A few words of gratitude and admiration

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Remembering Andrzej Trautman
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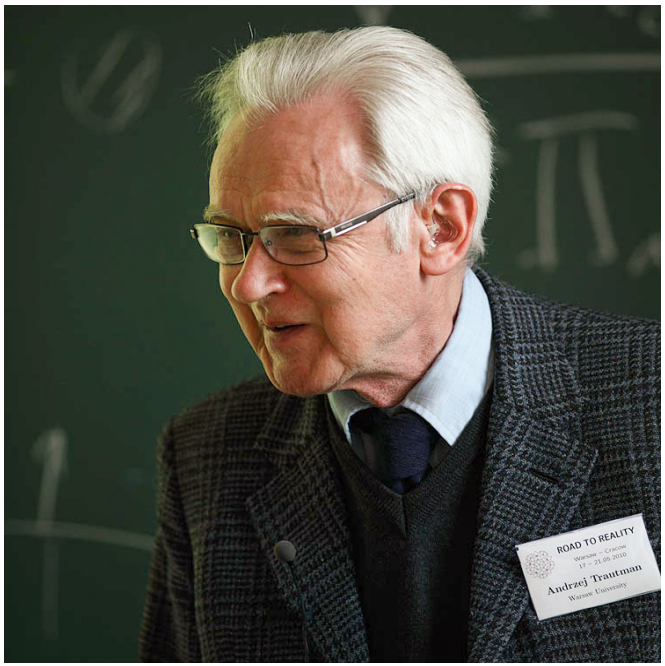
Professor Andrzej Trautman was a brilliant and original Theoretical and Mathematical Physicist. Besides his seminal and widely acclaimed publications on Relativity and Gravitation, he shaped new research directions and novel mathematical methods.



Professor Andrzej Trautman in 2010.

Andrzej Trautman's scientific legacy is so widely known, in Poland and abroad, that here I will only briefly recall his main achievements.

My short talk will be focused mostly on personal memories, and the extraordinary role he played in my early years, when he supervised my Diploma work and the beginning of my Doctorate at the University of Warsaw, where I became a teaching assistant in September 1965.

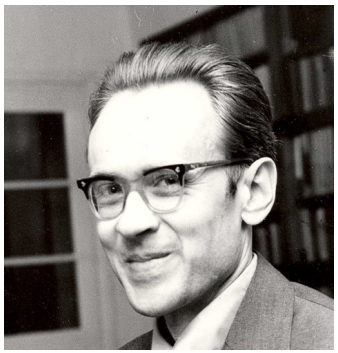
Leopold Infeld's Relativity School

Leopold Infeld (1898 – 1968) **was the founder of Polish Relativity School after his return from Canada in** 1950. **His first pupils were Jerzy Plebański and Stanisław Bażański.**

Left: Leopold Infeld in 1953; **Center: Jerzy Plebański in** 1962; **Right: Stanisław L. Bażański in** 1965,

Leopold Infeld's PhD Students

The next brilliant bunch of theoretical physicists comprised Andrzej Trautman, Iwo Białynicki-Birula, Włodzimierz Tulczyjew and Róża Michalska-Trautman.

Róża Michalska-Trautman†.

Another talented female student was Joanna Ryteń, who became Ivor Robinson's wife in 1967, and followed him to the USA, where both settled in Dallas.

The Robinson-Trautman solution

Finding a solution to Einstein's equations describing an asymptotically spherical gravitational wave was a major and widely acclaimed success.

(I. Robinson and A. Trautman, Phys. Rev. Lett. 4, 431 (1960); Proc. R. Soc. London A 265, 463 (1962))

Left: Andrzej Trautman convincing Leopold Infeld about physical reality of gravitational waves; Right: Ivor Robinson and Andrzej Trautman in early 60-ties.

Andrzej Trautman's scientific legacy

After seminal research articles on radiative solutions of Einstein's equations, Andrzej Trautman's interests turned towards the mathematical structure of General Relativity and its generalizations.
The subsequent works addressed topics such as:

- The geometry of gauge fields, fibre bundle spaces and theories of Kaluza-Klein and the Yang-Mills field equations;

- Elucidating a coherent definition of mass and energy of gravitational field the so-called ("Trautman-Bondy mass")

- Solutions of the Maxwell and Yang-Mills equations associated with Hopf fiberings, Cauchy-Riemann structures in optical geometry (with I. Robinson).

Andrzej Trautman's scientific legacy

- Geometry with torsion and Einstein-Cartan theory; cosmological models based on this theory that avoid the initial singularity (joint work with Wojciech Kopczynski);

- Mathematical theory of spinors (with Paulo Budinich) resulting in the book "The Spinorial Chessboard");

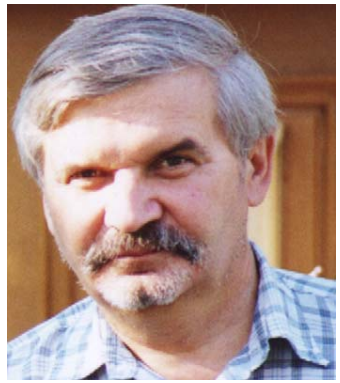
- Research conducted jointly with Michel Cahen, Simone Gutt, Ludwik Dąbrowski, Ivor Robinson and Wojciech Kopczyński investigating the "Spin" and "Pin" groups, and the spectrum of the Dirac operator on manifolds with non-trivial topology;

- Analysis of the mathematical structure of Emmy Noether's conservation theorems as applied to gravity, and their generalization.

Trautman's Relativity School 1.0

Andrzej Trautman was an extraordinary Teacher and Educator, whose career lasted more than half a century.
Among his first PhD students there are three world-class astrophysicists: Marek Demiański, Jean-Pierre Lasota and Marek Abramowicz.

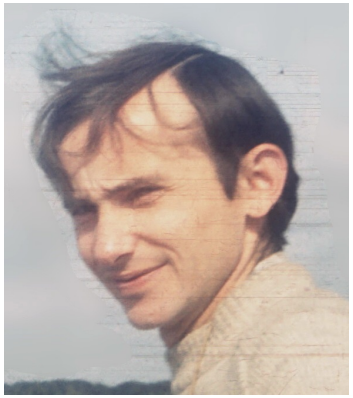




Andrzej Trautman's PhD students: Marek Demiański, Jan-Piotr Lasota, Marek Abramowicz.

Trautman's Relativity School 2.0

The next generation of Trautman's PhD students was also successful: the three most prominent ones became professors: W. Kopczyński (1946 – 2022) authored several books and many research papers; J. Lewandowski (1959 – 2024) very active in Loop Quantum Gravity and directed the Relativity Group of Warsaw University until his untimely death in 2024. J. Tafel is still an emeritus professor in Warsaw.



Left to Right: Wojciech Kopczyński, Jacek Tafel, Jerzy Lewandowski .

Diploma "Magisterium"

In 1964, at the end of my fourth year of Physics studies, (and Astronomy studied parallelly during the first three years) I started working on my Diploma memoir under Andrzej Trautman's guidance.

The subject suggested by my advisor was the modern mathematical formalism of differential geometry in terms of fibre bundles. It led to generalization of the five-dimensional Kaluza-Klein theory including non-abelian gauge groups describing the Yang-Mills fields.

I defended my Diploma work in May 1965. The examiners were Andrzej Trautman (supervisor), Iwo Białynicki-Birula and Włodzimierz Tulczyjew, whose advices and suggestions were really priceless.

Professor Trautman agreed to become my PhD thesis supervisor. Consequently, I was hired as Teaching Assistant by the University of Warsaw, and became a member of the Relativity and Electrodynamics Lab founded by Leopold Infeld

I taught physics classes for first-year mathematics students, followed by courses on Thermodynamics and Statistical physics, Mathematical Methods of Physics, and General Relativity, and studied literature recommended by my supervisor, including the modern approach to differential geometry by Élie Cartan and André Lichnerowicz, and the latest monographs by Kobayashi and Nomizu.

At the same time, I diligently attended seminars on theoretical physics and mathematics, and also participated in a philosophy seminar organized by Dr. Helena Eilstein, editor-in-chief of the quarterly "Studia Filozoficzne".

Profesor Trautman's good advices

The first piece of serious advice concerned the choice of a topic for my doctoral thesis. The most sensible option was to continue working on the theory of connections and curvature, and on the modern formulation of the gauge theory and the Yang-Mills fields.

After the first year, I became interested in the two-body problem in General Relativity and even started calculations based on a new idea (as it seemed to me then). I asked Trautman whether I might pursue this line of calculation more seriously, and received the following reply:

- This is one of the most complex and difficult problems in Einstein's theory of gravity. Many accomplished physicists struggled in vain trying to solve it, even approximately.
Actually, you need to complete your doctoral thesis within a reasonable timeframe.
The risk is too great; I advise you to continue working on **Yang-Mills fields**: that is where you will feel most at ease.
I followed my Professor's wise advice, and over the course of the following year (1967), I advanced the work far enough to produce a draft for potential publication in scientific journal.

In the fall of 1966 the philosophical quarterly "Studia Filozoficzne" featured an article by Wojciech Frejlak entitled "A Critical Analysis of Certain Issues in Relativistic Physics and the Physical Theory of Space and Time".
Shortly after, at the author's request, a debate was held at the Institute of Physics at 69 Hoza Street, featuring Andrzej Trautman, Iwo Bialynicki, Marek Demianski, and some younger physicists.
The outcome of the debate was inconclusive; to avoid the impression that the matter remained unresolved, my professors asked me to write an article making the issue clear, for publication in "Studia Filozoficzne" under the right to reply.

Adventure with Philosophy

My article titled "On the Interpretation of the Theory of Relativity"appeared in issue No. 1 (48) of “Studia Filozoficzne”.

I cannot say whether I convinced my opponent, but the piece appealed to Dr. Helena Eilstein, who encouraged me to write a longer article on the philosophical implications of the concepts of time and space in the Theory of Relativity.

Flattered by this proposal, I set to work eagerly, and within a week I showed the editor the beginning of my essay, under a bit preposterous title: “Beyond Time and Space.”

A Phlosophical adventure

Left: Dr. Helena Eilstein, 1922- 2009; Right: The cover of "Studia Filozoficzne", 1965. Two articles in this issue are particularly noteworthy: the first, by Stanisław Lem, entitled "Summa Technologiae: Postscript to the Discussion," the second one by Jerzy Rayski, "The Hypothesis of Multidimensional Space".

Professor Trautman's advices

I prudently mentioned the article to Trautman, who in his inimitable style, looking slightly embarrassed and expressing his disapproval with a soft clicking of the tongue talked me out of the idea:

- When someone with a solid track record publications in prestigious scientific journals tackles such topics, his arguments and opinions are taken seriously. But when an inexperienced, novice doctoral student speaks out on such fundamental and essential issues, he easily becomes a target for malicious criticism and ridicule. And that could seriously harm your future academic career.

I followed this sound advice and withdrew the unfinished article, much to Ms. Helena's dismay.

First scientific research

A generalization of the Kaluza-Klein theory to be used as an adequate geometrical description of the Yang-Mills fields generated by the symmetry groups $SU(2)$ and $SU(3)$ was suggested by Trautman, and turned out to be an excellent choice for a future PhD thesis. I was able to complete the calculus and to present my supervisor a finished article project in September 1967.

This is a publishable paper - Trautman declared.

- Professor, it was your idea, so the paper should be cosigned by you as well - I proposed.

- No, you made all the calculations by yourself. Besides, it will be much better for your future career if the article is signed by you alone - was the answer.

My first scientific publication

Until today I can't tell whether my Thesis Advisor had some premonitions about my future in France. But the fact is, that he sent my article on non-abelian generalization of the Kaluza-Klein theory to the French journal "Annales de l'Institut H. Poincaré", specialized in Mathematical Physics, quite prestigious at the time.

The cover of "Annales de l'Institut Henri Poincaré".

The troublesome year 1968

My first scientific article was sent to the Parisian Editorial Board at the end of May 1968, and accepted for publication soon after.

It happened after the wave of students unrest and strikes occurred the same year in March. My participation in those events was very modest indeed: I just helped with typing and copying various strike flyers.

Nevertheless two plainclothesmen visited my Advisor and Boss, suggesting in rather insisting manner - that as the Director of the Relativity Group he should not renew my Teaching Assistantship contract beyond its administrative limit, i.e. past September 30, 1968.

The last advice

The next day Andrzej Trautman informed me about the visit of Security agents.

-What do you think my chances are, Professor, of renewing my contract past September? - I asked.

- Well, there is still the entire Summer ahead. Who knows, perhaps they will forget about you. My feeling is that a 50% probability remains for your contract's renewal - in any case, I will do my best to make it happen.

I thanked the Professor, telling him that certainty is better than uncertainty, and that I decided to submit my resignation myself, and opted to take advantage of the opportunity of traveling abroad that the Polish authorities of the time offered to the chosen minority of citizens.

I said goodbye to my Professor, expressing my gratitude for the extended help and care during my first years of scientific career.

At the end of September I left for Paris, with my French wife Dominique.

I had no recommendation letters, but my article was accepted for publication in the Annales of Inst. H. Poincaré; besides, the very name of my PhD advisor was enough: after short phone calls to André Lichnerowicz and Laurent Schwartz, whose numbers I found in a phone book, I was directed to Yvonne Choquet-Bruhat, who happened to need a teaching assistant. After a visit to Madame Choquet's home I got the position at the University of Paris, where I completed my PhD thesis, and worked for the next 45 years.

Master and Teacher

Andrzej Trautman's influence on my subsequent scientific career cannot be overestimated.

Luckily enough, later on we met many times, first in Paris, then in Warsaw, which I was able to visit fifteen years after I left Poland, on Professor Trautman's invitation.

Since then, I tried to pay back my debt of gratitude by bestowing upon my Diploma and PhD students a similar helping care as I got from my extraordinary Master and Teacher.