Ailsa Land INFORMS History Interview

—extensively edited for clarity—

Introduction. Growing Up in the Birmingham region, England

LÁSZLÓ VÉGH: Hello. I'm László Végh. I'm an associate professor in the Operational Research Group at the London School of Economics, and I'm here today with Ailsa Land, who is an emeritus professor at the LSE. She was one of the founders of the discipline at LSE and one of the pioneers of linear and integer programming. I'm really pleased and honoured to have this interview with her today in Totnes.

Ailsa, I would like to start with some questions about your childhood, your early life. Where did you grow up? I know you've been through various countries. Can you tell me about these years?

AILSA LAND: Thank you. I'm very pleased to meet you. I hope that you can get something that's useful to you out of this interview. I was born in West Bromwich, which is a city close to Birmingham in what is called the Black Country.

My father was from a long-standing family of West Bromwich. He and his family owned a sport shop in West Bromwich, started by his grandfather, and my father was Harold Horton Dicken. And so he was a descendant of this sports trade family, which regarded itself as pretty well thought of in West Bromwich, to the extent that my father was at one point asked if he would stand for the Tory party in the General Election in 1945, which my mother and I wouldn't allow on any account.

My father was in the British army in the First World War. I think he joined up early. I have no information of what he was doing up until 1918. But in 1918, he started a diary, and I have his diary for the whole of 1918. I know exactly how he met my mother and how it came that he invited—asked her to marry him.

She was in the Women's Auxiliary Army, which did exist in the First World War, as well as in the Second. Lots of people don't seem to know this. They were both working in military offices. My mother was born in Glasgow in Scotland, and her mother died when my mother was only a few months old. She was brought up by her family, as one did in those days. So, she was very much an orphan.

She had been working in the post office as a telegraphist using the Morse code to convey the telegraphic messages. Telegraphic messages were received at a local Post Office and then hand-delivered to the intended recipient by a telegraph ‘boy’. That was the way families received news of their loved ones at the front.

She joined this Women's Army Corps, and had found herself, as I say, by 1918, working as a telegraphist in an office in the town of Rouen in France where she met my father, who was a sergeant by this time. And romance developed.

My father left Rouen during 1918 because he had volunteered to join the RAF, which was just beginning to exist. By the end of 1918, before the armistice, he was notionally training to be a pilot but the war came to an end before he did any active service as a pilot.

But a consequence was that when the Second World War broke out, he was taken back into the RAF. He wasn't compelled to as he was above the call-up age.

But we're talking about the time when I was born. I was born at home in this, I think, council house, and removed fairly rapidly to somewhere else in the Birmingham neighbourhood where I grew up. I was the only child.

I had a very happy childhood. My father left the family shop, but he was hired by Dunlop Company, which had a sports section. He was very much a sports retailer. He knew all about the trade. And he became a representative, earning the nickname ‘Dickie Dunlop’. We would now call him, I suppose, a “travelling salesman”.

I started at the local village school. It was a very small school. It had only two classes for all ages up to 14, juniors and the older ones. And I learned to read and write there, though with a lot of education from my mother.

I was then moved to the junior department of a Girls' Grammar School in Litchfield (a City famous as having been the home of Dr Johnson, compiler of the Dictionary that bears his name, as well as its magnificent Cathedral), not far from where we were living by this time.

But I do remember, quite separate from that, having a book about the solar system. I was absolutely grabbed by that. However, I wasn't very happy at that school, either.

LÁSZLÓ VÉGH: Do you recall a particular interest in mathematics?

AILSA LAND: Well, science. But I don't even know how long I was at that school. Perhaps two years, not much more. My parents knew I was not very happy there, not liking the teacher very much. I had the problem of talking too much in class, finding it very difficult to shut up.

Boarding School in Hastings, England

They looked into the problem of finding a nice, small boarding school for me, which they did, a small boarding school in Hastings. So, I was transferred there in 1938, aged 9 or 10 and I did love it there. It was a very small school.

Looking back, I recognize who my fellow students were—mainly children of people who were colonial officers of one kind or another in India or somewhere in the Empire. And they were abandoned in these schools. But it was very good. There were only about 50 kids altogether in this school.

LÁSZLÓ VÉGH: In the entire school?

AILSA LAND: Of all ages. There was an infant school, and there were half a dozen my sort of age. And we were taught in very small groups. And we each worked, particularly in mathematics, we each worked at our own pace. It was very good from that point. Your teacher wasn't particularly mathematical, but you had your textbook, and if you got stuck, you went and asked to talk to her about it, and you raced each other through these books. And this was clearly my strongest point.

But they were very good in taking us to various institutions around Hastings. We went to the gasworks on one occasion, I remember. And we were taken in a little group, in our little school uniforms, and instructed how exactly coking coal was converted into the gas, which was then transported to people's houses, for gas lighting and gas cooking. So, this was this little school using the facilities of the town to teach their children how things worked.

And we went to see a film, a movie, going behind the scenes, seeing how that worked. I think we were getting a good education. Another thing we used to get is the BBC which used to put out educational programs for schools. And I can remember it. Somehow or another, I do remember the construction of how a thermometer came to be designed and used, about air pressure and all that kind of thing, by listening to a radio program. It was on a certain time of the day every week. That was a good series, too. This was a nice school. We had nice grounds, the run of quite decent grounds. There were boys and girls. It was mixed.

LÁSZLÓ VÉGH: Was that usual at that time, to have co-educated schools?

AILSA LAND: We had a little swimming pool. We learned just about swimming, of course, in our little swimming pool. And the boys and girls were all together. We didn't wear swim suits, and I remember, that it was very modern that way. I think we used to go naked on the beach as well, which we wouldn't do now. Very funny. I mean, it's not funny. It's funny that we don't do it now. But at that time, I think, all the boys at that school were below 10 years old.

Emigration to Canada

I was very happy at the school but was there less than two full years, I think. Because in 1939, my parents were sufficiently aware that there was going to be another war, and they did not want to be involved in another war. So, they began to think, where shall we emigrate to?

I know my mother's family had people who'd emigrated, some of them to New Zealand, I believe, and some of them to Canada. And in fact, two of her Aunts had gone to Vancouver. So, it was agreed that in April 1939, at Easter time, my parents sent cables—that was the way you communicated—to these sisters in Vancouver. Could Ailsa and Bess— that was my mother's name—come and visit you at our expense for a holiday?

This was dropped on me when the Easter holidays started. And I said, well, what about school, when the holidays are over? Oh, they said, you might miss a term. Well, you might miss a bit of the term. And in fact, we did on something like two weeks' notice take this decision, that my mother and I, would take off to Vancouver over that April 1939 holiday.

LÁSZLÓ VÉGH: But your father stayed behind.

AILSA LAND: My father stayed behind. My mother's task was to see what the opportunities were in Vancouver. Didn't take long to find out that Vancouver was in the depth of the depression then. But we didn't know that then, so we embarked on one of the big liners, the Athenia. It started in Portsmouth, I think. But we picked it up outside Liverpool by going on a tender from Liverpool to the Athenia, which was anchored outside the port. My father came on the tender with us, before returning to Liverpool. We waved and we didn't know that we weren't going to see him again for 5 and 1/2 years.

Anyway, we got there. And fortunately, this was the time when my mother took up a bit of writing. I found it many years later after she died that she'd written quite a lot. I've transcribed that as well. So have a good record of that journey. We went up the St. Lawrence and we didn't get past Quebec. There we ran into trouble. The St. Lawrence river was still ice-bound and the authorities then thought we didn't have enough money with us to be emigrating to Canada. And we had no sign of support, we didn't have a return ticket. So, they put us in jug for the night. I had one night in jail. But then they contacted our family in Vancouver, who guaranteed us. I don't know what they were using for money at the time. They were very hard up, too. But we got out the next morning.

We managed to get onto the train to Vancouver, which took I think five days and four nights to cross the continent.

I went to school. I somehow managed in a year to go to three different schools in Vancouver.

Just got myself settled in one which was about right, by the summer of 1940. The first half year of 1940 at least was known as the phony war before the Germans invaded Belgium and Holland and British forces were in the wrong place. To everybody's horror we didn't know France was going to fall.

By the early summer of 1940 my mother decided we were going home. So, we took a train. We crossed the border and went to the States, which of course was not at war. Canada by this time was at war. We took the train to New York, where my mother had an old friend. But we couldn't stay in the States, because the money that we were getting from my father in England to live on was not enough to keep us - there'd been a tremendous depreciation in the pound. So, we had to move.

We didn't have enough money to go back to Vancouver. So, we decided to cross the border and visit some of my father's relatives who lived in Toronto. And that's where we settled for the next three years. By this time, I was still accepted at school in Canada based on the work that I'd done in Hastings. My mother told them that I had done mathematics nearly up to calculus level and was literate and well educated. As a result, I was put into the second year of the high school instead of the top year of the juniors. That made me much younger than anybody else in the class.

LÁSZLÓ VÉGH: Your mother's initial plan was to return to England, but then you got stuck again in Toronto for a couple of years?

AILSA LAND: We got stuck in New York, in fact. The ship we booked on had already gone when we got there. We'd been pursued across the continent by cables saying “insane to come”. France fell in June 1940. And we were expecting England to be invaded.

My father by this time had re-joined the Air Force. We decided we couldn't go back. We were stuck in Canada. So, I stayed in that school for three years. It did all right, but got very bored. I used to skip school and go to the movies, quite often bringing other people into disrepute with me.

Enlisting in the Canadian Army at 16

I wouldn't say I was a very successful scholar. I found a lot of this stuff rather boring, really. My birthday was in June, which is when the Canadian school year ended. And one of the things we talked about, my mother and I. Why don't we join the Women's Army or the Women's Air Force or Women's Navy, because they by this time were sending troops, including the women's forces to Britain.

What we didn't know is they didn't send people who were just 18. My mother was in fact over the age limit that they were going to send people, and thinking I was 18 I was clearly not going to be sent. In fact, I was 16.

LÁSZLÓ VÉGH: But yet you claimed you were 18?

AILSA LAND: Yes. Went back and told my mother I'd done it. She went downtown and joined up, too. I spent a good bit of my time learning to type better and shorthand. I qualified as a stenographer in the Canadian Army. My mother and I were separated. I spent time in Saskatoon, Saskatchewan. My mother worked in Toronto all the time.

LÁSZLÓ VÉGH: Here are some pictures.

AILSA LAND: Oh, I like that picture. Yes. It's a nice one. That's my mother and that's me. Of course, we got into the local papers as a mother and daughter joining up. But they didn't let us stay together. Though in the end, we were both working in Ottawa, in National Defence Headquarters.

A job that our office did was taking documents from Britain and reconstructing them and passing them to the Americans, or taking material from the Americans and reconstructing them and retyping them, to pass them to the Brits. So, we were part of the communications relay.

Return to England

LÁSZLÓ VÉGH: When and how did you manage to get back to England?

AILSA LAND: By summer of 1944. Clearly it was pretty obvious that the Allies were going to win the war. What happened to my mother and myself, we were both working in the same office in Ottawa, as I've explained. We had a message from England that my father was very ill and was having an operation on his throat and my mother badly wanted to get home.

The Army was perfectly happy to give her the compassionate discharge and helped to arrange for her to go. But she said “I’m not going without Ailsa”. And they said, “oh she'll have to wait till she's de-mobbed at the end of the war”, and I said “but I'm not 18 yet. I'm still only 17”. I wasn't 18 until D-Day. They couldn't keep me; I had my birth certificate in my pocket.

AILSA LAND: So, I went with her. We went I think in what was probably the last big convoy across the Atlantic. Took us 10 days to cross the Atlantic in November. Which is not a nice time to cross the Atlantic in any size of ship. We were both very seasick for 10 days. But we got back. Of course, by this time my father had had his operation, but when he recovered, they sent him off to Egypt, so we didn't really see very much of him when we got back to England. We did see him when he was recovering.

But we had nowhere to live. The house that we'd expected to go into had been let during the war, and we had no priority. The government didn't allow us to chuck out the tenants and take over. So, we were homeless. Eventually we found accommodation.

Studies at LSE

LÁSZLÓ VÉGH: What was your motivation for choosing LSE, in particular, for choosing economics?

We moved to the north of England to Yorkshire. I started to think about getting ready for going to university. I went to some rather unsatisfactory evening courses. I wasn't prepared to go back to school, which would mean going back into school uniform. It was below my dignity. Coming from Canada I knew little about Universities in Britain, but had heard about LSE from reading about its controversial Professor Harold Laski, and liked the position he took. I applied to the LSE, was rejected the first time – in that post-war period universities only took 10% of their admissions from schools – but accepted me when they discovered I had served in the Canadian Army.

I joined LSE in October 1946 at the beginning of the LSE school year. Most of us did the BSc Econ, which covered a great range of topics. There wasn't a mathematics department then, but there was a statistics department, economics, economic history, and many more. But the first year was a general course where you took a selection of topics, and I took economics and I did well in that, indeed I was awarded a prize for my economics exam. However, not in history nor in geography. I remember getting a disastrous mark on those two topics. But I must have done well on the statistics. Certainly on the economics.

So, I took the economics course. It was—you ask in one of your questions to me how quantitative it was. It wasn't. Economics was very—you've probably seen some of the material that we had. It was all diagrams. Students were taught economics with aid of diagrams to illustrate the theory. The diagrams became more and more complicated. It suited my temperament. I took to it.

LSE had a system of appointing a member of the teaching staff as an annual “tutor” for each undergraduate student. (I assume this is still the case, but don't know for sure). The tutor's duty was to see the student at least once or twice a term, and serve as a first point of contact if the student was in any doubt or difficulty. I was very fortunate in having Karl Popper as my first-year tutor. I believe he had been head hunted to join LSE, from an appointment in New Zealand, in January 1946. He had two “tutees” that year, myself and another first year student, a man who had served in the Army since 1939. Popper would see us together and I became a good friend with my fellow tutee and his wife (who had a first-class degree from LSE, gained during the war years when LSE was located in Cambridge). Popper had just published “The Open Society and its Enemies”. I naturally bought a copy, and equally naturally he asked what I thought of it. I am sure that I responded enthusiastically, though I remember complaining about the way that footnotes were dealt with. He offered to sign the book, but I was dumb enough to reply that I didn't want to bother him!

I suspect that Popper was new to this form of tutoring, and he required us to write an essay—mine was about my opinion on how children should be educated. (Some years later I read it, and destroyed it with embarrassment!) He obviously saw me as extremely naive, not to say, plain ignorant, but he was always very kind and understanding. I had no reluctance to request a reference from him, and he supported me as long as we both were at LSE

I had started by choosing one of my first-year options being mathematics, but quickly realized that the expected level was beyond my attainment. Popper had no difficulty in suggesting that instead I take his course “Introduction to Logic”, since this assumed no prior knowledge. This was a very entertaining course, and I chose his continuing course “Introduction to Scientific Method” to complement my “special subject” of Economics for the remaining years of the degree.

When I say that Popper's course was entertaining, it's because there were some students who had done some study in that area and had very pronounced disagreement with Popper. His response was always to engage in a strongly worded debate with his opponent! To those of us who had not received alternative presentations, there was no question about who won this debate! Of all the courses I attended at LSE, the ones which inspired most vigorous discussion after the lecture was Popper’s course. I didn’t actually purchase Popper’s 1959 “Logic of Scientific Discovery”, but I am sure that by the time one had enjoyed his final year course, one had pretty well covered that ground, with the added pleasure of hearing his debates with students. I did not pursue Popper and controversies, but have never felt it necessary to differ from his devotion to the Open Society and to be wary of its Enemies. I have also always suspected the claims of a science unless they are subject to the possibility of falsification by the discovery of newly discovered facts.

PhD Research

On graduating in 1950, I joined the Economics Research Division as a Research Assistant. We got these miserable salaries, but you worked as an assistant to somebody on the staff, and could boost your income by marking first year statistics exercise and examination papers. That is also where I met Frank Land and his twin brother Ralph. After a courtship conducted largely in the statistical machines room, we married three years later. I took the surname Land as we thought if we later had a family, having the same name would be less confusing for the children.

LÁSZLÓ VÉGH: So, you started working with Helen Makower and George Morton at this point?

AILSA LAND: No, George wasn't there, but supervisor was Helen Makower. Certainly she was before George. George by this time was teaching in Manchester. Helen and George were interested in linear programming, or rather in activity analysis. They were giving seminars on that type of thing.

LÁSZLÓ VÉGH: Yes, so Helen wrote that book on activity analysis, which was like one of the first books of linear programming applied for economics. Was it from her that you first heard about linear programming?

AILSA LAND: It probably was, yes, although I was earning some money by doing some typing for Helen and at the same time learning some maths terminology. One of the things that she was also doing at that time was running short courses for people in

business in London. They were either one week or two weeks courses for people who were either from firms or from big government offices. By this time the Labour Government was running the coal mining industry with a Coal Board and the steel industry. All these things had been nationalized.

There were offices running them in London. And some of their young people that they hired were sent out on LSE courses. They would spend a week doing this elementary statistics course, and quite soon along the way they were doing a linear programming course. Somehow or other I got involved in doing that.

Helen also wanted me to learn to do some of the calculations needed for econometrics. I was sent to Manchester to be taught by George Morton to find out what a matrix was and invert it, which I did. But I have to say that was the worst experience of computing in the whole of my career. We used a desk calculator, where you put in numbers up to five. We worked on a job for the paper company Bowaters and I experimented using a computer by writing a program for LEO where my husband Frank [Land] was a programmer. He ran this program during his lunch break and it seemed to produce miles of printed output.

LÁSZLÓ VÉGH: I wanted to ask you a bit more about your PhD work and your supervisor. So, you mentioned in the earlier discussion that Helen Makower and George Morton were very opposite personalities. But what were they like? What was your experience with both of them?

AILSA LAND: If I tell you when Helen retired what she did, she became a missionary in China, learning Mandarin when she retired, I wasn't a very good research assistant for her. I didn't like the econometric model. I'm sure she thought I was idling away because I spent the summer calculating on these horrible desk calculators. And I discovered that there was a mistake in the scale of the data. It didn’t seem possible to incorporate the correct data item in my calculations rather than just start again. Or that’s what I did, anyway. I think she thought I hadn't achieved very much over that summer and I'd been slogging away at the blasted thing.

Incidentally, Helen was the only one at LSE, when I reappeared after the birth of my first baby, who took it upon herself to tell me that she disapproved of a woman returning to work when she still had a small baby, though I don't doubt that there were others who agreed with her. This didn't affect our friendly relationship and she subsequently invited me to visit her and her partner for an evening meal.

LÁSZLÓ VÉGH: Can you tell me about your work with George Morton?

AILSA LAND: George moved from Manchester University to LSE and I was moved to being his research assistant. George had completed his PhD working on the minimum nutrients in a diet problem, searching for the minimum cost of providing for a country’s diet. As a research assistant my job was to update the current prices in a large number of countries to make comparisons. And I did an awful lot of calculating on that. This

involved setting up a small LP model for each country. I discovered how to use the solution of one country's LP as the initial condition for the next country.

George Morton was the sort of person who pursues new and interesting things, but gives up on what he was then working on even though it was not completed and had not been written up for publication. He would give up on the old stuff and chase for something new. He's an excellent person to have around because of the sharpness of his mind, but is not very good for getting papers published. And as you know, you have to publish or perish.

LÁSZLÓ VÉGH: Well, maybe in those days it wasn't that stark, or was it?

AILSA LAND: Well, it was. He didn't get promoted beyond a Readership at LSE, and if he had published some of these things he did, or started on, he could have easily got published. He was good. We did good work together. I did write some joint stuff with him. At that time, it was called the laundry van problem. We later discovered it was as the TSP (travelling salesman problem).

LÁSZLÓ VÉGH: Yes, on the travelling salesman problem, your paper. That was a joint paper with him.

AILSA LAND: Right, yes. This was trying to find an efficient way of getting good solutions, but not seeking the optimum outcome. It was a heuristic as I recall. It was called the laundry van problem because in those days people on the whole didn't own washing machines. They either went to a public laundry, which they could use, or if they were a bit better off, they sent it to a laundry, and the laundry van company had to ply this route, picking up dirty washing weekly and returning it cleaned. Obviously, the company that ran the laundry had to plan regular travelling salesman type routes.

Mathematics Motivated by Applications

LÁSZLÓ VÉGH: And were you involved with any particular company or you just thought that this is an interesting problem where one might look for an efficient method?

AILSA LAND: Not at that time; it seemed like an interesting problem, planning routes. You'd see vehicles everywhere, and many of them doing regular routes. Why were we interested in these things? Well, we thought is there a way of planning these routes. Graph theory was something that one knew about a bit.

LÁSZLÓ VÉGH: But how did you learn about work in the US and the travelling salesman problem?

AILSA LAND: I can't remember exactly, but the LSE always had American visitors in its Economics and Statistics Departments, and George Morton had visited the States himself. And, of course, we did read the journals. To us then it was just an obvious extension of things that you can do with the simple transportation problem. You want to

extend that to something slightly more complex. If you know the sources and destinations, you hope you find a way to optimize that TSP.

One American visitor who came and taught courses at LSE several times over the years was Harold Kuhn of Princeton University. Harold and his PhD supervisor were responsible for the Kuhn-Tucker conditions for optimality of certain non-linear optimality problems.

My only economics paper concerned Factor Price Equalisation—the proposition that, despite one country being better endowed with important factors of production (e.g. coal and iron ore) than another country, nevertheless international free trade leads to the equalisation of both product prices and factor prices.

I followed the then LSE traditions of illustrating economics propositions in two dimensional diagrams to suggest that free trade was not necessarily sufficient to lead to equalisation.

Harold wrote an extension of the model to multi-dimensions. I was enormously embarrassed by his extension being published in very much smaller print in Economica. Fortunately, Harold found this very amusing, and it did not prevent a continuing friendship over the years between our families. By the time there was a response to the paper—I don't know if it was published—I had lost interest in the topic, having become involved in ILP methodology. I don't think Harold took it up either.

My PhD was not based on the TSP, but on finding a way without using a computer to solve a large transport simple problem when origin to destination costs are not known, and only rail network distances between junctions.

LÁSZLÓ VÉGH: So that's what you actually did as your PhD, which was a transportation problem from the coal mines to coking ovens, connecting back to your Hastings year and when you first visited the power station?...

AILSA LAND: Yes. Because Helen Makower and/or George knew the head of the Coal Board. We went to see him and he said, “well, obviously if you're going to use an optimizing method, you've got to have the condition that it may be like the transport problem,” but it's got to be about a homogeneous commodity. We do have within our mining industry coal mines which are producing a particular type of coal. The type that's used for the converting to gas. That's the coking coal, it's a particular grade of coal which is required. It's sufficiently homogeneous, in that the people who are converting it to gas don't care where it comes from. So, it is a homogeneous problem. And a simple transport problem. We used minimum rail ton-miles rather than costs as this provided the simplest way of optimizing the distribution of coking coal on the rail network, in which all 'origins' and 'destinations' are nodes (junctions or terminals) on the network, and distances between neighbouring nodes are known. Rather than carrying out a preliminary operation to find the minimum rail mileage for every possible colliery to coke

oven and using the standard TP algorithm, the distances were obtained as part of the manual algorithm.

The availability and requirement data were presented as the amounts delivered from Collieries to Coke Ovens during a particular period (month or quarter, not sure now). The quantities available at the Collieries and required at the Coke Oven destinations were obtained by the amounts moved in that particular period. The actual starting Graph (diagram) was obtained by looking for obvious connections on the rail network (not essentially the shortest as the computation might find shorter paths). The first operation was to locate any loops (circuits) on this (assumed) feasible graph and remove each such loop one at a time by adjusting the 'flow' of tonnage around the loop until the loop was broken by one or more flow being reduced to zero. This led to the graph becoming a Tree Graph, a connected Graph without loops, and (in LP terms) a Basic Feasible solution.

Thinking of LP (Activity Analysis) as an Economic model is because associated with a basic feasible solution there is always a Dual solution which can be interpreted as location values of the 'commodities' used by the Activities (in the Coking Coal transport problem as location values of the homogeneous commodity at each node of the tree graph).

From this point onward, the solution algorithm is to examine every location value compared to its neighbours on the rail network to see if it shows a potential 'profit'. If it does, it can be introduced into the graph and the 'flow' adjusted round the loop to return the graph to being a tree graph. There may be more than one optimal solution, but so long as there is no potential profit to be made by including an unused link of the rail network the current solution is optimal.

LÁSZLÓ VÉGH: So, you came up with a tailored version of the simplex method which made this problem more amenable to manual solution. How long did it take for you to actually solve the problem?

AILSA LAND: Quite a long time. I remember crawling around on the floor with that damn thing, whilst also heavily pregnant. What I'd already discovered at the smaller scale, obviously, was that it made quite good sense to think in terms of a tree graph. And I did it entirely in terms of a tree graph. So, a basic solution is any tree that's on the feasible side of the requirements, and that provides you automatically with the dual values.

Solution Methods Motivated by Economics

This is where economics comes into it. The dual values are the values, the ‘x’ of the activity levels and the resulting “price” the ‘y’ values of the coal at the collieries. This is where if you read in a text book how to solve that transportation problem the dual values appear as negative numbers so are not obviously values.

If you think of the transport problem as an economic model, there's this part of all you have to do is find a price that's here at this point, and the price that you've got at another point, [where the] difference between the prices is less than the cost of the trade-off. You could find a cheaper way. And when you do that, you find that you've made yourself a complete circuit within the current tree. That's the point. And then it's just a question of where do you break the circuit, have a new tree. Then look again at the prices.

This is what I like about Simplex and economics. Every activity, in my interpretation, is a column that tells you what you could do. You could take a mix of these columns, inputs or outputs, positives or negatives, and you could get yourself a basic solution which satisfied the constraints. And if you then priced have the dual ‘y’ values the quantities using those, that basic solution, you find that a new variable—

LÁSZLÓ VÉGH: You can find a new—

AILSA LAND: New values are prices in the same way as they are on that network. That's the way they've always looked at it. But the column is what you could do with the goods, the commodities.

And the rows are quantities available and required of the commodities and the values of the x's are the level of the activity. And the y's are the duals, the prices. And I've always looked at the setting up of LP this way.

And that's where I come to some of the—I find it more efficient to design an LP with that model in mind. Instead of, as a lot of people do, seem to somehow start with the constraints. To me, that's backhanded.

I want to know what those things are. There's a list of things. And there's a list of things you could do with the things.

LÁSZLÓ VÉGH: So, this is really the economist mindset of looking at linear programming.

AILSA LAND: Yes, that's economics. It's a little model of a business, and you want to make profits along the way but you've got your constraints are, in fact, the goods that you already have and want to have. I have to say that I never was very successful in persuading students this was the right way to do it. I always presented it to them this way, which I felt was the obvious way.

LÁSZLÓ VÉGH: Something that occurred to me in your dissertation, you discussed that possibility of using analogue computers for this kind of transportation problem rather than digital computers. What were you referring to there?

AILSA LAND: I suspect it came from discussions in seminars, but it was not a topic I knew much about. But what I remember is helping an OR academic from Birmingham

University, K.B. Haley, who had constructed an analogue computer to solve certain kinds of LP transport problems, to move his contraption in the back of our car when he moved.

Integer Programming

LÁSZLÓ VÉGH: Let's move on to integer programming. So, when you first encountered problems, which were linear problems, but then you had additional integrality constraints. What was your initial feeling? Is it just some small additional tweak which could be somehow integrated into Simplex?

AILSA LAND: I knew it was more difficult. You had to have a rule for doing it. And also, what made it much more difficult, as well, is there was no way you could have a local optimality check.

I saw it very much the way a lot of people did, finding a point within the convex hull in the right neighbourhood. What was it? Markowitz and Manne (Ref: Markowitz, H.M. and Manne, A.S. (195 On the Solution of Discrete Programming Problems. Econometrica Journal of the Econometric Society,1957) were the ones that added a lot of constraints. Actually, having found a set of constraints, you can test optimality, because you have an LP solution if those constraints can be shown not to have cut off any integer values.

But I don't think, even when you've got a branch and bound solution, you still can't look at it. You don't have enough constraints to say that you've got a local optimal. No. It is much worse.

It was a cutting notion. Sort of pushing back the value of the function till you intersected with it. You know, you see pictures of it.

There's the inner—in two dimensions, it's only too easy to make a diagram with the integer points, intersections. Then you have an outer hull, the hull of—the convex hull of that set. And then you reduce that convex hull by chopping off bits. That's the way I thought of it. You pushed back the function until you hit an integer point to find the optimum solution.

Branch and Bound and the Travelling Salesman Problem

LÁSZLÓ VÉGH: Probably your best-known paper is the one on the branch and bound method with Alison Doig. Can you tell us a bit about the background of how this paper was born, about Alison and your collaboration?

AILSA LAND: Alison Harcourt (née Doig) had taken a Master's degree at Melbourne University in Australia, with a thesis on integer programming (ILP). She had then come to work for a period in LSE. She joined the Research Division and had published with LSE's Statistics Professor, Maurice Kendall, the Bibliography of Statistical Literature. She had an Australian friend who was reputed to have solved a large LP

model for a refinery without an electronic computer. He was currently employed at British Petroleum (BP) which was using LP at that time for refinery planning. Not surprisingly, BP was beginning to want to restrict some of their LP variables to take integer values. They offered to pay salaries for both of us for a year to tackle that ambition.

We quickly realised that we had no hope of using the company's large dataset, particularly as we had at the time no access to a computer. We talked to the company and they agreed that we should forget trying to solve their problem and concentrate our efforts on discovering an algorithm to model LPs with 'some' discrete variables. I think we had already some idea how to tackle the problem.

We felt that we had to demonstrate the solution of at least two published integer problems as well as a discrete values example and show how it could perform like a Fortran computer program, although laboriously solved on our desk calculators. In fact, we were allowed to employ some additional calculator operators. As you know, the algorithm later acquired the name Branch and Bound -- not a difficult concept!

When we had written our paper, we had to decide where to submit it for publication. I suspect it was my choice to go for Econometrica as a journal with a very high reputation in LSE (though not, as far as I remember, containing any papers from the Economics Department). We chose to submit it with only our initials and surnames, with deliberate intention. A choice which I don't feel would appear sensible today.

Econometrica accepted our paper, but apologised for delaying it for a month because the next edition had already accepted R. Gomory's first ILP solution method. I think the apology was because they felt that they were denying us precedence, but it wasn't bothering us.

Alison stayed on at LSE as a staff member of the Statistics Department for about two years before returning to Australia. I think the OR group was perhaps seen as growing a bit too vigorously, and Alison was not drawn into teaching OR as much as she would have liked.

I felt Gomory’s solution in that Econometrica paper had problems. You couldn't keep going putting Gomory-type constraints on without going back to representing the LP that you were now solving in terms of the original constraints.

I spent a lot of time in the first two or three years after retiring, on making an automatic branch and bound procedure for moderately large-scale travelling salesman problems, and what I achieved was one which works for up to 150 variables, 150 points.

Others spent, I think, a huge amount of effort and time to solve what in many ways seemed nonsense problems. They seemed to be searching for ways to find solutions to problems with ever more points – aiming to solve bigger problems. In reality the solutions were highly sensitive to the measurements provided by the data. A small

difference in a measurement could provide a very large divergence in the solution – and we knew that measurements of the variables in actuality were largely inaccurate or subject to rapid change. You can change the scale of the data slightly. Put it into kilometres instead of miles, and you probably get a different answer. So many of the so-called solutions are in practical terms absolutely useless.

I didn't calculate all the cost data items until I needed them in my automatic algorithm. I didn't need to store the cost. But I found that I could get different answers if I now computed the distance to four decimal places or three decimal places for the distances. And if I tried to get realistic ones off a map, that was much less useful because they were pretty sloppy. And the answer you get are very dependent on the scale that you've put the numbers in at.

If you use just two decimal places or 10 decimal places, you get completely different answers. It just seems to make the whole question a silly one, in my view. So, I stopped doing it.

I always meant to just write a small paper based on TSP examples, generated in this way with a limited convex hull, that demonstrated how very sensitive it could be to minor changes in the scale of the data. The diagram showing the salesman's path to visit all points was always principally following the outer boundary, with a few ventures into the centre of the space and return to the boundary. (These diagrams were printed automatically.) If the distances between the points were computed by the algorithm to different scales (nearest integer, one decimal place, or two, or three, for instance) the optimum solution costs were not very different from one another, but the actual route to be followed by the salesman could look very different from one another.

LÁSZLÓ VÉGH: Back in time, a bit, to your branch and bound paper as applied to TSP?

AILSA LAND: Yes, I was using branch and bound for TSP with some additional constraints. (Note that some of the constraints were 'local' (apply only to the branch in which they were generated, and others 'general', not dependent on any values temporarily fixed by the branch.) One type I used was the so-called 'method of integer forms'—or Gomory constraint. These appeared to be useful only if they could be expressed in the initial unit levels of the x variables with small integers (range -2 to +2). Another useful cut was a so-called 'comb' constraint, generated by a small graphical inequality. This procedure didn't guarantee to generate all possible comb constraints, but was nevertheless sometimes useful in truncating a branch.

LÁSZLÓ VÉGH: Do you remember what was the first real world application of branch and bound, where you solved the problem still manually, where they eventually applied or used the output?

AILSA LAND: No, at that time we tested our methods against problems set in the journals. An example came from Markowitz and Manne who demonstrated the solution to an integer problem. We proved that it could be solved by desk calculators though we

found a different but valid solution. But we thought we'd better solve another one. So, we solved the same data but without the 0/1 restriction, allowing any integer because it's obviously slightly less restrictive.

But it was equally hard to solve. It was a bit more complicated because you need the branch on both sides. When you have a non-integer variable, you've got to find out what its next variable is above and below. If it's a naught /one problem, there's only one way to look. It's simpler, a bit quicker.

LÁSZLÓ VÉGH: When did you finally start using computers for your research?

AILSA LAND: I don't recall the date, but before LSE had its own computer, we used the service of the London University Atlas computer. Using that service meant carrying packs of punched cards to Guildford Street in Bloomsbury for input and returning next day to pick up the cards and printed output. Even when LSE got its own computer circa 1968, an IBM 1440, bigger jobs had to be taken to Guilford Street.

BP agreed, that we'd got as far as we needed to get. That they would do the computing work which I think they did.

AILSA LAND: Alison returned to statistics on going back to Australia, having worked in an earlier period with Maurice Kendall. She didn't continue with LP at all. I didn't keep in touch with her professionally, only as friendship. But she did very well with her statistics and was also very practical with it, I gather.

She used statistics in a good social way. I don't know the details of that. But she is very much admired for that. She never took a PhD, except she's now been awarded an honorary one based, partly, on what we did all those years ago.

And the next thing I heard is she was on the Queen's Birthday honours list in June 2019, becoming an Officer of the Order of Australia.

Martin Beale and Steven Vajda

AILSA LAND: I agreed to supervise a PhD student jointly with Martin Beale. But unfortunately, he became ill and Martin died. We were registered to take this student jointly, and the joint supervision might have been an opportunity to understand each other's approach. Because Martin and I just didn't see LP in the same way at all. He didn't get my idea of seeing it as an economic model at all.

LÁSZLÓ VÉGH: What was his perspective? Very mathematical?

AILSA LAND: He couldn't see my interpretation of the dual value of an LP as being equally important as the primal solution.

LÁSZLÓ VÉGH: Can you, now that you mentioned him, tell a bit more about Martin Beale and how you met him, what you have been working together?

AILSA LAND: I knew Steven Vajda. He and I were jointly involved in examining a PhD, with Steven acting as the internal and I acting as external examiner. Steven was working at that time for the Royal Naval Scientific Service of the British Admiralty, and Martin Beale was his assistant.

LÁSZLÓ VÉGH: Was he at Birmingham, after the Admiralty?

Yes, Steven Vajda did join Birmingham University in 1964 after retiring from Admiralty. But he did supervise the PhD. In fact, I disagreed with one of his students. He had this student whose PhD had something to do with connection of the Great Lakes in Canada to the sea. He had a very complex LP-type model, which he took a long time solving. Maybe it was partly integer. I don't remember.

Steven accepted it, that he'd found the optimum solution. But it was precisely not what he claimed, that it was the answer to the real problem. I was very indignant about that. I thought it just not decent to claim that you've solved their problem when, in fact, you've negated it.

I don't know what he did. I think we had a little argument about it. And the candidate he just got away with making some changes in the wording of the thesis.

And Steven thought I was being very unreasonable on that one occasion. But mostly we got on very well. He wrote a well-known book on linear programming.

A Poorly Formulated Problem

AILSA LAND: He did, didn't he? I think he and Martin got on better with each than I did, with either of them, when it came to the details of work.

But that dispute with Vajda leads me to give another example of some issues I have with the way OR is some sometimes practised. One of my PhD students is very angry with me still. He wanted me to give a talk to his students in Canada. The talk I gave was to illustrate a very bad way of doing an OR job, with a project I had been involved with. It is something I'm very ashamed about. I came into a project which had been formulated by the firm itself and a couple of other people who had programmed the animal feed problem.

Well, you know when you buy a bag of dog feed. It says on the label that it's got such and such protein and such and such this and that. But it's a lie. Because they're very sloppy about measuring these things on the factory floor. It depends entirely on what the raw material is that they put it in each day, which varies. Sometimes it's a load of pig feed. Another time it's a surplus from a chocolate factory. I think the quantities of the specified nutrients are quite different.

At the same time, I stupidly agreed to solve a linear programming problem with a quadratic constraint on it. Now if I'd known any of my statistics a bit better. Do you know John Howard?

LÁSZLÓ VÉGH: Yes.

AILSA LAND: Well, he made me feel a complete twit that I had accepted this model. It just doesn't model the real situation at all. They had invented the quadratic constraints.

But when it came to actually modelling the thing, it didn't work. Because they were just irrelevant constraints. I put a lot of work into using their model.

The couple who'd got involved in it before me had designed the computer system that took the daily stuff and produced an answer. Which, in fact, was very different from what you could work out. It shouldn't have been a branch and bound procedure, obviously. I might have been interested in trying to develop a valid model, but I was not in a position to offer to try.

I thought somebody else had done the maths. But they hadn't. So, I thought it was a reasonable thing to use my experience to warn people against repeating my mistake.

You don't take somebody else's formulation and waste time on developing it if without properly checking it first.

LÁSZLÓ VÉGH: You spent a year in Philadelphia at the Wharton School, right?

AILSA LAND: Yes, I did it on sabbatical leave from the LSE in 1975/76.

I didn't fill a faculty position, Frank [Land] had a visiting Professorship in the Department of Decision Sciences which coincided with my sabbatical. LSE simply paid me my sabbatical in the normal way. What the university provided me with was a desk, and a terminal to the computer. And that's where I spent a lot of time on this stupid wrong problem.

Computational Work

Over the years we held regular seminars at the LSE for those interested in mathematical programming and amongst those who came to these were people working for the Road Research Laboratory, a Government establishment. Amongst those attending was John Murchland who had done a lot of work in the graph theory area.

And another person who'd done a lot of work in the graph theory area was Alison Doig, because she'd translated one of the classical early graph theory books by a French author. I don't remember which one.

LÁSZLÓ VÉGH: [Claude] Berge?

AILSA LAND: Yes. She translated it into English. Some of us, including George Morton, Alison and John Murchland used to meet and have a session on graph theory as a result.

John was also expert at Fortran. And he knew I'd done my operations by hand when I should have been using a computer.

But I had not learned any computer language. So, John Murchland and I came to an agreement. He would teach me Fortran while I would teach him how to solve an LP using Fortran. And that we did. We just sat together for two or three afternoons, I think. Which is where I learned to use a computer and he learned how to solve Simplex. It all went quite well.

LÁSZLÓ VÉGH: So later, with your student, Susan Powell, you also developed a software package for linear programming and wrote a book on Fortran codes for solving mathematical programming problems?

AILSA LAND: Yes, we wrote that book, and although we say it's for general use because that is the way we developed it, I think I used it mainly as the textbook for some stuff I was teaching.

LÁSZLÓ VÉGH: So, you kept these codes freely accessible for research—

AILSA LAND: Yes.

LÁSZLÓ VÉGH: But for business use, were there any attempts or offers to develop commercial software?

AILSA LAND: I wasn't trying to make money out of it, definitely not. I didn't want to be responsible for somebody's mess ups. But anybody could have the codes. I do remember travelling to Italy with a great big box of punched cards for one of the Italian universities.

The whole MP code was in it. We had it freely available on LSE's computers. Anybody could get it. I don't think it's there anymore. Pity.

LÁSZLÓ VÉGH: Punch cards are not used anymore.

AILSA LAND: No, no. But for a long time, you could put in an LP and solve it at LSE. Or you could take a copy of Fortran which a lot of people did.

LÁSZLÓ VÉGH: This computational work was the first time you also experimented with combining branch and bound and cutting plane methods, that you already mentioned for the travelling salesman problem?

AILSA LAND: Yes.

LÁSZLÓ VÉGH: What were your initial experiences with combining branch and bound and cutting planes, which later became a really successful combination for integer programming?

AILSA LAND: Yes. I must admit that I didn't try awfully hard to keep up with other people's literature because I found it hard to read. I do remember spending a good few hours wrestling with the decomposition algorithm. Whereas, of course, if you think of it simply as a firm with two branches, it's a very nice dual price mechanism to connect the two.

It didn't seem to me an awful lot of fancy maths to say it. Just as well, because I couldn't read it. Occasionally, I found myself needing to express things that way.

But I don't think, although that became a way I could think of it, I don't honestly think that I communicated it well to students. Perhaps it just wasn't the best way to think about it. It was the best way for me, which is something different.

Teaching at LSE

LÁSZLÓ VÉGH: So, you started a master's program in operational research early on?

AILSA LAND: We did. Well, we started on behalf of the British iron and steel industry for BISRA – the British Iron and Steel Research Association. At that time the iron and steel industry were one nationalized unit, but subsequently privatized. Probably wisely, because I don't think they were terribly well-organized.

But they hired young graduates who hadn't done any OR. And so, they decided they needed a year's training before they were fit to be useful. And I think they looked at the LSE and they looked at Imperial College. Yes. I think we both ran one-year courses, alternative courses.

And after a while, it occurred to us that other departments in the school were running one-year master's courses. We thought, this is ridiculous. We're doing just the same thing. I don't see why the students shouldn't get a master's degree out of it.

So, we did. We got them to agree to change the name to master's degree. We developed the courses as we went along. The students had to do some statistics, and develop some more statistics. Pity that I hadn't gone along, as well.

Each student had to do a real study in a business that we had to find. If the student was sponsored by a business, they had to do a project set by them. Otherwise, we had to find another company that would take them on, give them a project, and help supervise them. That was a very difficult bit of the core job getting other companies to help with this teaching business. And then, of course, we had big troubles with the OR Society,

the British OR Society that didn't like the fact that we were giving degrees without what they considered sufficient practical experience.

LÁSZLÓ VÉGH: Well, didn't this project students did with the company qualify as practical experience?

AILSA LAND: Yes, it did in the end. But we didn't want to have to supervise them in that. We felt we were very much academics, interested in developing the subject. When we perhaps should have the way the British OR Society does emphasize the importance of practical experience in applying the techniques we taught them. I have feeling that has been ditched now with this new whole maths approach transferring OR from the Department of Management to the Department of Mathematics. I know Jonathan Rosenhead is very upset about it. It's always been a conflict between the OR Society and academia. I think we've gone too far in the American way.

At the time when we felt we wanted to shake off being part of the Department of Statistics, we were sort of given the option. Do we go with Management, or do we go with Mathematics? And the OR group really was in conflict over that.

LÁSZLÓ VÉGH: I'd like to ask you about your insights about teaching OR, if you would like to share what you felt—what were your favourite topics to teach, or what were kind of some good practices that worked particularly well?

AILSA LAND: Going back to the earlier discussion I have always been interested in improving the process by developing techniques and I am good at that. But I recognize the importance of understanding the real situation to which the techniques can be applied. Indeed, I think the things that Frank [Land] does and that Jonathan [Rosenhead] does are very valuable. But I don't want to be asked to do them. That's all. Because I don't feel I'm as competent in that aspect of the work.

LÁSZLÓ VÉGH: Yes. The viewers may not know what we're referring to: Jonathan Rosenhead and the soft OR and problem structuring methods.

AILSA LAND: That's right. Well, I can't say I've kept up with the details of what he's done, but it makes sense to me.

The First Woman OR Full Professor in the UK

LÁSZLÓ VÉGH: I also wanted to ask—you were the first woman promoted to full professor in OR in the UK. And in fact, in this oral history series, you are the very first woman being interviewed. This always has been a very male dominated field. Can you share some experiences about what kind of challenges did you have here in such a male-dominated world?

AILSA LAND: It's not curiously enough something that's bothered me much either way. I'd been very well-treated by LSE. I had maternity leave three times, as well as not

losing any sabbatical opportunities. They treated me very well. I don't think I would have done if I'd been the boss.

LÁSZLÓ VÉGH: Yes. You had three children during the years when you did your PhD and there had been all these papers in the '50s and '60s. So how did you manage to balance things?

AILSA LAND: Obviously, my life was split in two. Monday to Friday, the evenings—mostly the evenings, but certainly the entire weekend—I regarded that as not for academic study at all. I resented it bitterly when LEO [Computers Ltd., Frank Land's employer] thought that you ought to work on a Saturday. I fought that, didn't I?

FRANK LAND: Yes.

AILSA LAND: I think we actually won that. You were regarded as rather slack because you wouldn't go in on a Saturday. We thought if you had children you needed to live with them. But I was very fortunate in having a well-trained nanny, Ann, who did the Monday to Friday stint very efficiently, sufficiently efficiently that if I went into a shop in Leytonstone with the children, the people would look at me. What are you doing with those children?

They thought that they belonged to Ann.

LÁSZLÓ VÉGH: Part of that could have been also your impact. Like, you also had several female students over the years. Was that something you were conscious about?

AILSA LAND: No.

LÁSZLÓ VÉGH: Or it just so happened?

AILSA LAND: No. It just so happened that I happened to work with other women. Perhaps men don't like working with a woman. Even though I did always work very well with people like John Murchland or George Morton and many others.

And some of the students like Takis [Panyiotis] Miliotis in Greece. He wrote some papers about solving travelling salesman's problems, using the branch and bound, using our codes. And Dantzig was very rude about it. He would not accept that Takis had obtained an optimal solution.

LÁSZLÓ VÉGH: At the end of your TSP paper with George Morton, there was an exchange of arguments?

AILSA LAND: Yes, the argument was about George not finishing things. So, what I'd worked on with him was the diet problems. And he never finished it. He never published it. So, I was wasting my time from that point of view. Very good at inventing new things, but didn't want to think anything through to the end.

Views About OR

LÁSZLÓ VÉGH: I wanted to ask you to talk a bit about your general views about OR. You really have seen almost the whole history of that field developing over more than 70 years. What were the most important accomplishments from your perspective? Where do you see the whole field going now? What do you see as the most important challenges?

AILSA LAND: I don't think OR is done very well because it has not managed to make a good join up between the soft OR, if you like, the practical connection, the careful study of the problems and the theoretical ideas underlying the development of techniques. Partly because the current 'neo-liberal' economic system is so badly run, in my view.

I'm not saying that the nationalized systems were good. They weren't very good. Because they largely used the same people that had been running the economy and industries.

They nationalized the companies, but handing them over to the people who'd been running them before. And that didn't work awfully well, so they went in the opposite direction privatizing everything in sight.

The fact is, I'm much more interested in the way the economy is run than I am in the rather ineffective, I have to say, efforts of the OR people. I cannot see that an objective which is just profit makes any sort of sense at all. It's not the way a world should be run. I'm not offering any solutions. But I think it would be nice if they hadn't lost interest in where OR is going. Because it has the potential to take as its criteria a more sensible perspective.

LÁSZLÓ VÉGH: And if you look from a more technical side, for example, at the developments of integer programming over the last many years?

AILSA LAND: I know how fascinating it can be. I kept seeing a problem and thinking I could work on that. That's interesting. Unlike some, I did tend to pursue perhaps beyond the point of common sense sometimes such as the waste of time over the travelling salesman problem.

LÁSZLÓ VÉGH: Looking back a bit at your career, is there something you would have done differently?

AILSA LAND: I think I was so lucky all the way through. I was able to pursue interesting topics. But in terms of what I have achieved as a lifetime, have I left the world in any sense better by doing what I did? I think the answer is no. Might I have done better if I'd lived amongst the economists and had some effect there? I don't know.

LÁSZLÓ VÉGH: Like, less mathematical economics you would have worked on?

AILSA LAND: Yes. I don't think mathematics is the important bit. I'm not impressed by econometrics models.

I'm impressed by people like Keynes, who understood how the financial system worked and could see a bit further than most people seem to. But I really despise so much economics, as I tend to view it, and as for OR it doesn't tackle the big problems. They're not given the opportunity to write down the big problems.

They were during the war. War time is great for people who've got ideas of how things should be run because people listen to them. They can get away with it. Nowadays, how many people turn to OR to solve their business problems or running their offices, or the economy? They listen to economists. But I don't think they can distinguish the good economists very well.

LÁSZLÓ VÉGH: What do you think OR's main weakness is? Should it find better ways for policymakers to understand real life problems and influence them?

AILSA LAND: That would put it very nicely, yes. You can take that as my view, if you like. But I don't think they're given the opportunity to do that.

That’s what they did get during this period when it was first flourishing, people thought, well, maybe it can provide the answers we are looking for. But too many in the OR community weren't looking for the answers. However, an interesting area we got into was DEA.

LÁSZLÓ VÉGH: Data Envelopment Analysis?

AILSA LAND: That potentially has its uses for comparative studies of doing a thing this way rather than that way. But it's value for policy formulation is not taken up either though Gautam Appa was doing some of that.

But then again, one got wrapped up in the interesting maths of it or the interesting way of, perhaps, doing it more efficiently.

LÁSZLÓ VÉGH: Gautam Appa, a professor emeritus at LSE, mentioned work you have done when the government was trying to close down some schools based on some spurious Data Envelopment Analysis. And you agreed to counter these arguments. Can you tell a bit about this?

AILSA LAND: Well, we offered our services, Susan [Powell] and I. Or Susan and Gautam and I, I think. But nobody seemed to be interested in seeing what we had to say.

LÁSZLÓ VÉGH: Just to finish on a more positive note, you had a number of excellent PhD students who have done some great work. Can you maybe mention some of them and what you have been working on and how their careers later developed?

AILSA LAND: Well, they've scattered throughout the world. For example, there's one in Canada. Gilbert Laporte. I know what he was interested in was very important scheduling of timetables. These are jobs that have to be done. That kind of thing is sensible.

But again, it's sort of marginal, isn't it? When you're seeing big things going wrong, it can lead you to stop worrying about the details? It does me.

I'm just depressed about the world now. And I don't see OR as presenting any answers that the people are listening to, that they've got things that are important to say. Well, I'm sorry about that. But if you want my basic opinion about OR is that it was great for war time. And it was necessary when you had nationalized large chunks of the economy, to give some sort of a measure of efficiency.

I feel that OR has not positioned itself or been positioned to tackle the real problems that face our economy. Whether it can or cannot, I don't know. Whether it can or should, I don't know.

It's a shame that effort goes into things that don't have big effect. You cannot claim that integer programming is a profound help in the world, can you?

LÁSZLÓ VÉGH: Well, I mean, it really contributes to solving large scale industrial optimization problems. In that sense, it does have a very serious effect.

AILSA LAND: Perhaps I'm just too lazy to find out what they're doing. Susan and I did write a paper where we tried to find out how people were using it appropriately. It was very difficult to really find something you could say this was significantly a good thing.

I remember when we were trying to sell something to some businessman, but I can't remember, he said, oh, he says, you just want everything to be branch and bound, advanced mathematical programming, something like that. Well, it's not true.