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## INTRODUCTION

Although pre-Triassic rocks cover an area roughly equal to that of the Mesozoic and Tertiary rocks in the Alps, their history is much less well known. They form relics of older orogenic belts which have been overwhelmed by the Upper Cretaceous-Miocene orogeny and involved with the later sediments in the complex Alpine deformation, partly overthrust, as in the Eastern Alps, the Pennine nappes and the Briançonnais Zone, locally remetamorphosed and intruded by younger igneous rocks. In the external massifs, from Argentera in the south-west to the Aar Massif in the north-east, the pre-Triassic rocks preserve their earlier structures and expose a fragmentary picture of the Hercynian and older basement complex and the small basins of Upper Palaeozoic sediments.

At the eastern extremity of the external massifs (Zentralmassive of most German-speaking authors), in the eastern Aar Massif, three small areas of pre-Triassic sediments are exposed within the crystalline rocks. These areas have in the past been studied separately by several geologists, and have given rise to a number of conflicting opinions on the origin and age relationship of the sediments. The present study has been undertaken to resolve some of the problems by detailed stratigraphical and structural investigations of these three isolated areas, and attempt to lay down some general correlations with the late Palaeozoic rocks of neighbouring areas. The results of previous geologists have been summarized for each area in order to illustrate the conflicting views and the evidence on which they are based. The regional significance of the results of the present study is discussed in the final chapter.

### *The Main Problems*

One of the greatest controversies in the eastern Aar Massif concerns the age of the Tödi granite and its associated contact metamorphism, and the question of whether or not it is related to the Central Aar granites. FAUL (1962) stated: '... the Tödi granite ... is thought to be stratigraphically younger than Westphalian D and probably older than Permian (WIDMER 1949). It is the only stratigraphically recognized Hercynian rock in the central Alps, but it is badly altered and a measured age is not available.

The study of contacts between crystalline rocks and stratigraphically dated sediments is extremely difficult in areas as severely smashed as the Alps. It is not surprising that a contact may appear to be much more "eindeutig" in the literature than it actually is in the field. The question whether the Tödi granite really does intrude the Westphalian D would be answered quite differently by different field geologists who have studied the area.'

The two possibilities are that the Tödi granite and its related pegmatites do intrude the dated Upper Carboniferous sediments (ESCHER 1911, who considered that only

the pegmatites intrude the dated sediments; WIDMER 1949) or that it is intrusive into an older succession and is overlain unconformably by the Upper Carboniferous (WEBER, in HEIM 1922; HÜGI 1941). The former explanation, implying post-Westphalian age for the granite or its pegmatites has been accepted in recent years and is incorporated in the most recent summaries (CADISCH 1953; HÜGI 1956).

The plant-bearing Westphalian D (?)–Stephanian sediments of the NE Tödi area are relatively easy to describe stratigraphically, for they are well bedded and contain distinct lithological types. The sediments further west, in the Maderanertal, are on the other hand rather problematical. They contain no fossils; they are predominantly volcanic and lack distinctive lithological types which may be used for correlation, and they are more metamorphic than the rocks NE of Tödi (with biotite and chlorite).

The earliest studies of these sediments described them as tuffaceous rocks and flows (W. STAUB 1911; PFLUGSHAUPT 1927; BRÜCKNER 1943), whilst the latest study (SIGRIST 1947) denies the presence of surface volcanic rocks either as flows or as tuffs, and describes the rocks in question as intrusive sills with minor relics of Carboniferous slates (p. 76). The basic problem of the relative ages of the rocks north of the Central Aar granite had not been satisfactorily solved, despite its importance in dating the late Paleozoic magmatic history of the Aar Massif.

The Upper Carboniferous sediments in the north of the Aar Massif can be drawn as two more or less continuous belts, the northern one stretching from the Bifertengrätli area through the Klein Tödi into the Maderanertal and over Bristenstäfeli to Intschi in the Reuss valley, and the southern one passing from Tscharren to Rossbodenstock. A further belt of sediments is known from the southern part of the eastern Aar Massif in the Val Gliems and Val Russein area. These were described by WEBER (in HEIM 1922) as part of the older Carboniferous sedimentary succession. A later study by EUGSTER (1951) correlated these rocks with the Upper Carboniferous succession of the NE Tödi area as described by WIDMER and explained their higher metamorphic grade as a result of the post-Carboniferous granite intrusion. The uncertainties in the Carboniferous stratigraphy worked out by WIDMER hindered a comparison between the two areas; it was not appreciated that the Upper Carboniferous lay unconformably above an older succession and that the volcanic Grünhorn Formation is in fact older than the plant-bearing Bifertengrätli Formation.

## THE NE TÖDI AREA

### INTRODUCTION AND SUMMARY OF PREVIOUS WORK

The Biferten inlier on the NE side of Tödi is the most significant area of the eastern Aar Massif for a discussion of the sedimentary rocks that form the younger part of the basement complex. Besides the dated Upper Carboniferous sediments, hornfelses, knotenschiefer, tuffaceous sediments, granites, diorite and quartz porphyry have been considered as Upper Paleozoic. Hornblende gneisses are assumed to be the oldest rocks present as they contain structures which are not shared by any other rocks.

In 1809 CONRAD ESCHER VON DER LINTH described anthracitic schists from Bifertengrätli, but not until 1879 were determinable plant remains found by A. ROTH-