beside a sagebush near the traveled road. I could not stop for any careful examination at the time. I saw no indication of there ever having been a house, village or camp at the spot. The fragments are about one fourth inch thick and appear to be parts of two vessels, though they may belong to one. The ware is the usual coil-made variety without decoration or color. The pressure marks on the outside of the vessel were roughly smoothed over but not obliterated. The natural color is brownish on the outside—gray to blackish within. The firing had been done from the *inside*. This is shown by the blackened surface of the interior and also by the ware having been more burned inside than out, the heavy burning extending to between one eighth and one sixteenth inch of the outer surface. This characteristic of inside firing I have noted in other ware from the region north of the Colorado River. In this connection I may say that the remains of dwellings and the fragments of pottery are exceedingly numerous north of the Colorado River as far as the southern Rim of the Basin, and westerly as far as the Beaver Dam Mountains. Easterly they follow up Green River and its tributaries at least as far as latitude 40. The northwesterly limit has not been determined or even approximated as yet. I believe some remains have been found near Parowan but I was unable to authenticate information at this locality. On the Escalante Desert I found no indications as we crossed toward the Pine Valley Mountains, nor could any one I saw tell me of any. It is, nevertheless, possible that there are both pottery and habitation remains there near springs, and it would be desirable to have the region carefully examined.

On Bright Angel Point, south end of the Kaibab Plateau, I found remains of several very small houses near the brink of the canyon. Some fragments of primitive pottery were lying around and there were two good specimens of the primitive grinding stone—that is, the kind that are hollowed out. These were of red sandstone. The house walls were very slight, the best preserved being about 8 x 22 feet, with a dividing wall in the middle. This was within twenty feet of the edge of the canyon. The stones were roughly dressed in the usual fashion and were so few apparently that the walls must have been very low. I did not have time to dig, but the soil seemed thin.

It is possible that there was a trail down to the Colorado from this promontory. Down below there are remains of other houses and grinding stones of a similar type, which I saw many years ago.

There appears to have been less decorated pottery north of the Colorado River than south, and this might be taken as an indication of a more primitive condition of the art in that region. The potsherds around most of the village sites are apt to be without decoration entirely, or only slightly decorated. Most of the whole specimens found along the valley of the Virgen are undecorated, and are either corrugated or roughly smoothed without the addition of a slip or of lines in color. The shapes are sometimes good, particularly from the Santa Clara district, where some beautiful examples of red ware have been found. The finding of the ruder forms of pottery in a locality may not imply the occupation of that locality by Amerinds of the stone-house-building type for tent dwellers have made rude pottery and the modeling of occasional pots and firing them from the inside seems to have been understood by many tribes of Amerinds south of the Columbia River.

F. S. DELLENBAUGH.

CRAGSMOOR, N. Y.,
July 6, 1903.

SHORTER ARTICLES.

THE RELATION OF LIME AND MAGNESIA TO METABOLISM.

IN a previous communication to this journal (Vol. XIV. (1901), p. 31) the writer discussed some work carried out with Dr. Oscar Loew on the relation of lime and magnesia to plant growth, the results forming the matter of Bulletin 1, Bureau of Plant Industry, U. S. Dept. of Agriculture. Since coming to this station further studies have been made by the writer

in the investigation of the relation of these elements to animal production.

Many analyses show that the percentage composition of plants grown on different soils varies quite noticeably. From Wolff's tables of analyses, for example, the calcium oxide in maize varies from 0.6 to 3.8 per cent., and in meadow hay from 6.0 to 40.1 per cent. of the ash. Wunder found (*Landw. Vers. Stat.* 4 (1862), p. 264) that turnips grown in a clay soil rich in lime contained 9.28 per cent. of lime in the ash, while those grown in a sandy soil poor in lime contained only 5.47 per cent. Emmerling and Wagner report (*Centbl. Agr. Chem.*, 8 (1875), p. 333) that hay from a peaty meadow contained only 6.50 per cent. of lime in the ash, while that from a good marsh soil contained 9.83 per cent. of lime.

It is a well-known fact that the greatest development in live stock has been attained in limestone regions. Opinions differ as to the reason for this, but it would appear that at least the chemical composition of the soil influences the size and the strength of the bone of animals feeding upon the herbage grown thereon. A number of experiments go to prove that the strength and composition of the bones of our domestic animals may be modified by feeding. Notably, Henry found (Wisconsin Station Bul. 25) that the bones of pigs fed on corn with bone meal or hardwood ashes in addition were double in strength of those of pigs getting corn alone, while the per cent. of ash in the bones of the former was 50 per cent. greater. The feeding of mineral matters to quick-maturing animals like pigs is now generally practised, and it can probably be wisely followed with animals of large size and of longer maturity in those regions where there is a deficiency of lime in the soil and a relatively small percentage in the plants.

In our former work we found that there was a relation between the amounts of available lime and magnesia in the soil for the most favorable growth of plants. Loew states with reference to plants (Bul. 1, Bureau of Plant Industry, p. 16) that lime is necessary for the formation of certain calcium compounds of nucleo-proteids required in the organized structure of nuclei and chlorophyl bodies, while magnesia serves for the assimilation of phosphoric acid, since magnesium phosphate gives up its phosphoric acid more readily than other phosphates of plant juices. In case of an excess of lime the assimilation of phosphoric acid will be retarded, because it will combine with the lime and thereby diminish the formation of magnesium phosphate. On the other hand, the presence of an excess of soluble magnesia will tend to the transformation of the calcium nucleo-proteids of the organized structures into magnesium compounds, thereby causing a disturbance that may prove fatal.

In the animal structure lime is very necessary in the formation of bone, and its presence in the blood and tissues of the body indicates the need of it in other organs. Boehm states (*Ber. Akad. d. Wissensch.*, Wien, 1875): "In order to form the cell wall from starch and sugar lime is just as important as for the formation of the bone. The lime forms the skeleton of the cell wall." Again, lime salts have great effect upon the action of the heart, as repeated results have demonstrated. Lime also plays an important part in the division of cells. Herbst states (*Arch. f. Entwicklungsmechanik*, Vol. V., p. 667) that the most important salt for the development of the sea urchin's egg is calcium phosphate, and in its absence the completion of segmentation is impossible.

In this, the blue grass region of Kentucky, the soil has been formed largely by the disintegration of a limestone very rich in phosphates. It is a region long noted for the beauty and quality of its live stock, especially the thoroughbred horse, an animal uniting the greatest speed with endurance. The studies here reported have been undertaken with the view of finding whether in even this favored section the quality of our animals may not be improved by the further addition of certain mineral elements to the food. So far experiments have been carried on with pigs to which varying amounts of lime and magnesia have been given in the feed, noting the rate

of gain and the metabolism of the food given. From the results so far attained with thirty-five animals fed in series of five each, it would appear that there is a definite relation between the amount of lime and magnesia that enters into the animal organism. In the case of added lime, especially with the calcium phosphate, there is an increase in the rate of gain with a reduction of the amount of food required per pound of increase. A very small addition of a magnesium salt also appears advantageous when fed with a lime compound, though the point of benefit is easily passed. Where the magnesium is given regularly in any excess the gain in weight is reduced to a minimum. Though the health of the animal may be apparently unaffected and the coat noticeably smooth and glossy, there is but little gain in weight from the food consumed. Another instance of the action of magnesia may be here noted. In fattening beef cattle for market they are fed large quantities of grain and occasionally become surfeited or, as it is termed, get 'off feed' for several days. By giving an animal in such cases magnesium sulphate it is quickly brought back to its regular ration. In human medicine calcined magnesia is given when the system has become overcharged with food as in some cases of dyspepsia and gout. As the concentrated feeds such as grains are rich in magnesia as compared with lime, while in the growing plant the opposite is true, it seems reasonable to suppose that magnesia operates favorably in the assimilation of food materials when present in the proper proportion, especially in heavy feeding. The results from the presence of lime and magnesia in the animal body in excessive amounts may be somewhat understood from their well-known physiological tendencies, *i. e.*, the lime compounds are constipating, while the magnesium salts are laxative in their nature.

From the effect of lime compounds in the animal body from both a medical and a dietetic standpoint this element may be said to be constructive and fixative in its results. On the other hand, magnesia is more movable in its relation, serving to carry assimilable phosphoric acid, which it gives up readily, and is thereby enabled to repeat the process many times. Therefore, a too small amount of magnesia is less detrimental than a deficiency of lime. If, however, with magnesia in excess there is a tendency for the lime as the stronger base to unite with the acid of the magnesium salt and the magnesia to form magnesium nucleo-proteids, such a disturbance would result in the elimination of products rather than in a further constructive effort. In the physiological effect of an excess of magnesia in the animal organism we find such a result indicated.

D. W. MAY.

KENTUCKY EXPERIMENT STATION.

NOTES ON THE EVIDENCES OF HUMAN REMAINS FROM JACOBS' CAVERN.

BY the courtesy of Dr. Charles Peabody, Director of the department of archeology, Phillips Academy, Andover, Mass., and of Professor Warren K. Moorehead, curator of this department, the writer was permitted during the month of May, 1903, to examine and assist in excavating a cave in southwest Missouri, in which were found numerous evidences of human occupancy. The cave is located on the north bluff of Little Sugar Creek two and one half miles southwest of Pineville, the county seat of McDonald County, four miles from the Arkansas line and fourteen east of the Indian Territory line. In honor of the discoverer, Mr. E. H. Jacobs, an enthusiastic archeologist of Bentonville, Ark., the cave has been named Jacobs' cavern. To each of these gentlemen are due my sincere thanks for many kindnesses extended during a week's visit to their camp.

The hills along Sugar Creek are composed of massive ledges of limestone containing a large amount of flint and chert, in the form either of regular layers or of nodular concretions. To this formation the name Boone chert has been applied by geologists. It is the rock that outcrops extensively in the southwest part of Missouri, the northeastern part of the Indian Territory and northern Arkansas. In the lower part of the Boone, flint is often absent and the rocks consist of massive gray limestone arranged in definite