supply to an organ. Splenic arteries can be successfully implanted into the kidney, and surgeons are now trying to do the same with the liver, because an increased blood supply is useful in the treatment of many pathological conditions including cancer.

AGRICULTURE

Growing and Testing

THE annual report of Rothamsted Experimental Station was becoming so unwieldy that it has had to be split in two. This year's report (price £1 10*s*) comes in two parts, the bulging report of the year's progress in the various departments and a thorough assessment of the most famous piece of agricultural research—the wheat experiment on Broadbalk field at Rothamsted. Recent changes in this experiment, set up in 1843, have been so extreme that the second part of the report is devoted to this topic.

When John Bennet Lawes and J. H. Gilbert first planted wheat in the thin plots on Broadbalk field, they wanted to know the relative importance for plant nutrition of nitrogen and "minerals"—their name for compounds containing potassium, sodium and magnesium. They gave the plots either no manure; farmyard manure; nitrogen only; "mineral manures", or "mineral manures" plus nitrogen, and similar treatments have continued ever since. Lawes and Gilbert soon found that yields were small unless nitrogen was given and that "minerals" produced increases only when given with nitrogen. Onlookers were amazed that a few hundredweight of chemicals could produce wheat yields equal to those obtained with many tons of manure. Since then, the Broadbalk plots have continued to show farmers the sorts of fertilizers they should be using to obtain the best yields of wheat.

The variety of wheat grown on Broadbalk field has now had to be changed to a short strawed type, to bring the experiment into line with modern farming, and so in 1967 the scope of the work was further extended by the drastic innovation of introducing new crops. Potatoes and spring beans will be grown as well as wheat, in various cycles of rotation. The first harvest after the change was unspectacular—1968 was a bad year—but interesting effects are beginning to emerge. The pre-emergent herbicide used on the beans, for example, only partially controlled weeds on the manured plots, but on the unmanured plots it damaged the young bean plants.

Another innovation is described in the annual report of the National Institute of Agricultural Botany. This is the first issue of a recommended list of grass varieties. The list has grown out of the annual farmers' leaflet describing the grass varieties commercially available in England and Wales, issued since 1960. The new list recommends varieties of perennial, Italian and hybrid ryegrass, timothy, meadow fescue and cocksfoot on the basis of trials carried out by NIAB.

The digestibility of the grasses in the list is expressed in the new unit—the D-value—which has replaced the DMD (digestible dry matter). The new unit can be defined as digestible organic matter in the dry matter. For grass the conversion factor is about 0·9 and it is easy to establish that 70 per cent DMD includes about 7 per cent mineral matter, giving a D-value of sixty-three.

SHELLFISH

Mussel Eating Hazards

EIGHTY people became severely ill in Northumberland last year after eating local mussels, and along the neighbouring coast sea birds and sand eels died in great numbers (*Nature*, **220**, 21; 1969). The epidemic turned out to be a case of paralytic shellfish poisoning, never previously recorded in England but common enough on the coasts of Peru, Japan, the United States and Canada.

British Columbia has long been afflicted with outbreaks of the disease, and the Fisheries Research Board of Canada has just issued a booklet describing its researches into the matter (*Paralytic Shellfish Poisoning in British Columbia*, Fisheries Research Board of Canada Bulletin 168, Ottawa, 1969). The first recorded instance of the disease took place on Captain Vancouver's voyage of discovery along the Canadian coast in 1793. The captain gave a detailed description of the meal of fresh mussels which sent several of his men into a state of "numbness, sickness and giddiness" and cost the life of one of them. In 1799 a Russian expedition lost 100 men in similar circumstances at Peril Strait, Alaska.

After the Captain Vancouver incident, the next recorded outbreak in British Columbia was in 1942 when the consumption of poisoned clams led to much illness and three deaths. Since 1942, the Canadians have carried out regular surveys of shellfish toxicities in their coastal waters, and there is a now considerable amount of information about the disease. The poison in the shellfish is a compound of low molecular weight and of empirical formula $C_{10}H_{17}N_7O_4.2HCl$, called saxitoxin. It is one of the most potent known poisons and 100 micrograms is thought to be the human lethal dose by oral ingestion. It probably acts directly on nerve and muscle membranes, blocking their permeability to sodium ion.

The toxin is made by certain dinoflagellate species, but it only becomes a threat when the dinoflagellates reproduce explosively to produce their characteristic "blooms", sometimes bringing tracts of the ocean to the colour and consistency of tomato soup. Unfortunately the growth of a bloom is highly unpredictable, depending on a critical balance of temperature, light, salinity and nutrition. In bloom conditions, it is sometimes possible to extract saxitoxin from the ocean itself, and shellfish feeding on dinoflagellates naturally accumulate the toxin, though apparently without themselves suffering harm.

It was only in 1965 that a dinoflagellate responsible for an outbreak of paralytic shellfish poisoning was identified in British Columbia. It turned out to be *Gonyaulax acatenella*. (The closely related *Gonyaulax tamarensis* was responsible for last year's Northumbrian outbreak.)

Canadian ecologists have given much thought to the possibility of forecasting outbreaks of paralytic shellfish poisoning, but the complex topography and weather conditions of the Canadian coastline probably doom all such efforts to failure. A blanket ban on the eating of shellfish is likewise impracticable. The Fisheries Research Board of Canada is therefore contenting itself with an investigation of detoxification techniques, a routine sampling programme, and the generation of a publicity machine to give warning when necessary.