

甘肃酒泉盆地西北部志留纪珊瑚化石*

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1955年中国科学院古生物研究所穆恩之教授及李积金同志等至甘肃西北部酒泉盆地研究地層,在南山系中采集了一些令人异常注意的珊瑚化石,并惠贈作者予以鑒定。由于对南山系中珊瑚化石以往知道得很少,因此將这些經鑒定过的化石标本作一簡單的描述和报导还是完全有其必要的。

南山及其鄰区的地質,曾經中外許多地質学家进行过詳細的研究,但是由于变質程度很深,化石稀少,南山系的地質时代及其上下界限很久未得解决。就作者目前所知已故計榮森先生曾經描述过南山系頂部石灰岩中采得的二塊床板珊瑚化石,但因标本保存不好,且已遭受变質,故未能鑒定种名,其时代也只能粗略地暫定为下石炭前紀(Pre-Dinantian)或泥盆紀。1947年尹贊勛、王尚文二位先生在玉門县境的南山系中發現笔石,因而确定了其中有中下志留紀地層的存在,1954年边兆祥先生曾發表了“宁夏的南山系”一文,在文中对宁夏南山系的时代作了比較詳尽的討論,并認為其时代应新于寒武奥陶紀而老于下石炭紀。

南山系的地層据陈庆宜、穆恩之、徐旺、王平等的未出版报告,可分为三个部分自上而下:

旱峽系 以紫紅色石灰質砂岩为主,夾含頁岩及很薄的石灰岩透鏡体,輕微变質,厚度約在1000米以上,其时代在野外定为泥盆紀,其中仅采得一塊可以鑒定的珊瑚化石。

泉腦溝系 上部:頁岩及砂岩

中部:頁岩夾富含珊瑚类化石的石灰岩

下部:頁岩及砂岩,頁岩中含笔石化石

本系厚約1300多米,俱經变質作用,其时代定为志留紀。

妖魔山系 其时代未能十分确定,因其位于泉腦溝系之下,并且其中發現过奥陶紀

* 1956年8月20日收到

化石以及近似于华北寒武纪之鲕状灰岩,故其时代定为寒武奥陶纪。

本文所描述的大部分材料均采自泉脑沟系中部,计有下列各种属。

Ptychophyllum (*Nanshanophyllum*) *typicum* Yu

Ptychophyllum sp. ind.

Paleofavosites hansiensis Yu 新种

Favosites forbesi Edwards & Haime

Favosites forbesi var. *multiporoides* (var. nov.) 新变种

Halysites elongatus (sp. nov.) 新种

Heliolites interstinctus var. *abnormis* (var. nov.) 新变种

就珊瑚化石性质来分析 *Favosites forbesi* 分布很广是世界各地中志留纪至上志留纪下部常见的化石,在波罗的海的哥特兰岛及其在苏联境内沿岸地区,英国以及在朝鲜西北部的 Kinnho 灰岩中都被描述过。在中国境内如湖北的罗惹坪统,滇东的马龙灰岩以及滇西的挖色层中也均曾发现过。就单体四射珊瑚 *Nanshanophyllum typicum* 来看,虽然它是一个新亚属,然而与其相近似的一些种属大都是发现于欧洲、澳洲等地的中志留纪及上志留纪下部的地层中,同时在本系中发现的一些太阳珊瑚和链珊瑚也都带有中志留纪的色彩。这些事实说明了含珊瑚化石的地层时代应为中志留纪即温洛克期。和我国南方标准中志留纪地层罗惹坪灰岩可大致相当。

此外, *Paleofavosites* 在玉门县旱峡的旱峡系中发现是件值得注意的事情。这一属最初是出现在苏联乌拉尔西坡及北美等地的中奥陶纪地层中,而至下和中志留纪则达到其繁育之鼎盛时期,苏联境内波罗的海沿岸地区,瑞典的 Greenland 岛,北美的 Anticosti 岛,英国,澳大利亚,朝鲜西北部以及蒙古等地的下或中上志留纪地层中均有发现,因而亦成为一广阔分布的属,但却从未在泥盆纪地层中发现过。这一属在中国境内也还是初次发现。 *Paleofavosites* 在旱峡系中的发现可能表示旱峡系中可能含一部份志留纪的地层。或者此属可能延至泥盆纪。因为我们所拥有的化石材料太少,而且又是一个新种,还不能确切的结论。无论如何旱峡系中的珊瑚化石还是值得继续研究的。

本文之成,承穆恩之教授惠赠标本,并给予宝贵指示,王鸿祺教授在百忙之中详尽地审阅了原稿并给予亲切的鼓励和宝贵的指示。斯行健教授详尽地修改了英文原稿并给予重要的指示,作者谨向他们致以深切的谢意。

种属描述

珊瑚纲

四射珊瑚亚纲

科 Acanthophyllidae

属 *Ptychophyllum* Edwards & Haimo, 1850

亚属 *Nanshanophyllum* 新亚属

特征: 单体珊瑚, 隔壁很多, 一级隔壁及次级隔壁的边缘部分均显著加厚, 并且在一级隔壁的轴端亦有着同样的加厚, 隔壁在对象限区较主象限区者生长为速, 主内沟显著呈狭长形, 脊板发达, 鳞板发育组成珊瑚体的大部分, 牀板被分化成内外二带。

基型种: *Nanshanophyllum typicum* 新亚属新种

甘肃西北部酒泉盆地、中志留纪泉脑沟系

(图版 II, 图 4—6)

野外号碼 CF 85 登記号碼 PB 8693, 8694

讨论: 此新亚属长而边缘部分加厚了的隔板, 及其宽阔的鳞板带等特点颇与 *Ptychophyllum* Edwards & Haime 相近似, 但是他们中间主要的差别, 并且亦是作为此一新亚属创立所依据的特点, 在于我们的标本中隔壁较短并未在中心内卷成假中柱, 而且隔壁的加厚部分亦不仅仅是局限于边缘部份, 在一级隔壁的轴端亦同样是加厚着。

此新亚属同样可以其隔壁加厚的形状以及宽阔的鳞板带等特点与 *Acanthophyllum* Dybowski 相比较, 但是大多数的 *Acanthophyllum*, 却除去为 Hill 在 1939 年所描述的特化了的种以外, 隔壁均呈梭状, 即其加厚的趋势, 分别向轴部及周边部份减弱。

就其具有分化了的牀板以及加厚而且有脊板的隔板形状来看, 本亚属颇与 *Entellophyllum* (*Xylodes*) Wdkd. 1927 接近, 但是它们之间显著地不同处在于隔壁加厚部分以及隔壁的构造。

Nanshanophyllum typicum (Subgen. & sp. nov.) 新亚属新种

(图版 II, 图 4, 5, 6)

特征: 同属的特征。

描述: 本种仅有一块保存不太完美的标本, 外部形状未知, 但从薄片中看来似呈弯阔锥状。在直径为 26 毫米的横切面中计有 84 个长短相间的隔壁。一级隔壁较长可达

軸部,并微显向一方扭轉的趋势,次級隔壁进入軸部后又复变粗,在横切面上于是形成二个较为明显之隔壁加厚帶,一在珊瑚体的边缘部分,另一则在軸部;脊板發达,如同所有志留紀珊瑚所具脊板的形状一样呈曲折狀排列。鱗板發育,在边缘部份組成較寬的鱗板帶。床板分化成内外二帶,內帶中的床板排列較紧密,水平狀,稍有起伏;外帶中的床板不太規則,互相交叉。

比較:此种与 *Ptychophyllum* (?) *kinllei* Smith 1945 頗相近似,但所不同之点在我們的标本中,隔壁相对地來說是比較短的,在軸部并未扭曲成一假中柱,再者,在我們的标本中隔壁的加厚部分并非仅仅是局限于鱗板帶內而且亦并無向边缘部变細現象。

当前的标本以其長而具有脊板并且是加厚了的隔壁以及寬闊的鱗板帶等特点也可与 *Acanthophyllum nansfieldense* (Dan) Hill 1939 相比較,但是我們的标本中所具有的一些特点如床板的分化現象,以及內溝的出現等特点,在 Hill 的标本中却始終未見到。再者,我們的标本亦并無間歇性膨脹的隔壁存在,这些均可作为与后者的区别处,据作者看来 *A. nansfieldense* (Dan) Hill 1939 可能代表 *Acanthophyllum* 中一个特化了的种,而与我們的亞屬性質比較密切些。

此外,在我們的标本中一些較為突出的特点,即隔壁在边缘部与軸部同时加厚了的特点尚可以跟其他一些比較接近的种相区别,如 *Phaulactis near angusta* Smith 这一种 1940 年 Hill 曾經建議將其归入 *Entellophyllum* 中,其与本种近似之处在其較長的隔壁,床板的分异以及主內溝的出現等等特点,但是該种的隔壁加厚部分,仅仅是局限于隔壁的軸端。又如本种与 *Entellophyllum* (*Xylodes*) *pseudodianthus* Weissert 亦頗相近似,該种于 1944 年曾被王鴻禎教授采用作为他所創立的新亞屬 *Stereoxylodes* 的亞屬型,然而后者的隔壁加厚部分是仅仅局限于边缘部分。

产地及層位 与屬相同。

Ptychophyllum sp. ind.

(圖版 II, 圖 7)

这是一塊保存在石灰岩內破碎的标本,外形無法得知,并且只能制取一个横切面,在直徑为 17.5 毫米的切面中計有 70 个隔壁,一級隔壁長达中心,并在軸部互相扭結,次級隔壁的長度为一級隔壁長度的 $\frac{1}{3}$ — $\frac{1}{2}$,彼等的边缘部分均显著加厚,然而逐漸向軸部变細,脊板發育呈曲折狀排列,鱗板發育。

討論:此标本与 *Ptychophyllum* E. & H. 屬下的几个种均比較接近,但是所不同之处,本标本的隔壁較少而且珊瑚的体徑亦远較其為小,是否能代表一新种,由于标本

之破碎無法取得更多的切面,因而进一步詳細的鑒定于是就感到困难。

产地及層位 产于甘肃西北部酒泉盆地,中志留紀石灰岩中。

野外号碼 CF 85 登記号碼 PB 8696。

珊 瑚 綱

床板珊瑚亞綱

目 Favositacea Wdkd. emend. Sokolov

科 Favositidea Dana, emend. E. & H. emend. Sokolov

屬 *Paleofavosites* Twenhofel, 1914

Paleofavosites hanhsiensis Yü sp. nov. (新种)

(圖版 I, 圖 5, 6)

特征: 复体珊瑚,塊狀,單体的形狀主要为六边形,較小,直徑自 0.8—1.2 毫米;体壁較薄,隔壁刺不太發育;床板水平稍有傾斜或弯曲,排列較紧密,5 毫米長度內計有 15—16 个床板,壁孔圓形,小,直徑約 0.2—0.27 毫米,全部位于相鄰个体間的体壁角上。

描述: 塊狀群体珊瑚,其完整的形狀由于是包含在石灰岩內,故無法得知。單体呈規則的多角形,大部分为六角形,有些是五角形甚至是四角形,但后者在切面中較少見到;各單体間体徑相差不太大,約 0.8—1.2 毫米左右,而以体徑为 1 毫米者較為普通,时常在切面中可以看到許多較小的个体圍繞在較大的个体周圍排列成規則的圖案;体壁較細,在橫切面中显得較直,可是在縱切面中却成弯曲狀,連接相鄰个体間的体壁,其总的厚度約为 0.05—0.08 毫米。隔壁刺發育。床板薄,水平狀,但稍有弯曲和傾斜,有时相鄰的床板可以互相融合在一起,床板的間隙不太一致,但却比較紧密,在 5 毫米長度內約为 15—16 个。壁孔由于重結晶之故显得不太清楚,但一旦出現很清楚地可以看出他們均位于体壁的棱角上,呈圓形,很小,直徑約 0.2—0.27 毫米,相鄰壁孔間之間距約为 0.2—0.4 毫米。

注釋: 基于以上的描述特别是壁孔排列在棱角上的特点显然應該把此种归入 *Paleofavosites* 屬內。就其形狀、大小、个体間排列的形式及床板的排列等等特点,該种是很容易区别于所有与其有关的种的,故作者在此將其定为一新种。

产地及層位 作者在此暫將其归入志留紀,原因在序言中已詳为討論,产地甘肃酒泉盆地早峡早峡系中。

野外号碼 ×××登記号碼 PB 8688, 8689 (正型标本)。

屬 *Favosites* Lamarck, 1816*Favosites forbesi* Edwards & Haime 1851

(圖版 I, 圖 1, 2)

同义对比表列于英文描述部分中

· 这一广布于世界各地的种, 这里我們拥有三个以上的标本, 它們均和那些野外号碼为 Cf. 85 的珊瑚共生于同一層位。群体珊瑚由許多角狀的單体組成, 單体的形狀与大小都不相同, 比較大些的个体常散布在許多較小个体的中間呈六角形或八角形, 其体徑为 1.5—2.0 毫米, 很少是在 2.0 公厘以上; 較小的珊瑚个体其直徑为 0.5—1.2 毫米, 四边者居多很少是成三角形。体壁直, 較厚, 其厚度約为 0.05—0.1 毫米。隔壁刺在各單体中發育不太平均, 有些單体中較多, 但另一些中却很少。床板薄, 在各标本中排列方式都不同, 有些是間隔較規則但有些却是呈紧密与稀疏相間的形式, 一般都是水平的, 但有时却稍有傾斜或弯曲。壁孔由于重結晶之故一般不太明显, 很小, 直徑約 0.1 毫米, 排列成一到二列。

注釋: 根据 O. A. Jones (1936) 的意見, *F. forbesi* 被認為是 *F. gotlandicus* 的一个 form 其所以有不同形狀与大小的个体是由于周圍个体間相互影响, 相互制約之故 (form envirimental), Johnes, 并重申了这一类型 (form) 的特点为具有較多的刺与較厚的体壁。苏联古生物学家 Sokolov 在 1952 年对于 *F. forbesi* 的特点作了比較詳細的討論, 他認為表現在个体間形狀与大小不一的珊瑚体的强烈繁殖能力是完全具备了作为种的特点的。作者在这里完全同意 Sokolov 的意見 *F. forbesi* 应被認為是一个独立的种, 它的特点應該是如下所述的:

(1) 个体的大小不等, 其体徑的差异范围約在 0.5—2.0 毫米之內, 虽然有时大者其体徑可达 2.5—3.0 毫米, 小者甚至低于 0.5 毫米, 但是这种情况是少見的。

(2) 体壁較厚, 壁刺發育。

(3) 床板較密間隔不太規則。

(4) 壁孔較小, 其直徑約为 0.1—0.2 毫米。

产地及層位 甘肃酒泉盆地积陰功台, 中志留紀。

登記号碼 PB 8684, 8685

Favosites forbesi var. *multiporoides* (新变种)

(圖版 I, 圖 3, 4)

塊狀不規則的群体珊瑚, 長 6.3 厘米, 寬度最大者可达到 6.0 厘米, 底平坦, 其直徑

为 2.4 厘米。

各單体間的形狀与大小各异, 多角狀, 較大的个体呈六边形或八边形或稍具圓形, 其体徑为 1.6—2.0 毫米, 其余較小的單体均圍繞其周圍呈五边形和四边形, 很少呈三角形的, 他們的体徑也大小各异, 大部分为 0.6—1.2 毫米, 在很少的情况下是小于 0.5 毫米的。体壁不等厚, 多少显得有些弯曲, 連同介于相鄰个体間之白帶一起計 0.1—0.15 毫米厚。壁刺很多, 短而尖銳垂直于体壁, 有时稍有傾斜。床板薄, 完整, 呈水平狀, 有时稍有傾斜, 偶而互相交叉, 在 5 毫米長度內計有 9 个床板。壁孔不太明显, 看来似乎是成双行排列, 其直徑为 0.13 毫米。

比較: 本种近似于 *F. forbesi* 处在其較小的及体徑不同的个体, 然而区别之处同时也是接近于 *F. multipora* 之点在其發育較多的隔壁刺以及比較厚的体壁。

从上述的一些特点看来此种似乎为介于 *F. forbesi* 及 *F. multipora* 間一过渡类型, 由于大部份特点都是接近于 *F. forbesi*, 故作者定其为 *F. forbesi* 的变种。

产地及層位 甘肃酒泉盆地西北部积陰功台, 中志留紀。

野外号碼 CF 85 登記号碼 PB 8686, 8687。

科 Halysitidae Edwards & Haime, 1849

屬 Halysites Fisher, 1813

Halysites elongatus Yü sp. nov. (新种)

(圖版 II, 圖 1, 2, 3)

特征: 鏈狀群体珊瑚, 由鏈所組成的網眼不太規則, 个体較小, 呈長橢圓形, 体壁較厚, 床板較平, 微向上方凸起, 在 5 毫米長度內計有 12 个, 隔壁刺不發育, 間隙管較小, 呈四边形。

描述: 塊狀群体珊瑚。網眼較小而且不太規則, 常呈狹長形, 其寬度仅 2—4 毫米; 一鏈由 3—11 个單体珊瑚組成。个体較小呈長橢圓形, 为間隙管分隔; 个体的長徑約 1.3—1.6 毫米, 其短徑則約为 0.48—0.75 毫米。体壁較厚, 其厚度約 2 毫米左右, 床板平坦, 中部稍微向上突起, 在 5 毫米長度內为数約 12 个, 間隙管較小, 呈四边形, 体徑为 0.35 毫米, 其內部構造由于重結晶之故, 显得模糊不清, 其中的床板似乎呈水平狀, 在 1 毫米長度內計有 3 个, 隔壁不發育。

討論: 从新种所具备的一些特点来看, 如群体中較小及排列不規則的網眼, 个体的形狀較小而呈長橢圓形等等, 是很容易与本屬之基型种 *H. catenularia* 区分的。

此外, 就本种中各單体的形狀和大小来看, 它又与朝鮮产的 *H. sapporiporoides*

Shimizu, Ozaka & Obata 1934 頗相近似,但是區別于后者之处在其床板之排列方式以及間隙管的出現等等特点。

产地及層位 甘肃酒泉盆地积陰功台,中志留紀。

野外号碼 CF 85 登記号碼 PB 8690, 8691, 8692。

Heliolitida Lindström

科 Heliolitidae Lindström

屬 Heliolites Dana, 1846

***Heliolites interstinctus* Linne[V] var. *abnormis*.**

(圖版 II, 圖 8, 9)

特征: 半球狀或穹窿狀之群体珊瑚,大管的体徑几乎相等,体壁較薄,隔壁較長可延伸至近軸部处,或者在近軸部处互相交叉,具有中柱,床板水平狀稍有凹凸起伏現象,小管呈規則的多角狀,四边、五边或者甚至六边形。狀板排列較紧密。

描述: 在研究材料中,本种仅有一塊破碎的标本,其一半已被風化侵蝕掉,而且由于变質作用的影响已高度矽化。从标本看来它是呈半球形或穹窿形,具平坦而有同心狀飾紋的底面,連同已風化掉的一半估計在內約有 70 毫米高,底面直徑約 130 毫米。

大管圓形,邊緣稍有曲折,直徑約 0.8—1.1 毫米,各个体間的体徑相差不太大通常总在 0.9 毫米左右。相鄰大管間之間距約为 1.0—1.8 毫米,很少相隔 2 毫米的,在它們中間相应的排列着 5 个到 9 个小管,大管之体壁較薄,但与小管的体壁相比还是厚得多,其厚度为 0.05 毫米。隔壁發育,很長,有时可以达到軸部与中柱相連,大部分是在近軸部处相交,在大管的中部几乎無例外的出露着中柱,成扁豆体狀或細板狀,在縱切面中則表現为一不連續的白綫;床板完整一般是呈水平狀,稍有曲折起伏,有时互相相交,在 5 毫米的長度內約有 13—15 个。小管照例是成多角形,四边五边或甚至六边形的都有,各小管之直徑約 0.2—0.4 毫米。体壁薄,分布在小管中的床板較薄,排列很紧密,在 5 毫米長度內約有 19—20 个。

比較: 本种非常接近于 *H. interstinctus* 处,在其具有較長的隔板以及中柱之出現等特点,但區別于后者之处則在其隔壁較長可以达到中心,在近軸部处相交或与中軸相連;在这个特性上他也与 *H. parvistella* Roemer 有某些近似之处,但是它們間主要之区别点在于本种未曾具有像 *H. parvistella* 那样成網狀之假中柱。

1937 年 Tschernishev 曾經描述过蒙古的一个种, *H. exgr. interstinctus* 在那塊标本中,隔壁也同样的比較長,有时可达到中心并且網狀的假中柱在那塊标本中亦同

样是并不存在,于是那位苏联学者就曾考虑到这块标本应该是 *H. interstinctus* 的一个变种,但是作者在其描述部分或插图中,无论是在纵切面或者是横切面上始终未曾见有作为 *H. interstinctus* 主要特点之一的中柱存在。

在 *H. interstinctus* 中隔壁发育的程度曾经许多古生物学者讨论过,但大部分人的意见都认为 *H. interstinctus* 中的隔壁是比较短,一般只能达到轴部与边缘的中间处,虽然, Lindström (1882) 曾经把一些隔壁较长可达到中间的类型归入 *H. interstinctus* 中,但是他亦指出这并不是 *H. interstinctus* 正常的或典型的代表,于是,本文作者根据标本所表现出的隔壁发育的程度以及其他一些特点将此种定为一新的变种,并认为是可以作为介于 *H. parvistella* 和 *H. interstinctus* 之间的一过渡类型。

产地及层位 甘肃西北部酒泉盆地毛海头、中志留纪。

野外号碼 CF 86 登记号碼 PB 8690, 8691, 8692。

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SOME SILURIAN CORALS FROM THE CHIUCHÜAN BASIN, WESTERN KANSU

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During the course of stratigraphical studies in the "Nanshan Series" of the Chiuchüan Basin, Western Kansu in 1955, Prof. A. T. Mu collected several impressive fossils of corals, which were sent to the writer for determination. Since very scanty information in regard to the corals in the Nanshan series has been hitherto made, a description of these corals seems therefore desirable.

The geology of the Nanshan range and the adjacent area has been studied by many geologists, but the age and the limitation of the Nanshan Series are not yet definitely settled. As far as the writer is aware, the only work dealing with the fossils from the Nanshan Series was made by Y. S. Chi in 1935. In this paper two tabulate corals were described. The specific affinities of these forms cannot, however, be determined due to the highly metamorphic state of preservation. As remarked by Chi, the geological age of Nanshan Series may be of pre-Dinantian, or probably of the Devonian. Many important fossils of graptolites were later discovered by Yin and Wang in 1941. These graptolite fossils were believed by Yin and Wang to be Middle Silurian in age. In a paper published in 1953 entitled "The Nanshan Series of Ninghsia", Pien stated that the age of the Nanshan Series of the former Ninghsia Province is younger than Cambro-Ordovician and older than Lower Carboniferous.

The stratigraphy of the Nanshan Series has been divided by Mu into three subdivisions. In descending order they are as follows:

3. Hansia Series: This series consists of slightly metamorphosed purlish-red calcareous sandstone intercalated with shales and thin limestone lens. The total thickness of the series is estimated at about 1000m. Devonian.

2. Chuan-Nau-Kou Series: The upper part of this series consists mainly of shales and sandstones, the middle part is composed only of shales intercalated with limestones rich in corals, and the lower part is characterized by slightly metamorphosed shales and sandstones. The shales yield graptolites. The total thickness of the Chuan-Nau-Kou series is no less than 1,300 m.

1. Yao-Mo-Shan Series: The rocks of this series are highly metamorphosed. The exact geological age of this series cannot be determined. It is considered

to be Cambro-Ordovician in age.

It was from the Chuan-Nau-Kou series that corals dealt with in the present paper were found. The species and varieties of the Chuan-Nau-Kou series described in the present paper are as follows:—

Ptychophyllum (Nanshanophyllum) typicum (subgen. et sp. nov.)

Ptychophyllum sp. indet.

Palaeofavosites hanhsiensis (sp. nov.)

Favosites forbesi

Favosites forbesi var. *multiporoides* (var. nov.)

Halysites elongatus (sp. nov.)

Heliolites interstinctus var. *abnormis* (var. nov.)

The world-wide spread species *F. forbesi* is reported from the Wenlock to Lower Ludlow in Gotland, England and Baltic provinces of the U. S. S. R. and from the Kinnih limestone in northwestern Korea. In China this species has been recorded from the Lojoping series of Hupeh, from the Malung limestone of eastern Yunnan and from the Waseh formation of western Yunnan. The new subgenus *Nanshanophyllum* strongly resembles those tetracoral forms such as *Ptychophyllum* and *Entelophyllum* mainly from the M. Silurian or the Lower Ludlow (Upper Silurian) of Europe and Australia. The occurrence of *Heliolites interstinctus* and *Halysites* also indicate a Middle Silurian age of the coral-bearing horizon of Chuan-Nau-Kou series, which in age corresponds in a general way probably to the Lojoping series, the typical Wenlock strata of S. China.

The occurrence of *Palaeofavosites* from the Hanshia series of Hanshia, Yumen district is interesting, because it is a characteristic type ranging from the Middle Ordovician to the Middle or upper Silurian, the oldest representative of this genus occurs in the M. Ordovician of Anticosti island of N. America, in the west slope of the Ural Mountains of the U. S. S. R. and in other places. In the Lower and Middle Silurian, this genus reached its maximum development; it has been found in Europe, North America, Australia and Korea in East Asia. The genus is therefore of world-wide distribution. Since no fossils of *Palaeofavosites* have been hitherto found in the Devonian, the discovery of this genus from Hanshia series is of great importance. It is highly possible that a part of Hanshia series is Silurian. The other alternative possibility is that the genus *Palaeofavosites* may persist in China to the Devonian age.

The writer is grateful to Prof. A. T. Mu for kindly forwarding these materials to him for study and for his valuable informations and suggestions on the stratigraphy

of Chiu-chuan Basin.

He wishes to express his deep thanks to Prof. H. C. Wang for his cordial encouragement and valuable suggestions. Finally, the writer is much indebted to Dr. H. C. Sze for his critical reading of the manuscript.

Description of species

Class Anthozoa

Subclass Zoanthoria Rugosa

Family Acanthophyllidae

Genus *Ptychophyllum* Edwards et Haime 1850

Subgenus *Nanshanophyllum* Yu subgen. nov.

Diagnosis: Simple rugose corals, with numerous long, carinate septa characteristically dilated at the peripheral zone of both the major and minor, and dilated again in the axial end of the major septa. Dissepiments well developed and constitute the greater part of the corallum. Tabulae differentiated into an outer and inner series.

Genotype: *Nanshanophyllum typicum* gen. et sp. nov., Middle silurian, Chiu-chuan basin, NW Kansu, China. Pl. II fig. 4-6.

Remarks: The new subgenus agrees quite well with *Ptychophyllum* Edwards and Haime in the long, peripheral dilated septa and in the wide dissepimentarium zone, but the main difference which seems to be of subgeneric value lies in the less longer septa, which are not involved at the center as a vortex in our specimen, and in the nature of dilation on its septa. The septal dilation in our form is not only restricted to peripheral region, but also appear at the axial end of the major septa.

The new subgenus resembles also *Acanthophyllum* Dybowski in regard to the septal dilation and to the wide dissepimentarium, but in most *Acanthophyllum* Dybowski, except some specialized form of this genus as described by Hill in 1939, the septal dilation are spindled, dilation decreasing towards the periphery as well as towards the axis. Furthermore, *Acanthophyllum* does not possess the dominant cardinal fossulae so well seen in our specimen, nor has it in its longitudinal section the well-marked differentiated tabulae as the characteristic of our form.

With regard to the distinctly differentiated tabulae and to the dilated and carinate septa, our form may compare with *Entelophyllum* (*Xylodes*) Wdkd., but differs therefrom in the position of septal dilation and in the septal structure.

The present form appears to be more allied both with the genus *Ptychophyllum*

and the genus *Acanthophyllum*.

Nanshanophyllum typicum, subgen. et sp. nov.

(Pl. II, figs. 4, 5, 6)

Diagnosis: as for the genus.

Description: The species is only represented by a single and not well preserved specimen. The external form is unknown. It may probably be a curved-ceratoid form. There are 84 septa alternately long and short in a section measuring about 26 mm in diameter. The septa in the cardinal quadrants are shorter, while those in the counter quadrants are much accelerated. The major septa reach the central portion, showing a weak enrolling tendency and the minor septa vary from $1/2$ to $2/3$ of the length of the major. Both of them are more dilated at their broad peripheral area, but never form a stereozone and become attenuated gradually toward the centre. When the major septa run into the axial portion, they are characteristically dilated again in their axial end, thus forming in the transverse section two more or less distinctly dilated septal zones, a peripheral and an axial. Carinae, like those characteristic of Silurian forms which form an elbow, are well developed on the whole. The narrow fossulae formed by abortion of cardinal septum are quite distinct. The dissepiments form a wide peripheral area, and constitute the greater part of the coral-tissue. They are large, sloping downward and somewhat flattened in the axial portion. The tabulae are differentiated into an outer and an inner Series. The axial tabulae are closely packed, horizontally disposed, flat, concave or convex, while the periaxial tabulae are more irregular and anastomosed with each other.

Remarks: The present species is most closely related to *Ptychophyllum* (?) *kindlei* Smith, 1945, from which it is, however, distinguished by the less longer septa which are not twisted at the center as a vortex. The septal dilation in the latter form is restricted at the dissepimentarium and taper to a point peripherally.

With *Acanthophyllum mansfieldense* (Dan) Hill 1939, our specimen agrees in the long, carinate and dilated septa, but differs from the latter in the well differentiated tabulae and in the less pronounced periodic, wedgewise septal dilation. It seems to the writer that *A. mansfieldense* probably represents a specialized form of genus *Acanthophyllum*, which is closely related to our new subgenus.

The outstanding character of our specimen, i. e. the dilated septal zone both at the peripheral and at the axial portion is also obviously distinct from its allied forms, *Phanlactis* near *angusta* Smith, which was regarded as a species of *Entelo-*

phyllum by Hill, 1940 in which the septal dilation is restricted at the axial portion. Our specimen agrees with the latter in the long numerous septa, in the presence of cardinal fossulae and in the differentiated tabulae.

With *Entelophyllum* (*Stereoxylodes*) *pseudodianthus* Wang our specimen also agrees in the long carinate and dilated septa, but the septa dilation in the latter form being only restricted to the peripheral area.

Horizon and Locality: From Chiyinkungtai, Chiuchüan, Kansu Province; Middle Silurian. Loc. No. CF85. Holotype. Cat. No. PB 8693, 8694, PB 8695

Ptychophyllum sp. indet.

(Pl. II, fig. 7)

Only a broken specimen embedded within the limestone, the external form of which is unknown, and from which only a transverse section was made, represents the present species.

There are 70 septa at a diameter of 17.5 mm. The major septa are long, reaching the center and involved, the minor septa are $1/3-1/2$ the length of the major. Both of them are more dilated at the peripheral area, but become attenuated toward the center. Carinae are well developed on the whole, and are originated from the zig-zagging of the septa from elbows. Dissepiments well developed.

Remarks: Our specimen closely resembles species in *Ptychophyllum* E. & H., but differs from the latter in the smaller number of septa and size of the corallum. As no more sections can be made, its precise determination is not possible.

Horizon and Locality: Same as the former species Cat. No. PB 8696.

Subclass Tabulata

Order Favositacea Wdkd. emend. Sokolov

Family Favositidae Dana, emend. E. & H. emend. Sokolov

Genus *Palaeofavosites* Twenhöfel, 1914

Palaeofavosites hanhsiensis sp. nov.

(Pl. I, figs. 5,6)

Diagnosis: Massive corallum with corallites mainly in hexagonal shape of more or less small and unequal size, ranging from 0.8-1.2 mm in diameter. Wall moderately thin, with the septal ridge or spine fewer and projected from the inner of walls. Tabulae horizontal, somewhat obliquely inclined, concave or convex

and closely-set, numbering 15-16 in a space of 5 mm. Mural pores circular in outline, about 0.2-0.27 mm in diameter, all situated at the corner of the corallites wall.

Description: Massive corallum, entire external form unknown, as it is embedded within the slightly metamorphic limestone. The corallites are regularly polygonal. Most of them are hexagonal, sometimes pentagonal and occasionally tetragonal in outline. The diameter of corallites ranges between 0.8-1.2 mm, 1.0 mm being common. Often it can be seen that there are numerous smaller corallites surrounding the larger in more or less regular arrangement. Wall moderately thin, straight, but zig-zagging in the longitudinal section, measuring 0.05-0.08 mm in thickness between 2 adjoining corallites. Septal ridge or spine may be preserved in one corallite but entirely obscured in others in one and the same corallum. Tabulae thin, horizontal or inclined, more or less concave or convex. Sometimes two tabulae get fused at the centre of the corallites and forming one single plate. The intervals between two succeeding tabulae varies widely, but are rather closely-set, being 15-16 in a space of 5 mm. The mural pores are not well preserved owing to recrystallization, but, when present, they are situated all at the corner of the corallites wall and arranged in a vertical series. They are of moderately small size, being 0.2-0.27 in diameter, and from 0.1-0.4 mm apart.

Remarks: Based on the foregoing description, this species is obviously assigned to the genus *Palaeofavosites*. With regard to the size, shape, the arrangement of corallites and the tabulae in our specimen, it may be easily distinguished from its allied forms.

Horizon and Locality: The writer tentatively regards the age of the specimen as Silurian. It was collected from Hanshia series, Hanshia, Chuichuan, Kansu Province. Loc. No. CF80. Holotype. Cat. No. PB 8688,8689.

Genus *Favosites* Lamarck 1816

Favosites forbesi Edwards & Haime, 1851

(Pl. 1, figs. 1,2)

1851, *Favosites forbesi* Edwards et Haime. Arch. Mus. d'Hist. Nat. Paris, Vol. 5, p. 238.

1855, *F. forbesi* E. & H.: "A Monography of the British Fossil Corals" Pt. 5, p. 258, pl. 60, figs. 2,2a-e, 2g.

1879, *F. forbesi* Nicholson: "On the Structure and Affinities of the 'Tabulate Corals' of the Palaeozoic Period". p. 56, pl. 1, fig. 7; pl. 2, figs. 1, 1a-b.

- 1902, *F. forbesi* Pocta: "Anthozoaries et Alcyonaires, Systeme Silurien du Centre de la Boheme" vol. VIII, Tome II, p. 236, Pl. LXXVII, figs. 5-9; pl. C, figs. 1-16.
- 1915, *F. aff. forbesi* Yabe et Hayasaka: "Palaeozoic Corals from Japan, Korea and China" p. 67.
- 1926, *F. cfr. forbesi* Grabau, Palaeontology Sinica, ser. B, vol. VIII, fasc. 2, p. 22, pl. 1, figs. 3, 4a, b.
- 1934, *F. cfr. forbesi* Shimizu, Ozaki and Obata: "The Journal of the Shanghai Science Institute" Sec. II, Vol. I, p. 70, pl. XIII, fig. 1, Shanghai.
- 1934, *F. forbesi* Poulsen: "Meddelelser om Gronland, vol. 72, II, No. 1, pl. 1, fig. 1.
- 1936, *F. goilandicus* Lamarck *forma forbesi*, Jones Ann. Mag. Nat. Hist., 10 th ser., vol. 17, p. 9-12, pl. 1, figs. 5-7.
- 1937, *Favosites forbesi* Чернышев, "Силурийские и Девонской Tabulata Монголий и Тувы" стр. 9, табл. 1, Фиг. 3а-б, табл. 4, Фиг. 6а-б.
- 1948, *F. forbesi*, Yang. Fifteenth Anniversary Papers of the National Peking University, p. 129, figs. 1-4.
- 1951, *F. forbesi* Чернышев "ВСЕГЕИ" Министерства геологии Москва; 1951.
- 1952, *F. forbesi*, Соколов "Табляты Палеозоя Европейской Часть СССР" часть 3 р. 47, табл. 17, Фиг. 3-5; табл. 18, Фиг. 1-2.

This world wide-spread species of which more than 3 specimens have been found occur with corals in Loc. CF85 in the same bed.

Corallum massive, composed of numerous polyhedral corallites, varying both in shape and size. The larger corallites are scattered among the smaller, usually hexagonal or octagonal in outline, being 1.5-2.0 mm in their maximum diameter, rarely exceeding 2.0 mm. The smaller ones are 0.5-1.2 mm in diameter, usually tetragonal in shape. Wall straight, moderately thick, 0.05-0.1 mm in thickness. The septal spine are well developed in some specimen but may be fewer in others. The tabulae are thin and variably arranged in the specimen. They may be somewhat evenly spaced or may be alternately close and loose. They are essentially horizontal, but sometimes obliquely inclined both convex or concave. In a space of 5 mm, there are 7-11 tabulae. Mural pores are not well preserved as a result of recrystallization, but when present, they seem to be rather small, about 0.1 mm in maximum diameter and arranged in one or two rows.

Remarks: *F. forbesi* is regarded as a form of *F. goilandicus* by Jones on account of the form environment of the corallites. The main character of the species, as re-

defined by Jones, is the thick wall and the well-developed septal spine. In 1952, Sokolov made a critical discussion on the morphological character of *F. forbesi*, and is of the opinion that the ability for intensive gemmation expressed in the variability of size of the corallites may be an important specific character. The present writer fully agrees with Dr. Sokolov that *F. forbesi* may be regarded as an independent species. The characteristic features of this species are:

1. Corallites of unequal sizes, the limitation of the size variably lies between 0.5-2.0 mm in diameter, though occasionally ranging to 2.5 or 3.0 mm or falling below the minimum.
2. Wall relatively thick and septal spine well developed.
3. Tabulae more closer and irregularly spaced.
4. Mural pores relatively small, about 0.1-0.2 mm in diameter and arranged in one or two rows.

Horizon and Locality: From Chiyinkungtai, Chiu-chuan, Kansu Province. Loc. No. CF85. Middle Silurian. Cat. No. PB8684, 8685

Favosites forbesi var. *multiporoides* var. nov.

(Pl. I, figs. 3,4)

Diagnosis: Massive corallum. with corallites mainly in hexagonal shape or circular in outline. The size of the corallites is unequal. Walls moderately thick, more or less flexuate, with numerous septal spines, both long and short. Tabulae thin, horizontal and complete, more or less concave or convex, numbering 9 in a space of 5 mm. Mural pores small, being 0.13 mm in diameter and arranged in two vertical rows.

Description: Massive corallum. The specimen under study has the following dimensions: height 63 mm, maximum width 60 mm, diameter of base 24 mm. The corallites are polygonal, varying both in shape and size, the larger ones mainly hexagonal or octagonal and more or less circular in outline, 1.6-2.0 mm in diameter. The smaller ones which are interstitial between the larger, are usually pentagonal or tetragonal in shape, mostly 0.6-1.2 mm in diameter, rarely less than 0.5 mm. The total thickness of the wall measures about 0.1-0.15 mm between adjacent corallites. The sharply pointed septal spines project perpendicularly from the wall of the corallites, sometimes showing a slightly upward inclination. Tabulae rather thin, usually complete and horizontal, sometimes obliquely inclined, curving slightly upward and downward, rarely incomplete or intercalated with each other. There are 9 tabulae in a space of 5 mm. Mural pores not well

preserved and seem to be arranged in two rows, size about 0.13 mm in their diameter.

Remarks: The present form closely resembles *F. forbesi* in the relatively smaller and unequal size of corallites, and resembles *F. multipora* in the numerous septal spine, and in the rather thickened corallites wall.

The writer considers the present variety morphologically transitional between *F. forbesi* and *F. multipora*, and would be assigned it to a variety of the species *F. forbesi*.

Horizon and Locality: same as the former species. Cat. No. PB8686,8687

Family Halysitidae Edwards & Maime, 1849

Genus *Halysites* Fischer, 1813

Halysites elongatus sp. nov.

(Pl. II, figs. 1, 2, 3)

Diagnosis: *Halysites* with the meshes of reticulation irregularly arranged, and with rather small and elongated oval corallites. Walls moderately thick. Tabulae flat, slightly arched, about 12 in a space of 5 mm. No septal spine traceable. Interstitial tubuli present, rather small and quadrangular in outline.

Description: Massive corallum. The meshes of reticulation are rather small and irregularly arranged, often narrow and long, about 2-4 mm across. The corallites are rather small and arranged in rows composed of from 3-11 individuals. They are elongated oval in outline and are separated by small interstitial tubuli. The longer axis of the corallite section varies from 1.3-1.6 mm and the shorter axis from 0.48-0.75 mm. The walls are moderately thickened, about 2 mm in thickness. The tabulae are flat, slightly arched. There are 12 in a space of 5 mm. The interstitial tubuli are rather small, quadrangular in shape, about 0.35 in their maximum diameter. The internal structure of the tubuli is obscured by recrystallization. The tabulae in the tubuli appear to be horizontally arranged, about 3 in a space of 1 mm. No septal spine is traceable.

Remarks: The present species is easily distinguished from *H. catenaria*, the type of this genus, by the small size and irregular arrangement of the meshes, by the rather small corallites of elongated oval form, and by the relatively arched tabulae.

With regard to the shape and size of corallites, our specimen bears some resemblance to the Korean species *H. sapporiporoides* described by Shimizu, Ozaka and Obata in 1934, but differs therefrom in the arrangement of tabulae of the corallites and in the presence of tubuli.

Horizon and locality: From Chiyinkungtai, Chiu-chuan, Kansu Province. Middle Silurian. Holotype, Loc. No. CF 85.

Cat. No. PB 8690, 8691, 8692.

Heliolitida Lindström

Family Heliolitidae Lindström

Genus *Heliolites* Dana, 1846

Heliolites interstinctus var. *abnormis* var. nov.

(Pl. II, figs. 8, 9)

1767, *Madreporites interstinctus* Linne. Syst. Nat., ed. 12, p. 1276-7.

1850-1854, *H. interstinctus* Edwards & Haime. British Fossil Corals. p. 249, pl. LVII, figs. 9, 9a-d.

1899, *H. interstinctus* Lindström, K. Sv. Vet.-Akad. Handl. Bd. 32, No. 1, p. 41, pl. II, figs. 1-2; Pl. III, figs. 1-2.

1937, *H. extr. interstinctus*, Труды Монгольской Комиссии № 30, вып. 6, Text-figs. 3,4.

1940, *H.? interstinctus*, Jone & Hill, Proc. Roy. Soc. Queensland, Vol. LI, No. 12, pl. IX, figs. 2a-b.

Diagnosis: Hemispherical or dome-shaped corallum; with tabularia of somewhat equal size. Wall moderately thin, with longer septal spines reaching or touching each other in pair near the centre; central columella well developed; tabulae horizontal, more or less in concave or convex. Tubuli regularly polyhedric in outline, 4-5 or even 6 sided, with sola rather closely spaced.

Description: The specimen at my disposal is weathered incomplete corallum, and was highly silicified by metamorphism. But it appears to have an original hemispherical or dome shape, with a flat and concentrically wrinkled base 130 mm in diameter, and 70 mm in vertical height (together with the weathered half).

The tabularia, circular in outline with slightly exerted margin, has a diameter ranging from 0.8-1.1 mm, commonly 0.9 mm. The distance between two neighbouring tabularia varies from 1.0-1.8 mm, rarely 2 mm, with 5-9 rows of tubuli between. The walls of the tabularia are moderately thin, but are thicker than those in tubuli, being 0.05 mm in thickness. The septal spines arise from within the wall along the edge and are slender and long. They may reach the centre, uniting with each other, and in connexion with them lies the columella. In most cases they touch in pair near the centre of the calicle. In the axial part of the tabularium there is almost without exception a prominent lamellar columella, which

is discontinuous in the longitudinal section. The tabulae are complete, as a rule horizontal, waving slightly upward or downward, sometimes may intersect with each other, numbering 13-15 within a space of 5 mm. The tubuli are in the rule polygonal, 4-5 or even 6 sided and varies in the size between 0.2-0.4 mm in their maximum diameter. The sola are thinner and closer than in the tabulae, about 19-20 in a space of 5 mm.

Remarks: Our specimen strongly resembles *H. interstinctus* in the long septa and in the well-sited columella, but differs from the latter, however, in that the longer septa may reach the centre and connect with the columella.

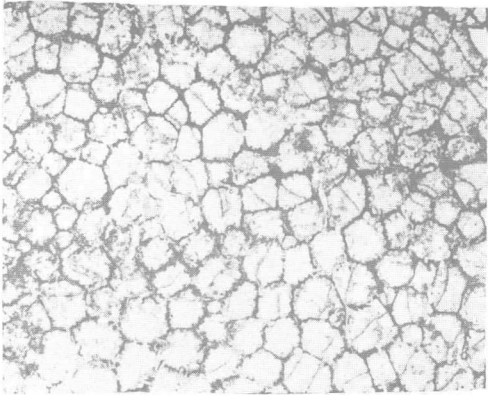
It also bears some resemblance to *H. parvistella* Roemer, but differs therefrom in the absence of network-like pseudocolumella.

In 1937 Tschernyshev described *H. exgr. interstinctus* from Mongolia, in which the septa are similarly longer, reaching the center of the tabularia and the pseudocolumella is also absent. Thus, the Soviet author considers it as a variety of *H. interstinctus*. But from the description and schematic drawing of Tschernyshev, no central columella, the main character of *H. interstinctus*, can be seen whether on the transverse section or on the longitudinal section.

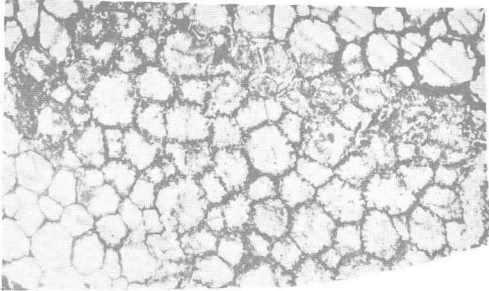
The degree of development of septa in *H. interstinctus* has been discussed by many authors. Many of them are inclined to the view that the septa of *H. interstinctus* are generally short, though Lindström (1882) once had included some form into *H. interstinctus*, in which the septa are long and reach the centre in connexion with the columella, which, according to the same author, is however not a typical or normal form of *H. interstinctus*.

Accordingly, with regard to the degree of development of the septa and other characters, the writer considers the Chinese species to be a new variety. It may be regarded as a transitional form between *H. parvistella* and *H. interstinctus*.

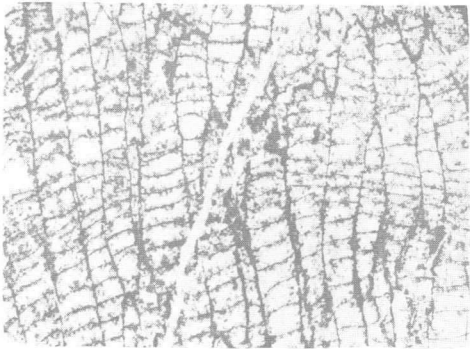
Horizon and Locality: From Mao-Hai-Tai, Chiuchüan Basin, northwestern Kansu, China. M. Silurian. Loc. No. CF85, Cat. No. PB8697, 8698.



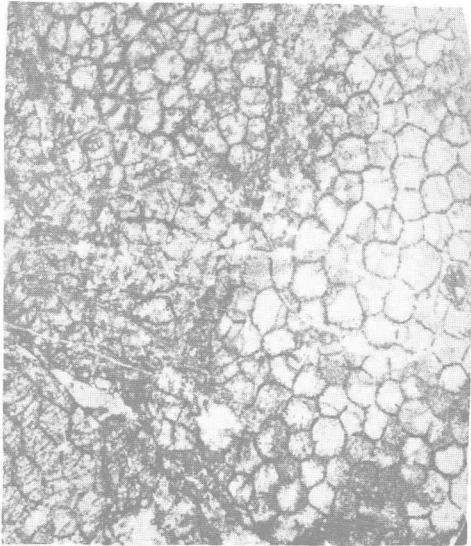
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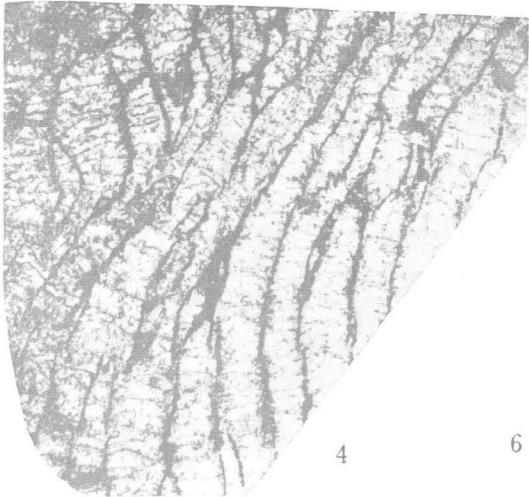
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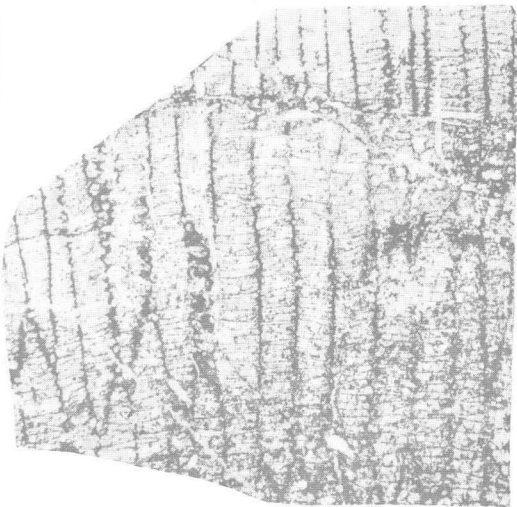
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圖 版 說 明

所有圖影未加任何潤飾, 攝影者为刘雪筠同志, 薄片均保存在中国科学院古生物研究所。

圖 版 I

(版內各圖均系放大 $\times 4$)

圖 1—2. *Favosites forbesi* Edwards & Haime

1. 橫切面 登記号 PB 8684

2. 縱切面 登記号 PB 8685

产地 甘肅西北酒泉盆地玉門县积陰功台, 中志留紀, 泉腦溝系。

圖 3—4. *Favosites forbesi* var. *multioporoides* (var. nov.) (新变种)

3. 橫切面 登記号 PB 8686

4. 縱切面 登記号 PB 8687

产地同上, 正型标本

圖 5—6. *Paleofavosites hanhsiensis* (sp. nov.) (新种)

5. 橫切面 登記号 PB 8688

6. 縱切面 登記号 示壁孔排列位置均在相鄰个体間之角上 PB 8689。

产地 甘肅西北酒泉盆地玉門县旱峽, 旱峽系。

正型标本

圖 版 II

这一个圖版內的圖影其产地同为甘肅省西北部酒泉盆地积陰功台, 中志留紀, 泉腦溝系。

圖 1—3. *Halysites elongatus* (sp. nov.) (新种)

1. 磨光面, 放大 $\times 4$, 示珊瑚个体排列情形。 登記号 PB 8690。

2. 橫切面, 放大 $\times 4$ 。 登記号 PB 8691。

3. 縱切面, 放大 $\times 4$ 。 登記号 PB 8692。

正型标本

圖 4—6. *Nanshanophyllum typicum* (subgen. & sp. nov.) 新亞屬及新种

4. 橫切面, 放大 $\times 2$ 。 登記号 PB 8693。

5. 橫面(磨光面), 放大 $\times 2$ 。示壯年期隔壁排列情形。 登記号 PB 8694。

6. 縱切面, 放大 $\times 2$ 。 登記号 PB 8695。

正型标本

圖 7. *Ptychophyllum* sp. ind.

7. 橫切面, 放大 $\times 2$ 。 登記号 PB 8696。

圖 8—9. *Heliolites interstinctus* var. *abnormis* (var. nov.) (新变种)

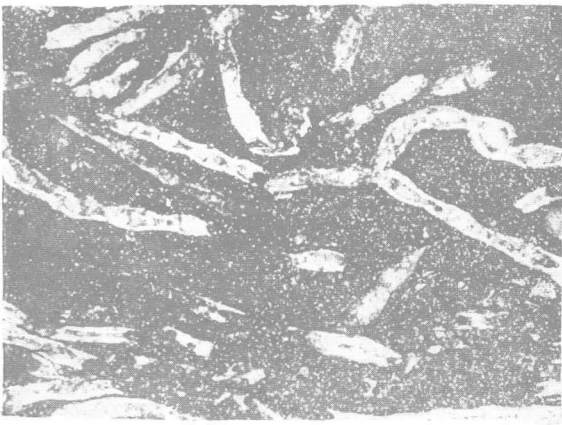
8. 橫切面, 放大 $\times 4$ 。 登記号 PB 8697。

9. 縱切面, 放大 $\times 4$ 。 登記号 PB 8698。

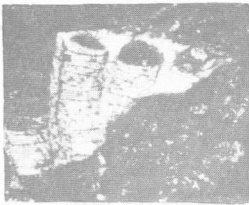
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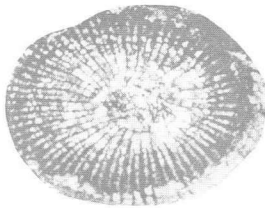
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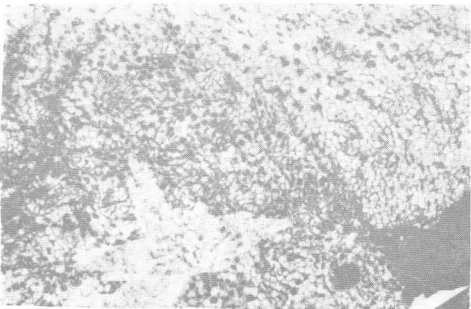
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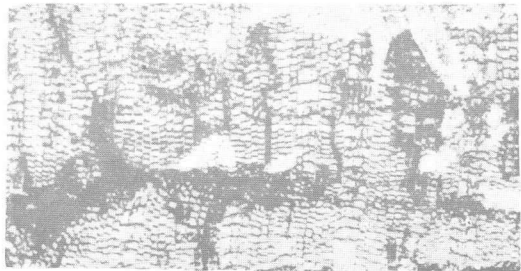
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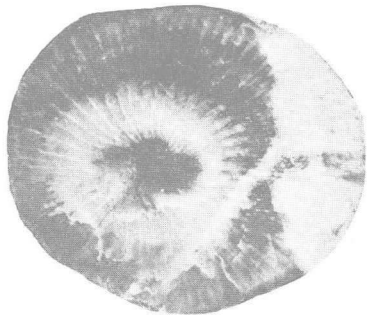
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