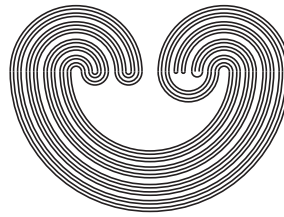

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by

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RALPH KOPPERMAN: SOME REFLECTIONS

JIMMIE LAWSON

The “27th Summer Conference on Topology and its Applications,” held July 25-28, 2012 at Minnesota State University, Mankato, Minnesota, was advertised as being “in honor of Ralph Kopperman’s 70th birthday.” This was a most apt and fitting tribute since Ralph himself was the originator of this conference and has been its driving force through the years. The first two of the “New York Conference on Limits” took place July 2-3 of 1984 and 1985, then skipped 1986, the year of the Prague Topology Conference, and resumed in 1987. In the following years Ralph set the conference on a firmer and more enduring foundation by establishing an organizing committee with rotating membership, expanding the scope of the conference under the banner of the “Summer Conference on Topology and its Applications,” and broadening the conference site and hosting duties to include other universities and, before too long, international hosts. Over the period of its existence the Summer Topology Conference has become one of the major attractions for topologists, from those early in their careers to leading researchers, and has brought together researchers from around the world representing a broad cross-section of topology-related mathematics.

Ralph started his mathematical life as a logician, but in time moved to topology. This move was motivated by topological considerations that arose in his work in logic, but he rapidly found the topological community a congenial one in which to work, and adopted topology as his new (and lasting) research focus. One of his research directions involved developing connections between topology and computer science. Since many of the mathematical models in this direction involved finite or “discrete-like” structures in one direction and continuous domains in another, one was led to consider T_0 -spaces that were definitely non-Hausdorff as models.

All this led Ralph to a broader interest in what he likes to call “asymmetric topology,” which has one manifestation in the “order of specialization” of T_0 -spaces, definitely a relation eschewing symmetry (but nonetheless often exhibiting interesting dual structures, another keen interest of Ralph’s). Another motivation (coming from logic) involved first-order axiomatic descriptions of topology, where generalized, not necessarily symmetric, metrics played an important role. Ralph illustrated such asymmetric metrics by noting that in certain contexts it makes sense that distances measured uphill should be longer than those measured downhill. These interests have led Ralph to be involved in organizing and presenting in numerous special sessions in the Summer Conference devoted to (asymmetric) topology and computer science.

Mathematics is a world-wide discipline and Ralph has embraced that diversity. He has reached out in a variety of ways to mathematicians from a wide background of specialties, backgrounds, and locations and indeed has written joint papers with a substantial number of them. I am confident that my fellow topologists will join me in expressing appreciation to Ralph for the ways he has enriched our lives—through the Summer Topology Conference, through his mathematics, and through personal contact (see a few examples in the tributes that follow). We wish Ralph all the best in this year of his 70th birthday and in the years to come.

Ralph Kopperman is devoted to both the Summer Topology Conference series and the New York Seminar on Topology and Topological Algebra, and his diligence on their behalf is legendary. When I first joined the Seminar, although I had no previous experience, Ralph convinced me to organize the sixth summer conference at Long Island University - C.W.Post in 1990. He talked my colleague, Sheldon Rothman, into doing the same thing nine years later. Other members of the Seminar have been similarly persuaded. Prabudh Misra hosted the conference at the College of Staten Island in 1989, Gerald Itzkowitz chaired one at Queens College in 1992 and, of course, Ralph himself organized the summer conference five times at City College. All of us have been impressed with Ralph’s insistence on obtaining the best possible speakers while keeping participant costs to an absolute minimum.

Ralph’s mathematical achievements are outstanding, and a key to his impact is the number of his coauthors, which is upwards of 50 by now. He delights in the cross-fertilization of ideas among specialties and individuals. From my own experience, Peter Nickolas discussed with Ralph the well-known Ellis’ Theorem, that a group with a locally compact Hausdorff topology making multiplication separately continuous must be a topological group. Ralph had the idea to generalize it to the asymmetric

case and suggested that I look at the paper *Bitopological and topological ordered k -spaces*, which he had coauthored with Jimmie Lawson. The result was our joint paper *An asymmetric Ellis theorem*, as well as a later paper extending this result to *A family of asymmetric Ellis-type theorems*, containing a generic theorem that can be applied to an asymmetric space whenever the symmetrization of that space with its k -dual is a Hausdorff k -space for which a classical Ellis-type theorem is known. Strashimir Popvassilev was an additional coauthor and found an example letting us know the limits of the theory. Ralph is currently promoting asymmetric, digital and metric-like spaces, but through his seminar invitations and wide variety of papers, he exhibits broad interest in much of mathematics. Whatever the topic, he follows a talk closely, asks questions, and sometimes plants seeds for further development with a gentle “Do you really need that requirement?”

Susan Andima
Long Island University - C.W.Post, USA

The early days of topology were dominated by the Hausdorff axiom and if this is less true today then Ralph and a few fellow spirits can take much of the credit. Of course there are good reasons why the Hausdorff axiom is important. Many properties, such as that of compactness, only gain their full strength in its presence. It is also associated with symmetric structures such as metric spaces that occurred, and continue to occur in many applications. With the passage of time, however, increasingly many applications have produced non-Hausdorff spaces, often from structures that are overtly nonsymmetric. Nowhere is this more the case than with Computer Science, and in his work towards a theory of such spaces, to which he gives the name “Asymmetric Topology”, it is Computer Science that largely provides the impetus. Domain theory and digital topology, to mention just two, are topics that continue to bind the Asymmetric Topology and Computer Science communities tightly together.

The human attraction to symmetry is strong, and it was J. C. Kelly who first noted that by considering a pair of topological spaces and expressing their joint properties in a suitable way it may be possible to recover a form of symmetry that is not present in either space individually. Ralph used bitopological spaces in an essential way in his theory of duality. Thus one can consider a class of spaces which together with a specific dual have a particular bitopological property. Here we mention just one example, the important class of skew-compact spaces obtained using the de Groot dual and bitopological joincompactness. The literature on this aspect of Asymmetric Topology continues to grow rapidly.

Another topic in Asymmetric Topology that still interests Ralph and his co-workers is digital topology. Here the aim is to place the topology of the digital plane on a truly topological foundation. The pioneering work on Connected Ordered Topological Spaces is essential in this context. Finally, this short sketch of Ralph's work would not be complete without mentioning the computer storage of topologies, the representation of more classical spaces by finite topologies and his notion of generalized metric that can generate arbitrary spaces.

At the turn of the century the joint work by topologists and computer scientists was the inspiration for the Dagstuhl Seminars organized by Ralph and his co-workers. It was a great honour for me to attend two of these meetings and I benefited greatly from the excellent presentations and quiet atmosphere. The 2000 meeting was particularly important for me since it was there that I first mentioned to Ralph the possibility of holding a conference in Ankara. The outcome was the 2001 Conference on Applicable General Topology held in Hacettepe. The international organizers and keynote speakers reflected to a large extent the composition of the Dagstuhl meeting and as can be expected Asymmetric Topology was given pride of place. I learned a good deal from Ralph about the techniques and etiquette of organizing a conference, and I am greatly indebted to him for his help and unfailing enthusiasm.

Which brings us last, but certainly not least, to one of his best known achievements - the Summer Conferences on General Topology and its Applications. From a modest start as a series of conferences in New York City, it has developed under Ralph's guidance into perhaps the most important General Topology Conference Series on the mathematical calendar. I wish it every success in the future and hope very much that Ralph will continue to be at the helm for very many years to come.

I am sure that everyone will join me in wishing Ralph a very happy 70th birthday and a long, happy and productive retirement.

Lawrence M. Brown
Hacettepe University, Turkey

Many gifted colleagues in mathematics are most deserving for their unique contribution to a particular specialism that leads our discipline forward. But few can be as broad and modest in their multiple contributions as is Professor Ralph Kopperman. Having worked closely with Ralph for twenty years I have seen a great communicator & teacher with his students, a risk taker having the gall & patience to argue that *All Topologies come from Generalised Metrics*, the cool calm administrator of this

Summer Conference or the Chair of Mathematics at City College CUNY, and most importantly the friend of all friends.

I recall once arriving from the UK, straight into the back of Ralph's evening class at City College. Enthralled by material I once learnt twenty years earlier on regular spaces, Ralph just connects with his students as though this was the first ever class in human history. At the time I was so envious how anyone could possibly teach so well, so I had to amuse myself by wondering how any good teaching could happen using those curious chairs with a leaf table? After all, we Brits across the pond manage okay without them? It is a mark of Ralph's great teaching gift that he is at ease with an undergraduate topology class, as he is with a graduate student, as he is with a trying colleague such as myself who needs much time & patience to assimilate technical foundations.

Over some twenty years Ralph has helped me understand my own research in Computer Science as an important contribution & ally to his own interests in generalised metric topology. Ralph has argued long & passionately for the use of asymmetry in general topology, while I with others have found ourselves converging to a similar position from the Computer Science perspective of *domain theory*. Ralph's quiet persistent contributions to asymmetric topology have taken time to flourish. Most notably the Asymmetry Session of this Summer Conference has enabled many researchers such as myself to straddle the unfortunate divide between Hausdorff topology and T_0 -separable domain theory.

At 70 Ralph surely deserves a rest, but no, for one more year he would be Chair of Mathematics at City College. I had the moving experience of seeing Ralph the administrator & leader at work, taking it all in his stride as just another day at the office. This reminds me of how once Ralph was on study leave in the UK, commuting each week around Birmingham Computer Science, Imperial College Computing, & Oxford. Ralph has been such a great teacher, co-worker, & friend. The latest lesson for me from Ralph at a Mexican restaurant on the eve of the 2012 Summer Conference: "Steve! This is the US! You're allowed to eat food with your fingers!"

Steve Matthews
University of Warwick, United Kingdom

I met Ralph Kopperman at a topology conference in 2001. I found him very modest and easy to approach for discussing mathematics. I was a Ph.D. student in Iran at the time and we could spend 6-9 months outside of the country for research. I decided I wanted to work with Ralph. I started working with Ralph in October 2002 in England while he was on

his sabbatical. He was extremely helpful and nice. I could get in touch with him almost any time to discuss mathematics and he was very patient, especially 10 years ago when I had a stronger accent than today and not as much vocabulary. After I was in England for a couple of months, I thought immigrating might be a good idea for me and discussed it with Ralph. Since then he has been helping me generously not only in my mathematics life but also in my entire life. He helped me to start a post-doc in Ireland after my Ph.D. Then, he helped me to come to the US. We have continued to do research together and to share ideas. He has always been a great mentor in my life, even though there have been times when I was not been the best I could be, due to my conditions. But he always was understanding. Not only is he a great mathematician but also an exceptionally great person.

Homeira Pajoohesh
Medgar Evers College, CUNY, USA

I think I first met Ralph in New York at the Independence Day Conference on Limits in the mid 1980's. Ralph was newly converted to General Topology having been raised a logician (I think Paul Meyer had some influence in this conversion). Our collaboration started during my sabbatical at Lehman College in 1987 and has continued off and on for 25 years. We have met and worked regularly, not only in Mexico City and New York, but also at conferences and meetings on three continents. Ralph is dedicated to asymmetry and our work has always involved non-Hausdorff spaces, which most topologists tend to ignore. I think it's fair to say that Ralph has done more to interest topologists in the class of T_0 -spaces than almost anybody. Moreover, he has proved so many interesting results regarding this class of spaces so long looked down upon.

I know Ralph has been talking about retiring for a few years now. While I don't entirely believe that he will take that drastic step, I am sure that if he does, what he means is that he will be retiring from CUNY and teaching - I'm quite sure that his plans still include skewcompactness, partial metrics and spectral systems. I'm also pretty sure that Connie has not yet seen the last visiting topologist at their home!

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