From studies to research with François (Englert) and Robert (Brout).

Jean-Marie Frère,
Head , « Service de Physique Théorique », ULB

Memories which don't only relate to the past : within the group founded and inspired by Robert Brout and François Englert, the quest goes on... Discussions with François are a stimulating intellectual challenge ; you will always find him available to discuss physics (forget administrative matters!), and he will impose his own way to go right into the depth of things. Not that Robert Brout (who died 2 years ago) could be replaced, but his influence, his way to understand a problem through a mix of approaches are very present amongst us.

Daring courses ... on Saturday mornings.

I met François for the first time in 1970, when he taught us Quantum Mechanics, in the 2nd year of the physics curriculum, and Robert 1 year later during some personal work where they both guided me through the basics of Quantum field theory.

These were enthusiastic and daring times, universities were in quick expansion...just before the first « petrol crisis » struck. Those young professors dared to innovate. To introduce quantum mechanics in the 2nd year was a kind of revolution, certainly in a French-inspired curriculum. Not only was it new, but they taught it in style. As ever, François does not hesitate to use the proper tools, but shuns unnecessary technicalities. He uses Dirac's formulation (and his book), provides from he onset a deep conceptual vision. Elsewhere, he will use Feynman's pedagogical approach...

Three hours of brilliant teaching in a row, (François is a very convincing speaker!) on Saturday mornings,...this left the rest of the weekend to review notes, and prepare an exciting session of questions and answers for the next course.

I think that it is essential to introduce fundamental concepts very early, and from a pedagogical perspective, this certainly strongly motivates the students (too many curricula forget that both relativity and quantum mechanics date back more than a century). To use the real tools, to learn when and how to use them are a much stronger motivation than reassuring but sterile cramming, resting more on the application of recipes than on an intellectual challenge.

I was thus not surprised to find the same innovative attitude when I helped them teach first year students, (with equal success for physics and biology students!). This innovation spirit is to be put in parallel to the steps taken around the same time by leading US universities, where top-notch physicists took charge of introductory courses (like Feynman in CalTech, or the Berkeley physics course). These were also sources of inspiration for François and Robert.

Seen as revolutionary in the 70's, Robert and François 's teaching could by a curious twist appear even more so today. Too often, the reform of European teaching (under the so-called "Bologna Reform") is used as a pretext to return to a less audacious,more shabby first cycle program "to avoid problems for prospective Master students coming from other universities". This is a vain hope: students will on the contrary only transfer from other universities if there is a real reason to do so, and other means to ensure a transition are not lacking.

How can you choose to do your Master's degree (and later PhD) with …?

The year is 1972, François is barely reaching 40, and 8 years have passed since their (now) famous paper, using "spontaneous symmetry breaking" to provide mass for intermediary bosons, and open the way for Weinberg to the "Standard Model of electroweak interactions" (1967). Yet, François and Robert are seen as "outsiders" in the department. Their approach is met with defiance by established local theorists, and not really considered by the experimentalists. In fact, they belong to the "Physics Pool", a group of young "general physics" teachers assembled by Paul Glansdorf.

When I start a Master's degree (and later a PhD thesis) with François (which in practice, will mean with François and Robert), I receive concerned warnings: "Why would a good student choose to work with…?"

Not that I regretted the choice!

One year later, the first experimental verifications (1973) of the Standard model start to establish Quantum Field theory and Gauge theories as the new consensus, allowing it to spread from an intially very restricted group of physicists.

But...returning to the studies...Completing a Master's degree with François is not a restful experience, he is not the one to ask for dotting i's and crossing t's on a well-scouted question, or to perform one more calculation in an established theory. On the contrary, it means being confronted directly, on a daily basis with the forefront of research, with its joys, its doubts, its anguish.

In practice, it means long afternoon brainstormings, almost daily, with Robert, Pierre Nicoletopoulos, and François, all four taking turns in curious game of musical chairs between the blackboard (yes, we still use chalk today!) and a 3-seater sofa facing it.

What excitement, what hopes sometimes quickly dashed, what disappointment at the moment of going home with the impression of an impasse, how many new paths after "sleeping on it".

The easiest for a young student is probably not to call François, Robert and Pierre by their first name, (totally unusual in a French-speaking university, where the polite "vous" was more in order), but then, the discussions were mostly in English.

2cv car and Inter-university courses

The modern approach to Fundamental Interactions (largely made possible by the 1964 papers) was not much taught in Belgian universities in the early 70's. François and Robert embarked on a series of inter-university courses, with the UCL and KUL groups. At the PhD and Postdoc levels, this initiative built the basis of a collaboration which led (30 years later!) to the Inter-University Attraction Pole "Fundamental Interactions", coordinated by our group.

But this did not go without some scary moments. Imagine the ever-distracted Robert taking us to Leuven in his 2cv car, the car dangerously leaning in the sharp curve to exit the highway, while he draws Feynman graphs on the foggy windscreen …

How (not to) read a preprint

Particle physics developed very early an open preprint exchange system. While it may seem strange for scientists from other fields, scientific research is distributed world-wide, even before submission to a journal. Scientific priority is thus easily established, and goes ahnd in hand with fast distribution. Nowadays, it suffices to send the paper to "archiv.org", and it is made available world-wide the next day. In the 70's the procedure was a bit more tedious: send copies to CERN, SLAC and a few other institutions, and they will include them in their weekly preprint lists. It was also

customary to mail copies to a few dozen leading institutes. In turn, we would receive each week dozens of preprints to leaf through. Watching François and Robert tackle a pile was an interesting experience. Three categories quickly emerged: the obvious, the uninteresting, and the surprising ones. No need to bother with the first two sets, but for the few "challenging" papers, the discussion quickly starts between François and Robert, arguments fly, without reading further than the abstract...After the dust from the blackboard has settled, the result becomes "obvious" and thus does not require further reading.

If the above description may seem a bit caricatural, the lesson learnt is important: before starting to read along the author's line, stop a while to consider the question, to wonder where is the crucial point, and (if needed) start the reading in a critical way.

We don't receive "hard-copy" preprints any more, but the latest preprints are discussed by students and staff in weekly "journal clubs" .

Towards the Theoretical Physics group

Robert Brout was professor at Cornell when François when there as a post-doc, before both settled in Brussels. International exchanges, special care to avoid in-breeding, have prevailed on the building the group. This precluded any recruitment without an international career (typically at least 2 years supported by a foreign institution), and an open international recruitment. This was not easy, since by that time, the first blows to the economy had landed, university growth had disappeared,...and the practice then was often to promote locally, which jammed recruitment.

Fortunately the group has progressively developed, and what was the exception then is now seen as simply good practice.

It is no accident if the group is simply named "Theoretical Physics" (without further qualification), since François and Robert have always seen physics as "one", helping themselves to analogies from various domains (their condensed matter experience was central to writing the 1964 discovery).

We have kept a wide open view on answering the questions put forward to us by nature (rather than merely by men). Physics beyond the Standard Model, "dark matter", "dark energy", the asymmetry between matter and antimatter or more simply of the particle spectrum are the current challenges. To answer them, we must seek clues not only from accelerator data, but from neutrino experiments or observation and from observational cosmology, where giant detectors, cosmic rays and satellite experiments play a growing role.

By 1973, little contact existed with ULB experimenters, (some of the first neutral-current events, a first indication of the Standard Model where scanned in ULB-VUB labs), and I often had to stretch to establish a link. A common (theory+experiment) course in Standard Model physics was started in 1989 (in collaboration with experimentalists Pierre Vilain and Ghislaine Cooremans, later with Barbara Clerbaux) and was taught in various forms until 2011.

Today, theorists and experimentalists from most Belgian universities collaborate inside the federally funded Inter University Attraction Pole (IAP) "Fundamental Interactions", ..an on-going task!

http://www.ulb.ac.be/sciences/physth/

Italics refer to personal opinions ...