

The Auld Lang Syne Group,
of Late Triassic and
Jurassic(?) Age,
North-Central Nevada

GEOLOGICAL SURVEY BULLETIN 1394-E



The Auld Lang Syne Group, of Late Triassic and Jurassic(?) Age, North-Central Nevada

By D. B. BURKE and N. J. SILBERLING

CONTRIBUTIONS TO STRATIGRAPHY

GEOLOGICAL SURVEY BULLETIN 1394-E

*Defines stratigraphic nomenclature for a
thick sequence of lower Mesozoic rocks
in north-central Nevada*



UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

V. E. McKelvey, *Director*

Library of Congress catalog-card No. 73-600257

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington, D. C. 20402 - Price 35 cents (paper cover)
Stock Number 2401-02431

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CONTRIBUTIONS TO STRATIGRAPHY

THE AULD LANG SYNE GROUP, OF LATE TRIASSIC AND JURASSIC(?) AGE, NORTH-CENTRAL NEVADA

By D. B. BURKE and N. J. SILBERLING

ABSTRACT

As herein defined, the Upper Triassic and Jurassic (?) Auld Lang Syne Group comprises the previously defined Grass Valley, Osobb, Dun Glen, Winnemucca, O'Neill, Raspberry, Singas, Andorno, and Mullinix Formations. The group is composed of as much as 25,000 feet of generally argillaceous and sandy strata that were derived from an eastern source area and that were seemingly deposited in a shallow marine, deltaic environment.

INTRODUCTION

The name Auld Lang Syne Group is hereby proposed for a very thick, lithologically uniform sequence of formations in north-central Nevada (figs. 1, 2, and 3). The Triassic Grass Valley, Osobb, Dun Glen, Winnemucca, O'Neill, Raspberry, Singas, and Andorno Formations and the Triassic and Jurassic (?) Mullinix Formation constitute parts of an apparently continuous succession of variably metamorphosed, interlensing, argillaceous and sandy strata, with subordinate amounts of limestone and dolomite. The lithologic character of this sequence stands in marked contrast to that of the two older Mesozoic groups exposed in the region—the volcanic and tuffaceous clastic Koipato Group of Early Triassic age (Silberling, 1973) and the predominantly carbonate and coarse clastic Star Peak Group of Early to Late Triassic age (Silberling and Wallace, 1969). The strata included here in the Auld Lang Syne Group overlie with sharp contact the strata of the Star Peak Group and is unconformably overlain by Tertiary volcanic rocks. The type and reference sections of the Auld Lang Syne Group have a total thickness of about 25,000 feet. This new name is proposed in order to express the uniform lithologic character of the formations within this part of the Mesozoic section in north-central Nevada and to set these formations apart, as a single stratigraphic entity, from the groups that form the lower parts of the section.

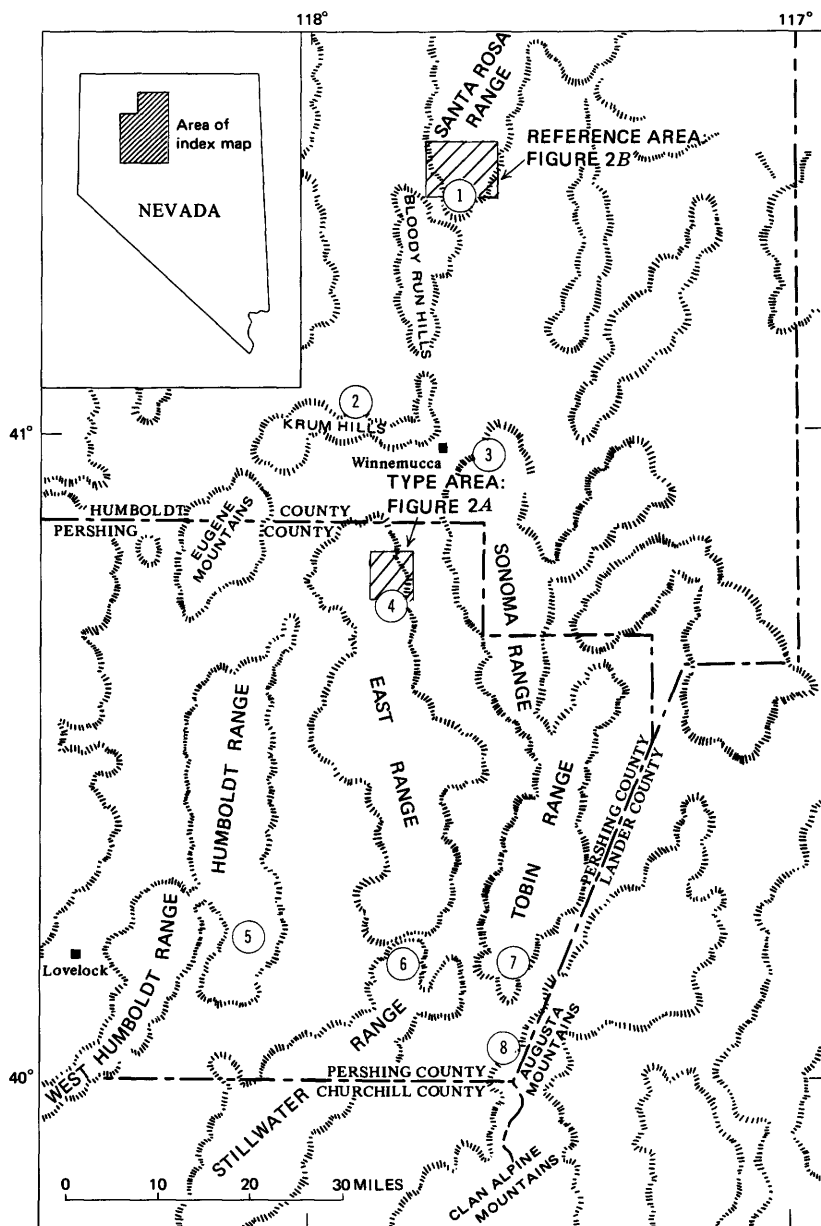


FIGURE 1.—Index map of north-central Nevada showing the type and reference areas of the Auld Lang Syne Group, location of columns in figure 3, and geographic features referred to in text.

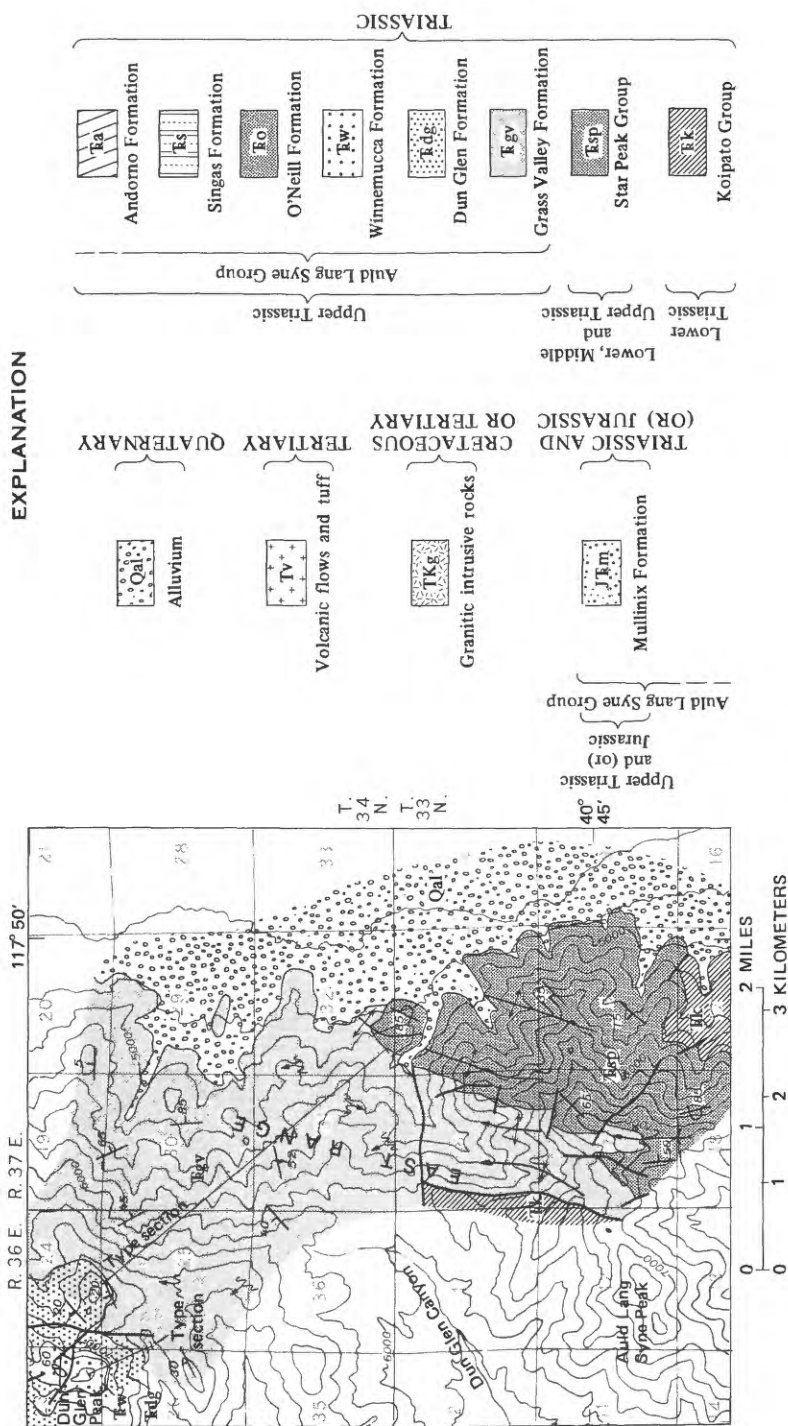
In order to bring the definitions of the formations of the Auld Lang Syne Group into closer accord with the modern rules of stratigraphic nomenclature, the original "type localities" of the Grass Valley, Osobb, Dun Glen, Winnemucca, and Raspberry Formations (Ferguson and others, 1951b; Muller and others, 1951) are here redesignated as type areas. New type localities which are geographically more restricted than the old type areas are defined in table 1. In addition,

TABLE 1.—*Type localities of the formations of the Auld Lang Syne Group*

Formation and initial description	Coordinates of type localities as designated in this report	15' quadrangle
Grass Valley Formation (Muller and others, 1951)	Secs. 30, 31, and 32, T. 34 N., R. 37 E., and Secs. 24, 25, and 36, T. 34 N., R. 36 E.....	Rose Creek.
Osobb Formation (Muller and others, 1951)	Sec. 21, T. 25 N., R. 39 E.....	Cain Mountain.
Dun Glen Formation (Muller and others, 1951)	Sec. 26, T. 34 N., R. 36 E.....	Rose Creek.
Winnemucca Formation (Muller and others, 1951)	Secs. 4 and 5, T. 34 N., R. 38 E	Winnemucca.
Raspberry Formation (Ferguson and others, 1951b)	Secs. 31, 32, and 33, T. 34 N., R. 36 E	Rose Creek.
O'Neill Formation (Compton, 1960)	Secs. 26 and 35, T. 41 N., R. 38 E	Paradise Valley.
Singas Formation (Compton, 1960)	Secs. 26 and 27, T. 41 N., R. 38 E	Do.
Andorno Formation (Compton, 1960)	Secs. 15, 16, and 17, T. 41 N., R. 38 E	Do.
Mullinix Formation (Compton, 1960)	Secs. 17 and 20, T. 43 N., R. 39 E	Hinkey Summit.

the "type areas" of the O'Neill, Singas, Andorno, and Mullinix Formations (Compton, 1960) are here redesignated as type localities and are given geographic coordinates in table 1.

Acknowledgments.—Field studies by the 1971 Stanford University summer field geology class (under our direction) have supplied much of the information in this report about the geology of the northern East Range. Some of the field investigations that have supplied information incorporated here were supported by grants GA-1398 and GA-19424 to Stanford University from the National Science Foundation.



A, Northern part of the East Range near Auld Lang Syne Peak.

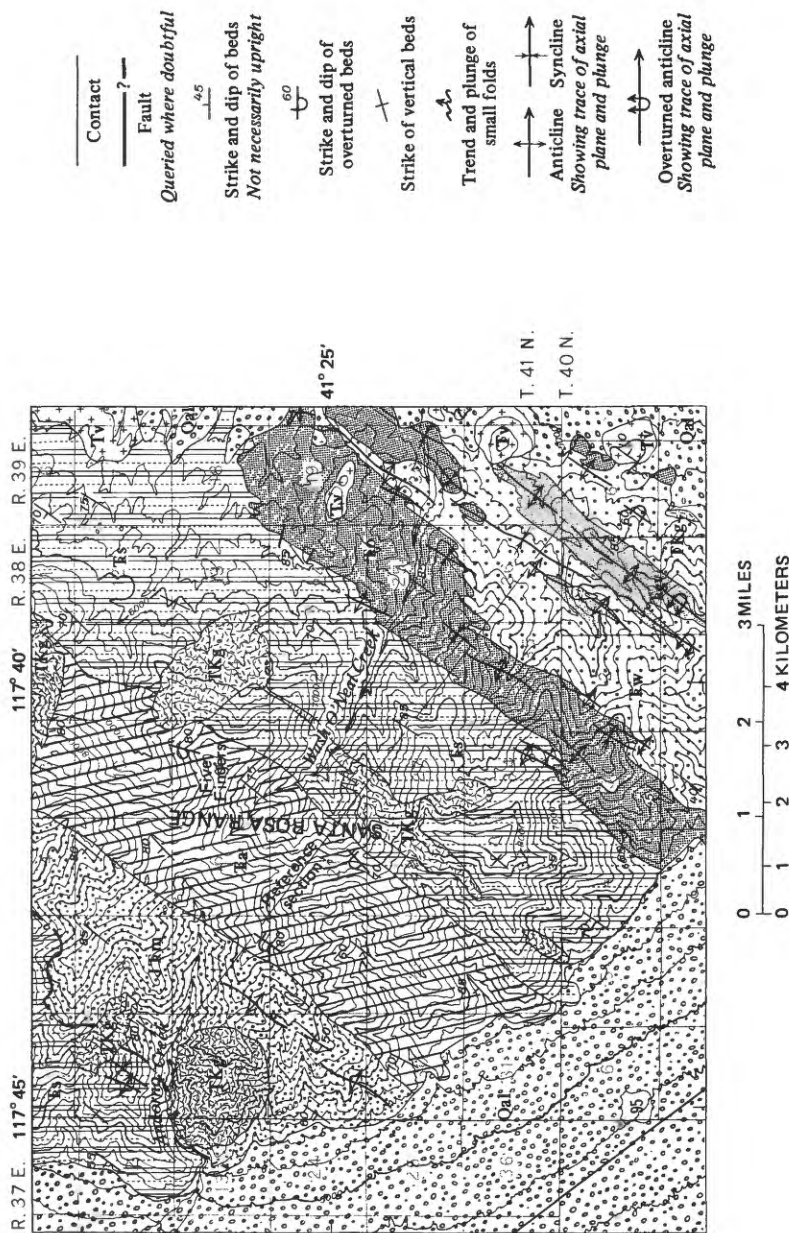


FIGURE 2.—Generalized geologic maps of the type and reference areas of the Auld Lang Syne Group. B, Southern end of the Santa Rosa Range (reduced from 1:62,500 map in Compton, 1960).

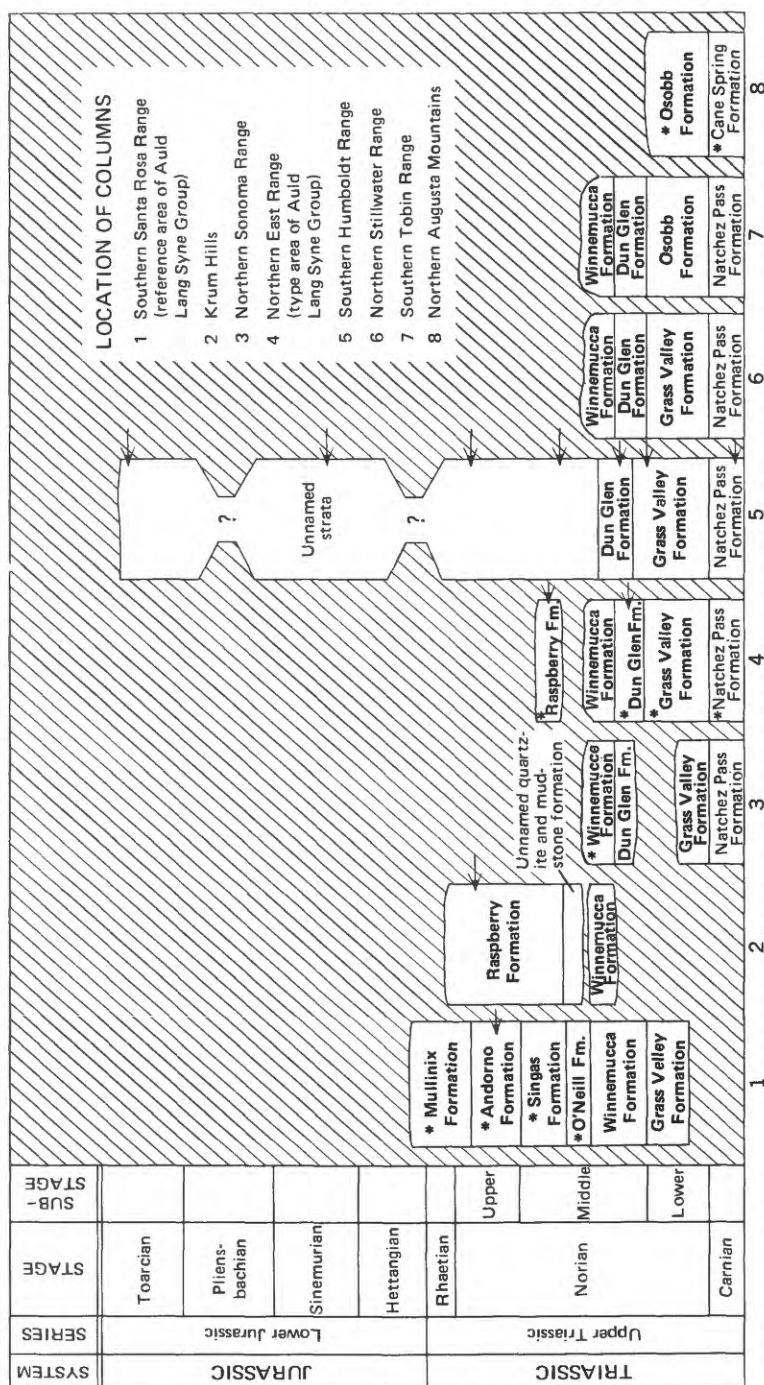


FIGURE 3.—Time-stratigraphic correlation of Upper Triassic and Lower Jurassic rock units in north-central Nevada. Names of rock units included in the Auld Lang Syne Group in boldface type; occurrence of age-diagnostic fossils indicated by arrows; lack of stratigraphic record indicated by diagonal ruling; type areas of units indicated by asterisks with names. Ages of all formation boundaries only approximate. See figure 1 for location of sections.

STRATIGRAPHIC DESCRIPTION

TYPE AREA AND SECTION

The type area of the Auld Lang Syne Group is in the northern East Range, southwest of Winnemucca (figs. 2A and 3). The type section is north of Auld Lang Syne Peak (sec. 12, T. 33 N., R. 36 E.; Dun Glen quadrangle), the source of the name, and it extends from sec. 32, T. 34 N., R. 37 E. to sec. 23 and 24, T. 34 N., R. 36 E. on the Rose Creek quadrangle. This section crosses exposures of typical Grass Valley Formation, typical Dun Glen Formation, and Winnemucca Formation (figs. 2A and 3). The type Raspberry Formation also crops out near this section and is included in the group. It is not, however, in stratigraphic sequence with the other formations.

The lower boundary of the Auld Lang Syne Group is a sharp, perhaps disconformable, contact between gray massive carbonate rocks of the Natchez Pass Formation—the highest unit of the Star Peak Group (Silberling and Wallace, 1969)—and the olive-gray noncalcareous argillite of the overlying Grass Valley Formation. This micaceous and thinly parted argillite is interstratified with thin-bedded units of fine-grained impure sandstone having a diversity of sedimentary structures. Linguloid ripple marks, ripple-drift crossbedding, load casts, and other sole marks are characteristic of these strata and of those with comparable lithology in overlying formations. In the higher part of the Grass Valley Formation, medium to thick interbeds of markedly lensoid cross-stratified feldspathic sandstone and several thick-bedded lenses of bioclastic limestone like those in the overlying Dun Glen Formation are interstratified with the pelitic rocks. The Grass Valley Formation is generally poorly exposed; but small tight folds common in the isolated outcrops indicate that the unit has been much deformed. The formation is at least 2,000 feet thick in the type area of the Auld Lang Syne Group; elsewhere in the northern part of the East Range; it is no more than 300 feet thick.

The Dun Glen Formation, which gradationally overlies the Grass Valley Formation, is composed of gray, very thick to thick-bedded limestone and dolomite with minor interbeds of sandstone and argillite similar to those of the Grass Valley Formation. The limestone is predominantly fine grained and contains whole or broken fossils of shallow-water marine invertebrates, including corals, spongiomorphs, echinoderms, mollusks, and brachiopods; subordinate interbeds of cross-stratified calcarenite also are present. Most of the dolomitic beds in the formation have fine-grained saccharoidal textures and are evidently secondary in origin. All these strata are characteristically lenticular, but the Dun Glen as a whole maintains a relatively constant thickness of about 600 feet throughout the East Range.

The Winnemucca Formation includes a diversity of rock types gradationally overlying the carbonate rocks of the Dun Glen Formation. The upper boundary of the unit is an unconformity with Tertiary and Quaternary rocks both in the East Range and in its type area in the Sonoma Range. The younger Raspberry Formation is faulted against the Winnemucca in the East Range and in the Krum Hills north of the East Range. The Winnemucca Formation in the East Range consists of a laterally variable succession of thin- to thick-bedded siliceous and calcareous feldspathic sandstone and pale-colored laminate fine-grained clastic rocks. Gray thin to thick lenticular beds of Dun Glen-like limestone and dolomite occur throughout the Winnemucca; these beds constitute as much as 50 percent of the formation in its higher parts. The thickest section of the Winnemucca Formation that is exposed in the East Range is about 1,200 ft; the less complete section in the type area of the Auld Lang Syne Group is about half as thick.

In its type area in the northwestern part of the East Range, the Raspberry Formation is mainly composed of argillaceous rocks but has subordinate amounts of limestone in its lower part (according to Ferguson and others, 1951b). Intercalations of sandstone form only a minor part of the formation. In the East Range, where neither the base nor the top is exposed, a thickness of 3,000 feet was estimated by Ferguson, Muller, and Roberts (1951b). Farther north in the Krum Hills the strata assigned to the Raspberry Formation by Willden (1964) are believed to be at least 7,000 or 8,000 feet thick.

REFERENCE AREA AND SECTION

The south end of the Santa Rosa Range is designated the reference area of the Auld Lang Syne Group (figs. 2B and 3). The reference section in this area extends from sec. 6, T. 40 N., R. 39 E., to sec. 7, T. 41 N., R. 38 E. and includes the Grass Valley, Winnemucca, O'Neill, Singas, Andorno, and Mullinix Formations. The lithologic character, stratigraphy, and structure of these rocks have been well described by Compton (1960) in his report on geology of the Santa Rosa Range and Bloody Run Hills. The O'Neill, Singas, Andorno, and Mullinix Formations were first defined by Compton; their type areas—here redesignated type localities (table 1)—are in and near the reference area of the Auld Lang Syne Group. The reference section follows the line of cross section B-B' on the map that accompanies Compton's report.

Both the Grass Valley and Winnemucca Formations are recognized in the metamorphosed strata of the Santa Rosa Range, but the Dun Glen Formation, which intervenes between these units in the East Range, is seemingly reduced to only isolated lenses of carbonate rock

in what has been mapped as Winnemucca Formation (Compton, 1960). The overlying O'Neill, Singas, Andorno, and Mullinix Formations complete the Mesozoic sequence in the range, and they are unconformably overlain by Tertiary volcanic rocks. These formations are predominantly composed of pelitic rocks with subordinate sandstone. The finer grained strata have been regionally metamorphosed to slate and phyllite, and the sandstone units to quartzite. Lensoid beds of carbonate rocks, now represented as fine-grained calcite or dolomite marble, are a variable but small fraction of the total rock volume. The contacts between these units are gradational, and the units are largely defined by changes in the proportions of different rock types. Compton mentions that the phyllite, quartzite, and minor clastic limestone of the Singas Formation are lithologically similar to much of the Raspberry Formation.

AGE

Very few age-diagnostic fossils have been found in the Auld Lang Syne Group (fig. 3), although shell debris is a major component of many limestone beds, and silicified wood fragments (and occasional large logs) occur in sandstone in the lower parts of the group.

In the Humboldt Range, the underlying Natchez Pass Formation in the upper part of the Star Peak Group is late Karnian (early Late Triassic) in age, and the uppermost Grass Valley Formation is early middle Norian (middle Late Triassic). The base of the Auld Lang Syne Group, therefore, approximately coincides with the Karnian-Norian boundary (Silberling and Wallace, 1969).

Fragmentary ammonites from the type Dun Glen Formation are characteristic of the lower middle Norian *Juvavites magnus* Zone of Silberling and Tozer (1968). Ammonites from an unknown stratigraphic position in the type Raspberry Formation represent the *Himavatites columbianus* Zone of late middle Norian age, and the late Norian bivalve *Monotis subcircularis* occurs in rocks assigned to the Raspberry by Ferguson, Muller, and Roberts (1951b) in the Krum Hills. Deformed ammonites from the Winnemucca and Andorno Formations in the Santa Rosa Range, reported by Compton (1960), are too poorly preserved to warrant even a tentative age assignment (Silberling and Wallace, 1969, p. 16), but *Monotis* cf. *M. subcircularis* and the brachiopod *Halorella* sp. indicate a late Norian age for the Andorno. Considering the lack of fossils in the 5,000 feet or more of strata in the overlying Mullinix Formation and the apparently short duration of the Rhaetian Age (Silberling and Tozer, 1968), the Mullinix, and therefore the uppermost part of the Auld Lang Syne Group, may well include strata of Jurassic age.

REGIONAL EXTENT

STRATIGRAPHIC AND STRUCTURAL SETTING

Strata that can be assigned to the Auld Lang Syne Group crop out widely in north-central Nevada (figs. 1 and 3). Other strata, comparable in lithology and age but as yet little studied and unnamed, occur in stratigraphically isolated exposures throughout the north-western part of the state.

Most of the present formational nomenclature in north-central Nevada was defined in the reports based on the initial reconnaissance mapping of the region (Ferguson and others, 1951a and b; Muller and others, 1951; Ferguson and others, 1952). The numerous Mesozoic formations were at that time separated into two distinct "facies," for it was believed that a thrust with tens of miles of displacement (the Tobin thrust) had juxtaposed two generally age-equivalent but lithologically distinct successions of lower Mesozoic strata along with upper Paleozoic rocks during Jurassic orogeny. Silberling and Roberts (1962) later questioned the magnitude of post-Triassic thrust faulting and suggested that juxtaposition of upper Paleozoic rocks occurred prior to Triassic deposition. Because the stratigraphic relation between the "lower-plate facies" and "upper-plate facies" was left in doubt, these successions were redefined as the "Winnemucca" and "Augusta sequences." Recent investigations have substantiated that there was an episode of large-scale thrust faulting in the earliest Triassic—the Sonoma orogeny—and have demonstrated that the diverse Mesozoic formations defined in the earlier reports are all essentially autochthonous and are far more laterally variable than had been realized (Burke, 1970; Silberling, 1973).

STRATA NORTH AND WEST OF THE TYPE AREA

In the Humboldt Range, strata that overlie massive carbonate rocks of the Natchez Pass Formation (the upper part of the Star Peak Group) have been assigned in part to formations that are here included in the Auld Lang Syne Group. The Grass Valley Formation is recognized in the northwestern and southern parts of the range, and the Dun Glen Formation and younger unnamed units overlie the Grass Valley in the southern part of the range (Silberling and Wallace, 1969). The Grass Valley is at least 2,000 feet thick. Stratigraphically continuous carbonate rocks that are assigned to the Dun Glen are generally only 100–150 feet thick, but discontinuous beds of Dun Glen-like carbonate rock occur in the two unnamed units stratigraphically above. These unnamed units consist of at least 2,000 feet of intensely deformed, poorly exposed strata. Silberling and Wallace (1969, p. 44) have pointed out that they are "lithologically similar,

partly correlative, and genetically related to the Winnemucca Formation and Raspberry Formation." However, because the Winnemucca and Raspberry Formations in their type areas are "neither unique in lithologic composition nor bracketed by distinctive stratigraphic boundaries," lithologic correlation of the unnamed units and the two formations is not possible. The unnamed strata in the Humboldt Range include the variety of rock types characteristic of the Auld Lang Syne Group in its type and reference sections; discontinuous beds of argillite, ripple-marked or cross-stratified siltstone and sandstone, and impure limestone and dolomite predominate in the section. Fossils from these strata indicate that they are as young as Toarcian (late Early Jurassic) in age.

Numerous stratigraphically isolated exposures of Upper Triassic and Jurassic strata to the north and west of the Humboldt Range present even greater problems of correlation with the Auld Lang Syne Group. Although the lithology and sparse fossil content of these strata indicate their relation to the group, it is presently impossible to refer many of them to specific parts of the group.

In south-central Humboldt County, outside the area of the Santa Rosa Range and Bloody Run Hills, Willden (1964, p. 43-47) locally recognized the Winnemucca and Raspberry Formations. Although Willden's report was published after Compton's (1960) report, it had apparently been written somewhat earlier, for his "unnamed quartzite and mudstone formation" between the Winnemucca and Raspberry Formations in the Krum Hills corresponds to Compton's O'Neill Formation (fig. 3).

Thick sections of strata that are lithologically similar to, and correlative with, the Auld Lang Syne Group crop out over large areas of western Humboldt, western Pershing, and Washoe Counties. These strata are in part the Triassic and Jurassic(?) "phyllite, slate and quartzite unit" of Willden (1964, p. 49-50) in Humboldt County and the "Nightingale sequence" of Bonham (1969, p. 6) in Washoe County.

STRATA SOUTH AND EAST OF THE TYPE AREA

The Grass Valley, Dun Glen, and Winnemucca Formations, overlying the massive carbonate strata of the Natchez Pass Formation (Muller and others, 1951), have been mapped to the south and east of the East Range. In the northern Stillwater Range, the upper half of the Grass Valley Formation is predominantly cross-stratified micaceous and feldspathic sandstone. In the south end of the Tobin Range, the correlative beds are entirely sandstone with only a few thin intercalations of argillite and limestone. In the northern Augusta Mountains, lithologically similar sandstone, with persistent beds of fossiliferous limestone in the upper part, were defined as the Osobb

Formation by Muller, Ferguson, and Roberts (1951). Like the Grass Valley, the Osobb overlies a massive carbonate unit, the Cane Spring Formation. It is now apparent that these various exposures demonstrate the interfingering of typical Grass Valley and Osobb strata above formations that can be assigned to the Star Peak Group. Because the strata that have been mapped as Grass Valley Formation in the southern Tobin Range (Muller and others, 1951) are almost entirely sandstone, they are reassigned to the Osobb Formation (fig. 3). For these reasons, therefore, the Osobb is included within the Auld Lang Syne Group.

Still farther to the south in the Stillwater Range, the Clan Alpine Mountains, and southernmost Augusta Mountains, Page (1965) and Speed and Jones (1969) have described a very thick sequence of Upper Triassic and Jurassic terrigenous clastic and carbonate rocks that are lithologically similar to the Auld Lang Syne Group. Speed and Jones (1969) have informally divided the Mesozoic rocks that predate their Boyer Ranch Formation (Jurassic) into three mapping units (units I, II, and III), and these units are equivalent in part to the Koipato, Star Peak, and Auld Lang Syne Groups as they are defined to the north. Unit II consists of the entire exposed sequence of Triassic rocks in the northernmost Stillwater Range and the Augusta Mountains; it includes the volcanic and tuffaceous sedimentary rocks of the Koipato Group, the carbonate rocks of the Star Peak Group and its lateral equivalents, and the predominantly terrigenous clastic rocks of the Osobb Formation, regarded here as the lower part of the Auld Lang Syne Group. The strata of unit I are slaty or phyllitic shale, siltstone, and sandstone, with intercalations of massive limestone and dolomite in the highest part of the sequence in the Clan Alpine Mountains.

Fossils collected thus far from unit I indicate that it is everywhere younger than the Star Peak Group and that its lower part is correlative with the lower part of the Auld Lang Syne Group (that is, the lower part of unit I is correlative with the uppermost part of unit II). In the Stillwater and West Humboldt Ranges, unit I grades upward into Lower Jurassic calcareous siltstone, shale, and silty limestone designated as unit III. Although generally similar in composition to the Auld Lang Syne Group, the terrigenous clastic rocks of units I and III were deposited under a different and generally more marine regime than the Auld Lang Syne Group and are not amenable to subdivision into formational units coordinate with those of the Auld Lang Syne Group. These seemingly abrupt lithologic differences between units I and III and the Auld Lang Syne Group may simply be the result of lateral variations in depositional environment and provenance, but they may in part be the result of significant thrust trans-

lation of units I and III during later Jurassic orogeny (Speed and Jones, 1969).

PALEOGEOGRAPHIC INTERPRETATION

The Auld Lang Syne Group and its lithologic correlatives in northwestern Nevada are composed of an impressive volume of sedimentary material. If the combined thickness of the East Range and Santa Rosa Range sections is not abnormal (and the thick but stratigraphically isolated exposures elsewhere suggest that it is not), at least 100,000 cubic miles of these sediments were deposited in Humboldt, Pershing, and Washoe Counties alone. This volume of material is enough to cover the entire United States and its territories to a depth of more than 100 feet.

In the absence of a more formal terminology, geologists working in northwestern Nevada have long referred to the post-Star Peak Group Mesozoic strata as "the mud pile," and no succinct term could better express the homogeneous lithologic character of these strata. Only where the Star Peak Group supplies a reference datum or where the Dun Glen Formation serves as a marker unit have these rocks been amenable to lithologic correlation. The homogeneity that sets "the mud pile" apart as a separate stratigraphic entity has also been the major impediment to its more detailed understanding.

Wherever they have been spared from the extreme effects of later metamorphism, and regardless of their stratigraphic position within the group, the mineralogic and sedimentary features of the Auld Lang Syne Group and related strata indicate that their lithologic homogeneity is largely the reflection of a consistent provenance and depositional environment during Late Triassic and Early Jurassic time (Compton, 1960; Silberling and Wallace, 1969). This enormous volume of material was transported from the east and was deposited under very shallow marine conditions, apparently on and around a large westerly prograding delta. Beach and bar sands occur in minor amounts throughout the group, particularly at its base in the more southeastern exposures (the Osobb Formation), and periods of locally reduced terrigenous clastic influx are manifested by shallow-water carbonate units such as the Dun Glen Formation. By far the greatest fraction of the total rock volume, however, was formed from argillaceous and silty sediment deposited under deltaic conditions.

Although transport of these clastic materials was clearly from the east (Silberling and Wallace, 1969; El-Hawat, 1970), the source of these sediments is something of an enigma. Compton's (1960) study of the rocks of the Santa Rosa Range shows them to be consistent in overall mineralogy and unlike what would be expected if they were derived from the Paleozoic rocks of western or central Nevada (Sil-

berling and Wallace, 1969). The source of the Auld Lang Syne clastic sediments must have been farther east, perhaps from the Colorado Plateau or Rocky Mountain regions as suggested by Silberling and Wallace (1969). This interpretation supports the conclusion of Stanley, Jordan, and Dott (1971) that no significant highlands — the Mesocordilleran geanticline — separated western Nevada from the continental interior during middle Mesozoic time.

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