

# Attracted by the (baby) monster.

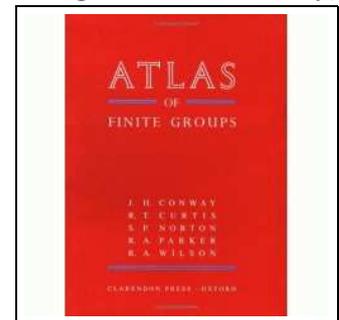
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## 1 UVA Amsterdam

The first time I met mijnheer Van der Waall was in 1988 in my first year of Mathematics at the Universiteit van Amsterdam. Later he told me we were always a bit of a special year for him. One reason was of course that his daughter, Alexa, was in our year, but we were also the last big group of first year students at the Math Department: forty to fifty students started and finally about seventeen students finished their master including Alexa and me.

Mijnheer Van der Waall was our Algebra A lecturer. I have to admit that Algebra was a shock to me. After high school I expected that Mathematics mainly consisted of a lot of ‘functie-onderzoek’, looking for properties of functions that I expected to become more complex (not directly in the mathematical sense) during the years. Algebra was completely different. The first part, on integers and the Euclidean algorithm, was still OK, but then group theory started. Instead of working with ‘real’ numbers, like with analysis, we suddenly had to manipulate permutations and words in abstract generators. For me it was a bit too much and although mijnheer Van der Waall explained it quite well, I failed the exam.

Fortunately the next year I started to understand a bit more about the cycles, the normal subgroups and the isomorphism theorems and I could continue to Algebra B. Suddenly, after getting the idea, Algebra B was much easier and as I now really started to like it as well, I voluntary continued with courses like Galois theory, Advanced Group theory (Sylow’s theorems) and Representation theory (based on Isaacs book). This also meant that I entered the domain of mijnheer Van der Waall, as he was at that time the fixed and only lecturer for courses on finite group theory. Probably at that time, but maybe already in the previous years, I came aware of something called the Group Atlas. This was a very large, red book, see Fig. 1, that had a prominent place in our library. The Atlas started with character tables of groups that were by that time quite familiar to us students, like  $A_5$ , but ended with large and unaccessible tables of groups with dangerous names as the Baby-Monster and even the Monster.



**Figure 1:** Group Atlas.

## 2 Groups '93, Galway

My study approached its last year and therefore I had to think about a master thesis project. Somehow I talked about it with mijnheer Van der Waall and he came up with the idea to visit the big group theory conference 'Groups '93', see Figure 2. Not only would this conference give an overview in the state of the art of group theory at that time, it would also host a workshop on GAP, a computer algebra system built around the Atlas. Visiting a conference was quite special for an ordinary master student, but fortunately the organization somehow liked the idea and even gave a considerable discount to me and my fellow student, Judith Keijsper.

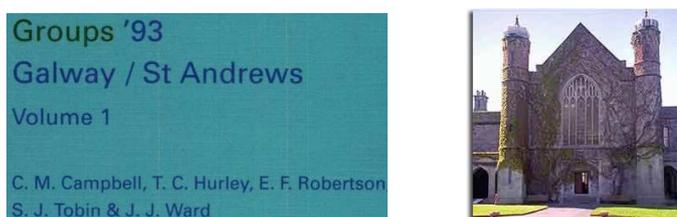


Figure 2: Groups'93 conference at University College Galway, Ireland

We decided to combine the visit to the conference with a holiday and went by bike from the airport in Dublin to Galway, at the west coast of Ireland, where the conference took place. We tried to attend as much talks as possible and understand all of them, which was quite impossible, therefore the first week was very tiring. Mijnheer Van der Waall was much more at ease at the conference, and easily skipped some talks because he had other issues to discuss with colleagues that he knew from previous occasions. A social highlight of the first week was the excursion to the peat bogs. It suddenly became aware to me that it was a very strange situation: to be with a majority of the world's leading group theorists in the middle of a swamp!

After the actual conference a workshop in the usage of GAP was organized. This was a bit easier to follow for me and moreover, mijnheer Van der Waall had a short discussion with the leader of the GAP development team at that time, Prof. Neubüser, in which it was agreed on that I could do my master thesis project at Lehrstuhl D für Mathematik at the Rheinisch Westfälische Technische Hochschule in Aachen.

## 3 RWTH Aachen

Shortly after New Year 1994 I arrived in Aachen with two pages of assignments prepared for me by Mijnheer Van der Waall, see Figure 3. Basically the question was to check some conjectures on the computer, using GAP, that were too large to check by hand. Aachen was the perfect place to do this, because here the development team of GAP was situated at that time. Therefore Aachen had a completely different atmosphere than Amsterdam.

At the University of Amsterdam there were one or at most two specialists in one field, in Aachen I was suddenly surrounded by a complete section of maybe 10-15 people all doing finite group theory.

In Aachen I actually used the Group Atlas a bit and for one of the assignments I did some computations within  $M_{11}$ , the short name for one of the Mathieu groups. This group is one of the 26 so-called sporadic simple groups, a list containing 'left-overs' in the classification of the finite simple groups. The other finite simple groups all belong to some series, like e.g. that of the alternating groups  $A_n$ . The character tables of the sporadic simple groups form the main ingredient of the Atlas and are presented by increasing group size, ranging from order 7920, for  $M_{11}$ , towards order

$$2^{46} \cdot 3^{20} \cdot 5^9 \cdot 7^6 \cdot 11^2 \cdot 13^3 \cdot 17 \cdot 19 \cdot 23 \cdot 29 \cdot 31 \cdot 41 \cdot 47 \cdot 59 \cdot 71 \approx 8 \cdot 10^{53}$$

for the very largest one, that is, the monster itself.

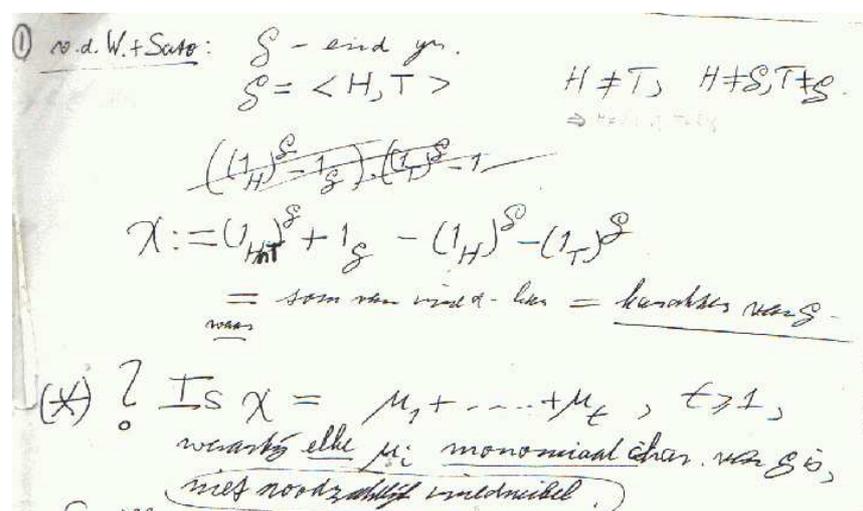


Figure 3: One of my master thesis assignments

As I now had help from two sides, every week by email from Mijnheer Van der Waall, and in situ by my German supervisor Thomas Breuer, the project progressed quite well. Mijnheer Van der Waall provided me with the right articles and arguments and Thomas Breuer showed how to bend GAP in the direction of the answer by means of a lot of 'tricks' and by 'basteling' some nice little programs. After half a year and after a personal visit by mijnheer Van der Waall, most of the assignments were solved and I could, back in Amsterdam, successfully defend my master thesis 'Monomiale Charaktere, B-Gruppen und GAP', see Figure 4, not after noticing that German is a very difficult language to write in, and not after mijnheer Van der Waall finished one of the assignments by pen and paper, hopefully because he got some ideas on how to continue by my efforts.

Having obtained my master thesis, I was allowed to say Robert to mijnheer Van der Waall, which was quite difficult to get used to for me.

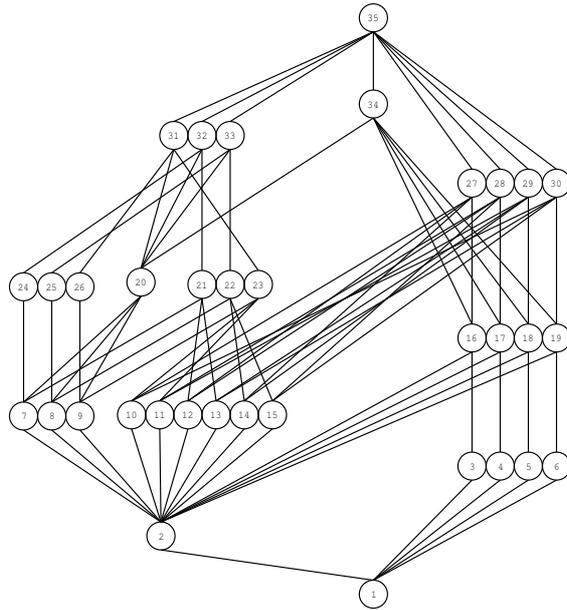


Figure 4: Subgroup lattice of Group 48.50

## 4 RIACA Eindhoven

After I passed my master exam, I was called for military service. I didn't like the prospect to serve in the compulsory part of the Dutch army, that was built down at that time. Therefore I rejected service and was allowed to do alternative service instead. This could be done at any institute, as long it was clear that it was not commercial. I found a place at RIACA, the Research Institute for Computer Algebra, where my supervisor Arjeh Cohen gave me the task to create an interactive Algebra book in the one year that my service took, using all software available at that time. So the challenge was to help first year students by making their first meeting with group theory easier by providing them with modern educational material, see Figure 5.

Meanwhile Robert and I worked together on an article based on the results of my master thesis. This was an interesting job, as together we represented two worlds. I was typing all results directly into LaTeX, while Robert prepared manuscripts in the traditional way, that is, handwritten, with lots of comments on how to typeset every mathematical symbol. Of course we had obtained our common results in a similar way: Robert used pen and paper and the right theorem out of his encyclopedic database of group theory theorems at the right place; I used the brute force of the computer, while trusting that all algorithms were implemented in the right way. For my work it was important to ensure that the lists of lists that were representing the groups were not growing out of bound, because then the computer would get stuck instead of producing an answer.

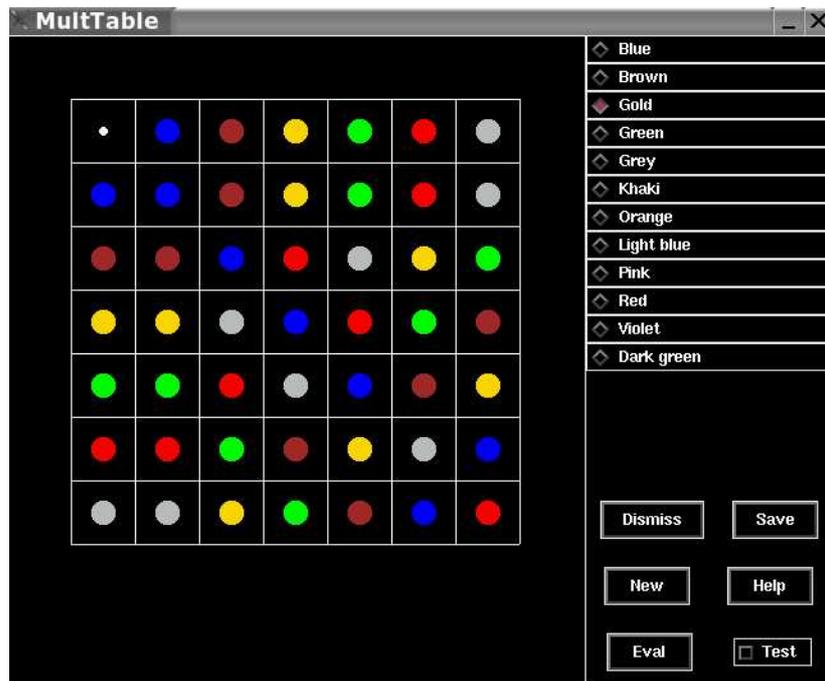


Figure 5: Applet for playing with multiplication tables of small groups.

## 5 London

After finishing my alternative service I was offered an eight months research position at Queen Mary and Westfield College in London. Here I worked on a library of presentations of sporadic groups under supervision of Leonard Soicher. Finitely presented groups can be constructed by giving generators and relations between these generators, the so-called words. The shorter the words, the easier to handle the presentation both for humans and computers.

Robert was interested in visiting me and my research group in London, and he decided to travel to London by the at time recently opened tunnel between France and England. Unfortunately, on the morning of his departure to London, the tunnel was on fire and he wisely decided not to come.

At the end of the project the library contained 27 presentations and many short words generating maximal subgroups. After I returned to the Netherlands I did a PhD in Utrecht and was very pleased to find Robert among the audience at my defense, because he was the one that at the end of my study guided me in such a way that I got a lot of pleasure in working in mathematics and especially in group theory!