

Chapter 11

My Colleague

Arrhenius. Till now I'd worked in my special field more or less on my own, but now this under populated field area started to attract independent minds and other researchers coming from different areas began to move in. The first of these was Svante Arrhenius.

I'll never forget the day—it was in June 1884—on which I heard his name for the first time. All on that 1 day I'd got a painful gum infection, a wonderful new daughter and a manuscript from Svante Arrhenius entitled “Études sur la conductibilité des électrolytes”.¹ All that together was too much for 1 day and I had a feverish night with bad dreams.

The gum infection soon went away and my daughter caused no great problems, since the birth was easy and her mother recovered surprisingly quickly and I only had to take my role as father seriously in the later stages of her development. But the paper caused me headaches and more than one fretful night—and this was most unusual for me. What he'd written was so contrary to everything that was known and accepted that at first I thought it must be nonsense. But then I saw that the obviously very young author had presented some calculations of the chemical affinity of the acids which agreed with the values that I'd already reached from a completely different starting point. Finally, having read the paper in detail I convinced myself that this young man had approached the problem of the relationship of acids and bases—a problem I'd expected to spend my life working on and for which I'd

¹This is the Ph.D. thesis of Arrhenius submitted to the University of Uppsala. The correct title is “Recherches sur la conductibilité galvanique des électrolytes. Première partie: La conductibilité des solution aqueuses extrêmement diluées déterminée au moyen du dépolarisateur. Bihang till Kongl. Svenska vetenskaps-akademiens handlingar 8 (1884) No. 13. Seconde partie: Théorie chimique des électrolytes. Bihang till Kongl. Svenska vetenskaps-akademiens handlingar 8 (1884) No. 14. Stockholm 1884. Kongl. Boktryckeriet.

managed by hard work to clarify a few points—the most important of which was the demonstration that there is a fixed quantity for the affinity which is irrespective of the type of process involved. He had looked at the problem in a much more generally applicable way and had, to some extent, even solved parts of it.

You may well imagine the jumble of feelings which this caused in a young researcher trying to build his future in a field he believed to be under populated but who now found that he had a forceful and energetic competitor. His work had its weaknesses (which were soon to be seized on by other critics in a rather excessive way), so that I could still believe, if I wanted to, that he'd hit on the right answer simply by chance.

I struggled inwardly for a few days just as the the black and white retainers struggled for the soul of the huntsman in Bürgers ballad "The wild huntsman" (Der wilde Jäger). Since not very many people were interested in this field, it wouldn't have been difficult to simply ignore this interloper. One simply had to damn the whole work on the basis of the errors it contained and in any case the publication was in the *Annals of the Swedish Academy of Sciences* which automatically restricted its impact because few chemists read this journal. I only had to ignore the paper and I'd have got rid of my competitor, maybe not forever, but at least for the immediate future.

I must add that these thoughts were never formulated then with the clarity and precision I give them now. It was more in the form of waves of feeling that now and then managed to wash over the borders of consciousness.

The details of the techniques for dealing with unwelcome colleagues and competitors were things I learned only later, initially by witnessing the intrigues of colleagues against me and then, once I'd recognised what was going on, by following the developments in the chemical literature. On the other side I held to the scientific ideals which I'd learned from my teachers Karl Schmidt, Johann Lemberg and Arthur von Öttingen, as the prerequisites for work in this highest region of human endeavour. The selfless and heartfelt letter of recommendation which Karl Schmidt had sent to the Polytechnic and which was doubtless decisive in their decision to offer me the professorship was an ever present example for me. In addition, it is always a joy to find a new colleague with whom to open up a new field, especially when there is room for everyone and particularly when such new colleagues are equipped with those intellectual tools which I lacked and which together with mine would guarantee that we would both succeed in progressing.

The electrical conductivity of acids. In a few days it was clear to me what direction I must follow. I wrote to the author of the manuscript in Uppsala and tried to get a clear detailed view over one major issue. This was the relationship between the electrical conductivity of acids and their relative chemical affinities which I had established.

Already in Dorpat I'd noted the work of F. Kohlrausch who'd invented the measurement of the resistance of electrolyte solutions using alternating current.²

²Kohlrausch F (1876) *Ann Physik* 235:233–275.

For the few acids he'd investigated the order of their electrical conductivity fitted with the order of their chemical affinity. However, I wasn't able to make any sense of this and the measurement of conductivity was at that time a complicated business so that I wasn't in a position to determine it for all the acids I'd investigated.

But now Arrhenius presented in his paper an interpretation which not only explained the parallel between the two sets of values but actually demanded it. In the meantime Kohlrausch's method for determining conductivity had been simplified to such an extent that I could set it up myself.

I hadn't procured any electrical measurement equipment in Riga but now my love of tinkering which I'd retained from my boyhood came to the rescue. I'd found an old but adroit mechanic in the Polytechnic who was just hanging about because no one seemed to need his services. I at once took lessons from him at the lathe and bench vice which surprised my elder colleagues and caused a certain amount of amusement amongst them. In this way I was able to make modified versions of the necessary equipment and was able to borrow for just a few days a resistor box from the local post office which we copied so that in a short time I was able to determine the electrical resistance of solutions with more than enough precision. I measured the whole collection of acids which I'd saved from my earlier work and, with a pounding heart, found that one value after another fitted exactly into the prediction. Since all the solutions were to hand and each measurement only took a few minutes, the results poured in faster than I have ever otherwise experienced. The end result was that I had here a means of determining in just a few minutes the chemical affinities which, using my old methods, had taken as many days. I quickly wrote up a short communication³ of my confirmation of Arrhenius's idea and sent it to the editor of the *Journal für praktische Chemie* (*Journal of Practical Chemistry*). By a happy chance it could be published right away. In it I expressed my firm opinion that the work of Arrhenius was one of the most significant results to be published recently in the field of chemical affinity.

The second journey. On my first visit to Germany, which I'd made because of the construction of the new laboratory, I'd been under such time pressure that I'd only been able to gather an impression of a tiny part of the country's vast treasures in the arts and sciences. Because of this I wanted to make my second visit more relaxed. In addition it now turned out that the library in the Polytechnic was insufficient for my now well advanced work on the text book, so that it was now desirable, indeed necessary, that I visit other larger and more complete libraries. I therefore applied to the Board of Governors for a travel stipend which was given me for the summer holidays of 1884. After these events were all completed I decided to follow up my written contacts with the strange Swede with a personal visit and to travel back to

³Ostwald W (1884) *J Prakt Chem* 30:93–95.

Germany via Sweden. Since there was a direct steamer connection between Riga and Stockholm the matter was not difficult to arrange.

Visit to Uppsala. After I'd visited the museums in Stockholm and had seen the wonderful landscapes which make it one of Europe's most beautiful cities, I travelled on to Uppsala where Arrhenius was waiting for me.

So that we'd recognise each other he came to meet the train holding up like a flag a reprint of my paper which I'd sent him.

This meeting was the start of a long friendship which has continued ever since. He insisted that I stay with him for there was naturally a lot to discuss and we planned how we would together study the extensive new area which had opened up before us.

On the first evening we went to a beer garden where as the sun set the waiter brought us felt blankets to ward off the cold evening fog. From time to time Arrhenius would be called over by young people who greeted him warmly and shook his hand. He told me later that these were student friends who wanted to congratulate him on the special honour done him by a well known foreign full professor who had come all the way to Uppsala to visit him and who treated him as an equal. It turned out that he had used the work from his publication to produce a thesis for his accreditation as a university teacher. He'd submitted this to the faculty but there had been some problems concerning its contents. Earlier he'd run up against the physicist Thalén whose lowering and unfriendly manner I would later get to know. I should say right away that this was the only Swede of this type I met for otherwise they are about the friendliest nation I have come across. Thalén had either refused to allow Arrhenius to work in the physics institute or at least made his life there so unpleasant that he'd gone instead to Stockholm to the academy member Edlund who worked in the same laboratories in which Berzelius had spent the last 10 years of his life. I visited Edlund later with Arrhenius and was met by a strange little bent over man whose goodness of heart shone out of his eyes. He showed me the remains of Berzelius's chemicals and equipment which lay all higgledy piggedly in a cupboard. I gazed in astonishment at the balance with which Berzelius had made more than one extremely exact measurement because it was a very primitive thing that even back then one would hardly have offered to a beginner. It was immediately clear to me that the equipment is less important than the man who uses it. I saw here a justification for my habit—inherited from my rather impoverished childhood—of being satisfied with the simplest equipment.

Arrhenius had carried out the experimental part of his project in Edlund's lab and had measured the conductance of a number of electrolytes which Kohlrausch had not looked at. However the procedure which Edlund had suggested he use turned out to be difficult and not terribly effective. He later brought this apparatus with him when he came to Riga to work with me. However once he saw the simplified version of the Kohlrausch equipment which I had built, he used it instead and took the unopened box containing his equipment with him when he left.

Of course in Uppsala I made the usual round of visits. I was received in a particularly friendly manner by the respected chemist Cleve, who could not hide his

surprise that I was so impressed by the strange ideas of Arrhenius. Nevertheless, he was prepared to hear me out on the subject. This discussion took place some 2 years before the theory of the dissociation of electrolytes had been formulated and yet Cleve, with rigorous logic, drew one conclusion after another from Arrhenius's hypothesis and at the end asked me, "So do you really believe that in this beaker with the solution of sodium chloride the sodium atoms swim about on their own?" I answered, "Yes" and he glanced at me sideways as if to signify that he now had reason to doubt my chemical common sense. That didn't in any way change his friendly attitude and he invited us both to lunch the following Sunday. We got there a little late because as Arrhenius put on his best clothes the trousers ripped and it took a while to repair the damage. Instead of sitting down at table we collected plates from a well arranged set and went to the lady of the house who distributed our soup and other food. One went off with the booty and—standing—ate as well as one could. I was told later that this was an old Swedish custom that nationally minded people were trying to revive. I do so hope that in the meantime they have given up the attempt. All the other cheerful lunches and dinners I had in Sweden were eaten at table as in the rest of Europe.

I also remember an excursion to the baroque castle of Skokloster, though plans for the future were more at the front of our minds than old weapons and furniture. We agreed that Arrhenius should come to Riga as soon as possible so that we could work together on the solution of our problems. For that it was necessary that his thesis be approved and that he be given a travel grant. These difficulties had been much reduced by my personal appearance in Uppsala and in fact were soon overcome. Later Arrhenius wrote me that none of it would have been possible had it not been for my visit.

Apart from these things which were important for me, I hadn't forgotten the reason for which I'd been given the grant by the Board of Governors. I turned to the library there to look for the references I needed only to find that this was a matter which lay in the hands of Professor Thalén. This was the situation mentioned above, in which I met the exceptional Swede who was unfriendly. It turned out that he just had a rough outer shell, for my request was granted. After that Arrhenius and I went to Stockholm for the meeting with Edlund which I described above.

In addition I met a number of Swedish chemists with whom I thereafter stayed in contact.

Chief amongst these was Oskar Petterson, a small wiry figure with a square head, short light moustache, a sunburned face which was darker than his hair. He moved liked a sailor and was in fact a passionate yachtsman. His friends told me that he considered a summer wasted if he had not at least once been shipwrecked, though he always managed to get out unhurt. He had recently published remarkable papers in the field of physical chemistry and I valued the independence of his mind. He introduced me to his friend Nilsson⁴ who as Professor of Agriculture lived in a marvellous official villa outside the city. He didn't have much in the way of

⁴The spelling is incorrect. Ostwald refers here to Lars Fredrick Nilson.

teaching duties and so could devote himself to science. He was blessed with a sweet wife and a house full of children and in general lived a life which seemed to me to be ideal. Seeing that this sort of thing was possible awoke in me the desire to achieve something similar for myself. Through all the changes of my later life I kept this goal in mind until I was finally able to realise it with my country house “Energy”.

From Stockholm I went on to Göteborg. Close at hand lay the beautiful Aspen lake which I tried capture in watercolour paintings. I’d already bought a paint box and paper in Stockholm and had tried to paint some of the wonderful scenery I’d seen all around there. The results were not terribly impressive and I was convinced that this technique was inadequate for my purposes. When later, in Norway, I had to leave one marvellous scene after another unpainted because the colours would not dry in the damp air; it became clear to me that the only thing that would work would be oil paint. After I returned home I tried them out and afterwards enjoyed many happy hours painting.

From Göteborg I took a ship through the Schären islands to Christiania. There a great treat was waiting for me—a meeting with Guldberg and Waage.

Christiania. We entered the Christiania fiord on a misty morning. To begin with we sailed between rocks bare of vegetation on which the waves broke, later came larger islands with the odd weather beaten pine tree. The further we went the more the vegetation increased and with it came the first signs of civilisation—fishermen’s huts and farmhouses. From time to time we could see the green banks. Suddenly a ray of sunshine broke through the clouds and the silvery light illuminated a glittering city at a bend in the fiord. Then a cloud and a bank of mist covered it all up again. The experience was like a well constructed symphonic movement. It was this that sparked my later thoughts on the art of motion pictures.

Once I reached the city I immediately went to visit my two colleagues whose solid work had smoothed my first entry into the field. I’d established from their addresses that Waage was a chemist, but that Guldberg was a mathematician, and so I went first to Waage. I was met by an elderly man whose unkempt hair and beard almost covered his face. He was of short stubby stature and looked more like a farmer than a professor. He glared at me suspiciously as I introduced myself. When he’d finally grasped who I was he was overcome with joy. He danced around me shouting “So young. No! He’s so young”. He’d imagined that I must be a dignified old man like himself and his brother in law Guldberg and had a hard time convincing himself that it was really me.

Waage insisted that I stay to lunch and sent to invite Guldberg too. At home he had a little flock of children, some grown up some still small—most of them were daughters. In addition there were several older ladies of the sort one sees around pastors. It turned out that he had a strong interest in youth clubs, church homes, abstinence societies and the like, all of which had a strong Christian bent, though that didn’t stop him being an enthusiastic hunter and mountaineer. The main part of the meal consisted of snow grouse which he had shot himself and he recounted the details of the hunt in a way that reminded me of my father’s hunting stories.

In the meantime Guldberg had arrived. He was outwardly the opposite of his brother in law. He was tall and slim, with an aristocratic-intellectual face, protruding nose and white hair and beard both of which were cut short. He looked more like a senior military officer than a professor. It soon turned out that the idea behind the work had been his. Waage seemed not to have done much more than deliver the chemical analyses. Nevertheless in questions of hunting and mountaineering he was not a whit less enthusiastic than Waage and insisted that the next day I should come and taste his snow grouse. These were hunted high up in the mountains, immediately roasted, tightly packed and dipped in melted butter so that they were preserved sterile and could be kept for a whole year.

Although it was already late in the year my Norwegian friends wanted to show me some of the beauties of their country. Since they were held up by their lectures they worked out an itinerary for me up to Hønefos by train, car and on foot which I undertook over the next few days. Since I'd grown up in flat country the wild and magnificent Norwegian scenery shook me with an intensity I'd not expected.

The weather was almost always dull and it often rained so that the distant scenery was usually hidden and yet the 3 days of wandering left me with unforgettable memories. It was the first such experience I'd had—and the strongest. What particularly impressed me was that I experienced water not as a peaceful element but as a living crashing cascade, which was often enough of enormous power. At Høgsund I could see within the breadth of one glance three huge waterfalls. I returned to Christiania shaken and soaked to the skin.

From there I took a ship to Copenhagen to visit Julius Thomsen the thermo-chemist whose work had been an ideal for me and to whom I wished to pay my respects. My Swedish and Norwegian colleagues had warned me that in him I would be meeting a self-assured and rather unapproachable colleague. However he had recently publically praised my work so that I had no hesitation in going to see him. I indeed met a very distinguished closely shaved man—every inch of whom might have been a privy councillor, but who had an unusual growth on his left temple. Nevertheless there soon developed an intensive and fruitful discussion and after an hour as I was leaving he retreated far enough from the formal plane to suggest that I visit the Tivoli Park in the evening where there would be a garden party. I went there and it was very nice.

During a visit to the Thorwaldsen museum, I experienced for the first—and almost the last time—a sense of artistic elation from looking at sculptures. A visit to the Church of the Lady with its paintings from the late pious period was by comparison a disappointment.

A steamer brought me to Lübeck which I was glad to see for merchants from this city had been the founders of Riga. Lübeck is really very pretty. From there I went on to Leipzig to discuss the success of the first part of my book and to say hello to all my acquaintances there. I was also going to meet up with Arrhenius in the city. My publisher couldn't tell me much but he was obliging and friendly. I met Kolbe and von Meyer and was once again convivially greeted as was Arrhenius whom I introduced to them. However the plans to offer me a professorship, which a year ago had seemed so firm, had not got anywhere and Kolbe pointedly refused to be

drawn on the matter. My other Leipzig acquaintances were all away on holiday. In his lab Kolbe showed me the start of his work on indigo. He'd challenged his rival von Baeyer, who'd made significant progress in this work but then given it up for a while, and bet him that he'd solve the problem within a year. However he had not foreseen that his early death would free him from his duty in this respect. About a year later he'd attended a meeting in the best of health at which decisions were to be made about the future of a Society of which he'd long been a member and in which he expected to have a senior position. However the majority voted against him and he was so enraged that on the way home he suffered an apoplexy and soon died.

Arrhenius and I arrived in Magdeburg in time to attend the Natural Scientists Meeting there at which I was slated to hold a lecture. It was the first meeting of this sort that we'd attended. We were lodged as guests with the family of a young businessman where we were kindly looked after and I learnt the blithe goings-on of this science fair. I knew quite a few of my colleagues from my previous visit a year and a half ago. Once again there were hints that I might be appointed to a professorship, though after my recent experience on Leipzig I regarded them all with polite scepticism. In particular there seemed to be some interest in Göttingen. I don't remember whether my lecture was a success or not. I conclude from that that it wasn't a success otherwise my memory would have worked a little better. From there we went home, which I was longing to do, and in any case the holidays were coming to an end.

The only other thing I can remember from the Magdeburg meeting is that at the city's one-time mayor—Otto von Guericke of air pump fame—was smuggled into each of the innumerable speeches and toasts as a means of making some sort of connection between the Natural Scientists Meeting and the city.