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A Brief History of Biodiversity Exploration and Scientific Expeditions on and off the Island of Santo

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The aim of these few lines is not to draw up an exhaustive inventory of all of the data that the botanists, zoologists, ecologists and marine biologists who have conducted research on and off of the island of Espiritu Santo have gathered since the first Europeans landed on the island. Because of the lack of easily accessible information —and despite the relative low level of interest shown by biologists towards Vanuatu during the last century compared to other parts of the world— such an aim would be out of reach for the non-historians that we are. More reasonably, we shall focus below on the data collected through the collective effort that has preceded the Santo 2006 expedition, and that has significantly increased our knowledge of the terrestrial flora and fauna of Vanuatu.

Of course, in a certain manner, the first biodiversity explorers on Santo were —as far as we know— the first Lapita settlers more than 3000 years ago. Also, today, the vernacular botanical and zoological knowledge that the Ni-Vanuatu villagers possess illustrates the richness of the human perception of diversity; this knowledge can be linked to the potential use of the plants and animals concerned.

No doubt the first European explorers were also interested by the (for them) exotic flora and fauna of the island, and by the local domesticated plants and animals; however, for obvious geopolitical reasons, their first scientific aim was geographic (cartographic). In 1606, during Quiros' expedition, Torres, the captain and pilot of the second ship (the "*Almiranta*" San Pedro) was also a cartographer. He and Prado y Tovar drew the first representations of the coast of La Austrialia del Espiritu Santo —as Quiros had named the island. One of Tovar's maps, which indicates the ships' mooring sites inside of the present-day Big Bay, seems to reflect the strong impression the mountains and forests of the island made on the Spaniards: trees were drawn as if they were many hundreds of feet high on top of the mountains. The Spaniards, who spent 36 days on Santo made more or less reliable observations about the local flora and fauna. "We have seen on Santo", Quiros writes, "a tree with such a large trunk that 15 to 20 men could not make a circle around it with their arms."

In August 1774, James Cook reached the newly-named New Hebrides aboard the vessel, *The Resolution*. On board were Johann Forster and his son George, who gathered the first substantial botanical collections on the archipelago. *The Resolution*, however, only made a short landing on Santo, northeast of the Cumberland Peninsula. A few years before, the French government had sent Louis Antoine de Bougainville with two vessels, *La Boudeuse* and *L'Étoile*, to the South Pacific. The French botanist Philibert Commerson participated in this expedition (1766-1769) that also visited the New Hebrides.

Others scientists followed, but they seldom penetrated into Santo's interior. It was only at the very beginning of the 20th century (August, 1901) that one of them, the botanist Ollivier, crossed the southern part of the island. The trip took him six days, from the Segond Channel to Big Bay; he needed the help of a team of thirty porters to cross a country which was, at that time, considered a very inhospitable area.

THE WHITNEY SOUTH SEA EXPEDITION (1920-1932)

Under the leadership of the ornithologist Rollo Beck from San Jose, California, the "Whitney South Sea Expedition" was organized primarily to collect ornithological and other zoological specimens for the American Museum of Natural History (AMNH) in New York City (Fig. 52). The expedition was financed by a fund provided to the Museum by the philanthropist Harry Payne Whitney, a rich, thoroughbred horse breeder. During over more than 12 years, a team of scientists and collectors, travelling on board a Tahitian sailing ship named *France*, visited hundreds of islands in the South Pacific Region. They collected more than 40000 bird skins, as well as many other animals (reptiles) and plant specimens. Beck's wife, Ida, who participated in the expedition and had a personal interest in Oceanic cultures, oversaw the extensive collection of anthropological artifacts and photographs which, for the most part, are now the property of the Department of Anthropology at The California Academy of Sciences.

Figure 52: The logo of the Whitney South Sea Expedition.

The Whitney South Sea Expedition visited Santo in 1926. In 1929, Ernst Mayr — who later became famous as an ornithologist and evolutionist — succeeded Beck as the leader of the project. As the associate curator and then the curator of the Whitney-Rothschild Collection of bird specimens in the AMNH, Mayr collected bird specimens in the Solomon Islands and studied specimens from Santo. The study of these collections enabled him to publish a series of papers in American Museum Novitates — the *AMNH journal* — under the generic title "*Birds collected during the Whitney South Sea Expedition*". They provided the basis for Mayr's noteworthy ornithological field guide published in 1945, *Birds of the Southwest Pacific*, and for other, more significant theoretical writings on ecology and evolution. The success of the expedition also induced its patron to offer US$ 750 000 to the City of New York for the construction of the building known as the Whitney wing (built in 1936), one entire floor of which is dedicated to presenting the birdlife of the Pacific region.

THE OXFORD UNIVERSITY EXPEDITION TO THE NEW HEBRIDES (1933-1934)

On a smaller scale, but specifically concerning Santo Island, the "Oxford University Expedition to the New Hebrides" directed by the zoologist John Baker was undertaken under the auspices of the Oxford University Exploration Club. Baker had already visited Santo (mostly the northeastern peninsula) in 1922-23 and in 1927 with biological and geographical objectives; during these expeditions he climbed Mt Tabwemasana, which allowed him to draw up a precise map of the area that was published in the *The Geographical Journal* in 1929.

In an article published in the same journal in 1935, Baker reminds us, based on his own experience, that "it is not always easy to collect money for scientific expeditions". The organizers of Santo 2006 would undoubtedly agree with him! And, as Baker notes in his 1935 report: "our famous forerunner, Quiros, had sent in no fewer than 51 'memorials' asking for financial support for his proposed second expedition to these islands". Eventually, the Oxford University Expedition — which was also sponsored by the Royal Society, the University of Oxford, New College and the Percy Sladen Trust — could take place in Santo starting from September 1933. The small team comprised six people including Baker, his sister (a botanist) and his wife (a photographer). John Baker stresses the "two very definite main objects (of the expedition); namely (1) to study the breeding seasons of animals in a climate which scarcely varies during the course of the year, and (2) to discover which is the highest mountain in the New Hebrides, to climb it, and to survey the whole surrounding district". His results were also published in different issues of the *The Geographical Journal*. The detailed study of the breeding season of animals led to the dissection of over 3 000 bats, birds and lizards. During the different outings conducted on the most mountainous part of the island, Baker and his colleagues collected numerous species of animals including invertebrates, despite the fact that "the heavy rain made the collection of insects very difficult"; they also gathered "plants in flower, including several species of Orchids". Climbing this mountain again, Baker could conclude by means of barometric readings that "there is no doubt that Tabwemasana is the highest mountain in the New Hebrides".

THE ROYAL SOCIETY-PERCY SLADEN EXPEDITION TO THE NEW HEBRIDES (1971)

In 1968, at a meeting of the Royal Society of London concerning the results of an expedition held in the Solomon Islands in 1965, the discussion focused on the biogeographical relationships of the Solomon flora and fauna with those of adjacent island groups, and consequently the organisation of an international expedition in the New Hebrides progressively took shape. Mainly funded by the Royal Society and the Percy Sladen Trust, this expedition was led by K.E. Lee from the Australian Commonwealth Scientific and Research Organisation (CSIRO), and involved 21 researchers from seven countries. Members of the expedition began arriving in the New Hebrides on June

20th, 1971, and all of the field work was completed by October 24th. Six of the main islands of the archipelago, including Santo, were explored. Participants were specialists with different backgrounds in diverse areas of terrestrial biodiversity which led to an extensive study of, inter alia, the flora and phytogeography, vertebrates, and invertebrates (e.g. earthworms, insects). The quantity of samples collected had no previous equivalent for the area concerned, with, for example, more than 15000 samples of insects obtained uniquely through hand collection and by sweeping the foliage of low vegetation.

In his final paper published in the special issue of *The Philosophical Transactions of The Royal Society B*, which compiled a dozen articles presenting the results of the expedition, Lee writes that "before the Expedition the flora and fauna of the islands were little known and that a great deal of knowledge has resulted from the Expedition's work". Two lines later he notes that "there was much we could not cover in our four months' work and there is wide scope for further exploration of the islands' biota". No doubt that both phrases remain relevant for the Santo 2006 expedition despite its unequalled, large-scale dimension.

THE TSUKUBA BOTANICAL GARDEN, NATIONAL SCIENCE MUSEUM EXPEDITIONS (1996-2001)

In 1996, 1997, 2000 and 2001, the Tsukuba Botanical Garden (TBG) at the National Science Museum in Japan sent four successive botanical expeditions to Vanuatu (mostly to Santo Island), under the direction of Tsukasa Iwashina. Six to nine botanists were involved each time, including Ni-Vanuatu participants from the Vanuatu Environment Unit and Department of Forestry; among them was Sam Chanel, who actively participated in Santo 2006. The scope of the TBG expeditions included fern and fern allies, gymnosperms and angiosperms (Fig. 53). The results were published under the generic title "Contributions to the Flora of Vanuatu", in special issues of the Annals of the Tsukuba Botanical Garden, and are available through the website (http://ci.nii.ac.jp/vol_issue/nels/AN10009042_en.html).

Figure 53: The understory of the forest in Santo, Cumberland Peninsula, Saratsi Range, 600 m a.s.l.

DEEP SEA MARINE BIODIVERSITY DISCOVERY IN SANTO

Since the discovery of the Vanuatu archipelago by Quiros in 1606, the marine fauna has been known solely from specimens gathered by naturalists along the shore (Fig. 54). The deep sea fauna of the Indo-West Pacific was discovered during the so called "Great Expeditions".

- The 1874 *Challenger* around-the-world expedition sampled fauna from the western Pacific. This great expedition, however, only sampled a small area of the Coral Sea; after some stopovers in the Fiji Islands, they sailed towards the Torres Strait passing by the New Hebrides archipelago (Vanuatu's former name given by James Cook), without conducting any sampling.
- In 1928, *The Dana* expedition sampled in the Fiji Islands as well as at a few points in southern New Caledonia.
- In 1951, *The Galathea* expedition sampled in the Solomon Islands archipelago.

Figure 54: The seashore; South of Santo.

Hence, the first deep-sea expedition to sample on and around the Vanuatu Islands was the MUSORSTOM 8 cruise onboard the *Alis*, a small French oceanographic vessel (Fig. 55). The deep sea fauna was sampled along the slopes of the main islands of Vanuatu between 100 and 1 500 m deep. While the species composition of the southern islands shows some similarities with New Caledonian deep-sea fauna, the islands north of Efate (17° 30' S) shelter different species. On the deep sea floor, the amount of food available is very limited, and all of the organic substrates sinking from the surface are integrated into the food web. By far, wood makes up the main organic substrate present in the deep sea. To the north of Santo, Big Bay — which is a very large and deep bay — was also sampled. The fauna associated with the sunken wood found there was so different from that found elsewhere that a new scientific program on sunken wood was established. As a result, several other deep sea expeditions were organized to further investigate the deep-sea fauna around Vanuatu and especially the north of Santo Island. Multibeam mapping completed during the cruises BOA 0, BOA 1 and SANTOBOA revealed the very strange seabed morphology of Big Bay: two long, underwater rivers carve through the sea floor (Fig. 56). The beds of these rivers are filled with sunken wood. Several scientific studies in the areas of zoology, genetics and biogeography have been conducted on the deep sea fauna of Vanuatu. A large list of deep sea species from Vanuatu is already available through the Ocean Biogeographic Information System (OBIS) website (http://www.iobis.org/).

Figure 55: The oceanographic vessel *Alis* belonging to IRD: a 28 m long scientific trawler on which the sampling of the slopes of Santo have been done.

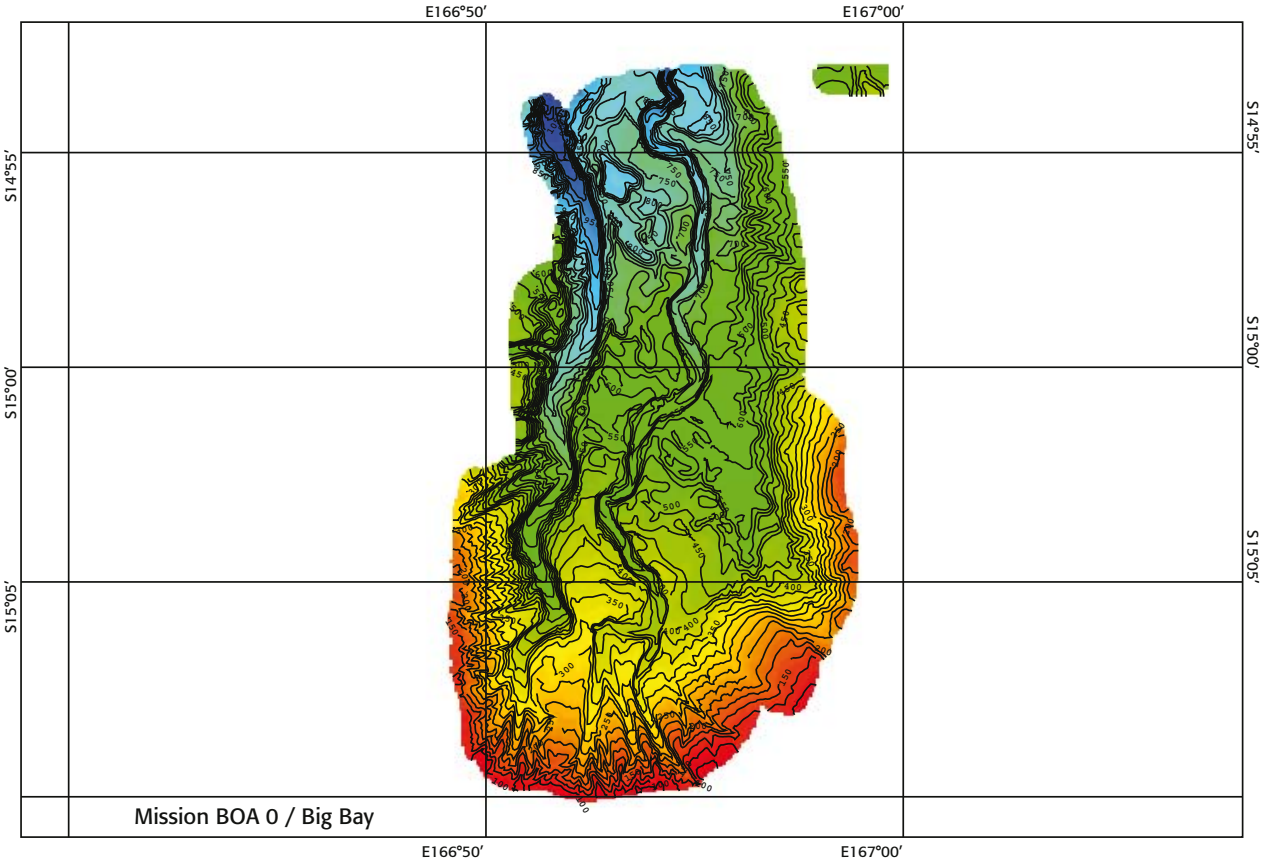

Figure 56: Mapping of the bottom with the multibeam echosondeur revealed in Big Bay a complexe network of "fossil" rivers well inscribed inside the sediments to more than 1 000 m deep. In these river beds were collected plenty of sunken wood with their associated fauna. The colors are describing the depth in meters, red for the shallowest and blue for the deepest.

FAMOUS 20th CENTURY SCIENTISTS IN SANTO

Some famous 20th century biologists spent a few days on Santo or worked on samples collected from the island. Here we shall discuss the work of only three of them who, not surprisingly, are well-known for their contributions to a better understanding of island biogeography.

As we saw above, the great biologist Ernst Mayr analyzed the avian distributions of birds on 31 islands in the South Pacific, including Vanuatu, largely on the basis of collections made during the Whitney South Sea Expedition. It is generally accepted that these results have had a great impact on the development of Mayr's evolutionary theories.

In January 1955, Edward Osborne Wilson, the well known ant specialist and Robert MacArthur, the great theoretician on island ecology and coauthor of the famous book *The Theory of Island Biogeography*, spent a few days on Santo where he collected samples of his favorite insects in the immediate vicinity of Luganville.

Jared Diamond, famous for his recent, best-selling books, including *Collapse: How Societies Choose to Fail or Survive* also made some brief visits to the New Hebrides. His studies on the "distributional ecology of breeding land and fresh-water birds in light of immigration-extinction equilibria" are largely based on his own collections and mostly on data gathered in 1971 during the Royal Society-Percy Sladen Expedition to the New Hebrides.

CONCLUSION

The Santo 2006 Global Biodiversity Survey is by far the largest expedition ever to take place on Vanuatu; moreover, it is probably one of the largest ever organized on Earth since the beginning of scientific exploration. Based on the observations and collections made during this expedition, many scientific peer-reviewed articles will undoubtedly be produced; some have already been published, others are in preparation. Due to the scale of the expedition, the diversity of the disciplines involved and the unavoidable asynchronic rhythms in the processing of the collected samples and data, it is totally unrealistic to conceive of a coordinated publication of the results. Some efforts have been made towards this end: for instance, a special issue of the journal *Zoosystema* published in 2009 by the Muséum national d'Histoire naturelle and edited by one of us includes 17 contributions describing new zoological taxa collected from the bottom of the sea to montane forests. Undoubtedly, the present book will remain the best account of the expedition for generations to come —and maybe, by that time, among the young participants in Santo 2006, some will have become as famous as Ernst Mayr or Edward Wilson are for today's biologists, partly due to discoveries made on and off Espiritu Santo Island.