We copy from Berzelius the following analysis of the bones of man and those of the ox:

	Man.	Ox.
Gelatin, (soluble in water,)	32.17	33.30
Vessels	1.13	
Neutral phosphate of lime	51.04	55.45
Carbonate of lime	11.30	3.85
Fluoride of calcium	2.00	2.90
Phosphate of magnesia	1.16	2.05
Soda and muriate of soda	1.20	2.45
	100.00	100.00

The experiments made by Barras inform us that the proportion of carbonate of lime varies in different animals, as well as in the bones of the same individual. He found, for every 100 parts—

	Carbonate of lime
Bones of a lion	2.03
sheep	24.12
chicken	11.70
frog	5.76
fish	2.52

Chevreuil, Dumeril, Marchand, and other chemists, have analyzed the bones of various fishes; they vary considerably, as will be seen by the following results obtained by the three first mentioned:

	Skull of a cod.	Bones of a pike.	Bones of a whale.
Organic matter	43.94	37.36	78.46
Phosphate of lime	47.96	55.26	14.20
Sulphate of lime			0.83
Carbonate of lime	5.50	6.15	2.61
Phosphate of magnesia	2.20		
Sulphate of soda			0.70
Soda and common salt	0.60	1.23	2.46
Fluoride of calcium and loss			0.74
	100.20	100.00	100.00

The gelatinous part of the bone consists of carbon, hydrogen, oxygen, nitrogen, and sulphur. One hundred parts of gelatin of bones produce, when fermented, twenty-two pounds of ammonia, together with carbonic acid. The sulphur, as we have seen, is also an ingredient of plants.

The phosphate of lime is soluble in all acids, and we may say that all the phosphates are soluble in an excess of acid. When bones are surrounded by fermenting organic matter, such as is offered in a manure or compost heap, the phosphate of lime is dissolved in the humidity by the carbonic acid which is constantly being evolved by

the fermenting mass. This operation is more or less prompt according to the activity of the fermenting heap. In the field, where carbonic acid is always present, this process is constantly going on; but, owing to the presence of the cartilaginous or gelatinous portion which surrounds the particles of phosphate, the action is less apparent on a large bone than if it were in powder, and the finer the powder the more rapid the decomposition.

Many farmers are in the habit of collecting the refuse bones of their farms and covering them up in the accumulating manure in the barnyard, where, in the course of time, they become soft and pliable, as if they had been immersed in muriatic acid. Such an addition gives increased strength to the manure in proportion as the quantity of bones, which, thus dissolved, becomes immediately active, but endure a less time than when added to the land without preparation. For when bones in large pieces are applied to the soil the action is slow; when divided, more rapid, according to the state of division, and still greater when dissolved, as the state of division is then perfect, provided the operation has been well conducted.

The crushing of bones, owing to their tenacity and hardness, is attended with some difficulty and expense, and, therefore, where the operations are large, steam-mills are employed. But in other places the bones are steamed or boiled, after which they are easily reduced to powder. By that process, however, the gelatinous and fatty matters are extracted and used; the grease for making soap, and the gelatin for fabricating size or glue. We have seen that the organic portion of bones contained fertilizing matter, (nitrogen, sulphur, carbon, &c.) If this be previously extracted, so much is lost to the land; and it is a question of loss to the farmer if the dust be sold by weight. Some burn the bone in order to reduce it to extreme division. Here again the organic portion is entirely destroyed, save only a part of the carbon. It is known that animal black (charred bones) is a great deodorizer and antiseptic, largely used by sugar boilers for refining sugar, and by chemists for whitening sulphate of quinine, &c. It has the property of condensing gases; and charcoal, derived from the calcination of bones, possesses this property to a greater extent than any other substance; it will absorb ninety times its volume of ammoniacal gas. Hence, it becomes a consideration with farmers to know whether they do not gain more by charring the bones than they lose by chasing off the volatile matters. If the bones be burned in contact with the air, the greater portion of the carbon will be driven off with the other combustible parts of the bone; and in order to avoid that result the bones should be charred in air-tight vessels. Iron cylinders are used for the purpose.

Whatever method may be employed, it is important that the bone, previous to treatment with acid, should be divided; otherwise the operation will be imperfect, and particularly so if sulphuric acid be used to form the compound called bi-phosphate, super-phosphate, or acid-phosphate of lime, known to farmers under those appellations. For if the bone, without being reduced to powder, be treated with sulphuric acid, gypsum or sulphate of lime is formed, and that substance being insoluble, surrounds and prevents the further action of the acid upon those parts of the bone not already acted on. If muriatic acid be employed, that difficulty does not present itself, because the muriate of lime which is formed is very soluble, and so long as acid may be present the decomposition of the bone continues until the operation is complete. In the latter case, the phosphates and muriates would be in solution, which is less convenient of application; this, added to other reasons not necessary to mention, makes it preferable to employ sulphuric acid, which is largely manufactured, and may be obtained everywhere. It is important, however, that the farmer should look to the density of the article, for it is by no means immaterial whether it be strong or weak; otherwise, in the case of the weak or diluted acid, he will be paying for water instead of acid. By the addition of sulphuric acid to crushed bones they are decomposed, and effervescence takes place, arising from the escape of carbonic acid, which has been liberated by the sulphuric acid combining with the lime and forming sulphate of lime, or gypsum.

The insoluble phosphate of lime is decomposed, a part of the lime combining with the sulphuric acid, and liberating the phosphoric acid, which combines with that portion of the phosphate of lime not decomposed, forming a phosphate of lime with excess of phosphoric acid, called bi-phosphate, super-phosphate, or acid-phosphate. The sulphuric acid also combines with the potash, soda, and magnesia. Heat is evolved, the excess of water (if there be not too much) is absorbed, and the mass, when the operation has been well conducted, remains in a dry, pulverulent form. The gelatinous portion of the bone is also modified by the action of the acid, becoming more assimilative. The operation is simple, offering no difficulty whatever. Any farmer may fabricate his own super-phosphate with the implements he may have at hand, and avoid the necessity or risk of paying for an impure article; for every one knows that frauds, to an enormous extent, have been perpetrated upon the confiding farmer, who has often paid high prices for that which was of no value as a manure, and might be had for the collecting.

Sulphuric acid (oil of vitriol) is a substance to be procured in all our markets, and its value depends upon its density, specific gravity, or its state of concentration. The weaker it is, the less valuable. The proper density should be about 1.85.

The quantity of acid required for the decomposition of one hundred pounds of bones depends upon whether they are in meal, half inch, or entire, or whether they are in their natural state, boiled, or burned. The finer the powder the more perfect the action, and the more acid will be required. If the bones are in their raw state, they contain, as has been said, an amount of animal or organic matter, which varies according to the age or species of animal from which they have been derived. The amount of bone-ash obtained from the calcination or burning of bones in contact with the air, may be set down, on an average, at fifty per cent. For every hundred pounds of bone-ash, eighty-seven or eighty-eight pounds of sulphuric acid will be required. The operation may be practiced in a hogshead, on a tight floor, or on the ground, or in the field where the mixture is to be used.

Take, for instance, one hundred pounds of powdered bone-ash, throw

into a hogshead, to which add from five to six gallons of water, and mix with a stout wooden shovel or paddle. Then pour on about eighty-eight pounds of concentrated sulphuric acid. The mass should now be well turned and mixed. It will effervesce and foam up, give off steam in profusion, and the temperature will be found to have risen sometimes as high, or higher, than 212° Fahrenheit. Instead of adding the entire amount of acid at once, it may be divided into two portions, and added separately. In handling acid, have a little care, otherwise an eye or the clothes may be the forfeit, as such accidents have happened. After mixing for some time, the mass will stiffen, when it should be covered, and allowed to stand for a day. It may now be thrown out in a dry place, to remain sufficiently long to be ready for powdering, or it may be mixed with dry peat, charcoal, calcined plaster of Paris, or even dry mold, or saw-dust, and powdered, when it is ready for use.

A mode which is extensively practiced on farms in England was first suggested by Mr. Pusey, and is, briefly, very similar to making mortar out of sand and lime. The circular wall of sand may be replaced by coal ashes, or bone-dust itself. The bone-dust is deposited in the middle of the circle, then thoroughly saturated with water, when the sulphuric acid is added, and the mass well and frequently turned over, until there is no further action. The decomposition is more perfect when the temperature is high, and this is obtained by making the wall of ashes as lofty as possible. The operation is more or less well conducted as the mixture has been the more evenly made, and the parts thoroughly mixed. The mineral phosphorite, coprolites, and varieties of guano, rich in phosphoric acid, may be treated with acids, and will produce super-phosphate of lime, having all the efficiency, and with precisely the same properties of that manufactured from bones, the only difference being that the one may contain salts, which are absent from the other, and more or less phosphoric acid.

The super-phosphate of lime, from its comparatively high value, leads to adulteration. Water is added to increase the weight; earths, chalks, lime, old plaster, oyster shells, &c., are sometimes mixed in a manner to deceive the eye. Some of these substances may be detected, with the aid of a magnifier, by acids, or by simple washing with water, and examining the residue after decanting. If old plaster is suspected, the hair will be seen; if oyster shells or chalk, the effervescence and particles of shells will furnish indications which will lead to closer scrutiny. The sulphate of barytes, or sulphate of lime, increases the weight of the mixture, and the former particularly will fall to the bottom, when thrown into a tumbler of water, more rapidly than the super-phosphate. Recourse may be had to a chemist, whose familiarity with the properties of different substances will enable him to arrive at conclusions not to be expected from those whose occupations are of an entirely different character.

The loss that is taking place in this most essential ingredient to life (phosphorus) is enormous, unavoidable, and impossible to estimate with any correctness. Independent of that continuous drain which takes place by the washing of the soil, together with the waste ever occurring in provisions of all kinds, grains, vegetables, and animals exported, and but a small part of which finds its way back to the place whence it came, there is another gradual yet certain loss which, in time, will be felt—I allude to the amount of phosphorus in our bodies—a loss to be attributed to the respectful and pious custom followed in all civilized countries, that of burying the dead. By this practice much is entirely withdrawn from circulation; for the depth at which the bodies are deposited in the ground is below the reach of vegetation. Supposing the inhabitants of the United States at this time to amount to twenty-five millions, and that each individual contains, on an average, four pounds of phosphate of lime, (which will be found not far from the truth,) when this population shall have passed away, one hundred millions of pounds of the phosphate of lime will have been abstracted from the soil, or from activity in the endless change of life.* It will be borne in mind that the extinction of the present generation does not limit the loss; for population increases much more rapidly than supplies; and if we reflect how wonderful has been its augmentation in the United States since its settlement, and its probable continuance, even in a greater ratio, we shall be less apt to underrate the future consequences.

The ocean is a vast reservoir of life's requirements, from which science may find means of recovering supplies, especially of this valuable ingredient.

It is hardly necessary to remark that, while phosphoric acid is an essential part of all fertile soils, it is not the only substance required, for the application of the phosphates may be made without any apparent good result, owing to the absence of other substances not less necessary. With a view to supply every important quality, much ingenuity has been employed in making artificial and saline mixtures, not only to furnish special manures for special crops, but such also as would satisfy the wants of all vegetation. Many saline mixtures may be compounded to increase the efficiency of each other, and at the same time to accelerate, promote, and supply the requirements of plants; but we cannot refrain from cautioning the farmer against the exaggerated accounts now everywhere published in favor of certain fertilizers. They are far from being always what they are described, either in composition or effect, and are very often quite the contrary. At best, composts would frequently appear to be mere dilutions, or attempts at making the truly useful do more service than is possible. The most shameful impositions are being daily practiced. From the nature of the substances employed, these frauds may not easily be detected by the farmer; but he should rather trust, if he will have unusual mixtures, to such as he may manufacture on his own ground, and under his own eye, from materials of positive utility, and purchased from dealers of undoubted character.

* Monsieur Elie de Beaumont, who has made a similar calculation, in detail, for the amount of phosphate of lime abstracted from culture, by burial, estimates that France has thus lost not less than two millions of tons.—*See Etude sur les Gisements Geologiques du Phosphore.*

The reader will thank us for directing his attention to the above-named work, recently published by our distinguished friend and professor, M. M. L. Elie de Beaumont. We have read it with great interest, and are indebted to the learned author for many valuable suggestions.

VETERINARY SCIENCE AND ART.

BY CAPTAIN JOHN C. RALSTON, PRESIDENT OF THE COLLEGE OF VETERINARY SURGEONS, NEW YORK.

In this country, the veterinary art appears to have suffered, and is still allowed to suffer, unaccountable and most undeserved neglect, in an educational or duly qualified point of view. Its practice has mainly fallen into the hands of the stable-man, the shoeing smith, and the charlatan; for the number of educated practitioners, derived from foreign schools, (chiefly from the Royal Veterinary College, London, or the Veterinary College of Edinburgh,) is very limited, when contrasted with the forcible occasions and wide field for their services, at once to be found in the larger cities and in the farming districts everywhere. Grave considerations, alike creative of surprise on the one hand and of regret on the other, are thereby involved, when due reflection comes to be directed to this state of things: of surprise, because this country has been so quick and ardent as relates to the introduction or improvement of whatsoever otherwise has presented any aspect of benefit or utility; and, assuredly, veterinary science prefers very high claims, whether in relation to agriculture, stock raising, or any other public or social interest, and may be said to be only second to those claims which appertain to the science of human medicine and surgery: of regret, because the horse, first, and after him all other domestic animals, requires, and should have, intelligent and scientific care and treatment in health and sickness, and which can never prove the case where the means of education and right information are wanting. The aforesaid neglect seems the more singular when the vivid example presented by other countries is considered. The veterinary schools of Europe are numerous and highly valued; have been sustained by monarchs, governments, associations, and individuals; and are acknowledged on all hands to have been the sources of no ordinary general benefit; while the attainments and skill of the members of these schools have conferred high professional respect, alike in private life, public or governmental employ, and in the capacity of commissioned veterinary-medical officers of the cavalry and artillery services.

In the early times of Europe and Asia, veterinary art was assiduously cultivated. In ancient Greece, especially, it obtained a leading place, along with the general pursuit of medical and surgical knowledge. The physicians of those days seem to have given coequal attention to anatomical and physiological research and pathological investigation, human and veterinary, and have left behind numerous treatises upon the latter art. By the Romans, veterinary art was also held in much esteem, and their medical and agricultural writers have treated of it with acumen. Among the Moors, particularly during their domination in Spain, solicitous attention was, in like manner, bestowed on the subject. But it were not fitting, here, to seek to enlarge on these remoter chronicles of this estimable science, except to note the forcible