never come down together?—as to one or two). Some puffiness below patella. Grating felt on moving joint. Movement limited.

Operation.—Loose body brought down on inner side of joint. Incision made over it and body expressed. Found to be of size and shape of an almond. White and cartilaginous in nature and highly polished. Wound closed.

After-History.—Patient came up to out-patients for some time. He very soon walked with the quick military step.

CASE XXX.

Loose Cartilages, Internal and External: Excision.

J. H., aged 39, miner, Grimethorpe, admitted March 20th, 1901, complaining of pain and swelling on inner side of right knee. He states that on December 27th, 1900, he slipped with his leg under him. The joint began to swell immediately after. Could not bend the knee or bear any weight on the leg. Doctor called in who moved the leg freely. Made patient keep the leg straight for some time supported by sling from shoulder, the patient going about on crutches. Had several attacks since. Been unable to work, as leg did not support him.

Present Condition.—Much swelling of joint. Enlarged semi-membranous bursa. Swelling considerably diminished with rest in bed. By March 26th the two knees were the same size. There was pain over the outer side of joint. On flexing the knee the leg becomes locked. A grating sensation is felt on moving the knee.

Operation.—Joint opened on inner side by oblique incision. Synovial membrane found to be inflamed. Internal cartilage found to be more movable than normal, but there was no fracture. Similar condition of synovial membrane and cartilage on outer side, cartilages stitched down to head of tibia. Joint closed. Wounds healed by first intention. Complete recovery.

CASE XXXI.

Fractured Internal Cartilage: Excision.

H. P., aged 24, miner, New Marske, admitted August 8th, 1901, complaining of attacks of pain in left knee. Eighteen months ago he had his knee injured by a fall of earth in the pit. The knee swelled up, and he was unable to walk for three weeks. Since then it has never been strong, and he has been subject to attacks of severe pain and swelling.

Present Condition.—Left knee swollen. Contains some fluid. Tenderness over inner side of joint.

Operation.—Oblique incision. Internal cartilage found fractured at junction of middle and posterior thirds. Fractured portion removed. Coronary ligament noticed to be ruptured. In response to letter, December, 1901: "As well as ever; no further trouble; no limp."

CASE XXXII.

Fractured Internal Cartilage: Excision.

A. S., aged 31, quarryman, Morley, admitted on October 7th, 1901, complaining of his right knee letting him down. Six months ago patient, when walking at ordinary pace, felt a "click" in his knee, accompanied by very sharp pain. He found his leg was bent, and was only able to straighten it by great effort, when the clicking was noticed again. The joint began to swell soon after; has pained him since. This letting down has recurred at frequent intervals. The last attack was a month ago.

Present Condition.—Knee swollen, especially on inner side. Has slightly inflamed appearance. At beginning of flexion and completion of extension there is soft crepitus. Some fluid. No thickening of synovial membrane. There is slight springing on pressing suddenly on extended limb.

Operation.—Oblique incision into joint. Excess of fluid. Synovial membrane reddened. Internal cartilage found fractured at junction of middle and posterior thirds. Anterior portion removed. Wound closed. He had some pain in the joint after operation with some elevation of temperature on fifth day. Dressed on seventh day, and wound found healed. Joint contained much fluid and was tender. Then temperature began to run higher, and swelling increased. Joint incised on outer side on eleventh day. Turbid fluid evacuated. Cavity syringed out with in 4,000 biniodide solution, and then with saline solution. Tube inserted for two days. Inflammation soon cleared up. The fluid contained diplococci. Patient discharged on November 16th.

After-History.—Seen on December 25th at infirmary. Leg quite well. Able to walk without any trouble or pain. Considerable movement in leg, but full flexion not yet complete. No clicking.

CASE XXXIII.

Fractured Internal Semilunar Cartilage: Excision of Cartilage.

Three years ago was thrown at football, and hurt his left knee. Synovial effusion followed, and he rested for two or three weeks. Since the accident he has been subject to something slipping in the joint, leading to synovitis, of which he had had eight distinct attacks.

Present Condition.—Great wasting of muscle of left thigh. No effusion in joint. Tenderness over the internal semilunar cartilage felt.

Operation. June 15th, 1901.—Oblique incision. Transverse fracture of internal cartilage found. Both ends removed by scissors. Healed by first intention.

December 21st.—Letter to say knee quite well, and muscles have regained their former size.

THE METRIC SYSTEM IN AMERICA.—A Bill to adopt the weights and measures of the metric system as the standard for the United States has been favourably reported by the House Committee on Coinage, Weights, and Measures. It provides: "That after January 1st, 1904, all the departments of the Government of the United States in the transaction of all business requiring the use of weight and measurement, except in completing the survey of public lands, shall use only the weights and measures of the metric system, and after the first of January, 1907, the weights and measures of the metric system shall be the legal standard weights and measures of and in the United States."

THE COMPOSITION AND NUTRITIVE VALUE OF BILTONG.

By W. D. HALLIBURTON, M.D., F.R.S.,
Professor of Physiology, King's College, London.

In July, 1900, Major F. A. Saw, R.A.M.C., sent to the Editor of the BRITISH MEDICAL JOURNAL some samples of biltong from South Africa, accompanied by a letter from which the following are extracts:

The biltong was made from some kind of buck, probably the hoodoo. It has not changed since I bought it about a year ago. The Boers scrape it with a knife. When grated on a nutmeg grater it is much more palatable than you would imagine from its appearance. I have never seen an analysis of biltong in any book, and I think if you can get one made it might be of interest to the profession generally.

Shortly after this the Editor sent on the specimens to me, but pressure of other work has prevented my attending to the analysis until recently. The material has kept quite well all this time; its appearance is certainly not appetizing; the strips of dried meat look very much like leather thongs. I have had it reduced to powder by means of a nutmeg grater, and the grated biltong has been kept in well-stoppered bottles. The powder from various pieces has been thoroughly mixed together, so that samples taken for analysis may give a more correct average. Although I have not actually tasted it, I can confirm Major Saw's statement that the grated material has not the unattractive appearance of the original strips.

In W. L. Solater's *Fauna of South Africa* the following account of the manufacture of biltong is given:

The great trek-bokken, a periodical migration, is still to be witnessed in portions of Cape Colony. In 1896, for instance, on the borders of the Prieska and Hope Town divisions, the trekking spring-boks completely covered an immense extent of country, their numbers being estimated at the very lowest computation at 500,000 head. During the trek an enormous destruction takes place; all the neighbouring farmers and their people turn out and kill thousands, the skins are cured, and the flesh made into biltong, or sun-dried and cured meat for future consumption.

In carrying out the analysis I have received assistance from Miss M. Christine Tebb, Mr. C. H. Barber, B.A., and Mr. W. E. Blackall, B.A., whom I have to thank for their valuable aid. Messrs. Barber and Blackall carried out the preliminary grating and mixing of the material, the estimation of the proportion of water and solids, of inorganic and organic solids, and the examination of the ash. The estimations of nitrogen and of fat, and the experiments relating to artificial digestion, were executed by Miss Tebb.

It will not be necessary to enter fully into all the methods adopted which were the ordinary ones commonly in use. But before giving a statement of results, I purpose giving a brief account of the analyses in a few cases. In all cases two, and sometimes three, analyses were made and the numbers given represent the average.

Proportion of Water and Solids.

Fresh meat roughly contains 75 per cent. of water. The small amount of water found in the biltong shows how very effective sun-drying is. When the total solids had been weighed after drying to constant weight at 110°C., the residue was incinerated, and the ash weighed; the organic solids are obtained by subtracting this from the total solids. The following are the figures obtained:—

Water	19.41 per cent.
Total solids	80.59 "
Inorganic solids	6.592 "
Organic solids	73.998 "

Constituents of the Ash.

The inorganic solids were examined qualitatively, but only a rough quantitative examination of them was made. Phosphates are the most abundant salts, then chlorides, while sulphates are present in quite small amounts. The metals present are potassium and sodium, and of these potassium is the more abundant. Calcium and magnesium are present in only small quantities, and of the two, magnesium is the more abundant; traces of iron are also found.

The organic solids are of more interest, and were examined in greater detail.

Nitrogen Determinations.

The fresh biltong was found to contain 12.445 per cent. of nitrogen; this corresponds to 15.445 per cent. of the dry material. Bernard Dyer's very simple modification of Kjeldahl's method was used.

Biltong after thorough extraction with alcohol contains less nitrogen; in the calculations this is taken to represent the proteid nitrogen²; the nitrogen which is present in the form of extractives soluble in alcohol is found by subtracting this from the total nitrogen. The following are the figures obtained:

	Parts Per Cent. in	
	Fresh Biltong.	Dry Material.
Nitrogen from proteids—Analysis 1 ...	11.080	13.750
" " Analysis 2 ...	11.130	13.810
" " Average ...	11.105	13.780
Total Nitrogen Analysis 1 ...	12.440	15.440
" " Analysis 2 ...	12.450	15.450
" " Average ...	12.445	15.445
Nitrogen in extractives—Average ...	1.340	1.665

The percentage of proteid calculated from the nitrogen is 65.866 for the fresh biltong, or 81.732 per cent. of the total solids

Estimation of the Carbohydrates.

The carbohydrates (sugar and glycogen) were estimated by making hot aqueous extracts of weighed quantities of the biltong. The successive extracts were mixed together and then concentrated. Sugar was estimated in this by Fehling's solution. Another portion of the solution was then treated with sulphuric acid and another sugar estimation made. The increase of sugar was taken as the basis for calculating the amount of glycogen.³ The fluid gave the iodine test for glycogen, though it was not markedly opalescent. The large proportion of glycogen present is an indication of the rapidity of the drying produced by the South African sun.

The mean figures in percentages of the fresh biltong are:

Sugar	0.090
Glycogen	0.133
Total carbohydrate	0.213

Estimation of the Fat.

The numbers given as fat represent the quantity of material extracted by ether in a Soxhlet's apparatus. After a first extraction in this way the remaining undissolved material was subjected to gastric digestion⁴ and again extracted in a Soxhlet's apparatus. The numbers that follow represent the total amount of ethereal extract before and after gastric digestion. They are:

Analysis 1 ...	5.26 of fat per cent.
" 2 ...	5.02 " "
Average ...	5.14 " "

This number (5.14) is the percentage of fat in the fresh material; it corresponds to 6.477 per cent. of the dry residue. This is a fairly low number; the Boers evidently select lean strips of meat for the preparation of the material; there is an absence of greasiness in the grated biltong.

Composition of Biltong.

Putting all these facts together we can now present the following table. The other organic substances which were not estimated are roughly grouped together as extractives, and their amount is obtained by subtracting the sum of the solids estimated from the total.

Water	19.410 per cent.
Solids	80.590 "
Inorganic solids	6.502 "
Organic solids	73.908 "
Proteids	65.866 "
Fat (ether extract)	5.140 "
Glycogen	0.133 "
Sugar	0.090 "
Extractives (by difference)...	2.769 "

Digestibility of Biltong.

The preceding figures show that chemically biltong is a valuable food; the loss of water by rapid drying renders it portable and concentrated. The large percentage of proteid points especially to its high nutritive value. Experience, moreover, has shown that it is not prone to undergo decomposition.

But mere chemical analysis is never an absolute criterion of the nutritive value of any food material, unless at the same time experiments to determine its digestibility are made also.

There are many preparations which, from the chemical point of view, are highly nutritious, but which are really comparatively valueless, because their indigestibility renders it difficult for the body to utilize them.

The most satisfactory experiments from this standpoint are those performed *in vivo* upon animals, or, better still, upon man himself. Here the food taken in must be carefully analysed, the excreta thoroughly examined, and the body weight, etc., observed. We are not aware that such experiments have ever been performed with biltong, and the small amount of material at our disposal prevented us from performing them. Still, although experiments of this nature made with scientific exactitude are lacking, an experiment on a vast scale *in vivo* is being made in South Africa, where the Boers, and to some extent our own troops, use biltong as their staple meat food. This experiment has shown that biltong at any rate possesses no marked disadvantages as an article of diet.

We have necessarily been limited to experiments made *in vitro* with artificial gastric and pancreatic juices. As a rule such experiments form a good guide to what occurs in natural digestion.

We found, as one would anticipate from *a priori* considerations that biltong is readily digestible in both varieties of artificial juice, and we can therefore safely say that it is a valuable and nutritious food.

Numerous observers have pointed out that various forms of cured meat are less easily digested than fresh flesh; the same is true for cooked meat. But the natural digestive juices of healthy people are sufficiently powerful to overcome this disadvantage.

It was therefore a matter of interest to see quantitatively whether this is also the case for biltong.

We took the usual standard of comparison, namely, fibrin. This was first dried at 40°C. until it became something like biltong in appearance; it was powdered and kept in stoppered bottles from which samples were taken for analysis (determination of water and solids), and for artificial digestion experiments.

Approximately equal weights (usually about 1 gram) of the fibrin and biltong were taken; each was subjected to the action of the same amount of artificial juice; at the end of a given time, the residue was collected, washed, dried and weighed. The numbers given are percentages of the dry residue in proportion to the dry material of the original substance.

Experiment 1.—Digestibility of fibrin and biltong in artificial gastric juice compared; the digestion was stopped at the end of forty minutes, the temperature of the warm bath in which digestion took place was 38°C. At the end of this time 0.69 per cent. of the fibrin, and 7.91 per cent. of the biltong remained undigested.

Experiment 2.—Repetition of experiment 1; time of digestion thirty-five minutes—2.36 per cent. of the fibrin and 10.37 per cent. of the biltong remained undigested.

Experiment 3.—In this experiment artificial pancreatic fluid was employed instead of gastric juice. At the end of thirty-five minutes 2.76 per cent. of the fibrin and 7.40 per cent. of biltong remained undigested.

These experiments show that more residue occurred in all cases when biltong was used. The comparison, however, is not perfectly fair, because fibrin is a nearly pure proteid, and biltong contains a considerable proportion of solids which are not proteid in nature; this will in part account for the comparatively large residue. The difference is not so marked in the case of pancreatic digestion; this is what one would expect.

A further experiment was therefore made in which the digestibility of biltong was compared with that of another form of flesh. Miss Tebb had in stock some rabbit's muscle, which had been dried at a low temperature (30°C.) and subsequently powdered. This contained 16 per cent. of water.

Experiment 4.—Gastric digestion of dried rabbit's muscle compared with that of biltong. Time of digestion 45 minutes. At the end of this time 3.63 per cent. of the rabbit's muscle remained undigested and 13.30 per cent. of the biltong.

We here see that the digestibility of the biltong is less than that of rabbit's muscle; this probably indicates that the tropical sun had some coagulating influence on the proteids of buck's flesh.

After all, however, biltong is readily digestible, and a residue of even 13 per cent. is by no means large for a brief digestion in a flask. As stated before, digestion *in corpore* is more effective, and so our experiments, both from the

chemical and physiological standpoints, show the valuable nutritive properties of the substance under investigation.

NOTES AND REFERENCES.

¹ London: R. H. Porter, 1900. ² The number so obtained was used for calculating the amount of proteids on the basis of Chittenden's (*Zeitschr. f. Biol.*, vol. xxv, p. 358) analyses of myosin, which showed it to contain 16.86 per cent. of nitrogen. ³ Probably what is taken as glycogen includes also intermediate substances between glycogen and dextrose. ⁴ Dormeyer (*Plüger's Archiv*, vol. lxi, p. 341, lxxv, p. 90) has pointed out the importance of this precaution. If gastric digestion is omitted, all the fat is not extracted.

FOUR CASES OF RODENT ULCER TREATED BY X RAYS.

By JOHN WILLIAMSON PUGH, M.D.LOND.,
Brighton.

THE following cases of rodent ulcer successfully treated by x rays are placed on record, as the number of such cases hitherto published is very small. The treatment is so successful

Fig. 1.-A.

that if applied at an early stage the ravages of this disease ought to be almost completely prevented. The danger of dermatitis is almost absent if the treatment is carried out under proper supervision, including an efficient arrangement of masks. There can be little doubt that the exaggerated fears of dermatitis which prevail have led to this efficacious form of treatment not being utilized to anything like the extent which it deserves, and which is desirable in the best interests of the patients. As a matter of practical detail I do not advise a sitting beyond fifteen minutes for cases of rodent ulcer. I am, however, at present giving longer sittings for a patient suffering from carcinoma of the breast, for which operation has been refused, special precautions being taken in this case against dermatitis. There can be no doubt, in my opinion, that the x rays have a marked destructive effect upon lowly organised and rapidly-growing cells, as seen in the following cases of rodent ulcer and in recorded cases of ulcerating carcinoma. I have applied the same treatment to boils, and in several instances have noticed that the course of the suppuration was much curtailed.

CASE I.—Mr. S., aged 93, gardener, for his time of life enjoys very good health.

History.—Three years ago a small pimple was noticed on his left cheek.

A year later he struck the pimple when chopping wood, and from that date it began to grow and ulcerate, and also to pain him at times.

State on Examination.—At the beginning of December, 1900, the ulcer was nearly circular, about an inch in diameter, the edges considerably raised (one-sixteenth to one-tenth of an inch) and depressed in the centre (crateriform). The discharge was blood stained.

Treatment.—I commenced treating him with the x rays on December 11th, 1900, using a coil which gave a 10-in. spark, and was worked by a 12-volt battery. At first the rays were applied for 5 minutes twice a week, keeping the ulcer 6 in. from the focus tube. The face was covered by a mask of lead foil with a hole opposite the ulcer. The time of exposure was gradually increased to 10 minutes, and the tube was brought within 4 in. of the ulcer.

Progress.—Up to the middle of January, 1901, there was not much encouragement; at that time the ulcer was a little smaller and the edge not quite so raised.

On February 11th, and up to the 18th, I gave him a daily sitting of ten minutes, and by that time the mask had become too small through the edges tearing away, and thus the greater part of the right side of the face was exposed to the rays. The result was that the patient had a sharp attack of dermatitis over the exposed part, but the effect on the ulcer was most marked. The discharge and pain almost ceased, and the edge was considerably reduced. Lotio plumbi c. op. was applied and the dermatitis rapidly disappeared. From February 18th to March 11th the rays were applied every other day, the edge gradually disappeared, the ulcer acquired a healthy appearance, and healed up from the sides

Fig. 1.-B.

The process was complete by March 18th, 1901, and the treatment was then discontinued. The scar at the present time (March 25th, 1902), is perfectly sound, and looks better than it did at first. (See Fig. 1.-A and B.)

The rays were applied about thirty-six times altogether. The hairs were destroyed over the exposed part where he had dermatitis. The same thing happened to my own finger while attempting to intensify the effect of the rays by holding a convex lens between the focus tube and the ulcer. This was a useless proceeding, as the rays, I understand, are very slightly, if at all, refracted by an ordinary convex lens.

CASE II.—Mr. T., aged 83, was treated for a rodent ulcer upon the left temple, 1½ in. by 1 in.

History.—It commenced about thirty years ago, and for many years it had been too tender to allow him to lie upon that side. During the last two years he had suffered very much from severe darting pains. The discharge was very abundant and bloodstained.

Treatment and Progress.—The treatment was commenced on March 18th, 1901. After a few sittings the first improvement noticeable was the disappearance of the pain and the lessening of the quantity of the discharge, which became of much lighter colour. Owing to the infirmities of the patient the rays could not be applied from April 27th to May 11th. Then a slight improvement was noticeable in the ulcer, the edge on one side was less raised, and its circumference was diminished. The tube had hitherto been placed about 4 in. from the ulcer, and the rays applied for seven and a-half minutes. As the ulcer was healing from the sides the distance of the tube was increased to 6 in., and the hole in the mask