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广东南雄、始兴，江西贛州的蛋化石*

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古脊椎动物与古人类研究所在 1962—1963 和 1963—1964 两个季度在广东南雄、始兴一带工作时，除发現大批的新生代初期化石外，还在南雄层中发現了一些恐龙化石和龟化石等。但最多的发現还是蛋化石。关于这一地区的这些化石采集和分布情况，已有初步报导（张玉萍、童永生 1963）。第二季度的工作对前一季度作了一些补充，就蛋化石的分布与保存情况看，增加不多。但是两个季度的工作，可以使我們对于这一地区的蛋化石有了基本的了解，代表着迄今为止所知道的关于蛋化石最丰富的地区。

最近在中南区工作的人員，在这一地区也找到了一些蛋化石，說明这一类化石的确是十分丰富的。

此外北京自然博物館也于 1964 年春，在江西贛州发現了可以和南雄的蛋化石相比的蛋化石。这就大大地把我們对于南方紅层的了解提高了一步。

本文只着重就在南雄地区和江西贛州的蛋化石加以一般的研究。显微鏡的观察不包括在內，以后再为补充。中南区工作的人員在南雄所采的化石估計当然不出于以下所描述的种类之外。

两季度在广东南雄、始兴所采的蛋化石，列如表 1。

以表 1 的不完全統計，一共有碎蛋片 2916 片，完整或比較完整的蛋 78 枚包括有九个近于完整或部分整窩蛋，应当說是一个丰富的采集。該表已把在野外的相重复或相接近的地点加以归并，但仍然相当之多。但由該表很清楚可以看出，实际上除了始兴县馬市以外南雄产蛋化石地点可分为三大区，即南雄城及其附近，湖口附近和烏径区。每一大区，又可分为一些小区如南雄可分南雄城一带，瑤屯、修仁等。湖口范围比較小，烏径也是如此。

由于几乎所有的碎片都是在沿山坡的地面上检拾的，它們彼此連系的情况不清楚。絕大多数蛋或多或少受了风化磨蝕。因之本文的研究着重根据成窩或部分成窩而較完整的蛋和其所附碎片。其他碎片只能帮助說明蛋化石分布的丰富，在分类的意义上并不很大。自然，根据表面和显微鏡結构，也可以大体分出种类。

江西所发現的蛋化石的最佳者为在贛州所发現一窩蛋，共有 24 枚左右。此外在同一地区和以北的泰和也找到一些蛋的碎片。其全部材料列如表 2。

如表 2 所指出，江西的蛋和广东蛋的絕大数蛋为同一种，这具有很重要的意义，說明虽然盆地不同，隔着南岭，而同年代的地层是存在的。

到目前为止，广东和江西两地区的蛋，是我們所知道的最丰富的蛋化石产区。

* 1965 年 2 月 16 日收到。

表1. 广东南雄、始兴蛋化石地点表

(Table 1. Localities of fossil eggs from Nanhsiung and Szesheng)

室内号码 Cat. No.	野外号码 Field No.	地点 Localities	保存情况及多少 Occurrence			附记 Remarks
			碎蛋皮 fragments of shell	整蛋 complete eggs	碎骨等 other remains	
V.2781	6215a–63090	南雄城南 1.5 km	39			
V.2781a	6215	南雄城南 2.5 km	564	2 枚	15	
	6216	南雄城南西塘木西村 1—2 km	558			
V.2782		南雄城南约 2 km	71	4 枚	4(蛋印模)	(地质所李存桢采)
	63098	南雄城南西约 8.5 km	34			(路线调查拾的)
V.2783	63089	南雄主田北 1 km	97	4 枚	1 牙	
V.2784	6220	南雄瑶屯北西 2 km	603	20枚		(一整窝蛋)
V.2785	63093	南雄瑶屯正北 1 km	124	10枚	碎骨	
	6219	南雄修仁	110			
	6230	南雄湖口东 3 公里	92			
	63094	南雄湖口长市青山北约 1 km	25		2 牙、龟骨	
V.2786	63092	南雄水口当面岭		11枚		(一窝蛋)
	63097	南雄黄坑	81		3	
	6221	南雄乌径公社高山坑	31		若干	
V.2787	6222	南雄乌径禾倘坑	201	7 枚		(圆蛋)
	6223	南雄乌径珠璜塘西南	293			
V.2788	6224	南雄乌径南 4 km 腊树园东口		18枚		(一整窝蛋)
V.2789	6225	南雄乌径腊树园	41	2 枚		(小蛋)
	6226	南雄乌径新田圩西北小山	18		碎骨	
	6235	始兴县马市东南	137			(包括 16 薄片)

表2. 江西所采蛋化石

(Table 2. Localities of fossil eggs from Kiangsi)

北京，自然博物馆编号 Cat. No. of PMNH	野外号 Field No.	地点 Localities	保存情况 Preservation	附记 Remarks
PMRE 147	ks1	江西泰和三都圩公社荀师岭	蛋片 130，产于砖红色砂质泥岩中	在附近约三公里内均有碎片
PMRE 148	ks2	江西泰和三都圩公社锣岭村公路的东西两侧	蛋碎片 82 片，另有不能鉴定的爬行类骨骼(?肋骨) 8 块	
PMRE 149	ks3	江西赣州西南蟠龙镇北 2.5 公里的黄坑	蛋片 28，碎骨一块 (在灰绿色砂岩中)	
PMRE 150	ks4	同上，蟠龙镇北下区乌潭村后岗山上	蛋片 11，在灰绿色砂岩中	
PMRE 151	ks5	江西赣州城南五里亭南 1.5 公里山上	一窝完整的蛋，共 24 个附近另有碎骨若干和许多成堆的蛋碎片	
PMRE 152	ks6	同上	三碎蛋片	可能归圆形蛋
PMRE 153	ks7	同上	一破了的蛋的切面呈椭圆形，甚小	

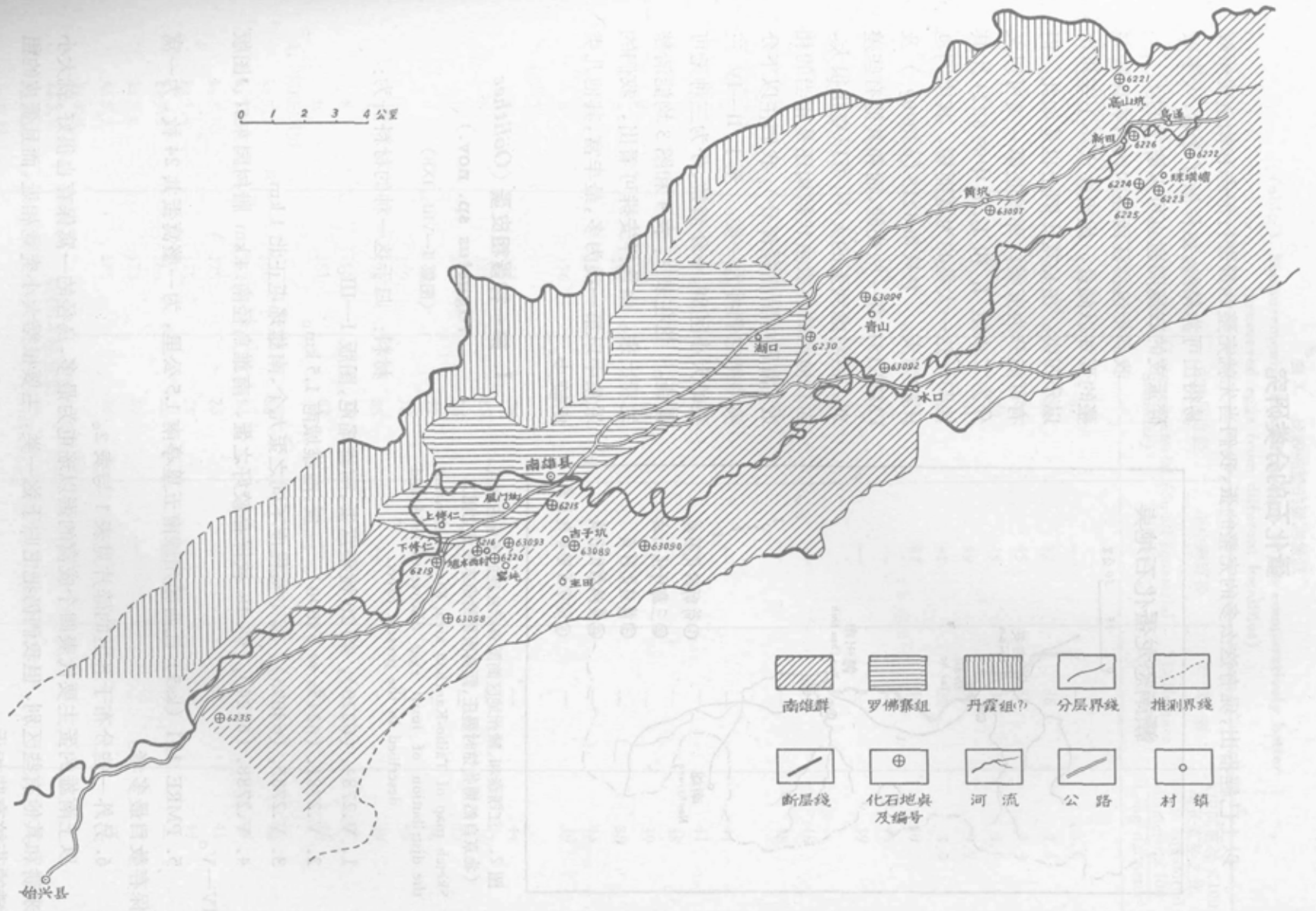

图 1.　广东南雄、始兴地区蛋化石地点分布图(由张玉萍等(1963)附图修订)。

Sketch map of the Nanhsiung area showing the distribution of the fossil eggs described in the present paper. Modified from Chang and Others 1963.

蛋化石的分类研究

以上已經指出，現有这么多的完整的蛋，我們当先就完整的蛋进行形态和构造观察較易得出可靠結論，这样做了之后，大多数碎蛋皮的归属問題也可以解决的。

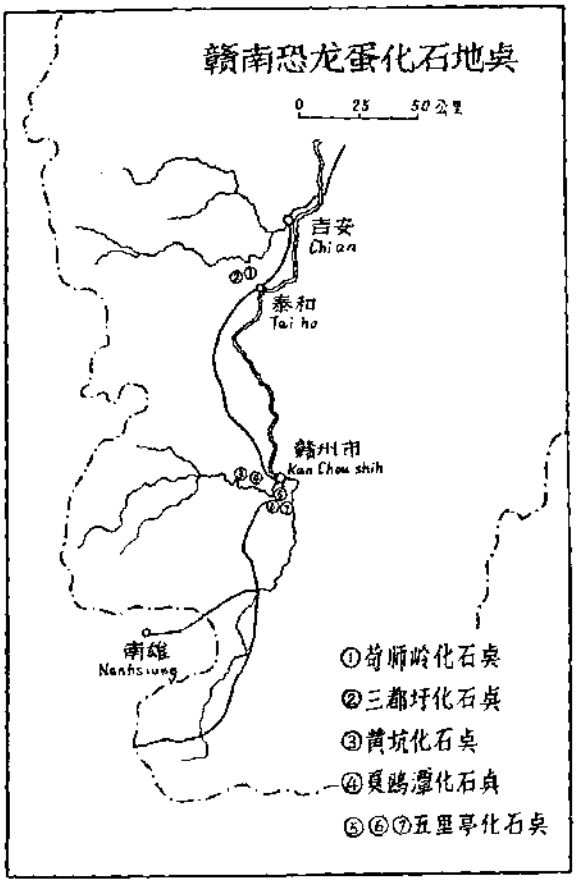

图 2. 江西泰和、贛州地区簡图表示发現的蛋化石地点（北京自然博物馆时墨庄、甄朝南供給尚未发表之图）。

Sketch map of Taiho-Kanchou area, Kiangsi showing the distribution of fossil eggs discovered 1964 and described in the present paper.

我們把包括江西在內的所有比較完整的蛋加以測量，发現在大小上至少可以分四类。在长寬比例上也是如此。但有可能分为五类，那就是第一类可以又分为二小組 I_1 和 I_2，I 中的 6224 比其他归于这一大类的为寬而短，其比例也比較为大。它只和 6215（63090？）及 PMRE151 有一些交錯，而和其他有些差别。但考虑到蛋的大小，可以变化很大，而且他們的外表虫状結构还是相当的相近（靠近中間直径部分），我們在以下分类中把它們并为一类。至于 II—IV 三类的大小区别，十分清楚，分为三种无可置疑。这在表 3、表 4 和图 3 均能清楚的看出来。由这样安排可看出，我們的采集中以第一类为多，最丰富，其他几类比較少。

I. 第一种蛋粗皮蛋（*Oölithes rugustus* sp. nov.）

（图版 I—VIII，IXB）

材料：归于这一种的材料計为：

1. V.2784.（6220），約 20 枚整窝蛋，南雄瑤屯，图版 I—III。

2. V.2781.（6215a = 63090），三蛋，南雄城南 1.5 km。

3. V.2785.（63093），其完整程度不同之蛋九个，南雄瑤屯正北 1 km。

4. V.2788.（6224），約 18 枚保存較好之蛋，南雄烏径南 4 km 腊树园东山、图版 IV—V。

5. PMRE 151（ks5）江西贛州城南五里亭南 1.5 公里，为一整窝蛋共 24 枚，为一窝保存数目最多者。

6. 另外一些分布于各区的碎片見表 1 与表 2。

以上南雄的蛋主要代表四个成窝的蛋以瑤屯为最多，烏径的一窝保存也很好，就大小来講和其他有些区别，但我們仍把它归于这一类，主要根据大小究竟相近，而且蛋皮的粗糙的花紋有些相近。

表 3. 比较完整的蛋测量表

(Table 3. Measurements (in millimetres) of the comparatively better preserved eggs from different localities)

地点 Localities of field number	长直径 (Long diameter)	大中间直径 (Large equatorial diameter)	小中间直径 (Small equatorial diameter)	二者差 (Difference of the two)	大中间直径×100 / 长直径 (Large equatorial diameter×100 / Long diameter)
I_1, V.2784(6220)					
a	191	67	—	—	3.5
b	201	88	52	36	4.4
c	191	84	45	39	4.4
d	205	79	45	34	3.9
e	208	81	49	32	3.9
f	200	79	51	28	3.9
g	194	78	62	?16	40
h	189	86	—	—	45
i	200	78	—	—	39
I_1, V.2781(6215)					
a	178	85	—	—	48
b	?195	94	—	—	48
I_1, V .2785(63093)					
a	190	77	—	—	41
b	186	76	—	—	41
c	198	76	—	—	38
d	208	81	—	—	39
e	198	76	—	—	38
f	182	78	—	—	43
g	176	69	—	—	39
I_2, (6224)					
a	171	76	—	—	44
b	181	85	—	—	47
c	169	76	—	—	45
d	172	77	—	—	46
e	169	76	—	—	45
f	173	85	—	—	49
g	165	75	—	—	45
h	181	83	—	—	46
I, PMRE[D]151					
ks 5.1	180	88	—		48
ks 5.2	172	84	—		48
ks 5.53	175	73	55	18	41
ks 5.4	175	79	—		44
ks 5.5	180	—	—		—
ks 5.6	175	62	—		35
ks 5.7	185	76	—		35
ks 5.8	破损，不能测量				
ks 5.9					
ks 5.10					
ks 5.11					

（續表3）

地点 Localities of field number	长直径 (Long diameter)	大中间直径 (Large equatorial diameter)	小中间直径 (Small equatorial diameter)	二者差 (Difference of the two)	大中间直径×100 / 长直径 Large equatorial diameter×100 / Long diameter
ks 5.12	180	83	54	29	46
ks 5.13	180	72	—		40
ks 5.14	180	75	—		41
ks 5.15	185	—	—		—
ks 5.16	180	76	55	21	42
ks 5.17	165	—	—		—
ks 5.18	165	85	—		51
ks 5.19	160	—	—		—
ks 5.20					
ks 5.21	残破，未测量				
ks 5.22					
ks 5.23					
ks 5.24					
II,V.2781(6215)					
a	144	67	—	—	47
b	149	61	—	—	41
II,V.2783(63089)					
a	143	70	37	—	49
b	?134	63	42	—	47
c	?145	55	—	—	38
II,V.2786(63092)					
a	151	63	—	—	42
b	137	63	—	—	46
c	133	65	—	—	49
d	138	77	—	—	55
II,V.2782	145	76	44	—	52
	131	72	—	—	55
III,6222	84	55	—	—	65
	93	66	51	—	60
	75	60	49	—	80
III, PMRE 11. 山东莱阳金刚口夏家营 (Machiayin, Chingkankou, Laiyang, Shantung)					
PMRE11.1	84	70	47	23	83
PMRE11.2	95	66	49	17	69
PMRE11.3	97	70	—	—	72
PMRE11.4	100	67	49	18	67
PMRE11.5	80	66	51	15	82
PMRE11.6	91	58	45	13	63
PMRE11.7	残破，未测量				
PMRE11.8	78	68	55	13	87
PMRE11.9	80	70	—	—	87
PMRE11.10	残破，未测量				
III, PMRE126. 山东莱阳红土崖 (Hungtuyeh, Laiyang, Shantung)					
PMRE126.1	103	76	—	—	64

（續表 3）

地　点 Localities of field number	长直径 (Long diameter)	大中间直径 (Large equatorial diameter)	小中间直径 (Small equatorial diameter)	二者差 (Difference of the two)	大中间直径×100 与长直径之比 Large equatorial diameter×100 / Long diameter
PMRE126.2	91	88	40	48	96
PMRE126.3	105	87	—	—	82
PMRE126.4	93	78	45	33	83
PMRE126.5	83	77	—	—	92
PMRE126.6	90	72	40	32	80
PMRE126.7	88	79	45	34	89
PMRE126.8	95	79	—	—	82
PMRE126.9	96	76	—	—	79
PMRE126.10	99	80	—	—	88
PMRE126.11	88	76	—	—	86
PMRE126.12	残破，未测量				
IV,2789(6225)	44	36	30	—	82
IV,PMRE153.	39	31	—	—	70

1）登记号前有 PMRE 字样的为北京自然博物馆的标本。（Those with PMRE are specimens of the Peking Natural History Museum.）

表 4. 照大小分类簡表

(Table 4. Eggs classified according to measurements)

Type of eggs	Length	Breath	Small diameter	Ratio
I_1	171—208	67—94	45—52	35—48
I_2	168—181	76—85	—	44—49
II	133—151		—	38—55
III	75—93	55—66	49—51	63—96
IV	44	36	30	82

V.2784 为我們所采集的最好的标本，共計約有 20 个蛋。图版 I 表示未修理前露出之情况，共有13个蛋露出，其中 8 个較完整，另 5 个（靠左边）已受风化很利害只有切面可辨認，图版II表示修理后全部露出的情况，除了以上 13 个蛋外还在下层有 7 个蛋全部或局部露出，所以一共有 20 个蛋。这些蛋很有規律的排成圓形，看来至少有二层，卽上面的 13 个为一层，底下的 7 个为一层、但上边 13 个不完全在一平面上，还可能代表的不是一层而为二层、那末就共有三层。这样看起来全窝蛋的数目恐怕在 40 以上。至少就最下一层和以上的蛋介以 10 毫米左右的紅土，这些紅土当然已变硬成为岩石，很可能說当产蛋时由生蛋动物埋藏的。傾角約为 40°。

所有这些蛋都是較齐的一头向內而多少具有尖的一头向外，也就是內大外小。蛋中部相当一大部分是两边大体平行的。其寬窄大小已見表 3。其长度介于 191至208 毫米，寬介 67—86 毫米，而长寬比例为 3.5 到 4.5 之間。就近赤道部分的直径差别看，蛋是相当扁的。

蛋皮外表（图版 III）十分粗糙具体紋飾各部不相同，大体說来以点为主，只有中部有相連的虫状紋飾。蛋皮一般的比較厚，約二毫米左右。

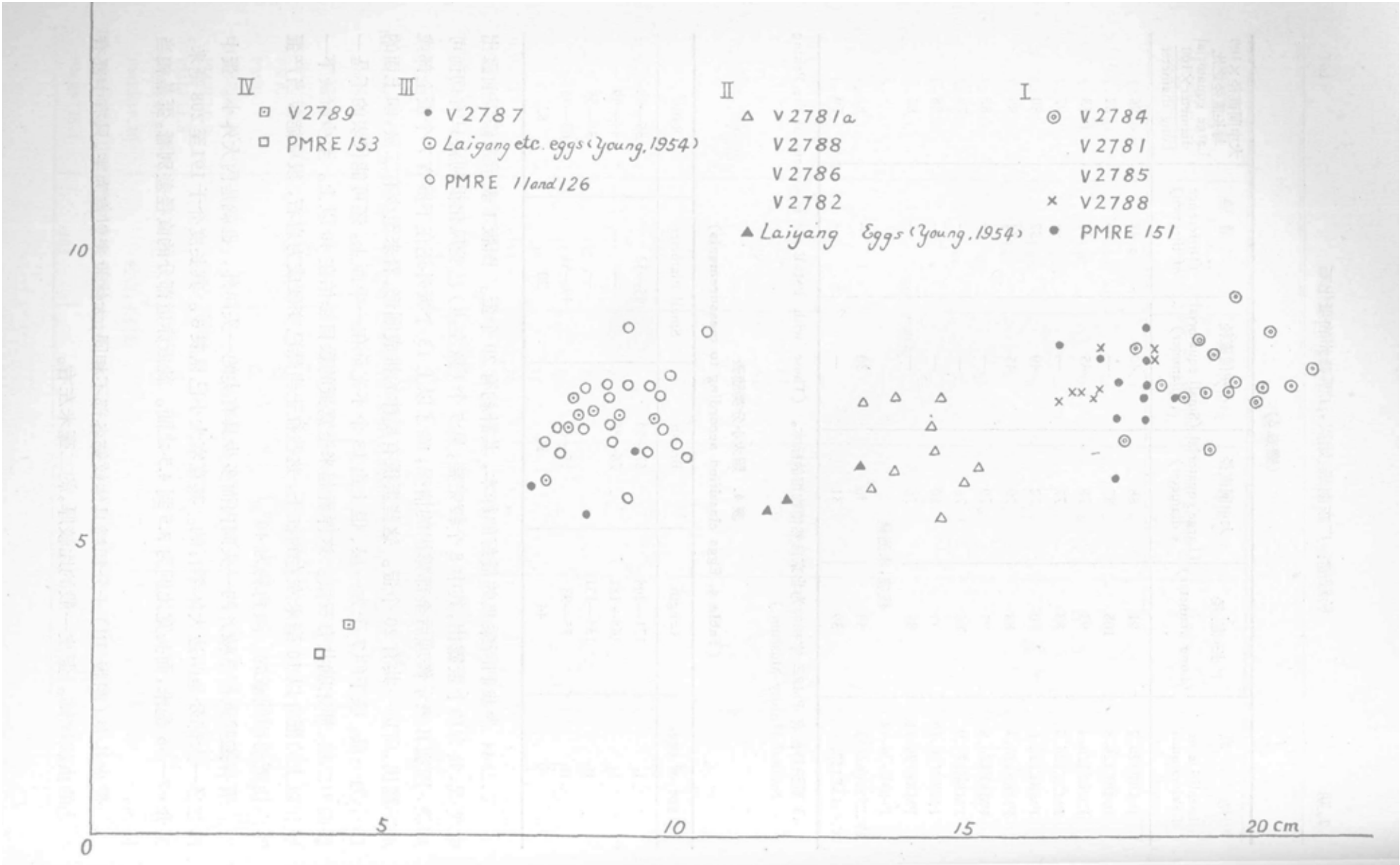

图 3. 南雄、赣州、莱阳等地蛋化石的长与最大直径比较图。长，横座标；宽，纵座标。以毫米计，详看正文。

A diagram showing the comparative length (horizontal) and breadth (vertical) in millimetres of various eggs (marked at the upper part of the figure). For details see text.

V.2781(6215a = 63090)为一不完全的蛋窝，只有三个蛋，其中最大的一个内端缺失。另一个較短，代表下边一层。这两个保存較好的蛋，很接近或相当于前一窝蛋的大小。外表紋飾也相同，所以我訊为归于这种是无何疑問的。

V. 2785(63093) 这是第二季度所采的最好的一窝蛋，看起来頂部露出在下而下部在上，一共有 10 个蛋和三个沒有壳的蛋印痕。就其排列情况看，其上已活动者为一层，当代表下层，而其余較固定的蛋似代表两层，故共有三层。这一窝蛋虽也作放射状排列，但作椭圓形，且有几个蛋看来已有些凌乱。此外則与其他归于这一种之蛋无疑，蛋的大小和紋飾以及厚薄都与 V.2784 相同。

V.2788(6224) 为另一窝保存好的蛋(图版 IV—VI)这一窝蛋在未修前共暴露出 8 个完整的和两个蛋的內端。修理后一共为 18 枚，但其他也只是局部露出，一共作三层排列，但若当中的一个算作一层，因此可能为四层(因 6220 当中缺一蛋，故也可能为四层)。所以总的說来，都不能看作一完全的整窝蛋。一完全的整窝蛋估計在 40 以上。 V.2788 各层間所夾的土比 6220 还要厚一些。

6224 的保存比 6220 要好一些，大多数完全的蛋壳未破，所以接近完整。如上所述，这一窝蛋除了在大小上比其他归于这一种的蛋較小外，其他性质非常接近。在大小上(图 3)，在可測量的几个蛋中，只有两个和其他交叉。一般的是短一些。但另外一方面，蛋仍是較齐的一端为內，較尖的一端为外，蛋壳外部的紋飾，特別是中部具拉长条紋的情况十分相似。因此我們訊为应当列入这一种之內。

PMRE151(ks5) 为在江西赣州发現的一整窝化石(图版 VII—VIII) 赣州这一窝蛋保存很完整，除了三个蛋經风化破碎外，其他均很完整，清楚地分作三层，排列的方式和以上其他南雄的蛋完全一样。在大小上接近于 6224 而和其他稍有差别，但总的說来是归于这一种的。蛋皮的結构也和其他一样。和这一窝蛋同一地区也有一些蛋的碎片，大多属于这一种有些甚至代表破坏了的一窝蛋。可以訊为赣州的蛋化石和南雄是一样丰富的。同这些蛋在一起还有一些骨骼，可惜不能作詳細的鑒定。

II. 第二种蛋（cf. *Oölithes elongatus* Young）

(图版 IX—XIII A)

材料：归于这一种蛋的材料計为：

1. V.2783(63089) 南雄主田北約一公里为一窝的一部分共七蛋。

2. V.2786(63092) 南雄水口北当面岭共 11 蛋为部分一窝。

3. V.2782 (地質所采，无号)南雄城南約 2km 三比較完整蛋，三印模，作放射状。

4. V.2781a(6215) 南雄城南約 2.5km 一对較完整之蛋。

5. 此外尚有各地点一些零碎蛋片可归于此一种。

以上各蛋大部分集中于南雄城南一带。与上种共生，但在烏径西部未見到。所有这些蛋均代表一窝的部分，但均不完整。它們的大小很相近(見表 3 和图 3) 所以列入此一种。

V. 2783(63089)，是一个受了变动的一窝蛋。也找不出清楚的放射状情况，只有三个蛋勉強可測量出大小。另有两个部分蛋和两个蛋的部分印模共七个。

V. 2786(63092)，保存較好，共有 11 蛋，至少有两层，上层有 8 个，几全部露出，其他

三个位于中心，局部露出。这一窝蛋只有四个可以测量(見表3)其他均过于破碎。

V.2782 也是部分一窝蛋只有三个較完整(一个断裂，两个长短可靠)，另有三个蛋的印模，合起作放射状。这几个蛋看来原为一整窝，所保存部分，显然只代表一窝蛋的最底层的下围(图版 XII, XIIIA)。

V.2781a(6215)，只有一对蛋(图版 XI)，也当然是一窝蛋的一部分。

以上这些蛋除 V.2783 較凌乱外，V.2781 較少外，其他的放射状排列是很清楚的，应当訊为和前一种一样同具有放射状性质。但在大小上比上一种小的多，其中只有一个蛋，长到151毫米，比上一种最短的还短17毫米。在直径寬度上和可以得到的比例也有很大的差别，可以肯定应当另作一种。至于蛋壳表面紋飾，比前一种較細一些，壳皮也薄一些(一般在2毫米以下)，也符合当作另一种的結論。那就是肯定不归于上一种，而应当作为是另外一种蛋。至于蛋的排列也是大头向内尖端向外，二者相同。

这一种蛋在一般形状和大小上和山东萊阳的长形蛋有类似之处，不过在大小上山东的蛋更小一些(图3, II)，其交叉情况不如以上6220和6224之近，所以也有可能不是一种。在目前我們暫且当作可和萊阳比，归于一种 (cf. *Oölithes elongatus*)。

III. 第三种蛋圓形蛋 *Oölithes spheroides* Young

(图版 XIIIB—XVIA)

材料：1. V.2787(6222)或多或少受压的几个蛋，一印模，一些碎片。南雄烏径禾尙坑。

2. PMRE 152(ks6) 的三碎片可能归此种。

3. 北京自然博物館从山东萊阳所采的两窝蛋 (PMRE 11，山东萊阳金刚口夏家营和PMRE126，山东萊阳紅土崖)亦可归此种。

这一种蛋只見于这一地点，在南雄其他地方未发現可归于这一种的整蛋。但在各地的碎片中，也有可能归于此一种的蛋片，經初步检查，可能性不很大。

上述的三蛋已不在一起只图版 XV 所示一完整的蛋和其他两蛋的一部分(一显示內面、一显示外面)。其他四蛋和所附的蛋碎片对于这三蛋的位置，已无法辨訊，但归于同一窝当无何疑問。在排列上也未发現任何規則。一如以前在山东萊阳发現的圓形蛋。即就是那些保存較好的蛋其表面也多破裂为碎片，可以想象是受过一定挤压的。不过对于測量大小方面影响不大，这一种至少可測量的几个見表3，其特点是比前两种看来特别短，寬在长的一半以上(比例60—80)，碎片观察到的厚度一般較厚，在2—2.5毫米左右。

此外北京自然博物館1964年在江西贛州五里亭距 ks5 整窝蛋不远，发現有三个碎蛋片，都比較厚(約3毫米)。此厚度比起一般的这一种来，稍厚一些，但比山东萊阳赵曉的厚皮蛋(楊 1959)厚 5—7mm，还是較薄，所以不可能为厚皮蛋，而很可能归于这一种。

在研究广东和江西的蛋化石过程中，有机会把北京自然博物館在山东萊阳所发現的两窝蛋加以观察，一窝产自萊阳金刚口夏家营(PMRE11)一共有十个蛋，一窝采自萊阳紅土崖 (PMRE126) 一共有十二个蛋均排列无一定規律，足証明这圓形蛋的生蛋方式是不規則的。两窝蛋中夏家营者只有八个可以測量，紅土崖者有十一个可以測量，均見图3。由这十九个蛋的大小可以看出，虽然在长度和直径方面，比已发表的材料大一些，但交叉的还是不少，所以肯定为一种。至于在南雄烏径禾尙坑的可測量的三蛋，虽然比較小一些

(又短又窄)但依然清楚地归于同一羣。山东的两窝蛋的表面构造也和以前所发見的圓形蛋完全一样。

由以上所述我們可以得出結論，就是山东的圓形蛋比我們以前所知的既多分布也广。据了解除了北京自然博物館所收藏的外，北京地質博物館、天津自然博物館等都收藏有山东萊阳的蛋化石，其中至少一大部分是属于这一种的。另一結論是由山东的新材料看，圓形蛋是很好的种，十分典型，可以当作标准化石。最后广东南雄也清楚地有这一种蛋、江西也很可能有(虽然材料很破碎)。

IV. 第四种蛋，南雄蛋 (*Oölithes nanhsiangensis* sp. nov.)

(图版 XVII—XVIII)

材料：1. V.2789(6225) 南雄烏径腊树园，共有两蛋，一大部分保存、一保存了一半。此外还有碎片。

2. PMRE 153(ks 7) 江西贛州城南五里亭南 1.5 公里。一个破蛋但蛋的輪廓和蛋皮构造可以清楚看到。

3. 由薄的蛋皮观察，可能一些其他地点中零碎的薄蛋皮或归此种。

腊树园的标本保存最好，就形状看来，主要由于比以上所描述的长度特别小，保存好的一个长 44 毫米，大直径 36 毫米，小直径 30 毫米，比例 82，形状略扁。蛋皮很薄約 0.8 毫米(图版 XVII—XVIII)。

江西五里亭的标本虽然很破，但由其大小来看，无疑归于这一种。可量的长度为 39 毫米，直径为 31 毫米。其蛋壳厚度也与南雄的相同。

这几个很小而蛋皮很薄的蛋显然代表一新的至今未发見的蛋化石。至于产这蛋的动物为何动物我們将在以下加以討論。

V. 其 他 蛋 化 石

(一) 新疆的蛋化石

A. 1963 年古脊椎动物与古人类研究所新疆的工作队，在新疆奇台将軍庙南十公里的公路东側，作第二次路綫調查时，发見了一些蛋化石碎片。据野外观察其时代为白垩紀。初步观察分为两种。

一种薄的約 1—1.5 毫米，表皮上多具有較长的条紋。看来与我們以上所描述第一第二类蛋近似，但更相象的为蒙古的原角龙的蛋，这种共五十片。V.2790。

另一种只有两片，一为 2 毫米厚、一为 3 毫米厚，外皮前者有点粒状的紋飾很密，但較光滑。后者表皮粗糙或由风化之故。二者也可能不是一种。但因材料不多，暫归于一种。看来这两蛋片可以和在山东、广东和江西发見的較厚的蛋相比較。V. 2791。

B. 在 1964 年的古脊椎动物与古人类研究所在新疆的工作队，又发現了两个蛋化石地点。

1. 新疆吐魯番胜金口(野外号 64021-18)一蛋片，由紋飾与厚度近于原角龙的蛋。

2. 新疆呼图壁雀儿沟西沟(Cr_2 东沟統)也为一蛋片，可归同一类。

新疆的材料虽少，但說明白垩紀时，从山东到新疆，南到广东都有蛋化石。可以說分

布是非常的广的。

（二）南雄、贛州等地的蛋化石碎片

除了以上所描述的，南雄和贛州的完整的成窝的蛋和部分的完整的蛋以外，在两地和始兴还有大量的（三千多块）蛋的碎片。这些碎片的絕大多数，都是从地面上检拾的。根据野外观察，有的成堆、有的是零星的。成堆的可能代表原来在原地或者距原地不远处，曾有一窝蛋的存在。当然多数是經过风化的。这在以后还要討論，目前，有两点可以申述。

从种类上講，除了南雄蛋和圓形蛋容易区分外，看来多数的蛋皮是属于粗皮蛋或者长形蛋的。另外由于一方面如上所述，在同一蛋上，飾紋就有所不同，另一方面，多数蛋壳受有不同程度的风化，因之飾紋也有改变，因之单根据蛋壳碎片来鑒定种类是不一定可靠的。这也是为什么这次研究把重点放在所有完整的蛋上。但反过来說，零碎蛋片，却起很重要的地层作用，如新疆奇台虽无完整的蛋，但可以断定其时代大体上为晚白堊世。因到目前为止我們所发現的蛋都是晚白堊世，似乎起标准化石的作用。

由于技术及其他条件限制，本文未包括关于蛋碎片的显微鏡研究，将来再做此工作。即使这样，我們也当首先注意整窝蛋的切片研究，因为其属种是已定的。因此这三千以上的蛋碎片实际上除了表明这些地区蛋化石的丰富以外，其他作用不大。

討　　論

I. 南岭两側有多少种蛋化石

我們通过以上的研究，認为四种蛋化石的存在是毫无疑問，第一种粗皮蛋就各窝的大小統計来看，V.2788 和 PMRE151 十分相近，而和其他如 V.2784，V.2785 以及 V.2781a 虽有些区别，但总的說来，在同一大的范畴內，和第二种蛋差的很多，所以作为蛋講，我們把它們归为一种是十分恰当的。这是一种巨形蛋，为前所未見。絕大多数零星地点的破蛋皮，也归这一种，看来很多，分布也很广。

第二种蛋，也是长形蛋，但比粗皮蛋显著的小一些。这一种蛋虽然如上所述，把它归之于在山东萊阳发見的长形蛋，但并不是沒有区别的，广东的比較大一些，尖端比較鈍一些。但总的說来，应当列为一种，如果所属不錯的話，說明对于广东、山东含化石的地点起了对比作用。这一种蛋到目下为止，未清楚地在江西找到，自然有可能一些蛋碎片是归于这一种的。

第三种蛋，如果說只有南雄的材料，那就很难得出可靠結論，但幸而可以利用山东（包括若干辽宁同一种蛋）材料相互对比，覺得南雄的第三种蛋，应归于山东的圓形蛋的可能性比上一种还要可靠一些。尤其是我們用了北京自然博物館的材料，加以比較，扩大了应当属于一种的准确性。北京自然博物館的圓形蛋大小，基本上和其他蛋一致的。只有个别稍大一些。这說明了，蛋的大小变化較大，也可以間接証明上两种的定法是正确的。这一种蛋在广东、江西、山东的存在，使我們对于地层对比起了一定的作用。

第四种蛋，材料較少，可以掌握的一共只有三个蛋，且沒有一个是完整的。但由于这些蛋的特别小，并且其直径大大超过了长度的一半，以及非常薄的蛋皮均表示，这应当是

另一种蛋。

总的說来，我們在广东南雄和江西贛州一共有四种蛋。

毫无疑問南雄盆地和贛州盆地成窝的蛋化石的发現，証明这些地层是属于上白垩統的。

II. 中国及蒙古人民共和国已知蛋化石及其分布[1]

本文所記述的华南的蛋化石，是近年发現蛋化石最多，而保存最好的一次。加上在山东萊阳和其他地区新发現的一些蛋化石，大大地增加了我們的古蛋类学的知識。此外，在新疆奇台、呼图壁、吐魯番和湖南茶陵发現的蛋化石碎片，虽然保存不大好，但在分布上却起了很大的作用。在此以前，有在山东萊阳发現了蛋化石，在內蒙二連发現了蛋化石碎片。总的說来，我国是一个蛋化石非常丰富的国家。在蒙古人民共和国的牙道黑达所发現的蛋化石也較丰富，而且距国境很近。这些蛋化石可以用表 5 表示。

表 5 所列八种蛋，除第六种蛋（属于原角龙的蛋）产自蒙古外，其他七种均产自我国。如果以上鉴定为可靠的話，在分布上以圓形蛋为最广，长形蛋次之，再次为粗皮蛋和南雄蛋，其他則只限于一个地点。这些蛋除了两种（新疆奇台和內蒙二連）未能确定外，其他六种蛋无論就蛋的大小、形状、外皮构造以及蛋壳的厚薄来看，其区别是十分清楚，未能定的两种，可能为已知之种，已在附記中注明。

III. 关于生态方面的一些問題

有几个关于蛋化石方面的生态問題，值得在以下談一談。

1. 关于蛋窝的排列　根据野外采集人王存义和甄朔南，在南雄和萊阳的观察，許多成窝的蛋，在排列上，似有一定規律（Wang and Zhen 1963）。在萊阳，整窝的和由成堆碎片代表的原来是成窝的蛋的排列，为每距离两米一窝。这些蛋根据現在研究都是属于圓形蛋的。另外在南雄也有窝与窝之間有規則的距离現象，不过更多，更大一些。这些成窝的蛋，也是由成窝的和由碎片代表的地点計算的，相距較大可以达七米到八米之远。最多的可以有五、六窝之多，他叫作一組蛋。因为上述的采自南雄的蛋，圓形蛋和南雄蛋两种各只有一窝。所以可以肯定是由粗皮蛋或长形蛋造成的。这些現象非常有趣，充分指明，一組蛋是由一个动物一次生下的。每窝蛋以至少 30 枚計算如为六窝就有 180 个蛋之多，而这些蛋又相当之大，可以認为是由相当大的动物造成的。但是，就連最大的恐龙，不見得有这么大的肚子，可以一次产这么多的蛋。也不可能想象，由六七个动物排上距离相等的队来同时生蛋。至于圓形蛋距离很近，蛋也較小，当然也只能属于一个动物。但也有类似問題。因此，关于这个問題，我們还难肯定結論，有待进一步証明。关于归属問題，以下还要討論。

2. 关于每窝蛋的排列　按我們研究了大批的蛋化石以后，粗皮蛋和长形蛋每窝的排列，都是作椭圓形放射状的排列，可以重迭到三层（四层？）蛋的数目越向圓心越少，蛋的大

1) 在本文研究过程中，湖南地质局測量队第三分队在湖南茶陵枣子园墟发現了类似第二种蛋的許多蛋片（野外号 3-9900-4）。在其上部也含有第三紀初期哺乳动物化石的紅层。其情形和南雄及贛州很象。这说明华南紅色地层在这些地区很相似。

表5. 中国及蒙古人民共和国已知蛋化石概况

名称 Name of the fossils	简要特性 Leading characters	蛋壳厚度 Thickness of the shell	分布 Distribution	附记 Remarks
1.粗皮蛋 *Oölithes rugustus*	大，平均长180毫米左右，蛋皮特粗，狭长，赤道处直径不及长的一半 Largest fossil reptilian eggs so far known Average length 180mm. Surface coarsely decorated. Greater equatorial diamater less than half of the length	2毫米或更少 Ca. 2mm or less	广东南雄、江西赣州 Nanhsiung, Kwangtung; Kanchou, Kiangsi	
2.长形蛋 *Oölithes elongatus*	中等大小，平均长140mm左右，表皮装饰较细，一般大赤道直径不及长的一半，但有的稍超过 Moderate size. Average length ca. 140 mm. Surface rather finely sculptured. Greater equatorial length usually shorter than half of the length, but sometimes may longer than the same	2.3—2.5毫米 2.3—2.5 mm or less	广东南雄、山东莱阳、新疆、湖南茶陵等 Nanhsiung, Kwangtung; Laiyang, Shantung; Sinkiang; Chaling Hunan etc.	
3.圆形蛋 *Oölithes spheroides*	较小，平均长度约80毫米，作长圆形，蛋面较光，但有点状构造 Rather small. Average length ca. 80mm. Clearly elliptical, with one end rather pointed. Surface smooth with pitted structure	2—3.3毫米 2—3.3mm	广东南雄、江西赣州、山东莱阳、新疆奇台 Nanhsiung, Kwangtung; Kanchou, Kiangsi; Laiyang, Shantung; Chitai, Sinkiang	
4.未定之蛋 *Oölithes* sp. indet.	可能作椭圆状表面作点状或条纹状 May be elongately rounded. Surface decarated with vermiculated or pointed ornamentation	约2毫米	新疆奇台 Chitai, Sinkiang	此种可能归上2，也可能为原角龙蛋 May belonging to *O. elongatus* or *Protoceratops*
5.未定之蛋 *Oölithes* sp. indet.	差不多为圆形[1]直径75 mm，壳皮较光滑 Almost rounded diameter 75mm. Surface of the shell rather smooth	1.5—2毫米[1] 1.5—2mm	内蒙二连东约七公里。 Inner Mongolia, Iren Dabasu	有整蛋也有碎片，就大小与形状判，可能归上种，也可能为一特殊蛋种 Including some complete eggs and many shell fragments. According the size and shape, it may belongs to *O. spheroides* or an another form
6.原角龙蛋 Eggs of *Protoceratops andrewsi*	依布龙与石来克完全蛋和大量碎片 较作长圆形，壳皮作条纹状，或点状外饰[2]	1.2—2.3毫米 1.2—2.3 mm[2]	蒙古、牙道黑达 Djadochta in Shabarakh Usu, Mongolia	依布龙等此蛋也作圆形排列 According Broon and Schlaikjer, the eggs of the nest is circular in arrangement
7.厚皮蛋 *Oölithes megadermus*	蛋皮较粗状 Shell surface coarsely shagreened	5—7毫米 5—7mm	山东莱阳 Laiyang, Shantung	就这保存的部分看，可能为较圆的蛋与上3相近 Probably the eggs of rather rounded type

（續表 5）

名　称 Name of the fossils	簡　要　特　性 Leading Characters	蛋壳厚度 Thickness of the shell	分　布 Distribution	附　记 Remarks
8. 南雄蛋 *Oölithes nanhsiung-ensis*	特别小，长44毫米，蛋皮薄表面有細点状构造 Very small, length 44mm shell thin	0.8 毫米 0.8mm	广东南雄、江西贛州 Nanhsiung Kwangtung Kanchou, Kiangsi	

1) 一部資料来自施瓦茲等，一部为根据尼古拉夫人所供給的来自同地点的蛋皮所观察，前者也为她所供給。
Informations taken from Schwarz and other (1962), P. 124—125 and some fragments of egg-shells from the same locality kindly sent by Mrs. Rachel H. Nizhols. The information given in Schwarz's paper is also given by her.

2) 材料采自 Brown and Schlaikjer (1940) 以及尼古拉夫人所送的产自同一地的蛋片。Information taken from Brown and Schlarkjer (1940) and the shells kindly sent by Mrs. Rachel H. Nichols.

小越向圓心越大。因此，可以認为，粗皮蛋和长形蛋虽然不同，但应当是种属相近的动物生的。

必須要指出的是，蒙古的原角龙蛋，依照步龙和石来克所示图(1940, Plate 12)，虽然从下側看，但可以断定其傾斜度比南雄的大的多(南雄照王、甄为 40°，而此則大多数近于直角)，因此，虽有部分的圓状排列(只外圓，內圓就不很規則)也因之无重迭現象，所以和以上两种蛋的多数重迭状况大不相同，可以認为，这两种蛋不見得是属于原角龙，甚至于原角龙所属的角龙目。

至于圓形蛋則沒有什么規律，据王、甄观察鱷和龟类的生蛋也是不規則的排列。但我們自然不能結論說，这圓形蛋就是这两类中第一类生下的。

3. 关于古气候　我們还沒有作这些蛋化石的显微研究，很难說出，这些蛋生长时所需要的环境条件。我們在一地区，如南雄或棻阳，所知的蛋，均大体上属于一个层，因之当时气候是相同的。因蛋的大小与厚薄，应当主要是种类上的不同，而不是其他原因。

4. 关于蛋的孵化　蒙古的原角龙蛋，因和原角龙的骨骼共生，有許多年齡不同的原角龙，以至刚孵化出来的小个体。我們的許多蛋化石地点，只有少数有一些可鑒定，或根本不能鑒定的恐龙化石(此将在以后加以研究。而且就野外观察，也沒有看出有什么刚孵化出来遺留下壳的蛋。但在所有成窝的蛋或部分成窝的蛋，有可能有些破碎的，并不一定的由于挤压或破碎，乃是孵化后遺留下来的。因为完全完整的蛋不可能已經孵化石化的。此外上边所說的，由一些破碎蛋类所代表的整窝蛋，也不見得沒有可能是孵化后的遺留，不一定完全是由于风化的影响。

5. 近蛋的岩石的有机成分　联系到上一問題，有必要談一談蛋中心或附近岩石的情况。根据化学分析的結果，6224 含有机碳 (Organic carbon) 为 0.98%，可以說是非常之少的，不及百分之一。而 6220 只有 0.39%，更为稀少。看来原来的有机質均由长期的石化作用而消失殆尽了。

IV. 关　于　地　层

首先这些蛋化石是不是出于同一地层。根据张玉萍等观察，南雄羣是一很厚的地层。单上部含蛋化石的这一层，就有 250—1000 米，其下还有 500—1500 米上下厚的地层，未

发現有任何化石。这蛋化石的地层分布，照他們的柱状图来看，除了最底部外，一般都有。我們目下蛋化石的研究看不出有什么可以再分层的証据。就地面分布講，南雄的蛋化石主要分布于南雄城西南、湖口和乌径三区，这三区的化石如上所記以南雄与乌径較多，成分也有些区别，但看不出有什么上下的不同。

关于江西，只有粗皮蛋与南雄蛋共生，但有理由相信和南雄、始兴的情况，应当是十分相同的。

第二个問題，为含蛋化石的确切年代問題，南雄的蛋中，圆形蛋是南雄（可能也有贛州）和莱阳共同的。这就是強烈表示，前者含蛋化石的地层也是上白垩統，再加上如果第二种蛋（长形蛋）照我們現在所理解是属于原角龙或与之相近的种类的話，那么应当属于上白垩統的可能性要更多一些。所以，至少就蛋化石講，凡是广东、江西含有蛋化石的地层都应当訊为是上白垩統。甚至上上白垩統。

遺憾的是两地区的与之共生的骨化石都是非常之殘破的（此当在以后研究发表），現据初步鑒定，有如下一些种类：

表 6. 南雄爬行动物化石簡表

(Table 6. Preliminary list of the reptilian fossils found from Nanhsiung hsien)

室内号码 Cat. No.	野外号 Field no.	材料 Material	可能种属 Preliminary determination	附記 Remarks
V.2793	6214 南雄风门坳东南约 1km	一个大牙齿 A big tooth	Carnosauria size approaching *Tyranosaurus*	
V.2794	63094 南雄长市附近，青山北约 1km	一个牙齿 One tooth	Sauropoda indet.	此处有蛋化石碎片 25 块 with 25 fragments of eggs
V.2783	63089 南雄主田北约 1km	一个牙齿 One tooth	Hadrosauria indet.	此处有完整蛋化石 4 枚，碎片 97 块 with 4 complete and 97 fragments of eggs
V.2795	6221 南雄乌径高山坑	一些保存不好的肢骨，至少分属于两种类型 Some poorly preserved limbs bone, at least two forms	較大的一类是一种小型 Coelurosaurid 的胫骨 The larger one represents a tibia of a small Coelurosaurid	此处有蛋化石碎片 31 块 with 31 fragments of eggs
V.2781	6215 南雄城南约 1 km	一些破骨 Some fragmentary bone	其中有一为 Nodosauria 的眉片 One represents a scute of a Nadosauria	此处有完整蛋化石 2 枚，碎片 564 块 with 2 eggs and 564 fragments
V.2789	6225 南雄乌径腊树园	一个大龟 One large turtle	*Nanhsiungchelys Wuchingensis*	此处有完整小蛋 2 枚，碎片 41 块 two small eggs and 41 fragments

由上表除了(Young 1962)前在始兴所記述的虚骨龙属种未定种以外有以下各种：虚骨龙类；大肉食类[1]、蜥脚类、鴨嘴龙类、結节龙类、大龟类、未定之骨若干。

1) 在江西泰和也有两种恐龙一为大肉食类恐龙，一为蜥脚类恐龙，但后者与南雄者不同种(杨 1963 年)。

这些化石，从肉食类和鳥臀类来講，应当属于上白堊統当无疑問，因为鴨嘴龙和結节龙都是以上白堊統为主。其他化石也和这个說法不矛盾，也和蛋化石的观察相符合。

所以南雄羣至少上部含化石部分，应当为上白堊統。

V. 蛋化石的归属問題

最后可以談一談，这些蛋化石的归属問題，到底他們的父母是誰。

首先要說明的就是，我們所述的一些蛋化石的所謂"种"，当然不是代表一个生物意义的种，只不过为了易于区别，并表示其一部分特性給他們一个名称罢了。这些各种不同的蛋，也可归属于一个单一的动物，也可能不归属于一个单一动物，因蛋的大小，和表皮形状与飾紋的差异可以是很大的。在图版 XVI 上搜集了几个現代爬行类和家鸡的标本。B 是龟(种名不詳)，C 是鱷(可能是中国揚子鱷)，D 是家鸡，E 也是家鸡。可以看出，除了龟蛋相当特殊以外，鱷类和鸡蛋很相近。另外一方面两个鸡蛋大不相同，表皮也有差异，E 特别长，赤道部分在带状分布的小斑点。这一个蛋无疑是长形的发育。这个情况很清楚的說明单凭蛋来定其归属是不容易的。

此外，这次研究的蛋化石材料中，共生的动物化石是很少的，而且多数很破碎不能作可靠鑒定，这也为我們了解蛋化石的归属問題增加了困难。

因此，我們以下对蛋化石的归属問題，只是提出到目前为止，对于他們归属問題的一些看法。由一些已知的材料看起来，以下的看法还是比較可以考虑的。

首先关于圓形蛋，圓形蛋在南雄和莱阳很多，贛州也有其迹。莱阳且有两种，一为狹义的圓形蛋，一为厚皮蛋。在以前周明鎮(Chow, 1951)曾指出这种蛋可能属于鴨嘴龙一类动物的蛋，但依拉普林(1955, in Piveteau P.924)属于 *Hypselosaurus priscus* (依同一作者为属于 Titanosauridae 一科的蜥脚类。盘足龙也归同科)的蛋是橢圓的(图版 XIXA)。按其大小很接近于我們的厚皮蛋。所以如果拉普林所引的蛋，的确属于蜥脚类的这一属，那么就很有可能不但厚皮蛋是属于蜥脚类的，而且小一点圓形蛋如不是属蜥脚类也有可能属于范围大一点的蜥臀类的肉食恐龙类。在南雄泰和莱阳等有蛋化石的地点，均有肉食恐龙牙齿等，支持圓形的蛋大体上属于蜥臀类的說法。很有可能蜥脚龙較大，大的橢圓蛋属于此类，而小的圓形蛋属于肉食恐龙类。由于我們还缺乏确实証明，这些蛋到底属于那一属那一种目前作肯定的判断是不現实的。

另外在以上的描述中，我們已經指出，山东、南雄的长形蛋(即第二种蛋)和蒙古的訊为是属于原角龙的蛋很相似(如非一种的話)。把訊为属于原角龙蛋(Brown and Schlaikjer, 1940; Lapparent, 1955, p.1925)和我們的第二种蛋相比較(图版 IX—XII 和图版 XIX, B)，其相似的程度是显著的(有必要指出图版 XIX,B 的一窝蛋也和 Brown and Schlaikjer 1940，图版 12 下图一样，是代表一窝蛋的下面。这样就更易和我們的蛋相比較)。

但是在莱阳、南雄等地，我們都沒有清楚地，可属于原角龙以至角龙类的化石。相反，在莱阳有属于鴨嘴龙的譚氏龙、青島龙和其他一些不能鑒定的鴨嘴龙和剑龙。在南雄有一种鴨嘴龙存在，和一种結节龙，但都很破碎。因此，有可能这一种圓形蛋是属于以上所指出的某一属的。无論如何，看来长形蛋属于鳥臀类动物，問題不大。

如果这样的話，那末所有这些大型的长形蛋(*Oölithes rugustus*)，也应当属于鳥臀类。

我們以上已經指出，蛋化石变异很大，也可能属于一种，也可能不属于一种。很有可能这个大型的蛋为較大的动物所生，如青島龙等，而小型者（长形蛋）則应当属于或者是未发見的角龙类或者其他鳥臀类如剑龙或結节类等。当然爬行类蛋的大小，并不代表动物的大小，已为熟知之事。但在比例上究竟可作为参考。

至于南雄蛋的归属問題比較清楚。发現这一种比較起来特别小，虽然也是橢圓的，但看来更圓些，比例为82而且蛋壳非常之薄，因而考虑不大可能属于恐龙一类的蛋而可能是属于龟类的。特别支持这个說法的一个有力事实是这两个蛋是和一大的完整的龟化石共生的（野外地点号碼6225）此化石正在研究，定名为鳥径南雄龟 *Nanhsiungchelys wuchingensis*（未发表）因此，这一种蛋属于这一种龟，应当比較可靠[1]。

綜合以上所述，我們現在所掌握的蛋化石的归属可以初步地以下表表达。

表7. 蛋化石归属表

(Table 7. Systematic position of the known fossil eggs)

目 (Order)	科 (Family)	属 种 (Gen. and sp.)	蛋 (Eggs)
蜥臀类 Saurischia			
肉食龙类 Carnosauria	—	—	*Oölithes spheroides*
蜥脚类 Sauropoda	—	—	*Oölithes megadermus*
鳥臀类 Ornithischia	Hadrosuridae	—	*Oölithes elongatus*
	Protoceratopsidae	*Protoceratops andrewsi*	可能归此种的有 *Oölithes elongatus*
	? Hadrosuridae	?—	新疆奇台蛋，內蒙二连的蛋
	?	?	*Oölithes rugustus*
Chelonia	Nanhsiungchelylidae	*Nanhsiungchelys wuchingensis*	*Oölithes nanhsiungensis*

总的說来，我們現在在中国所知道的蛋化石，比較橢圓形的可归蜥臀类。其中一种可能属肉食类恐龙，一种可能属蜥脚类。另外除了已知的原角龙蛋外，比較小的长形蛋可能属与此有关，但也可能属其他鳥臀类如角龙、結节龙等。大的蛋即粗皮蛋可能属鴨嘴龙，但前一种蛋属于鴨嘴龙的可能性也不能完全排除，因为至少在山东萊阳金刚口，那一窩长形蛋是在靠近大量青島龙的产地相近地方发現的。至于南雄蛋則属于龟的可能性很大。

在本文准备过程中使用了尼古拉夫人以前寄来的法国和蒙古，以及我国內蒙二連的蛋皮碎片，在研究中起了很大的作用。北京自然博物館时墨庄和甄朔南二同志，对于他們和王存义在江西发現的蛋化石，不但提供了研究的便利，且供給了測量的数据。副館长陈炳同意在本文中包括江西材料一起研究。古脊椎动物所王哲夫照了所有本文用的照片，发現南雄地区蛋化石的张玉萍等在工作中帮助不少，謹对以上各位表示感謝。

1) 承叶祥奎见告。

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FOSSIL EGGS FROM NANHSIUNG, KWANGTUNG AND KANCHOU, KIANGSI[1)]

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INTRODUCTION

During the field season of 1962—63 and 1963—64 members of the Institute of Vertebrate Paleontology and Paleoanthropology collected many fossil eggs, mostly of dinosaurian origin, beside the vertebrate remains of late Cretaceous and Early Cenozoic age. Concerning the general accounts of the occurrence of the eggs and the related geological condition of 1962—63, it has already been reported by Chang and others. The work of the second season added very little as concerning to the fossil eggs, although many new localities and well-preserved specimens were found. It is no doubt that we have to deal with so far the most rich collection of fossil eggs known besides those of Mongolia and Shantung.

Recently field geologists of S. China reported that they had collected some fossil eggs from the same area, suggesting that the egg-remains are indeed very rich in Nanhsiung.

In 1964 members of the Peking Natural History Museum collected fossil eggs from Taiho and Kanchou, Kiangsi. As noted below both the characters of the eggs and the geological condition of Kiangsi are closely comparable with those of Nanhsiung and thus our knowledge concerning the understanding of the Red Beds of South China is greatly advanced.

In the present paper a general study of all the eggs from Kwangtung and Kiangsi is given, except those collected by the field geologists of South China which are presum-

1) Contributions of the Vertebrate Paleontology of the Peking Natural History Museum number 2.

ably within the limit of the forms included in the present paper. The microscopic study of the eggs will be given later.

For the list of localities of fossil eggs from the Nanhsiung and Szesheng area see Table 1 p. 142 of the Chinese text.

As shown in Table 1 our collection consists of about 2,916 egg shells and about 78 more or less completely preserved eggs including nine nearly complete or partly preserved nests. It is indeed a rich collection of fossil eggs. The duplicated localities or sites which are nearly situated together are combined and yet they are widely distributed. They are mainly concentrated in three areas: In the vicinities of the Nanhsiung city, Hukou area and Wuching area. Only one locality with fossil eggs is known in the Szesheng area (See textfigure 1, p. 142).

Many of the egg-fragments were collected along the hillsides so that their occurrence is not clear and in addition they are more or less weathered. Therefore the following description is mainly based upon the nearly complete or partly preserved nests and their associated fragments. Other fragments bear very little systematic value, although it is possible to classify them by means of the surface ornamentation or microscopic study.

For the eggs of Kiangsi see Table 2 in the Chinese text (p. 142 and textfigure 2, p. 144).

As shown below most of the eggs from Kiangsi and Kwangtung are identical, even pertaining to the same form. This is very interesting in showing that the Red Basins separated by the Nanling Range are closely comparable.

CLASSIFICATION OF THE FOSSIL EGGS

As shown in the foregoing lines we have to deal first with the more or less complete eggs to reach more reliable conclusions. In doing so, the classification of the egg-fragments is also easy to treat.

In Table 3 (p. 145—147 of the Chinese text) we have grouped all the detectable measurements of the better preserved eggs. It is clear that they may be easily grouped into four forms both according to the size and according to their ratios of the long diameter and the large equatorial diameter. Nevertheless, the possibility of being five forms cannot be entirely excluded. In other words the form I may be subdivided into two sub-forms, I_1 and I_2. The eggs of 6224 are shorter and broader. Their ratios are also greater. They overlap only with those of 6215 and a few of PMRE 151. Otherwise they show very little difference as compared with the eggs of the other localities. In view of the greater variation in size of the fossil eggs and the close similarity of the surface vermicular structure especially near the equator, we consider them as pertaining to the single group in the following description. Groups II to IV are very distinct in size and in shape and thus represent three different forms. Such classification is clearly seen in Table 3 and Table 4 as well as in Figure 3 (Table 4, p. 147 and Figure 3, p. 148). It is also clear that most of the eggs belong to group I, while those of the others are comparatively rare.

I. Form I. *Oölithes rugustus*, new form.

(Pls. I—VIII and Pl. IX, fig. B)

Material. 1. V.2784 (6220), a nearly complete nest with 20 eggs. Yaotun, Nanhsiung. Plates I—III.

2. V.2781 (6215a—63090), three eggs, 1.5 km S. of Nanhsiung.

3. V.2785 (63093), more or less nine completely preserved eggs, 1 km north of Yaotun, Nanhsiung.

4. V.2788 (6224), about 18 complete eggs, Lashuyuan, 4 km south of Wuching, Nanhsiung. Plates IV—V.

5. PMRE 151 (Ks5, about 24 more or less well preserved eggs, 1.5 km south of Wuliting, south of Kanchou, Kiangsi.

6. Many fragments of eggshells from various localities listed in Tables 1 and 2.

As showing in the list of material, the eggs are beautifully preserved in several localities. We consider them as all belonging to a single form chiefly by the size and the structure of the outer surface.

V.2784 represents the most well preserved nest of eggs in our collection. It includes at least twenty eggs arranging in circular manner. There are at least two layers, 13 above and 7 below. Since the 13 eggs are not lying in the same level, it is possible that they may represent two layers, altogether three. In this way the number of eggs of the whole nest may be more than 40. There are about 10 mm thick and hardly consolidated dark red clay intercalated between those layers of eggs. It is probably buried by the animal to cover the newly produced eggs. The inward inclination of the eggs is about 40 degrees.

In all the eggs the more or less truncated end is toward inwards while the rather pointed end is directly outerwards. A considerable part of both borders of each egg is nearly parallel. The measurements are showing in Table 3. Their length varies between 191 to 208 mm; breadth, 67—86 mm and ratios 3.5—4.5. Judged by the diameters near the equator the egg is rather flat.

The outer surface of the egg (Plate III) is coarsely ornamented which varies from place to place. In general, it is more pitted, only the part near the equator is vermiculated. Thickness of the shell rather thick, about 2 mm.

V.2781 (6215a=63090) represents an imcomplete nest, only three eggs are preserved of which one of the inner end is broken. The other is rather short, representing probably the egg of the lowermost layer. The two better preserved eggs show the same size as those of the precedingly described eggs, also with the similar ornamentation. Therefore we consider that the three eggs are referable to the same form as V.2784.

V.2785 (63093) represents the best specimen of eggs collected in the second season. This nest with 10 actual eggs and three impressions is probably upside down so that the upper layer representing the lower one. The upper movable ones represent the lower layer while the other rather fixed eggs seem to be divided again into two layers, altogether three layers. Although the eggs are also arranged in a radiated manner, it is by far not so rounded but rather elliptical and a few of them are even rather disordered in arrangement. Besides, all the other characters are perfectly in accordance with those of the eggs precedingly described.

V.2788 (6224) represents another better preserved nest (Plates IV—VI). Before the preparation, only eight eggs and the inner part of another two were exposed. They are arranged in three layers. But if the middle one represents one layer, there are possibly four layers. (If the middle one is considered as missing in 6220, it may also be four layers.) Both V.2784 and V.2788 are not complete nests, the total number of eggs

may be at least fourty or more. In this nest, the intercalated red clay is decidedly thicker than that of 6220.

On the whole the preservation of 6224 is better than that of 6220. Most of the eggs are not borken and complete. As noted in the foregoing pages the size of the eggs of this nest is somewhat smaller. As shown in Figure three (p. 148), only a few measurements overlapped with those of the others. The other features are about the same so that we consider that this nest belongs also to the same general type of eggs.

PMRE 151 (Ks5) from Kanchou of Kiangsi represents also a nearly complete nest. With the exception of three weathered broken ones, all the others are more or less complete, arranging in three layers in a circular manner. Their size is somewhat closer with that of 6224. On the whole all the other features including the ornamentation of the shell are the same as those of the foregoing described ones. Those fragments of eggshells found in the same general district belong mostly to the same form, some of them may even indicate the residuum of a nest of eggs. In any way it seems that the fossil eggs of the district of Kanchou are just as rich as that of Nanhsiung. In association with the eggs, there are a few undeterminable bones.

II. Form II. *Oölithes elongatus* Young

(Pls. IX—XIIIa)

Material. 1. V.2783 (63089). About 1 km north of Chuetien, Nanhsiung. Seven eggs, a part of a nest.

2. V.2786 (63092). Tangmienling, N. of Shuikou, Nanhsiung, 11 eggs, part of a nest.

3. V.2782 (No field number, collected by members of the Geological Institute, Academia Sinica). About 2 km S. of Nanhsiung. Three complete eggs and three impressions clearly circularly arranged.

4. V.2781a (6215). About 2.5 km S. of Nanhsiung. A pair of complete eggs.

5. A number of shell fragments from various localities referable to this form.

All these enumerated eggs are concentrated in the area south of the Nanhsiung city and absent in the Wuching area. Most of the eggs represent part of a nest but less well preserved. Their size is very close to each other (See Table 3 and Figure 3) and apparently referable to the same form.

V.2786 (63092) is better preserved with 11 eggs arranging at least in two layers. The upper layer denotes eight eggs almost wholly exposed and other three located near the middle and only partly exposed. Only the measurements of the four eggs of this nest are given (Table 3).

V.2782. Also a part of a nest. One of the three eggs is broken, only the length of the two eggs is measurable. Together with the impressions, there is no doubt that they represent a part of a nest arranging in a circular manner (Plates XII, XIIIA).

V.2781a (6215). This pair of eggs represents also a part of a nest.

V.2783 (63089). It is a much distorted nest of eggs. Only three of them are measurable. In addition, there are two broken ones and two with their impressions only.

With the exception of V.2783 which is somewhat distorted and V.2781a with only two eggs, all the others show clear circular arrangement. It is clear that the radiated manner of the eggs of this form must be the same as the precedingly described form. In

size, however, it is much smaller, only one of the eggs with the length of 151 mm which is 17 mm shorter than the shortest eggs of *O. rugustus*. In the diameter of the equatorial breadth and the detectable ratios the difference is also remarkable. The surface ornamentation of the shells is much finer and the thickness is also thinner (mostly less than 2 mm) than those of the preceding form. It is therefore clear that the present material represents a separate form of eggs. In the arrangement of the eggs there is however no difference between the two, circularly arranged and with the pointed end directing externally.

In the general size and in shape this group of eggs is similar to *Oölithes elongatus* from Laiyang. The size of the eggs of Laiyang is however much smaller than that of the present form. The difference is much greater than that between 6220 and 6224, so that it is probable that the present described eggs may represent a different form, although it is considered here as *Oölithes elongatus*.

III. Form III. *Oölithes spheroides* Young

(Pls. XIIIB—XVIA)

Material. 1. V.2787 (6222). A few eggs more or less compressed and an impression of an egg. A number of fragments. Hoshangkong, Wuching, Nanhsiung.

2. PMRE 152 (Ks6). Three fragments possibly referable to this form.

3. Two nests of eggs from Laiyang (PMRE 11, Hsiachiayin, Chingkankou and PMRE 126 Hungtouyeh) are referable to this form.

This form of eggs is so far only recorded in Hoshangkong of Nanhsiung area. But it is possible that it may be represented by the fragments of the other localities, although we found in vain after a preliminary survey.

The three eggs of the named locality are no more connected together. The better preserved one is shown in Plate XV together with part of the other two, one showing the inner surface and the other the outer surface. The other eggs and the associated fragments are found isolatedly and their relative position with those eggs is no more detectable. As in the case of the eggs of *O. spheroides* from Laiyang, there is also no regular arrangement concerning the distribution of the eggs even in the most complete one, the egg-surface is much broken due to deformation. Nevertheless it is possible to give its measurements (Table 3). In comparison with the other two described forms it is much smaller, short and broad (ratios, 60—80). Average thickness of the shell 2—2.5 mm.

The three fragments from Wuliting, Kanchou were found not very far from the complete nest of eggs (Ks5) but differ from it by the greater thickness of the shell, about 3 mm. This is distinctly thicker than most of this form. Nevertheless, it is much thinner than the egg *O. megadermus* (Young, 1959, thickness, 5—7 mm). Therefore it is possible to refer them to the present form.

In the course of the present study it is possible to make some observations on the two nests of eggs collected by the Peking Natural History Museum, PMRE 11 and PMRE 126. In PMRE 11 there are ten eggs and in PMRE 126, 11 eggs. Both are disorderly arranged showing that the way of producing eggs is at random. Although the size of those eggs is averagely larger but many of their measurements are crossed each other. The size of the Hoshangkong specimen is smaller, but still can be easily considered as belonging to the same form. The surface structure of the two nests of Laiyang is the

same as that of the previously described form from the same district.

From the foregoing statements we may conclude that the distribution of *Oölithes spheroides* is much wider than it was originally supposed. Besides those discussed in the present note, the eggs of the same type are also secured by the Museum of Geology at Peking and the Tientsin Natural History Museum, a large number of which are referable to the present form. In addition, it is clear that *O. spheroides* represents apparently a well defined species, useful as an index fossil. At last traces of this form are known both from Nanhsiung and Kanchou.

IV. Form IV. *Oölithes nanhsiungensis*, new form

Material. 1. V.2789 (6225). Lashuyuan, Wuching, Nanhsiung. Two eggs, one rather complete and the other about one half preserved. A few fragments were found together.

2. PMRE 153 (Ks 7), 1.5 km south of Wuliting Kanchou. A broken egg both its outline and the structure clearly observable.

3. Some very thin eggshells may be possibly referable to this form.

Among these enumerated specimens, those of Lashuyuan are better preserved. This sort of eggs is mainly characterized by the unusual small size. The length of the better preserved one is 44 mm; larger equatorial diameter, 36 mm; smaller, 30 mm and the ratio, 82. The shape of the egg is a little flat (Plate XVII—XVIII).

The specimen from Wuliting is very poorly preserved. But the size fits well with this form. The measureable length, 39 mm; diameter, 31 mm; thickness of the shell about the same as that of Nanhsiung.

All these small and thin-shelled eggs represent certainly a new form of eggs so far not known before. Concerning their systematic position, see infra.

V. Other fossil eggs

1. Egg Fragments from Sinkiang

A. A number of fragments of eggs have been collected by the members of a field party of IVPP 1963. Locality: East of the high way about 10 km south of Chiangchun Miao, Chitai, Sinkiang. According to the field observation the beds with those eggs are Cretaceous in age. Two kinds of eggs may be observed.

One with rather thin shell (about 1—1.5 mm). Surface with vermiculated ornamentation. It is rather similar with the Form I or II described in foregoing pages. But it looks still similar to the eggs of *Protoceratops andrewsi*. About 50 fragments. V.2790.

The other kind is only represented by two fragments. One 2 mm in thickness and the other 3 mm in thickness. The outer surface of the former is densely pitted and smooth. The surface of the latter is rather coarse due probably to crosion. It is possible that the two fragments represent two different forms of eggs. We consider here, however, as one form. These two fragments may be comparable with thicker eggs from Kwangtung and Kiangsi. V.2791.

B. During the work season of 1964 by the same institute two new localities of dinosaurian eggs were discovered.

1) Shengchingkou, Turfan, Sinkiang (Field number, 64021-18). A fragment.

2) Chuehrkou (Hsikou), Hutupi, Sinkiang. Also only one fragment.

Judged by the sculpture of the surface and the thickness of the shell it is very probable that they both belong to the Form II of the egg, similar to those of *Protoceratops*.

Although the eggs are very poorly represented but the three localities of egg-remains show that during the Cretaceous time the dinosaurian eggs were widely distributed from Shantung to Sinkiang and from Sinkiang to Kwangtung.

2. Note on the Fragments of Fossil Eggs from Nanhsiung and Kanchou

Besides the foregoing described nests or part of the same, there are a great number fragments of broken eggshells from Nanhsiung, Szesheng and Kanchou, more than three thousands. Most of them have been collected from the surface. According to the field observation, many of the eggshells were found in heaps and still more rather scattered in distribution. The former may represent a destroyed nest at the very place or nearby. Many of them were of course more or less weathered. I shall come back to this question later. Presently, two points may be briefly stated.

With the exception of the eggs of *O. nanhsiungensis* and *O. spheroides* which are rather easy to recognize, it seems that most of the broken eggs belong either to *O. rugustus* or to *O. elongatus*. On the other hand, it is certainly difficult to determine those eggfragments more precisely. As noted before, the ornamentation of the surface varies from place to place. In addition many of fragments are more or less weathered, so that the surface ornamentation is less reliable. That is the reason why the main aim of the present study is concentrated to the complete eggs and nests. It must be noted, however, that those fragments of eggs are by no means less important, especially from the stratigraphical point of view. For instance the eggfragments from Sinkiang indicate pretty well that the beds from which the eggs were derived are Upper Cretaceous in age, since so far no such finds were recorded from any other older formation.

For some other reasons the present study is restricted to the general description and discussion. The microscopic study will be done later. Even so, we shall use those of the nests as first hand material, because of their more precise determination. In this case the rich fragments of more than three thousands eggshells besides those nests indicate mainly the richness and wide distribution.

DISCUSSION

I. How many forms of eggs are there along both sides of Nanling

From the present study it is clear that there are four forms of eggs present along both sides of Nanling. The first form, *O. rugustus*. According to their size, V.2788 and PMRE 151 are rather close to each other and somewhat different from V.2784, V.2785 and V.2781a. But all of them are within the variation of a highest category and quite different from the second form and it is save to consider them as a single group. This is a form of gigantic eggs heretofore unknown. Most of the fragments of eggs belong probably to this form. It is apparently a rich and widely distributed form.

The second form of eggs is *O. elongatus*. It is decidedly smaller than the first form. As noted before there are some minor points rather different from the eggs of Laiyang. Those of Kwangtung are a little larger and the pointed end more obtuse. But on the whole, they are very likely belonging to a single form. If so, it is interesting to note that similar or the same form of eggs are found from such widely separated place

like Shantung and Kwangtung. Up to now there is no sure indication of the presence of this kind of eggs in S. Kiangsi, although some of the fragments may be referable to it. As noted before, this form of eggs is closely comparable with the eggs of *Protoceratops*, if not a synonym of it.

The third form. The eggs of this form are poorly represented in our collection. Fortunately we can use the similar eggs of Shantung (including some of Liaoning) for comparison. We feel that this form of eggs is most probably the same form as *O. spheroides* from Shantung. During the present study, we have used the new collection made by the Peking Natural History Museum. This makes the determination more reliable. The size of the eggs of PMRE is essentially very close to that of the other ones, only a few being somewhat larger. It shows that the variation of the size of the eggs is greater. This form is known in Shantung, Kiangsi and Kwangtung. Its wide geographical distribution is interesting stratigraphically.

The fourth form. The remains of this form are very scanty. Only three eggs are known but none of them is complete. Since they are very small, with the diameter much more than half of the length, it is evidently a special kind of eggs.

All in all, we have four kinds of eggs as already made clear in the foregoing pages.

It is no doubt that both the egg bearing beds in Nanhsiung and in Kanchou are Upper Cretaceous in age.

II. The distribution of fossil eggs in China and Mongolia*

The fossil eggs described in the present paper represent the richest egg-remains discovered recently. In addition to the eggs newly discovered in Shantung and other places, our knowledge concerning the palaeontology in China is considerably increased. Although the eggfragments from Sinkiang and Hunan (see foot-note supra) are poorly preserved, but they are interesting on account of their wide distribution. In addition, fossil eggs have been recorded from Laiyang, Shantung and Iren Dabasu, Inner Mongolia. All those records show that fossil eggs are richly represented in China. Although the eggs of *Protoceratops* in Djadochta, Mongolia were found outside of China, but their localities are very close to the boundary of China, and is interesting to note for the sake of distribution.

For all the known fossil eggs in China and its related area, see Table 5, p. 154.

With the exception of the eggs from Mongolian People's Republic, all the other forms of eggs are found exclusively in China. Using the determination we have made, the form *O. spheroides* is more widely distributed, the next is *O. elongatus* and then *O. rugustus* and *O. nanhsiungensis*. The other eggs are only limited in one locality. According to the shape, size, decoration of the surface and the thickness of eggs most of the enumerated forms are well defined. Those marked as "Sp. Indet." possibly belong to the known forms which are given in the coloumn of remarks.

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* During the present study, remains of eggfragments have been found from Tsatzeyuanhsu, Chaling, E. Hunan by the menbers of the Bureau of Geology. The fragments look much like the second type of eggs according to our classification. This interesting find shows that the geological and palaeontological condition duplicates the same way as in Nanhsiung and in Kanchou (Also followed by mammalian bearing strata of Early Tertiary time) (Field No. 3-9900-4).

III. Biological remarks

Concerning the biological interpretation of the fossil eggs, the following points may be discussed.

1. CONCERNING THE ARRANGEMENT OF THE EGGS According to the observation made by Wang and Zhen (Wang and Zhen, 1963), it seems to exist some regular manner about the distribution of the nests of eggs. In Laiyang, the nests are arranged about two meters between each two nests as indicated either by nests of eggs or heaps of fragments of the same. All those eggs are belonging to the form *O. spheroides*. The same condition is observed also in Nanhsiung of two elongated types of eggs and in a more elaborated way. It is also represented by the nests and some heaps of the same but about a distance in seven or eight meters. Such way of the distribution can be observed as much as five or six nests in a "set", as they called them in the field. Since the eggs of *O. spheroides* and *O. nanhsiungensis* are represented only by a single locality, no such arrangement of eggs is observed. In any way, such observation is very interesting. It suggests strongly that each set of nests is produced by one animal. In such way we must assume that one animal is able to produce eggs as much as 200 or more. This can hardly be done even by animal of gigantic size. On the other hand, it is difficult to assume that six or seven individuals lined up regularly at the same time in producing eggs. The distance of nest of *O. spheroides* is shorter but must also belong to one individual. We like to wait for more evidences for reaching a definite conclusion. Concerning the producer of the eggs see discussion in following pages.

2. THE MANNER OF ARRANGEMENT OF THE SINGLE NEST As already made clear, the eggs of both *O. rugustus* and *O. elongatus* are circularly arranged in three layers or more. The number of eggs decreases towards the centre while the size of them increases to the centre. Therefore, it is obvious that both forms of eggs should be regarded as systematically very close.

Judging from Brown and Schlaikjer, the nest showing in the lower figure in Plate 12 (1940, opposite page 256) should be looked from below and the inclination of the eggs is nearly vertical (at least the outer circle), while those of ours are about 40 degrees. The circular arrangement is especially clear in the outer layer and less clear in the inner circle. In this manner there is no clear overlap of the various layers of the eggs. The same disorderly manner is also observed in the other nest of the same form (Plate XIX, lower figure). All in all, it seems that our two forms of eggs are rather different from the typical ones of *Protoceratops*. They may belong to forms of the same order or related form in close connection with that genus.

According to the observation of Wang and Zhen there is no regular arrangement in the eggs of crocodiles and turtles. Of course we cannot conclude therefrom that *O. spheroides* the eggs of which are disorderly arranged, bears any relationship with either of the two orders.

3. PALAEOCLIMATOLOGICAL Since the microscopic study of the eggs has to wait for further opportunity, we are not able to draw any conclusion concerning the climatological condition from this kind of research. However, all the different eggs were found from approximately the same general level in the same area. It is therefore obvious that they were laid under the same climatological condition. The difference of the

size, thickness and other features of the eggs denotes chiefly the characteristics of various forms.

4. CONCERNING THE HATCH OF THE EGGS In the eggs of *Protoceratops* a great number of newly hatched eggs have been observed as indicated by various young animals in association with the broken eggs. Only in a few localities of the eggs of Nanhsiung and Kanchou very poorly preserved or even indeterminable bones were found (the description of them will be given latter). There is no positive trace of hatching eggs observed in the field. It is, however, possible that the broken eggs of the nest or part of the nest may represent some hatched eggs and at least not all of them due to compression. The complete ones are of course non-hatched. Even the nests represented by heaps of fragments may be partly hatched ones and not all of them were the result of weathering or deformation.

5. CHEMICAL COMPOSITION OF THE ROCKS WITHIN AND OUTSIDE OF THE NEST In connection of the foregoing problem it is interesting to give the result of the amount of organic canbon made from the two nests. In that of 6224 it is 0.98% which is very rare, less than 1 percent. In that of 6220, it is 0.39% still rare. We may conclude therefore that the organic matter is nearly lost entirely due to the long period of fossilication.

IV. Stratigraphy

The first question has to be settled whether those eggs are derived from the same geological horizon. According to the observation made by Y. P. Chang and others, the Nanhsiung Group is a thick formation. Only the upper part with egg-remains is estimated about 250—1,000 meters thick and the barren lower part, 500—1,500 meters thick. As shown in their columnar section, the eggs were practically found throughout the upper part of the section only the basal part being barren. As a result of the present study, there is no positive evidence from the fossils to divide the concerning beds in two or more divisions. Geographically, the eggs are chiefly concentrated in three areas, the part S. W. of the Nanhsiung city, Hukou and Wuching areas. There are some differences of the composition of forms of eggs in each area but no indication of any stratigraphical difference.

The second question is the age of the egg bearing beds. In the eggs of Nanhsiung district (possible also Kanchou), *O. spheroides* is the only form known also in Laiyang of Shantung. This fact suggests strongly that the geological age of the egg bearing strata of Nanhsiung (and Kanchou) is Upper Cretaceous. In addition, the probability of being Upper Cretaceous is still stronger, if the second form of eggs, *O. elongatus* belongs to *Protoceratops* or its related form, as we supposed. Therefore, all the egg-bearing formations both in Kwantung and in Kiangsi are most probably Upper Cretaceous in age.

Unfortunately the fossil bones in association with the egg-remains are exceedingly rare in all the localities. This is showing in Table 6, p. 156.

From the given table the following forms are known:

Two coelurosaurians,

A lage carnosaurian[1],

1) In Taiho of Kiangsi there are two kinds of dinosaurs, one carnosaurian and one sauropod, but the latter differs in species from that of Nanhsiung (Young, 1963).

A sauropod,
A hadrosaurian,
A nodosaurid,
A chelonian, *Nanhsiungchelys wuchingensis* Yeh[1].

All these fossils indicate clearly the Upper Cretaceous age although they are poorly represented. This conclusion fit well with that reached by the study of the eggs.

Therefore it is evident that at least the upper part of the Nanhsiung Group is Upper Cretaceous in age.

V. To what animals our fossil eggs belong

Now we are in position to discuss the important problem, to what animals our fossil eggs belong?

First of all we have to make clear that it is not necessary at all that those forms of eggs we have described represent a real species in biological sense. The various names given for those eggs are nothing but to denote morphologically their difference in size, shape and other features. Each form of the different eggs may or may not be produced by one species, since the size, shape and the ornamentation of the eggs vary considerably even in each form. In Plate XVI we have given several recent eggs of reptiles and hens. B, turtle (gen. et species indetermined). C, a crocodile (possibly *Alligator sinensis*); D and E, hen. With the exception of the very characteristic egg of turtle, the others are more or less elongated. The two eggs of hens are quite different, including the surface ornamentation. E is especially long with vermiculated spots near the equator. This is an egg of extremely elongated type, although it is most probably an abnormal development. These features indicate how difficult it is to distinguish forms of animals merely by means of eggs.

In addition, all the eggs of the present collection are very poor in associated bones which, if any, are fragmentary in preservation. This makes certainly our determination of the belonging of the eggs more unsatisfactory.

Therefore the following statements concerning the systematic position of the known fossil eggs are entirely preliminary. Based on the present available data, they seem, however, the most probable suggestions we can deduce at present.

First, the rounded eggs. They are present in Nanhsiung and Laiyang and possibly also in Kanchou. In Laiyang even two forms are present, one is *O. spheroides* in proper sense and the other is *O. megadermus*. Chow (1951) suggested that the former eggs may belong to a hadrosaurian. But according to Lapparent (1955 in Piveteau, p. 924), the egg of the oval type belongs to *Hypselosaurus priscus*, a sauropod under the family Titanosauridae and the Chinese genus *Euhelopus* is referred also to this family by the same author. The size and shape of the egg are closely comparable to our *Oölithes megadermus* (Plate XIX, A). If the determination of Lapparent is correct, it is very likely that not only *O. megadermus* belongs to a sauropod but also *O. spheroides* to the same suborder or carnosaurian of the order Saurischia. In Nanhsiung, Taiho and Laiyang teeth of carnivorous dinosaur are known, a fact supports the latter assumption. It is, therefore, possible that the large oval eggs belong to sauropdious dinosaur and the small oval eggs to carnivorous dinosaurs. It is of course not wise to give a precise determination to which

1) Personal communication by H. K. Yeh.

genus or species those eggs belong to.

In the foregoing description, we have already pointed out that the second form of eggs, *O. elongatus,* is very similar to the eggs of *Protoceratops*. To compare the eggs figured by Brown and Schlaikjer (1940) and Lapparent (1955, p. 925) and those of ours (Plates IX—XII), the similarities are very striking. (In this connection we must point out that like in the case of the lower figure of Plate 12 of Brown and Schlaikjer, the nest figured in Plate XIX reproduced from Lapparent shows also the under side of the nest. This makes the comparison much easier.)

The trouble is that both in Nanhsiung and in Laiyang where rather extensive collections of eggs have been made, there is no trace of the presence of *Protoceratops* or even its related form. On the other hand, in Laiyang there are rich remains of hadrosaurians like *Tanius* and *Tsintaosaurus* and some poorly preserved hadrosaurs and stegosaurs. In Nanhsiung we have two kinds of hadrosaurs and one nodosaur, all very fragmentary. It is therefore probable, that the elongated eggs belong to one or the other named genus, if not belong to *Protoceratops* not yet discovered.

In doing so, it becomes also apparent that the other larger elongated form, *O. rugustus,* must belong also to ornithischian dinosaurs. As already pointed out the variation of eggs is great. It is possible that the larger eggs were produced by larger ornithischian like *Tsitaosaurus* and the smaller elongated eggs may be produced by some other form like ceraptosian or stegosaurian. Of course it is well-known that the size of the eggs in reptiles does not necessarily in proportion with the size of the body.

The present view is essentially in accordance with that given and illustrated on the eggs by Colbert (1962).

At last, the identification of the systematic position of *O. nanhsiungensis* is clearer. Since it is found in association with the large turtle, described by Yeh as *Nanhsiungchelys wuchingensis,* from the same locality, and in addition, the size and the shape of the eggs have most probably nothing to do with those of dinosaurs, we consider that these small eggs belong most probably to the named turtle.

To sum up, the rounded eggs are referred to Saurischian, one to carnosaurian and the other to sauropod. In addition the small elongated eggs, *Oölithes elongatus,* may also belong to one or other Ornithischian if not to *Protoceratops*. The large elongated eggs are possibly produced by a larger hadrosaur, like *Tsintaosaurus*. The small rounded and thin-shelled eggs are most probably those of the Nanhsiung turtle. See Table 7, p. 158.

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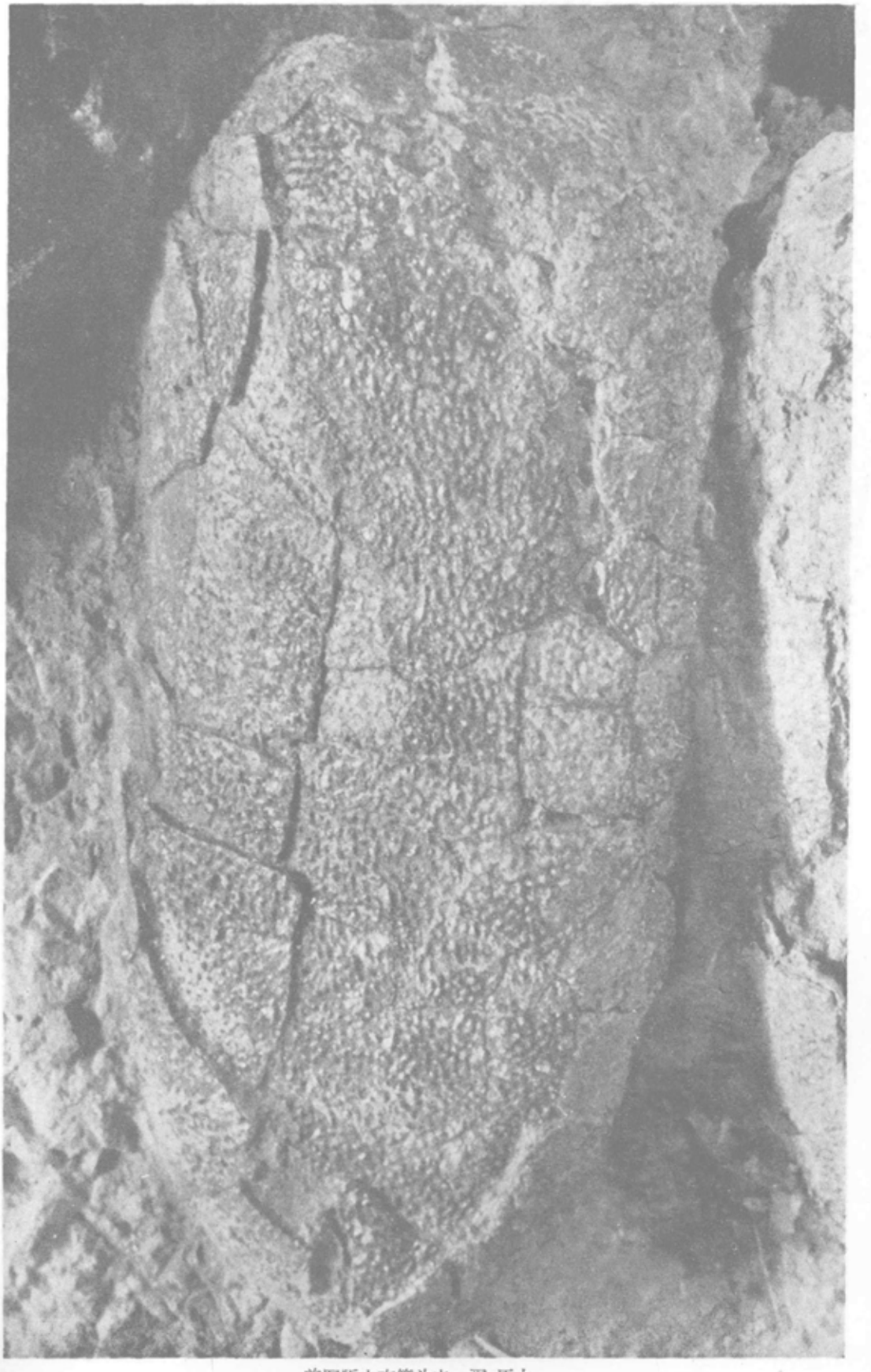
粗皮蛋的一窝 (V.2784(6220))，正在修理中的照片，1/5 原大。
Oölithes rugustus A nest of eggs (V.2784(6220)). A plate taken during half way of the preparation. 1/5 nat. size.

同前图，修理完成后之情况，有箭头之蛋见图版 III，1/5 原大。
Same as the preceding plate after the final preparation. The egg with arrow is shown in Plate III. 1/5 nat. size.



前图版中有箭头之一蛋，原大。
The egg marked with arrow in preceding plate showing in natural size.

粗皮蛋之另一窩 (V.2788(6224))，未修理完毕前之情形，1/5 原大。
Oölithes rugustus. Another nest of eggs (V.2788(6224)) before the end stage of preparation. 1/5 nat. size.

前图修理完毕之情况，1/5 原大。有箭头一蛋见图版 VI。
The same as the preceding plate after the preparation. The one with arrow is shown in the following plate. 1/5 nat. size.