FARMING AS A CHEMICAL INDUSTRY.

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This title may seem a bit questionable to some and lead them to conclude that the typesetter made a mistake. This is no typographical error, however, but a recognition of the many chemical changes constantly in action on a farm. Those who are careful observers realize that this round of changes taking place in crops of one year makes possible greater crops and changes the following year. It would be hard to conceive of farming continuing if the elements of our plant and animal bodies were not frequently released to future usefulness. "That we are but parts of a grand system, and the elements we use are not our own" ought to be more evident to the man who plows and watches the fresh earth sliding and rolling from the moldboard than to one in any other walk of life. In the soil are found the remains of generations of plant and animal life in all stages of oxidation or decay, supporting an innumerable population of bacteria, molds, worms, and insects. Thus it would seem that the sunbeam is the builder and oxygen the destroyer but in reality the one supplements the work of the other in this great soil laboratory.

The Raw Materials.—The materials out of which farm products are manufactured are usually simpler than those employed by other manufacturers as every 100 pounds from the farm plant factory are made from about five pounds of soil, 20 pounds of air and 75 pounds of water which are combined and vitalized by many hours of sunshine. The methods used by the farmer-chemist make a lot of difference in the amounts and quality of the final product as nature can be induced to add fine colors, fragrant odors, new flavors, high protein ratios in corn or wheat, etc., depending on the products desired.

Each Cell a Chemical Factory.—The cells of plants are wonderful bodies varying in size from about one-thousandth of an inch to ten inches or more as the small carrot cell or the large round ones in an orange or the long ones in hemp. The inside of the cell is partly filled with a liquid protoplasm and a little round body called the "nucleus" which is surrounded with this protoplasmic fluid. This nucleus is capable of dividing into two parts with complete cell walls thus enabling rapid cell multiplication (sometimes dividing every 30 minutes as is believed to be the case in the growth of a mushroom or a puffball.) Thus it will be seen that this simple little water bag without any doors or windows is capable of assembling from air, soil, water and sunshine the simple raw materials and manufacturing from them complex proteins, fats, and carbohydrates, which are then moved through the cell wall ready for shipment in the sap stream. This seems like a simple process, but in reality it is so complex that no one has ever suc-

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ceeded in making anything which acts like a protein or a fat, although some success has attended recently the manufacture of sugar, by the test tube route.

Sunshine and Starch.—Probably the most subtle phase of farm chemistry relates to the intimate connection between starch manufacture and sunlight. When the big power plant, the Sun, comes up on an August morning, all the wheels of the corn factory start turning and before sundown about 170 pounds of starch, seven pounds of protein, and three pounds of fat have been produced per acre in this farm laboratory. During the night the elevator in this corn factory continues to run, moving the starch before midnight from the leaves where it is made, so that long before daybreak the corn machinery is cleaned for another day's output.

The Soil—The Farmer's Main Laboratory.—Over the door of an agricultural building of one of the state universities is inscribed the words "The wealth of the State resides in the soil." When one considers that this wealth is not so much in valuable ore deposits as in valuable farm land it suggests the further inquiry as to what is so valuable about some farm land when so much of it is not worth its taxes. It is not uncommon to find a difference of 2,000 pounds of nitrogen, phosphorus or calcium, per acre plow depth, yet most farms are bought and sold without the purchasers knowing what amounts of these vitally essential elements are present in the soil in question or what the additional cost would be to add the amounts needed. It is hard to conceive of a man buying a grocery or hardware store without first finding out the value of what is on the shelves. When this chemical industry of the farm is understood generally, farms will be sold by their fertility content and not by the acre. At the soil's bank, if a balance were made after a 100 bushel crop of corn was checked out it would be noted that the available supply of raw materials of this chemical plant had been lowered by about 71 pounds of potassium, 23 pounds of phosphorus and 148 pounds of nitrogen, besides numerous other elements not rated as quite so important. At the present market price of these elements there would have to be put back into this land bank to even accounts 2.76 cents worth of phosphorus, 29.6 cents of nitrogen and 3.5 cents worth of potassium for *each bushel* of corn taken. Therefore, it is plain to be seen that the main reason so many of these farm manufacturing plants are not prosperous is because the land bank is "broke" on account of the lack of the return of these elements.

Chemistry—Bacon and Eggs.—The utilization of corn or other grains when fed to live stock involves the most difficult phase of farm chemistry. It is not possible at this time to follow the various chemical changes by which the hog converts corn into breakfast bacon or the hen changes it or other grains into eggs, or the cow changes green grass into white milk, but all these problems are being studied as never before and if solved it will probably not be by the "Ford Synthetic Cow" method.

Modern livestock chemistry has passed the mere feeding trials of a few years ago in which one feed was merely compared with another without a knowledge of their chemical differences. This method has been useful, but it has contributed all it has to offer and is at the end of its rope.

It used to be thought that if a ration had a proper amount of carbohydrates and fat material in comparison with protein to make a wide or narrow ration as desired (which was considered a balanced ration) that it was sufficient. Now it is known that there are good and poor proteins as well as fats and that the prosperity of the livestock factory largely depends upon how well the feeder knows the good proteins, carbohydrates, fats, minerals and even vitamins as well as how to mix them. If the feeder, for example, has to wait for the hen to send in an order for egg shell or feather material his egg factory will soon be for sale.

The Necessity of Eyes Trained to Observe Farm Chemistry.—Those readers who were raised on a farm are aware of how commonplace many objects used to appear which in later years, when viewed through eyes better trained to observe became matters of unusual interest or even of wonder. I will mention here only some of these common but often unobserved chemical changes taking place on the farm without attempting to expand on them. The following are among the more common:

The souring of milk, butter and cheese making; the making of apple butter or vinegar; the leaching of wood ashes and the making of soap; the sweating of the grain and the heating of hay, silage and horse manure; the warmth of feed stable from oxidation of food by cattle; the rotting of logs and rusting of iron fences, plows, hinges, etc.; the weathering of a name on a rock or changes in colors and composition of soil after having been plowed for a few days; the aroma of clover before and after cutting; the healing of a wound in a tree; the germination of grain; the curing of meat by salt and hickory smoke; the burning of a brush pile; the spraying of trees; the making of bread; the cattle shivering around a straw stack in winter; the softening of hard water; the changing of leaves from green to red, yellow, etc.; the painting of a house; the frosting of the glass in a horse stable from the ammonium carbonate deposit.

These and other illustrations which might be given will serve to show that chemistry is the basis of practically everything of a constructive nature in farm life and whether he realizes it or not the real farmer is the world's greatest synthetic or constructive chemist.

Farming As a Biological Industry.—It is probable that those who are familiar with biology and bacteriology could easily show that farming also is an important biological industry. The birds, insects, bacteria and worms certainly have their rightful places there and all help to make farm life interesting and profitable.

Conclusion.—Thus it is believed that agriculture, which is the biggest business of our state, is largely chemical in its most important operations, is moving forward as rapidly as the difficulties and complexities of the industry will admit and will eventually become a more scientific and profitable business than has ever been known.