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COMMEMORATIVE

Out of the Ivory Tower: The Significance of Dirk Struik as Historian of Mathematics*

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1. CAPTIVATING

The significance of Dirk Struik as historian of mathematics can be stated in very few words: for mathematicians of the past half century, all over the world, he determined the image of the history of their field. He did so through one book, his *A Concise History of Mathematics* [Struik 1948]. The book was first published in 1948 and from then on it found its way to the bookcases of mathematicians and mathematical institutes, was regularly updated, was translated into many languages, and was adjusted to the regional mathematical cultures of its various publics.

Struik's significance, then, was established through the written word. And he wrote much. His death offers a good opportunity[1] once more to browse his famous and less famous writings. They are captivating, and they raise, as good texts do, the question of what secret enables the author to captivate his readers.

Naturally the secret has to do with Struik's personality, but also with his ideas about mathematics, its place in society, and the function of the study of its history. In this article I go in search for that secret—without finding it, obviously—hoping that along the way Struik's significance as historian of mathematics will appear. It goes without saying that I should often let him speak for himself. I do so by means of texts taken mainly from two publications of 1980 [Struik 1980] and 1986 [Struik 1986], in which he spelled out his vision of the history of mathematics.

2. IN HIS OWN WORDS

In the article of 1980, with the title "Why study the History of Mathematics?" Struik gives an example to show how fascinating the history of mathematics is and how effective, therefore, in capturing the attention of pupils and students. His example is the history of the decimal positional system of writing numbers:

> It originated in India in the early years of the Christian Era, with or without (probably without) inspiration from China. It travelled east to Indochina, and West via caravan routes and coastal traffic to the countries of Islam. Here, around A.D. 825, a mathematician called Muhammed Al-Khwarizmi, or

* Translation of an address given April 20, 2001, at Amsterdam, during a conference session in memory of Struik; the original Dutch version was published as [Bos 2001].

[1] Because of his death in 2000, and earlier on the occasion of his 100th birthday in 1994, several publications on his life, work and personality appeared, such as [Alberts 1994, 2000, 2001, Rowe 1989, 1994].

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> Muhammed of Chiwa in present Uzbekistan, wrote a book in Arabic about these Indian numbers, which was translated into Latin when these numbers travelled further West to Spain and the Italian cities of the Middle Ages. Here an Italian merchant–mathematician, Leonardo of Pisa, wrote a huge Latin tome about the use of these numbers and what you can do with them. He is also known as Son of a Good Fellow, or Fibonacci, and the series called after him can be found in this book in connection with the propagation of cunicula, rabbits. The date of the book is 1202. Through Leonardo and other merchants, teachers, and men of learning, via the places where Christianity and Islam met, the rise of the decimal position system—now with symbols very much like our own—found its way across mercantile as well as learned Europe. Not without some opposition from those who preferred the use of the traditional counting boards or abaci, where you worked on lines with pebbles or counters like the ones we still see on baby pens with little balls on wires. The results of the computations were written down in Roman numerals. The opposition had some sense: You could so easily make an error, or even cheat, with these Saracen symbols, change a 1 into a 7, or a 0 into a 9. We still take precautions against such muddling when we write a cheque. In the long run the decimal position system won out and, at the end of the fifteenth century when the first printed books on counting appeared, they used our symbols 0, 1, 2, . . . , 9 with the same ease as we do.[2]

I find such a text captivating, even hard to keep up with. I am still wondering whether Chiwa is indeed in Uzbekistan (it is), and whether the story about the Good Fellow is true (one reads otherwise elsewhere) . . . but I'm already moving on with Struik's staccato tempo, and, somewhat out of breath, I catch up with him at the end where he says that in the 15th century *our* number symbols were used . . .. Struik makes his point: I am captivated, caught in the current of his narrative.

Not only the style, but also the themes of the text are characteristic of Struik. Thus I can use it to introduce three themes which are central in his historical writings about mathematics. They are:

Mathematics does not, and did not, live in an ivory tower.

On the contrary: Mathematics accompanied caravans and ships, lived in trading houses, migrated between great cultures, and was *used*.

History of mathematics is written for the mathematicians of today.

Indeed, whom does Struik address? *Us*, mathematicians, who know about the Fibonacci series, and who are curious how people in the past used *our* symbols 0, 1, 2, . . . , 9, as easily as we do.

History of mathematics reflects the great, global developments of mankind.

Struik tells a literally global story, on world scale, moving from East to North and West over continents, through the ages, accompanying the great cultures; on that scale: grand and sweeping.

In what follows I elaborate these themes.

3. THE IVORY TOWER

Struik himself summarized the idea of mathematics in an ivory tower in this way:

> [. . . in 1942 . . .] it was still fashionable to think that mathematics came out of Heaven, or, at least, out of a pure, socially unadulterated, Pythagorean type of mind.[3]

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[2] [Struik 1980, 5-6].

[3] [Struik 1986, 287].

Mathematics is abstract, he writes, but that does not mean that it has nothing to do with the world or with reality:

> Its [sc. mathematics'] abstract symbolism can blind us to the relationship it carries to the world of experience. Mathematics, born to this world, practised by members of this world with minds reflecting this world, must capture certain aspects of it—e.g., a "number," expressing correspondences between sets of different objects; or a "line," as the abstract of a rope, a particular type of edge, lane or way. The theorem you discover has not been hauled out of a chimerical world of ideas, but is a refined expression of a physical, biological, or societal property.[4]

In the beginning of "his" century, around 1900, the view of mathematics as pure, totally detached thinking was widely accepted. Struik opposed it from early on. When, in the 1910's and 1920's, he found a basis for his world view and his political convictions in socialism, the Marxist view of history gave him a theoretical foundation for his rejection of the ivory tower idea: Mathematics, like all other abstract, mental, and cultural human concerns, has its origin in the confrontation of communities of men with the struggle for survival, with the hard reality of staying alive, food supply, production, trade.

This view of mathematics and science became more common in the years between the world wars; in England especially a number of prominent and articulate scientists, such as Bernal, Hogben, and Needham, promoted, from the same conviction as Struik, the idea that *science* had a *social function* and that scientists should become aware of that. In this spirit a journal was founded, *Science & Society*, in which Struik published on mathematics and its embedding in the historical development of civilizations, a subject he called "sociology of mathematics."

In a much harsher manner than the writers just mentioned had in mind, the second world war focused public awareness on the relation between science and society; the military–industrial complex was established, the military success of countries was seen to be essentially dependent on scientific know-how, and scientists were enlisted in the war effort through "operations research." And in the years after the war science was seen as a major progressive force of recovery and restoration.

Shortly after the war *A concise history of mathematics* [Struik 1948] appeared. Struik portrayed mathematics as connected to the economy and the culture of its ambient society; an approach which contributed to the book's success because the image of a pure, "socially unadulterated," mathematics creates a distance which is, after all, hardly inviting. Moreover, there was a clear note of conviction in the book, but without dogmatism and also without theoretical ballast; Struik sketched the social contexts in the various historical periods, but presented no stringent analyses of the connections between these contexts and the developments within mathematics. Also he wrote with a lively interest in the human actors of his story and with a clear love of mathematics.

Yet the idea that society influences mathematics long continued to provoke distrust. Behind this reaction was fear of political–ideological infiltration of science, and also, I think, a fear of losing mathematics' exclusivity: where are the borders of mathematics if we consider it as interwoven with social phenomena? Then applications belong to mathematics too, industrial calculations, even simple reckoning, together with the grandest abstractions! Then one could no longer, as Hardy had done in 1940, write a *Mathematician's apology*

[4] [Struik 1986, 286].

[Hardy 1967] for "real" mathematics, which excluded applications and could therefore not be held responsible for misuse of knowledge in wars or economic disasters.

Such fears often induce a sympathy for strict and narrow definitions of mathematics. Struik never had these fears; his view of mathematics was very broad, and thereby in a sense liberating. Small wonder that he was enthusiastic for "Ethnomathematics" [Struik 1995], a movement which since about 1980 has claimed attention and respect for the mathematical elements in the thinking of cultures situated, geographically or historically, outside or on the periphery of the Western cultural era.

Personally, it is here that I see most clearly a link between Struik's political interests and his thinking about the history of mathematics: it is his solidarity with people to whom the access to material and cultural riches (such as mathematics) is denied by the existing division of power.

4. HISTORY OF MATHEMATICS IS WRITTEN FOR THE MATHEMATICIANS OF TODAY

The relation between Struik's political ideas and his conception of history is probably the best known characteristic of his historical studies on mathematics. While rereading his writings I was struck by two other characteristics: his affinity with a public of professional mathematicians and his fascination with the great questions of human history.

As to his public: I think he was decidedly serious when he wrote:

> This may sound a little facetious, but one of the advantages in the study of the history of mathematics is to bring colleagues together and improve the harmony of the department.[5]

Historians, he went on to say, could facilitate the communication between mathematicians whose specialisms were so far apart that they were unable to converse about their research. Behind the remark is a particular vision of mathematics. Struik was convinced that mathematical knowledge was gathered over the ages through a process of selection in which much was discarded, but only what was unimportant; the essential mathematics was kept, and in that sense mathematics was a *cumulation* of all mathematical research in the course of the ages. He writes:

> In contrast to art and literature, mathematics, like physics and other natural sciences, is cumulative. . . . Results of previous ages, if important, have become parts of our mathematics, like the theorem of Pythagoras, Cartesian coordinates or the Riemann integral, and usually in simpler and more elegant form than at the time of their birth.[6]

With this opinion he takes a clear position with respect to one of the fundamental dilemmas of the historian: does the importance of history lie in the past or in the present? Struik discusses this topic in connection with a formulation of the dilemma by the Dutch historian of science Dijksterhuis, whom he cites. Dijksterhuis distinguished an *evolutionist* and a *phenomenological* approach to the history of science. The former stresses the genesis of *present day* science (mathematics); the latter aims at understanding science (mathematics) as it was in the past. In Struik's opinion his public, the mathematicians, are best served by the evolutionist approach:

[5] [Struik 1980, 24].
[6] [Struik 1980, 4].

> I hold that the evolutionist method, as followed in our history books, is the best for those students curious to know what happened to mathematics in the past with reference to our present day. But it sometimes pays to interfere to correct an essentially unhistorical critique. We have to realize, for instance, that the concept of rigor is historically delineated. Euclid was rigorous in his day, and exemplary for centuries to come, but his rigor is no longer satisfactory.[7]

Thus he takes present day mathematics as starting point and warns merely for the danger of misguided value judgements about past mathematics. He does not doubt that the historical road to “our mathematics” was one of progress:

> In the case of general history, however, not all practitioners will think in terms of progress. They have left this to the Enlightenment or to Marxists or some others considered utopians or at least optimists. But the historian of mathematics sees progress.[8]

This view of history is at present no longer very popular, there is more attention for the authenticity of past mathematics (including the un-“important” parts that were later discarded), and for the differences between past and present mathematical thinking. Personally I agree with that approach, I can actually get very enthusiastic about it. But then, reading Struik, I realize that this position does imply a challenge, namely, to retain the connection with the modern mathematical public, because authentic mathematicians of the past are no longer available as readers of my studies.

5. HISTORY OF MATHEMATICS REFLECTS THE GREAT, GLOBAL DEVELOPMENTS OF MANKIND

Struik was not afraid of what he called the “great questions” of the history of mathematics. Questions such as the explanation of the “Greek wonder,” the idea, appearing seemingly out of nowhere in Greece in Thales’ and Pythagoras’ times, of constructing mathematical theories logically and deductively; or the reason that it was precisely in Western Europe in the 17th century that the “scientific revolution” occurred, which took experiment and mathematics as the basis for understanding the phenomena of nature. He did not find definitive answers and I think he decided rather early on that such answers were not to be found; he did a lot of detailed historical research on various aspects of mathematics and knew well how often such research contradicts simplistic answers to the great questions.

But he liked these questions, and he also liked speculative ideas about global developments in mankind’s history, witness his description of his own reaction to a thought provoking analogy:

> But when Christopher Caudwell ... sees a relationship between the bourgeois world of separate individuals held together and moved under a mysterious force, the market, and Newton’s world of separate particles held together and moved under a mysterious force, gravity, then I sit up and take notice. But when I study further I shall probably accept it only in a modified form.[9]

I find his reaction very recognizable; the charm of such an analogy, and at the same time the anticipation that the idea will ultimately slip through one’s fingers. A similar partiality for seductive ideas I sense in a passage which I give as the last example of Struik’s writing. He asks the question how mathematics can be so beautiful when it is the result of hard human

[7] [Struik 1980, 15].
[8] [Struik 1980, 12].
[9] [Struik 1980, 22].

struggle for survival. He imagines prehistoric times when man first made instruments:

> For instance, the axe became smaller and more elegant, taking on geometrically regular form that could not have been produced unless people developed higher intellectual functioning.
>
> Since the most rational form of an artifact was often one exhibiting attributes such as symmetry, these objects may well have been seen as beautiful. In other words, it is possible that, at least to some extent, both mathematical concepts and aesthetic feelings found their origin in the experience of generations of craftspeople.[10]

6. FINALLY

At the end of the text on number notation I quoted as introduction, Struik writes: "This tale could be embroidered upon . . . ."[11] This characterizes Struik the narrator, who made the history of mathematics captivating by effective facts, particulars, and anecdotes, and at the same made the reader feel that what he told was part of one grand, engrossing narrative, the history of mankind and human thinking and working. He wanted more than only to tell the story of mathematics; he hoped that the story would liberate mathematics from the ivory tower, in order that the subject would not remain restricted to the abstract thinking of Pythagorean, "socially unadulterated," minds without obligations, but would cover a much larger range in which there was place as well for commercial arithmetic and even for, say, the traditional techniques of basket makers in Mozambique.[12]

A narrator with a partiality for great questions and seductive speculative ideas, which, like Caudwell's idea about the market and gravity, make him "sit up and take notice." I can see him making that gesture. A man with an enviably active mind, who was, and is, of great significance for mathematics and its historiography. I am glad to have known him.

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[10] [Struik 1995, 43].

[11] [Struik 1980, 7].

[12] To mention a fascinating topic from "Ethnomathematics," cf. [Gerdes 2000].