EDITORIAL

What has become of biology and biomedical research in recent decades?

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Biologists who have had long professional careers have witnessed a remarkable evolution in their practice. Less than 30 years ago, technicians prepared reagents in test tubes, weighing powders and adjusting solution pH levels. Liquids were pipetted by mouth, sometimes using rubber tubes, later pipetting bulbs. Reactions were observed in reusable glass tubes. Some color reactions were evaluated by eye. The coffee cup rested on the lab bench. The magic of witnessing a chemical reaction and making a discovery was a dream come true.

Gradually, hygiene and safety conditions, once considered restrictive, became mandatory. Now, commercial "kits" are used. New European certification conditions tend to strongly discourage any "home" adaptation of methods. All liquid manipulations are performed using automatic pipettes, even robots. Colorimetry or radioactivity have been replaced by fluorescence and chemiluminescence, which are more sensitive and less polluting. Rest areas allow for safe snacking.

Furthermore, each diagnostic method must be properly qualified, measuring its reliability, accuracy, and reproducibility. The administration and collection of documents and "procedures" are increasing as fast as manual methods are disappearing. One sees more technicians or biologists behind a computer than at the lab bench. Test tubes, beakers, and chemicals have practically disappeared from the shelves and are replaced by cardboard boxes containing more emptiness than small vials of ready-to-use reagents. Quality assurance and traceability have become top priorities, with the desire for discovery taking a backseat to administrative tasks.

However, the evolution of biology is not only about the practice of assay methods but also about the strategic approach. Much previous work has described the basic principles. Research topics focused on very specific and narrow aspects. This was called a "reductionist" approach, easily understandable. The "elementary" things have now been largely clarified.

Now, with experience, the simplification of methods and the sensitivity of analyses have considerably increased and accelerated progress. The power of new technologies in genomics, cytomics, and other omics, coupled with computational contributions, allows for the acquisition and analysis of a multitude of information. For example, the discovery of minute mutations has led to the knowledge of new molecules and biochemical steps, providing a better understanding of cellular mechanisms. The task of biologists seems to be simplified, at least technically.

But that is not the case. Biologists must have a wide range of techniques at their disposal. While a large part of the elementary things has been clarified, the more difficult problems still need to be solved. Moreover, it is no longer sufficient to observe a phenomenon or a clinical case and derive hypotheses from it; it is necessary to duly document it, dissect from the gene to the protein, from its structure to its function, and test the effect of defective or excessive expression through genetic manipulations. Furthermore, the reductionist, elementary approach must give way to a "systemic" approach. A mechanism must be integrated within the complexity of the systems it depends on, taking into account inter-individual variability and numerous interfering parameters: metabolic, endocrine, immunological, microbiotic, neuropsychiatric, and even societal. The work increasingly requires interdisciplinary team

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coordination to combine and benefit from different expertise.

In short, biology is no longer the domain of a wild-haired "mad scientist" working in the depths of their garage. It has become considerably more "professionalized," from project conception to the potential publication of results, potentially involving project designers, professional coordinators, and scientific writers, akin to the past practice of engaging public writers. Biology must transition from individual genius to collective intelligence. Working in teams is not the scientist's culture, but it is through these cooperative methods that it