

THE ADVERSITIES OF ANGELINA (A FOSSIL, NOT A MOVIE)

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CURATOR OF INVERTEBRATE FOSSILS

PAULINE had her Perils; Belinda the Beautiful Boiler Maker's Daughter had more than her share of woes. Happy are those who can retire to a quiet case in a museum. One of the retired characters staying here with us is *Angelina*. Her present address is Hall 37 (Frederick J. V. Skiff Hall), where she is propped up in the upper right-hand part of the case devoted to Cambrian fossils.

Our *Angelina*, and thousands of her kindred with such thoroughly un-British names as *Shumardia*, *Asaphellus*, *Olenus*, *Triarthrus*, and *Euloma*, were trilobites, living quietly with a multitude of smaller and less active neighbors in the quiet sea that covered a large part of England in the late Cambrian period.

However confident we may be that "there'll always be an England," we may be still more certain that there has not always been an England—at least not the same rabbit-shaped island that we sometimes call Albion.

A long time ago, before the North Sea and the English Channel flooded the edge of Europe, England was a part of the continent, and the Thames a minor tributary of the Rhine. And long before the Thames started flowing, Britain was a region of arid basins of high, block-like mountains shining bright red under a semitropical sun. Before that, it was a low, swampy place with mountain ranges where are now Wales and Scotland.

ONCE DOMINANT CREATURES

But even this was long after *Angelina's* time. She and her relatives with the queer names found their warm sea-bottom a good place to live and feared nothing in it, for they were the biggest and strongest of all its creatures.

Angelina may have lived four or five years, slowly crawling about on the muddy sea-floor and chewing up the smaller animals that had died and fallen to her table. Then, having attained a length of about two inches, she too died in the fullness of age, settled down into the mud, and wasn't seen again for 600 million years. Her life had been uneventful, but her troubles had not yet begun when the slowly settling silt of the Cambrian sea closed over her paper-thin shell (Fig. 1).

A trilobite is a very much-jointed animal, even more so than the related horse-shoe crab of the present time, and *Angelina* had sixteen different pieces to her shell, hinged

together to help her move about: a head-shield, a segmented body-shield, and a small tail-shield. Her under side had no shelly covering, and even the legs, of which a pair stuck out from under the ends of each shell segment, were soft and weak, each with a feathery gill for obtaining oxygen from the water.

MERGED INTO SHALE

When *Angelina* died, her soft parts quickly decayed, and she was left with nothing but the test (shell) that covered her back. Soon the slowly accumulating clay and silt of the sea-floor buried her deeply, and in course of time, when the overlying material had consolidated and become shale, *Angelina* became part of the shale.

At the end of the Cambrian period (550 million years ago), *Angelina* lay well buried, so well buried indeed that the first gentle upheaval of the earth's crust, anticipating a period of mountain building, had no effect upon her. With the beginning of the next period, the Ordovician (480 million years ago), some of the newly formed Cambrian rocks were arched above sea level in the region of the present English-Welsh border, east of *Angelina's* former home. It was a naked land, and the streams that carried off the rain water fallen upon it carried off the land as well, depositing it again to the westward. Thus *Angelina* was buried ever more deeply.

High above *Angelina's* grave now was a moderately deep sea of quiet, warm water, with animals different from those she had known. Conditions of life were a little harder; the trilobites no longer ruled the sea. There appeared animals larger than her kind—cone-shaped cephalopods with arms like the modern octopus and appetites like the modern schoolboy. But even more disturbing was the continued evidence of crustal unrest. Volcanoes broke out, both on the land as far east as what is now London and in the sea itself, where they formed chains of islands much like the Hawaiian chain. The ash and dust from the volcanoes fell as sediment on the bottom of the sea. Lava pouring from the volcanoes flowed out under the water in wrinkly, stubby sheets, while the water boiled and bubbled and the local trilobites were stewed alive. *Angelina*, however, was safely underneath all this commotion, and even the lava rising to the volcanoes through cracks in the

earth's crust by some fortunate chance happened to miss her delicate shell.

ADVERSITIES BEGIN

But at the close of the Ordovician period, *Angelina's* luck ran out. The shale in which she lay imprisoned, along with the other rocks since deposited above her, was folded into gentle waves and lifted above sea level. With the folding and accompanying pressure, the shale became harder, more like slate. It is here that the real adversities of *Angelina* began, for the folding of the rocks pushed her shell a little out of shape and she didn't look herself at all (Figs. 2 and 3).

For a while there was peace and quiet. The low hills were eroded by the run-off of rain water until the land was flat and near sea level. During the next period, the Silurian (390 million years ago), this new lowland slowly sank beneath the waters and again there was a sea, with *Angelina* down there somewhere far underneath its bottom, but no longer lying flat, as before, for the late Ordovician folding had tilted the bed of rock in which she lay. Several times during the Silurian there were episodes when the rocks were again squeezed into tighter folds and she was further distorted. The pulses of activity were becoming more and more frequent.

COMES THE REVOLUTION (GEOLOGICAL)

Finally, at the close of the Silurian period, the greatest and longest-continued epoch of compression occurred, and the rocks were not only tightly folded but were broken and pushed along. It was the birth of a major range of mountains, the Caledonian range, rivaling the Rocky Mountains in size though not in beauty, for they were without trees—without plants, indeed, except for lichens and possibly some very tiny woody reeds.

The Caledonian Revolution ended hundreds of millions of years ago, and the mountains then formed have long since been worn down to plains and valleys, covered again with further deposits and now again uplifted and eroded. During this erosional cycle, in the cutting of one of the present valleys, the bed containing *Angelina* was finally exposed. Ages passed;

KEY TO FIGURES

Fig. 1—*Angelina sedgwicki* as she appeared in life. One-half natural size.

Fig. 2—*Angelina* as she appears in exhibit of Cambrian fossils in Frederick J. V. Skiff Hall (Hall 37). Natural size.

Fig. 3—Another *Angelina sedgwicki*, which happened to lie in a different relation to the Caledonian pressure. One-half natural size.



Fig. 1



Fig. 2



Fig. 3

glaciers and glacier-dammed lakes occupied the valleys. Stone Age man hunted now-extinct animals; Druids performed strange rites in their leafy temples; Welsh tribesmen hurried past in their successful defense of Wales against the legions of Caesar, Hadrian, the Danes, the Normans; plows and cultivated fields appeared; and, finally, a paleontologist with his hammer and chisel.

While breaking up piece after piece of the Tremadocian shale, the scientist discovered *Angelina*, very nearly ruined by the vagaries of Nature. *Angelina*, we blush to relate, has even lost her shell; for, as the valley was cut closer to her bed, the slowly moving water always present just below the ground had dissolved it. What we see of her now in Skiff Hall is only a distorted cast of the shell's lower side. Almost destroyed, she is still recognizable as a member of the species to which J. W. Salter, in November of 1864, gave the name *Angelina sedgwicki*.

Soon after her discovery, *Angelina* was set on her travels, her first since the Caledonian Revolution had moved her original burial place. Eventually she arrived in Rochester, New York, at Ward's Natural Science Establishment, and in 1891 came to Chicago as a member of the first collection of fossils in what was then the Columbian Museum. Since that time *Angelina* has been blandly ignoring the stares of countless visitors. She will ignore you too, if you go to see her.

A UNIQUE AMERICAN PALM, VEGETABLE IVORY

By JULIAN A. STEYERMARK
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Normally ivory, the hard dentine-containing substance found in the teeth of most mammals, is secured from the large teeth of elephants, walruses, hippopotamuses, and narwhals. Although it has no structural counterpart as such in the vegetable world, the fruit of some tropical American palms contains a remarkably hard, creamy-white substance resembling the consistency and appearance of true ivory to such a degree that it is called "vegetable ivory." The generic name of these palms is *Phytelephas*, meaning "plant elephant," because of the obvious resemblance between the ivory of the elephant and that of the plant. The Spanish name, often applied to fruit of this palm, is "marfil vegetal," which means "vegetable ivory."

About a dozen species of vegetable ivory palm are known. Although most of them occur in South America in Venezuela, Colombia, Ecuador, Peru, and Brazil, some extend as far north as Panama. They are usually vigorous palms having a short stout erect trunk topped in plume-like fashion by long dark green feathery fronds. These leaves may attain a length of twenty feet, each leaf segment measuring up to three feet in length and two inches in width. A single leaf may have 160 segments.

The leaves are used as thatch in much the same way as those of other palms, but are considered inferior because of their limited durability. In very young plants the leaves appear to arise directly from the ground, whereas the trunk becomes thicker and more elongated as the plant grows older. Even in mature plants the height of the stem does not exceed ten or fifteen feet. The plants grow in tropical or subtropical rain forests from near sea level up to an altitude of 3,500 feet, usually inhabiting damp areas, such as valleys, banks of streams, and moist slopes near rivers. Probably the species best



VEGETABLE IVORY AND PRODUCTS

Various toys and ornaments carved from the seeds of the vegetable ivory palm. In the center two of the seeds are shown with their wrinkled exterior. Inset: The fruit of the palm. It consists of a compact head of single fruits, each containing from four to six seeds, some of which are shown sectioned.

known is *P. macrocarpa* of Ecuador, Peru, and Brazil. During my explorations of the quinine forests in southern Ecuador this palm was often seen at elevations of 3,000 to 3,500 feet, occurring nearly at the lowermost limit of growth of the quinine forests.

In Ecuador the plant itself is called "cadi," and the seed, which contains the hard white ivory-like substance, is known to the inhabitants as "tagua" or tagua-nut. The trees are often cut down by local people for the tender whitish heartmeat found within the growing tip below the leafy crown. This may be eaten as a salad, which is quite delicious when mixed with some kind of dressing, or plain with only salt added to flavor it, or cooked like any other vegetable. It has the rich meaty quality peculiar to most palms. As is well known, many other palms are commonly used for food. It is a wasteful practice to destroy such large plants for the sake of relatively small amounts of food, though such delicacies constitute for the people a real change in the otherwise monotonous daily diet limited to rice, beans, potatoes, and tortillas (corn cakes).

Actually it is a time-consuming as well as laborious task to cut down one of these palms for the heartmeat alone, because the trunk is very hard and tough. A man may spend half an hour or more whacking away at one of these trunks with his machete before felling the plant. In Ecuador, for

example, the halves of the trunk are severed with the machete, and the leaves are then laboriously cut near the base of each thickened leaf-stalk or petiole. As these overlap with one another and surround the central core of the stem in a spiral manner, each leaf-stalk must be chopped off separately from the main trunk. Finally, the growing point is encountered on the inside and the delicious white interior can be taken out. It consists of the bases of the unexpanded leaves and petioles.

Aside from the use of this plant for food, its most interesting and profitable part is the hard ivory-like portion of the seed. In the vegetable ivory palm, the sexes, contained in the flowers, are found on separate plants, some of the plants bearing only male flowers, others female flowers. The fruits, found only on the female palms, consist of clusters of six or seven large drupes, the whole mass becoming the size of a man's head. At first these clusters are erect, but later, owing to the increasing weight of the ripening fruits, become pendulous.

When ripe, these clusters may weigh about 25 pounds. The outside of the fruits is marked by dark brown woody wrinkles or convolutions. The inside consists of a hard white portion containing the seed. At first, the inside of the young fruit consists of a clear tasteless liquid, often drunk by the inhabitants as a thirst-quencher. Gradually, the liquid assumes a milky color and solidifies into a hard ivory-like substance. This solid portion, vegetable ivory, has great commercial importance. The inhabitants of Ecuador carve from it all kinds of ornaments, toys, ash trays, rings, reels of spindles, knobs of walking sticks, etc.

USED FOR BUTTONS

But far more important than these are the hundreds of thousands of tons of buttons that are made from this material. Large quantities are exported to Europe and North America, as well as to various South American countries. As early as 1840, quantities of 150 tons were imported into England. The buttons are very durable and, until a short time ago, were as commonly used, if not more commonly, than ordinary pearl buttons. Now, with the introduction of plastics, the button industry that uses vegetable ivory is meeting greater competition. In Ecuador alone, the exportation of tagua nuts occupied fifth place in that nation's exports, nearly 65,000,000 pounds being shipped annually. Most of the shops manufacturing buttons are in the towns of Manta, Guayaquil, and Ambato.

Ecuador is believed to possess the highest grade of vegetable ivory found anywhere. Thus far, attempts to establish plantations of this palm in other countries have been unsuccessful. An exhibit showing the natural fruit and various articles carved from vegetable ivory may be seen in Case 7 of Hall 25 (Food Plants and Palms).



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