cal Manufacturers Association conducted among 100 member firms. "Trends in R&D Manpower in the Pharmaceutical Industry" (PHS Publication No. 1443), eighth in the PHS series of reports on "Resources for Medical Research," is available for 25 cents from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20401.

The American Psychological Association (APA) has published a booklet called **"Standards for Educational and Psychological Tests and Manuals."** The 40-page handbook sets standards applicable to personality and interest inventories; to projective instruments and related clinical techniques; and to aptitude, ability, and achievement tests. It is a revision of two booklets published in the middle 1950's: "Technical Recommendations for Psychological Tests and Diagnostic Techniques" and "Technical Recommendations for Achievement Tests." The new booklet was prepared by a committee representing APA, the American Education Research Association, and the National Council on Measurement. Copies are available for $1 from the American Psychological Association, 1200 17th Street NW, Washington, D.C. 20036.

Scientists in the News

C. Gordon Little has been appointed deputy director of the Environmental Science Services Administration's Institutes for Environmental Research. He will continue as director of the Institute for Telecommunication Sciences and Aeronomy, at the Boulder, Colorado, laboratories of the National Bureau of Standards.

Milton Harris, recently retired vice president and research director of the Gillette Company, has been elected chairman of the American Chemical Society's board of directors, the society's highest executive position. He succeeds **Arthur C. Cope**, who died in June.

Niels K. Jerne, formerly chairman of the microbiology department at the University of Pittsburgh medical school, has become director of the Paul Ehrlich Institute, Frankfurt, Germany. He has been succeeded at Pitt by **Julius S. Younger**.

Neil Bartlett, formerly at the University of British Columbia, has joined Princeton University as a professor of chemistry. Bartlett, 33, has been widely honored for creating the first noble-gas compound, xenon hexafluoroplatinate.

The Federation of American Societies for Experimental Biology have elected **Kenneth M. Brinkhous** president. He is chairman of pathology at the University of North Carolina medical school.

Three biologists who had been on the faculty of Dartmouth medical school until this summer have joined the University of Pennsylvania. They are **Shinya Inoue**, professor, and **Gordon W. Ellis** and **Hidemi Sato**, associate professors of biology.

Recent Deaths

Alto Edmund Feller, 56; associate dean of medicine and professor of microbiology and internal medicine at the University of Virginia; 5 July.

Jacob Straus, 40; associate professor of biology at the University of Oregon; 3 July.

James W. Teener, 42; head of the space power systems project in the Johns Hopkins Applied Physics Laboratory's space division; 28 July.

REPORT FROM EUROPE

United States Looks at Swedish Shipbuilding Technology

London. The argument that the United States has much to learn from Europe about technological advance directly stimulated by the civilian economy draws strength from the U.S. Navy's investigation of shipbuilding at a highly organized and mechanized yard in Sweden.

The investigation grows out of a large U.S. Navy program of building support vessels and transports. It had been thought that many of these might be built in Britain to help offset the dollar cost of large fleets of American Phantom and F-111 jets being purchased for the British air force and navy. Indeed, Defense Secretary McNamara gave some support to this supposition in recent testimony to Congress in which he noted that construction costs are lower in British than in U.S. shipyards.

There was pleasure at these remarks in Britain, where the shipbuilding industry has been regarded as fragmented into too many small firms, technologically retarded, unready to properly survey the technical needs of customers, and burdened by fierce antagonism between workers and managers. The recent Geddes report on the shipbuilding industry recommended drastic concentrations of firms and a fresh approach by both management and labor; progress on both these items has already been reported.

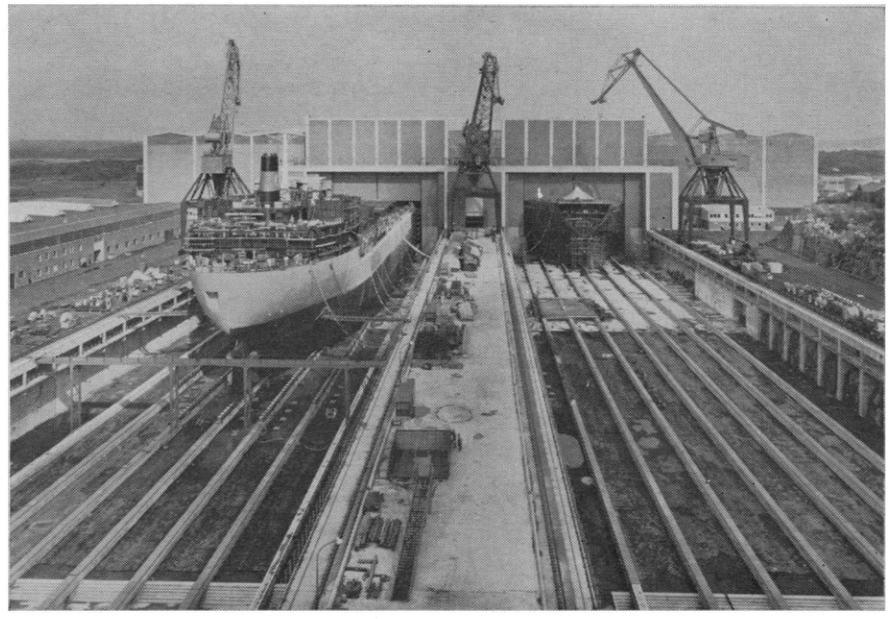
But this British progress may have come too late to forestall action by the U.S. government which may concentrate the Navy shipbuilding program in America. Such a move would be based, however, on the requirement that U.S. yards drastically change their costly practices and adopt at least some of the remarkable new streamlined shipbuilding techniques tried out at the Arendal shipyard near the Swedish port city of Göteborg.

The chief stimulus to U.S. interest in these Swedish techniques is the Navy's need for about 20 "fast deployment logistic" ships able to move military equipment anywhere in the world at speeds between 20 and 25 knots. The orders for these ships will total about $1 billion in the next few years. A sum that large provides enough leverage to force significant improve-

ment in the organization and equipment of U.S. shipyards.

Hence, representatives of two large American firms and of the Stanford Research Institute paid a call in March at the Arendal yard, opened in 1963 by Götaverken, builder of ships and marine engines. Götaverken is one of the world's major shipbuilding firms, although the number of its employees is modest compared to U.S. or Japanese counterparts; its operations are concentrated in two large yards in the Göteborg area. In May, Navy Secretary Paul Nitze followed up the experts' visit to Arendal.

The U.S. is negotiating for license rights on a number of important patents for the Arendal yard. Anyone who has visited this remarkable shipyard can see why. Its operations represent a codification of shipbuilding techniques gradually developed in the 20 years since the requirements of World War II gave real force to the pressures for industrialized shipbuilding.



Two ships in different stages of construction emerge from their dry docks at the Arendal shipyard. [Götaverken]

Instead of stretching for a great distance along the shore, like the usual shipyard, the Arendal plant has a seafront of only 300 meters and extends inland for about 1 kilometer. At the inland end of this narrow strip is a yard where steel plates are stored outdoors within easy reach of an overhead crane or a special lift truck.

From the moment they are placed on a system of conveyor rollers to the time they emerge as part of a ship, the plates remain under cover, protected from extremes of temperature and the rusting effects of rain and wind. After being placed on the conveyor belt, the plates, traveling more or less in a straight line, pass through a shot-blasting plant, where they are freed of rust picked up in travel and storage; then through a plate shop, where large machines cut and bend and stretch them; then on to the welding and assembly shops, where they are built into subassemblies.

Such prefabrication is standard shipbuilding practice today, but at Arendal there are novel elements: the process takes place under cover, in a straight line, and requires very costly equipment and a comparatively small staff.

All this meant a drastic change in work practices and would have been impossible without close and sympathetic cooperation from organized labor. At Arendal, the union agreed to a new system for measuring the wage value of jobs and ran a school to teach officials how to carry out the running surveys required by the new system of payment. The union agreed to cooperate because it agreed with management's view that a completely new yard operating at maximum efficiency offered Götaverken its only chance to survive Japanese competition.

From the standpoint of labor, an important feature of the Arendal operation is the fact that workers generally stay in one place and do not follow a plate to various locations in the yard. For the visitor, however, the most dramatic aspect of the operation is the final stage of construction. The ships emerge from a covered dry dock into the open air in sections. The first section assembled is the stern. A system of hydraulic jacks pushes the stern out into the open, and hydraulic doors close around the inner end of the completed section. The next section is assembled, and then it, too, is pushed out, after being joined to the first section by a fast-moving welding machine. As the ship emerges into the open part of the dry dock it is fitted out with wires, plumbing, and engines. The completed ship is floated in the dry dock, not launched down ways; it can then be readied for sea trials within a week.

The outline of this design was worked out in the 1950's by Nils Svensson, a naval architect who has risen through the ranks to top rank at Götaverken. In 1958, Svensson's plans, elaborated in cardboard models which he built in the evenings in the cellar of his home, were adopted by Götaverken, which operates another very large yard in Göteborg, and planning for the Arendal shipyard was begun. The directors took this step in the light of the sudden and violent changes which overtook the shipbuilding industry after the Suez crisis had interrupted the supply of oil and the boom in raw materials had collapsed after the Korean war. After Svensson and others had toured the world's shipyards to check techniques, construction was begun, and the yard was completed in 4 years, at a cost of $40 million.

Svensson was doubtless helped, in developing his plan, by the friendly climate for engineers which prevails in Swedish industry. Over half the large corporations of Sweden—which are concentrated in fields such as machinery, pulp and paper, and iron and steel—are headed by graduates of the notable technical universities of Stockholm and Göteborg. Because many of the top executives have an engineering background, developmental activity of industrial laboratories is often more fruitful in Sweden than in many other European countries.

Arendal demonstrates that, in the right circumstances, a firm of moderate size can pioneer technologically—and benefit commercially. Thus, the technological advantages often enjoyed by huge, diversified firms in America are not insuperable. There are many American firms which can benefit from the example of Arendal.

—VICTOR K. MCELHENY