

Ivor Robinson: a Brief Appreciation of His Science

By Roger Penrose May 2017

Ivor Robinson had an important influence on my research into mathematical physics. I believe that it was through Dennis Sciama that I first met him, sometime in the 1950s. Ivor always spoke about his ideas with impressive gestures, distinctive prose, and infectious enthusiasm. He had a remarkable original talent for words, and this was his way of conveying his impressive research ideas to the world outside. When he could find an appropriate colleague to write it all up, this would usually result in an important joint publication. I never had the privilege of collaborating with Ivor in this way, but I benefited greatly, in particular, from his famous 1962 paper with Andrzej Trautman. This had a considerable importance for me with regard to my understandings of asymptotically flat space-times, and how to describe such asymptotic flatness in a clear geometrical way.

Even more influential for me was his seminal role in my development of the theory of twistors. This came from Ivor's ingenious procedure for the construction of what are called *twisting null* solutions of Maxwell's equations. He had found a way, starting from *non*-twisting such solutions, to obtain twisting ones, by displacing them in an imaginary direction, and then taking the real part. (The experts will know what I mean here!) The simplest case of this provided what I referred to as a "Robinson congruence", and it yielded the key insight, for me, enabling the launching of the theory of twistors in 1967. Although the actual picture (featured on the cover of *Twistor Newsletter*, and elsewhere) depicting a twisting family of interlinked circles—actually stereographically projected Clifford parallels—does not often enter into much of the details of current work in twistor theory, it was conceptually most important for my own thinking. I termed, the twisting shear-free family of light rays that this picture represents a *Robinson congruence*, in Ivor's honour. (Penrose, page 2)

Inspiring meetings with Ivor Robinson: in person and work

by Jiří Bičák, May 5, 2017

It was sometimes at the beginning of 1969 when I received a letter of invitation from Asher Peres to participate in an International Seminar on Relativity and Gravitation to be held at the Einstein Institute of Physics, Technion, Haifa, Israel on the occasion of the 60th birthday of Nathan Rosen. I was, of course, pleased but replied that, unfortunately, I do not have a means for travel and stay in Israel. In an envelope with my reply I also attached the copy of my paper on “Gravitational Radiation from Uniformly Accelerated Particles” which appeared in 1968 in the Proceedings of the Royal Society (communicated by Hermann Bondi). To my great surprise, after few weeks a letter came with the invitation to give one of the main lectures in the Seminar, with the air-ticket Prague-Tel Aviv enclosed and the promise to cover local expenses for a 2-week stay in Israel. Now I hurry to say that I was very happy, indeed, but I also realized that most likely there was a very human though simultaneously a “political” touch in my invitation. It came just a few months after August 1968 when Soviets and their allies occupied militarily/absurdly Czechoslovakia to stop the “Prague spring”. I was the only participant from the Soviet block; the regime then closed the border during 1971.

During the seminar I felt, perhaps wrongly, that for some participants it was somewhat strange that a 25-year old Czech was invited to give one of the main talks. Not so for Ivor Robinson! During the talk he asked most pertinent and interesting questions, which allowed me to explain various aspects in more detail, and we had several discussions in the following days. Although I did not dare at all to speculate that I might work with him he himself suggested that he will try to find some means to invite me to Dallas. This did not realize but the encounter with professor Robinson in Haifa meant a very special encouragement for me. (Bičák, page 2)

Much later, after “bringing black holes” to Czechoslovakia ☺ (after several months in Kip Thorne’s group) , I started to be attracted again by exact radiative spacetimes. And it was in 1986 when, with Zoltán Perjés, I wrote the first paper on the Robinson-Trautman spacetimes. They have become a source of inspiration also for my later work, in particular after important results by Piotr Chrusciel. Among various aspects I enjoyed perhaps most is the work with my PhD student Jiří Podolský published in Physical Review in 1995 and 1997 in which Robinson-Trautman spacetimes with a non-vanishing cosmological constant were shown to represent both exact models of formation of a black hole in an asymptotically non-flat spacetime and exact models of the “cosmic no-hair” theorem. In fact, until today a number of relativists in Prague have worked on these spacetimes including “higher dimensions” generalizations (cf. papers by M. Ortaggio, V. Pravda, A. Pravdová, J. Podolský, O. Svítek, T. Tahamtan, M. Žofka...). . (Bičák, page 3)

Peter Aichelburg, May 5, 2017

Dear participants at the memorial symposium in honour for Professor Ivor Robinson. I very much regret not to be able to attend. Although Professor Robinson and I were not in frequent contact, I met him at several conferences, listen to his contributions and had the opportunity for private conversations. His sharp intellect and his friendly powerful speech always impressed me. Some years ago, and I don't remember the date, I visited Professor Wolfgang Rindler in Dallas. On that occasion I had the privilege to be invited to the house of Joanna and Ivor for dinner. It was a pleasant evening and I remember well the lively discussion about a solution which Roman Sexl and I obtained by boosting the Schwarzschild black hole to the velocity of light. Ivor Robinson's contributions to General Relativity are substantial and certainly will not be forgotten. I wish you an interesting meeting with lively discussions, much in the spirit of Professor Robinson.

Michel Dahan, May, 2017

I met Ivor Robinson in Syracuse (NY) in 1963, when I came to spend a PostDoc year in the physics department where Peter Bergmann was heading a research group in relativity. Ivor came to pick me at the airport and drove me to the department on an icy road. I still remember the oscillating character of our trajectory. From this first day, I was totally fascinated by his warm personality and by the elegance and precision of his speech. His views on relativity were clear and original and certainly taught me a lot. He attracted me to Dallas and I spent more than six months a year in the Southwest Center for Advanced Studies from 1964 to 1972. Although we never published together, I certainly benefitted greatly from some of his remarks and from his algebraic virtuosity. It is thanks to him and to Wolfgang Rindler that I met Jeffrey Walker who invited me to Berkeley and made me switch my interests from relativity to differential geometry. Simone Gutt and I met again Ivor in 1983 in Dallas, where Joanna and him kindly invited us to their home. Our last interaction was in 1988 in Warsaw with Andrzej Trautman. Ivor's presence warmed considerably this very cold Polish winter. When thinking back of these Texan summers of the late sixties, I still dream of the nice human and scientific atmosphere which were due to Ivor and I thank him for it.

Wolfgang Kundt, May 2017

My contact with Alfred Schild, Engelbert Schuecking, and Ivor Robinson flourished during the 1950s and 1960s, i.e. during the 'founder years' of Relativistic Astrophysics, when all of us met quasi regularly, during conferences, and during visits - a wonderful time for me, as a young, curious scientist, student of Pascual Jordan, close collaborator of Juergen Ehlers, Engelbert (Schuecking), Ted Newman, Felix Pirani, Ray Sachs, Stephen Hawking, Ivor Robinson, Roy Kerr, John Wheeler, Remo Ruffini, and many other influential colleagues of mine, mostly close friends as well.

I am aging, as all of us do, though I still like climbing mountains, playing tennis, enjoying life with my wife Ulrike, daughter Liane and son Rasko, and my grand children Pia and Ely; and still use most of my spare time for studying the Universe, with convictions collected, among others, in 4 books: a yellow one, a green one, a blue one, and a red one. You can read a short summary of my recent interests in: <<https://wolfgangkuntt.wordpress.com>>.

And Ivor? He played a crucial role in my life, during the days of my dissertation, when he taught me - among others - to find complete classes of solutions for wave fields described by Einstein's field equations. And when we went horse-riding in Texas, together with Ulrike. We both like to remember those days.

Rainer Sachs, May 2017

I remember Ivor mainly from our interactions while I was in Europe, I think in about 1962. I had, belatedly, run across a tensor, the Bel-Robinson tensor, which he and Bel had studied previously. Ivor and I both thought the tensor might help clarify the intuitive idea that one should be able to assign an energy to the gravitational field and that this energy should, like all forms of energy, act to influence the gravitational field, i.e. itself. We both tried some calculations with the tensor to make this intuitive idea more precise. I never was able to make much sense out of my calculations.

At that time I was strongly anglophilic owing to my family's experiences in Nazi Germany. Ivor, ever the cosmopolitan, considered me over-enthusiastic and naive in this respect. We used to argue, good-naturedly but sharply. He always seemed to win the arguments. (Sachs, page 2)

Later, when we were both in Texas, Ivor organized international symposia that I remember as being particularly strong in their discussion of ideas, rather than emphasizing funding, prestige, and careers. One of these symposia was a turning point in my thinking about general relativity. Rather than being just a refuge from real physics, such as particle physics and other respectable sub-fields, it was clearly acquiring a much stronger observational arm and thus becoming real physics itself. I think Ivor's habitually broad and sophisticated approach was largely responsible for the especially valuable character of that symposium, and the others. (Sachs, page 3)

Andrzej Trautman, May 2017

We met first in 1958 in London, where I was giving seminar reports at King's College. We quickly became friends, Ivor took me to Liverpool, to his family residence (Hilltop), where I met his parents, his sister and brother. At my suggestion, Leopold Infeld invited Ivor to spend several months, during the academic year 1958-59, at the Institute of Theoretical Physics in Warsaw. Ivor explained then to me the idea of shear-free null geodesic congruences and suggested that we start looking for solutions of Einstein's equations that admit such congruences with expansion. We did most of the work, through correspondence by airmail, in 1959-60, when Ivor was at Chapel Hill with the DeWitts and I was at Imperial College in London with Abdus Salam. We continued our collaboration in 1961, when we were together at Syracuse University, invited there by Peter G. Bergmann. Our first publication, Spherical gravitational waves, *Phys. Rev. Lett.* 4, 431-432 (1968) was followed by eight other joint papers written during the years 1962-93. I consider my collaboration with Ivor Robinson to be the most important and agreeable in my scientific life.

Josh Goldberg, May 2017

I first met Ivor Robinson, not in the flesh, but through a paper he coauthored with Hermann Bondi and Felix Pirani. The paper was entitled *Gravitational Plane Waves in General Relativity, III. Exact Plane Waves*. This paper, written in 1958 and published in 1959, pointed out that the singularity in the Rosen attempt at a plane wave was a coordinate singularity. Ivor and his coauthors made use of the newly developed Lichnerowicz jump conditions across null surfaces to construct a plane wave pulse between two null surfaces. The pulse lasts a finite time and moves indefinitely. This paper impressed me because I had just learned about the jump conditions from Lichnerowicz's book. Also, in 1954 I had the opportunity to meet Einstein and to talk to him about attempts to generalize the work he, Infeld, and Hoffmann had done on the motion of point masses. Einstein remarked that he was not interested in the equations of motion. He wanted to find an exact solution for gravitational waves. Unfortunately, he died four years before that was done.

I finally met Ivor during my stay at King's College a couple of years later and was charmed by his wit and cleverness. It was during this time that Ray Sachs and I wrote the paper on the Petrov classification and proved the theorem that a space time with shear free and twist free null congruence is degenerate, that is, it has at least one principal null vector. We proved the necessity using the differential identity of the Curvature tensor, but to prove the sufficiency we used some of the results in the 1962 Robinson-Trautman paper: *Some Spherical Gravitational Waves in General Relativity*.

However, I really got to know him in the summer of 1962 at the mathematics workshop that invited people working in general relativity. While much of the workshop focused on quantum gravity, we had discussions about null rays and gravitational radiation. It was there that Alfred Schild recruited Ivor and Engelbert Schucking to organize a relativity group in Dallas. While Engelbert left to go to NYU, Ivor remained and built the important research group that has existed and still exists here at the University of Texas at Dallas.

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However, in the year 1962-3, both Ivor and Engelbert, along with many others, were visitors at Syracuse University. Among the very many attendants, this was known as the year of the kibbutz. In spite of the free spirit this identity indicates, while there, they collaborated with Peter Bergmann on a paper titled

I have been the beneficiary of the group that formed by Ivor and Engelbert. First of all, by the Texas Meetings on Astrophysics which were organized in 1963. But, mostly as I have had several opportunities to visit the group and to present my failed attempts to find generalizations of the EIH procedure. I am grateful that Ivor, Joanna, and the others were gracious in listening and gently questioning. The gentle part must have been very difficult for Ivor could be quite harsh in his criticism.

Finally, Ivor was very opinionated in his politics. His support of Israel and his denunciation of Communism was unabashed. He had a harsh judgement of the views of those, including myself, who did not completely share this unabashed opinion. However, at least in my case, that did not interfere with our friendship and mutual respect. However, it is perhaps worth briefly outlining an event that came close to breaking up the relativity community. The 1969 GRG meeting took place in the

Soviet Union at Tbilisi. Initially, the Soviets refused to admit any Israeli although at the last minute they made a visa available to Asher Peres, but also made it difficult for him to receive it. At the organizing meeting of the ISGRG at Copenhagen in 1971, Ivor presented a motion that the ISGRG should request an apology from the Soviet Union for the ruckus in 1969. The Soviet attendants walked out as did many other of their supporters. Finally, heads cooled and Ivor's motion lost by 46/36. I believe that part of the current by-laws of ISGRG has a statement that meetings are open to everyone and that no government should refuse entry of an attendant for political reasons.

I have sketched only a small part of Ivor's life and other people can fill in other aspects. But, even the small amount that I have described shows that it was a life well worth living.

Peter Hogan, May 2017

I met Ivor in Austin, Texas forty-four years ago and he invited me to Dallas. This started a period of over twenty years during which I visited Dallas quite frequently to work and to learn from Ivor. In all of this period I stayed with Ivor and Joanna and benefitted from their exceptional hospitality. Sometime during these years I was contacted by Ivor from Liverpool where he was visiting his mother suggesting that I might visit so that we could continue our discussions on Relativity. I spent a few very pleasant days discussing with Ivor and meeting his mother, sisters

and brother Leon. It was an edifying experience for me facilitated by the rather amusing notion that, after all, Liverpool is just a suburb of Dublin! My visits to Dallas included the added bonus of being able to interact with Piste Ozsvath and Wolfgang Rindler. Since Wolfgang played such an important consultative role in the symposium in memory of Ivor I am bound to record that fifty years ago exactly (in 1967) I was lucky enough to study Special Relativity for the first time from his book, which was published in the prestigious series of University Mathematical Texts by Oliver and Boyd Ltd.. Wolfgang's text is beautifully written and, importantly from a student's point of view, contains one of the best collections of exercises I have ever encountered in Special Relativity.

In fact some of the exercises have, over the years, achieved iconic status! I met the null cone for the first time in Wolfgang's text. His description of how a null cone subdivides space-time into a region inside the future sheet of the cone, a region inside the past sheet and a region outside the cone has always intrigued me on account of the word he chose for the region outside the cone. He called this "elsewhere". What an interesting choice of word! Over the years, when I have been involved in conversations in which I asked someone if they had been at such and such an event and they gave me the dismissive answer "I was elsewhere" I have always thought to myself "aha! I know where that is, thanks to Wolfgang Rindler". As a result of my engagement with Ivor my work has always had a thread running through it which reflects his influence on me and I have been forever grateful for that.

Don Salisbury, May 2017

I still vividly recall from 1977 Ivor's booming voice on my first encounter when he spoke up from the floor during GR8 in Waterloo, Canada. And I was grateful for the opportunity to really get acquainted with him when I invited him to give a talk at Reed College in 1984. This meeting was in part responsible for my decision to come to Texas where I knew I would be able to interact with Ivor's active relativity group at UTD. He was immediately supportive of my idea in 1989 to establish a North Texas Relativity Seminar with most of our regular meetings on the UTD campus, and he was a regular contributor. I recall many a blackboard filled in his characteristic spontaneous style by the world's bi-vector master! María Cecilia and I treasure so many fun-filled memories of Ivor's graciousness and wit at home in his element.

Christine DeWitt, February 2020

(Anecdotal Memories of her mother, Cécile Morette-DeWitt)

At the International Jablonna Conference on General Relativity and Gravitation (GRG-3) in 1962, organized by Infeld, Infeld had instructed his students to take care of all the world-famous physicists during their stay in Warsaw - essentially the wish of the guests was their command; and somehow the opportunity to go horseback-riding with Joanna (or thanks to Joanna) arose, and my mom leapt at the chance since she loved to horseback-ride. Ivor Robinson also came along, and Cecile believed it was at this conference that Ivor met Infeld's student, the lovely Joanna Ryten. While they were all trotting along, the gregarious Ivor fell off his horse and landed on his derriere. Cecile recalled it being a rather funny scene, with Ivor sitting on his derriere on the ground looking up to Cecile on her horse, and exclaiming, jovially, "Cecile, that will be the last time you look down upon me!" And everyone broke up in laughter.

Another DeWitt family anecdote of Ivor. At some point during Ivor's stay or visit to UNC, my parents, who had built a large house out in the country, hosted a party for Ivor, or Ivor hosted it at my parents' house, but Ivor brought all the liquor, and apparently my little sister, Abigail, and I went around sipping the remains of alcohol that were in the glasses ... and we both ended up a bit tipsy. I think we were both in elementary school or younger. So, my parents would often comment, "remember what happened at Ivor's party."