THE INFLUENCE OF AN EXCESSIVE MEAT DIET ON FERTILITY AND LACTATION.

By B. P. WATSON, M.D., F.R.C.S.E.,

UNIVERSITY GYNAECOLOGICAL TUTOR, EDINBURGH ROYAL INFIRMARY,
PHYSICIAN TO THE WOMEN'S DISPENSARY, CANONGATE, EDINBURGH.
(From the Physiological Laboratory, Edinburgh University.)

THE problem of the falling birth-rate has for some time occupied the attention of medical men and social workers, and various causes have been assigned to account for it. Chief among these may be mentioned the artificial prevention of conception and the later age of marriage, and these, no doubt, play an important part. The results of the present investigation, however, would seem to open up another line of inquiry, and lead me to ask whether the altered conditions of living, and especially the alteration in the constituents of the daily dietary of the people in the form of the increased consumption of meat, may not have an important rôle.

It has been shown by Chalmers Watson¹ that the consumption of meat in this country has risen from 3 lb. a head per annum in 1850 to 50 lb. a head per annum in 1902. It is within this period that the decrease in the birth-rate has arrested attention. It is chiefly the middle and artisan classes of the population which are responsible for our increased meat consumption, and it is noteworthy that the decrease in the birth-rate chiefly affects them, and that there appears to be no diminution in the size of the families of the poorest classes among whom meat is still only a very occasional article of diet. This class incidence, of course, also supports the preventive and late marriage theories, so too much stress must not be laid upon it as an argument in favour of a dietetic cause.

Along with the decline in the birth-rate there has been a notable decrease in the number of mothers who nurse their infants on the breast. While the majority of these mothers wilfully shirk their duty for social or other reasons, it is a matter of common clinical experience, and a fact brought out by the report of the Departmental Committee on the subject, that a large and increasing number of women are physically incapable of nursing their children because of the poorness of their mammary development and inadequacy of their supply of milk. Here again my results raise the question as to the possibility of this being due to a dietetic cause.

The idea of testing the effect of an exclusive meat diet on the functions of reproduction and lactation was suggested by Chalmers Watson. In a paper on the Influence of Diet on Growth and Nutrition,² he showed that in rats a diet of ox flesh begun when the animals were weaned interfered with the development of pregnancy, none of the four flesh-fed animals having young, whereas all the control animals from the same litter became pregnant. On the other hand it is stated of three families fed on horse flesh from the age of 2½ months approximately that all became pregnant, from which he concludes that "the use of this diet in animals of this age appears not to affect the supervision of pregnancy." He also noted in the meat-fed animals which became pregnant that the mammary tissue was less developed than in control bread and milk-fed rats.

These observations I have extended, and with a larger amount of material at my disposal am able to amplify his statements and, as regards the question of fertility, to modify them.

The method of conducting the investigation was as follows: Twelve female rats and several males were put upon a bread and milk diet, and the females were continued on this throughout pregnancy and lactation. These served as the controls. Seventeen females and five males were put upon an ox-flesh diet, but were otherwise under exactly the same conditions as the animals given bread and milk. The animals were begun on a meat diet at various ages, from the second up to the fourth month, and some of them were kept on the diet for as long as five months.

Of the 17 animals fed upon a meat diet only 8 became pregnant, and of these 4 bore young within twenty-one days (the usual gestation period in the rat) of being put on the diet, so that only 4 actually conceived while on meat feeding. Of these latter 1 had been twenty-four, 1 twenty-five, 1 twenty-seven, and 1 thirty days on an exclusive ox-flesh regimen. The other 9 animals, although

kept for several months, did not conceive, and this in spite of the fact that they were seen to copulate freely right up to the end of the experiment. This reservation must, however, be made, that one of these 9 animals probably had young which were eaten, and it is possible that this happened in other cases. It is not at all probable, however, as the animals were frequently carefully examined, and if there was any indication of their being pregnant were at once transferred to separate cages.

Of the twelve animals fed on a bread and milk diet all became pregnant and had young; so that we may conclude that a meat diet is decidedly prejudicial to the occurrence of pregnancy in rats when the diet is begun when the animals are from two to four months old.

In order to determine whether the fault resided in both sexes or in only one a fresh male which had been fed on bread and milk was put beside the sterile females which had been on meat for several months. When the animals were killed some days after, one of them was found to be in an early stage of pregnancy and must have been impregnated by the male fed on bread and milk. This would appear to indicate that the cause of the sterility is partly due to the male, but we have not had sufficient material to form any more definite conclusion regarding this.

For the second part of the investigation—the effect of a meat diet on lactation—the same animals were used: the twelve controls fed on bread and milk and the eight meat-fed animals which became pregnant. The point specially attended to was the weight of the mammary tissue of the animals killed after suckling their young for varying periods.

In the nursing rat the mammary tissue forms a continuous sheet spread under the skin of the abdomen on each side of the middle line. In addition there are extensions of it into the axillae, up along the neck and into the groins, while in some cases it spreads out so much laterally as almost to reach the back. The nipples are in a double row extending from thorax to the groins.

The animals were killed at different periods during lactation. The weight of the mother and the number and weight of the young at the time of death were ascertained. The skin and subcutaneous tissue of the mother's abdomen was immediately removed down to the muscle, care being taken that no mammary tissue was left behind in the axillae or in the groins. The skin was put into 5 per cent. formalin for a few days, when it was quite easy to separate the mammary tissue from the skin on one hand and from the areolar tissue on the other. If an attempt were made to strip the mammae before first fixing in formalin, it was found that a great deal of milk was squeezed out. The immersion in formalin prevented this, although it extracted a small quantity of milk, as shown by its cloudy appearance at the end of twelve hours. It is to be understood, then, that the mammae were weighed out of formalin.

The basis of comparison between the meat and the bread and milk fed rats is the percentage weight of the mammary tissue to that of the mother. By a reference to

Table Giving the Lactation History of Twelve Rats Fed on an Exclusive Bread and Milk Dietary.

Weight of Animal at Death.	Weight of Mammas.	Per Cent.	Time During Lactation when Killed	Number of Young.	Weight of Young.
Grams.	Grams.				Grams.
147	12.5	8.0	1st day	7	32
140	10.0	7.1	3rd day	7	45
180	18.0	10.0	6th day	7	70
225	18.5	8.2	10th day	7	115
120	17.0	14.1	21st day	5	150
140	19.0	13.5	21st day	7	220
115	7.5	6.5	21st day	3	120
130	11.5	8.8	22nd day	4	100
160	19.0	11.2	25th day	7	145
150	13.5	9.0	30th day	—	—
160	15.0	9.3	27th day	6	175
130	13.0	10.0	—	6	—

Average percentage = 9.6

Table Giving the Lactation History of Eight Rats Fed on an Exclusive Ox Flesh Dietary.

Number of Days on Meat before Parturition.	Weight of Animal at Death.	Weight of Mammae.	Per Cent.	Time of Lactation when Killed.	Number of Young.	Weight of Young.
	Grams.	Grams.				Grams.
30	180	13.0	7.2	1st day	10	50
9	140	8.5	6.0	1st day	10	43
27	230	19.5	8.4	1st day	—	—
25	150	13.0	8.6	7th day	5	48
12	115	10.5	9.1	20th day	6	120
15	130	12.0	9.2	21st day	7	185
21	110	10.1	9.1	21st day	6	11
24	140	11.5	8.2	22nd day	4	82

Average percentage = 8.2.

the table it will be seen that there are wide individual variations in this percentage among the bread and milk fed animals. This is explained by the different times during the course of lactation at which the animals were killed, and also by the varying numbers of young which they suckled. Thus there is a fairly uniform rise in the percentage from the first up to the twenty-first day, after which there is again a fall; and taking animals killed at the same lactation period the percentage is higher in those which nursed the larger number of young. We may therefore take it that the mammary gland in the rat is most actively functioning about the twenty-first day of lactation, and that after this, as the young begin to feed themselves it undergoes atrophy.

It will be seen that the average percentage weight of the mammae of all the animals fed on bread and milk was 9.6, while that of the meat fed ones was only 8.2. This difference would in all probability have been greater but for the fact that the average number of young suckled by the bread and milk fed animals was only 4.6, by the meat fed animals 6.3.

As before stated, the longest period before the birth of the young during which the mother had been on a meat diet was 30 days. Taking this into consideration the difference is sufficiently marked to point to the conclusion that the result of a meat diet is to diminish the amount of mammary tissue in nursing mothers.

The effect of this relatively poor mammary development on the young of the meat fed rats is shown by a comparison of their weights with those of the young of the control animals towards the end of the lactation period. Thus the average weight of each of the young of the rats fed on meat at the twentieth to the twenty-first day was 21.6 grams, in contrast to 29.4 grams, the average weight of each of the young of the bread and milk fed rats. It is thus evident that the young of the animals fed on meat suffered in general nutrition and growth as compared with those whose mothers are on a bread and milk diet.

Whether this is due to a mere deficiency in the amount of milk available for their use or to some alteration in its constituents has not been determined, but the probability is that the former plays a large part.

No marked differences were observed on microscopical examination in the histological characters of the mammary tissues. The character of the glandular tissue varies according as the acini are full of secretion or empty; and while the mammae of the meat fed animals showed a preponderance of closely-packed empty lobules, this may only have been due to the fact that the mother had been killed shortly after the gland had been emptied by suckling.

There can thus be no doubt that a meat diet in rats affects prejudicially their powers of reproduction and lactation, and these results suggest to me that the increasing consumption of animal food in this country may be an important factor in the causation of the decrease in the birth-rate and the diminished powers of lactation. At any

rate, the results are suggestive, and call for more extended observations along similar lines.

REFERENCES.

¹ *Lancet*, July, 1905. ² *Journ. of Physiol.*, vol. xxxiv, p. 111.

THE FOOD FACTOR IN THE TWENTIETH CENTURY.*

By GEORGE J. SEALY, M.D.,
WEYBRIDGE.

THOUGH it is universally recognized that man should know how to feed himself rationally to preserve his youth and his strength, and though it is also expected that the physician should know how to prescribe for him the most efficacious diet if he falls ill, yet no method of treating disease is generally used with less confidence and precision than dietetics. This is doubtless largely due to the lack of any proper system of instruction in the subject in medical schools. It seems to me the time has fully come when we, as practitioners of medicine and guardians of the public health, are called upon to give to the question of dietetics the same precision and care that we give to the ordering of drugs. There can be little doubt that the future of medicine lies in the direction of hygiene rather than of therapeutics.

Most of us are employed in the ordering of patients' lives from the cradle to the grave, and in so doing have greater opportunities for following such a subject out and forming correct conclusions than usually fall to the lot of many more conspicuously placed. We are in a better position for dealing with what is called the personal factor, more often than not itself an outcome of defective methods of nutrition, individual or hereditary.

One cannot be in close observation of, in many instances, the same people for thirty years and more, as I have been, without getting a considerable insight into the influences at work in connexion with their fitness in health and their resisting and recuperative powers when assailed by disease. When one indulges in anything in the nature of a professional retrospect, the first thing that strikes one is the increased frequency and seriousness of abdominal troubles in the present day; appendicitis, perityphlitis, gouty colitis appear to have taken the place of flatulent colic and troubles of similar calibre with which we were prone to be occupied thirty years ago.

The simpler ailments of the earlier period were due apparently to simple causes, whilst those of the later period are traceable to microbic influences and are of more serious import. I vividly remember cases of appendix trouble with which I had to deal in the early period; but they were few, and occurred in subjects in whom this rudimentary structure was sufficiently patent to admit a cherry-stone or some similar foreign substance. Nowadays undue patency is not necessary.

In looking about for a cause for such changes we naturally consider the food factor, and we see that great facilities have been afforded for augmenting the carnivorous tendencies of the English people. The importation into this country of large consignments of live, frozen, and tinned meat has aggravated the tendency, which seems to have existed from a very early period in the English people, to regard the butcher's shop as the source of all real nourishment, and of all the most highly appreciated flavours. In the last quarter of a century the consumption of meat per head of population has, I believe, quadrupled. Doubtless this national failing is largely conducted to by our climate. Our raw and oftentimes sunless atmospheres, favour the consumption of stimulants, and that meat is much more of a stimulant than is generally supposed should be strongly insisted upon. Stimulants necessarily demand frequent repetition, and one stimulant begets another, consequently the best friend of the publican and tea merchant is the butcher.

The fact that the people who eat the most meat are those who want the most meals, though not in accordance with most persons' ideas, is absolutely correct. The stimulating property of meat is largely responsible for the fact that those who have for a length of time abandoned the use of meat at breakfast and luncheon, confining their

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