pneumophila has been observed; inhalation infection in guinea-pigs required only about one two-hundredth as many organisms as intraperitoneal infection to produce a comparable febrile response.¹

This clinically important feature of *L. pneumophila* might be explained, at least partly, by the unusually acid conditions which it requires for growth. The optimum pH for culture of *L. pneumophila* in vitro is 6.6-6.9.² As the pH is increased beyond 7 growth becomes poorer, until at about 7.25 it is either extremely sparse or does not occur. The pH of fertile hen's egg yolk sac, also used for the culture of *L. pneumophila* (and organisms such as rickettsias), is between 6.6 and 6.85, depending on the age of the embryo.

Human subcutaneous tissue pH is similar to that of blood, about 7.4 at 37°C.³ However, pulmonary tissue pH is much more acid at about 6.7⁴—that is, the hydrogen ion concentration in the lung is about five times that in subcutaneous tissues and optimum for the growth of *Legionella*. If other extrapulmonary tissues have pH values similar to subcutaneous tissue, it is hardly surprising that *L. pneumophila* is primarily a pulmonary pathogen.

A similar argument might also apply to certain other micro-organisms which tend to infect by inhalation, such as *Mycobacterium tuberculosis* (optimum pH 6.5-6.8), *Francisella tularensis* (pH 6.8), and other legionellas. Although the first two have optimal pH values similar to that of *L. pneumophila*, their ability to grow under more alkaline conditions might explain their greater capacity to cause extrapulmonary disease.

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SIR,—Your leading article (2 August, p 339) rightly draws attention to the variable severity of legionnaires' disease, and prompts some comments.

Legionellosis covers an ambiguous clinical spectrum of illness ranging from mild self-limiting disease unassociated with pneumonia (for example, Pontiac fever) to multisystem illness including pneumonia associated with significant case fatality rates; a recent paper described also chronic aspects with pulmonary fibrosis.¹ Despite the extraordinary expansion of knowledge in several aspects of legionnaires' disease, understanding of many pathophysiological reactions in man following legionellosis is still rudimentary, and virtually nothing is known about the factors responsible for disease production, particularly in the lungs.

In addition, the histopathological findings in lung tissue vary considerably and may be due also to secondary infections, the results of therapy, or underlying disease.² The undoubted role of the host defences in determining mild or severe illness is more presumed than established; however, recent experimental observations have demonstrated that *Legionella pneumophila* can enter a type of human cell not specialised for phagocytosis (that is, the fibroblast), thrive intracellularly, and exert a cytopathic effect.³ The marked pulmonary pathology associated with fatal infections by this organism may be related to

initial destruction of lung cells by a similar mechanism. Subsequent bacterial multiplication within inflammatory cells may account for the inflammatory cell necrosis often prominent in the histopathology of legionnaires' disease, and release of lysosomal enzymes from lysed cells may intensify the pulmonary damage.³ In other words, if bacteria are killed by the alveolar macrophage disease is averted, while replication of the invading organism within the phagocyte causes the host to be compromised.⁴ According to most recent data (presented by M A Horwitz and S C Silverstein recently at the 20th Interscience Conference on Antimicrobial Agents and Chemotherapy), *Legionella pneumophila* resists killing by human phagocytes, antibody, and complement.

Finally, you rightly state the relevance of knowledge of the biological characteristics of the causative organism. From this point of view, it is important to call attention to the "toxic" products of the bacterium as potential candidates in the pathogenetic mechanisms.⁵ Until now we have had few data on haemolytic,⁶ proteolytic,⁷ and cytotoxic activities,⁸ and more consistent observations regarding an endotoxin-like property,⁹ demonstrated also in legionella-like organisms.¹⁰

These summarised data are clearly preliminary and their interpretation is limited by the small number of experiments. More detailed study dealing with the biological profile of the bacterium will be necessary. However, despite these limitations, we believe that the findings are very encouraging for the understanding of what has been called the "fascinating yet horrible" organism.

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A better system for polio vaccination in developing countries?

SIR,—In a recent communication in your journal (23 August, p 542) the "cluster" or "pulse" immunisation studies employing trivalent vaccines even with 97.9-99.3% loss in vaccine potency are reported to have yielded seroconversion rates of 74%; 96%, and 71% for types 1, 2, and 3 respectively. These results appear to match well with their earlier results with potent vaccines when used in sporadic manner. It has been presumed that the use of potent vaccines in a mass campaign within a very short span of time would enhance the low seroconversion rates observed so very frequently in warm areas.¹

Strangely enough, the authors have not stressed the need of ensuring delivery in the mouth of each vaccinee of adequate numbers of live virus particles of each type. Certainly it has been customary to assess the live virus

content of a trivalent vaccine in terms of the sum total of live virus particles of three types²; but such a practice seems to be very doubtful indeed, because a partial or even complete inactivation of one or two of three types will be compatible, on in vitro testing, with a satisfactory and adequate total live virus content. Is it therefore not possible that all these low seroconversion rates for type 1 and 3, so far, have in reality been due to the grossly insufficient or even negligible quantum of the homotypic strain in the vaccine drops delivered in the individual's mouth?

The authors would also appear not to have considered the insults and tortures to which even a potent vaccine with an adequate quantum of each type can be subjected to at the final moment of its administration to an individual. Apart from the use of outdated vaccine with hardly enough live virus particles, exposure to sun for long hours, simultaneous ingestion of chlorinated water, dipping the spoons for delivery of vaccine in either bleaching powder or disinfectants and detergents, taking hot drinks just after vaccination, and injecting vaccine into cubes of desiccated semiporous sugar (which may well be full of enteropathogenic microbes) are well recognised.^{2,3} Obviously the final procedures may neutralise all the meticulous planning and care that might have been taken earlier to ensure vaccine of good quality.

It goes without saying that, apart from maintenance of a cold chain during transport of vaccines, only a check on the administration practices in vogue and delivery of an adequate quantum of each serotype to every vaccinee will ensure satisfactory seroconversion rates, as observed in certain areas.⁴ All who are concerned with poliomyelitis all over the globe should wake up to these realities of vaccine potency and the actual administration of vaccine, which alone will solve the problems of the so-called vaccine failures.

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Not so unusual seat-belt injuries

SIR,—I read with approval the various leading articles which offer general support for the compulsory wearing of car seat belts. I feel, however, that the case might be more usefully presented if some specific advice were given on the design of seat belt most recommended, for clearly some must be superior to others.

On that note I write in support of the inertia-reel type of belt, for in the past 18 months I have treated three patients with serious injuries resulting from the use of the fixed variety of seat belt. Each of my patients sustained his injury while alighting from a stationary car: each unwittingly placed one foot in a trailing loop of the seat belt, the entangling effect of which resulted in a heavy fall to the ground.

The first patient, a woman aged 61 years, sustained an external rotation, fracture-dislocation of the right ankle. The second patient, a woman aged 63 years, sustained a comminuted fracture of the lower third of her left tibia and fibula. The third patient, a man

aged 35 years, sustained a Maisonneuve fracture-dislocation of the left ankle.

Initially I believed these accidents to be uncommon, but on searching the literature I find 11 similar cases reported by Nemes and Kerényi,¹ and it seems likely that such accidents are much more frequent than might be anticipated, for clearly only the seriously injured patients will present at hospital.

Therefore, I would like to suggest, that when the compulsory wearing of seat belts is again raised, the discussion be broadened to include the relative merits of the different types available, for however strong the arguments are for their use, it is to be strongly doubted whether unfortunate experiences, such as befell my patients, will increase the enthusiasm for seat belts in drivers who consistently oppose the idea.

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¹ Nemes GA, Kerényi IG. *J Trauma* 1978;18:736-7.

Health education to improve rubella immunisation in schools

SIR,—I was most interested to read the paper "Health education to improve rubella immunisation in schools" by Dr S A M Jones (6 September, p 649), because I wrote on rubella immunisation in my thesis for the DPH in 1972 at Manchester University Department of Social and Preventive Medicine.

I personally designed a form for use in the school health service, based on survey results for my thesis. I found that use of this form alone, without the concomitant use of other health education, produced an uptake of vaccine of 85-95%. These results have been consistently obtained over a period of eight years, in the schools which I have served as a clinical medical officer, whereas other schools in the other parts of the Blackburn Health District have had an uptake of rubella vaccine of only 30-50%. The differences in uptake were due, in my opinion, to the design of the consent form. My consent form made clear the fact that all girls should be immunised because a history of German measles could not be relied on, that rubella caused serious congenital abnormalities in the unborn child of the non-immune young woman if this disease occurred at a critical time of pregnancy, and that rubella vaccination would prevent this eventuality. Other forms in use at this time in the area did not make these points at all clear. In fact one form allowed an unconfirmed past history of rubella as a reason for not having the vaccination. Another form simply offered the vaccine without any explanation as to why it was a good thing to accept it. Naturally also, health education talks and slide shows were not used.

I am pleased to state that the message has at last been understood in the Blackburn Health District and a sensible consent form has been produced, which explains properly the reasons for rubella vaccination. Also formal health education is to be given.

My present impression is that the total percentage uptake will not be improved in the schools I serve, or used to serve, because there is always a certain number of parents who will not see the future advantage that

their daughters will enjoy and are against any immunisation on principle. At present, approximately 10% of parents at one school have sent the new forms back refusing their consent, and at present all forms except one have been returned. However I feel that in other parts of the health district the uptake will radically improve because the parents will have on the consent form more information and more accurate facts on which to base their consent. The health education programme will also tend to influence the compliance of the schoolgirls involved, since the urban areas of the Blackburn Health District tend to house more deprived families than the relatively prosperous Ribbles Valley and they will be able to see that vaccination is to their personal advantage.

However, I feel that eight years is a long time to evolve an effective method of achieving a high uptake of rubella vaccine. May I point out that the *British Medical Journal* refused to publish my thesis in 1972, nor did it ask me to write a short article on my findings. Perhaps, if the findings of my thesis had been disseminated sooner a more effective rubella vaccination campaign would also have evolved sooner in more areas of the country. Also perhaps a more effective uptake of rubella vaccine would have been achieved if the DHSS had issued more concrete guidelines on the approach medical officers should take in introducing the rubella vaccination campaign into their areas.

In conclusion, my own findings and those of Dr S A M Jones show that a clear understanding of the reasons for rubella vaccination is necessary for a maximal uptake of rubella vaccine. My own experience suggests that a suitably worded consent form which is efficiently distributed and collected is sufficient.

Perhaps additional health education may reinforce the message, but I feel that Dr Jones's findings would not have been as conclusive if his survey had been carried out in the Ribbles Valley.

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Bone-marrow aspiration and trephine biopsy

SIR,—The article on bone-marrow aspiration and trephine biopsy (26 July, p 280) justifies four comments. Firstly, it is my opinion, based on well over 10 000 personally conducted bone-marrow aspirations and trephine biopsies, that the sternum should not be used for this procedure unless previous irradiation renders the iliac crest unsuitable. This anatomical site leaves the patient virtually unable to avoid following each manoeuvre of the operator, and I have found this to be a needless cause for anxiety. Essentially the same information can be obtained with less discomfort to the patient by aspirating material from the iliac crest—preferably posteriorly.

Secondly, in the preparation of the slides it is a useful practice to gently crush the particles left in the trails. If this is done with care no morphological distortion of the cell should occur and, instead of being left with a lump of material entirely unsuitable for interpretation, excellent morphological display of cells can routinely be obtained.

Thirdly, I respectfully submit that inadequate attention is given to the technique for the trephine biopsy. It is seldom necessary to

incise the skin if the obturator is sharp, although that is a matter of personal preference. My major criticism is that unless the needle is directed anteriorly and outwards at an angle of approximately 15° it will soon encounter the inner table thereby reducing the length of the biopsy or distorting the material by scraping periosteum from the bone. Observation of the proper angle will result in core material greater than 3 cm, and with a little experience the individual performing the procedure will develop the necessary confidence to obtain an adequate biopsy. Since this is invariably an uncomfortable procedure for the patient attention to this type of detail, particularly during training of new registrars, is essential.

Finally, the essential point of aftercare has not been adequately stressed. The firm pressure over the site is generated by the patient lying on his back with the weight concentrated over the biopsy wound. I believe that two or three minutes is too short and at least 15 minutes is required. Where we have tried to reduce this time, or the patient has been uncooperative, local small haematomata may form resulting in discomfort for many days after an otherwise successful procedure.

I would be interested to hear whether others carrying out large numbers of procedures have had similar experience.

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Postoperative care

SIR,—The scandal of inadequate postoperative pain relief referred to by Dr A A Spence (2 August, p 367) is mainly due to inadequate resources in the NHS. A regular four hourly intramuscular injection, intravenous titration of analgesic, or epidural top-up requires the services of a busy nurse or a highly trained anaesthetist; while programmed automatic syringe systems are expensive.

A single injection of 2 mg of preservative-free morphine in 10 ml of normal saline injected into the epidural space at the appropriate level before the induction of general anaesthesia gives prolonged and adequate pain relief postoperatively for up to 24 hours. We use this technique routinely in patients having vascular surgery. These patients usually have pre-existing respiratory and cardiovascular problems. Epidural morphine does not cause autonomic, sensory, or motor paralysis but allows the patient to breathe adequately, minimising postoperative hypoxaemia. The complications of intrathecal morphine (2 August, p 351; 6 September, p 645) are not a feature of epidural morphine.

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Salt and blood pressure in Scotland

SIR,—In their paper "Salt and blood pressure in Scotland" Dr D G Beevers and others (6 September, p 641) concluded that since hypertensive subjects neither consumed nor excreted more sodium than normotensive subjects dietary salt is unlikely to be a major cause of hypertension. Although their statistics are clearly beyond reproach the conclusions appear unwarranted.

If high salt intake is a population-wide characteristic and hypertension is, as generally