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The treatment of the patients referred to in this paper required at least 700 bottles of blood, and I should like to express, on behalf of these patients, their debt of gratitude to the blood donors and to those who collected and cross-matched all this blood without error.

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INFECTIVE HEPATITIS IN A MIXED SCHOOL, WITH HIGH ATTACK RATE IN FEMALES

BY

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A small epidemic of infective hepatitis in an urban district of the County of Lancashire consisted almost entirely of girls at one mixed school, although there was no great excess of girls in any one class at the school.

Pickles (1939), in his classical description of infective hepatitis in rural Yorkshire, does not give any figures showing that females are specially susceptible to this disease.

MacCallum *et al.* (1951) reprint tables for Denmark (1928-45) and Sweden (1931-7)—countries in which the disease was nationally notifiable—and also for their special area of study, the wartime Eastern Region of England, where all types of jaundice were made notifiable in November, 1943. Again there is no mention of differences between the attack rates for the two sexes; for example, an excess of female cases in the Eastern Region "was due almost entirely . . . to the absence of adult males on active service."

The factors in the Lancashire school epidemic were analysed, and finally compared with figures quoted by MacCallum *et al.* (1951), which refer to large numbers of pupils and schools.

The Epidemic

A semi-urban community of about 10,000 in the south-west of Lancashire was served by three primary

schools, of which one, X, traditionally took its pupils from a well-localized area in the township.

After a period of freedom of six months or more the first three cases of infective hepatitis occurred in January, 1959. They were all pupils at school X. The epidemic came to an end in June; no new cases were reported up to the beginning of 1960.

In all, 30 cases were notified by the school welfare officer, health visitors, and general practitioners—jaundice was voluntarily notifiable from May 22—or were discovered by me on the home visit made to each case. Of these, 29 were school-children, of whom 27 attended school X. Conversely, among the 87 household contacts of these 29 children jaundice or suspicious symptoms occurred only once. Among the 86 contacts who escaped clinical infection were 23 of school age; 8 attended secondary schools and 6 primary schools other than X. Evidently this was a true school epidemic.

However, some of the 27 pupils of school X may have been infected by a sibling attending the same school—that is, when the second child fell ill 15 to 40 days after its sibling. In 13 households only one child per household was affected; in another six households hepatitis attacked two children in each, the interval between the two illnesses being 0, 4, 15, 18, 29, and 95 days respectively. In the last household two children and the father fell sick, with an identical interval of 27 days between each of the siblings, and between the second sibling and father.

We have therefore the alternative of 27 "school" cases, or 23 "school" cases and 4 "home" cases.

Age and Sex Incidence.—No personal or household history suggesting hepatitis was obtained from any teacher, school-meal-service helper, or workman on the premises. There was a high female attack rate (Table I).

For comparison, an outbreak of mumps in October/November, 1959, involved 15 girls and 8 boys, a distribution which I find could have arisen by chance once in 3 to 5 situations.

Evolution of Epidemic.—There is a three to four weeks' periodicity of number of cases against time (see Graph).

Relation to Vaccination against Poliomyelitis.—Groups of children were given their first or second injection on December 15, 1958, April 13, 1959, or May 4, 1959. The last two sessions were held when the weekly report of the school welfare officer had shown no absences due to jaundice for at least six weeks. This was an inadequate precaution (see Graph);

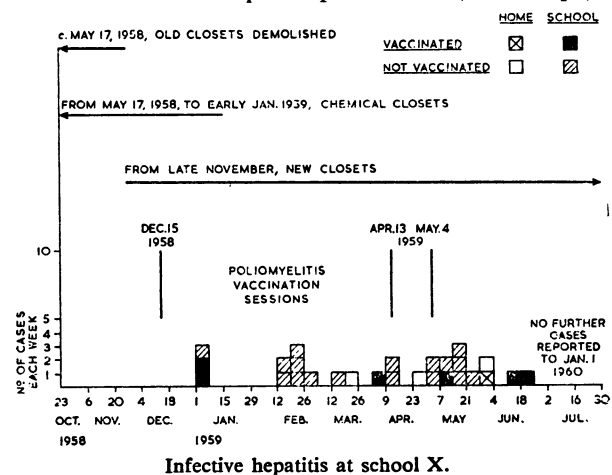


TABLE I

Age in Years:	<5	5	6	7	8	9	10+	Total	Total All Cases	Expected Numbers	
										School cases only	All cases
No. of girls	10	17	23	23	18	15	17	123	23	12.3	14.5
No. of girls with hepatitis { "School" cases "Home" cases	3 0	4 0	4 0	3 0	1 1	2 0	4 1	21 2			
No. of boys	6	12	13	21	18	20	17	107	4	10.7	12.5
No. of boys with hepatitis { "School" cases "Home" cases	0 1	0 0	0 0	2 0	0 1	0 0	0 0	2 2			

These figures are highly significant. Counting 27 "school" cases, $\chi^2 = 10.96$ with 1 degree of freedom, whence $P < 0.001$. Counting 23 "school" cases, $\chi^2 = 13.06$ with 1 degree of freedom, whence $P < 0.001$.

absences must have been attributed to diagnoses based on pre-icteric symptoms. The records show that only 7 of the 27 cases had received an injection within the previous six months, whereas for the whole school two out of every three pupils had received at least one injection by May 5, 1959.

The intervals between the injection(s) and onset of jaundice were 17, 19, 19 (40), 25, 51 (114), 88 (155),* and 136 days respectively.

Other Factors.—Hepatitis was equally prevalent among those who ate school dinners (2 boys and 12 girls) and those who lunched at home (1 boy and 12 girls). No infestation by insects or rodents was discovered anywhere on the premises or meals centre.

Toilet Accommodation.—The original toilets were of a trough type—namely, four places and one urinal for junior boys, and four places and one urinal for junior girls and infants. In May, 1958, these were demolished to make way for a new hall, the contractor substituting chemical closets—namely, three places for boys, and three places for girls. In late November, 1958, new water closets became available—namely, two places and one urinal for boys, and four places for girls. Finally, in early January, 1959, the chemical closets were removed. Thus there was only one short period—November, 1958, to January, 1959—when toilet accommodation was adequate, in quantity at least. In the summer and autumn of 1958 great disturbance of soil and subsoil took place as a result of this work and rebuilding. However, in a school where all classes were mixed it is unlikely that this factor would operate to produce a differential attack rate.

Discussion

Exclusion of Transmission by Syringes

An attempt to sterilize the hypodermic needle *in situ* on the syringe between injections, as described by Fleming and Ogilvie (1951), met with unexpected difficulties and was abandoned. The technique used for most injections is open to criticism. A 1-ml. syringe was used to give the injection, pressure being maintained on the plunger until the needle had been replaced by another sterile needle. The process was repeated until the phial of 9 or 10 doses was empty, when the syringe was resterilized.

There is argument concerning the existence of separate viruses typically causing infective hepatitis and homologous serum jaundice respectively. Parenteral injection of blood or serum from cases of infective hepatitis has been followed by jaundice at intervals of less than 40 days in some cases (McCallum, 1955).

*This child's sibling, who had not been injected, developed jaundice four days later. Thus at most four children developed jaundice 40 days or more after an injection.

In this epidemic there was a three to four weeks' periodicity in the case incidence, and four at most of the cases developed jaundice later than 40 days after injection. Irrespective of any estimates of incubation period, only seven instead of an expected number of 18 cases followed an injection, and these were not gathered into an explosive outbreak.

Girls and boys were inoculated together in random order.

Role of Bowel-to-mouth Transmission

Inadequate or unhygienic closet accommodation causes most inconvenience to females; males can be more fastidious. The most striking effects should be obvious where: (1) closet accommodation is inadequate; (2) toilet facilities are separate for the two sexes; (3) infection is being spread through infected toilet-seats, etc., and/or perfunctory hand-washing; and (4) the disease is not exceedingly infectious and is infectious for only a short time; contact must be fairly close to spread the infection.

With regard to No. 4, Pickles (1939) says: "This disease has an astonishing behaviour in families—and in small villages that are like families—which has no counterpart in any other disease. There is what may be termed serial incidence." He also makes this interesting observation: "Wives almost invariably infected their husbands and in more than one instance their children escaped. Husbands, curiously enough, did not infect wives."

All the conditions (1) to (4) were satisfied in the Lancashire epidemic, if we assume an intestinal-oral transfer of the virus.

MacCallum *et al.* (1951) analyse three epidemics by sex and age.

(a) A small school epidemic (page 31): attack rates for boys and girls were almost equal. School toilet accommodation may have been adequate; outside, "pail privies were universal"; 7 out of the 26 cases may have been infected at home.

(b) An institutional epidemic (page 44): attack rates for age-group 5-14 again almost equal. However, the institution was one for mental defectives, and 38 out of 82 cases belonged to a very low-grade group with unhygienic habits.

(c) Consolidated figures for epidemics in day schools (page 13) (Table II).

TABLE II

Area and Date	No. at Risk, Ages 5-14			Attack Rates (%)		
	Male	Female	Total	Male	Female	Total
Southend, 1943	4,300	3,924	8,224	4.5	4.2	4.4
Bishop's Stortford, 1943-4	572	460	1,032	8.2	11.3	9.6
Bungay	495	285	780	17.0	25.6	20.1

Here there is the expected type of inequality in rates when we pass from urban to rural conditions; this is not explained by an excess of females at risk in the more vulnerable 10 to 14 age-group—for example, see detailed table for Bungay (Table III).

TABLE III

Age-group (Years)	5-9	10-14	Total	Both Sexes 5-14
No. of girls at risk	126	159	285	780
Attack rates (%)	15.1	34.0	25.6	20.1
No. of girls with hepatitis ..	19	54	73	157
Expected numbers, for equal attack rates on boys and girls			57.4	
No. of boys at risk	142	353	495	
Attack rates (%)	12.7	18.7	17.0	
No. of boys with hepatitis ..	18	66	84	
Expected numbers for equal attack rates			99.6	

For the age-group 5-14 years $\chi^2=7.88$ for $D=1$, whence $P<0.01$, which is significant.

Summary and Conclusions

Under certain conditions, which are enumerated, an infection with the bowel-to-mouth type of spread should show a high attack rate in females. A school epidemic of infective hepatitis provides an example.

Bowel-to-mouth transmission of this disease has been proved experimentally in volunteers; this epidemic appears to be a demonstration in the field of the same fact.

The infection was not spread by injections of poliomyelitis vaccine given at a time when the extent of the epidemic was not realized.

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"County Hall, London, has acquired five letters from Mrs. Humphry Ward, written to 'Dr. Barlow,' afterwards Sir Thomas Barlow, physician to Queen Victoria. They have been given by Miss Helen Barlow, his daughter. They are written in a clear hand, and, naturally, well phrased, and they belong to the 1898-9 season when Mrs. Ward was organizing the Tavistock Settlement, which now bears her name. She wrote to Dr. Barlow about the invalid children's school she wanted to found. She asked him to suggest a doctor for the committee, and later invited him to see the school and take tea with her. Finally she thanked him for a 'generous gift'—presumably money. The letters have a social significance, for this school for cripples became, as Mrs. Ward prophesied, 'the beginning of a general scheme for invalid children's education.'" (*The Guardian*, September 29, 1960.)

LONG-TERM FOLLOW-UP OF HYDROCEPHALIC INFANTS TREATED BY OPERATION

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Before the introduction of plastic substances which human tissues would tolerate without reaction, surgeons strove mightily, but largely in vain, to lead unabsorbed cerebrospinal fluid from the spinal canals of hydrocephalic infants to sites where it would be absorbed. Quincke (1891), Parkin (1893), and Cushing (1905) were the principal pioneers, and the German surgeon Heile from 1910 to 1927 the most persistent (Heile, 1925). For twenty years thereafter few such operations seem to have been performed, but with the addition of "polythene" tubing to surgical equipment, surgeons began again to anastomose the ventricles or the spinal theca to the ureter, mastoid cavity, peritoneal or pleural cavity, vertebral marrow, jugular vein, and many other likely and unlikely sites.

It is not the purpose of this paper to advocate any particular method, although the cases described were all treated by theco-peritoneal anastomosis. Each method has its champions, and the results overall are claimed to show from 30 to 80% of "cures" varying widely according to the definitions of hydrocephalus and the criteria for operation. Laurence (1958) followed up 182 untreated hydrocephalic infants and showed that half of the survivors were educable and potentially useful members of society. This by implication raised the question of the advisability of treating hydrocephalus surgically.

As the long-term investigation of cases operated on is limited by the small number of years in which the operation has been technically practicable, it will not be possible for a long time to assess the intelligence and social usefulness of a large surviving series. It is, however, over seven years since the first infants were operated on in this centre, and the five survivors of the eight children treated during the first year are now at school. The investigation of these children's present status by psychologist, psychiatrist, and neurological surgeon is the subject of this paper. Although the number is small, the series seems fairly representative of the larger one presenting in the following years, and the findings, although tentative, may be important.

Material and Results

Eight infants with communicating hydrocephalus were operated on during 1952, of whom three died. One developed a staphylococcal meningitis six weeks after operation. One died a year after operation, and at post-mortem examination was found to have large chronic subdural haematomata, which had probably developed in the immediate post-operative period as the result of a too sudden lowering of the intracranial pressure. One