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Morphological Planning

Many scientific discoveries are made in a highly nonscientific way - they are stumbled upon by accident. But Dr. Fritz Zwicky of Mt. Wilson and Palomar Observatories believes that this is wasteful and uncertain. He has developed a systematic, orderly way of solving not single problems but whole groups of problems by what he terms the morphological method. This brief explanation of Dr. Zwicky's ideas is based on a talk, "The Morphology of Scientific and Engineering Invention", given by him in 1951 to the Friends of the Pestalozzi Foundation of America and the Alumni of the Federal Institute of Technology in Zurich, Switzerland.

Morphological thinking aims at knowing all of the essential aspects of a given problem. The successful exploration, analysis, classification, and evaluation of all of these aspects furnish the clues of how one must act and live most organically and realistically under any circumstance. Morphological thinking helps to eliminate prejudices, bogeymen and fear as far as that is possible. This type of thinking is the tool of free men, and it in turn makes men free.

The morphological method is particularly powerful when complicated and large scale problems are involved. To prevent all misunderstandings, we emphasize right from the beginning that the new method is not restricted to science and technology. The morphological inquiry applies to all subject matters, whether they be technical or generally human in nature, as long as these matters fall within the realm of communicable truth.

Using the Morphological Method

The morphological method, briefly, proceeds as follows:

1. The problem to be solved is exactly formulated. Great rigor and precision in all definitions used are imperative.
2. Every concept and every operation which occur in the formulation of the problem are analyzed and the significant parameters (variables) are isolated, analyzed, and put in order. These parameters usually are many-valued.
3. All possible solutions of the given problem are deduced and subsequently ordered in a so-called "morphological box," which is a multidimensional affair of as many geometrical dimensions as there are determining parameters.

During the first three steps of our procedure no attention whatever is paid to any possible value of any of the solutions which are to be obtained or which have already been obtained. Premature prejudices with regard to values are fatal. They inevitably hinder or make impossible the achievement of a total perspective on the given problem.

4. At this stage, one finally chooses a value or different values, in which one may be interested and one determines the performance, with respect to these values, of all the solutions which have been obtained.
5. Finally, with all the knowledge which one has gained on the nature of the solutions and on their performance characteristics, one chooses those solutions which one wishes to utilize, and proceeds to do so.

Morphological Planning and Power Plants

The conscious application of the morphological method as we have formulated it is of quite recent origin. In 1943, it was known that the Germans were far ahead of the rest of the world in the development of rockets. It was therefore necessary to catch up with them quickly. This was only possible through the use of far more powerful methods of scientific research and engineering invention than had ever been used before. The morphological method was developed and applied as a direct consequence.

Jet engines and propulsive power plants in general thus became the first field of application of the new method. The question was asked as to the character of all possible propulsive power plants which move in various types of media such as in a vacuum (interplanetary space), in the earth's atmosphere, in and on bodies of water and on the surface of the earth or through it.

The amazing fact emerged that the new method led with ease to invention on a prolific scale. Where the inventor of old had plowed through unknown jungles, making occasionally a find here or there, the morphological method literally opened up this jungle of possibilities to the inner eye, so that its whole structure and contents were laid bare for comparative scrutiny.

In hundred of years the ordinary engineering method of invention had produced at most a dozen basically different pure medium propulsive power plants. The morphological analysis revealed that potentially there exist 20 000 basic propulsive power plants which derive their energy from chemical reactions. Many of them should eventually find their proper place in technological applications.

Astronomy promises to become a most fruitful field for morphologists. In fact, this seems to be a science in which new discoveries can be made with the most astounding ease, notwithstanding the fact that it is the oldest among the sciences. The morphological scrutiny of astronomy has been remarkably effective from the very beginning. Among the discoveries which came from applying the morphological method to astronomy was the spectacular one concerning the supernovae. From the study of these stupendous stellar explosions, the first direct proof for the occurrence of nuclear stellar reactions was obtained.

Morphological Results

Because any use of the morphological method reveals not just a single answer, or the answer that one may be looking for, but all of the possible answers to any problem, it is a method that can be adopted only by truly free men. Any binding or restricting associations with group interests, any enslavement by material or spiritual ambitions throws one off that peculiar and unique vantage point from which alone the morphological perspective can be gained.

The morphologist comes to have a basic belief that many things which have come to be thought of as impossible are not so impossible after all. It is indeed most difficult to produce real proof that a certain thing cannot be done. Unless such proof is given no morphologist will admit impossibility.

Any of the results that can be achieved through the use of the morphological method in science and technology are likely to be of value in the daily activities of the human society. Far beyond this, however, the morphologist of our time must be concerned with the destiny of man because this destiny today seems more in doubt than ever before.