

The Myogog Formation and Its Tectonic Significance

Chang Hi Cheong

Department of Geology, Seoul National
University, Seoul, Korea

Ha Young Lee

Department of Geology, Kyungpook National
University, Taegu, Korea

卯谷層과 後大同紀 地殼運動

鄭 昌 熙

서울대학교 文리과대학 地質學科

李 河 榮

慶北대학교 文리과대학 地質學科

(Received Oct. 9, 1966)

ABSTRACT

Upper Jurassic sediments between the Daedong and Gyeongsang Systems have not yet been known in south Korea. But the Myogog Formation distributed in the area of Jaesan-myeon, Bonghwa-gun, North Gyeongsang Province, was clarified as upper Jurassic.

The Myogog Formation, more than 150 meters thick, is bounded by a thrust fault on the side of Wonnam Formation and is overlain unconformably by the lowermost part of the Nagdong Series of lower Cretaceous. The Myogog Formation is composed mainly of black to dark greenish gray shales, and dark to light gray arkose sandstones. The non-marine fossils, *Trigonioides*, *Plicatounio*, *Unio*, *Corbicula* and *Viviparus*, and some fossil plants, *Onychiopsis*, *Adiantites*, etc. are found in the Myogog Formation. These fossils indicate that the formation is to be of upper Jurassic to lower Cretaceous in age. The Myogog Formation is strongly folded and thrust, whereas the rocks of Nagdong Series overlying the Myogog formation is monoclinial with gentle dip. So far, the so-called Daebo disturbance has been known to have taken place during late Jurassic to early Cretaceous. But the fact that the oronized Myogog Formation of upper Jurassic is overlain by the almost undisturbed Nagdong Series of lower Cretaceous limits the time of the movement to the end of late Jurassic. Here, the Nagdong orogeny is proposed for the movement. As for the disturbance which took place just before the Myogog Formation was formed, the Myogog movement is proposed.

INTRODUCTION

No notable orogenic movement took place during Paleozoic and early Triassic in Korea. Cambro-Ordovician Joseon or Choseon System and the Pyeongan System, ranging from late Carboniferous to early Triassic, are distributed closely accompanying each other with a disconformable contact, notwithstanding the big hiatus between these two systems. However, the geosynclinal

basin of the Pyeongan Seas were destroyed by the movement which took place in late Triassic. For this movement, the Songrim (Shorin) disturbance has been proposed by Kobayashi (1930). The Songrim disturbance was strong enough to provide the scattered depositional sites, in which the Daedong System was formed.

After deposition of the Daedong System, and before deposition of the Daebo Formation, correlated to the Silla Series of middle to late Creta-

ceous, there was a time when the most severe orogeny took place. Konno (1928) named the orogeny the Daebo movement, investigating the Pyeongyang area in north Korea.

One of the writers (Lee 1963) described the Myogog Formation, distributed in Jaesan-myeon, Bonghwa-gun, North Gyeongsang Province,

in 1963. The writers found the formation to be an interesting sediments in solving the problems related to the Daebo movement. The Myogog Formation, including fossils of late Jurassic, thrust and folded, occupies an unique position between the Daedong System and the Nagdong Series.

The present paper is to describe the stratigraphy and structure of the Myogog Formation and the related strata, and to date the age of movements which took place during late Jurassic.

No detailed work of the area has been published. But the Explanatory Text of the Geological Map of YEAN Sheet, by D. S. Lee and H.Y. Lee, published in 1963 was a helpful guide for this investigation.

OUTLINES OF GEOLOGY

Geology of the area studied is composed of the oldest Wonnam Formation, the late Jurassic Myogog Formation, and the Cretaceous Gyeongsang System. The Gyeongsang System is divided into the Nagdong and Silla Series, the Nagdong

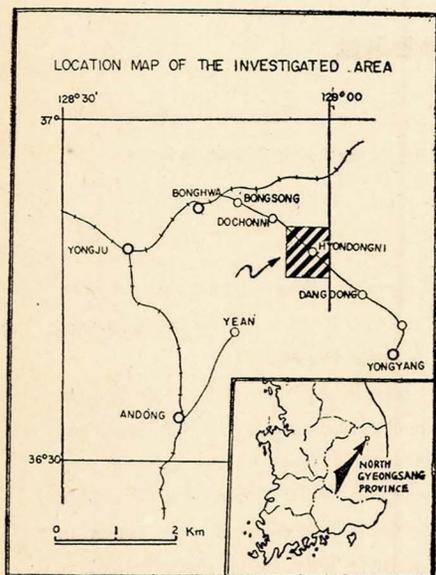


Table 1. Stratigraphic succession in Jaesan-myeon, North Gyeongsang Province.

Geologic age		Geologic Succession		
Cretaceous	Gyeongsang System	Silla Series	Cheongyangsan Formation	Osibong Member
				Cheongyangsan Member
		Nagdong Series	Disconformity	
			Gasongdong Formation	
Donghwachi Formation	Red Mudstone Member			
	Arkose Sandstone Member			
Late Jurassic	Unconformity	Ullyeonsan Formation		
		Myogog Formation		
Unknown	Fault contact	Wonnam Formation		

Series being subdivided into the Ullyeonsan, Donghwachi and Gasong-dong Formations, and the Silla Series represented by the Cheongyangsan Formation.

The lower sequence of the Myogog Formation is unknown and the older Wonnam Formation contacts the Myogog with a thrust. But the Myogog is covered unconformably with the base of the Nagdong Series, viz. the Ullyeonsan Formation, which has not been thrust or severely folded.

The Myogog Formation contains *Trigonioides*, *Plicatounio*, *Onychiopsis*, etc. dating the formation to late Jurassic.

The sequence of the strata found in the area studied is summarized in the Table 1.

ACKNOWLEDGEMENTS

The writers wish to express their sincere appreciations to Professor Chi Moo Son of the Department of Geology, Seoul National University, and Assistant Professor K.H. Chang of the Department of Geology, Kyungpook National University, who gave the writers some important criticism and suggestions on the problems of the crustal movements in Korea. Professor Dae Sung Lee of College of Education, Seoul National University helped the writers in the completion of the field work. Thanks are due to Professor Bong Kyun Kim of the Department of Geology, Seoul National University, who encouraged them in preparing the paper, and to Mr. Yong Ahn Park who has read the paper and given them many advices. The writers acknowledge to Professor Myung Soo Kim for the proof-reading to shape the paper.

STRATIGRAPHY

Stratigraphy of the area studied will be described in ascending order from the Wonnam Formation.

Wonnam Formation

The Wonnam Formation is the lowermost sequence in the area and is composed of meta-sediments. It is overlain unconformably by the Ullyeonsan and Donghwachi Formations. Though the Myogog Formation is believed to be younger than the Wonnam Formation, the inferred unconformity is not found in the area.

The formation is composed mainly of quartz-feldspar gneiss, and is associated with limestones and schists of less than ten meters thick.

The quartz-feldspar gneiss is fine grained in texture and light gray to light brown in colour. Porphyroblasts and augens of feldspars are scattered in it. The main components of the gneiss are quartz and feldspar, and the minor components are biotite, muscovite, sericite and garnet. Most quartz and feldspar grains have been crushed and the quartz shows a strong wavy extinction. Sericitization is recognized along boundaries and cracks in the grains. Feldspar is sodic plagioclase, showing albite twinning.

The quartz schists are generally light gray in colour. Schistosity of the rock is due to the development of muscovite.

The limestones are fine grained and massive, and bluish gray to gray in colour.

Though the Wonnam Formation is largely made up of gneiss, the parent rocks are inferred to be of the sedimentary origin.

The age of the original sediments of the Wonnam Formation is supposed to be of Precambrian, but there has been no clues to clarify it. In some places in south Korea, gneisses are turned out to be of late geologic time, for instance, late Paleozoic or Jurassic.

Myogog Formation

The Myogog Formation crops out typically in Myogog-ri, Jaesan-myeon, the central part of the area studied.

The Wonnam Formation and the Myogog Formation are bounded by the Galsan Thrust in the northwest and the Taegog Fault in the east. The stratigraphic relation of the Myogog Formation to the lower sequences is unknown. But the two patches of the Myogog Formation found on the eastern side of the Taegog Fault seem to suggest that the formation is unconformable to the Wonnam Formation, though the very contact is hidden under the alluvium. The Myogog Formation is overlain unconformably by the Ullyeonsan and Donghwachi Formations.

The Myogog Formation is a noteworthy unit, which belongs neither to the Daedong Series nor to the Gyeongsang System.

This formation is composed mainly of dark gray to black shales and dark gray to light yellow sandstones. Some calcareous shales and three thin coal seams, less than 0.3 meter thick, are intercalated in the lower part of the formation.

Coarse arkosic sandstone and gray coarse sandstone predominate in the formation, and the latter contains well rounded pebbles ranging from 10 to 30 millimeters in diameter.

In the black shales and calcareous shales of the lower part of the formation, fossil plants and mollusks are found. (Plate I & II)

The columnar section obtained from the eastern part of the Myogog Formation is shown on Table 2.

Table 2. Columnar section of the Myogog Formation in ascending order.

Rocks	Thickness in meters
15. Shale, dark gray, poorly fossiliferous	25.0
14. Sandstone, lightgray, arkosic, coarse	50.0
13. Shales, gray; Sandstones, light yellow, alternation	70.0
12. Shale, black to dark greenish gray, poorly fossiliferous	6.0
11. Sandstone, light yellow, gray, fine	13.6
10. Shale, black, dark green, poorly fossiliferous	12.0
9. Sandstone, light yellow, dark gray, fine	4.0

8. Shale, black	8.0
7. Sandstone, gray, fine	3.0
6. Shale, black	5.0
5. Sandstone, light yellow, gray, medium	6.0
4. Shale, black	2.5
3. Sandstone, gray, pebbly in parts, coarse	3.0
2. Shale and sandy shale, black to dark gray, fossiliferous	12.0
1. Sandstone, dark, fine, fossiliferous	0.5

Microscopic observation of the gray sandstones of the formation shows that the rock consists of 30 percent quartz, 15 percent feldspar, 30 percent clay minerals, 20 percent rock fragments, five percent micas and others in average. According to the ratio of the components, the sandstones may be classified as graywacke.

Owing to the fault contact of the Myogog Formation at its base, the full thickness of the Myogog Formation is unable to be measured, but the measured thickness of the Formation is 150 meters.

Ullyeonsan Farmation

The Gyeongsang System is divided into two Series, viz. the Nagdong and the Silla in ascending order. All of the sequence younger than the Myogog Formation in this area belongs to the Gyeongsang System.

As is shown in Table 1, the Ullyeonsan Formation has been described as the lowermost unit of the Nagdong Series, even older than any lowermost part of the Nagdong Series known so far (Lee and Lee 1963).

The Ullyeonsan Formation covers both the Wonnam and the Myogog Formations unconformably, and changes gradually upward into the overlying Donghwachi Formation.

The formation is composed mainly of very coarse conglomerate, intercalating some light gray arkosic sandstones and red mudstones. In the conglomerate, cobbles and boulders are more abundant than pebbles. These gravels are composed of subrounded gneiss, granite, schist, quart-

zite, sandstone, limestone and shale. Matrix of the conglomerate is made up of poorly sorted arkosic sands which are, in turn, filled by finer grains such as muscovite, iron oxide and clay.

The intercalated light gray arkosic sandstones are commonly coarse to very coarse grained in texture and the sands are poorly sorted.

In general, the sandstones tend to increase upward, and red mudstones are more thinly interbedded.

No fossil has been found in the formation to date its age.

The maximum thickness of the Ullyeonsan Formation is estimated to be at 500 meters in Hasinchon district, though it thins out westward.

Donghwachi Formation

This formation also belongs to the Nagdong Series, and rests on the Ullyeonsan Formation conformably. The formation is subdivided into two members, based on the lithology. They are the Arkosic Sandstone Member and the Red Mudstone Member in ascending order. Average thickness of the formation is 600 meters.

Arkosic Sandstone Member

This member consists of arkosic sandstones, red mudstones and conglomerates. The lower part of the member is interbedded with thin black shales and coaly shales.

The arkosic sandstones are light gray to light greenish gray in colour, and coarse in texture. The main components of the sandstones are quartz and feldspar, and a small amount of muscovite, biotite and hornblende are found as minor components. These grains are angular to sub-angular and range from 0.5 to 1.0 millimeter in diameter. They are filled with sericite and clay minerals.

Conglomerates in the member are consisted of various gravels such as hornblende granite, gneiss,

limestone, quartzite and sandstone, ranging five to thirty centimeters in long diameter. They are rounded to well rounded.

The thickness of the member ranges from 200 meters to 350 meters.

Red Mudstone Member

This member overlies the Arkosic Sandstone Member conformably. Red mudstones are predominant in the member and exceed arkosic sandstone. Conglomerates, marls and tuffaceous sandstones are frequently associated with the member.

Main components of the red mudstone are mica and clay minerals. Fine acicular hematite needles are disseminated in the mudstone to colour the rock.

Conglomerates in the Red Mudstone Member are similar to those in the Arkosic Sandstone Member, except the smaller size of the pebbles, ranging three to five centimeters in long diameter, and roundness, which tend to be higher.

Two or three greenish gray marl beds are intercalated in the upper part of the member.

Sedimentary structure such as cross beddings, ripple marks and sun cracks are often observed in the sandstones.

In mudstones, irregularly shaped calcareous concretions, ranging two to ten centimeters in diameter are found.

Thickness of the Red Mudstone Member ranges from 100 to 450 meters.

Gasongdong Formation

The Gasongdong Formation is the uppermost part of the Nagdong Series in this area. The formation rests on the Donghwachi Formation conformably. The formation is composed chiefly of greenish gray marls and dark gray shales. Two or three beds of conglomerates are intercalated in the middle part of the formation and

one conglomerate bed of four to five meter thick lies in the base of the formation.

Any typical sedimentary structure, except the well-developed stratification in the formation, is not observed. A few fragments of silicified woods are found.

The estimated thickness of the Gasongdong Formation ranges from 350 to 450 meters.

Cheongyangsan Formation

The Cheongyangsan Formation is correlated to the lower part of the Silla Series of the Gyeongsang System. The formation is subdivided into two members, viz. the lower conglomeratic Cheongyangsan Member and the upper volcanic Osibbong Member.

Cheongyangsan Member

This member is underlain by the Gasongdong Formation disconformably. The formation is composed mainly of conglomerates, intercalating marls, sandstones, mudstones and limestones.

The thickness of the member shows a great irregularity, thinning out entirely in Myeongjang district, the southern part of the area. Its maximum thickness is estimated to be at 350 meters.

Osibbong Member

The Osibbong Member is the highest unit of the area. This is characterized by the alternation of volcanic andesite lavas and clastic sediments.

Thickness of the member is estimated to be at 120 meters or more.

GEOLOGIC STRUCTURE

Due to the severe metamorphism, the Wonnam Formation seems to display no strong evidence of folding.

The Myogog Formation, however, were subjected to an intense deformation in contrast with the Cretaceous Gyeongsang System. The dip and strike of the Myogog Formation are variable

through the area, but a fairly well defined anticlinal and synclinal structures, having a trend of north-northwest are found. Along the contacts between the Myogog and the Wonnam Formations, the former is more severely disturbed.

To the north, the Wonnam Formation thrusts up on the Myogog Formation with a low angle dipping 25-30 degrees toward northwest with a strike northeast. This is the Galsan Thrust.

To the east of the Myogog Formation is a vertical fault, the Taegog, striking north-northeast, which resulted in the west side, that is, the Myogog Formation down. The Taegog Fault cuts the Galsan Thrust.

There is no evidence to estimate the exact throw of the faults, though a minimum value for the Galsan Thrust is estimated to be at 210 meters, and for the Taegog Fault, 110 meters.

The Gyeongsang System, including the Ullyeonsan, Donghwachi, Gasongdong, and Cheongyangsan Formations, is rather simple in structure. The base of the Ullyeonsan Formation, overlies unconformably the Myogog and the Wonnam Formations. The system is also cut by the Taegog Fault, showing west side down. The system shows a steep dip along the faults, but it dips 20-30 degrees to south-west in the area far from the faults.

GEOLOGIC AGE OF THE MYOGOG FORMATION

Fossils in the Myogog Formation

The Myogog Formation contains fossil animals and plants, as shown on Table 3.

Table 3. Fossils from the Myogog Formation

A. Fossil Animals

Pelecypoda

Trigonioides sp.

Plicatounio sp.

Unio sp.

THE MYOGOG FORMATION AND ITS TECTONIC SIGNIFICANCE

Corbicula aff. tetoriensis Kobayashi and Suzuki

Corbicula sp.

Gastropoda

Viviparus sp.

B. Fossil Plants

Filicales

Cladophlebis denticulata (Brongn.)

Cladophlebis browniana (Dunker)

Cladophlebis geyleyriana (Nathorst)

Adiantites yuasaensis Yokoyama

Onychiopsis elongata (Geyley)

Onychiopsis mantelli (Brongn.)

Equisetales

Equisetites sp.

Ginkgoales

Ginkgodium gracile? Tateiwa

Nilssoniales

Nilssonia sp.

Incertae Sedis

Podozamites sp.

As compared with the Mesozoic fossils described from the Daedong and the Nagdong Series, fossils in the Myogog Formation are quite different from those in the two series.

Both the Daedong and the Gyeongsang Systems are composed of terrestrial sediments, and occurrence of fossil animals have not been frequent. In the Daedong System, a few fresh water mollusks, *Cyclotheroides coreanica*, *Euestheria Kawasaki* and *Cyrena sp.* have been reported, and such fauna does not retain any relation with the Myogog fauna. On the other hand, the Nagdong fauna, containing *Trigonioides kodairai* and *Plicatounio naktongensis*, described by Kobayashi and Suzuki (1936), Suzuki(1943) and Tateiwa(1929) is somewhat similar to the Myogog fauna, even if it does not coincide completely. Since the establishment of *Trigonioides kodairai* and *Plicatounio naktongensis* in 1936, these species have been used as index fossils of the Nagdong Series, and the Series has been correlated to the Wakino Series in Japan and to the Talatzü For-

mation in Manchuria by these species.

Trigonioides sp. and *Plicatounio sp.*, found in the Myogog Formation are clearly distinguished from two species in the Nagdong Series mentioned above. Furthermore, *Unio*, *Corbicula* and *Viviparus*, found in the Myogog Formation, is also distinguishable from those of the Nagdong Series in the other areas.

These facts seem to show that the Myogog Formation is unique in fossils. As for the fossil plants Table 4 is to be referred.

Table 4. Comparison of the Myogog flora to the Daedong and Nagdong floras.

Species	Daedong Flora	Myogog Flora	Nagdong Flora
<i>Cladophlebis denticulata</i>	×	×	×
<i>C. browniana</i>	—	×	×
<i>C. geyleyriana</i>	—	×	×
<i>Adiantites yuasaensis</i>	—	×	×
<i>Onychiopsis elongata</i>	—	×	×
<i>O. mantelli</i>	—	×	×
<i>Equisetites sp.</i>	×	×	×
<i>Ginkgoales gracile?</i>	—	×	×
<i>Nilssonia sp.</i>	×	×	×
<i>Podozamites sp.</i>	—	×	—

From the Table 4 it is clear that the Myogog flora differs entirely from the Daedong flora, except the three species, which persisted through Mesozoic. The Myogog flora, however, is quite similar to the Nagdong flora. The similarity of these two floras may be ascribed to the persistency of the floras from upper Jurassic to lower Cretaceous.

In biostratigraphic aspect, the Myogog is entirely distinguished from the Daedong and is also clearly separated from the Nagdong Series. The Myogog Formation is said to be the formation that has a unique character, occupying a position lying between the Daedong and the Nagdong Series.

Geologic Age

It is known that the Myogog Formation has a younger assemblage of fossils than that of the

Daedong Series, and it is inferred that the formation might have deposited after the destruction of the basins, in which the Daedong sediments were accumulated. And it is clear that the Myogog Formation underlies the Nagdong Series unconformably. But in order to determine the age of the Myogog Formation, it is indispensable to discuss the fossils in the formation and to date the base of the Nagdong Series.

Myogog Fauna and Flora

Genera *Plicatounio* and *Trigonioides* have been reported in the sequence ranging from upper Jurassic to upper Cretaceous in the eastern Asia, covering the wide area from the upper region of the Amur River of north Manchuria to the Mekong River of Indochina. *Unio*, *Corbicula* and *Viviparus* have also commonly been described from the same area.

However, the *Trigonioides* and *Plicatounio* in the Myogog Formation are found to be new species, which, probably, have not yet been described in eastern Asia. And the other three genera, except *Corbicula aff. tetoriensis*, are not in good shape to give the writers their specific names. Therefore, the age of the Myogog Formation is hardly clarified in range narrower than from upper Jurassic to upper Cretaceous.

As for the flora from the Myogog Formation, the genera indicates the age of the formation to be of from late Jurassic to early Cretaceous. *Onychiopsis elongata* is a typical index fossil, which was prosperous during late Jurassic to early Cretaceous in eastern Asia. It has been found in the contemporaneous sequence in various areas in Asia.

All the facts derived from the fossils seem to indicate the age of the Myogog Formation in the range from late Jurassic to early Cretaceous.

Age of Nagdong Series

In spite of many a discussion of the age of

the Nagdong Series, no agreement seems to have been reached yet. The general stratigraphic columnar section of Korea (Cheong 1959) indicates that the age ranges from upper Jurassic to lower Cretaceous. Yabe(1905) has reported that the formation ranges from middle to late Jurassic in age correlating the formation with the Tetori Group of south-western Japan by the fossil plants. Tatewiwa(1929) commented that it falls generally under upper Jurassic, and more closely related to lower Cretaceous rather than middle Jurassic. On the other hand, Kobayashi(1942), Kawasaki (1927), Matsumoto (1953), and Inoue (1907) insisted that it might be reasonable to place its age in early Cretaceous. Particularly, Kobayashi (1942) insisted that the lower limit of the Nagdong Series might be equivalent to Wealdean or much later than Wakino Series exposed in northern Kyushu in Japan, corresponding to the Yoshimo Formation, that is the upper part of the Toyonishi Group which belongs certainly to the lower Cretaceous. The writers are of the opinion that the age of the Nagdong Series is to be later than late Jurassic because the Myogog Formation, overlain by the Nagdong Series, contains late Jurassic to early Cretaceous fossils in it.

Age of the Myogog Formation

By the range indicated by the fossils in the Myogog Formation and by the age of the Nagdong Series, the age of the Myogog Formation may be determined to be of late Jurassic.

CORRELATION

In the vicinity of Sineuiju, North Pyeongan-do, north Korea, a small patch of Mesozoic sediments was reported. Kobayashi (1953) dated the age of the sediments to be of upper Jurassic on the ground of fossil mollusks and fishes found in it, and correlated the sediments with Jého Group.

THE MYOGOG FORMATION AND ITS TECTONIC SIGNIFICANCE

Although detailed stratigraphy and paleontology of the sediments have not been reported, at the present, the sediments may be the only one which can be correlated with the Myogog Formation in Korea.

In Manchuria, many formations and some parts of groups are ascribed to upper Jurassic and correlated with the Myogog Formation. They are the Fuhsin Coal Measures in the upper part of the Jêho Group, the Holung Coal Measures, the Misan and the Hokang Formations.

As in the case of the Myogog Formation, the Huhsin Coal Measures produce *Onychiopsis elongata* and overlain unconformably by the Sunchiawan Conglomerate, which is composed largely of cobbles and boulders, and known as lower Cretaceous in age. The conglomerate seems to have some resemblance to the Ullyeonsan Formation, which overlies the Myogog Formation unconformably.

The same relations are found in other areas, too. In the Lungching district in southeastern Manchuria, the *Onychiopsis elongata* bearing Holung Coal Measures are overlain unconformably

by the Lungching Series, which consisted of boulder conglomerate. The Misan and the Hokang Formations in eastern Manchuria also include *Onychiopsis elongata* and both are overlain by boulder conglomerates.

The upper Jurassic to lower Cretaceous sequences are found in the upper part of the Toyora Group, Toyonishi Group, Kanmon Group, etc. in southwestern Japan, and Tetori Group, Ryoseki Formation in Outer Zone in south western Japan. These strata contain *Onychiopsis elongata*, *Trigonioides* and *Plicatounio*. The Utano Formation, the upper part of the Toyora Group, contains *Onychiopsis elongata*, and is covered unconformably with the lower part of the Toyonishi Group, the Kinosue Formation, which is composed predominantly of conglomerate and arkose sandstones as in the case of the Ullyeonsan Formation.

These facts seem to indicate that the Myogog Formation may be correlated with the Utano Formation of upper Jurassic in age.

Table 5 shows a correlation of the upper Jurassic to lower Cretaceous sequences reported in eastern Asia.

Table 5. Correlation of upper Jurassic to lower Cretaceous sequences in eastern Asia.

Geologic time	Korea		Manchuria		Japan	
	Daegu-Woegwan Area (Tateiwa 1929)	Jaesan Area (The writers)	Jêho Area (Kobayashi, 1959)	Lungching Area (Kobayashi, 1959)	Yamaguchi-Ken (Matsumoto, 1953)	
Lower Cretaceous	Chilgog Formation		Sunchiawan Coarse Conglomerate	Talatzu Oil Shale	Yoshimo Formation	Wakino Subgroup
	Jinju Formation	Gasongdong Formation				
	Hasandong Formation	Donghwachi Formation				
	Nagdong Formation	Ullyeonsan Formation		Lungching Series	Kinosue Formation	
Upper Jurassic		Myogog Formation	Huhsin Coal Measures	Holung Coal Measures	Upper part of Utano Formation	

THE NAGDONG OROGENY

In Pyeongyang City in north Korea, the Yu-

gyeong Series of middle Jurassic occupies a small area. The Yugyeong Series is the upper part of the Daedong System, which is overlain

unconformably by the Daebo Series in the vicinity of the City. The Daebo Series is correlated to the Silla Series in south Korea. The Yugyeong Series has been subjected to a strong disturbance, but the Daebo Series has no tint of severe movement.

Noticing the fact, Konno (1928) proposed the Daebo movement, which took place after deposition of the Yugyeong Series, viz. the upper Daedong System, and before deposition of Daebo Series viz. the Silla Series.

Konno himself had dated the time of the movement to be of late Jurassic. But Kobayashi (1950) pointed out that the movement does not embrace only one movement but two different movements of two different ages, namely, the one in middle Jurassic and the other in late Jurassic. One of the writers (Cheong, 1959) used a collective name, the Post-Daedong orogeny, for the movement.

The great hiatus encompassing upper Jurassic to lower Cretaceous seemed to give no basis for the debates in determining the age of the Daebo movement, though their guesses are accepted as reasonable.

The Myogog Formation, however, casts a light for the problem on the Post-Daedong orogeny.

Myogog Disturbance

Since the Myogog Formation, exposed in the area studied, is not in direct contact with the Daedong System, the relation between the two strata is not able to clarify. However, the upper Jurassic sediments in the vicinity of Sineui-ju seem to have deposited in the basin independent of the Daedong basins.

The fact that no upper Jurassic sequence has been known on the top of the Daedong System in Korea may give a passive support to the different basin theory.

For the first possible movement, which con-

tributed to the destruction of the Daedong basins, the name Myogog disturbance is proposed here.

Nagdong Orogeny

After the deposition of the Myogog Formation in the independent basin from the Daedong basins, a strong orogeny took place to squeeze and thrust the Myogog Formation and all the rest of the eastern Asia. Though the Songrim disturbance destroyed the basins in which the thick sequences of the Paleozoic to lower Mesozoic strata were deposited, it was an embryonic one. Most of the Paleozoic to the middle Jurassic sequences were severely distorted by the second movement which took place after deposition of the Myogog Formation. The name Nagdong orogeny is proposed here for the second movement.

Judging from the ages of the Myogog Formation and the overlying Ullyeonsan Formation, the Nagdong orogeny may be dated as to the end of Jurassic. The Yenshan movement in China, Oga disturbance in Japan and the Nevadian disturbance in western part of the United States may correspond to the Nagdong orogeny in age. The Daebo movement by Konno (1928) may encompass two movements, or may leave some other meanings.

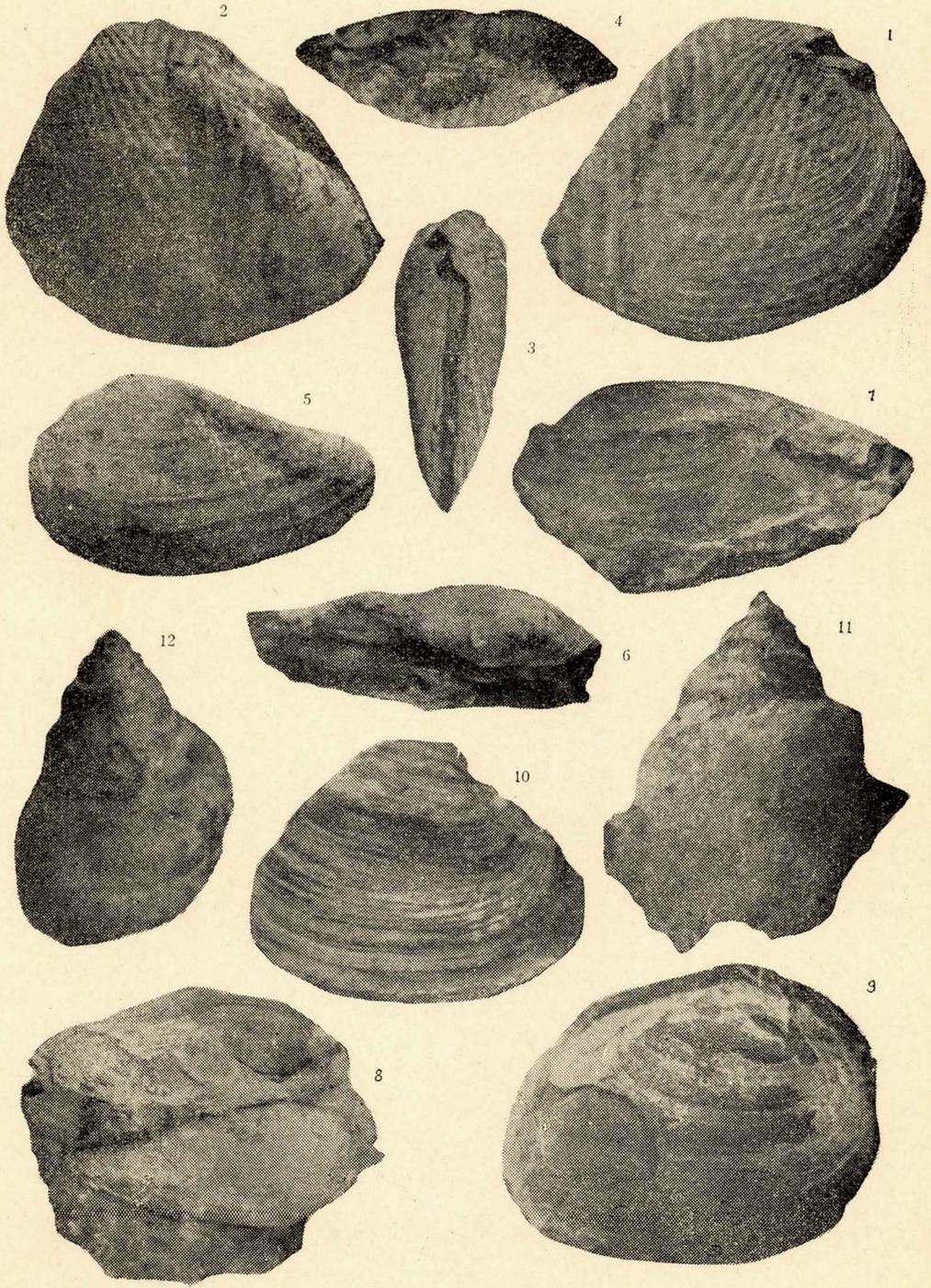
CONCLUSION

1. The Myogog Formation, composed chiefly of dark gray and dark green shales and arkosic sandstones, was formed in a terrestrial basin during late Jurassic.
2. The Myogog Formation seems to have been deposited in the separate basin after destruction of the Daedong Basins. For this movement, the Myogog movement is proposed.
3. The Myogog Formation was disturbed and thrust at the end of Jurassic. This movement has widely been recognized in Korea, and, especially, well represented by the Paleozoic to Jurassic sediments. For this movement, the

EXPLANATION OF PLATE I

Fossil Mollusks from the Myogog Formation

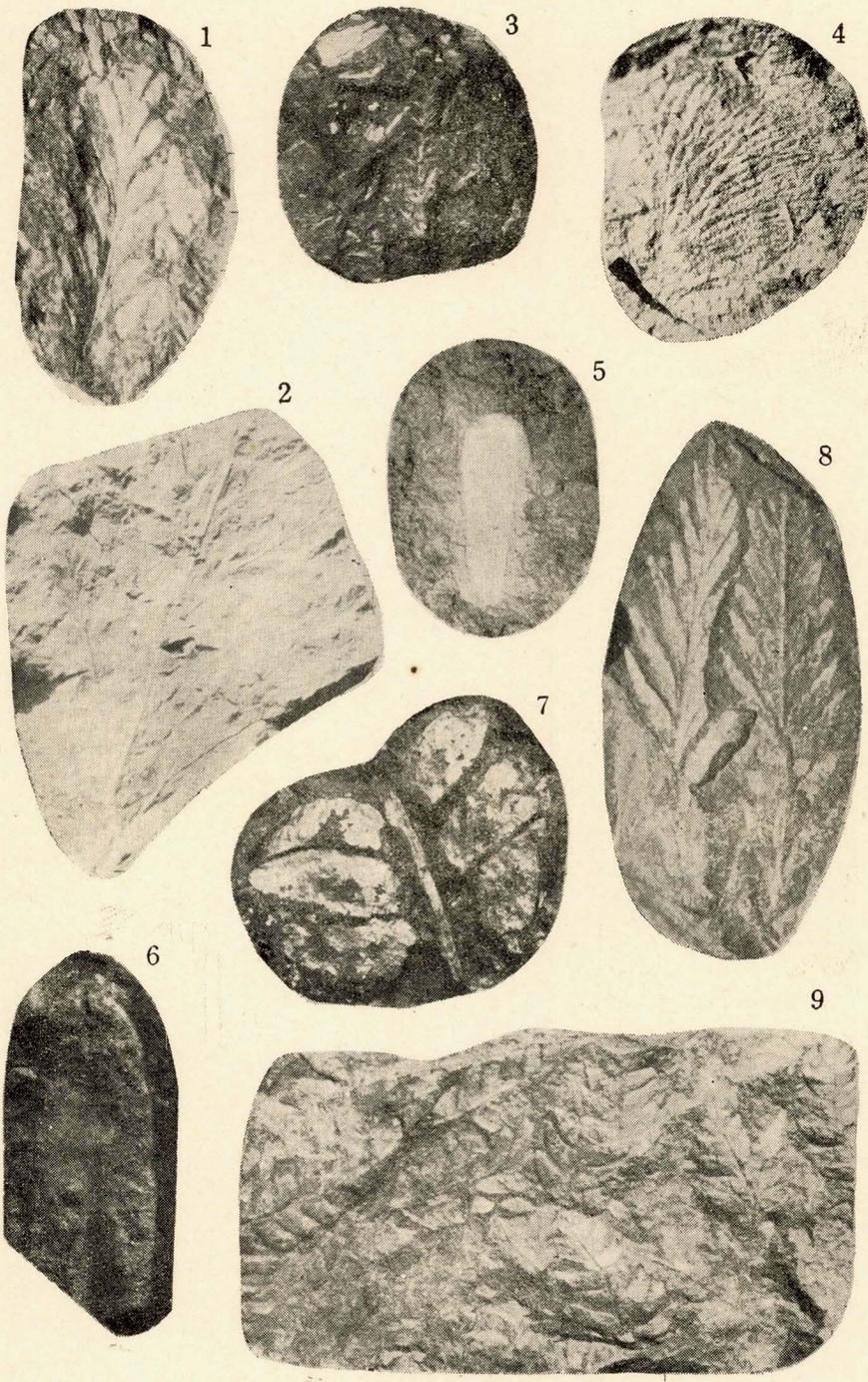
- Fig. 1-4**—*Trigonioides sp.* ×1.3. 1—Lateral view of right valve.
2—Lateral view of left valve. 3—Anterior view. 4—Dorsal view
- Fig. 5-7**—*Plicatounio sp.* ×1. 5 & 7 Lateral view 6—Dorsal view.
- Fig. 8**—*Unio sp.* ×1.
- Fig. 9**—*Corbicula sp.* ×2. Lateral view.
- Fig. 10**—*Corbicula aff. tetoriensis.* Kobayashi and Suzuki ×2. Lateral view.
- Fig. 11-12**—*Viviparus sp.* ×3.2.



EXPLANATION OF PLATE II

Fossil Plants from the Myogog Formation

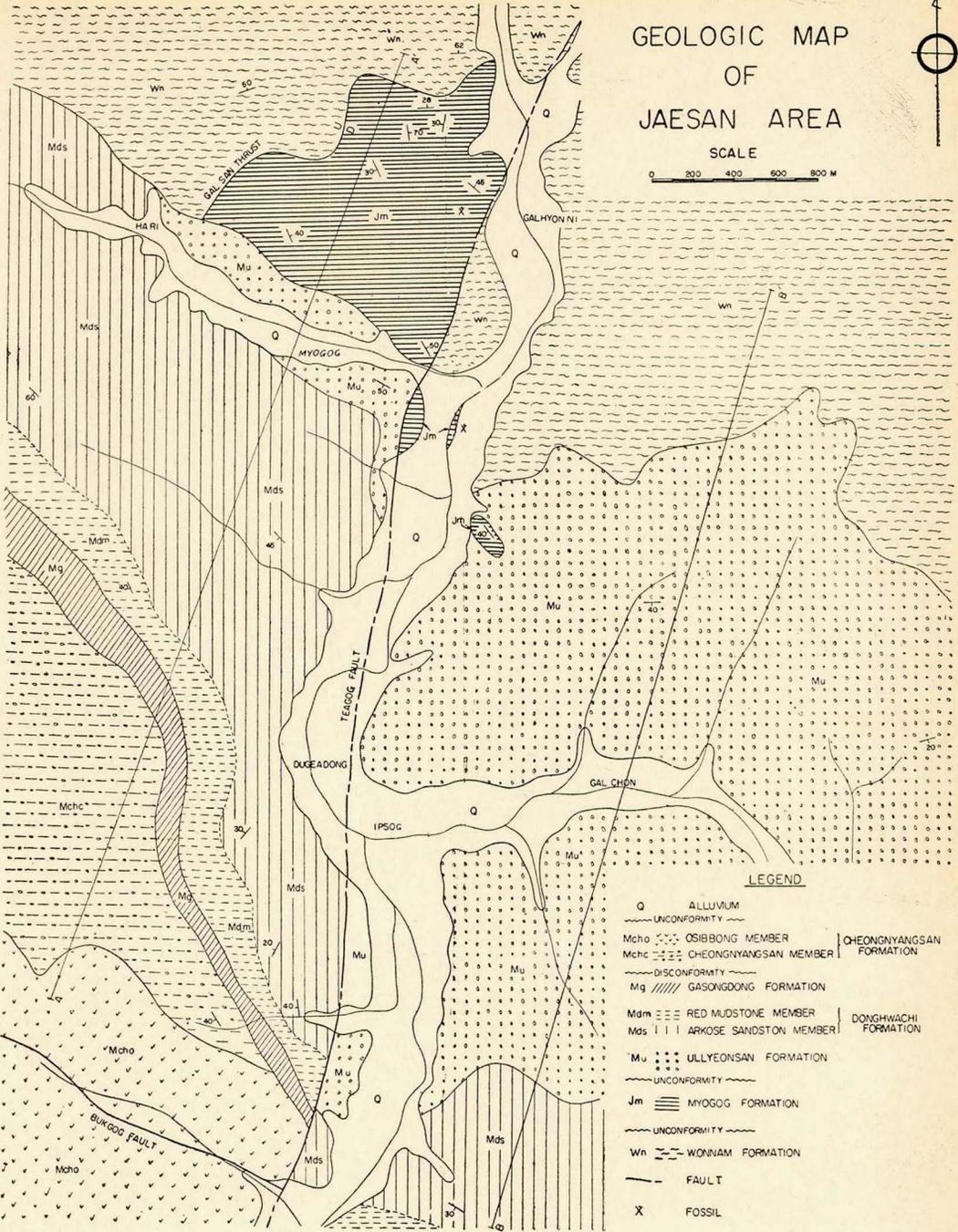
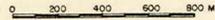
- Fig. 1 & 3**—*Onychiopsis elongata* (Geyler) 1—Sterile leaf. 3—Fertile leaf $\times 0.6$.
Fig. 2 & 8—*Onychiopsis mantelli* (Brongn.) Sterile leaf. 2— $\times 3$ 8— $\times 2$
Fig. 4—*Adiantites yuasansis* Yokoyama $\times 1.7$
Fig. 5—*Ginkgoales gracile?* Tateiwa \times
Fig. 6—*Nilssonia* sp. $\times 0.7$
Fig. 7—*Podozamites* sp. \times
Fig. 9—*Cladophlebis browniana* (Brongn.) $\times 2$



GEOLOGIC MAP
OF
JAESAN AREA



SCALE



LEGEND

- Q ALLUVIUM
- UNCONFORMITY
- Mcho OSIBBONG MEMBER
- Mchc CHEONGYANGSAN MEMBER
- DISCONFORMITY
- Mg GASONGDONG FORMATION
- Mdm RED MUDSTONE MEMBER
- Mds ARKOSE SANDSTON MEMBER
- Mu ULLYEONSAN FORMATION
- UNCONFORMITY
- Jm MYOGOG FORMATION
- UNCONFORMITY
- Wn WONNAM FORMATION
- FAULT
- X FOSSIL

CHEONGYANGSAN FORMATION

DONGHACHI FORMATION

