

TAIPEI '98 NATURAL HISTORY SHOW™

# 史·前·探·索·之·旅

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展出地點：美麗華大飯店 5 樓 (台北市民權東路3段2號)

TAIPEI MIRAMAR HOTEL TAIPEI, TAIWAN, R.O.C.



Photo by R.J.B. Rock Shop

主辦單位：  山河國際藝術有限公司

# *Santana* ~ 中生代化石的瑰寶

Gunter Bechly 著

巴西屬古白堊紀的Santana岩層，包含了立體保存的古代魚類及其他脊椎動物的化石，和白堊紀中保存最完整的昆蟲、蜘蛛網節肢動物及植物。Santana最早出土的化石是在1819年由兩位德國自然學家JOHANN BAPTIST VON SPIX和CARL FRIEDRICH PHILIPP VON MARTIUS所挖掘出來的，他們是一個由巴伐利亞國王下令組成的巴西科學探險隊的領隊。他們主要的發現是有魚化石的凝塊。這裡首先發現的昆蟲化石，在本世紀中葉已經有所討論了，但是完整的Santana區古昆蟲學研究一直到1980年代中期才開始，而第一個針對植物化石的古植物學研究，才就此展開。

Santana岩層的露頭位於Chapada do Araripe的北坡，一個在Caera省北邊的的中生代高地。Caera是巴西東北邊的一個乾燥貧窮的省分。

在前寒武紀(550百萬年前)底層上，有700公尺屬於青侏羅紀及古白堊紀(約144百萬年前)的中生代沉積岩。所謂的Santana岩層包括三種不同的層次。最上一層是Romualdo層，其中包含了具有知名脊椎動物化石(魚、翼龍類)的石灰岩層。在Romualdo下的是Ipubi層，它主要是由石膏組成，而且它顯示了日漸蒸發中的Santana湖。Crato層是整個Santana岩層的最底層，在這一層有3至8公尺厚的石灰岩。最特別的是，從這些原本位在鹹水湖裡的石灰岩中可發現125百萬年前的昆蟲化石。

在Crato石灰岩層中，除了有大量節肢動物化石外(主要是昆蟲及蜘蛛網節肢動物化石)，還有陸生植物的化石遺跡，及少數的脊椎動物化石，不過數量和Romualdo層凝塊比起來少了很多。唯一發現量較大的適於屬的Dastilbe的幼體標本。稀有的發現是龜類、翼龍類、鱷、鳥羽毛和青蛙的殘骸。植物化石包括了裸子植物及被子植物，甚至還有同時具備根、果實和花的標本。很多植物，甚至都被像植物標本般非常良好地保存著。這些植物對科學研究有特別的功用，因為他們提供開花植物早期進化過程的線索，及絕佳研究植物和昆蟲同步進化的機會。

同時，這裡最具代表性的現存昆蟲種都已經有所記錄，可是大多數的資料則尚無研究。這個地點也因它具有昆蟲的幼蟲及成蟲、和陸生、水生和可飛行等各種種類而更顯獨特。昆蟲化石的保存大致來講都相當完整，只有少部份因壓迫而受損。未受侵蝕的標本可能可以照原本的樣子保存下來，不過，大部份的標本都是以無機的形式保存而成為石灰岩。兩種保存方式都可顯示出微小的細節，如細小的毛髮、昆蟲複眼中的小眼及昆蟲表皮上細小的紋路。有時，甚至連昆蟲的軟體部份也都保存下來了，如飛行肌肉，胃和內臟。最特別的是翅膀，或甚至原本鳥體顏色的保存，例如在少數的燈心蜻蜓化石上仍可看到部份牠原來的顏色鐵綠色，而這顏色正是現存的蜻蜓的顏色。連一般Santana岩層的昆蟲化石，都大致保存得比著名的

Solnhofen石灰岩層中最出色的標本還好。

Santana岩層獨特的重要性也和其屬於古白堊紀有關。不過，30年前，著名的德國昆蟲學家Willi Hennig博士在他的書Insect Phylogeny中寫：「我們對於昆蟲學的知識最大的鴻溝之一，是欠缺對白堊紀化石的瞭解。在不同地點已有個別的昆蟲發現，但這些發現，無法反映出發生在白堊紀的事件的重要性。」雖然同時白堊紀昆蟲化石在少數地點都已有所發現，但這些發現沒有一個具有Santana岩層的重要性，因為各種不同的昆蟲化石區，少說也有幾百種以上不同的種類，而大部份都還沒有人研究。

美國古昆蟲學家John G. Maisey博士在他的圖解集Santana Fossils (1991)中強調Santana的重要性：「即是我們隨便看一張這本書裡的照片，我們就能理解為什麼這個化石發現地會被列為世界頂級的了。化石間完全的差異尤其是魚類，翼龍類和其他脊椎動物加上這些化石本身極佳的保存品質，創造出110百萬年前古白堊紀生物無可匹敵的價值。幾乎沒有化石可以保存的像Santana的化石一樣好，而且也幾乎沒有化石可以被分析得像Santana化石一樣詳細。然而除了脊椎動物外，這些地層還包含一些和數百年前當地環境有關，能提供新資訊，但卻又具有爭議性的植物和昆蟲。

總括來說，Santana地層被認為是研究中生代魚類、昆蟲和植物最重要的地點之一。

雖然這個令人重視的遺址，早在180年前就已發現了，這些露頭獨特的重要性，卻是在幾年前才被發現，而這也得歸功於長期和全球科學家及博物館合作的德國化石商，同時也是優秀的標本製作專家Michael Schwickert的開創工作。他的收藏是40多人辛苦工作數年的成果。這些珍貴的化石都是在他那可算是歐洲最大的實驗室中整理的。專門的技術和長期的實驗，使得在製作標本上的技術及成果不是其他Santana化石標本製作專家所能相比的。它的收藏裡所有的魚化石經由古昆蟲學家Andre Nel博士鑑定後，被歸為「種」，而全部的節肢動物化石被歸為「目」，但是一般的節肢動物化石都是歸在「科」或是「種」。因此，Michael Schwickert的收藏是所有化石收藏中最珍貴的，也是被科學博物館及私人收藏家高度評價和收藏的對象。

Translated Sophia Ho (Ho, Shou-Wan) and Dirk D. Ross (Wu Xun-Ci).

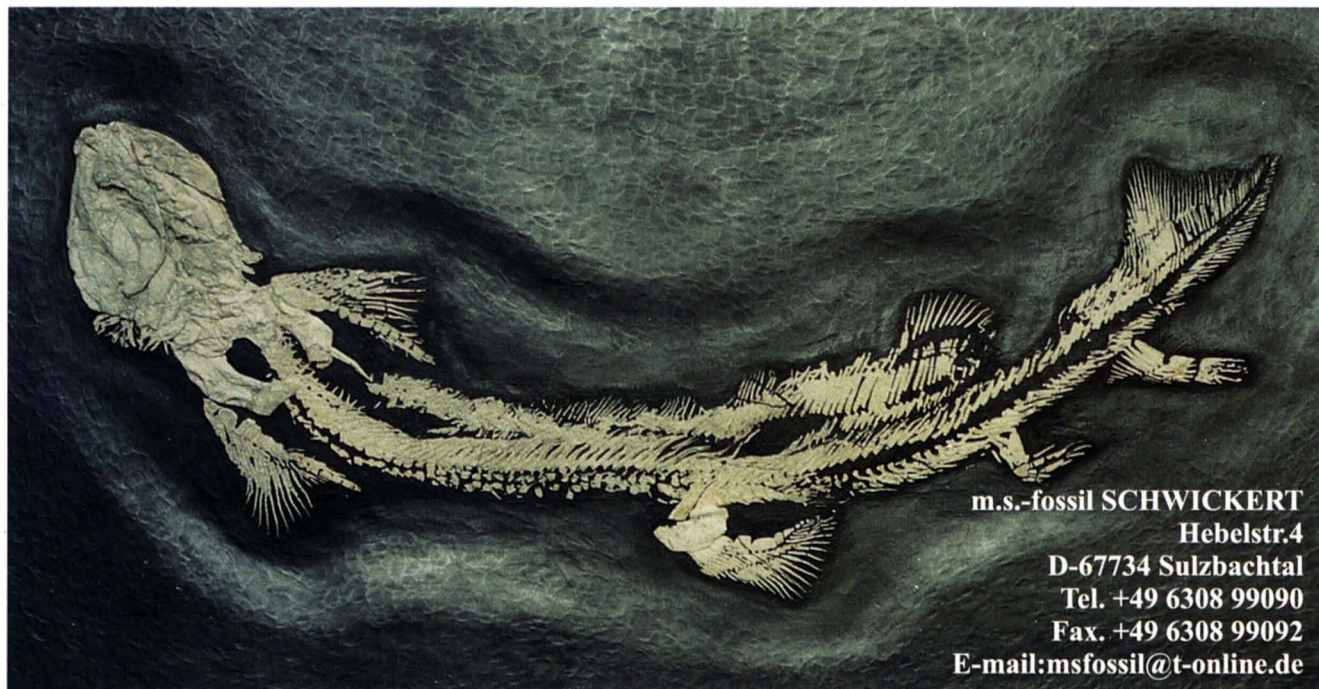


Fossil spider. Santana Fm. Brazil.  
蜘蛛化石

Photo by m.s. Schwickert



# m.s.-fossil SCHWICKERT



## FROM GERMANY: m.s.-fossil SCHWICKERT

We are glad to exhibit at the first TAIPEI NATURAL HISTORY SHOW  
**ROOM 5002 and ROOM 5004**

Ammonites and other FOSSILS from different eras and localities  
Spectacular Insects, Plants and Fishes, from the Lower Cretaceous of Brazil  
Permian Sharks, Amphibians, Fishes, Plants and Stromatolites from Germany  
Devonian Giant Eurypterus and Ctenurella-Eocene Frog, Bird, Snake  
Coelacanths from Madagascar and Brazil - New Triassic Fishes from Brazil



Fossil insect. Santana Fm., Brazil

Photo by m.s. Schwickert

## SANTANA - THE ELDORADO OF MESOZOIC FOSSILS

by Günter Bechly

The Lower Cretaceous Santana Formation of Brazil yields three-dimensionally preserved fishes and other vertebrates, but also the best preserved insects, arachnids and plants from the Cretaceous. The first fossils from this unique locality have been discovered in 1819 by the two German naturalists JOHANN BAPTIST VON SPIX and CARL FRIEDRICH PHILIPP VON MARTIUS, during a scientific expedition to Brazil on behalf of King MAXIMILIAN I. of Bavaria. They mainly found concretions with fossil fishes. The first fossil insects from this locality have been described in the middle of our century, but thorough palaeoentomological studies of the Santana fauna started not before the mid eighties. First palaeobotanical studies of the highly interesting fossil plants have just begun.

The outcrops of the Santana Formation are located along the northern slope of the Chapada do Araripe, - a Mesozoic plateau in the southern part of the state of Ceará, in the semiarid and poor north-east of Brazil.

On the Precambrian basement there are 700 m of Mesozoic sediments from the Upper Jurassic and Lower Cretaceous. The so-called Santana Formation includes different layers which are usually assigned to three members. The uppermost member is the Romualdo Member and contains the calcareous concretions (geodes) with the famous vertebrate fossils (fishes, pterosaurs, etc.). Below these layers is the Ipubi Member that is mainly composed of gypsum and indicates a progressive evaporation of the Santana lagoon. The Crato Member is the lowermost member of the Santana Formation and includes limestones of 3-8 m thickness. Fossil insects are exclusively found in these limestones that originated in a brackish lagoon about 125 Mio. years ago.

Beside the numerous fossil arthropods (mainly insects and arachnids), the Crato limestones also yielded remains of terrestrial plants, but only very few vertebrate fossils, contrary to the mentioned concretions of the Romualdo Member. The only abundant vertebrates are juvenile specimens of the bonefish genus *Dastilbe*. Rare findings are aquatic turtles, remains of pterosaurs and crocodiles, bird feathers and frogs. The fossil plants include gymnosperms and angiosperms, and even specimens with roots, fruits and blossoms are found. Many of the plants are uniquely preserved and rather look like herbarium specimens. These plants are of particular scientific interest since they provide informations about the early evolution of blossom plants, and thus also offer the unique possibility to study the co-evolution with insects.

Meanwhile representatives of most extant insect orders have been recorded from this locality, but the majority of the material is still undescribed. This locality is also unique because it yields larval as well as adult insects, terrestrial species as well as aerial or aquatic ones. The preservation of the fossil insects is generally excellent with most specimens being complete and only slightly flattened. Unweathered specimens may be organically preserved, but most specimens are inorganically preserved (limonite). Both types of preservation often show minute details, like bristles, facets of compound eyes, and micro-sculptures of the body surface. Sometimes even soft parts are preserved, such as flight muscles or the stomach and guts. A most unusual feature is the preservation of colour pattern of the wings, or even of original body colours. For example a few of the fossil damselflies still show parts of the original metallic green body coloration that is also typical for

their extant relatives. Even average fossil insects from the Santana Formation are generally much better preserved than the top specimens from the famous Solnhofen limestones.

The particular importance of the fossil insects of the Santana Formation is also related to their Lower Cretaceous age. Only thirty years ago the famous German entomologist Prof. Willi HENNIG still wrote in his book *Insect Phylogeny*: «One of the most regrettable gaps in our knowledge of insect phylogeny is the almost complete absence of fossils from the Cretaceous. Individual insects have been found at various localities, but in no way does the extent of these discoveries reflect the importance of the events which must have taken place during the Cretaceous.». Although several fossil localities for Cretaceous insects have meanwhile been discovered, none of them matches the importance of the Santana Formation because of the very diverse fossil insect fauna with several hundred different species, most of them still undescribed, the excellent preservation of the fossil insects, and the large amount of specimens found.

The American palaeontologist Dr. John G. MAISEY highlighted the importance of this locality in his illustrated atlas *Santana Fossils* (1991): «Even a casual glance at the photographs in this book will reveal why this fossil locality is ranked among the world's greatest. The sheer diversity of fossils - especially fishes, but also pterosaurs and other vertebrates - coupled with their spectacular preservational quality, provides an unparalleled view of a Lower Cretaceous biota some 110 million years old. Rarely are fossils so well preserved as these, and rarely can so much anatomical detail be extracted for so many species. Besides vertebrates, however, these strata have yielded important plant and insect fossils, providing new and sometimes controversial data concerning the local environment all those millions of years ago.»

Altogether, the Santana-Formation has to be regarded as one of the most important localities for Mesozoic fishes, insects and plants at all.

Although this remarkable fossil locality is known since 180 years, the unique importance of these outcrops has been realised since only a few years, also because of the pioneer work of the German fossil trader and gifted preparator Michael Schwickert who is collaborating with scientists and museums around the globe. His collections are the result of several years of hard work by more than 40 people. The precious fossils are prepared in his private laboratory in Germany which is the largest of its kind in whole Europe. The specialisation and long time of experience resulted in a quality of the preparations that is not matched by any other preparator of Santana fossils. All fishes in his collections are determined till species level and all specimens of fossil arthropods have been determined till order level at least, often till family or even species level, by professional paleoentomologists (e.g. Dr. André Nel). Therefore his fossils are the very highlights of any collection and thus most appreciated and sought after by scientific museums as well as by private collectors.