la consolidación de las pendientes inestables (figs. 12 y 13), un conjunto de elementos ligeros se opone al fenómeno de la erosión repitiendo a escala sistemática el efecto de las raíces de las plantas, sustituidas por un conjunto calculado con precisión de estructuras ligeras ancladas y conectadas por hilos, redes y telas insertadas en el terreno que hay que proteger. La protección ya no es una cosa externa, sino una cosa intrínseca (aunque artificial) al terreno mismo.

El análisis de los sistemas naturales llevado a las últimas consecuencias sugiere proyectos que son al mismo tiempo revolucionarios y están en línea con las soluciones naturales más habituales: el drenaje del agua salina que causa la desertización del territorio (y de esta manera se protege el terreno) se hace mediante la instalación de una serie de «árboles sintéticos» (figs. 14 y 15) que repiten de una forma sistemática el proceso de absorción del agua y de evaporización —inspirado por la acción coordinada de los aparatos de las raíces y de las hojas de los vegetales—, de los intercambios gaseosos que se dan en las branquias de los peces y en los pulmones de los mamíferos, reproducidos con métodos y materiales artificiales.

A dialogue between materials and environment. Designing protection: observation, models, solutions, in the task of the Centre for Research of the European Institute of Design

The solution to any specific design problem requires, on behalf of the work group facing it, the secure possession of a store of reflection and general methodological choices. The design of an object, of a system, of a productive process, presupposes a global orientating plan whose validity goes beyond specific design occasions, and does not indicate specific solutions, but rather the conceptual way to be followed when searching for concrete answers.

For the Centre for Research of the European Institute of Design (CREID), these two poles (the «conceptual compass», and the specificity of the problems) are represented respectively by bionic methodology and applied research. The first is the result of research activity and collection which began in 1976 and which has become more and more precise and profound during the succeeding years till it has become a coherent group and a continuous development of information, data, and a work method that orbits around the observation of the nature and material structures of the animal and vegetable world. This careful and selective observation is used to identify (from a consideration of the origin of any specific design problem) specific solutions —of material, form or process— existing in nature, to respond to particular needs.

From the observation of these «natural objects» (animal skeletons, vegetation trunks, circulation and alimentary liquid distribution systems, processes of interchange between organisms and environment), we cannot derive immediate borrowings as formal or functional solutions: our attention is rather concentrated on the relationship between natural form and the distribution of material within the «object», on the relationships between the constituting parts of an articulated member or group of organs, and, above all, on the way in which the parts, the quality and the dis-

tribution of material, the subdivision and coordination of the various elements, collaborate towards the solution of a functional problem that has been defined as central.

It is not a case, therefore, of drawing specific suggestions from nature, but rather of constructing, on the basis of observations of natural data, a reference model for the solution of a problem. The model is not an object, it is a premise for arriving at the definition of an object, to define its characteristics in a manner adequate to the requisites. Design itself, properly speaking, has not at this point entered on the scene; it has only found its point of reference. Design keeps its entire importance precisely because it is not converted into a «copy», more or less refined, of nature, but rather finds in nature a concrete base field.

At the end of the operation, when design is practiced in the distinct definition, constructive even in the technical sense, of an artificial object inspired by bionic methodology, the joint conceptual heritage is at the same time enriched by the experience of a new specific solution: the circle is closed, and from applied research general methodological information, valuable for the patrimony of design culture which will constitute the basis for future research, enters into the circle.

Bionic methodology is, therefore, interested in functions more than in the natural objects themselves; it is a field of research of the relationships between objects and of the interaction between the environment and the materials of which the objects are made. The concrete field of design which has as its function that of *protecting* (protecting a construction from atmospheric agents, a part of the human body from blows, a portion of territory from acoustic pollution), is particularly apt to illustrate the multiplicity and richness of solutions that these conceptual instruments allow us to develop.

Designing protection in terms of a dialogue between materials and environment means, before designing objects, designing the strategy for the re-establishment of balance. The stimuli (or aggressions) of the environment towards the object of protection actually tend to alter a pre-existing balance. The objective of design is to allow (by means of a product, a system or a process) the re-establishment of balance with the environment, in favour of the object of protection.

In the activity carried out by the CREID, this vein, particularly rich in results, is represented by a gamut of designs which goes from the world of architecture to that of packaging, and includes the whole range of productive technology and uses.

In the case of the system designed in 1991 for the Magona, Italy (figs. 1 and 2), protection is applied to pre-existing constructions rather like a second skin, a skin made up of auto-bearing modular panels superposed on existing walls, which not only reinforces their resistence to atmospheric agents but also increases their esthetic qualities. Like any natural skin, it adds communicative functions to the primary functions of protection, accepting a variety of superficial *textures* and colours that allow for a rich range of variety: a «personalized» protection adequate to esthetic levels required by architecture.

Also in the architectural field, we show another design for protection (figs. 3 and 4): another barrier, a sheet of metal as a material base, although in this case the objective does not refer to architecture, but rather to terrain. It is an acoustic barrier, destined to isolate the noise of highway traffic. The bionic model on which the adopted solution is based is that of cellular structures, which suggest the possibilities of interposing several barriers to the propagation of sound, adapting, at the same time, the form of the barriers to the unforeseeable variety of the configurations of the terrain.

The concept of protection, however, does not end at the barrier: it is linked and superposed to another function, one of the richest in application of the world of design, the function of wrapping. Wrapping, in its wider sense, as a system of custody of the object of protection, and, therefore, also a «wrapping» of the human body. The helmet for motorcyclists, made up of a series of articulated sections (figs. 5 and 6), draws from the observation of nature and the laws of mechanics an unknown design concept: protection not as an interposition of rigid defenses, but rather as an optimization of the dispersal of energy. As happens with the cranial plaques of new-borns, the sections of the helmet, in case of impact, are displaced over each other, and develop an efficient protection precisely thanks to their capacity to change their form. They protect the body according to characteristics —adaptability, elasticity, form change— typical of corporal tissues, which themselves make up an efficient «wrapping» for the group.

Another fundamental characteristic of the natural model of protection is the efficient coupling of the diverse materials, from which the flexibility, lightness and resistence are derived. Designing an efficient cou-

pling (fig. 7) is equivalent to giving life to a new material, which in this case will wrap heavy and particularly fragile articles, and which can also be used to make transport containers or structures for temporary expositions.

Some of the research of the CREID has taken into account wrapping in the strictest sense of the word: containers whose technical characteristics are specifically functional, to be used in a determined category of merchandise. For example, packaging for fruit (figs. 8 and 9), which parts from the study of «natural packaging»: of pods, of the sections of citrics, of the internal disposal of pomegranate seeds, which create a particularly efficient system in the confection before the conservation and transport. The famous jest of Bruno Munari (who in *Artista e designer* described, in 1966, oranges and peas as an example of packaging) acquires the sense of a concrete indication, both fun and fruitful: from the form of the fruit we derive the form of its wrapping.

Protection, once again, does not mean remaining tied to a rigid material, but rather choosing a form of protection according to the situation and, therefore, going towards a material of varying consistency, elastic in the literal and technical sense of the word. This is the case of the container for a line of cosmetic products (figs. 10 and 11), which expands according to the amount of the product it contains. This is an idea which comes from the observation of vegetable tissue and the human body, whose capacity for varying their forms according to the use situation is one of the main advantages from the design point of view: it means space saving in storage and transport, minimum dimensions after use, complete reversibility of form, and, therefore, the possibility of reuse, which respects economy and environment.

The concept of protection, however, acquires its highest value when protection systems for territory come into play. It is no longer a question of creating flexible or efficient barriers, but rather of making nature and artifice interact thus creating proper mixed systems; in the project of artificial roots destined to consolidate unstable slopes (figs. 12 and 13), a group of light elements is opposed to the phenomenon of erosion by repeating on a systematic scale the effect of plant roots, substituted by a carefully calculated group of light structures anchored and connected by threads, nets, and fabric inserted in the terrain to be protected. The protection is no longer an exterior element, but rather an intrinsic one (although artificial) of the terrain itself.

The analysis of natural systems taken to its furthest consequences suggests projects that are at the same time revolutionary and in line with the most usual natural solutions: the drainage of saline water which causes desertification of terrain (thus protecting the terrain) is done by means of the installation of a series of «artificial trees» (figs. 14 and 15) that repeat in a systematic manner the process of water absorption and evaporation inspired by the coordinated action of the machinery of roots and leaves of vegetation, the interchange of gases that take place in fish gills and mammal lungs, reproduced in artificial methods and materials.