Special Articles

THE NATURAL HISTORY OF THE COMMON COLD

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ATTEMPTS to prevent or cure colds are held up by ignorance of what may be termed the natural history of the disease. On the one hand, it is often evident that a cold is "caught" by contact with one who is already a victim. On the other hand, colds often appear to be acquired quite otherwise—e.g., through getting the feet or body wet or chilled. Some observers deny the truth of this last view of the causation of colds and think infection all-important. Others go to the opposite extreme and deny that cross-infection plays any part at all. In this difficult field accurate observation and experiment are both of value, and an attempt will be made to see how far each method can contribute to a solution of the problem. At present the gaps in our knowledge are very great. We should, for instance, dearly like to know the answers to the following eight questions or groups of questions :

(1) Is the common cold an entity or a group of diseases ? If it is an entity, how variable is its clinical course ?

(2) What is the causal agent—bacterium or virus or neither? What are its properties ?

(3) How long can the agent persist (*a*) in the host, (*b*) outside ?

(4) Is infection always caught from another victim ? Or can it be activated in a subject already harbouring the agent ?

(5) If it is "caught," what are the means of spread ?

(6) If it is activated, what stimuli are effective and through what mechanism ?

(7) What explains the seasonal incidence ?

(8) Why does resistance vary from one person to another and in one person from one year to another ?

Though none of these questions can be fully answered, pertinent information is available from several sources. Observation of happenings in semi-isolated communities has provided some of this. A clear answer to the first three questions could probably be obtained readily enough if we had a convenient susceptible laboratory animal or any of the numerous techniques now available for the study of influenza virus.

The Common Cold Research Unit in Salisbury set up by the Medical Research Council and Ministry of Health in 1946, had as its primary objective the discovery of a laboratory technique with which colds could be conveniently studied. It was obvious to those concerned that without such a technique progress must needs be very slow. At the beginning the work had necessarily to be based on the testing of materials on human volunteers as the only technique available. During the two and a half years of the unit's existence some knowledge about colds has been acquired—in part as a by-product of the main endeavour—and this bears on several of our eight questions. Before dealing with these in turn, an account will be given of the conditions of study at the Salisbury unit. These have been briefly described before (*British Medical Journal* 1947, Andrewes 1948).

THE COMMON COLD RESEARCH UNIT

A unit for research into the common cold was established at Harvard Hospital, Salisbury, in the summer of 1946 as a joint project by the Medical Research Council and the Ministry of Health. The name "Harvard" commemorates the part played by Harvard University in establishing and staffing this hospital unit in Salisbury in 1940–41. At the end of the 1939–45 war it was handed over by American generosity to the Ministry of Health ; its earlier history has been described (*British Medical Journal* 1947). It consists of the twenty-two prefabricated huts sent over from America and some Nissen huts and other outlying buildings added later. Six of the main huts have been divided into two, to provide twelve "flats" for human volunteers ; these are connected by covered runways. Others of the huts are used as laboratories, staff quarters, &c. Each of the volunteers' flats is planned to accommodate two people ; we thought that few would relish the prospect of ten days' solitary confinement.

THE VOLUNTEERS

We have used our volunteers almost wholly as indicators of the presence of a cold-producing agent in test materials. For instance, after attempted cultivation of a virus in eggs, material from the egg is tested on volunteers to see whether the virus has survived. Each member of a pair of volunteers always receives an inoculum of the same material. We at first recruited almost all our volunteers from among university students during their vacations, but later obtained many from industrial firms, especially Messrs. W. D. & H. O. Wills, from the British Red Cross, and by appeals to the general public through the help of the press and the B.B.C. People between the ages of 18 and 40 were asked to come forward ; they had to be free from a history of tuberculosis, asthma, hay-fever, and recurrent sinusitis. In two and a half years we have had 899 visits from volunteers ; this figure does not involve 899 separate persons, for many have been two or three times. Return visits are allowed after six months' interval.

AMENITIES AND PRECAUTIONS

To evoke a regular flow of volunteers, conditions are made as attractive as possible. Railway fares to and from Salisbury are paid, and volunteers receive 3*s*. a day pocket money. Each "flat" for two persons contains a sitting-room, a dining-room, two bedrooms, a medical room, a bathroom, and a w.c. Sitting-rooms are provided with a wireless set and a telephone. Indoor games and books are provided, and there are facilities, in outlying huts, for playing table-tennis and other games between partners. Precautions are taken to obviate the risk of cross-infection when one recreation room is used later by another pair. Country walks are allowed on condition that built-up areas, buildings, and vehicles are avoided ; and volunteers are asked to keep 30 ft. away from people they meet. Their only human contacts during this ten-day isolation are with their own partners and with the masked and gowned doctor and matron who visit them daily. Individual thermometers and other medical equipment are provided, and each hut has its own crockery, cutlery, and vacuum containers for the delivery of hot meals. These hot meals are left at the entrance to the flats three times a day. Between each ten-day trial a four-day period is used for cleaning out the flats and their contents. No precautions are taken to prevent possible introduction of infection on papers, letters, or the outside of food containers, milk bottles, &c. ; nor are books, games, and furniture sterilised between trials.

ROUTINE OF TRIALS

Volunteers arrive on a Wednesday morning, are met at Salisbury station, are brought to the hospital, and have a talk explaining the nature of the trial and the

* The work from Harvard Hospital is presented on behalf of the Common Cold Research team. Many of the ideas put forward in this paper arose in course of discussion within the team. Members of the team : (*a*) those engaged wholly or mainly on this problem, C. H. ANDREWES, M.D., F.R.S., the late D. K. M. CHALMERS, M.D., D.P.H., K. R. DUMBELL, M.D., F. FULTON, D.M., E. J. LOWBURY, M.B., T. SOMMERVILLE, M.B. ; (*b*) others collaborating, W. H. BRADLEY, M.D., J. A. DUDGEON, M.D., W. J. ELFORD, D.SC., D. HORSTMANN, M.D., J. S. F. NIVEN, M.D.

reasons for the rules necessary to avoid accidental infection; they then disperse to their flats. They have a routine clinical and X-ray (chest and sinuses) examination and are then observed for three days in case any should already be incubating a cold. All who are not free from signs and symptoms are, together with their partners, excluded from the main trial, but most of these can be used in other studies. On the Saturday they are inoculated intranasally, 0·5 ml. of fluid being run into each nostril with the patient supine. This position is maintained for 2 min., and the person is instructed not to blow his nose for half an hour. A similar technique is used when it is desired to wash out a person's nose to obtain a fresh supply of infectious material. About 10 ml. of saline solution is run into the nostrils a little at a time and then caught in a petri dish when the person tilts his head forward.

Sheets for daily recording of symptoms by the volunteers are provided; the matron visits each flat daily and records temperatures and pulse-rates, and immediately afterwards the clinician makes his round. He notes such signs as watering of the eyes, evidence of nasal obstruction and discharge, and any abnormal signs in nose or throat. He inquires about the amount of nasal discharge during the day, sore-throat, cough, and other symptoms. In practice most information is obtained by inspection of the handkerchiefs used during the past twenty-four hours and of the secretion expelled "on demand." Gross changes in nose and throat have almost always been associated with definite subjective symptoms. An attempt has been made to gauge the severity of colds by giving "marks" for each sign or symptom, greater weight being placed on the objective signs. Colds are finally assessed as severe, moderate, mild, doubtful mild, or absent. For purpose of analysis the "doubtful mild" colds are classed as negative.

PRECAUTIONS AGAINST SUBJECTIVE ERRORS

Frank colds are readily diagnosed. Our test materials, however, often produced symptoms which in the aggregate were significant but which in any one case were hard to interpret. We guarded as carefully as we could against bias, on the part both of volunteers and of observers, which might affect accurate interpretation. Most trials included instillation into some subjects of "control" supposedly inert material. Before inoculation, control and test materials were distributed into bottles, each containing enough for two people and labelled with a different letter. With a table of random numbers the bacteriologist, who alone knew what each bottle contained, allotted one lettered bottle to each flat. Thus volunteers did not know what they were getting nor whether we were expecting them to catch a cold or not. The clinical observer did not know what any pair received until he had committeed himself in writing at the end of the trial as to which had developed a cold and which had not. Even if three pairs had received the same inoculum, these would have been given material from bottles labelled with three different letters; so the clinician would have found it a difficult feat, even if he had tried to guess. From knowledge of their own intense interest in the results of tests, all members of the team felt that this enforcement of complete objectivity was of first-class importance.

This "control" system had the advantages of assuring us, as the study proceeded, that our preliminary quarantine period was long enough and that our isolation precautions were adequate. In practice, of 47 volunteers receiving sterile serum-broth intranasally, 2 developed doubtful mild colds and 45 remained symptom-free. We can now consider how far our studies and those of other workers can give answers to the 8 questions propounded above.

IS THE COMMON COLD AN ENTITY?

One can be fairly sure that several infections induce symptoms such as most people call "colds." We, like several other observers, have produced mild symptoms of a cold by inoculating influenza-A virus attenuated for man by long-continued cultivation in fertile eggs; such symptoms were induced in our trials in 3 of 15 inoculated subjects. It is likely that, in normal circumstances, influenza virus can produce mild cold-like symptoms in some relatively immune people. Dingle and his co-workers (Commission on Acute Respiratory Diseases 1946) have reported that an agent producing atypical pneumonia in some people gave rise in others to symptoms of a common cold; in both groups the incubation period was to 14 days. On the other hand, we have stored at -76°C two strains of cold-producing agents for many months, and with these and materials obtained by serial passage of them through man have produced a disease with only a moderate range of variation in signs and symptoms. Some roughness or soreness of the throat developed in 61 of 88 of these experimental colds, usually right at the onset. The incubation period was normally 2 or 3 days (see table I) with a range of 1–6 days. Nasal discharge was an almost invariable symptom; it was usually thin and serous at first but sometimes viscid from the beginning. Twenty-four hours after the onset it was commonly mucopurulent. Malaise and headache were common at the onset, but fever was exceptional. About a third had cough, usually unproductive. Postnasal discharge was uncommon; so were complications in the form of mild sinusitis or tracheitis. In fact, the experimental colds were rather mild and of brief duration, usually less than 6 or 7 days. Some people reported worsening of symptoms after going home, possibly through exposure to secondarily infecting bacteria. Many subjects receiving known infective material developed symptoms suggesting to them that a cold was developing, but this soon aborted. Such symptoms were not reported by the controls. We therefore suspect that in nature many colds abort spontaneously. The symptoms in our experimental colds were much the same as in the spontaneous colds detected or developing in 71 subjects during their quarantine period; this fact suggests that the disease we have studied possibly represented one of the commonest types of infection in the community. In short, even though there are other agents which produce a picture like that of the common cold, we are likely to find a large part of the total of colds forming "a" disease. Whether there exist different serological types of the causal agent, as with influenza viruses A and B, is an open question.

TABLE I—INCUBATION PERIODS OF EXPERIMENTAL COLDS

Length of incubation (days) ..	1	2	3	4	5	6
No. of definite colds	9	37	34	7	3	2
No. of doubtful mild colds ..	0	6	5	1	6	1

WHAT IS THE CAUSAL AGENT AND WHAT ARE ITS PROPERTIES?

The syndrome just described has been produced by intranasal inoculations in 60% of our volunteers; bacteria-free filtrates through gradocol membranes (average pore diameter 0·7μ) have been almost or quite as effective as unfiltered washings. Such colds have been transmitted in series through four persons and are almost certainly due to a multiplying agent, which we feel is to be regarded as a virus. The incidence of colds as a result of these inoculations has not demonstrably been affected by the age or sex of the subjects. The infectivity is reduced by dilution 1 in 100; with such diluted material 6 colds were produced in 22 subjects

TABLE II—RESULTS OF TESTING FILTRATES OF COMMON-COLD WASHINGS ON VOLUNTEERS

Average pore diameter (mμ)	Number tested	0	±	+
410	3	1	0	2
310	15	5	1	9
230–220	8	7	0	1
140–120	20	10	1	9
68–57	22	20	1	1

+, definite cold ; ±, doubtful mild cold ; 0, no cold.

(27% positive). Washings diluted 1 : 10,000 were inactive (three attempts). Virus filtrates suffered no demonstrable loss on storage in sealed ampoules in dry ice (−76°C) for two years. At −10°C they survived at least 27 days and at 4°C for at least 3 days ; longer periods were not tested.

The size of the virus has been estimated by filtration through Elford's gradocol membranes. In every case at least 10 ml. was filtered to ensure saturation of the membrane and sufficient broth was used as diluent to keep the absorption of virus at a minimum. The results of testing these filtrates on volunteers are shown in table II.

These filtration results suggest that the common cold virus is considerably smaller than the influenza virus. How much smaller is difficult to say, because the filtrates were almost certainly of low titre, and it depends on the significance of the one cold observed in the group of volunteers infected with 68–57mμ filtrates. If this was a genuine experimental cold, the most probable size is about 20mμ or less. If, on the other hand, the cold was only apparently induced by that filtrate, the most probable size is 40–50mμ.

As already mentioned, the first object of the Salisbury unit was to find a laboratory tool with which to study the virus. Successful cultivation of the virus in fertile hens' eggs seemed to offer most hope of attainment. Four commonly used techniques were available to us. For inoculations on chorio-allantoic membranes we used 462 eggs, and for amniotic inoculation 432 ; 28 volunteers were used for testing the membrane "cultures," and 54 for those in the amniotic cavity. 272 eggs were used for attempted cultivations in the allantoic sac, and the resulting fluids were tested in 99 volunteers. Yolk-sac cultivation was tried in 230 eggs, and 65 volunteers were used for testing. No evidence of successful cultivation was obtained, nor even of survival for one passage. At first we hoped we had succeeded ; 15 mild colds and 20 doubtful ones were produced with our "cultures." Uninoculated embryonic membranes and fluids were, however, not so innocuous as serum-broth had proved, for they produced 8 mild and 8 doubtful colds in 57 attempts. The incubation period for these was the same as for our other experimental colds ; we felt it possible that we might be activating with a mild irritant a cold-agent carried by some persons.

Our failure to cultivate a cold virus in fertile eggs contrasts with the published reports of Kneeland et al. (1936), Pollard and Caplovitz (1947), and Topping and Atlas (1947). Possibly some or all of these workers were dealing with a different infectious agent from ours ; this seems especially likely from the account of the clinical features given by Topping and Atlas. Our techniques have, so far as we are aware, duplicated those of American workers. We have also tried to infect with virus several species of animals, using for most of them the technique of "blind passage," which involves passage of possibly infectious material through several animals in series, despite the absence of visible lesions. We used mainly intranasal but also intracerebral, intravenous, corneal, intraocular, and intratesticular inoculation. We did not, for obvious reasons, test chimpanzees, the only known susceptible species other than man. We used rabbits, guineapigs, rats, mice, cotton-rats, hamsters, voles (*Microtus arvensis*), grey squirrels, ferrets, kittens, pigs, hedgehogs, and several species of monkey—baboons (*Papio papio*), a sooty mangabey (*Cercocebus fuliginosus*), brown capuchins (*Cebus fatuellus*), green monkeys (*Cercopithecus œthiops sabœus*), and a red patas monkey (*Erythrocebus patas*). No symptoms or lesions attributable to the common cold were produced in any species, nor did the virus persist even for one passage in the ferret, mouse, hedgehog, hamster, cotton-rat, or capuchin monkey.

Many workers have failed to find in cold secretions cultivable bacteria likely to be of significance. Some bacteriologists nevertheless believe that pneumococci or other bacteria may cause some colds. This idea could be tested without difficulty ; if bacteria-free filtrates of washings from such colds should induce colds transmissible in series, it would seem likely that the bacteria present were merely secondary invaders, arriving with special promptitude.

HOW LONG DOES VIRUS PERSIST IN OR OUT OF THE BODY ?

Clinical opinion supports the view that colds are especially infectious in the early stages. Our experience confirms this ; indeed we have found virus in nasal secretions well before symptoms develop. Volunteers were infected intranasally, and the nasal spaces were washed out 12, 24, 36, and 48 hours later. Only on the last occasion were symptoms present when washings were taken. The washings were inoculated into volunteers ; no virus was detected in the 12-hour washings ; but good "takes" were obtained with the 24-, 36-, and 48-hour specimens—i.e., virus was present, probably plentifully, 24 hours before the cold showed itself.

Direct tests for persistence of virus after a cold are incomplete. Epidemiological evidence, however, suggests that virus dies out rapidly from a small community. Colds normally cease to trouble an isolated group, such as a band of arctic explorers, soon after they have left civilisation behind. According to Paul and Freese (1933) colds become infrequent in Spitzbergen within a fortnight of the departure of the last ship at the end of October, and remain very rare until an epidemic is provoked by the visit of the first ship at the end of the following May. Dr. E. J. S. Woolley informs us that in Tristan da Cunha visiting ships bring with them epidemics of colds, but that these are brought only by ships from Cape Town, the voyage from which lasts not more than 12 days. Ships coming from Panama round Cape Horn do not bring colds. Perhaps the virus normally dies out within a few weeks.

Experiments of ours at first sight conflict with such a view. Nasal washings from normal persons without colds have, in tests on 28 persons, produced 6 colds, all mild ones. It has not yet been proved by serial transfer that these are caused by a virus. Epidemiological data from Spitzbergen and elsewhere show that ships may bring colds to a community even though those on board have no colds. The existence of normal carriers is therefore suggested. Possibly in a large community virus keeps going by passage from man to man, not necessarily producing symptoms in all whom it visits, and tending to die out if it is not from time to time reinforced in its activity by finding a susceptible victim.

We have no direct evidence that cold virus can survive long outside the body. Influenza virus certainly can persist for a fortnight in dust (Edward 1941). There is an exception to the rule that Arctic explorers do not catch colds in polar regions. Several records attest that, when bundles of clothes or blankets which have been stored for many months are opened, an epidemic of colds may result. It would be important to know whether such were really virus colds.

ARE COLDS ALWAYS "CAUGHT"?

That infection is often caught from people with colds cannot be doubted. Attempts to study the matter experimentally are difficult because the incidence of natural contact infections is so low. In one trial at Salisbury three pairs of volunteers were infected. Two of these pairs were chosen as "donors," and normal people ("recipients") were exposed to them by remaining together in one room for about 10 hours. The recipient pairs thereafter remained in isolation. Exposure of 8 persons was in the pre-symptom stage of the donors (24–34 hours after infection); 11 others were exposed to full-blown colds (72–82 hours after infection). Only one unequivocal cold developed, and that after 5 days, in a person exposed to pre-symptom colds; 5 other "recipients" had doubtful symptoms which we could not class as positive; 13 remained symptom-free. This result confirms a report by Kerr and Lagen (1933–34); these workers failed to obtain evidence of natural transmission of colds. Long et al. (1932) record the catching of a cold by two chimpanzees from a person who was incubating one and developed it next day. Reasons are given below for thinking that in all our transmission studies we are attempting with an enormous dose of virus to overcome a fairly high resistance. Because colds do not pass readily to normal resistant people, it does not follow that they do not do so to people who are for some reason vulnerable.

Opinions differ about the rôle of cold feet, draughts, and so forth in inducing colds. Experience in the Arctic suggests that such factors do not act in the absence of the infective factor. It could well be, however, that in people temporarily carrying a virus various happenings could upset a precarious host-virus equilibrium and lead to the appearance of a cold.

BY WHAT MEANS DOES VIRUS SPREAD?

The old idea of droplet infection has in some quarters lost popularity in favour of Wells and Wells' (1936) conception of droplet-nucleus infection. They conceive that many small particles leaving the nose or mouth evaporate instantaneously to a diameter of less than 10μ and remain suspended in the air for an hour or more. Probably only a minority of such nuclei will carry micro-organisms, and these will commonly be exposed to the lethal effects of daylight. In any case the quantity inhaled will be infinitesimal. This infinitesimal dose may well suffice to infect, let us say, a child fully susceptible to measles. Where, however, we are dealing with a population having a fairly high resistance to a particular infective agent, it seems likely that coarse droplets, giving a "direct hit" from a sneeze, or some other method of transferring a large dose, will be more important. If this is so, the prospects of diminishing the incidence of colds by air sterilisation are not very rosy.

Studies in collaboration with the Medical Research Council's air hygiene unit at Salisbury show that bacteria can be dispersed into the air in enormous numbers when handkerchiefs are shaken or even handled. Though at present evidence is inconclusive, it is not unlikely that cold virus can become airborne in the same way. If so, there is much promise in recently developed techniques for impregnating handkerchiefs with disinfectants which will kill the organisms on the handkerchiefs and cut down by 95% the numbers which reach the air on shaking (Dumbell et al. 1947). Unpublished studies show the enormous possibilities of spreading infection by indirect manual transfer—from nose to handkerchief to fingers to anything touched and to someone else's fingers, handkerchief, and nose. In this connexion we recall an observation by Bliss and Long (1933): 5 chimpanzees developed colds 48 hours after eating food prepared by a food-handler in his 2nd day of a severe cold. This person had no direct contact with the apes or their attendants.

HOW COULD COLDS BE ACTIVATED?

One suspects that, if activation of a cold in a virus carrier is possible, it probably operates through some local change in the nasal mucosa. Mudd and Grant (1919) using a thermopile, found that chilling the body caused, by reflex vasoconstriction, a fall of temperature in the nasopharynx. This was not quickly recovered from. The lining of the upper respiratory tract is apparently covered by a sheet of mucus continuously moving backwards. Local drying up of this is a possible factor leading to a temporary breakdown in defence against infection. Several observers attest that allergic reactions in the nasal mucosa to pollens or other allergens may be followed by what seems to be a genuine infectious cold.

WHY ARE COLDS SEASONAL?

We all associate colds with cold weather, but data are scanty and do not all agree as to how much commoner colds are in winter than in summer. Attempts to relate the incidence of cold to temperature, rainfall, humidity, and sunshine have not been convincing. The climatic changes associated with an increase of colds may vary from country to country. Thus the onset of cold weather heralds a wave of colds in temperate climates; elsewhere monsoons may determine the issue. In the Virgin Islands in the West Indies (Milam and Smillie 1931) a wave of colds may come in December, when the temperature is only a few degrees below that at midsummer. Unknown factors may tend to make the disease inherently periodic, and climatic changes, varying from country to country, tend to keep that periodicity in harmony with an annual cycle. One must also bear in mind that people's habits vary through the year; in the winter they crowd more together indoors, whereas in summer many people get a change to another environment. If this involves a holiday in the open air, particularly away from the "madding crowd," the general health may improve but resistance to colds may simultaneously fall.

WHY DOES RESISTANCE TO COLDS VARY?

General experience tells us that resistance to colds does not last long. Dingle and his fellow workers (Commission on Acute Respiratory Diseases 1947) inoculated 5 volunteers with a cold virus and produced colds in 4 of them. Meanwhile they stored some of the same virus in the cold until, 19 days later, these colds had cleared; they then used the stored virus to challenge the immunity of the same 5 persons. Again 4 out of 5 developed colds—the one who had resisted the first inoculation was this time a victim. Such a result need not mean that immunity to colds is necessarily quite so short in natural circumstances.

As already indicated, the dose of virus received when undiluted washings are given intranasally must be thousands of times as big as any conceivable "natural" dose. Even so, about 40% of persons prove resistant, though hardly any of them claims to be free from colds throughout the year. Our data are not yet big enough to satisfy us, but so far they do not suggest that resistance of our volunteers to colds evidently depends on the time elapsed since their last cold. Knowledge of herpes simplex, another recurrent virus disease, renders it arguable that resistance to colds may be independent of variations in antibody level (Burnet 1939). (Those subject to recurrent herpes simplex have high antibody titres; those who never have it are immune despite a lack of antibodies.)

Nowadays one has to consider the "interference phenomenon" in discussion on resistance to virus.

Possibly the carrying of one, perhaps avirulent, virus in the nose may be associated with resistance to other viruses. It would be of interest to try to relate the presence of a "carried" cold virus in normal people to their resistance to inoculation with cold filtrates from another source.

We are quite without evidence as to whether serological types of cold viruses exist. If immunity does not depend on antibodies, the question may be irrelevant. One could argue that, if immunity to the virus is so brief, evolutionary factors might not tend to antigenic diversity. Stories that travellers from abroad develop colds on reaching England may be related less to contact with a strange virus here than to infection through close contact with fellow passengers on board ship before it reaches port.

Many observers attest that resistance to colds varies in individuals from year to year (Gafafer and Doull 1933, Browning 1942) and for no apparent reason. This fact incidentally has much to do with the reputations, transient though these usually are, of most cold preventives.

An interesting possibility has emerged from analysis of our records at Harvard Hospital. With a 60% "take" among volunteers living in pairs one can calculate the probable distribution of colds in each flat, whether two positives together (++) two negatives (00) or one of each kind (+0). In practice members of a pair tend to react alike, the +0 result being much below expectation. Most pairs come together, either as married couples or friends, at any rate from the same environment, and the tendency to react alike is seen particularly in such associates. It is conceivable that, if there is a cyclic variation in susceptibility to colds, close associates might tend to be in the same phase of the cycle. Such a cycle might depend on acquisition, temporary carriage, and ultimate loss of a virus from the nose. Our data are capable of alternative explanations, and this "phase theory" has no strong evidence in its support. We are, however, satisfied that the tendency of members of a pair to react alike is not likely to be due to cross-infection of one partner from the other.

We cannot help concluding that for certain studies our volunteers are too resistant and too variable in their resistance to be ideal subjects for experiment. We should be much better off if we had available Spitzbergenites assembled during April at a period when their susceptibility was probably low and uniform. Experimental work on colds is difficult. We are convinced that much of great value is still to be learnt simply by accurate observation and recording of happenings in suitable, particularly in isolated, communities, in the Arctic or islands and in ships.

CONCLUSION

It may be useful to consider the possibility that colds are due to a virus which, in a large community, is constantly passing from one person to another, usually causing no symptoms, often only abortive ones, and a real cold only when it finds a victim whose local resistance is for some reason at a temporary low ebb. From such a person it is dispersed in greater quantity. Few people harbour it for long; hence in isolated groups it commonly soon dies out. Such a conception is not proven, but is in harmony with known facts.

REFERENCES

Andrewes, C. H. (1948) *J. roy. Soc. Arts*, **96**, 200.

Bliss, E. A., Long, P. H. (1933) *Proc. Soc. exp. Biol., N.Y.* **31**, 31.

British Medical Journal (1947) i, 650.

Browning, C. H. (1942) in Control of Common Fevers. London.

Burnet, F. M. (1939) *Lancet*, i, 629.

Commission on Acute Respiratory Diseases (1946) *Bull. Johns Hopk. Hosp.* **79**, 97.

— (1947) *J. clin. Invest.* **26**, 957, 974.

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HEALTH SERVICES BILL IN AUSTRALIA

FROM OUR AUSTRALIAN CORRESPONDENT

THE health minister on Nov. 24. introduced the long-awaited National Health Services Bill into the Senate. The outstanding feature is the proposal that the government should pay half the doctor's fee. This amount would be paid direct to the doctor in accordance with a "prescribed schedule of fees chargeable by doctors who participate."

Senator McKenna estimated that with full participation by doctors the medical-benefits scheme would cost about £A6 million a year and the dental scheme eventually about £A4 million. Both would be financed from the National Welfare Fund, with capital expenditure an additional charge to be appropriated by Parliament. Senator McKenna explained that the Bill was an enabling measure, giving only the broad outline of the proposed National Health Service. Details of the service and its administration are to be left to progressive development by regulations; this is regarded as the ominous phrase in the Bill, and it may prove the stumbling-block to its acceptance by the British Medical Association in Australia.

Senator McKenna emphasised that the government did not contemplate, nor did the Constitution permit, any nationalisation of doctors, dentists, or allied professions, and "faced with grave deficiencies in numbers of trained personnel, equipment, and buildings, the government realises that establishment of a complete health service must be achieved by gradual development."

GOVERNMENT POWERS

The Bill enables the Commonwealth:

> To provide or arrange for medical and dental services, including general practitioner services, consultant and specialist services, ophthalmic services, maternity and child-health services, convalescent, aftercare, and nursing services, and medical and dental services in universities, schools, and colleges; and to establish and maintain hospitals, laboratories, health centres, and clinics.
>
> To make payments to assist research and provide training courses in medical or dental science; to provide or assist in the provision of postgraduate training and scholarships in medicine and dentistry; to establish and develop courses of training in nursing, dental hygiene, radiography, radiation therapy, physiotherapy, and biochemistry; to undertake to develop and encourage measures for improvement of health and prevention of disease; to undertake the manufacture of medical and dental supplies, appliances, and equipment including visual and hearing-aids if adequate supplies are not assured at a reasonable price from other sources.

The medical benefit scheme would be begun as soon as possible, and extended as rapidly as circumstances permitted to include the various classes of specialists on terms similar to those of general practitioners.

It is proposed to pay a full-time salary to doctors in remote country areas, and to full-time specialists

DR. ANDREWES: REFERENCES—*continued*

Dumbell, K. R., Lovelock, J. E., Lowbury, E. J. (1947) *Lancet*, ii, 811.

Edward, D. G. ff. (1941) *Ibid*, ii, 664.

Gafafer, W. M., Doull, J. A. (1933) *Amer. J. Hyg.* **18**, 712.

Kerr, W. J., Lagen, J. B. (1933–34) *Proc. Soc. exp. Biol., N.Y.* **31**, 713.

Kneeland, Y. jun., Mills, K. C., Dochez, A. R. (1936) *Ibid*, **35**, 213.

Long, P. H., Bliss, E. A., Carpenter, H. M. (1932) *Bull. Johns Hopk. Hosp* **51**, 278.

Milam, D. F., Smillie, W. G. (1931) *J. exp. med.* **53**, 733.

Mudd, S., Grant, S. B. (1919) *J. med. Res.* **40**, 53.

Paul, J. H., Freese, H. L. (1933) *Amer. J. Hyg.* **17**, 517.

Pollard, M., Caplovitz, C. D. (1947) *Science*, **106**, 243.

Topping, N. H., Atlas, L. T. (1947) *Ibid*, p. 636.

Wells, W. F., Wells, M. W. (1936) *J. Amer. Med. Ass.* **107**, 1698, 1805.