

Future Trends for Organic Synthesis: An Opinion from Our Editors

For this month's Editorial Board Focus, we asked some of our Editors about their thoughts on the future of organic synthesis. Here's what they had to say:

Tom Rovis



Where is Organic Synthesis going? Every several years, an event comes along that causes a survey like this where we get all introspective about the field. Inevitably, the answer is something along the lines of "my field is moving in the direction of my research program". Rather than succumbing to this, I choose to paraphrase the late Frank Westheimer: if I knew what was

going to be important in 20 years, I'd be doing it right now.

What I do believe is that synthesis will still be important, central and relevant. It is our field that uncovers reactivity and pushes the boundaries of how we assemble molecules. Regardless of where organic chemistry ends up, making molecules will always be important. It is what makes chemistry central to all other areas of science.

Henry Wong



One of the most significant aspects of organic synthesis is its enormous degree of creativity, because organic synthesis can create not only known molecules, but also functional and hitherto unknown molecules. Through its connections with many other scientific disciplines, organic synthesis can also create interdisciplinary frontiers such as chemical biology, new

energy sources, and health industries. These new frontiers would in turn induce a great deal of challenge to synthesis, leading it to strive for more scientific creativity, and to reach new heights.

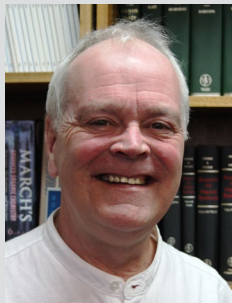
Paul Knochel



One important future goal in organic synthesis will be to prepare organic molecules in the most efficient manner in enough quantities so that the physical, chemical and biological properties of these organic molecules can be easily assessed. Over the recent years, the amount of material for such molecular property determinations has become increasingly smaller,

so that the preparation of complex target molecules can be envisioned to be performed using continuous flow methods. These fully automated machines are able to perform multistep syntheses of elaborated drugs including automatic analyses, purification, spectroscopic characterization as well as optimizations. Combined with retrosynthetic analysis programs, the overnight synthesis of complex natural products or potential drug candidates may become reality and routine. Based on the pioneering works of S. V. Ley,¹ Y. I. Yoshida,² T. Jamison,³ M. Organ⁴ and others,⁵ an important research field in organic synthesis will be the performance of multi-step sequences in continuous flow. The performance of organic reactions under these conditions is also a real advantage for generating unstable or dangerous intermediates under reproducible safe conditions, making such reaction intermediates – which were avoided in the past – into acceptable reaction partners for the design of organic target molecules. Although the way towards fully automated organic reactions is still long, feasible and reliable pathways toward such a goal are becoming apparent. The future availability of such automated total synthesis mechanisms would considerably facilitate the life of organic chemists, who would then be able to concentrate more on the design of new organic molecules with ambitious physical, chemical or biological properties. Much work and brilliant perspectives exist for the future generations of organic chemists!

Laurence Harwood



This is in haste but one area where I could see chemistry and biology combining is in a halfway house between whole cell culture and using enzymes. What I am thinking of is using combinations of organelles in a single culture to carry out multiple step conversions, e.g. Golgi bodies + mitochondria in the same medium, each carrying out its transformations as a mini synthesis factory, one organelle producing substrate(s) for the other. This would be more for industrial production than as a laboratory tool but it would need laboratory scale studies to develop and separate the specific organelles and to design the synthetic medium.

Matteo Zanda



As the Editor of *Synform*, I have to admit that I had an advantage over my fellow Editors, because I could read their contributions before writing these few lines. And I can't help but confess that – like Tom Rovis – I am a bit sceptical as I don't think anyone can really gaze into a crystal ball and come up with reliable predictions on what's the next big thing in any area of research,

including organic chemistry of course. It is not like predicting who is going to win the next World Cup, as we all have our biases here and we all probably tend to over-emphasise the field of research we are working in. Nevertheless, I'd still like to predict something, or – better – make an observation: the influence of Artificial Intelligence (AI) on chemistry will become massive. I don't think we'll get to a Terminator-like scenario any time soon – at least I hope not – but AI is already assuming a key role in a number of aspects of modern life, including research, and although the human factor is still vitally important, I suspect that the role of computers, algorithms and AI will continue to become increasingly important, which is pretty much in line with Paul Knochel's observations above on automated synthesis. It's already happening, that's why I don't think this is a prediction. AI will save a lot of our time and help us deal with a number of practical problems in chemical research, for example synthesis planning and execution, structure elucidation and experiment design. We just have to make sure that we use AI in the right way, as we don't want to end up like Sarah Connor and her son, do we ...

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Matteo Zanda