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INSECT FAUNAS OF SOUTH AFRICA FROM THE UPPER PERMIAN AND THE PERMIAN/ TRIASSIC BOUNDARY

by

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ABSTRACT

Those sites in South Africa where more than one insect fossil specimen has been found have been interpreted as younger than Middle Triassic or as Late Permian. One site which has yielded a number of specimens and is apparently near the Permian/Triassic boundary is a quarry in the town of Bulwer KwaZulu-Natal. There are six sites with more than one insect specimen which are stratigraphically lower than Bulwer, namely Escourt (a new site), Far End, Mooi River (National Road), Mount West, Balgowan and Lidgetton. According to the 1984 1:1 000 000 Geological Map of Southern Africa Bulwer is situated in the Tarkastad Subgroup of the Beaufort Group near its lower boundary; the Tarkastad has been considered as Triassic. the remaining sites, except Balgowan and Lidgetton, fall in the Estcourt Formation of the Beaufort Group, as do all the sites with single Late Permian specimens except for one similarly aged specimen from the more easterly Emakwezeni formation. The stratigraphically lowest sites are Lidgetton and slightly younger Balgowan; both are mapped as Volksrust Formation of the Ecca Group. An analysis is made of vertical distribution of taxa, with those of Lidgetton and Balgowan grouped together as a lower unit, of Bulwer as upper unit, and of the Estcourt formation sites and Emakwezini site as a middle unit. No obvious break between the three units has been noted.

KEYWORDS: Insects, Upper Permian; Permian/Triassic Boundary; Estcourt Formation; Volksrust Formation; Tarkastad Subgroup.

INTRODUCTION

Thirty years ago there were only two described African (Zaïre and Zimbabwe) specimens and another two South African specimens awaiting study. Since then the number of specimens of insects of Palaeozoic and possibly Lower Triassic age in Africa has grown to hundreds, most of which have come from an area about 90km from north to south and 50km from west to east in Kwazulu-Natal (Figure 1) this area includes the sites of all but one of the Upper Permian and possibly Lower Triassic specimens (the exception being from Emakwezini, further east) and all the Palaeozoic sites which have so far yielded more than one specimen. Most of the specimens from this area are in the Natal Museum, with a few, including some types, in the collections of the Bernard Price Institute for Palaeontological Research (BPI), University of the Witwatersrand, Johannesburg. These two collections include all the described material. A photographic record of types, and other important specimens, including undescribed taxa, is being compiled. Sufficient information is available to permit an analysis of the stratigraphic distribution of taxa.

MATERIALS AND METHODS

All the material in the Natal Museum has been studied and many types and other important specimens were photographed either previously, or recently. The types from the Bernard Price Institute were photographed in September 1996. Two insect fossils from a new site in Estcourt are represented by photographs supplied by Mr. D. Green. A small number of specimens has been discovered recently during a further splitting of material collected several years ago. Of these, one significant specimen which has not yet been accessioned has been included in the analysis of distributions. Photographs which included a millimetre scale and were enlarged similarly, greatly aided comparisons of specimens within a site and between sites. Specimens in which the radial vein appeared negative, i.e. as a trough instead of a ridge, were often also photographed with posterior lighting, which reversed the relief. By scanning photographs into a computer manipulations such as adjustments in size and reversals of wings to a standard apex-right view were made simple.

The specimens were grouped as members of three units, corresponding to divisions on the 1984 1:1000 000 Geological Map of Southern Africa: an upper unit for Bulwer specimens (Tarkastad Subgroup of the Beaufort Group), a lower unit for specimens from Lidgetton and Balgowan (Volkrust Formation of the Ecca Group), and middle unit for alll the other Palaeozoic Kwazulu-Natal sites (Estcourt or Emakwezini Formations). It should be note that Triassic fossil occur quite low in the Tarkastad Subgroup.

For the stratigraphic distribution of the insect groups, references was made to Riek (1970) and Kukalová-Peck (1991). The sequence of insect

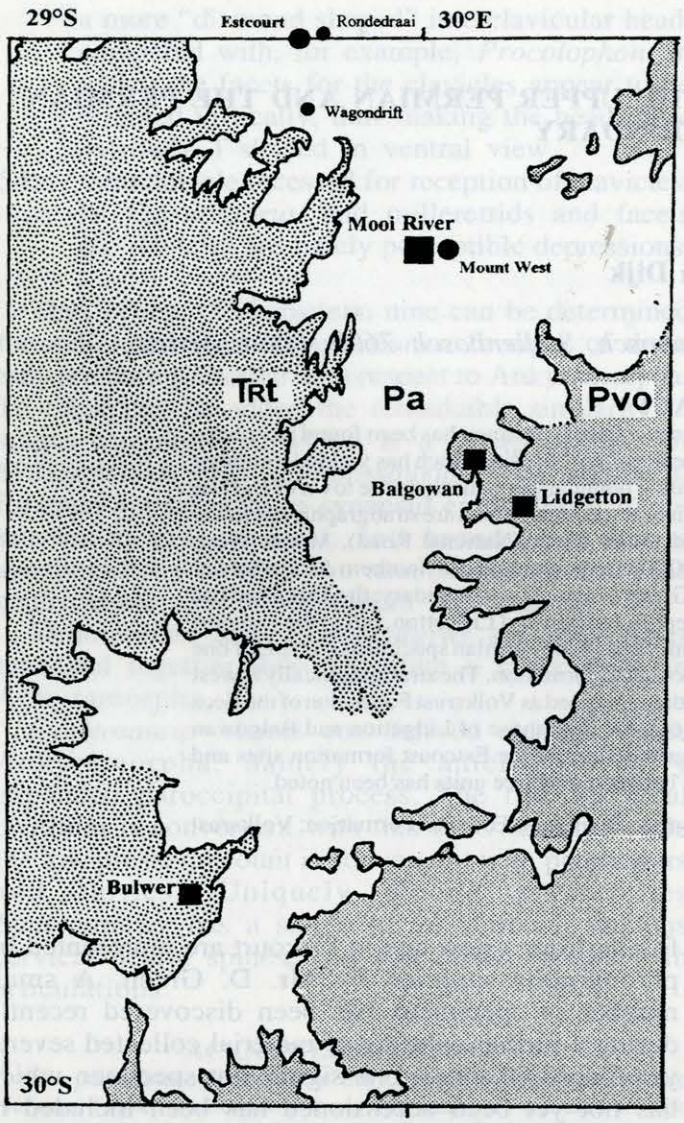

Figure 1. Map showing the study area, and the three units, the lowest being in the East, the highest in the West. TRt = Tarkastad Subgroup of the Beaufort Group; Pa = Estcourt formatin of the Beaufort Group; Pvo = Volksrust Formation of the Ecca Group. Boundaries are represented by dotted lines when they are obscured by dolterite intrusions.

groups in the latter was followed. The stratigraphic range of the Trichoptera is shown in the Triassic in Kukalová-Pec (1991), but in the Permian in Riek (1970), who unlike Kukalová, includes the stem-group amphiesmenoptera (Permian to Triassic) in the Trichoptera. The stratigraphic units form the upper two-thirds of the Carboniferous to the lower two-thirds of the Cretaceous were rescaled to a million years per millimetre, to represent the geological periods in proportion (Figure 2). The lengths of the three units under study have been arbitrarily made the same length, and together shown as considerably more of the Permian than they really represent. Species are represented as narrow lines, monospecific genera as broad lines.

RESULTS

The orders Paraplecoptera; Plecoptera; Orthoptera; Protelytroptera; Hemiptera; Mecoptera; and Neuroptera are apparently represented by the same taxon (genera and sometimes species) in more than one of the units (Table 1). In the case of Orthoptera, the taxon *Eolocustopsis* Riek 1976, is represented by a wing in one unit (middle one – Mooi River) and by specimens which include a thorax with wingbase only, at the other (lower – Lidgetton) unit. Protelythroptera, represented by *Phyllelytron acuminatum* Riek 1976, and Neuropter, represented by *Archeosmylus*, have been found only in the upper two units.

The stratigraphic occurrence of the Protelytroptera shown in Riek (1970) ends in the Permian, but they are shown as extending into the early Cretaceous in Kukalová-Peck (1991). The remaining four orders each have one genus which possibly extends from the lower to the upper unit. They are: Paraplecoptera, *Mioloptera* Riek 1973 (Figure 3); Plecoptera, Euxenoperla Riek 1973; Hemiptera, *Beauforticus* Riek 1976 – in lower and upper units only (Figure 4, note caption); and Mecoptera, *Prochoristella* Riek 1953 (Figure 5), the first record of the genus in South Africa being the species *P. hartmani* Riek 1976.

TABLE 1.

Stratigraphic distribution of Taxa known from more than one level, the three levels being represented by the sites listed.

Lidgetton Balgowan	Mooi River Far End Wagondrift Mr. West Rondedraai Estcourt Emakwezini	Bulwer
Paraplecoptera: *Mioloptera*		
Paracoptera: *Fuxenoperia*		
Hemiptera: *Beauforticus*		
Mecoptera: *Prochoristella*		
Paraplecoptera: *Mioloptoides*		
Hemiptera: Stenovicid		
Hemiptera: *Orthoscytina*		
Hemiptera: *Aleuronympha*		
Hemiptera: Permaleurid		
	Paraplecoptera: *Miolopterina*	
	Paraplecoptera: *Liomopteroides*	
	Protelytroptera: *Phyllelytron*	
	Hemiptera: *Austroprosboloides*	
	Hemiptera: *Dysmorphoscartella*	
	Neuroptera: *Archeosmylus*	

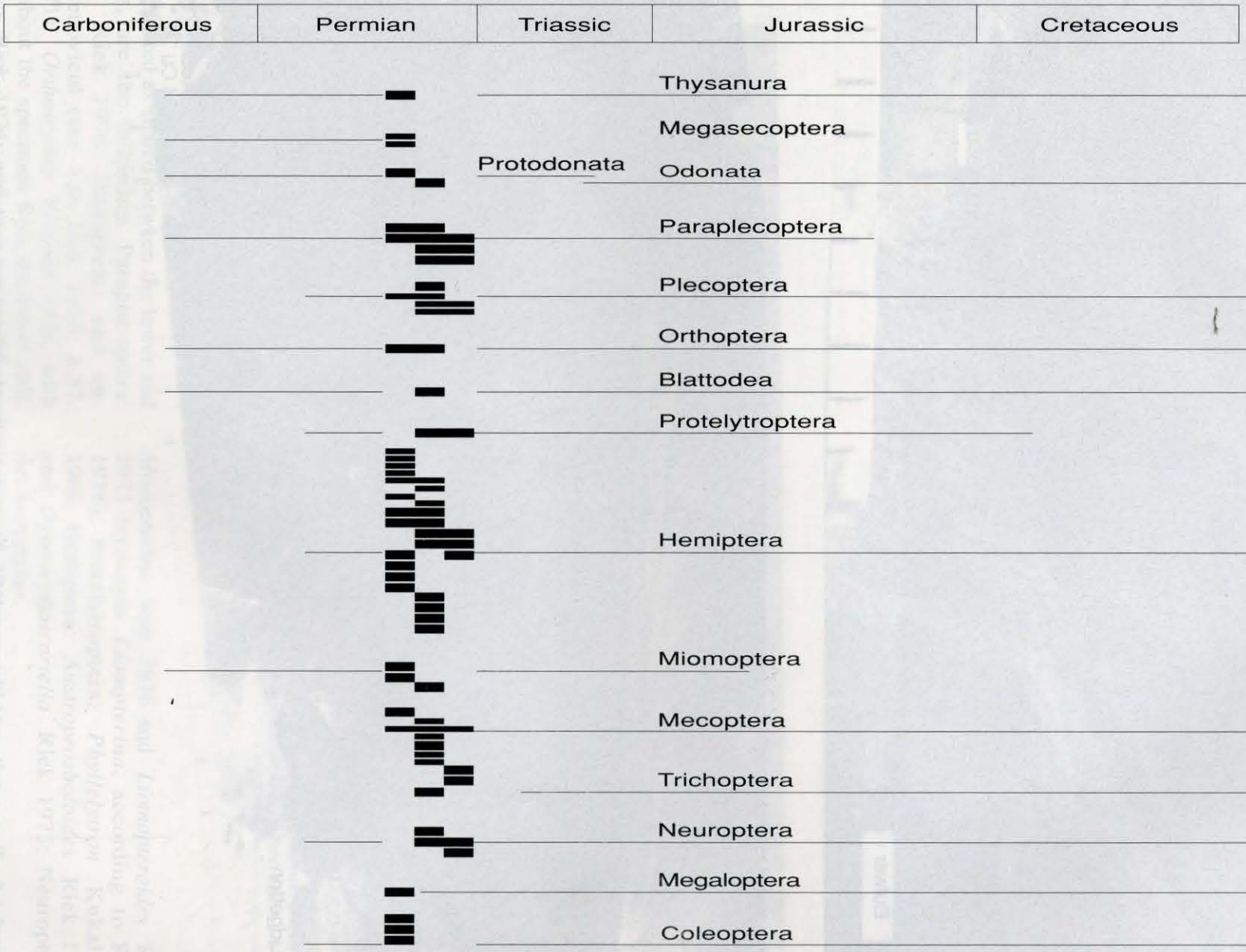

Figure 2. Fossil insect taxa reported from Kwazulu-Natal, South Africa, and the stratigraphic ranges of the groups after Kuklová-Peck (1991)

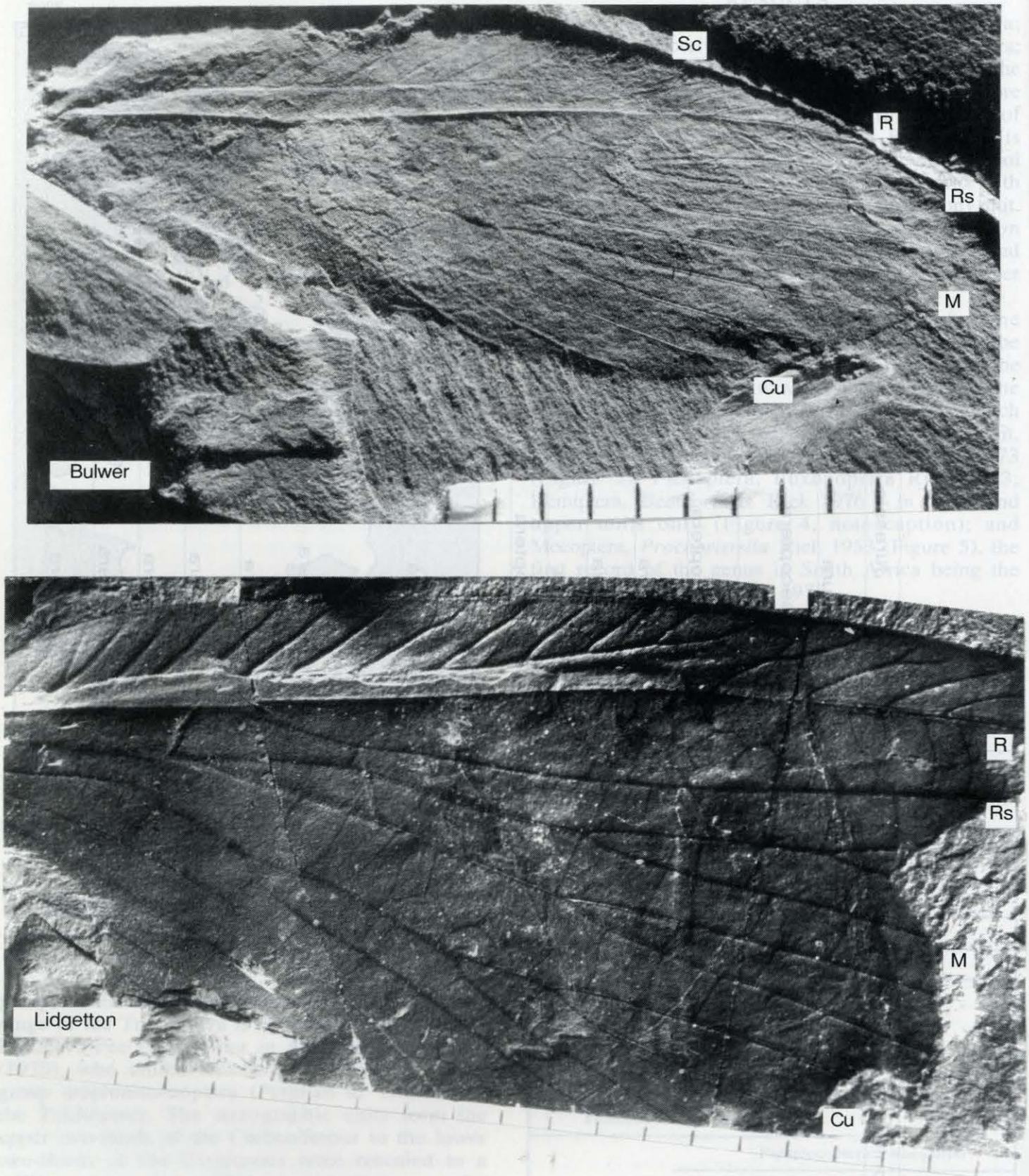

Figure 3. Specimens attributed to the genus *Mioloptera* (type locality Mooi River) and the lower unit (below, Lidgetton, one of several specimens); x8. Differences include the extra branch of the Radial Sector (Rs) in the upper specimen, and extra distal branch in the Medial (M) and (anterior) Cubital (Cu) in the lower speciment, all variable features in Mooi river specimens. The upper specimen appears to be considerably smaller (c. 20mm) and the lower specimen considerably large than the estimated 26mm of the Mooi River type.

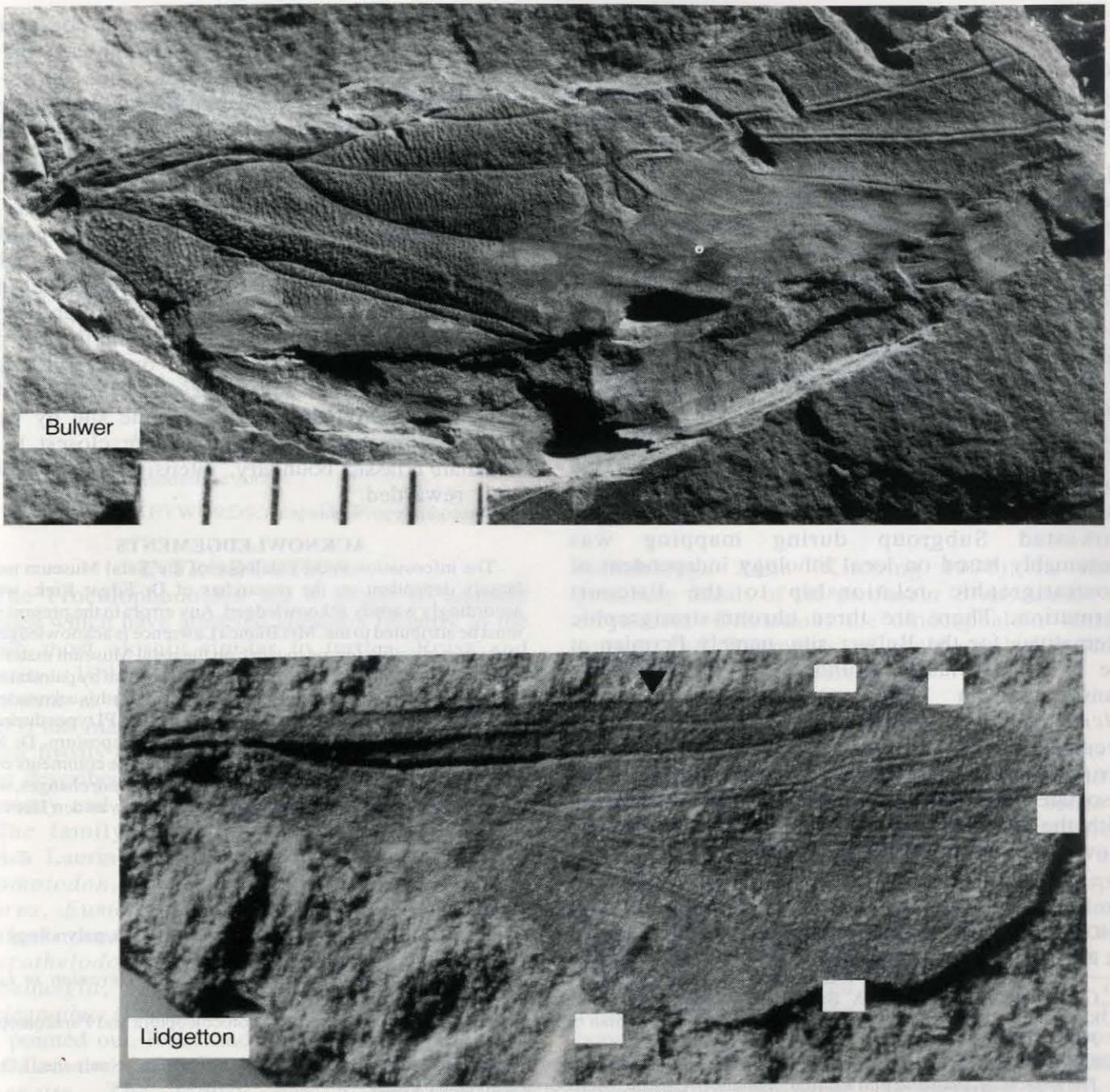

Figure 4. Specimen attributed to the genus *Beaufortiscus* (above, Bulwer, only specimen; reversed) and the type specimen of the genus from Lidgetton (below); x 10. The upper specimen shows a number of differences from the type. These include the lessor curvature of the Medial and Cubital veins at their common origin with the Radial, the more proximal branching of the Medial, and straighter marginal branches. These are at least specific differences, and may be generic ones.

The taxa reported as shared between the lower and middle units, are the following. Paraplecoptera: *Miolopoides* Riek 1976; Hemiptera: and undescribed stenovicid (see Van Dijk 1978: p.57. figures 70, 71); *Orthoscytina* Tillyard 1926, with some doubt about the specimen from the lower unit; *Aleluronympha* Riek 1974; and two species of a a new permaleurid nymph (Riek 1974 figure 74). The new taxa reported as shared between the middle and upper units are the following. Paraplecoptera: *Miolopterina* Riek 1976 and *Liomopteroides* Riek 1973 (synonym *Liompterina*, according to Riek 1976); Protelytroptera: *Phyllelytron* Kukalová 1966; Hemiptera: *Austroprosboloides* Riek 1973 and *Dysmorphoscartella* Riek 1973; Neuroptera: *Archeosmylus*.

Overall 30 recognisable genera are found in only one of the three units, 13 are found in two units, and three in all three units.

DISCUSSION AND CONCLUSIONS

There is no obvious discontinuity either between the lowest and middle unit or between the middle and highest unit. The flora, rather poorly represented in the lower unit (Lidgetton and Balgowan), is similar in the three units. Anderson & Anderson (1985) treat all the sites as Permian. Bulwer is shown as in the Estcourt Formation in their Map 2.8 (Anderson & Anderson 1985 p.34) The map is based on Map 1 of Anderson (1977), derived from a palynological study. Among the assemblages selected for the study by Anderson & Anderson there were none in the *Lystrosaurus* Assemblage Zone and two in the *Dicynodon* Assemblage Zone (which corresponds to the Estcourt Formation). Carbonaceous material does not occur at Bulwer, and has been sampled by A.J. Tankard, but no palynological results of a study of this material are known which might provide information indicating a Permian or Triassic age of the site. The inclusion of the Bulwer area in the Tarkastad Subgroup during mapping was presumably based on local lithology independent of biostratigraphic relationship to the Estcourt Formation. There are three chrono-stratigraphic alternatives for the Bulwer site, namely Permian at the Permian/Triassic boundary, or Triassic. The transition from *Glossopteris* dominated to *Dicroidium*-dominated floras seems to have occurred during the Early or Middle Triassic, a period for which the fossil record of the floras and the associated insect faunas in South Africa is poor. As with the flora, the insect fauna of the Bulwer site shows affinities with the older sites.

Further work at the Mooi River site is not feasible, as the site is covered by a broad highway, the N3 National Road. A test excavation made during the road-making into the road cutting yielded plants of inferior quality and no insects. A quarry just above the road cutting, on the farm Far End, yielded a small number of insects. The productive layers are probably exhausted. Some material from Far End was collected and store, and has yet to be studied. The Balgowan site is a small road cutting which probably could be further studied. Some Lidgetton material is being studied as present. Further study of the Bulwer site has been planned. In the town of Bulwer, this site is a discussed quarry with great potential for further continued study provided steps are taken to stop the invasion of the site by wattle trees. As this is the productive site closest to the Permian/Triassic boundary, intensive study may be well rewarded.

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