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Historia Mathematica 32 (2005) 312–357
HISTORIA MATHEMATICA
www.elsevier.com/locate/yhmat

Pure mathematics applied in early twentieth-century America: The case of T.H. Gronwall, consulting mathematician

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Available online 5 August 2004

Abstract

Thomas Hakon Gronwall (1877–1932) was a Swedish-American mathematician with a broad range of interests in mathematical analysis, physics, and engineering. Though he was primarly known for his results in pure mathematics, his career as a "consulting mathematician" in America from 1912 to his death in 1932 provides a backdrop against which one can discuss contemporary issues involved in the increasing application of mathematics to engineering, industrial, and scientific problems. This paper attempts a summary of his major mathematical contributions to industrial, governmental, and academic institutions while relating his often difficult life during these years.

Zusammenfassung

Thomas Hakon Gronwall (1877–1932) war ein schwedisch-amerikanischer Mathematiker mit briet-gefächertem Interesse an Analysis, Physik, und Ingenieur-Wissenschaften. Während er am besten bekannt ist für seine Ergebnisse in der reinen Mathematik, seine Karriere als "beratender Mathematiker" in Amerika von 1912 bis zu seinem Tod in 1932 bietet einen guten Hintergrund für eine Diskussion von Fragen der Angewandten Mathematik seiner Zeit. Diese Arbeit versucht Gronwalls Anteil an Fortschritten in industriellen, akademischen und Regierungs Bereichen zusammenzufassen, und gleichzeitig sein oft schwieriges Leben darzustellen.

MSC: 01A60; 01A70; 00A69

Keywords: History of mathematics; Biography; 20th century; General applied mathematics

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0315-0860/$ – see front matter
doi:10.1016/j.hm.2004.05.002

1. Introduction

On page 21 of the List of Officers and Members [1925–1926], of the American Mathematical Society of October 1926 [List of Officers and Members, 1925–1926, 21] one finds the entry "Gronwall, Dr. T.H. Consulting Mathematician. Care of Chemistry Dept., Columbia Univ., New York, N.Y." Sitting among the nearly 1700 entries for professors and instructors at colleges, universities, and high schools, and for employees of insurance companies, industries, and power companies are these two lines, a gateway to the life and work of an extraordinary mathematical talent which found expression in the years 1912 through 1932 in the United States.

The contributions of Thomas Hakon Gronwall [1877–1932] to pure mathematics are well known among specialists in the many fields in which he worked. He is responsible for the Area Theorem in univalent function theory, a classical upper bound on the growth of the divisor function in number theory, a summability method, several papers on the Gibbs phenomena, and an inequality known as Gronwall's Lemma in differential equations, to cite some of his best-known results. His talent for pure analysis extended over many fields, an achievement that was possible in, though by no means typical of, the era in which he worked.[1]

What is less well known, but of greater interest for the insights it gives into the American mathematical community in the first third of the 20th century, is his work in what might be called either applied or industrial mathematics.

The circumstances of his life gave rise to a nomadic existence in which Gronwall moved from one post to another in America, never staying anywhere for longer than two or three years, except for his final stop at Columbia University, with which he was associated for the last nine years of his life. If his achievements in pure mathematics, exemplified in his nearly 90 publications, are evidence of the relative independence of this work from the American mathematical community, the most illuminating work from the historical point of view is the handful of papers which relate to the stations of his life in his adopted country. These papers reflect the nature of the mathematical community and related institutions during what Parshall and Rowe have termed the third of four distinct periods shaping mathematics in America, the era (1900–1933) "during which the institutions and research traditions largely established in the previous era consolidated and grew" [Parshall and Rowe, 1994, 428]. In following the path of Gronwall's life one encounters such educational institutions as Princeton University, the University of Chicago, and Columbia University, and three of the six "towering figures" of American mathematics sketched by David Zitarelli [Zitarelli, 2001]. One comes across such firms as the Pennsylvania Railroad and U.S. Steel as well as those firms developing science-based research groups such as A.T.&T. and E.I. Du Pont de Nemours, Inc. One sees the members of the mathematical community making practical contributions to ballistics at Aberdeen Proving Grounds, as well as collaborating on pure science research at universities. Associations such as the National Academy of Sciences, the American Mathematical Society, and the Mathematical Association of America play a role in his life. The status of mathematics in such user groups as university engineering faculties, engineers themselves, and the National Bureau of Standards comes into view.

[1] For a summary of his life and work [Hille, 1932] is the most comprehensive treatment to date. Hille met Gronwall in 1921. This document lists Gronwall's published bibliography as well as the dates of his addresses to the American Mathematical Society and gives a detailed analysis of the significance of his pure mathematical work and a short biographical sketch. We will refer to this article as "Hille." Another good summary, in Swedish, is to be found in [Björk, 1946].