An interview with Gerta Vrbová

Conducted by Thelma Lovick with David Miller
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This is the transcript of an interview of the Oral Histories Project for The Society's History & Archives Committee. The original digital sound recording is lodged with the Society and will be placed in its archive at The Wellcome Library.

The Physiological Society

Gerta Vrbová photographed by David Miller in May 2013.

DM: We are here to interview Gerta Vrbová and Thelma Lovick is going to be principally conducting the discussion and carrying it along.

TL: I'd like to put on record how pleased The Physiological Society is that you've agreed to come and do this interview and talk to us about your life because it's been a very, very interesting and unusual one as I'm sure you're aware. And I think it's something we really do need to record. Now you've said to me that you'd like to talk about three main things. Firstly, your impressions on arriving from Czechoslovakia to the UK, I think it was in the late 1950s wasn't it?

GV: It was in 1959.

TL: 1959, so that's going to be an interesting part. And then of course we're all interested in your contribution to science, to physiology, which has not been inconsiderable. And the one thing that we're fascinated to hear is what you would have done with hindsight. So Gerta, please …

GV: Well I came to this country because while I was in Czechoslovakia, I met an Englishman called Sidney Hilton and we fell in love, wanted to stay together. And really the reason why I came to this country was because I wanted to live with Sidney. And so when I finally managed, because we had a lot of obstacles, to come to this country and get married, I was so happy that everything was rosy. Really my life seemed to be absolutely wonderful. And so my personal impressions when I first came seemed to be that there were many positive things in this country and I felt that I could really fit in very well. I was particularly impressed, and I must say this because this is a talk that concerns The Physiological Society, I was particularly impressed with The Physiological Society as it was then and with the training that young people got to conform to the standards of The Society. What impressed

me most was that young people learned how to give talks and how to explain what they thought and what the science was to everybody, not just to people that they were close to scientifically. And this made a tremendous impression on me, in spite of the fact that I really suffered when I gave my first talk to The Physiological Society. I was rehearsed at Mill Hill and it was a very traumatic experience. And when I first gave my talk, which was 10 minutes, I had four slides, which was the rule. And then when I finished they tore the thing to pieces. They said that it's impossible, that I don't consider the fact that a talk to The Society should be entertaining, that it's not just about science but it's about making the audience interested in you and the science, and I was reduced to tears. I had about four rehearsals and the third one, he got me to write everything out and then he underlined, 'here you turn to the audience, then you turn to the blackboard when you are talking about this.' And actually it was incredibly helpful. I'll never forget that because it helped me throughout my life for other things as well to consider that what you're doing is not just communicating your results but it's entertaining your audience. And that was one thing that impressed me with The Physiological Society . But the other thing that impressed me was that these fantastically bright scientists like Hodgkin, Huxley, Katz, that they took the trouble to educate young people by discussing their work. And what also was very impressive was it wasn't only when the work was relevant to their field of work but it was in general talks as well. And I think that's a pity that we lost that because that was very important and it was in different fields you sort of interacted with people like Hodgkin, Huxley, Katz who told you things from a completely different point of view. But they were very impressive. So when I came to this country that impressed me very much.

Then I worked for a time at the Royal Free Hospital in pharmacology and in Nora Zaimis's Department of Pharmacology where she was studying the role of depolarising drugs on neuromuscular transmission, which was a very important topic because it changed the whole field of anaesthesiology. I met some very interesting people there and I was very impressed with the very informal atmosphere. In most of the British scientific institutions compared to the ones on the Continent, I remember sometimes I was quite fascinated by the thing that it didn't matter if you arrived at 11, just for coffee, and it didn't matter if you really wasted your whole day doing something quite different. What mattered most what you did, even if it only lasted for half an hour. And I was very impressed by that. It did sort of promote a creative potential of people because they were not restricted.

TL: How does that compare then with your experience in Prague.

GV: Well my experience in Prague was very formal; working in an institute was very formal. You'd have to clock in in the morning.

TL: Really?

GV: You had to be there at 8 o'clock, clocking in. You had a ticket, you clocked in. And I was very lucky because I was in a group that was led by someone who was trained in Oxford, Ernest Gutmann, and although we had to clock in he wasn't very strict and formal about what we did. But in most other places it was: you had to be there those long hours, no matter what you did. So that was a big change; we had this freedom. And actually somebody from the University of Birmingham stole my card from …

TL: It was Sam Perry [a muscle biochemist in Birmingham], wasn't it? Yes, he told me about that.

GV: He brought me this card where I clocked in. So that's how it compared. And he liked this very unconventional attitudes to science so this was a sort of feat for him that he could steal my card.

DM: Did you have to clock out in Prague?

GV: Yes.

DM: As well as clocking in, so your day was constrained at both ends?

GV: Yes, yes. And you had to sit there whether you had anything to do or not. And this is what impressed me when I came here, that there was really this total freedom of movement and as I said this was very different. So these were the positive things, but I have also negative comments about my experiences and these I think were mainly related to attitudes of British scientists and British physiologists to women.

I remember when I applied for a job at University College and there was this guy, John Gray, a neurophysiologist. I was pregnant when I went for this job interview and when he saw me he said, well he couldn't really give me a job because it wouldn't be fair to my child. He didn't even bother to ask me anything; that was it. Finally, I was actually very lucky because in spite of this, I had the support of Andrew Huxley when I applied for a grant to the MRC. And so I had my own money from the MRC almost straight after I left the Royal Free. But I needed somewhere. I needed space where I could do the experiments that I planned to do. And Arthur Buller, who was a colleague of mine and worked at Kings interested in a similar topic, gave me space. But then he was also very concerned with my being not just a woman but very different from everybody else. I remember I once said to him, 'Arthur, you've got a very beautiful tie.' And he said that no English woman would have made such a personal comment to a colleague. And then he was very concerned that I didn't wear a wedding ring. 'Where is your wedding ring? Are you really married?' And so he was very conventional. And then the other thing that was negative was also reflected in Buller's attitude that he clearly didn't like unconventional ideas at that time, not very much. I had this idea that cell properties are affected and determined by activity and that was different from the idea that Eccles had and all the big names in the field. And people found it difficult to accept something that was different from the view of these big names and came from somebody who was a nobody. And again the only person who really responded, perhaps, or the person who supported me very much, was Andrew Huxley. The meetings of The Physiological Society when my colleague or I gave a talk were usually very lively because the 'conventional' group of people were attacking us. It was a bit like a bullfight; the lecture theatre was crowded because many physiologists wanted to hear the lively discussions we had. I remember at one time Andrew Huxley was chairing the session – I don't know whether I or a colleague of mine gave a paper – and Huxley praised it because our ideas were inspired by him. This was very badly accepted by the audience because it suppressed all the fun. And then these meetings became much quieter. So this was a negative thing about my feelings about coming here.

TL: So did you think that scientifically you might have made a mistake to come here?

GV: No, no, because it was a much more lively intellectual atmosphere and the discussions were particularly interesting because they were criticisms of my ideas and criticisms of what I was doing and that's very challenging, and I really enjoyed that and was very thrilled by it. It

made you think much more actively about everything because at that time it seemed that the whole world was against us. So I thought, 'Maybe they are right.'

DM: So at the time you were describing, Andrew would already have been at University College so were you able to meet him. You were saying how supportive he was. How did that actually happen?

GV: I first met Andrew and discussed my work when we organised a meeting together on slow and fast muscle and this is when we discussed a lot of the work together also. This meeting was in Birmingham – when I was already in Birmingham – and Huxley was at University College when he first talked to me about my work. But I was also very impressed at some other people who were prepared to take a lot of trouble to help me write papers. I remember I wrote a paper for *The Journal of Physiology* and Merton from Cambridge was one of the referees when I was at Kings College. Merton came to Kings College to see me to rewrite the paper with me. And that impressed me.

TL: That's a very generous thing to do, isn't it?

GV: Yes, because my English wasn't very good and also the way I wrote papers wasn't accomplished. I wasn't that well trained, and Merton came down and spent a whole day with me at Kings College to help me to rewrite the paper in a way that would be acceptable to *The Journal*. And it was accepted!

TL: So obviously he had great confidence in the work, just that your style …

GV: Well he thought it was interesting and I don't know, maybe he thought that a person who comes from that part of the world needs a bit of help. I don't know what, but he came down from Cambridge and he spent a day rewriting the paper with me.

TL: Well that's lovely.

GV: Some people were really, very, very generous.

TL: So you mentioned three places: you worked at the Royal Free to start off with, then you came …

GV: Then I went to Kings College in Arthur Buller's department and that's when I started my work on the role of activity in determining muscle properties. Because at the Royal Free I worked mainly with Nora Zaimis on neuromuscular blocking agents in different types of muscles, in slow and fast muscle. But there I met some colleagues at the Royal Free who came with me to King's, which was very nice.

DM: It's a little pedestrian, but what was the form of your employment then? As where were you employed?

GV: At the Royal Free. Nora Zaimis had a grant from a pharmaceutical company and I was a research assistant. And then I had my own grant from the Medical Research Council and with that grant I went to King's College. And on that grant I had a post doc and a technician. And two people from the Royal Free came with me then to King's.

TL: Was your salary on that grant?

GV: Yes. My salary and all my research expenditure and the post doc and a technician.

TL: Very unusual.

GV: Very generous. For somebody who really had no background in this country my colleagues were very good to me. I was very lucky. So with that grant I went to King's College and then I was at King's College I think about three years and I had two children during that time, two additional children because I came here with two children from my first marriage. And while I was at King's College I had two more children, so then I had a family of four and I was really very busy.

DM: You could say.

GV: And then my husband, Sidney Hilton, got a job in Birmingham and I was very upset about that because I was just settled at King's and I had a very active group there. And the other thing is my two girls from Czechoslovakia that I brought with me, they settled in a school here in London and I really didn't want to move them again and unsettle them again. I was very, very upset that Sidney accepted this job. I remember that I was asked by Feldberg to come for dinner to his house and he gave me a talking to that this is a terrible attitude I have because a wife should follow the husband wherever the husband goes, and that I shouldn't oppose his appointment to Birmingham. What upset me most is that he didn't consider the fact that it involved not just me but the whole family. And he had no sympathy for that.

DM: So you just related in this story that it was regarded as strange that you commented on somebody's tie but at the same time it's not strange that somebody dissects your entire life and career and gives you recommendations.

GV: Yes. But it was at the time the attitude. And Feldberg was terribly … well he was really a very sort of macho person: 'you do what your husband wants you to do.' And well so then we went to Birmingham, Sidney and I and the children and it was very hard for me, although I got my grant transferred to Birmingham. I first went to the Anatomy Department because I thought it would be easier not to work in my husband's department. So I went to Sir Solly Zuckerman's Anatomy Department and that was a very strange place. I think because it was totally sort of ruled by Solly Zuckerman who gave rewards to people like an FRS, 'If you cut my roses while I am away ...' It was a very strange place, the Anatomy Department and I didn't last out very long. I only spent there about a year because I couldn't stand it; it was so, you could say, corrupt or whatever, but it all depended how you behaved to Sir Solly Zuckerman, what you achieved there.

DM: And you were still at this point independently funded because …

GV: I was independent.

DM: Because you had your grant and …

GV: Yes, and I had space in the Anatomy Department, but I didn't like it. In fact others also left because they didn't like it. It was a very strange department. But they had a lot of money because Zuckerman was a very influential person, so they were very well funded and I think the teaching of anatomy was very good; they had very good anatomy teachers there. So then I moved to the Physiology Department and that's when I really started seriously with studying the effects of activity on muscle. So now perhaps I should talk about my work.

TL: Yes, can I just ask you before you do that, when you were an independent post doc basically, research fellow, which at the time was quite an incredible thing to do …

GV: Yes, without any degree, English degree.

TL: It was a tremendous vote of confidence in you I think by the scientific community.

GV: Well I think that it was really. I don't know whether it was, it wasn't just Andrew Huxley but there were a lot of people that thought that some of my ideas may be very interesting and that's why I think they had confidence in me.

TL: Can you tell us a little bit about the work that you were doing in Prague?

GV: Well I did work on how muscle changes in response to different changes of activity and to other different conditions and I had quite a few papers from Czechoslovakia on that topic. And I think Ernest Gutmann, my mentor in Czechoslovakia, had a very good reputation because he spent the war in Oxford and he trained us quite well. His work was very much appreciated. He worked on regeneration of peripheral nerves and on muscle and collaborated with Peter Medawar and J. Z. Young. And so I think that was one reason why people had confidence in me because I worked with Ernest Gutmann: he was a very good scientist with many new unconventional ideas. I think that also people probably appreciated that I had my own ideas and I stood up for them.

TL: But actually, as you said, you were discriminated against as a woman in science at that time. That might have made you seem very difficult.

GV: Well I might have been discriminated against but not enough to stop me … I remember that I once asked Andrew Huxley why there is so much discrimination against women and why men find it so difficult to accept women as colleagues, and he had a very funny response. He said, 'Well, we want to put them on a pedestal and admire them; we don't want them as colleagues.' [laughter]

TL: So we're a different species then?

GV: A different species. But anyway, it also helped that I had Sidney as a husband who was then very supportive and did help me.

TL: You said at the beginning the real, the major reason you came to the UK was Sidney, so it was a personal reason, but do you think that scientifically you would have been happy to stay in Prague if you hadn't met Sidney?

GV: I think I could have, I think I would probably have done the same things in Prague scientifically as I did here because the whole group of Ernest Gutmann were involved in this idea that what's important for muscle is some mysterious trophic influence. And I didn't quite agree with that; I though the most important thing is the activity that the muscle does; maybe the trophic factors mediate some of that activity, but they are not the main thing: that activity is the important thing. And so it would have probably taken me longer to do it in Czechoslovakia because I wouldn't have had the facilities and the things that I had in this country.

TL: Even the equipment?

GV: Well the materials because the reason why, when I came to England, I could do the experiments that I did was that new, 'implantable' materials were developed because of cardiac surgery and pace-makers; all the electrodes and everything; they were implantable materials that did not cause any reaction or rejection . And what I wanted to look at was how in chronic activity, chronic stimulation would change muscles. Without the availability of these materials I couldn't have done the experiments I had done. And these materials were not available in Czechoslovakia. They didn't have implantable plastics that did not produce any body reaction, and so I think that more than equipment it was the progress in material sciences that helped me to do the work that I've done. And so I think I would have got there in the end but …

TL: Not quite so quickly.

GV: Not quite as easily.

TL: How much contact did you have? Because Eastern Europe was sort of closed, wasn't it?

GV: From Czechoslovakia?

TL: With scientists in the West?

GV: No, we did try very hard, and the fact that Ernest had these contacts with Oxford made it possible for us to actually communicate with people in the West, and we read all the papers; we were very keen to have journal clubs every week. And we were not that cut off. We were very much also influenced by Eastern Europe, and that was also quite helpful. For example we had very good contact with China because that was also a communist country and we met some very interesting people, a very good scientist from Shanghai, and some of them came to Prague.

TL: So in terms of your restrictions on travel, you had enormous difficulty getting from Czechoslovakia to the UK but did you have the opportunity to travel freely within the Soviet Block or for example to visit China?

GV: Well we could travel to Hungary and to Poland and some of us travelled to Russia, but I was never in Russia. Yes we could travel to Poland and to Hungary and that's how I left, through Poland.

TL: Yes, I know.

GV: And I mean you met one of my Polish colleagues whom I had contacted; he was your supervisor.

TL: Yes he was: Andrzej Zbrozyna, who was at the Nevsky Institute at the time, wasn't he, in Warsaw? By chance I was his PhD student.

DM: Small world.

TL: And he helped Gerta enormously.

GV: He helped me with my children to get to Poland from Czechoslovakia when I escaped. He was very important for my escape.

DM: That's interesting in itself because one might think that to get from Czechoslovakia to Austria might have been the most obvious route, but I guess that's the one that was most difficult.

GV: No, that was very difficult to get to Austria. But to get to Poland wasn't so difficult. And at that time Poland had a new administration [in 1959], because Gomulka took over from a very much more Russian-oriented leader and he installed a new administration which was very inexperienced and that's why I could get through the passport control in Poland and go to Denmark from Poland. That's what I did. But also the Polish scientists were incredibly helpful in collaborating in my escape. And not just Andzrej Zbrozyna but the whole institute; they really enjoyed this defiance of the rules!

TL: Do you think that your experience – your life experiences during the war, which was dreadful, and then your escape – do you think that helped you as a scientists?

GV: Oh yes, it helped me to know that you can cross borders without being discovered, that you don't need permission to cross, to do anything; that you can do it. Yes, I mean I was well trained because by the time I did my escape from Czechoslovakia I crossed borders illegally during the second world war at least three times so I had very good training in that. [laughter]

DM: In this few months the kind of discussions, as you know, that are happening politically in Britain with things like restrictions of visas for visiting students from outside the EU. I mean, your experience seems to me to be fantastically positive to hear about, for others to hear about, but the way you are saying it is fascinating. To break the rules and to get in …

GV: Yes.

DM: And to be an illegal emigrant in your case as well as immigrant and so on; it's a fantastic model.

GV: I had a very strange experience in England because when I came to Denmark I didn't want to stay. I came from Poland to Denmark and I didn't want to stay in Denmark; well I don't want to go into detail because it's all in my book *Betrayed Generation*.

DM: Sure.

GV: I wanted to come to England because that's where I wanted to live, and I didn't want my children to have to spend time in a different country then change again. So I invaded England. [laughter] I changed my ticket because my ticket was Warsaw, Copenhagen, Prague and that was sent to me by Sidney. And I changed the ticket to Warsaw, Copenhagen, London. And so I thought when the immigration authorities will see me with two children they would certainly let me in. [laughter] So I came to Heathrow airport and there was this immigration officer and he said, 'Well you don't have any English visa', and they put us in a sort of prison flat and sent us back to Denmark; they didn't let me in. They wouldn't. Even though I had a job offer, I had a job offer from the Royal Free that they would employ me but they wouldn't give me a visa at Heathrow on the spot and they sent me back to Denmark. And the Danes were incredibly helpful and very, very informal because when I came back to Denmark with these two children, aged 4 and 6 so it was really quite hard. This immigration officer asked me, 'Well, you know, do you want to go back to Czechoslovakia or do you want to stay here?' So I said, 'I want to stay here.' So then

he said, 'Well will you get some employment?' And I said, 'Well, I probably will work somewhere.' And then he said, 'Then it's better if we don't give you any sort of proper papers because then you don't have to pay tax.' [laughter] 'All I will give you is a phone number to ring up if you need anything from a bank or anything, where you have to identify yourself.' And he gave me a password and whenever I needed anything I just rang up that number and I had no documents; I had nothing in Denmark. I was there completely sort of 'non-existent' and when I got a fellowship and did work in a very good laboratory I didn't have to pay tax. But, for a bureaucrat to actually say that, I thought was very good.

TL: Yeah, I think it might actually be more difficult these days.

DM: A little.

GV: Well these days they may not have sent me back from here.

DM: Oh I think so. I think I'd be more confident that they would send you back now.

GV: They would send me back definitely?

DM: Oh yes. I mean not from Denmark of course because it's in the EU but to start with you wouldn't have got on the plane without the paperwork, so …

GV: Anyway, so then they told me that they'd only let me in if I'm married. And I was very reluctant because I didn't want to be forced to marry, but then I had to marry and then I got in.

DM: That's fascinating. But as I say I think a lot of this plays into sort of very current topics about restrictions on movement of people.

GV: Yeah.

DM: And also particularly with graduate students being more restricted than they have been recently. So it's fascinating …

GV: Well I think I have great sympathy for some of them because I was really quite spoilt because they put us into this flat which was a very nice flat and they allowed me to see Sidney and my mother-in-law, Sidney's mother, came, and she was very sweet. She spent some time to get to know me and to get to know the children and I had some other visitors who came. So I was in this flat for24 hours and I had quite a good time in that flat. And then British Airways had to take me back to Denmark.

TL: I think you'd have been put in a detention centre these days.

GV: Yes, I would have been.

TL: Until they could deport you.

GV: Well British Airways felt they were responsible for this because they allowed me to board this plane without a visa, so it was their responsibility that I ended up here.

TL: Ah, so it was good luck that you didn't manage to invade the country successfully on your first attempt [laughter] but …

GV: So that is why they had to pay for my fare back, I think. [laughs]

TL: And your second invasion was successful but that was with a visa, was it?

GV: Well, Sidney came and we actually went by boat then because by that time we accumulated a lot of things. And we had to make a statement that we'd get married within seven days of me entering this country. And it was quite funny because I didn't have any clothes to get married in so my mother in law lent me a dress.

DM: Fantastic.

GV: And then we got married in Kensington and we were very conventional.

TL: Well it was quite a long time ago.

GV: Yes.

TL: I mean, it sounds incredible now that to get married was important; to actually be married.

GV: It was important, yes.

TL: Because it's not now.

GV: Well the fact that we were sort of partners didn't make any difference to anybody; nobody accepted that.

DM: No.

TL: You really had to get this piece of paper.

DM: And it seems pivotal from what you described earlier that it must have been within quite a short time that you got this MRC grant that gave you this, it seems to me, vital independence; you were an independent agent.

GV: I think it was about, well I was at the Royal Free for about 9 months, so it must have been about 6 months that I got a grant.

DM: That's amazing.

TL: Yeah, that's fantastic. Because your mind must have been in turmoil. I mean all this, you'd finally made it and you'd brought the children out and it was so difficult. To keep being creative and to work …

GV: And also I felt very happy indeed. I think we were very happily married at that stage really and we felt that we'd got what we wanted; we were a very happy couple. And the only problem was really settling the children, and that was quite difficult because they were very settled in Denmark and then when they came here they had to go to a different school. My older daughter settled quite easily because she was a very accomplished swimmer; the school she went to had a big sports department for swimming and she was a star. But my younger daughter she really didn't like it here and she wanted to go back, she loved Denmark. And I remember I once came to school and the teacher said, 'Great day!' My younger daughter's name is Zuza: 'because Zuza didn't cry all day.' And they gave her a big applause.

TL: So Gerta you're going to tell us a little bit now about your contribution, you've told us about your background …

GV: My contribution. Well it all started with this idea that I tried to explain why muscle properties change and one of the explanations I thought I could provide was that activity is the most important factor for the development of the motor unit. The way the motor unit develops depends on the type of activity that the motor neuron is imposing onto the muscle. And one way of showing this was to externally apply onto the muscle a particular pattern of activity and see whether that will change muscle properties. And so what I think my contribution was was to introduce the method by which you can do that. My colleagues and I used implantable electrodes to stimulate the muscle with patterns of activity that we chose. And then we looked at the muscle properties and saw that it changed its properties according to the pattern of activity that we imposed onto them. What is satisfying is that this result still holds firm, and has been confirmed by others: the pattern of activity does determine some properties of the muscle, not all of them but quite a lot of them. It determines the contractile speed, its endurance, and I think and these of course are regulated by the biochemistry of the muscle. So I think my contribution was to actually introduce and provide evidence for the idea that activity is the most important thing that determines muscle properties. Naturally this activity is imposed on the muscle by the motor neuron and this is why within a muscle group you have different types of motor units because different motoneurones activate the muscle fibres by specific patterns of activity. You have motor neurons that fire at slow frequencies and those that fire at high frequencies, and the muscle fibres these motor neurons supply adapt to this activity and in this way form a spectrum of motor units that then can be used to produce coordinated movements. I think my contribution was to say that activity is the most important factor of determining muscle properties.

And I think that it's quite nice to realise that this hypothesis, or it's no longer a hypothesis, that these results have stood the test of time. A lot of people working on this problem provided support to this idea and also recently discovered how the muscle recognises a particular pattern of activity. Signalling molecules that are important in this process of saying that this muscle is going to be slow, fast or intermediate have now been identified.

I continued to expand the idea of activity on the development of the neuromuscular junction, and there also it seems a very important factor of activity and type of activity for what sort of neuromuscular junction you will have. But it wasn't as dramatic and clear cut as it was for the muscle itself.

So really during my whole career, I followed this notion that activity was a crucial element for the working of excitable cells and it's quite satisfying that we now have all these people that stimulate cortex and stimulate this and that to make people run more quickly and do things better. And the whole industry of stimulation has actually been developing very quickly. The other reason why I'm pleased that I started this research is that it had some practical implications, that this method of stimulating muscles is being used in rehabilitation and in making paralysed people walk again. It's been really a very useful tool, a method in rehabilitation, so it was transferable to practical questions. And I've always been interested in the practical aspect of research and how it could be used for helping people to do things.

TL: When you started on the idea – which was really inquisitiveness, you know, 'How is the muscle performance determined?' – did you ever envisage that it would be taken into the clinic?

GV: Well I did but nobody else did. I remember when I went to ask Doug Willkie once what he thinks, is it a feasible approach? And he said, 'If you do that you will kill the muscle. You couldn't possibly stimulate it for 6 weeks if you're going to stimulate it 12 hours a day; it's just going to die.' And he was wrong! But I had a lot of resistance from many well-established muscle physiologists to the idea that activity may be important. I was therefore particularly pleased that Andrew Huxley supported me. He tried to explain the results of Eccles and Buller on changing muscle properties by cross-innervation by suggesting that this change is due to a change of activity and not as proposed by them by atrophic influence of the nerve. Andrew Huxley said, 'No, it's probably the vibratory stress that you are imposing on a muscle.'This was a very important comment he made and is published in the discussion of the original Buller *et al*. paper. And it really was very important for me that he did really expect that it will work.

TL: Which seems with hindsight seems incredible: why should it die?

GV: Well because if you do such excessive stimulation to a muscle that's never been exposed to such excessive activity it may get ischaemic, it may not have enough energy – I think that was their argument, that there wouldn't be enough energy for it to contract. Interestingly following several hours of stimulation the muscle stops contracting, so it is not vibratory stress but something else that is converting it.

DM: Yes, as far as a short term muscle physiologist is concerned, it's dead.

GV: And the other thing that we have never picked up enough when we worked on this problem, and that was glaring into our eyes, was the fact that the size of fast muscle fibres are getting smaller and that the muscles are actually weaker; so the fast muscles become more fatigue resistant, work very efficiently, but are getting weaker. We never looked at it because we focused our attention on different things. But it's something that I would like to know more about.

So then I spent a lot of time when I was at University College trying to figure out why motor neurons when they develop are dependent on their interaction with a target. And I haven't got an answer to that, but they are. And one of the things that I think may be important is that the motor neuron either has to transmit or to grow, and if you disconnect it from the target and it doesn't transmit and doesn't grow … I think that's why it probably dies, because there's nothing else for it to do! But this is something I'd really like to see whether it is true or not, and we have some project going with a Polish colleague of mine which may give us some sort of answer to that. So that was my last bit of research that I did, but I didn't get a very satisfactory answer regarding activity. Well it is activity because it's got to do something.

DM: That's true.

GV: It would fit in that category. So this is really what I think my contribution was and the satisfying thing as I was saying was that whatever we found is being used in helping people. And all these enormous meetings that they have now with the functional electrical stimulation and all the engineers that are building all sorts of machines [laughter] but it is actually, it's very satisfying that they actually do something because it can get people walking; the Paralympics showed that. Well not just the Paralympics but I think that this whole field of robotics and driving the body with external machines has got to be very

exciting, because there is a great future for it to combine externally driven things and use the excitability and the adaptability of the body to perform.

TL: It's also a really nice example of how different disciplines have to interact. When you mentioned right at the beginning that you felt that if you'd stayed in Prague you wouldn't have progressed so fast because you didn't have access to materials, and so material science was of paramount importance for the rate your work could progress. And now at the latest stage it's not only material science but it's robotics and …

GV: Well yes, but it's for material science as well; it's a combination. Well, what wasn't very successful in humans was using implantable electrodes to drive muscles, and they did much better with providing externally applied electrodes that had, not just electrodes but the machine, the stimulator; they were electromagnetic so they could penetrate much more of the muscle mass in humans. But implantable electrodes in humans were not very successful because of the movement of the muscle; they always get displaced.

DM: Gerta, the way you've described it – so you've had, if you like, this one big idea that you've doggedly pursued and then it's extended itself, but do you have any idea why you were so confident about the plasticity of muscle in response to its stimulation? Do you know where that idea, that set of concepts came from?

GV: I think from bacteriology, because, I don't know why, I was reading about bacteria getting used to penicillin and adapting to different antibiotics. I was just sitting in the library reading about it and how adaptable these bacteria are, and so I thought, well I mean, why not muscle? I think that's how the idea came, from really reading something about resistance to penicillin and how they developed a whole new system of enzymes to cope with it. So I thought, well maybe muscle also will do that.

DM: That's a fantastic analogy, yes.

GV: But I think that most people get their ideas from something quite different.

DM: We like to think so but I'm amazed you could crystallise that so well.

GV: Well I remember it; I remember, this was some time in Prague even, I think, and I was reading about this resistance to penicillin and how careful we have to be about it. And then I thought, 'If there is this adaptability in bacteria, well maybe eukaryotic cells have it too?'

DM: Yeah sure, no that's a wonderful idea. So by the time you spoke about the Buller–Eccles experiment of cross innervation this was already …

GV: Yes, I already had, because some of the papers that Merton was helping me with were about tenotomy, because I tried to alter the activity of postural muscles by stopping the spindles from working. So before I started stimulating I just wanted to make them quiet and then see whether they get fast, and they did get fast. So that was the paper that I published, the first paper. I tried to change the activity by other functional means like producing hypertrophy and moving the synergies and seeing whether these muscles will change. But the fast muscles changed a bit but not very much because the wiring in the spinal cord is very rigid and so the pattern of activity, even when you have hypertrophy, is not altered very much actually. They fire the same pattern, just the load is bigger on the muscle and the load then produces the hypertrophy, not the firing pattern. The firing pattern is very much the same. But with the postural muscles you can change the speed of

contraction just by unloading them. And this is happening more so I think in space flight; that's why they are getting so weak, because the postural muscles are not actually responding and they are getting weaker. But fast muscles that we are using most of the time, their pattern of activity changes very little. Also in space flight the fast muscles are not affected. So that was [laughs] that was what I thought my contribution was. Not very much but there you are!

TL: Oh I think that's a big understatement, Gerta; it's a huge contribution.

GV: It was great fun, I must say; whatever else it was, it was very nice and what was very nice and the reason actually I stopped doing it was that I could predict the result. After a while I knew that this pattern is going to produce this result and that one is going, and then I thought, 'I'm getting bored with it', and I started doing the neuromuscular junction and other things but I probably should have stopped really.

DM: There is another angle which does fascinate me, which I would like to think is quintessentially physiology, in that you had the biological problem but you also had very much the technical problem. And the way you had to solve the technical problem of how to stimulate, what you could stimulate, what patterns you could achieve, how localised it could be; all of this is technical, mechanical, but it feeds into the way you were able to explore the problem and it seems to me that's often the case in physiology; there's a strange tie-up between technique and concept that I don't think is there in a lot of other biological sciences.

GV: Yes, I think this is true, that physiology does combine a lot of cell biology, technology, instrumentation – actually I wasn't very good at instrumentation; I needed a lot of help with that. I could produce different patterns of activity from a commercially available stimulator, but I wasn't very good at designing it. But there were lots of people who did that. The question of pattern of activity has been taken on very much by the commercial people that produce these stimulators. If you read their sort of blurb about what the stimulator does they have all sorts of interesting things: rate at which it increases intensity of stimulus and the rate at which it increases the rate of firing, and then they have different combinations of frequencies for different gadgets because a stimulator is being used now, for example it's being used for incontinence, for prolapse, for all sorts of things. And all these, they are actually very well designed. They have very good programs as to what sort of patterns they should use for various sphincters and pelvic floors. They have done very well, the industrial people that produce these stimulators. And they are very neat gadgets which people can just take into their handbag and use and it's, I think, very important because for a lot of people these disabilities that are connected with incontinence and prolapse are much more worrying. And there's a whole variety of stimulators where the companies have done extremely well in designing them with the right sort of frequencies, the right type of electrodes; very good. The only problem is that, for example in Switzerland and Austria and Sweden they are used much more than here. Here really the surgeons are not very keen to actually tell you to go and get yourself a stimulator for this or that; they don't believe in it very much. I don't know why. But in, for example, Austria if you are in a skiing resort and you break your cruciate ligament on the knee, they put you in plaster but they also make some holes in the plaster so they can stimulate your quadriceps, because that way you may avoid having ligamentary suture because it will strengthen your quadriceps. And the same in Switzerland, in all Swiss resorts you get this put in. In England

if you break your cruciate ligament there are very few orthopaedic surgeons who will tell you, go home, get a stimulator, come in 2 months' time; they will operate. And that is a shame because there are statistics and there is a lot of evidence that you don't need to suture the ligament, that if you strengthen your quadriceps you will be alright. I don't know why English surgeons are so reluctant to accept that. And the physios, it's mainly the private practices that will do that. They are being used for incontinence quite a lot. But I don't think enough for other muscular problems.

TL: But despite your reservations about the conservatism of British surgeons do you feel satisfied with the work you did and what it's led to and what it continues to be?

GV: Well, I think I could have done a lot more, but considering that I had so many other commitments, I think I did quite well.

TL: I think you did quite well!

GV: To talk about what would I have done differently, there's one thing: I should have spent more time with my children. Yeah, I do feel that. Maybe I could have enjoyed them more.

TL: But you were a mother of four, which is an awful load, and yet you've achieved so much scientifically. Was it a terrible strain?

GV: They were very good children; they were really very understanding, and they helped me a lot. Except my son tells me now that I haven't spent enough time with him and that I was always on the phone talking to someone about nerve muscle contraction … just when he wanted to tell me something. But he's done very well.

TL: Do you ever think about how your life would have gone if you hadn't left Czechoslovakia?

GV: If I would have stayed there? Yes, I think about that quite a lot, and I think that I probably would have always felt frustrated that I didn't leave. I think I would have always regretted it, so in some ways I think I needed to go through this even though my marriage collapsed and everything – I did need to explore. And I think if I hadn't left Czechoslovakia, well I think my work wouldn't have been that different; I think I would have done probably similar things in my profession because I was very set on that. And in a way some of my friendships in Czechoslovakia were so intense and close that maybe that would have compensated for a lot. And I still have some friends there that I'm very close to and that's very important, these human relationships, and they weren't always associated with work but with some other activities. So you miss something too when you leave because you miss the relationships that you had for years and that you leave behind, but I knew that.

TL: Yes. It's a calculated risk.

GV: Yes. But I don't, it's very difficult to say what my life would have been there. I think I would have felt very frustrated.

DM: Did you have the opportunity or the inclination, say, to go to the USA? I'm thinking the sort of period of time when things were particularly hard in Britain, you must have had opportunities I'm sure. Did you think about that?

GV: Actually it was very funny. I was very annoyed with the Americans because when I first applied for an American visa, the consul asked me to come and talk to him. And that was I think in 1963/64 or something. And he gave me a long list of jobs that he could offer me in

top universities, but the first thing he asked me: 'This is the first time you are applying for an American visa?' So I said, 'Yes.' And he said, 'And why didn't you apply before?' And I said, 'Well my family is here, my husband is here, I'm here because of them.' And he got so disdainful and then he was telling me how much better I would do in the States. I thought it was so arrogant that I really didn't want to go. And then the other thing that upset me about the States was their sort of hypocrisy. I remember I went to give a paper in New York at the Albert Einstein Institute or wherever, I've forgot where it was, and I gave this paper and people came up to me and said what a wonderful paper it was and how much they enjoyed it. I thought, 'Fantastic'. And the next day I listened to another paper somebody gave which was absolutely awful, but they said the same thing to him as they said to me the previous day. And so I thought, 'Oh God!' And the other thing was I think that I went to give a talk to Washington University at St Louis, about how chemosensitivity is controlled along with the muscle fibre, and then somebody came up to me and said what a wonderful paper it is, and then a month later he published a very similar result and I thought, 'I don't want to be in such a country.'

And also, I was very upset with the arrogance of the consul , and the strange thing was that they ask you when you apply for a visa whether you were a member of the Communist party, and that annoyed me. That's nothing to do with them. I didn't answer that question. And then he gave me a list of jobs I could have, which is the same sort of … and I didn't want to go. Sidney was very tempted. He had an offer, I think, in Los Angeles somewhere and he would have liked to have gone. But I didn't want to go. Also I felt that I'm closer to Europe here, you know; I'm still in Europe, whatever the Conservatives say now! I wasn't too tempted.

DM: I was thinking at around that time there was a period when the brain drain was working, and there was clearly big finance for research in physiological areas and it was very difficult here.

GV: They had a list. The consul had a list of jobs that I could have had with the sort of money I could have had for my work. They were very organised. It wasn't just that they felt there was a brain drain, they really worked at it.

TL: Well they didn't succeed…

DM: No, they didn't.

TL: And that's the UK's gain.

GV: [laughs] Also I thought I'd moved enough. So I was very put off by this arrogance: 'Is it your first time? Why didn't you apply before?' and they're so much better than anything here. I was very cross about it.

TL: Gerta, that's a fabulous story.

GV: But a lot of people went, I think, at that time.

DM: Yes. A lot of folk were tempted and some sort of never came back and it's quite striking.

GV: Yeah. Simon, Richie, Brenda, they all went there. I'm not sure whether they were, I don't know about, but I don't think Brenda was very happy there.

DM: Did you have industrial sponsor money at any stage? Was that a route that opened for you?

GV: I didn't have sponsor money but some people that were producing these stimulators they asked my advice, what frequencies would be best suitable, and they gave me some money for that; consultation money. And I built a summer house on the garden for that money! And that's still standing.

DM: Fantastic.

GV: It wasn't an awful lot; I think I got about £20,000 from them. It was just about enough! And actually I had very friendly relationships with the group of people who were making the stimulators and trying to apply it to humans and they were very nice people.

DM: Well as you say that field has made enormous progress.

GV: Oh it's tremendous, yes. I should have patented it but then I wanted to patent something together with this company because when they were saying about deep vein thrombosis in aeroplanes I wanted to, with these funds, develop a small stimulator that they would give people that are flying on aeroplanes instead of a sock, because a sock is useless, to give them a little stimulator to put on their leg. And I wanted to do this together with this company that I worked with, and University College wasn't interested at all … because I wanted to do it through College, I didn't want to do it as a personal thing. They said that they didn't think it would sell, or something; they rejected the whole project.

TL: Remarkable!

GV: And it would have been very good because, I mean you can go on the aeroplane, it's nothing.

DM: Except I think I am right, if you are stimulated externally it feels as fatiguing as doing it yourself, doesn't it?

GV: Well not if you have the right stimulus pattern because you have long intervals because for this purpose what you want is actually to get the blood flow going, and that's all. You don't want to transform the muscle. You know, so you could have just used vasodilation every 10 minutes or so.

DM: Yes, that would be enough.

GV: And it would have to be a special stimulator, a different one, but College wasn't interested; the Provost wasn't interested at all and they just shelved it … and at this stage they would have made a lot of money.

DM: For sure.

GV: Because they are so cheap to make, I mean it was nothing. And they could have given it to people that fly for £5 and taken it back and…

DM: Well it's still an opportunity; it's open to you.

GV: Somebody should do it, because I think it would be very useful rather than the stupid socks that they're selling you. So these are my experiences with industry. But I had good experiences with a company that was making a sort of stimulator but they were making a stimulator for the beauty industry to make people slim! And that was quite a good one because you lose your muscle bulk and you lose fat, so they were good stimulators. But I'm

not doing anything with them anymore. I think it's been overtaken; there's so much of it. But I met a lot of interesting people who were different from scientists. They really were trying to make money, but that's alright.

DM: Partly thinking that way, did you have any strong connections to the sporting side, because the whole of sports science has grown as an industry, never mind as a human activity?

GV: I didn't have too strong attachments to the sporting side. There was Craig Sharp in Birmingham, who was very keen on trying to do a lot of things in this field. And Craig was a very good friend of mine, but we didn't do very much. He was actually a Glasgow guy, and he came from a very clever lab. He was a vet or something, he was a virologist, he was very well trained, very clever. But I also feel that I'm not sure whether I agree with this top performance, this striving for top performance. I think that it's much more important that children should have enough exercise at school and that they should like doing exercise. Somebody doing something 2 seconds faster than somebody else: I don't know whether that would excite me very much. So I was never very keen on trying to interact with these people who tried to achieve these top performances. And then that's become terribly fashionable now after these Olympic Games. I really think that it's much more important to stop children from being obese, so…

TL: But that's somebody else's problem. Apart from spending more time with your children …

GV: Yes, more time with my children and then the other thing I should have done differently which is more related to the science, I think that I had too big a group …

DM: Really?

GV: When I came to University College I have I don't know how many PhD students, I had a group of about, I don't know, 15 people and I think that was too big. And that meant that because I had a lot of PhD students that the problem sort of sprawled out and it wasn't focused enough because each PhD student had to have his own project and that also takes up an awful lot of time. And I think that it wasn't good for my science, because it stopped being focused, it was sprawling along, and not actually focused enough. It probably was good for training a lot of people because, as I said, I had about 12 PhD students at the time which was too much. And in spite of the fact that I tried to organise it so I had very clever post docs who helped, it meant that each of them had to have an independent project and the whole thing sprawled out a bit and became less focused.

TL: What do you think would have been the optimal size of a research team?

GV: I think two post docs and five PhDs. I think, when I moved to London, I should have not expanded too much, and then I could have focused more on the mechanism that led to these changes of phenotype or the muscle because you can't give a PhD student something that is unlikely to bring a result, and these were problems that may not for a long time be resolved, so I couldn't tackle them and that's where I think I probably I could have done better with myself: to restrict the number of students I had. But then I felt I that I had to have these students because they were mainly women and they came to me because I was a sort of role model and so it was very difficult to restrict it.

DM: One of your great strengths is that you do have such a wide range of collaborators who were trained by you, and in that sense you must feel a huge sense of achievement to have this big family.

GV: Yes, but as I said, it restricts you in what you want to actually investigate because you have to give them something that's solvable, not something that you might not get an answer to for 20 years. But that was my decision; I knew that's what I was doing so I think I may regret it, but I don't think I should have changed it. And I think the other thing that was good about it was that people enjoyed working with it; they had a good time.

TL: That's very, very important.

DM: Yes, well for two things: looking at it from outside we would say, I mean, you can live vicariously through these many people that you have started, and many of them have continued in this scientific area, but also that breadth of coverage is now partly a result of you allowing that dilution to happen.

GV: Yes, I think, and some of my students are doing very well, ex-students doing very well.

TL: That in itself must be very satisfying because it's another legacy …

It's been wonderful, Gerta. I really enjoyed our conversation.

DM: I think we're very flattered by how open you've been about yourself and your history.

GV: I didn't tell you about the breakdown of my marriage [laughs]. I think I'll not finish with that.

DM: At which point, I press the stop button.

GV: You'd better stop! [laughter]

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