

dairy purposes, as in Cheshire,—or eaten off by growing stock, as in many of our hill pastures,—they have been applied with great profit. Even where the grass lands are wet, the bones have produced remarkable benefits.

What do bones consist of?—Bones consist of glue or *gelatine*, which may be partly extracted by boiling them in water—and of bone-earth, which remains behind when bones are burned.

Is the glue or *gelatine* of bones a good manure?—Yes, it is a powerful manure. It assists very much in pushing forward the young turnip plant, when this crop is raised by the aid of bones.

What does bone-earth chiefly consist of?—It consists chiefly of phosphoric acid and lime.

Does this earth of bones act as a manure?—Yes, because all plants contain, and therefore require for their healthy growth, a certain quantity of lime and phosphoric acid.

Why do old dairy pastures especially require bones?—Because milk and cheese contain bone-earth, and if these be carried away and sold off the farm for a number of years, the land is robbed by degrees of this bone-earth, more than of any other substances. Only those grasses can then grow which require little bone-earth.

And what effect follows from adding to the bones?—The bones supply the bone-earth of which the land had been robbed. New grasses then spring up which contain much bone-earth, and these, when eaten by the cow, produce milk in greater abundance, and richer in cheese.

Are bones applied in any other form?—Yes. They are sometimes dissolved in sulphuric acid (*oil of vitrol*.)

How do you dissolve bones in sulphuric acid?—About equal weights of bone-dust and of acid are taken. The acid is diluted with three times its bulk of water and poured upon the bones, and the mixture is stirred occasionally for two or three days.

What is the advantage of thus dissolving the bones?—One of the chief advantages is, that the substances of which the bones consist are very minutely divided. They can thus enter more readily into the roots of plants, and a smaller quantity produces an equal effect upon the crop.

Is hair much used as a manure?—No. Hair is generally too expensive to be used as a manure. But in China, where the people's heads are all shaved, the shavings are collected for manure, and the sweepings of our hair-cutters' rooms might be also employed with profit.

In what form is wool used as a manure?—In the form of woollen rags. Mixed with earth woollen rags make an excellent compost. They are much used for manuring the hop grounds.

What kinds of animal dung are most commonly employed as manures?—Night-soil, horse-dung, cow-dung, sheep's dung, pig's dung, and bird's dung.

Which of these is the most valuable?—In general, night-soil and bird's dung are the most val-

uable; next to these is horse-dung, after that, pig's dung, and lastly, cow's dung.

Why is night-soil so valuable?—Because men generally live upon a mixture of animal and vegetable food, which renders the dung richer.

Why is the solid part of horse-dung richer or hotter than cow-dung?—Because the horse voids little urine, compared with the cow.

What is the principal objection to using pig's dung?—The disagreeable smell and taste it is said to give to the crops raised from it.

What is the best way of using pig's dung?—The best way is to make it into a compost, or to mix it with the dung of other animals.

Why is cow-dung colder and less liable to ferment than most other kinds of dung?—Because the large quantity of urine voided by the cow carries off a greater proportion of that which would otherwise cause it to ferment.

In what respect does the mixed dung of animals differ from the food on which they live?—It differs principally in containing a less proportion of carbon, and a greater proportion of nitrogen than the food they have eaten.

How does it come to contain less carbon?—Because animals throw off a large quantity of the carbon of their food during breathing.

In what form does the carbon of the food come off from the lungs during breathing?—In the form of carbonic acid gas.

How much carbon does a man give off in this form from his lungs in a day?—A full grown man gives off about half a pound in a day, and a cow or a horse eight or ten times as much.

Does all the nitrogen of the food remain in the mixed dung and urine of animals?—Yes. Nearly all the nitrogen remains—mixed with a smaller quantity of carbon than was in the food.

Is this larger proportion of nitrogen the cause of the greater activity of the dung of animals?—

Yes. It is one of the principal causes.

What form does this nitrogen assume during the fermentation of animal manures?—It assumes, for the most part, the form of *ammonia*.

What is ammonia?—Ammonia is a kind of air which has an exceedingly strong smell, and possesses alkaline properties,—the common hartshorn of the shops is merely water impregnated with this gas.

Under what circumstances is ammonia produced naturally?—It is produced in fermenting compost or manure heaps, and in fermenting urine, and it is the cause of the smell perceived in hot stables.

How can you detect the presence of this ammonia?—By dipping a rod or feather in vinegar, and holding it over the dung heap or in the stable, when, if ammonia is present in the air, white fumes will become visible.

What does ammonia consist of?—Ammonia consists of the two gases, nitrogen and hydrogen.

How does this ammonia enter into the roots of plants, when it is formed in the manure?—It is