the mechanism is so light it is very responsive, allowing extremely rapid trills and ornaments to be played. The plectra are made of special plastic. This is one of the maker's few concessions to the twentieth century, since the more traditional vulture quills are a problem to supply and replace, especially here in Wiltshire.

The most time consuming part of the construction process was the voicing. Each plectrum has to be cut to exactly the right length and thickness so that the notes all sound balanced. I spent many laborious hours with a bright light and a scalpel, improving my command of my native tongue each time I scraped a fraction of a millimetre too far and had to start all over again with a new plectrum.

Mine is a single manual harpsichord. It has 58 keys, each with three strings. This provides great richness of tone. Each string has its own jack, however, so every task was multiplied by 174. This repetitive work had a curiously relaxing, almost hypnotic effect.

The whole thing took about six months to finish.

Since then I have been learning to play it. I spend hours tuning it, too, for it is morbidly sensitive to changes in the weather. For the first 20 minutes or so after a tuning it sounds glorious. It then undergoes a sort of malignant change, especially if the air is damp, and gradually comes to sound like a honky-tonk harpsichord. The frustrations of assembling the kit have now paled into insignificance beside the problems of getting to grips with harpsichord technique. You have no control over how loud a note is, for either the jack plucks a string or it doesn't. But you do have complete control over the timing of each note, and it is this precision that provides the subtlety of playing.

Making the harpsichord was tremendous fun and very satisfying, for I achieved a definite aim. But the real challenge now lies in learning to play it.

The next Early Music Exhibition will be held in London in late October or early November 1993. John Storrs kits are available from North Mundham, Chichester, West Sussex PO20 6JU (tel 0243 776263).

Medicine—the hearing profession?

Mark J Clemons, Kate R Clemons, Rod Skinner

Severe deafness may seem incompatible with a career in medicine. Many practising doctors, however, have other chronic illnesses or disabilities,¹ which shows that doctors do not have to be physically perfect specimens of humanity. Although some medical school admissions tutors are willing to look favourably on applications from young people with disabilities of this nature, such attitudes may not be universal among those who give careers advice.

This article aims to suggest that hearing impaired medical students can not only survive the undergraduate course but can also function normally once qualified and, furthermore, may be able to offer colleagues and patients special attitudes and skills as a result of their experiences in life. Two of us, MJC and RS, are practising doctors who have been deaf from infancy; KRC, a medical student studying the education of the hearing impaired child and adult, helped to clarify many of the views expressed in this paper.

Using the "good" ear

I (MJC) have been hearing impaired since infancy, my loss being moderate at low frequencies but profound at higher frequencies. A hearing aid in my less severely affected ear, combined with a degree of speech reading and recognition of non-verbal cues, enables me to maximise my residual hearing. I was brought up in an "oralist" way, living as a hearing person in a hearing world. I learnt to cope in a mainstream school by sitting at the front, asking the teacher to face towards me, and interrupting if I missed anything. I knew I wanted to be a doctor from an early age and was encouraged by family and teachers. I considered myself a successful pupil by any standard, deaf or not, and did not mention my hearing loss on my university application form.

I encountered many difficulties throughout my six years as a student but did not allow them to discourage me. The preclinical course had many problems, especially in lectures. The combination of background noise from 130 fellow students, the continual pacing of many lecturers, and the intermittent obliteration of visual clues by darkness created considerable difficulties. My colleagues were able to "focus"

their hearing onto the lecturer, but this was almost impossible for someone wearing a hearing aid since all of the peripheral sounds were amplified equally, allowing little voluntary selection. I was able to compensate only by concentrated reading around the subject.

In the clinical course, most of the difficulties I encountered were related more to other people's lack of understanding of deafness than to my hearing impairment itself. On my first day on the wards I was humiliated by the consultant, who did not understand that I had failed to hear his questions. There were eight people, in descending order of rank, between us, and the clatter of bedpans was amplified out of all proportion as they were closer to my hearing aid than the consultant was. Even though I had no idea that he was talking to me, I was branded as inattentive. After that I was always to be found at the front of the group on ward rounds. However, I still have to endure the sight of "professionals" shouting at deaf patients and treating them as though they lacked intelligence. This attitude is degrading to the patient and, I feel, to the doctors themselves.

I do not think that my clinical skills have suffered greatly from my hearing impairment. I use a specially amplified stethoscope and have not been aware of missing many auscultatory signs heard by my peers. In the ward I sit by the patients' beds with my "good" ear towards them to maximise my hearing.

I have received much support from my peers and many qualified colleagues, who have shown genuine interest in my problems, readily offering flexibility to smooth my path. Simple words of encouragement from several consultants have strengthened my determination. On qualifying last year, I felt that I could see light at the end of the tunnel. As a working member of the medical team, I am in a better position to manipulate situations to maximise my hearing. Nevertheless I realise my limitations and still need to work hard to compensate for them.

Working at hearing and understanding

In the nine years since I (RS) left medical school, I have worked in a variety of busy junior posts in both

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medicine and paediatrics, and I am now a lecturer and senior registrar in paediatric oncology. There's nothing unusual about this, except for the fact that I suffer from severe bilateral sensorineural hearing loss of 70-80 dB and need to use postauricular hearing aids and an electronically amplified stethoscope.

When I attended a careers meeting at the age of 16, I was advised by a lecturer in social medicine that I had no chance of a medical career. My "deafness" itself seemed to be reason enough—she made no attempt to discuss its severity or inquire how I managed at school. Undaunted, my father and I wrote to the admissions tutors of eight medical schools. The favourable replies from Birmingham and Newcastle encouraged me to apply. After normal interviews, both medical schools offered me a place. I trained at Birmingham, and now find myself in Newcastle.

Many other people told me that I should (not could, an important distinction) forget about wanting to be a doctor. They had the best of intentions—wishing to protect me from the likelihood of disappointment. However, I had wanted to be a doctor since I was six years old and that was all there was to it. Once I was at medical school, my ENT consultant and others suggested various non-clinical careers or "less taxing" clinical careers. But by the time I decided to train in paediatrics they knew me well enough not to attempt to dissuade me.

I do not think that I have needed more natural ability or intelligence than the average medical student. What I have needed is determination, and support from my family, friends, colleagues, teachers, and patients. Every medical student and doctor needs these to a greater or lesser degree.

I do not feel that my hearing loss has had any effect whatsoever on my medical career so far, and I am hopeful that it will not do so in the future. Colleagues, teachers, and patients have treated me as a normal doctor, which is how I see myself. Many close friends and colleagues say that they never think of me as being deaf.

I do not want to paint too rosy a picture of life as a doctor with hearing loss. My ENT surgeon believed that I would always have to work much harder than others at hearing and understanding, and that this would prove very taxing—I have no way of comparing, but I suspect that he was probably right.

However, being deaf and wearing hearing aids has some compensations (I appreciate the peace and quiet of night when I take my aids out) and lighter moments: as a student, I learnt that the whistle due to acoustic feedback from hearing aids can mimic bleeps, especially "cardiac arrest" calls, perfectly.

An insurmountable barrier?

What is our conclusion? We believe that deafness, or any other chronic illness or disability, is not necessarily an insurmountable barrier to a medical career. Only when the person is considered as a whole can decisions on his or her suitability for a job or degree course be made. Evaluation of how disabled applicants cope with daily life and school may be very informative—if they have managed to get as far as seriously considering their chosen career, they may have much to offer it.

1 Walters S. A doctor despite a disability. *BMJ* 1988;297:1665-6.

The practical physics of hearing aids

N D N Belham

Audiometric testing shows that, with the onset of old age, the general sensitivity of hearing decreases and the frequency response of the ear falls off rapidly for sounds of high pitch—above about 2000 Hz. The basic electronic hearing aid consists of microphone, amplifier, and earpiece, so it would seem logical to increase the amplification for high pitched sounds. Unfortunately this action has an unwanted side effect, which can be severe enough to cause some people to discard the aid altogether: it enhances room noise considerably. The results of several simple experiments show how hearing aids, and the conditions for their use, can be improved.

Basic improvements

Journalists are often shown thrusting their microphones quite close to the face of the interviewee in order to cut down unwanted sound. Pop stars act in a similar manner, almost swallowing their microphones to cut down feedback from the blasting loudspeakers. This suggests an answer to the problem of amplification experienced by hearing aid users. It is to connect the microphone to a long lead and to place it near to the source of the wanted sound. Electret microphones are most suited to be placed near a television as they are not affected by the magnetic fields produced there. Several friends were fitted up in this way—to the satisfaction of both patient and spouse. The technique was extended when a group of people visited a person with hearing difficulties. For the experiment a ring main was fitted round the edge of the room with a plug box near each

chair and the television. Small microphones were clipped to the clothing of each person, rather like on a chat show. At the end of the afternoon the daughter remarked that she had not heard her father talk so much for years.

A very simple amplifier is quite effective. A low noise transistor (for example, BC109) followed by a low power integrated circuit, such as the LM386, will do the job. The cost of the components, including 8.4 V PP3 nicad rechargeable battery and lightweight headphones, need not exceed £20.

Hearing on the move

Experiments were then conducted to test ways of dispensing with the microphone lead. A pair of walkie-talkies is a possible solution but has two disadvantages. The first is lack of privacy. The radio signal will travel all over the neighbourhood and anyone with a suitable receiver can pick it up. Chance remarks could therefore lead to social chaos. The second disadvantage is that such a system is not adaptable for group use. More than one transmitter tuned to close frequencies will produce audible heterodyne tones (whistles).

Another possibility is to use infrared as a link. Although this worked, daylight produced a continuous background hiss and artificial light produced a steady hum owing to current alternations. To overcome these two disadvantages powerful transmitters would be needed. This system would be a heavy drain on battery power as hearing aids are used for long periods.

Magnetic loops are very costly compared with a

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