山旺古生物图鉴

Shanwang Fossils

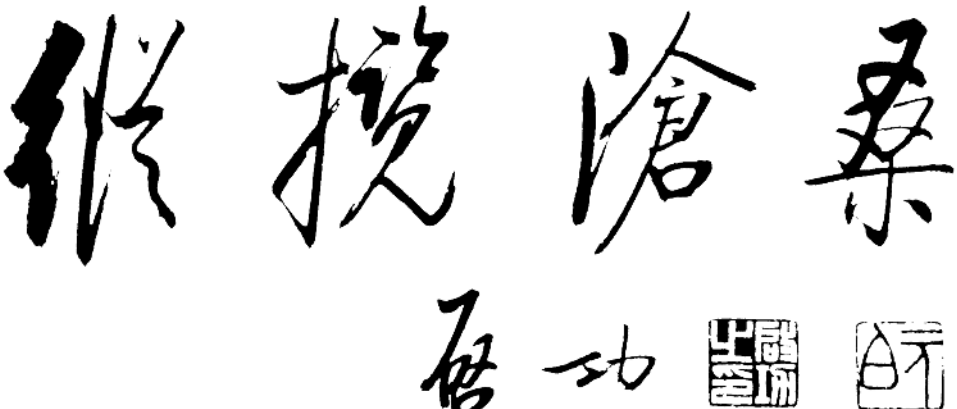
孙 博

（山旺古生物博物馆）

(Shanwang Paleontological Museum)

科学出版社

张揆沧桑



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序

山旺一是山东省临朐县城东22公里的一个小山村。这里的地层由许多薄如纸张的硅藻土页岩组成，它形成于距今大约1800万年，地质历史上的早中新世。我国古人曾形象地将这里的地层比喻为“万卷书”。

这里因盛产各种精美完好的古生物化石而闻名遐迩，素有“化石宝库”之称。

山旺化石现在已经发现的有十几个门类600余种，植物化石包括苔藓、蕨类、裸子植物和被子植物，其中以植物的枝叶最多，花、果实和种子保存也很完美。

动物化石包括蜘蛛、昆虫、鱼、两栖、爬行、鸟和哺乳动物。昆虫化石翅脉清晰，色彩斑斓；蝌蚪、变态蛙、成体蛙再现了两栖类从水到陆的生活周期。难于保存为化石的鸟类，在这里也多有发现，到目前为止已发现了五种鸟化石。

早期的长颈鹿—三角原古鹿和东方祖熊骨架是迄今世界上保存最完好的标本。60多个柄杯鹿组成了颇为壮观的柄杯鹿群，它们和近无角犀、矢木氏近貘、山旺意外蝙蝠等一起组成了山旺哺乳动物群。

山旺盆地较大规模的发掘，实际上从1955年就开始了，当时的发掘目的并不是为了化石。硅藻土是一种化工原料，也是一种很好的保温材料。由于化石本身伴生在硅藻土矿床之中，因此开矿取土时连同化石一并发掘出来，这种发掘办法往往被硅藻土的社会需求量所左右，挖挖停停，一直延续到1980年。既然是开矿，就免不了要放炮，动用推土机、铲车等，当然，对化石来说无疑是破坏性的开采。从化石来看，既无人管理也无人重视。不少高等院校、科研单位和博物馆都在山旺采集过标本，北京自然博物馆，上海自然博物馆和山东省博物馆都有专门的山旺化石陈列。硅藻土矿的采矿工人也多次发现化石珍品，山旺山东鸟就是1976年采矿工人发现后送交山东省博物馆的。

1978年10月，中国古生物学会在山旺召开了现场会，听取了关于硅藻土矿的发展设想和对化石保护的报告，中国科协向国务院申报了建立“山旺化石自然保护区”的建议，山东省政府1979年7月正式向国务院申请建立“山旺化石自然

PREFACE

Shanwang is a small villlage 22km E to the Linqu County, Shandong. Nearby, the very fine-layered diatomacerous shale is well developed. It was formed in the Miocene, about 18 million years ago. It has long been depicted as Wan juanshu"the book of ten thousand volumes".

The place is well known for its exquisite and well-preserved fossils, likened often to "A treasure house of fossils".

So far more than 6 hundred species belonging to ten-odd phyla of organisms have been found. Among the plants there are briophyte, pteridophyte, gymnosperm and angiosperm. The fossllized stems and leaves are the most numerous; the flowers, fruits and seeds are often delicately preserved.

Among fossil animals there are spiders insects, fishes, amphibians, reptiles, birds and mammals. The insects, sometimes, preserved their original gorgeous colour,with the veins of the wings clearly seen. Tadpoles, metamorphoing frogs with long or short tails and fully adult frogs recapitulated their life-ciclc from water to land. The birds are usually rare preserved as fossils, but five species have so far been found here.

In fact, the excavation in great quantities of the Shanwang Basin began in 1955, its purpose at that time is not for fossil but open mines such as diatomite, phosphorus and peat. Diatomite is a raw material for chemical industry. Because of the fossils associated with this mines, so they have been excavated together, this way of excavation was influenced by the social need of the diatomite and the work continued to 1980 intermittently, there were bound to use bulldozers and trucks and demolitions in the work,it is undoubtedly doing great damage to the fossils. Although no one took the matter seriously, many colleges and scientific institutes have collected fossil samples in Shanwang. The Beijing Natural Museum, Shanghai Museum and Shandong Museum all have exhibits of the Shanwang fossils specially. Some valuable fossils had been founded by the workers of the diatomite mine. The fossil Shandongornis shanwangensis was found by the workers in 1976 and was delivered it to the Shandong Museum.

山旺古生物博物馆　Shanwang Paleontological Museum

保护区”。1980年2月17日国务院批复，将山旺列为国家级自然重点保护区。山东省政府批准成立了相应的化石保护管理机构——山旺古生物保护所。1985年4月5日成立了“山旺古生物博物馆”。目前馆藏标本两万多件，如今山旺古生物博物馆已成为中国科学院、中国地质大学、北京大学等科研、教学单位的基地，通过学术交流和广泛的国际合作，山旺化石的研究工作正朝着多学科、综合研究的方向发展。

难能可贵的是作者把长期工作实践中积累的大量资料以图谱的方式奉献给大家，让更多的世人认识山旺，了解山旺。

贾兰坡

1994年6月13日

In 1978, the paleontological society of China convened an on-the-spot meeting in Shanwang and the Chinese Scientific Association reported the State Council the proposal for establishing the" Shanwang Natural protectorate", and on February 17, 1980, the State Council approved the report and Shanwang was classified as first-rate natural protectorate, the government of Shandong Province established a corresponding administrative setup. The Shanwang Paleontological Protect Institute, the government of Linqu County founded the Shangwang Paleontological Museum on April 5,1985, there are more than twenty thousand samples in the museum at present. It has become a scientific base and by academic exchanges and international cooperations, the research work of Shanwang fossils is developing to a multidiscipline and synthetical study.

总论

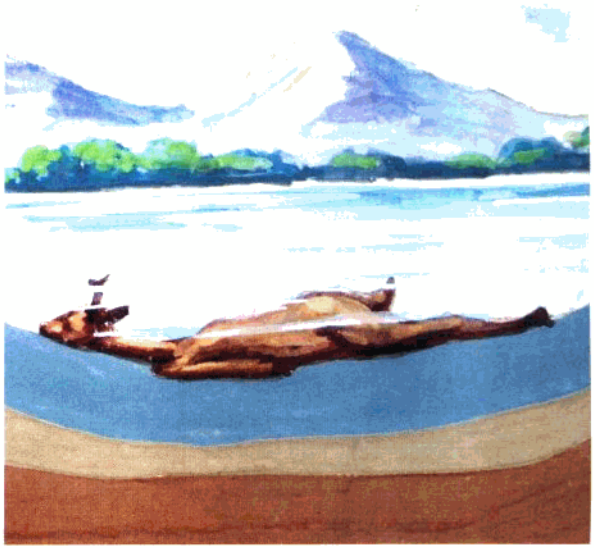
OVERVIEW

1.什么叫化石
WHAT IS FOSSIL

生物体或其遗物(如排泄物)埋入地下，在与空气隔绝无氧化分解作用，经过较长时间(通常以百万年计)的交代作用，地下水中的矿物质部分地或接近全部地将有机物质交代替换，使生物体或其遗物“岩石化”，但仍保留其外部形态和内部结构，这样就形成了化石。

生物的遗迹(如脚印)或生物体的印痕(如皮肤印痕)也能石化并保留其外部形态，一般称之为痕迹化石。

最早的化石定义要比现在的含义广泛得多，18世纪初，人们把地下挖出来的任何物体，不论是岩石，还是矿物，或者其它什么东西，都笼而统之称为化石。因此，当时的地质学家遂将拉丁文“挖出”(fossilis)一词转用于化石，过了不久，人们认识到岩石、矿物和古生物遗骸统称为“化石”有些混乱，就把化石(fossil)一词的含义只限于岩石 中保留下来的动植物遗体和遗迹。



a

The living organism itself or its excrements buried underground and under the condition of being completely cut off from air and without oxidation, went through a long time (generally counted in millions of years) replacement, the mineral materials replaced the organic matter, and the organism or its excrements became "petrified", but without altering the original substances, so the fossil formed.

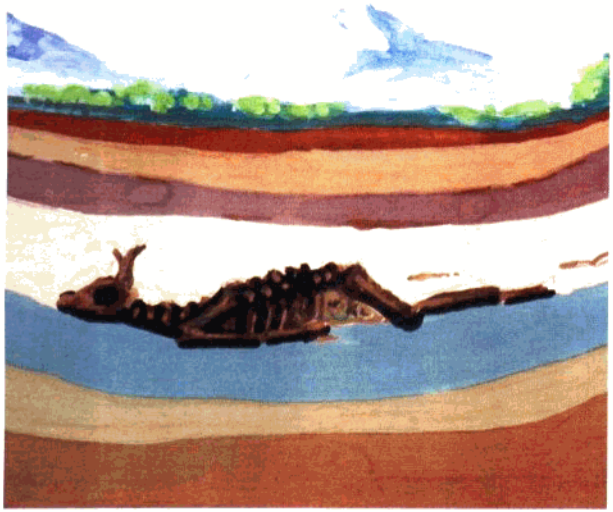
The vestiges of organism (as footprint)or its molds (as skin molds) also could be petrified, it is generally called imprint fossil.

The term fossil was at first loosely applied to any excavated object found underground whether rocks, minerals or odds and ends, but it gradually came to be restricted to the organisms as now defined, including any recognizable organic structure or impression of the same,preserved from the geologic past.

b

化石的形成

Formation of animal fossils



c

d

a

动物死后，遗体被冲到湖里或低洼沼泽地带

This animal happened to die in a lagoon or swamp

b

遗体迅速被砂泥掩埋，不致受细菌的侵蚀，或氧化作用的破坏而腐烂消失

The body was rapidly covered by sediment and was protected from decay or destruction by oxidation and scavengers

c

在地下水的渗透作用下，矿物质代替了遗体的有机物，最后形成了化石

All or part of the organic structure of the skeleton was replaced by minerals in the water which filtered through the bones. The remains were thus preserved as fossils

d

化石因所在岩层被剥蚀或地壳变动而露出地面

The fossils were exposed when the rocks were weathered or disturbed by earth movement

2.中新世
MIOCENE

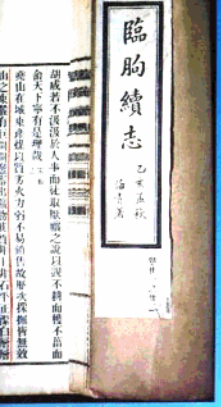
代 Era	纪 Period	世 Epoch	主要生物演化 Evolution of major lite-foms	距今大约年代 Years ago
新生代 Cenozoic	第四纪 Quaternary	全新世 Holocene	现代植物 Modern plants　人类时代 Age of man	0.01百万年 (million)
		更新世 Pleistocene		1.64百万年 (million)
	第三纪 Tertiary	上新世 Pliocene	 	5.2百万年 (million)
		中新世 Miocene		23.3百万年 (million)
		渐新世 Oligocene		35.4百万年 (million)
		始新世 Eocene		56.5百万年 (million)
		古新世 Palaeocene	被子植物 Angiosperms　哺乳动物 Mammals	65.0百万年 (million)

中新世是地质年代学中的一个名称。它代表新生代晚第三纪的一个地质历史时期。其延续的时间大约为距今2330—520万年前。山旺组地层沉积时期即属于早中新世晚期。

中新世的气候比现在温暖得多，大部分现生动、植物在当时或已出现或其最近的祖先已产生，因此中新世是生物演化历程中的一个重要时期。

The Miocene is a term of Geochronology,representing a period of geological history in late Tertiary of Cenozoic. It lasted for as long as 23.3—5.2 million years BP.The sedimentation time of the Shanwang Series was in the later stage of early Miocene.

The climate in Miocene was much warmer than that of today. Most of the modern animals and plants either appeared or their close ancestors had already came forward at that time,therefore,Miocene is an important period in the evolutive course of the organisms.



3. 万卷书
THE BOOK OF TEN THOUSAND VOLUME

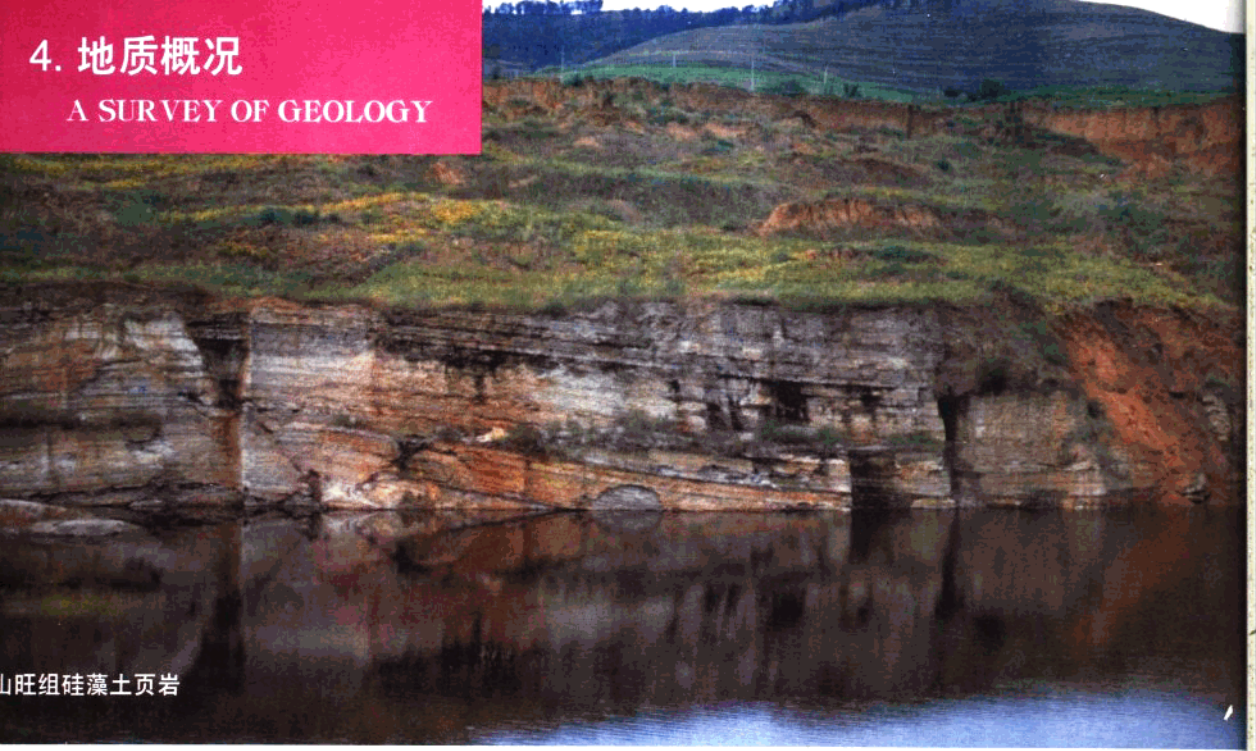
据临朐县志记载："灵山东南五里，俗传山麓溪间边有特别产物，曰"万卷书"……其质非土非石，平整洁白，层迭若纸，揭示，内现黑色花纹，备虫、鱼、鸟、兽……花卉诸状态。"

这里所说的"万卷书"乃是一种特殊的岩层，它由硅藻遗体和粘土构成，由于层薄如纸，内含大量古生物化石，稍经风化，即可层层翘起，宛若书页，所以被形象地比喻为"万卷书"。

According to the records of Annals of Linqu County: " Common saying, 5 li SE of the Lingshan Mountain,there are special outcomes at the stream sides on the foot of this mountain,it was called 'the book of ten thousand volumes'... Its texture is neither soil nor stone it is smooth and spotlessly white,and appeared repeatedly as paper layer when it has been uncovered, there are black patterns of insects, fishes, birds, beasts, flowers and so on."

What is called the book of ten thousand volumes here is a special bedded rock which is composed of remains of diatoms and clays, because it is as thin as papers and contains a large number of fossils,and would become warped after slight weathering, and just like the book pages, then be vividly analogied as "the book of ten thousand volumes."

4. 地质概况
A SURVEY OF GEOLOGY



山旺组硅藻土页岩

山旺地区位于华北地台鲁西台背斜的东北部，昌乐凹陷的南端，其东侧为郯庐断裂带的主干断裂之一鄌郯—葛沟深断裂，西界为益都大断裂。区内少有褶皱构造，发育大量NE—NNE向和NW向的断裂构造，它们均为郯庐断裂系的组成部分。

本区地势平缓，属低山丘陵地形，大部分海拔高度为200—400米。

山旺地区大面积分布的地层是新第三纪基性—超基性火山岩及沉积夹层，仅西南部出露有少量太古界片麻岩，一些盆地内有较厚的沉积岩系。鉴于新第三系剖面上火山岩地层占绝对优势，岩性地层单位应以岩浆活动的旋回性及其岩石组合特征为依据。根据这一原则，本区新第三系可划分为三个组，从下往上依次为牛山组、山旺组和尧山组。这些地区产状平缓，基本上没有褶皱构造，侵蚀切割强烈，发育一系列平行区域构造线方向的深切沟，沟内主要为厚层的第三纪和第四纪沉积物，因此可以推断，本区第三纪以来的构造活动以地壳整体抬升和断裂为主。

山旺盆地的平面形态为圆形，直径约一公里左右，是一个以牛山组玄武岩为基底的中新世盆地。其外围的地层主要由牛山组玄武岩组成，岩性单一，主要是致密块状碱性橄榄玄武岩，某些层位上含有较多的深源包体。盆地内出露的地层主要为山旺组，根据岩性组合特点可以划分为上、中、下三段。

下段地层出露于盆地边缘，呈环形分布，由下部的火山集块角砾岩及其上覆的次生火山角砾岩组成，上部可见少量沉积夹层和动植物化石碎片。地层厚度1—27米，局部可达50米，与下伏牛山组玄武岩整合接触。

中段的下部为硅藻质页岩、硅藻土，夹油页岩夹层，含有较多的磷结核和丰富的生物化石，常见薄层火山碎屑岩透镜体；上部为黄绿色泥岩，粘土质页岩，厚50米左右。与下段地层呈过渡关系。

上段的下部为碧玄岩(β_3^1)，上部为碱性橄榄玄武岩(β_3^2)中间夹平均厚度约为一米的碳质页岩，厚约4—20米。

The Shanwang area is situated in the northeastern part of the plateformal antiform of western Shandong of the North China platform, and at the southern side of the Changle Depression. The east side is the main fault,the Tangwu-Gegou deep fault of the Tancheng-Lujiang fault Zone; and the western side is Yidu great faut.Few fold structure was found in this area, and a large number of NNE and NW faults developed, they all belong to the Tanchen-Lujiang fault system. The terrain slopes of the area gentlely, is a hilly land with an elevation generally of 200—400 meters.

The strata extensively distributed in the Shanwang area are the Neogene basic and ultrabasic volcanic rock and interbedded sedimentary rock, only a few Archean gneiss lie on the southwestern part, and there is rather thick sedimentary rock in several little basins. The Neogene system here which can be divided into three series from bottom to top successively are Niushan, Shanwang and Yaoshan series. The beds are dipping gentlely, there are not the fold structure on the whole and the beds are often affected by small faults, a series of deep gullies parallel to the main tectonic direction developed and deposited thick loess in them, thus, the inferences can be drawn that the tectogenetic movement took up lift and fault as the dominant factors.

The Shanwang basin is a roundshaped one with a diameter about 1 kilometer, and the basal bed of this Miocene basin is basalt of the Niushan series. Immediately above the Shanwnag series extends the protecting cap of basalt, mainly the fine and compact olivine basalt.The Shanwang series, main strata in the basin, can be divided into the upper, middle and lower sections.

The lower section of the Shanwang series is exposed around the basin, composed of volcanic agglomerate breccia. The thickness is 1—27m,and locally 50m. This part overlies the basalt conformably.

The lower part of the middle section are composed of diatomaceous shale, interbedded with oil shale, containing much phosphorite nodules and abundant organic fossils; and the upper part of is yellowish mudstone, clay shale, the thickness about 50 meters, transiting to the lower section.

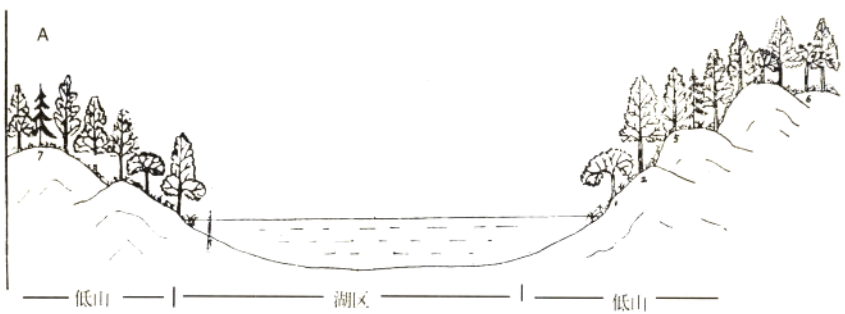
The lower part of the upper section is basanite, and the upper part is alkaline olivine basalt, I meter of carbonaceous shale between them. The total thickness 4—20 meters

俯瞰山旺盆地地貌

5. 山旺湖演化的主要阶段
THE MAIN STAGES OF EVOLUTION OF THE SHANWANG LAKE

山旺湖是一个纵横约一平方公里的小湖盆，从地质历史的发展角度分析，在山旺组地层沉积之前，山旺一带正处于地壳运动活跃阶段，形成了大规模的多次火山喷发，在此基础上在山旺一带逐渐形成了一个四周高中央低的小凹地，随地壳活动的加强，该处不断下降，四周的水流逐渐汇聚于这一近圆形的小湖盆中，至此形成了山旺湖的雏形。

The Shanwang Lake was a lake basin one kilometer in length and breadth.Before the sedimentation of the Shanwang series, this area was at active period of crust movement. There were extensive volcanic eruptions many times, and on what had been formed, the Shanwang area shaped a depressed ground. Along with the enhancement of crust movement, this area had subsided gradually, and the streams all around co-verged in the lake basin, it was the embryonic form of the Shanwang Lake.



A. 山旺湖形成的初期

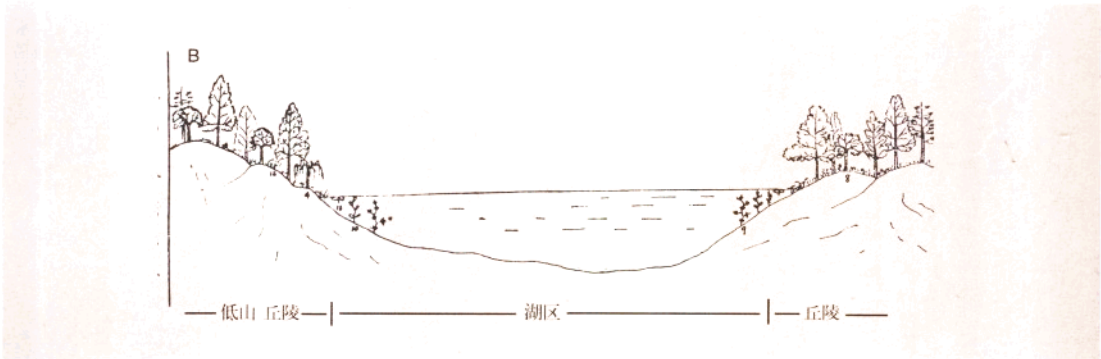
在地层上主要由一套粗碎屑的砂泥岩组成，中夹数层薄层黑灰色泥岩及灰白色硅藻土，厚度由几十米至几米不等，多分布于湖的四周边缘地带。

此时湖水面积极小，地势高差较大，在四周较高的山地里则有较多的山地针叶树林，反映在孢粉植物群中山地针叶树种花粉的含量明显增多。相反一些喜湿热的亚热带成分如木兰、冬青则少见；山核桃属的含量也不如中期繁盛。水体面积尚小，一些水生的黑三棱、眼子菜、菱尚不常见；相反该阶段一些生态适应幅度较广的属种，如胡桃属，栎属等相对较多，因而在低洼的湖岸四周形成了以阔叶落叶林为主的植物景观，在湖岸浅水地带开始生长少量的黑三棱，眼子菜等水—沼生植物。从植物群的生态环境分析，大多数属种反映了南温带的特性，但也有一定数量的亚热带成分及少量的典型亚热带成分，所以此时的古气候应为北亚热带气候下的温暖期。

THE INITIAL STAGE OF THE FORMATION OF THE SHANWANG LAKE

Stratigraphically, it consisted of a group of clastic sandy clay, interbedded with thin dark-grey mudstones and grey-white diatomites, distributed in the border districts of the lake.

The space of the lakewater was rather small and the coniferous trees grew flourishingly at the mountainous regions all around, and in the lowlying lakesides, the broadleaf trees and deciduous-leaf trees as the dominant plant landscope and at the shallow lakewater near the borders, a few Burreed and potamoget on were developed. On the basis of the analysis of the ecological environment of the flora in this area, the climate at that time should be a warm period under the Northern Subtropical climate.

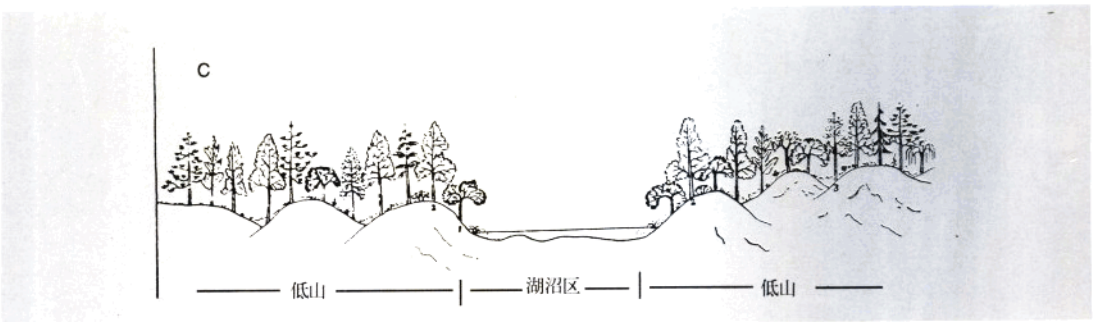


B. 山旺湖发展的全盛阶段

该阶段为山旺组地层的主体，一般厚度大而稳定，由一套细的灰白色硅藻土和杂色泥岩、页岩等典型的湖相沉积地层组成，因而该阶段湖盆面积最大，地势渐趋平缓，加之气候更为温暖湿润，使得性喜湿热的亚热带植物得到进一步发展，因而在湖岸四周的平原上形成了一片片郁郁葱葱含有常绿阔叶成分的落叶阔叶混交林。只在距湖较远的四周低山丘陵地带才长了一些以松科各属为主的山地针叶树，形成了针叶阔叶落叶混交林，由于气候温暖雨量充足，在湖岸浅水地带开始繁盛一些水生草本植物，在湖中尚有一些菱科植物生长。此时的古气候较早期更加温暖湿润，古气候带上划归北亚热带的暖湿期。

THE PRIME STAGE OF THE DEVELOPMENT OF THE SHANWANG LAKE

In this stage, the main part of the strata of the Shanwang series was developed. On the whole, the stratigraphical units thick and stable, are composed of a set of grey-white fine diatomite, parti-coloured mudstone and shale, thus the space of the lakebasin was greatest in this stage, the terrain slopes of the place were gradually gentle and the climate was further warm and moist, there were mixed forests of broadleaf and deciduous leaf trees that contained evergreen broadleaf component parts. Only at the hilly land far around the lake, some coniferous trees mainly Pinus were developed. Owing to the warm climate and rich rain water, some aquatic herbaceous plants came to grow and some Trapaceae plants developed in the lake. The climate at that time in the Shanwang area was further warm and moisten, it was a warm-moist period of the Northern subtropical zone.



C. 山旺湖衰亡阶段

此时由于地壳运动复趋活跃，一次又一次的火山喷发，地势高差分异再次加大，使湖泊面积大大缩小，湖水变浅，局部出现了沼泽。所以该阶段地层分布非常局限，厚度很小，主要岩性为黑色炭质页岩及杂色泥岩，反映了湖泊沼泽相的沉积类型。从孢粉植物群看，再次出现了山地针叶树种相对增加的趋势，喜静水生活的菱科植物消失，一些陆生草本植物的含量明显增加，而亚热带成分较中期显著减少，气候上反映了温带气候的因素加强。从整体上仍不失为亚热带古气候。所以该阶段可以称为亚热带的温凉期。

总之，山旺湖兴衰演变过程大体上受地壳活动的控制和气候变化的影响。在山旺湖形成阶段古地理表现为低山丘陵，湖盆面积不大。古气候处于亚热带的暖湿期。古植被为针叶—落叶阔叶混交林。山旺湖的发展及全盛阶段，由于地壳活动相对平静，湖在不断下沉，加之降雨量增加，湖水面积进一步扩大。古气候处于亚热带的暖湿期。古植被表现为含常绿成分的阔叶落叶林。在山旺湖的消亡时期由于火山喷发，地壳运动复趋活跃，湖区全面抬升，形成残湖—沼泽。古气候反映为亚热带的温凉期。

THE DECLINE STAGE OF THE SHANWANG LAKE

As the crust movement became active again at that time, the volcanic eruptions broke out repeatedly,the difference of heights of topography in this area enhanced,that caused enormous losses to the lake area, and the marshlands appeared locally,therefore, the strata of this stage are very limited and thin,the main rocks are dark carbonaceous shale and particoloured mudstone, reflecting the sedimentary style of marsh.The sporopollen statistics shows that the species of the mountainious coniferous vegetation increased relatively again, and the Trapaceae plants disappeared, some terrestrial plants obviously increased but their subtropical composition was reduced, thus this stage may be called a pleasantly cool period of the subtropical zone.

To state succinctly, evolution of the Shanwang Lake was controlled by the levels of crust movement and the climate variations on the whole.

6. 研究简史与现状

BRIEF HISTORY AND PRESENT SITUATION OF THE RESEARCH

1934年秋，就职于中央地质调查所新生代研究室的杨钟健和卞美年到山东泗水、新泰一带工作，途经济南时，前往齐鲁大学(现山东大学)拜访地质系主任施寇特(Scott)教授，杨钟健和卞美年在参观陈列室时曾看到采自山旺的鱼和植物化石，唯当时未觉其重要，当结束了泗水、新泰工作返回北京后，反感此化石之重要。

1935年春，当时的中央地质调查所所长翁文灏得知山东昌乐一带发现“龙骨”，杨钟健也曾认为昌乐一带地层中可能产恐龙化石，随即杨钟健奉派赴昌乐一带调查。

至济南，杨钟健再次造访齐鲁大学施寇特教授，详询山旺化石发现经过及产地情况。据施氏介绍，化石系产自山旺村之东北1—1.5公里处，是1900年(清宣统元年)12月由保罗·贝尔金(Paul Berge)采自临朐县山旺村之东北解家河，经由滕县海斯(Hays)博士转赠齐鲁大学的。

In the Autumn of 1934, Young Chung-chien and Bian Meinian, in the employ of the Cenozoic Laboratory of National Geological Survey, went to the Sishui-Xintai area of Shandong Province for field work. They paid a visit to Professor Jas Cameron Scott, Chief of the Department of Geology of Qilu University, they noticed the fossil fishes and plants in the exhibition hall of the department, but they had no time to pay attention to them, and when they returned to Beijing, they thought highly of these fossils.

Later on, in Spring 1935, Weng Wenho, the Director of the National Geological Survey, was informed that some "dragon bones" had been recently unearthed in Changle, Shandong, andYoung Chungchien also considered it is possible to find dinosaur fossils in the Changle area, then he set out to condact a research into this case.

When he visited Prof. Scott again in Jinan Young acquired detailed situation of the Shanwang fossils. As far as Scott knowing, the fossils recovered in the place 1—1.5km N.E. from the Shanwang village, they were excavated by Paul Berge in 1900 and he handled these fossils to Hays who lived in the Tong County at that time, then the fossils were attributed to the Qilu University.

杨钟健教授(1897—1979)