The Occurrence of Cocaine in Egyptian Mummies - New research provides strong evidence for a trans-Atlantic dispersal by humans

Dominique Görlitz
Technische Univerität Dresden, Institut für Kartographie, Germany
(received 22 May 2016, accepted 29 June 2016)

Abstract

One of the unsolved problems of modern science is whether the pre-Columbian peoples of the New World developed completely independently of cultural influences from the Old World or if there was a trans-oceanic contact? A number of scientists agree that there are many – and often remarkable – similarities between the cultures of pre-Columbian America and those of the Mediterranean world. Nevertheless, there is no agreement, as yet, on how cultural diffusion can be differentiated from independent invention. Scientific analysis shows that scholarly positions are often strongly pre-formed from paradigms (scientific based assumptions), which tend to hinder consideration of solid scientific data offered by geo-biology and its trans-disciplinary examination of the subject under investigation here.

An unambiguous answer to the question, what historical processes led to the emergence of the ancient American agriculture, hasn't been given. However, the archaeological discovery of crops with clear trans-oceanic origin, in addition to advances in molecular biology, increasingly support the hypothesis that humans from the distant past influenced each other across the oceans at a much earlier stage. The vegetation and zoo-geography indicate, by numerous examples that some species could only have spread through perhaps unintentional (passive) human transmission [1].

There are two very old crops found in the 'New World', which contradict the paradigm of a completely independent origin for American agriculture. These are the African Bottle Gourd (*Lagenaria siceraria* L.) and the ancestral cotton species (*Gossypium herbaceum* L.) of the domesticated spin able sub-genus of tetraploid cotton. The historical spread of both types has been under discussion for decades, especially in respect of trans-oceanic human contact with the American continent. There has also been a debate in the 'Old World' ever since the discovery of nicotine and cocaine in Egyptian mummies, centering around whether 'New World' plants (or the ingredients) might have been transmitted in the reverse direction, back to the presumed start in centers of the Ancient World's oldest civilizations.

This article is based on extracts from the writer's PHD thesis of [2], whose research continues the work of Dr. Svetlana Balabanova on this much disputed topic of cocaine in Egyptian mummies.

Keywords: *cocaine and nicotine in Egyptian mummies, trans-Atlantic crop dispersal, Geo-Botany, Egyptology, proto-historical voyages, ancient diffusion and cultural interaction*

1. The Biology of Coca Plants

Coca plants belong to the sub-class off lowering plants. Currently there are known to be about 300 species of this genus. Only two of these species have anyeconomic significance – for cultivating or gathering edible coca leaves. The Mansfeld's Encyclopedia of Agricultural and Horticultural Crops is referring a third cultivated coca species in Ecuador – *Erythroxylum ulei* O.E. Schulz [3]. The two important ones are the New World species *Erythroxylum coca* Lam. and *Erythroxylum novogranatense* (D. Morris) Hieron. The most common species in South America is *Erythroxylum*

coca. The second domesticated species *Erythroxylum novogranatense* colonizes the arid region so northern South America, the northern coast of Peru, and up into southern Central America [4].

The plant

The genus name *Erythroxylum* refers to the characteristic red-colored wood and the red bark of these plants (Fig. 1). The original name coca originates from the Aymara word "khoka", which simply means ‘tree’ in the language of this ancient American tribe.

Fig. 1: Representatives of the coca species are spread throughout the southern hemisphere. Only two species in the World (Neotropics) produce the alkaloid cocaine in sufficiently high concentrations for human consumption. This picture shows the leaves of the species Erythroxylum coca, which enjoys the greatest popularity among the Andean nations. Finds of cocaine in Egyptian mummies by Balabanova & Parsche [5] *caused great controversy when first announced.*

The species of the genus *Erythroxylum* are predominantly slender, but densely bushy, trees or widely extended shrubs up to five meters in height [6]. The cultivated species are shrubs of up to three meters in height. When harvested regularly, without allowing the shrubs to grow fully [7], cocaine is formed in larger quantities.

The leaves are pointedly ovoid to lanceolate and of dark green color. Towards the leaf margin, its characteristic nerves are connected to each other. Important for the comparison of plants on different continents is the colors and shape of the characteristic scaled leaves at the base of young branches [8]. A good coca shrub provides three harvests per year of up to 300 grams of fresh leaves, which corresponds to an amount of about130 grams dry weight.

The flowers are inconspicuous, hermaphrodite and a white-cream color. They are pollinated by insects. After fertilization, the flowers evolve oblong-ovoid drupes with one seed, which is then mainly spread by birds. These seeds are non-toxic to the birds because they excrete the undigested [9].

The main alkaloids of the two New World cultural and shamanistic plants *Erythroxylum coca* and *E. novogranatense* are cocaine and cuscohygrin. They belong to the group of tropanal and ecgonin alkaloids, and are based to the two amino acids proline and ornithine. Acetate is also involved in the formation. Their evolutionary function is to protect the plant against herbivores. Many members of the genus contain a number of other alkaloids and ingredients, which were also used by the naturopath [10].

Natural Spread on Earth

The *Erythroxylaceae* form a pantropical family and the numerous species of the genus *Erythroxylum* are spread over four continents. It can be determined, from the recent spread, that two large development centers originally emerged – the Amazon Basin and Madagascar. Both regions show some analogies in the configuration of certain species. However, it is not possible to prove a dependency upon each other [11, 12].

Most species are to be found in the New World, but only plants with striped stipules. Particularly striking are the species with a large calyx. By contrast, on the continents of the Old World there are only a small number of species. The few species in tropical Africa have no relationship to those in the Americas, but instead are close to those of Madagascar and Asia [13]. Because of this, it is reasonable to assume that members of the genus *Erythroxylum* spread throughout the southern hemisphere from America over to Africa, then Madagascar, and southeast Asia, including Australia (see. Fig.2).This is probably due to geological processes involved in plate tectonics [14].

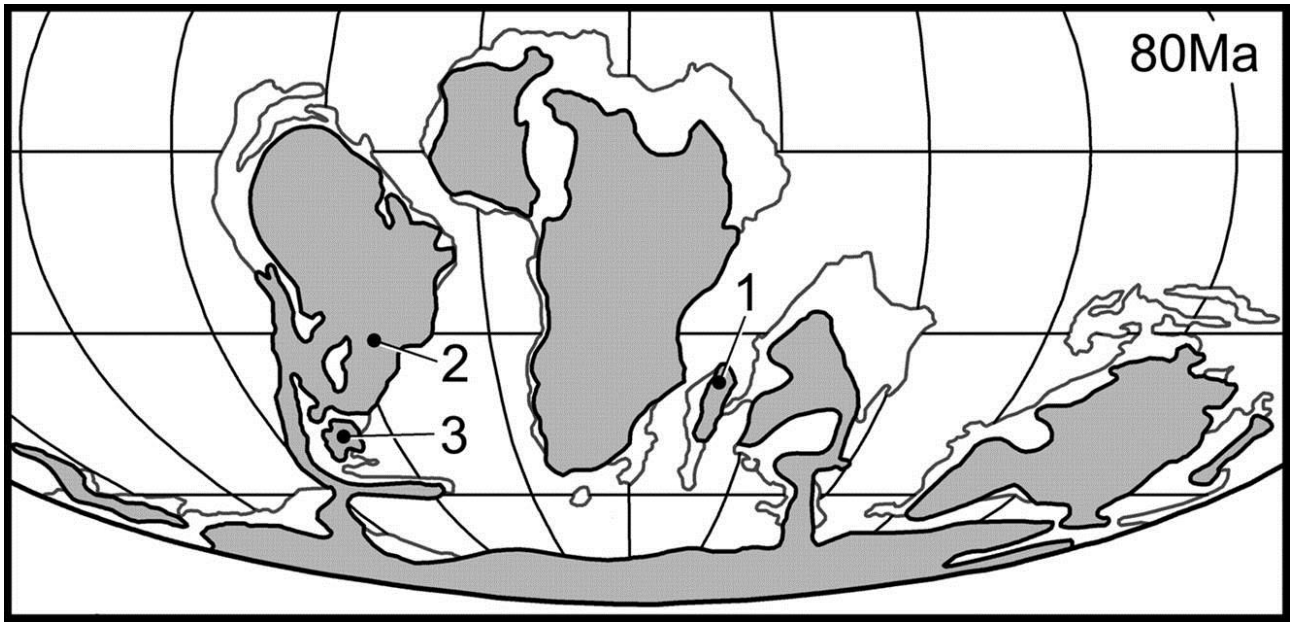

Fig. 2: The tertiary land bridges between the Neotropics, Palaeotropis, Australis with the Antarctic about 80 million years ago. The major land bridges in the southern hemisphere are: 1.Madagascar/Seychelles/India 2.India/Kerguelen/East Antarctica, 3. South America/West Antarctica and 4. Australia/East Antarctica (according to [15]). Over these tertiary land bridges, the South American coca and tobacco species got their palaeolithic spread across the southern hemispheres outside the New World. However, Madagascar separated very early from Africa, so that only four coca species were spread across the narrow Strait of Mozambique to Africa by other natural effects.

Domestication, Use and Anthropogenic Spread

On the American continental landmass, the use and cultivation of the coca bush has a very ancient history. Since earliest times the Andean peoples used this very versatile plant. In the arid lowlands of Peru, remains of coca leaves were found, along with lime and associated coca usage items, in numerous pre-Columbian graves, dated to at least 5,000 years before the present [16]. In many pre-Columbian cultures coca had an extremely important function as an economic commodity, in medicine, as an aphrodisiac, and as a ritual intoxicant. The consumption of coca is synonymous with Andean civilization [17].

When the Spanish conquered Peru, the coca bush immediately aroused the attention of the conquistadors. All writers who dealt with the history of the region reported the wonderful effects of this plant. The coca plant was introduced to central Europe first when Clusius (1605) translated the Spanish writings of the physician, Nicholas Monardes from Seville, into Latin (*Simplicium Medicamentorum Historia*):

> That from early morning until evening the Indian is continually chewing the sun-dried coca leaves in the mouth without consuming the same. This is done partly for pleasure addiction, but also partly to suppress hunger and thirst and sustain their enormous efforts, especially in traveling. In order to prevent the dry leaves from being crushed to quickly between the teeth, they are mixed with ashes and quicklime, which is obtained from Conchylien shells, then placed into the mouth in the form of beads [18].

Large parts of today's south and Central American population use the coca leaf as a daily narcotic stimulant. This is also due to the fact that the leaves possess, beside cocaine, a relatively high nutritional value (per 100 g = 305 kcal). The Spanish conquerors tried to stop coca usage among locals. However, as a result, performances of the local work force declined, due to the now missing stimulatory effects of the cocaine. Therefore the Spanish conquerors allowed coca chewing to resume among the indigenous population. Their descendants chew coca leaves to this day.

Although the coca plant was introduced as a drug into Europe quite late, we find its first mention much earlier by Amerigo Vespucci in 1499. The first plants reached Europe around 1569. In 1859, the German chemist, Albert Niemann, isolated the alkaloid cocaine from the leaves [19]. At the end of the 19th century people began to smoke the leaves in America and England. These coca leaves were named 'Peruvian tobacco' [20]. The cultivation of the coca shrub has since been spread throughout the world, in such places as the Seychelles, East Africa and India [21].

At first, it was assumed that alkaloid cocaine had only been exploited in the Old World after the discovery of the Americas by Columbus. Then came the surprise discovery of cocaine concentrations in ancient Egyptian mummies, in addition to the identification of tobacco and its main alkaloid, nicotine [22] (Balabanova 1997a).

2. The Cocaine Controversy

2.1 Cocain in Egyptian Mummies

The fact that cocaine has been found in Egyptian mummies provides further indications of a trans-oceanic cultivated crop exchange. This discovery makes the whole issue even more complex:

> One could still try to explain the presence of tobacco in ancient Egypt with local, previously unknown African species of tobacco, but with cocaine it is not possible [23].

Alkaloid cocaine has been detected (Fig. 3) in the 1992 examinations of the mummy of Henut Taui. Hair samples were taken and it was found that these samples contained nicotine [24].

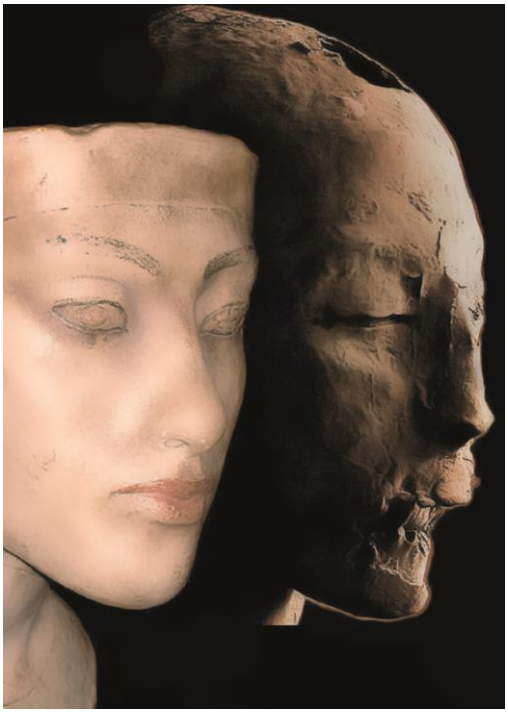

Fig. 3: The mummified skull of Henut Taui. Balabanova and Parsche (1992) found the first traces of the alkaloids nicotine and cocaine in this mummy. Later, they were able to discover these same alkaloids in other Egyptian mummies. But cocaine has only been found in Egyptian mummies, while nicotine has been identified in human remains in Europe, China and in the Levant.

Table 1: Balabanova and Parsche detected higher concentrations of cocaine, nicotine and THC in several Egyptian mummies. These investigation data were published by Parsche et al. [25].

Location in the mummies	***Alkaloids (numbers of samples)***	***Concentration in ng/g***
Hairs	*cocaine (n=4)*	*24 – 200*
	nicotine (n=4)	*300 – 900*
	THC (n=4)	*800 – 4.100,0*
Soft tissue		
	cocaine (n=7)	*69,6 – 441,5*
	nicotine (n=7)	*124,4 – 1.330,0*
	THC (n=7)	*59 – 2.686,0*

Both alkaloids (nicotine and cocaine) point us towards the New World (Table 1). As a source for cocaine it is only possible to take the two New World plants *Erythroxylum coca* and *Erythroxylum*

novogranatense into consideration – according to our present knowledge. However, the discovery of several tropanal alkaloids in the southwest African plant species *Erythroxylum zambesiacum* N. Robson might be worthy of further consideration. Robson gave Yahia et al. [26] arguments for a possible cocaine source for Egyptian mummification in South Africa. This species exists in the Zambezi River basin as well as in southeast Africa. It is related to the West African species *Erythroxylum manii* Oliv. and belongs to the Melanocladus section (uncommon designation for an infrageneric group) [27, 28]. However, there is no evidence of any cultivation history or indications of a local exploitation of these species. Also the literature fails to mention any applications of the bark or leaves by the local population in southern Africa [29].

The samples from the alkaloid study by Yahia (1987) represent seven of Schulz's (1907) designated sections of the genus *Erythroxylum*. They cover the basic geographical distribution areas in the world. The distribution pattern study of their acids makes special reference to four sections which are derived from southeast Africa and from there they expanded into a diversification of the genus. The distribution pattern and the presence of several tropanal alkaloids, organic acids and benzene acids within the Old World are clearly different from the examples in the New World. In particular, the New World species *Erythroxylum coca,* as a representative of the *Archerythroxylum* section, proves – according to Yahia (1987) – that there are no esters or acids in the root bark. The study of the alkaloids of *Erythroxylum zambesiacum* does not therefore provide any evidence of a close relationship in the chemistry of both classes. The same applies to the Australian species *Erythroxylum australe* F. Muell. (Coelocarpus section). All studies concluded that no cocaine has been detected in the Old World species [30, 31 & 32].

These newer chemical analyses are confirming not only the morphological observations of Schulz (1907) that the few species of tropical Africa have no immediate relationship to those of America, but also reinforcing the hypothesis that the cocaine synthesis of Andean species is the result of a vicariance process (isolated micro evolution). Ethnographic observations provide clear evidence that the existence of a previously hypothetical coca plant in southern Africa is highly unlikely to explain the origin of cocaine in ancient Egyptian mummies. All four coca species in Africa were never cultivated. The same applies to the numerous wild coca relatives in Madagascar. They all have the same cultural meaninglessness as the wild species in South America. Only the three cultivated (cocaine containing) species in the New World have been taken into the care of the native people. Two of them have then been spread by humans over vast areas, first within the Americas and later outside the western continent landmass.

These new findings are of great importance for the evaluation of a possible transatlantic importation of cocaine for ancient Egyptian mummification in pre-Columbian times.

2.2 The Chemistry of Cocaine Impacts Mummification Practices in Egypt

The result of investigations into the chemistry of coca species leads to the conclusion that the trim on related tropanal alkaloids and organic acids could be applied as a systematic feature within the *Erythroxylum* genus [33 & 34] (Plowman & Rivier 1983; Yahia et al. 1987). They confirm the

morphological and physiological differences of *Erythroxylum* species of Neo- and Palaeotropis [35]. Cocaine is a special representative of tropanal alkaloids, which exist exclusively in America and not in Africa or elsewhere outside the New World.

> It may sound unbelievable at first, but the only realistic explanation for the presence of cocaine in Egyptian mummies seems to be that there have existed trade relations between the ancient Egyptian world and America [36].

The results of my doctoral thesis [37] refute the paradigm that was established in ethno-biology and archaeology after the first simulation experiments with seeds in salt-water basins by Whitaker & Carter [39, 38, 40] (1954; 1961; 1971) and Stephens [41, 42, 43].
The ocean drift experiments made by my team, between 1999 until 2007 (Figs. 4 & 5), produced realistic measurements to show that the seeds and fruits of crops cannot drift for months across the Atlantic [44]. Trans-Atlantic dispersal from Africa to America and in the opposite direction, without the support of early man, appears to be very difficult. The results restrict broader speculation and fix the spread theories to a realistic basis.

Fig. 4: In trawls behind all ABORA reed boat expeditions, the writer examined the drift ability of multiple crops. Many types were tested and had no drift ability. Only tobacco and bottle gourds possessed a fair share of salt-water tolerance (approx. 200 d). This is, however, too little to explain an Atlantic Ocean drift in recent prehistoric times without human intervention. Furthermore, the ABORA Expeditions (I-III) prove experimentally that Stone Age seafaring across the large oceans might have been existed in prehistory.

Old World areas of crop cultivation in prehistoric and early historic times can probably not have been established as a result of trans-Atlantic drift. Most likely they were the result of very early human interactions across the Atlantic Ocean. The research results of the vegetation geography suggest that the people of the Stone Age and, later, of early antiquity, conducted extensive travel

upon the high seas for long-distance trade. These eastern trans-Atlantic areas of crops were not caused by hydrochory (water distribution). The only exception is the prehistoric spread of the A-genome ancestors of cotton to the Americas. These were spread by anemochory (air distribution) [45, 46].

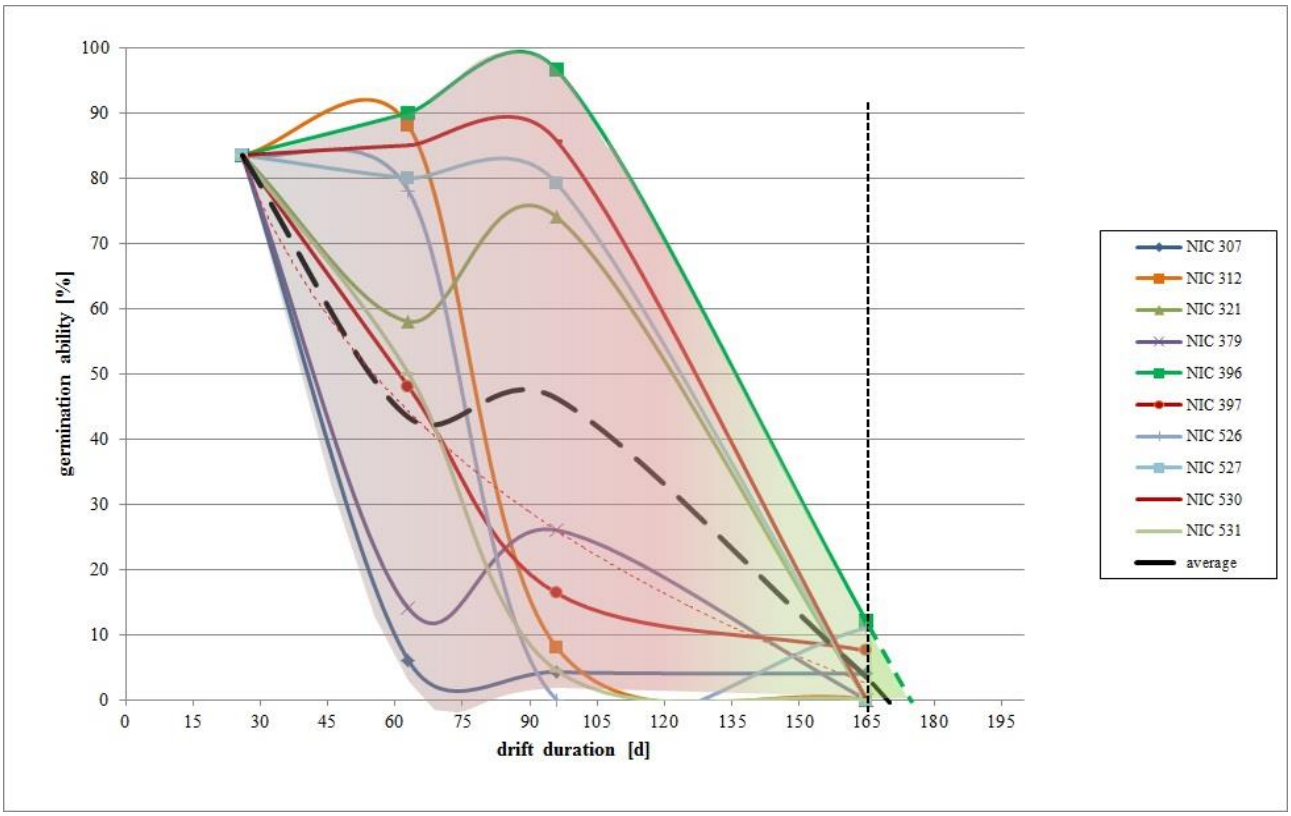

Fig. 5: This diagram shows the decreasing germination ability of Nicotiana tobacum L. *during ocean drifting. Several hundreds of seeds were tested to investigate the possible drift duration of an American crop in the Mediterranean Sea and Atlantic Ocean. The measurements indicate a maximum salt-water tolerance of between 165 to approx. 180 days. This drift capability is too short to explain a hydrochor dispersal event in prehistoric times, which is estimated by experts to be between two and three years [48]. These results also deliver strong evidence for a possible human dispersal of the cocaine in pre-Columbian times. The average of all tests is shown by the black broken line.*

These research results suggest that people of the Stone Age and in early antiquity had already conducted trans-oceanic voyages and long-distance trade. The concentrations of cocaine, as well as nicotine, in Egyptian mummies, measured by Balabanova & Parsche [47], offer strong biological evidence for early contact between the Old and New World. In the case of the spread of tobacco, we can even demonstrate the presence of its South American pest in Egyptian mummies and tombs [49, 50, 51, 52]. Alfieri [53] was able to identify several dozen specimens of the American tobacco beetle (*Lasioderma serricorne* Fab. 1792) in the anti-chamber of Tutankhamun's tomb (ca. 1,341-1,323 BC). Several biologists support the conclusion that these dry-resistant insects arrived as

passengers in tobacco leaves used during the mummification process [54, 55, 56, 57]. Accordingly, these tobacco discoveries, as well as the tobacco pests found in Egyptian tombs, support the cocaine analysis.

3. Summary

Cultivated plants that had been domesticated in prehistoric times on the American continent achieved a fairly rapid spread across the Atlantic Ocean within only a few millennia in the beginning of Holocene. The development of these eastern Atlantic distribution areas has not been convincingly explained to this date [58].

Drift studies with seeds of selected crop plants, as well as chemical analyses of several cocaine species, support the hypothesis of a pre-Columbian human interaction between the Old and New World. The emphasis in this article has deliberately been put on the dispersal and cultivation history of the American coca plant *(Erythroxylum*). This is because of the recent discovery of cocaine in ancient Egyptian mummies. There is also the dispersal history of the plant and existing knowledge of the use of a shamanic plant, which have led to controversial discussions over several decades about potential trans-Atlantic contacts prior to Columbus' rediscovery of America.

The spread and domestication history of the coca plant delivers striking evidence for the theory of anthropogenic dispersal of this species across the Atlantic in ancient times. The unique phyto-chemical characteristics of this plant, its south hemispheric distribution pattern and its limited water dispersal ability of crop plants (cocaine as well as tobacco, fig. 5) support this theory. The reconstruction of those dispersal routes, and the identification of the proto-historical merchants involved in such contacts, poses a fascinating challenge for future research.

Prehistoric trans-oceanic trade appears to be much older than accepted and published in the predominant mainstream literature. It was one decisive factor in the development of the first advanced civilizations. New discoveries of large 'step pyramids' similar in architecture to those in the Mediterranean as well as on the Canary Islands and even a Phoenician wreck off the Azores, are emphasizing the intensity and importance of trans-Atlantic activities in the late Neolithic times [59, 60, 61]. The enigma of the occurrence of cocaine in Egyptian mummies is not capable of revealing all aspects of these trans-Atlantic interactions between the Old and New World, but the bio-evidences strongly suggest regular trans-oceanic contacts long before the days of Columbus. The finding of nicotine and cocaine yields further evidence for the assumption that cosmopolition and internationalism are much older and part of our rich maritime heritage. Thus, prehistoric watercrafts were man's first major tool to explore and conquer the world.

References

[1] Fukarek, F., Hübel, H., König, P., Müller, G.K., Schuster, R. &Succow, M. (2000): UraniaPflanzenreich– Vegetation. Band 12. Urania Verlag, Berlin.

[2] Görlitz, D. (2012): Prähistorische Ausbreitungsmechanismen transatlantisch verbreiteter Kulturpflanzen. D M Z Verlag, Gotha und Universität Nürnberg-Erlangen.

[3] Hanelt P. & IPK (eds.), 2001: Mansfeld's Encyclopedia of Agricultural and Horticultural Crops, vol. 3, p.1110. Springer, Berlin.

[4] Rätsch, C. (2004): Enzyklopädie der psychoaktiven Pflanzen-Botanik, Ethnopharmakologie und Anwendung. AT Verlag, Aarau.

[5] Balabanova, S., Parsche, F. & Pirsig, W. (1992): First identification of drugs in Egyptian mummies. Naturwissenschaften 79:358.

[6] Schulz, O.E. (1907): Erythroxylaceae. Band 29. In: Engler, A. (Ed.): Das Pflanzenreich. Engelmann, Leipzig.

[7] ebenda 4

[8] ebenda 6

[9] ebenda 6

[10] ebenda 4

[11] ebenda 4

[12] ebenda 6

[13] ebenda 6

[14] Potratz, E. (1985): Zur Botanik der Coca-Pflanze. Curare, Sonderband (Ethnobotanik) 3/85:161-176.

[15] MacPhee, R.D.E. (2005): "First" appearances in the Cenozoic land-mammal record of the Greater Antilles: significance and comparison with South American and Antarctic records. Journal of Biogeography 32:551-564.

[16] Hastorf, C.A. (1987): Archaeological Evidence of Coca (*Erythroxylum coca*, Erythroxylaceae) in the Upper Mantaro Valley, Peru. Economic Botany 41:292-301.

[17] Mortimer, W.G. (1974): History of Coca: “The Devine Plant” of the Incas. Fritz Hugh Ludow Memorial Library Edition, San Francisco (Reprint von 1901).

[18] ebenda 6

[19] ebenda 4

[20] Lindequist, U. (1993): Erythroxylum. In: Bruchhausen, F. von: Hagers Handbuch der pharmazeutischen Praxis. Bd.5. Springer, Berlin.

[21] ebenda 14

[22] Balabanova, S. (1997a): Die Geschichte der Tabakpflanze vor Columbus außerhalb Amerikas sowie das Rauchen im Spiegel der Zeiten. Innovations-Verlags-Gesellschaft, Seeheim-Jugenheim.

[23] Collins, A. (2005): Neue Beweise für Atlantis – In Kuba und in Mittelamerika verweisen spektakuläre Funde auf eine globale prähistorische Kultur. Scherz Verlag, Bern, München, Wien.

[24] Balabanova, S., Rösing, F.W., Blüher, G., Schoetz, W., Scherer, G. & Rosenthal, J. (1997b): Nicotine and cotinine in prehistoric and recent bones from Africa and Europe and the origin of these alcaloids, Homo 48:72-77.

[25] Parsche, F., Balabanova, S. &Pirsig, W. (1994): Evidence of the Alcaloids Cocaine, Nicotine, Tetrahydrocannibinol and Theit Metabolites in Pre-Columbian Peruvian Mummies. Eres (Serie de Arqueologia) 5:109-116.

[26] Yahia, M., El-Iman, A., Evans, W.C., Grout, R.J. & Ramsey, K.P.A. (1987): Alkaloids of *Erytroxylum zambesiacum* ROOT-BARK. Phytochemistry 26:2385-2389.

[27] ebenda 6

[28] ebenda 26

[29] ebenda 26

[30] Evans, W.C. (1981): The comparative phytochemistry of the genus Erythroxylum. Journal of Ethnopharmacology 3:265-278.

[31] ebenda 26

[32] Plowman, T. &Rivier, L. (1983): Cocaine and Cinnamoylcocaine Content of *Erythroxylum* Species. Annals of Botany 51:641-659.
[33] ebenda 32
[34] ebenda 26
[35] ebenda 6
[36] ebenda 23
[37] ebenda 2
[38] Whitaker, T. W. & Carter, G. F. (1954): Oceanic drift of gourds. Experimental observations. American Journal of Botany 41:697-700.
[39] Whitaker, T.W. & Carter, G.F. (1961): A Note on the Longevity of Seed of *Lagenaria siceraria* (Mol.) Standl. after Floating in Sea Water. Bulletin of the Torrey Botanical Club 88:104-106.
[40] Whitaker, T.W. (1971): Endemism and pre-Columbian migration of the bottle gourd, *Lagenaria siceraria* (Mol.) Standl. In: Riley, C.L., Kelley, J.C., Pennington, C.W. & Rands, R.L. (Eds.): Man across the sea: Problems of pre-Columbian contacts. University of Texas Press, Austin & London.
[41] Stephens, S.G. (1958): Salt water tolerance of seeds of *Gossypium* species as a possible factor in seed dispersal. American Naturalist 92:83-92.
[42] Stephens, S.G. (1966): The potentiality for long range oceanic dispersal of cotton seeds. American Naturalist 100:199-210.
[43] Stephens, S.G. (1971): Some problems of interpreting transoceanic dispersal of the New World cottons. In: Riley, C.L., Kelley, J.C., Pennington, C.W. & Rands, R.L. (Eds.): Man across the sea: Problems of pre-Columbian contacts. University of Texas Press, Austin & London.
[44] ebenda 2
[45] ebenda 2
[46] Wendel, J.F. (1995): Cotton. *Gossypium* (Malvaceae). In: Smart, J. & Simmonds, N.W. (Eds.): Evolution of Crop Plants.Longman Scientific & Technical, Harlow.
[47] ebenda 5
[48] Sedlag, U. (2000): Urania Tierreich – Tiergeographie. Band 7. Urania Verlag, Berlin.
[49] Steffan J.-R. (1985): L´Emtomofaune. In: Balout, L. & Roubet C. (Eds.): La Momie de Ramsés II. Recherchesur les Civilisations, Paris.
[50] Layer-Lescot, M. (1985): Feuilleset Fleurs. In: Balout, L. & Roubet C. (Eds.): La Momie de Ramsés II. Recherchesur les Civilisations, Paris.
[51] Paris, R.R. & Drapier-Laprade, D. (1985): Présence de Nicotine dans la Cavite abdomilae de la Momie. In: Balout, L. & Roubet C. (Eds.): La Momie de Ramsés II. Recherchesur les Civilisations, Paris.
[52] Balout, L. & Roubet, C. (1985): Les résultats scientifiques. In: Balout, L. & Roubet, C. (Eds.): La Momie de Ramsés II, Recherche sur les Civilisations, Paris.
[53] Alfieri, A. (1932): Les insectes de la tombe de Toutankhamon. Bulletin de la Societe Entomologique d´Egypte 24:188-189.
[54] Ashworth, J.R. (1993): The biology of *Lasioderma serricorne*. Journal of Stored Products Research 29:291-303.
[55] ebenda 22
[56] ebenda 51
[57] Bellstedt, R. (2009): report passim. Museum der Natur Gotha.
[58] ebenda 2
[59] Görlitz, D. (2013): Die vergessenen Pyramiden der Azoren–Ein transdisziplinärer Blick auf die Bedeutung dieser Entdeckung für transatlantische Handelsfahrten vor Kolumbus. Mysteries **1**.
[60] APIA (2011): http://portuguese-american-journal.com/archeology-prehistoric-rock-art-found-in-caves-on-terceira-island-azores/; http://www.ancient-wisdom.co.uk/portoazores.htm
[61] APIA (2013): http://frontiers-of-anthropology.blogspot.de/2013/09/archaeologists-reveal-secrets-of.html