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Information resources on corrosion

J.R. Duncan

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INFORMATION RESOURCES ON CORROSION

J R DUNCAN

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INTRODUCTION

Living in New Zealand, we perhaps feel out of the mainstream of world science and technology. In the corrosion scene, though, we are most definitely not. We have a small petrochemical industry and an aluminium smelter, with plants built in areas with very high levels of sea-salt fallout by world standards, so bringing all the atmospheric corrosion possibilities as well as the corrosion within the actual process plant. One of our major tourist centres is built in a geothermal zone where corrosion is rampant, with reliability of services and structures needed if world-wise tourists are to leave satisfied. We have built our major population centres in all the appropriate places to enhance atmospheric corrosion: Christchurch in a valley where the pollution doesn't blow away, and Auckland, Wellington and Dunedin (to a lesser extent) where sea-salt is regularly blown in by prevailing strong winds. We rely on the agriculture and horticulture industries to earn our overseas funds, yet these industries are possibly capable of saving a considerable part of their costs by avoiding corrosion.

This paper considers ways that New Zealand can tap into overseas resources of information in our corrosion work, and some strategies we might adopt in future. We have to tread a fine line; it is important not to waste the small allocation of the nation's resources given for corrosion investigation by repeating overseas discoveries and "reinventing the wheel"; but it is also important that the corrosion problems that are of special importance to New Zealand are counteracted by methods suitable for New Zealand, rather than by using "imported" methods simply because an "overseas expert" said we should.

CORROSION IN AGRICULTURE

This is a good example to follow through in a little more detail. It brings out many of the worst problems involved in reduction of corrosion problems because:

(a) There were 76633 farms in New Zealand at 30.6.84, and it would be impossible for corrosion advisers to make a personal inspection of every farm. Further, the move for farmers to have to pay for advice from MAF will mean that fewer "accidental" cases of advice on corrosion mitigation are likely than, say, 5 years ago.

(b) There are a lot of ingrained attitudes in the agriculture sector, along the lines of "Fertiliser storage sheds always corrode, so there's no point in my trying to stop it." It has been suggested that farmers take much more notice of their "intimates" than of expert advisers (Phillips, 1982).

(c) There are positive tax advantages in having buildings and equipment corrode away, since maintenance tends to be immediately tax deductible and initial capital expense (which is likely to be higher for better corrosion protection) must generally be depreciated more slowly. This is a dangerous approach, since it does not take notice of the problems that can arise if a building or a piece of equipment is out of service when needed. If a dairy factory has to close down in mid-season, the cost in lost production is tens of thousands of dollars per day, and this cannot later be recovered. Similarly, if a grain crop is ready for harvest, the equipment must be reliable on that day, or there can be large financial costs.

(d) New chemicals are continually introduced for improvement of productivity, whether to kill pests, or fertilise, or provide better storage properties for produce, with the farmer often not made fully aware of any positive or negative side effects on materials degradation before he puts the chemical into service.

Overseas studies have shown that:

(a) In the UK in 1980, the cost of corrosion in the agricultural and horticultural industries alone was greater than 600 million pounds (Elliott et al, 1986).

(b) In the USA in 1975, the direct cost of corrosion to the agriculture sector was about 2.3% of its total input costs, and 58% of this was calculated to be avoidable using known methods.

(c) In Sweden in 1968, 50% of the cost of corrosion in agriculture was calculated to be avoidable.

It is at this point that we must sit back and take stock. Corrosion is obviously a big problem in agriculture in these overseas countries, and so it is probably an important cost in New Zealand too. But farming is a much more intensive industry in these countries (especially in the UK), with a lot of housing of animals and a lot of chemicals used as feed additives and preservatives, which isn't as common in New Zealand. Yet again, glasshouse culture is similar in both the UK and New Zealand, and the UK doesn't have problems with kiwifruit support fence durability which New Zealand might yet face. There is every reason, then, to expect on balance that corrosion is a big problem in both buildings and equipment in the farm-based industries in New Zealand, but that the types of structures and equipment attacked will be in a different order of priority from those overseas.

The problems listed above for corrosion in agriculture are repeated in many other industries. Both the building and light manufacturing sectors are fragmented (as (a) above), have an acceptance of corrosion problems which would be avoidable, have the same tax rules as noted at (c), and are continually faced with introduction of new materials and practices for which there has not always been adequate training of those who will use them.

HOW COULD ANSWERS BE FOUND?

There is an increasingly wide range of sources of information on corrosion rates. "Expert Systems", corrosion rate data bases and lists of published material are now accessible to anyone in the world who has a computer terminal that can connect to a telephone, and the right passwords to get to the appropriate host computer. Thus, in 1982, when for a joint

BRANZ/DSIR project it was desired to do a literature survey on corrosion problems in agriculture, a computerised search was made of the Engineering Index file using the DIALOG Information Retrieval Service in California. This took about 60 minutes "on-line" and turned up 151 references; it is reasonable to assume that these are virtually *all* the references in the corrosion in agriculture field noted in this abstracting base from 1969 to late 1982. A manual search would take many hours to perform this task: a preliminary search of the Agricultural Engineering Index had uncovered only a handful of papers after half a day's search. In contrast, for the computer search, the total computer and telephone link charges were less than $160, and needed about 3 man-hours in total to plan and later analyse, so that this is a very cost-effective and fast means of searching for information. All of the libraries listed in Table 1, and many public libraries, have access to these systems.

There is an obvious corollary here, also, that if a researcher is to have the value of his work maximised he should aim to publish it in a location which will be noted on the computer-held reference banks, since it is quite possible that within a few years computer searches for relevant references will have outmoded the traditional manual library search.

Having found references to previous work, it is still necessary to get access to the original text.

New Zealand is fairly well served by its libraries in keeping up subscriptions to corrosion journals. Table 1 shows some of the libraries listed in 1987 as holding current subscriptions to three major corrosion journals. Some libraries, especially the first four in Table 1, have built up good collections of corrosion-oriented textbooks. It is pointless to try to list here the range of books and journals available: there are comprehensive lists of journals, books, conference proceedings and films which were available in 1977 in the Corrosion Prevention Directory (Department of Industry, 1978). The ACA Corrosion collection is housed in the library of Auckland Industrial Development Division of DSIR, and enquiries there may locate otherwise unavailable material, especially for proceedings of corrosion conferences. ACA members receive, each month, a Current Awareness Bulletin listing recently published material.

Mattson (1981) and Kelly (1987) summarised some of the available computer-readable bibliographic databases. Orbit Information Technologies have now set up a computer-readable system giving data on corrosion resistance of a wide range of metals, plastics, and other non-metals. NACE, in association with US National Bureau of Standards, have a similar system available, through dial-up facilities, and in part on floppy discs for IBM PCs and compatible computers. (This PC system is a computerised version of the Metals Section of the 6th edition of "Corrosion Data Survey", covers 25 materials in about 1000 corrosive environments, and costs $US200-300. There is intended to be a companion non-metals system available soon.) The sophistication of this NACE-NBS data base ranges from raw data, which will still need an "expert" to interpret, through to more extensively-evaluated data (Verink et al 1987).

This area of using the computer as the interpretive "expert" is now receiving a lot of attention. Kelly (1987) describes the ACHILLES system operated by UKAEA at Harwell, and lists some other "expert systems". The ACHILLES system can provide interactive advice to an engineer or designer, giving general advice on carbon steels and stainless steel, and more specific advice on marine corrosion problems and corrosion inhibitors.

Hines and Basden (1986) discuss AUSCOR, another "expert system", which deals with corrosion of stainless alloys in a wide range of environments, and predicts probabilities of passivity/general corrosion/localised corrosion/stress cracking, and an assessment of the suitability of a given alloy for an environment in light of these probabilities.

However, the availability of such "expert systems" remains limited — they are expensive to produce, and so only cost-effective if the problems they assist to avoid are costly enough to allow large savings by the "right" decision. In November 1986, the basic subscription for a New Zealand company wishing to use ACHILLES would have been 8,000 pounds, before telecommunication and other costs.

For most of the problems that are met in New Zealand, therefore, there is a need to find a "personal expert", and personal contacts, books and journals are an essential resource.

FINDING THE "RIGHT" PERSON

The New Zealand Branch of the Australasian Corrosion Association (ACA) (Box 5961, Auckland), which has active groups in Auckland, Wellington and New Plymouth, and a membership of around 190, is the primary corrosion-related organisation in New Zealand. Most of those working in this field in New Zealand belong to this organisation, and enquiries to it should therefore reach someone knowledgeable in the field (or who at least knows the most appropriate person to ask).

ACA also provides links to other organisations in the corrosion field, with formal links to National Association of Corrosion Engineers in North America and Institute of Corrosion Science and Technology in UK. ACA NZ Branch nominates the NZ delegates to the International Corrosion Council, under whose auspices an International Congress is held every three years. These would be the biggest, truly international, corrosion conferences. The last two have been held in Mainz in 1981 and Toronto in 1984, and the next is scheduled for Madras in November this year. Each has drawn a high fraction of the presented papers from corrosion workers outside the host country. Other important conferences are held annually in North America by the National Association of Corrosion Engineers and in UK by the Institution of Corrosion Science and Technology. Groups such as these, the American Society for Testing and Materials, and the European Corrosion Federation, also organise "special interest" meetings at irregular intervals on aspects of corrosion. Though most of these meetings eventually have published proceedings, such publications rarely capture all of the discussion or the special nuances that can be gathered by personal attendance. It is in New Zealand's interest that opportunities become available for attendance at them - and then critically important that those able to attend ensure that there is good distribution of the information that they collect.

On the Australasian scene, ACA organises an Annual Conference, with the venue moving around the branches. This tends to be a large regional meeting with about 250 attending in Rotorua in 1984 and in Adelaide last year, and rather fewer in Newcastle in 1985. This November the Conference is in Melbourne, next year in Perth.

DISSEMINATION OF INFORMATION

This topic is now a regular feature of programmes for ICC Congress since a very successful session at the Mainz Congress in 1981. Some of the major points to emerge from that session, as valid today as they were then, are:

(a) Effective communication is all-important, and "information multipliers" such as University or Training College lecturers and the editorial staff of journals, should be prime targets. If information is supplied in suitable form to these people, even if they do not use it directly themselves, they should be better attuned to ideas which might later be advanced in the corrosion field.

(b) Protection against corrosion can be induced either by consumer demand or "big stick" push. An example of the latter is in using Standards Association committees to ensure that products reaching the market have a sensible degree of built-in corrosion prevention.

(c) A study by the Institution of Corrosion Science and Technology in the UK across a range of industries showed a big variation in availability and use of training facilities. The gas and electricity authorities in the UK seem to know far more about the corrosion problems likely to occur in the equipment they have than do the manufacturers of it, and similarly farmers in the UK know more about corrosion than suppliers of their machinery and equipment.

(d) The sophistication of corrosion awareness varies between industries, and between countries within an industry. In Egypt and the USA, the costs of corrosion as a percentage of input cost in their oil refining industries are about equivalent but the Egyptian food canning industry loses proportionately eight times as much as the USA due to corrosion. The multi-national industries (such as in oil refining) no doubt have good internal data-sharing mechanisms between countries and companies.

Each of (a) to (c) is a reflection on the need for good communication between those who have corrosion problems and those with corrosion knowledge. Many countries have conducted surveys of the cost of corrosion in their community. Some of these are discussed in a report of a symposium on international approaches to reducing corrosion costs (NACE 1986). Almost always the answer emerges as 3-4% GNP, of which one fifth could be saved by application of existing technology.

CORROSION ADVISORY SERVICES IN SOME OTHER COUNTRIES

The UK Government, as a result of the Hoar Report in 1971, took an active role in promoting corrosion awareness, and established the National Corrosion Service in South London, and the Corrosion and Protection Centre attached to the University of Manchester Institute of Science and Technology (UMIST), in the early 1970's. These bodies are now largely self-financing, the NCS in providing advice to industry under contract and CAPCIS funding itself by attracting research contracts from companies and Government agencies both within UK and overseas. A smaller sum is gained through advisory consultancy work. The Government's contribution to funding has, therefore, been markedly reduced (Elliott 1982). One very

positive outcome of this initial involvement was a series of booklets published by the Department of Industry. The titles are listed in Table 2, and they form, in my view, the most valuable English-language tool available to the corrosion advisory worker, by providing, in relatively simple terms, a discussion of problems and solutions in corrosion.

While it might be argued that the UK, because it is massively larger in population terms than New Zealand, is not a suitable model, Denmark, with a population of around 5.1 million, is much closer to New Zealand's size, yet has a dedicated corrosion centre unlike anything in New Zealand. Korrosionscentralen ATV was founded in 1964 on a similar basis to Research Associations in New Zealand — with 66% direct funding by Government and 33% from industry support, with a requirement that Government funding would decrease markedly within a few years. By 1975, there was a staff of 28, with 65% of income sourced from consulting and laboratory work (including research contracts). By 1982 Korrosionscentralen had a staff of 52 (13 "administration", 20 "professionals", 19 "technicians"). In 1984 their sources of funding were:

Consulting	75%
Government : base support grant	15%
Specific research (Govt/industry)	10%

This corrosion centre serves the whole Danish economy, and provides corrosion failure investigation services, consultation on selection of materials and methods of their protection, and training and teaching in corrosion fields, among other services. It provides a focus and a co-ordination for corrosion awareness activities in Denmark in a way which we do not see in New Zealand at present, despite the efforts of ACA, DSIR and other bodies.

A study in 1982 in Australia (Cherry and Skerry 1983), led to a proposal to establish a National Corrosion Centre, with Government funding. The expected purposes could be to provide a central referral service for queries on corrosion, and other services similar to those described above for Denmark. Government funding did not eventuate, but ACA established a referral service operated from Monash University, funded by a fee that consultants, seeking to have work referred to them, paid for inclusion. The ideal recognised at the time that Cherry and Skerry were working on their report was that there would be a referral centre in each state capital. Over the past 18 months, there has been interest from the State governments in South Australia and Victoria to set up state-funded centres. Very recently, the Victoria State Government has committed $A550,000 to establish the "Australasian Corrosion Centre", which will supersede the service operating from Monash. The Centre will have as its staff an Executive Officer, a Training Officer and a Secretary. Its functions will include referral and technical consultation services, and it will also provide some administrative assistance to ACA. This Centre will have to become effectively self-supportive in 3 years.

A CORROSION CENTRE FOR NEW ZEALAND?

Though ACA New Zealand Branch has made submissions to NRAC and to the Beattie Committee on the desirability of a corrosion centre in New Zealand, there seems to have been no interest in commitment of Government funds to such a venture. ACA, made up of voluntary members, has gone almost as far as it can in establishing meetings, symposia etc for information exchange. There would appear to be a need for a more dedicated organisation; bodies such as BRANZ are regularly receiving requests for guidance on corrosion matters. A survey I conducted for ACA earlier in

1987 suggested there are about 27 person-years research in corrosion fields going on in New Zealand, spread across 12 organisations. The Corrosion Section of DSIR Industrial Processing Division, the biggest of these groups of researchers, is already recovering a major fraction of its expenditure from clients. Four DSIR divisions (AIDD, SIDD, Chemistry and Industrial Processing) are involved in corrosion work, and all operate "user pays" systems for assistance with specific queries. Other organisations such as MWD Central Laboratories and BRANZ provide testing and consultancy services. There may, therefore, be no room for a further investigative organisation in the corrosion field in New Zealand. But no "permanent" organisation has the role of co-ordinating investigations - nor, more importantly, of ensuring that the fundings from them reach the people who can use them. There must, in the national interest, be improved availability of reliable information. The model for a focussing and co-ordinating body is there, in Korrosioncentralen. The mechanism already exists in New Zealand, in the research associations. The Heavy Engineering Research Association has worked precisely in this fashion, as an information collector and disseminator with no laboratories of its own. But if this idea is to go further, it will need expressions of support, including financial support, from potential users. Will this be available?

CONCLUSIONS

New Zealand has many corrosion problems, and only a rather fragmented system of delivery of advice to those with problems. There is little trouble obtaining access to overseas databases, or to published information, but the information must still be interpreted for New Zealand conditions. The Australasian Corrosion Association is playing an important role in providing a forum for learning and advice, but is a voluntary organisation. Establishment of a National Corrosion Centre in New Zealand, for which there are good role models in other countries, could be a useful step in improvement of availability of information to solve corrosion problems.

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TABLE 1

Availability of some major corrosion journals in New Zealand Libraries
(based on National Library Finding List, 1987)

	Materials Performance	British Corrosion Journal	Corrosion Science
AIDD	X	X	X
Engineering School Auckland University	X	X	X
Engineering School Canterbury University	X	X	X
Chemistry Division DSIR, Wellington	X	X	X
MWD, Wellington	X	X	
BRANZ, Wellington	X		X
Canterbury Public Library	X		
CIDD		X	

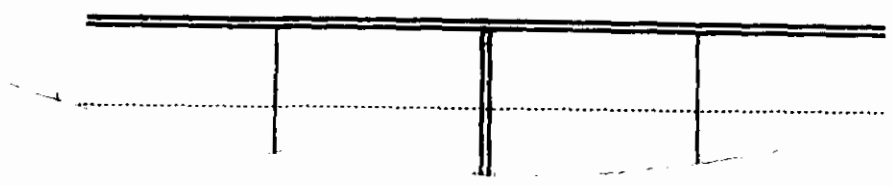
Note: Not all these libraries have unbroken holdings reaching back to Volume 1.

TABLE 2

Titles in Corrosion Awareness Series
Published by UK Department of Industry

CONTROLLING CORROSION
1. Methods
2. Advisory Services
3. Economics
4. Standards and Specifications
5. Case Studies on Corrosion
6. Monitoring

GUIDES TO PRACTICE IN CORROSION CONTROL
1. Sources of Corrosion Information
2. Corrosion of Metals by Wood
3. Packaging for Handling and Transport of Coated Goods in the Construction Industry
4. Stress Corrosion
5. The Handling and Storage of Coated and Wrapped Steel Pipes
6. Temporary Protection
7. The Corrosion of Steel, and its Monitoring, in Concrete
8. Corrosion Factors in Pumps and Valves
9. Cathodic Protection
10. Corrosion Control for Buried Pipelines
11. Avoidance of Corrosion During Chemical Cleaning of Plant
12. Paint for the Protection of Structural Steelwork
13. Surface Preparation for Painting
14. Bi-metallic Corrosion
15. Corrosion in Agriculture



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