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ATTACHMENT D

Overseas visit report PROJECT CS70L

In the last year I requested funds for partial support towards a conference trip in the USA, together with a visit to the principal laboratory in the USA investigating tillage and compaction. After I made this application, I received a further invitation to undertake some work in West Germany with Professor Rainer Horn, a leading worker in the field of compaction. This work in West Germany was not supported by the Cotton Research Council, nor was it directly concerned with cotton soils. Nevertheless, the work that we undertook on compaction is of direct relevance to my work on the cotton soils, so I shall report on this visit also.

1. Conference - NATO Advanced Research Workshop on Mechanics and Related Processes in Structured Agricultural Soils, Univ. Minnesota, USA, 13-16 Sept. 1988.

This conference really did follow the workshop format, with numbers restricted to about 40 invited researchers, mostly form NATO countries. About 2/3 of the papers were poster presentations, with plenty of time for viewing and discussion. About 1/3 of the total time in the workshop was set aside for discussions in four smaller groups dealing with particular topics. These topics were:

1. Mechanics of structured soils.
2. Modelling of soil structure.
3. Root responses.
4. Tillage and compactive effects.

All these topics were also discussed in open session after the group discussions had taken place.

One recurring theme throughout the workshop was the need in tillage and compaction studies to use more advanced soil models. In particular it was felt that in compaction studies there was a need to account for shear stresses in addition to the vertical compaction stresses. I pointed out that in fact I had already been doing this for some time. My own presentation ("Critical state soil mechanics for unsaturated soils - measuring the parameters and predicting deformations") attracted considerable interest, with several enquiries concerning my methods and computer programs. There were also some very useful summaries of the latest research in tillage design, though here too the need for improved soil models was also felt. It was pointed out by one speaker that tillage theories accounted reasonably well for forces on the tine, but were very poor at predicting soil deformation. In discussion with this speaker I suggested that my own methods may have much to offer here. (Note, although my own work on cotton soils has been concerned with compaction, it is based fundamentally on the mechanical behaviour of the soil, and thus can be applied to tillage also.)

The enquiries concerning my own work, and other contacts made were, in my opinion, the most useful part of the conference. With a couple of researchers in particular, I discussed the possibility of future collaboration in tillage/compaction studies.

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The final day of the conference was a field trip to look look at research on problem soils in Minnesota. Although there is much concern about, and research into, compaction problems in the region, the largest problem discussed on the field trip was the impact of the recent severe drought in the Mid-Western USA. Yields were clearly badly affected in the regions that we visited.

2. Visit to the National Soil Dynamics Laboratory, Auburn, Alabama. This visit was to have taken place after the Minnesota workshop. However, during the workshop the Director of the laboratory approached me to say that they had been requested, at fairly short notice, to take part in a review of the research of the whole laboratory. My visit had to be cancelled.

However, I did take the opportunity in the workshop to discuss at length with NSDL staff the latest research at NSDL, their advances in soil instrumentation, deformation theories, permanent bed systems and so on. Subsequently, they have sent me a very complete set of recent papers and reports from NSDL.

The funds requested from the Cotton Research Council for this visit were $500. Because the visit was not undertaken, this has been returned.

3. Visit to West Germany to work with Professor Rainer Horn, Nov.-Dec. 1988.

This trip resulted from an invitation from Prof. Horn for me to undertake some work with him. The trip was funded by German sources.

The work undertaken was concerned with compaction, and fell into two distinct phases. In the first phase we performed a short series of wheelings with a small two wheeled tractor in a large box. The experiments involved measuring the stresses and suctions continuously during wheeling which, as far as we know, has not been attempted before. Soil samples were collected before and after wheeling. Wheelings took place at two different moisture contents and two different speeds (i.e. four experiments).

In the second phase, samples of soil were tested for shear strength and compressional properties. Importantly, we were able to construct some equipment to measure these properties at very high rates of deformation, on the same order as those in the field. Most previous research has used much lower rates of deformation, and certainly there is no compaction study that has measured shear strength at high deformation rates. This is due principally to equipment limitations. It has been tacitly assumed in the past that the stresses and deformations at lower rates (several orders of magnitude lower) are not significantly different from those at more realistic rates, even though it is known that compaction effects are dependent on the speed of the tractor. Thus we are the first to be able to test this assumption explicitly, and the first to be able to analyse a compaction event with soil parameters measured under realistic conditions.

The data from this work are now being analysed both in Germany and by myself in Canberra. Publications will flow from this work.

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This conference followed the workshop format, with numbers restricted to about 40 invited researchers, mostly from NATO countries. About 2/3 of the papers were poster presentations. The main themes were; mechanics of structured soils, modelling of soil structure, root responses and tillage and compaction effects.

Many speakers stressed the need in compaction studies to use more advanced soil models to account for shear stresses in addition to the vertical compaction stresses. My own presentation ("Critical state soil mechanics for unsaturated soils - measuring the parameters and predicting deformations") was concerned with this topic and attracted considerable interest concerning my methods. There were also some very useful summaries of the latest research in tillage design, though here too the need for improved soil models was felt. One speaker noted that tillage theories accounted reasonably well for forces on the tine, but were very poor at predicting soil deformation. My own methods may have much to offer here.

The final day of the conference was a field trip to look at research on problem soils in Minnesota.

I also had discussions with staff of the National Soil Dynamics Laboratory about the latest research at NSDL, their advances in soil instrumentation, deformation theories, permanent bed systems and so on.