

IBPG - Darwin

The Institute of Biopaleogeography
named under Charles R. Darwin



IBPG 14 (2022) 1-88

E-ISSN 2956-4573

Natural Rubber (*Hevea brasiliensis*) – a Scientific and Touristic Expedition to the South-West India

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The Institute of Biopaleogeography named under Charles R. Darwin

Publisher's Address:

Scientific Publishing House DARWIN at The Institute
22/12, Adama Mickiewicza Street, 78-520 Złocieniec,
District Drawski, West Pomerania, Poland

Cite of this article:

Tomasz Borowski, Tadeusz Hryniewicz. Natural Rubber (*Hevea brasiliensis*) – a Scientific and Touristic Expedition to the South-West India. *The Institute of Biopaleogeography named under Charles R. Darwin 14 (2022) 1-88*

ABSTRACT

This Project was started at the beginning of a new, 21st century, after realizing the first scientific visit of the second author to India. By the end of the twentieth century, the 2nd author first visited Bombay, to discover the natural beauty and exotics of this sub-continent. That time, there was a scientist as a Polish Consul in Bombay, Dr. Krzysztof Majka, coming from the Koszalin University of Technology (KUT), and he received a visit there of the 2nd author, Prof. Tadeusz Hryniewicz. Over a decade later, the first author of this book decided to join the Surface Electrochemistry Division at the KUT for his PhD studies. In 2006, the authors started to develop a Project concerned with the use of the natural rubber to the new sources of energy. That year, a scientific expedition to the natural rubber (*Hevea brasiliensis*) plantation in Ranni, Kerala State on the south-west India, was carried out. The aim of this expedition was to receive a natural rubber and bring it back under natural state to Poland in view of performing an electrochemical modification for further studies in view of application//using the modified layouts//systems of conductive natural rubber. This work is to present also natural, sightseeing, tourist, and environmental elements of the beautiful natural geography of West India.

Keywords: natural rubber, *Hevea brasiliensis*, chemical and thermal process of latex, Ranni, Kerala State, India, touristics, natural environment, nature of India, geography of India

INTRODUCTION

Natural rubber (*Hevea brasiliensis* Müll. Arg., Family: Euphorbiaceae) finds a wide application in industry all over the world. The natural rubber is obtained as a latex milk from plantations and is a natural product, being one of the main sources of income for multiple family private plantations of rubber trees in India. Caoutchouc is a natural rubber composed of polymers of isoprene along with minor impurities of other compounds. Rubber is a pliable material derived straight from the sap of the rubber tree [1-33].

Due to the European climate that is not conducive to cultivation of the rubber trees plantations, it was decided to organize a scientific expedition to the south-west India in view of obtaining natural rubber and bringing it to Poland in a liquid state, as a latex milk to further scientific works.

It is worth noting that in the nineties of the 20th century the second author, Professor T. Hryniewicz (**Figure 1**), visited India, looking for a possible scientific co-operation. To say even more, those days a scientist from the Koszalin University of Technology (KUT), Dr. Krzysztof Majka stayed as a Polish Consul in Bombay (**Figure 2**), so it was an opportunity to visit him on the post there. Over a decade after, the first author came for the PhD study to the Department of Surface Electrochemistry, Faculty of Mechanical Engineering at the KUT. New sources of energy were under the scope of the study those days.

The scientific and touristic expedition was organized from Poland to India in June 2006, with a change in Milan//Italy, and Bombay – Mumbai /India to the city of Cochin, in Kerala State, India. As a curiosity it appears, in India, there were no trash cans visible.

The flight with Alitalia airlines from Warsaw//Poland to India (Bombay) was comfortable, with nice views (**Figures 3 & 4**). When leaving the plane at Bombay//Mumbai airport, the

aromatic spices, famous from India, could be smelled at once. At the Bombay airport, there were no trash cans visible. Rubbish has been thrown everywhere, even at your feet. It was immediately understood that there, in India, the environment protection is an unknown and incomprehensible subject.

Toilets at the airport in Warsaw (**Figure 5**) are very different from toilets at the airport in Bombay/Mumbai. There is a hole in the floor, a cup and a faucet with water for washing (**Figure 6**). It is visible at the outset, a large cultural and moral difference between Poland and India.

STAY IN INDIA

The first night was spent in a very cheap hotel in Bombay. Monsoon season, that is pouring water from the sky caused there was ankle-deep water in the hotel in the room. Ubiquitous moisture and leaking windows, these are and the charms of cheap hotels during the monsoon seasons in Bombay/Mumbai (**Figures 7-10**).

For the flight from Bombay to Cochin city, the Indian airlines 'KINGFISHER' were used (**Figures 11 & 12**). The plane travel was pleasant but a bit dangerous as the monsoon season caused a lot of turbulence during the flight.

From Cochin city the expedition went several dozen kilometers to the east, stopping for a while along the way in the rice fields (**Figures 13 & 14**), reaching the family private plantation of rubber trees in the evening (**Figures 15-19**).

Collection of natural rubber, that is latex milk, was performed using the traditional method. After cutting the bark of the rubber tree, natural latex milk flows into the bowl. This stage took several hours. Then, harvested latex milk in liquid form is collected in a bucket (**Figures 20-25**).

Flowing latex thickens over a longer period of time as it oxidizes with atmospheric oxygen, as shown in the photos (**Figures 26 & 27**).

Regional technological process of the collected latex milk relies on an addition of formaldehyde (**Figures 28 & 29**), and then the mass is pressed on rollers (**Figures 30 & 31**) in the form of slices. After heat treatment, it is suitable as a commercial product (**Figure 32**).

Natural rubber was brought to Poland in liquid form dissolved in toluene (99.9%), sulfur-free. Manufactured by Spectrum Chemicals, Edayar, Cochin-683 502, India, Code: T 0105. The rubber was dissolved in a toluene solvent in a 1 : 1 ratio to volume. Two liters of this rubber solution were brought to Poland

On this plantation, vanilla (**Figures 33 & 34**), bananas (**Figure 35**), papaya (**Figure 36**), chili (**Figure 37**), fruit of the bread tree (**Figure 38**), coconuts (**Figure 39**), Lychee (**Figure 40**), and coffee (**Figures 41 & 42**), were also cultivated. Finally, after a full dinner, we took a photo together (**Figure 43**). This photo (**Figure 43**) presents: the first on the left and the first on the right – they are taxi drivers, the second on the left is the first author, Dr Tomasz Borowski, and the second on the right is the owner of a private plantation of rubber trees.

During the return trip by car, we had stopped many times, taking pictures of wonderful landscapes of south-west India (**Figures 44-99**).

In the photos (**Figures 61-77, 94**), ubiquitous tea plantations are presented. This tea is cultivated in the mountainous southwestern part of India. In the photos (**Figures 80-85**), a tourist attraction – Indian elephant – is presented. One could sit down on it for a small fee.

Figure 87 presents a search for insects – regional beetles.

After returning from a natural rubber plantation, the first author stopped in a cheap hotel, but with high culture class, in Cochin city (**Figures 100 & 101**).

ON THE TRIP BACK FROM INDIA

Leaving the Cochin city by plane to Bombay, being still at the airport Cochin, it looked exceptionally clean and tidy (**Figures 102-108, 111**). It appears, during the flight to Bombay, one could feel and had an epiphany! For the first time one eyes could see a Hindu divine deity!! In the photo (**Figure 108**), this goddess is presented: beautiful, pretty, kind and smiling, the goddess of Hindu culture and beauty.

Returning to the reality! In the photos (**Figures 109 & 110**), there are Bombay slums, views from the plane. In **Figure 110**, there is a cow from Bombay: skinny, hungry, and bony – going through a human hell. This cow should be in the meadow and should be grazed. It appears, there is a difference in the Hindu culture...

Figures 112-138 present some pictures of the environment, revealing beauty and reality of Bombay//Mumbai.

Indian Ocean from the side of the city of Mumbai is dirty and smelly, as presented in the photos (**Figures 113-122**). Ubiquitous garbage is a standard of Mumbai city (**Figures 123-125**). The same as around the world, people live under bridges, and in Mumbai it is a standard: the interesting fact is that the people living under bridges in Mumbai are clean and cleanly dressed (**Figure 126**). In the return trip, at the Mumbai airport, there was nice and cultured service (**Figures 111, 139-143**) [34-52].

CONCLUSIONS

A quest for natural rubber to India was interesting, and a great life experience. Different culture, different lifestyle and the beauty of nature are advantages of this country. People are very nice and polite. One can easily observe large social class differences. There is a big problem with environment protection in the big cities like Mumbai or Cochin, and it should be solved in a near future.

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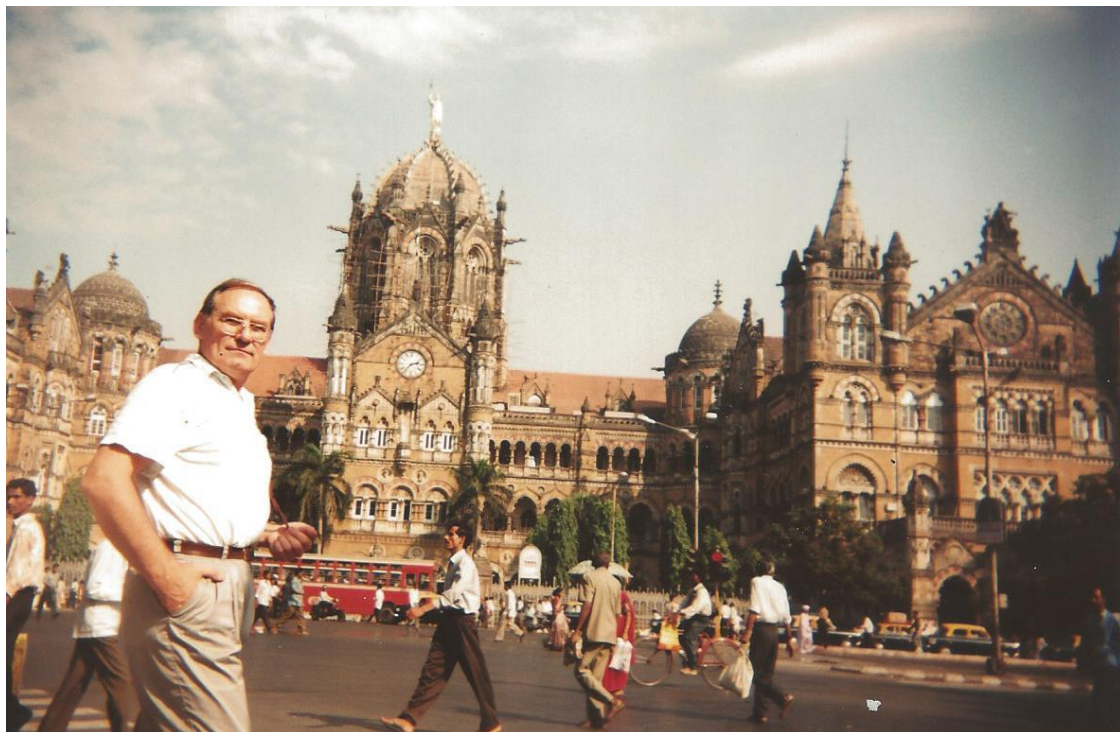


Figure 1. The co-author/T. Hryniewicz in the center of Bombay, India.

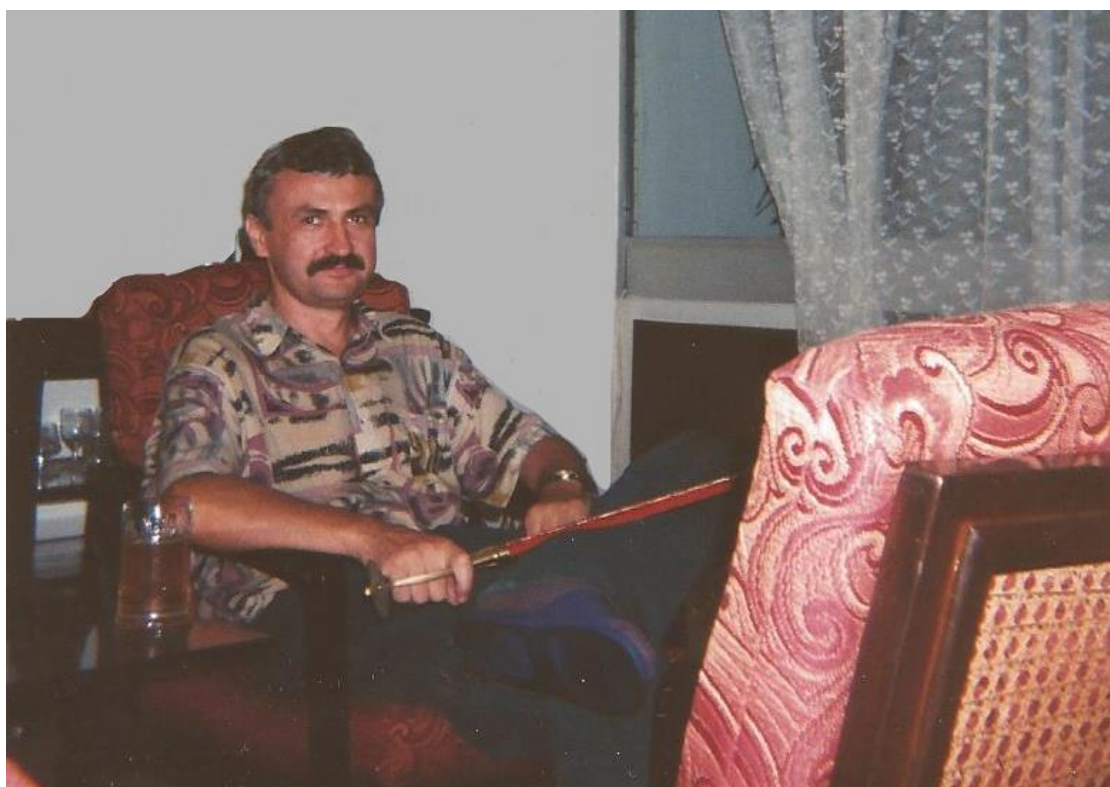


Figure 2. Polish Consul/K. Majka in his residence in Bombay, India



Figure 3. Cruise by Alitalia airlines from Poland to India



Figure 4. River Kizilirmak is visible in the middle; in the distance you can see the mountain Erciyes, 3916 m high, central Turkey



Figure 5. Airport toilet in Warsaw



Figure 6. Airport toilet in Bombay//Mumbai. Hole in the floor, a cup and tap with water, and water for washing



Figure 7. Cheap hotel in Bombay//Mumbai in monsoon season – damp and wet



Figure 8. Cheap hotel in Bombay//Mumbai in monsoon season – damp and wet



Figure 9. Cheap hotel in Bombay//Mumbai in monsoon season – damp and wet

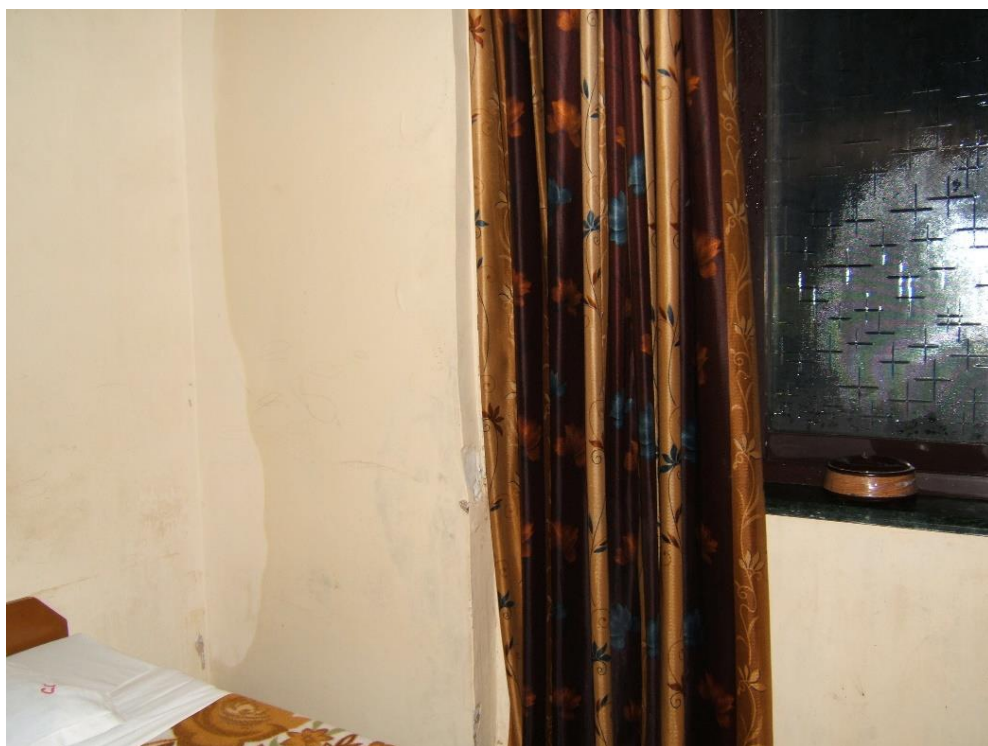


Figure 10. Cheap hotel in Bombay//Mumbai in monsoon season – damp and wet

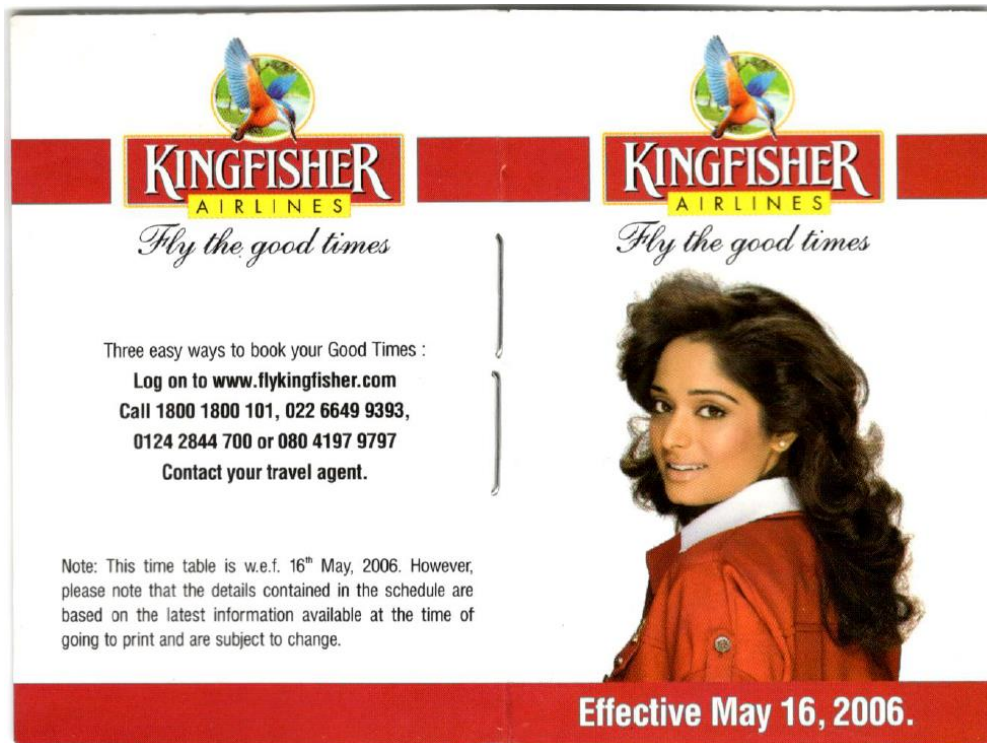


Figure 11. Advertising flyer of 'KINGFISHER' Air India



Figure 12. 'KINGFISHER' Air India



Figure 13. Rice cultivation fields



Figure 14. Rice cultivation fields (Author - Tomasz Borowski).



Figure 15. Rubber tree plantation (*Hevea brasiliensis*, Müll. Arg.)



Figure 16. Rubber tree plantation (*Hevea brasiliensis*, Müll. Arg.)

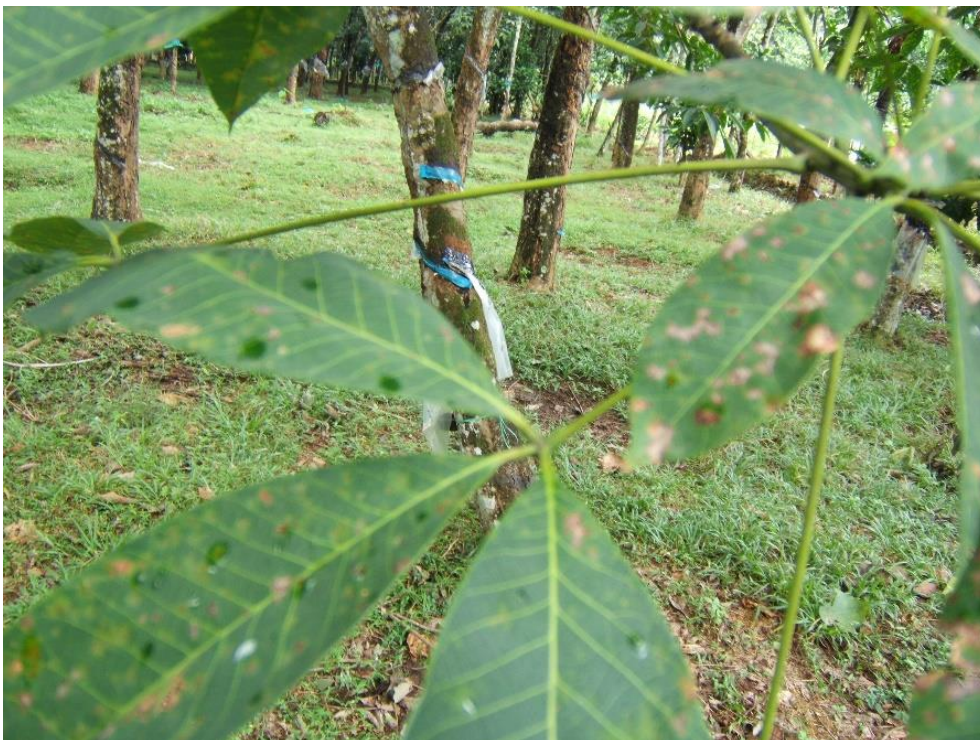


Figure 17. Rubber tree plantation (*Hevea brasiliensis*, Müll. Arg.)



Figure 18. Rubber tree plantation (*Hevea brasiliensis*, Müll. Arg.)



Figure 19. Rubber tree plantation (*Hevea brasiliensis*, Müll. Arg.)



Figure 20. Collection of natural latex milk (*Hevea brasiliensis*)



Figure 21. Collection of natural latex milk (*Hevea brasiliensis*).



Figure 22. Collection of natural latex milk (*Hevea brasiliensis*).



Figure 23. Collection of natural latex milk (*Hevea brasiliensis*).



Figure 24. Collection of natural latex milk (*Hevea brasiliensis*).



Figure 25. Collection of natural latex milk (*Hevea brasiliensis*),



Figure 26. Oxidized latex milk (*Hevea brasiliensis*) after a longer time



Figure 27. Oxidized latex milk (*Hevea brasiliensis*) after a longer time



Figure 28. Natural rubber (polyisoprene) after a chemical treatment



Figure 29. Natural rubber (polyisoprene) after a chemical treatment



Figure 30. Natural rubber (polyisoprene) after chemical and mechanical treatments



Figure 31. Natural rubber (polyisoprene) after chemical and mechanical treatments



Figure 32. Natural rubber (polyisoprene) after chemical, mechanical, and thermal treatments, as a finished commercial product



Figure 33. Cultivation of vanilla.



Figure 34. Cultivation of vanilla.



Figure 35. Cultivation of banana.



Figure 36. Cultivation of papaya



Figure 37. Cultivation of chilli



Figure 38. Cultivation of breadfruit



Figure 39. Cultivation of coconuts



Figure 40. Cultivation of Lychee (Lichi)

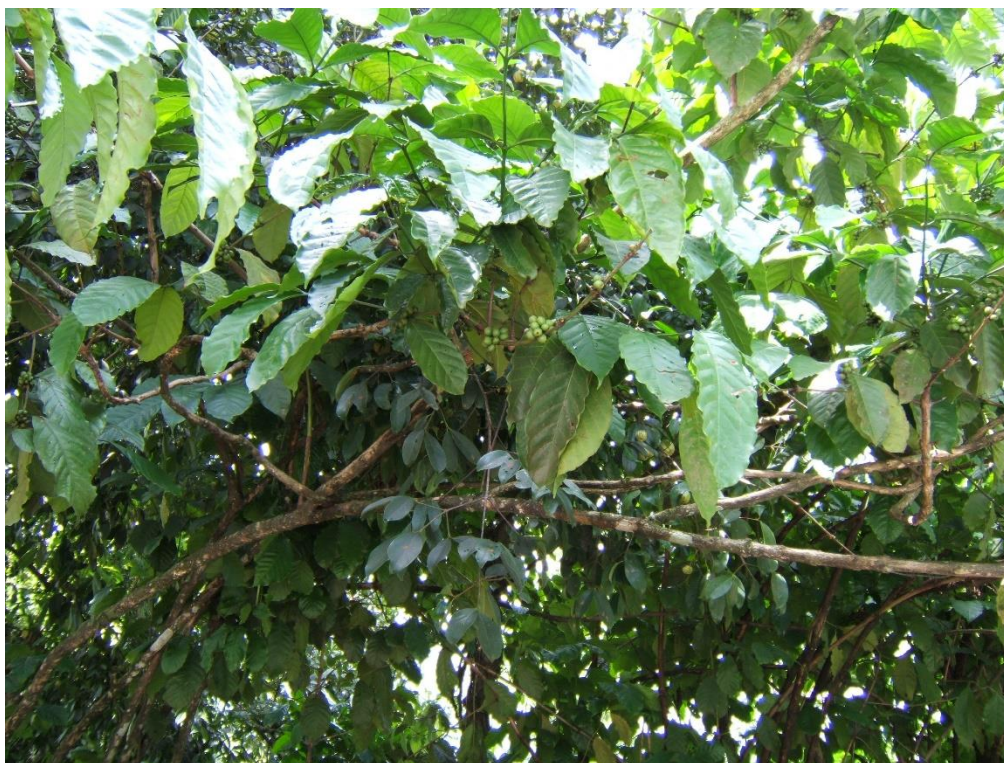


Figure 41. Cultivation of coffee.



Figure 42. Cultivation of coffee.



Figure 43. A common photo on natural rubber plantation (the second on the left is the first author, Dr. Tomasz Borowski).



Figure 44. Beauty of local landscapes.



Figure 45. Beauty of local landscapes.



Figure 46. Beauty of local landscapes (Author - Tomasz Borowski).



Figure 47. Beauty of local landscapes (Author - Tomasz Borowski)



Figure 48. Beauty of local landscapes (Author - Tomasz Borowski).



Figure 49. Beauty of local landscapes.



Figure 50. Beauty of local landscapes (Author - Tomasz Borowski).



Figure 51. Beauty of local landscapes.



Figure 52. Beauty of local landscapes (Author - Tomasz Borowski).



Figure 53. Beauty of local landscapes.



Figure 54. Beauty of local landscapes.



Figure 55. Beauty of local landscapes.



Figure 56. Beauty of local landscapes.



Figure 57. Beauty of local landscapes.



Figure 58. Beauty of local landscapes.



Figure 59. Beauty of local landscapes.



Figure 60. Beauty of local landscapes.



Figure 61. Plantation of tea



Figure 62. Plantation of tea



Figure 63. Plantation of tea



Figure 64. Plantation of tea



Figure 65. Plantation of tea



Figure 66. Plantation of tea



Figure 67. Plantation of tea



Figure 68. Plantation of tea



Figure 69. Plantation of tea



Figure 70. Plantation of tea



Figure 71. Plantation of tea



Figure 72. Plantation of tea



Figure 73. Plantation of tea



Figure 74. Plantation of tea



Figure 75. Plantation of tea

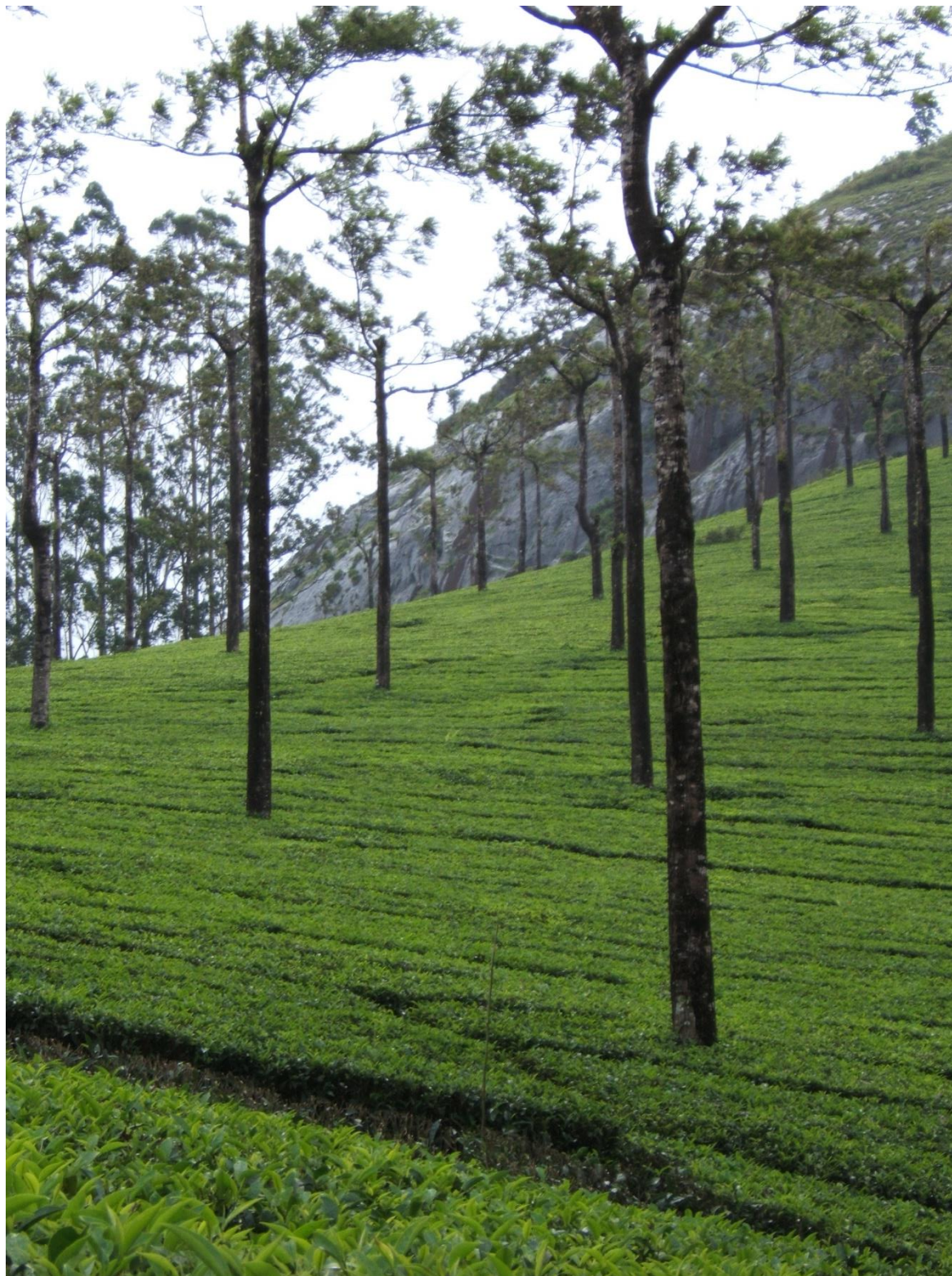


Figure 76. Plantation of tea



Figure 77. Plantation of tea



Figure 78. Beauty of local landscapes.



Figure 79. Beauty of local landscapes.



Figure 80. Local touristic attraction: elephant



Figure 81. Local touristic attraction: elephant



Figure 82. Local touristic attraction: elephant (Author - Tomasz Borowski).



Figure 83. Local touristic attraction: elephant (Author - Tomasz Borowski).



Figure 84. Local touristic attraction: elephant



Figure 85. Local touristic attraction: elephant (Author - Tomasz Borowski).



Figure 86. Beauty of local landscapes.



Figure 87. Searching for insects – regional beetles



Figure 88. Beauty of local landscapes.



Figure 89. Beauty of local landscapes.



Figure 90. Beauty of local landscapes.



Figure 91. Beauty of local landscapes.



Figure 92. Beauty of local landscapes.



Figure 93. Beauty of local landscapes.



Figure 94. Beauty of local landscapes.



Figure 95. Beauty of local landscapes.



Figure 96. Beauty of local landscapes.



Figure 97. Beauty of local landscapes.



Figure 98. Beauty of local landscapes.



Figure 99. Beauty of local landscapes.



Figure 100. A cultural hotel stay after returning from the rubber tree plantation



Figure 101. A cultural hotel stay after returning from the rubber tree plantation



Figure 102. Airport in Cochin City



Figure 103. Airport in Cochin City



Figure 104. Flight to Bombay/Mumbai from Cochin City



Figure 105. Flight to Bombay/Mumbai from Cochin City



Figure 106. Flight to Bombay/Mumbai from Cochin City



Figure 107. Flight to Bombay/Mumbai from Cochin City



Figure 108. The most beautiful woman – Hindu goddess seen on the authors' eyes during stay



Figure 109. Slums of Bombay/Mumbai



Figure 110. Slums of Bombay/Mumbai



Figure 111. Anteroom at the airport in Bombay/Mumbai



Figure 112. Pretty/gorgeous Hindu cow, though scrawny with visible bones, but sacred; this cow generally gets through the human hell, it should be in the meadow to be grazed



Figure 113. Cluttered Indian Ocean



Figure 114. Cluttered Indian Ocean



Figure 115. Cluttered Indian Ocean



Figure 116. Cluttered Indian Ocean



Figure 117. Cluttered Indian Ocean



Figure 118. Cluttered Indian Ocean



Figure 119. Cluttered Indian Ocean



Figure 120. Cluttered Indian Ocean



Figure 121. Cluttered Indian Ocean



Figure 122. Cluttered Indian Ocean



Figure 123. Cluttered Bombay/Mumbai City



Figure 124. Cluttered Bombay/Mumbai City



Figure 125. Cluttered Bombay/Mumbai City



Figure 126. Indians/Hindu living under a bridge



Figure 127. Hindu taxi



Figure 128. Hindu taxi

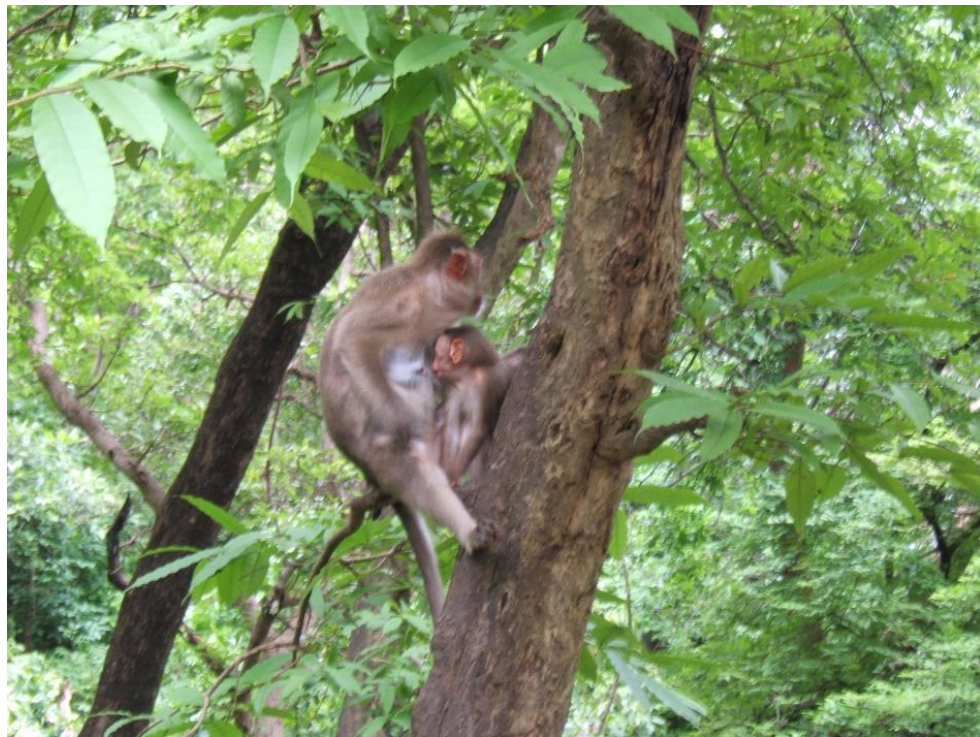


Figure 129. Beauty of the nature of Bombay/Mumbai surroundings



Figure 130. Beauty of the nature of Bombay/Mumbai surroundings



Figure 131. Beauty of the nature of Bombay/Mumbai surroundings



Figure 132. Beauty of the nature of Bombay/Mumbai surroundings



Figure 133. Beauty of the nature of Bombay/Mumbai surroundings



Figure 134. Beauty of the nature of Bombay/Mumbai surroundings



Figure 135. Beauty of the nature of Bombay/Mumbai surroundings



Figure 136. Beauty of the nature of Bombay/Mumbai surroundings



Figure 137. Beauty of the nature of Bombay/Mumbai surroundings



Figure 138. Bombay/Mumbai City



Figure 139. Airport in Bombay/Mumbai



Figure 140. Airport in Bombay/Mumbai (Author - Tomasz Borowski: the first on the right).

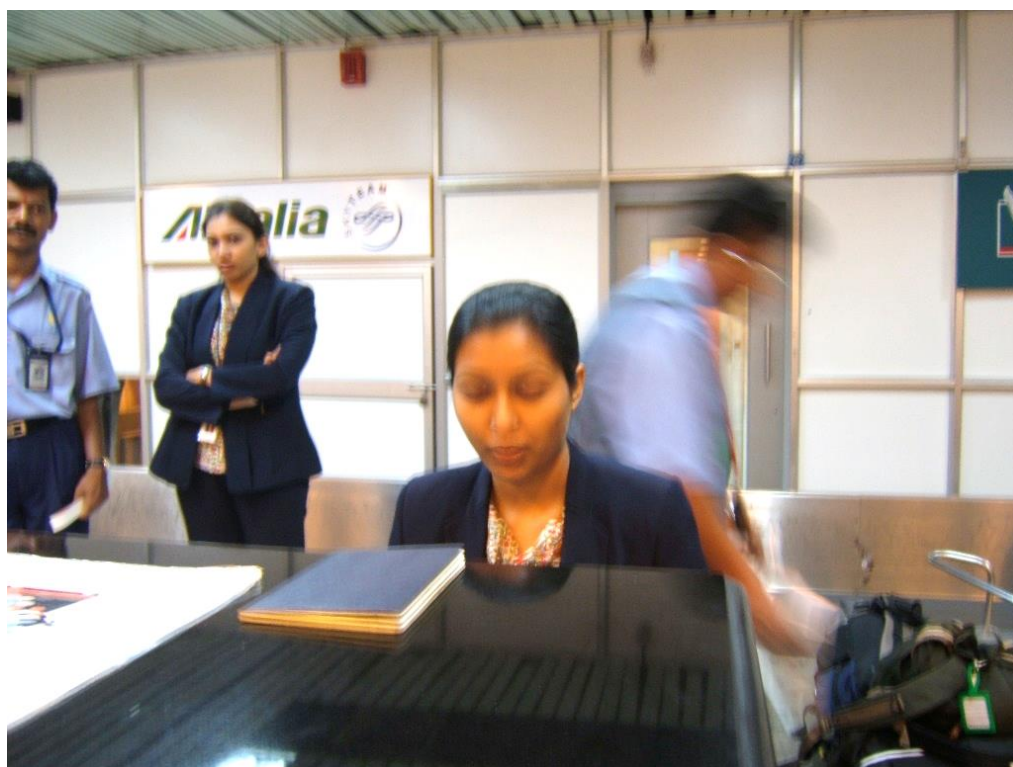


Figure 141. Airport in Bombay/Mumbai



Figure 142. Airport in Bombay/Mumbai



Figure 143. Airport in Bombay/Mumbai