The century that has passed since the birth of Marie Sklodowska Curie has witnessed many events, changes, revolutions, and upheavals, which have left deep imprints on human society. Perhaps the most far-reaching change was the new insight which man has acquired during this period into the basic working of nature. It was in that century that the problems of the structure of matter were seriously attacked and, to a surprising extent, also solved. We know today, and we did not know a hundred years ago, many of the basic principles on which the behaviour of matter is founded. We have acquired a far deeper understanding of what is going on in our environment; this knowledge also has enabled us to deal with our environment in a vastly more efficient way than before. It laid the ground for modern technology which has thoroughly revolutionized our way of life. The discoveries of Marie Sklodowska Curie initiated this development and are therefore in many ways symbolic for the new spirit of physical science.

One hundred years ago, physics was, to a large extent, a descriptive science. The question asked was 'how', and not 'why'. Examples are the description of the motion of solids or liquids in mechanics and hydro-dynamics, the description of the behaviour of electric and magnetic fields by Faraday and Maxwell, the behaviour of substances in chemistry. The chemists of that time described the reactions of atoms and molecules without explaining them.

During the lifetime of Marie Sklodowska Curie, the question 'why' was attacked in the study of material behaviour. Physics changed from description to explanation. A great development took place — the discovery of the quantum of action, of the nuclear atom, of quantized orbits and, finally, of quantum mechanics, which is the way in which atomic behaviour can be described and understood. The dynamics of the atom was discovered and cleared up, and, with this insight, all phenomena of the world of atoms and their aggregates, the fact of spectroscopy, of chemistry, of solid state, of material science, fell into place and could be explained and understood as the effects of one fundamental interaction: of the electric force between atomic nuclei and electrons. Against the background of this development, let us look at Marie Sklodowska Curie's work.

We know what important role radioactivity played, since it provided the necessary tool which enabled Rutherford to find the nuclear atom. But it was much more than this. Marie Sklodowska Curie's discovery was an anticipation of the next step which physics took more than thirty years later, a step which could only be taken after having gained insight into the workings of the atom: the search for the structure of the atomic nucleus. It introduced a new aspect into physics. When Marie and Pierre Curie isolated radium in that famous shed in the School of Physics in Paris, when they were awed by the uncanny gleam of that substance in the dark, they were looking at an extraterrestrial phenomenon, a phenomenon which goes beyond the ordinary atomic world of our environment. We know today that what the Curies saw, was a remnant of the times when terrestrial matter was in a very different environment, in an exploding star. The natural radioactive substances are the last witness, the last embers still glowing, of the eventful times at which our elements were formed.

Thus Marie Sklodowska Curie's work initiated a third period in physics. It is the period which started in the 1930's, after quantum mechanics had explained the world of atoms. Then physics took a new step which we may call the leap into the cosmos. It started with Marie Sklodowska Curie's discovery, but it really gathered momentum only after 1930, when systematic research was done, to get at the inner structure of the atomic nucleus, to discover its composition, protons and neutrons, its dynamics and its basic laws. A new force of nature revealed itself, the nuclear force between protons and neutrons, much stronger than other forces with strange and apparently rather involved properties.

We should be aware that the processes and reactions revealed in this new branch of physics do not occur naturally on earth, except in those few processes found by Marie Sklodowska Curie. It is largely a man-made world, produced by our technical devices. But we have strong reasons to believe that this world plays a fundamental role in the universe; it is as essential for the interior of stars as atomic physics is for the surface of the earth. In terms of quantity of matter and energy, nuclear processes are relevant for a vastly larger part of the universe than atomic phenomena.

The end is not in sight yet of the leap into the cosmos by modern physics. Today our new accelerators penetrate into the sub-nuclear realm, into the internal structure of the nuclear constituents themselves. One discovers a new world of phenomena which lies beyond the world of nuclear processes; one finds excited protons, mesons and heavy electrons; all this will lead to a deeper insight into the basic laws of matter.

When it will be better known what is going on within the proton and the neutron, we may understand better the nature of the nuclear force; it may be reduced to a simpler and more fundamental interaction, just as the chemical force was explained by the simpler and more fundamental electric interaction. Nuclear physics may become the 'chemistry' of a new physics of elementary particles.

Today, we are only at the beginning of this great new development, which was initiated by Marie Sklodowska Curie's work. She and her collaborators and successors were able to deal with cosmic processes here on earth; they recreated such processes in our terrestrial environment. The investigation of these new phenomena was of tremendous importance for gaining new insight into the basic structure of matter and its behaviour at high energy. But it has also another important aspect: the confrontation of nuclear processes with our terrestrial environment creates new effects and phenomena, which are of great scientific and practical interest. It must have been of great significance to Marie Sklodowska Curie that this confrontation did lead to practical consequences, even at the very beginning of this new science, when exposing living tissue to radioactive radiation led to such promising results. The treatment of cancer by the newly discovered rays should be a reminder to those people who believe that science should be interested only in the immediate environment of man and should not look
for new phenomena, far removed from our daily experience.

But it happens rarely that application follows so quickly after discovery as it did in Marie Skłodowska Curie’s work. Perhaps we were spoiled by this case and by the speed in which the application of nuclear energy followed the discovery of nuclear structure. In most instances a long time must pass before new discoveries are well understood and well in hand so that their interaction with our environment can be applied and made useful for other purposes. Imagine how long it would have taken to produce nuclear energy if there were less than two neutrons emitted per fission. A new and unusual field of research stands alone at the beginning and has no connections yet with other fields of interest. But whenever a completely new realm of phenomena is discovered, as it was in nuclear physics, as happens today in high-energy physics, there comes a time when the confrontation of these phenomena with our environment will lead to unexpected effects and to a broader involvement with the rest of our scientific and technical interests.

This is why it is short-sighted to judge the importance of a new field of research by its present state of application or relevance for other sciences. Science must proceed undirected, independent of any aims at application, in particular, in those fields where it penetrates into new and unexplored regions. It was the drive to find out where the radiation comes from in pitchblende that made Marie and Pierre Curie discover radium. They were led by the great curiosity of the true scientist for what goes on in nature, But Marie Skłodowska Curie’s curiosity was paired with a deep concern for the human fate. She was the great discoverer in the shed of the School of Physics and the driver of an ambulance in the battlefields of the first world war. Human existence is based upon two pillars: compassion and curiosity. Compassion without curiosity is ineffective; curiosity without compassion is inhuman.

Her life and her interest point to another human element in science: the supranational nature of science. I expressly use this term instead of ‘international’. Science springs from a deeply human urge: to know and understand what happens around us. It is a language, common to all human beings and therefore is above any nationality. Marie Skłodowska Curie was aware of this, right from the start, with her double nationality, Polish and French. In her later years she actively worked for the cause of international understanding by scientific collaboration. She saw that science is most potent in bridging over the divisive forces of nationalism, racism, and different political systems. We may say without undue pride that the scientific community was to a large extent immune to prejudices of this kind and was most efficient in collaborating across geographical, racial and political boundaries. Let me quote a statement by Marie Skłodowska Curie: ‘I believe that international work is a heavy task but that it is nevertheless indispensable; it must be pursued at the cost of many efforts and also with a real spirit of sacrifice. However imperfect it may be, the work of Geneva has a grandeur which deserves support’.

Of course, she had in mind the League of Nations which collapsed soon after. Perhaps there might be a consolation in the thought how much she would have approved CERN, the new European Laboratory for high-energy research in Geneva, which is a truly supranational laboratory run by many nations, where scientists of the different countries work closely together and where any national origin vanishes when they enter the door. CERN is not the only one of such hopeful beginnings. There is a similar institution in Dubna north of Moscow run by a large group of nations.

But this is not enough; we must follow Marie Skłodowska Curie’s great appeal and make our contacts between all centres of science stronger and more durable. There must be more interchange and common work between scientists from different parts of the world. The new tasks which science faces are so great that they require a common approach by all those who are participating. The costs are so high that they should not be wasted by lack of mutual help. Some steps were already taken in this direction: as an example, let me mention the close collaboration between CERN in Geneva, the Saclay Laboratory in France, and the new high-energy centre in Serpukhov, in which the Western European physicists join their skills with the Soviet physicists in order to exploit most efficiently the new 70 GeV proton accelerator at Serpukhov. But this is not sufficient; why are there still so few so-called ‘Western’ scientists working in so-called ‘Eastern’ laboratories and so few from the East in the West? Why is the collaboration of American and Soviet scientists still subject to the vagaries of day-to-day politics? Why is there no Chinese physicist anywhere with us here?

The significance of scientific collaboration far exceeds the narrow aim of a more efficient prosecution of our scientific endeavours. It stresses a common bond between all human beings. Scientists, wherever they come from, adhere to a common way of thinking; they have a common system of values which guides their activities, at least within their own profession. New ideas for bringing nations together can perhaps be discussed with more ease within this community, some political misunderstandings can be cleared up, and dangerous tensions reduced. As an example, we recall that the agreement to stop the testing of nuclear bombs above ground stemmed in part from prior meetings between scientists.

We must keep the doors of our laboratories wide open and foster the spirit of supranationality and human contact which the world is so much in need of. The present deterioration in the political world is a reason stronger than ever for closer scientific collaboration. The relations between scientists must remain beyond the tensions and the conflicts of the day, even if these conflicts are as serious and frustrating as they are today. We need this community as an example for collaboration and understanding, as an intellectual bridge between the divided parts of mankind, and as a spearhead towards a better world.