its freedom from toxicity to humans and warm-blooded animals. It is enjoying a rising demand for use in stored grain protection and for insect-repellent packages (see page 991) for cereals and premixed foods. And it is used on some crops such as spinach, cauliflower, broccoli, and sugar beets. Cost and deterioration by sunlight usually discourage its application on crops, but the gradual decomposition is an asset at times.

But by far the biggest use of pyrethrum is in outdoor and household sprays and aerosols for the control of flies, mosquitoes, and roaches. There it is especially effective against insects that have developed resistance to DDT, chlordan, or other standard insecticides.

The increase in demand is encouraging efforts to step up production of the basic raw material in Kenya and the Belgian Congo, where most of the world's pyrethrum flowers are grown. Output of dried flowers, which contain about 1 to 1.6% by weight of active insecticide, is expected to reach 6.7 million pounds in Kenya and more than 4.5 million in Belgian Congo this year. Combined production in those countries is expected to reach about 16 million pounds within two or three years.

Growth Limited by Economics

Pyrethrum flowers can be grown in many parts of the world, but economic production requires high annual yield at low cost. Generally, this means cultivation near the equator at high altitude and where labor is plentiful and costs are low. Picking requires selection on the basis of maturity and machines are not successful. Kenya, which straddles the equator, has roughly 20,000 acres of pyrethrum under cultivation at an altitude of about 7000 to 9000 feet. Belgian Congo has approximately 8000 acres under cultivation at about the same altitude.

Although some distance north of the equator, Japan also produces pyrethrum. Japanese exports of the dried flowers totaled about 1 million pounds in 1954, a large share of which went to Argentina and other South American countries. This year, Japan has exported very little if any pyrethrum and, in fact, is currently considering the importation of African material.

Continuing efforts are being made to grow pyrethrum in South America. Obviously, U. S. companies, which traditionally prefer not to depend exclusively on a single source of supply of any material, don't want to be caught empty handed in the unlikely, but not impossible, event that the African supply is curtailed by a war or a crop failure.

During World War II, concerted efforts were made to encourage pyrethrum growing in Brazil, where, in one wartime year, output reached about 2.5 million pounds, principally for export to the U. S. Since the war Brazilian production has dropped below local demands.

Pyrethrum growing is today a much more active operation in Ecuador, primarily at the urging of U. S. companies. Ecuador began commercial production in 1951 and is expected to turn out about 450,000 pounds of dried flowers in 1955, with 560,000–670,000 pounds next year.

The high cost of harvesting is one reason why pyrethrum growing in the U. S. has never been a real success. As another key factor, the flowering season in the U. S. lasts only about 2 months, as compared to 8 to 10 months in Africa. Some years ago, an attempt was made to grow pyrethrum commercially in Colorado, but was eventually abandoned.

Extract Production Rising

In the past, most pyrethrum has been shipped as flowers in highly compressed bales. But the extract, which has lower shipping cost and better stability of active ingredients, is getting attention in Africa. In late 1953, Kenya made its first large shipment of extract to the U. S. —some 40,000 pounds of material containing 25% pyrethrins. Belgian Congo expects to have its first extraction plant in operation within a month.

As another noteworthy development, the Pyrethrum Board of Kenya recently completed its new chemical and biological laboratory for research on improved strains of pyrethrum flowers and better methods of crop management. The growing of pyrethrum is being rotated with the growing of wheat, corn, and other crops to maintain soil fertility.

The price of pyrethrum has remained relatively steady for the past year and a half and is expected to stay that way for at least another year. The present level is about 45 cents a pound in the U. S. for dried flowers.

Largest single U. S. processor of pyrethrum is Fairfield Chemical Division of Food Machinery, which takes about half of pyrethrum imports. Other major processors are McLaughlin Gormley King, Prentiss Drug & Chemical, Olin Mathieson, and S. B. Penick. Among the largest American producers of finished pyrethrum insecticides is Gulf Oil.

Today, compounds are available that are outstandingly effective in increasing the insect killing power of pyrethrum. Because these synergists also appreciably lower the cost of pyrethrum application, very little pyrethrum is actually used without such an additive. Fairfield's piperonyl butoxide, introduced in 1946, is widely used domestically and abroad. Other available synergists include Penick's sulfoxide and McLaughlin Gromley King's MGK 264.

Researchers are also working on new synthetic compounds resembling pyrethrum chemically and in insect killing properties. The most commercially successful of these has been allethrin. Other synthetic pyrethrum-like compounds such as cyclethrin and Furethrin have also been developed, but suffer from the major drawback that they cannot be synergized as effectively as pyrethrum.

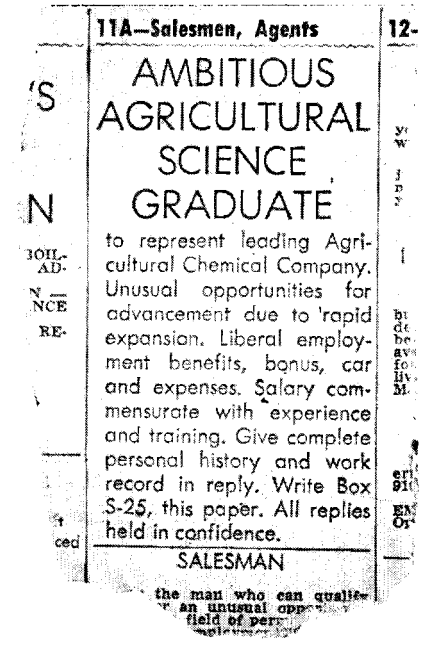
One industry spokesman predicts that world consumption of pyrethrum may double in the next five years. The most rapid growth, he says, will be in areas such as India and the Middle East, where insect problems are especially severe. Indications are that, if the demand existed, Kenya and Belgian Congo could double their pyrethrum production—and, in not too many years, may very well be doing just that.

Agriculturists for Chemical Industry

Shortage of trained specialists in agricultural sciences will soon affect the chemical industry

THE CHEMICAL INDUSTRY not only takes many of our graduates, but this year it also took four of our staff members." This statement from an agricultural college dean was not a com-

Help-wanted ad from newspaper is typical of offers from chemical industry


11A—Salesmen, Agents

AMBITIOUS AGRICULTURAL SCIENCE GRADUATE

to represent leading Agricultural Chemical Company. Unusual opportunities for advancement due to rapid expansion. Liberal employment benefits, bonus, car and expenses. Salary commensurate with experience and training. Give complete personal history and work record in reply. Write Box S-25, this paper. All replies held in confidence.

SALESMAN

plaint against the chemical industry. It was made to emphasize the extent of problems growing out of a shortage of technically trained agricultural specialists.

The chemical industry, in recruiting the annually increasing number of agronomists, plant pathologists, entomologists, and related scientists it needs, does not feel the shortage so acutely as it does the shortage of chemists and chemical engineers, because it can usually get its pick. But the shortage then shows up in other phases of agriculture. And it is in these other phases of agriculture that manufacturers of fertilizers, pesticides, and feed supplements will eventually suffer the effects of shortage.

The use of chemicals in agriculture will suffer if experiment station, extension, and educational activities are hampered by lack of scientific specialists. Chemical companies in the agricultural field depend heavily on experiment stations, not only for fundamental research, but also for important work of translating advances in science into practice. Extension services are in key positions of influence.

The Association of Land-Grant Colleges and Universities estimates that 15,000 new graduates with land-grant college agricultural education are needed each year. There are only 8500 Of the 15,000 needed, 3000 are needed by industry. This includes the machinery and equipment, food processing, feed, and dairy industries, in addition to the fertilizer and pesticide industries.

Another 3000 are needed for education—also of vital importance to any industry selling to agriculture. Nonindustrial research could use 1000 agricultural graduates, and the remaining demand is distributed among agricultural business (nonmanufacturing), conservation, services, communications, and of course, farming. All of these play a part in advancing scientific agriculture.

Chemical Companies Offer Much

It is not too difficult to see why the chemical industry often has first choice from each year's crop of agricultural graduates. To an able, ambitious young man, a position with a chemical company offers a higher starting salary and better opportunities for advancement than most other jobs.

Generally, chemical companies hire agricultural graduates for either sales or research, but some, like International Minerals & Chemical, also employ agricultural engineers, and sometimes agronomists (also chemical engineers) as fertilizer plant superintendents.

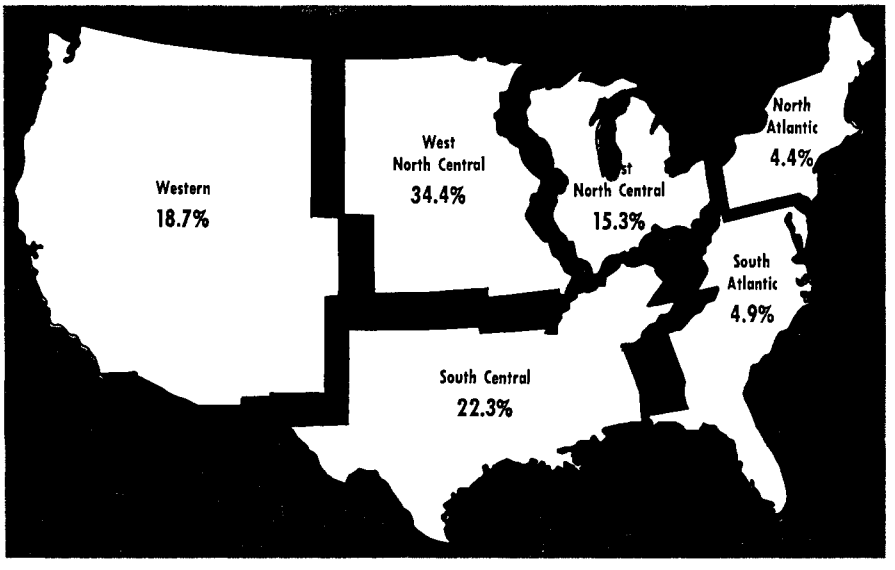
In most chemical companies starting salaries are slightly lower for agricultural graduates than for chemical engineers. Although restriction of experience to agricultural science may retard promotion to the very top posts in a chemical company's research organization it has an advantage for advancement in sales departments of fertilizer and agricultural chemical makers. Here the agricultural graduate is at least on an equal footing with chemical graduates—and may be in a more favorable position.

Not all agricultural graduates would be happy working for a chemical company. Many of them get a satisfaction from teaching, experiment station, or extension jobs. Then too, many hope some day to have their own farms.

More Students Must Be Encouraged

It is to industry's interest to help more students to get agricultural education at college. A number of fertilizer and pesticide companies already offer financial aid to students through scholarships, but most go to graduate students. There is a big need to encourage more high school students in agriculture at the universities. Then too, many undergraduates marry and leave college. Scholarships would make it easier for them to continue.

The agricultural sciences must compete with other fields for students. One midwestern professor of soils says: "With the great diversity of subjects now presented in high schools, it is easy for even the brilliant to slide into some of the less difficult courses than it is to take the mathematics and physical science courses necessary to prepare him for technical work in agriculture. Also, the great amount of publicity about agricultural surpluses has probably led a number of young people to believe too much has already been done in improving agriculture. More publicity about possible food shortages in the future might help interest more young people in scientific agriculture."



National production of cattle and calves on a live weight basis by regions

Geography of Meat Packing

Slaughtering centers grow near areas of high population and stock production

THE GRADUAL but consistent western movement of the meat packing industry, dramatized by Wilson & Co.'s recent announcement that it is discontinuing Chicago slaughtering operations, also focuses attention on the growth of medium and small sized independent meat processors since World War II. An important reason for the shift—to establish operations in a more advantageous geographical location—is one of the primary reasons why smaller operators are enjoying rapid growth.

By transferring its slaughtering activities to other Midwest locations, Wilson hopes to benefit from:

- A growing western population.
- Savings in mounting transportation costs.
- Ability of more farmers to truck livestock instead of depending on railroads.
- Smaller financial outlay by expansion of facilities in Iowa, Minnesota, and Nebraska, compared with the huge investment necessary to rehabilitate old facilities in Chicago.

Growth of the independent operators and the geographical shift of some of the majors, even before Wilson's decision, put slaughtering centers like Omaha in high livestock producing areas. Accord-