OBITUARY

KUNIHIKO KODAIRA

Kunihiko Kodaira, who died on 26 July 1997, was the outstanding Japanese mathematician of the post-war period, his fame established by the award of the Fields Medal at the Amsterdam Congress in 1954.

He was born on 16 March 1915, the son of an agricultural scientist who at one time was Vice Minister of Agriculture in the Japanese Government and had also played an active role in agricultural developments in South America. Kodaira studied at Tokyo University, taking degrees in both mathematics and physics. From 1944 to 1951 he was an associate professor of physics at the University. His PhD thesis was published in the *Annals of Mathematics* [**18**], and it immediately attracted international attention. Essentially this filled a significant lacuna in the basic theorem of W. V. D. Hodge on harmonic integrals. Kodaira had worked on this for many years but, because of the war, his research was carried out in isolation from the international community and did not become known until much later.

Hermann Weyl, who had been a keen supporter of Hodge's work, realised the importance of Kodaira's thesis, and arranged for him to come to the Institute for Advanced Study in Princeton in 1949. This was the start of Kodaira's 18-year residence in the United States, a fruitful period which saw the full blossoming of his research, much of it in collaboration with Donald Spencer. Kodaira spent many years at Princeton, divided between the Institute and the University, but the years 1961–67 were more unsettled, seeing him successively at Harvard, Johns Hopkins and finally Stanford. In 1967 he returned to a professorship at the University of Tokyo, where he remained until the normal retiring age. From 1975 to 1985 he worked at Gakushuin University, where retirement restrictions did not apply.

During his time at Princeton, Kodaira continued his involvement with harmonic forms, particularly in their application to algebraic geometry, the area which had also provided the motivation for Hodge's work. The 1950s saw a great flowering of complex algebraic geometry, in which the new methods of sheaf theory, originating in France in the hands of Leray, Cartan and Serre, provided a whole new machinery with which to tackle global problems. Sheaf theory fitted with Hodge theory, so it was natural that Kodaira should have been well placed to exploit the new developments. This he did, in a rapid succession of papers written in collaboration with Donald Spencer. These papers altered the face of algebraic geometry, and provided the framework in which Hirzebruch and others of the younger generation were able to make spectacular progress. Large numbers of problems left unsolved or incomplete by the Italian geometers of the classical school were now disposed of in convincing fashion. In particular, a full understanding of the arithmetic genus in higher dimensions emerged, and the Hirzebruch–Riemann–Roch theorem was the culmination of a long story (and the beginning of a new one).

In addition to the general theorems, which combined sheaf theory and harmonic forms to provide the new foundations, Kodaira made two specific and notable contributions. First, in collaboration with Spencer, he developed the theory of

Bull. London Math. Soc. 31 (1999) 489–493

deformations of complex structures. This generalised the classical theory of Riemann surfaces in a very satisfactory manner, although the story of higher dimensions is much richer and more complex.

But perhaps his most striking individual achievement was in the general characterisation of projective algebraic varieties in [**38**]. A few years earlier, Hodge had drawn attention to what he modestly called 'Kähler manifolds of restricted type', ones where the periods of the Kähler form are integral. Hodge had shown that these possessed all the important properties of algebraic varieties that could be deduced from the theory of harmonic forms. For a short while, André Weil had appropriately christened these 'Hodge manifolds'. Unfortunately for Hodge, this terminology dropped out of use as soon as Kodaira proved in [**38**] that Hodge manifolds are all projective varieties. This striking theorem of Kodaira generalises the classical results, going back to Riemann and Siegel, characterising complex tori which are algebraic. The proof was typical of Kodaira's work, involving a masterly use of the new analytic methods together with a detailed understanding of the relevant geometry.

In 1955–56, having just completed my PhD, I was a visiting member of the Institute at Princeton, and regularly attended Kodaira's lectures at the University, at which the front rows were filled by the new generation of young geometers: Hirzebruch, Serre, Bott and Singer. The front rows were actually rather crowded, since Kodaira's voice rarely rose above a whisper. Fortunately, he wrote very clearly, very slowly and in very large handwriting, so his lecture notes were impeccable. I remember attending his Fields Medal Lecture at Amsterdam in 1954, where he alternated slowly between the microphone at the dais and the blackboard behind him. Not much information was conveyed by this process, but the audience did not mind, because his manner was an attractive combination of extreme shyness, genuine humility and repressed humour. There was a twinkle in his eye which relieved the embarrassment.

The Kodaira–Spencer collaboration was more than just a working relationship. The two men had very different personalities, which were complementary. Kodaira's shyness and reticence were balanced by Spencer's dynamism. In the world of university politics, Spencer was able to exercise his talents on Kodaira's behalf, providing a protective environment in which Kodaira's mathematical talents could flourish. At home, Kodaira was equally protected by his wife Seiko, the sister of the distinguished mathematician S. Iyanaga, and a much more worldly figure than her husband. She even mowed the grass of their Princeton garden.

After Kodaira's return to Japan, he gave lectures and ran seminars which attracted many able students. Kodaira's influence was so pronounced that one could say that he established a new school of Japanese algebraic geometers. It is noteworthy that the other two Japanese mathematicians to receive Fields Medals (Hironaka and Mori) are also algebraic geometers. In Princeton his one outstanding student was W. L. Baily Jr, who became a close friend and eventually learned Japanese.

Kodaira's contributions were widely recognised. The work for which he received the Fields Medal was reported on, in his inimitable style, by Hermann Weyl, and was published in the Proceedings of the Amsterdam Congress. In his home country, Kodaira received the Japan Academy Prize and the Cultural Medal, the highest level of recognition for cultural achievement. In 1988 he was awarded the Wolf Prize. He was a member of the Japan Academy and a foreign associate of the National Academy of Sciences, and he was elected an Honorary Member of the London Mathematical Society on 15 June 1979. In the last decade of his life he suffered from

ill health, and this prevented him from putting in an appearance at the International Congress in Kyoto in 1990, even though he was chairman of the organising committee.

Everyone who came into contact with Kodaira realised what a unique and charming individual he was: a deep thinker, a hard-working mathematician, but incredibly quiet and bashful. Even in private conversation you had to listen carefully, and occasionally there would be some subtle humour with a flicker of a smile.

I am grateful to Donald Spencer for letting me see in advance the article he wrote on Kodaira for the *Notices of the American Mathematical Society* (Volume 45, Number 3, March 1998).

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https://doi.org/10.1112/S0024609398005153 Published online by Cambridge University Press