AGE AND CORRELATION OF THE DEVONIAN SLY GAP BEDS NEAR ALAMOGORDO, NEW MEXICO

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ABSTRACT. Recent faunal collections from Sly Gap beds near Alamogordo, New Mexico, have yielded additional species allowing greater assurance in the determination and correlation of the strata. Specific comparison shows that twenty-nine forms are common to the Sly Gap beds and the Independence shale of Iowa, twenty-two not being found elsewhere. The Sly Gap beds and the Independence shale are definitely correlated and appear to be chronologic equivalents. Furthermore, the Sly Gap fauna is similar generically to the Cuboides fauna of the Frasnian of Europe and the conclusion is reached that, with the Independence fauna, it is the American equivalent.

INTRODUCTION

IN 1935 the writer announced and illustrated a Devonian fauna from strata in the Sacramento Mountains near Alamogordo, New Mexico. As the fauna showed many similarities to that of the Independence shale of Iowa, the containing beds were correlated with that formation. It was also suggested that the New Mexico beds, because of faunal dissimilarity, were not a part of the Percha shale of the south-central part of the state.

A few years later Stevenson (1941), described and named the Sly Gap formation of the San Andres Mountains of New Mexico and stated that the fauna in general was equivalent to that of the Hackberry (Lime Creek) of Iowa. Apparently the beds described by me near Alamogordo were included in his formation.

In 1942 Cooper et al. in the correlation chart of the Devonian placed the Sly Gap as equivalent to the Martin limestone of Arizona, Cerro Gordo of Iowa and Chemung of New York.

Stevenson again in 1944 stated the equivalence in time of the Sly Gap to a part of the Devonian of Iowa as younger than the Independence shale and slightly older than the Hackberry group. More particularly the presence of *Manticoceras regulare* in the Sly Gap was said to show contemporaneity with the Cerro Gordo of Iowa and part of the Chemung of New York. He also stated that the Sly Gap *Hypothyridina* resembles one found in the Devil's Gate of Nevada.

In 1945 the writer showed that most of the species occurring in the Sly Gap beds in Alamo Canyon near Alamogordo were present, almost without exception, in the Independence shale of Iowa. He concluded that the faunas were equivalent. He suggested, not knowing what Stevenson had found in the type area of the Sly Gap in the San Andres Mountains, that perhaps the Alamo Canyon fauna was older, assuming that Stevenson was correct in correlating the Sly Gap with the Hackberry (Lime Creek).

Stevenson (1946) finally discussed the stratigraphy of the beds in question and gave a list of the fossils of the Sly Gap (p. 239). He reiterated his conclusion that the Sly Gap fauna was slightly older than the Hackberry and younger than the Independence, slightly older than the Martin limestone of Arizona and tentatively equivalent to the Devil's Gate of Nevada.

Although Stevenson has thus shifted in his opinion of the age of the Sly Gap from equivalency to the Cerro Gordo of Iowa to one which is slightly older, there is still disagreement regarding the chronological relationship of the Sly Gap with the Independence of Iowa. Recent collections of Sly Gap fauna in the neighborhood of Alamogordo, New Mexico, has added considerably to the number of species and consequently there is greater possibility for more accurate comparisons with faunas at hand. The conclusions reached in a study of this new material are given below.

FAUNAL DESCRIPTIONS

In 1945 Dr. C. C. Branson, then residing in Alamogordo, New Mexico, sent the writer for identification several small collections of Sly Gap fossils secured in the Sacramento Mountains north of Alamo Canyon. Among them were a number of forms which the writer had not seen previously in the Sly Gap of the area. Later the writer had opportunity to collect fossils in several places kindly located for him by Doctor Branson. The number of Sly Gap species was greatly augmented and affords considerably more material for correlation of the fauna with those of other formations and with greater certainty. The fauna listed below is from the immediate region of Alamogordo, New Mexico.

CORALS

Corals are few in number both specifically and individually. At least three and possibly four genera were recovered.

Macgeea thomasi Stainbrook

Plate 1, Figs. 23, 32

Macgeea thomasi Stainbrook, 1935, Jour. Paleo., vol. 9, plate 83, figures 26-27; Stainbrook, Jour. Paleo. vol. 20, p. 422, plate 58, figures 1-7, plate 59, figure 14, plate 61, figure 9.

The largest specimen at hand though somewhat weathered has the trifoliate shape of the calyx characteristic of the species.

Occurrence—Sly Gap beds, Indian Wells.

Types—Hypotypes M.A.S. 1567.

Syringaxon calvini Stainbrook

Plate 1, Figs. 41, 42

Syringaxon calvini Stainbrook, 1946, Jour. Paleo., vol. 20, p. 408, plate 58, figures 15-18.

The single specimen shows the typical shape, broad calyx and calicinal pit of the Independence species.

Occurrence—Sly Gap beds, Indian Wells.

Types—Hypotype M.A.A. 1582.

Aulocaulis singularis Stainbrook

Plate 1, Figs. 39-40

Aulocaulis singularis Stainbrook, 1946, Jour. Paleo., vol. 20, p. 426, plate 57, figures 17-19.

The specimen at hand although not as well preserved as desired has the typical shape and method of growth of the Iowa form.

Occurrence—Sly Gap beds, Alamo Canyon.

Types—Hypotype M.A.S.

Microcyclus? sp.

Plate 1, Fig. 34

Microcyclus sp. Stainbrook, 1935, Jour. Paleo., vol. 9, plate 83, figure 7.

EXPLANATION OF PLATE 1

Figs. 1-2, *Nervostrophia thomasi* Stainbrook: 1, Pedicle view of a hypotype, Sly Gap beds; 2, Pedicle view of the holotype, Independence shale of Iowa.

Figs. 3-4, *Nervostrophia multinervosa* Stainbrook: 3, Pedicle view of a specimen from the Independence shale of Iowa; 4, Pedicle view of a worn individual from the Sly Gap beds (fine costae are missing).

Figs. 5-6, *Schizophoria amana* Stainbrook: 5, Posterior view of a paratype, Independence shale of Iowa: 6, Posterior view of a specimen from the Sly Gap beds.

Figs. 7-8, *Schuchertella prava* (Hall): 7, Brachial view of a specimen from Independence shale of Iowa: 8, Similar view of a specimen from the Sly Gap beds.

Figs. 9-14, 18-19, *Cariniferella iowensis* Stainbrook: 9, Internal view of pedicle valve, Independence shale of Iowa; 10, Same view of a pedicle valve from the Sly Gap beds; 11, Pedicle view of an example from Sly Gap beds; 12, Pedicle view of Independence shale example; 13, View of brachial valve, Sly Gap beds; 14, Similar view of a brachial valve, Independence shale of Iowa; 18, External view of a brachial valve; 19, External view of a large incomplete pedicle valve, both from the Sly Gap beds.

Figs. 15-17, *Aulacella infera*, Pedicle and brachial views, x 5 of a specimen, Sly Gap beds, 17, Brachial view of an example, Independence shale of Iowa.

Figs. 20-22, *Productella rugatula* Stainbrook: 20-21, Pedicle views of two examples from Sly Gap beds; 22, Pedicle view of a paratype, Independence shale of Iowa.

Figs. 23, 32, *Macgeea thomasi* Stainbrook: Lateral view of a specimen, x 1, and of another, x 2; both from Sly Gap beds.

Figs. 24-25, *Strophonelloides deeringi* Stainbrook: 24, Pedicle view of an immature example from the Sly Gap beds; 25, Pedicle view of the holotype, Independence shale of Iowa.

Figs. 26-27, *Douvillinaria variabilis* (Calvin): 26, Pedicle view of a specimen from the Sly Gap beds; 27, Pedicle view of a paratype, Independence shale of Iowa.

Figs. 28-30, *Pseudodouvillina euglyphea* Stainbrook: 28, Pedicle view, x 2, of a specimen, Sly Gap beds; 29, Pedicle view of the holotype, Independence shale of Iowa; 30, Pedicle view of a large example, Sly Gap beds.

Figs. 31, 37, *Sulcatostrophia calvini* (Miller): 31, Pedicle view of a hypotype, Independence shale of Iowa; 37, Similar view of a small example, Sly Gap beds.

Fig. 33, *Arthroacantha* sp.: view of the basal plates, worn, Sly Gap beds.

Fig. 34, *Microcyclus* ? sp.: Calicinal view, x 2, of the only specimen seen, Sly Gap beds.

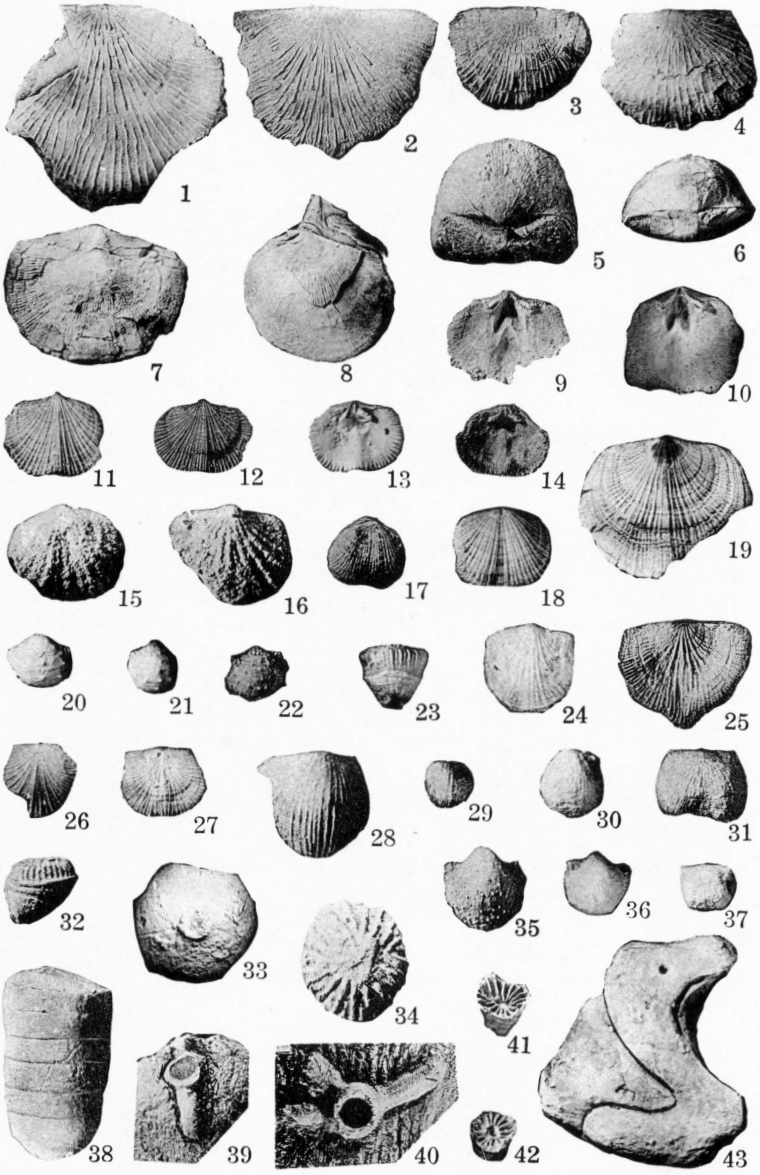
Figs. 35-36, *Devonoproductus vulgaris* Stainbrook: 35, Pedicle view of the holotype, Independence shale of Iowa; 36, Pedicle view of a worn example, Sly Gap beds.

Fig. 38. *Michelinoceras* sp., Sly Gap beds.

Figs. 39-40. *Aulocaulis singularis* Stainbrook: 39, Calicinal view, x 2, of a specimen, Sly Gap beds; 40, Calicinal view, x 3, of the holotype, Independence shale of Iowa.

Figs. 41-42, *Syringaxon calvini* Stainbrook: 41, View of a paratype, Independence shale of Iowa 42, Similar view of an example, Sly Gap beds.

Fig. 43. *Manticoceras* sp. An incomplete example from Sly Gap beds.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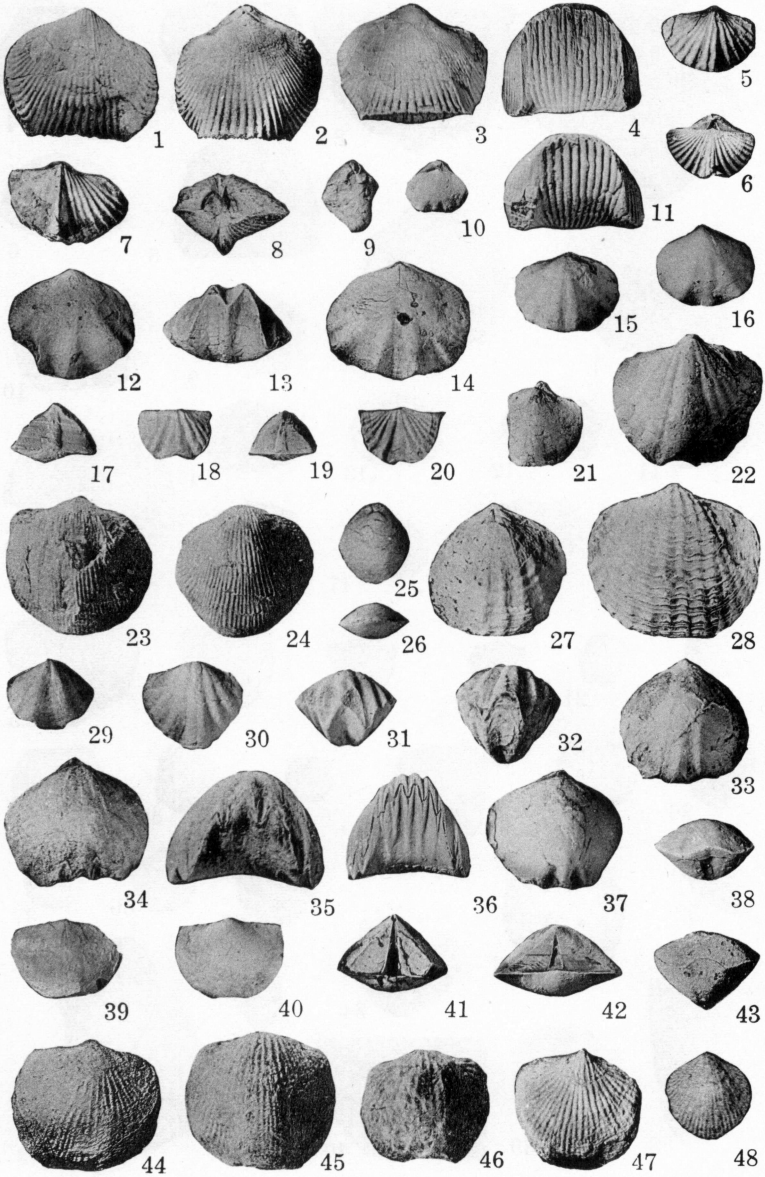
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No other example of this problematic form has been recovered. Stevenson has expressed doubt that it was found in the Sly Gap but the lithology is that of the formation and the block also contains other species present without doubt in that terrane. Although it may not be a *Microcyclus*, the occurrence of that genus in the Upper Devonian would not be too surprising as *Syringaxon* and *Skenidium*, hereto known from the

EXPLANATION OF PLATE 2

Figs. 1-4, 11, *Hypothyridina emmonsi* (Hall and Whitfield): 1-2, 11, Pedicle, brachial and anterior views of a specimen from Sly Gap beds; 3-4, Brachial and anterior views of an example from the Independence shale of Iowa.

Figs. 5-8, *Spirifer strigosus* Meek: 5, Brachial view of a specimen from Sly Gap formation; 6, Brachial view of a specimen from the Independence shale, Iowa; 7-8, Brachial and posterior views of a specimen from the Sly Gap beds.

Figs. 9-10, *Gypidula munda* Calvin: 9, Posterior view of an example, Sly Gap beds; 10, Brachial view of the type specimen, Independence shale of Iowa.

Figs. 12-16, *Calvinaria bransoni* Stainbrook n. sp.: 12-13, Pedicle and anterior views of the holotype, M.A.S. 1580, Sly Gap formation; 14, Brachial view of a paratype, Sly Gap beds; 15-16, Brachial and pedicle views of a small specimen from the Independence shale of Iowa.

Figs. 17-20, *Cyrtina inulta* Stainbrook; 17, Posterior view of a hypotype; 18, Brachial view of another, both from Sly Gap beds; 19, Pedicle view of a paratype; 20, Brachial view of another, Independence shale of Iowa.

Figs. 21-22, *Elytha diversa* Stainbrook; 21, Brachial view of an incomplete example, Sly Gap beds; 22, Brachial view of the holotype, Independence shale of Iowa.

Figs. 23-24, 48, *Atrypa devoniana* Web.: 23, Brachial view of an example, Sly Gap beds; 24, Brachial view of another, Independence shale of Iowa; 48, Pedicle view of a small example, Sly Gap formation.

Figs. 25-26, *Cranaena* cf. *navicella* Fenton and Fenton: Brachial and anterior views of a specimen from the Sly Gap beds.

Figs. 27-28, *Hystricina trulla* Stainbrook: 27, Brachial view of a specimen, Sly Gap formation; 28, Brachial view of a specimen, Independence shale of Iowa.

Figs. 29-32, *Acutatheca* cf. *propria* Stainbrook: Pedicle, brachial and anterior views of several specimens, Sly Gap beds.

Fig 33-37, *Pugnoides schucherti* Stainbrook: 33, Brachial view of a specimen, Independence shale of Iowa; 34-35, Brachial and anterior views of a Sly Gap example; 36, Anterior view of an Independence shale specimen; 37, Brachial view of another, Sly Gap formation.

Fig. 38-43, *Thomasaria altumbona* Stainbrook: 38-41, Anterior branchial, pedicle and posterior views of hypotypes from the Sly Gap beds; 42-43, Posterior and anterior views of paratypes from the Independence shale of Iowa.

Figs. 44-47, *Atrypa varicostata* Stainbrook: 44-45, Pedicle and brachial views of the holotype, Independence shale of Iowa; 46-47, Brachial and pedicle views of a specimen from Sly Gap beds.

lower Devonian, have been found in the Independence shale and the Sly Gap.
Occurrence—Sly Gap beds, Alamo Canyon.

BRYOZOANS

The bryozoans are sparsely represented in the Sly Gap near Alamogordo and only one species has been identified.

Lioclema slygapensis Fritz

Lioclema slygapensis Fritz, Jour. Paleo., vol. 18, p. 38, plate 12, figures 8, 9, 12.

The specimens appear to be similar to an undescribed form from the Independence shale of Iowa.
Occurrence—Sly Gap, Alamo Canyon.

BRACHIOPODS

Brachiopods comprise the bulk of the fauna as more than 90% of the species belong to this group of animals. Only the articulate orders are represented and they are about equally well developed. The orthacea have four genera.

Schizophoria cf. *amanaensis* Stainbrook

Plate 1, Figs. 5-6

Schizophoria amanaensis Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 17, plate 1, figures 1, 13.

The specimens at hand although incomplete show no important differences in shape or external markings from the Iowa species.
Occurrence—Sly Gap beds, Indian Wells.
Types—Hypotypes M.A.S. 1573.

Skenidium independense Stainbrook

Skenidium independense Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 14, plate 1, figures 14-18.

There seems little doubt that the Sly Gap specimens are conspecific with the examples from the Independence shale of Iowa.
Occurrence—Sly Gap beds, Alamo Canyon.

Aulacella infera (Calvin)

Plate 1, Figs. 15-17

Aulacella infera Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 15, plate 1, figures 19-28.

The specimens though small are similar to those from Iowa.
Occurrence—Sly Gap beds, Alamo Canyon.

Cariniferella iowensis Stainbrook
Plate 1, Figs. 9-14, 18-19

Cariniferella iowensis Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 16, plate 1, figures 29-37.

This species apparently is more numerous in the Sly Gap than is *Aulacella infera.* In Iowa the reverse is true. Several examples attain larger dimensions than any recovered from the Independence shale. Otherwise they are quite the same and specimens of the same size are indistinguishable.
Occurrence—Sly Gap, Indian Wells.
Types—Hypotypes M.A.S. 1568.

The Strophomenacea are the most common group of brachiopods and six genera are represented.

Strophonelloides deeringi Stainbrook
Plate 1, Figs. 24-25

Strophonelloides deeringi Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 19, plate 2, figures 25-33.

The specimen at hand is immature but shows the beginning of the spoutlike extension of the pedicle valve characteristic of the species. The specimen is more elongate than usual but can be duplicated in examples from Iowa. The costae increase by intercalation also.
Occurrence—Sly Gap beds, Indian Wells locality.
Types—Hypotypes M.A.S. 1570.

Douvillinaria variabilis (Calvin)
Plate 1, Figs. 26-27

Douvillinaria variabilis Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 24, plate 3, figures 1-4, 25.

Specimens from New Mexico present no differences from typical Iowa forms.
Occurrence—Sly Gap beds, Indian Wells.
Types—Hypotypes A.A.S. 1569.

Pseudodouvillina euglyphea Stainbrook
Plate 1, Figs. 28-30

Pseudodouvillina euglyphea Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 27, plate 3, figures 17-20.

The examples from New Mexico differ in no respect from Iowa specimens. It is one of the common forms in the Sly Gap but specimens are usually attached firmly to the matrix.
Occurrence—Sly Gap beds, Alamo Canyon and Indian Wells.
Types—Hypotypes M.A.S. 1571.

Sulcatostrophia calvini (Miller)
Plate 1, Figs. 31, 37

Sulcatostrophia calvini Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 29, plate 3, figures 6-11, 23-24.

The New Mexico examples average smaller and have a slightly fainter pedicle sulcus than Iowa examples but agree with them in other particulars.
Occurrence—Sly Gap beds, Indian Wells and Alamo Canyon.
Types—Hypotypes M.A.S. 1586.

Nervostrophia thomasi Stainbrook
Plate 1, Figs. 1-2

Nervostrophia thomasi Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 31, plate 2, figures 1-4.

Examples are moderately common but incomplete. They display no difference when compared with Iowa specimens.
Occurrence—Indian Wells and Alamo Canyon.
Types—Hypotypes M.A.S. 1581.

Schuchertella prava (Hall)
Plate 1, Figs. 7-8

Schuchertella prava Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 34, plate 2, figures 19-20.

The single incomplete individual at hand apparently does not differ from the Iowa form.
Occurrence—Sly Gap formation, Indian Wells.
Types—Hypotype M.A.S. 1603.

The productids are represented by two species, both sparsely represented by slightly incomplete examples.

Productella rugatula Stainbrook
Plate 1, Figs. 20-22

Productella rugatula Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 36, pl. 3, figures 48, 49.

The examples recovered appear indistinguishable from Iowa specimens.

Occurrence—Sly Gap formation, Indian Wells.
Types—Hypotypes M.A.S. 1584.

Devonoproductus vulgaris Stainbrook

Plate 1, Figs. 35-36

Devonoproductus vulgaris Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 37, plate 44, figures 44, 51-54.

The specimens have the same size, shape and markings of the Iowa form.
Occurrence—Sly Gap, at Indian Wells and Alamo Canyon.
Types—Hypotypes M.A.S. 1587.

The Pentameracea have one species of which only one example has thus far been recovered.

Gypidula munda Calvin

Plate 2, Figs. 9-10

Gypidula munda Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 41, plate 4, figures 8-9.

A single small example, a pedicle valve, apparently represents this species, but the material is not sufficient to determine definitely. Stevenson reports a species from the Sly Gap but refers it to *Gypidula cornuta* F. and F., a much larger form.
Occurrence—Sly Gap formation at Indian Wells.
Types—Hypotypes M.A.S. 1603.

The rhynchonellids have three species, one of them described as new.

Hypothyridina emmonsi (Hall and Whitfield)

Plate 2, Figs. 1-4, 11

Hypothyridina emmonsi Merriam, 1940, Geol. Soc. Amer. Sp. Paper no. 25, p. 41, plate 9, figures 18-19; Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 42, plate 4, figure 10-14.

The New Mexico specimens are generally larger than examples from Iowa and may differ in some slight details which are not of specific importance. Several examples of a possible distinct variety seen in the University of Missouri collection shows more similarity to the Independence form.
Occurrence—Sly Gap formation, Indian Wells.
Types—Hypotypes M.A.S. 1605.

Pugnoides schucherti Stainbrook

Plate 2, Figs. 33-37

Pugnoides schucherti Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 43, plate 4, figures 15-19.

Individuals from New Mexico display considerable variation in size, development of fold and number of plications. Although generally attaining a larger size than the types from Iowa they are similar in other respects.

Occurrence—Sly Gap formation, Indian Wells.

Types—Hypotypes M.A.S. 1585.

Calvinaria bransoni Stainbrook, n. sp.

Plate 2, Figs. 12-16

Shell below medium size, subequally biconvex, transversely subquadrate in outline with rounded angles, straight front margin and broadly rounded lateral margins, broadest at the mid-length, hingeline gently curved centrally, anterior commissure uniplicate and dentate. Dimensions of the holotype and of two paratypes are: length 17.3 mm., 15.1 mm., and 15.6 mm., width 20.8 mm., 21.3 mm. and 18.9 mm.; thickness 10.3 mm., 9.1 mm. and 11.1 mm. Thicker individuals are occasionally encountered.

Pedicle valve small for the greater part, strongly and regularly curved along the midline from beak to front, gently arched transversely, highest posterior to midpoint; the surface sloping with about equal rapidity to the lateral and posterolateral margins, slightly concave on each side of the beak. Sulcus originating well up on the umbo, extremely shallow at front, in form of two grooves with a ridge between, broadening rapidly beyond the midpoint, the anterior portion projecting as a lingual extension, strongly curved nearly at right angles to the plane of the valve; median part occupied by a strongly angular plication. Slopes depressed, convex to nearly flat. Umbo low, broadly convex; beak short, pierced by a large apical foramen open at base.

Brachial valve moderately arched from beak to front along midline, most convex toward front, moderately arched transversely in posterior half, strongly so anteriorly. Fold originating posterior to midpoint, truncated at front, in form of two large plications with a deep groove between; plications

high, broad, and angular at front. Slopes curving rapidly from fold to lateral margins, arching regularly from back to front. Umbo broad, low; beak short, wide, very slightly projecting. Internally a thin median septum extends anteriorly nearly to the midpoint.

Exterior smooth, shell substance fibrous. Lateral slopes flexed at borders by two to four short low broad rounded plications which generally do not extend to the umbo. Fold as a rule has two plications and sulcus one; one has a low plication in the median sulcus of the fold and two low plications in the sulcus of the pedicle valve.

Calvinaria bransoni differs from *Calvinaria ambigua* of the Independence shale of Iowa in its much smaller size, proportionately more pronounced fold and sulcus which are developed much earlier. A specimen of *Calvinaria ambigua* of comparable size will be smooth with little or no appearance of a fold or sulcus. Plications on lateral slopes are fewer than those of *Calvinaria ambigua* and plications of the fold are undivided.

Two specimens in the Independence shale of Iowa questionably included in *Calvinaria ambigua*, appear to belong to *Calvinaria bransoni.* They are small with high fold and deep sulcus which appear at an early stage.

Occurrence—Sly Gap beds, Indian Wells locality.

Types—Holotype M.A.S., 1580; paratypes M.A.S. 1617, 1618.

Only a single specimen of a terebratulid has as yet been recovered in the Sly Gap near Alamogordo by the writer.

Cranaena cf *navicella* (Hall)

Plate 2, Figs. 25-26

Shell small, subovate in outline, longer than wide, the antero-lateral margins longer and broadly rounded to the front, postero-lateral margins short, nearly straight, greatest width near midlength, anterior commissure slightly sinuate. Measurements of the single example are: length 11.9 mm.; width 10.5 mm.; thickness 5.6 mm.

Pedicle valve the more convex, broadly and regularly arched from beak to front, highest near middle, the surface curving with equal rapidity to the front and antero-lateral margins, a little more strongly posteriorly, anterior median portion slightly projecting but not developing into a fold. Umbo broad,

projecting; beak incurved with large foramen. Two short septa visible in apical portion of the valve.

Brachial valve highest in the umbonal region, straight or slightly concave along midline thence, lateral slopes slightly depressed anteriorly, antero-median portion elevated a little to form a broad mesial fold. Beak short, blunt, a little projecting.

Surface of valves smooth, the shell substance minutely and closely punctuate.

This *Cranaena* is near *Cranaena navicella* (Hall) but differs in that it is a little less elongate and a proportionately broader shell with the greatest width near middle instead of anterior, and with no distinct sulcus developed in the pedicle valve.

Occurrence—Sly Gap beds, Indian Wells.

Types— M.A.S. 1606.

As usual in the Devonian strata the Atrypidae are well represented in genera and individuals.

Atrypa devoniana (Webster)

Plate 2, Figs. 23-24, 48

Atrypa devoniana Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 47, plate 5, figures 24-26, 29-31.

The New Mexico examples present few, if any, differences from Iowa specimens which show some individual variations consistent with the formations containing them.

Occurrence—Sly Gap beds, Indian Wells and Alamo Canyon.

Types—Hypotypes M.A.S. 1574.

Atrypa variacostata Stainbrook

Plate 2, Figs. 44-47

Atrypa variacostata Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 47, plate 5, figures 13-17.

This species is readily distinguished from the preceding form by the shape and by the variation in size of the costae at the front of the shell.

Occurrence—Sly Gap formation, Indian Wells and Alamo Canyon.

Types—Hypotypes M.A.S. 1576.

Hystricina trulla Stainbrook

Plate 2, Figs. 27-28

Hystricina trulla Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 50, plate 5, figures 2-10, 12.

The specimens at hand are not well preserved, being mostly decorticated but do have the three plications on the fold. They appear to be nearer the species named than to any other member of the genus.
Occurrence—Sly Gap beds, Indian Wells and Alamo Canyon.
Types—Hypotypes M.A.S. 1604.

The spiriferids apparently are not as common as in other formations in the Upper Devonian but four genera only being represented.

Spirifer strigosus Meek
Plate 2, Figs. 5-8

Spirifer strigosus Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 52, plate 6, figures 14-21.

The larger but incomplete examples are similar to specimens from the Independence shale. Only one shows the external markings of fine granulae arranged in radial lines.
Occurrence—Sly Gap beds, Indian Wells and Alamo Canyon.
Types—Hypotypes M.A.S. 486 and 1598.

Acutatheca propria Stainbrook
Plate 2, Figs. 29-32

Acutatheca propria Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 55, plate 1, figures 39-41.

The holotype of this species from the Independence shale of Iowa is small and very probably immature. However, if enlarged to the size of the New Mexico examples, specific characteristics would differ little from those of that form.
Occurrence—Sly Gap beds, Alamo Canyon and Indian Wells.

Elytha diversa Stainbrook
Plate 2, Figs. 21-22

Elytha diversa Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 56, plate 6, figures 9-11.

The single specimen appears to represent this species.
Occurrence—Sly Gap beds, Indian Wells.
Types—Hypotype M.A.S. 1619.

Thomasaria altumbona Stainbrook
Plate 2, Figs. 38-43

Thomasaria altumbona Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 58, plate 4, figures 22-30.

This is one of the commoner species in the formation and shows a little individual variation. Specimens in general tend to have a small and more curved cardinal area than Iowa examples. These differences are not of specific importance as almost identical examples occur in both formations.
Occurrence—Sly Gap beds, Indian Wells and Alamo Canyon.
Types—Hypotypes M.A.S. 1579.

Cyrtina inulta Stainbrook
Plate 2, Figs. 17-20

Cyrtina inulta Stainbrook, 1945, Geol. Soc. Amer. Memoir 14, p. 59, plate 6, figures 26-29.

Examples from New Mexico are indistinguishable from specimens from Iowa but are not preserved sufficiently well to display the finer external markings. This is true of most of the Iowa examples.
Occurrence—Sly Gap beds, Indian Wells and Alamo Canyon.
Types—Hypotypes M.A.S. 484 and 1572.

Echinodermal remains with the exception of crinoid stems are rare. A set of three basal and an incomplete radial of a crinoid calyx have been recovered.

Arthroacantha sp.
Plate 1, Fig. 33

The specimen admits of no more than generic identification but is apparently different specifically from the Independence shale form. Stevenson reports a species from the Sly Gap.
Occurrence—Sly Gap beds, Indian Wells.
Types—Specimen M.A.S. 1566.

Mollusks likewise are rare or at least are in the localities explored by the writer. Only a tentaculite and two cephalopods are represented.

Tentaculites sp.

The species apparently does not differ greatly from an undescribed form known in the Independence shale.
Occurrence—Sly Gap beds, Alamo Canyon.

Michelinoceras sp.
Plate 1, Fig. 38

Only an incomplete specimen with six camerae is at hand. It is apparently unidentifiable specifically.
Occurrence—Sly Gap formation, Alamo Canyon.

Manticoceras sp.
Plate 1, Fig. 43

Only fragments of the phragamacone are at hand and are not complete enough to display a complete suture. The species may be *Manticoceras regulare* F. and F. as identified by Stevenson but better specimens will be necessary to determine definitely.

Occurrence—Sly Gap beds, Indian Wells.

Types—Hypotypes M.A.S. 1577.

A few fish teeth represent the vertebrates.

Ptyctodus calceolus Meek and Worthern

Several specimens are at hand and show few differences from examples from the Devonian of Iowa.

Occurrence—Sly Gap beds, Indian Wells and Alamo Canyon.

Correlation of the Sly Gap Fauna
faunas of the western United States

The fauna of the formation geographically nearest to the Sly Gap (other than the terranes immediately above and below) is that of the Martin limestone of Arizona. The fauna has been listed by various authors from different parts of Arizona as noted by Darton (pp. 60-61). An inspection of these lists indicates that many forms are incorrectly identified or else faunas of formations other than that of the Martin limestone are included. Perhaps both conditions are true. Fossils collected in the type area at Bisbee Arizona, are listed by H. S. Williams (Darton p. 61) as follows: (Probable specific identifications by the writer are given in parentheses).

Acervularia davidsoni Ed. and H. (*Hexagonaria inaequalis* H. and W.)

Pachyphyllum woodmani White (*Phillipsastrea woodmani*)

Cladopora prolifica H. and W. (*Cladopora floydensis* F. and F.)

Stromatopora erratica Winchell

Cyathophyllum caespitosum Goldfuss (*Diphyphyllum tubaeforme* F. and F.)

Atrypa reticularis Linne (*Atrypa devoniana* Webster)

Cyrtia cyrtinaformis H. and W. (*Tenticospirifer cyrtinaformis*)

Dielasma calvini H. and W. (*Cranaena calvini*)

Schizophoria striatula Schlotheim (*Schizophoria magna* F. and F.)
Productella speciosa Hall (*Strophalosia rockfordensis* H. and C.)
Spirifer hungerfordi Hall (*Theodossia hungerfordi*)
Spirifer orestes H. and W.
Spirifer whitneyi Hall (*Cyrtospirifer whitneyi*)
Strophodenta (*fragilis*) *perplana* Hall (*Nervostrophia rockfordensis* F. and F.)
Strophonella coelata Hall (*Strophonelloides reversa* Hall)
Delthyris consobrina d'Orbigny
Spirifer cf. S. *jeremejevi* Tschernyschew
Spirifer cf. S. *euryteines* Owen

A small collection at hand from the Martin limestone on Mt. Martin, Bisbee, Arizona, has *Atrypa devoniana* and *Spirifer* (*Theodossia*) *hungerfordi* as the principal constituents. As a whole the Martin fauna, since that *Spirifer* is distinctive, may be termed the *hungerfordi fauna.* It is equivalent in general to the Lime Creek fauna of Iowa as developed in the Cerro Gordo member. Although some of the species may possibly occur in other formations of slightly older age, the *hungerfordi* assemblage is not duplicated elsewhere in the United States. Comparison with the Sly Gap fauna shows without question, even though some of the genera may be common to both, that the Martin limestone is not a correlative. Consequently they apparently are not synchronous.

The nearby Percha shale and Ouray limestone of Colorado are regarded by geologists generally as Devonian in age. There is nothing, however, in common between the Percha and the Sly Gap faunas. The Percha fauna has recently been discussed by the writer as of possibly Mississippian rather than Devonian in age (1947).

The fauna of the Devil's Gate limestone of Nevada shows considerable similarity to that of the Sly Gap as Stainbrook (1945, p. 9) and Stevenson (1945, p. 245) have suggested. This conclusion is supported by the presence in each fauna of *Hypothyridina emmonsi* (H. and W.), *Leptostrophia* cf. *multinervos* Stainbrook, *Spirifer strigosus* Meek, species of *Phillispastrea*, *Atrypa*, *Pugnoides*, *Paracyclas* and others. The similarity of the Sly Gap and Independence faunas would seem to indicate that the *Hypothyridina emmonsi* zone is to be sought

in Iowa in the latter formation rather than in the Shellrock as intimated by Merriam (p. 64).

IOWA DEVONIAN FAUNAS

As the fauna of the Lime Creek beds of Iowa are best developed in the Cerro Gordo member only that will be considered here. A casual study is sufficient to demonstrate that the Cerro Gordo fauna is largely identical with that of the Martin limestone. The predominance of *Spirifer* (*Theodossia*) *hungerfordi* and its associates indicates that in Iowa this is the typical development of the *hungerfordi fauna.* The same objections to correlating the Sly Gap with the Lime Creek, are therefore pertinent, even though the occurrence of several species in each might indicate closer relationship. The presence of species of *Hexagonaria*, *Phillipsastrea*, *Tabulophyllum*, *Lioclema* and *Manticoceras* might be used to argue that the faunas are more nearly contemporaneous than is granted here. But these genera are nearly all long ranging. *Hexagonaria* occurs in the Shellrock and Cedar Valley and in the Middle Devonian, *Phillipsastrea* in the Shellrock and Cedar Valley, and *Tabulophyllum* also. *Lioclema* is present in the Independence and *Manticoceras* ranges down into the Middle Devonian. To the writer the occurrence of these genera in the Sly Gap does not necessarily show close relationship to the Lime Creek (Hackberry).

With the Shellrock beds of Iowa, the Sly Gap shows, when compared, few relationships other than a number of genera in common. These are usually long ranging forms occurring in other formations and therefore of little correlative value in themselves. There are, as far as known, no species in common to the two formations. The Sly Gap, is then, distinctly not a correlate of the Shellrock as might be indicated by Stevenson's suggestion that the Sly Gap is slightly older than the Lime Creek. The presence of the genus *Hypothyridina* in each, however, may be indicative that they both are in the lower part of the Upper Devonian.

The Cedar Valley occurs below the Shellrock and the same objections to correlating the Sly Gap with it, are pertinent. They have some genera as *Hypothyridina* in common but no species as far as the faunas are known at present.

Of the Iowa Devonian faunas only that of the Independence

shale shows any considerable resemblance to that of the Sly Gap. This is displayed not only in the generic similarity but in the specific identity of many of the forms. Twenty-nine species are common to the Sly Gap beds and the Independence shale. They are:

Macgeea thomasi Stainbrook, *Syringaxon thomasi* Stainbrook, *Aulocaulis singularis* Stainbrook, *Lioclema slygapensis* Fritz, *Schizophoria* cf. *amanaensis* Stainbrook, *Skenidium independense* Stainbrook, *Aulacella infera* (Calvin), *Cariniferella iowensis* Stainbrook, *Strophonelloides deeringi* Stainbrook, *Douvillinaria variabilis* (Calvin) *Pseudodouvillina euglyphea* Stainbrook, *Sulcatostrophia calvini* (Miller), *Nervostrophia thomasi* Stainbrook, *Nervostrophia multinervosa* Stainbrook, *Devonoproductus vulgaris* Stainbrook, *Gypidula munda* Calvin, *Hypothyridina emmonsi* (H. and W.), *Pugnoides schucherti* Stainbrook, *Calvinaria bransoni* Stainbrook, *Atrypa devoniana* Webster, *Atrypa varicostata* Stainbrook, *Hystricina trulla* Stainbrook, *Spirifer strigosus* Meek, *Acutatheca propria* Stainbrook, *Thomasaria altumbona* Stainbrook, *Cyrtina inulta* Stainbrook, and *Ptyctodus calceolus* M and W.

Additional species in common may be present as indicated by Stevenson's list of Sly Gap forms. His *Camarotoechia* cf. *duplicata* Hall, *Spirifer* cf. *disjunctus*, *Coenites* cf. *floydensis* F. and F., *Tabulophyllum* sp., *Bellerophon*, *Platyceras* and *Straparollus* may eventually be found on comparison to be conspecific with Independence forms.

Of these species twenty-two occur elsewhere only in the Independence shale of Iowa. This can be said of the fauna of no other Devonian formation. To the writer the number of identical species common to the Sly Gap and to the Independence shale is indicative of a high degree of relationship between the faunas of the two formations. Further evidence of this relationship is seen in a study of genera in common. *Arthroacantha*, a striking genus of crinoids, has a representative in each fauna. It does not occur in any other formation of the Iowa Devonian. *Hypothyridina* is a characteristic genus in each. Moreover, these genera — *Syringaxon*, *Skenidium*, *Aulacella*, *Pseudodouvillina*, *Thomasaria* and *Acutatheca*— are limited to these two formations in the upper Devonian.

The nonoccurrence of the genera *Arthroacantha*, *Acutatheca*, *Syringaxon*, *Hypothyridina*, *Aulacella*, *Cariniferella*,

Thomasaria, *Skenidium*, and *Pseudodouvillina* in the Lime Creek appears to the writer to indicate that the Lime Creek and Sly Gap are not closely related and to outweigh the evidence afforded by the ammonite genus *Manticoceras*. The evidence appears nearly conclusive in favor of the correlation of the Sly Gap beds of New Mexico with the Independence shale of Iowa. With no other formation is a closer relationship indicated.

Granted then that the faunas of the Sly Gap and Independence are closely related and that the formations are to be correlated with each other, are they synchronous, or are they of different ages as indicated by Stevenson? The latter stated that the Sly Gap was probably younger than the Independence and slightly older than the Lime Creek.

The occurrence of two closely related faunas but widely separated by nearly 1500 miles might be interpreted in several ways. 1. They may have advanced into the areas they are now found from the same parent region. 2. The Sly Gap fauna may have migrated from New Mexico into Iowa. 3. The Independence shale may have migrated into New Mexico from Iowa, directly or in a roundabout way.

In the first case, if the area of origin were in eastern United States, then Iowa would be expected to have been invaded first and New Mexico later. In this event the Independence shale would be a little older than the Sly Gap by the time it took for the fauna to move 1500 miles. But as far as known no fauna identical with that of the Independence shale has been reported in the Appalachian geosynclinal area. The High Point fauna seems to be considerably higher. Therefore this hypothesis may be abandoned.

The Arctic-Mackenzie region may have been the gateway for the entrance of the Independence-Sly Gap fauna into the interior. Iowa is somewhat farther north than New Mexico and might be reached first. On the other hand, New Mexico is very near the Cordilleran geosyncline which was occupied during the Middle Devonian. Consequently the fauna probably would have had an easier and more accessible route of migration down the geosyncline and may have reached New Mexico earlier or simultaneously. However the Independence-Sly Gap fauna has not yet been definitely recognized in the north Canadian area and the invasion of the fauna from the north may be regarded for the present as unproven.

In the third case the Independence-Sly Gap fauna may have migrated from New Mexico to Iowa. This is favored by the suggestion of the presence of the fauna in the Devil's Gate limestone of Nevada which Stainbrook thought might correlate with the Independence and Stevenson with Sly Gap. The Devil's Gate is within the area of the Cordilleron geosyncline which was the site of deposition during a considerable part of the Lower and Middle Devonian (Merriam). The fauna would naturally be expected to appear in the geosyncline first, then in New Mexico not far away and lastly in Iowa on the great central platform, much of which was not covered during the Middle Devonian. This path of migration seems to have been taken also by the *hungerfordi fauna* of the Martin limestone of Arizona into the Lime Creek beds of Iowa. Since New Mexico is much nearer a geosyncline and the open sea to the southwest, this migration route would be logical. In this event the Sly Gap formation would be slightly older than the Independence shale of Iowa. At least the preponderance of the evidence seems to favor the earlier age of the Sly Gap if the formation is not contemporaneous with the Independence shale of Iowa.

AGE OF THE SLY GAP FORMATION

Comparison of the Sly Gap fauna of Alamogordo, New Mexico, with that of the Independence shale of Iowa, demonstrates that they are practically identical and therefore, probably of the same age. The writer attempted (1945, p. 3) previously to show that the Independence fauna was the equivalent in North America of the fauna of the Cuboides Schichten (Frasnian) of Germany, and therefore basal Upper Devonian, since these beds lie on the Middle Devonian Stringocephalus beds. However, this has been questioned (Schuchert, p. 705) and Cooper (1942, p. 1737) stated that the probable true position of the Independence fauna is between the Juniper Hill shale and the Cerro Gordo members of the Lime Creek of Iowa, although the shale lies below the Cedar Valley limestone. He, therefore, places the Independence as well as the Sly Gap high in the Frasnian. Comparison of the Sly Gap fauna with that of the Cuboides Schichten leads to a somewhat different conclusion.

The calcareous shales and argillaceous limestones of Aachen

lie immediately on Stringocephalus limestone (Williams, p. 485-6). Kayser states that the Cuboides beds make the base of the Upper Devonian near Aachen (p. 848). They contain fossils as listed below with the probable generic reference by the writer.

Rhynchonella (*Hypothyridina*) *cuboides* Sowerby
Spirifer (*Cyrtospirifer*) *verneuili* Murchison
Receptaculites neptuni Defrance
Spirifer (*Elytha*) *euryglossus* Schnurr
Rhynchonella (*Pugnoides*) *acuminata* Martin
Athyris concentrica von Buch
Atrypa reticularis Linne
Pentamerus (*Gypidula*) *galeatus* Dalman
Orthis (*Aulacella*) *eifelensis* de Verneuil
Orthis (*Schizophoria*) *striatula* Schlotheim
Melocrinus heiroglyphicus Goldfuss
Phillipsastrea verneuili Ed. and H.
Acervularia (*Hexagonaria*) *pentagona* Ed. and H.

In Belgium corresponding beds are called Frasnian limestone and shales (Williams, p. 485). Fossils listed by Gosselet (p. 96) are:

Bronteus (*Scutellum*) *flabellifer* Goldfuss
Crypheus arachnoides
Goniatites (*Manticoceras*) *intumescens*
Spirifer nudus
Spirifer urii
Spirifer (*Elytha*) *euryglossus* Schnurr
Spirifer bifidus
Spirifer (*Cyrtospirifer*) *verneuili* Murchison
Spirifer (*Cyrtospirifer*) *orbellianus* Abich
Spirigera (*Athyris*) *concentrica*
Atrypa reticularis linne
Rhynchonella (*Hypothyridina*) *cuboides*
Camarophoria (*Calvinaria*) *formosa*
Camarophoria (*Calvinaria*) *megistana*
Pentamerus (*Gypidula*) *brevirostris*
Orthis (*Schizophoria*) *striatula* Schlotheim
Productus (*Productella*) *subaculeatus* Murchison
Cyathophyllum (*Hexagonaria*) *hexagonum* Edwards and Haime

Favosites (*Thamnopora*) *cervicornis* De Blainville
Alveolites aequalis
Acervularia (*Hexagonaria*) *goldfussi*
Receptaculites neptuni de France

Smith (1945) states that in the Beaulieu shales and Ferques limestone, Ferques, near Boulogne, France, has:

Metriophyllum bouchardi Edwards and Haime
Macgeea gallica Lang and Smith
Phillispastrea boloniense Edwards and Haime
Prismatophyllum davidsoni Edwards and Haime

The beds are said to be Frasnian but whether exactly equivalent to the Cuboides Schichten is not known to the writer.

The following list indicates the parallelism between the fauna of the Sly Gap and those of the Cuboides Schichten and other Frasnian beds.

FRASNIAN OF EUROPE	SLY GAP OF NEW MEXICO
Rhynchonella (*Hypothyridina*) *cuboides* Sowerby	*Hypothyridina emmonsi* (H. and W.)
Spirifer (*Cyrtospirifer*) *verneuili* Murchison	*Cyrtospirifer* sp. (Sly Gap)
Receptaculies neptuni De France	*Receptaculites* sp. (Muddy Mts).
Rhynchonella (*Pugnoides*) *acuminata* Martin	*Pugnoides schucherti* Stainbrook
Productus (*Productella*) *subaculeatus* Murchison	*Productella rugatula* Stainbrook
Athyris concentrica von Buch	*Athyris* sp. (Sly Gap)
Atrypa reticularis Linne	*Atrypa devoniana* Webster
Pentamerus (*Gypidula*) *galeatus* Dalman	*Gypidula munda* Calvin
Orthis (*Aulacella*) *eifelensis* de Verneuil	*Aulacella infera* (Calvin)
Orthis (*Schizophoria*) *striatula* Schlotheim	*Schizophoria* cf. *amanaensis* Stainbrook
Phillipsastrea verneuili (Edwards and Haime)	*Phillipsastrea* sp. (Sly Gap)
Acervularia (*Hexagonaria*) *pentagona* Edwards and Haime	*Hexagonaria* sp. (Sly Gap)
Goniatites (*Manticoceras*) *intumescens*	*Manticoceras* sp.

FRASNIAN OF EUROPE	SLY GAP OF NEW MEXICO
Spirifer (*Cyrtospirifer*) *orbellianus*	*Cyrtospirifer* sp. (Sly Gap)
Spirifer bifidus	*Tylothyris* cf. *mesacostalis* (Sly Gap)
Camerophoria (*Calvinaria*) *formosa* Schnurr	*Calvinaria bransoni* Stainbrook
Favosites (*Thamnopora*) *cervicornis* De Blainville	*Thamnopora* sp. (Sly Gap)
Alveolites aequalis	*Alveolites* sp. (Sly Gap)
Macgeea gallica Lang and Smith	*Macgeea thomasi* Stainbrook
Spirifer simplex Phillips	*Thomasaria altumbona* Stainbrook
Camarophoria megistana	*Calvinaria ambigua* (Calvin)

An inspection of the lists above demonstrates that for many of the Cuboides Schichten species there is an analogous form in the Sly Gap. The assemblage and association of genera is practically the same in both and probably is not duplicated anywhere else in the Devonian of North America. To the writer this assemblage of the same characteristic genera carries more weight in the correlation of the beds in which it occurs than does the occurrence of a single genus of ammonite or other species of fossils. The remains of a single form of animal are much more subject to chance in the course of its distribution in the Devonian seas of the world. Also a single genus might well live longer in one part of the world than in another but that an assemblage of the same genera would do so is more unlikely. That a large group of genera in such an association as in the Sly Gap and Cuboides Schichten beds should appear at two separate times would appear to be somewhat improbable. The rate of migration between Europe and North America probably would be sufficiently rapid so that beds of the two areas would not differ greatly in time. Accordingly it seems that the Sly Gap is the American correlate of the Frasnian Cuboides Schichten in Europe and that they are approximately the same age, i.e. basal Upper Devonian. Cooper (p. 1767) has stated that the Independence fauna is the "one assemblage most closely related to the 'Cuboides zone' of Europe." The Sly Gap is even more closely related to that fauna as it has in addition

Hexagonaria, *Phillipsastrea*, *Athyris*, *Receptaculites*, and *Manticoceras*, which genera have as yet not been recovered from the Independence shale of Iowa.

As the Independence and Sly Gap faunas are closely related the parallelism with the Frasnian fauna may be further continued by Independence species which appear to be analogous.

FRASNIAN	INDEPENDENCE SHALE
Spirifer (Elytha) euryglossus Schnurr	*Elytha diversa* Stainbrook
Melocrinus heiroglyphicus Goldfuss	*Melocrinus* sp.
Metriophyllum bouchardi Edwards and Haime	*Metriophyllum iowense* Stainbrook
Spirifer simplex Phillips	*Thomasaria altumbona* Stainbrook
Camarophoria megistana Lebon	*Calvinaria ambigua* (Calvin)

Direct comparison of the fauna of the Frasnian and of the Independence-Sly Gap would probably yield further evidence of their similarity.

CONCLUSIONS

The Sly Gap fauna of Alamogordo, New Mexico, and that of the Independence shale of Iowa are definitely similar enough to indicate that the two formations are probably contemporaneous.

The position of the Independence shale near the base of the Devonian section of Iowa indicates that the Sly Gap is older than granted by geologists hitherto.

Comparison of the Sly Gap fauna with that of the Cubiodes Schichten, Frasnian, of Europe indicates that they are homologous and perhaps synchronous.

The association of genera and the general assemblage seen in the Cuboides Schichten is repeated in the Independence shale of Iowa and more completely in the Sly Gap of New Mexico. *Hypothridina* is an important member of this group of associated genera, is easily recognized, and therefore a good horizon marker. In the United States the genus *Hypothyridina* appears to be generally Upper Devonian as reported Middle Devonian occurrences are not unquestioned. The Tully limestone has been placed in the Upper Devonian by some geologists. The Cedar Valley limestone lies above

the Independence shale and does not seem to be Middle Devonian. The occurrence of the genus in Nevada in Middle Devonian is not unquestionable as the Middle-Upper Devonian line cannot apparently at present be definitely drawn. Occurrence of *Hypothyridina* with definitely Upper Devonian faunas would apparently be indicative at least of the lowermost portion of the Upper Devonian.

In discussing the place of the Independence shale Cooper and Warthin state (p. 1767) that the goniatites place it in the Frasnian. Presence of *Cyrtospirifer disjunctus* and *Dalmanella* (*Aulacella*) is said to place the fauna in the Chemung. This cannot be granted any more than the genera *Syringaxon* and *Skenidium* place it in the Helderbergian. The Chemung likewise does not have the genera *Thomasaria*, *Acutatheca*, *Skenidium*, *Pseudodouvillina*, *Gamphalosia*, *Leptalosia*, *Gypidula*, *Hypothyridina*, *Grunewaldtia*, *Elytha*, *Metriophyllum*, *Macgeea*, *Caninia*, *Amplexus*, or *Ponticeras*. The assemblage and association of genera does not appear to be Chemung. Similarly the Sly Gap fauna differs from that of the Chemung, and probably is somewhat older. The writer would then place both the Sly Gap and the Independence shale near the base of the Upper Devonian.

ADDENDUM

Since the foregoing was written the writer has had the privilege of studying Upper Devonian faunas of northwest France and of Belgium preserved in the British Museum of Natural History and in the museums of the State and Free Universities of Lille, France. Many similarities of species to and generic identities with Independence forms were discovered in addition to those noted above. The writer now has no hesitation in stating that the fauna of the Independence of Iowa and Sly Gap of New Mexico is most closely related to that of the Calcaire du Ferques, near Boulogne, France.

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