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easternmost part of the range where its time-span *(Prohungarites* and *Subcolumbites* beds up to *Haugi* Zone) and lithology are similar to these of the Tobin Formation. Typical exposures of the latter formation are found in the southern Tobin Range, and there are also extensive outcrops further South, in the Augusta Mountains and New Pass Range (NICHOLS & SILBERLING 1977).

The next overlying Brown Calcareous Sandstone Unit pinches out before final truncation against the three basement highs of the northern Humboldt Range. Its marine depositional environment is ascertained by the presence of extremely scarce and unidentifiable ammonoids and a few brachiopods occurring at its upper limit. The detritic character of these evenly fine-grained rocks and their uniform siliciclastic composition markedly contrast with the enclosing lithologic units and do not suggest derivation from a nearby source. The Brown Calcareous Sandstone Unit is here regarded as a shallow marine, distal equivalent of the mainly conglomeratic and partly subaerial Dixie Valley Formation which overlies the Tobin in the eastern part of the Star Peak Basin (southern Tobin Range, Augusta Mountains and to a lesser extent in the New Pass Range). The Brown Calcareous Sandstone and the Dixie Valley Formation are both thought to record the same major detritic input which originated at the eastern edge of the Star Peak Basin, at the close of the Lower Triassic.

Strata deposited during early transgression of the Fossil Hill here locally escaped later uplift and erosion, which did not occur in central part of the Star Peak Basin. In the northern Humboldt Range, most of the preexisting topography was drowned, except for the Star-Humboldt and Arizona which were then residual basement highs. The former pronounced depositional trend which prevailed during Spathian time did not subsist later on, as inferred from the comparatively much more evenly deposited Fossil Hill Member. Though much more uniform, sedimentary rates of the Fossil Hill nevertheless vary from block to block. In such circumstances, lithostratigraphic thickness are not of much help and may even be somewhat misleading in that lowest rates as inferred from faunal sequences are not necessarily to be found above a formerly emerged basement high (reversion).

A Lower Anisian age can reasonably be assumed for the Lower Member of the Favret Formation which conformably rests upon the Dixie Valley Formation in the eastern part of the basin (NICHOLS & SILBERLING, 1977). No more accurate age-diagnostic fossils than coiled nautiloids and brachiopods could be obtained from this limited shallow carbonate platform. Its upper limit is rather well age-constrained by the overlying Fossil Hill, the basal strata of which may be either of Lower or Upper Hyatti age depending on various synsedimentary faulted blocks (BUCHER, 1988, Pl. 7).

3. The latest Spathian and Lower Anisian ammonoid sequence from Nevada

The basic biochronologic scheme was produced by SILBERLING & TOZER (1968), SILBERLING & WALLACE (1969) and SILBERLING & NICHOLS (1982). The biochronologic procedure employed both by the workers mentioned above and in the present note are all consistent with concurrent-range-type units.

Three newly recognized biochronologic units are fitted into the Lower Anisian succession (Tabl. 1). They are intercalated between the formerly known *Haugi* Zone (late Spathian) and *Caurus* Zone (Lower Anisian). The forthcoming attempt in correlating

STAGE/SUBSTAGE	SPATHIAN	LOWER ANISIAN			
Biochronologic Units	Upper Haugi Zone	J. welteri beds	P. guexi beds	Mulleri Zone	Caurus Zone
Neopopanoceras haugi (Hyatt & Smith)	************				
"Acrochordiceras" inyoense Smith	************				
"Hungarites" yatesi Hyatt & Smith	************				
Keyserlingites subrobustus (Mojsisovics)	************				
Metadagnoceras pulchrum Tozer	************				
Preflorianites sp. indet.	************				
Olenekites sp. indet.	************				
Isculitoides sp. A	************				
Karangatites multicameratus (Smith)	************				
Japonites welteri n. sp.		***********			
Japonites starensis n. sp.		***********			
Hemilecanites cf. H. paradiscus Kummel	- - - - - -	***********			
Metadagnoceras sp. indet.		***********			
Paracrochordiceras sp. indet.		***********			
Pseudokeyserlingites guexi n. gen. n. sp.			***********		
Paracrochordiceras silberlingi n. sp.			***********		
Leiophyllites sp. indet.				***	
Grambergia sp. indet.				***********	
Ussurites sp. indet.				********	
Caucasites nicholsi n. sp.				********	
Silberlingites mulleri n. gen. n. sp.				********	
Silberlingites tregoi n. gen. n. sp.				********	
Paracrochordiceras cf. P. americanum (McLearn)				***********	
Paracrochordiceras mclearni n. sp.				********	
Paradanubites crassicostatus n. sp.				********	
Metadagnoceras youngi n. sp.				********	
Sageceras cf. S. walteri Mojsisovics				********	
Groenlandites pridaense n. sp.				********	
Gymnites billingsi n. sp.				********	
Paracrochordiceras plicatus n. sp.					***********
Japonites cf. J. surgriva Diener					***********
Isculites meeki Hyatt & Smith					***********
Gymnites tregorum Silberling & Nichols					***********
Lenotropites caurus (McLearn)					***********
Groenlandites merriami n. sp.					***********
Ussurites detwilleri n. sp.					***********

Table 1: Stratigraphic distribution of latest Spathian and Lower Anisian ammonoids in the northern Humboldt Range.

the Nevada succession necessitates inclusion of these two zones in the time interval described hereinafter in ascending order. Location of the author's relevant localities is given in the appendix (p. 1002).

Haugi Zone

Index species: *Neopopanoceras haugi* (HYATT & SMITH)

Type locality: USGS Mesozoic loc. M114, Union Wash, Inyo Mountains (SILBERLING & TOZER 1968). Union Wash Formation (MOUNT 1971).

Occurrence: USGS Mesozoic loc. M2834, 2823, 2824, 2827 (SILBERLING & WALLACE 1969); loc. HB 107, 140, 141, 142, 108, 110, 111, 143, 219, 236 (northern Humboldt Range, Carbonate Unit of the Lower Member of the Prida Formation).

In the northern Humboldt Range where the *Haugi* Zone is in close succession with the *Subcolumbites* and *Prohungarites* beds, it has potential for further refinements or subdivisions. This zone includes at least two discernible associations, the younger of which is represented at localities M2834 or HB 110, 111, 143, 219 and 236. For our purpose here, this upper subdivision is conveniently, though provisionally, labelled as Upper *Haugi* Zone and is apparently a nearly exact correlative of the type locality in the Inyo (see remark by SILBERLING & TOZER 1968, p. 39). The entire *Haugi* Zone will be treated separately (BUCHER, GUEX & TAYLOR, in prep.) and we are presently only concerned with its upper part.

Updating the faunal content of the Upper *Haugi* Zone as listed by SILBERLING & WALLACE (1969) is desirable, at least in regard to the taxonomy. New generic names are evidently needed for *"Acrochordiceras"* cf. *"A". inyoense* SMITH and *"Hungarites" yatesi* HYATT & SMITH. It should be made clear that both are respectively distinct from exclusively Anisian *Paracrochordiceras,* nor *Acrochordiceras* s.s. and Ladinian *Hungarites* s.s., but at least *"H". yatesi* was adequately illustrated by SMITH (1914) to prevent it from being considered of having Anisian affinity (ASSERETO and others 1980, DAGYS 1988b).

Besides several still unidentified ammonoids, two noteworthy additions to the Nevada Upper *Haugi* Zone are representatives of *Preflorianites* and *Olenekites.* Specimens of *Preflorianites* collected at locality HB 236 are closely similar to *P. intermedius* TOZER from the *Subrobustus* Zone but have stronger ribbing. Presence of *Olenekites* is indicated by a single specimen collected by N.J. Silberling at locality M2834.

Presence of *Keyserlingites subrobustus* (MOJSISOVICS) in the Upper *Haugi* Zone as first suggested by SILBERLING & WALLACE (1969) and later asserted by GUEX (1978) is well established. Specimens collected by N.J. SILBERLING at the same locality M2834 (= *"Tirolites" pacificus* HYATT & SMITH, in SILBERLING & WALLACE 1969) are unequivocally assigned to this species. In the Inyo Range, *Keyserlingites subrobustus* occurs again but was found several tens of feet above the type locality of the *Haugi* Zone, at USGS Mesozoic locality M2595 (SILBERLING & TOZER 1968). From the same bed, J. Guex and N.J. Silberling collected additional, undescribed ammonoids which include *Olenekites* and a new genus (BUCHER, GUEX & TAYLOR, in prep.). The latter is characterized by a compressed, evolute shape and is provided with both single and looped ribs. It's body chamber also bears conspicuous marginal tubercles related to the looped ribs only. This locality presumably yielded the youngest Spathian ammonoids but still needs detailed taxonomic treatment. Therefore, this locality is not yet taken into account.

As noticed by Dagys and others (1979) and Dagys (1988b) *"Xenodiscus" bittneri* Hyatt & Smith and *"X". multicameratus* Smith resemble the Lower Anisian Siberian genus *Karangatites* Popov. Such a generic attribution seems justified on morphological grounds and therefore is adopted here. However, the significance allocated to *Karangatites* for correlations diverges from that of Dagys (1988b) (see comparisons and correlations).

In taking into exclusive consideration the northern Humboldt Range succession, one can already state that there are only few Upper *Haugi* Zone or even older genera ranging up to the next overlying Anisian biochronologic units (e.g. *Metadagnoceras* and *Hemilecanites*). At a higher taxonomic rank, *Sageceratidae, Xenodiscidae, Khvalinitidae, Aplococeratidae, Acrochordiceratidae, Longobarditidae* and *Keyserlingitinae* which originated during Spathian time, undoubtedly extend to the Nevada Anisian strata.

It must be stressed that a nearly barren lithological unit, whose maximal thickness is of about 100 m (i.e. the Brown Calcareous Sandstone Unit of Silberling & Wallace 1969), is intercalated between the *Haugi* Zone and the Lower Anisian faunas of the Fossil Hill Member. It must be kept in mind that the lack of age-diagnostic fossils from the Brown Calcacerous Sandstone Unit induces a non-negligible gap into the Nevada ammonoid sequence.

Japonites welteri beds

Index species: *Japonites welteri* n.sp.

Type locality: USGS Mesozoic loc. M2364 (=HB 184), Star Creek Canyon, northern Humboldt Range (locality plotted on Silberling & Wallace 1967).

Occurrence: Loc. HB 92, 109, 181, 235, northern Humboldt Range (Fossil Hill Member, Prida Formation).

This biochronologic unit occurs at the very base of the Fossil Hill Member, about 4 m above the boundary with the Brown Calcareous Sandstone Unit at its type locality. The *Japonites welteri* beds are located there at the top of conspicuous blocky outcrops formed by a dense group, 1 m thick, of impure dark-grey limestone beds. Such a lithology somewhat contrasts with the usually soft-weathering black micritic limestones-silty shales alternation that makes up most of the Fossil Hill. Allowing for some minor lithological variations, this horizon has proved a useful lithological marker that is traceable throughout the easternmost outcrop belt, between Star Creek and Coyote Canyons. This lithological horizon invariably yielded the same *Japonites welteri* fauna.

Further west, towards the core of the Range, the same fauna was found at locality HB 92, right on top of the Coyote basement high, at about 8 m above the Koipato-Fossil Hill disconformity. At that place, the lithology of the *Japonites welteri* beds has lost its peculiar character and conforms to that of the regular facies of the Fossil Hill Member.

The *Japonites welteri* beds correspond to the *Eophyllites* sp. A-bearing strata of Silberling & Wallace (1969). Because enough well preserved specimens showing the suture line were obtained, *Eophyllites* sp. A turned out to be a japonitid, referred to as *Japonites welteri.* This is by far the most common form of this low diversity fauna. Other scarce co-occurring ammonoids are *Japonites starensis, Paracrochordiceras* sp. indet., *Hemilecanites* cf. *H. paradiscus* and *Metadagnoceras* sp. indet. At first sight, this assemblage displays both Spathian *(Hemilecanites, Metadagnoceras)* and Anisian *(Paracrochordiceras, Japonites)* ammonoids. As demonstrated by its occurrence in the indisputably Anisian *Mulleri* Zone, *Metadagnoceras* is a long ranging genus which is not significant with respect to the stage assignment of the *Japonites welteri* beds. A Lower Anisian age is thus largely favoured for these beds on the grounds of *Japonites-Paracrochordiceras* co-occurrence. Association with the Spathian hold-over *Hemilecanites* nevertheless permits erection of this low diversity fauna as a concurrent-range unit.

Pseudokeyserlingites guexi beds

Index species: *Pseudokeyserlingites guexi* n. gen. n. sp.

Type locality: HB 138, Coyote Canyon, northern Humboldt Range.

Occurrence: Loc. HB 147, 223, 250, 251, northern Humboldt Range (Fossil Hill Member, Prida Formation). USGS Mesozoic loc. M1599, Union wash, Inyo Mountains (Union Wash Formation).

On the northeastern edge of the Coyote basement high, the *Pseudokeyserlingites guexi* beds at loc. HB 223 were found stratigraphically 12 m below the type locality of the *Mulleri* Zone (loc. HB 56). Right on top of the same Koipato basement high, the type locality of the *P. guexi* beds occurs stratigraphically 6 m above the *Japonites welteri* beds (loc. HB 92).

Though momentarily of very low diversity, this biochronologic unit contains two characteristic and readily identifiable ammonoids *(P. guexi* and *Paracrochordiceras silberlingi).* However, *P. guexi* has more than a local biochronologic significance because it is known in the Inyo Range (California), where at least one undoubtedly recognizable specimen was collected by Miller Ellis in 1948 at the USGS Mesozoic loc. M1599 (White Pine Quad.). Unfortunately, locality M1599 is not in sequence with the *Haugi* Zone strata (N. J. Silberling, written com. 1989).

Mulleri Zone

Index species: *Silberlingites mulleri* n. gen. n. sp.

Type locality: HB 56, Coyote Canyon, northern Humboldt Range.

Occurrence: Loc. HB 59, 88, 91, 94, 95, 115, ?120, 222, Coyote Canyon, northern Humboldt Range (Fossil Hill Member, Prida Formation).

The *Mulleri* Zone is found to have its typical development in the northern tributary of the Coyote Canyon where it is in stratigraphic sequence with the next underlying biochronologic units. Within the same area, the next overlying available bedrock localities occur stratigraphically 15 to 20 m higher in the section and are of Lower *Hyatti* age.

On the Coyote basement high, a single talus block containing ammonoids indicative of the *Caurus* Zone (loc. HB 247) was collected a few meters stratigraphically above the *Mulleri* Zone at bedrock locality HB 88. For want of more conclusive evidence, this is by now the unique superpositional relationship available between *Mulleri* and *Caurus* Zones. It must be added that no fault that would obscure the succession was noticed from loc. HB 88 upwards, until the next overlying bedrock localities of Lower *Hyatti* age. The beds from which the float *Caurus* Zone block is derived could unfortunately not be precisely relocated, however there is no other possible provenance than from the strata bracketed between the *Mulleri* and Lower *Hyatti* Zones.

In Bloody Canyon, where the *Caurus* Zone occurs on strike about 30 to 40 m above the *Japonites welteri* beds, the *Mulleri* Zone has so far not been found in sequence. However, these apparently unfossiliferous strata leave ample room for the *Mulleri* Zone.

If not formally demonstrated by first order evidence, occurrence of the *Mulleri* Zone below the *Caurus* Zone is nevertheless the most likely. This well diversified fauna is here formally introduced at zonal rank. *Silberlingites, Groenlandites* and *Caucasites* are the most common forms of the *Mulleri* Zone.

Caurus Zone

Index species: *Lenotropites caurus* (McLearn)

Type locality: East limb of anticline west of Mile Post 375, Alaska Highway, northeast British Columbia, Toad Formation (Tozer 1967).

Occurrence: USGS Mesozoic loc. M2367, M2358, M2828 (Silberling & Wallace 1969); loc. HB 51, 74, 180, 201, 225, 247, 252, northern Humboldt Range (Fossil Hill Member, Prida Formation).

The *Caurus* Zone was first recognized in the northern Humboldt Range sequence by Silberling & Wallace (1969). Taxonomic treatment of this low diversity assemblage was given later, by Silberling & Nichols (1982). *Japonites* cf. *J. surgriva, Groenlandites merriami* and *Ussurites detwilleri* are here newly reported from this zone.

4. Comparisons and correlations

Biochronologic comparisons are summarized on Table 2. This is a deliberate selection of the most relevant Lower Anisian sections. Absence of manifest condensation and vertical continuity (i.e. lower and upper limits respectively in sequence with Spathian and Middle Anisian faunas) formed the prime criteria along which data were selected. This leads to a critical examination of the available literature, followed then by acceptance of a few sections only. Data from Hallstatt-type limestone exotics (Himalayan crags, Diener 1895; Nifoekoko block of Timor, Welter 1915) are consequently among those that were discarded. Ammonoids collected from these exotics are interesting from the point of view of systematics but they will remain of equivocal biochronologic significance as long as the internal stratigraphy of these blocks is not adequately and cautiously reinvestigated.

When both unreliable and spotty data are taken out, the synthetic chart merely highlights the poor knowledge of the Lower Anisian substage which mainly consists of gaps and unrelated faunas. Vertical lines on Table 2 emphasize the uncertainty about the correlation of either individual or groups of biochronologic units.