A BELGIAN MATHEMATICIAN : Jacques TITS

Francis BUEKENHOUT

Belgian ? Yes. Until he was forced, somewhat against his will, to take French citizenship in order to qualify for a chair at the famous Collège de France in Paris. Together with other contemporary mathematicians from Belgium, such as Pierre Deligne, Pierre Van Moerbeke and Jean Bourgain, he has achieved international recognition for his outstanding contributions to mathematics. The work of Jacques Tits belongs to the double stream of group theory and geometry. Since the early work of Felix Klein, Henri Poincaré and Elie Cartan, he has emerged as one of the main contributors to the synthesis of these streams. Today, we can speak of a Tits geometry going beyond the old projective geometry. The latter had unified various classical geometries. In Tits' monumental theory of buildings, projective spaces appear instead as the main particular case and as building blocks for more complex geometries which are closely related to the groups of Lie type over $\mathbf{R}$ and $\mathbf{C}$ but also over finite fields, p-adic fields and a few more.

Jacques Tits was born in Uccle (Brussels) on August 12, 1930. His father was a professor of mathematics and his mother gave piano lessons. His brother and sisters were respectively 7, 4 and $1\frac{1}{2}$ years older. His family observed very early that he learnt with exceptional ease. Everything taught to his youngest sister was immediately transferred to him, by osmosis. Thus, he could read and write before he was 5 years old. At the Ecole Decroly, he was allowed to enter directly into the second year. Similarly, when his sister went into the first year of secondary school at the Athénée d'Uccle, in September 1940, Jacques' mother insisted that he prepared the entrance examination there, thus he skipped the sixth year of elementary school to start secondary studies at age 10.

At the family table, his elder brother used to ask their father mathematical questions. Jacques understood parts of the conversation and was able to reconstruct the rest. In this way he mastered quadratic equations at the age of 9. In 1941 his brother went to the Engineering School at the University of Brussels. As a consequence Jacques heard about differential and integral calculus. As usual he wanted to know! His father had the two volumes of the famous treatise by Charles de la Vallée-Poussin but he was worried that his younger son would neglect his other schoolwork and he told Jacques that it was forbidden to look at those books. When his father became ill, Jacques took advantage of the situation to read the two volumes and he soon came to his father, saying proudly "I know".

In April 1943, his father died. Jacques understood the financial pressure his mother and the family had to withstand. Somewhat later he gave lessons to his brother and friends on their second year University calculus course. The University of Brussels had closed its doors in November 1941 during the German occupation of the country and the students met in small groups in order to study further.

In September 1944, Tits started the 5th year of secondary school. His mathematics teacher, Mr. Nootens, advised him to prepare the entrance examination at the Engineering School,

BULLETIN DE LA SOCIETE MATHEMATIQUE DE BELGIQUE,t.XLII,1990

which was to take place in December, a rather unusual moment, due to the end of the German occupation. The young man was thus ready to skip the two final years of his secondary studies. Mr. Nootens realized that Tits did not know a word about spherical trigonometry. He lent him a book of about 60 pages. The next day, Tits gave it back: he had mastered it already. As usual he read the main facts only and was able from that to reconstruct the details in his head. He was ranked first in the examination and so was allowed to enter the section of mathematics at the University of Brussels, at age 14, in January 1945.

After three weeks, a problem session was organized for the geometry course of Paul Libois. There he met Jean-Claude Piret, another student, who soon became his close friend and, later, his brother-in-law. Libois circulated a series of problems written on cards. These were intended to provide work for small groups of students for periods up to two hours. The pack of cards circulated and students chose a problem and worked on it. The pack then circulated around. When it arrived at the team of Tits-Piret, Tits looked at the problems and from time to time said "Yes, of course!". Piret, who was well prepared for his studies, kept protesting. He would have liked more explanation. But Tits persisted. He kept a single problem, which has remained famous amongst Libois' students. Here it is:

"Candles of lengths $\ell_1, \ldots, \ell_n$ and masses $m_1, \ldots, m_n$, erected on a horizontal plane, are burning simultaneously. What is the locus of the barycenter (center of mass) of these candles ?".

During the examination period from May to July, Tits had a lot of leisure: he had been mastering all the material (and more) for a long time. At his examination, Libois asked him to extend the theory of quadrics, explained during the lectures, to the case of cubic surfaces, of which he knew nothing. Libois gave him "20", the highest possible mark, but Tits said to his friends "I failed".

Tits was attracted by the field of Analysis, taught by Théophile Lepage. An important reference was the treatise in 3 volumes by Goursat, which went much further than the material taught in 3 years at the University. Tits mastered the whole treatise before his 16th birthday. He wanted to obtain his degree in 2 years instead of 4, and was quite disappointed to hear from Lepage that it was not possible.

In the second year, Libois lectured about the one-dimensional affine and projective groups. He stated open problems of increasing difficulty. Tits solved them, one after the other. This went on during the third year. For six weeks, Tits was immersed in feverish research and his family feared for his health. Libois discovered that his student was accumulating amazing results. There was a classification of all finite sharply n-transitive groups with $n \geq 2$ and a complete theory valid for infinite groups as well. Moreover, Tits had extended this theory to the affine and projective groups of any finite dimension. This was essentially the material for his "doctorat" (Ph.D.) obtained at age 19, whereas the most brilliant students would normally obtain it at around 27.

Libois realized that Tits had no training at all in writing and exposition. The first memoir had to be rewritten five times before it was accepted by Libois.

Libois took the young Tits to an international congress in Paris. Emil Artin explained to him that the classification of the finite sharply 2-transitive and 3-transitive groups had been published by Zassenhaus in 1935. This was unlucky for Tits. However his theory involved other contributions and he acquired immediate international recognition.

With the recommendation of Artin, he was invited to spend one year at the Institute for Advanced Study in Princeton. Meanwhile, Libois advised him to start studying Lie groups and in order to do so to work under the direction of Heinz Hopf in Zürich. As a continuation of his earlier work, Hopf introduced Tits to the Helmholtz-Lie space problem, which had been intensively investigated from 1868 to 1892, with the purpose of obtaining a common characterization of Euclidean and non-Euclidean geometries in terms of their motion groups. A rather

similar motivation had led Killing to his classification of Lie algebras. In 1930, Kolmogorov had suggested a new approach to the Helmholtz-Lie problem in terms of topological spaces. On the basis of a few axioms, Tits gave a complete classification of these spaces, which in particular he developed towards homogeneous universes of general relativity.

In the classification of simple Lie groups, it was rather obvious from the beginning that the classical groups have a geometric interpretation in terms of projective spaces, symplectic polarities and projective quadrics. The exceptional groups were ... exceptional: they had no geometric interpretation. Tits filled the gap on the basis of a construction using the group and well determined subgroups. These coset geometries, obtained in 1953, were to lead later to buildings.

In 1954, Tits presented a huge "thèse d'agrégation". The thesis was circulated among the jury and was lost for a while. Finally, he got his degree in 1955. He clearly had the ability to have a position as a Professor. He obtained this in Brussels in 1957 but it did not quite fit his exceptional personality. In 1964, he became Professor at the University of Bonn, called by F.Hirzebruch. In 1975, he was elected to the "Chaire de Théorie des Groupes" created for him at the Collège de France. In 1979, he became a member of the Académie des Sciences in Paris.

How about family life ? While studying in Rome in 1955, Tits met a young Belgian historian, Marie-Jeanne Dieuaide, a graduate, as he was, from the University of Brussels. They married in 1956 and since then have formed an inseparable pair, known by mathematicians all over the world.

Tits is a great lecturer, not only because of his deep knowledge and understanding of large parts of mathematics but also because of his ability to explain the most sophisticated ideas to any audience, with a fantastic sense of humor.

The rest of the story is better known and we shall not go into further details. Let us only mention that many mathematicians have been lucky enough to benefit from the ideas and the charming personality of this great man.

Acknowledgment

A slightly different French version of this text has been published in "Math-Jeunes". We are grateful to the editors of that journal for their permission to use a great deal of that paper in this article.

Université Libre de Bruxelles
Département de Mathématique
Campus Plaine C.P.216
B-1050 Bruxelles
BELGIUM