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POINT OF VIEW

Revisiting the Ruetsap Quadrant: A Dual Alert to Comfort Zone Researchers and the Need for Scientific Services

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Forty years ago, the academic community was divided over the dispute between “basic” and “applied” research. This resulted in a distortion in research proposals that tried to present research as solving relevant societal problems despite knowing that meaningful results would not materialize for decades. Additionally, some proposals lacked any fundamental reasoning that would justify them.

Donald Stokes[1] wrote an excellent book addressing the evaluation of research as basic or applied; he also considered mixed possibilities. His concept involved a two-dimensional plane, with the Y-axis representing Bohr’s basic research and the X-axis representing Edison’s applied research. Pasteur’s quadrant is in between and represents basic research leading to viable applications. All three situations lead to useful results.

Twenty years ago (2005), coincidentally, Unicamp translated this book[2] and revisited this publication, calling attention to a (sad) possibility disregarded by Stokes—the occurrence of research proposals in the Ruetsap quadrant[3] (Figure 1). This quadrant is opposite to Pasteur's quadrant and is defined by the negative vectors of basic and applied sciences—that is, research without justifiable goals. Despite being written in Portuguese,[3] current translators make it easy to browse through that publication. This might be useful for a self-critical appraisal, which we all need to do from time to time.

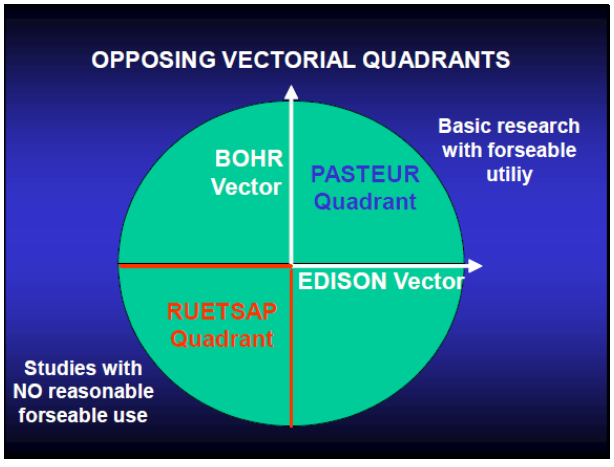

Figure 1. The desirable Bohr and Edison vectors and their combination in Pasteur’s quadrant. These are opposed to the undesirable Ruetsap’s quadrant, which consists of non-sense, non-useful research proposals devoid of sensible reachable goals.[3]

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By the end of 2005, the clever “h” index, proposed by Jorge E. Hitsch,[4] was published to rank researchers worldwide based on the number of citations of their publications. This development emphasized the necessity for researchers to seek publication in highly ranked journals, which are usually determined by their impact factor (IF). The IF is also based on the number of citations of papers. This started an era where the prevalence of “h” became important in decision-making. It was often completely disconnected from the field of work, the size of the community working in the area, and other aspects that directly affect the representativeness and comparability of “h” figures.

Added to this “h pressure” was the expansion of research groups, which put pressure on researchers to find their space in the scientific community. It also led to a transformation in the understanding of innovation, or at the very least, the novel information required for the acceptance of manuscripts submitted to stricter and more “qualified” scientific journals.

This situation may be questioned for not aiming at a true appraisal of researchers; nonetheless, compliance with the system was the sole means of receiving good feedback from journals and sponsors.

More recently, while the Pasteur's quadrant approach was compared with others, the Ruetsap quadrant continued to be neglected.[5]

Thus, after twenty years of increasing pressure on researchers worldwide, it seems appropriate to revisit this situation and alert scientists under pressure to avoid the pitfalls of dwelling in the Ruetsap quadrant.

Figure 1 illustrates Stokes' vectors and Pasteur’s quadrant and highlights Aquino Neto's undesirable Ruetsap quadrant. Details of the concept are discussed elsewhere.[3] A few emblematic situations related to analytical chemistry have developed in the last 50 years, challenging many established careers and research groups. Many researchers, caught off-guard, reacted by complaining they were being wrongly downgraded and were unable to realize the shifts taking place in their long-standing and successful research environment.

Within a few decades, front-end initiatives with worldwide impact have become commonplace *Technical Services*, producing at least two devastating results for scientific careers. On the one hand, principal investigators (PIs) of research groups faced the end of the innovative relevance of their long-standing research endeavors. On the other hand, and even more dramatic, all the group's staff and former students were induced to follow the leader to a pitfall that was not anticipated.

It happened with the structural identification of molecules by single-crystal X-ray diffraction. From relevant publications during the early days, they became merely integrated into the experimental section following the development of equipment and software. In natural product chemistry, the simple analysis of a “new” plant species or individual became devoid of publication relevance. Then there is genomic determination, which moved from a worldwide effort to characterize the first gene to over-the-counter kits to track one’s ancestry and relatives.

Therefore, in the analytical chemistry field, the former Pasteur’s quadrant research was pushed to Ruetsap’s quadrant, or irrelevant research, and it has taken the scientific community quite a while to realize it and readapt to the new order. Interestingly, this occurrence happened due to the success of analytical chemists, who significantly improved concepts, instruments, and software, making these operations commonplace.

It is important to highlight that while some doors were closed, others were opened. While the research was initially innovative *per se*, only with the availability of accessible analytical techniques would the acquisition of large amounts of data become possible. However, due to the lack of proper, fast, and encompassing processing, this wealth of data could not become an innovation. Therefore, in many fields, researchers became trapped in this limbo. Now, with the development of big data management, the acquisition of large datasets, especially those comprising historical series, may be used to derive innovative interpretations of large-scale phenomena. The advent of artificial intelligence is boosting this new era even further.

However, how will all the data necessary for these new data-crunching developments be scientifically gathered while adhering to strict quality control measures for reproducibility? The excellence needed for the reliability of these datasets will not be a publishable innovation! On the other hand, it will continue

to resist becoming a mere technical analysis for a significant length of time. Due to the quality of the data needed, it is important to differentiate between *Technical Services* for everyday use and *Scientific Services*, which are collected under strict scientific criteria. Of course, a novel financial attitude should be established as *Scientific Services* cannot simply be categorized as *Technical Services*; however, they do not constitute by themselves an R&D prospect.

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