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Excellencies, Honorable guests, Distinguished participants, I feel honored to take part in this conference on "Building Mathematical and Scientific Talent," and I am thankful to the organizers to allow me to present my views on this subject as President of the International Physics Olympiad (IPhO).

Dear guests, it seems odd to me that, in general, the richness of a country is measured simply in economical terms—notably, the amount of natural resources, such as oil, minerals, and the like. And it is clear from this perspective that not all countries are equally rich. But isn't it strange that the *human* resources of a country are hardly mentioned and, even when they are, are done so in less esteem? After all, even if a country is rich in natural resources, if it does not develop its human resources, how can it ever expect to be able to profit optimally from the economical richness it possesses? I am convinced that the development of the talents possessed by the people of a country is a *conditio sine qua non* for its prosperity.

To be able to develop talents, one needs to spot them. Competitions can play a role in that regard, and that is the subject of my contribution to this conference. However, before continuing, I would like to stress that none of what is spent on talented children should be at the expense of lesser talented individuals; the talents of each and every individual should be developed.

How can we recognize the talents of students?

It is obvious that the talents of children will go unnoticed unless there is a context in which the children are able to exhibit their talents. Many factors, of course, play a role in providing that context. On the one hand, children must feel free enough to be able to show what they are able to do; on the other hand, some children need a push. Whatever is the best way depends highly on the child itself—on his or her character and how, for instance, the child behaves under stressful circumstances that go together with a test.

The competition as a means of spotting talent

A competition can be a good way to spot a certain group of talented children, whereas, for other groups, it will not always work well. That is true for the Physics Olympiad as well as for other competitions; I will come back to this idea later.

I am not claiming that the IPhO is the one and only way to spot children with a talent for mathematics, physics, or other natural sciences. But the IPhO is certainly one of the best international competitions there is, and it is a fact that thousands and thousands of youngsters enjoyed their participation in the IPhO. Indeed, the IPhO inspired many of them to seek a career in the natural sciences. It is known that being among peers, who have interests similar to one's own, can be a strong challenge, as well as a good motivator, for developing that interest further. It is important to take into account that, from their inception, the Olympiads were exams aimed at determining whether a child should pass to the next grade in school. In some countries, Olympiads are still held for this purpose. However, after over 40 years of International Physics Olympiads, the nature of the competition has changed radically. Nowadays, the competition is much more a place where youngsters from all over the world can meet their peers and enjoy each other's company while sharing at least one fascination in common: the natural sciences (and, often, mathematics as well). Beside this interest, for science, it is a fact that many of the youths make friendships that last for the rest of their lives.

Now, a competition such as the Physics Olympiad not only affords youngsters the opportunity to showcase their talents, but also is a place that gives them the motivation to pursue

a career in science. Some youngsters need to gain confidence that they are able to do so and that they possess talents which can be developed. The competition simply strengthens their self-confidence.

How is the Physics Olympiad organized?

At the International Physics Olympiad, teams consisting of five students and two team leaders per country are invited. At this moment, some 85 countries are entitled to participate. This year, 82 countries actually did participate. Every national team is the result of a selection procedure at the national level; therefore, this procedure differs from country to country. Many countries organize a kind of training to prepare their teams for the competition. The intensity, duration, and level of training differ considerably across countries.

To set up a national competition, a nationwide infrastructure is needed to be able to reach a country's schools, teachers, and students. A team of teachers from secondary schools and from universities is needed to compose the tests, to mark them, and to administer the results. In general, a selection procedure consists of several stages. At progressively higher stages, harder tests are presented, demanding new problems and more grading. Often, once the top five students are selected, they get training to prepare them for the theoretical and experimental tests administered at the International Olympiad.

Let me take my own country, The Netherlands, with a population of 16 million, as an example. The national selection procedure consists of three stages. The first stage is a theoretical exam held at the schools that voluntarily join the competition. Nowadays, some three thousand students participate in this theoretical exam. The test consists of a number of multiple-choice questions as well as a few essay questions. From the first stage, about 50 students are selected for the second stage. This group receives papers on different extracurricular topics to study, after which they take the second-stage test, whose problems are about these new topics. The second stage encourages the students to work on new material.

From the second stage, the top 20 students enter the final stage, which is held during one week. Throughout this week, the qualifying students receive lectures on advanced topics, and at the end two tests are performed, one theoretical and one experimental. At the end of this stage, the top 5 students will be part of the national team. These students get training during three days where mostly their experimental skills are trained. The selection procedure is financed by three sources: for the biggest part by the Dutch government, a smaller part by large enterprises, and scientific institutions.

The financial means allowing the selection to take place is not the only and surely not the most important factor in the whole procedure: The involvement and interest of teachers of physics at secondary schools and university professors are paramount in most countries for the whole procedure leading the best students to the International Olympiad. These are the people who have to compose good theoretical and practical tests; they are the ones who will stimulate the students.

Some of the teachers take the opportunity the first stage offers to organize a school competition in which the school donates awards. The students work in a friendly atmosphere where tea and cookies are served. Often, the test is discussed afterwards during physics class, and a debate takes place about the different possible solutions of the problems. In this way, the selection for the Olympiad becomes a "scientific" event with as many students as possible involved. As a matter of fact, the test is becoming a part of the curriculum of many schools and a means by which an interest in physics is developed. Interested teachers prepare those students

who are willing to participate by discussing former tests and by teaching subjects that appear in the problems.

Other competitions

Apart from the International Physics Olympiad, there are many more competitions in natural sciences and mathematics. You might be familiar with Olympiads for biology, chemistry, and mathematics. They have more or less the same structure as the Physics Olympiad. Although a national team takes part, the competition is purely individual, focusing on the best individual students, each of whom must take the test alone and must show what he or she is capable of. It is may be for this reason that notably in physics Olympiads—the participation of girls is rather meager.

There are other competitions that are of a completely different nature. An example is the Science Olympiad of the European Union (the EUSO). This competition is based on teamwork among the three students of each team. During the competition, each team has to solve two extensive experimental problems of a multidisciplinary nature, so the team members have to divide the lab work between them in order to solve the problem. This implies that during the test the students discuss what to do and how to proceed. One should not be surprised that for instance the percentage of girls who take part in this kind of competition is much higher than in the Science Olympiads, in which the emphasis is on individual performance. Girls seem to prefer teamwork rather than individual work, and the different nature of such competitions makes it clear that talents other than those required in the Physics Olympiad are needed and should be encouraged. Thus, each country must experiment with what suits its students best and what is most likely of interest to its teachers, whose enthusiasm is key to inspiring the students.

Other competitions I like to mention are the International Young Physicists' Tournament; the International Conference of Young Scientists; the International Junior Science Olympiad; and a few regional Olympiads, such as the Asian Physics Olympiad.

It is important to note that depending on one’s nature a student feels much more confident with the Physics Olympiad focusing on individual performance, while someone else likes it much better to join the International Young Physicists' Tournament because of the research and the teamwork. It might be good to underline the importance of the role of the teacher. Sure, without the teachers the competitions cannot take place. But much more important is the enthusiasm of the teacher in order to inspire the students.

Let me conclude with a few words on the follow-up after the competition, when the participants go home and are left to themselves. My experience is that only in those cases where the student is assertive enough to keep in touch with the national organizers, who are very often teachers and professors at universities, will there develop a relationship from which the student can profit. But this is rather an exception than a rule. I think that we are missing an opportunity here to continue developing a talent by using the impetus that the student gained from his or her experience during the competition. The problem is that it takes time to nurture these talents, time that is precious, time that we don't seem to have. In some countries, a talented student gets access to special schools, and a good result at a competition guarantees entry to better higher education, sometimes even without paying for it. In Western countries, we don't often have that arrangement, and that might be a reason some countries, especially in the Far East, have developed so much more quickly during the last few decades and do so much better than Western countries in science and economics. Certainly, it is not the only reason, but I believe that it surely has to do with the country's appreciation of the talents of its people. As I stated at the outset, the richness of human resources is as good as, or maybe even better than, the richness of natural

resources. Both should be handled with care and both should be subject to careful development. I am convinced that a country which does not take good care of its human resources is doomed to regress or stand still, both socially and economically.

Thank you very much.