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# DEPARTMENT OF MINES
# SOUTH AUSTRALIA

GEOLOGICAL SURVEY

PALAEONTOLOGY SECTION

## LOWER MURRAY DAM SITE INVESTIGATION:-
## STRATIGRAPHY

by

N. H. Ludbrook,
Palaeontologist



13th September, 1961.

D.M. 518/61

V.T. Geraghty

RB 53/59

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Rept. Bk. 53/59
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ABSTRACT:

Two bores on the west bank of the River Murray in the Hundred of Finniss intersected part of the Mannum Formation and the Ettrick Formation before entering weathered granite. Site 5, Bore 1, 2 miles east of Mannum had the lower part of the Mannum and the upper part of the Ettrick missing; this is interpreted as being the result of cliff collapse. Three water bores in the Hundred of Younghusband were examined for comparison. These intersected Loxton Sands, Mannum Formation and Ettrick Formation sediments.

## 1. INTRODUCTION

Three bores drilled as part of the programme to investigate a dam site on the River Murray near Teal Flat have been examined micropalaeontologically in some detail. These have been compared with 3 water bores in the Hundred of Younghusband on the eastern side of the river to obtain general information on the Tertiary stratigraphy of the area. Surface samples collected by W. Johnson and N. H. Ludbrook have been correlated with the bore sections.

## 2. STRATIGRAPHY

### (1) Fluviatile sands and silts

River sands and silts were intersected in Site 1, Bores 1 and 2, Site 4, Bores 1 and 2, Site 5, Bore 1. These were 59 feet thick in Site 1 Bore 1, with bands of freshwater mollusca (*Corbiculina angasi* and *Velesunico ambiguus*) at depths between 58 and 68 feet. Megaspores of the water fern *Azolla* which grows in stagnant lagoons along the Murray and other rivers and freshwater ostracode valves are also present.

### (2) Loxton Sands

Loxton Sands are present only at higher levels in the Mannum area. They occur at Mannum township (Ludbrook, 1961, pp. 40-41), they are from 165 to 178 feet thick in the three bores examined in the Hundred of Younghusband, Sections 47, 92

and 114. They were not intersected in the bores sited on the river.

(3) Mannum Formation

The Mannum Formation was intersected in Site 4 Bore 2 and the three water bores in the Hundred of Younghusband. Site 4 Bore 2 intersected, between 4 and 68 feet, 64 feet of limestone typical of the lower part of the Mannum Formation with a "Longfordian" fauna characterized by Calcarina mackayi, Astrononion centroplax. Sherbornina atkinsoni is common in the sandy limestone and clay at the base of the formation. This lithology and microfauna are present in the three bores in the Hundred of Younghusband and in surface samples collected over Kanmantoo bedrock near Teal Flat. However, Site 5 Bore 1 intersected between 40 and 85 feet calcareous sandstone and limestone of different lithology and with a microfauna characterized by Operculina victoriensis, Nonion victoriense and Amphistegina lessonii. The lowest (Upper Oligocene) beds of the Mannum Formation and the uppermost clay of the underlying Ettrick Formation are absent. This is interpreted as evidence of cliff collapse, the bore having intersected fallen blocks from the upper part of the Mannum Formation.

The greatest known thickness exposed of the Mannum Formation is in the high river cliff 4 miles west of Bowhill Hundred of Younghusband, Section B1. Samples F30/61 and F31/61 were taken from the top of the Mannum Formation in this cliff.

(4) Ettrick Formation

Site 4 Bore 2, Site 5 Bore 1 and 2 of the water bores in the Hundred of Younghusband passed into the Ettrick Formation below the Mannum Formation. This formation has a varying lithology of mudstones, limestones, calcareous sandstones and marls, with carbonaceous beds in some marginal areas up against bed rock highs.

The formation varies in colour from light to dark grey in contrast with the yellow-brown of the Mannum Formation. It has a very rich microfauna into abundant foraminifera of which

Massilina torquayensis, Bolivinopsis crespinae and Globigerina euapertura are characteristic.

3. BORE LOGS: Dam Site

The bores examined have been partly relogged from microscopic examination of washed sludges.

LOWER MURRAY DAM SITE

Site 1, Bore 1 — Bore Serial 975/61
Hd. Younghusband — Pt. Sec. Z
R.L. 112' approx.

Depth(feet)

| | |
|---|---|
| 0' - 4'6" | Grey and brown grey fine silty sand with plant fragments, fine angular quartz grains. |
| 4'6" - 7'2" | Grey silty sand with clay lenses; fine angular quartz and ferruginized clay. |
| 7'2" - 17' | Grey silt and clay with fine angular quartz, muscovite, marcasite, plant fragments of various kinds including Azolla megaspores, wood, etc. Ferruginized clay at 14'-15'. |
| 17' - 36' | Greenish grey fine silty sand interbedded with clayey silt with fine angular quartz grains, carbonaceous silt, fine muscovite. |
| 36' - 58' | Greenish grey fine silty sand with silt and clay lenses. |
| 58' - 69' | Grey coarse sand with subrounded to subangular quartz, some muscovite, tourmaline and abundant fragments of freshwater shells, principally Corbiculina angasi at 58-59, 60-61, 67-68. Velesunio ambiguus at 58-60, Azolla at 58-59, ostracodes 60-61. |
| 69' - 74'9" | Grey coarse well sorted sand with marcasite cemented quartz. |
| 74'9" - 75' | Grey quartz grit with aggregates of quartz cemented with iron sulphide, probably marcasite with a small amount of pyrite (AMDL Report P277/61) (appended) |
| 75' - 76' | Grey coarse quartz sand. |

Depth (feet)

76' - 84' Grey coarse sand with marcasite on quartz grains. Grains and pebbles of pyritic schist and pyrite-epidote rock (Kanmantoo Group)

84' - 88' Grey medium sand and quartz gravel with marcasite cemented aggregates.

88' - 91' Quartz grit and Kanmantoo bedrock - pyritic quartz schist.

91' - 94'6" Kanmantoo bedrock.

Stratigraphic summary

0' - 91' Fluviatile sand and silts containing mollusca ostracodes and plants living in the River Murray at the present time and commonly deposited in large numbers during floods.

91' - 94'6" Kanmantoo bedrock the boundary being placed somewhat low, as if the bedrock is steeply dipping quartz grits would penetrate along the joint planes e.g. from 89 feet depth.

LOWER MURRAY DAM SITE

Site 1, Bore 2 — Bore Serial 991/61
Hd. Ridley, — Sec. 386

This bore was not examined in detail. It intersected fluviatile sands and silts similar to those in Site 1 Bore 1 with shells of Corbiculina angasi at 31 feet.

LOWER MURRAY DAM SITE

Site 4, Bore 1 — Bore Serial 990/61
Hd. Younghusband — Sec. $P^{SW}$

This bore also was not examined in detail as it intersected fluviatile silts and sands of the present river syste

LOWER MURRAY DAM SITE

Site 4, Bore 2 — Bore Serial 996/61
Hd. Finniss — Sec. 456/57
4 miles East of Mannum
R.L. 117.57 feet.

Depth(feet)

0'0" - 0'6" Brown and red mottled clayey sand with ironstone nodules.

0'6" - 4' Yellow fine calcareous, micaceous sand with muscovite and calcite. Anomalina glabrata,

| Depth(feet) | |
|---|---|
| | Cassidulina subglobosa, Lagena hexagona, Pullenia quinqueloba, Trifarina bradyi. |
| 4' - 8' | Yellow ferruginized sandy bryozoal limestone with some angular quartz grains and glauconite pellets. |
| 8' - 14' | Yellow brown partially recrystallized limestone with quartz grains. Crespinella sp. 1, Notorotalia howchini, Cibicides pseudoungerianus, Fibularia gregata. |
| 14' - 20' | Yellow-buff partially recrystallized sandy limestone with some glauconite pellets and schist chips: Globigerina mackayi, Notorotalia howchini, Anomalina glabrata, Planorbulinella inaequilateralis. |
| 20' - 30' | Yellow brown partially recrystallized limestone with some polished subrounded quartz. Foraminifera similar to above with Crespinella sp. 1; and Astrononion centroplax. |
| 30' - 43'9" | Yellowish fine-grained sandy limestone with abundant fine angular quartz grains, glauconite. Same microfauna as 20'-30'. |
| 43'9" - 61' | Yellow brown ferruginized limestone with limonite pellets and calcite veins. Foraminifera include Astrononion centroplax, Crespinella sp. 1; Cibicides umbonifer, Amphistegina lessonii, Textularia vertebrata. |
| 61' - 64' | Reddish-brown speckled ferruginized clayey and sandy limestone with abundant red brown limonite pellets, subangular quartz. Abundant Cassidulina subglobosa, with Sherbornina atkinsoni. |
| 64' - 68' | Core at 64'. Brown mottled clay with abundant greenish brown glauconite pellets and foraminifera. Very abundant Cassidulina subglobosa, with Sherbornina atkinsoni, Gümbelitria sp; Globigerina ciperoensis. |

| Depth(feet) | |
|---|---|
| 68' - 74' | Dark grey mudstone with fine angular quartz ferruginized clay, glauconite pyrite. Foraminifera include Globigerina ciperoensis, G. woodi, Gümbelitria sp; Sherbornina atkinsoni, Bolivinopsis crespinae. |
| 74' - 77' | Grey silty very fine sand with glauconite grains, shell fragments, and abundant foraminifera. |
| 77' - 80' | Grey to dark grey pyritic mudstone with mica, pyrite, very abundant small foraminifera, scaphopods, echinoid spines, etc. |
| 80' - 84' | Greenish-brown grey sandy marl with ferruginized clay pellets. Abundant foraminifera including Cibicides brevoralis, Massilina torquayensis, Notorotalia crassimura. |
| 84' - 85' | Greenish brown grey calcareous shell sand. |
| 85' - 91' | Light green-grey shell sand, marl sand limestone with Hofkerina sp; Notorotalia crassimura, Massilina torquayensis. |
| 91' - 93' | Light greenish grey somewhat silty shell sand. |
| 93' - 96' | Light greenish grey sandy marl and shell sand with abundant Sherbornina atkinsoni. |
| 96' - 101' | Light greenish-grey bryozoal limestone. |
| 101' - 138' | Light greenish grey bryozoal sandy limestone. with Sherbornina atkinsoni, Eponides repandus, Stomatorbina concentrica, Globigerina euapertura. |
| 138' - 140' | Yellow-brown grey shelly limestone. |
| 140' - 153' | Brownish grey sandy limestone and marl. |
| 153' - 190' | Yellow sandy marl and limestone with abundant quartz grains, ironstaining, Sherbornina atkinsoni, Notorotalia crassimura, Eponides repandus, Cibicides vortex, Massilina torquayensis, Heronallenia parri. |
| 190' - 210' | White clay and quartz washings consist of coarse angular quartz some pyrite. |

Depth(feet)

Stratigraphic Summary

| | |
|---|---|
| 0' - 4' | Post Mannum with reworked Mannum Formation. |
| 4' - 61' | Mannum Formation. |
| 61' - 68' | Mannum Formation basal beds. |
| 68' - 190' | Ettrick Formation. |
| 190' - 210' | Deeply weathered granite bedrock. |

LOWER MURRAY DAM SITE

Site 5, Bore 1 — Bore Serial 505/62
Hd. Finniss, Se. 297 — R.L. 111.20 feet.

| | |
|---|---|
| 0' - 40' | Grey and brown sand and silt with medium angular quartz grains calcite pyrite, mica. |
| 40' - 67' | Yellow calcareous sand and limestone with medium subangular quartz glauconite. Foraminifera include Operculina victoriensis, Notorotalia howchini, Nonion victoriense, "Rotalia" beccarii, Fibularia. |
| 67' - 85' | Yellow-brown ferruginized recrystallized limestone, with limonite and some quartz. Operculina victoriensis, Amphistegina lessoni and Fibularia gregata common. |
| 85' - 95' | Dark greenish grey glauconite shell sand. Washings consist almost entirely of glauconite shell fragments and foraminifera, consisting of Massilina torquayensis, Sherbornina atkinsoni, Notorotalia crassimura and a rich associated fauna. |
| 94' - 95' | Buff brown calcareous shell sand and marl. Washings consist almost entirely of medium angular to subangular quartz, shell fragments, foraminifera etc, some glauconite. |
| 95' - 115' | Yellowish green brown calcareous glauconitic sandstone grading to limestone, with medium subangular quartz, limonite pellets. Globigerina ciperoensis, Bolivinopsis crespinae, Cibicides brevoralis with Heronallenia parri. |

| Depth(feet) | |
|---|---|
| 115' - 170' | Greenish grey calcareous sandstone and marl with recrystallised calcite, glauconite, medium angular quartz pyrite. At 170' Globigerina cf. ciperoensis, Globigerina euapertura, Heterohelix rugosa. |
| 170' - 184' | Grey calcareous clay grading to marl with pyrite nodules, glauconite mica, fine angular quartz, Globigerina cf. ciperoensis, Globigerina euapertura. |
| 185' - 199'10 | Grey and brown silty shelly sand with abundant pyrite, medium to coarse angular to subangular quartz. Sherbornina atkinsoni, Notorotalia crassimura with Globigerina euapetura and abundant small foraminifera. |
| 199'10- 237' | Brown coal. Dark brown coal with earthy carbonaceous matter, some foraminifera and quartz grains. Cibicides umbonifer, Cibicides vortex, small species of Bolivina and Bolivinella, sponge spicules and partially carbonized wood fragments. |
| 237' - 240' | Dark brown carbonaceous matter and quartz. Washings consist of coarse angular quartz grains. This material is the same as that on Site 4, Bore 2, 190'-210' except that the matrix is impregnated with carbonaceous matter. |

Stratigraphic Summary

| | |
|---|---|
| 0' - 40' | Fluviatile sands and silts of present river system. |
| 40' - 85' | Collapsed Mannum Formation. |
| 85' - 200' | Ettrick Formation. |
| 200' - 237' | Probably Ettrick Formation. |
| 237' - 240' | Deeply weathered granite. |

## 4. BORE LOGS: WATER BORES EAST OF MANNUM

### BORE FOR H. A. ROSENBERG, MANNUM - Bore Serial 89/56

Hd. Younghusband, Section 47

| Depth(feet) | |
|---|---|
| 0' - 7' | Reddish brown sand and kunkar. |
| 7' - 28' | Reddish brown calcareous fine sand. |
| 28' - 47' | Reddish brown silty fine sand. |
| 47' - 70' | Buff calcareous very micaceous fine sand with abundant foraminifera. |
| 70' - 123' | Buff calcareous very micaceous fine sand with abundant foraminifera "Rotalia" tepida and Elphidium sp. |
| 123' - 167' | Buff calcareous very micaceous fine sand with abundant foraminifera. |
| 167' - 169' | Buff gritty limestone with limonite pellets and quartz. |
| 169' - 177' | Buff sandy limestone with bryozoa, echinoids, Operculina victoriensis. |
| 177' - 270' | Light yellow brown limestone. |
| 270' - 294' | Light yellow brown recrystallized limestone with some quartz grains. |
| 294' - 297' | Yellow brown sandy limestone with limonite. |
| 297' - 310' | Dark grey fossiliferous clay with abundant small foraminifera. |

#### Stratigraphic Summary

| | |
|---|---|
| 0' - 7' | Surface sand and kunkar. |
| 7' - 167' | Loxton Sands. |
| 167' - 169' | Loxton Sands basal bed |
| 169' - 294' | Mannum Formation. |
| 294' - 297' | Mannum Formation - basal beds. |
| 297' - 310' | Ettrick Formation. |

BORE FOR R. F. MANN, MANNUM - Bore Serial 148/58

Hd. Younghusband, Section 93

| Depth(feet) | |
|---|---|
| 0' - 1' | Brown calcareous silty fine to coarse sand. |
| 1' - 10' | Reddish brown kunkar and sand. |
| 10' - 17' | Light reddish brown calcareous and clayey very fine sand. |
| 17' - 80' | Light reddish brown clayey micaceous fine sand, with ironstained quartz and "Rotalia" tepida. |
| 80' - 91' | Yellowish brown calcareous clayey silty fine sand with abundant "Rotalia" tepida and Elphidium sp. |
| 91' - 150' | Buff calcareous sand with bands of hard sandy limestone. Abundant "Rotalia" tepida, Nonion victoriense and Globigerina triloba |
| 150' - 160' | Buff calcareous very micaceous sand and rounded grit with fragments of sandy limestone. |
| 160' - 175' | Buff calcareous and very micaceous silty fine sand with abundant "Rotalia" tepida, Nonion victoriense, Elphidium advenum. |
| 175' - 195' | Yellowish brown calcareous grit with limonite pellets, abundant mica and shell fragments. Ostrea, Chlamys, barnacles, miliolids. |
| 195' - 205' | Yellowish brown weathered recrystallized bryozoal limestone with Operculina victoriensis, Crespinella sp. nov. |
| 205' - 305' | Yellowish brown sandy limestone with shell fragments. Operculina victoriensis, Crespinella sp. nov. |
| 305' - 330' | Brown and grey sandy limestone with Sherbornina atkinsoni, Eponides lornensis. |
| 330' - 331' | Grey fine sandy marl with a rich microfauna containing Uvigerina, Trifarina, Cassidulina Sherbornina atkinsoni, Globigerina woodi, Globigerina bulloides. |

Stratigraphic Summary

| Depth(feet) | |
|---|---|
| 0' - 17' | Surface sand and kunkar. |
| 17' - 175' | Loxton Sands. |
| 175' - 195' | Loxton Sands (basal bed) |
| 195' - 305' | Mannum Formation. |
| 305' - 330' | Mannum Formation (basal beds) |
| 330' - 335' | Ettrick Formation. |

BORE FOR E. W. HAGE, COOLCHA - Bore Serial 86/56

Hd. Younghusband, Section 114

| Depth(feet) | |
|---|---|
| 0' - 3' | Reddish brown sand. |
| 3' - 8' | Light pinkish brown calcareous silt and grit. |
| 8' - 82' | Light yellowish brown very micaceous fossiliferous fine sand and silt. |
| 82' - 89' | Light yellowish brown micaceous calcareous sand and hard sandstone. |
| 89' - 124' | Light reddish brown calcareous and micaceous fine sand. |
| 124' - 127' | Light yellowish brown hard calcareous and micaceous sandstone. |
| 127' - 173' | Buff calcareous and micaceous fossiliferous fine sand. |
| 173' - 190' | Light yellow brown gritty bryozoal limestone. |
| 190' - 215' | Light yellow brown bryozoal limestone. |
| 215' - 235' | Cream rubbly bryozoal limestone with some quartz. |
| 235' - 255' | Buff bryozoal limestone. |
| 255' - 275' | Light buff sandy and rubbly bryozoal limestone. |

Stratigraphic Summary

| | |
|---|---|
| 0' - 8' | Surface sand. |
| 8' - 124' | Loxton Sands. |
| 124' - 173' | Loxton Sands basal bed. |
| 173' - 275' | Mannum Formation. |

## 5. SURFACE SAMPLES

F22/61 W. Johnson TF 1. Hd. Younghusband, Section Z.

Grey clay under limestone near granite contact. The clay contained medium to fine angular quartz, glauconite pellets, some converted to limonite, calcite. Foraminifera include Sherbornina atkinsoni and Sherbornina cuneimarginata with Astrononion centroplax and Notorotalia howchini.

This is a clay deposited near the base of the Mannum Formation of which the age at this level is considered to be upper Oligocene.

F23/61 W. Johnson TF 2. Hd. Younghusband, Section Z.

Partially recrystallized limestone overlying clay in small outcrop north of granite quarry, near granite contact. The limestone contains ironstained calcite, fine angular quartz, limonite, occasional glauconite. The fauna is the same as that of F22/61 indicating a position near the base of the Mannum Formation.

F24/61 W. Johnson TF9. Hd. Ridley, Section 14 - 130 yards north of farmhouse in small washaway.

Grey clay mottled with yellow-brown with medium angular quartz, abundant glauconite limonite and gypsum. It contains abundant Cassidulina subglobosa with Sherbornina atkinsoni and Anomalina glabrata. Its stratigraphic position is near the base of the Mannum Formation.

F25/61 W. Johnson TF 10. Hd. Ridley, Section 14 - 130 yards north of farmhouse.

Yellow partially recrystallized friable limestone with abundant foraminifera, bryozoa, glauconite. Abundant large Cassidulina subglobosa with Sherbornina atkinsoni and Globigerina woodi. This fauna is indicative of the base of the Mannum Formation.

F26/61 W. Johnson TF 12, Hd. Ridley, Section 14 - 330 yards east of farmhouse.

Speckled brown-white calcareous sandstone with coarse ovoid shining limonite pellets and quartz grains in a calcite matrix. Echinoid fragments, brachiopods

and occasional foraminifera are present. These are basal sediments of the Mannum Formation.

F27/61 W. Johnson TF 13, Hd. Ridley, Section 14 - 400 yards east of farmhouse.

Brown calcareous gritty sandstone with coarse to medium subrounded quartz, brown shining limonite pellets, abundant bryozoa and echinoids with mollusca and foraminifera. This is the same material as F26/61 - Mannum Formation.

F28/61 W. Johnson TF14, Hd. Ridley, Sec. 14 - 560 yards NE of farmhouse.

Yellow ferruginous gritty limestone with coarse quartz grains, limonite pellets in calcareous matrix, kaolinitic matter. Foraminifera, bryozoa, echinoids and mollusca are present but diagenesis has proceeded too far for their recognition. The material is the same as F27/61 and F26/61.

F29/61 Collected W. Johnson and N. H. Ludbrook 14/6/61 Hd. Younghusband, Section 156.

Clay pocket at contact of Mannum Formation and granite in granite quarry. Grey mottled red and grey clay of which washings are mainly glauconite pellets changing to limonite, gypsum. There are glauconite infilled foraminifera casts of gastropods, fragments of echinoids. This is a clay pocket developed in the Mannum Formation at its contact with the granite.

F30/61 Collected by W. Johnson and N. H. Ludbrook 14/6/61. Hd. Younghusband, Section B1 - 4 miles west of Bowhill.

Partially recrystallized bryozoal limestone at top of high cliff on east bank of river. Sample taken from roadway leading down to river. Fibularia gregata present with Operculina victoriehsis and Crespinella sp. nov. A. This represents the upper part of the Mannum Formation of Lower Miocene ("Long fordian" age Carter's Unit 8).

F31/61 Collected W. Johnson and N. H. Ludbrook 14/6/61. Hd. Younghusband, Section B1 - 4 miles west of Bowhill.

Top of Mannum Formation exposed in high cliff on east bank of river. Sample taken 10 feet below F30/61 on roadway leading down to river. It consists of partially recrystallized bryozoal limestone with abundant Operculina victoriensis, Crespinella sp. nov. A., Calcarina verrucata and Gypsina howchini. The age is Lower Miocene near top of "Longfordian" at approximately Carter's Unit 8.

F33/61 Collected W. Johnson and N. H. Ludbrook 14/6/61 Hd. Ridley, Section 14 - 400 feet north of farmhouse, in small washaway at same locality as F24/61.

It contains Cassidulina subglobosa, Globigerina woodi; Anomalina glabrata and associated small foraminifera characteristic of the base of the Mannum Formation.

## 6. REFERENCE

LUDBROOK, N.H., 1961. Stratigraphy of the Murray Basin in South Australia, Geol. Surv. S. Aust. Bulletin 36.

## 7. PETROLOGICAL REPORT A.M.D.L. P277/61

MP 1.2.0/915

REPORT OF INVESTIGATION

| | |
|---|---|
| YOUR REFERENCE: | P277/61 |
| MATERIAL: | Sample from bore-hole |
| LOCALITY: | Lower Murray dam site; Hd. Younghusband, Sect. Z. |
| IDENTIFICATION: | T/S 8350, P/S 5470 |
| DATE RECEIVED: | 26/6/61 |
| INFORMATION REQUIRED: | Identification of cementing material. |

RESULTS

The cementing material in this specimen consists predominantly of finely granular opaque iron sulphide. It mostly occurs as granules, with an average size of about 30 microns, along the boundaries of most grains. However granular aggregates

are also present. This iron sulphide has a very low reflectivity and is anisotropic in reflected light. In dilute hydrochloric acid it effervesces giving off hydrogen sulphide. Thus it is not pyrite but probably a form of marcasite. Pyrite grains occur in the cement but only in a minor amount.

Investigated by: D. E. Ayres

Officer-in-Charge, Mineralogy Section: H. W. Fander.

L. Wallace Coffer
Director

10/8/61

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13/9/61