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EPIDEMIC NAUSEA AND VOMITING

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In July and December, 1935, two episodes in a widespread outbreak of nausea and vomiting in Denmark were observed by Rischel (1935) and Henningsen (1936). In March of the following year Miller and Raven (1936) recognized the same condition in a boarding-school for girls in Thanet; and in October, 1938, an outbreak occurred both in a girls' school and amongst the general population of Hayling Island (Gray, 1939). From conversations with colleagues, particularly medical officers to the public schools, it is probable that outbreaks of a similar nature had occurred in England before 1935. During recent months this comparatively trivial disorder has become much more common.*

Although the disease is of minor significance clinically and economically, it may give rise to considerable administrative uncertainty. Those who are unfamiliar with the clinical and epidemiological picture may be led to suspect food-poisoning or dysentery and be stampeded into ineffectual and wasteful action. It is important that at the present time "epidemic nausea" should be considered in the differential diagnosis of all outbreaks of gastro-enteritis, and the following incomplete account of an outbreak at present under investigation may serve to emphasize some of the differentiating points.

On Oct. 27, 1942, the medical officer of health for an urban district with a population of about 10,000 was informed by the medical officer to a girls' public boarding and day school that a number of children had been attacked almost simultaneously with vomiting and diarrhoea. Both boarding and day girls were involved. The boarders constituted three separate feeding groups, and the only aliments obviously common to all the affected children were school milk and the mains water supplied to the whole town. Since inquiry of the practitioners in the town brought to light no evidence of an explosive outbreak of dramatic proportions in the rest of the town strong suspicion fell on the school milk, originating in two accredited farms producing together about 100 gallons a day. Half of this milk was bottled and distributed to certain schools unpasteurized in 1/3-pint bottles by one of the three retail dairies in the town; the remainder was sold in larger bottles or in cans to private householders. Investigation was concentrated in this direction, the school milk being withdrawn and the retailer requested to provide the Health Department with a list of his customers in order that they might be circulated and advised to boil their milk. The retailer refused this request.

On Oct. 28 it was learnt that 120 of 400 girls in the school had been ill, but that other schools consuming the milk were not involved. Milk examined on this day was free from pathogenic organisms. However, on the 29th an explosive outbreak occurred in the boys' public boarding and day school in the town, and the Ministry of Health was asked to advise as to further action. The following account records observations made on Oct. 30 and Nov. 3.

Incidence and Age

It is unusual for patients affected with this disorder to call their doctors, since most of them begin to feel better within a few hours. The disease is not notifiable, and without a

house-to-house survey no estimate of incidence among the general population can be made. Reliable information concerning attack rates was, however, obtained from a few selected samples, that concerning the girls' school being most complete. The school buildings in this instance are at present occupied by the public school proper and by an evacuated school party, the school proper occupying them in the morning and the evacuated party during the afternoon. The school proper maintains three boarding-houses, but the majority of pupils live in their homes. The evacuated party is billeted with private householders near the school, except for one small group occupying a hostel. There are thus four residential communities, each representing a separate feeding group but occupying the same building for school purposes. There is little physical contact between the school proper and the evacuated party except at midday, when members of both schools may meet in cloakrooms and corridors. The schools are independently staffed. The known attack rates during the first week of the outbreak are tabulated below:

Table showing Attack Rates during First Week of Outbreak

	Boarders			Day Girls			Total		
	Roll	Incidence	Attack Rate %	Roll	Incidence	Attack Rate %	Roll	Incidence	Attack Rate %
Girls' public school ..	85	58	68	324	123	38	409	181	44
Evacuated school ..	21	8	38	181	27	15	202	35	17

The attack rate for the general population is unlikely to have exceeded that among the day girls in the evacuated school, say 15%, although in a few households all the members were affected.

While the incidence would at first sight appear to be highest in communities of young people, in one household the ages of the persons attacked were 50, 54, 56, and 81 years, and the attack rate among the adult staff of the girls' public school was high.

Clinical Picture

Vomiting.—This was the most characteristic sign, and in young people it tended to be projectile and of great urgency. The first vomit usually contained food, but second and third vomits were of copious clear fluid only faintly bile-stained. A child who sat down to lunch feeling well "suddenly turned green" and had vomited before she could leave the room. A boy vomited on to his plate during a meal. This precipitate emesis was particularly distressing when it occurred during the night: sleeping children woke suddenly and vomited before they could get out of bed. On the other hand, projectile vomiting was by no means invariable, and a large proportion of the cases, particularly adults, did not vomit, or vomited only after a prolonged period of nausea.

Nausea.—Usually nausea was present with the vomiting, but more characteristically preceded it for a period of hours or even days, and in several cases persisted unaccompanied by emesis. Nausea, which some patients described as being indistinguishable from the sensation of sea-sickness, was associated with the feeling of fullness or of "a lump" in the epigastric angle. In a case in which it had persisted for a week the epigastrium became tender to touch.

* Received for publication Dec. 8, 1942.

Vertigo.—Nausea often included a sense of instability and dizziness. A desire to fall over or faint was present in some cases and patients disliked sitting up for this reason, but in few instances only did dizziness amount to true vertigo.

Aches.—Some degree of frontal headache was almost invariably present, and in some cases lasted for three to four days. Occipital headache also occurred. Headache was not persistent, but tended to come and go in spasms. Abdominal aching occurred mainly in the epigastric angle, but sometimes involved the umbilical region; in patients with diarrhoea it sometimes occurred below the umbilicus. Pain from colic was conspicuously absent.

Diarrhoea.—This symptom was of minor importance, and in those cases in which it occurred the stools were watery and the bowel actions hurried but not greatly increased in frequency. Mucus was not present, and in most cases the stools were normal in appearance. In one case red blood was passed, but the stool was not characteristic of dysentery.

Frequency of Symptoms.—The relative frequency of the symptoms in one girls' boarding-house was as follows:

Population at risk		35
Vomiting without diarrhoea		11
Vomiting with diarrhoea		7
Diarrhoea only		1
Nausea only		7
Total cases		26

Physical Signs

Central Nervous System.—When a group of these cases were seen together the impression that the central nervous system was primarily involved was a strong one, particularly when signs of gastritis or enteritis were absent. There was no evidence of dehydration, severe intoxication, or collapse. Routine examination of the central nervous system failed to detect any recognized signs apart from a suspicion of mydriasis with sluggish ocular reflexes. Widely dilated pupils were observed in some children on the first and second days of the disorder. Although the school children remained limp and tired for a few days they returned to classwork when nausea and vomiting had ceased, and their teachers did not notice any lack of co-ordination, precision, or concentration following the attack.

Temperature and Pulse.—The temperature rhythm was disturbed in almost every case in which observations were made, but rises in temperature above 100° were not numerous, although a very few cases showed rises to 102°. Pyrexia was

Temperature chart of one of the more persistent cases.

rarely of more than 24 hours' duration. The pulse was disturbed in minor degree only. Bradycardia, which had been observed by Gray, was not characteristic in the present series. The temperature chart of one of the more persistent cases is here reproduced.

Alimentary System.—The appearances in the mouth were uniform and almost constant throughout the first two days. The tongue was moist and lightly covered with a white fur through which projected hyperaemic papillae. These appearances were no less striking, and could easily be confused with those seen in the first day or two of streptococcal throat infections, but the papillae were scattered evenly over the tongue surface and not confined to the tongue margins. The fauces and posterior pharyngeal wall were moderately injected in some cases, but there was no exudate on the tonsils. So suggestive were the tongue and throat appearances that swabs were taken from eight cases of nausea. One of these cultures yielded *Str. pyogenes*, Lancefield group C; the remainder gave a normal throat flora only. *Epistaxis* occurred in two children.

Examination of the abdomen did not suggest any dilatation of the stomach or increased peristalsis, and in most cases the abdominal wall moved freely and the patient was not disturbed by palpation. Sometimes the sensation of nausea was increased by epigastric pressure, but tenderness was not elicited except in three cases in which umbilical aching radiated into the right iliac fossa and tenderness over the appendix gave rise to a suspicion of appendicular involvement. These three patients made dramatic recoveries without operation.

A number of cases relapsed after an interval of about one week. Relapses were also reported by Rischel (1935) and Gray (1939).

Epidemiology

Family Outbreaks

By asking a few individual patients whether their friends or acquaintances had suffered from a similar condition a number of family outbreaks were brought to light. Chronologically the earliest involvement detected preceded the present events by five weeks, and in this instance four of six members of a household became characteristically ill almost simultaneously and had attributed their discomfort to the mutton consumed one to two and a half hours previously. In another household all of six persons were involved. First the cook and the master became ill. Two days later, on Oct. 8, 1942, while at an evening choral practice, M., a schoolgirl evacuee, was attacked with "vertigo" and giddiness, and thought she was going to faint. She left the class, and half an hour later vomited. She then slept normally for a few hours before awaking suddenly and vomiting precipitately, and about six hours later she passed one watery stool. During the next two days this evacuee's hostess and her daughter became ill, and on Oct. 10 the last of the six—another evacuee, J.—fell sick, complained of giddiness, and thought she would faint, but had neither vomiting nor diarrhoea. The two evacuees mentioned were members of the sixth form of the evacuated school party, which remained well until three weeks afterwards and which will be discussed later.

H., an elementary-school teacher aged 50, lived with her father aged 81, her sister aged 51, and a guest aged 56. On Oct. 20, 1942, the guest and the sister were ill with nausea and vomiting. On Oct. 27 the teacher felt cold and chilly, and complained of her head "swimming" and felt seasick. Next day she was "very ill" in the afternoon. "Vertigo" continued for three or four days, and a week after the onset she still had nausea and epigastric discomfort and tenderness, and wished she could be sick, but neither vomiting nor diarrhoea occurred. On the 28th her sister suddenly relapsed and vomited violently for two hours, but had negligible nausea and no diarrhoea. On the evening of the 29th her father vomited precipitately and complained of "vertigo." Nausea persisted throughout the next day, but there was no diarrhoea. H. continued to teach her class in the elementary school, but no cases had appeared amongst her pupils within seven days of the cessation of her symptoms.

H.'s nearest neighbour, who lived in an isolated house with her husband and two daughters, was breaking her fast with a cup of tea at 7 a.m. on Oct. 28, 1942, when she was seized with intense nausea and passed an urgent stool. During the morning nausea became almost intolerable and she passed more urgent stools, but it was seven hours before she vomited. Giddiness persisted throughout the 29th, and she was still feeling weak on Nov. 2. Up to this date the condition had not been transmitted to the three other members of her household. This woman had neither left her cottage nor received visitors since Oct. 24.

Community Outbreaks

The family histories described served to show that the disease was present in the town before cases appeared in the schools and that there was considerable variation in the pattern of the outbreaks in households. Similar variations were found in community outbreaks.

Girls' Public School

Junior Boarding-house (Girls).—Population at risk, 20; children known to have been attacked, 12. On Oct. 25, 1942, one child reported diarrhoea. At 5 p.m. on the 27th two young girls vomited and had passed hurried stools before bedtime. Between 5 and 8 p.m. five other girls vomited, but

had no diarrhoea; and between 8 p.m. and midnight five more children vomited before they could get out of their beds. Next morning another child developed diarrhoea without vomiting. No further cases were detected during the following week.

Senior Boarding-house (Girls).—Population at risk, 35; children known to have been attacked, 26. A child was sent to bed with diarrhoea and a slight temperature on Oct. 6, 1942. On the 12th another child had precipitate vomiting during the night, and some nausea and headache persisted through next day. Fifteen days later, between 8.30 and 9 p.m. on Oct. 27, some of the younger girls began to vomit, and by midnight 11 of the 35 children had vomited and 5 others were complaining of nausea. Further cases appeared particularly amongst the older girls on the morning of Oct. 28.

Another Boarding-house (Girls).—Population at risk, 30; children known to have been attacked, 19. There is no record of alimentary upset in this series since the beginning of term until Oct. 27, when between 8 p.m. of that day and 8.30 a.m. of the 28th 14 girls vomited. Cases continued to occur throughout the latter day, and by the 29th 17 children had vomited and 2 had had nausea only. Two of the staff became ill 24 hours after the first appearance of the disease in the children.

Evacuated Day School Hostel.—Population at risk, 21; children known to have been attacked, 8. The ages of these girls range from 7 to 15 years, but the outbreak was confined to 8 of the 10 juniors, the seniors and staff escaping. The first case occurred at 1.40 p.m. on Oct. 27, 1942, when a child vomited precipitately at lunchtime before she had eaten any of the meal. She improved during the next day, but vomited again on the following night, and subsequently passed blood in her stool for three days. The second case in this hostel appeared at 7.30 p.m. on Oct. 27. At 8.45 p.m., soon after the children had gone to bed, others were taken ill, and between 2.30 a.m. and 5 a.m. of the 28th three further cases vomited. None of these children developed diarrhoea.

Evacuated Day School; Billeted Children.—Population at risk, 181; children attacked, 27. Although only 27 of these children were absent from school with this condition it is probable that some nauseated children continued to attend classes. Furthermore, new cases were still appearing on Nov. 3, when these notes were made, and the final score is unknown. Some billeted children in the junior classes were attacked at the same time as their fellow pupils living in the hostel—that is, on Oct. 27 and 28. The timing of the attack on sixth-form girls was entirely different. All these girls lived in billets or with their families. The cases M. and J., mentioned under family outbreaks, were ill on Oct. 8 and 10 respectively. Of the remaining 18 girls in this form nine became ill, three without vomiting—on Oct. 28 (one case), Oct. 30 (two cases), Oct. 31 (one case), Nov. 2 (one case), Nov. 3 (two cases), Nov. 4 (one case), Nov. 11 (one case) respectively—and nine had remained well.

Boys' Public School

The majority of pupils attending this school are day boys, many of whom have sisters in the girls' public school. The two public schools draw their day pupils from rather exclusive social and economic levels, representing virtually the same home environments. It is known that day boys were already affected on Oct. 26, and the attack rate appeared to be of the same magnitude as among the day girls. The three boarding-houses suffered more explosive outbreaks, two of which are summarized below.

"O" House.—Population at risk, 36 junior boys; number known to have been attacked, 15. The house master, his wife, his daughter, his staff, and the 36 boys constitute one feeding group. The 8-year-old daughter attends the girls' public school and is a class-mate with girls in the junior boarding-house there. At 5.30 p.m. on Oct. 27, after returning from the girls' school to "O" House, she vomited, and continued to do so throughout the night. She had no diarrhoea. Forty-eight hours later her mother became nauseated and, after five hours' increasing discomfort, vomited at 10 p.m. on the 29th. The same evening 10 of the boys were attacked, most of them between 4 and 7 p.m., and the matron also developed nausea, which persisted for four days before she vomited. At first sight this sequence suggests that the house master's daughter was the primary case in this community. Further inquiry brought to light a boy in

the house with diarrhoea starting on Oct. 23, one with nausea on the 25th, and two further cases of vomiting on the 28th. It is therefore not improbable that, if the spread of this disease depends on contact, there were at least two primary sources of infection in this house.

St. J. House.—Population at risk, 42; number attacked, 22. This house constitutes a separate feeding group and occupies a neighbouring building, 100 yards away from "O" House. The recorded incidence of nausea and vomiting was as follows: Oct. 28, 10 cases; Oct. 29, 8; Oct. 30, 2; Oct. 31, 0; Nov. 1, 1; Nov. 5, 1. The majority of the 10 boys attacked on Oct. 28 were unable to get up on that morning. The peak of the wave in this series was therefore at least 33 hours before the peak in "O" House.

Bacteriology.—Three specimens of milk from the suspected source and twelve specimens of vomit and faeces were examined at an Emergency Public Health Laboratory, all with negative findings.

Discussion

It is difficult to avoid the impression that the explosive outbreak reported to the medical officer of health was in fact the summit of a wave of disease which had been mounting not only in the town but also in some of the communities for some days. This impression is strengthened by the observation that the peaks of the several parts of what at first sight appear to be one explosion do not coincide but range over a period of days. This pattern is unlikely to be produced by poisoning from food simultaneously consumed, but food-poisoning cannot be dismissed on these grounds alone. Each of the several groups of cases discussed was independently fed on food obtained from different sources and prepared separately, and the pattern may have arisen if a common aliment had been used on one day in one house and on another day in another house. Investigation of this possibility was conducted on the assumption that if the symptoms were due to ingestion of a toxic factor in food the incubation period was in all probability a matter of a few hours rather than days. A peculiarity of the outbreak was that one could not identify any single meal as having been consumed at a reasonably constant interval before the onset of symptoms in the several groups: considering only those cases occurring on the day of maximum incidence, the last common meal was breakfast in one house, dinner in another, tea in another, and supper in a fourth. These variations do not necessarily argue against the disorder being *ex alimentatione*; they merely suggest that if the cause of the trouble was ingestion of a common aliment the incubation period was variable, usually exceeded 12 hours, and may have been of several days' duration. Other considerations suggest that if the toxic factor was food-borne it withstood cooking.

In the absence of more exact knowledge as to the nature of the toxic factor or of the incubation period, and without minutely detailed food lists and menus covering several days, such widely distributed non-perishable items as dried eggs or dried milk, chocolate, etc., could not be excluded. Liquid milk could, however, be excluded with some degree of certainty on the grounds that (1) some of the patients becoming ill during the peaks of the wave did not take milk from any source and others did not take school milk, which was the only source suspected; (2) the same milk, bottled and delivered at the same time and under identical conditions and consumed at approximately the same time, did not give rise to disease in some of the schools supplied; (3) only by the remotest chance could contaminated milk have been distributed so as to give rise to the disease in one group on one day and in other groups on other days. Furthermore, the milk was withdrawn on the morning of Oct. 28, but this withdrawal did not prevent the appearance of explosions in some communities subsequent to this date. It is interesting to note that the girls' school milk was all delivered at the school at the same time, but was consumed at different times of the day by the different groups of children affected (junior girls' public school, 10.30 a.m.; senior girls' public school, 11.45 a.m.; evacuated girls' school, 4.30 p.m.), and there is no constant relation between these times and the times of onset of illness in the several groups. All school milk was consumed on the day of delivery.

Conclusion

Previous writers have concluded that epidemic nausea and vomiting is an upper respiratory infection with an incubation period of from two to seven days, probably due to an unknown virus. The present outbreak strengthened the impression that the disease is communicable and that the portal of entry is the upper respiratory passages. The incubation period was probably within the range of from two to seven days, but could not be determined accurately. Infection *ex alimentatione* immediately preceding the attack was excluded with some confidence by the circumstances. An alimentary vehicle consumed a few days before the appearance of symptoms could not be excluded, but as a cause was thought to be improbable.

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TWO CASES OF RUBELLA MENINGO-ENCEPHALITIS

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The occurrence of meningo-encephalitis in association with rubella is exceedingly rare. Taylor (1937), in his account of meningo-encephalitis following German measles, states that only 12 other cases had been reported up to that date.

Case I

A Naval Air Arm observer aged 19 was admitted to the zymotic ward on June 2, 1942, with the diagnosis of meningitis. His communication sheet stated that on May 29 he reported to the sick bay at his own depot with a typical rubelliform rash, cervical adenitis, and slight general malaise. There had been an epidemic of rubella in this establishment immediately prior to this date. He was diagnosed and treated accordingly. On June 1 he complained of severe frontal headache. His temperature was normal. The duty medical officer noticed that the right pupil was larger than the left. No other abnormal signs were reported. Next day the headache was worse; temperature 100°; pulse 80; tongue heavily furred; severe pain on flexion of neck, and weakly positive Kernig's sign present both sides; pupils equal and reacting sluggishly to light.

June 2.—On admission he lay curled up in bed, face towards the wall and away from the light. He was mildly annoyed at being disturbed for examination, and somewhat drowsy, but with intelligent and co-operative. Some exposure phobia was evident, as is commonly found in meningitic cases. He was obviously feeling ill: face pale, tongue furred, and remains of what might have been a rubelliform rash over his trunk, most pronounced on the back. Temperature 100.8°. Glands in posterior angle of neck enlarged and tender. No Koplik's spots seen on buccal mucous membrane. Pupils equal in size; reactions brisk. All reflexes normal. Babinski's sign absent. Kernig's sign negative. Marked nuchal rigidity with pain on flexion. Heart, lungs, and abdomen normal. Lumbar puncture was performed and 16 c.cm. of clear fluid withdrawn under increased pressure (Table I). Sulphapyridine was administered as a routine measure in view of the possibility of meningococcal meningitis, several cases of which had recently been in the ward.

June 3.—Condition much the same. Temperature 100°. Kernig's sign positive; marked neck rigidity. Knee-jerks rather brisk. Doubtful plantar response.

June 5.—Neck rigidity less severe. Flexor plantar response. Knee-jerks normal. Kernig's sign negative. Pyrexial still. Lumbar puncture repeated: 20 c.cm. of clear yellow fluid withdrawn under increased pressure.

June 6.—Temperature 99°. Condition improved. Complained of slight cough. A few crepitations heard at left base.

June 8.—Temperature rising. No clinical change.

June 12.—A general marked rubelliform rash again present over trunk and proximal part of limbs, pink and papular in nature, typical of rubella. A few spots also present on face. No Koplik's spots seen. Tender cervical adenitis present. Temperature 100°. C.N.S. normal. Lumbar puncture performed: 15 c.cm. of clear fluid obtained, not under pressure.

June 14.—Rash completely gone. No skin staining left. No symptoms beyond slight headache. C.N.S. normal.

The patient made an uneventful recovery from this date and went through his period of convalescence without the appearance of sequelae.

TABLE I.—Results of C.S.F. Examination in Case I

Date	Protein (mg./100 c.cm.)	Cells per c.mm.	Lymphocytes	Polymorphs	Sugar (mg./100 c.cm.)	Chlorides (mg./100 c.cm.)	Organisms	Red blood cells	Fibrin	Range Gold Curve
2/6/42	160 Glob. +	3	—	—	—	730	Nil T.B. not found	—	—	4444322110
5/6/42	100 Glob. +	20	94%	6%	60	720	Nil	+	+	3444553100
10/6/42	50	50	96%	4%	30.3	730	Nil	—	—	0012332210

Wassermann reaction negative

In view of the typical nature of the rash in this case, together with the fact of the rubella epidemic in progress, the diagnosis of rubella must be considered as confirmed. The occurrence of a second rubelliform rash is difficult to explain unless it be considered as a relapse, which, although rare in rubella, is not unknown. The C.S.F. findings are interesting in view of the marked increase of protein, especially with regard to its dissociation from the cell count. A similar dissociation is found in cerebral arteriosclerosis, some cranial tumours, and spinal tumours. This point in common with arteriosclerosis is worthy of comment in so far as Taylor (1937), describing a case of encephalomyelitis which came to the post-mortem table, mentions the extreme degree of arterial degenerative proliferation found in the brain together with perivascular cuffing of small lymphocytes with occasional large ones. The red blood cells and the minute fibrin clot found in the second specimen of C.S.F. were probably an artefact due to the previous lumbar puncture.

Another case of rubella which portrayed the signs and symptoms of encephalitis is included in the records of this hospital for the year 1940.

Case II

Feb. 5, 1940.—During a large epidemic of rubella a rating aged 18 was admitted with the typical rash, cervical adenitis, and sore throat. No Koplik's spots were seen, and there were few signs of respiratory catarrh or conjunctivitis. We had 200 cases of rubella in the hospital at this time.

Feb. 10.—The patient, who had been progressing normally apart from a mild degree of pharyngitis, vomited a greenish fluid several times and had a small epistaxis. He complained of headache. Temperature rose to 101.2°. He was tender in the right hypochondrium and was thought to have gastritis. A slight cough was present.

Feb. 12.—Patient vomited again. He was found to be extremely listless, drowsy, and emotionally unstable. Was easily tired and unable to concentrate on any one thing except for a very short time. Articulation was poor, with a tendency to mumble. No physical abnormality was detected. Blood urea 36.5 mg., sugar 104.6 mg. per 100 c.cm.

Feb. 14.—Still vomiting. Very ataxic. Could barely stand even with feet well apart. Marked emotional instability present. Right pupil larger than left: reactions normal. Optic disks showed faint blurring of edges. Other cranial nerves intact. Investigation of the C.N.S. showed impaired muscle sense when tested by movements of feet or fingers. Finger-nose test especially bad, the finger alighting well up the forehead. Kernig's sign negative. Remainder of C.N.S. normal. No neck rigidity. The *status quo* was preserved during the next 9 days, with slight improvement.

Feb. 23.—Lumbar puncture performed (Table II). Now apyrexial, and remained so throughout rest of illness and convalescence.