

广东南雄上湖组叶肢介化石的发现

——并论中国古新世陆相地层

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一、上湖组叶肢介化石 发现的意义

近十年来,中国早第三纪叶肢介化石的不断发现和报道(王思恩,1974;陈丕基,1975;张文堂等,1976;沈炎彬、陈丕基,1979;沈炎彬、张显球,1979;陈丕基、沈炎彬,1980),从世界范围来讲,是叶肢介化石研究中的一项重大突破和进展,因为在此以前不久,第三纪还被认为是叶肢介演化史上的一个空白锁链(Kobayashi, 1972)。

中国早第三纪的叶肢介化石,曾被划分为三个叶肢介群(张文堂等,1976;陈丕基、沈炎彬,1979),出现最早的一个原称做 *Perilimnadia-Yunmenlimnadia* 群,前者产自江苏、安徽阜宁群第二组或相当地层;后者的层位有争论,究竟是上白垩统上部(湖北公安寨组),还是下第三系,有待进一步采集研究。这里建议只取前一个属名作为中国早第三纪第一个叶肢介群的首要代表,称为 *Perilimnadia* 群,包括 *P. jiangsuensis*, *P. gaoyouensis*, *P. taizhouensis*, *P. lingtangqiaoensis* 等四个种。第二个称做 *Fushunograptia changzhouensis* 群,分布比较广泛,除苏皖地区阜宁群第四组外,还见于杭州湾附近长河组的下部,辽宁抚顺的古城子组,以及河南三门峡和甘肃环县甜水黑沟的下第三系,近年来在蒙古奈玛盖特盆地拉楞布拉克组发现的叶肢介化石(Трусова и Бадамгарав, 1976),依其外形与生长带上装饰的特点,也可能属这一动

物群,除首要分子外,还包括 *F. ovata*, *F. subcycloria*, *F. brachysellipsa*, *F. changheensis*, *F. huaixianensis*, *Cixiella serrulla* 等两属七种化石。第三个称做 *Paraleptestheria menglaensis* 群,分布最为广泛,在云南、广东、湖南、江苏、安徽、浙江、宁夏和黑龙江等地始新世早期地层都有发现(陈丕基、沈炎彬,1980),除代表分子外,还包括 *P. anquilonaria*, *P. mohanensis*, *P. triangularia*, *P. lanpingensis*, *P. jingtianensis*, *P. yunlongensis*, *Nanhaiestheria sanshuiensis* 等两属八种化石。叶肢介在演化史上进入新生代以后虽然走向衰落,但中国早第三纪的这三个化石群经过不断发现和深入研究,仍像在中生代一样,对陆相地层的划分对比有重要作用。

广东早第三纪的叶肢介化石,最初是在三水盆地埤心组找到的,以 *Paraleptestheria menglaensis* 为主,还有少量 *P. baoyueensis* 和 *Nanhaiestheria sanshuiensis*, 及一块保存不完整的 *Fushunograptia* sp., 被怀疑是这个属的孑遗分子。从整体看,埤心组的叶肢介化石应属于 *Paraleptestheria menglaensis* 群。1976年华南红层现场会议期间,笔者与沈炎彬同志一起,又在南雄盆地全安公社营保前附近的浓山组竹桂坑段,采获大量 *P. menglaensis* 化石。关于浓山组的地质时代,在研究脊椎动物化石的学者之中,或与研究微体化石的学者之间,一直都有意见分歧。当时笔者依据新发现的勐腊近狭叶肢介群,支持了早始新世之说,但遗憾处是在下伏无争议的古新世地层上湖组中没有找到叶肢介化石,而关于上湖组的地质时代,在古脊椎动物学

家中间则有早、中古新世(童永生等, 1976; 郑家坚、邱占祥, 1979)或中古新世(周明镇等, 1977)两种说法。关于上湖组与下伏上白垩统南雄组的接触关系, 也有整合与假整合的不同见解(周明镇等, 1977; 何俊德、黄仁金, 1977; 张显球, 1984)。

由上述事实可以看出, *Perilimnadia* 叶肢介群的已知分布很有限, 只在江苏发现; *Fushunograptus changzhouensis* 叶肢介群多年来只发现在华北、西北、东北和东南沿海苏浙皖三省, 在中南和西南广大地区则隐匿不见; 而 *Paraleptestheria menglaensis* 叶肢介群则广布于全国各地(插图 1)。

1983 年冬天, 中国科学院白垩-第三系界线地层研究队重测了南雄坪岭和风门坳两条剖

面, 系统采集无脊椎动物化石和岩石样品, 在室内进行介形虫标本处理分析时, 在上湖组底部和上部都发现了叶肢介化石(插图 2), 经鉴定全属于 *Fushunograptus cf. changzhouensis*, 数量和保存均不理想, 但生长带上的弯曲线状纹饰特征清楚(图版 I, 图 6a, 7a), 对上湖组层位的进一步划分对比, 对深入认识上湖组与南雄组的接触关系, 都是很有意义的。

江苏下第三系陆相地层和化石的研究, 是从五十年代开始的, 从下而上划分为阜宁群、戴南组和三垛组三个大的地层单位, 阜宁群还被进一步划分为一、二、三、四四个组(表 I), 最初确定阜宁群的时代为始新世, 戴南组和三垛组的时代为渐新世, 后来一般将阜宁群一组划归古新统(侯祐堂等, 1982; 宋之琛等, 1981)。

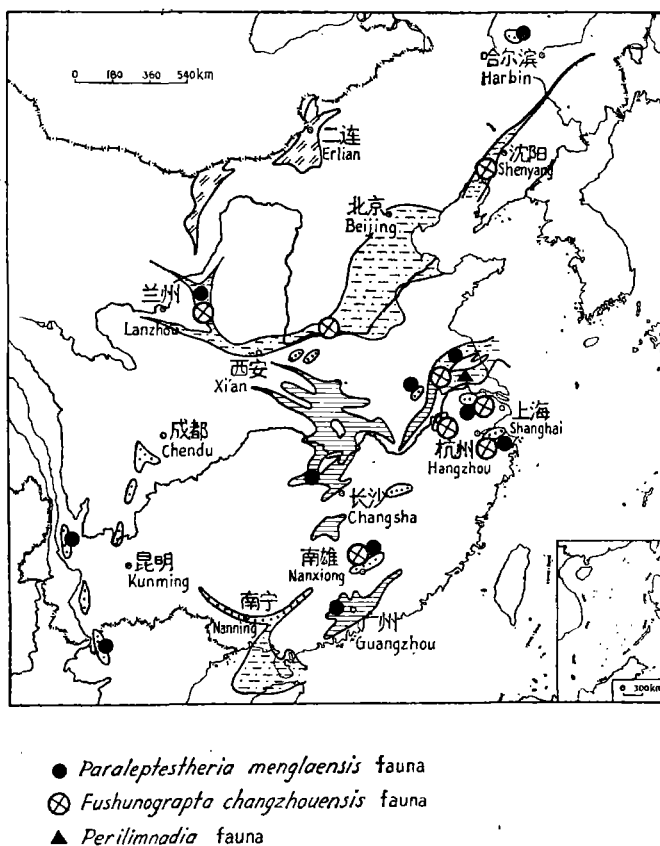


插图 1 中国早第三纪沉积及叶肢介化石分布示意图

Sketch Map showing the distribution of the Paleocene deposits and fossil conchostracans of China

这些层位的化石大多是第一次被描述的,没有可靠的年代对比证据,但二十多年来却成为国内其它地区第三纪陆相地层划分和对比的依据,流传颇广。

江苏下第三系有三个叶肢介化石层,阜宁群第二组产 *Perilimnadia* 群,第四组产 *Fushunograptus changzhouensis* 群,戴南组产 *Paraleptestheria menglaensis* 群。因为当初发现时这些皆为新的属种,关于时代意见,笔者曾从旧说,未敢妄加推断(陈丕基,1975)。后来由于国内其它地点第三纪叶肢介化石不断发现,特别是由于皖东相当戴南组的红层中脊椎动物化石的研究,如来安县张山集组的 *Rhombomylus laianensis* (翟人杰等,1976),宣城双塔寺组的古脊齿兽、中兽、中华柱兽动物群(郑家坚、邱占祥,1979;徐钦琪,1976),曾使笔者在报道南雄浓山组的叶肢介化石时提出 *Paraleptestheria menglaensis* 群的时代为早始新世,推测 *Fushunograptus changzhouensis* 群的时代为始新世最早期, *Perilimnadia* 群的时代为古新世,并进而指出“江苏古新统的发育和完整程度不会在广东南雄之下,而且是另外一种沉积类型”(陈丕基、沈

炎彬,1980,186页)。后来,又就这一意见略做了发挥和补充(Chen Pei-ji and Wang Zhen, 1984),但囿于原有资料,尚有许多不足。

周明镇等(1977)曾经指出,上湖组阶齿兽(*Bemalambda*)动物群的时代为中古新世,上湖组与下伏上白垩统南雄组之间是假整合接触。但如上所述,还有一些人认为上湖组的时代为早、中古新世,与南雄组是整合接触。这次常州抚顺雕饰叶肢介(*Fushunograptus changzhouensis*)群在上湖组上、下部的发现支持了周说,因为按照江苏下第三系的划分对比,上湖组只相当于阜宁群第四组,下面还缺失三组地层,说它的时代为中晚古新世也不为甚。对南雄组恐龙化石研究的情况表明,南雄组上部只相当于坎佩尼期(Campanian)(董枝明,1979),至少还缺失马斯特里赫(Maastrichtian)一个阶,因此,南雄盆地白垩—第三系之间有一个相当长的沉积间断。

二、中国古新世陆相地层

我国的古脊椎动物化石工作者,从六十年代初期起,为奠定中国古新统的研究,先是在广

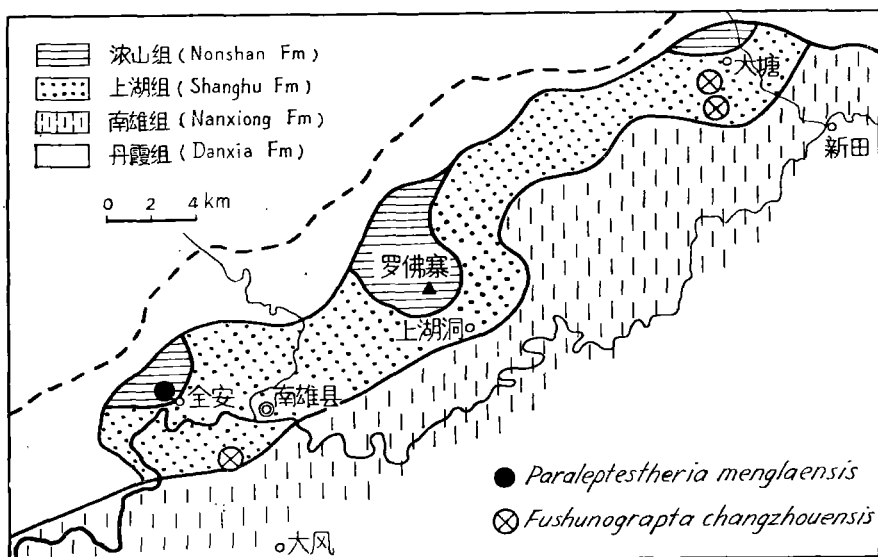


插图2 南雄盆地早第三纪叶肢介化石产地分布示意图

Distribution of the Paleocene conchostracans from Nanxiong basin

东南雄,继之在江西、湖南、安徽和河南等地进行了长期、大量而卓有成效的工作,1976年召开“华南白垩纪—早第三纪红层现场会议”时已做过一次总结。但由于脊椎动物的生态和埋藏保存条件,这些发现和研究工作主要是在山间盆地或湖滨、河流入口处进行的。在此基础上,近年来淡水无脊椎动物和植物化石工作者也对已确定古新世地层中的材料陆续进行了研究和描述报道,综合分析这些已有的成果,笔者在1984年曾经提出中国的陆相古新统有三种类型,又经过一段时间的调查与修正,现详细讨论如下:

1. 山间盆地型:

分布面积小,沉积物薄,以红色为主,例如广东南雄盆地和新疆吐鲁番盆地等,可以前者为例,其划分*和所含化石内容自上而下的情况是:

上覆地层: 早始新世浓山组 354.89m

上部暗棕色粉砂质泥岩为主,与浅棕色钙质粉砂岩不等厚互层,夹青灰、灰绿色泥灰岩、砂砾岩和含砾粗砂岩薄层或条带,产介形类、轮藻、腹足类、龟类、鳄类和哺乳动物化石,厚241.79m,称大塘段;下部棕红色粉砂质泥岩,夹青灰,灰绿色泥灰岩,局部夹含砾砂岩透镜体,产脊椎动物、虫管、藻叠层石、介形类、腹足类、轮藻、叶肢介和植物化石,厚113.10m,称竹桂坑段。其中叶肢介 *Paraleptestheriu menglaensis*; 腹足类 *Policirsas gracilicostata*, *P. obtusospiralis*, *Renistoma regularium*, *R. anomphalum*, *Cirsomphalus laevigatus*, *Amnicola zhenjiangensis*, *Bithynia* aff. *lordostoma*, *Nanxiongospira uniptychia*, *Opea guangdongensis*, *Pupoides zhejianensis*; 介形类 *Sinocypris excelsa*, *S. subfuningensis*, *S. arca*, *S. reticularis*, *S. ovata*, *Eucypris sanshuiensis*, *E. squarrosa*, *E. dongguanensis*, *E. hukouensis*, *Ilyocypris macilenta*, *Parailocypris changzhouensis*, *Cyprois robusta*, *C. buxinensis*, *Candona resupina*, *Cypris pyriformis*, *Cyclocypris nobilis*, *Metacypris biformis*, *Limnocythere honggangensis*; 轮藻 *Neochara sinuolata*, *N.*

squalida, *N. huananensis*, *Peckichara subsphearica*, *P. longa*, *P. varians*, *Croftiella humilis*, *Grovesichara changzhouensis*, *Stephanochara brevivalis*, *S. hukouensis*, *Rhabdochara jiangduensis*, *R. changzhouensis*, *Gobichara deserta*, *Harrisichara yunlongensis*, *H. poculiformis*; 植物 *Palibinia pinnatifida*, *P. kororoinii*; 脊椎动物 *Hokouchelys chenshuiensis*, *Asiatosuchus nanlingensis*, *Planocrania datangensis*, *Lestes datangensis*, *Huaiyangale* sp., *?Pachyaena* sp., *Archaeolambdidae*, *Adapidae*, *Pseudictopidae*, *Phenacolophidae*, *Arctostylopidae*

——整 合——

古新统: 上湖组 272.67m

10. 紫红色粉砂岩、粉砂质泥岩及泥岩互层,局部含灰绿色团块,顶部有10—30cm厚的褐红、灰绿色含砾细砂岩,富含轮藻及腹足类化石 37.89m
9. 紫红色粉砂质泥岩、泥质粉砂岩,夹三层灰绿色薄层钙质砂岩,底部一层较粗并含细砾,产叶肢介化石 (ND305) *Fushunograptia* cf. *changzhouensis* 32.93m
8. 紫红色粉砂质泥岩,富含钙质结核 39.68m
7. 底部紫灰色含砾粗砂岩,往上为紫红色泥质粉砂岩、粉砂质泥岩,夹细砂岩 38.97m
6. 紫红色粉砂质泥岩,富含钙质结核 50.32m
5. 暗紫红色泥质粉砂岩,底部和上部各有一层黄灰色含砾粗砂岩 32.24m
4. 紫红、黄褐色粉砂质泥岩,底部有一段(8m左右)被覆盖 31m
3. 紫红、灰紫色薄层砂岩与泥质粉砂岩互层 3.14m
2. 紫红色粉砂质泥岩 5.8m
1. 黄灰色厚层砂砾岩,砾很细,侧向局部相变为紫红色泥岩与泥质粉砂岩,夹2—3层黄绿色页岩,每层厚1—2cm,含叶肢介化石 (ND172) 0.4—1m
Fushunograptia cf. *changzhouensis*

----- 假 整 合 -----

下伏地层: 上白垩统南雄组

* 这里的分层和厚度是引用大塘区杨梅坑—逆龙坑实测剖面资料。

紫红色砂砾岩和泥岩层,产恐龙、恐龙蛋、介形类和轮藻化石。其中脊椎动物 *Microhadrosaurus nanshiungensis*, *Nanshiungosaurus brevispinus*, *Tarbaurus* sp., *Coelurosauridae*, *Nanshiungchelus wuchingensis*, *Ovaloolithus* cf. *chinkangkouensis*, *O. laminadermus*, *Macroolithus yaotunensis*, *M. rugustus*, *Elongatoolithus elongatus*, *E. anderwsi*, *Nanshiungoolithus chuesienensis*; 介形类 *Talicypridea amoena*, *T. parallela*, *T. biformita*, *T. protracta*, *T. sublatissimata*, *T. globra*, *T. quadrata*, *T. zhutianensis*, *T. hemiselenata*, *T. nanxiongensis*, *Cypridea brevis*, *C. profussa*, *C. trita*, *C. da-fengensis*, *C. cavernosa*, *C. recta*, *Pseudocypridina subterra*, *P. guanzhouensis*, *P. longa*, *Candoniella postrotunda*, *C. subsinensis*, *C. hubeiensis*, *Quadracypris favosa*, *Limnocythere orientalis*; 轮藻 *Latochara cylindrica*, *L. curtula*, *L. eucylindrica*, *L. guanglongensis*, *Charites tenuis*, *C. dalangshanensis*, *Porochara anluensis*, *Gobichara deserta*, *Nemegtichara prima*; 腹足类 *Mesolanistes nanxiongensis*, *M. latericea*, *Lymnaea* sp.

上湖组的厚度有变化,在盆地其它地方 470—600m,在罗佛寨以南上湖洞村以西,与下伏南雄组的假整合接触关系比较清楚,底砾岩层厚,砾石也比较大而典型。

上湖组从上到下都富含介形类、轮藻、腹足类和脊椎动物化石,它们是: 介形类 *Eucypris sanshuiensis*, *Parailocypris changzhouensis*, *Ilyocypris macilentia*, *I. subhuangqiaoensis*, *Cypris pyriformis*, *Cypris robusta*, *C? guangzhouensis*, *Limnocythere nemegtensis*, *Candoniella postrotunda*, *Metacypris biformis*; 轮藻 *Grovesichara changzhouensis*, *Gyrogona huajiazhuongensis*, *Stephanochara microcoaca*, *S. brevivalis*, *Peckichara subsphaerica*, *Sinochara caopiensis*, *Rhabdochara jiangduensis*, *R. changzhouensis*; 腹足类 *Ptychochilus bellus*, *Nystia luminosa*, *Hydrobia datangensis*, *Amnicola datangensis*, *Flumnicola guangdongensis*, *Agallospira multispiralis*, *Zhenji-*

angospira dignata, *Shangjuspira costata*, *Grandipatala? deformis*; 脊椎动物 *Bemalambda nanshiungensis*, *B. pachyosteus*, *B. crassa*, *Yuodon protoselenoides*, *Paladiodon siurenensis*, *Hukouthorium ambigum*, *Dissacusium shanghoensis*, *Dissacus feiganensis*, *Lofochaius brachyodus*, *Linnania lofoensis?*, *Ectoconus* sp.

2. 大河下游平原三角洲水网区;

这些河流生存的时间比较长,沉积厚而完整,如皖东苏北、华北、下辽河、三水盆地等,可以苏皖地区的层序为例:

上覆地层: 早始新世戴南组

上部浅棕、灰白色砂岩夹暗棕色泥岩; 下部灰白色砂砾岩,褐色与灰黑色泥岩夹砂岩,含介形类、轮藻、叶肢介和孢粉化石 550m
产叶肢介 *Paraleptestheria menglaensis*, *P. (?) jingtianensis*; 介形类 *Sinocypris reticulata*, *Ilyocypris gaoyouensis*, *I. aff. cornae*, *Cypris decarryi*, *Limnocythere hubeiensis*, *L. postero-bicosta*, *Paracandona euplectella*, *Eucypris versuta*; 轮藻 *Obtusochara longicolumnaria*, *O. jianglingensis*, *Gyrogona qianjiangica*, *Groftiella steniformis*, *Nemegtichara* sp.;

此外还具有孢粉: 杉粉-松粉-山核桃粉组合。在这一孢粉组合中,蕨类孢子含量很低; 具气囊的松柏类花粉含量在 15—20%,以松粉属和雪松粉属较为常见; 杉粉属和无口器粉属含量一般都在 20—30%,个别样品中可达 40%,其中以破隙杉粉 (*Taxodiaceapollenites hiatus*) 出现最多; 被子植物花粉中以小榆粉 (*Ulmipollenites minor*)、三角山核桃粉 (*Caryapollenites triangulus*)、来茵苗榆粉 (*Ostryoiipollenites*)、小亨氏栎粉 (*Quercoidites microhenrici*) 等出现较多; 还有一些零星的草本植物花粉。

~~~~~ 不 整 合 ~~~~~

古新统 阜宁群

1780m

四组: 灰、灰黑色泥岩夹灰白色粉砂岩、泥灰岩,生物灰岩及油页岩,在金坛直溪桥一带含膏盐层,500m。 产叶肢介 *Fushunograptia changzhouensis*; 介形类 *Herpetocyprilla?*

binoda, *Neomonoceratina bullata*, *Sinocypris multipuncta*, *S. funingensis*, *Candona subcombibo*, *C. jiangsuisensis*, *C. bellula*, *Lineocypris symmetrica*, *L. lubrica*, *Pseudocandona subreniformis*, *Moenocypris cylindrica*, *Ilyocypris subhanjiangensis*, *Parailocypris* aff. *changzhouensis*, *Metacypris changzhouensis*, *Limnocythere qintongensis*, *L. funingensis*, *Cyclocypris arca*, *Cypridopsis hanjiangensis*

三组: 灰白色砂岩与灰黑色泥岩互层, 在常州金坛地区以灰绿和灰色泥岩为主, 夹棕红色泥岩与砂质泥岩, 280m。产介形类 *Sinocypris funingensis*, *Typhlocypris gibbosa*, *Eucypris stagnalis*, *Pseudocandona poriformis*, *Caspiocypris modesta*, *Candoniella ellipsoidea*, *Cypris concina*; 植物: *Palibinia angustifolia*。

二组: 灰、灰黑色钙质泥岩夹薄层生物灰岩、泥灰岩及方沸石化凝灰岩, 300m。产叶肢介 *Perilimnadia jiangsuisensis*, *P. gaoyouensis*, *P. taizhouensis*, *P. lingtangqiaoensis*; 介形类 *Sinocypris longa*, *S. elliptica*, *Ilyocypris hanjiangensis*, *Homoeucypris bucerusa*, *Cyprinotus (Heterocypris) salinus*, *Caspiocypris leguminella*, *Lineocypris acclinia*, *Parailocypris changzhouensis*, *Cypria subtera*, *Cyprois xuyiensis*, *Limnocythere sinucosta*, *L. subexilicosta*; 此外还有孢粉: 小榆粉-漆树粉组合 (*Ulmipollenites minor*-*Rhoipites*)

一组: 棕红色砂岩与暗棕色泥岩互层, 顶部夹黑色泥岩, 富含石膏结核, 700m。产介形类 *Cypridea vitrea*, *C. xindianensis*, *Pseudocypridina haianensis*, *Parailocypris taizhouensis*, *Ilyocypris sublevis*, *Candona wangdianensis*, *Homoeucypris privis*, *Damonella?* *ovata*; 轮藻 *Peckichara varians*, *Gyrogona wubaoensis*, *Grambastichara rudongensis*, *Sinochara rudongensis*, *Neochara gaochunensis*, *Grovesichara changzhouensis*, *Latochara curtula*, *L. yizhengica*; 此外还产有孢粉小榆粉-三孔粉组合 (*Ulmipollenites minor*-*Triporopollenites*)

—— 整 合 ——

下伏地层: 上白垩统

泰州组: 上部灰黑色钙质泥岩; 下部灰白、浅棕色砂岩, 局部地区为含砾砂岩。在苏南地区全为暗棕色砂岩、泥岩, 局部夹紫色钙质泥岩, 300m。产介形类 *Cypridea antimaginia*, *C. orbinoda*, *C. semimorula*, *C. floribunda*, *C. posterotunda*, *C. micans*, *C. xindianensis*, *C. jintanensis*, *C. cellularia*, *C. acriformis*, *C. nodihebes*, *C. hebes*, *C. taizhouensis*, *C. vitrea*, *C. protrata*, *Talicypridea turgida*, *T. aff. bifurcata*, *Bisulcoocypris jiangjiaheensis*, *Caspiocypris jiangduensis*, *Candona wangdianensis*, *C. triangularis*, *Paracandona caudata*, *Quadracypris ovata*, *Q. favosa*, *Q. brevis*, *Pseudocypridina tera*, *Parailocypris taizhouensis*, *Cyprois depressa*, *C. sphaeroidalis*, *C. globra*, *Disopontocypris tralatitia*, *Heterocypris arcuatus*, *Sebastianites tumida*, *Limnocythere microbinoda*, *Metacypris elongata*, *Eucypris magnifica*, *E. jiangjanensis*, *Typhlocypris arrecta*, *Ilyocypris huangqiaoensis*, *Rhinocypris subelliptica*, *Ziziphocypris simakovi*, *Damonella?* *ovata*; 轮藻 *Latochara cylindrica*, *L. yizhengica*, *L. curtula*, *Collichara taizhouensis*, *C. xiaohekouensis*, *Aclistochara* sp.; 此外还产有孢粉: 上部为雪松粉-罗汉松粉-小三瓣孢组合 (*Cedripites*-*Podocarpidites*-*Trilobosporites minor*); 下部为希指蕨孢-麝粉类组合 (*Schizaeisporites*-*Aquilapollenites*)

~~~~~ 不 整 合 ~~~~~

赤山组: 砖红色块状砂岩夹薄层泥岩,

200—695m。

阜宁群二至四组的轮藻化石组合面貌是相近的, 主要分子有 *Peckichara varians*, *P. longa*, *P. subsphaerica*, *Stephanochara fortis*, *S. jiangsuisensis*, *S. brevivalis*, *Neochara huananensis*, *N. sinuolata*, *Gobichara deserta*, *Charites laminata*。

阜宁群三、四组的孢粉化石很丰富, 组合很近似, 不易区分, 被称为榆粉-山龙眼粉-松粉组合 (*Ulmipollenites*-*Proteacidites*-*Pinuspollenites*) (宋之琛等, 1981)。

## 3. 大型内陆湖泊:

最典型的是华中云梦泽,比现代洞庭湖还大,从晚白垩世早期开始接受沉积,一直到现代;虽已进行了不少地层古生物工作,可惜有关古新统和白垩-第三系界线的研究还很薄弱。京山、安陆、应城地区位于湖盆东北边缘,有关层序如下:

## 下第三系 应城群

灰绿色岩组:灰绿夹灰紫色泥岩、粉砂岩及泥灰岩,下部为钙质泥岩、泥质粉砂岩夹薄层石膏。产介形类 *Cypris* sp. 480m

膏盐组:灰绿色泥岩,紫红色砂质泥岩,粉砂岩互层,由上而下为含石膏岩段、含钙芒硝段、含盐岩段、含钙芒硝段、含石膏段,产介形类 *Cypris* sp., >1598m

白沙口组:灰白色长石砂岩、含砾砂岩、砾岩与紫红色泥岩互层 470m

————— 整 合 —————

## 上白垩统

云台山组:紫红色砂质泥岩及薄层石膏,泥质细砂岩,含砾砂岩,细砾岩,向西相变为砾岩 730m

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公安寨组:紫红色薄层砂岩、粉砂岩、泥岩,夹黄绿色页岩、薄层石膏,底部为砂砾岩,东部夹玄武岩数层。产叶肢介 *Yunmenglimnadia hubeiensis*, *Y. rhombica*, *Y. yingchengensis*; 介形类 *Talicypridea* cf. *amoena*, *T. longa*, *Cyprois guangzhouensis*, *Cypridea* sp., *Pseudocypridina* sp., *Eucypris* sp., *Limnocythere* sp., *Cyprinotus* sp., *Metacypris* sp.; 轮藻 *Porochara anluensis*, *P. sphaerica*, *P. jinshanensis*, *P. stipitata*, *Latochara yunnanensis*, *Sphaerochara parvula*, *Euaclistochara mundula*, *Turbachara specialis*, *Peckichara* sp., *Croftiella lili* 1000—1700m

宜昌、荆门、当阳地区位于盆地西北部,离岸稍远,岩性比上述地区细,有关层序如下:

## 下第三系 宜都群

石子岭组:砖红、黄褐色厚层至块状粉、细砂岩,夹棕红色泥岩、粉红色泥灰岩及薄层

## 细砾岩

80m

方家河组:红色、棕红色砂岩、泥岩、粉砂岩,与浅灰、灰绿色泥岩互层,夹浅灰、灰白色泥灰岩、钙质泥岩与黑色页岩。产介形类 *Cypris-Ilyocypris-Limnocythere* 组合,包括 *Cypris decaryi*, *C. favosa*, *Heterocypris dongyuemiaoensis*, *H. subtriangularis*, *Candona candidiformis*, *C. paracompressa*, *C. yujiaowanensis*, *Candoniella* cf. *albicans*, *C. cf. suzini*, *Paracandona reniformis*, *Cyclocypris laevis*, *Ilyocypris cornae*, *I. errabundoides*, *Sinocypris multipuncta*, *Parailocypris changzhouensis*, *Limnocythere hubeiensis*, *L. spinisulcata*, *Bisulcocypris fangjiaheensis*, *Sinometacypris dongyuemiaoensis*, *Eucypris subtriangularis*, *Eucypris* *Cypris triangularis*, *Darwinula cylindrica*, *Metacypris* sp.; 轮藻 *Peckichara zhijiangensis*-*Gyrogona huajiazhangensis* 组合,包括 *Peckichara zhijiangensis*, *P. coronata*, *P. zoumalingensis*, *Gyrogona huajiazhangensis*, *Grovesichara changzhouensis*, *Stephanochara fortis*, *S. jingmenensis*, *S. aeris*, *Neochara huananensis*, *N. gaochunensis*, *N. dangyangensis*, *Harrisichara honghuensis*, *Charites angustior*, *C. bangueshanensis*; 植物 *Palibinia angustifolia*; 鱼 *Osteochilus linliensis* 810m

————— 整 合 —————

## 上白垩统跑马岗组

棕红、紫红色砂岩、泥岩、粉砂岩,夹多层灰绿色粉砂岩和砂质泥岩以及杂色泥岩。产介形类 *Talicypridea*-*Cypridea*-*Candona* 组合,共包括 18 属 69 种,其中 *Talicypridea* (19.6%), *Candona* (18.6%), *Candoniella* (9.3%), *Cypridea* (8.3%), *Darwinula* (6.2%), *Quadracypris*, *Limnocythere* 和 *Metacypris* (各占 5.15%), 其余 10 属占 22.45% (*Cyprois*, *Sinocypris*, *Eucypris*, *Pseudoeucypris*, *Heterocypris*, *Hemicyprinotus*, *Parailocypris*, *Mongolianella*, *Ziziphocypris*, *Clinocypris*); 轮藻 *Latochara cylindrica*-*Charites tenuis* 组合共包括 14 属 26 种化石,其中 *Charites guanpingensis*, *Gyrogona hubeiensis*, *Pe-*

*ckichara paomagangensis* 等也都是优势种。另外, *Tectochara*, *Croftiella* 和 *Grambastichara* 三属亦占有显著地位, 但还有少量 *Porochara jinshanensis* 存在

555m

综上所述, 南雄山间盆地型的陆相古新统虽然因为古脊椎动物化石显著的研究成就而蜚声国内外, 但发育不如大河下游三角洲平原沼泽区(例如苏皖地区)完整, 后一类型富含微体动植物化石(表 I), 过去所定时代偏新, 经过

校正, 将对今后中国古新世地层的划分对比, 特别在沿海石油勘探工作中起推动作用, 因为这些微体化石数量多, 分布广泛, 易于采获。大型内陆湖泊型(例如江汉盆地)下第三系的研究程度远逊于苏北和广东南雄, 迄今还没有划分出可靠的古新世地层, 但从介形类与轮藻化石的分布看, 有不少古新世的分子出现, 而且白垩-第三系在湖北宜荆当地区是连续沉积, 很值得进一步研究。

表 I 中国三种主要古新世沉积类型划分对比简表

Correlation of the three main types of the Paleocene deposits in China

| 地区及<br>时代<br>分类              | 叶肢介<br>Conchostracans                     | 介形类<br>Ostracods                                                                                                          | 轮藻<br>Charophytes                                                                             | 孢粉<br>Sporo-pollen                                                                       | 南雄<br>Nanxiong      | 苏北<br>N. Jiangsu   | 湖北 Hubei                                           |                                 |                       |
|------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|---------------------|--------------------|----------------------------------------------------|---------------------------------|-----------------------|
|                              |                                           |                                                                                                                           |                                                                                               |                                                                                          |                     |                    | 东山、安陆、应城                                           | 宜昌、当阳、荆门                        |                       |
| 早始新世<br>Early Eocene         | <i>Paraleptestheria menglaensis</i> fauna | <i>Sinocypris reticulata</i> ,<br><i>Limnocythere hubeiensis</i> ,<br><i>L. postero bicostata</i>                         | <i>Obolusochara jianglingensis</i> — <i>Gyragana qianjiangensis</i> flora                     | <i>Taxodiaceapollenites</i> — <i>Pinuspollenites</i> — <i>Caryapollenites</i> assemblage | 浓山组<br>Nonshan Fm.  | 戴南组<br>Dainan Fm.  | Eocene<br>—<br>Paleocene<br>—<br>世新始<br>始新世<br>始新世 | 灰绿色岩组<br>Grayish-Green clay Fm. | 石子岭组<br>Shiziling Fm. |
| 古新世<br><br><br><br>Paleocene | <i>Fushunograptachangzhouensis</i> fauna  | <i>Sinocypris multipunctata</i> , <i>Neomonocera tina bullata</i> ,<br><i>Herpetocypris hindei</i>                        | <i>Peckichara longa</i> — <i>Obolusochara elliptica</i> flora                                 | <i>Ulmipollenites</i> — <i>Proteacidites</i> — <i>Pinuspollenites</i> assemblage         | 上湖组<br>Shanghu Fm.  | 四组<br>4th Fm.      |                                                    | 膏盐组<br>Salt-Gyps Fm.            | 方家河组<br>Fangjiahe Fm. |
|                              |                                           | <i>Sinocypris funingensis</i> ,<br><i>Eucypris stagnalis</i>                                                              |                                                                                               |                                                                                          |                     | 三组<br>3rd Fm.      |                                                    |                                 |                       |
|                              | <i>Perilimnadia</i> fauna                 | <i>Sinocypris longa</i> ,<br><i>Ilyocypris huijiangensis</i> , <i>Parailocypris changzhouensis</i>                        |                                                                                               | <i>Ulmipollenites minor</i> — <i>Rhopites</i> assemblage                                 |                     | 二组<br>2nd Fm.      |                                                    | 白沙口组<br>Baishakou Fm.           | 跑马岗组<br>Paomagang Fm. |
|                              |                                           | <i>Cypridea wilrea</i> ,<br><i>Pseudocypridina hai-onensis</i> , <i>Ilyocypris sublevi</i> s                              |                                                                                               | <i>Ulmipollenites minor</i> — <i>Triporopollenites</i> assemblage                        |                     | 一组<br>1st Fm.      |                                                    |                                 |                       |
| 晚白垩世<br>后期<br>Late Up. Cret. |                                           | <i>Cypridea</i> spp.,<br><i>Talicypridea</i> ,<br><i>Ilyocypris</i> , <i>Cypris</i> ,<br><i>Eucypris</i> , <i>Condona</i> | <i>Latochara cylindrica</i> — <i>Charites tenuis</i> flora                                    | <i>Cedripites</i> — <i>Podcar-pidites</i> — <i>Trilobasporites</i> minor assemblage      |                     | 泰州组<br>Taizhou Fm. | 云台山组<br>Yuntaishan Fm.                             |                                 |                       |
|                              |                                           | <i>Cypridea</i> — <i>Talicypridea</i> — <i>Eucypris</i>                                                                   | <i>Porochara anluensis</i> ,<br><i>Refusochara</i> , <i>Amlypochara</i> , <i>Jonghaachara</i> | <i>Schizaeisporites</i> — <i>Aquilapollenites</i> assemblage                             | 南雄组<br>Nanxiong Fm. | 赤山组<br>Chishan Fm. | 公安寨组<br>Gonganzhai Fm.                             |                                 |                       |

三、化石描述

常州抚顺雕饰叶肢介(比较种) *Fushunograptachara* cf. *changzhouensis* (Chen)

(图版 I, 图 4—7)

材料 一共只有四块破碎的标本, 是分析处理介形虫标本时发现的。

有两块标本各保存了半个壳瓣, 判断其完整的轮廓近圆形, 个体很小, 生长带宽而平, 微细纹饰在另一个碎片上表现得特别清楚, 是一些长而弯曲的细线, 排列紧密拥挤, 中间可能有

更细的横靶相连, 致使细线在外模上呈现断续状, 有时还向上或向下分叉, 分叉现象无规律可循。

比较讨论 广东南雄的标本与江苏常州的模式标本(图版 I, 图 1—3)相比, 生长带相对较宽, 壳瓣小而薄, 可能与产出的干热气候条件有关。

产地层位 广东南雄大塘坪岭与逆龙巷附近, 南雄城西风门坳; 古新统上湖组。

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## ON THE CHINESE NON-MARINE PALEOCENE FROM THE NEW DISCOVERY OF THE CONCHOSTRACAN FAUNA OF NANXIONG, GUANGDONG

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During the recent decade, Paleocene conchostracans have been reported many times from China and Mongolia (Wang, 1974; Chen, 1975; Zhang & al., 1976; Трусова & Бадамгарав, 1976; Shen & Others, 1979; Chen & Shen, 1980); however, about 14 years ago, the Tertiary estherids were still unknown in the world and were thus called the discontinuity

in the evolution of this group (Kobayashi, 1972).

There are three Paleocene conchostracan faunas in China: (1) the early Paleocene *Perilimnadia* fauna (including *P. jiangsuensis*, *P. gaoyouensis*, *P. taizhouensis*, *P. lingtang-qiaoensis*) from the 2nd Formation of the Funing Group in Jiangsu; (2) the late Paleocene

*Fushunograptia changzhouensis* fauna (including *F. changzhouensis*, *F. changheensis*, *F. huanxianensis*, *F. ovata*, *F. subcyloria*, *F. brachysellipsa*, *Cizella serraula*) from the 4th Formation of the same Group in Jiangsu and Anhui, the Changhe Formation of Zhejiang, the Paleocene deposits of Sanmenxia of Henan, and Huanxian of Gansu; and (3) the early Eocene *Paraleptestheria menglaensis* fauna (including *P. menglaensis*, *P. lanpingensis*, *P. yunlongensis*, *P. mohanensis*, *P. jingtangensis*, *P. anquilonaria*, *Nanhaiestheria sanshuiensis*) with the most extensive distributions in Yunnan, Guangdong, Hunan, Jiangsu, Zhejiang, Anhui, Ningxia and Heilongjiang (text-fig. 1). These conchostracan faunas are of importance to the subdivision and correlation of the Tertiary non-marine rocks as well as to the Mesozoic terrestrial deposits in China.

The Lofochai Group deposited in the Nanxiong basin of N. Guangdong is one of the well-known representing early Tertiary red beds of China, which may be divided into the Shanghu Formation below and the Nonshan Formation above. This group underlies the Danxia Formation, and overlies the Nanxiong Formation which yields the fossil skeletal bones, teeth and egg shells of dinosaurs, ostracod *Talicypridea* fauna and charophyte *Latochara cylindrica*-*Porochara anluensis* flora; it can be assigned to the Campanian of the Upper Cretaceous (Dong, 1979).

The Shanghu Formation containing the outstanding mammalian fauna characterized by *Bemalambda*, which is believed belonging to the Middle Paleocene, overlies the Nanxiong Formation disconformably (Zhou & al., 1977). The Nonshan Formation, which carries another mammalian fauna (*Pachyaena?* sp., *Lestes datangensis*, *Huaiyangale* sp., etc.), the ostracod *Sinocypris-Eucypris* assemblage, charophyte *Peckichara longa*-*Obtusochara elliptica* assemblage, and gastropod *Polycircus gracilicostata*-*Nanxiongospira uniphychia* assemblage, is generally thought to be of either the Late Paleocene or the Early Eocene (Zhou & al., 1977;

Zheng & Qiao, 1979; He, 1979; Huang, 1979; Yu, 1977), but the writer supports the latter opinion based on the *Paraleptestheria menglaensis* fauna collected from the lower part of the Nonshan Formation near the Yingbaoqian village of Quan'an in Nanxiong county in the winter of 1976 (Chen & Shen, 1980).

Seven years later, *Fushunograptia* cf. *changzhouensis* was occasionally found from the upper and basal parts of the Shanghu Formation near Datang and the Nanxiong town (text-fig. 2) while Mr. Zhang Xiarqiu and the writer made a second excursion to the Nanxiong basin in the winter of 1983. This discovery is of great significance in the subdivision and correlation of the non-marine Paleocene in China, though there are only a few specimens of this species.

In N. Jiangsu, the *Paraleptestheria menglaensis* fauna appears in the Dainan Formation of early Eocene and the *Fushunograptia changzhouensis* fauna in the upper 4th Formation of the Funing Group. The *Perilimnadia* fauna is absent from the Nanxiong basin (table I), showing that there is a sedimentary discontinuity between the Cretaceous and the Tertiary, and the sequence of non-marine Paleocene in N. Jiangsu may be more complete than in other parts of this country. But unfortunately, the materials are mainly collected from the drill core because only a few outcrops can be found on the ground in this region.

The non-marine Paleocene in China consists of three main sedimentary types:

Type (1) The intermontane-basin represented by the Nanxiong basin in N. Guangdong. The stratigraphic sequence and fossils of the Paleocene section from Yangmeikeng to Nilongkeng in the Datang district are described in descending order as follows:

#### Overlying early Eocene Nonshan Formation

Composed of dark purplish-red silt mudstones with purplish-red calcareous siltstones, sandstones, conglomerates and greyish-green marlites in the upper part; and purplish-red silt mudstones with greyish-green marlites in the lower part 354.89m  
Yielding conchostracans: *Paraleptestheria meng-*

*laensis*; ostracods: *Sinocypris excelsa*, *S. subfuningensis*, *S. arca*, *S. reticularis*, *S. ovata*, *Eucypris sanshuiensis*, *E. squarrosa*, *E. dongguanensis*, *E. hukouensis*, *Ilyocypris macilenta*, *Parailocypris changzhouensis*, *Cyprois robusta*, *C. buxinensis*, *Candona resupina*, *Cypris pyriformis*, *Cyclocypris nobilis*, *Metacypris biformis* and *Limnocythere honggangensis*; charophytes: *Neochara sinuolata*, *N. squalida*, *N. huananensis*, *Peckichara subsphaerica*, *P. longa*, *P. varians*, *Croftiella humilis*, *Grovesichara changzhouensis*, *Stephanochara brevivalis*, *S. hukouensis*, *Rhabdochara jiangduensis*, *R. changzhouensis*, *Gobichara deserta*, *Harrisichara yunlongensis* and *H. poculiformis*; gastropods: *Policirsas gracilicostata*, *P. obtusospiralis*, *Renistoma regularium*, *R. anomphalum*, *Cirsomphalus laevigatus*, *Amnicola zhenjiangensis*, *Bithynia* aff. *lordostoma*, *Nanxiongospira uniphychia*, *Opea guangdongensis*, *Pupoides zhejiangensis* and plants: *Palibinia pinnatifida* and *P. kororoinii*; vertebrates: *Hokoucheilus chenshuiensis*, *Asiatosuchus nanlingensis*, *Planocrania datangensis*, *Lestes datangensis*, *Huaiyangale* sp., *Pachyaena* sp., *Archaeolambdidae*, *Adapidae*, *Pseudictopidae*, *Phenacolophidae* and *Arctostylopidae*.

———— conformity ————

Paleocene Shanghu Formation 272.67m

The sequence can be described as follows (in descending order):

10. Interbedding of purplish-red siltstones, silt mudstones and mudstones, with red or greyish-green sandstones (10—30cm) in the top part, rich in charophytes and gastropods 37.89m
9. Purplish-red silt mudstones and clayey siltstones, with 3 layers of thinbedded greyish-green sandstones, yielding ostracods, charophytes and the conchostracan *Fushunograpt* cf. *changzhouensis* 32.93m
8. Purplish-red silt mudstones, rich in calcareous nodules, yielding ostracods and charophytes 39.68m
7. Purplish-red clayey siltstones and silt mudstones, intercalated with thin sandstones, with a layer of purplish-grey thick sandstone in the basal part 38.97m
6. Purplish-red silt mudstones, rich in calcareous nodules and fossils 50.32m
5. dark red clayey siltstones, with 2 layers of yellowish-grey thick sandstones in the upper and basal parts separately 32.24m
4. Purplish-red or yellowish-brown silt mudstones rich in fossils 31m
3. Interbedding of purplish-red or greyish-purple thin sandstones and clayey siltstones 3.14m
2. Purplish-red silt mudstones 5.8m

1. Yellowish-grey thick-bedded sandy conglomerates with purplish-red mudstones and clayey siltstones, yielding ostracods, gastropods, charophytes and the conchostracan *Fushunograpt* cf. *changzhouensis* 0.4—1m

----- disconformity -----

Underlying Upper Cretaceous Nanxiong Formation

Composed of purplish-red sandstones, conglomerates and mudstones, yielding dinosaurs, ostracods, charophytes and gastropods.

In this basin abundant fossils were found through the whole formation in addition to the conchostracans, such as: vertebrates: *Bemalambda nansiungensis*, *B. pachyoesteus*, *B. crassa*, *Yuodon protoselenoides*, *Palasiodon siurenensis*, *Hukoutherium ambigum*, *Dissacusium shanghoensis*, *Dissacus feiganensis*, *Lofochaius brachyodus*, *Linnania lofoensis* and *?Ectoconus* sp.; ostracods: *Eucypris sanshuiensis*, *Parailocypris changzhouensis*, *Ilyocypris macilenta*, *I. subhuangqiaoensis*, *Cypris pyriformis*, *Cyprois robusta*, *C.?* *guangzhouensis*, *Limnocythere nemegtensis*, *Candoniella postrotunda* and *Metacypris biformis*; charophytes: *Grovesichara changzhouensis*, *Gyrogonia huajiazhouensis*, *Stephenochara microcoasta*, *S. brevivalis*, *Peckichara subsphaerica*, *Sinochara caopiensis*, *Rhabdochara jiangduensis* and *R. changzhouensis*; gastropods: *Ptychochilus bellus*, *Nystia luminosa*, *Hydrobia datangensis*, *Amnicola datangensis*, *Flumnicola guangdongensis*, *Agallospira multispinalis*, *Zhejiangospira dignata*, *Shanguspira costata* and *Grandipatala? deformis*.

Type (2) The deltaic plain and marshland represented by the N. Jiangsu basin with the following Paleocene sequence:

Overlying early Eocene Dainan Formation

Brownish or greyish sandstones with dark brown mudstones in the upper part; greyish sandstones, conglomerates and brown or dark grey mudstones with sandstones in the lower part

550m

Yielding conchostracans: *Paraleptestheria menglaensis* and *P. (?) jingtansensis*; ostracods: *Sinocypris reticulata*, *Ilyocypris gaoyouensis*, *I. aff. cornae*, *Cypris decarryi*, *Limnocythere hu-beensis*, *L. posterobicosta*, *Paracandona euplectella* and *Eucypris versuta*; charophytes: *Obtuso-*

*chara longicolumnaria*, *O. jianglingensis*, *Gyrogonia qianjiangica*, *Croftiella steniformis* and *Nemegtichara* sp.; sporo-pollen: *Taxodiaceapollenites*-*Pinuspollenites*-*Caryapollenites* assemblage

~~~~~ unconformity ~~~~~

Paleocene Funing Group 1780m
4th Formation 500m

Grey or greyish-black mudstones with greyish siltstones, marlites and oil-shales, including some gypsum-salt rock found at Zhixiqiao of Jingtang county, and yielding conchostracans: *Fushunograptia changzhouensis*; ostracods: *Herpetocyprilla*? *binoda*, *Neomonocerotina bullata*, *Sinocypris multipuncta*, *S. funingensis*, *Candona subcombibo*, *C. jiangsuensis*, *C. bellula*, *Lineocypris symmetrica*, *L. lubrica*, *Pseudocandona subreniformis*, *Moenocypris cylindrica*, *Ilyocypris subhanjiangensis*, *Paraillyocypris* aff. *changzhouensis*, *Metacypris changzhouensis*, *Limnocythere qiutongensis*, *L. funingensis*, *Cyclocypris arca* and *Cypridopsis hanjiangensis*.

3rd Formation 280m

Greyish sandstones and dark grey mudstones, yielding ostracods: *Sinocypris funingensis*, *Typlocypris gibbosa*, *Eucypris stagnalis*, *Pseudocandona poriformis*, *Caspiocypris modesta*, *Candoniella ellipsoidea* and *Cypris concina*; plants: *Palibinia angustifolia*

2nd Formation 300m

Dark grey calcareous mudstones with thin-bedded marlites, bioclastic limestones and analcite-tuffs, yielding conchostracans: *Perilimnadia jiangsuensis*, *P. gaoyouensis*, *P. taizhouensis*, *P. lingtangqiaoensis*; ostracods: *Sinocypris longa*, *S. elliptica*, *Ilyocypris hanjiangensis*, *Homoeocypris bucerusa*, *Cyprinotus* (*Heterocypris*) *salinus*, *Caspiocypris leguminella*, *Lineocypris acclinia*, *Pseudocandona tumida*, *Paraillyocypris changzhouensis*, *Cypris subtera*, *Cypris xuyiensis*, *Limnocythere sinucosta* and *L. subexilicosta*; sporo-pollen: *Ulmipollenites minor*-*Rhoipites* assemblage

1st Formation 700m

Interbeddings of brownish-red sandstones and dark brown mudstones, with black mudstones in the top part, rich in gypsum nodules, yielding ostracods: *Cypridea vitrea*, *C. xindianensis*, *Pseudocypridina haianensis*, *Paraillyocypris taizhouensis*, *Ilyocypris sublevis*, *Candona wangdianensis*, *Homoeocypris privis* and *Damonella*? *ovata*; charaophytes: *Peckichara varians*, *Gyrogonia wubaoensis*, *Grambastichara rudongensis*, *Sinochara rudongensis*, *Neochara gaochunensis*, *Grovestichara changzhouensis* *Latochara curtula* and *L. yizhengica*; sporo-pollen: *Ulmipollenites minor*-*Triporopollenites* assemblage.

———— conformity ————

Upper Cretaceous

Taizhou Formation 300m

Dark grey calcareous mudstones in the upper part; greyish or purplish-red sandstones in the lower part, rich in fossil ostracods, charophytes and sporo-pollen.

~~~~~ unconformity ~~~~~

Chishan Formation 200—695m

Lateritic-red massive sandstones with thin-bedded mudstones, yielding ostracods, charophytes and sporo-pollen.

There is a similar charophyte assemblage in the 2nd-4th Formations of the Funing Group, including the following leading forms: *Peckichara varians*, *P. longa*, *P. subsphaerica*, *Stephanochara fortis*, *S. jiangsuensis*, *S. brevivalis*, *Neochara huananensis*, *N. sinuolata*, *Gobichara deserta*, *Charites laminata*. The 3rd and 4th Formations of the Group yield very abundant fossil sporo-pollen called the *Ulmipollenites-Proteacidites-Pinuspollenites* assemblage (Song & al., 1981).

Type (3) The large inland lake, such as the Jiangnan basin in central China, yielding ostracods, charophytes, conchostracans, sporo-pollen and a few dinosaur and fish fossils. The deposition there ranges from early Late Cretaceous up to Recent and the sequences of the Paleocene exposed in the NE and NW margins of this basin can be recognised as follows:

Jingshan-Anlu-Yingcheng region near NE margin of Jiangnan basin

Paleocene Yingcheng Group

Greyish-green Formation 480m

Greyish-green mudstones, siltstones and marlites with greyish-purple intercalations of calcareous mudstones, clayey siltstones and thinbedded gypsum in lower part, yielding *Cypris* sp.

Gypsum-salt rock Formation >1598m

Interbeddings of greyish-green mudstones, purplish-red sandy mudstones and siltstones, with gypsum, salt and glauberites, yielding *Cypris* sp.

Baishakou Formation 470m

Greyish arcoses, conglomerate sandstones, conlomeretes and purplish-red sandstones.

———— conformity ————

Upper Cretaceous

Yuntaishan Formation 730m

Purplish-red sandy mudstones, thin-bedded gypsum, clayey fine-grained sandstones and fine conglomerates, laterally changing to conglomerates.

———— ? ————

Gonganzhai Formation 1000—1700m

Purplish-red thin-bedded sandstones, siltstones and mudstones, with yellowish-green shales, thin-bedded gypsum, conglomerates in the basal part, yielding conchostracans: *Yunmenglimnadia hubeiensis*, *Y. rhombica*, and *Y. yingchengensis*; ostracods: *Talicypridea* cf. *amoena*, *T. longa*, *Cypris guangzhouensis*, *Cypridea* sp., *Pseudocypridina* sp., *Eucypris* sp., *Limnocythere* sp., *Cyprinotus* sp. and *Metacypris* sp.; charophytes: *Porochara anluensis*, *P. sphaerica*, *P. jingshanensis*, *P. stipitata*, *Latochara yunnanensis*, *Sphaerochara parvula*, *Euaclistochara mundula*, *Turbochara specialis*, *Peckichara* sp. and *Croftiella* sp.

Yichang-Jingmen-Dangyang region near NW margin of Jiangnan basin

Paleocene Yidu Group

Shiziling Formation 80m

Lateritic-red or yellowish-brown thick-massive siltstones and fine-grained sandstones, with brownish-red mudstones, pink marlites and thin-bedded fine conglomerates.

Fangjiahe Formation 810m

Interbeddings of red or brownish-red sandstones, mudstones, siltstones and greyish or greyish-green mudstones, with greyish marlites, calcareous mudstones and black shales, yielding ostracods: *Cypris-Ilyocypris-Limnocythere* assemblage; charophytes: *Peckichara zhijiangensis*-*Gyrogonia huajiazhangensis* assemblage; plants: *Palibinia angustifolia*; fish: *Osteochilus linlingensis*.

———— conformity ————

Upper Cretaceous

Paomagan Formation 555m

Brownish or purplish-red sandstones, mudstones and siltstones, with greyish-green siltstones and calcareous mudstones, yielding ostracods: *Talicypridea-Cypridea-Candona* assemblage; charophytes: *Latochara cylindrica*-*Charites tenuis* assemblage.

To sum up, the non-marine Paleocene of deltaic plain and marshland in China (such as N. Jiangsu) has been more completely developed than that in the Nanxiong intermontane basin, though the latter is better known due to the distinguished research on the vertebrate Palaeontology there. It's rich in microfossils (text-fig. 3), which are extensively distributed in all parts of this country and are of great significance in oil prospecting.

In the past, less research work has been done on the non-marine Paleocene around the large inland lake than on the N. Jiangsu and Nanxiong basins. The Paleocene has not been recognized so far in the Jiangnan basin, though some characteristic ostracods and charophytes of this stage have been found from the continuous sediments along the NW margin of this basin. Therefore, the Cretaceous-Tertiary boundary in this region is worthy of further studies in greater detail.

## 图 版 说 明

所有标本保存在中国科学院南京地质古生物研究所。

## 图 版 I

1—3. *Fushunograptus changzhouensis* (Chen)

1. 左瓣内模  $\times 5$ 。采集号: 常 1-1。2. 全模标本 (Holotype), 左瓣内表面  $\times 5$ 。登记号: 22928。3. 另一块标本透过几丁质壳内表面看到的生长带上的线脊装饰  $\times 40$ 。登记号: 22933。江苏常州(1,2)与盱眙(3)两地钻孔资料;古新统阜宁群四组。

4—7. *Fushunograptus cf. changzhouensis* (Chen)

4. 一块不完整的壳瓣内模  $\times 10$ 。采集号: ND172, 登记号: 94442。5. 另一块不完整的壳瓣外模  $\times 10$ , 采集号: ND172, 登记号: 94443。6, 6a. 同一块外模标本  $\times 10, \times 40$ , 显示生长带上的线脊装饰。采集号: ND305, 登记号: 94444。7, 7a. 另一块内模标本,  $\times 10, \times 40$ , 生长带上的线脊装饰约略可见。采集号: NF22-1, 登记号: 94445。广东南雄大塘坪岭 (ND172), 逆龙巷西 (ND305) 和城西凤门坳附近 (NF22-1); 古新统上湖组。

8. *Perilimnadia jiangsuensis*, *P. gaoyouensis* and*P. lingtangqiaoensis*

群体  $\times 2$ 。登记号: 22912。江苏高邮菱塘桥; 古新统阜宁群二组。

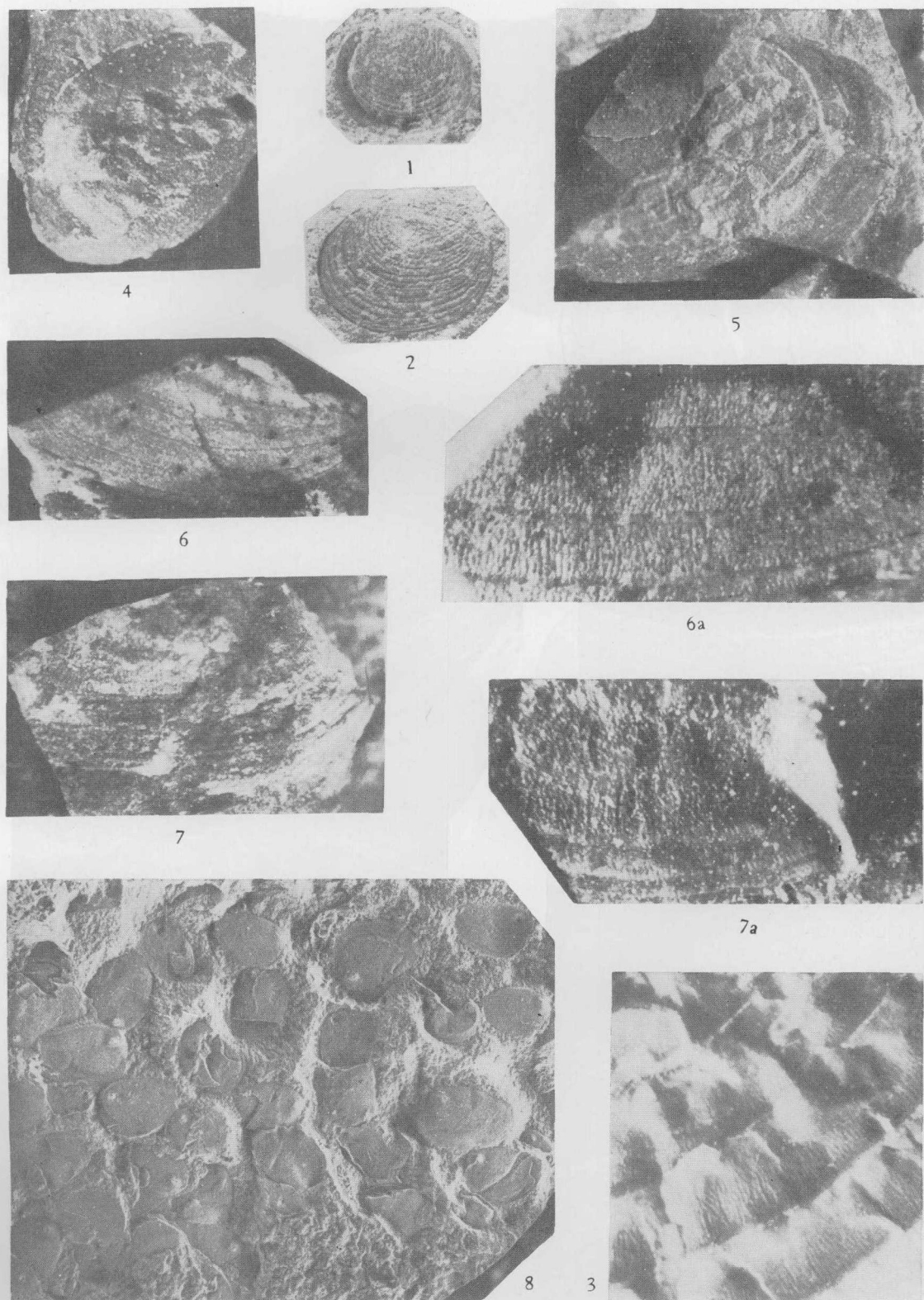
## 图 版 II

1—3, 5, 6. *Paraleptestheria menglaensis* Chen

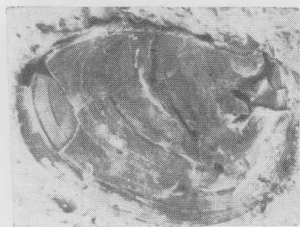
1. 左瓣外模  $\times 17$ 。登记号: 49651。2. 另一块外模标本示生长带上的大网状装饰  $\times 40$ , 登记号: 49652。广东南雄全安公社营保前; 早始新世浓山组竹桂坑段。3, 3a. 右瓣外模  $\times 10, \times 40$ , 登记号: 44527。广东三水河口, 始新世埗心组一段上部。5. 一个几丁质生长带正面上的大网状装饰  $\times 40$ , 登记号: 29873。安徽定远城南 3 km; 始新世红层。6. 右瓣  $\times 10$ , 登记号: 29872。云南勐腊; 始新世红层。

4. *Paraleptestheria jintanensis* (Chen)

4. 右瓣, 全模标本 (Holotype)  $\times 5$ , 登记号: 22911。4a. 同一标本生长带上的装饰  $\times 40$ 。江苏金坛直溪桥; 早始新世戴南组。



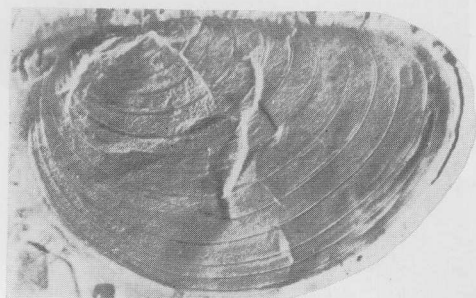




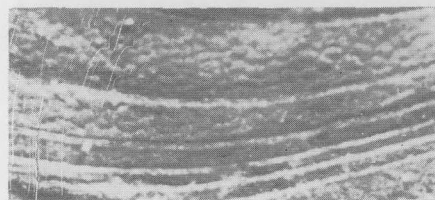
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1



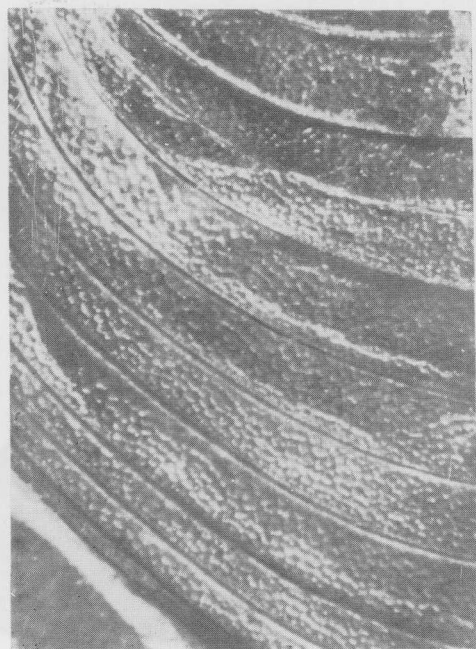
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5



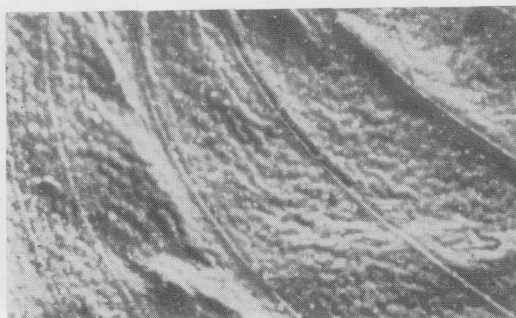
6



3a



4a



2