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SOIL CLASSIFICATION IN AUSTRALIA - AN OUTSIDER'S VIEW

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Introduction

Soil classification has many purposes, the main ones being to organise knowledge, to bring out relationships among the objects classified, to facilitate communication, and to provide a framework for soil management practices and soil research. In Australia, there are currently two 'local' classification systems in use, the so-called Great Soil Group system (Stace *et al.* 1968) and Northcote's Factual Key (Northcote 1979). Recently, however, the spectre of change has arisen. Firstly, Ray Isbell has been developing a new 'National Australian Soil Classification', currently of 'Second Approximation' status (Isbell 1992a). Secondly, there has been renewed interest in the application of Soil Taxonomy to Australian soils, particularly in South Australia. Such interest was clearly shown at the 4th National Soils Conference, held in Adelaide in April this year, where four papers suggesting changes to Soil Taxonomy were presented. These developments appear to have polarised opinion as to whether changes are necessary, which classification system, or systems, are 'best', and the optimum way of introducing such changes.

My purpose in this article is to consider these questions from the perspective of a New Zealander who has spent a mere 10 months in Australia (all in South Australia) and to offer some personal comments based on similar dilemmas in 'classification metamorphosis' in New Zealand. It is my intention to be constructive rather than critical. In the end, of course, the future directions of soil classification in Australia are entirely up to the soil science practi-

tioners and soil users here, and the money managers.

The New Zealand experience

Up until the 1970s, New Zealand was well served by N.H. Taylor's 'New Zealand Genetic Classification' system (Taylor & Pohlen 1968). This classification is similar in some ways to the Great Soil Group system in Australia in that its roots stem in part from the Russian ideas of soil genesis and zonality that spread to the western world earlier this century. First published in 1948 as a map legend, it has been little modified apart from some changes to nomenclature of high level categories. However, as Allan Hewitt (DSIR, Dunedin, New Zealand) described in his key-note address at the Adelaide conference, it was showing 'signs of strain' and hence the newly-published 'Soil Taxonomy' (Soil Survey Staff 1975) was adopted for a trial period by Soil Bureau, DSIR, in the late 1970s (Hewitt 1992a). At that time, Soil Taxonomy, with its new nomenclature and novel use of diagnostic horizons, was seen by some as a saviour and by others as a villain. However, even ardent protagonists of Taylor's system, including (my mentor) Harry Gibbs, for example, acknowledged that Soil Taxonomy was an excellent way of *describing*, as opposed to *classifying*, soils and that it 'opened one's eyes' to many previously unseen or ignored features of the soil profile. Gibbs and others were opposed to Soil Taxonomy because it tended to downplay genesis, concentrating more on measurable profile features (this perception of ignoring genesis is not entirely true), it relegated hydromorphic (gley) and volcanic ash-derived soils

to suborder level, and so on. But perhaps more important was the view that it would be better to put effort into upgrading Taylor's classification rather than into Soil Taxonomy.

In the event, Soil Taxonomy held sway for a number of years, so much so that it was designated the 'official' language of the 1981 'Soils with Variable Charge' Conference held in Palmerston North, New Zealand. Soil Bureau eventually made a big contribution to Soil Taxonomy, publishing a series of flow charts for keying out diagnostic horizons and orders, coordinating the development of the new order of Andisols, first published in 1990 (Soil Survey Staff 1990), and initiating the Guy Smith Interviews. In the early 1980s, however, Soil Bureau decided that their efforts would be better placed

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in developing a new 'local' classification that built on the good points of both Taylor's system and Soil Taxonomy, including the use of diagnostic horizons. One of the reasons for this development was that the rate of development of Soil Taxonomy was seen to be too slow - an ironical twist in that it was the first soil classification system to have an in-built mechanism for accommodating new knowledge without destroying its fundamental framework. In the words of Allan Hewitt, the lasting legacy of the Soil Taxonomy trial was the development of a large computer data base of soil profiles (series) throughout New Zealand. This data base enabled the construction of the new classification largely from the 'bottom up' in the classification hierarchy, i.e. in an inductive fashion. The higher taxa, broadly known from the groups of Taylor's system, enabled concomitant construction from the 'top down', i.e. in a deductive fashion.

Hewitt began work on the new system in 1983. Version 1 was published in 1987, version 2 in 1989, and version 3 in 1991, with the 'final' version due to be published later this year (Hewitt 1992b). At all stages, draft copies were sent to soil scientists throughout the New Zealand science community for comment and trial, and specialists (e.g. in allophanic volcanic ash soils) were asked to help set limits in defining diagnostic horizons and so on for specific orders. At the same time, regular progress reports were published in *New Zealand Soil News* commenting on the principles and purposes of the new classification, its structure, and other features (e.g. Hewitt 1984). As well, a revised soil description handbook and soil horizon nomenclature handbook were published. All in all, the process from conception to completion has taken about ten years. During this time, contributions to Soil Taxonomy were also being made, and it is a written objective in the new classification that soils should be correlatable with Soil Taxonomy. In other words, New Zealand is now operating essentially two systems: a local, modern classification system designed specifically for New Zealand soils and conditions only

(Hewitt's), and an international system (Soil Taxonomy). Hewitt's system is less complex than Soil Taxonomy and has fewer hierarchical categories (four).

Does Australia need change?

Returning to the questions posed in the introduction, the first consideration is whether change is needed in Australia. Have the Great Soil Groups and Factual Key systems had their day? From an outsider's viewpoint, the answer regarding the Great Soil Groups is surely yes. It is my understanding that Northcote first developed his Keys around 30 years ago chiefly because the Great Soil Groups system was inadequate even then for large scale mapping of Australia. On field trips associated with the recent Adelaide conference, I found it rather incongruous that we should be given sophisticated analytical data on soils but at the same time broad terms such as 'red clay soil' should occasionally be used. The Northcote Keys, to the uninitiated, are totally meaningless (I suppose the same argument could be levelled at any classification system to some extent!) and nowhere were we given even a simple explanation of the Key's structure. The Factual Keys may be a good way of 'storing' knowledge but less useful for communicating it. In the long run, the answer as to whether change is needed in Australia must come from the practitioners and users of soil science here, and the impetus for such change, as was the New Zealand experience, must come from dissatisfaction with the systems presently in use.

If the answer to the question "Is change needed?" is yes (and the development of the Isbell system states that is the case: see Isbell 1984, 1992b), then there are at least three major difficulties ahead. These are no doubt well known to most, but can be viewed in light of the New Zealand experience outlined above.

(1) Australia is very large, comparable in size to the conterminous United States. Guy Smith and others began working on Soil Taxonomy in 1951 - more than 40 years ago - and it was not published until 1975 (its precursor, the so-called '7th Approximation', appeared in 1960).

Since then, there have been four editions of the 'Keys to Soil Taxonomy' published and a 2nd edition of Soil Taxonomy is tentatively planned for about 1995. What I'm saying here is that the task of developing a comprehensive classification system for a land mass the size of Australia is daunting, even if relatively large areas might be able to be grouped into a large order such as "Arid Soils" or whatever. In addition, the landscape is generally old, the soils often have relict features not always easily accommodated in soil classification systems, the continent spans many different climatic zones, and has unique flora and fauna.

(2) There seems to have been no single unifying body concerned with mapping and classifying soils in Australia. My understanding is that although much work in this regard has obviously been done by the CSIRO Division of Soils, other organisations such as the Department of Agriculture and the Department of Primary Industries also make a major contribution. Lack of coordination (even competition these days?) of these different groups, and the universities, is worsened by the notorious interstate rivalries that seem to occur in Australia (for whatever reason).

(3) In these days of squeezed budgets and a growing 'user pays' philosophy, there is great pressure to undertake more 'applied' research in soils than was the case even five or ten years ago. The consequence of this is that scientists have diminishing time to spend on what might be regarded as 'esoteric' work such as contributing to the development or understanding of new systems of soil classification.

In contrast to points (1) and (2), New Zealand is a small country with relatively young soils, and the Soil Bureau has had the unifying role of mapping and classifying the nation's soils since the late 1920s - early 1930s. But it is now evident that neither Hewitt's new classification system nor the input into Soil Taxonomy by New Zealand could have taken place if the process was begun today - there are just insufficient resources and the 'user pays' philosophy is far more advanced in New Zealand than in Australia. In

fact, Soil Bureau as such ceased to exist some years ago, being replaced (several times) by an amalgam of multidisciplinary successors (DSIR itself ceases to exist on 1 July 1992).

So, having stated some of the difficulties, what are some of the possible directions?

Which way Australia?

It is evident that Soil Taxonomy is regarded as the primary international system although the FAO-UNESCO World Soil Map system (FAO-UNESCO 1988) is also used for this purpose (particularly in Europe). Consequently, familiarisation with Soil Taxonomy is close to becoming a necessity for Australian soil scientists. This status, unpalatable as it may seem to some, is reinforced by the editorial policy of the *Australian Journal of Soil Research* which states that soils must be classified for publication purposes in terms of either Soil Taxonomy or FAO in addition to whatever local system is used. The second fact of life is that Isbell's new Australian Soil Classification, which was actually initiated as long ago as 1981, has been available since 1989 when the "First Approximation" was published as *CSIRO Division of Soils Technical Memorandum* 31/1989, and is now well advanced in its development (Isbell 1992a). The development has been a full-time project for the Convenor since early 1989, and the Standing Committee on Soil Conservation announced in July last year that "all States/Territories will test and introduce the new Australian Soil Classification System" over the next two years (*Soils News* 89, p.5, 1992).

Thus, Australian soil scientists are apparently faced with the prospect of having to deal with up to four classification systems, which is clearly totally unsatisfactory. My opinion is that the dual option adopted by New Zealand is probably the best course to pursue, with the Isbell and Soil Taxonomy systems effectively displacing the Great Soil Groups and Northcote Factual Keys. Whilst this suggestion may seem to some to be as disrespectful as recent efforts to change the Australian flag, the parallel does not hold because (ideally) soil classification systems must

evolve to keep pace with the growth of new knowledge (flags are entirely symbolic and do not have a real 'function', apart from identification purposes, in the way that classification systems do). Clearly, the current systems will be around in the literature for a long while yet but this should not be seen as an insurmountable obstacle. Approximate correlations, suitable for small and medium scale maps, for example, are easily made.

The question arises as to why bother with two systems at all - why not just opt for either Isbell's system or Soil Taxonomy and be done with it? I think the answer here is that, like New Zealand, there is room for both systems because they both have merits worth retaining. Soil Taxonomy is a complex and at times infuriatingly difficult system to use although the nomenclature, once understood, is simplicity itself. The difficulty comes when trying to key out soils and being faced with unfamiliar terms and concepts, let alone rather (necessarily) pedantic English expression. This is because the latest 'Keys to Soil Taxonomy' are essentially documenting as many properties as possible of all the soils listed in the Soil Taxonomy data base, i.e. they are ideally a repository of all the (known) soils of the world. Therefore it is little wonder that some aspects will be beyond the experience of even the most experienced pedologist. In addition, recent experiences with Soil Taxonomy in South Australia suggests that some of Australia's soils are not adequately catered for in the current 'Keys to Soil Taxonomy'.

On the other hand, the Australian Soil Classification has a lesser brief because it focuses solely on Australian soils and conditions (still a big task, as noted previously). As with Hewitt's New Zealand Soil Classification, it is generally simpler and easier to use than Soil Taxonomy because it is more field orientated with less reliance on supporting laboratory data. At the same time it has a modern hierarchical system similar to that of Soil Taxonomy, uses diagnostic horizons, and has many of the Greek and Latin-based terms found in Soil Taxonomy. Consequently, there

should not be too much divergence in getting to grips with the two systems.

One criticism often raised about Soil Taxonomy is that it is always changing, and that such changes are hard to keep up with. However, this is surely true of science in general, and the regular updating of the 'Keys to Soil Taxonomy' means that all changes are readily available.

But the biggest difficulty is perhaps the question of how best to develop and 'sell' the systems.

How to sell the new systems

The first point here is that the adoption of such a dual system needs to be 'voluntary' rather than 'directed' - the carrot rather than the big stick approach. The long term benefits of change need to be identified and spelt out and then weighed against the efforts required to make the changes.

The second point is that the classifications can be tested and developed in parallel - the same soil profile can be described and samples analysed to the betterment of both systems, not to the detriment of one or the other. Furthermore, as was found in New Zealand, the testing phase should result in the accumulation of a wealth of data about the soils of Australia - is this not a desirable objective? Far from being an esoteric exercise, the development and documentation of soil classification systems in effect becomes the data base (and tool) for future research and land management strategies. Recent experience with Wayne Hudnall (an American Visiting Scientist at CSIRO Division of Soils, Adelaide) has shown that quite a proportion of soils in South Australia 'don't fit' the current 'Keys to Soil Taxonomy'. They can be classified in the Keys, of course, but the point is that modifications to the Keys improves the classification. There is a set mechanism for proposing such changes and so Australia could make a real contribution at an international level as well as at the national level.

My third point is that a coordinating body is needed to facilitate the adoption and ongoing development of the classifications. The state and departmental boundary lines need to

'disappear" so that a unified approach is taken. A small classification body should be set up in each state to help with communication from local to national level (I believe such a group has been informally established in South Australia already). An essential role of these groups would be to run appropriate workshops to teach the new systems to all who are interested - I believe this is the *only* way they will become understood and adopted. Such workshops on Soil Taxonomy were run in South Australia last year by Wayne Hudnall, and were outstandingly successful. In addition, simple articles should be widely published to explain the rationale and functioning of the new systems (in *Soil News*, for example).

The geoscience and soil science departments of the universities need to be involved in this process as well. In the University of Waikato in New Zealand, we have been teaching the new Hewitt classification system to undergraduates since 1990. Although this seemed an onerous job at first that required a fair amount of work, it has surprised me how quickly the new names and so on became familiar, and how stimulating it was to be involved, even in a small way, with the development of a new system. (Soil Taxonomy has been taught at the University of Waikato since the early 1970s.)

Perhaps the adoption and promotion of the new systems will eventually be the factor in integrating and 'driving' soil research in Australia in the same way that Soil Taxonomy fulfils this role in the United States?

Conclusion

In many ways the advancement of a discipline is reflected by the state of development of its system of classification, and soil science is no exception to this. Perhaps the importance of classification to soil research and land management - a means to an end - has not really been adequately appreciated in some quarters in Australia. W.L. Kubierna in 1948 (in Buol *et al.* 1989) made the observation "Show me your [classification] system and I will tell you how far you have come in the perception of your research problems". For various reasons, the country now appears to be

facing the job of developing and 'selling' two modern classification systems to its soil science practitioners who must in turn promote their use to land managers. This is a challenge that needs both a willingness to seek change and a coordinated and well organised effort to make those changes before it's too late.

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