



André Lichnerowicz



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Commemoration – André Lichnerowicz was elected to our Pontifical Academy of Sciences in 1981. He was a very active member and attended nearly all the plenary sessions. He was with us in November 1998, indeed very present, making very fruitful remarks during the discussions on many scientific papers and also during our business session.

He was born on 21 January 1915 in Bourbon l'Archambault, France. His parents were brilliant teachers: he had a literary father who was secretary general of the Alliance Française and a mathematician mother from the Ecole Normale Supérieure of Sèvres. He was a student of the Ecole Normale Supérieure in 1933, doctor in sciences in 1939 with a thesis on general relativity, and Maître de Conférences in mechanics at the Faculté des Sciences of Strasbourg, where he published his first treatise 'Algèbre et Analyse Linéaire' in which he presented theories which were rather poorly taught during that period in France. The book became immediately famous.

In 1949 André Lichnerowicz was appointed to a position in the Sorbonne, at the Faculté des Sciences de Paris, where he established a new diploma on mathematical methods in physics (MMP), and in 1952 he was appointed to a chair in mathematical physics at the Collège de France. He taught there until 1986 and he remained scientifically active until his death on 11 December 1998. His is a wonderful and exceptional curriculum. André Lichnerowicz was an immensely cultured man, interested throughout his life in the most varied problems, whether scientific, philosophical, educational, artistic, social or religious in character. He was a great intellectual, always ready and happy to discuss issues and questions with people. He had a great desire to communicate his ideas. Talking with him was always fruitful. He understood rapidly what you wanted to say and often saw quickly the weakness of your position.

He showed an active interest in the role of sciences, and particularly of mathematics, in the life of the community. He was not only an active participant, but also one of the most important organisers during the fifties of national conferences, which were open to a broad public including people belonging to all political formations and whose object was to emphasise the need for a serious reform of the universities and our research system. (Caen 1956-Amiens 1960). He was one of the twelve scientists who belonged to the first Comité Consultatif de la Recherche Scientifique et Technique created by de Gaulle immediately after becoming President of the country in the late 1950s.

It should also be recorded that from December 1966 to June 1973 he was the president of the famous ministerial commission on the teaching of mathematics, which everybody called the 'Lichnerowicz commission'. The fundamental idea of Lichnerowicz was that to ensure the harmonious development of our society it was necessary to give our people a strong scientific culture and within such culture a prominent place was given to mathematical culture. The project was ambitious. Many Institutes de Recherche sur l'Enseignement Mathématique were created. Many are still in operation. They have done excellent work and it is thanks to them that the mathematical education of young people in France is still quite good. But most of the hopes and expectations of Lichnerowicz have not yet been realised. The commission met formidable obstacles which still remain and which have to be tackled if we want to bring to mathematics teaching the qualities dreamed of by Lichnerowicz. These obstacles were sociological inertia, administrative and corporate rigidity, the narrow-mindedness of many mathematicians, and the mathematical illiteracy of most of the population.

The mathematical production of Lichnerowicz was fantastic. He published more than 350 papers and books and he had a great many students of his own. One should emphasise that he was one of the first professors in France to introduce a closer kind of direction of theses. Instead of expecting to be told "Here is a thesis topic. Come back and see me when you have found a new result", the student knew that he could go to see him very often. Lichnerowicz considered himself responsible for anyone who was or had been his student. That explains why he had so many of them. He provided them with unfailing support, particularly when they had difficulties in their professional or private lives. Lichnerowicz knew how to choose for each one a thesis topic appropriate to that person's tastes and capacities, a topic which would permit him – encouraged and helped as much as necessary – to obtain the sought-for diploma. This remarkable diversity of choices offered by Lichnerowicz to his students came from the variety of his own interests.

It is time now to say a few words about his personal scientific achievements. This is an impossible task. Fortunately, five former students of Lichnerowicz who are all first-class mathematicians, Marcel Berger, Jean-Pierre Bourguignon, Yvonne Choquet-Bruhat, Charles-Michel Marle and André Revuz, have written a joint paper in the 'Gazette des Mathématiciens' (n. 32, 1999, pp. 90-109) which has been published in various forms in the Notices of the AMS (vol. 4, n. 11, pp. 1387-1396). Lichnerowicz was at one and the same time a geometrician and a physicist. He was fascinated by mechanics and more generally by the mathematical representation of the physical universe. Let us note only briefly the most important domains in which Lichnerowicz worked and published.

Lichnerowicz was interested in many facets of differential geometry. The relation between curvature and topology is a very natural topic in Riemannian geometry. Many papers were devoted to what may be called roughly the Bochner heritage, in particular Leplacian calculations. Lichnerowicz demonstrated his ability to make difficult calculations in a very clever way and to find formulae that described deeply fundamental properties. He was also a master of the Kähler domain, motivated in particular by the long-standing question of Elie Cartan. Among the questions in which he obtained important results were those connected with the classification of Riemannian manifolds and the use of their holonomy groups in order to obtain the answer.

Another broad field of research of Lichnerowicz was general relativity. His thesis belonged to this field. In 1939 he provided a global differential geometric point of view of general relativity. Later on, he made explicit in the appropriate general context the necessary and sufficient conditions for a metric to be a global solution of the Einsteinian equations. Lichnerowicz's methodology has been used in the construction of numerous models. He was the first person to obtain a coherent mathematical formulation of the theory of relativity.

In 1970 he gave courses on hydrodynamics and relativistic magnetohydrodynamics including thermodynamics, and obtained in particular beautiful results on shock waves. One must also cite his works on gravitational radiation, spinor fields, and the quantisation of fields on curved space-time.

One should also mention another set of important contributions to symplectic geometry and to the various manifolds which can be useful in providing the basis of convenient formulations of physical situations: Poisson manifolds, Jacobi manifolds and their geometry. A new field of research which he introduced in about 1970 was the theory of the deformation of the algebra of functions on a manifold. With his co-workers, Lichnerowicz showed that the formal deformations of the associate algebra of differential functions of a symplectic – or Poisson – manifold offered a method for the quantisation of classical Hamiltonian systems.

To close this rapid look at the works of Lichnerowicz, I would like to say that all those who attended lectures or courses given by André Lichnerowicz would agree with the opinion of Charles-Michel Marle: 'I admire his exceptional virtuosity in calculation and the perfect arrangement of difficult proofs which he always explains in a complete manner. The most admirable of his mathematical skills is the depth of his vision which permitted him to abstract key concepts of today's and tomorrow's mathematics'. I would like to add a few observations of a more personal character to conclude this commemoration of André Lichnerowicz as a mathematician and his radiance within human culture and the human city. I borrow the first from Jean-Pierre Bourguignon. With his wife, who was born in Peru and taught Spanish in a Paris high school, he formed an extremely interesting blend of different sensitivities. The two of them were sharp, remarkably cultivated, and open to many cultures. Nothing escaped their notice. An after-conference dinner with them (she often accompanied him on his scientific trips) was certainly an enriching experience. The second concerns his faith. He was a believing Catholic. I may mention here two places where he expressed his thoughts. One is a paper in a collective volume entitled 'Le savant et la foi' (edited by Jean Delumeau-Flammarion and published in 1989). Its title is 'Mathématicien et chrétien' (pages 187-204). The other is an interview in a special issue of the magazine 'Sciences et Avenir' entitled 'Dieu et la Science'. As was always the case with Lichnerowicz, his thought was very clearly expressed.

Paul Germain

Summary of scientific research

L'oeuvre d'André Lichnerowicz porte essentiellement sur la géométrie, la physique mathématique et leurs rapports. Ses principaux thèmes concernent la géométrie différentielle, la relativité générale, la théorie quantique des champs sur un espace-temps courbe, celle des déformations des algèbres de Lie de dimension infinie et leurs applications à la mécanique quantique, la cohomologie des algèbres de Lie.