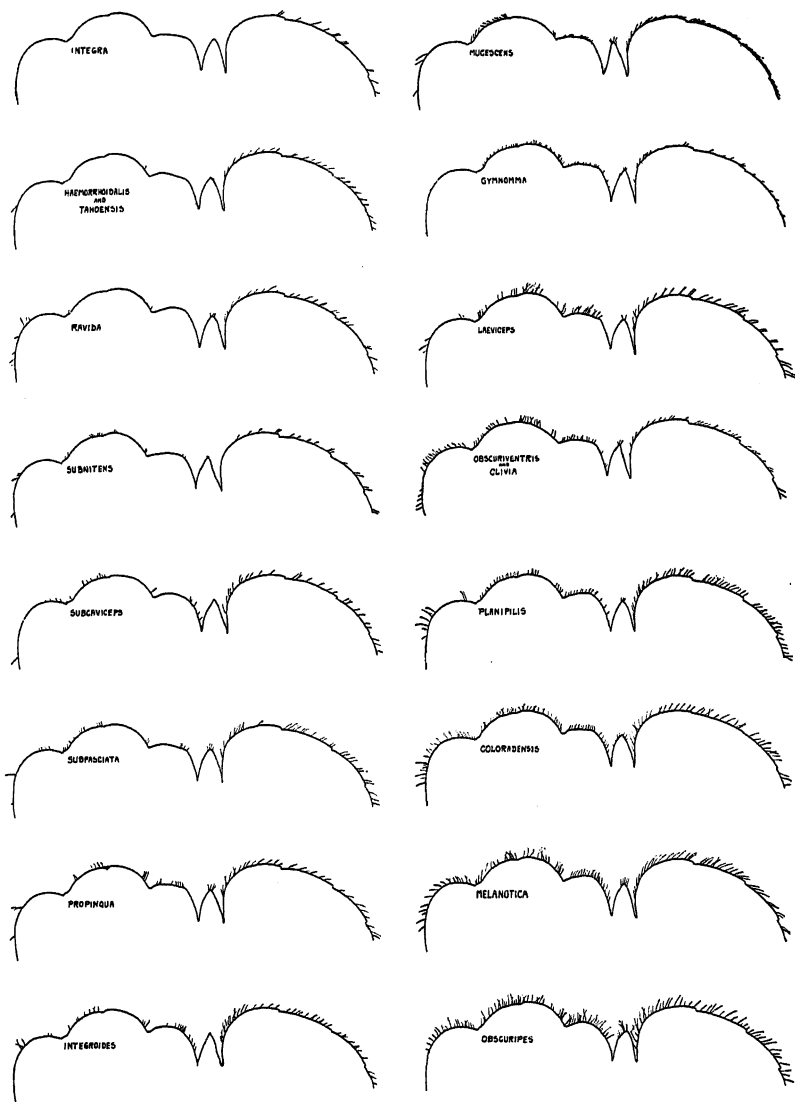


Fig 1. Profile view of worker major showing hair patterns in various subspecies of *Formica rufa*.

obscuripes available for comparison, therefore Emery's *aggerans* must have been something different from *obscuripes*. Returning to the original description Wheeler redefined the characteristics of *aggerans* and shifted its relationship to the subspecies *obscuriventris*.

One extraordinary aspect of the matter is the fact that Carlo Emery, the only person who had been able to compare the type material of *aggerans* and *obscuripes*, was never consulted. More remarkable still he accepted Forel's synonymy without comment either because he was able to confirm it or, as one suspects, because of a growing weariness with the whole problem. Most remarkable of all is the fact that not one of the three men involved ever expressed any suspicion that the type series of *aggerans* might have been mixed. Yet it seems to the writer that this possibility ought to have been obvious from the first in view of the widely separated points from which the type material of *aggerans* came.

It is plain that the only satisfactory solution of the problem lies in a reexamination of the type material on which *aggerans* was based. While it seems certain that no types of *aggerans* were returned to this country I have been able, through the kind cooperation of Dr. Carlo Menozzi, to secure information which authenticates certain specimens in the collections of the National Museum and The American Museum of Natural History as a part of the type series. It was the custom of Pergande, when he sent specimens to Emery, to divide each nest series, half of which was retained. Such specimens, while not actually types, can be depended upon if one is able to secure exact information as to the labelling of the type series. As mentioned above Dr. Menozzi was good enough to transmit the needed data. In addition Dr. M. R. Smith very generously arranged a loan of some of the material in the collection of the National Museum. These specimens were of great aid in determining the true nature of Emery's *aggerans*.

In reply to my inquiry requesting exact data on the type series of *aggerans*, Dr.

Menozzi made no mention of the Colorado types. As may be recalled this variant was based upon specimens taken in Colorado, South Dakota and Nebraska. For reasons which I shall presently explain it is to be hoped that the Colorado types of *aggerans* are still in existence. I believe that specimens present in the collection of the National Museum are a part of this series but there seems to be no way of determining their authenticity. The following analysis is based, therefore, only on the South Dakota and Nebraska material. An examination of these specimens has revealed a badly muddled situation which goes far in explaining previous confusion. The South Dakota specimens come from Hill City and consist of two nest series (Nos. 186 and 167). The specimens numbered 186 are unquestionably the same variant that Wheeler described in 1905 as *gymnomma*. The specimens numbered 167 I regard as belonging to the subspecies *melanotica* although they have now faded to a shade more nearly like that of *obscuripes*. The gastric pubescence is not dense and opaque like that of *obscuripes* but more dilute with the abdomen very feebly shining in certain lights, a condition characteristic of *melanotica*. As this appearance is not infrequently produced in old specimens by the extrusion of a thin film of grease on the surface of the gaster I soaked some of the specimens, first in ether and afterward in carbon tetrachloride, in order to remove any grease which might be present. This treatment produced no change in the appearance of the gastric surface. The Nebraska specimens also came from two nests to judge from a difference in numbering. A single specimen, numbered 325, differs markedly from the rest of the series which bear no numbers. This numbered specimen is almost entirely devoid of hairs and seems in all respects similar to certain specimens of *integra* which occur at the western end of the range of that form. The unnumbered Nebraska specimens are again *melanotica* if we may judge from the abdominal pubescence and surface sculpture. If we are correct in assuming that Emery used the Colorado types as the basis for his association of

aggerans with *obscuripes* the constitution of the type series of *aggerans* is as follows:

- (1) *obscuripes* (Colorado types?)
- (2) *gymnomma* (Hill City types No. 186)
- (3) *melanotica* (Hill City types No. 167 and unnumbered Nebraska types)
- (4) *integra* (Nebraska types No. 325)

The form which Wheeler attempted to identify as *aggerans* in 1917 is not represented in the material examined.

It is to be hoped that this will settle the *aggerans* problem, for it is more than obvious that, unless we wish to make a bad matter worse, we had best accede to Emery's synonymy of *aggerans* with *obscuripes*. Any other course is certain to lead to name changes of a most deplorable sort. It is the opinion of the writer that Emery had recognized the heterogeneous character of the type series of *aggerans* and had placed the Colorado specimens with *obscuripes*. It is certain that he ultimately possessed a correct concept of that variant since there are present in the collection of the American

Museum specimens so determined by him which he received from Wheeler for comparison. It is greatly to be regretted that Emery never made a specific restriction of the type material of *aggerans*. Until the selection of an appropriate lectotype is made Emery's association of *aggerans* with *obscuripes* may be called in question by anyone who chooses to regard one of the other members of the type series as typical. I have every reason to believe that such a choice would never be made by anyone with the slightest regard for our present nomenclature in this group. No one wishes to see the name *aggerans* replace *melanotica* or *gymnomma* and, unless I am very much mistaken, myrmecologists will welcome the opportunity for leaving *aggerans* a synonym of *obscuripes*.

There remains the matter of the treatment of the material believed to be *aggerans* by Wheeler in 1917. This is a very distinct subspecies which I have described in the present paper under the name *clivia*.

THE RUFA-TRUNCORUM QUESTION

The second problem to be considered is that of the specificity of *truncorum*. This, like the previous question, was an outcome of views published by Wheeler in his 1913 monograph. In proposing specific status for *truncorum* (then *truncicola*) and its related variants Wheeler expressed himself as follows:

"The difference (between *rufa* and *truncicola*) is more apparent in the habits, perhaps, than in the nest structure, for *truncicola* does not build large, independent mound-nests like *rufa*, *pratensis*, *aggerans*, *obscuripes* and their varieties, but nests about stumps and logs and the roots of plants, though it banks the latter with vegetable detritus."

For a number of years the writer was prepared to agree with this interpretation since it seemed to hold in the case of those variants which I had seen in the field. In the summers of 1932, '33 and '34, however, my range of field observations in the western United States was considerably extended. During that period I was able to study the nests of all but two of the

variants of the *rufa* complex. As a result of this study I am convinced that Wheeler considerably oversimplified the case. In a future paper I hope to show that each of the forms belonging to this complex is marked by slight but distinct ecological peculiarities. Indeed, Wheeler himself held a similar view, but where I consider that he was mistaken, was to attempt to force all the variants into one or the other of two main habit groups. It is true that a number of the variants show closely similar habits as regards nest construction but there are certainly more than two patterns which the insects follow. The type of nest produced is the result of the interaction of two factors, (1) the choice of nest site and (2) the freedom with which thatching is used. I consider that there are four fairly stable behavior patterns exhibited by this complex with a fifth pattern which is distinguished by flexibility rather than uniformity. I list below these groups with their representatives:¹

¹ The subspecies *subfasciata* is not included in this list. I have not seen this form in the field.

Group 1.—Nest site selected in open areas devoid of cover. Nest begun at the base of some small plant (frequently sagebrush). Extensive use made of thatching. The finished nest consisting of a large mound of collected detritus: subspecies *obscuripes*, *ravida* and *planipilis*.

Group 2.—Nest site selected in areas of moderate to heavy cover. Nest begun in or under a log or stump. Extensive use made of thatching. The finished nest considerably influenced by the size of the object in which it was started but, when this is small, a dome shaped nest results: subspecies *coloradensis*, *integroides*, *propinqua*, *integra*.

Group 3.—Nest site selected in areas of moderate to sparse cover. Nest begun under log or stone with many of the passages running into the soil. Moderate use made of thatching, often little of this visible on the outside of the nest. Large domes or heaps of thatching rarely produced: subspecies *tahoensis*, *obscuriventris*, *gymnomma*, *laeviceps*, *haemorrhoidalis*, *clivia*, *mucescens*.

Group 4.—Nest site selected in open areas devoid of cover. Nest begun under stone or by excavation in the soil. Little or no use made of thatching. The finished nest without any superstructure or with a thin disc of thatching spread around the opening: subspecies *subcaviceps*, *subnitens*.

To the above groups may be added a fifth which includes only the subspecies *melanotica*. This variant has always been something of a puzzle to the writer, since the only consistent thing about its habits appears to be an infinite variability. I have seen nests of *melanotica* which would fit into any one of the above groups and this flexibility of habit is coupled with a tolerance for the most diverse kinds of environment. I have taken *melanotica* in the extremely arid deserts of eastern Oregon, in the Cascade Mountains of Washington, in cotton-wood bordered stream bottoms in Wyoming, on high intermountain plateaus in Colorado, in open oak groves in Minnesota and in dense stands of aspen in the mountains of Utah. If *melanotica* is a geographical subspecies it is most assuredly a very peculiar one. We need additional information on this form.

In view of what has just been said it is not necessary to explain further why I have given up the idea of using nest form or habits as a basis for specific division within the *rufa* complex. Despite the fact that the presence of so many variants in a single species produces a very unwieldy assemblage I cannot see how any other course is possible. I have prepared a key which, I trust, will permit an easier separation of the variants than has been possible heretofore. Before presenting this key I wish to point out certain factors which must be considered if it is to be successfully employed. Much of the key is based upon slight differences in color and pilosity (see Fig. 1). These will show most clearly in fresh, clean specimens and may be difficult or impossible to see in old material which has faded or become covered with grease. Even in the case of fresh specimens, however, distinctive pilosity may be worn away in certain individuals. For this reason the person who seeks to identify isolated individuals rather than adequate series of material had better throw either the specimens or the key into the waste basket. A further difficulty will be found in the case of those specimens which come from regions where the ranges of two or more subspecies adjoin. Such specimens will show intermediate structure or coloration which will often make it impossible to assign them with certainty to a particular subspecies. Two of these areas of intergradation are worthy of mention since each is marked by forms whose transitional character frequently defies analysis. The region extending from northern Illinois through Wisconsin and into eastern Minnesota lies at the eastern limit of the range of *obscuripes* and *clivia* and the western boundary of the range of *obscuriventris*. A further reason for complication lies in the fact that the northern boundary of the range of *gymnomma* reaches the southern portion of the area just outlined. The second area marked by extensive intergradation begins on the eastern slope of the Sierras in northern California and runs northward along the eastern slopes of the Cascades in Oregon. Here the subspecies involved are *integroides*, *subcaviceps*, *sub-*

nitens and *propinqua*. Much of the material coming from either of these regions will be found to be impossible of exact determination. This is precisely what might be expected in the case of geographical subspecies and, in the writer's estimation, strengthens the validity of the variants involved.

KEY TO THE NORTH AMERICAN SUBSPECIES OF
Formica rufa

- 1.—Erect hairs on the middle and hind tibiae confined to a double row of bristles along the flexor surface. 2.
Erect hairs on the middle and hind tibiae usually abundant and covering all surfaces, but at least there are a number of erect hairs beside the bristles on the flexor surface. 12.
- 2.—Abdomen densely clothed with short, erect hairs which form a thick investiture (mountains of Colorado and Utah) *mucescens*.
Erect hairs on the abdomen widely spaced, not forming a thick investiture. 3.
- 3.—Dorsum of the thorax without erect hairs or with no more than six erect hairs. 4.
Dorsum of the thorax with at least a dozen erect hairs, usually many more present 7.
- 4.—Head and thorax of the small workers in part or entirely brownish black; medias with dark spots on the head and thorax 5.
Head and thorax never infuscated in the medias and only rarely in the minors; infuscation when present light brown rather than blackish. 6.
- 5.—Head of the major worker with straight sides and well-marked occipital angles; minor workers in part reddish (mountains of eastern Nevada to the Sierras) *tahoensis*.
Head of the major worker with moderately convex sides; minor workers entirely black (mountains of western Montana) *ravida*.¹
- 6.—Abdomen feebly shining with dilute pubescence (northeastern United States and Canada west to Michigan) . . . *integra*.
Abdomen opaque, the pubescence dense and gray (transition zone in Colorado and Utah) *haemorrhoidalis*.
- 7.—Clypeus and genae strongly shining. 8.
Clypeus and genae very feebly shining or opaque. 9.
- 8.—Erect hairs of the dorsum of the thorax long and numerous (La Sal Mountains,

- Utah) *laeviceps*.
Erect hairs on the dorsum of the thorax short and sparse (central Oregon) *subnitens*.
- 9.—Head of the largest workers with numerous, erect hairs at the occipital angles. 10.
Head of the largest workers with few or no erect hairs at the occipital angles. 11.
 - 10.—Occipital border straight (Coastal Mountains and western slopes of Sierras, California) *integroides*.
Occipital border slightly concave (high plateaus east of the Cascades, Washington and Oregon) *subcaviceps*.
 - 11.—Head, thorax and legs clear yellowish red in majors and medias, minors slightly or not at all darker; gastric segments clear brown with only the posterior border piceous (San Bernadino Mountains, California) *subfasciata*.
Head and thorax dirty brownish red, the legs usually darker than the thorax, the minor workers usually somewhat darker than the majors; gastric segments rather extensively infuscated (eastern slopes of Sierra and Cascade Mountains) *propinqua*.
 - 12.—All sizes of workers extensively and deeply infuscated with piceous black; as a rule only the heads of the major workers are clear red and these may be tinged with black in some cases. *melanotica*.
Extensive infuscation, if present, confined to the smallest workers and brownish in color rather than piceous; larger workers with the head and thorax clear or at most bearing blotches of brownish shading. 13.
 - 13.—Gaster densely pubescent, only the posterior edges of the segments shining, the rest opaque. 14.
Gaster with dilute pubescence, the entire surface of each segment only a little less shining than its posterior edge. 16.
 - 14.—Erect hairs on the thorax short and of about equal length; cephalic hairs longer and notably sparser. 15.
Erect hairs on the thorax long and rather unequal in length; cephalic hairs only a little less abundant and not much longer than those of the thorax (North Dakota to the Pacific Northwest with a southern extension in the Rocky Mountain Region) *obscuripes*.
 - 15.—Smaller workers extensively infuscated with brown, medias more or less marked with brown; legs in all sizes of workers brownish black (mountains of eastern Nevada) *planipilis*.
Color of all workers, except occasional minors, clear red; legs not infuscated, scarcely or not at all darker than the thorax (mountains of Colorado and Utah) *coloradensis*.
 - 16.—Erect hairs on head and thorax only moder-

¹ In a large series of workers of *ravida* taken by the writer at Sieben, Montana, are a few major workers having perhaps a dozen or more erect hairs on the thorax. As this condition appears to be exceptional I have included *ravida* with the variants which have reduced thoracic pilosity.

ately abundant; clypeus and genae strongly shining; eyes usually hairless (Black Hills of South Dakota to southern New England with a southern extension in the Appalachian region). . . *gymnomma*.

Erect hairs on head and thorax very abundant; clypeus and genae usually opaque or feebly shining; eyes with small but prominent hairs. 17.

- 17.—Minor workers extensively infuscated with brown; majors and medias with at least the scale of the petiole infuscated (Wisconsin to the Pacific Northwest with a southern extension in the foot hills of the Rocky Mountain Region). *clivia*.

Minor workers less deeply infuscated, dirty yellowish brown in color, major workers with the scale of the petiole clear yellowish red (Northeastern U. S. and Canada west to Wisconsin). *obscuriventris*.

Formica rufa clivia, new subspecies

This is the variant described by Wheeler in 1917 as *aggerans* (Proc. Amer. Acad. Arts and Sci., LII, p. 540). As Wheeler noted in that description the insect is very similar to the eastern *obscuriventris*. The most obvious difference lies in the more extensive and rather darker infuscation of the smaller workers of *clivia*. In many of the smaller workers of *clivia* the neck and the humeral portion of the pronotum are less heavily infuscated than the remainder of the thorax. This results in a curious collar-like band of dirty yellow which is very distinct in most of the specimens which I examined. This band is usually absent in the minors of *obscuriventris* but when present in this subspecies it is much less pronounced because of the feebler infuscation of the rest of the thorax. The infuscation of the larger workers of *clivia* is rather variable but at least the scale of the petiole is darkened even in the largest individuals. In addition, *clivia* appears to be slightly but definitely more hairy than *obscuriventris*.

The female of *clivia* is duller in coloration and definitely more hairy than that of *obscuriventris*. Numerous conspicuous erect hairs are present on the dorsum and sides of the thorax of each of the seven females present in the type series. The female of *obscuriventris* has much shorter and finer erect hairs on the dorsum of the thorax and many specimens lack erect hairs on the sides of the thorax. The three dark bars on the mesonotum are much more pronounced in the female of *clivia* than in *obscuriventris* despite the deeper ground color of the former subspecies. The male of *clivia* appears to be indistinguishable from that of *obscuriventris*.

Holotype, allotype and ergatotype deposited in the collection of The American Museum of Natural History.

Paratype material of this form consists of a series of males, females and workers

coming from the same nest as the types. These specimens were taken by the author at the Fish Creek Ranger Station, Glacier National Park, Montana, in July, 1934. Sticklers for priority would probably demand that the type material for *clivia* should consist of one of the several series of specimens cited by Wheeler in his 1917 description of *aggerans*. I prefer to give over what is actually a debatable point in the matter of priority for the more pertinent consideration that the specimens selected as types are the only series I have seen containing males and females as well as workers. Additional material comes from the following localities:

Colorado: Boulder (T. D. A. Cockerell, W. S. Creighton)

Wolf Creek, San Juan Nat. Forest (W. S. Creighton)

Montana: Flathead Lake (C. C. Adams, W. S. Creighton)

Wyoming: Devils Tower (W. S. Creighton)

British Columbia: Ravelstoke (J. C. Bradley)

Golden (W. Wenman)

Manitoba: Treesbank (G. C. Hewitt)

I am convinced that there has been considerable confusion in the past between this variant and *obscuriventris*. Many of the older records of the latter form coming from western stations should, in my opinion, be referred to *clivia*. Wheeler was of the opinion that *obscuriventris* occurs sporadically in Colorado. I think that this may be doubted although I have seen a single nest which may, perhaps, be referred to *obscuriventris*. The colony was taken at an elevation of 9500 feet on Niwot Ridge above the University of Colorado Geology Camp (Nederlands, Colo.). This elevation is far in excess of that at which the nests of *clivia* occur. Because of the considerable southern extension of the range of *clivia* in the Rocky Mountain region it is necessary to accompany any statement concerning elevational preference with a consideration of the part of the range involved. Yet it is true that in the extreme southern portions of its range *clivia* is confined to elevations not exceeding six thousand feet while in the more northern portions of its range

it occurs at much lower elevations. The nests of *clivia* are usually found in foothills having medium cover. They are ordinarily constructed under or in logs with only moderate use of thatching. As has been noted *clivia* intergrades with *obscuriventris* in the region extending from eastern Minnesota to northern Illinois. Material coming from this region cannot be certainly referred to either subspecies.

Formica rufa laeviceps, new subspecies

The worker of *laeviceps* has moderately abundant, erect, yellow hairs of uneven length on the dorsum of the thorax. The erect hairs on the head are notably sparser than those of the thorax. Most of the erect hairs of the abdomen are widely and evenly spaced and more even in length than those of the thorax. The posterior abdominal segments bear, however, a number of hairs which are notably longer than any of the other hairs. The sculpture of the head and thorax is rather feeble. The head is strongly shining in the region of the clypeus, frons and genae. Minor workers with the occiput, the dorsum of the pro-, meso-, and epinotum, the coxae and legs, the mesopleurae and the scale of the petiole infuscated with brown. Large workers with the head and thorax clear, rich red, only the legs infuscated. Abdominal pubescence rather dense, whitish gray in color and more abundant than in *obscuriventris* but not thick enough to give the opaque surface found in *obscuripes*.

The worker of *laeviceps* is not unlike that of *obscuripes* but differs in the following respects:

The pilosity and pubescence of *laeviceps* are sparser on all parts of the body, particularly on the head where there are only a few erect hairs and little, if any, pubescence. The sculpture on the head and thorax is much feebler in *laeviceps* so that the surface is feebly shining on the thorax and rather strongly shining on the front, clypeus and genae. In *obscuripes* the thorax is opaque and the parts of the head just mentioned are only very feebly shining. In coloration the two forms are rather similar but the infuscation of the legs of *laeviceps* is not as deep as that of *obscuripes*.

Female with the head and abdomen very smooth and shining, the thorax somewhat less shining. The head and thorax are sordid yellow in color, the abdomen deep blackish brown. Thorax with very long erect yellowish hairs which are more abundant on the dorsum than on the sides. Cephalic hairs also long but sparser than those on the thorax. Dorsum of the gaster entirely devoid of erect hairs except for a few fine ones at the base and a cluster of longer coarse hairs at the tip. Pubescence extremely short and very dilute, the surface of the gastric segments feebly shagreened. Wings hyaline, the veins and stigma brown.

The female of *laeviceps* differs from that of any of the other forms in the group in the almost complete lack of erect hairs on the dorsum of most of the gastric segments. In addition it is extraordinarily smooth and shining in contrast to other known females of *rufa* subspecies. There are several subspecies which have females possessing a gaster almost as shining as that of *laeviceps* (*coloradensis*, *obscuriventris*, etc.) but none of them show this peculiarity on the head and thorax as well.

The male of *laeviceps* is unknown.

Holotype (female) and ergatotype deposited in the collection of The American Museum of Natural History. Additional paratype material consists of a series of females and workers taken from the same nest as the types. This colony was found by the author on August 4, 1933, near Warner Ranger Station in the La Sal Mountains, Utah. The nest was in the ground beneath a stone which had been largely covered with detritus. The nest was situated on an open hillside which supported a considerable stand of sagebrush. Elevation, about 8500 feet.

Formica rufa planipilis, new subspecies

Workers with the erect hairs on the thorax moderately abundant, short, fine and all of about the same length. The erect hairs on the gaster are longer than those of the thorax but are also even in length. Erect cephalic hairs sparser than those elsewhere and more variable as to length. Surface of the head and thorax opaque, only the mandibles and frontal area feebly shining. Gaster opaque, covered with dense, long grayish pubescence. Minor workers with the thorax, legs and antennae heavily infuscated, the head with more or less infuscation in the region of the occiput. Infuscation in the larger workers usually confined to the legs, coxae, antennae and node of the petiole. Sexual forms unknown.

This variant is closely related to *obscuripes* from which it differs mainly in the less abundant shorter, finer and more even hairs on the thorax and abdomen. The erect tibial hairs are generally shorter and fewer in *planipilis* although this characteristic is somewhat variable.

I took many nests of this subspecies at Mt. Wheeler (Lehman Cave) Nevada in August, 1934. The holotype and paratypes deposited in the collection of The American Museum of Natural History came from this material. In addition I possess a large number of workers collected

in the same area but in the previous year by Dr. Glen Richards. Further material was taken by the writer at Harrison Pass, Elko County, Nevada, in the summer of 1934. In both areas the nests of *planipilis* were of the large isolated mound type. They were constructed among sagebrush bushes and generally fully exposed. At present *planipilis* is known only from the mountains of eastern Nevada but I suspect that its range may extend entirely across the state. If so it must be discontinuous since *planipilis* does not occur at elevations below 7500-8000 feet. The eastern end of the range of *planipilis* appears to border upon that of *obscuripes* in southwestern Utah. In this area may be found intergrades connecting the two forms. Throughout eastern Utah and Colorado the dominant mound builder is *obscuripes*.

***Formica rufa subnitens*, new subspecies**

Head of the major worker with the occipital border concave, as in *subcaviceps*. All sizes of workers with the dorsum of the thorax bearing about a dozen short, fine, erect hairs. Front and occiput with two or three longer and stouter erect hairs. Anterior border of the clypeus with a row of hairs at the edge and one or two borne behind the edge. Gula with one or two erect hairs. Eyes with numerous, very fine, short but conspicuous hairs. Gaster bearing a few scattered, golden, erect, hairs. Surface of the thorax finely but densely sculptured, opaque. Head, particularly the clypeus and genae, less densely sculptured, shining. Pubescence very sparse on the head, moderately abundant on the thorax, dense, long and prominent on the gaster where it forms a grayish investiture. Minor workers extensively infuscated. Infuscation of the majors and medias less extensive, largely

confined to the legs, the scale of the petiole and a patch on the pronotum. Sexual forms unknown.

This subspecies is obviously related to *subcaviceps* from which it differs principally in the more shining surface of the head and the sparser pilosity.

Holotype and paratypes based on a series of workers taken by the author from a single nest at Bly, Oregon, July 23, 1934. The holotype and a part of the paratype series are deposited in the collection of The American Museum of Natural History.

The nest of *subnitens*, like those of *subcaviceps*, was constructed in the soil with no covering mound of detritus. Since only a single nest was found it is impossible to do more than surmise concerning the range of *subnitens* but there are certain considerations which may apply. The country in the vicinity of Bly apparently represents a transition to the conditions found a short distance to the east where the very arid desert country begins. In many respects the country in the neighborhood of Bly is similar to the grassy upland plains to the east of the Rockies and like them it opens on the west into higher plateaus containing considerable sagebrush. In the latter areas *subcaviceps* occurs. At still higher elevations in the Cascade Mountains (3000-4000 feet) *subcaviceps* is replaced by *propinqua*. I am not prepared to claim that *subnitens* occurs along the foot of the eastern slope of the entire Cascade Range but it would not be surprising if this is the case.