Journal of Homotopy and Related Structures, vol. 2(2), 2007, pp.3–5

MAC LANE'S INFLUENCE ON HIS STUDENTS

W. HOWARD

(*communicated by Ronald Brown*)

Abstract

This is a short account of my experiences as a research student of Saunders Mac and is intended to celebrate his work and influence.

In considering how Mac Lane helped his students enter the world of mathematical research, one becomes curious as to how Mac Lane himself made the transition. He gives an account in his autobiograpy ("Saunders Mac Lane: A Mathematical Autobiography"; A. K. Peters, 2005). As an undergraduate at Yale, he was under the impression that mathematics was a completed product; there was nothing new to be done. Then, in a course by Oystein Ore, he was introduced to the work of Emmy Noether, which indicated to him:

"that there were brand new ideas to be found in mathematics. With this indication, my focus shifted from the accumulation of knowledge to the hope of discovering new knowledge"

(autobiography, p. 33). Thus, from Ore, he learned of the possibility of mathematical research. But when he went to Goettingen a couple of years later to write a thesis in mathematical logic, he still did not know how research was normally done. For his thesis he chose a project based on the work of Whitehead and Russell (1910-1913). It appears that his thesis was uninfluenced by contemporary developments in the field. As he indicates in his autobiography, p. 51, he did not realize that, normally, research consists of working on problems considered significant by contemporary workers in the field.

Immediately after getting his Ph.D. at Goettingen (1933), he spent a year as a postdoc at Yale. Since he was supervised by Ore, he was required to concentrate on modern algebra; but this was congenial to him, especially since he had been exposed to the exciting developments at Goettingen. After becoming an assistant professor at Harvard, he branched out into algebraic topology; the crucial event was his meeting Eilenberg in 1941).

He began supervising Ph.D. students at Harvard (1938-1948), then at the University of Chicago (1948 onward). Sometimes the dissertation topic was suggested by Mac Lane, from one of his own fields of expertise. Other times, the student approached him with his own topic, not in any area of Mac Lane's expertise (at least, not in an area of his current interests). He showed an impressive ability to

Received August 18, 2006, revised October 7, 2006; published on December 27, 2007.
2000 Mathematics Subject Classification: 01A70, 01A80.
Key words and phrases: Saunders Mac Lane, thesis supervision, doctoral students, influence, mathematical culture.

adjust the manner of his supervision accordingly. For an account of his supervision of several of his students, see his autobiography, Chapters 11 and 55.

Let me give my own experience of writing a thesis under Mac Lane. In the spring of 1954 I had become interested in mathematical logic but I saw no possibility of finding anyone in the Mathematics Department to direct a thesis in that field. One day, Anil Nerode told me that he had gotten Mac Lane to agree to supervise our dissertations in logic. This came as a great surprise. I knew Mac Lane quite well, and I had the impression that his view of mathematical logic was rather negative. I asked Nerode:

"What gave you the idea of approaching Mac Lane?"

He told me that he had investigated the background of a number of faculty and found that Mac Lane had written his Ph.D. thesis in mathematical logic (under Bernays at Goettingen, 1933).

My interest was in proof theory, a rather specialized area of mathematical logic. Mac Lane knew very little about this topic. That did not faze him; I could teach him. Meeting with him once a week for several weeks, I explained the work of Hilbert and Gentzen, and also why I felt that my results would make a useful contribution to the field. He was overseas for much of the next year. When he returned, I gave him what I regarded as something close to a final draft of my thesis. Then began a big tug-of-war. He insisted on extensive changes: in the first place because my exposition was poor; in the second place because he did not think I had enough results. I agreed with him on the first point but not on the second. During subsequent weeks I submitted several drafts to him, each time returned to me heavily marked up, requiring very extensive changes. He seemed impossible to satisfy. A typical conversation would be:

MAC LANE: "The thesis is not long enough."

BH: "It is the quality of the results that matters. There are enough results here."

MAC LANE: "Your bibliography is not long enough."

BH: "Very little work has been done in this area."

Finally, at wit's end, I got a professional typist to type the thesis up in final form. I went to Mac Lane's office and handed it to him, saying:

"Here is my thesis."

Rather to my surprise he accepted it, asking for only a few token changes.

From page 311 of his autobiography, it appears that he thought I would do all right once I got out into the research community, so he decided to take a chance on me. In subsequent years my research career was reasonably successful, and that made him happy.

The salient characteristic of his supervision of my thesis was: he was willing to accept a topic outside any of his areas of expertise. A second characteristic was: he was a ferocious editor, and he insisted on a clear exposition. A third characteristic was: he pushed me to my limit, always insisting that I could do better.

It would be of interest to know the extent to which his other students experienced something like these characteristics. David Eisenbud mentions the ferocious editor (p. xiv of the autobiography). He also mentions a variant of the first characteristic: Mac Lane was willing to accept a topic far from his current area of interest. But actually, his range of interests was surprisingly broad, in the sense that he had become seriously engaged in a number of areas during the course of his career. For example, although I had gotten to know him quite well in my early days as a student, I had no idea that he had ever been seriously interested in mathematical logic; but the interest was there, on the "back burner", all along. As a second example, I was surprised to learn from his autobiography that he was seriously interested in theoretical mechanics. During his undergraduate years at Yale, a course by E. W. Brown left a strong impression on him. The ultimate result of this is that, at the request of Subramanyan Chandrsekhar, he gave a course in "geometrical mechanics" several times, starting in 1967; see pp. 243-244 of his autobiograpy; it makes fascinating reading.

Besides passing on the culture of mathematical research to his students, Mac Lane had a second, broader influence on many of his students. This might be described as "cultural transmission"; in other words, transmission of the mathematical culture or even a broader culture. Certainly Mac Lane had his areas of expertise, but pursuit of these areas was part of a larger enterprise: pushing back the frontiers of mathematics as a whole. During my student days and later, I was struck by the fact that he was constantly going to seminars and talks; I did not know what to make of this. But from his autobiography it is clear that he simply wanted to know what was going on in as many areas as possible. Also, this was in line with his conception of mathematics as a social activity: mathematics was an activity that one did with other people. His broader concerns included issues about the relation between mathematics and society. On the one hand, mathematics had an intrinsic worth; it was a sort of ultimate good. On the other hand, mathematics played a role in the sciences. He had well thought out views of the purpose of universities. He was much in favor of the liberal education. He greatly admired Robert M. Hutchins (president of the Universtity of Chicago), both for his educational innovations and his concern for academic excellence.

In summary, not only did he share his enthusiasm for research, but also he enlivened various broader issues such as the relation between mathematics and society and the purpose of universities. I suspect that these influences were important to a number of his students. Certainly this was so in my case.

This article may be accessed via WWW at http://jhrs.rmi.acnet.ge

W. Howard
wahow@uic.edu

Department of Mathematics, Statistics, and Computer Science
University of Illinois at Chicago
Chicago, IL 60607
USA