A Personal View of the Life and Times of the Subcommittee on Polymer Terminology

by Roger C. Hiorns

You're coming!

Dick said over the phone. The crimson heat of the office in mid-summer wasn't helping me to take the call seriously.

I'm not sure about this. Errm. I've got a lot on. You know—papers to write, a couple of new students coming in. I'm not sure where I'd find the mon y.

The call had been going on for fi e minutes already and I was starting to get desperate for excuses.

Look don't worry about the money—we can find something o get you there—it's not a lot, but it should pay for your travel and the hotel. Not fi e-star, probably not even two-star, something near the station...

Dick was quite clear about this.

Well that's very generous, you know, but, err, I've, I've got a holiday coming up.

I thought that would work. No one can refuse someone else a holiday.

"No Rog. Look, you'll enjoy it. I really think you'll enjoy it. Just make sure you can come."

I'm thinking he didn't hear me say holiday.

No, I really don't think I can.

Two weeks later, I walked into a stark metal and glass meeting room in Torino. The year was 2007. Anyone who has ever been to a meeting of the Subcommittee on Polymer Terminology, SPT to its friends, doesn't forget the fir t time. I certainly haven't. I arrived late, having only just managed to get a ticket on the train and, by adept use of internet booking, a hotel somewhere "local-ish" to the meeting venue and away from the station. Of this I was quite proud. However, as it turned out, the hotel wasn't quite as close to the meeting. As late had turned into later, I squeezed in at the end of the table and was astonished to find myself next to Dr. Graeme Moad, one of the discoverers of RAFT, a man whom I later found to have a wonderful sense of humour, but at that moment was making room so that I could settle in and look around at the forty or so people crammed into what looked like a greenhouse stuffed with square, modern furniture. As my hearing tuned in like an old radio, the succession of phrases, thrown like spears across the room, started to become comprehensible. I listened in awe as conversations about changing polymer education in some country or other, working with Africa, organising a conference in *Tierra del Fuego* (more of which later), were followed by deliberations on how such and such a polymerization might best be defined for the benefit of the whole world. As it all turned about in my head, it felt as if I had by some strange accident gained a place at a meeting of Greek Gods as they oversaw, measured, and planned future events and the fates of nations and individuals in the world below.

Given my naivety, everything was, of course, mixed up. Over the few days that I was there, in that room, with new found friends—they welcomed me at coffee, and later on a tour and at an end-of-meeting dinner—I was treated as an equal but still had little idea of what they were saying and how all of the meetings had panned out. Professor Bob Stepto, the former Division President, architect of the modern Polymer Division, and destined to become known to me as the person who, amongst other achievements, had adapted the term *dispersity* to polymers, took time to welcome me with biscuits while handing out coffee. All the while, he nodded and smiled gently at the conversations around him and listened seriously to any suggestions, even from a complete ignoramus like me. Professor Michael Hess, the Division Secretary with an Asterix-like glint in the eyes, said, "Yes, all these great people—they always make you feel welcome. I know how you feel! Isn't it great!" while Professor Dick Jones (disclosure: Dick had been my PhD supervisor so I'm a little biased), then the Chair of the Subcommittee, directed the meetings with aplomb. "OK, you initiate that..." 'that' meaning a new conference in Prague. "That's decided then," was a declaration that the new term *dispersity* was to replace *polydispersity index* for millions in industry, research, and education worldwide. But it was all still very vague. What I didn't realise was that I had attended three meetings compressed into one, and in one very small room. One meeting was of the whole Polymer Division, overseeing its roles, finan es, and activities and receiving reports from above and below.

Some, though not all, of the SPT members and observers in São Paulo, Brazil, 2017. From left to right: Paul Topham (UK), Karl-Heinz Hellwich (Germany), Michael Walter (USA), Tamaki Nakano (Japan), Ray Boucher (UK), Claudio dos Santos (Brazil), Michel Vert (France), Jiasong He (China), Volker Abetz (Germany), Olga Philippova (Russia), Patrick Theato (Germany), Graeme Moad (Australia), Jiri Vohlídal (Czech Republic), Mario Malinconico (Italy), Guido Raos (Italy), Adriana Sturcova (Czech Republic), Jan Merna (Czech Republic), Melissa Chin Han Chan (Malaysia), Marloes Peeters (Netherlands), Werner Mormann (Germany), Greg Russell (New Zealand), Jiazhong Chen (USA), and Roger Hiorns (France).

Another concerned the then embryonic Subcommittee on Polymer Education, which was planning to develop projects and web-based materials for worldwide use. The final meeting was that of the SPT, within which, I had—perhaps recklessly—opened my mouth.

Notwithstanding the Division's 50 years, the Subcommittee has itself a long and particular history which I should summarize here, the full story being told elsewhere [1]. What is now called SPT has changed its name, position and responsibilities within IUPAC over the 50 years since the birth of the Polymer Division. Originally it was called the IUPAC Commission on Macromolecular Nomenclature. It was this body that really set the language and standards of polymer terminology and nomenclature for our time, and though in the early days the distinction was not explicitly drawn, produced a series of papers that laid the ground for the key publications in each area, *Definitions of Basic Terms in Polymer Science* [2,3], and *Nomenclature of Regular Single-Strand Organic Polymers* [4]. The latter was the prime publication on structure-based nomenclature dealing with the naming of organic polymers whose unique repeating structures can be written within the framework of ordinary chemical principles. Starting in the 1970s, this work continued through to the 1990s and beyond, always with a group of high level scientists drawn from many different countries. More diverse subjects such as stereochemistry [5], inorganic polymers [6], and source-based nomenclature for copolymers [7] were also being addressed.

Polymer science more generally, and not just polymer chemistry, became the focus of later terminology papers such as those dealing with dilute solutions [8], and crystalline polymers [9] and their classific tion [10]. An early compilation of these documents resulted in the publication of the fir t edition of the so-called Purple Book, or Compendium of Macromolecular Nomenclature, in 1991 [11]. The '90s saw an extension to new areas such as the nomenclature of double-strand polymers and of irregular single-strand polymers, and the terminology of liquid crystal polymers and of non-ultimate mechanical properties [12], amongst others.

With the restructuring of IUPAC in 2001, in the course of which the Division of Chemical Nomenclature and Structure Representation (Division VIII) was

created along with the shift from commission-based to project-based work, the Commission changed its name to that of the present-day subcommittee, and the distinction between terminology and nomenclature was thereby at long last explicitly acknowledged. The terminological work continued unabated with publications on functional polymers, polymer composites, sol-gels, and ionic polymers. However, nomenclature work did not end, as by mutual agreement Division VIII was happy to delegate the development of polymer nomenclature to SPT while not relinquishing overall responsibility.

The 2nd Edition of the Purple Book appeared in 2008, and in it one can find many of SPT's key publications [13]. The last decade or so has seen a continued expansion of terminological work towards inter-science areas, those where polymers find application in electronics (resist materials and semiconducting polymers), biology (polylactides) and computing (modelling and simulation of polymers). In the nomenclature arena, the more commonly used source-based nomenclature has for the fir t time been elaborated in its totality [14]. Structure-based nomenclature is now being developed for star polymers under the excellent leadership of Jiazhong Chen, from Dupont, one of our valued members from within industry [15] and, importantly, given the different possible names for any one polymer, the publication of recommendations of preferred names is imminent [16].

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The problem for many scientists and students of accessing and assimilating all this work in order to use it correctly has been attacked on various fronts. The Purple Book was made available online as a pdf file in 2014 [17], while numerous efforts to make terminology and nomenclature more available have been made through work with Wikipedia [18], and on an active online multilingual translation facility for the *Glossary of Basic Terms in Polymer Science* [19]. The point at which I fir t opened my mouth in SPT, without giving it any great thought, was to launch the idea of preparing *A Brief Guide to Polymer Nomenclature*—a Polymer Division analogue of the Physical Chemistry Division's Green 2-page leaflet *A Concise Summary of Quantities, Units and Symbols in Physical Chemistry* published in 2009—the intention being to offer a ready understanding and easy access to all our definiti e nomenclature publications. To me, it shows the strength of SPT that, as soon as I'd spoken, Dick said, "Go away and develop a project." He knew that if the idea was a bad one, the membership would turn it into a good one or shoot it down in flames. In fact, the team rallied around what seemed at fir t sight to be a daft idea, *i.e.,* to compress all of IUPAC's polymer nomenclature into two pages to make it more accessible; they then turned it into something tangible. A true team-effort ensued, resulting in a student-friendly reference document that is now also used by most polymer journals and societies around the world [20].

All the above describes how SPT has evolved and what it produces, but why does it do it and how does it do it? Furthermore, how have events and personalities shaped the work in SPT?

IUPAC publications are used world-wide by governmental and non-governmental bodies (the EEC, UNESCO, *etc.*), legal entities (litigation courts, solicitors and patent offices), publishers (such as ACS, Elsevier, RSC, Springer, Wiley, *etc.*), universities and schools for their research and teaching, and Wikipedia and other websites adopt our definitions. Why though? I think that this question is best answered by a quote from the Director of Patents for a large, multi-national company: "In the drafting, prosecution and litigation of chemistry patents we are grateful if we can rely on exact nomenclature and definitions as provided by IUPAC, as this helps us to define the claimed scope of protection more precisely. In patent law, clear and concise claims are also an important requirement for a patent to be valid. So, your work is much appreciated." While this statement validates the work done within SPT, it also shows that the crafting of definitions for terminology and of rules for nomenclature can have a very real economic impact. The work of SPT and of IUPAC more widely helps companies maintain their scientific programs. For scientists at the bench, we help ensure that concepts, and chemicals and other materials are clearly defined and specified. Similarly, in the publishing industry, our work saves editors time and money by ensuring that expressions and names used by authors identify specific parameters and materials that do not require deciphering or transcription. Additionally, our defin tions help ensure that searches lead to relevant publications. In education, the usage is even simpler to understand. We provide clear, simple definitions for what can sometimes be quite complex concepts. Teachers

and students know that these have been carefully examined by working groups of world leading experts in the relevant fields. What they might not know is that the definitions can go through twenty or more iterations and be subject to scrutiny over a period of several years in intense meetings and ping-pong like electronic exchanges before being presented for public review and final approval for publication by the higher committees in IUPAC. What is also rarely known is that all IUPAC recommendations are made freely available and can be reproduced in any form whatsoever as long as they are done so in whole and with citation, which is fine as they are often short. So much for the why, now for the how.

SPT is only one of four subcommittees in the Polymer Division, and while not being the largest, it is the greatest user of funds. The reason is that for its work to be completed assuredly, it requires regular face-to-face meetings of its members so that the meanings and implications of each definition and rule are not open to misinterpretation. Recently, as electronic communication improves, from time to time some members engage with each other using Skype or meetings by video link. However, experience has shown that a maximum of two video connections are possible for any meeting. Every year without fail SPT meets for four days. These meetings are quite often in exotic locations from around the world, preferably near a beach but always near a bar. Following the changes of 2001, it was decided that project funds were to be used to ensure Division members—in particular SPT members—get help with travel and accommodation at the annual meeting venues. When distributed, this does not result in a great deal of money and it certainly doesn't cover all costs; it reflects the dedication of our volunteers that they are prepared to find the balance from other sources and sometimes from their own pockets.

Val Metanomski

Itaru Mita

Bob Stepto

Once assembled at our annual meetings, a recent innovation has been to have a lecture on a topic of relevance, and then to get any administrative business out of the way before spending an hour planning the coming week of project meetings. The Subcommittee currently has about 18 projects, each with a team of between 4 and 10 people chosen from both inside and outside of SPT. Weighed against the constraints of available time and the ability of members to move between rooms simultaneously like Schrödinger's cat, each is allocated an hour or two for discussion time. Once the timetable is set, members begin work, discussing terms and defining rules for nomenclature. This might sound dry, but dealing with issues of chemistry, for which full understanding of the underlying principles is required in order to develop definitions that can be understood by all, the frankest of discussions develop amongst friends and colleagues. There is respect for all views expressed and a team spirit guides all work towards clarity and consensus. This is surely one of the highest callings in science: that of an international team of volunteers working to the limit of its abilities. Inevitably there are some heated arguments but these are to be weighed against farcical exchanges when laughter reigns. However, when all is said and done, everyone comes together around the work in hand.

The years since SPT came into being have been witness to the sad demise of some of those who were in at the beginning: Val Metanomski from the Chemical Abstracts Service, whose scholarly contributions spanned the years between the publications of the 1st and 2nd editions of the Purple Book. Itaru Mita from Japan, who served for even longer, brought his gentle manner, patience and clear understanding of how IUPAC documents are best presented for the benefit of the non-English-speaking world. Our former Division President, Bob Stepto steered us to safe waters following the 2001 reorganization. Others from that era no longer travel to our meetings but still contribute to our progress and keep us safely aware of all that has gone before, in particular Pavel Kratochvil of the Czech Republic and Aubrey Jenkins (UK), both chairs of the former Commission on Macromolecular Nomenclature. The same years have also seen the recruitment of many excellent new members: Karl-Heinz Hellwich from Germany, who is presently the President of Division VIII and a mine of knowledge concerning nomenclature; Michel Vert from France, who has led SPT in addressing issues concerning biological polymers; and

Werner Mormann, also from Germany, who has been a leader in the field of polymer education as well as contributing to terminology and nomenclature.

In 2017, the Subcommittee continues to pursue traditional projects, typically *Definitions of Terms Pertaining to Polymers in the Solid state: Molecular Arrangement from the Nano- to the Micrometer Scale*, and a *Guide and (Brief Guide) to Polymer Semiconductors,* respectively under the leaderships of Natalie Stingelin and Michael Walter. These are just two of a number of younger members who have joined SPT recently, and the 'Brief Guide' that will be an integral, though self-standing, part of the latter project is indicative of a shift towards the preparation of shorter documents directed towards achieving far wider dissemination of our recommendations. *A Brief Guide to Polymer Terminology*, a sequel to the fir t of these concise documents, the *Brief Guide to Polymer Nomenclature* (*vide supra*), is in preparation.

A particular key to our success is the very strong camaraderie within SPT. A couple of years ago in South Korea, we had a delightful lecture from Professor Werner Mormann on the occasion of his retirement from the Subcommittee. He told about how he would fill his time in future, of his family activities and on how he had enjoyed being a member of SPT. It seems, however, that he couldn't keep away, for we were particularly pleased to see him return to join us in Brazil in 2017! We hope that other 'retired' members, such as Dick Jones, will follow his example at the next General Assembly planned for Paris in 2019 and be able to return.

Recent years have also seen tumultuous events, the most notable being when MACRO 2016 and our annual division and SPT meetings were held in Istanbul. (see page 33) The timing was such that we fl w straight into the attempted Turkish *coup d'état*. I remember many things from that time: the warm spirited strength and open friendliness of Professor Yusuf Yagci and his team who looked after us so well; all of the SPT members and observers, alongside others from the Division, participating and making their very best and courageous contributions to ensure that all SPT meetings were so productive; and the tours and the wonderful late night meals and bars that were such good fun. Everyone, including new members and young observers, wanted to make sure that the right thing was done. I particularly remember the camaraderie and support of friends and colleagues from all around the world who were much more worried about us than we were for ourselves. This strong bond that exists between all members of SPT now also helps to warmly welcome our new members and observers.

It's easy to see that part of SPT's ethos is to ensure that after hard days spent debating there are good evenings to be enjoyed. Here we are very much indebted to the efforts of the Subcommittee Secretary, presently Dr. Paul Topham, a friend and colleague of remarkable efficie y. With the help of local members, he has organised meeting rooms and tours which this year included a visit to the tallest building in São Paulo to drink champagne, in addition to taking concise minutes and keeping the Chair in timely order. Indeed, the annual Thursday afternoon tour is always an important social event of SPT members' week abroad. When I was the Secretary a few years ago, I organised one in Puerto Rico at which our bus driver was replaced at the last minute by someone called John. John, as it turned out, had been retired for longer than he had worked. This is no great problem for many, but for John, as driver and tour guide rolled into one, it presented a challenge. As he animatedly explained that Obama was President, and how such and such a building was a hotel, he rattled us through San Juan to the Bacardi rum centre. Once there, we were relieved to find that a one-drink ticket was seemingly recyclable, and that the barman was happy to take us on for any cocktail we could imagine. On our return to the city in the full heat of the day, we were too joyful to care whether or not John could unstick the bus from a corner wall that he'd wrapped it around, and as the traffi in the centre of San Juan stopped moving and police motorbikes swooped in, we abandoned him to his fate and headed to the nearest bar.

Early on I mentioned *Tierra del Fuego.* This was written whimsically in the hope that poetic licence will be allowed in *Chemistry International,* but given that it is an IUPAC publication, even the slightest flight of fancy, not even for a story hook, can be allowed. In all truth, finding new venues for our meetings is becoming increasingly difficult, so this year Chris Fellows proposed that we consider holding MACRO-2028 at the very tip of South America, in *Tierra del Fuego.* In later conversations with Professor Carlos Graeff of São Paulo State University, it became apparent that this idea is not quite as crazy as it seems, and even though the average temperature in July is only 4 ˚C, there are some towns which might be able to cater for 1500 people. While Argentina is not currently affil ted to IUPAC, Chile is, so it would have to be held on its side of the border. Sadly, there wasn't enough time at this year's meeting for Chris to do a test run before presenting the idea to the Polymer Division, but I hope that maybe there would be support for a conference in February when temperatures have been known to soar to 9˚C!

All of this is an entirely personal snapshot of SPT past and present. There are many people that I haven't been able to mention for reasons of space, but all our members play important and often complementary roles in developing recommendations that are acceptable world-wide in a peaceful atmosphere of fun and goodwill, thereby clearing the road for the communication of science. I'd like to take this opportunity to thank all members for the wonderful job that they do; it's an amazing team of which I'm proud to be part.

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