and 2 cm. in diameter. In spite of the fact that great care was taken to ensure that the liquid came into intimate contact with the charcoal, the granular charcoal failed to pick up pyrogens. The average rise in temperature produced on injection of the water after passing through the tower was 1.5° F. and the number of positive reactions noted was 12 in 13. The results thus

TABLE II.—Pyrogen Content of Standard Water after Shaking with Charcoal

	Controls	Powdered Charcoal			Granular Charcoal
Grammes of charcoal per 100 c.cm. of water ..	—	1.0	0.1	0.01 (B.D.H. activated)	1.0
Average rise in temperature (°F.) ..	2.14	0.20	0.27	0.32	1.22
No. of positive reactions by inspection of temperature charts ..	9/9	1/31	1/16	0/4	21/30

parallel those obtained by the shaking technique. We were reluctant to come to the conclusion that granular charcoal was completely useless for this purpose, as the possibility had been entertained of making use of it in an automatic pyrogen-removing filter. It was found possible to remove pyrogens from large quantities of water by forcing under pressure through a bed of powdered charcoal. This method, however, seems to have no advantage over the use of large-scale Seitz asbestos filters.

The results show that a strongly pyrogenic water or solution may be freed from pyrogens by the simple procedure of shaking for a few minutes with a very small quantity (0.1 per cent.) of powdered charcoal. This quantity of charcoal can be readily removed by allowing the liquid to stand for a minute or two and then decanting through a fluted filter paper. The receiving vessel, which must be spotlessly clean, should be washed out with a little of the filtrate before collecting the remainder. Although there seems to be little to choose between different charcoals as regards efficiency in picking up pyrogens, from the point of view of cheapness, availability, and chemical cleanliness B.D.H. activated powder seems the most suitable for this purpose.

Summary

Shaking for fifteen minutes with powdered charcoal (1 part per 1,000) removes pyrogens from heavily contaminated water. The charcoal can be readily separated by decanting through a filter paper. This provides a simple emergency method for obtaining water suitable for preparation of intravenous infusions.

We desire to express our thanks to Professor A. J. Clark for his continued interest and advice in carrying out this research. The expenses of the work were defrayed from the Moray and Crichton (J.C.L.) Funds of Edinburgh University.

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DENTAL ANAESTHESIA IN CHILDREN A COMPARISON OF VINYL ETHER AND ETHYL CHLORIDE IN A SERIES OF 200 CASES

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Within the last few years vinyl ether has taken its place among the agents employed to produce relief from pain. It is a quickly acting anaesthetic of low toxicity, and its use in dental anaesthesia has been favourably reported upon by Goldman (1936, 1937), Ramage (1937), Roche (1937), and others in this country, and by Gunter, Beach, and Looby (1936), Feldman and Cartin (1938), Rosamilia (1938), Lyons and Frank (1939), and Cartin (1938), among others, in America.

It is not our purpose here to discuss the physical properties of the drug or the various methods of administration, but to describe briefly the results using one method only, and compare them with those obtained from the use of another anaesthetic of the same type—namely, ethyl chloride.

In this series 200 cases were treated: 100 received vinyl ether and 100 ethyl chloride. The patients were all children attending the dental clinic of the School Medical Service in Coventry, or children under 5 years of age referred for dental treatment from the Coventry Child Welfare Centres. The investigation covered a period of four months (February to May, 1939). At the start it was intended to make this a strictly controlled experiment, allocating alternate cases to each anaesthetic, but for reasons which will be discussed later a certain amount of selection had to be exercised. Broadly speaking, however, the groups were comparable. The anaesthetics were all administered by one of us (J. O. F.) and the extractions were performed by the other joint authors.

No premedication was used, but parents were asked not to let the children have breakfast on the morning the anaesthetic was to be given. The extractions were done in the sitting posture in an ordinary dental chair; straps were not employed in restraint, and no prop or gag was inserted before beginning the anaesthesia. A throat pack was inserted in all cases.

Both anaesthetics were given by the closed method—vinyl ether with the Goldman inhaler, in the manner described by Goldman (1936), and ethyl chloride with a similar closed apparatus, the drug being volatilized rapidly by placing the container in hot water. The duration of the different stages of anaesthesia was timed by a dental attendant on signals by J. O. F. The amount of vinyl ether used was 3 or 5 c.cm., and of ethyl chloride 3, 4, or 5 c.cm., according to the age of the

patient. Table I shows that the two groups of cases were similar in respect of most factors which might have influenced the course of anaesthesia. There is a difference, however, in the age distribution. This will be discussed later.

TABLE I

	Vinyl Ether	Ethyl Chloride
Sex distribution :		
Males	40	48
Females	60	52
Age distribution :		
Under 5 years	33	16
5-9 years	51	47
10 years and over	16	37
Associated diseases :		
Rhinitis	3	1
Cleft palate	1	—
Blepharitis	1	—
Chronic bronchitis	1	—
Tuberculous cervical adenitis	—	1

The results obtained will be tabulated under certain headings and will then be briefly discussed.

Induction Period

TABLE II.—Showing the More Important Features of the Induction Period

	Vinyl Ether	Ethyl Chloride
Struggling during induction :		
None	57	77
Slight	25	17
Moderate	13	4
Marked	5	2
Duration in seconds of induction period :		
Mean	40.7	52
Shortest	15	30
Longest	70	85

The induction period was noticeably quieter in the cases given ethyl chloride. We attributed this largely to the fact that vinyl ether has an unpleasant smell, but it was probably also because a greater number of the ethyl chloride patients were in the over-5 age groups, and we found children of these ages to be more co-operative and reasonable. With vinyl ether the occurrence of struggling and shouting during the induction appeared to have some influence on the nature of the resulting anaesthesia, rendering it both lighter and shorter than in cases in which the child had been reasonably quiet throughout. Similarly, when the patient was exceptionally quiet during induction and breathing was shallow the anaesthetic did not seem to be well absorbed, the anaesthesia being in such cases also both lighter and shorter than when breathing had been of the normal character. These variations were not noted with ethyl chloride.

The length of the induction period is of little importance in itself, but, as the figures show, it was slightly shorter with vinyl ether. In this connexion it may be stated that the anaesthetic signs with vinyl ether are so slight and so variable that it is easy to miss the optimum moment

of anaesthesia. Cartwright (1939) has stressed this point. Attempts to lengthen the duration of vinyl ether anaesthesia by increasing the time during which the mask was held on the face merely resulted in the period of effective anaesthesia being correspondingly reduced. This was not the case with ethyl chloride; and with ethyl chloride, moreover, the anaesthetic signs were much more definite.

Nature and Duration of Period of Effective Anaesthesia

TABLE III.—Showing the More Important Features of the Period of Effective Anaesthesia

	Vinyl Ether	Ethyl Chloride
Duration in seconds of effective anaesthesia :		
Mean	42.1	67.55
Shortest	Nil	30
Longest	70	180
Relaxation of jaw :		
Good	72	48
Moderate	16	24
Poor	12	23
Impossible to open mouth	—	5
Cyanosis :		
None	75	50
Slight	19	30
Moderate	6	14
Marked	—	6
Excessive salivation	28	11
Lacrimation	44	16
Cough	13	5
Loss of bladder control	1	3

TABLE IV.—Number of Teeth Extracted

Teeth Extracted	Vinyl Ether	Ethyl Chloride
Mean number	5.61	6.04
Maximum number	13	15
Actual number :		
0	2*	4†
1-3	17	21
4-6	52	37
7-9	21	24
10-12	7	13
13-15	1	1

* In one case because the anaesthetic appeared to be quite ineffective; in the other because the tooth which the dentist first attempted to remove crumbled and the period of anaesthesia had ended before any extractions could be made.

† In one case because the anaesthetic was given only for the incision of an eruption cyst; in two cases because rigidity of the jaw rendered it impossible to open the mouth; and in one case because tonic spasm of the limbs made extractions impossible although relaxation of the jaw was satisfactory.

Very much better relaxation of the jaw was obtained with vinyl ether than with ethyl chloride. Relaxation was not wholly satisfactory in 52 per cent. of the ethyl chloride cases, and in five it was impossible to open the mouth during the period of anaesthesia. In only two cases, however, did the operation have to be abandoned on this account; in the other three the required extractions were done during the analgesic period.

Cyanosis appears to be almost a natural concomitant of the administration of ethyl chloride, being met with in

50 per cent. of cases. With vinyl ether it was seen in 25 per cent. of cases; but the cyanosis of vinyl ether is an unpleasant slaty colour, unlike the florid cyanosis of ethyl chloride. In no instance did cyanosis cause alarm with either drug.

Excessive salivation occurred much more often with vinyl ether, and was a really troublesome feature of the anaesthetic, making the surgeon's work very difficult. This is an undesirable characteristic of vinyl ether administration, but it could doubtless be avoided by suitable pre-medication.

Effective anaesthesia was found to be distinctly longer in duration with ethyl chloride. The mean period of effective anaesthesia with vinyl ether was 42.1 seconds, which compares very unfavourably with the mean period of 67.55 seconds for ethyl chloride. It was on this account that we were compelled to abandon the idea of making a strictly controlled experiment, because it speedily became apparent that with older children, who required more numerous extractions, the work could not be completed under vinyl ether anaesthesia. Especially was this so if permanent teeth had to be removed. In nine of the vinyl ether cases the anaesthesia produced was too short to permit all the intended extractions to be undertaken. This occurred only twice with ethyl chloride. In four of the nine cases in which vinyl ether produced too short anaesthesia to finish the necessary extractions the face-piece was reapplied and a further 3 c.cm. of the drug given; but this was never satisfactory, as the presence of blood and saliva made the ensuing operation difficult and unpleasant for both surgeon and anaesthetist.

It was soon found that vinyl ether was almost wholly unsuitable for the removal of permanent teeth, especially molars; it was also found to be unsuitable for the removal of very carious teeth, which were apt to crumble. If the tooth was not removed at the first attempt the anaesthesia was too short. We were therefore compelled to exercise a certain amount of selection, and to give ethyl chloride to cases in which difficulties from this cause were to be anticipated. In other less well defined ways the short anaesthesia of vinyl ether was found to be disadvantageous. It allowed no margin for the occurrence of minor accidents of extractions under general anaesthesia—for example, the slipped gag, the difficult insertion of a throat pack, the dropping of a pair of forceps—events which are bound to occur from time to time. With ethyl chloride these things did not matter; with vinyl ether they were of serious import.

Attention must be drawn to the fact that there is apparently no period of analgesia with vinyl ether, but this is not true of ethyl chloride. With vinyl ether the patient seems to be sufficiently conscious to feel *and to remember* pain, whenever the forty seconds or so of anaesthesia has ended. Three patients who had had vinyl ether stated afterwards that they had felt the last tooth coming out. While pain may also have been felt by some of the ethyl chloride patients, none of them remembered it, and, furthermore, it may be reiterated that in three of the ethyl chloride patients in whom rigidity of the jaw prevented opening of the mouth during anaesthesia the required extractions (to the maximum number of three) were done during the analgesic period without discomfort to the patient. When all these factors, therefore, are considered we are of the opinion that ethyl chloride is more satisfactory than vinyl ether.

Finally we may say that we agree with Rosamilia (1938), who, speaking of vinyl ether, states that "its use requires

more than ordinary diligence and perfunctory care: it demands intense application and extreme care." We believe that the routine use of ethyl chloride in dental clinics imposes much less strain both on the surgeon and on the anaesthetist. This is a factor of no small importance in such work, when extractions under anaesthesia are being done for several hours.

Nature of Recovery Period

At first an attempt was made to measure accurately the duration of the recovery period, but this soon had to be abandoned on account of non-cooperation on the part of our young patients, many of whom refused to answer their names or to give other definite evidence of return to full consciousness, though one knew very well they had reached that state. Generally speaking, however, it was noticed that full consciousness returned much more quickly with vinyl ether than with ethyl chloride. With the former the patient had usually recovered within a minute, with ethyl chloride not for two or three minutes, though exceptions occurred to both these rules, and in many cases there was confusion for several minutes. Seven of the vinyl ether patients and ten of the ethyl chloride patients were exceptionally noisy and uncontrollable during the recovery period.

Vomiting immediately after the anaesthetic occurred in ten cases, and these had all had ethyl chloride. There can be little doubt that it is more inclined to have this undesirable effect than is vinyl ether; but the upset does not last long, and in half an hour or less all patients were able to walk out of the clinic to go home.

Unfortunately we were not able to follow up our cases systematically to learn if the anaesthetics had any delayed effects, but certain patients who did report at the clinic for further treatment gave no history of undesirable sequelae with either substance.

Summary and Conclusions

A series of 200 children were given anaesthesia for extraction of teeth under similar conditions with (a) vinyl ether or (b) ethyl chloride.

The results showed that these are both safe and useful anaesthetics.

The action of vinyl ether is shorter and less certain than that of ethyl chloride, but it is useful for producing a short anaesthesia for the extraction of a few deciduous teeth in young children.

Vinyl ether is more likely to cause struggling during the induction period, and this is attributed in part to its unpleasant smell.

Vinyl ether causes troublesome salivation in many cases, but seldom produces rigidity of the jaw; recovery from the anaesthetic is very rapid.

Ethyl chloride may cause troublesome rigidity of the jaw, but when this is overcome it is very certain in its action and duration, and may be used in children of all ages for the extraction of any teeth, deciduous or permanent.

Recovery from ethyl chloride is slower than recovery from vinyl ether, and is more likely to be accompanied by vomiting, but these factors do not contraindicate its use.

Our thanks are due to Miss Batsford, dental nurse, for her interested co-operation, and to Miss M. Dinan, Miss F. Gayton, and Miss M. Ward, dental attendants at the Central School Clinic, Coventry, for their accurate time-keeping, which made the work of this experiment possible.

We are greatly indebted to Dr. A. Massey, medical officer of health and chief school medical officer, City of Coventry, for permission to publish the results of this investigation, and

to Mr. M. Raeside, L.D.S., senior school dental officer, City of Coventry Education Department, for his helpful criticism.

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AN INQUIRY INTO THE HOUR OF BIRTH

BY

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An investigation into the relative frequency of deliveries by day to deliveries by night has been carried out in a small series of 2,225 patients delivered per vaginam during the years 1934-7 at the Royal Free Hospital. The following table shows the number born during these years, arranged according to the time at which the birth occurred.

TABLE I
Births by Day

	8-10 a.m.	10-12	12-2 p.m.	2-4 p.m.	4-6 p.m.	6-8 p.m.	Total
Primiparae:							
1934 ..	11	29	27	28	25	26	146
1935 ..	27	42	36	26	42	26	199
1936 ..	33	39	44	56	53	45	270
1937 ..	43	42	39	38	41	41	244
Total ..	114	152	146	148	161	138	859
Multiparae	32	25	44	36	52	36	225
Total ..	146	177	190	184	213	174	1,084

Births by Night

	8-10 p.m.	10-12	12-2 a.m.	2-4 a.m.	4-6 a.m.	6-8 a.m.	Total
Primiparae:							
1934 ..	29	23	16	23	24	17	132
1935 ..	29	36	42	46	40	23	216
1936 ..	48	42	45	44	41	37	257
1937 ..	51	42	43	42	49	35	262
Total ..	157	143	146	155	154	112	867
Multiparae	47	43	46	43	45	50	274
Total ..	204	186	192	198	199	162	1,141

If we reckon "night" as from 8 p.m. to 8 a.m. there are over the total series 5.25 per cent. more births by night than by day, the preponderance of night births over day births being smaller in the primiparae than in the multiparae. Only 0.9 per cent. more primiparae are delivered by night than by day, whereas the corresponding figure for multiparae is 22 per cent. It would be unwise, however, to draw any inference from this variation, considering the small numbers in our group of multiparae.

The following table shows the comparison between night and day figures for primiparae only.

TABLE II

1934 ..	146	by day and 132	by night	(100 day, against 90.4 night)
1935 ..	199	" " 216	" "	(" " 108.5 ")
1936 ..	270	" " 257	" "	(" " 95.2 ")
1937 ..	244	" " 262	" "	(" " 107.4 ")
Total ..	859	" " 867	" "	(" " 100.9 ")

It will be seen that the yearly figures vary slightly around 100 (- 9.6 per cent. to + 8.5 per cent.), and for 1934 and 1936 show a smaller number of births during the night than during the day. These variations are well within the limits of probable error, and suggest a comparatively even distribution of births over night and day. When, however, the records as to the hour of birth in other centres [as published by Guthmann and Bienhüls, 1936, Dyroff and Mulhäuser (Ritala, 1931), Lane (Halban and Seitz, 1927, 1929), Meyer, 1935, Knapp, 1909-10, Lynch, 1907, Veit (Nathanson, 1935), White (Puppel, 1932), Birlinski (Quigley, 1931)] are studied, it is found that in over 180,000 cases there is a slight predominance in the number of cases delivered by night over those delivered by day. It must be noted here, however, that the definition of "night" varies between 7 p.m. to 7 a.m. and 10 p.m. to 10 a.m., according to the different authors. Meyer (1936), Jenny (1933), and Guthmann and Bienhüls (1936) find that year by year the number of children born by day is increasing. In our small series no such increase is found.

May one perhaps assume that the great diversity of opinion in the literature as to the hour when most births occur is some support for our contention that the distribution throughout night and day is relatively even? The following is a list of the most usual and the least usual incidence of the hour of birth according to different writers:

	Maximum	Minimum
Royal Free Hospital ..	4 p.m.	8 a.m.
Knapp ..	11-12 p.m.	6-7 p.m.
Jenny ..	5 p.m.	5 a.m.
Veit ..	1 a.m.	5 p.m.
Guthmann and Bienhüls ..	11 a.m.	—
Birlinski ..	4 a.m. and 1 p.m.	7 a.m. and 8 p.m.
Lynch ..	8-9 a.m.	1-2 p.m.
Henry (1932) ..	3 a.m.	2 p.m.

Summary and Conclusion

An investigation into the relative frequency of deliveries by day to deliveries by night has been carried out in a small series of 2,225 patients delivered per vaginam.

The variations are well within the limits of probable error, and suggest a comparatively even distribution of births over night and day.

I am deeply indebted to Professor Amy Fleming for her constant help and encouragement during the course of this work.

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Dr. Lucien Dautrebande, professor of pharmacology at Liège University and member of the Royal Academy of Belgium, has been awarded the Montyon prize for his work on the toxicology of war gases and the vapours of solvents used in industry.