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in new zealand

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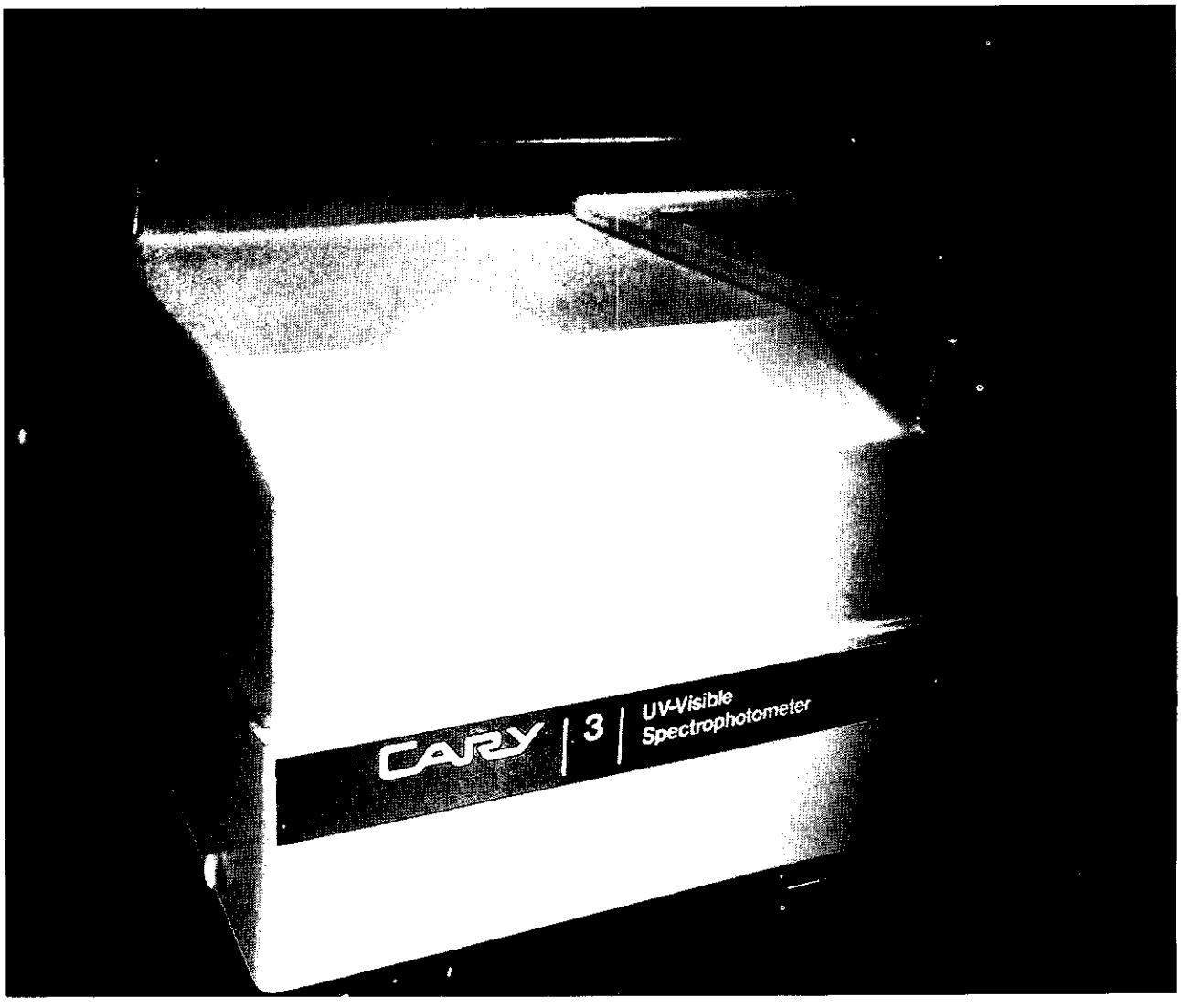

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IMPORTANT TRANSTASMAN LINKS STRENGTHENED BETWEEN NZIC AND RACI

MEMORANDUM OF UNDERSTANDING
Association of Chemists in Australia and New Zealand
A.C.A.N.Z.

After careful consideration the following document was signed by the President of the New Zealand Institute of Chemistry Joyce Waters and David James, the President of the Royal Australian Chemical Institute on 23 August 1990.

Whereas the Royal Australian Chemical Institute and the New Zealand Institute of Chemistry have been formed as independent bodies to promote the advancement of knowledge of chemistry through research, teaching and applications, within their respective countries; both organisations now recognise their common interests and objectives could be furthered by joint cooperation established on some formal basis. The purpose of such cooperation would be to ensure the free, regular exchange of professional information and by so doing encourage collaborative effort amongst the chemists of both countries.

Accordinly we agree to form the A.C.A.N.Z. to serve this purpose. Membership shall be automatic to all chemists who are financial members of R.A.C.I. or N.Z.I.C. and all A.C.A.N.Z. members shall enjoy the equivalent but non-voting priveleges of each other's Institutes. The presidents of both Institutes (or their nominees) will become coopted members of each other's Councils and be invited to attend each other's Council meetings scheduled at the time of their national Congress/Conference meetings. The means for disseminating information amongst the chemists of both countries will be a new Journal which will include a proportionate content of Australia and New Zealand news.

Contributions will be communicated by the New Zealand editor to the editor the new Journal to reflect this change. It will continue to be edited and administered by the R.A.C.I. and will be distributed in New Zealand by N.Z.I.C. following bulk delivery from Australia.

Both Institutes acknowledge and express their intent to exploit any new opportunities A.C.A.N.Z. provides for furthering their local interests at the national level and representing the joint interests of the Australasian chemical community at the international level. For simplicity of operating and maintenance of institutional independence any financial matters concerning A.C.A.N.Z. shall be apportioned on the basis of the level of each Institute's respective membership. Both Institutes therefore will retain their existing identity and autonomy on financial matters.

Whatever governance of A.C.A.N.Z. may be required shall be the joint responsibility of the current presidents of R.A.C.I. and N.Z.I.C. Any action, if needed, will be executed by the president of R.A.C.I. following appropriate consultation with the president of N.Z.I.C. If at any time either Member body forming this agreement of association deems it an encumbrance to the advancement of chemistry in their respective countries they have the unconditional right to withdraw from this agreement whereby A.C.A.N.Z. will become null and void and so cease to exist.

Signed Joyce Waters NZIC

Signed David James RACI

1990/91 President of NZIC - Dr H.J. Percival

Dr H.J. Percival was elected as President for 1990/91 at the AGM of the Institute in August 1990.

Harry, 47, was educated at Victoria University of Wellington gaining MSc (Hons) in 1966, and a PhD in Chemistry in 1970, both under Professor J.F. Duncan. His PhD research introduced him to the high temperature chemistry of clay minerals and ceramic materials and he continued in this field at the NZ Pottery and Ceramics Research Association (PACRA), working there for eighteen months. Then followed two years of post-doctoral research on carbonate minerals at the Department of Industrial Chemistry, Universite Libre de Bruxelles, Belgium, under Professor W.L. De Keyser.

On his return to New Zealand late in 1973, Harry joined the staff of the NZ Fertiliser Manufacturer's Research Association. He regained his association with ceramic materials research by becoming Director of PACRA in 1974. In 1981 Harry joined NZ Soil Bureau, DSIR where his main research interests were the equilibrium and kinetic relationships between soil minerals and solutions. His was appointed Science Manager (Marketing) of NZ Soil Bureau in early 1988 and was responsible for consultancy services and contract research within New Zealand.

Since NZ Soil Bureau became part of the Division of Land and Soil Sciences late in 1988 and then DSIR Land Resources (1990) Harry has managed several scientific teams and is currently a Team Leader (Chemical and Physical Processes in Soils) in the Environmental Processes Group.

Harry has been a member of NZIC since 1970 and became a Fellow in 1981. He is a past Chairman (1982/83) and Council delegate (1982/4) of the Wellington Branch, represented Council on the Standards Association of NZ Council from 1979 to 1988, and is current NZIC representative (since 1986) on the Member Bodies' management Committee of RSNZ (he was also on this committee as a Member Bodies'representative from 1982-1986). He was a member (1984-89) of the National Committee of Chemistry (IUPAC). In additional to NZIC, Harry holds membersip in the Wellington branch of RSNZ, the NZ Society of Soil Science, and the NZ Association of Scientists.

LETTER FROM THE PRESIDENT

Dear Member.

I enjoyed very much participating in the Wellington Convereńce with its wide range of generally very good plenary speakers. It was an intense three (and a fraction) days but stimulating and satisfying. An innovative venue for the Dinner (at the famous Southward's Car Museum near Waikanae) and an excellent after-dinner speech by Neil Waters, Vice-Chancellor of Massey University rounded off the Conference nicely. For future Conferences Council has decided, as the underwriter, to co-opt the Chairperson of the organising committee to Council. This will allow good liason and oversight of Conference organisation and finances.

An exciting development that occurred at the closing ceremony for the Conference was the signing by the then President of NZIC and RACI (Joyce Waters and David James) of a Memorandum of Understanding between the two Institutes (reproduced in full elsewhere in this issue) that forms The Association of Chemists in Australia and New Zealand. This "umbrella" association will allow the co-ordinated development of closer, active relations but with both Institutes retaining "Sovereignty" over their own affairs. A joint NZIC/RACI Journal (currently under discussion) will in the medium term lead to lower per capita costs for both Institutes.

Although the Institute's financial statement in the August issue of the NZIC Journal showed a small surplus of income over expenditure a significant portion of the income included by the auditor was, as is usual, subscriptions in arrears. This actually meant an operational loss of about $18,000 for 1989/90. I would therefore urge members in an arrears situation to contact the Executive Officer, Alan Turner, to help redress this situation. For 1990/91 Council is attempting to hold expenditure to affordable levels but still provide the flexibility to fund activities and initiatives for the benefit of members and our chemistry profession. As part of this approach the February 1991 Council meeting will be a phone conference, therefore providing a significant saving on internal travel and accommodation costs. Council members will still gather for the August 1991 meeting and the Canterbury Conference.

As mentioned in the April issue of this Journal Council this year moved to strengthen links with the Specialist Groups by appointing me, when I was First Vice-President, as the representatives/liason person for their interests on Council. Council has agreed that I will retain this important function for this year. The Auckland Branch, in consultation with myself, will be preparing a review paper on the role and operations of Specialist Groups within the Institute, with further recommendations for improved, mutual relations.

Regards
H.J. Percival
President

EDITORIAL

MAJOR CHANGES AHEAD FOR "CHEMISTRY IN NEW ZEALAND"

Published in this issue of "Chemistry in New Zealand" and also in the next issue of "Chemistry in Australia" is the Memorandum of Understanding signed by the Prsidents of the Royal Australian Chemical Institute and The New Zealand Institute of Chemistry at the closing ceremony of the 1990 NZIC Conference in Wellington. This memorandum which formalises the formation of The Association of Chemists in Australia and New Zealand A.C.A.N.Z. will result in a continuation and strengthening of the growing cooperation betwen Chemists in both Australia and New Zealand.

Of immediate impact will be the disappearance of "Chemistry In New Zealand" to be replaced by a new joint venture monthly magazine containing a range of news articles, reports and editorial comment fully covering the needs of both RACI and NZIC members. Considerable advantages are seen in having a larger, more frequently published joint journal but these advantages will not be fully realised without a lot of preliminary groundwork and enthusiastic support by way of contributions from NZIC members. The discipline of monthly deadlines should see news and comments appear before issues are forgotten and also allow the use of the magazine for classified advertisements. Planning has already commenced for the new arrangements to commence probably early in 1991.

A perusal of "Chemistry in Australia" shows that many of the problems and issues facing Chemists are the same or similar in both countries. Much can be gained from shared experience and joint approaches. As an example there are many initiatives being taken to reverse the current misguided but fashionable trend for the public to regard anything of a chemical nature with suspicion. Educational programmes to improve the image of chemistry are needed for people of all ages.

As New Zealanders go to the polls nothing is more certain than that whatever the outcome, funding of science based research and development will continue to be subject to political idealism and the needs of short term financial survival. Never has it been more imperative for competent management skills to be aquired and used by all those who choose to use their chemical and other scientific training as a means of satisfying their employers and at the same time enjoying a rewarding professional career. Unfortunately the subjective language of business is difficult to combine with the objective language of science. The only common denominator is the language of money; unfamiliar territory for a researcher.

R. B. Hall
Editor

CONFERENCES & SYMPOSIA

11th AUSTRALIAN SYMPOSIUM ON ANALYTICAL CHEMISTRY HOBART, 8-12 JULY, 1991
HOBART, 8-12 JULY, 1991

Registration of Interest & Call for papers

The symposium will highlight current development, future and current applications in Analytical Chemistry.

Concurrent Paper and poster sessions will be held.

A number of workshops and an Instrument exhibition will also be held.

Registration of Interest to:

Eleventh Australian Symposium on Analytical Chemistry
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HOBART TAS 7000
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"PERSPECTIVES IN MARINE NATURAL PRODUCTS"

University of Auckland, 7-8th February 1991

This is a two-day symposium organised by the Department of Chemistry, University of Auckland, and sponsored by the Auckland Branch and the Fats and Oils Group of the NZIC. It aims to promote interest in marine natural products and to show the importance of chemistry in this sphere. It follows similar successful one-day symposia held in Auckland in 1982 and 1987. The venue is the Conference Centre at the University.

The programme consists of thirteen invited lectures and a session devoted to poster presentations. The Convenor welcomes additional contributions for the poster session in which all registrants are invited to participate.

The invited lectures will be given by:

Professor Patricia Bergquist, Zoology Department, University of Auckland, "Sponge Chemotaxonomy: An Overview".

Dr Murray Munro, Chemistry Department, University of Canterbury, "Anti-tumour and Antiviral Compounds from New Zealand Marine Organisms".

Dr John Blunt, Chemistry Department, University of Canterbury, "NMR and Molecular Modelling in Natural Product Structure Determination".

Dr Peter Murphy, Australian Institute for Marine Science, Townsville, Australia, "Aspects of the Chemistry of the NCI Shallow Water Marine Organism Collection".

Dr Robert Capon, Organic Chemistry Department, University of Melbourne, Australia, "Marine Norterpene Cyclic Peroxides: A Stereochemical Paper-chase".

Dr John Volkman, Department of Oceanography, CSIRO, Hobart, Australia, "Novel Aspects of the Lipid Biochemistry of Marine Microalgae: Applications to Geochemistry and Taxonomy".

Dr Tad Molinsky, Department of Chemistry, University of California, Davis, U.S.A. "Identification of Antifungal Marine Natural Products through Mechanism Selective Bioassay".

Dr John Coll, Department of Chemistry, James Cook University, Townsville, Australia, "Reef Chemistry:Structural and Ecological Aspects".

Dr Bruce Bowden, Department of Chemistry, James Cook University, Townsville, Australia, "Current Research on Marine Natural Products".

Dr Mary Garson, Organic Chemistry Department, University of Queensland, Brisbane, Australia "Chemistry and Biochemistry of Marine Animals".

Dr Ian Millar, Carina Chemical Laboratories, Wellington, "Seaweeds as a Source of Industrial Raw Materials".

Mr Peter Bain, DSIR, Wellington, "The Omega-3 Fatty Acid Content of Fish Oils".

Mr John Croft, McFarlane Laboratories, Auckland, "The Practicalities for Marine Natural Products".

The social programme includes a seafood lunch and a happy hour with mussels and a cheese board on Thursday 7th. Visitors from out of town can be accommodates at O'Rorke Hall on request to the Convenor.

As a consequence of generous sponsorship, the registration fee has been set at only $100 to encourage as many students as possible to attend, a nominal fee of $30 has been set for bona fide students. Registration forms are available from the Convenor, Professor R.C.Cambie, Department of Chemistry, University of Auckland, Private Bag, Auckland.

AUSTRALIAN CORROSION ASSOCIATION INC
Conference 30 - CASS '90
Pan Pacific Hotel, Auckland,
New Zealand
19-23 November, 1990

Invitation

The New Zealand Branch, on behalf of the Australasian Corrosion Association, invites you to attend this, the 30th Annual Conference of the Association. The Conference is to be held in the Pan Pacific Hotel, Auckland, New Zealand from the 19th to 23rd November 1990.

1990 is the Sesquicentennial year for New Zealand and this Conference forms part of the celebrations for this event.

Theme

The title of the Conference CASS '90 is an acronym for Corrosion - Air, Sea, Soil, which forms the theme for the Conference; a theme which is very relevant to New Zealand conditions, with its long coastline, narrow configuration and unique soil conditions in some parts of the Islands.

Over 60 papers will be presented on a wide range of corrosion topics and the technical standard of these papers is exceptionally high. Together with the papers there will be five plenary lectures from World Authorities, the P.F. Thompson Memorial Lecture by Dr J. Duncan, New Zealand; the AMAC Award Lecture; President's address, and an outstanding forum, unique to this Conference, on "International Corrosion Centres" led by the Presidents of NACE and ICorrSt, a Senior Research Scientist from the Swedish Corrosion Centre and the Managing Director of the Australasian Corrosion Centre.

CONFERENCE 30 COMMITTEE
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PHONE 07 377 2140

BRANCH NEWS

VUW

Dr John Craig and Professor John Tonlinson retire in January after long service to the University and the Chemistry community; replacements are expected to arrive during next year. Professor Neil Curtis has been kept busy as Acting President of the Royal Society. Dr Brian Halton will be on leave in England and Holland during the December-January period.

CIT

The CIT will be running a one year full-time NZCS course in Chemistry from 1991. Dr Paul Fawcett has moved from CIT to the Pharmacy School at Otago University. He is the first chemist to make this move in the wake of the decision to close the CIT pharmacy programme.

Wellington

The Branch Chairman, Dr Robin Ledger was in Nelson in the middle of the year to give his address to members in the area; Alan cooke of the Cawthron Institute continues to provide the liason. After his second year as Chairman, Robin is taking a well earned leave for three months in the UK. Dr Ken McKenzie and his Committee have recovered from the ordeal of conference organisation and are to be congratulated on providing a stimulating, smooth-running event that attracted about 250 registrants.

DSIR

Dr Richard Furneaux (Carbohydrates Group) returned from a trip to the UK in time for conference but his colleague in the section Dr Peter Tyler arrived just in time for his conference presentation.

RULE CHANGES

At the August Council Meeting the following rule changes were approved:

Life Membership

Upon election after August 1990 a Life Member shall continue to enjoy former rights and privileges for a reduced subscription in addition to payment to cover the cost of the "Chemistry in New Zealand." This subscription to the Journal shall be optional."

the effect of this rule change is that Life Members elected after August 1990 will be asked to pay a nominal subscription in addition to paying for the Journal.

Quorum at General Meetings

"At an Ordinary General Meeting thirty (30) corporate members personally present shall form a quorum with power to act. At any Extraordinary General Meeting forty (40) corporate members personally present shall form a quorum with power to act. If at an Ordinary or Extraordinary General Meeting a quorum be not present within half an hour after the time appointed for the meeting, the meeting shall lapse."

This rule change deletes the requirement for a quorum at an Annual General Meeting.

THE TWO MAJOR PARTIES ANNOUNCE THEIR SCIENCE POLICIES

THE KEY TO GROWTH
THE LABOUR PARTY POLICY ON SCIENCE

SEPTEMBER 1990

THE PRINCIPLES

The future of science in New Zealand is critical to the growth and prosperity of the whole nation. Scientific development, research and technology are one of the basic building blocks of our economic growth. New Zealand is trade dependent. Our future prosperity as a trading nation depends on our ability to develop our human resources, so that we can use the latest technologies and research developments. We must nurture more scientists and technologists and all New Zealanders must become more scientifically and technologically literate.

Our people resources are one of our key competitive advantages in the trading world. These must be developed to a much greater extent for New Zealand to prosper in an increasingly competitive world market.

While the end goal is greater competitiveness, which means greater applied research and development, that does not mean the de-emphasising of pure or basic research. Likewise the Labour Party understands the importance of a long-term approach to scientific research.

The Labour Party believes that:

* pure and basic research are the building blocks of all applied research and the means to developing scientists and technologists
* government investment in science is a vital ingredient in the nation's future.
* the government's investment in science must be cost-effective and must not pre-empt private sector investment.
* the private sector must be encouraged to spend more on research and development.
* scientific cooperation is a vital ingredient in New Zealand's economic future.
* education is the key to developing scientists and technologists and greater scientific and technological literacy amongst all New Zealanders.

THE ACHIEVEMENTS TO BE BUILT ON

From 1987, the Labour Party manifesto declared the direction for science reform. One of the most important and fundamental achievements has been that Labour has defined public good science in legislation. It is science which:is basic, physical, biological and social science; maintains a strategic scientific skills base, and; is pre-commercial research and is some distance from application.

Labour has established a ministerial portfolio of, and a Cabinet Committee on, Research, Science and Technology which will continue to report directly to Cabinet. The committee's main role will be to determine R,S & T policy and priorities.

The structure Labour has created is wholly new. These reforms in research, science and technolgy reflect the high priority science has as one of the keys to New Zealand's future prosperity. The Labour science reforms are, and will continue to be, based on the principles of effectiveness, efficiency and community participation, through:the separation of research, science and technology policy, funding, and operations; funding of science outputs through contestability; long term strategic planning through determining New Zealand's research, science and technology priorities.

MoRST will be the principal policy advisor to government and, along with the Foundation, will recomment R S & T priorities to government following widespread consultation; review science activities; and promote the importance of research, science and technology throughout New Zealand.

The Foundation will purchase public good science outputs on behalf of the government to maximise broad social and economic returns to the community. Eventually the Foundation will allocate 100% of the public good science output fund, and manage the fund as a portfolio. Thinking at present suggests that 70% of funds will be allocated to scientific programmes of three years duration or more. Labour will provide stability of funding to maintain the vital science infrastructure of the major Crown science providers.

The Foundation and the Royal Society of New Zealand are important independent sources of scientific advice and information to Government. The Royal Society will continue to have responsibility for commenting on research, science and technology human resource issues.

THE LABOUR WAY FORWARD FOR SCIENCE

Since the recommendations of the Science and Technology Advisory Committee were accepted, much has been achieved. What is left, and needs to be completed, is a second stage of reform that reviews government research institutions and finds in each case, through wide consultation, the most suiable structure for its industry or community.

It is Labour's intention to encourage greater private investment in research and development, and to extensively enhance the effectiveness and efficiency of Crown investment in research, science and technology.

When industry increases its investment in R S & T that will not result in an accompanying decrease in government investment.

Labour has set a goal of achieving an increase from the current total investment (public and private) of 1.1% of gross domestic product to 1.25% by 1993.

The Labour Party's goal is to develop a strong scientific infrastructure and skills base through establishing CENTRES OF RELEVANCE.

Centres of Relevance would concentrate on excellence in basic and strategic research relevant to the needs of industry and the community. This will have a significant effect on the structure of Crown science institutions, requiring greater collaboration and partnership in research endeavour.

To achieve this DSIR, MAFTech, MAFFish, the Meteorological Service, and the Forest Research Institute must have appropriate commercial powers. They should be able to invest in equity and source (a wide range of) capital. They should be able to earn royalties on the intellectual property they own and retain a portion of their earnings.

Consultations with industry and interested community groups will be comprehensive to determine the most effective structure that suits government science, research and technology investment. In order to secure greater private sector investment Crown operational research will be linked more closely with industry and universities.

STIMULATING PRIVATE SECTOR INVESTMENT

Labour will stimulate private sector investment in research, science and technology through deveveloping plans with industry to indentify long term trends in research needs. Joint ventures between the public and private sector will be encouraged. The Technologies Programe managed by the Foundation will continue to be developed.

The recently passed Commodity Levies Act provides primary industries with the ability to raise additional R&D investment

funds. Similar legislation will be considered for secondary industries.

The 100% tax deduction on research and development will be maintained, and Labour will continue to provide support for R&D to small business.

Labour will encourage the development of industry based Research Associations as a means of promoting private sector investment in research, science and technology.

SOCIAL SCIENCES

Labour has made great advances by placing public good funds for social science with the Foundation. Labour will enhance the social science research by developing a comprehensive infrastructure of funding for social science.

Under the Foundation fundamental social science funding will be expanded and the Federation of Social Sciences will be encouraged to join the Royal Society.

EDUCATION - THE KEYS TO THE FUTURE

In terms of proven commitment there have been few Governments as committed to education as Labour. There has been a massive increase in investment in education.

Labour believes the development of people resources in research, science and technology is absolutely fundamental to the success of our technology-based economy.

The goal is to have a more specifically and technologically literate population and a wider skills base.

Tertiary education institutions' role is public good research will be enhanced by achieving closer relationships with government research divisions. Tertiary education sector participation in the public good science fund administered by the Foundation will become a reality.

A Tertiary Research Board will be established and greater collaboration between Universities, Polytechnics, Colleges of Education, Iwi Authorities, and proposed Centres of Relevance will be encouraged. As a consequence post graduate student exchange and "sandwich courses" will be possible.

Labour will ensure that a technology syllabus for schools is developed. Labour will promote research, science and technology in schools and tertiary institutions, especially technical courses at Polytechnics, to increase the numbers of students with technogical capability. Formal links between industry and schools will be established.

Formal consultative mechanisms between employers and tertiary education institutions will be promoted to ensure required workforce skills are being taught.

Labour will further promote science and technology in primary schools to develop greater interest and recruitment in later careers.

STRATEGIC PLANNING - THE FUTURE

Long term planning is essential for science in the future. Planning cannot take place without adequate data.

Databases, annually updated, will be established for the use of the Government, the private sector and education sectors, relating to science investment and people resources.

New Zealand data will be regularly furnished to OECD and UNESCO so that New Zealand's performance can be compared internationally.

International links in this respect are vital keys to New Zealand's prosperity. Accordingly Labour will nehance New Zealand's existing international government to government science agreements, and ensure they contain a strong technology component that assists the export of New Zealand technology and import of relevant overseas technology.

Labour will ensure collaboration between MoRST and the Trade Development Board in establishing an overseas technology monitoring unit.

LABOUR WILL PUBLISH CLEAR STRATEGIES ON RESEARCH, SCIENCE AND TECHNOLOGY WHICH WILL BE BASED ON EXTENSIVE COMMUNITY-WIDE CONSULTATIONS AND WILL BE UPDATED ON AN ONGOING BASIS.

NATIONALS POLICY ON SCIENCE RESEARCH AND TECHNOLOGY

SEPTEMBER 1990
SCIENCE, RESEARCH AND TECHNOLOGY

THE CHALLENGE

If New Zealand is to remain within reach of the world's most advanced societies, our scientific literacy and ability to manipulate and adapt emerging technologies will be crucial.

National's challenge is to ensure that new funding mechanisms encourage commercially-driven research without mortgaging the long-term nature of much publicly-funded science.

NATIONAL'S APPROACH

National recognises the vital role that science, research and technology play in New Zealand's development.

In underwriting the intellectual capital base of the research community and the economy at large, National will see New Zealand's science, research and technology industry competing in the international marketplace.

KEY POINTS

A National Government will:

* Dis-establish DSIR and MAFTech as corporate entities and restructure them as a series of free-standing research institutes.
* Direct Crown funding for the Institutes through the Foundation for Research, Science and Technology with an element of medium-term contract funding alongside contestable funds.
* Set up a separate contestable pool to be administered by the Foundation specifically to encourage the commercialisation of products and processes emerging from public sector research. The funds will only be available where a private sector partner contributes to the project.
* Give the universities access to funding from the Foundation for Research, Science and Technology.
* Ensure that reforms to health research do not allow a destructive division to emerge between bio-medical and public health research by structuring the Health Research Council along the lines of the 1988 Medical Research Council review.
* give priority to a comprehensive review of science education

THE POLICY

The Present Climate

Since 1984, publicly-funded research has been subjected to relentless re-structuring. While a more commercially-responsive research community has emerged there have been heavy costs. A failure to identify appropriate levels of publicly-funded research and to spell out priorities before embarking on the reform process has seriously damaged morale.

Ironically, the thrust to commercialise government science agencies has failed to address long-standing problems confronted by these aencies in seeking equity participation in commercial ventures. Meanwhile, poorly managed economic restructuring has left the private sector poorly placed to set about improving its research and development capabilities.

Underlying the problems faced by both public and private sector research is an inadequate scientific and technical skill base to the economy through short cominings in the education system.

The Structure and Funding of the Public Sector Science Investment

The reform of public sector financing has seen a radical shift from funding bricks and mortar to funding specific outputs. This is a sensible change in emphasis. In the past, funding has been driven by agencies whose capabilities and reach reflects historical accident.

There is, however, a danger that the new arrangements go to the other extreme. A balance is required; there is a need to ensure that funding provides some medium-term stability for those who work in research institutions, without reinstating the luxury of vote-funding divorced from performance.

The key to this is a change in the way public research agencies are conceived. Presently, DSIR and MAFTech are forced to operate as corporate entities, increasingly commercial in structure and motivation but, given their scale, able to bid very successfully for 'public good research'.

There are two problems with these organisations as they are presently structured.

Firstly, as commercial players they are in direct competition with private sector consultants who are unable to draw on the research expertise that the public sector's traditional mission has conferred on these agencies.

Secondly, as DSIR and MAFTech are presently structured, there is growing pressure on them to become the developers, promoters and proprietors of technologies and processes. Yet some key commercial disciplines are lacking.

In our view, commercialisation is best left to private sector players whose capital is at risk and whose proximity to the market place imposes stringent commercial realities. We do not support the further corporatisation of public sector science.

There is an undoubted need to capitalise on the fruits of long-term publicly-funded research. But the initiative for that should come from the private sector. If encouragement is needed to overcome difficulties in transferring knowledge and technologies from research institutions to private businesses, programmes should be developed explicitly to meet that need.

For these reasons, we consider that neither the corporate nor the old departmental model is appropriate for our public sector research agencies. We propose, instead, to adopt an alternative structure which would provide our research community with a degree of medium-term stability but retain the benefits of contestable funding through the Foundation for Research, Science and Technology (FRST).

The elements of National's proposal are as follows:

* MAFTech and DSIR will be dis-established and restructured as a series of free-standing research institutes. The recent reduction in the number of operational divisions within the DSIR provides a useful foundation for this re-focusing.

* Crown funding for the Institutes will be directed through FRST and be available in three tiers:

1) Funds from the main contestable pool administered by FRST. These funds will be available to secure specified public good science outputs.

2) Funds from a special pool to be administered by FRST to promote joint public/private sector research ventures. These contestable funds will only be available where a private sector partner brings funds to the table either to facilitate joint research or to commercialise products or processes developed to a pre-commercial stage in the Institutes.

3) Contracts of five years duration signed with Institutes to provide funding that is not narrowly defined in terms of outputs but can be used flexibly within the output areas on which each Institute is focused. These contracts will give the Institutes some independence from the politically-driven priorities laid down by the Foundation. They will also enable the Institutes to secure the long-term viability of research teams which may not always be recognised by contestable, output-driven funding.

* While it would be approproate for the research institutes to fund some services jointly, management functions currently undertaken by corporate head offices would be transferred to the institutes.

* The Ministry for Research, Science & Technology will be responsible for consulting with science providers and users in proposing priorities to the government.

In proposing this restructuring, National will:

i) Provide the Institutes with some funding stability by recognising their ongoing existence through the contracts and provide a measure of insulation from politically-driven priorities.

ii) Emphasise, through the contracts, the importance of retaining in the Institutes skilled researchers in fields of strategic importance to New Zealand. The level of funding provided by way of contract would vary from institute to institute but would not alone be sufficient to fund existing activities.

iii) Provide the Institutes with a greater measure of autonomy to enable them to benefit from the ownership of licences, patents and other intellectual property rights without compromising either contract or contestable funding levels.

iv) Make explicit both the non-commercial nature of the Crown's investment and its interest in funding technology transfer and commercialisation.

v) Acknowledge the private sector's primary role in commercialising the fruits of research and remove unfair competition from Crown-ownded consultancies.

vi) Locate management responsibility closer to researchers.

vii) Allow for career development within a system not totally predicated on contestable funding.

viii) Facilitate, over time, the development of centres of excellence.

The Universities

Re-organising the government's research agencies as a group of research institutes will remove many of the differences in working environment that exist between university staff and government researchers at present. Useful links between DSIR, MAFTech and the universities already exist but there is room for much greater co-operation.

If this is to be maximised, the universities must be given access to the pool of contestable funds administered by FRST. National will:

* Move to integrate university and institute research at an early date.

The current proximity of a number of research centres to univesities means that some joint university/institute teams will be able to expand almost immediately. Over time, institutes may find it desirable to re-locate closer to universities where that is appropriate. New centres of excellence will be able to emerge.

To make the most of a consolidated funding regime, we will:

* Encourage flexible employment arrangements that allow scientists to move freely between teaching and non-teaching institutions over the duration of their careers.

* Seek to increase the opportunities for doctoral and post-doctoral research in the non-teaching institutions.

Forest Research Institute

Given the proposed move towards focussing research on a small number of research institutes funded by contract and contestable grants, it would be anomalous to leave the Forest Research Institute under the umbrella of the Ministry of Forestry. The FRI will, accordingly, become a stand-alone institute funded on the same basis as the other Research Institutes.

Medical & Health Research

National views with grave concern the way in which the present Government has pursued the reform of medical research. In particular, we are disturbed that the proposed Health Research Council's priorities will see public health research expanded at the expense of an already small but internationally recognised bio-medical research community.

We believe that the Medical Research Council has acted in an exemplary manner in seeking to improve the quality and the amount of public health research in recent years given the slender resources available to it and that the attacks made upon it are wholly unwarranted.

Equally, National considers the case for expanded public health research has been well made and that a re-evaluation of Health Department and Area Health Board resources and priorities should be undertaken to achieve the necessary expansion.

National favours an evolutionary approach and will ensure that:

* Any increased funding for public health research is not made at the expense of the existing investment in bio-medical research.

* The Council has the scientific weight necessary to maintain

the high standards set by the Medical Research Council.

Linking the Private Sector with Public Sector Institutions

For the reasons outlined earlier we do not believe that public sector research establishments should regard themselves as primarily commercial entities. The private sector should be the prime mover when it comes to commercialising the processes and technologies that emerge from our long-term research base. We acknowledge, however, that it is not always easy to link private sector commercial expertise to the output of government research institutions.

To facilitate the commercialisation of research work in the institutes, a National Government will:

* Require FRST to establish a contestable pool to encourage joint public/private sector research.

Funds from the FRST will only be available where the private sector partner is prepared to invest funds of its own. The aim will be to meet part of the costs of picking up processes and/or technologies that Government institutions have developed to the pre-commercial stage.

Research Associations

The shift to contestable funding by FRST has seen Research Associations surrender voted funds in return for access to the Foundation's pool. National believes this is the appropriate way in which to fund co-operative, industry-based research.

Where industries can command widespread support amongst their members, National will:

* Support research levies which are likely to be an important source of funding both for industrial research institutes and collaborative proposals placed before FRST.

Social Science Research

Research by social scientists has long been the poor cousin in New Zealand.

The amount of research specifically allocated to the Social Science Research Fund has amounted to only $300,000 per annum. These funds have now passed to the Foundation.

The true measure of social science research is not easily measured since a large amount of work is commissioned by Government Departments and agencies like the Planning Council on an ad hoc basis.

A National Government will:

* Conduct a review of the resources currently devoted to social science research with a view to making contestable some of the resources presently devoted to social science research in the government sector.

The Royal Society

Natonal recognises the Royal Society's role as the representative of a very broad scientific community and we will:

* Review the role of the Society to faciliate its development as a independent focus for scientific associations in New Zealand.Scientific & Technological Literacy - The Education System

Investment in research and development is meaningless unless there are sufficient skills in the community to make use of that investment. Providing a scientifically and technically equipped workforce is the single biggest way in which the Government can assist the productive sector to compete internationally and raise living standards at home.

Policies to overhaul the Government's investment in science education and technical skills will be the subject of a separate policy announcement.

SUMMARY

Many problems currently faced by New Zealand research, in the public and private sectors, can be attritubuted to an inadequate skill base.

A National Government will equip school-leavers and graduates with the skills demanded by a modern, technologically-sophisticated society.

Our alternative structure of public sector research agencies will provide medium-term stability, yet retain the benefits of contestable funding, through the Foundation for Research, Science and Technology.

LETTER TO THE EDITOR

GREENHOUSE EFFECT

Dear Sir,

We have been hearing about the so called "Greenhouse Effect" for some time and I would like to add my contribution for what it is worth.

The so called "ozone layer" was first postulated by Heavyside about 80 years ago when it was generally known as the "Heavyside Layer". As we got to know more about it, and the effects of solar radiation on the rarified oxygen content of the upper atosphere, particularly the dominant part played by solar flares it became known as the "Ionosphere" and its behaviour became better understood. It undergoes well defined cycles of approximately 11 years because solar flare activity is generally greater about every 11 years. At present it is approaching or will reach its maximum in New Zealand this coming summer. I have before me the figures, recorded in Wellington for last May which reached a solar flux maximum of 263 on the 20th., with a monthly average of 186.8. This is exceptionally high from my own memory could well be the highest for over 40 years. Once the peak is reached the ozone concentration will steadily decrease for the next 4 or 5 years and then it will increase. I do not know whether the increased ionic concentration reduces the ultra violet concentration at ground level: possibly the greatly increased solar activity causes an increase in ground level ultra violet. In view of the enormous effect of solar radiation I suggest that any man made activity would have a negligable effect.

When I was a boy, which is some 80 years ago all our cooking was done on the kitchen range, which was lit first thing in the morning and continued until bedtime. We had open fires in living and bedrooms to keep the house warm in winter, a copper in the wash house and a califont to heat our bath water. At night we used candles or oil lamps for illumination unless we were lucky enough to have gas laid on. We bought coal and firewood by the dray load and a fleet of ships brought coal to the gasworks. We travelled by trains and steam traction engines harvested the crops in our fields. All factories of any consequence had their own steam boilers. Today virtually all this energy is electric. Certainly we have replaced horses by motor cars, which contribute CO_2 but unfortunately also carbon monoxide and oxides of nitrogen, which are nasty. This makes me wonder whether our thermal power stations and industrial boilers are producing as much CO_2 as we did 80 years ago. Unfortunately wind and gales originating over the Australian desert or the Coral Sea sweep over New Zealand and blow all our valuable CO_2 out over the vast wastes of the Pacific Ocean.

There are an awful number of sources of CO_2 apart from fires and boilers. There are three million N.Z. people walking around, all of whom consume tonnes of carbonaceous and hydrocarbon material (which after are simply CO_2 and water in solid form, plus some Nitrogen and minerals) and which is burnt up and the CO_2 returned to the atmosphere from which it burnt up and the CO_2 returned to the atmosphere from which it originally came. Add to these some millions of cattle, deer, sheep, rabbits, opossums, birds, flies, insects, grubs, worms, yeast, bacteria etc. all of which are contributing to our supply of CO_2 and I venture to suggest that they are the major source. To that we must add geothermal CO_2 which, in New Zealand is not negligable and is new. Natural fermentation of organic matter in or on the ground is also a major contributor.

Going back to my boyhood days, I well remember the pumice desert which covered the whole of the central plateau of the North Island. About this time a certain Mr. Vaile planted some pine tree seeds near his house on the shores of Lake Taupo and was astounded at the phenomenal growth rate. This led him to experiment with a small "forest". The result was the development of our great exotic forest industry. This growth was not achieved without a corresponding consumption of water and CO_2 and it could suggest that if we want to consume CO_2 quickly we should cut down our native forests and replant them with pine trees. When our forefathers first settled they could not eat kauri or rimu and they either cut or burnt the forest as quickly as possible and plowed the land to grow grass or crops. A properly managed ryegrass/clover pasture has an enormous carrying capacity and it could well produce more carbonaceous (and nitgorenous) matter than pine. Our pastures could be better consumers of CO_2 than native forests. While we are about it, consider also grain crops, vegetable gardens, the household lawns and gardens, orchards and so on, without end. Let us stop worrying about the amount of Carbon Dioxide gas in the air; in any case, there is nothing we can do about it. Nature will look after it much better than we can.

L.S. Spackman QSM FNZIC ZL1AC

ADHESIVES BASED ON FORMALDEHYDE

E.J. BLANCHARD - A.C. HATRICK (NZ) LTD

This paper was presented as part of a two-day symposium on Adhesive Technology organised by the Polymer Group of the N.Z. Institute of Chemistry 16th and 17th May, 1990.

INTRODUCTION

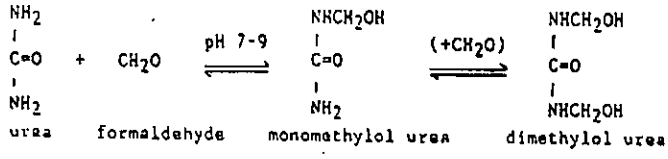
Adhesives bases on formaldehyde are manufactured as resins and may be used either as supplied or in combination with other materials such as fillers, extenders, hardeners or crosslinkers depending upon the resin and upon the application for its use.

The adhesive resins produced from formaldehyde fall into two broad groups, amino resins and phenol-formaldehyde resins. These groups can be sub-divided but from a general chemistry view point that is unnecessary while from an application view point it is very important.

CHEMISTRY OF FORMALDEHYDE RESINS

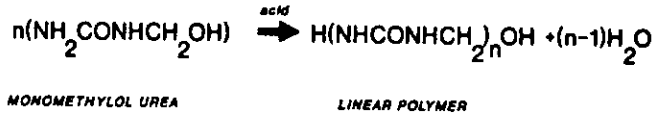
1. Amino Resins

Amino resins are made by reaction of formaldehyde with suitable amines such as urea or melamine to form methylol compounds which are subsequently condensed to give resinous polymers.



In practice the methylol compounds are not isolated and neither are they formed as discrete chemical compounds. In manufacture of unmodified UF resins the molar ratios are varied usually in the range 2.5/1.0 to 1.05/1.0 (F/U).

The methylol compounds are condensed under acidic conditions to give polymers. For instance a 1/1 F/U mole ratio could give linear polymer as below.



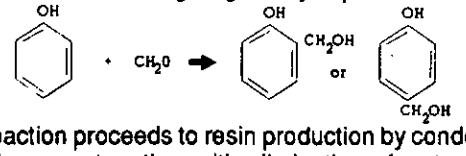
Where the F/U mole ratio is higher than pendant methylol groups can provide crosslinking resulting in an infusible three dimensional structure.

In most cases the reaction is followed by taking viscosity measurements and when the required value is reached the reaction is stopped by neutralisation and cooling.

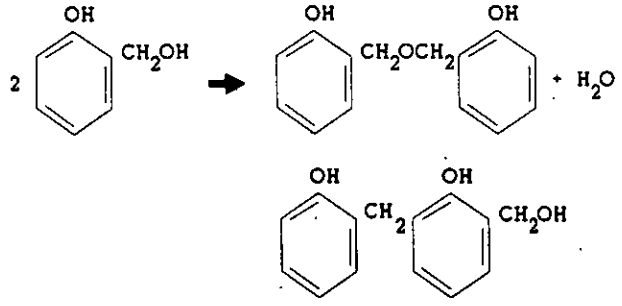
Melamine resins are made in a similar way however, the molecular weight which can be obtained is relatively low as the resins become unsoluble in water at lower molecular weights than UF resins do. Replacement of all or part of the urea by melamine improves the properties of the cured resin such as water and chemical resistance, hardness and high temperature resistance. However, melamine-formaldehyde (MF) resins are appreciably more expensive than UF resins so that their useage tends to be restricted to applications demanding better properties than UF resins can provide.

Phenolic resins

The reaction between phenol and formaldehyde is general acid/base catalysed and is highly exothermic. The first step is the substitution reaction giving methylol phenols.



The reaction proceeds to resin production by condensing the methylol groups together with elimination of water and rearrangements involving formaldehyde so that methylene ether, groups or methylene groups join the benzene rings.



The actual reactions occurring after the formation of methylol phenols will be dependant upon the molar ratio of phenol and formaldehyde. With a molar ratio of 1.0/1.0(F/P) or lower, linear polymers are formed under acid conditions. In these polymers (known as novolaks) the bonds between the rings will be mainly methylene groups and the products will be thermoplastic resins.

When the molar ratio (F/P) is raised above 1.0/1.0 then the third reactive site on the benzene ring comes into the reaction. The resins produced, called resoles, are made under alkaline conditions. They are thermosetting polymers which are unstable and will increase in molecular weight at room temperature and eventually gel. The alkaline catalyst (normally sodium hydroxide) causes the resins to be water soluble at first, but the water solubility decreases as the molecular weight increases.

Resoles are made to crosslink into infusible three dimensional structures by the application of heat.

In use, Novolaks are caused to change from thermoplastic systems into thermosetting resins by introducing formaldehyde or another reactive material (eg hexamine).

On heating, the mixture behaves similarly to a resole giving an infusible three dimensional structure.

USES OF FORMALDEHYDE RESINS

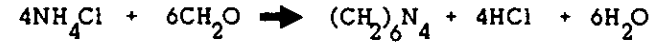
Particleboard, Medium Density Fibreboard (MDF) and Strandboard

These re-constituted timber products are usually made with unmodified urea-formaldehyde resins. This is mainly because of cost considerations. The resin is applied to the wood particles as an aqueous solution in conjunction with paraffin wax which is used to provide some moisture resistance to the finished board. Solid resin useage is normally 7-10% and the wax content is typically up to 1% of the dry wood weight.

The coated wood particles are compressed to the required thickness in hot presses. Conventional presses are run at temperatures between 150 C and 210 C.

Urea formaldehyde resins are cured or crosslinked under acid conditions which favour the condensation reaction. With increased temperature the degree of acidity required for a given cure-rate decreases. This means that some thin boards can be manufactured without any additional acid or other hardener present. However, in the centre of thick particleboard the temperature rise is slower and economic pressing times can only be achieved by including hardeners. The hardeners most commonly used are ammonium salts such as ammonium chloride or ammonium sulphate. These react with small quantities of formaldehyde in the resin and produce acid which reduces the pH to a level which will give more rapid gelation.

Idealised reaction



In MDF production the pH of the fibre is usally lower than that of the wood chip used in particleboard and so there is less requirement for the use of hardeners.

Most of these products are made in presses which can produce several boards at once as the conventional presses have several openings between oil heated platens. However, there is a new type of press now available which is capable of injecting steam into the board thereby giving very rapid tem-

perature rise and fast press cycle. One example of this type of press is operational in New Zealand with the world total still being less than ten.

Over the past 15 years or so resin manufacturers have been continually developing their resin formulations and production methods so as to reduce the amount of formaldehyde in the workplace where the resin is used and also to minimise the release of formaldehyde from the board products after manufacture.

One of the major routes towards these goals is to reduce the formaldehyde to urea mole ratio in the resin cook. For instance mole ratio of 1.6/1.0 were once used but now 1.2/1 or lower are common.

In itself, this change makes the resin more difficult to cure quickly as the crosslink density is reduced. Therefore, the curing reaction has to be pushed harder and the use of hardeners in MDF production may become more common.

A further problem is introduced by these resin modifications. That is that the strength of the board, and other important physical properties can be reduced. This may mean that the amount of resin required to provide the strength necessary for applications such as flooring board may have to be increased.

Melamine fortified urea formaldehyde resin(MUF) can be used in board manufacture where the use of the product demands better water resistance than UF resins provide (eg in wet-areas such as bathrooms).

Even better water resistance can be obtained by using phenolic bonding agents. Although this type of board is not made in New Zealand, overseas, spray dried phenolic powders are used in manufacture of waferboard which is regarded as being exterior durable (suitable for siding in domestic houses) and tannins (natural phenols) are used in production of water resistant particleboard.

PLYWOOD

Both amino rsins and phenolic resins can be used in manufacture of plywood depending upon the intended use for the board.

In New Zealand the majority of plywood is produced using phenolic resins (resoles). The gluelines of properly made phenolic bonded plywood are resistant to water and suitably treated plywood can be used as a building material for cladding the outside of buildings with confidence that the interlaminar bonds will remain unimpaired for a period in excess of thirty years.

Plywood is made by laying the required number of veneers into a stack with the grain of the timber of a particular veneer at right angles to that of adjacent veneers. Each second veneer is coated both sides with glue before lay-up. The boards are pressed in multi-opening hot presses usually operating at 135°C-150°C.

If the resins were used as supplied, the pressing operation would cause over-penetration of the binder into the timber with relatively poor interlaminar bonding as a result. Therefore, filler and extenders are used in glue formulation to modify the flow characteristics of the adhesive and also to reduce glueing costs.

Example of a phenolic resin gluemix for plywood.

Phenolic resin	1200 parts by wt.
Water	200 " "
Extender (wheat flour)	100 " "
Filler (eg. nut shell flour)	100 " "

The cure-rate of plywood resins and their ability to tolerate in-process variables are normally dependent upon the formulation and manufacture of the resin although there is some room for modification of the properties by alterations in the glue mix. For instance, the viscosity and wet-tack properties can be modified by altering the amount of wheat flour used.

Plywood for interior use can be made using UF resins and a similar product called Lambar is also made in New Zealand. The colourless nature of UF gluelines is an important factor in the market place acceptability of such a product. UF resins require the addition of hardeners to achieve a cure-rate quick enough for plywood production.

ADHESIVES

In the manufacture of adhesive bonded timber constructions formaldehyde resins are widely used in industry. UF resins are used in veneering of particleboard and other panel products. The conditions of use are similar to those employed in plywood manufacture. In joinery and furniture production UF resins can be used, normally with acidic hardeners such formic acid which will produce satisfactory cure at room temperature.

Phenolic resins are rarely used in wood gluing because of the necessity for hot curing. However, resins made from a more reactive phenolic material called resorcinol can be used to produce water resistant bonds without the necessity to provide additional heat.

Resorcinol formaldehyde (RF) resins are made as thermoplastic novolak resins and are caused to set at room temperature by mixing with paraformaldehyde.

Although water resistant bonds can be obtained with this type of resin it is necessary to be careful to keep the glued item at about 20°C or above while the glue cures.

RF resins are widely used in manufacture of laminated beams for building construction.

MF resins give bonds which are intermediate between UF and RF in terms of resistance to water, but require hot cure.

All formaldehyde resins are able to be cured by radio frequency radiation which allow very fast cure and short clamping times. With this type of heating, the cost of water resistant joints can be minimised by using phenol-resorcinol-formaldehyde systems which cure at intermediate temperatures.

PAPER LAMINATES AND IMPREGNATING

Both phenolic resins and amino resins can be used to impregnate paper for a wide variety of products. These include electrical circuit boards, high pressure decorative laminates, sign over-lays, paint rollers, automotive oil and air fillers, battery cell separators and wall boards.

The majority of these use low viscosity phenolic resins. However, the hard wearing decorative laminates used to provide work surfaces in kitchens are faced with papers impregnated with colourless MF or MUF resins.

PAPERMAKING

In the manufacture of paper products, urea formaldehyde resins can be used to provide wet-strength. For example, wallpaper and garbage sacks normally contain UF resin. Wet-strength from 0-5% to 20-30%.

The resins used are modified UF resins which are co-condensed with materials which impart ionic charges to the resin in order to improve the pick-up of the resin on the wood fibre and thereby increase the efficiency of the resin performance.

In paper manufacture, the resin cure is initiated by the drying conditions used on the paper machine. However, the paper may not achieve full wet-strength properties for several days after manufacture.

INSULATION

Heat and sound insulation are areas where phenolic resins are used as binders for glass fibre or other inorgaic fibres. The insulating materials can be made as blankets for use in wall and roof insulation in buildings and also can be prefabricated into shells for thermal insulation of pipes and tanks.

The resins used are exclusively PF types, normally supplied as low molecular weight and high F/P mole ratio. This helps to give good heat resistance by providing a heavily crosslinked structure.

FOUNDRY RESINS

Amino resins and phenolics of both novolak and resole types are used in a variety of processes to make moulds for casting of molten metals. In all the processes the resinous material is used to bind particles of sand which have been coated with the resin. Amino resins, normally UF types are acid cured while the phenolics are heat cured. The moulds are for single use, that is, each mould is used only once and will be broken prior to removal of the metal casting after the metal has cooled.

ABRASIVES

Both UF and PF resins are used in the manufacture of abrasive papers. In production of wood finishing papers, UF resin with suitable fillers and a latent hardener such as ammonium chloride is roller coated onto a belt of robust backing paper. The abrasive material is scattered onto the belt, often with an electostatic field being used to make the particles "stand up". The resin is cured by passing the belt through a heated oven. Subsequently a second resin coat is applied. This may be the same resin but would normally be a different mix formulation probably containing a lubricant such as zinc stearate to prevent clogging of the paper during use. This is cured in much the same

COURSES

ACOL
(Analytical Chemistry by Open Learning)

The Infra-Red Spectroscopy course detailed below is one of three that has been developed at ATI.

Infra-red Spectroscopy:

A three day practical workshop course supplemented by a self-paced learning text.

Date of Course: November, Tues 20th - thurs 22nd

With this course, the students will be invited to cover the theory detailed in the ACOL text in their own time prior to the course.

The practical part of the course will involve use of both Dispersive and Fourier Transform Infrared Spectrometers and practice will be gained in the following areas: procedures for optimisation of the spectrometer; sampling techniques for liquid, solid and gaseous samples; reflectance techniques for sampling films and surface coatings etc.; interpretation of IR spectra, applications including: petrochemical, surface coatings, pharmaceutical, general organic IR.

If you would like further information on this course, or to register as a participant, please contact: Bruce Fraser, Faculty of Science and Engineering, ATI, Private Bag, Auckland.

UNIVERSITY OF OTAGO
Distance Teaching Programme
Biotechnology

Biotechnology has been available by Distance Teaching since 1988 from the University of Otago.

The Diploma in Science (Biotechnology) and the Diploma for Graduates (Biotechnology) are offered nationally through a teleconference network. Designed for those who wish to update and extend their knowledge of biotechnology and perhaps redirect their careers, the course is structured to meet the needs of both graduates and, in the case of the Diploma of Graduates, non-graduates who hold a good professional qualification and are experienced in some appropriate field. Tuition in the course next year will be provided by lecturers from the Departments of Microbiology, Biochemistry, Botany and Chemistry.

Major advantages of teleconference learning are its participatory and interactive aspects. Students receive instant answers to questions and teachers are able to regulate their session as a tutorial or as a lecture, depending upon the requirements of the subject under discussion and the needs of the students. Experts from other centres in New Zealand or visiting from overseas can be incorporated into a session, a useful resource in a rapidly developing field.

The course can be taken at the students own pace, generally two to four years, without the need for leave of absence from work. Venues range from Whangarei in the north to Invercargill in the south.

Enrollments for 1991 close November 1st. For a comprehensive prospectus write to: The Enrolment Officer, Distance Teaching Unit, University Extension, University of Otago, PO Box 56, Dunedin.

INSTITUTE PRIZE WINNERS

The following Prize Winners were announced at the Annual General Meeting.

Easterfield Award	Dr V McKee
ICI Prize	Dr K J D McKenzie
Shell Prize	Dr I W M Brown
	Dr K J D McKenzie
	Dr G V White

way as the first coat.

PF bound abrasive paper manufacture is a similar process. However the products are intended for use as "wet and dry" abrasives in applications such as auto refinishing. Here, the water resistance of the phenolic resin allows water to be used as a lubricant without causing the loss of abrasive particles from the paper.

Belts for industrial sanders and grinding discs also use phenolic resins because of their excellent resistance to water and heat and exceptional adhesion to the abrasive materials.

SURFACE COATINGS

Modified UF and MF resins are used in manufacture of stoving enamels in conjunction with flexible resins such as alkyds. In the amino resins, methylol groups are etherified with alcohols such as n-butanol or methanol so that the products are solvent compatible. MFs are all heat cured and are used in automobile enamels and other applications requiring durable chemical resistant non-staining finishes eg. household appliances, fridges, washing machines.

UF types can be cold cured by the addition of acid catalysts and can be used in the production of high build gloss coatings for woodwork and furniture.

Phenolic resins are widely used in metal coating systems always in conjunction with more flexible hydrophobic resins such as epoxy or alkyd types. Main uses are in primers and undercoats because of the poor colour and tendency towards discolouration. Many PF resins used in coatings are made from substituted phenols so that solvent compatibility is achieved. The coatings are resistant to heat and chemical attack and some specialised types are used in coatings for food containers where the film must be able to withstand sterilization procedures as well as resist acidic contents.

RUBBER AND ADHESIVES

Solid Resoles are used in vulcanisation of rubber, particularly butyl rubber. The crosslinking reaction between the phenolic resin and the rubber is relatively slow and so para-substituted phenols are used in preparation of the resoles. This reduces the phenolic condensation rate so as to be similar to the rate of reaction with the rubber.

Specialised thermosetting adhesives for structural use in metal to metal and metal to rubber bonding are made by combining resoles with thermoplastic polymers. Thermoplastics used include polyvinyl acetal and nitrile-butadiene rubbers.

Also phenolic resins are used in contact adhesives made from polychloroprene (neoprene) where the phenolic component contributes to the tack, and resistance to temperature. The adhesives are used in shoe manufacturing, and in the automotive upholstery, furniture and construction industries.

Other phenolic resins are used in rubber processing and in adhesives for bonding tyre reinforcing materials.

FRICTION MATERIALS

Phenol and cresol resins are used almost exclusively as binders for friction materials used in brake and clutch linings in the automotive industry. Very often the resins are modified by addition of reactive additives such as tung oil or furfuraldehyde as the unmodified resins give brake linings which tend to fade in efficiency on heat-up.

MOULDING COMPOUNDS

Moulding compounds are made from phenolic and amino resins in conjunction with fillers such as cellulose fibres, wood flour and asbestos.

The phenolic resins show excellent heat resistance but are naturally dark in colour. Their major applications are in mouldings for electrical use, as handles for appliances and in the automotive industry.

Urea-formaldehyde moulding powders using cellulose fibre are readily colourable and are used in production of a wide range of articles such as electrical switches, bottle caps, buttons, beakers, trays and toilet seats.

Melamine-formaldehyde moulding powders are more expensive and have better heat and chemical resistance than UF powders. They are used in production of break-resistant tableware.

POISED FOR ACTION: LACTOFERRIN - THE RED MILK PROTEIN

Andrew M Brodie, Department of Chemistry and Biochemistry, Massey University New Zealand.

Today the field of inorganic biochemistry or bioinorganic chemistry as it is also called, is well established, with special conferences, journals, and books devoted to it. This has not always been the case. About thirty years ago Dwyer, from the Australian National University, in an article titled "The Future of Inorganic Chemistry in Biology", almost apologetically asked for the readers "indulgence for possible shortcomings in the use...of the terms and concepts of biology and possibly for the unorthodoxy of some of the views expressed." (1). His article concentrated on the inorganic aspects of the interface between inorganic chemistry and biology and predicted a 'fascinating future' for the area.

This future has now arrived. The functions and properties of a wide range of metal-containing enzymes and proteins are well known (2-4). Metalloproteins exhibit special characteristics not seen in small molecule compounds. They are of course much larger, with relative molecular masses over 10,000 and often up to 100,000, compared to masses of 100-1000 for typical inorganic coordination complexes. They often have intriguing and unusual spectroscopic properties not seen in small molecule compounds. The now classic examples are found in the 'blue copper protein' family with their very intense bands in the visible region of the spectrum and the low values of the hyperfine coupling constant (A_{11}) in their electron paramagnetic resonance (epr) spectra (5,6). The metal ions themselves can act as built in spectroscopic probes and give information about various regions of the protein. The groups that bind to the metal ions (the ligands) are offered in rich abundance by the protein, arising from the variety of amino acids present e.g. phenolate from tyrosine and imidazole from histidine. In fact the geometry of the metal binding site is to a large extent defined by the protein, the metal ion having very little say in the matter, unlike in small molecule chemistry.

I will now take the ion-binding, human milk protein - lactoferrin - and illustrate how these ideas can be applied and developed. We at Massey University became interested in lactoferrin in the early 1970's. Dr Sylvia Rumball was in a local pharmacy shop picking up a prescription when an article, called, 'What Grandmother Knew' in the latest copy of the Health magazine, caught her attention. It was the words "the value of human milk lies in its power to bind iron" which particularly aroused her curiosity. The article explained that the result was that the iron was then no longer available to bacteria for growth. On following up the information in this article (7), Dr Rumball discovered that it was refering to research on the bacteriostatic effects of human milk and the importance of an iron binding protein called lactoferrin.

Iron is the fourth most abundant element (6%) in the earth's crust and is by far the most abundant transition element (2,4). It is not surprising therefore that it has such an important functional role in living systems. The key role of iron has been recognised for many years. A legend dating from 1500BC tells that Prince Iphyclus of Thesally was cured of his sexual impotence by Melampus a physician and seer. Melampus removed an iron knife from an oak tree into which it has been stuck, scraped the rust off the blade into a glass of wine and administered the beverage to Iphyclus. After ten days of this treatment he was cured (8). In Roman times iron therapy was commonly used for many disorders and today iron salts are prescribed for anaemia.

The chemistry of iron shows some characteristic features which are important for understanding its biological function (2,4). It has two readily accessible oxidation states, +2 and +3, both of which are used by nature. The two oxidation states are readily interconverted and iron (ii) is easily oxidised to iron (iii). Sometimes, as in redox proteins, the facile interchange of oxidation states is physiologically important. At other times it is prevented e.g. in iron storage proteins. Iron in the +3 state is readily hydrolysed in aqueous solution to hydroxo or oxo species but this can be prevented in metalloproteins if the iron is in a hydrophobic region.

A 70kg person contains 4 to 5 g iron - enough to make a good sized nail! It is widely spread in the body. Substantial amounts are held by the iron storage proteins ferritin and haemosiderin (25%) which are found in the liver, spleen and bone marrow. Even more is found in the oxygen transport protein haemoglobin (65%). The oxygen storage protein, myoglobin (5%), the electron transport cytochromes (0.1%) and the iron containing enzymes (<1%) contain smaller amounts.

An important protein which only contains a small amount of the total iron (0.1%) is transferrin. It is involved in iron transport and is but one member of the transferrin family of proteins (9,10). Another is lactoferrin, the subject of this article. It was originally detected in the 1930's as a red protein in milk (11) but it was not until 1960 that it was independently isolated by three groups from human and cow's milk (12-14). While it is possible to see a salmon pink colour develop as iron (III) is added to fresh human colostrum it is a lot easier to demonstrate the formation of a similar colour using egg whites (15). This is because of the presence of ovotransferrin, another member of the transferrin family, and the protein responsible for the bacteriostatic properties of egg white. This leads me to an interesting aside. Good cooks have known for years that it is better to use copper bowls for producing a good stiff egg white. It has been suggested that the binding of copper ions to ovotransferrin, which makes up about 12% of egg white somehow stabilizes the foam (16).

Lactoferrin occurs in high concentration in human milk (1-2 mg/ml) and in even higher concentration in colostrum (7-8 μg/ml). It also occurs in other mammalian milks but at lower concentrations (17). It should especially be noted that the concentration of lactoferrin in mature cows milk is much lower (20-200 μg/ml) when compared to human milk (18).

It was the high concentration of lactoferrin in human milk that focussed the attention of scientists in the early 1970's on the role the protein could play in infant nutrition. It was also known that there is a lower incidence of bacterial infection in infants fed on breast milk when compared to those fed on bottled milk. Certain strains of E.coli can assert themselves in the intestine thus leading to gastrointestinal infections (19). work by Bullen and co-workers showed human milk had bacteriostatic properties towards E.coli. These were eliminated when iron was added. Lactoferrin, in the presence of a specific antibody, exerts a similar effect, which is also lost on the addition of iron. It was therefore postulated that the bacteriostatic effect of human milk was due to lactoferrin and a specific antibody working together (20). While it is noted that the factors involved in resistance to bacterial infection are numerous and complex, an important feature is the ability of the host to withold iron from invading

bacteria. Iron is an essential element for growth and almost all bacteria have a requirement for it. At physiological pH, iron is very insoluble due to the formation of iron (III) hydroxide, $Fe(OH)_3$, and is unavailable for microorganisms. Many bacteria however, are able to produce iron binding molecules called siderophores which solubilize iron (III) ions making them available for assimilation. An example is enterobactin, which can wrap itself around the iron (III) ions, binding to them with its phenolate oxygen atoms (Figure 1). Their high formation constants, K, of about 10^{50} and above, indicate that the iron is held very tightly (21).

The lactoferrin in human milk is only about 5% saturated with iron which means only amount 5% of the total iron binding sites are occupied. The rest are free to bind further iron if it becomes available. Lactoferrin is known to pass through an infants's stomach (which in breast fed infants is in the pH range 6 to 6.5) undigested and into the small intestine. Here the lactoferrin can compete for the free iron making it unavailable for the bacteria (19).

Lactoferrin also occurs in other bodily secretions such as saliva, tears, nasal and seminal fluids where it could have a protective role. It is also found in leucocytes (white blood cells) and it has been suggested it may protect cells from free radical damage by binding potentially-catalytic free iron (22). Evidence for a nutritional role for lactoferrin is less clear cut (19) but it may regulate iron absorption by binding to specific receptor sites in the small intestine (23). Undoubtedly the function of lactoferrin is more complex than the simple bacteriostatic role postulated initially by Bullen and co-workers. However it is clear the functions ascribed to it depend very much on its ability to bind or release iron from its special iron binding sites. In its native state it is truly a protein poised for action.

To understand its mode of action we must know about its structure at the atomic and molecular level, and in particular the special or specific iron binding sites. The interplay between both clinical and bacteriological observations and a knowledge of the structure of the protein at a molecular level is very important. As we understand more about the structure of lactoferrin and its metal binding properties, so will the results of in vivo and in vitro experiments make more sense. further questions will be asked which will require further knowledge of the protein to answer them.

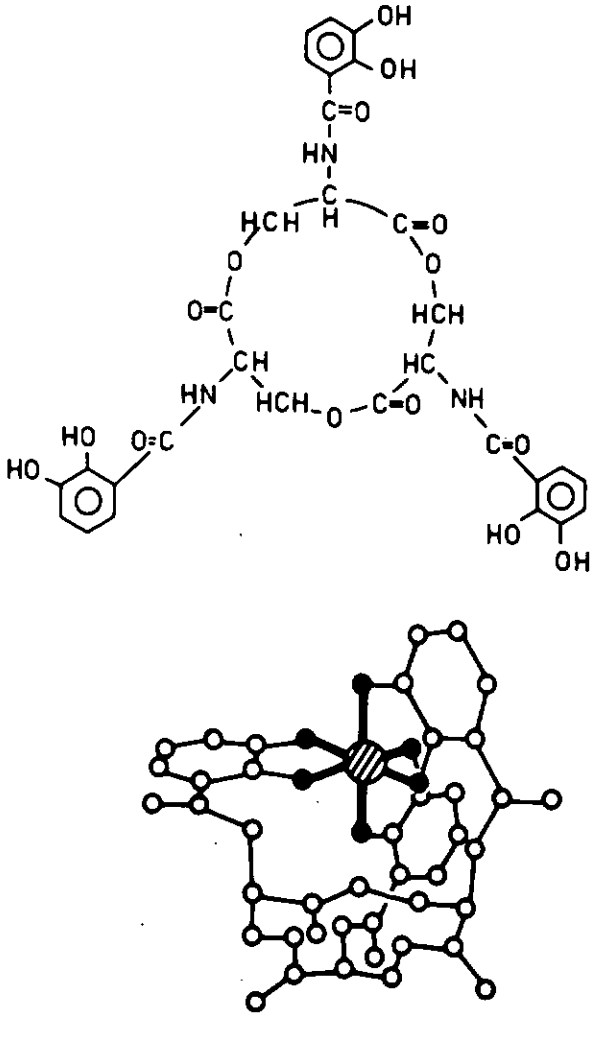


Figure 1 The enterobactin molecule (top) can wrap itself tightly around the iron(III) ion (below).

There are two methods of attack. The first is to study the protein itself. However lactoferrin is a large molecule (its relative molecular mass is about 80,000) which can make such a study difficult. As a second line of attack it can therefore be useful to study small molecules which have relevant donor groups binding to the metal. I will illustrate both approaches, concentrating on the specific iron binding sites.

Lactoferrin is a glycoprotein which means it has carbohydrate residues attached to it. It contains no subunits - the 691 amino acids which make up the protein are joined together in a continuous chain like beads in a necklace. Two iron (III) ions bind to one molecule of protein in two specific iron binding sites. In conjunction with each metal ion that binds, one carbonate anion is required (9). This is a unique feature of the transferrin family and the iron (III) ions will not bind specifically unless an anion is present.

The 691 amino acids in the polypeptide chain can be divided into approximately two halves and if these are lined up with each other it will be seen that 42% of the amino acids are the same in each half. Each half contains an iron site which has led to the suggestion that the two sited transferrins have evolved from a single sited precursor of half the size, by gene duplication (24).

As mentioned earlier, when the iron-free protein (apo-protein) binds iron, it goes red and appears to become more compact. As chemists we would like to have detailed information on the nature of the iron binding sites and be able to answer the questions: What are the ligands binding to the iron (III) ions and what is the geometry around the iron (III) ions?

Are there any differences between the two specific iron binding sites?

Where is the concomitantly bound carbonate ion located?

Other anions, apart from carbonate bind to lactoferrin - where do they bind? What is the nature of the structural change when the metal binds to the protein?

Are there any differences between the lactoferrins of different species e.g. bovine and human?

Some of these questions I will be able to answer - others will require further research.

When Dr Eric Ainscough and I started our research into lactoferrin using spectroscopic techniques, it was known that lactoferrin, like the other transferrins, bound two iron(III) ions in a high spin state i.e. the five valence electrons in the 3d orbitals are all unpaired. Proposed ligands for lactoferrin were two or three phenolates from tyrosine residues and at least one or two imidazoles from histidines. It will be on these proposed ligands that I will first concentrate.

Those of you who have studied organic chemistry will no doubt recall the classic colour test for phenols which involves adding iron(III) ions to the test solution (25). The development of an intense purple-red colour indicates the presence of a phenol and arises because of the formation of an Fe(III) - phenolate complex which absorbs visible light. Similarly lactoferrin itself absorbs visible light. The intense absorption band has a maximum at 465nm (Figure 2) and gives the protein its

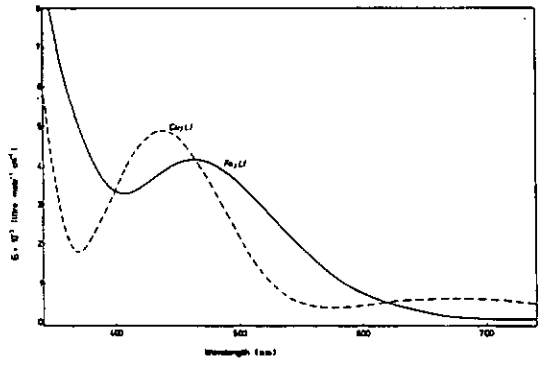


Figure 2 The electronic absorption spectra of iron(III)- and copper(II)- lactoflavin.

characteristic red colour. The high intensity of the absorption band (μ = 2070 m^{-1} cm^{-1} per Fe^{3+}) indicates that it is a charge transfer absorption. Specifically it is assigned to a ligand to metal transition between the phenolate pπ orbitals and the half-filled metal ion dπ^* orbitals (26).

Work on relevant small molecule complexes shows the wavelength of the band to be sensitive to the number of phenolates bound to the iron(III) as well as to the number and nature of the co-ligands (27). Increasing the number of phenolate oxygens and imadazole nitrogens bound to the iron(III) causes the absorption band to move to shorter wavelengths (i.e. higher energy). For example the 2-(5-methylpyrazol-3-yl)phenolate ligand (L1) provides oxygen and nitrogen donor atoms to mimic the phenolate and imidazole groups respectively. For the series of complexes [Fe(L1)]2+,$[Fe(L1)_2]^+$ and $[Fe(L1)_3]$ there is an increase in the energy of the visible band (Figure 3) as the d * orbitals are destablised by successive complexation of phenolate groups. The X-ray structure on crystals of the bis-ligand complex shows it to contain the cation $[Fe(L1)_2(MeOH)_2]^+$ with two methanol molecules completing the co-ordination sphere (Figure 4).

There are two problems in using small molecule compounds to mimic the iron binding site of lactoferrin. The first is the strong tendency of iron(III) to form oxo-bridged dimers with phenolate type ligands. This is typified in the reaction of the 1,1'-biphyl-2,2'-diolate ion (L2) with iron (III). The dimeric structure of the complex formed $[Fe(L2)_2]_2^{2-}$ (Figure 5) is achieved with two bridging phenolates (28).

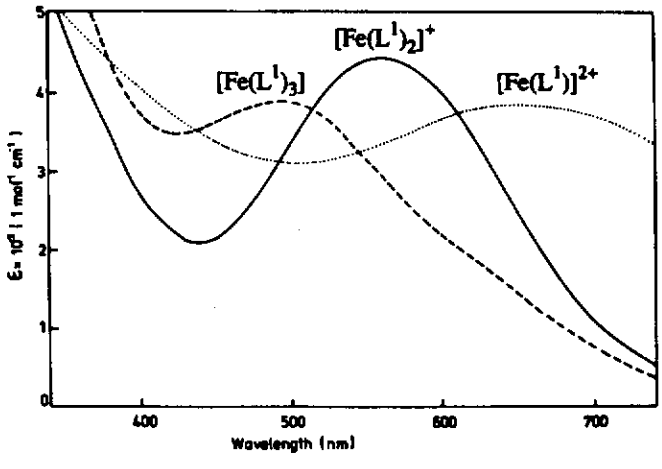


Figure 3 The electronic absorption spectra of $[Fe(L1)_3]$, $[Fe(L1)_2]^+$ and $[Fe(L1)]^{2+}$. Increasing the number of L1 ligands attached to the Fe(III) pushes the absorption band to shorter wavelengths (higher energy).

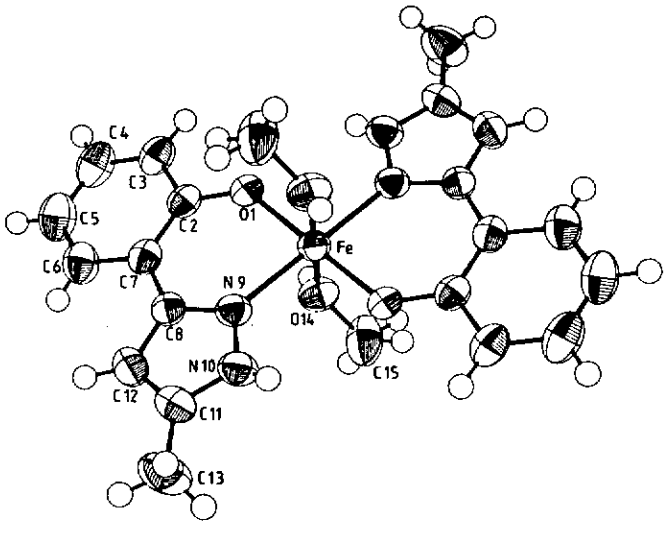
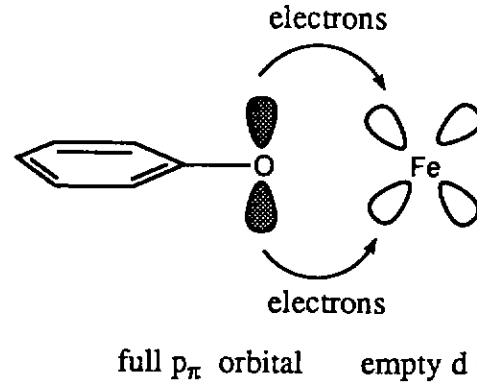


Figure 4 The structure of $[Fe(L1)_2(MeOH)_2]^+$ as determined by X-ray crystallography.

In lactoferrin itself oxo-bridging is blocked by the steric constraints of the protein chain around the iron(III) ions. The second problem inorganic chemists have in devising small molecule analogues for the specific iron binding site of lactoferrin is to find complexes which exactly mimic the characteristic electron paramagnetic resonance signal of lactoferrin. The spectroscopic technique of electron paramagnetic resonance (epr) requires the compound to have unpaired electrons and thus iron(III) complexes, where the metal ion is in a rhombic environment, show a strong signal at g=4.3 and weaker resonances at higher g values (Figure 6). The dimer $[Fe(L2)_2]_2^{2-}$ does not show such a spectrum (Figure 7) but when it is dissolved in donor solvents such as pyridine and 1-methylimidazole the dimeric structure is lost and other signals at g=4.3 (1500 gauss) appear. However



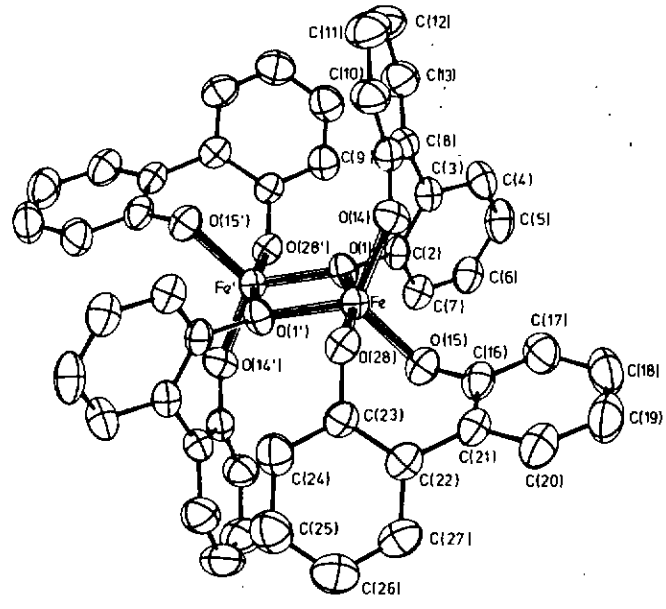
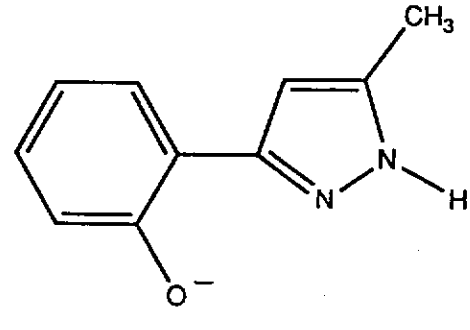
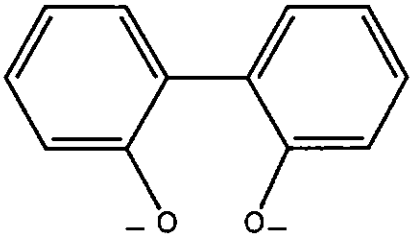


Figure 5 The structure of the complex [Fe(L2)2]22- showing it contains two iron(III) ions linked by bridging oxygen atoms.



L^1

for these and many other rhombic iron(III) complexes no evidence is seen of the characteristic splitting of the g=4.3 signal as observed for iron(III)-lactoferrin (Figure 6) indicating that the precise geometry around the iron in lactoferrin has not been achieved in these small molecule systems.



L^2

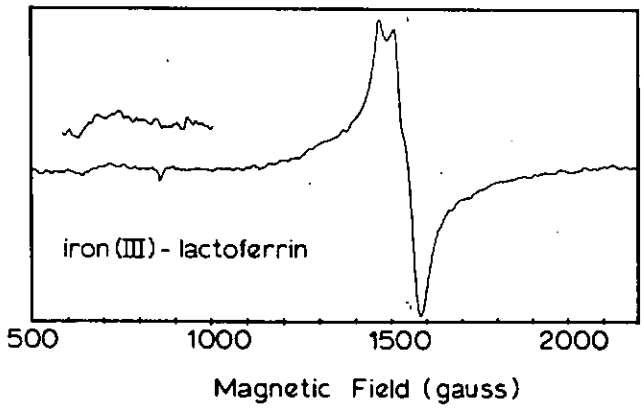


Figure 6 The electron paramagnetic resonance (epr) spectrum of iron(III)-lactoferrin.

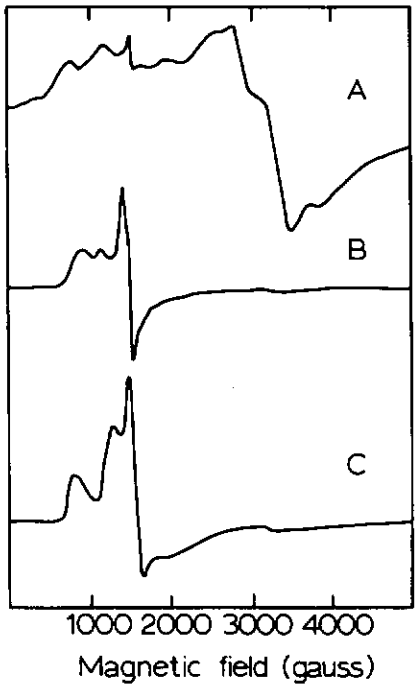


Figure 7 The electron paramagnetic resonance (epr) spectra of $[Fe(L2)_2]_2^{2-}$ in: A chloroform, B pyridine, C 1-methylimidazole.

Lactoferrin, like the other transferrins, will bind a range of metal ions in the specific metal binding sites (26). Characteristic colours develop as the metals bind: copper(II) and cobalt(III) yellow; manganese(III) brown and chromium(III) grey green. In each case, except for chromium(III)lactoferrin the intense colours are a result of the intense phenolate to metal ion charge transfer transitions occuring in the visible region of the spectrum (see Figure 2 for copper(II) lactoferrin). The presence of these intense electronic absorptions allows the spectroscopic technique of resonance Raman spectroscopy to be used to probe the metal binding sites. In the case of the various metal substituted lactoferrins, the observation of spectral features at approximately 1600,1500,1260-1290 and 1170 cm^{-1} (Figure 8) assignable to vibrational modes of metal-coordinated phenolates indicates similar metal-tyrosinate coordination for each (29). The resonance Raman spectral properties are also nearly identical to those of the other metal-transferrins, indicating the geometrical features of the sites are closely similar.

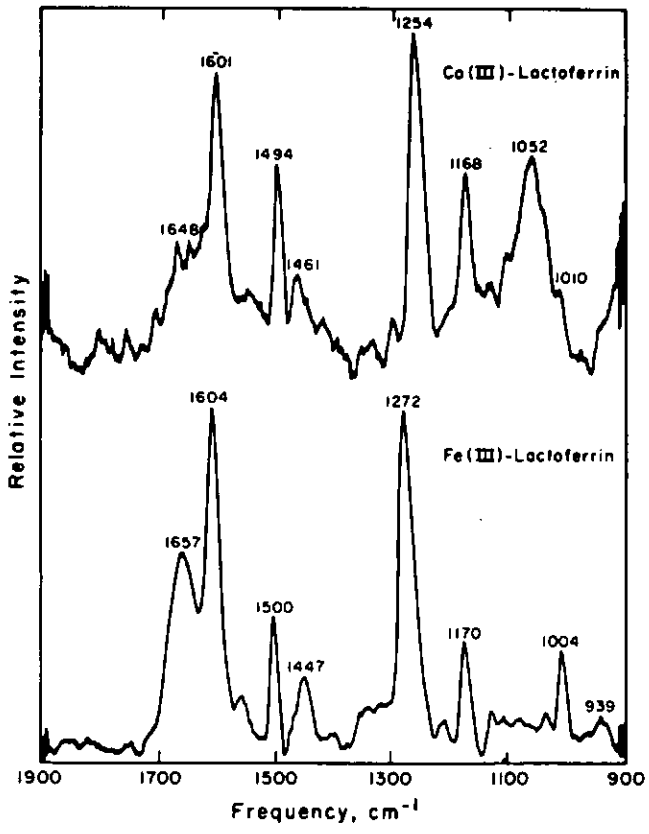


Figure 8 The resonance Raman spectra of cobalt(III) - and iron(III) - lactoferrin.

To illustrate how additional information can be obtained by changing the metal in the specific site from the naturally occuring iron(III), I will now discuss the spectroscopic properties of copper(II)-lactoferrin in more detail.

The electronic spectrum (Figure 2) is dominated by an intense band at 438 nm which can be assigned, as indicated earlier, to transition from phenolate $P\pi$ orbitals into copper d * orbitals. This asignment has been the subject of some debate with some workers assigning the band to a copper to phenolate transition. By studying the variation in the energy of the charge transfer absorption for an extensive series of small molecule copper(II)-phenolate compounds where (a) the phenolate was kept constant and the co-ligands were varied and (b) the phenolate was varied and the co-ligands were kept constant we concluded that the ligand to metal assignment was correct (30). The electronic spectrum of copper(II)-lactoferrin also shows a less intense absorption at 677 nm which is assigned to an electronic excitation within the 3d orbitals (a d-d transition) (26). The position of the band points to one, or at the most two nitrogen donor atoms bound to the copper atom in a distorted tetragonal or rhombic environment.

Copper(II) has one unpaired electron in its $3d_9$ outer electronic configuration and hence is a particularly useful epr probe. The epr spectrum of copper(II)-lactoferrin (Figure 9) can be computer simulated. The calculations point to one nitrogen donor atom, presumably from an imadazole, being bound to the Cu^{2+} ion. The lowest field hyperfine line is resolved into three (A~ 10 gauss) which is also consistent with the presence of one N-donor in the coordination sphere (29).

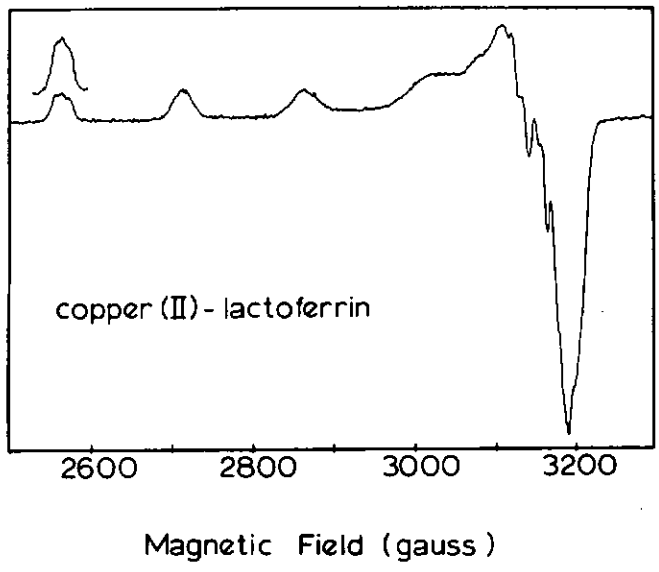


Figure 9 The electron paramagnetic resonance (epr) spectrum of copper(II) - lactoferrin.

Epr spectra of copper(II)-lactoferrin can also be used to probe the anion binding properties of the protein. For instance it is found that only one site will accept oxalate as the synergistic anion, whereas the other site will not, pointing to a small but real difference between the sites (31). This is supported by epr data on chromium(III)-lactoferrin (29). The epr parameters for copper(II)-lactoferrin with oxalate in the anion binding site are slightly different from those obtained when carbonate is present indicating that the anion is most likely bound to the metal ion.

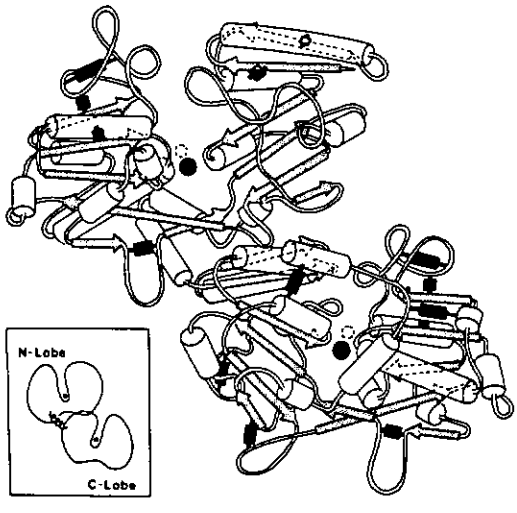


Figure 10 The structure of the iron(III) - lactoferrin molecule. Helices are shown as cylinders, β-strands as arrows, iron atoms ●, carbonate ions ◌, disulphide bridges. The inset shows the relative positions of the N- and C-lobes.

To obtain a more detailed understanding of the metal binding sites of lactoferrin and a full picture of the overall structure of the protein it is necessary to turn to the technique of X-ray crystallography. For this single crystals of a reasonable size are required - of the order of 1 x 1 x 1mm. These were obtained by members of Dr Ted Baker's protein crystallographic group at Massey University (32). From data collected on an X-ray diffractometer first a crude model of the protein was firt built up. This clearly showed the molecule was folded into two globular lobes, the N lobe (comprising the N-terminal half of the amino acid chain) and the C lobe (the C-terminal half). This was an exciting time as the structural features of the protein chain emerged. The final breakthrough came when a special solvent flattening technique was used which allowed the protein chain to be seen clearly and the iron sites identified (33).

The iron(III) ions lie in clefts formed by the two domains of each lobe (Figure 10). The actual atoms binding to the iron (Figure 11) include two phenolate oxygens from tyrosine residues and one imidazole nitrogen from a histidine. Quite unpredicted was the presence of a carboxylate oxygen from an aspartic acid although it is not entirely surprising as iron(III) is well known to have a strong affinity for ligands of this type. The fifth and sixth positions around the iron are occupied by oxygens from a bidentate carbonate ion. The geometry around the iron is thus very distorted from an ideal octahedron which explains the difficulty in mimicing the electron spin resonance spectrum. Thus in the case of iron(II)-lactoferrin the two sites appear to be the same with respect to the protein ligands and the anion binding.

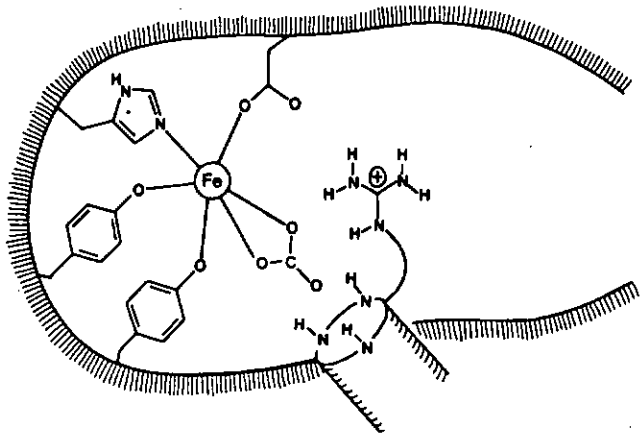


Figure 11 The iron binding site of iron(III)-lactoferrin showing the two tyrosines, one imidazole, one aspartate and the carbonate ion bound to the metal.

The structure of the protein suggests that as the iron(III) enters a cleft and binds the domains close over it. Certainly physical studies indicate that the protein appears to become more compact as iron binds to it. The recently determined crystal structure of iron free lactoferrin supports this view (34). One cleft (the N-lobe) was found to be wide open, although intriguingly the other (the C-lobe) was closed even though iron was absent. Why this is found is uncertain but it could point to an equilibrium in solution between the open and closed forms with the observed structure being selected by crystal packing.

Knowledge of the structure of human lactoferrin and its iron binding site while explaining many observations does not answer them all. For instance the circular dichroism spectra of the iron and copper substituted lactoferrins are different in the aromatic (tyrosine) region. Does this imply slightly different coordination spheres for different metal ions?) When larger lanthanide ions, eg neodymium(III), bind to human lactoferrin do they also have a six fold coordination or is their coordination number increased as is typically found for small molecule complexes of those ions? A third tyrosine, only 6 Å away from the iron is a potential candidate to increase the coordination number. Electron paramagnetic resonance (epr) studies have shown us that citrate binds sufficiently close to the iron(III) ions to perturb the spectrum for bovine lactoferrin (35). Where is the citrate binding and why are the two proteins different in this respect? It is known that there is a relatively higher citrate concentration in bovine milk than in human milk (36). Whether or not these differences in citrate binding are physiologically significant is an important question because of possible commercial production of bovine lactoferrin for infant formulae. These and many other questions will be answered as research continues using the techniques of spectroscopy and crystallography combined with genetic engineering to provide various modified lactoferrins with new spectroscopic and chemical properties.

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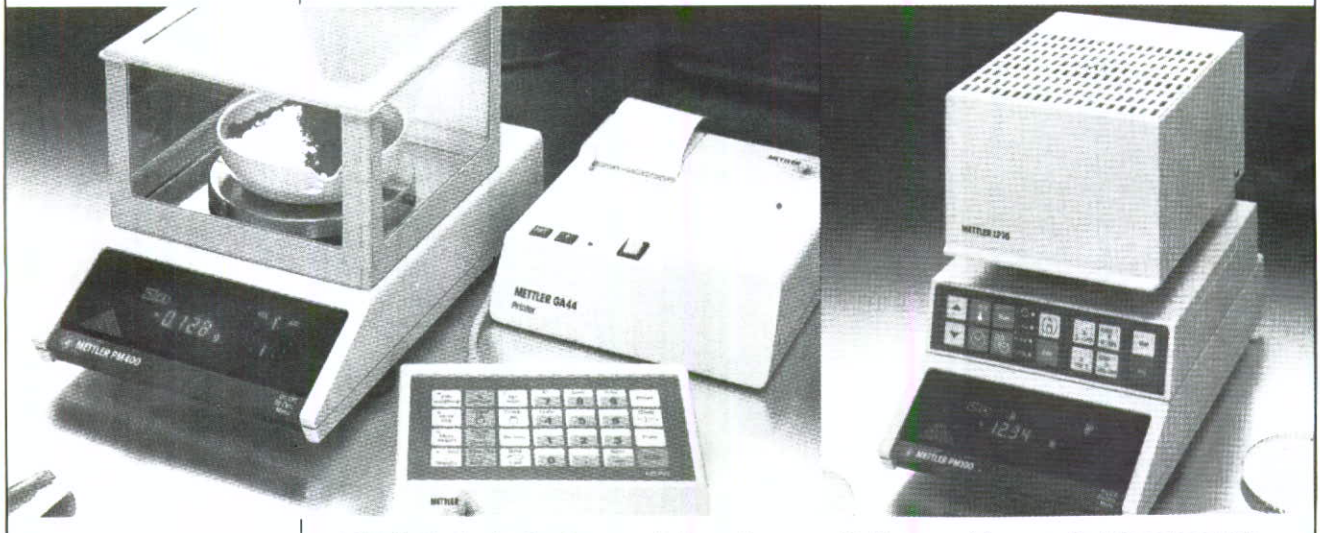

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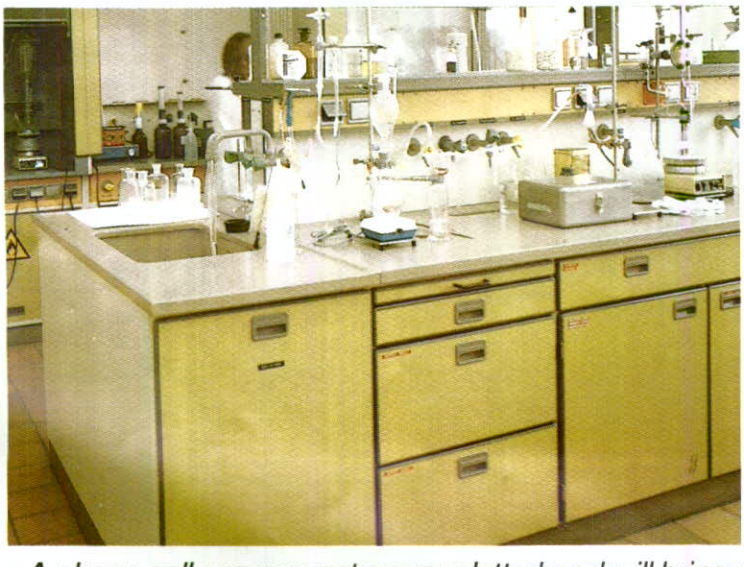

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