We now see why light is not only unnecessary to the healthy germinations of plants, but absolutely injurious. In light the leaves absorb carbonic acid and give off oxygen, and seeds exposed to the light follow the same rule; but in a healthy process, the reverse takes place, carbonic acid is given off, and oxigen absorbed; and how can we better exclude light than by covering the seed with earth? But, as we observed at starting, the earth in which we bury the seed must be in a peculiar condition: it must, first of all, contain air. Though, at a casual inspection, the soil seems to be too closely packed to admit the air, looked at more narrowly it is not so, but the interstices between the particles of the mould will be found to occupy a fourth part of the whole mass. Hence, 100 cubic inches of soil, finely pulverised, contain 25 cubic inches of air; the depth of ploughing being taken at 8 inches, the number of cubic inches of air on an acre will be 12,545,280; and as every additional inch of depth pulverised brings into activity 260 tons of fresh soil, the ploughing one inch deeper will introcuce into the soil 1,600,000 cubic inches more air. Thus, the deeper we plough, the greater amount of air we lay up as a store for the use of our plants.

Fig. 1 represents a grain of wheat magnified: *a* and *b* are the two skins, inner and outer; *c* is the cotyledon, and *d* the rudimentary plant, whence spring the root and stems.

Fig. 2 is a wheat plant germinated: *a* is a stem which has just left the sheath: *b* another starting: *c* another unevolved, and *d* the roots.

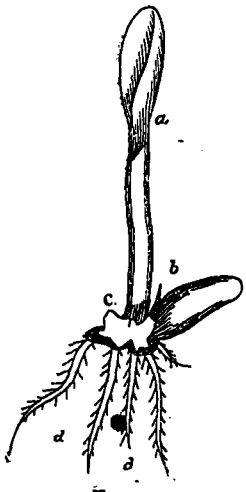

Fig. 1.

It will be easily understood, that, when the land is left full of stones and clods, the air cannot penetrate these obdurate masses, and, in consequence the roots in their tenderest stages are left to fight their own way under the greatest difficulties. Fig. III.

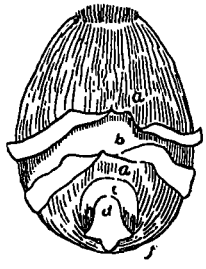

Fig. 2.

This air, again, must be above a certain temperature, or else the seed's vitality will remain dormant. Now, the more thoroughly pulverised land is, the more easily will it resist the induction of cold from without, and the less easily will it radiate its internal heat.

Besides clods and stones, the presence of water will exclude air. Fig. IV shows the seed lying in a well pulverised soil, the interstices of which are filled with water instead of air. Here, too, the seed cannot germinate freely; and, besides, water, during the necessary evaporation that takes place,


Fig. 3.


Fig. 4

produces cold: another hindrance to free germination. On the other hand, entire want of moisture prevents germination, as much as excess; as may be seen in fig. V, where the seed is placed in pulverised earth, and the interstices filled with air, but no moisture is visible between and in the particles of soil. When land is in this state, heat can enter and escape from it with equal ease; so the evils of the want of moisture, and of excess of heat, are evident. In fig. VI, however, we see the soil as it ought to be: the seed lying in its comfortable bed: the air finds easy access between every particle of soil, and the general warmth of the season, whether spring or autumn, finds an easy road to it; germination begins, and the future growth meets with neither check nor obstacle.

From the previous considerations we deduce the conclusion, that all soils which do not rest on a naturally pervious subsoil require draining. For, it will be seen, on inspection, that, where land lies wet in winter, cultivation in spring produces clods, instead of a finely pulverised surface; and instead of the early heat of summer warming the soil, it in reality chills it by evaporation. On such land, large belts of dark coloured earth may be seen in May, dotted about, here and there, among the lighter coloured parts: the plants want vigor when they start, their green is pale, the herbage coarse, hard, uninviting. The tread is unequal, one part of