FOOD LOSSES DURING COOKING.

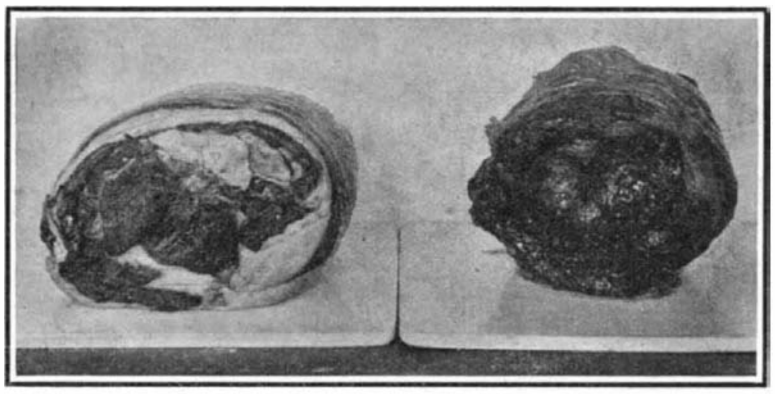
BY H. D. JONES.

With a view to securing accurate data regarding the changes which take place in meat when cooked, and at the same time obtaining information that may tend to lessen the miseries of a nation of dyspeptics, the professors of chemistry at the University of Illinois have been engaged for some years past in an elaborate series of experiments. The object of the work was to study the influence of the cooking of meats upon their digestibility; to determine the nature and extent of the losses which meats undergo during the cooking; to investigate the nutritive value of cooked meats; to study the character of the changes which take place in meats when they are cooked by the various methods, and to observe the influence of cooking upon the flavor and palatability of meats.

From time to time reports have been made to the Department of Agriculture concerning the progress of the experiments, and lately a more exhaustive report has been prepared, which sets forth the results attained during the work carried on by H. S. Grindley, Associate Professor of Chemistry, and Profs. Timothy Mojonnier, W. O. Atwater, and P. F. Trowbridge, at the University of Illinois.

The conclusions were arrived at after experimenting with various methods of cooking, for which the popular names of boiling, pan-broiling, *sautéing*, and roasting are applied by the scientists for want, as they explain, of a more precise nomenclature, which they think should be invented for use in such cases. The scientists found themselves at a loss to define the term "boiling," for instance, in reporting the result of the experiments, for the reason that cooking in hot water at any temperature is called boiling. As the temperature varied in the different experiments, the exhaustive reports made contained the temperature at which the various results were attained, so that the expert could tell whether the meat was cooked by stewing, simmering, or true boiling.

The method employed in the pan-broiling experiments was to cook the meat upon the surface of a medium hot, dry, cast-iron frying pan for the desired length of time, which was recorded in each case. No fat was added to the frying pan either before or during the cooking, but the meat was frequently turned. In the *sautéing* experiments the meat was cooked for fifteen minutes in a small amount of hot lard, the quantity used being sufficient to form a thin layer upon the bottom of the pan. In this case also the meat was frequently turned during the cooking. In the roasting or baking experiments the meat was cooked in a pan in a well-ventilated oven, and the details as to temperature and time of cooking carefully recorded.



Rolled Beef Rib Roast, Cooked and Raw.

In order to obtain exact data concerning the losses during cooking, it was essential to analyze the drippings from the meat, for there is considerable nourishment in dripping, and this is by no means a loss. Therefore, the drippings were carefully weighed, and kept in a dry place for two or three hours until the solid matter had settled. As much as possible of the fat was then poured off, and the remainder filtered, dry, warm filter paper being used, and the operation carried out in a large water oven kept at a suitable temperature. The solid residue from the drippings was cooled and washed several times with ether to remove the remaining fat, and this taken into consideration in the final summing up.

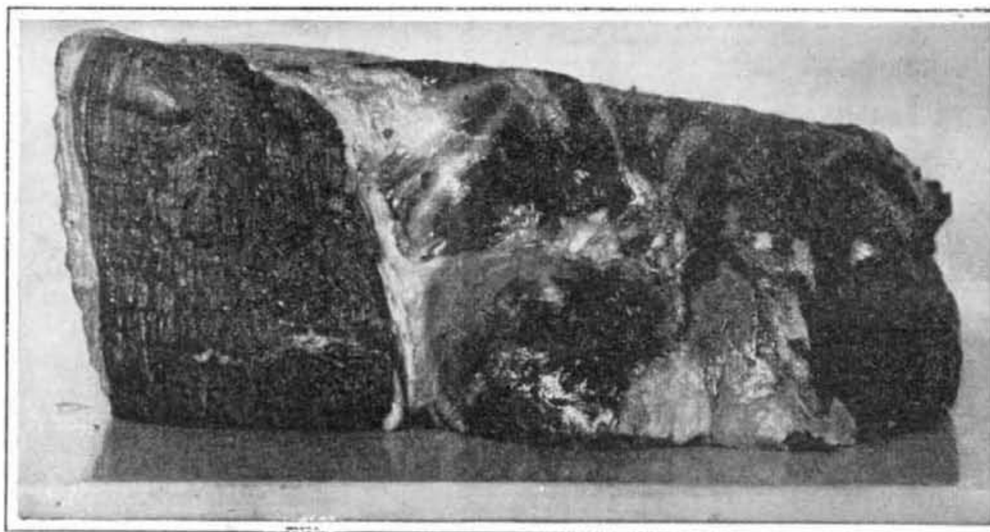
In the boiling experiments the meat was weighed before and after cooking, and the difference was taken as representing the total loss in weight resulting from the process of cooking. The broth was analyzed by cooling it and straining it through a piece of cheese cloth, rendering it free from the coarser particles of solid matter, and most of the fat, which was solid when the broth cooled. The total loss in weight, less the sum of the ingredients found in the broth, was assumed to represent the amount of water removed from the meat in cooking. The cooked meat was then analyzed, and the amount of each nutrient in the cooked meat was added to that in the broth, and the sum taken as the amount of the nutrients in the raw meat. From this amount and the amount in the broth, the percentage loss of each ingredient was calculated.

Proceeding along these general lines, with slight variation to suit the great number of experiments made, the chemists came to conclusions which are summed up in this manner:

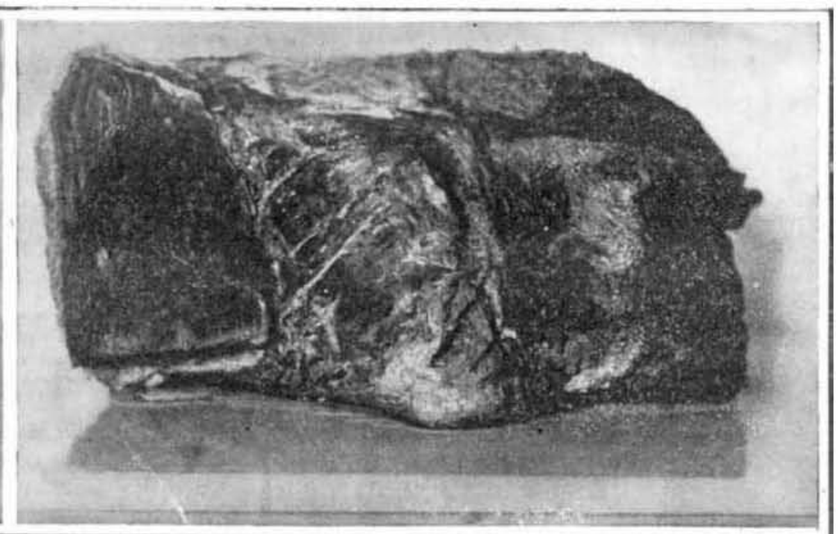
The losses in weight when meat was cooked in hot water varied in the individual tests from 10.61 to 50.20 per cent of the total weight of the fresh meat used, the average being 34.35 per cent. The amount of water removed during cooking varied from 18.05 to 68.90 per cent, and averaged 45.07 per cent of the total water in uncooked meat.

The results of the pan-broiling experiments showed that the total loss varied from 23.10 to 35.10 per cent, the average of all the experiments being 30.68 per cent. This was due almost entirely to the removal of water, the average loss of this constituent being 30.52 per cent.

In summing up the *sautéing* experiments, it was found that the amount of water driven off by heat varied from 40.44 to 51.39 per cent, averaging 46.86 of the entire amount contained in the original uncooked meat. The roasting experiments showed that the nature of the loss in this method of cooking is entirely different from that occurring in boiling, *sautéing*, and pan-broiling. In the case of the last three methods of cooking, the greater part of the loss is due to water, but in roasting the main loss is distributed between the water and the fat. In other words, the loss of fat resulting when meat is roasted is much greater than when it is boiled. In the roasting experiments the average loss of water amounted to 17.53 per cent, and the average loss of fat to 9.83 per cent of the total weight of the edible portion of the uncooked meat. In 91 boiling experiments the average loss of water amounted to 30.75 per cent, and the average loss of fat to only 1.21 per cent of the total weight of the edible portion of the uncooked meat.



Beef Round, Uncooked.

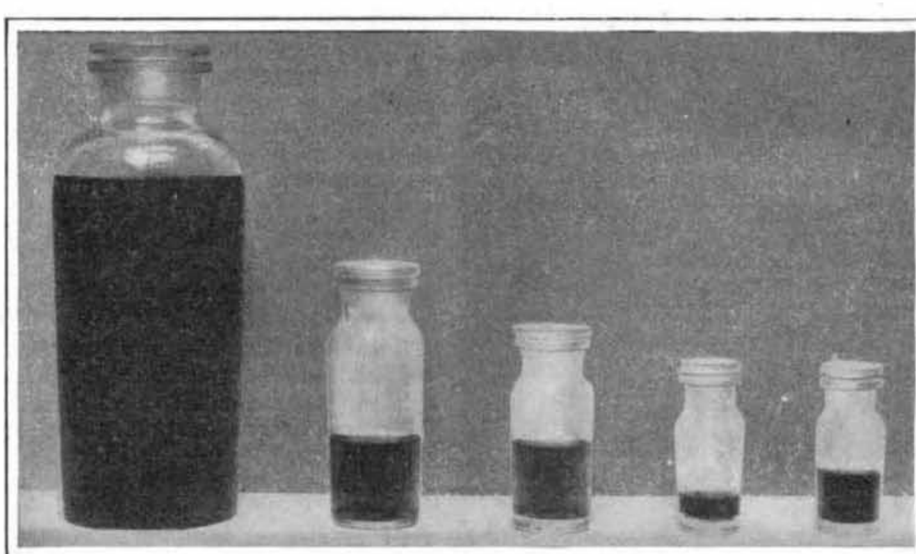


Beef Round, Roasted.

The general conclusions arrived at from the series of experiments are summed up as follows:

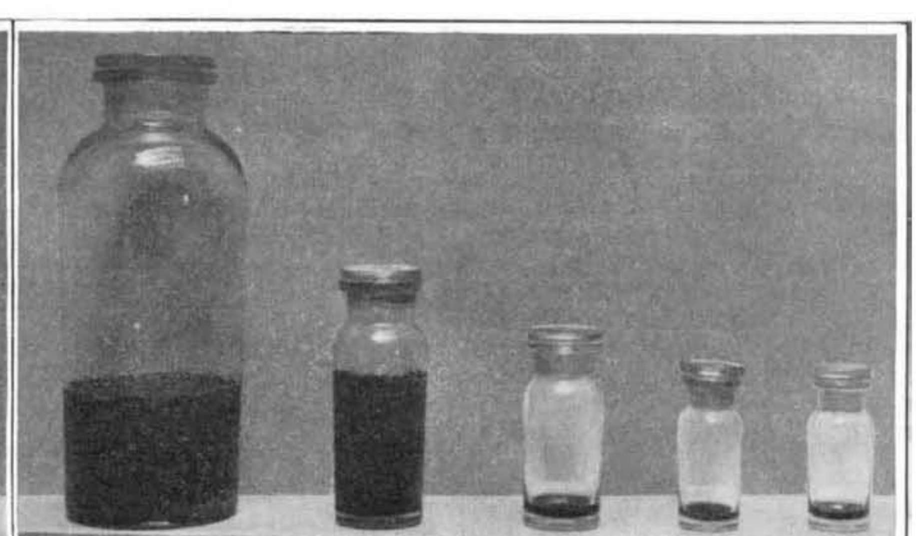
The chief losses in weight during the boiling, *sautéing*, and pan-broiling of meats is due to water removed by the heat of cooking. In the roasting of meats the chief loss is due to the removal of both water and fat.

The losses of nutritive material in the pan-broiling of meats are very small as compared with the losses which take place in boiling, roasting, and *sautéing*.



Water 4 lb. 4 oz. Fat 3.36 oz. Extractives 2.4 oz. Proteid 0.32 oz. Ash 0.91 oz.

Astonishing Losses in Boiling a 10-Pound Beef Round.



Water 1 lb. 7 oz. Fat 6.4 oz. Extractives 0.22 oz. Proteid 0.06 oz. Ash 0.10 oz.

Nutriment Lost in Roasting 10 Pounds of Beef.

FOOD LOSSES DURING COOKING.

When beef was cooked in water in these experiments, 3.25 to 12.67 per cent of the nitrogenous matter, 0.60 to 37.40 per cent of the fat, and 20.04 to 67.39 per cent of the mineral matter of the original uncooked meat was found in the broth. This material is not a loss if the broth is utilized for soup or in other ways.

When meat is *sautéed*, 2.15 per cent of the nitrogenous matter and 3.07 per cent of the ash occurring in the uncooked meat were taken up on an average by the fat in which the meat was cooked, while the cooked meat contained 2.3 times more fat than before cooking.

When the meats were roasted, 0.25 to 4.55 per cent of the nitrogenous matter, 4.53 to 57.49 per cent of the fat, and 2.47 to 27.18 per cent of the mineral matter present in the uncooked meat were found in the drippings.

Beef which has been used in the preparation of beef tea or broth has lost comparatively little in nutritive value, though much of the flavoring material has been removed.

In the boiling of meats, the fatter kinds and cuts, other things being the same, lost less water, nitrogenous and mineral matter, but more fat than the leaner kinds and cuts.

In cooking meats by boiling, *sautéing*, pan-broiling, and roasting, the losses increased in proportion to the degree of cooking. In other words, the longer the time and the higher the temperature of cooking, other things being the same, the greater the losses resulting.

As a rule, the larger the piece of meat cooked by the methods of boiling and roasting, the smaller were the relative losses.

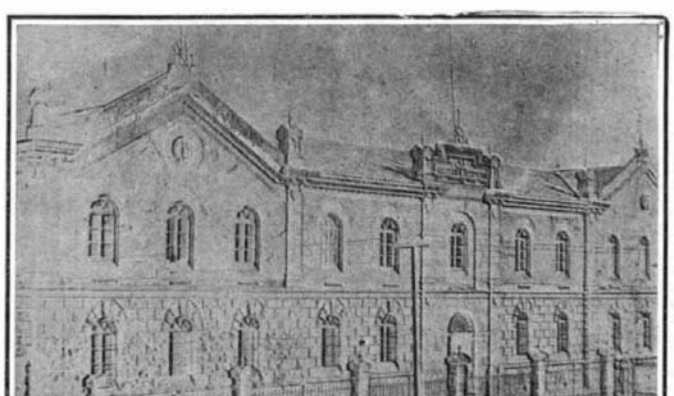
The experiments indicate plainly that different cuts of the same kind of meat behave very differently as regards the amount and nature of the losses which they undergo when cooked in hot water.

PHOTOGRAPHS WITH BAS-RELIEF EFFECTS.

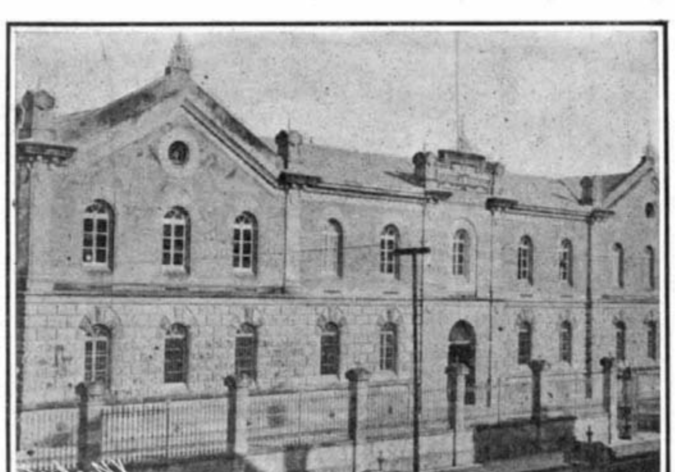
BY GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

Pictures of bas-reliefs owe their remarkable appearance to a peculiar distribution of light. They lack the contrasts which result from differences in distance. One side is sharply illumined directly and by light reflected on the background; on the opposite side a shadow, cast on the same background, increases the degree of the relief. When these modifications are made in any drawing, relief effects are the result. I devised and tried various methods for producing these while printing photographs, by the superposition of two negatives. These attempts were fruitless, but I obtained better results by the superposition, under certain conditions, of a negative and a transparent positive. The bas-relief pictures which illustrate this article were made by that process with ordinary photographs; amateurs who are familiar with the simplest photographic operations can easily make similar or better pictures. Glass plates cannot be used for both the negative and the positive transparent mediums; the printing is not done, as usual, with the film facing the paper, and, owing to the appreciable thickness of the glass, the image would be blurred. If the picture is small, as in the case of an ordinary portrait, a positive film may be used with a glass negative. If a larger picture is desired, this method will fail, as the positive film contracts during the developing process, and after it no longer coincides with the negative, except over a small area. The best results are obtained when the following process is used:

Select a fairly good negative plate, and make a positive glass transparency with it. Then, with the same negative plate, make a positive film, and with the positive plate make a negative film. Both films having gone through the same baths will contract equally, after being printed, and then their coincidence will be perfect. When developing the positive film, see that it be not darker and more strongly contrastive than the negative. If such were the case, the final printing would bring out an intaglio effect instead of a bass relief. When the films are dry, place them in the printing frame so as to get perfect coincidence. As the negative brings a shade behind every light of the positive, the transparency is flat, that is, almost without contrasts. Move one film a trifle diagonally, so as to destroy slightly the coincidence. Intense lights and deep shadows will suddenly be cast on opposite sides of every relief or hollow part. Keep the film in that position with one hand, and with the other place a sheet of sensitized paper behind it. Print in the direct light of the sun, without interposing a ground glass.

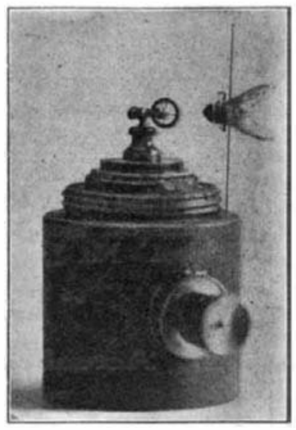


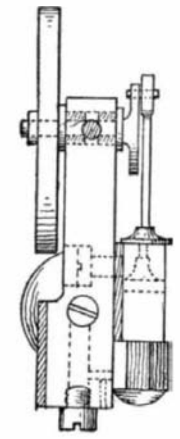
These Two Relief Effects Were Obtained by Printing from Superposed Positives and Negatives.



Photographs of the Above Subjects Made in the Usual Way.

PHOTOGRAPHS WITH BAS-RELIEF EFFECTS.





THE SMALLEST ENGINE EVER MADE. PLAN OF THE ENGINE.

THE SMALLEST STEAM ENGINE ON EARTH.

What is perhaps the smallest stationary engine ever constructed has been recently completed at his shop on Yonge Street by Thomas H. Robinson, watchmaker, of Toronto, Ontario. Smaller than a common housefly, it slips easily into a "22 short" empty cartridge with plenty of room to spare. It weighs complete just 4 grains troy. This is 120 engines to the ounce, 1,920 to the pound, and 3,840,000 to the ton. The horse-power is 1/498,000 part of a horse-power, and the speed is six thousand revolutions per minute. The vibrating piston rod when running at this speed emits a sound like that produced by a mosquito. The bore of the cylinder is 3/100 of an inch; the stroke is 1/32 of an inch. The cylinder and piston rod, shaft and crank are of steel. The engine bed and stand are of gold. The balance wheel, which has a steel center and arms, with gold rim, weighs 1 grain, and measures 3/16 of an inch in diameter. The shaft runs in hardened and ground steel bearings fitted to the gold bed.

Seventeen pieces were used in making the engine, which is mounted on an ebony stand, inside of which are brass connections, which convey the compressed air used to operate it to the hollow base of the engine. It was exhibited by request before the Canadian Institute in Toronto recently. When running no motion is visible to the unaided eye, but by means of magnifying glasses and lantern slides, which showed the construction, an examination was made, and the opinion freely expressed that the engine is the fastest of its size on earth. The calculations of both speed and horse-power were made by Prof. C. A. Chant, of the Physical Department of Toronto University.

Production of Gas, Coke, Tar, and Ammonia.

A report on the production of gas, coke, tar, and ammonia at gas works and in retort coke ovens during 1905 has been prepared by Mr. Edward W. Parker of the United States Geological Survey and is now ready for distribution. It is supplementary, in a measure, to the reports on the production of coal and the manufacture of coke, and is made in response to a demand from producers of gas and coke and the by-products of tar and ammonia, for statistical information on these subjects.

The present report includes, in addition to the statistics of the production of gas, coke, tar, and ammonia at gas works and in by-product coke ovens, a statement of the production of the quantity of gas and tar produced at water-gas works using crude oil for enriching purposes. These statistics have not been considered in any of the preceding reports. At some of the gas houses oil is used with the coal in the production of gas, but the entire production is included in the statistics of coal gas.

The total quantities of these products in 1905 was 40,454,215,132 cubic feet of gas (not including that lost or wasted) 5,751,378 short tons of coke, 80,022,043 gallons of tar, 46,986,268 gallons of ammonia liquor (equivalent to 22,455,857 pounds of anhydrous ammonia), and 38,663,682 pounds of ammonia sulfate, against 34,814,991,273 cubic feet of gas, 4,716,049 short tons of coke, 69,498,085 gallons of tar, 52,220,484 gallons of ammonia liquor (equivalent to 19,750,032 pounds of anhydrous ammonia), and 28,225,210 pounds of ammonia sulfate in 1904. The total value of all these products in 1905 was $56,684,972 against $51,157,736 in 1904.

Oil and Water Gas.—Returns were received from 477 oil and water-gas producing companies, and these show that the total production of water gas in 1905 was 82,959,228,504 cubic feet. Of this quantity 5,547,203,913 cubic feet, or 6.7 per cent, were lost by leakage, etc., leaving 77,412,024,591 cubic feet as the net production obtained and sold. As the quantity of gas made and sold at coal-gas and by-product coke oven works was 40,454,215,132 cubic feet, it appears that the consumption of water gas, and gas made from crude oil was nearly twice as much as that made from coal. It also appears that while the average price of coal gas in 1905 was 81.4 cents per 1,000 cubic feet, that of oil and water gas combined was a fraction of a cent in excess of $1 per 1,000 cubic feet. Still further comparison shows that whereas 66 per cent of the production of coal gas was sold as illuminating gas, 77 per cent of the combined production of oil and water gas was used for this purpose.

An American metallurgist states that plain carbon manganese steel, with an addition of 0.25 per cent of vanadium, had its tensile strength raised 65 per cent and the elastic limit 68 per cent, without in any way impairing the structure to withstand the regular physical tests. While the same carbon manganese steel with 3.34 per cent of nickel added, showed a tensile strength of 94,528 pounds per square inch and an elastic limit of 73,024 pounds per square inch, by the addition of 0.25 per cent of vanadium the tensile strength was increased 61 per cent, which was equivalent to 152,678 pounds per square inch, and the elastic limit was raised by 64 per cent, equivalent to 112,539 pounds per square inch, and gave an elongation in 2 inches of 26 per cent and a contraction of area of 32 per cent.