The "Winter College" Format

John Ziman

The International Centre for Theoretical Physics (ICTP) at Trieste needs no formal introduction to physicists. Since its founding in 1964, it has provided a forum of knowledge, and a haven of work, for theoretical physicists from East and West, from the Arctic to the Tropics. Under the direction of its prime instigator, Professor Abdus Salam, it is now jointly managed by the International Atomic Energy Agency and Unesco, with strong Italian support, national and regional.

The purpose of the ICTP is to give moral, intellectual, and material aid to theoretical physicists in "developing countries." A catalog of the problems and needs of the rising scientific generation in the "Third World" is a sad document, lacerated with words like isolation, inadequate facilities, political oppression, and bureaucracy. A full account of the activities of the Centre can be cheerful only in showing that something can be done, in various ways, to break the isolation barrier. The ICTP is both an agent, and an expression, of the international community of science.

One of the activities is an annual extended seminar, to which we have now given the name of a "Winter College." We thus distinguish it from a summer school, not merely because it actually takes place in the winter, but because it has a somewhat different plan.

The typical summer school runs for a few weeks and provides an up-to-date account of the situation at the research frontier in some very advanced and specialized field of science—for example, critical phenomena, electron scattering and nuclear structure, or mantle and core in planetary physics. A Winter College lasts for 3 months, with lectures on a whole range of subjects within a general title such as "High Energy and Elementary Particle Physics" (1965); "Nuclear Structure" (1966, 1968); "Theory of Condensed Matter" (1967, 1970). The goal in each case is to unfold a prospect of a complete subdiscipine of physics, not necessarily to the horizons of current speculation but displaying the rich cities to be discovered therein. Each lecturer is an expert of international repute, but he is asked to talk as if to a group of highly intelligent and well-motivated graduate students for whom his topic is almost new. In the 1970 course on condensed matter, for example, the theme was the theory of imperfect crystalline solids, which included such topics as lattice dynamics, dislocation theory, impurity states in semiconductors, localized states, internal friction, electron theory of alloys, surface physics, radiation damage, and strength of materials.

Why have we chosen this format? The simple reason is that there are not enough research workers in the whole "developing world" to provide an audience for more specialized themes. The course is intended primarily for the few dozen Africans, Indians, Latin Americans, and others, who are brought to Trieste for these few months at the expense of the Centre itself and of other agencies such as the Swedish International Development Agency and Unesco. An analysis of the applications soon shows that in these vast populations there are only half a dozen critical phenomenologists, or electron nucleon scatterers, or planetary core theorists, for whom it would obviously be grossly extravagant to duplicate the usual summer school curricula. At our recent Winter College, for example, we found ourselves able to group the participants in no less than seven different subfields, with interests as diverse as ionic crystals, phase transitions, and dislocations. This diversity and fragmentation is a measure of the weakness of basic science in the developing countries; it is also a fact that must be taken into account in any serious attempt to help them. No good at all would be done by forcing them all through some preset sausage machine such as many-body theory or neutron diffraction physics, as if these fashions of yesteryear were the only subjects worth doing anyway.

We must also be sensitive to the extreme variability of scientific experience and technical skill in such a group. In our 1970 Winter College, for example, we had a number of participants who could hold their own in any scientific institution in the world —men and women of great natural talents, already well trained in the arts of research. But what about the man who has never before left his native country, has very largely educated himself, and is now the sole teacher of solid-state physics in (say) Nepal or Samoa? As an international agency the ICTP is bound to respond to the law of the pork barrel, and to offer support to applicants from small, poor countries, even though they are not as well qualified as the sophisticated Ph.D.'s of the University of Illinois or of the Tata Institute. Three months is not nearly long enough to subsitute for years of high-powered graduate training; our syllabus cannot be more advanced than is intelligible to the energetic experimentalist; it must appeal by its breadth to the open-minded theoretician.

Curriculum

I would emphasize, indeed, the uniformly high qualities of character among the participants in the Winter Colleges. The scientific profession makes far greater demands upon the Nigerian, Indonesian, or Brazilian student than it does even at M.I.T. or Imperial College. His curriculum of study may not have been so advanced, but it is likely to have been presented much less coherently and persuasively. The opportunities for further employment appear much less glittering, and the struggle to maintain academic standards in an unsympathetic environment is endless. Those who survive have been tempered in fire and water; the experience of meeting and working with them is a peculiar privilege which the ICTP can offer to other scientists of all nations.

But beyond these practical reasons, we believe that a broad course of lectures is appropriate for many research physicists at this stage in their careers.

The author is a professor of theoretical physics at the University of Bristol, Bristol, England.

The typical participant at the Winter College is about 30 years of age, has obtained his Ph.D. quite recently, and has published several papers in his own field of research. His life for the previous 10 years has been concentrated on the study of basic physics and on the solution of some very particular scientific problems. He has had few opportunities to lift his head from the microscope of detailed research to look around him. Unless he has been especially fortunate in his graduate school training, he will not have seen very much of the larger world of science, whether pure or applied. It is all too easy, at this stage, to continue along the narrow path on which accident has set him, so that he comes to believe that only the theory of superconductivity, or the Mössbauer effect, or band-structure calculation, is fit for him—and he fit for it. For the product of the Cavendish or the École Normale —or even the Tata Institute—this attitude is just tolerable, since he can be fairly sure of a continued career in just that blinkered line. But if he has now to return to a tiny university department in Ghana or Pakistan, or to take a job with the Atomic Energy Commission in Argentina, he must be willing to shift his attention to whatever scientific topic is appropriate in those special circumstances. One of our tasks at the ICTP is to open up quite new horizons for him and to show the purist many-body theorist that a dislocation is also a beautiful thought, and that radiation damage or the strength of materials presents as great a scientific challenge as rediscovering the Josephson effect. We cannot, of course, give him the whole story; but a dozen lectures from a skillful expositor can carry the attentive listener a very long way into a new and fascinating field of natural philosophy.

In the opinion of many of us who have lectured in the various Winter Colleges, this type of curriculum is just as advantageous to the European or American Ph.D. at this stage as it is to his Indian or Brazilian colleague. Our bigger job market makes it much easier for us to match specialist training with vacant specialist posts; yet there is a big payoff for the individual in changing to new types of problems and acquiring a wider range of skills and knowledge. We would like to encourage many more of our own senior graduate students and postdoctoral assistants to attend a Winter College at Trieste, not just to polish up their thesis work but to fit them for a career in the physical sciences as they are likely to develop in the next few decades. The ICTP itself, of course, cannot pay living and travel costs for such participants, but the lecture course is freely open to them; and we already have a number from Italy, Belgium, Sweden, Germany, and Spain, who have come at their own expense or with support from their home institutions.

Structure of Centre

These participants from more advanced countries provide a very important ingredient in the social structure of the Centre. One of the reasons why the work of the ICTP cannot be duplicated by ordinary graduate schools or by summer schools is that it must create, within itself, a microcosm of the international scientific community. It is precisely the bringing together of people of similar education, similar standing, and with similar problems, that does most to break down those barriers of isolation. At the beginning of the course, each participant talks of the peculiar and daunting difficulties of science "in my country"; by the end, he has acquired a feeling of comradeship and sympathy with all the others who are in the same boat. It is important that he should also feel that he may count on the friendship and intellectual cooperation of his peers from more fortunate countries and realize that some of his problems are those of the scientific enterprise itself rather than of his material or social circumstances. The best antidote to isolation and self-pity is the feeling of belonging to a larger community, united by the two languages of mathematics and broken English, and participating in the same mysteries.

That is why a period of at least 3 months is necessary; it must be long enough to seem a significant fraction of one's life, so that one settles down into something of a routine, catching the noisy bus from the city of Trieste at the same hour, greeting the colleague with whom one shares a study, and looking out over the trees of the Miramare Park to the same expanse of the Adriatic and the Yugoslav coast, attending lectures in the same large auditorium, and grumbling at the food in the same cafeteria. One then has time to build up close personal friendships and intellectual contacts, to feel that the Centre is a home and that one is a member of its family. Such psychological mechanisms cannot be analyzed by cause and effect; but I have no doubt that they will, in the end, do more for physics around the world than anything said by the lecturers and duplicated in their notes.

For the same reason, we have tried to provide a fairly stable succession of lecturers and other senior participants at each Winter College. The main difficulty is finding one or two people of professorial standing to spend 3 months or more at Trieste, to direct the course as a whole, and to solve a variety of personal and administrative problems as they arise. The ICTP has no permanent scientific staff at this level, outside of high-energy physics, so we must rely upon volunteers on leave from their own universities. So far, we have been fortunate, but this is the sort of help that is specially needed. Since the place itself is agreeable, the facilities of the Centre excellent, the financial provision adequate, the daily duties modest, and the company first class, we scarcely need to appeal to mere charitable instincts!

But the lecturers themselves, coming for 2 or 3 weeks at a time and formally committed only to a daily lecture, find themselves mixing in with the participants and soon become part of the same community. Rather than inviting a large number of different lecturers—all big names no doubt, but each to give only two or three lectures or seminars before rushing away again—we have looked for a few experts known for their powers of exposition and sympathetic personalities; each one of these we have given a full opportunity to put his subject, and himself, across. I can only say that in my opinion this policy has been outstandingly successful; lecturers and audiences have spoken afterward of the pleasure they have had in each other's company, inside and outside the lecture hall.

All this sounds slightly patronizing: first-grade physics for the kiddies! Not at all! The formal lectures, which occupy the morning, are only half the program of a Winter College. The afternoons are kept free for spontaneous, unscheduled, intellectual activity, such as discussions, seminars, private research, and eventually, in some cases, the writing of scientific papers. As I have already remarked, among the 60 or so participants in our 1970 session

there were a couple of dozen fully competent solid-state theorists, about whom we knew in advance or who soon identified themselves in conversation. These, and others, soon found themselves cooperating in small research groups on particular problems. The lecturers were enlisted as advisers and consultants, and many specialist seminars by visiting speakers were arranged. On special occasions, we invited a number of leading scholars to come together for a 2- or 3-day symposium to discuss a really topical and controversial problem, such as the quantum theory of the disordered state, in which many of the participants were actively interested. It is a measure of the high standing of the ICTP that we were able to gather in a substantial proportion of the best-known workers in this field, from Europe, the United States, and Japan, almost entirely at their own expense. As in any good academic institution, we try to achieve a balance between formal courses that keep the students moving forward in their basic knowledge and the open-ended, anarchical, mutually cooperative research activity which is the ultimate aim of such education.

Indeed, at the end of 3 months the Winter College transforms itself into a research workshop where those who have shown adequate interest and ability are invited to stay on and undertake more serious and sustained research. With the coming of spring and the summer vacations, we have more scientific visitors to Trieste, with many European and American academics reviving themselves from the administrative ardors of term-time by stopping by and doing a little physics. This winter we have Stig Lundqvist, from Gothenburg, to lead the solid-state workshop group, but the job will be open for future years.

Notice, however, that the Winter College and the workshop are bound up together. Only by starting research activities from the very beginning can we leaven the lump of continuous formal instruction; only by providing the educational program can we give meaning and coherence to the community within and from which the research work is to arise. In the absence of permanent graduate schools and research groups at Trieste in all branches of physics, this seems the only way to build up a temporary assembly that is more than the sum of the individuals in attendance.

Projects and Plans

The plans for future years are still uncertain, but we envisage further Winter Colleges and research workshops in various fields. The format itself may gradually develop; we may find, for example, that the international community established one year can reconstitute itself in subsequent years, perhaps to study some particular topic in greater depth. The need for a very broad curriculum may decline as we draw in a higher proportion of the active young scientists in the developing world—or it may be that there is a whole ocean to be drained.

The most serious demand for international activity in scientific education may come at a somewhat lower level, to compensate for the inadequacy of graduate schools in many regions of the world. The curriculum of a Winter College assumes a certain standard of training, roughly on the level of a newborn Ph.D. Our experience with young graduates who have not yet reached this standard has not been happy: as I have already remarked, one cannot produce an instant graduate school by packing three or more years of advanced courses into a mere 3 months. Can the Winter College format be extended so as to provide sound instruction at a more elementary level, to potential participants, before they ever come to Trieste? This is a much larger and more complex exercise, for which we have neither adequate financial resources nor administrative strength. But we propose now to experiment with "regional schools"—in Africa perhaps, or Latin America, or Southeast Asia —where we shall try to gather together a number of recent graduates and other scientific workers, for basic courses on, say, solid-state theory, or statistical mechanics, or nuclear physics, presented by experienced lecturers from leading universities. In my own thinking on this scheme, there would also be a number of topical colloquia—lectures explaining in simple language the current situation in various branches of physics, again to broaden the intellectual horizons of the audience. But the pattern of a regional school would depend upon the university situation within the area, and little would be gained from an ICTP initiative without corresponding local enthusiasm and support. It is obvious, for example, that the scientific community in India is already so large and intellectually sophisticated that it could easily support its own Winter Colleges and research workshops in many fields.

In this account of our recent actions and present thinking I have neglected several interesting topics, such as the role of Trieste itself as a general nucleus for physics in Central and Southeastern Europe. Then again, what are the boundaries of theoretical physics in our title? Should this not include other useful and beautiful arts, such as quantum chemistry, computer science, or applied mathematics, which would seem quite ripe for the Winter College treatment? Strictly speaking, these are matters for decision by the scientific council of the Centre; but in our small group, which has been responsible for the program on condensed matter, we are naturally keen to infect others with enthusiasm for this style of positive international action. Let me repeat our main theme. The extension and strengthening of the scholarly community in all civilized lands is an urgent task, requiring deliberate action by specialized agencies and devoted personal attention from at least a few of our leading scientists. The Winter College program is a direct attack on one part of the problem and brings almost as much scientific and spiritual reward to the organizers as it does to those whom it is intended to benefit. For this reason alone, I need make no apology in thus bringing it to the notice of readers of this article.