giving no fixation showed any neutralizing antibodies, and in this case only partial neutralization was given by the serum diluted 1 in 2. The explanation might be that other factors are involved in resistance to the virus or that those who were not infected had not been exposed. In either event the provisional conclusion that the presence of complement-fixing antibodies indicates some degree of clinical immunity seems justified, as no cases of influenza occurred in those giving a positive reading.

Further facts to support this argument are: (1) One of us (L. H.) had a complement-fixation titre of 1 in 16 before the epidemic began. In spite of the fact that he has been in close and continued contact with infected material and that three cases developed in his household, he remained quite unaffected. (2) A second person, who also had a titre of 1 in 16 before the epidemic began, was in close contact with three cases of influenza, apparently infected one from the other during the course of their illness, and remained well throughout.

Discussion

Convincing evidence has been obtained that the human type of influenza virus, identical with that isolated in other places, was the primary aetiological agent in the recent epidemic of influenza in Manchester. Not only was the virus isolated from a number of cases, but there was also a definite increase in the antibody titre of convalescent sera as demonstrated by complement-fixation. In a few instances it was possible to examine the serum before and after an attack, and in each case an increased titre was recorded.

The results also suggest that individuals with a low antibody titre are more susceptible to infection than those with a high titre. This may be of some practical value, as recent work indicates that prophylactic vaccination may soon be available for general application. Francis and Magill (1937) have been able to produce a decided rise in antibody titre by the subcutaneous injection of living culture virus without causing any signs of infection. They suggest that this increase in circulating antibodies is accompanied by an increased ability to combat the natural infection. It follows, therefore, that if it is possible to differentiate immune from susceptible persons the application of active immunization will be assisted. The complement-fixation test is the most satisfactory of the tests at present available for this purpose, and is also the most simple to apply. By our method a titre of 1 in 16 or over suggests a high degree of immunity, while it seems probable that titres of 1 in 4 or 1 in 8 may represent an immunity sufficient to prevent infection in a mild epidemic.

Conclusions

1. The human type of influenza virus was the primary aetiological agent in the recent epidemic of influenza in Manchester.

2. The influenza virus has been isolated from thirteen cases of epidemic influenza and all strains examined were identified as the human type.

3. No evidence was obtained to indicate that any pathogenic organism (in particular *H. influenzae*) was involved in the cases examined.

4. By means of the complement-fixation test a high antibody titre was generally found in convalescent sera.

5. This test provides a possible method for differentiating immunes from susceptibles, and may prove of value when a satisfactory prophylactic is available.

We wish to express our gratitude to the many persons who have assisted in the collection of material.

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CONTINUOUS OPEN AIR FOR PNEUMONIA IN CHILDREN

BY

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The treatment of acute primary pneumonia in children is a subject which, more especially in the winter months, must provoke anxious thought and interest. While it is well recognized that alveolar or lobar pneumonia occurring in the older child is in the majority of cases a self-limiting illness having a comparatively low mortality, it has to be admitted when the disease is considered in all its aspects and in children of all ages that pneumonia still remains one of the commonest and most serious infections of childhood, claiming a vast number of victims each year.

The object of this paper is not to enumerate the various forms of therapy that may be employed in the treatment of pneumonia in children, but rather to stress the importance of one particular remedy which by its very simplicity can be almost universally applied. Since Claude Ker (1904) advocated the open-air treatment of bronchopneumonia complicating measles and whooping-cough, conceptions regarding the management of patients suffering from this disease have completely changed, and the majority of physicians are personally convinced that the era of the hermetically sealed window and the stuffy sick-room is rightly gone for ever. In spite of this general conviction, however, there would still appear to be considerable divergence of opinion as to whether all cases of acute pneumonia should be treated in the open air as a routine measure or whether such a regime should be limited to certain selected types of the disease. Furthermore, there does not appear to be any universal plan applicable to this form of treatment, since it is found that even in the most authoritative works on diseases of children a variety of opinions is expressed, and not infrequently there is noted a lack of precision as to what exactly is meant by open-air treatment. For example, is exposure to open air beneficial in all types of acute primary pneumonia in children of all ages, or should this plan of therapy be reserved exclusively for cases of bronchopneumonia or only for cases of lobar pneumonia? And if it be decided that the patient would benefit from some form of open-air treatment, should he be exposed to all the winds that blow, or should he, though placed in a well-ventilated atmosphere, be protected from draught?

During recent years it has been the practice in one of the wards at the Children's Hospital in Edinburgh to submit every case of pneumonia on admission to an intensive open-air regime. This is carried out irrespective of the season of the year or of weather conditions, with the one exception of fog, each child being placed on the windward side of the ward beside a widely opened window so that the cold air from without plays directly on the child's face. The aim in each case is to ensure that the maximum of cold air blows directly on to the child, an

entirely different procedure from what is usually understood by the somewhat ambiguous advice that "the child should be nursed in a well-ventilated room, adequately protected from draught." An essential precaution is, of course, that the patient should be warmly clad so as to prevent chilling, the face being the only part of the body exposed to the air. All cases of pneumonia are thus treated, both day and night, until the temperature falls and remains at the normal level. This somewhat rigorous method of treatment has now been thoroughly tested in approximately 300 consecutive cases of pneumonia, and the impression formed, not only by the physicians attached to the ward but also by the nursing staff, is that exposure to a moving current of cold air in this manner is the means of saving lives in children of all ages suffering from acute primary pneumonia. In this connexion, certain of the more striking clinical impressions may be worthy of record.

Clinical Impressions of the Treatment

It must first of all be stated that the treatment of pneumonia in the manner described appears to be free from all danger to the patient concerned, and in this series of cases it has not been possible to attribute to the cold air any ill effect whatsoever. One of the most interesting features is the attitude of the child towards this mode of treatment, since it is frequently observed that interruption of the flow of cold air by closure of the window tends to make the child fretful and restless, and that when the window is reopened he will almost immediately subside into a peaceful sleep. This impression is very striking and has been frequently noted, and it is a significant fact that sedative drugs are but rarely required to induce sleep or to allay restlessness. Another important feature is the effect of the open air on the child's appetite; it is exceptional to experience any difficulty in persuading the patient to take nourishment if treated in this manner. Apart from small doses of brandy, stimulants are hardly ever required except in the most desperate cases, and the administration of oxygen, either with or without carbon dioxide, has been almost entirely abandoned as irrelevant. Thus cold air appears to bring comfort to the patient, aids his appetite, and helps to render unnecessary other forms of treatment which may prove exhausting to a young child suffering from an acute illness.

Control Cases

When an attempt is made to assess the efficacy of any special method of treatment it has to be realized that clinical impressions are not sufficient, and one of the most difficult obstacles to overcome is that of obtaining suitable control cases for the purpose of comparison. This difficulty is very apparent in a disease such as pneumonia, which probably varies both in severity and in type from year to year, and it would therefore be of little value to judge the effect of any therapeutic measure by comparing the mortality rate at the present time with that during previous years. In this investigation into the value of open-air treatment in pneumonia there is, fortunately, what may be regarded as an almost ideal series of control cases, inasmuch as the latter are consecutive cases of pneumonia admitted to one of the other wards of the Children's Hospital during exactly the same period.

This control group comprises 275 cases treated according to a somewhat different scheme. In this group those patients admitted during the cold winter months were not as a rule subjected to an open-air regime, but were treated by such measures as the continuous administration of oxygen, the exhibition of powerful stimulants, and the

inhalation of air moistened by steam. The comparatively small minority admitted during the warmer months were in many instances placed adjacent to an open window, but always on the sheltered aspect of the ward and only when the weather was clement. Furthermore, open air was not favoured at any season of the year for the children in this group who were under 2 years of age. Thus there are two groups of cases: Group A, in which all cases were placed in the open air continuously and indiscriminately at all seasons of the year, and Group B, consisting of cases treated either by fresh air to a modified degree in the milder weather, or more frequently by various other forms of active therapy. It should be clearly understood that the difference in the management of these two groups of children is not merely one of degree, since in the control series an open-air regime was not employed as a routine measure, and in those cases where such a regime was adopted it was not carried out nearly so intensively as in Group A.

Comparative Mortality Figures

For the purpose of this survey the cases have not been classified according to bacteriological or pathological type, since there is as yet no uniformity of opinion as to the criteria which distinguish bronchopneumonia from alveolar pneumonia in very young children. Doubtless the view will still be confidently expressed by some that the vast majority of children under 2 years of age were suffering from bronchopneumonia. For this reason it was considered that a more accurate and a more intelligible comparison of the two groups could be made by dividing the cases in each group into various age periods rather than making a somewhat arbitrary attempt to differentiate pathological types. It is probably true also that the mortality rate in acute primary pneumonia is governed to a large extent by the child's age at the time of the illness, and a comparison of similar age groups in the two series will therefore afford reliable evidence. In consideration of the fact that this investigation is concerned entirely with treatment all cases in which the patient died within forty-eight hours of admission to hospital have been omitted from both groups, since it is probable that such cases were frequently beyond the scope of any form of treatment. Apart from this no selection whatever has been made in either group, and it is felt, therefore, that the two series are reasonably comparable.

Tables I and II show the number of deaths and the mortality per cent. in the two groups of cases, Group A representing those cases treated by the intensive open-air plan and Group B comprising the control cases. Owing to the very high mortality from pneumonia in infants as compared with older children the cases in each group have been divided into two large age periods.

TABLE I.—Mortality Rate in Group A

	Cases	Deaths	Per Cent.
Under 2 years ...	134	30	22.4
Over 2 years ...	158	4	2.5
Totals	292	34	11.6

TABLE II.—Mortality Rate in Group B (Controls)

	Cases	Deaths	Per Cent.
Under 2 years ...	136	51	37.5
Over 2 years ...	139	8	5.8
Totals	275	59	21.5

It will be noted that both under 2 years of age and over 2 the mortality is appreciably lower in Group A than in Group B, thus suggesting that treatment in the open air is beneficial alike to the very young child and to older children suffering from pneumonia. During a five-year period it is difficult to imagine that one particular ward in a hospital should admit all the severe cases of pneumonia whereas another ward in the same period admits all the mild cases, but it is conceivable that this state of affairs might occur to some extent during one particular year, and for this reason Table III has been prepared.

TABLE III.—Mortality Rate During the Various Years

Year	Cases	Mortality Per Cent.	
		Group A	Group B
1931-2... ..	113	6.0	27.0
1932-3... ..	93	13.5	19.5
1933-4... ..	105	9.2	23.5
1934-5... ..	124	13.4	17.5
1935-6... ..	132	14.5	19.0
Totals	567	11.6	21.5

In this table the mortality rate in the two groups is shown during each of the five years, and here it will be seen that although there is considerable variation in the mortality rates from year to year, in every instance the mortality in Group B is in excess of that in Group A. Thus it seems reasonable to assume that the difference between the two groups cannot be explained by an uneven distribution of cases, since the likelihood of this occurring during five consecutive years must be extremely remote.

Another possibility that had to be taken into account was a discrepancy in the age distribution in the two groups, and Tables IV and V show the age distribution and the mortality in Groups A and B respectively.

TABLE IV.—Mortality at the Various Age Periods—Group A

Age Period	Cases	Deaths	Per Cent.
Under 6 months ...	14	10	71.4
6-11 months... ..	43	10	23.3
12-23 months ...	77	10	13.1
2-5 years	97	3	3.1
6-12 years	61	1	1.6
Totals	292	34	11.6

TABLE V.—Mortality at the Various Age Periods—Group B
(Controls)

Age Period	Cases	Deaths	Per Cent.
Under 6 months ...	25	21	84.0
6-11 months... ..	35	12	34.3
12-23 months ...	76	18	23.7
2-5 years	84	8	9.5
6-12 years	55	0	0.0
Totals	275	59	21.5

Study of these tables reveals the fact that Group B contains a relatively larger number of cases in which the

children were under the age of 6 months, and this will perhaps tend to raise the general mortality for the whole group, since recovery from acute primary pneumonia during the early months of infancy is comparatively rare. If the first age period is discounted in both groups, however, it will be observed from the tables that the mortality still remains at a considerably lower level in Group A than in Group B. It is suggested, therefore, that the figures shown in all the above tables, whether considered individually or collectively, supply strong evidence in support of the favourable impressions formed at the bedside in connexion with the continuous open-air treatment of pneumonia in children of all ages.

Discussion

It has already been stated that the object of this investigation was to lay emphasis on one particular factor in the treatment of pneumonia in childhood. While it is readily admitted that for many years writers, both in this country and abroad, have advocated fresh air in the treatment of pneumonia, it is felt that the fundamental importance of this simple form of therapy is not sufficiently realized at the present day. The open-air treatment of pulmonary tuberculosis has long since ceased to be questioned, yet this simple but life-saving remedy has not as yet been whole-heartedly applied to other forms of respiratory infection. Old traditions die hard, and there can be little doubt that in many quarters it is still regarded almost as heresy to suggest that a child suffering from pneumonia accompanied by high fever should be nursed in the cold air.

Comparison of the two groups of cases in this series would appear strongly to justify the intensive open-air treatment in pneumonia in childhood, but it must be emphasized that such treatment will lose much of its beneficial effect if it is carried out in a half-hearted and timid manner. All the children in Group A were exposed to a moving current of cold air immediately on admission to the ward, and apart from adequate clothing were in no way protected from the draught. Furthermore, no distinction was made between bronchopneumonia and alveolar pneumonia, the treatment being the same for both types and for all ages. It is interesting to note that such treatment is not without physiological justification, since Leonard Hill (1936) has demonstrated that exposure of the face to a current of cold air causes a reflex dilatation of the bronchi and bronchioles, and this will tend to minimize respiratory distress and promote the maximum of aeration of the lungs. The remarkable peacefulness and comfort of the child treated in this way is probably a factor in lowering the mortality, owing to the minimum of strain being placed on the heart muscle. The increased appetite also enables a sufficiency of nourishment to be given without constant coaxing and cajoling, which can be so exhausting to a young child with pneumonia.

One obvious objection to open-air treatment carried out in hospital as described is the marked lowering of the ward temperature with a consequent danger to patients suffering from conditions other than pneumonia. This applies especially to marasmic and grossly debilitated infants, where it is frequently difficult to maintain the body temperature at a sufficiently high level. This real difficulty would be obviated if every children's hospital contained a special ward constructed according to sanatorium principles for treating cases of acute pneumonia. In view of the large number of respiratory cases admitted to hospital each year such a plan would be well worth while, since it would probably be the means of saving many lives. It is perhaps beyond the scope of this paper

to comment on the treatment of pneumonia in adults, but the view may be expressed that the continuing high mortality from this disease might be considerably reduced if the large general hospitals throughout the country were to provide better facilities for treating such cases in the open air. In the private house continuous open-air treatment can, in the majority of cases, be instituted with little inconvenience to other members of the household. Despite this there is frequently great reluctance on the part of parents to expose their stricken child to the cold air, and perhaps this reluctance could be largely overcome if the practitioner in attendance felt more strongly convinced of the great value of this harmless and easily applied remedy.

In this investigation the mortality rate only has been considered and no mention is made of the effect of an open-air regime on the duration of the fever or the incidence of complications. These questions and certain others are at present being investigated; nevertheless the actual mortality from pneumonia must remain the vital issue when judging the success or failure of any method of treatment, and it is a sincere belief in the life-giving qualities of the "airs from heaven" which has prompted this paper.

Summary

The importance of open air as a therapeutic measure in acute primary pneumonia in children is emphasized, and the belief is expressed that the value of this remedy is not sufficiently appreciated at the present day.

A comparison is made between a series of cases treated according to an intensive open-air regime and a control group of cases treated by other measures.

Exposure to a moving current of cold fresh air throughout the whole febrile period is advocated in all types of pneumonia in children of all ages, and it is suggested that if this simple and harmless expedient were to supersede certain of the more meddlesome forms of therapy frequently employed the lives of many children would be saved.

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Samuel Meaker (*J. Amer. med. Ass.*, December 5, 1936, p. 1847) discusses the treatment of human sterility. He states that all recent advances are based on a better understanding of the aetiology, which in the majority of cases is not one single defect but the summation of several factors. Absolute sterility is found clinically in only 30 per cent. of cases, the remaining 70 per cent. showing only a group of factors tending to depress fertility below the threshold of conception. These factors are so rarely limited to one patient that Dr. Meaker has ceased to speak of sterility in man or woman, but only of a sterile mating. Excluding rarities he considers the following the important factors of infertility: (a) genital hypoplasia, the organs showing the differentiation of a girl of 10 with ovarian immaturity and imperfect or absent ovulation; (b) abnormal viscosity of the endocervical secretions of chemical or infective origin; (c) partial or complete obstruction of the Fallopian tubes; (d) deficient oogenesis due either to depression in ovarian or pituitary secretions. Effective treatment is assured by complete diagnostic study. Male sterility can be examined by an accurate evaluation of semen. Endocervical infections are best treated by cautery; insufflation of gas and iodized oil only relieves partial obstruction, and salpingostomy may establish patency of the tubes. Deficient oogenesis calls for the services of the endocrinologist, and whereas hypoplasia once established can benefit little, Dr. Meaker believes that herein lies an opportunity for preventive gynaecology by proper attention to menstrual behaviour and to the health of the adolescent girl.

AUDITORY NERVE SECTION IN MÉNIÈRE'S DISEASE

BY

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The object of this investigation was to determine whether an accurate estimate of the depth of the internal auditory meatus from the outer table of the skull could be made before opening the skull, and if this was achieved to advocate the division of the eighth nerve when indicated through an operating endoscope in much the same way as one would use a cystoscope in the urinary bladder, thus reducing operative trauma to a minimum. If a suitable endoscope could not be devised it was thought that it might be possible to slip a flat graduated retractor into the subdural space, and when the calculated depth was reached to retract gently and find the foramen at once.

Preliminary Investigations

A preliminary investigation was made at the Museum of the Royal College of Surgeons, some fifty Egyptian and North American Indian skulls being measured with a view to finding a common factor whereby the depth could be estimated. The bi-mastoid diameter and the internal auditory meatus chord were correlated with the following results:

44	per cent.	of skulls	had the factor	2.6
16	"	"	"	2.5
12	"	"	"	2.3
8	"	"	"	2.1
6	"	"	"	2.8
6	"	"	"	2.2
4	"	"	"	2.4
2	"	"	"	3.0
2	"	"	"	2.9

In the above measurements the point taken on the mastoid process was situated at the upper and posterior part in the same horizontal plane as the internal auditory meatus. From the point of view of a consistent factor, and the difficulty of deciding which point on the mastoid process should be taken since the internal auditory meatus in the intact skull is invisible, the above factors have no practical value.

Other tentative measurements were made, and it was found that when one pair of supra-orbital notches was present the distance between each notch corresponded in the majority of cases with the distance between each internal auditory meatus; this was even true of the artificially deformed skulls of the North American Indians, these being flattened from before backwards and from above downwards, so that the bi-mastoid diameter is widened. The latter measurements, it was felt, did not lend any practical assistance because of the absence of one or both supra-orbital notches in a small percentage of skulls.

Dr. G. M. Morant, lecturer on anthropometry at University College, London, very kindly made a full statistical inquiry on a large number of English skulls at his disposal (100 male and 100 female). He found that an accurate estimate of the depth of the internal auditory meatus could be made from an external measurement, that external measurement being the distance between the asterion and the auriculare. To use his own words: "Taking all measurements in millimetres, the required asterion-internal auditory meatus chord is obtained by multiplying the determined asterion-auriculare chord by 0.581 and adding 26.33. So that the equation, which can be applied to either sex and to either side, is: