Ag and Food Interprets . . .

- USDA and local authorities get set for war against fire ant
- New plant food debuts soon before skeptical, interested audience
- Mexican phosphate deposits offer potential threat to Florida's
- Agroclimatology, long neglected, may be in for renaissance

The Fire Ant

Now ravaging 20 million acres. USDA hopes to get a big foothold this winter for its long-range eradication program

USDA's Agricultural Research Service is preparing to deaden the sting of the imported fire ant. Cooperating with state plant-pest agencies and local fire ant eradication groups, ARS will push for large gains this winter in its efforts to kill off this pest.

ARS now has funds ($2.4 million for 1958) specifically to carry on the program. But other important matters must be settled before it can offer a complete and effective campaign against the ants.

One procedure still to be legalized is a federal domestic quarantine. USDA wants the quarantine—believes it basic to successful eradication—to minimize risks of reinfestation during the treatment period. However, regulatory officials cannot impose restrictions without first holding a public hearing. Generally, at least 30 days is required, after a hearing notice is posted, to bring quarantine into practice.

In the fire ant program, the quarantine will mainly regulate the movement of soil. USDA says, though, that any infested soil can be fumigated or treated with insecticides. The chemicals that would be used are expected to kill not only the ants, but also to give a measure of protection against reinfestation.

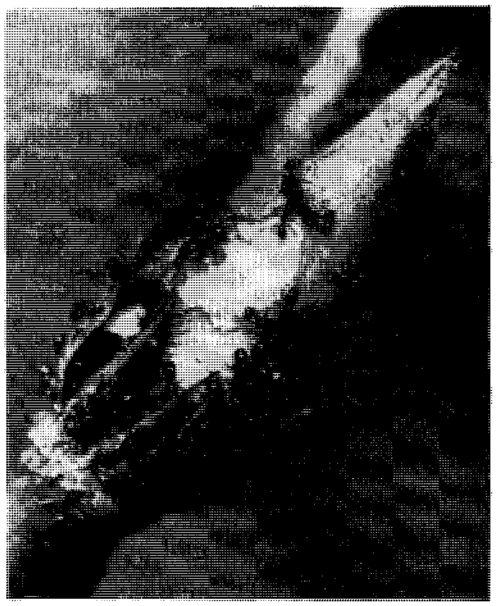
Another "indefinite" in the program is a chemical for use against the ant in large open areas. USDA says little research attention has been given the problem. Several chlorinated hydrocarbons kill the ant, but ARS scientists fear residues of these materials may create hazards. They are now working to find the best chemical for the job that will not introduce new difficulties. Results are needed quickly if the program is to get under way this winter. USDA prefers to conduct its work from November to April when most of the ants are underground.

Chemicals that have been used in small-scale eradications of the fire ant include chlordan, aldrin, dieldrin, and heptachlor. Best practical experience in treating a fairly large area was obtained in state-conducted program in Arkansas last May. According to the Farm Bureau Press of Little Rock, a 90% kill was achieved.

In this eradication campaign, about 12,000 acres of land was treated with granular heptachlor—1.5 to 2 pounds per acre. State officials observed no injury to plant or animal life during the treatment. And although it will take a year or more to tell whether there are any ants left, no live ones have been found so far. Cost of the treatment totaled $4.15 an acre, compared with original estimates of $6.00 to $7.00 an acre.

Scourge in the Southeast

The imported fire ant, so named because of its red-hot sting, is a triple menace in infested areas: It stings people and animals, sometimes causing serious infections. It destroys plants by gnawing holes in roots, tubers, stalks, buds, and pods. It builds pyramid-shaped, hard-crusted houses that are an eyesore on the countryside and can wreck blades on farm equipment as it ploughs through them.

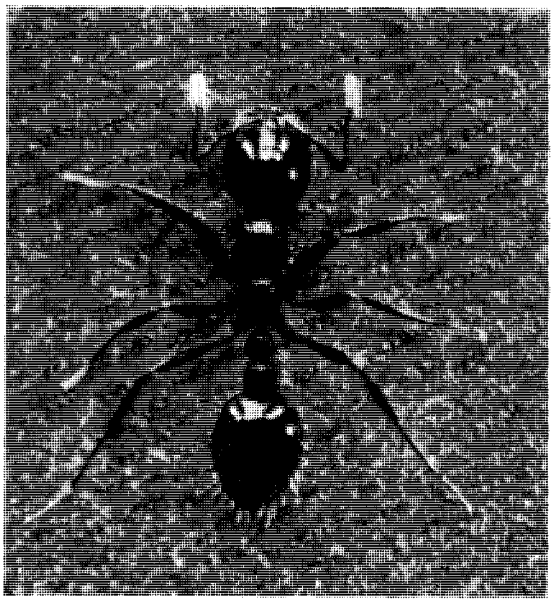


Imported fire ants eagerly feed on unopened flower bud of okra

Because of the danger these pests pose to humans and animals, they have been called the worst pest in the history of the South. Some believe if the ants are not controlled, they will spread northward and become a scourge to the entire East Coast. USDA, however, does not regard the fire ant situation as an emergency in the same terms as the Medfly infestation, for example. It intends, though, to keep a dynamic program moving toward eradication.

Ten states—all in the Southeast—are seriously infested with the imported fire ant. Estimates of the acreage involved now top 20 million acres. Hardest hit are Alabama, Mississippi, Louisiana, Texas, Florida, and Georgia. Less heavily infested areas are in North Carolina, South Carolina, Arkansas, and Tennessee. All of these states are interested in getting rid of

Fighting the Fire Ant



Worker ants range in size from $^1/_8$ to $^1/_4$ inch. An average colony contains 25,000 workers and only a few dozen winged ants. Winged males and females mate in flight. Then the males die off; and the females start new colonies. Worker ants supply food, maintain the mound, and protect the colony. They also take charge of moving if their mound is disturbed or becomes unmanageable.

Fire ants build mounds and live in almost any kind of soil, but they prefer open spaces—fields, pastures, or lawns. Their hard-crusted homes have a honeycombed framework about 15 inches in diameter. Living quarters extend as far as three feet underground.

In USDA's eradication program, treatment will be by plane, motorized equipment, and hand applicators. An orchard sprayer with hose and nozzle attachment (left) is efficient in treating small numbers of mounds. But a weed-boom attachment and power sprayer (above) is more practicable in large areas.

the ant, and Louisiana, Georgia, South Carolina, Florida, and Alabama have allotted funds to help in the fight.

Federal, State, and Local Groups to Cooperate

In the cooperative program against the fire ant, ARS and state agencies will encourage local groups—towns, cities, industries, railroads—to participate in a county eradication program and support it financially. As soon as a county is ready to start, the federal and state agencies will step in to assist with personnel, materials, and equipment.

ARS and the state plant-pest boards agree the ideal eradication program would start on the fringe of an infested area and move toward the center. And they will follow this pattern in the fire ant campaign whenever feasible. Then, as county funds are provided, these will be used to reduce progressively ant populations in more heavily infested places.

Some of the southern states have already organized local fire ant eradication districts. Georgia and Louisiana are best prepared for a quick start in the program. In Louisiana, the Farm Bureau and Agricultural Extension Service have formed committees of interested farmers and business people. Chairmen of these committees make up the over-all state eradication board.

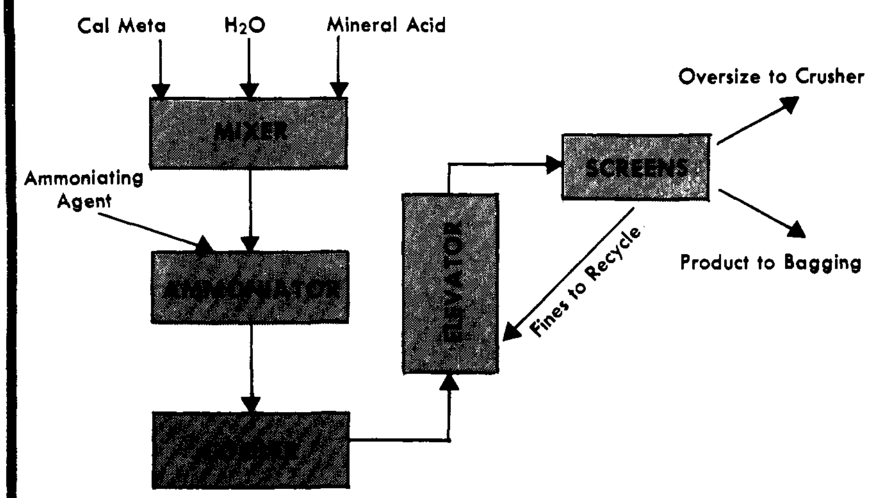
Headquarters for the fire ant eradication program is in Gulfport, Miss.—the ARS regional headquarters. An entomologist and chemist are already in the area, assigned to the project from USDA's Entomological Research Branch. During the program, ARS workers will measure the immediate kill and otherwise keep track of field progress. Meantime, at ARS's Beltsville, Md., laboratories, scientists will be testing new insecticides, determining optimum dosages, and working out other economic factors in the program. They feel an attractant to lure the fire ant would be a big help if one can be devised.

Local groups will be the starting point for USDA's planned public relations work to orient the fire ant eradication campaign. A public relations team will be sent to each eradication district at the beginning of its program. The team will distribute literature at meetings and to the general public. A fact sheet is now being prepared for this use, and a 5-minute TV spot will back up the team's work.

Calcium Metaphosphate

New plant food goes commercial next year while fertilizer makers look on—some skeptically

Central Farmers' Process for Mixed Fertilizers Containing Calcium Metaphosphate



COMING in about a year from now: first commercial production of calcium metaphosphate, $Ca(PO_3)_2$. From its plant near Georgetown, Idaho, the cooperative Central Farmers Fertilizer Co. will eventually ship "cal meta" to 30 member fertilizer manufacturing plants in a 13-state central area. From these plants, a new high-analysis complete fertilizer using cal meta as the principal ingredient will be marketed, to stand or fall on its own merits. The material will be sold for direct application, for dry blending with straight materials, and for use in high-analysis granular mixed goods.

A highly concentrated plant food (62 to 65% citrate-soluble P_2O_5), cal meta has been tested by TVA since 1938. To date, TVA has shipped about 450,000 tons of it, mostly to the Midwest and the South. Actually, the new fertilizer has been tested on soils in most of the 48 states—through TVA's cooperative research programs with agricultural experiment stations and through demonstration programs with extension services, distributors, and farmers. Crop response in acid to neutral soils is similar to that obtained with other phosphorus carriers. On alkaline soil, response varies, and cal meta is not generally recommended for use where a more soluble source of phosphorus is needed for early growth stimulation, says TVA.

But there is another big reason for interest in cal meta. Because of its high concentration, Central Farmers feels there is a pronounced economic advantage in storing and shipping the material. Take freight costs—a major factor in today's fertilizer economics. About 40% more plant food can be shipped as calcium metaphosphate than as triple superphosphate (which runs approximately 45% plant nutrient) for each $12—the approximate tonnage rate on these materials. And the same arithmetic holds for warehousing by dealers as well as for storage by eventual consumers. Central Farmers points out that its rock phosphate deposits, near which the cal meta plant is being built, lie from 1200 to 1500 miles from midwestern markets. The company feels that cal meta provides about the best way available to bring P_2O_5 into the central United States.

But other fertilizer makers are a bit skeptical. At best, they think cal meta's economy is questionable. One major producer thinks that, when comparing calcium metaphosphate with triple superphosphate, over-all costs are really close together. Which is more economical in the long run will depend on relative costs of electricity and sulfur.

Other producers around the country feel that the material offers nothing that isn't already on hand via wet process phosphoric acid. The latter is used to make triple superphosphate by a proved process, or it can go into diammonium phosphate for liquid fertilizer. These materials are used for direct application, or are blended into polynutrient fertilizers. Cal meta can be used directly just as well, but needs a hydroylsis step for use in polynutrient materials.

Direct application, incidentally, may turn out to be the most important use for cal meta. As one industry leader points out, it is quite possible that direct application of phosphates will increase faster in the future than use of mixed fertilizers.

Cal Meta Processes

The process which Central Farmers will use for making calcium metaphosphate on a plant scale was developed by TVA at Wilson Dam. Elemental phosphorus is burned in a combustion chamber and the resulting P_2O_5 then reacts with phosphate rock dust. To supply the elemental phosphorus, mined rock will be washed, beneficiated, and briquetted for charging into the elemental phosphorus furnace. A separate furnace is used to produce the cal meta, which emerges as a viscous liquid and flows onto a belt where it is quenched. After grinding, it is then ready to use.

To use the cal meta as a raw material for high-analysis granular mixed fertilizers, Central Farmers will employ a number of processes developed and provided by a member company, Illinois Farm Supply. These processes convert metaphosphates into high-analysis materials, mostly granular or semi-granular products. Some of them are completely water soluble. Patents on the processes are pending.

Arkmo Plant Food also has worked with cal meta for several years. But Arkmo has no plans to produce the material even though it holds cal meta in high regard. The company considers itself too small to handle much of the material, and initial capital investment demands are higher than Arkmo could meet, says a company official.

Like Central Farmers, Arkmo finds that in addition to making a successful high-analysis mixture, cal meta helps to:

- Reduce formula costs
- Improve granulation—it adds strength to and promotes uniformity of granules

And some analyses are impossible to duplicate without cal meta, the companies note.

Central Farmers says that the main part of its process is based on the hydrolysis of cal meta. Enriched superphosphate also can be made by this process by the reaction of different combinations of metaphosphates, rock phosphate dust, mineral acid, and water, followed by mechanical processing. The product should be cured to promote substantial conversion of the rock phosphate. The materials are mixed in an acidulator, and hydrolysis takes place at the same time that rock phosphate is acidulated. Hydrolysis is initiated quickly and proceeds rapidly. The mixture is transferred to a den for curing. A big advantage claimed for this process is its adaptability to conventional acidulation equipment.

To make mixed fertilizers, cal meta and various combinations of mineral acid and water are used—followed by ammoniation, potash addition, drying, cooling, classifying, and packaging. No cure is required. Any common P, P-K, N-P, or N-P-K ratio fertilizer can be made, claims Central Farmers.

Granulation with Cal Meta

TVA is also pilot planting cal meta-containing granulars. The process consists of partially hydrolyzing calcium metaphosphate with mineral acid, and ammoniating the product in TVA's continuous ammoniator. So far, says TVA, the pilot plant work has shown that a wide range of fertilizer grades can be produced using cal meta to supply all or part of the phosphate. Some commercial plants are using, or planning to use, the TVA process (see page 839).

Wisconsin Farmco Service Co-op, a member of Central Farmers, has incorporated cal meta as the major phosphate ingredient in a slightly modified conventional TVA system. Two grades have been produced and marketed so far, and experiments on other grades are going on in cooperation with Central Farmers.

Apparently no other fertilizer producer plans to enter the cal meta picture—for now, at any rate. But some admit to a possibility of getting in if the fertilizer proves itself competitively.

Central Farmers' full-scale demonstration of cal meta's merits and limitations will undoubtedly be a major influence in the fertilizer industry's thinking in this area for some time to come.

Phosphate Reserves

Fast expanding phosphate industry looks to using more low grade deposits and fine grain material

Even though some industry authorities expected that the rapid expansion of the phosphate industry—begun at the start of World War II—would cease by about 1950, such has not proved to be the case. By 1956, world phosphate rock production exceeded 32 million tons per year. The United States led with about 15.7 million tons. Next came North Africa with 9 million tons, Russia with 4.5 million, the Pacific Ocean island producers with 2.8 million. The U. S., Japan, United Kingdom, and continental Europe use more than 80% of world production.

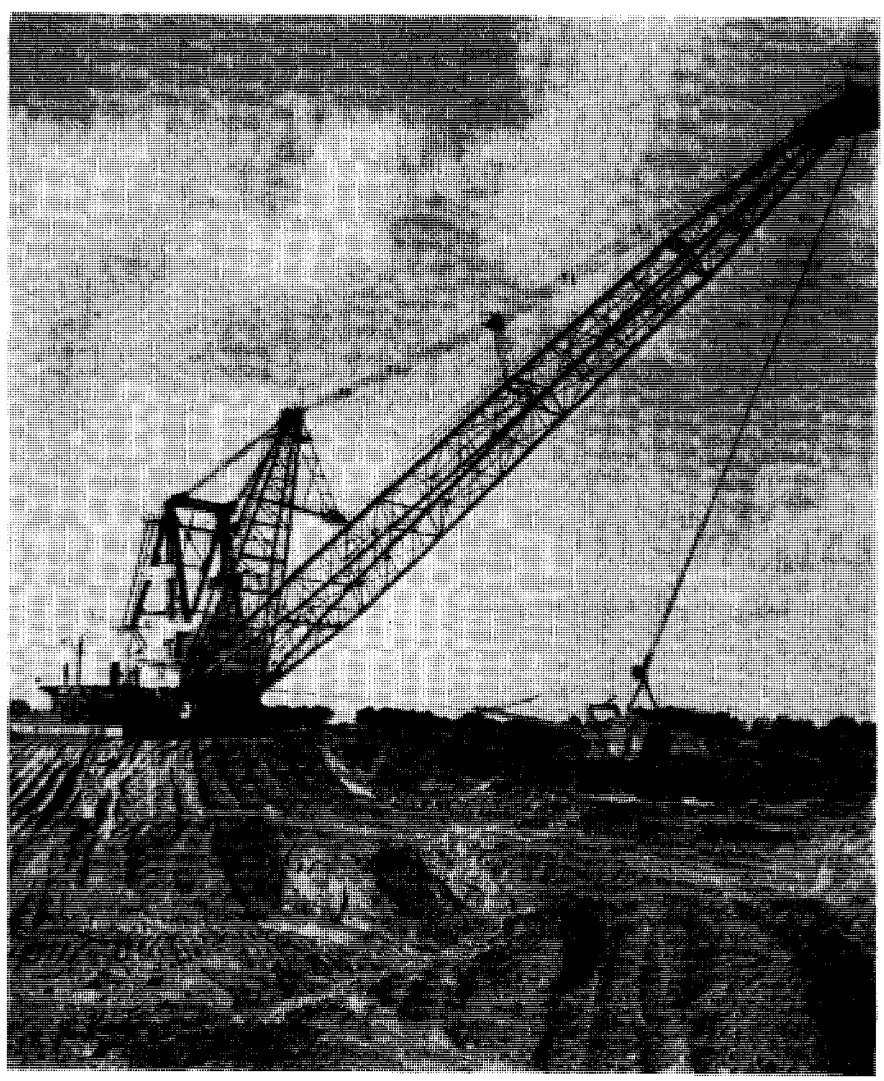
U. S. rock production has more than tripled since 1940, going from approximately 4 million to 15.7 million tons per year. And since 1950, the rate of increase has been faster—in six years, production is up 4.6 million tons per year. Of U. S. phosphate rock production last year 76% came from Florida, 10% from Tennessee, and 14% from several western states including Idaho, Montana, and Wyoming.

An estimated 60% of the country's reserves is in these three states. Here, too, are most of the new elemental phosphorus plants. Yet an unofficial estimate places usable Florida reserves at 50 billion tons. Limited and largely undeveloped deposits exist in Arkansas, Georgia, Kentucky, North Carolina, Oklahoma, South Carolina, and Texas. Thus, the U. S. will remain self-sufficient and an exporter for some time.

Florida's position as the top producing state seems unlikely to be threatened for some time because:

- Florida rock has a higher average phosphorus content
- Florida's deposits of land pebble phosphate cost relatively less to

Large-scale phosphate mining in Florida, as typified by IMC's mammoth dragline, which swallows 84,500 pounds of ore at each bite, seems secure for many years to come despite deposits found in Baja California



mine. The rock can be pumped as a slurry from mines to dressing plants

- The land pebble is amenable to effective beneficiation, and adequate water supplies exist
- Mines and processing plants are close to seaports. (Exports totaled about 2.4 million tons last year, and substantial tonnages of domestic rock also go by water)

Baja California Deposits

Both a potential threat to Florida producers' sales in the Pacific Ocean Basin area, and a challenge to mineral technologists, appear in large low-grade phosphate deposits found on islands off the coast of Baja California, Mexico. The deposits are unusual in that they exist as surface depositions of unconsolidated sand, uniform in size, and washed free of slime impurities.

The phosphate is found as the mineral, collophane. Deposits are estimated by A. K. Schellinger of Stanford University to average 3% P_2O_5. Despite their low grade, the deposits are of interest because of the deep water proximity to large markets, and because normal pre-processing steps of crushing and screening the raw rock may be by-passed to go directly to a beneficiation process.

Work at Stanford Research Institute has turned up several processes to concentrate this phosphate. A concentrate of over 29% P_2O_5 can be obtained by anionic flotation followed by cationic flotation and magnetic separation. Less sensitive than Florida phosphate to water ionic conditions, the Baja California phosphate concentrates will float in sea water. Quartz, ilmenite, and zircon can be recovered from anionic flotation tailings. These minerals figure importantly in the process economics.

Fines Problem

A second important challenge to technologists is how to recover valuable phosphate material finer than 200 mesh—either from tailings or from naturally occurring material. Even though great strides have been made in recovery methods, still almost a third of phosphate mined in Florida is lost. Large non-specific surface areas per unit weight of phosphate have been the big stumbling block to economical processes for beneficiating the under-200-mesh material. Chemical leaching methods that solubilize the P_2O_5 in a manner similar to that used in copper and uranium recovery look promising to some researchers working on the problem.

Florida phosphate rock, mostly land-pebble phosphate, goes through a several-step beneficiating process. Finer land-pebble (less than 1 mm. size), as it comes from the first washer step after mining, consists of clay slime, silica sand, and phosphate pebble. Larger size material (up to 0.75 inch) is further washed before drying and sale. Going next to hydro-separators, the finer materials separate as a less-than-200-mesh fraction that is discarded to a waste pond, and a 1-mm to 200-mesh fraction. A second classification gives 1-mm. to 28-mesh and minus-28 to 200-mesh fractions. Both fractions are beneficiated using a blend of caustic soda, kerosene, fuel oil, and fatty acid as a reagent. The beneficiated fine fraction may still contain 5 to 7% silica if good phosphorus recovery is achieved, less if some recovery is sacrificed. Often amine flotation is used to concentrate this fraction further.

Extensive beds of as yet non-beneficiable land-pebble (grain size below 200 mesh) are found in Florida. These beds provide an incentive for locating triple superphoshate plants in the land-pebble district for chemical recovery of phosphorus that would otherwise be lost.

Tennessee and the West

Tennessee phosphate deposits were concentrated by weathering action on limestones. Because grade and location of Tennessee phosphates vary widely, they are hauled by truck (and railroad, if possible) to electric phosphorus furnaces or beneficiating plants after strip mining. Since mine sites may be 10–15 miles from the plants, transportation costs prove important in selection of deposits to mine.

In the West, phosphate rock is largely strip mined. Cost problems of handling overburden grow, but producers estimate strip mining will remain economical for about 10 years in most cases. Underground mining means high costs, but these are offset by mass mining and by taking only the best possible ore to the surface

However, phosphate rock from Tennessee and the western states is not without an economic advantage. Since this rock contains appreciable silica as an impurity, it can be used directly in electric furnaces that need silica as a flux. Thus beneficiating steps are partly or entirely eliminated. This proves especially important in the West where water is seldom available in quantities needed for wet beneficiating.

Because transportation costs for moving phosphate from western states (about $6.00 per ton to San Francisco) and from Tennessee are high, maximum quantities are converted to elemental phosphorus and phosphate chemicals at or near mines where low cost electric power is available. And sulfuric acid for making fertilizer costs more in Tennessee and the West except for by-product acid from smelters.

Here arise other challenges to the phosphate industry—how to supply all phosphorus needed as plant nutrients to Pacific Ocean Basin areas, and how to utilize low grade deposits in the area at low or competitive cost. High analysis fertilizer made at the mine site may be one solution, but finding deposits that offer even lower processing costs, and shipping elemental phosphorus to make fertilizer at plants in fertilizer marketing areas are other possible future answers.

Agroclimatology

Renaissance is beginning in a long-neglected discipline

One of the greatest needs for a flourishing agriculture is a flourishing science of agroclimatology—meteorology or climatology specifically oriented toward agriculture's needs. But agroclimatology definitely is not flourishing. In fact, its status as a science has been described by one expert as "miserable." Because the situation is so bad, however, it should be extremely easy to improve.

The wasted condition of agroclimatology can be attributed chiefly to a single cause: the advent of commercial aviation. Until some 25 or 30 years ago, meteorology was being developed almost entirely for agriculture. The growth of aviation brought a major change in emphasis, to the point that in 1940 the Weather Bureau was taken out of the Department of Agriculture and placed under Commerce. Throughout the country, weather stations were gradually relocated at airports.

As a result, micrometeorology—the study of extremely localized weather conditions—fell by the wayside. Shelters for weather instruments to measure flying conditions are located well above the ground, and conditions below the shelters, down to and below the ground level are now largely ignored. For agriculture, of course, conditions at or very near the ground level are most critical. And attempts to extrapolate weather data from instrument shelter height down to the ground can lead to serious errors. It is easily possible for differences in weather conditions between instrument shelter and ground level to exceed differences in weather conditions between shelters 100 miles apart.

So far has the emphasis in meteorology drifted that today's meteorologist usually can offer the agriculturist no more than standard weather shelter data and a general forecast. But a readjustment in emphasis may now be in sight. Certainly some improvement can be expected if action is taken on recent recommendations by the Committee on Agricultural Meteorology and Climatology of the Agricultural Board, National Academy of Sciences. Presenting their ideas in panel discussion form at last month's annual meeting of the Agricultural Research Institute, members of the committee indicated numerous ways in which climatology and meteorology could contribute predictive data useful for agricultural planning.

A successful agroclimatology would enable crop specialists to provide two types of predictions. The first would be a prediction of plant response to the interrelationships between plant variables and weather variables, regardless of season or time of year. An example of a prediction of this type would be that of indicating that if a certain minimum temperature is reached, corn plants will be killed. The second type of prediction involves interrelationships between plant variables and weather variables with phase or season taken into account. This type of prediction involves a time relationship as well as one of magnitude. An example might be prediction of the degree of maturity a corn crop will have achieved when the first killing frost occurs. The two types are often interdependent, and hard to separate clearly.

As of now, unfortunately, data concerning the direct interrelationships between plants and weather are very meager. Too high a percentage of the data that are available has been derived from experiments set up for other purposes; far too little information has come from experiments specifically designed for agroclimatological research.

In the past, "macro" data have generally been used in attempts to relate weather conditions to biological response. Agriculture's great need in this regard is for more information on the conditions that are critical for crop thrift. Thus, the question is not how much rain falls on a field during a crop season, but instead how much water is in the soil around the roots, in the air immediately surrounding the plant, or actually on the plant parts. In short, the question is: what is the microclimate?

What to Measure?

Such questions need to be answered not only in connection with moisture, but for other weather factors as well. One member of the committee has proposed that the collection of weather data in agricultural regions be extended to include readings of a number of variables important to agriculture. Such variables might include radiation, air temperature at ground level and shelter level, with maxima and minima recorded for each day, maximum and minimum dewpoints each day, soil temperatures measured on bare soil, on soil beneath sod, and perhaps on soil beneath specified crops and at specified depths beneath the ground surface, total wind movement for daytime and nighttime, duration of dew on crop parts, total crop moisture availability, and total evaporation.

Mere collection of additional climatological data would not be an answer to the real problem, of course. For as one panelist pointed out, agriculture's climatological problem would not be solved even if scientists suddenly found they could predict or even control weather perfectly. So small is the body of knowledge in this area that agricultural science would not know what factors to predict or what factors to control to achieve optimum results. Far less is known about the effects of weather on crops than, for instance, about the effects of soil conditions on crops. Yet weather is certainly as important as soil for crop vigor.

Some even hold that weather is the most important single factor affecting crops. Why, then, is there such a dearth of good data on weather-crop relationships? The few well-designed experiments that have been carried out in this field have actually yielded some good data, indicating that significant agricultural progress is possible through research in agroclimatology.

Many reasons may be cited. There are too few weather stations properly located or properly designed for collection of the type of data most needed by agriculture. The equipment in use at existing weather stations was for the most part designed for other purposes, and is not suited for agroclimatological measurements. And there is no well-defined body of literature, in which the researcher can study what has been done before, or to which he can contribute publishable results of new research.

But the chief problem, as is the case in many sciences related to agriculture, is a shortage of the right kind of personnel. There are many good agriculturists and many good meteorologists, but there are few people who combine the essential qualities of both. Moreover, it appears that too little attention has been given to team effort of the sort that might substitute for individual researchers expert in both agriculture and weather.

Perhaps the trouble is, as one panelist suggested, that agroclimatology has no organizational niche, no traditional place in agricultural research. No box is provided for an agroclimatologist on the organizational charts of most agricultural research organizations, and no curriculum is provided, at most institutions, for the training of specialists in agroclimatology.

Yet the agroclimatologist is—or should be—an important member of almost any group doing almost any kind of agricultural research. He can contribute significantly to the success of research results by making sure that climate is accurately described in connection with agricultural experiments, by assisting in measuring the responses of plants and animals to environmental changes, and by studying and reporting on the physics of soil behavior and the effects of changes in other variables related to climate.

And while the agroclimatologist can contribute much as a member of a group concentrating on variables other than weather, it appears increasingly essential that he reserve a fair amount of time for research in agroclimatology as such. So important is the latter kind of research that some scientists feel it would be better in principle to cut off some of the "random" agricultural research now being carried on, and use the funds for controlled climate centers at which more useful results might be obtained.

A center of this type has been in operation for several years at California Institute of Technology, providing in short periods data that might require many years to amass in routine outdoor experiments. Purdue University is nearing completion of a $1-million center for studies of plant and animal physiology in relation to environment. Other controlled climate installations of varying complexity are in operation or are contemplated by other organizations. After a quarter-century of neglect, agroclimatology appears to be reasserting its importance as a part of agricultural science.