LAUDATIO

given in the Collegium Maius on the occasion of the retirement of Professor K. Grotowski

Rector Magnificus, Dean of the Faculty of Physics and Mathematics,
Ladies and Gentlemen,
Dear Kasimir,

It is a pleasure and honor for me to address you on the occasion of your retirement from the University of Kraków. When you showed me the Collegium Maius a few years ago I did not anticipate that I, one day, would be standing here and addressing you in this magnificent and historic place.

We are here today to celebrate almost 50 years in science. Professor Grotowski's first publication appeared in 1953, there have been more than 100 papers since, and I am convinced that we have not seen his last publication yet. To put the 50 years into the right perspective it might be worth to remember that such a venerable institution as the American Physical Society had its Centennial only a year ago, celebrated in Atlanta. Professor Grotowski's active scientific life thus spans almost half of the time of the existence of the APS.

Looking through Professor Grotowski's publications I have been reliving all the excitement of what would now seem the early years of nuclear physics, and the evolution that nuclear physics has undergone since. Names and concepts such as the fast–slow coincidence of Graham and Bell, and the work of Newns and Refai invoke nostalgic memories. The fast–slow coincidence method of Graham and Bell was employed for early lifetime measurements in the sub-nanosecond range at the Physico Technical Institute in Leningrad, where Professor Grotowski was a research associate at the Joffe Institute prior to obtaining his doctorate in physics at Kraków. The model of Newns and Refai was inferred to explain polarization in stripping reactions in conjunction with the measurement at Kraków of neutron polarization in the ^{12}C(d,n)^{13}N reaction, published in 1959. This measurement had been one of the firsts of its sort in the study of deuteron stripping and it reflects the front line and very timely character of the research done at Kraków. The optical model and direct reactions were then the frontiers of nuclear physics.

Although already proposed by Feshbach, Porter and Weisskopf in 1952, the optical model, or as it has been also called the cloudy crystal ball model, came only to fruition in the early sixties with the ready availability of computers and high-precision scattering data. Here names such as Perey and Perey, Greenlees and Hodgson come among others to mind. With Greenlees

Professor Grotowski worked together and published when he was a Research Fellow at the University of Birmingham from 1959–61, and Peter Hodgson, who sent his greetings, was one of the co-authors on some of the early papers of the Kraków group.

After some initial studies of deuteron elastic scattering and of direct reactions the main emphasis at Kraków had shifted to precision measurements of alpha particle scattering and the interpretation of these data. Making use of the large 160 cm scattering chamber it was possible to extend the measurements of the back angle data all the way out to 179 degrees. From an excitation function a broad and resonance-like structure was discovered at Kraków in 1965 in the back-angle scattering of the $\alpha + {}^{40}$Ca system. The strong enhancement of the cross sections at backward angles was found to be not just a singular effect peculiar to the $\alpha + {}^{40}$Ca system, a fluke of nature, but it has been observed since to systematically occur in the scattering from many sd-shell nuclei. This effect has become known as Anomalous Large Angle Scattering or ALAS. Kraków can be rightfully credited as the birthplace of ALAS. Following its discovery in Kraków, ALAS has in the late sixties and throughout the seventies become a research topic of considerable scientific interest that was actively pursued in many laboratories and that has been the subject of several topical conferences.

The fact that ALAS is most pronounced for alpha-like nuclei has led to various speculations about its origin and especially to the suggestion that alpha particle clustering in these nuclei might be the source of ALAS. We today know that there are two factors responsible for ALAS, the shape of the real potential and a weak absorption of the surface partial waves similar to the surface transparency found for heavy ion scattering and reactions. This surface transparency is a consequence of the strong binding of the alpha particle nuclei which leads to fewer open channels to which the scattering channel can couple. The effects of alpha clustering, if at all present, are thus reflected in the tight binding of these nuclei and not in the presence of physical alpha particle clusters. The Woods–Saxon squared form factor found for the real potential to be necessary to give the correct phases of the oscillations in the angular distributions resembles most closely the shapes of the microscopic potentials derived from folding the matter densities of target and projectile. The Kraków group had been among the first to successfully apply such microscopic folding potentials to alpha particle scattering.

It might interest you, Kasimir, to know that right now there is a proposal at Argonne to measure ALAS for the ^{44}Ti $+ \alpha$ system. ^{44}Ti would then be the heaviest alpha particle nucleus for which ALAS has been studied. ^{44}Ti being an unstable nucleus with a half-life of 60 years, the experiment would have to be performed in inverse kinematics by bombarding a helium gas target with a ^{44}Ti beam.

In the early eighties the research interests of Professor Grotowski and his co-workers shifted to the at that time nascent field of intermediate energy heavy ion physics. Key questions then were the transition from an energy domain in which the two colliding nuclei act as liquid drops to a region, in which the two-body collisions of the individual nucleons constituting target and projectile become important. How do the reactions evolve with energy. What are the highest excitation energies a nucleus can sustain, is there a gas–liquid phase transition and what can we learn about the equation of state of hot and dense nuclear matter.

The early work of Professor Grotowski and co-workers concentrated mainly on relatively light nuclear systems involving heavy ion scattering, the study of fusion and incomplete fusion, in which only part of the projectile fuses with the target, as well as on projectile breakup studies. The latter work making use of the 150 MeV ^{6}Li beams from the Karlsruhe cyclotron. In a study at Berkeley, with Professor Grotowski as the first author, the first firm evidence was found for the symmetric fission of a light nucleus, ^{44}Ti. Whereas fission of medium-heavy and heavy nuclei has been known for a long time, the symmetric fissioning of a light nucleus such as ^{44}Ti was rather unexpected. Quite characteristically the authors talk of symmetric splitting rather than of fissioning in their first paper, as if they did not quite trust their own courage. The discovery of the fission in the light nuclei has led to subsequent theoretical papers in collaborations with Profs Blocki and Swiatecki, and to follow up experimental work of the Kraków group.

Recurrent themes in the heavy ion studies of Professor Grotowski and coworkers are the origin of intermediate mass fragments and multifragmentation. At not too high excitation energies the compound nucleus will either decay via the successive evaporation of neutrons and charged particles, or it will undergo fission. But as we increase the excitation energy, the time between the successive evaporation steps will become shorter and shorter. With increasing excitation energies also the emission of light nuclei with masses greater than that of the alpha particle are observed, the so-called intermediate mass fragments. The origin of these intermediate mass fragments has been a research topic very much on the mind of Professor Grotowski for many years.

As the number of fragments increases with excitation energy and the lifetime of the compound nucleus decreases the question arises, whether there is a transition from sequential binary decay leading to a multifragment final state, to pure multifragmentation, in which the excited nucleus spontaneously disassembles into many fragments: the multifragmentation being a possible signature for a gas–liquid phase transition. To answer these questions one unfortunately cannot prepare the excited nucleus in isolation and then just watch its decay. The creation of the excited nucleus is a dynamic process, and there are different sources to produce *e.g.* the intermediate mass fragments. An important aspect thus had been to disentangle the various components both in inclusive and in exclusive measurements. To this end Professor Grotowski and his co-workers have successfully performed a great deal of modeling, and sophisticated multi-detector systems have been built. These studies have helped to clarify the contributions of the various different sources to the intermediate mass fragment production in light heavy ion induced reactions. In a very recent study of ^{40}Ca + ^{40}Ca at Grenoble at an energy of 35 MeV/nucleon the transition from sequential decay to prompt multifragmentation was clearly found and indications for the emission of intermediate mass fragments from the neck region were observed as the two colliding nuclei separate.

In the last two days much mention has been made of Professor Grotowski the outdoor person, exploring caves and climbing in the Himalayas. Kasimir will forgive me if I immediately made a link between his paper on "^{210}Pb from nuclear explosions in the environment" and his extra-curricular interests. In the paper it is written: "To collect fossil ice samples we organized five expeditions between 1973 and 1976 to glaciers in the northern and southern hemispheres". Unfortunately the paper does not tell us who the members of the expeditions were. From a subsequent paper by the same authors I learned how to construct a hydrogen bomb.

Let me finally turn to Kasimir the scientist, and Kasimir the person. Most of the research by Kasimir and his co-workers has been done at accelerators abroad, at Berkeley, Karlsruhe, Louvain-la-Neuve, in Grenoble and at the KVI, and probably this list is not even complete. As I noticed, very remarkably the overwhelming number of the joint publications originating from these collaborations have members of the Kraków group as the first authors, thus clearly identifying these experiments as Kraków experiments with a clear Kraków signature. In these days of large international collaborations it is often not made too difficult to be a freeloader, but this was not the style of the Kraków group. From my own experience in collaborating with Professor Grotowski I know to appreciate his very positive inbring both of ideas and instrumentation. Developing new instrumentation and equipment I believe has always had his interest. So I still remember seeing the large Kraków scattering chamber at Maryland even before meeting Kasimir for the first time in person. After the Maryland cyclotron was shut down the chamber then moved to Berkeley. A similar chamber was later installed at Louvain-la-Neuve, and at the KVI we profited from a multidetector setup of gas-filled dE detectors followed by silicon E-detectors, the whole setup including electronics built again at Kraków. We much hope still to be able to perform the experiment at KVI with you and the Wilczyński's that was planned already quite some time ago but that had to be postponed several times for various reasons.

As Professor Grotowski's impressive list of achievements has shown, he has always had a fine nose for what is interesting. From the phenomenological modeling of heavy ion reactions by him and his collaborators I also got to admire his concentration on the essentials, making plausible simplifications where possible, that purist would probably abhor, in order to cut through to the heart of the physics. I have here in particular the work by Gawlikowicz and Grotowski "On the distinction between multifragmentation and sequential binary decay" in mind. Starting from the empirical observation that the mass distributions from multistep sequential and multifragmentation are indistinguishable from each other, they took the mass distribution from their sequential decay model as the starting point for the modeling of multifragmentation. This concentration on the essentials is a way of doing physics that is especially appealing to me.

Dear Kasimir, with your retirement you now can look back with great satisfaction to a distinguished scientific career and to what you have accomplished under circumstances which I am certain have not always been easy and that were less privileged than those of many of your Western counter parts. It was a pleasure to collaborate with you. Your outgoing character and enthusiasm easily makes friends. With your retirement I would like to wish you and Anna all the best and many more years in good health in which you can continue to pursue with satisfaction the many out- and indoor things that interest you.

Rolf H. Siemssen