L. Colani, reveals on the small scales a revolutionary attention to ergonomic and anthropometric details. As he himself says: "Engineer's design products in order to facilitate production: their products are often angular and aggressive. I strive to devise lines that reveal the mark of the human body on the object. And in the case of photography, the relationship between the device and the hand is paramount"[85]. In industrial product area, which he designed, the following stands out: in 1981, the ballpoint pen for Pelikan; in 1984, headsets for Sony; in 1991, binoculars for Bresser; in 1993, the "mouse" and the "joystick" for Highscreen *(See Figure 19)* and, above all, the cameras he designed for Canon, of which the T90 stands out, one of the most popular products by L. Colani.

In fact, L. Colani started a collaboration, in 1974, with the Japanese company Canon, which will strongly influence the future industrial products of the brand. This collaboration gave rise to a series of experimental models of photographic devices in organic forms such as CB 10 and Hy Pro, or more conventional forms such as the Frog, and the Homic, designed for underwater photography *(See Figure 20)*.

He applied the formal principles of Biodesign to these projects, "considering that these are objects that we hold in our hands and touch our faces"[86]. Later these models gave rise to the Canon T90, the most complex of the T series, the result of L. Colani's collaboration with the company's design office, announcing the influences of its boldest models. Launched in 1986 in Japan, it quickly became an icon of industrial design, influencing the design of thousands of products worldwide. This experience demonstrated in practice, in a very evident way, how a designer with new conceptions sometimes considered utopian can collaborate with the project office of a large company and achieve an innovative result. The T90, with its organic forms that were clearly demarcated from the parallelepiped small box, *black box* style, has historically revolutionized not only the Canon range but also those of the competition *(See Figure 21)*. This formal trend naturally expanded later to most consumer electronics products, first to portable objects such as transistorized radios, walkman's, diskman's, etc. and subsequently to other more complex products. This helped that this type of product became more ergonomic and even more sensual.

But this fact also forced the development of more perfected CAD (Computer Aid Design)[87] systems, capable of representing and manipulating all these complex forms, allowing to create a skin that involves all the internal organs of these products. Enabling the use of more organic and ergonomic forms, there was a formal and structural approach to the human body, acting almost as extensions of it. As Raymond Guidot says about the projects developed by L. Colani for Canon: "Colani found shapes that somehow prolong those of the human body"[88].

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20 21

Figure 19. Products designed by Luigi Colani: Ballpoint pens for Pelikan (1981); mouse for Highscreen (1993); binoculars for Bresser (1991). **Figure 20.** Camera Models (1982) designed by Luigi Colani. Above, from left to right: Model CB10 and Model Hy Pro. Below, from left to right: Model Frog and Model Homic. **Figure 21.** Canon photo cameras, series T. Above, from left to right: T50 (1983), T70 (1985). Below: T80 (1985) and T90 (1986).

Conclusion

In this perspective, biological systems present an inexhaustible diversity of solutions tried for thousands of years, ranging from morphological evolutions, the development of structural or dynamic systems, the modes of information transmission and interfaces, but it is mainly from a wide knowledge of the system in which the object is inserted, that it will be possible to project it so that its adaptation is complete. In this sense, the contribution of areas such as Biology and Chemistry, as well as social and economic sciences, Physics and Mathematics will be essential for project culture enrichment and to create a future universe of fusion between natural and artificial. This proposal, which we will talk about later, passes, as is defended by the author, by the definition of *symbiosis* methodologies for a *fusion design* or *Symbiotic Design* that, considering biotechnical and biomorphic methodologies such as Bionics or Biodesign, goes further proposing a new methodology of

Figure 22. Planet Earth, about 4.5 billion years experimenting with symbiotic methodologies.

symbiosis between natural and artificial systems, with energy, communication and usage systems sharing.
Symbiotic Design is an attempt to understand and apply the methodologies and processes of the great *Symbiotic Project* that nature has been developing. Applying these methodologies and processes does not guarantee "success", because even nature learns through experimentation, but it places us within the process, with a greater probability of evolving more integrated and, therefore, with greater success. The 21st century, could be the turning point in this direction. We hope that this is the future, the construction of a "symbiosis universe" and the preservation of the "Living Laboratory called Earth". And on that day, we can say that we are an integral part of the *Symbiotic Planet*!

Notes

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7. N. Vossoughian, *op. cit.*, p.10.

8. F. Weinbrenner, *op. cit.,* 1819, pp. 101-102, citado em Nader Vossoughian, *op. cit.*, www.arch.columbia.edu
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14. H. Greenough, *op. cit.,* p. xvi.
15. *Idem*, p. xviii.
16. *Idem*, p. 71.
17. *Idem*, p. 60.
18. *Idem*, p. 61.
19. *Idem*, p. 9.
20. 2^0 *Idem*, p. 121.
21. R. C. Lewontin e R. Lewis*, op. cit.*, p. 234.
22. *Idem*, p. 235.
23. *Ibidem.*
24. *Idem*, p. 236.
25. P. Steadman, *op. cit.*, p. 115.
26. *Idem*, p. 116.
27 *Ibidem*.
28. R. C. Lewontin e R. Lewis, *op. cit.,* p. 248.
29. *Idem*, p. 249.
30. P. Steadman, *op. cit*., pp. 118-119.
31. R. C. Lewontin e R. Lewis, *op. cit*., p. 246.
32. H. Greenough, *op. cit.*
33. John George Wood, *Nature's Teaching's: Human Invention Anticipated by Nature*, Boston, 1885.
34. *Idem*, p. 195.
35. P. Steadman, *op. cit*., p. 213.
36. P. Steadman, *op. cit*., p. 212.
37. P. Steadman, *op. cit*., p. 214.
38. P. Steadman, *op. cit*., p. 214.
39. Patrick Gueddes, *Cities in Evolution*, London, 1915, citado em, Philip Steadman, *op. cit.*, p. 218.
40. *Ibidem.*
41. Technical Biology - Study of formal and structural systems produced in biological systems.
42. Bionics - study of formal and structural systems produced by natural systems and their application to the design of man-made systems.

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45. L. Gérardin, *op. cit.*, p. 11.
46. en.wikipedia.org/wiki/Velcro
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52. *Idem*, p.186.
53. Green Design - Design with concerns focused on environmental impacts. It emerges as an alternative to consumer design, especially from the 1980s onwards, calling for the use of recyclable materials and a "green lifestyle".
54. Ecodesign - Design concerned with environmental impacts as well as product life cycle (Lifecycle analysis-LCA).
55. Design for Environment (DfE) - Design that seeks to address all concerns that concern the life of a product, ranging from production processes such as industrial waste in the manufacture of the product to use, destruction, recycling and reuse of the product, including health and safety issues of use.
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67. *Christopher Dresser*, www..designmuseum.org
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75. *Idem*, p. 23. Regarding the quality of industrial products that are exception, read the following books: Volker Albus, Reyer Kras e Jonathan M. Woodham, *Icons of Design*, Munique, Prestel, 2000; Stephen Bayley, *The Conran Directory of Design*, London, Octopus Conran, 1985; Marie Bertherat e Martin de Halleux, *100 ans de Objects de Légende*, Paris, Atlas, 1996; Guy Julier, *Design Since 1900*, London, Thames & Hudson, 2004; Paulo Parra, *Ícones do Design. Colecção Paulo Parra*, Lisboa, Casa da Cerca, 2003; Penny Sparke, *100 Ans de Design*, Paris, Octopus, 2002.
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80. *Idem*, p. 48.
81. AAVV, *Luigi Colani-Designing Tomorrow*, Tokio, Ed. Car Styling, 1978, p. 47.
82. AAVV, *Luigi Colani-Designing Tomorrow*, Tokio, Ed. Car Styling, 1978, p. 77.
83. AAVV, *Luigi Colani-Bio-design of Tomorrow*, Tokio, Ed. Car Styling, 1984, p. 19.
84. Philippe Perdonet, Bruce Mehly, *Luigi Colani*, Paris, Ed. Dis Voir, 2000, p. 17.
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86. Raymond Guidot, *Histoire du Design 1940-1990*, Paris, Ed. Hazam, 1994, p. 283.
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88. *Ibidem.*

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Resumen: ¿Cómo se extrae el conocimiento operativo de los sistemas biológicos y se aplica rigurosamente en la práctica del proyecto? ¿Podemos hablar de metodologías biológicas, es decir, de metodologías proyectuales de la naturaleza? ¿Y estos métodos se pueden aplicar en metodologías técnicas? ¿Existe un evolucionismo tecnológico igual que el evolucionismo biológico?. La naturaleza siempre ha sido, de múltiples formas, una fuente de inspiración para el hombre. Sin embargo, según el autor, hay dos enfoques fundamentales de estos usos que conviene distinguir aquí. Son, por un lado, un enfoque más estructural y funcional, como Biónica y Morfología Estructural, para lo que se propone el nombre de Metodologías Biotécnicas y, por otro lado, un enfoque más formal, como son los casos de Streamlining y Biodesign, para que se propone con el nombre de Metodologías Biomór-

ficas. Estas dos metodologías son fundamentales en la definición de "Diseño Simbiótico", que tiene como objetivo identificar los procesos simbióticos aplicados por los sistemas biológicos y proponerlos como elementos importantes en el diseño integrado de sistemas tecnológicos. Desde este punto de vista, la relación entre el ser humano y los objetos se propone como un sistema simbiótico, en el que el Diseño se asume como un elemento articulador. Esta cosimbiosis, que permite una cooperación íntima, reduce la distancia entre los sistemas biológicos y los sistemas tecnológicos y proporciona una nueva unidad de proyecto para el siglo XXI.

Palabras clave: Simbiótico - Evolucionismo biológico - Evolucionismo tecnológico - Diseño - Funcionalismo orgánico - Biónica - Diseño biomórfico - Siglo XXI

Resumo: Como o conhecimento operacional é extraído dos sistemas biológicos e aplicado rigorosamente na prática do projeto? Podemos falar de metodologias biológicas, isto é, de metodologias projetuais da natureza? E esses métodos podem ser aplicados em metodologias técnicas? Existe um evolucionismo tecnológico tanto quanto o evolucionismo biológico? A natureza sempre foi, de várias maneiras, uma fonte de inspiração para o homem. No entanto, de acordo com o autor, há duas abordagens fundamentais para esses usos que devem ser distinguidas aqui. São, por um lado, uma abordagem mais estrutural e funcional, como Biônica e Morfologia Estrutural, para as quais se propõe o nome de Metodologias Biotécnicas e, por outro lado, uma abordagem mais formal, como são os casos de Streamlining e Biodesign, para qual o nome Metodologias Biomórficas é proposto. Estas duas metodologias são fundamentais na definição de "Design Simbiótico", que visa identificar os processos simbióticos aplicados pelos sistemas biológicos e propô-los como elementos importantes no design integrado de sistemas tecnológicos. Nessa visão, a relação entre o ser humano e os objetos é proposta como um sistema simbiótico, no qual o Design se assume como um elemento de dobradiça. Essa cosimbiose, permitindo uma cooperação íntima, reduz a distância entre os sistemas biológicos e os sistemas tecnológicos e fornece uma nova unidade de projeto para o século XXI.

Palavras chave: Simbiótica - Evolucionismo biológico - Evolucionismo tecnológico - Design - Funcionalismo orgânico - Biônica - Design biomórfico - Século 21