

## BORIC ACID AND FORMALIN AS MILK PRESERVATIVES.

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"THERE is no doubt that boric acid if taken in large quantities would be injurious to health, but we have not sufficient information to show whether such minute quantities as are generally added as preservatives would be regarded as having that effect, and more exact information is wanted before it can be decided whether a process which *primâ facie* may be regarded as intended to prevent the loss of valuable foods must be held to be prohibited by law." These were the words in which in 1890-91 the committee of inquiry of the Local Government Board gave its opinion on the important question of the use of preservatives in foods. It is remarkable that that "sufficient information" on the action of minute doses of "preservatives" habitually taken after the lapse of a period of almost ten years is still not forthcoming. The most recent legislation indicates the absence of such information. Thus Article 1, Section 7, of the Sale of Foods and Drugs Act, 1899, states: "Provided that an article of food shall not be deemed to be adulterated by reason only of the addition of any preservative or colouring matter of such a nature and in such quantity as not to render the article injurious to health." THE LANCET at the time of the appointment of the Adulteration of Foods, &c., Commission in 1896 urged the importance of an inquiry into the question of preservatives and by means of THE LANCET Sanitary Commission on the Use of Antiseptics in Food published the opinions of the most eminent authorities of this country. These were unanimously of the opinion that the use of antiseptics in food was injurious to health, but they could produce no direct evidence in support of their opinions. The Local Government Board have recently appointed a special committee "to inquire into the use of preservatives and colouring matters in food and to report (1) whether the use of such materials or any of them for the preservation and colouring of food in certain quantities is injurious to health, and if so, in what proportions does their use become injurious; (2) to what extent and in what amounts are they so used at the present time."

*The use of boric acid and borax.*—Boric acid was introduced into medicine in 1702 by Homberg as a sedative salt with anodyne and anti-spasmodic properties. In 1844 Binswanger in the Munich prize essay considered boric acid to be comparatively inert in its action, doses of from one to three drachms causing gastro-intestinal irritation; borax also caused similar symptoms and often an impetiginous eruption. Wild,<sup>1</sup> reviewing a larger number of cases which he had collected from English and foreign literature, sums up the question of boric acid and borax intoxications thus: "Two forms are recognised: 1. In which large quantities of the drugs are rapidly absorbed from the alimentary canal, from serous and other cavities, or from extensive raw surfaces; in these cases vomiting, diarrhoea, general depression, and partial paralysis of the nervous and muscular systems occur and may cause death. Erythematous and impetiginous rashes are common. 2. In which the drug is administered in small doses for long periods. Whether the condition of the kidneys or an individual idiosyncrasy in regard to the drug is the determining factor in causing toxic symptoms requires further investigation, but it is an important fact that the great majority of persons taking boric acid or borax do so without injurious effects." Gowers,<sup>2</sup> Liveing, Féré,<sup>3</sup> and others recorded that in several epileptic cases undergoing a course of treatment with boric acid or borax for a long period in some cases there were considerable gastro-intestinal irritation, nausea, and vomiting; they also noted the occurrence of a dry condition of the skin and mucous membranes, falling out of hair, striation of the nails, psoriasis, erythema, a special papular eruption, desquamation, petechiæ, œdema of the extremities, albuminuria, debility, and anæmia.

The doses in these cases amounted to from four to 10 grammes a day (about from 60 to 160 grains). Wild and Hall<sup>4</sup> record also several cases with similar symptoms which had been treated with doses of boric acid, or a mixture of that acid and borax, amounting only to from 30 to 75 grains daily. Doses of 80 grains per day for a single day produced no effect on 40 of Wild's cases, but doses amounting to 120 grains in four hours produced in Wild himself nausea, colic, diarrhoea, headache, depression, loss of appetite, and flushing of the skin. The only direct evidence of injurious effects being produced by the ingestion of "preserved milk" is obtained from the cases recorded by Dr. M. K. Robinson<sup>5</sup> the medical officer of health of the East Kent Combined Sanitary District. Five of the seven inmates of a certain house became suddenly ill after partaking of blanc-mange which had been made from milk of the previous day, to which, as was confessed, the dairyman supplying it had already added boric acid and to which the cook had added a further quantity to preserve it over-night. Nine fowls fed liberally with the blanc-mange became ill, five dying.

*Extent of the use of boric acid, &c.*—Dr. A. Hill's<sup>6</sup> paper read before the Society of Medical Officers of Health furnishes valuable statistics from Birmingham. Out of 2300 samples of food, 460, or 20 per cent., contained either boric acid, formol, or salicylic acid. Boric acid was found in 35 per cent. of 882 samples of butter and margarine, and in 15 of 24 samples of bacon, sausage, and other animal foods. In 5 per cent. of 1360 samples of milk boric acid was contained in quantities varying from three to 130 grains per gallon. The samples of butter analysed contained boric acid varying in quantities from seven to 84 grains per pound, or from 0.1 per cent. to 1.2 per cent. Five out of eight samples of cream contained boric acid. Several prosecutions in different towns of England are recorded of cases in which similar quantities of boric acid have been used.

*Action of boric acid.*—Professor Allen,<sup>7</sup> professor of physiology in Mason College, Birmingham, stated: "Boric acid and its compounds are quite foreign to the animal body and their presence must necessitate departure from the normal chemistry of life. The departure may be expected to consist partly in the formation of inert compounds of boric acid with calcium and magnesium (perhaps also iron), and the consequent removal of these indispensable metals from the economy. Whatever antiseptic may be used it should be remembered that in order to obtain its due effect there must be enough present to exert a decided influence on protoplasmic activity. This effect can hardly be expected to be beneficial to the tissues of the alimentary canal. Even the disinfection of the contents of the canal is a doubtful blessing in most cases, because the beneficial organisms are thereby destroyed. However harmless an occasional dose of boric acid (or one of its compounds) may be, it is evident that the case may be different when nearly every article of diet contains it."

The most systematic and complete experiments as to the action of boric acid and borax on the digestive ferments are those of Rideal and Foulerton.<sup>8</sup> They used a mixture of boric acid (25 per cent.) and borax (75 per cent.). The following are abstracts of their results.

### A.—ACTION ON AMYLOLYTIC DIGESTION.

#### 1.—Salivary Digestion of Starch.

Preservative.	Strength.	Retarding effect of preservative.
Boric mixture	1 in 2000	11.7 per cent.
"	1 ,, 1000	12.2 ,, "
"	1 ,, 333	14.0 ,, "

The retarding effect was measured by the amount of sugar formed as compared with a control sample containing no preservative.

<sup>4</sup> THE LANCET, Jan. 28th, 1899, p. 261.

<sup>5</sup> Public Health, August, 1899.

<sup>6</sup> Ibid., May, 1899.

<sup>7</sup> Report of THE LANCET Sanitary Commission on the Use of Antiseptics in Food, THE LANCET, Jan. 2nd, 1897, p. 58.

<sup>8</sup> Public Health, May, 1899.

<sup>1</sup> THE LANCET, Jan. 7th, 1899, p. 23.

<sup>2</sup> THE LANCET, Sept. 24th, 1881, p. 546.

<sup>3</sup> THE LANCET, Oct. 12th, 1895, p. 932.

2.—*Digestion of Starch.*

Preservative.	Amount.	Retarding effect on action of		
		Zymine.	Pancreatine.	Liquid taka diastase.
Boric acid mixture	1 in 2000	22.8 per cent.	36.0 per cent.	67 per cent.
"	1 ,, 1000	37.0 ,, ,,	46.4 ,, ,,	73 ,, ,,
"	1 ,, 333	49.2 ,, ,,	53.0 ,, ,,	80 ,, ,,

B.—PROTEOLYTIC DIGESTION.

1.—*Pepsin digestion of raw beefsteak.*

Preservative.	Amount.	Method of experiment.	N. dissolved.
<i>Nil.</i>	—	Digested for one hour.	46.8 per cent.
Boric acid mixture.	1 in 2000	Preservative and steak in contact for 24 hours before adding pepsin and acid.	45.5 ,,
" "	1 ,, 1000	" "	42.2 ,,
" "	1 ,, 333	" "	34.6 ,,
" "	1 ,, 1000	Digested for one hour.	50.7 ,,

2.—*Pancreatic digestion.*

Preservative.	Amount.	Method of experiment.	Retarding action.
Boric acid mixture.	1 in 2000	Preservative in contact 20 hours before digestion.	0.6 per cent.
" "	1 ,, 1000	" "	2.7 ,,
" "	1 ,, 333	" "	2.4 ,,
" "	1 ,, 1000	Without previous contact.	1.0 ,,

C.—INFLUENCE OF CURDLING OF MILK BY CHYMO SIN (RENNET FERMENT).

Very little influence was noted except that the borated samples showed more tendency to separate and that the curd was slightly more solid.

Several other investigators—Cripps,<sup>9</sup> Liffman,<sup>10</sup> and others—have obtained results differing in a very few details from these. The figures show that boric acid and borax have a detrimental action on all the digestive ferments to the extent of from 0.6 to 53 per cent., according to the amount used and the nature of the ferment action.

*Experiments on animals.*—Neumann<sup>11</sup> recorded the earliest experiments on animals. Dogs (in weight about 15 kilogrammes) received from five to six grammes of boric acid without effect beyond a fall of temperature. Larger doses produced vomiting and diarrhoea. Doses of 10 grammes and over produced death by nerve and muscle paralysis. Rabbits, pigs, horses, and fowls gave similar results. Chittender and Gies<sup>12</sup> experimented with full-grown dogs (in weight from eight to 12 kilogrammes) which were dosed during a period of from 27 to 46 days with borax and boric acid. They found that moderate doses of borax up to five grammes daily were without influence on metabolism or on general nutrition, while in doses of from five to 10 grammes daily borax disturbs metabolism, increasing excretion of nitrogen and of sulphuric and phosphoric acids through the urine. Boric acid up to three grammes had no effect. Still larger doses of borax or of boric acid disturbed the assimilation of proteids and fats, increasing the amount of faeces and of their nitrogen and fat. Diarrhoea and an increase of mucous secretion were also produced. Thus all experimental work on the subject has been performed on adult animals. No records of experiments with young animals have, as far as I can ascertain, been published. Many have stated that the quantities of boric acid used as preservatives are injurious to infants, without producing direct evidence to that effect. It has been often pointed out that the average quantities present in "preserved" milks is more than the ordinary maximum British

Pharmacopœia dose for an infant taking from 32 to 40 ounces of milk per diem.

Most authors<sup>13</sup> are agreed that not less than 35 grains per gallon (0.05 per cent.) of a mixture of boric acid and borax is a minimum efficient quantity necessary to "preserve" milk for 48 hours, while this quantity is rather more than sufficient for a period of 24 hours. In order to obtain some better indications of the probable action of boric acid on young infants and children I arranged a number of experiments on young kittens, three or four weeks old, just able to lap milk. Their condition at this age seemed more analogous to that of infants than in the case of most other animals, as they are entirely dependent on milk for their food until they reach the age of about two months. The experiments were made with boric acid—quantities of 40 grains and 80 grains per gallon being employed. Judging from the experiments of Chittender and Gies on adult dogs, boric acid seems to have a less deleterious effect than borax. The experiments were only preliminary and a further series, with less quantities of acid, are in progress. The animals were kept under the most favourable circumstances, being allowed during the greater part of the day to run about within a considerable area and at night they were housed in capacious cages in the animal house at the laboratory. A supply of fresh milk, renewed every few hours during the day, was always provided. As the animals grew older a little bread was added and later a little meat was also given. The results were very striking, as the following tables show.

A.—FIVE KITTENS TREATED WITH MILK PRESERVED BY BORIC ACID IN QUANTITY OF 80 GRAINS TO THE GALLON.

No.	Original weight.	Weight at end of			
		First week.	Second week.	Third week.	Fourth week.
1	388 grammes	410 grammes	387 grammes	313 grammes	Dead.
2	497 "	490 "	500 "	423 "	"
3	468 "	402 "	385 "	328 "	"
4	468 "	472 "	420 "	438 "	"
5	342 "	327 "	331 "	332 "	"

B.—KITTENS DOSED WITH MILK CONTAINING 40 GRAINS TO THE GALLON.

No.	Original weight.	Weight at end of			
		First week.	Second week.	Third week.	Fourth week.
1	442 grammes	395 grammes	340 grammes	330 grammes	Dead
2	345 "	335 "	308 "	Dead	—
3	268 "	253 "	215 "	"	—
4	540 "	482 "	488 "	500 grammes	Dead
5	495 "	462 "	440 "	502 "	"

C.—KITTENS RECEIVING UNTREATED MILK.

No.	Original weight.	Weight at end of				
		First week.	Second week.	Third week.	Fourth week.	Fifth week.
1	Grms. 457	Grms. 486	Grms. 443	Grms. 500	Grms. 492	Grms. 500
2	354	446	452	515	505	603
3	485	562	686	732	865	853
4	264	265	300	362	—*	—
5	313	320	333	340	384	441

\* Strayed and lost.

It was endeavoured to have kittens of as nearly as possible about the same weight and of the same age and born of the same cat in each of the groups A, B, and C, so that the conditions might be approximately the same. The earliest symptom manifested by the kittens of Groups A and B was loss of appetite; it was seen even after the first day or two that they took less milk than the control

<sup>9</sup> The Analyst, 1897, p. 184.

<sup>10</sup> Ibid., p. 102.

<sup>11</sup> Archiv für Experimentelle Pathologie und Pharmacologie, 1881.

<sup>12</sup> American Journal of Physiology, vol. i., 1898, No. 1.

<sup>13</sup> Rideal and Foulerton: Public Health, May, 1899, p. 534.

kittens. Diarrhoea, inactivity, and depression soon followed, then rapid emaciation and death. It is very evident from these experiments that much smaller quantities than 40 grains to the gallon would have considerable effect and experiments to test this are in progress. The results, I think, of these experiments cannot fail to lead us to infer that similar if not more injurious effects would be produced by repeated administration of similarly "preserved" milk as the daily food of young infants, and all the evidence tends to prove that milk, especially during the summer months, is habitually and systematically "doctored."

*The use of formalin.*—Formalin has only been introduced commercially within the last two or three years. It has been but little used in medicine except as a diluted vapour in the treatment of phthisis and whooping-cough, and no exact dosage has been assigned to it. Formol, formal, and formalin are terms in use for the commercial liquid which contains about 40 per cent. of pure formaldehyde (CHOH). The extent of its use as a milk preservative is seen from Dr. Hill's figures. Dr. Hill found formalin in 47 out of 1000 samples of milk examined. In some American cities its use had become so extensive that the sanitary authorities<sup>14</sup> provided each milk inspector with a small chemical outfit, consisting of ferric chloride solution, sulphuric acid, pipettes, and test-tubes, in order to test for formalin. After the passing of an Act in 1895 prohibiting the addition of any preservative to milk the open use of formalin ceased, but substitutes were presented for patronage under various names, such as "freezine," "milk sweet," "callerine," &c., which were found to be preparations of formalin. Costly circulars, booklets, and pamphlets were largely distributed to milkmen extolling the merits of the various preparations. The use of these was often described as "a new process for keeping milk and cream sweet *without ice*." The user was assured by the circulars that "it cannot be detected when used—in fact, a chemist could not find any trace of it if the milk were analysed." The medical officer of health of Philadelphia describes its use "as wholly mercenary, regardless of the injurious effects upon the digestion, especially of children and invalids." Cassal<sup>15</sup> gives his opinion that "formic aldehyde is a substance which must be regarded as even more objectionable than boracic acid."

*Action of formalin on digestive ferments.*—Rideal and Foulerton extended their experiments also to the action of formalin with the following abstracted results:—

A.—AMYLOLYTIC DIGESTION.

1.—Salivary Digestion of Starch.

Strength of formalin.	Retarding effect.
1 in 100,000	0.2 per cent.
1 ,, 50,000	4.0 ,,
1 ,, 10,000	11.0 ,,

2.—Digestion of Starch.

Strength of formalin.	Retarding action on		
	Zymine.	Pancreatine.	Liquid taka diastase.
1 in 100,000	3.6 per cent.	13.0 per cent.	5.0 per cent.
1 ,, 50,000	8.2 ,,	16.0 ,,	8.5 ,,
1 ,, 10,000	8.5 ,,	16.7 ,,	18.0 ,,

B.—PROTEOLYTIC DIGESTION.

1.—Pepsin Digestion of Raw Beefsteak.

Strength.	Retarding action.
1 in 50,000	2.6 per cent.
1 ,, 100,000, after 24 hours' previous contact.	8.6 ,,
1 ,, 50,000	8.7 ,,
1 ,, 10,000	12.6 ,,

2.—Pancreatic Digestion: Digestion of Casein.

Strength.	Retarding action.
1 in 50,000	0.3 per cent.
1 ,, 100,000, after 20 hours' previous contact with preservative.	5.4 ,,
1 ,, 50,000	5.9 ,,
1 ,, 10,000	8.6 ,,

Thus formalin in strengths of from 1 in 50,000 to 1 in 10,000 appears to have a deleterious effect on the digestive ferments to an extent varying from 0.2 per cent. up to 18 per cent., so that it is possible that the total effect of formalin after acting on the different digestive ferments on its way through the alimentary tract might amount to a very considerable total. Rideal and Foulerton<sup>16</sup> from experiments to ascertain the "preserving" effect of formalin on milk from a bacteriological point of view decided that not less than 1 part in 50,000 is necessary to preserve milk for 48 hours. There is but little doubt that milk, after passing through the hands of the wholesale purveyor, dairyman, and milkman, often contains considerably more than this quantity.

*Experiments on animals.*—The only recorded experiments are those of Rideal and Foulerton on three cats, one rabbit, and two guinea-pigs. The cats, which were three months old, and the guinea-pigs, which were over 200 grammes in weight, were not in such a condition as to furnish the best indication of the action of formalin. No effect was noticed after a course extending over some weeks. I therefore arranged a large number of experiments on young kittens, three or four weeks old, kept under conditions similar to those in the experiments with boracic acid. The results are noted in the following tables.

A.—KITTENS RECEIVING FORMALDEHYDE ONE PART IN 50,000 OF MILK.

No.	Original weight.	Weight at end of						
		First week.	Second week.	Third week.	Fourth week.	Fifth week.	Sixth week.	Seventh week.
	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.
1	273	271	305	336	399	—*	—	—
2	279	275	285	326	370	434	463	—
3	465	447	409	—*	—	—	—	—
4	425	420	445	438	410	537	646	590
5	315	303	290	367	331	—*	—	—

\* Dead.

CONTROL KITTENS RECEIVING UNTREATED MILK.

No.	Original weight.	Weight at end of					
		First week.	Second week.	Third week.	Fourth week.	Fifth week.	Sixth week.
	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.
6	315	320	333	340	384	441	—
7	425	486	450	583	680	744	836
8	430	380	358	445	547	609	—
9	432	473	478	538	672	731	—

B.—KITTENS RECEIVING FORMALIN ONE PART IN 25,000 OF MILK.

No.	Original weight.	Weight at end of					
		First week.	Second week.	Third week.	Fourth week.	Fifth week.	Sixth week.
	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.
1	408	416	518	510	537	558	583
2	405	485	568	567	612	630	585
3	539	565	717	692	706	700	—
4	537	575	695	727	764	760	793

<sup>14</sup> Annual Report of the Bureau of Health, Philadelphia, 1898.

<sup>15</sup> Public Health, 1899, p. 535.

<sup>16</sup> Loc. cit.

CONTROL KITTENS RECEIVING UNTREATED MILK.

No.	Original weight.	Weight at end of					
		First week.	Second week.	Third week.	Fourth week.	Fifth week.	Sixth week.
5	Grms. 544	Grms. 615	Grms. 756	Grms. 830	Grms. 955	Grms. 900	Grms. 883
6	424	509	633	627	682	635	639
7	485	562	686	732	865	853	868

C.—KITTENS RECEIVING FORMALIN ONE PART IN 12,500 OF MILK.

No.	Original weight.	Weight at end of					
		First week.	Second week.	Third week.	Fourth week.	Fifth week.	Sixth week.
1	Grms. 483	Grms. 535	Grms. 543	Grms. 465	—*	—	—
2	470	498	505	468	—*	—	—
3	550	556	566	525	445	487	514
4	389	435	470	485	540	580	—
5	395	365	401	462	497	581	—

\* Dead.

CONTROL KITTENS RECEIVING NO FORMALIN.

No.	Original weight.	Weight at end of					
		First week.	Second week.	Third week.	Fourth week.	Fifth week.	Sixth week.
6	Grms. 544	Grms. 615	G. ms. 756	Grms. 830	Grms. 955	Grms. 900	Grms. —
7	354	446	452	515	505	603	726
8	408	385	433	538	672	731	—

The following tables show the average weekly increase:—

Kittens A.		Grms.	Control Kittens.		Grms.
1st week, average of 5 kittens	—	8.2	Average of 4 kittens	+	14.7
2nd " " " "	+	3.6	" " " "	—	10.0
3rd " " " "	+	28.4	" " " "	+	89.2
4th " " " "	+	8.6	" " " "	+	96.7
5th " " " "	+	145.2	" " " "	+	60.5
Average total increase for 5 weeks ... ..		177.6			251.1

Kittens B.		Grms.	Control Kittens.		Grms.
1st week, average of 4 kittens	+	38.0	Average of 3 kittens	+	77.6
2nd " " " "	+	114.2	" " " "	+	129.6
3rd " " " "	—	0.5	" " " "	+	61.3
4th " " " "	+	30.5	" " " "	+	104.6
5th " " " "	+	7.2	" " " "	—	38.0
6th " " " "	+	7.2	" " " "	+	0.6
Average total increase for 6 weeks ... ..		196.6			325.7

Kittens C.		Grms.	Control Kittens.		Grms.
1st week, average of 5 kittens	+	20.4	Average of 3 kittens		46.6
2nd " " " "	+	25.4	" " " "		68.3
3rd " " " "	—	18.0	" " " "		80.6
4th " " " "	+	13.3	" " " "		83.0
5th " " " "	+	55.3	" " " "		34.0
Average total increase for 5 weeks ... ..		96.4			312.5

The earliest effect of the formalin was to cause a loss of appetite during the first week. Diarrhoea with noisy gaseous motions, gaseous distension of the abdomen, and changes in the fur (the hairs standing and feeling rough and unpleasant to the touch) followed. In some cases emaciation and death occurred; in others the condition continued with but little

increase in weight until the animals reached the age of about two months. The younger the animals the more susceptible they proved to the action of formalin. Compared with the control animals it is seen that the formalin in Group A (1 in 50,000) retarded the nutrition of the animals, as indicated by their increase in weight, to the extent of about 29.3 per cent., in Group B (1 in 25,000) to 39.6 per cent., and in Group C (1 in 12,500) to 69.1 per cent. It is evident from a study of the figures that experiments should be continued on a larger number of animals to avoid the very material effect which one animal in five may cause on the average.

From a consideration of the results of the above tests—chemically of the effect of boric acid and formalin on the different digestive ferments, and physiologically of the effect of these re-agents on the nutrition of young kittens—one is forced to conclude that these chemicals when used as preservatives of milk (and probably of other foods) are very injurious to the health of the consumer and particularly so to the health of young infants. Further, it is easy to conceive that the great infant mortality-rate from diarrhoea of many of our large towns may be closely connected with the practice, especially during the summer months, of systematically "doctoring" milk by means of the preservatives used by milk-purveyors, dairymen, and milkmen. These experiments on young animals will constitute the first of a large series by which "that sufficient information" as to the injurious effects of the use of preservatives in milk will be provided in order to make an action under the Sale of Foods and Drugs Act possible.

A CASE OF PYO-PNEUMOTHORAX FROM PERFORATION OF GASTRIC ULCER.

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THE patient, a single woman, aged 20 years, when first seen was apparently in the last stage of phthisis, from which disease, indeed, she was supposed to be suffering. Inquiry, however, elicited the fact that for a couple of years she had suffered from pain after food, with occasional vomiting, and that some months previously she had vomited dark blood. Six weeks previously to being seen, while she was shelling peas, the patient was suddenly seized with stabbing pains in the left axilla shooting across the stomach. Since then she had kept her bed, had had frequent vomiting of food and bile, and had coughed up phlegm of an unpleasant taste and odour to the extent, it was said, of half a pint in the 24 hours.

Examination showed extreme emaciation and an anæmic dry skin. The abdomen was flat, not very tender, and the stomach resonance mounted high near the heart. In the chest the resonance at the apices was poor, but there were no crepitations or bronchial breathing there. There was dulness only in the hinder and lowest part of the left axilla, over the greater part of which the note was sub-tympanitic. In the lower two-thirds of the left axilla and at the left base were amphoric breathing and metallic tinkling. There was no succussion splash. The diagnosis being made of pneumothorax from perforating gastric ulcer the patient was advised to come into hospital, but she only did so a week later.

On admission (Sept. 26th, 1898) the abdomen was found to be flat and did not expand well during inspiration in its left half. There was some tenderness on deep pressure in the left hypochondriac and lumbar regions. On the front of the chest there was fair resonance under both clavicles and the breath sounds were normal. The cardiac dulness reached from the fourth space up to the lower edge of the second rib (see diagram); below this was a high-pitched tubular note extending outwards to just outside the nipple line and downwards for two inches. Below this there was stomach resonance. Outside the nipple line and in the axilla, below the nipple level, was an area of absolute dulness which was continued posteriorly at the same level to within two inches of the spine. Over the greater part of this dull area both breath and voice sounds were absent; only at its upper