

HOW AN ANGLO-AMERICAN METHODOLOGY TOOK ROOT IN FRANCE

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Abstract

French organic chemistry had a strong nationalistic bent in the immediate aftermath to World War II. It continued to bask in the glow of the pre-World War I Nobel prize awarded jointly in 1912 to Victor Grignard and Paul Sabatier. In addition, the influence of the two mandarins then in power, Charles Prévost at the Sorbonne and Albert Kirmann, a Dean in Strasbourg who would be called upon as vice-director at the École normale supérieure in Paris, saw to it that the only theory of organic reactions, admissible in the classroom and in the laboratory, was Prévost's. As Mary Jo Nye has shown, a wall was erected against penetration of the ideas of the British school of Ingold and Hughes. Mechanistic chemistry, as was being vigorously studied by the contemporary Anglo-American physical organic chemists, was *persona non grata* in France. Publication by Bianca Tchoubar, in 1960, of *Les mécanismes réactionnels en chimie organique* opened a breach. The irony was for Dr. Tchoubar, a militant member of the Communist Party and a lady of fierce opinions, to have become a propagandist for the Anglo-American school of mechanistic studies. Truth for her overruled political propaganda. Her little book was revolutionary in the French context of the times. Together with the GECCO (*Groupe d'étude de chimie organique*) summer conferences pioneered by Guy Ourisson after his return from Harvard, it ushered in the new ideas.

This historical essay, based on an in-depth study of Tchoubar's book, will include a portrait of this remark-

able woman scientist. It will delve at some length into the renewal of French science initiated by De Gaulle's government after his return to power in 1958. The tension in the French scientific establishment of the sixties reflected two opposed versions of nationalism, the one conservative, Malthusian, inner-directed, the other forward-looking, eager for the recovery of national status, seeing a strong French science as a means for asserting national identity and independence from the two world power blocs.

Introduction

As I started my scientific career as an organic chemist in 1961, I learned by word of mouth that I urgently needed to get myself a copy of a little book. Why was that book thus advertised in somewhat hushed and conspiratorial tones? What was it about? Who wrote it? What purpose did it fulfill? My historical study aims at answering these questions.

French Science and its Insularity

My story is framed within French academic science at the beginning of the 1960s. To some extent the student revolt in 1968 aimed at casting off the straightjacket that French universities wore against change, and that students were determined to destroy. After World War II and for the next two decades, university professors had attempted to maintain their hegemony over French science. It remained insular to the extreme.

André Weil, a leading mathematician in the twentieth century who spent most of his career at the Institute for Advanced Study in Princeton, in 1955 published a little pamphlet, entitled "Science française?" denouncing the isolation and bad habits of French science (1). Each scientific discipline was ruled by a few professors in Paris. These mandarins enjoyed baronial privileges. They saw to it that their former graduate students were appointed to professorships in the provinces. They were intent, not at all in being part of the international community of scholars, but in maintaining what they felt to be essential Frenchness in the universities. Their teaching was extremely conservative. Not only were English-language textbooks totally ruled out, textbooks were not the norm. Their cost was an excuse. Likewise, most libraries lacked the funding to subscribe to foreign periodicals and purchase scholarly books. To some extent, the insularity was enforced by poverty. Professors supplied mimeographed lecture notes for rote learning by the students. The mimeographed words derived in turn from a single sacred text, Grignard's *Traité de chimie organique*, which dated back to 1935 (2). Grignard, a Nobel Prizewinner, had saintly status.

French Opposition to the Anglo-Saxon World

Before I turn to the topic of the little book which proved to be highly influential, let me briefly describe the political context. It can be given the general label of hostility to Anglo-Saxon dominance (3). Such negative feelings had been stoked during World War II, as well as the years of collaboration of the Pétain-led French State with Nazi Germany, by anti-English and anti-American propaganda within France (4). With the return of De Gaulle to power in 1958, his push for French independence from the Cold War American foreign policy (5) to some extent refreshed that public mood (6).

In between, after the Liberation of France predominantly by Anglo-American forces, there were the years of the Marshall Plan and of accruing benefits to French science, such as Fulbright Fellowships which began in 1948. There is quite a bit of truth in the saying that no good deed goes unpunished!

Hostility by the French toward the Anglo-Saxon world (7) was neither universal nor uniform. For instance, the monthly magazine edited by Jean-Paul Sartre, *Les Temps Modernes*, showed a fascination for American cultural life, for jazz as an art form and for writers such as John Dos Passos (8). However, it also embraced wholeheartedly the concept of *négritude*, as proposed

by the two great Black poets of the French language, Aimé Césaire and Léopold Sedar Senghor: segregation was the unforgivable sin in which the United States was mired (9).

Even though jazz, movies and popular music created considerable interest in the US, very few French people had traveled there. The two main drawbacks were the cost, since air travel had not yet turned to mass transportation, and language, since only a small percentage of the French were conversant in English. However, there was intense curiosity about the US, as shown, among other cultural artifacts, by the successes of a movie such as François Reichenbach's *L'Amérique insolite* (1960) and of books such as Claude Julien's *Le Nouveau Nouveau Monde* (1960) (10).

Last but not least, French chauvinism was an element in the tale I am recounting, that of a sudden breakthrough when the dam gates burst and French organic chemistry received an infusion of new ideas from the Anglo-Saxon world.

Professors Prévost and Kirmann

Back to organic chemistry as it was being taught in French universities and pursued in their poorly equipped laboratories. In 1960, within the French university system, highly hierarchical, just like the country itself, a good approximation to absolute power was wielded by two men who, in addition, were close personal friends, Charles Prévost (1899-1983) (11) and Albert Kirmann (1900-1974). They had been classmates at the *École normale supérieure* (12).

Prévost had held a professorship at the Sorbonne since 1937. During the 1930s, he and Kirmann had both recognized the importance of reaction mechanisms and of physical methods for the advancement of organic chemistry. Prévost, influenced by tautomerism and allylic rearrangements, focused on the intervention of ionic species in organic reactions. He came up with a theory of mechanisms in organic chemistry, and he coined terms such as *synionie* and *métaionie* for some of the relevant phenomena (13). Kirmann had pioneered use of Raman spectra for the characterization of organic molecules.

During World War II, Kirmann was deported and spent three years in a concentration camp. In terms of his scientific drive, he came back a broken man. At the beginning of the war, he was a professor on the faculty at the University of Strasbourg. After the Liberation, Kirmann resumed his position in Strasbourg, where shortly

afterwards he was elected Dean of the Faculty of Sciences. In 1955, Professor Kirmann received a call from his *alma mater*, the *École normale supérieure*, as head of the chemistry laboratories and as the assistant director of the whole institution, both administrative posts. During his tenure (1955-1970), Kirmann encouraged research on Grignard reagents. Such work was outside of the mainstream of international organic chemistry at that time, but Kirmann saw it as a patriotic duty to continue mining the vein which Grignard had discovered at the beginning of the century.

With respect to reaction mechanisms, Prévost and Kirmann were disappointed by the total lack of impact of Prévost's theoretical ideas in the international literature. Accordingly, they saw to it that the whole corpus of mechanistic work initiated by Ingold and Hughes in the UK during the 1930s was totally absent from the French curriculum in organic chemistry. Since both these professors held sway over appointments of organic chemists in French universities, their embargo on the "new" Anglo-Saxon theories of organic chemistry was nearly total. When Micheline Charpentier-Morize referred to the possible existence of a pi-complex to explain reactivity, during her doctoral examination, Prévost had this comment: "Madame, if I have one reproach for you, it is that you know the modern theories too well." (14)

French Backwaters

What I have just described for organic chemistry can be generalized in other sub-disciplines within chemistry. Quantum chemistry was practiced by a small team around Raymond Daudel. The emphasis was in celebrating the cult of Louis de Broglie and his *mécanique ondulatoire*. Until the early sixties, there was little penetration in France of either Pauling's valence bond theory or Mulliken's molecular orbital theory.

Polymer chemistry was likewise stifled. It was ruled by Georges Champetier, a professor at the Sorbonne. Charles Sadron, a polymer chemist from the University of Strasbourg, was intent upon building a research institute on polymers, in the American manner, and thus sought an appointment in Paris, either at the Sorbonne or at the Collège de France. Champetier repeatedly blocked those attempts. He did not want to accept competition and wanted to continue to hold French polymer chemistry hostage.

To judge by chemistry, French science at mid-twentieth century was hobbled by its insularity, by some igno-

rance of not-so-recent developments in the Anglo-Saxon world, and also by the positivistic reliance on facts alone and the steadfast refusal to indulge in interpretations relying upon electronic and quantum-mechanical theories.

Forces for Change

How did the badly-needed renewal come about? From the fringes and the periphery. From the provinces. From abroad. From both the written and the spoken word.

In 1950, Max Mousseron, a professor in Montpellier, organized an international colloquium on molecular rearrangements and the so-called Walden inversion, and it had some impact on the French participants. The Parisian professors though, frowned upon it because the initiative had not come from them. It remained more or less still-born, in spite of publication of the various contributions in the *Bulletin de la Société Chimique de France* (15).

In 1946, Marc Julia, the scion of a prestigious scientific family, after graduating from *École normale supérieure*, departed for London and the Imperial College of Science and Technology. He worked there in the laboratory of Sir Ian Heilbron and in 1948 obtained a Ph.D. in physics. After his return to France and a doctorate in chemistry, he obtained academic appointments in Paris. In 1959, he published a small book, in French, *Mécanismes électroniques en chimie organique* (16).

Another alumnus from *École normale supérieure* who also went abroad for graduate study was considerably more influential in launching a Renaissance in French organic chemistry. In 1950, Guy Ourisson went to Harvard University and worked in the laboratory of Louis Fieser. He obtained his Ph.D. in 1952, in only two years. In 1959, the year of the publication by Marc Julia of his little book, Ourisson set about to establish yearly meetings in France on the model of the Gordon Research Conferences which he had attended in the US. The first such meeting, known as GECCO, short for *Groupe d'étude de chimie organique*, was held in the summer of 1960. These yearly meetings, which served the purpose of a summer school, were an extremely efficient means for disseminating the "new" ideas on reaction mechanisms and their importance, within the French organic chemical community (17).

Bianka Tchoubar (1910-1990)

But the main actor of the renewal may well have been Mademoiselle Bianka Tchoubar (18). Of Russian Jew-

ish origin, from a small sect persecuted by fellow Jews as well (the Karaites who had originated in Babylon), she had emigrated to Paris, where she spent the rest of her life. She never married. She started her scientific career in Marc Tiffeneau's laboratory at the School of Medicine in Paris, under the supervision of Jeanne Lévy after Tiffeneau died in 1945. After her *Diplôme d'études supérieures* (1932), she had obtained her doctorate (1937) and immediately started running her own research group. During World War II, she was a fearless Resistant. She found a laboratory to host her continued career in chemistry at the Institut de biologie physico-chimique, where Edgar Lederer invited her after she gave a series of seminars in 1957-58 about the electronic theories of organic chemistry. She then followed him when he was appointed director of the newly built Institut de chimie des substances naturelles, in Gif-sur-Yvette, in 1961.

Bianka Tchoubar was memorable, a character almost out of a cartoon. Not only did she look indomitable, she gave an impression of being belligerent towards any and all. She was unkempt, obviously not giving a damn about her physical appearance. A chain smoker, she went everywhere with a cigarette held between her nicotine-stained fingers and was thus an accident waiting to happen with her habit of walking with a lit cigarette into a laboratory with its highly flammable solvents.

She was likewise totally innocent of risk when driving a car, a small Citroën *Deux-Chevaux*. There are numerous stories. One of them was witnessed by Michel Vilkas, another French organic chemist. He was once summoned to court for causing an accident. He arrived a few minutes early and heard the judge say to the person in front of him, "You, once again, Mademoiselle Tchoubar! But you are a public danger!"

For lunch, she would eat a sandwich at her desk, and wash it down with glass after glass from a nearby, highly visible bottle of red wine. There would also be on her desk a copy of the issue for that day of *L'Humanité*, the newspaper of the French Communist Party, of which she was a devout militant.

More likely than not, whenever you wanted to put a question to Tchoubar, as she was universally known, you would find her engaged in a scientific argument with one of her coworkers. It took the form of a shouting match, in which scholarly references were hurled as if they were insults. I have to engage in some subtlety here: Tchoubar constantly demonstrated in action that science thrives on discussion. She would never attempt to win an argument by asserting her authority by being a group

leader, or even from scientific experience. Yet, she hated losing *any* argument and she relished them. She was a formidable woman of science.

The audience for Tchoubar's little book

What about the group of people who, within France, were likely to be attracted to a chemistry renewed by mechanistic ideas of Anglo-Saxon provenance? They were predominantly from outside the university system dominated by Professors Prévost and Kirrmann or Champetier. They often belonged to Centre national de la recherche scientifique (CNRS).

CNRS was founded in the late 1930s. After the war years, it started to grow, both with the building of various Institutes and with the hiring of research personnel. The administration of CNRS was considerably more flexible than that of French universities. There was much less of an insistence that a person joining the ranks should show French degrees for both secondary and higher education.

Accordingly, during the aftermath of World War II, CNRS laboratories became a haven for refugees, typically well-educated Jews having survived the Holocaust and anti-Semitism in Eastern Europe. Bianka Tchoubar was from an earlier generation that had survived the Communist revolution in Russia and the subsequent civil war.

In addition to CNRS, there were other centers of active scientific research outside the university system. The Pasteur Institute in Paris was one, as well as the nuclear energy research centers, within the Commissariat à l'énergie atomique (CEA). CEA had two major research facilities, a central one in Saclay, south of Paris, and another in the provinces, in Grenoble, the Centre d'études nucléaires de Grenoble (CENG). André Rassat, a former co-worker of Guy Ourisson, and Didier Gagnaire, also an alumnus of *École normale supérieure*, started a joint laboratory at CENG in 1961, in the field of mechanistic organic chemistry (19).

Was there consciousness within these various subgroups of sharing a distaste for academic chemistry, as it was being taught and pursued in the universities? Was there consciousness of a need for reform and revitalization? You bet.

The GECO summer school was one of the providers of such hope and of some education in the new mechanistic ideas. Another was provided by attendance of Alain Horeau's lectures at the Collège de France in Paris. Alain Horeau, a pharmacist by training, was appointed in 1956

to a chair in organic chemistry at the Collège de France. He scheduled his lectures on Saturday mornings, which made attendance easier for all those of us who had regular jobs on weekdays.

A small lecture hall, holding about 60 people, was jammed—I am tempted to say with “groupies”—every Saturday morning. What was the attraction? Professor Horeau spent considerable time preparing his lectures and they were meticulous. Whereas the rule for a professor at Collège de France is to present his own research, Alain Horeau gave it a flexible interpretation. Each lecture was devoted to a separate chapter on organic stereochemistry. Horeau saw to it that it was totally up-to-date, with respect to international research progress; and that it was nourished with a comprehensive bibliography on the entire topic. The handouts summarized the various parts in each lecture and also provided an extremely useful bibliography.

Such informal gatherings of avid minds as I have described, with both GECO and the attendees of Horeau's lecture, were the fertile ground in which to sow the seeds of change. I will turn now to Tchoubar's little book and to its reception.

Claim

Bianka Tchoubar's little book (20) brought reaction mechanisms in organic chemistry to the fore. Henceforth, organic chemistry in France became up to date in its concerns and methodology. Establishing a reaction mechanism became the new paradigm, overturning the former paradigm of only adding to the catalog of existing compounds using standard reaction pathways from the books (21).

Her book was near-ideal for this purpose. It was very clearly written and it was short. This format made it possible to insert the book in the pocket of a laboratory coat—as everyone was wearing at the time. Thus, a worker at the bench, watching a transformation and waiting for it to be completed, could read or read again some paragraphs and thus become gradually initiated into the new language, with its curved arrows signifying motion of chemical bonds between atoms, as electronic pairs.

An essential feature of this guide was its brevity. It is just a little over 200 pages but, as mentioned already, in a small format, $4\frac{1}{4} \times 6\frac{1}{2}$ in (10.8×16.2 cm).

The short bibliography at the end enabled readers to complement it with other readings, some of which were translations into French of key textbooks.

Counterclaim

Tchoubar's little book was only a minor factor in the changes that finally overtook French science, French chemistry in particular, at the beginning of the 1960s (22). It was part and parcel of a much more general trend. Orthodoxies were being questioned the world over. Pope John XXIII (Angelo Roncalli) started the *aggiornamento* of the Catholic Church with the Vatican II Council in 1962. Even Communist China went through an upheaval during those years with the Cultural Revolution that Mao began in 1964.

To return to France, modernization began in every sector. Politically, the short-lived government by Pierre Mendès-France in 1954 put an end to the colonial war in Indo-China and was the portent for retreat by France from its colonial empire overseas (23). Culturally, French life underwent seismic changes. In music, Pierre Boulez, in the same year 1954, launched the *Domaine Musical* concerts which initiated French ears to contemporary music of various kinds, from the Dodecaphonic to concrete and electronic compositions. In the movies, the New Wave of directors such as François Truffaut, Jean-Luc Godard, Eric Rohmer, Agnès Varda, Jean Eustache, Jacques Rivette, Claude Chabrol, totally changed the style. All these changes began at the turn of the sixties. In the humanities, the teaching of literature was also upended, the new criticism launched with the publication of the essay by Roland Barthes, *Sur Racine*, in 1963. As an alternative to Marxist and Freudian interpretations of cultural phenomena in general, structuralist theory became the new orthodoxy, in the same period from the late 1950s into the early 1980s. Launched by the anthropologist Claude Lévy-Strauss as a rediscovery of the contribution of linguists from the Prague Circle such as Roman Jakobson, it engulfed other influential Parisian intellectuals such as the political thinker Louis Althusser, the psychoanalyst Jacques Lacan and philosophers such as Jacques Derrida and Jean Piaget, for example.

To focus once again on French science and its former isolation from the Anglo-Saxon world, it also underwent seismic changes during the early sixties. Young French scientists went abroad, to the United States in particular, for postdoctoral stays where they were initiated into the new, post-World War II science: solid-state physics, nuclear magnetic resonance, mass spectrometry, and, within chemistry, topics such as conformational analysis and modern stereochemistry, bio-organic chemistry, organometallic chemistry, quantum chemistry, etc. Conversely, lectures by British and American chemists became very

frequent in locations such as Lederer's Natural Products Institute in Gif-sur-Yvette, or the Institut de chimie in Strasbourg. Later on, during the 1970s, there were even, as a rather earthshaking development, appointments of foreign, English-speaking scientists within the French system. After some stillborn attempts to bring such scientists to France—Bernard Belleau or Martin Karplus (1972 and 1974), in the Paris area—later decades saw for example Enrico Clementi in 1991 and Martin Karplus moving to the University of Strasbourg in 1996, and, even more significantly, the British Nobel Prize winner Derek Barton taking over in 1978 from Edgar Lederer the directorship of the Institute in Gif-sur-Yvette.

A process of acculturation

Is it legitimate to frame this episode into, more generally, a history of acculturation? Indeed, it shares defining features with other kinds of acculturation, political or religious.

Perception of conflicting goals is one feature. We realized, in the early sixties, we had a choice between conformity if enrolled among graduate students of Professors Prévost, Kirmann, or another of their ilk, with the promise of a university position later on; or performing original research outside the orthodoxy without any hope of such a job afterwards (a jaundiced view which for many of us turned out to be unduly pessimistic).

Another perception goes with the onset of acculturation, that of a feeling of inferiority and outdatedness. Among French organic chemists in the early sixties, we knew that we lacked both knowledge and competence regarding the mechanisms of chemical reactions. We also knew where to look for what we needed—in the published work of British and American colleagues.

An essential feature of acculturation, whatever its kind, is a place of worship, so to speak. Those locales were provided to us by attendance of a GECO meeting in the summer and by Professor Horeau's lecture hall in the winter. In other words, the new religion was imparted to those who were already converts and only to those.

Acculturation means in addition assimilating a new knowledge. It consisted of, as already mentioned, the whole body of mechanistic results which British and American chemists had amassed. Bianka Tchoubar's little book served as a fine introduction to this new knowledge.

Beyond that, we were encouraged into acquiring a competence, that of digging out such mechanistic information ourselves: it entailed careful study of the accurate kinetics of a chemical transformation, exacting if rather

tedious experimental work which we had to learn how to carry out. This is also part and parcel of any acculturation.

Acculturation needs mediators, special people trading in the imparting of the new knowledge and competence; people whom one may wish to call "brokers" in that they do not own their stock in trade, merely distribute it. That was, typically, Bianka Tchoubar's function.

The last feature of acculturation I wish to mention is best conveyed by quoting I. Prothero's book *Artisans and Politics in Early Nineteenth-Century London*, "... what historians mean when they speak of 'the rise of the working class' is artisans becoming politically active." (24) In our case, such a division into social groups applied to *group leaders* as distinguished from the *rank-and-file*. The former, not the latter, were the subjects of the acculturation I have described.

Is this the end of the story, a stereotypical happy ending? Anglo-Saxon ideas henceforth permeated French chemistry which became up to date and regained its footing within worldwide science. I cannot deny the existence of such conventional wisdom. I also believe it to be unduly optimistic and largely mistaken.

In truth, the acculturation I have dealt with unfortunately did not include mentalities and institutional aspects. Over the years, CNRS assumed most of the unfortunate characteristics of French universities: patronage, a view of knowledge as compartmentalized in like manner to plots of lands owned by individuals, avoidance of competition, insufficient funding, lifelong appointments in fact if not in principle. But that is another story: one should never underestimate the ability of any conservative social system for self-preservation.

Conclusion

I have set down this account more as personal memoir than as history. A take-home lesson is the very unpredictability of this story, the irony, the necessity perhaps also, of a bigger-than-life immigrant from Russia bringing American and British ideas to the French.

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