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Remembering Ken Appel

by Wolfgang Haken October 23, 2013

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The mathematical achievements of Ken Appel can certainly be called unique and unusual. To describe them here in 10 minutes is a challenging task, in particular since I am about as slow as Ken was fast.

Ken told me that he enrolled at the University of Michigan as a Graduate Student just because this gave him the opportunity to get out of the Army half a year early.

He was always driven by the desire to do something practically useful but also by an irresistible interest in the foundations of knowledge. These two goals may appear to have very little in common. But Ken's unusual drive and working capacity enabled him to pursue both of them simultaneously and to come up with remarkable results.

He specialized in Mathematical Logic for his PhD in 1959 [with Roger Lyndon] and got more and more fascinated with computer languages and programming. By the time we met here in Illinois, in 1972, he had already learned 15 different Machine Languages for about as many generations of computers.

This was just at the time when I had decided to quit my work on a modification of H. Heesch's approach to the Four Color Problem because it was leading to a hopelessly large number of case-distinctions which had to be handled. Each case concerned a drawing in the plane of a graph with between 15 and 40 vertices, and computer-experts had tried to convince me that computers were useful only for numerical computations but not for drawings.

Ken Appel immediately said: "Of course, computers can be used for encoding and handling such drawings." And, obviously amazed by the challenge, he offered to do the computer work right away. This led to the proof of the Four Color Theorem four years later.

As if he had nothing else to do, Ken also served as an Alderman on the Urbana City Council. But strange enough, his expertise in politics turned out to be of decisive value for the sciences at Illinois: In early 1976, the University's administration had installed a "Cyber"-computer which was much more powerful than all the older computers. Then Ken achieved - against considerable resistance - that this computer could also be used by the scientists. As a consequence, the Four Color Theorem was proved 6 months - rather than 3 years - later.

Occasionally, it is claimed that the Four Color Theorem is the first example of a mathematical proof that essentially relies on computer work. This claim is still questionable. For instance, the classification of the finite simple groups of even order involved at least as much computer work. But the main part of that classification is genuine higher mathematics, and the computer work only confirms some tedious details.

In contrast to that, the proof of the Four Color Theorem does not involve any higher mathematics whatsoever, no calculus, no higher algebra, only middle school mathematics — besides extensive computing. And this aspect of the proof makes it a rease scarecrow for some traditional mathematicians.

As an example, in 1982 a New York film crew wanted to make a short documentary movie about the Four Color Theorem; and Ken thought it would be easier for himself and me to come to New York than for the crew with their equipment to come to Urbana; then the filming could be done at his Alma Mater in New York. There the Department Head allowed the filming, but he felt an obligation to protect the innocent souls of this students from exposure to the evil and did not allow them to meet with us.

In fact, it is not just a theoretical statement, that Middle School Students could understand the proof - provided they were interested in it and had the time and the patience required. In the summer of 1976, Ken and I found ourselves - unexpectedly early - with a proof that involved about 700 pages of drawings and few cubic feet of computer-out-print. We had been rather careful in producing that proof, but still had to expect an average of about one writing- or drawing-error per page remaining. Moreover, about 1800 computer-inputs had to be checked for being correct encodings.

In order to comb out the remaining errors, we employed 5 of our children, 3 of Ken's and 2 of mine, the 3 older ones in College, but the 2 younger ones still in High School and Junior High, respectively, to check everything over again. At this point, I find it appropriate to remember Ken's daughter, Laurel, who passed away a few weeks before Ken did.

She checked the drawings and found about 800 remaining errors, all but about 50 so minor that she could correct them on the spot. The remaining 50 required new computations — it is nostalgic to see her initials on many of the pages.