

PROFILE OF A MATHEMATICIAN: HENRI POINCARÉ

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Henri Poincaré was born in 1854 in Nancy, France. At school he was one of the top students in every subject, and his mathematics teacher described him as a “monster of mathematics”. In 1873 he went on to the Ecole Polytechnique in Paris. Here his excellent memory and ability to visualise what he heard were very useful, since his eyesight was so poor that he couldn’t read the blackboard in lectures. After graduating, Poincaré worked briefly as a mining engineer. In 1879 he completed his mathematics doctoral work at the University of Paris, and within a few years was appointed to chairs at the University of Paris, the Sorbonne and the Ecole Polytechnique, which he held until his death in 1912.

Poincaré is sometimes described as the last universalist in mathematics, meaning that he made major contributions to many different branches of mathematics. He also worked in the areas of celestial mechanics, the mechanics of fluid flow, special relativity and the philosophy of science.

In his twenties Poincaré developed the concept of automorphic functions (he called them Fuchsian functions after Lazarus Fuchs, but they were later renamed.) An automorphic function f is a function of a complex number z such that

$$f(z) = f\left(\frac{az + b}{cz + d}\right)$$

where a, b, c, d are any real numbers with $ad - bc \neq 0$. Automorphic functions have close links to non-Euclidean geometry, where the parallel postulate does not hold. (The parallel postulate says that if P is a point not on a line l , there is one and only one line

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through P that does not intersect l .) Later in life, Poincaré wrote that the crucial idea for automorphic functions came to him as he was about to get on a bus:

At the moment when I put my foot on the step the idea came to me, without anything in former thoughts seeming to have paved the way for it, that the transformations that I had used to define the Fuchsian functions were identical with those of non-Euclidean geometry.

Poincaré helped found an area of mathematics called algebraic topology, which seeks to classify surfaces in all dimensions using algebraic tools. The “Poincaré conjecture” regarding 3-dimensional surfaces is one of the big unsolved problems of mathematics today.

In Applied Maths Poincaré studied, among other things, optics, electricity, telegraphy and elasticity. In Physics, he was one of the co-discoverers of special relativity, along with Einstein and Lorentz. He also did important work on the three-body problem, which concerns how three bodies move subject only to one another’s gravity.

Poincaré was one of the first scientists to write about science for the general public, explaining recent discoveries and arguing for the importance of science and mathematics. He also wrote about the philosophy of science. In discussing the process of mathematical discovery, he said:

It is by logic we prove, it is by intuition we invent.

He believed that one could choose either Euclidean or non-Euclidean geometry as the geometry of real physical space, and criticised those such as Bertrand Russell who wanted to axiomatise mathematics.

Poincaré’s contributions to so many areas of mathematics and science saw him elected to all five sections of the Académie des Sciences: geometry, mechanics, physics, geography and navigation. He won numerous prizes and honours during his life and was truly one of the mathematical greats.

Further Reading: JJ O’Connor and E F Robertson, “Jules Henri Poincaré”,

<http://www-history.mcs.st-andrews.ac.uk/history/Mathematicians/Poincare.html>.