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On Being a Student of Dov Tamari

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Abstract I reminisce about being a student of Dov Tamari at the State University of New York at Buffalo in the late 1960's.

In 1963 I was one of five members of the recently formed Mathematics Department of the New York State University College at Fredonia (now SUNY at Fredonia) and a part-time graduate student working toward a Ph.D. at SUNY at Buffalo, which had just joined the New York State University system. For fall 1964 I had registered for a real variables course to be taught by a newly hired professor by the name of Dov Tamari. Tamari was about a month late arriving for the semester. I had been reading the assigned text, *The Theory of Functions of Real Variables* by L.M. Graves but when Tamari arrived we started with logic and set theory, then into analysis, not following the text at all, much different from what I was used to. As well, often the exercises were open-ended, again a complete change from my background. However, as the semester progressed, I adjusted and very much enjoyed the second semester in which we mainly did bounded variation, continuity, differentiation and Lebesgue-Stieltjes integration from the book, *Real Analysis* by McShane and Botts. In the meanwhile, with Tamari's encouragement, I applied for and received an NSF Fellowship for two years of graduate study at SUNY at Buffalo.

During this first year of full-time graduate study I took the first year graduate courses in algebra, complex analysis and topology. (As an aside, I have always been pleased that we used the English translation of Van der Waerden's two volumes, *Modern Algebra*. Over 50 years later, I still have my notes and examinations from this algebra course.) I thought these three courses would be enough but Tamari, who was now Chairman of the Mathematics Department, strongly advised me to sign up for his seminar as well. This was to be my first introduction to research. Tamari had invited several mathematicians to speak to this seminar and I was exposed to a wide range of topics. This was just part of Tamari's goal of improving the mathematics

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at Buffalo. (Buffalo had just recently joined the New York State system with the mandate of becoming one of the main research institutions in the state.) The task for Tamari was indeed a difficult one with recruitment of a research staff to have top priority. Related to this were the many colloquium lectures during the year, job candidates as well as several established mathematicians. One incident that I recall vividly is seeing Tamari jump up from his front row seat to clean the boards for the distinguished topologist from Poland, Kazimierz Kuratowski. I have no doubts this was done out of respect for Kuratowski.

I don't recall exactly when Tamari became my supervisor and I his student. It may have been during the real variables course. But, as soon as I became a full time student in fall 1964 he advised me on courses to take, always being encouraging and pushing as much breadth as possible. He arranged for me to earn some additional money, first by grading papers for the abstract algebra course he was teaching and then having me teach two weeks in the summer for a person who was late.

For the 1965 summer session, Tamari suggested that I read the recent book *Rings and Homology* by Jans, and as usual sign up for his algebra seminar which, this summer, was based on P.M. Cohn's book *Universal Algebra*. With Tamari's guidance this was one of my most rewarding times. I continue to follow some of these lines today. Somewhere around this time he had me read his first publication "On a certain classification of rings and semigroups" and to report on this in his seminar. Thus he was introducing me to research in mathematics. A slight generalization of this first paper of Tamari appears as a chapter in my dissertation and later served as an undergraduate research project for a Texas A&M student. Having to give a talk on a paper and then having to write an exposition on this report was one of the requirements of Tamari's seminars. Again, as I look back on this, I see how beneficial it was, not only introducing one to research but also mathematical exposition.

Near the end of the 1965 summer session, Tamari asked me to accompany him to the airport to meet a new professor, Yuzo Utumi, a Japanese ring theorist. I was indeed honored to do this since I was already aware of Utumi's work. I mention this just to show how thoughtful Tamari was toward his students. He realized this would be an excellent opportunity for me to meet Utumi. Sadly, Utumi became ill the following year and spent only one year at SUNY at Buffalo.

My thoughts for the fall 1965 were that I would spend all of my time on research for my dissertation. However, as I should have known, Tamari had other ideas. In addition to the necessary research he advised that I sit in on Utumi's algebra course, take the algebraic geometry course being offered by Federico Gaeta, who had just arrived from Brazil, the graduate number theory course offered by Frank Olson, and, of course, the usual Tamari seminar. This illustrates further Tamari's philosophy on breadth in mathematics. I have carried this through with my own graduate students (not always to their liking) and still feel that it is a necessary component of a graduate student's education.

Some time early in the 1965 fall semester I met with Tamari to discuss my research program. We discussed four areas:

1) Ring like domains; generalized rings;
2) Ordered semigroups and rings;

3) Semigroups and rings – extension of classification;
4) Problems of associativity.

At that time he was working on problems of associativity and gave me a preprint of "Sur quelques problèmes d'associativité: une structure de treillis finis induite par une loi demi-associative" which he was writing with Haya Freedman. He wanted to find an axiom system for this type of algebra, which has now become known as a *Tamari lattice*. I read this preprint in detail and thought about it for a time but was unable to come up with anything. It was at this time I discovered the papers by Albrecht Fröhlich on near-rings and the recent near-ring papers of James Beidleman and thus chose the direction of ring like domains and generalized rings.

During this year (1965–66) Tamari was very busy with his position as chairman, as I mentioned above, focusing on building a research department. He was involved in many meetings and was gone on several trips away from Buffalo. It was not easy for me to meet with him, in fact, I often had to make an appointment a week or so in advance, to set up a meeting. By the time of the meeting I had often solved the problem I wished to discuss with him. I found this process somewhat frustrating at the time but over the years I have realized that I really benefited from having to search and think by myself. However, I do not advocate this procedure and I don't think Tamari would in general. It was just the events of the time! Also during the Spring 1966 semester I had to prepare and submit a degree plan. I prepared, what I thought, was a rather good draft and gave it to Tamari. Within a short time it came back to me covered in red ink suggesting several modifications. After getting over the initial shock, I realized that Tamari indeed had several excellent suggestions and I now appreciate his thoroughness, it greatly improved my exposition.

I was to return to my position at Fredonia in the fall of 1966 and while there, complete my research and finish my dissertation. However before that, in the summer session, Tamari continued on my breadth requirement by having me take the logic course offered by John Myhill, and once more the Tamari seminar.

That next year, when I was in the final stage of writing up my dissertation, I would drive the 50 miles to Buffalo and meet with Tamari in the evening at his home. These meetings occurred about every other week and were very cordial and always professional. After an hour or so we would take a break for tea and cookies, served by Mrs. Tamari. I have fond memories of these meetings. As a result of these evening sessions and with Tamari's generous help I was able to submit my dissertation on time and complete all requirements for my Ph.D.

After moving to Texas in 1969 I had very little physical contact with Tamari although we did have intermittent contact through letters. Through various colleagues, in particular, Ken Magill, I was kept informed of Tamari's activities and his many health problems. Also, at various times he would send me a packet of preprints/reprints often accompanied by a very nice letter.

What was it like to be a student of Dov Tamari? There is no doubt the answer to this question has varied over time. I still recall the frustration of being unable to meet with him when needing some (what I thought at that time) immediate advice. I have very fond memories of the pleasant evenings discussing "my" mathematics at his home. As the years passed, I have often wished that we might have had some

conversations about mathematics and mathematicians in general. I would have been interested in his mathematical career, his contact with the Bourbaki group as well as other mathematicians.

I always knew he was there in support of me and my work, helping me with my writing and certainly writing recommendation letters for me. I will be forever grateful for the roads he opened for me and his supervision in starting my research career. I am very pleased that I had the opportunity to study with this well-known mathematician and I am indeed very proud to say that I was a student of Dov Tamari.