

air in the soil expands as it is heated, and thus some of it is driven into the atmosphere. If the rise in temperature amounts to 10° when the temperature of the soil stands at 45° , then one-fiftieth of the air in the heated zone is expelled; and if it amounts to 20° , then one-twenty-fifth is expelled, and so on. The change of atmospheric pressure also aids. If the pressure falls half an inch, the air expands and about one-sixtieth of it escapes; if the pressure falls one inch, one-thirtieth escapes. Rain is a very potent factor. As the water sinks into the ground, an equal volume of air must be displaced. As it passes away, by drainage, by evaporation, or by absorption into the plant, the air is drawn into the soil again. Drainage aids very materially. When rain falls on undrained land, the imprisoned air must escape upward through the water as the water sinks down; the two actions thus opposing one another, the air escapes very slowly, often so slowly that large quantities of water, being unable to make their way into the soil, run off the surface and are lost. But if the soil is well drained some of this run-off may be prevented, the imprisoned air escaping downward through the drains as the weight of water above increases, fresh air following the rain into the soil. This gives us another reason for the great superiority of the drained soil over the undrained. Proper tillage increases the efficiency of all these agencies of aeration.

Another factor, and one that is gaining some prominence at the present time, is a proper sanitary environment for the roots. The latest investigations of the Bureau of Agriculture at Washington arouse the suspicion that the apparent "exhaustion" of soils is not due so much to the depletion of the stock of plant food as to the lack of proper sanitary conditions. Animals forced to exist in an atmosphere rendered foul by their own poisonous exhalations soon cease to thrive; the plant above ground likewise gives up waste products, which if not removed, become a menace to its safety; is it not therefore natural to expect that from the roots of the plant also there are excreta that, if allowed to accumulate, threaten its very existence? As proper ventilation is necessary to insure the health of the animal, as diffusion, drafts and winds must bring fresh air to the leaves, so must tillage or other treatment purge the soil of the injurious substances cast off by the roots. In this purifying process it is believed that air, and therefore cultivation and drainage, plays an important part, certain fertilizer ingredients are effective under certain conditions, but more potent still is organic matter in the form of humus. There is another method, however, of eliminating the toxic or poisonous effects of these excreta. Whatever they may be, it appears that those cast off by one variety of plant are not, as a rule, injurious to another variety, hence the possibility of rotation of crops. By the time the first crop comes round again, the intervening cultivations having stirred up the soil, exposed it to the weathering processes, allowed the air to enter in and permitted the humus to do its work, all the excretions injurious to that crop have been removed or neutralized and we secure a yield equal to the last one. Hence it is that by proper rotation we may go on cropping our fields from year to year, cropping them indefinitely, without any apparent exhaustion, and indeed by wise rotation even increasing the yield.