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PROFESSOR AKITSUGU KAWAGUCHI

Talk on occasion of the Anniversary of Akisugu KAWAGUCHI's 100 years birth, who is the Founder of Tensor Society August 5-9, 2002

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We have gathered here to commemorate and celebrate the centenary of the birth of the prominent mathematician Professor Akitsugu Kawaguchi.

He was born on April 8, 1902. He was only four years old when his father suddenly died. Difficult times started for the family. His mother worked hard as a teacher, so the young boy was accustomed at an early age to work without anyone's help and work harder than other boys, but later he received much reward. He was admitted into Tohoku Imperial University, Faculty of Science, Department of Mathematics at Sendai in 1922. In 1925 he obtained the Bachelor degree, was admitted to the postgraduate school of the same University, and at the same time he gained a research fellowship from the Japanese Ministry of Education. In 1930 he was engaged as an arranging officer to establish the foundation of the new Faculty of Science, Hokkaido Imperial University, where he first obtained an associate professorship, and in 1932 he was appointed as a full professor of the Department of Mathematics. He had served this University very well until 1966, when he reached the retirement age of 63. During this period he became an internationally renown mathematician. He played a decisive role also in the development of his Department at Hokkaido University. On his retirement he was granted the title of Professor Emeritus of Hokkaido University. At the same time, at the height of his creative power, he was inaugurated as a distinguished guest professor of Nihon University College of Science and Technology, and in the next year he became simultaneously the Director of Department of Mathematical Engineering in Sagami Institute of Technology.

He was only 26 years old when was appointed a research fellow to Europe and the United States of America for two years. Later this experience was followed by a number of fruitful scientific visits to Germany, France, Poland, USA, Greece, Austria, Romania, Italy, Hungary, etc. He visited almost all countries of Europe, and later India and South Asia. He accepted many invited lectureships and was visiting professor many times at leading universities. At that time abroad he was already one of the most famous Japanese mathematicians.

He worked much and efficiently. He had several brilliant ideas, but some of them are not yet completely developed and exhausted. Among these, the first concerned the projective differential geometry. In this area he wrote about 20 papers between 1927 and

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1931. Also since then this area was developed and investigated by many mathematicians all over the world.

Like Hilbert, he worked on a theme through several years, and then he changed to another one. - After the projective diffierential geometry, from 193I to 1937, he investigated different concepts of parallelisms, displacements and general connections. Among these there are interesting papers on Finsler geometry. We cannot say that Finsler geometry would have been the main field of his most important investigations, however he made essential contributions to this field, and he was the initiator of the investigations in this field in Japan. He can be considered as the founder of the worldwide famous Finsler geometric school with numerous collaborators led later by Professor M. Matsumoto. The flourishing of this school started in the 1970's and lasts even now.

The problem which attracted him for the longest time (mainly from 1937 to 1944, but also after that) is the foundation and developing of the higher order geometry. Spaces dealt with in this geometry are commonly called Kawaguchi spaces. It is well known that the Riemannian arc length of a curve $x(t)$ is given by the integral of the square root of a quadratic form in $\dot{x}$ with coefficients dependent in x. This integrand is of course homogeneous of the first order in $\dot{x}$. If we drop the quadratic property, and retain the homogeneity only, then we obtain Finsler geometry. It is most natural to suppose that the integrand depends not only on x and $\dot{x}$, but also on the higher derivatives $\ddot{x}$, . . . up to the k-th derivative $x^{(k)}$. This is an important, natural, clear and simple idea for the metric in general.

Big ideas usually are simple. The father of the differential geometry of the euclidean space, Gauss, derived the metric tensor g_{ij} of a hypersurface ϕ from the coordinates of ϕ, and he could express every metrical relation on ϕ by this g_{ij}. Riemann's idea was basically that g_{ij} should not be derived from ϕ, but given arbitrarily; and he obtained the Riemann geometry. This was just as important, natural, clear and simple an idea as Kawaguchi's. However, detailed development, acceptance and dissemination of a new idea often need reasonable time, sometimes a long time. Riemann's idea lacked the notion of parallelism and connection. The rapid development of Riemannian geometry started only 40-50 years after Riemann's discovery. Bolyai's and Lobachewski's ideas were accepted also only 50 years after their discovery. A similar case happened with G. Cantor and many others. − The idea of the higher order geometry may be very clear and natural, its development was not yet quite simple. More recently Prof. Miron and his collaborators have made considerable and successful progress to give the higher order geometry a more simple form and attach to it a well treatable apparatus. It is my deep personal conviction that higher order geometry has still a great future before it.

After world war II, he started to develop the geometry of areal spaces. It is well known that in the euclidean geometry from the length (from the distance) one can derive the area of different dimension. It is the same in the Riemannian and also in the Finsler geometry, however in the latter the notion of the area found little application until now. Neverthless one can begin directly with the notion of the area, and try now to build a geometry on it. One can see that the apriori given area is more general than that which can be derived from a V^n or F^n. Development of a geometry built on the notion of the k-dimensional area seems to have the same importance and to be the counterpart of the geometries built on the distance (arc length i.e. 1-dimensional area). But this seems to be a definitely difficult task. We have not yet found the necessary tools, apparatus, perhaps

not even the appropriate notions. I guess it is not only a problem of the differential geometry. It certainly needs also direct geometric, and maybe also other considerations. In this direction still less has been done than in the higher order geometry.

He published nearly one hundred and fifty papers, most of them in leading Japanese journals, such as Tohoku Mathematical Journal, Proceedings of the Imperial Academy of Tokyo, also in Tensor, Old and New Series; and a number of papers in foreign journals, such as Monatshefte für Mathematik und Physik, Transaction of the Amer. Math. Soc., Comptes Rendus Paris, Rendiconti di Palermo, and in many other journals over the world, and in proceedings of conferences in different fields. He published also a number of books (exactly 36) mainly textbooks. From 1930 to 1934, 16 university textbooks appeared by him covering all fields of geometry. His enormous activity is admirable.

We cannot finish the appreciation of his life-work without mentioning Tensor Society and the journal Tensor. In the period between the two wars (1920-1939) considerable development took place in the Japanese mathematics. The number of geometers materially increased and their cooperation needed an organization. This was recognized by Akitsugu Kawaguchi, who at that time was already an established, experienced and energetic, yet relatively young mathematician with international fame. In 1938 at Sapporo he founded the Tensor Society in order to promote research, further development and facilitate cooperation among differential geometers. At that time the Society was a national organization and its journal, the Tensor, published articles in Japanese. After the world war II the Society became international, and the new series of the Tensor published papers in the usual languages of international mathematical journals (now almost always in English). It became a well known international journal of high prestige, with an international Editorial Board. Although Professor Kawaguchi obtained essential aid from his pupils with the editorial work, he invested very much time and energy into the journal which sometimes needed also his private financial support. He also established and maintained Kawaguchi Research Institute in Chigasaki in order to foster research and cooperation with his guests, pupils and students, and to house the editorial office of the Tensor. - The journal and the Society are essential establishments of his life which are successfully continued and sustained now by his sons.

Professor Akitsugu Kawaguchi died in 1984. He was one of the most famous Japanese differential geometers acknowledged all over the world. His achievements often were acknowledged by high state decorations. He had a number of excellent pupils. For this time they became successful mathematicians, and most of them are professors at different universities or colleges. He has 7 children, among them 4 boys. There of them succeeded him in his profession and they are professors of mathematics. The journal Tensor and Tensor Society have survived and flourished. His ideas act even now. He is honored and esteemed in these days in his country and over the world not less than in his life. We received from him a rich scientific heritage. If he looks back upon us and upon this generation he can be satisfied. He did not live in vain. His ideas will live among us still for a long time.

He was born 100 years ago. On this occasion we pay our tribute and bow our head to him. I was fortunate enough to meet him several times. I remember him well on all of these occasions. I would like to pay also may personal tribute to his memory.