Prentice, the Minister of Public Building and Works, said that his ministry had appointed a permanent committee to consider the applications of computers to construction.

There are signs that the Ministry of Technology is about to take up a new challenge. Edmund Dell, Cousin's recently appointed deputy, has said that the government and the British scientific instrument industry will have to get together to meet increasingly successful overseas competition. Dell told a meeting of the Scientific Instrument Manufacturers Association on 3 May that in 1958 only 11 percent of Britain's requirements for scientific instruments were being met by imports, whereas in 1964 the figure was almost 30 percent.

A major problem for the British instrument-makers, Dell said, was fragmentation: over half the firms had fewer than 100 employees and only 10 percent have over 1000. The smaller firms, he said, couldn't be expected to do enough research and development to keep up.

In all these fields, however, the British Government's attitude is against rule-making and compulsion and in favor of persuasion. "I can't be a dictator of British industry," Cousins told the *Sunday Times*. "I've got to persuade people to do things, just as I did when I was General Secretary of the Transport and General Workers Union."

On a recent visit to the Soviet Union, Cousins was told about a government program wherein industries were required to adopt new technology and were then compensated for any subsequent losses. "But you can't do that sort of thing in our political system," Cousins said. In general, the Russians face problems "very similar to ours," Cousins noted, "and they don't seem to be any closer to solving them."

He summed up his philosophy of persuasion this way: "The problem of modernization is persuading people to do things that they ought to know by themselves need to be done."

—VICTOR K. MCELHENY

Research and Industry in Czechoslovakia

Prague. The Czechoslovak government and the Czechoslovak Academy of Sciences have given strong support to the recently founded Institute of Macromolecular Chemistry here, where the use of hydrophilic polymers as contact lenses was developed.

The institute, directed by Otto Wichterle, has grown up rapidly, with a single-mindedness and on a scale unusual for Czechoslovakia, where scientists have had to compete vigorously for chronically short resources and where it is not uncommon to find an institute's laboratories scattered all over town, even in converted apartments.

The Institute of Macromolecular Chemistry occupies a large building sheathed in aluminum and green glass. The nine-story building stands on a commanding height at the end of a trolley line west of town. It is full of expensive modern equipment, a good deal of it American.

The staff of about 300, whose average age is under 30, was not pulled out of other laboratories, but was recruited directly, during university training, in the late 1950's and early 1960's. The recruitment goes on, chiefly among the 50 or so postgraduate students who now work at the institute.

The growth of the Institute of Macromolecular Chemistry shows that Czechoslovakia, like other countries concerned about their industrial expansion, has been led by this concern to make a large effort to encourage specific lines of basic research.

Although the institute limits itself fairly specifically to fundamental studies of synthetic macromolecules, there were practical, industrial pressures behind its foundation.

The chemical industry, including the production of man-made fibers, is important to Czechoslovakia. It is worth noting that the earliest-completed section of the great pipeline bringing Soviet petroleum from beyond the Urals terminates at Bratislava. Besides, Czechoslovakia remains in some ways the most industrially advanced nation in eastern Europe. She is thus an important supplier of chemicals and artificial fibers to other Communist countries, which, like Czechoslovakia, are seriously dissatisfied with their domestic growth rates.

But Czechoslovakia also requires greatly increased earnings of western currency in order to buy goods she cannot get elsewhere. An important way to earn such money is through the fees from patent licenses. The Institute of Macromolecular Chemistry has scored a notable success in this field with a patent on the use of hydrophilic polymers as contact lenses (see box).

The needs of the Czechoslovak chemical industry did not, however, lead Wichterle, or the Academy of Sciences, or the government to plan a laboratory too closely allied to existing industrial commitments.

The Academy, whose president is František Šorm, head of the institute of organic chemistry and biochemistry, accepted the idea of an institute that would emphasize basic research.

According to Wichterle, the work of the institute is not dictated by current industrial preoccupations but by its interest in basic research. Nonetheless, it is helpful if a theoretical laboratory can, without being required to do so, supply processes and chemicals of practical interest. One must never make the mistake, Wichterle says repeatedly, of feeling that basic research is "higher" than applied studies. Application requires the same inventiveness and creativity as more fundamental studies. Indeed, it can be argued that one of the most important kinds of "fallout" from an institute like Wichterle's is a continuing supply of scientific-minded people for industrial laboratories; there is a shortage of such people in Czechoslovakia.

Thus, Wichterle and his colleagues try to maintain friendly ties with industry because they know that such ties are essential to the application of their ideas. Men from the institute are members of boards of research labo-

ratories that serve industry directly, and representatives of industry are on the institute's board.

With such a philosophy, the Academy and the government could accept the institute's need for the latest equipment, no matter what its source. Hence, the required foreign exchange was supplied.

It was necessary, nevertheless, to demonstrate to the Czechoslovak cabinet the potential industrial benefits of basic research on macromolecules before the green light was given for the institute.

Wichterle and his colleagues were helped to do this by work that they had done on nylon since the war. The work began clandestinely during the Nazi occupation, in a Bata shoe factory in Moravia. Because they found the studies "exciting," Wichterle notes, the researchers continued their work at the Technical University of Prague. In visits to Germany, Wichterle was able to see that the wartime work closely paralleled studies in what is now the Ludwigshafen establishment of the Badische Anilin und Soda Fabrik.

At Prague, Wichterle and his colleagues worked for many years on catalysts, processes, and reactions relating to the form of nylon known as nylon 6. In 1957 there was an important result. A new process was developed that allowed the manufacture of large nylon castings for industry—gear wheels, pipe, and so on. The size of the castings was practically unlimited, Wichterle says. The castings could weigh a ton or more.

In the process, according to Wichterle, the raw material, a monomer, is polymerized directly in the mold. The thermal reactions turned out to be "extraordinarily convenient" and the castings emerged as solids without the use of intermediates. The resultant castings lasted much longer than steel in processes where abrasion was a major factor.

Wichterle's group put a great deal of effort into finding a way of making direct conversion of monomers to polymers a continuous process. They wanted to be able to apply their discovery to the continuous extrusion of "shaped profiles" like rods.

Previously, the polymer was formed separately and then stored as pellets or a powder. Then the pellets or powder would have to be melted in a separate machine before they could be extruded. But Wichterle's group found a way whereby the monomer could be converted into the desired polymer and then directly extruded.

It was this method that Wichterle demonstrated one day to the cabinet. The members were impressed, and they gave their approval to the institute.

The Institute of Macromolecular Chemistry came into being formally 1 January 1959. Construction of the building began in 1960. In 1962 and 1963, the members of subunits of the institute moved in from their quarters elsewhere. Wichterle and such associates as Drahoslav Lím, now head of the chemical division, moved over from the Technical University. Blahoslav Sedláček, now head of the physical division, and his colleagues moved over from Šorm's institute of organic chemistry and biochemistry. J. Hnídek, now vice director of the institute, came from an industrial laboratory at Pardubice.

In planning for the institute, Wichterle and his academic and industrial colleagues had to face the fact that

Czech Invention Licensed in the U.S.

The method of using hydrophilic polymers for contact lenses that has been developed at the Institute for Macromolecular Chemistry in Prague by Otto Wichterle, institute director, and Drahoslav Lím, head of the chemical division, is a notable early entry into East-West technological trade. The process for making the lenses has been licensed in the United States, and the institute will be paid license fees of more than a million dollars. This is well over twice the purchase price of the institute's American scientific equipment.

The lens invented by Wichterle and Lím is not, like the lenses now worn by millions, made of a rigid polymethyl methacrylate, but uses a hydrophilic acrylic polymer which absorbs the tear material of the eye.

Because the lens is permeable, there can be a normal exchange of liquid through the lens, allowing the escape of both heat and carbon dioxide and the entry of fresh oxygen. (The impermeability of rigid contact lenses can cause discomfort on hot days.)

Clinical tests of the Czech gel lenses were conducted in Buffalo, New York, by Allan A. Isen, an optometrist, who reported that there was very little pressure against either the eyelids or the corneas of patients who tried the lenses. Such pressure makes wearers of normal contact lenses almost constantly aware of their presence. Further, the surface of the eye deforms slightly to conform to the inner surface of the rigid contact lens, so that when a user removes his contact lenses and puts on a pair of spectacles he notices some temporary blurring of vision.

Because the softness, permeability, and flexibility of Wichterle and Lím's lens eliminate these problems, it is possible that the lenses will have a wide sale.

A further advantage is that they are cheap to make. In an interview here in the summer of 1965, Wichterle said that the gels build up the correct dimensions of a contact lens in a rapidly rotating mold. Trial machines have turned out thousands of gel lenses in an hour, Wichterle said.

In the 3 years between Wichterle's first proposal to the Americans and the final license agreement, development work went on in both the United States and Czechoslovakia to iron out problems. Only after this work did the lenses become the favorable marketing prospect they now seem to be, according to Jerome Feldman, president of the National Patent Development Corporation, which holds Western Hemisphere rights to the process.

But development and production problems are common in the exploitation of an invention. The Institute of Macromolecular Chemistry can certainly claim that, early in its career, it has justified the premise that the Czech chemical industry needs and can benefit rather quickly from the foundation of a well-equipped institute devoted to basic polymer chemistry.—V.K.M.

there still were few academic programs of basic polymer chemistry in Czechoslovakia or elsewhere, despite the early example of Herman Mark in Brooklyn. The Technical University of Brno did not even begin teaching the subject until after the war. All Czech instruction in the field lacked the latest equipment.

Hence it was necessary to go directly to the universities and recruit young researchers while they were still students. With the plans for the institute in mind, the students were encouraged to take the courses that would be most useful to them later at the institute.

The institute was thus enabled to assume quickly its present organization into two divisions, physical and chemical, each with nine departments. But this formal organization merely organizes researchers by the technique they use, not by the material or the process they study. An examination of the papers produced by the institute shows almost universal collaboration among departments and divisions.

Much of the institute's staff, naturally, devotes itself to studying various aspects of the polymerization process and the influence on polymer characteristics of such variables as the molecular weight of units, the distribution of weight, the length of the polymer, its coiling, interactions between chains, and possible crystallization. The mechanical and electrical behavior of these high-molecular-weight compounds is much more variable with temperature and pressure than the behavior of smaller molecules.

The Institute of Macromolecular Chemistry had an important opportunity to show its work and build stronger international contacts when it held a large international symposium on macromolecular chemistry at the end of August 1965. The conference followed a practice increasingly used at large chemical meetings: the papers were submitted in advance, many of them as abstracts and later as preprints. Registrants received the preprints before departing for the conference, and so the meeting itself was left largely free for discussion in small groups. There were also a number of symposium lectures by such well-known specialists as H. W. Melville of Britain, Herman Mark, and Charles Sadron of France.

Of the 750 papers submitted, about 50 came from the Institute of Macromolecular Chemistry. The numbers from Communist and from non-Communist countries were about equal. About 130 came from the Soviet Union, and there were large numbers from the United States, Britain, France, Italy, and East and West Germany.

Most research groups of the Institute of Macromolecular Chemistry presented work to the conference. There were several papers from Wichterle, Lím, Sedláček, and others on the properties of gels of the sort used in contact lenses.

The institute was thus able to show both its emphasis on fundamental research and the industrial utility of this approach. It appears that the Institute of Macromolecular Chemistry is a significant example of the growing awareness in Communist countries of the need for practical steps to encourage basic research that will stimulate industry.—V.K.M.

CERN and Serpukhov Prepare for Collaboration

London. The physicists of Serpukhov, where the Soviet Union is building a proton synchrotron with a planned maximum energy of 70 billion electron volts, hope to get their first beam by the end of 1967, but they acknowledge that they may miss this target by a year.

This information is given in a report by five physicists from the European Center for Nuclear Research (CERN), in Geneva, who visited Serpukhov in November 1965. The report was published in the April issue of the CERN magazine, the *Courier*.

The physicists' visit was part of the preparation for collaboration between CERN and Serpukhov. A. A. Logunov, director of the new Soviet laboratory of high-energy physics, and several colleagues visited CERN last fall. In December, the council of CERN gave its approval of outgoing director Victor F. Weisskopf's initiative in pushing for collaboration. CERN's new director, Bernard Gregory, visited the Soviet Union at the end of May.

When the CERN scientists looked over Serpukhov, they found most of the giant magnets, which will be used to focus the beam, in place. Installation of the magnet coils had begun. The domed experimental hall, they found, has been designed without internal supports that would interfere with placement of the equipment for experimenting with beams extracted from the machine. The hall is vast, measuring 150 by 90 meters.

The Serpukhov physicists told their CERN visitors that they would not perform experiments with neutrinos until they had installed equipment for ejection of beams. Such neutrino experiments remain a major preoccupation of the two largest proton accelerator centers now operating—CERN, and Brookhaven in the United States. The neutrinos, obtained from the decay of secondary particles in an extracted beam, are used for studies of the so-called weak interactions. Physicists think that there is a particle mediating these reactions, analogous to the pion, which mediates strong interactions. With machines of the energy of those at CERN and Brookhaven, (around 30 Gev), the effort to find the mediating particle of weak interactions, the so-called W or "intermediate" boson, has failed. This failure heightens interest in Serpukhov, where the design of two beam-extraction systems is nearing completion.

The CERN physicists said that completion of a fast-ejection system for protons (up to 40 Gev) and a slow-ejection system for protons (up to 60 or 65 Gev) is planned for a year to 18 months after the first beam is accelerated on the machine. By that time, a large French bubble chamber, now being built at Saclay, should be in place at Serpukhov.—V.K.M.