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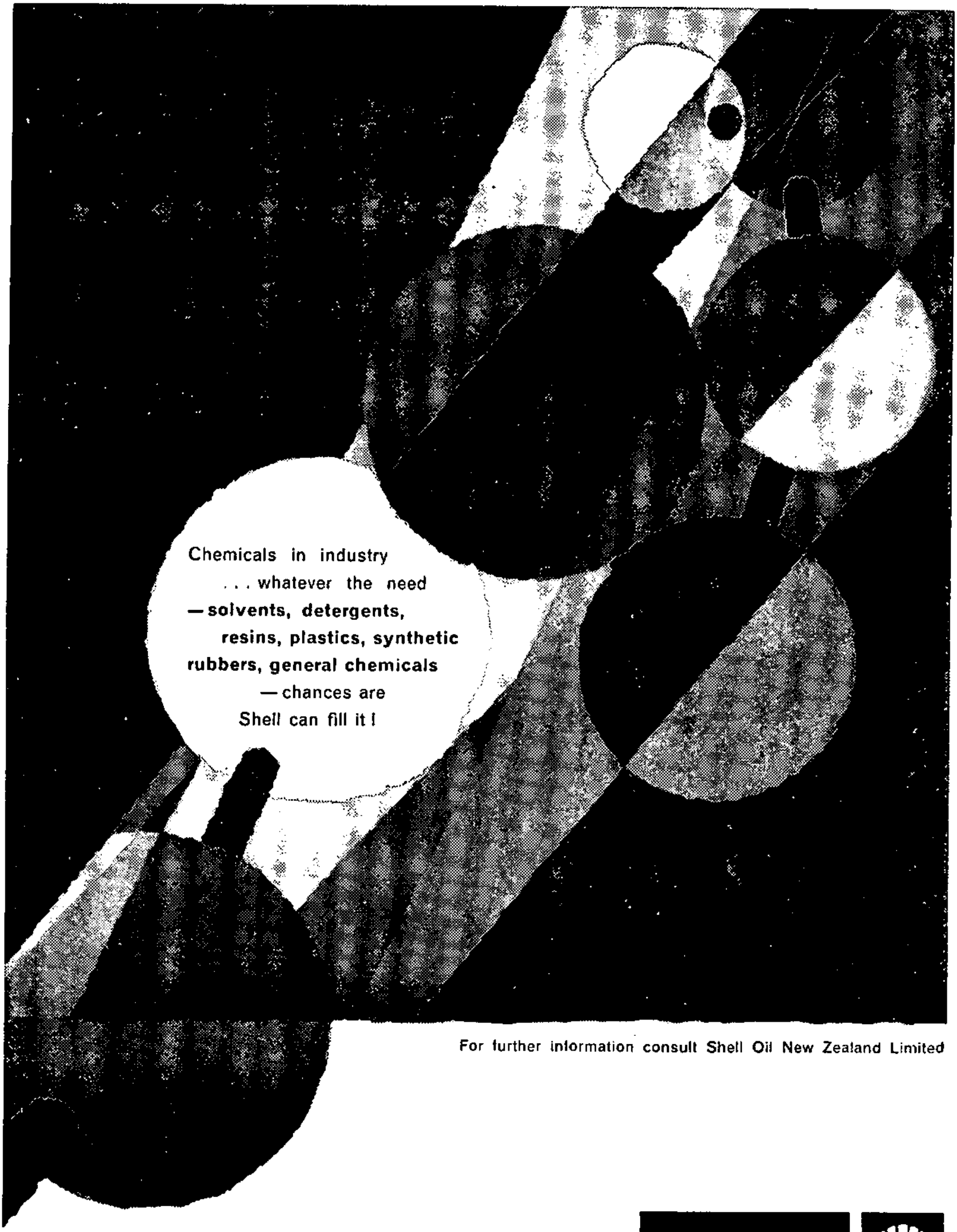

Chemicals in industry
. . . whatever the need
— solvents, detergents,
resins, plastics, synthetic
rubbers, general chemicals
— chances are
Shell can fill it !

Editorial . . .

RECENT events leave New Zealanders in no doubt as to the importance of wool in our country's economy. Polymer chemistry is responsible for the development of synthetic fibres which rival wool in many respects. To counter this rivalry chemistry is being used to modify and improve wool. Two articles in this issue indicate some of the work that is in progress in New Zealand.

An Institute member in another field of chemistry has been working on a rather different line—to turn wool into an edible protein. If this resulted in a thriving industry, can we be sure that, despite the enormous shortage of edible protein for the world's population, it will not suffer the same fate as surplus casein has done in the past—be made into buttons? To fasten our synthetic garments, perhaps?

INSTITUTE PRIZES

Members are reminded that the closing date for entries for the three prizes is April 30.

THE CHEMICAL ESSAY PRIZE. Offered for an essay or review paper of not more than 5,000 words, on any aspect of chemical science. The prize is open to all members and local members. The value of the prize in recent years has been $50.

THE I.C.I. PRIZE. This prize of $100 and a medallion has been donated by Imperial Chemical Industries (N.Z.) Ltd. It is awarded for "some major contribution to be judged by research work published or accepted for publication during the five years immediately preceding April 15 in the year of the award". Members may apply for the award or they may be nominated by Branch Committees or by individual members.

THE MORCAM GREEN, EDWARDS PRIZE. This is of the value of $50 and is donated by Messrs. H. H. Edwards and Morcam Green. It is offered "for the encouragement of original work by young chemists in pure and applied chemistry, with emphasis on applied chemistry". Applicants must be below the age of 35 years on June 1 in the year of the award. The candidate is assessed on published work or on a process he has designed or developed, or the product he produces.

THE CHEMIST AND INSURANCE

G. A. Lawrence, J.P., O.B.E., B.Sc., F.R.I.C.

(Retired. Previously Chairman of Directors, H. W. Lawrence and Son Ltd.)

THE subjects of this article are those which can be covered by insurance. The range of subjects concerns defects in manufacture of products, processes and packaging, damage during transport and some hazards in industry.

The chemistry involved is usually not very profound. Very often the analyst is called upon to give opinions on many matters when little or no chemical investigation is required. But the chemist through his training and experience should be a keen and critical observer, which eminently fits him for these tasks. The fundamental requirements are a sound, wide knowledge of manufacturing processes, of packing, of materials used in packing and of the various conditions of storage and transport.

In some cases where chemical tests are used in the investigation of damaged cargoes, some insurance organisations specify that the chemist shall report the results of the tests only, and that no opinion shall be given as to the identity of the agent causing the damage or defect. However, in most cases his opinion is required.

Defects found by importers may be due to manufacturing faults or to conditions of transport. To get a product from the manufacturer to the retailer road, rail, canal, sea and air transport may be used. Insurance covers of different types may be involved and more than one insurance company may be concerned. Therefore, the chemist must exercise the utmost care in giving an opinion, otherwise the burden for payment of the claim, which may involve many thousands of pounds, may fall in the wrong place.

Just after the last war we were importing large quantities of cigarettes. I was asked to examine a shipment which had arrived damp and mouldy and to give an opinion as to whether they became damp before shipment from the overseas port, or while being unloaded in Wellington in very wet weather. The damage was due to fresh water. The cases containing the cartons of cigarettes were uniformly damp to the centres and mould growth was well advanced. Finding this, and knowing the length of the time of the voyage to Wellington, I concluded that contact with water must have occurred before being loaded overseas. Enquiries in the country of origin proved that the cases had got wet in the rail trucks taking them to the loading port. The claim was accepted by the railways. As the value of the cigarettes was around £11,000 the desirability of tracking the cause of damage to the correct source will be appreciated.

Condensation

Damage due to condensation occurs in the corrosion of metals as well as soft goods, dried fruit, etc. It can happen not only when metal objects are shipped bare but also when they are wrapped in paper, enclosed in cartons then packed in water-proofed paper-lined wooden cases. The use of woodwool packing can enhance the possibility of condensation. Changes of temperature within the case during storage and transport and the inability of the moisture to escape through the waterproof paper results in condensation on the metal surfaces and corrosion. Similar conditions cause stain and mould damage in packages of soft goods.

Some years ago I examined a consignment of electric irons. Each iron was first enclosed in a piece of glassine paper, followed by porous tissue paper and then a carton. A number of the cartons were then packed in a water-proofed, paper-lined wooden case. The manufacturers had gone to great trouble to ensure that the irons would arrive in this country in perfect condition, but this was not the case. Most of the edges of the brightly polished sole plates had small areas of corrosion. Changes in temperature of the small amounts of air enclosed by the first piece of paper resulted in small amounts of condensate which could not be re-sorbed. Had the first wrapping been the absorbent tissue paper, the corrosion might not have occurred. The degree of corrosion was small but sufficient to mar the appearance from a buyer's point of view.

Condensation damage has been observed in bales of soft goods, e.g. cotton sheeting. The inner covering of the bale is usually one or two thicknesses of waterproofed paper with an outer covering of hessian. If the bale is stored in a warm place or exposed to the sun, moisture evaporates from the soft goods, producing high humidity. A subsequent temperature drop causes precipitation of moisture and resultant staining and mould growth.

An unusual type of condensation damage occurred when New Zealand imported some Canadian flour. The flour, packed in hundred pound linen sacks, was loaded at Vancouver one winter. Every care was taken in stowage on the ship, wooden dunnage and brown paper covering being used. But when the flour arrived in New Zealand it was found that in most of the sacks the flour was caked along certain areas of the inner walls. These areas coincided with air spaces which occur when sacks are stacked. The flour had been transported to Vancouver over the Rockies at sub-zero temperatures so that when loaded onto the ship it was at, or below, freezing point. As the ship went south into warmer weather, the ventilators passed into the hold humid air which reached dew point when coming into contact with the flour sacks. This accounted for the fact that only those parts of the sacks which could be reached by the air were affected.

Corrosion

During transport, corrosion of metal products occurs frequently. In New Zealand, damage to galvanised sheet and wire is often encountered. Mere exposure of galvanised products to a damp atmosphere will rapidly cause dulling of the surface due to formation of basic zinc carbonate.

Corrosion is often caused by contact with sea water and other chemical substances. Years ago it was the practice for assessors to do their own silver nitrate tests and there is little doubt that because of this many cases of corrosion were wrongly attributed to sea water. The mere presence of chloride does not justify the conclusion that damage has been caused by sea water. Other common sources of chloride are common salt, calcium chloride from brine circulation systems, potash manures, ammonium chloride, hydrochloric acid, leakage from ship's sewage systems, urine, and certain chlorinated hydrocarbons.

When seawater or common salt is in contact with zinc a complex series of reactions occurs, producing ultimately a mixture of basic zinc carbonate, zinc oxychloride and sodium carbonate. Probably any calcium and magnesium present would ultimately be converted to their carbonates. I have often encountered corrosion products from galvanised sheet and wire where the chloride has been converted to the rather insoluble zinc oxychloride. It is dangerous to rely on simple extraction with distilled water as suggested in Lloyd's Survey Handbook. The only sure method is to weakly acidify with nitric acid before carrying out tests for chloride, calcium and magnesium. The procedure I have adopted over many years is: Scrape the corrosion products from the surface with a knife and boil a small quantity in distilled water;

take its pH if necessary (a month's contact of galvanised wire with seawater or salt can produce an extract of pH 10.4); weakly acidify with nitric acid and test for chloride, sulphate and phosphate. Another portion is tested for nitrate or nitrite. Quantitative estimations of those present are then done and then their ratios calculated. Tests for sodium, potassium and bromide are also done. It should be remembered that industrial grade common salt nearly always contains some bromide, as do many potash fertilisers. The presence of phosphate could indicate contact with certain fertilisers, but if coupled with the presence of chloride, urine could be indicated. The presence of nitrate could indicate contact with potassium or sodium nitrate or nitro-lime, in which case further identification tests are indicated. It is not uncommon to find traces of phosphate in corrosion products of wire because it has been stored or handled in or near a place where phosphate fertilisers are stored and the dust has fallen on the wire.

Sometimes the above tests are negative. Useful information can often be obtained by testing for volatile acids and alkalies. Acetic acid has been found to be the cause of corrosion. The corrosion products are distilled from water weakly acidified with phosphoric acid. The distillate is further purified by another distillation, neutralised, evaporated to dryness, then a semi-micro dry distillation carried out. Ortho-nitro-benzaldehyde detects liberated acetone. Formic acid and the higher molecular weight acids do not yield acetone under these conditions. Formic acid may be detected by the silver reduction test.

The causes of corrosion can cover a very wide range. The manufacturer is sometimes at fault. On one occasion the manufacturer had apparently bought some old sacking to bind round the ends of his galvanised water pipes. Some of the sacking was old salt sacks. The condition of the pipes when they arrived in New Zealand was indescribable.

Packaging

Recent years have seen considerable improvements in packaging. Polythene bags and plastic containers in steel drums to carry salts and liquids have reduced spillage considerably. A number of chemical products are packed in hessian sacks with or without polythene liners. The "Use No Hooks" notice is often ignored and the spillage can cause damage to other things.

A consignment of ferric chloride arrived in Wellington from overseas. The manufacturers completely overlooked its deliquescent nature and packed it in forty gallon steel drums with loosely fitting lids. During the voyage, moisture was absorbed, the liberated acid ate through the walls of the drums and flowed onto the floor of the 'tween decks where the drums were, then finally escaped to the scupper outlets. Here, with final decomposition in contact with air and sea water, the ship's side from midships to stern was covered with the brown film of ferric oxide. The acid caused considerable etching of the decks and scupper outlets.

I stressed the importance at the beginning of this paper of the responsibility for damage being directed to the right quarter. A large consignment of canned sardines arrived in New Zealand in a damaged state. Inside the cartons the labels on the cans were discoloured and keys and edges of the cans showed varying amounts of rust. 'Someone' tested for chloride and concluded that seawater was responsible. The insurance company was about to accept responsibility when 'someone' had second thoughts and decided that a fuller investigation should be made, and I was called in. The first thing I noticed was that there was no real evidence of sufficient external wetting of the cartons to match the condition of the cans inside. Certainly I found chloride on the labels and wrapping paper, but I decided that it was not due to sea water. The usual method used to wrap a can of sardines is to place the key on top of the can, cradle the can on a piece of paper, draw the free edges together and secure by sticking the label over the top. The chloride was an ingredient of the adhesive and was present in such quantity that it had caused deliquescence, and the discolouration of the labels and the rusting of the keys and can had been brought about by the dampness. The packers of the sardines accepted responsibility.

Spray-painting

The following case was possibly the first instance when coloured photo-micrographs were submitted as evidence in court in New Zealand. An injunction was applied for by some householders against the operators of a spray-painting plant. The householders claimed that the fumes and dirt from the plant caused deterioration of their houses. The Court and Counsel for both sides agreed to ask me to investigate the complaint and make a report.

The spray booth was large, well constructed and well vented .In another part of the works was a grinding wheel for grinding steel objects. The houses in question fronted a macadam road and were a short distance from a busy highway. The windows, both facing the factory and away from it, were all rather grubby with a brown dust-like film, just like the appearance of windows near a busy highway. The only real evidence of paint-spraying was the odour of solvents on the curtains. Microscopic examination of damp filter paper swabs of the windows disclosed a magnificent collection of microscopic globules of paint of every colour used in the spray booth. A paper-covered magnet passed over the windowsills collected minute fragments of steel from the grinding plant. Colour photomicrographs were taken of the swabs from the windows and provided striking evidence in Court that spray-booth material was actually reaching the houses.

Explosions

Many years ago an explosion in a fertiliser works caused severe injuries to a number of workmen. A consignment of sulphur was being transferred by bucket-type elevator from trucks to the bin. The elevator was driven by an electric motor through a friction belt. Sometimes the heavy load caused the belt to be thrown off the pulley. When this happened a ratchet and pawl came into operation to stop the elevator from slipping.

It appeared that a dense cloud of sulphur dust developed and an explosion occurred, coinciding with the ratchet and pawl coming into operation. It was thought that a spark was struck when the pawl came into contact with the ratchet, and that the spark may have ignited the sulphur dust. However it was never proved. The electric motor was exonerated because it was enclosed.

We carried out a number of experiments in the laboratory, but found it difficult to induce ignition with the sort of spark that we thought may have been produced. Incidentally, we found that Lycopodium powder was an ideal dust to demonstrate a dust explosion.

While giving evidence in this case I listed some of the dusts known overseas to have caused explosions and instanced flour dust in flour mills. The presiding Judge interrupted me to say that he had been in many flour mills and had never noticed any dust. I respectfully explained that he had seen none because modern flour milling machinery is effectively screened to prevent dust getting into the atmosphere, but that if these protective measures broke down and flour dust invaded the atmosphere, it was a definite explosive hazard.

Electrolysis

Some time ago certain roller bearings which were imported as replacements in the front wheels of a popular make of car broke down with abnormal wear of the bearing surfaces after only a few hundred miles running. The bearings consisted of outer and inner rings, rollers and a pressed steel cage to hold the rollers in place. A dark coloured grease impregnated the bearing.

The wear was seen as deep, transverse parallel etchings across the bearing surfaces of both rings, coinciding with that part of the circumference of each roller halfway between the two bearing surfaces. The edges of the cage adjacent to the rollers were also etched. The remaining parts of the bearing surfaces were quite bright, which showed that the grease itself was not the corroding agent. As this appeared to be a clear case of electrolysis, the several components were tested and marked differences of potential recorded. Analysis of the grease showed that it was somewhat crude and contained among other things small amounts of moisture and a water-soluble sulphur compound. The presence of these two substances in the grease provided the electrolyte and this together with the differences of potential of the bearing parts provided the circumstances for this unusual case of electrolysis. It can easily be realised that when the bearings were used the finely etched trenches developed into corrugations, then complete breakdown of the bearing surfaces. In view of the worldwide distribution of these spares, the manufacturers were very pleased to have the matter brought to their notice.

During the last war when the Germans introduced that deadly menace to shipping, the magnetic mine, the British as a counter measure introduced the degaussing of ships. A ship well known in New Zealand was degaussed in a South Island port, then docked in Wellington for its periodical inspection and painting. The morning she was docked the company management asked me to come to the dock to advise them on a problem that had arisen. The paint was heavily blistered on practically the whole of the sides of the ship. In some places the paint had already fallen off and in others there were bulging blisters about the size of the palm of a hand. There was a considerable thickness of paint so the force needed to lift it off the side of the ship will be appreciated. When these blisters were broken they were found to contain a black pasty mass, no doubt consisting of mainly ferrous oxide because it rapidly turned reddish-brown when exposed to the air.

It was clear that these conditions had been brought about by some electrolytic action whereby hydrogen had been generated at the surface of the steel plate, had caused the blisters and reduced the oxide to the ferrous state. I reported to the management accordingly, and not knowing what work the degaussing had entailed, advised them to ascertain whether the ship had been connected to some source of shore electric current during the work. Word came back that several electric welding units had been used and that someone had blundered in earthing them to the vessel.

During the better part of fifty years, I have been called upon on many, many occasions to give advice on matters concerning ships, problems of corrosion, of odours in holds, in oil tanks, water supplies, engine bearings, fuels and lubrication, and hosts of problems in connection with cargoes. But this was the most astonishing and impressive thing I have ever seen in shipping. The whole of the sides from waterline to keel, from stem to stern, was pockmarked with these huge blisters. The earthing of the welding machines had turned the vessels into a vast electrode—and what could have been a more suitable electrolyte than sea-water?

THE YELLOWING OF WOOL

J. L. Hoare, M.Sc., Ph.D. and R. G. Stewart, M.Sc., A.R.I.C.,
Wool Research Laboratories, Lincoln

ONE of the advantages of wool as a textile fibre is the ease with which it can be dyed to a wide range of colours. In certain instances however this advantage is reduced for one or both of the following reasons:

i. The wool may not be white, which precludes its use for bright pastel shades.
ii. The lightfastness of the wool itself may be such that, depending upon conditions of exposure, it may bleach or yellow and so give rise to a shade change in the dyed article. This fault is particularly evident when the wool has been dyed to lighter shades.

This problem of yellowness in wool is of considerable importance since the advent of synthetics. Generally they are more difficult to dye than wool but they are obtainable as bright white fibres whose colour stability after dyeing, in many cases, is good.

The relatively poor colour performance of wool fibre has several aspects which may be considered as follows:

(1) Wool is prone to discolouration by a wide variety of agencies during growth and storage prior to processing. Since it is not clear beforehand whether these discolourations are removable by washing, discoloured wool invariably fetches a lower price at auction than its "good" coloured counterpart. A considerable proportion of the New Zealand wool clip is discoloured to some extent and hence is less valuable than it otherwise would be. Some of the sources of colour in raw wool are dirt, faecal matter, etc.; urine stain; weathering, soiling of the tips of the staples; black fibres, dip stains, brands, etc.; pigments in the suint (dried sweat); pigments produced as a result of microbiological activity; chemical damage caused by alkaline suint; combined effect of heat, moisture, alkaline suint, microbiological activity, etc. during storage of wool in the bale.

Of these, the first three could be reduced by covering the wool during its growth. But

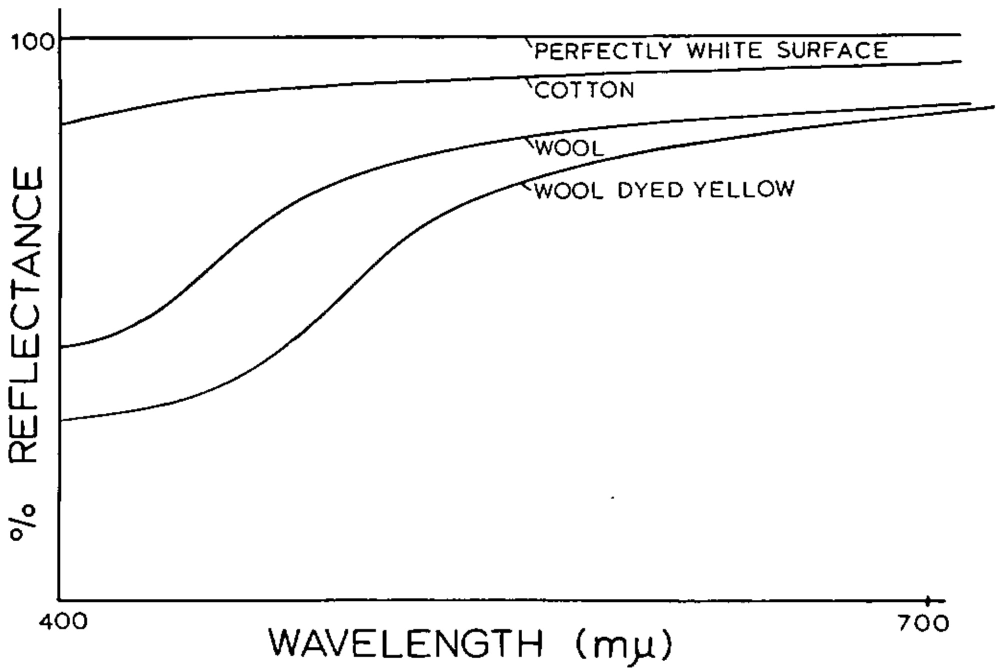


Fig. 1

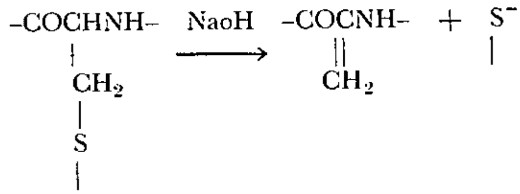
the economics of covering are poor and the mitigation of these particular faults will depend on some as yet unseen improvements in sheep management techniques. The production of black fibres is genetic in origin and can be eradicated by careful breeding. The elimination of discolourations due to branding is likewise in the hands of the farmer. The last four aspects seem to offer scope for research. Thus it has been reported[1] that the discolouration of moist wool during storage in the bale is inhibited by para-formaldehyde. However, these phenomena are little understood and much more work needs to be done.

(2) Chemically unmodified clean wool has a tendency to absorb blue light selectively and so appears cream in colour rather than bright white (fig. 1). This limits the brightness of shade attainable in dyeing pastel colours, when total dyestuff quantities are 0.1 percent or less.

Bleaching with hydrogen peroxide and/or sodium bisulphite reduces the absorption of blue light but does not eliminate it completely. Bleaching may also produce problems of subsequent lightfastness of the dyed material.

(3) Wool is yellowed by conditions of high pH and heat. This may occur if processing is carried out incorrectly or during laundering or ironing. Although a considerable amount of work has been done and is in progress, neither a clear understanding of the origin of the yellow colour nor a means of preventing it has yet emerged.

Certain of the amino acid residues, e.g. cystine, in wool are sensitive to both heat and alkali and could therefore be involved in the yellowing. However, because relatively simple polymers, such as those of the polyamide (nylon) type, are yellowed by heat it seems highly likely that main chain modification may be a factor. Strong alkali is known to degrade wool by a β-elimination mechanism at the cystine linkages and formation of an amino-acrylic acid intermediate[2] as follows:



Conceivably this could lead to increased overall conjugation within the protein network, a shift in the U.V. absorption spectrum to higher wavelengths and, hence, yellowing.

(4) Wool is susceptible to discolouration by water-soluble coloured matter and ions during processing and laundering. This is particularly true if the wool has been chemically modified by bleaching or chlorination (shrink-proofing). Special detergent mixtures have been developed to overcome this disadvantage in the case of iron contamination in the water supply,[3] while discolouration during processing can be avoided by modifications in the processing cycle.[4]

(5) Many yellow discolourations fade when exposed to visible light which is substantially free from U.V. radiation. This can cause pastel colours to change shade,[4] as when wool is exposed to sunlight through window-glass. The effect is probably due to photo-oxidation and disruption of the conjugation responsible for the absorption of blue light.

(6) Sunlight containing relatively large amounts of radiation in the 290-350$m\mu$ range will cause wool to yellow. This effect is particularly noticeable if the wool is wet and has been bleached with certain oxidising agents or brightened with fluorescent brighteners.

Once again, in spite of a considerable amount of work and the demonstration that certain of the amino acid residues, e.g. tyrosine, tryptophan and cystine, are attacked,[5] the precise origin of the colour remains a mystery. Even more important, a practicable industrial process for preventing yellowing is still lacking. Certain ultra-violet absorbers will prevent yellowing of dry wool by a fluorescent sunlamp in air, but only when applied in fairly large amounts (1-7% w/w or more).[6] Similarly, treatment with a mixture of thiourea and formaldehyde works quite well for wet wool exposed to sunlight.[7] Unfortunately, the effect is temporary and largely removed by washing.

Certain amino acid side chains, e.g. tryptophan, probably play an important role in the absorption of ultra-violet radiation,[8] e.g. in sunlight. Part of the resultant yellowing may be a consequence of main chain attack as discussed in 3. Experiments with model compounds have shown[9] that substances containing the peptide link are modified by radiation in the presence of O_2 as follows:

$$RCONHC^{14}H_2R \xrightarrow[O_2]{h\nu}$$

$$RCON = C^{14}HR \xrightarrow{\text{hydrolysis}}$$

$$RCOOH + O = C^{14}HR + NH_3$$

In wool this would presumably give rise to keto acids after hydrolysis as follows:

$$RCONHCH(R')CONHR'' \xrightarrow[O_2]{h\nu}$$

$$RCON = C(R')CONHR'' \xrightarrow{\text{hydrolysis}}$$

$$RCONH_2 + R'COCOOH + R''NH_2$$

Keto acids have been detected[10] in the hydrolysate of wool exposed to simulated sunlight, confirming the above hypothesis. The introduction of unsaturation into the peptide chain by radiation may contribute to the yellowing by causing a shift of the absorption spectrum further into the blue region.

Work on this diverse problem of yellowness in wool is proceeding along two main lines at the Lincoln laboratories.

Advantage is being taken of the present situation in which the Wool Commission has bought large quantities of crossbred wool. Selected bales have been sampled and will be resampled over the months ahead to follow the development of discolouration, if any. By correlating changes in colour with changes in other parameters it is hoped to obtain an indication of the mechanism involved and also the economic importance of any deterioration that occurs.

The second line of investigation has been to study the mechanism by which suint (the water soluble fraction of the fleece) becomes so alkaline (pH values of 9.5-10 being common). These high pH values are often associated with yellow in the fleece as shorn. Already it has been found possible to raise the pH of the suint of normal white greasy wools to these high values by suitably adjusting conditions. If this can be correlated with development of yellowness we will be progressing towards a possible explanation of why greasy wool yellows on the sheep's back —and hence towards methods of eliminating this fault

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MODIFICATION OF WOOL

W. S. Simpson, M.Sc., Ph.D.(Leeds)
Wool Research Organisation of N.Z. (Inc.)

THE textile industry has undergone a revolution over the past twenty years. Synthetic fibres have become more diverse in type, the means of processing and dyeing them have become increasingly efficient, and perhaps most significant, the trend is for them to become cheaper. The wood-cellulose based rayon fibres, once regarded as cheap, low quality textiles have also become formidable competitors to natural fibres and the stronger man-made fibres due to progress in the technologies of their production and utilization. Wool research laboratories around the world have the responsibility for creating the foundations for similar technological advances over the whole structure of the wool industry.

Wool may improve its competitive position by—

(a) Improving fleece quality, classification and marketing.

(b) Using more efficient and novel processing methods.

(c) Applying intelligent promotion.

The first two categories are largely within our province although many parts of them lie more within the provinces of our agricultural research organisations and the Wool Industries Research Institute. One major contribution the Wool Research Organisation can make is its ability to carry out biochemical, chemical and physical research on wool and wool proteins. In this area one proposition being explored at present is that wool may be chemically modified, or additives bound to it, in such a way that the resultant fibre is better adapted to particular end-uses which need not necessarily be in textiles. Two of these projects are briefly outlined.

Polymer Grafting

Previous attempts to alter wool by introducing internal deposits of various polymers into wool fibres resulted in physical changes of limited technological value. Chemical catalysts suitable for initiating the polymerisation of typical monomers such as acrylonitrile and styrene must be capable of penetrating the wool structure, which means they must be soluble in water or a strong organic acid. The obvious examples tried for wool-polymer grafting are persulphate[1] or ferrous ion-peroxide,[2] but these unfortunately degrade the wool substrate by oxidative attack on the disulphide cross-links between keratin chain molecules. More recently γ-ray or 500 KV electron initiation has been tried[3,4,5]. Adequate dosages (0.3-1.0 MRad) required to achieve useful amounts of grafted polymer (20-60 percent weight increase) are well below the level of about 3.0 MRad at which protein chain degradation begins to show itself as decreased tensile strength or increased solubility of the modified wool.

In collaboration with the Institute of Nuclear Sciences, D.S.I.R., a wide range of polymers have been grafted in wool, principally using Cobalt-60 γ-ray initiation. Rapid grafting can be achieved using a mutual radiation technique, i.e. the wool, monomer and solvents are irradiated simultaneously. Grafting is relatively slow and the yields are much reduced if the wool is first irradiated then placed in monomers later, even if contact with oxygen (which forms stable addition radicals) is prevented. E.S.R. spectroscopy studies at Physics and Engineering Laboratory, D.S.I.R., and in Australia indicate that the radicals which are first formed in the wool convert to more stable radicals which are less effective in promoting grafting.

A novel chemical initiator has been developed[6] which avoids the problems of oxidative damage to the wool. An addition complex is formed when copper acetyl acetonate is added to an excess of trichloroacetic acid. It is also formed *in situ* when wool is soaked briefly in a solution of the two and remains bound internally when the excess acid is removed by rinsing. Wool impregnated in this way and placed in an acrylonitrile/water solution will double in weight due to non-extractable polymer deposition, within two hours at 60°C. The details of the mechanism of initiation are not certain but the pH dependence and specificity of the initiator for certain monomers indicates an ionic mechanism rather than a free radical one. The trichloroaceto ligand apparently decomposes to form CCl_3^- and carbon dioxide. The dependence of the rate on trichloroacetate concentration indicates that one molecule of bound acetylacetonato-copper generates a number of CCl_3^- initiating groups by a continuous process of ligand bonding, followed by its decomposition.

Work is still in progress to develop satisfactory methods for grafting monomers which cannot be polymerised with this initiator. The changes in physical properties which we have observed up to this stage indicate that technologically valuable new wool-based products are possible. Both increased stiffness[7] (e.g. for carpets) and increased softness and elasticity (e.g. for apparel) are among the effects so far observed.

Chemical Modification

A proper account of what is possible in this field would need to be a review of a large part of protein chemistry, but the most obvious areas for attention can be grouped under:

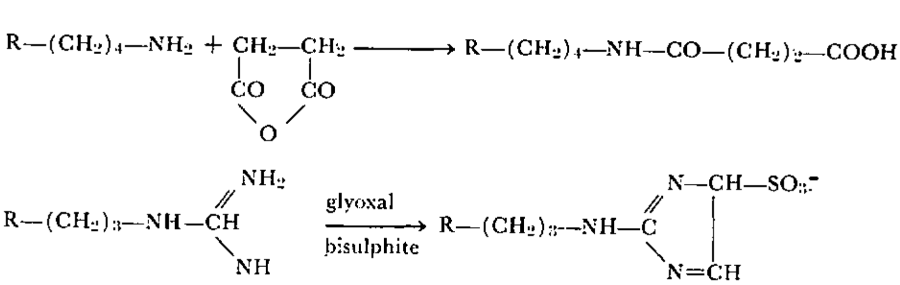
(a) Increase in the number and stability of inter-molecular cross-linkages.
(b) Increased stability towards heat, alkalis and light.
(c) Altered affinity for water, dyestuffs, etc.

One aspect of the third category that we are examining is the potential of wool as an ion-exchanger or selective absorbant. The pK values for the ionization of basic groups (amino, guanidino and imidazole) and acid groups (carboxyl) are affected by their environment inside the fibre (Donnan membrane effect). This effect is eliminated when the wool is solubilized and fractionated into soluble proteins which can then be titrated in solution. If the ε-amino groups of lysine are succinylated (Reaction 1) and/or the guanidino groups of arginine are treated with glyoxal-bisulphite[8] (Reaction 2) the ratio of acidic to basic groups in the dissolved protein can be considerably altered.

The consequence appears to be a pronounced shift to higher pK values for all the carboxyl groups. To put this observation in another way, the charge density over the surface of the solvated wool protein molecule is sufficiently high so that the ionization constant for any particular chemical group is a function of the net charge borne by the whole molecule.

The analogous conversion of terminal carboxy groups to basic groups may have even more practical benefit, but further fundamental research is needed to develop simple, effective means of doing this.

(1)
(2)



Some novel methods are being tried in order to determine the affinity of wool for various classes of compounds and ions. Clean wool is first broken down into component cortical cells with papain-bisulphite.[9] These cells are approximately 100μ x 6μ in size, comparable to particles used as substrates for column or thin-layer chromatography. Wool cell dispersions produce robust thin layers with a texture and strength similar to chromatography paper. Preliminary experiments show that these thin layers or wet columns are capable of resolving mixtures of similar compounds. The results may suggest possible industrial applications for wool in the general field of filtration and purification. Preliminary trials have been made of wool cigarette filters, both here and in Australia. Wool proteins cast in the form of membranes show some promise as temporary skin for severely burned patients. To cite a concrete example of the use of this ubiquitous fibre as a filtering medium, Los Angeles possesses a tourist attraction of no mean drawing power, a wool filter bed several acres in extent, used for the disposal of sewage!

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R.I.C. Monographs for Teachers. Nos. 12, 13.

The theoretical tenor of sixth form chemistry today makes teachers feel more acutely the need for suitable background reading.

The two most recent Royal Institute of Chemistry Monographs for Teachers:

No. 12, 'Elements of Chemical Thermodynamics' by E. A. Guggenheim, 70 cents;

No. 13, 'Principles of Osmotic Phenomena' by J. F. Thain, 80 cents;

will make welcome additions to the list of titles.

Professor Guggenheim states that the aim of elementary thermodynamics is to teach the student how the direction of chemical reactions and the equilibrium condition for balanced reactions can be determined from calorimetric and related measurements. Nine examples are given to illustrate the way the tables of standard enthalpies, entropies and heat capacities may be used to calculate partial pressures, boiling points, transition temperatures, equilibrium constants and solubilities, and to decide which of two processes is possible.

The early chapters, which outline the scope of thermodynamics and define the most important quantities using up-to-date conventions, are most useful. But an approach which was less formal and more inclined to the pictorial would appeal more to the reviewer who fears that teachers may be dismayed by symbols in such a high concentration.

Osmotic pressure makes its appearance among the colligative properties almost as an afterthought put in to round off the topic without being related in a straightforward way to the others. This monograph helps to put it in perspective.

Dr Thain first outlines definitions and then briefly traces the historical development of ideas on osmosis. Three theoretical chapters follow and after these, methods of measurement and proposed mechanisms are dealt with. The last two chapters on osmotic phenomena in animals and plants will prove of value to biologists.

In both monographs, the mathematical sections provide useful summaries for those whose physical chemistry operates at this level while the descriptive sections contain material of direct value which will commend them to teachers.

A. F. BAKER.

THE 1967 LIST OF MEMBERS

For the first time the List of Members comprises two sections, one Alphabetical, the other Occupational.

The Alphabetical section follows the familiar pattern of the past. To the best of the information available it is correct as at December 1st, 1967.

Until this year it has been customary not to list the origin of bachelor's and master's degrees conferred by the University of New Zealand. Now that these degrees are diminishing in proportion to the total it was decided to list the source of all masters' degrees but not the level—e.g. First Class Honours. Bachelors' degrees continue to show only the degree, not the source, but the B.Sc. (Hons.) degree is noted. Wherever possible this alteration has been made but in cases of doubt the listing is unchanged. It is hoped that members concerned will ensure correction at the reprinting in two years' time.

A number of former scientific officers in the Government Army do not realize that demobilization has taken place and that now they are members of a Kafka-like body of bureaucrats called "Scientists". Only oversight will have saved any officer from being stripped of his rank and consigned to the body scientific.

(Well.) appears after some degrees for the first time. This is the official abbreviation for degrees conferred by the Victoria University of Wellington. Gratitude is expressed to the authorities for abandoning the heathen hybrid "Massey University of Manawatu", for "Massey University" is much shorter to transscribe. Being grateful, the committee has corrected all Massey listings.

But these are dull things, probably only pleasing to a chairman who is showing symptoms of pedantry. Much more interesting and controversial is the Occupational section. The response to this was excellent and as a result of suggestions made by members the original nineteen categories have been increased to thirty-five. It was realised that some members would have preferred to be listed in one of the additional categories had they known of them. Typical is "Petroleum Chemist".

The committee has therefore exercised a judicious mixture of members' choice, personal knowledge, clairvoyance, and downright arbitrariness in placing each member into a suitable calling or callings. Those who are displeased with the station in life to which it hath pleased the committee to call them will be enabled to remedy the matter when the List is reprinted in 1969.

The most problematical category to allocate was "Administration". It became obvious that many members no longer practised as chemists but spent their days oiling administrative machinery so that others might pursue chemistry in peace and prosperity.

The solution to placing inspectors, principals, vice-chancellors and registrars was simple. The three teaching categories, secondary, technical institutes, and universities, were widened to include administration. It only needed the inclusion of teachers colleges with the universities to pigeonhole almost all members connected with education, however remotely.

The other administrators were more difficult. Thanks to the management consultants industry abounds with grand titles. Titles are cheaper than salary increases and many carry less responsibility than the name would suggest.

Because of this, the committee decided to err on the side of harshness. Only those known to be occupying the top administrative posts in organizations have been included. Directors of research institutes qualified, directors of research sections did not. Company managers did, but technical managers did not. Perhaps a little unkindly, neither did plant superintendents. In cases of doubt, age was sometimes invoked. The committee considered that administrators tend to be over forty. The younger set may draw comfort from the probability that such folk are perhaps also balding and paunching.

Co-operation is sought in correcting any injustices but it is firmly intended to maintain "Administration" as an exclusive grouping.

The term "chemist" when used in reference to a member of the N.Z.I.C. carries a guarantee of professional qualification. The committee thought that the term "chemical engineer" should carry a similar guarantee and therefore barriers have been erected around this category. Only those with a degree in the subject or who are corporate members of a chemical engineering institution have been included.

Probably the chief virtue of an "Occupational" section is that it provides a quick reference to "who works at what" in New Zealand. It provides a rapid means of getting in contact with those engaged in any particular professional activity. For this reason it is hoped that a number of younger members who are not working will not be too startled to find themselves in the "Retired" category. It was thought that anyone seeking a chemist for part-time work would look in the "Retired" section. Accordingly anyone who appeared as though they might be prepared to do part-time work was included, rather than open a category "Housewives and Allied Trades."

The term "Applied Chemist" rested comfortably on the shoulders of those in research organizations, whilst their brethren in industry were almost all "Industrial Chemists".

The latter group is large and could well be subdivided. A start has been made by splitting out "Meat", "Dairy", and "Building Materials". Suggestions for more splits would be welcome.

"Research Students" have not been listed solely because it was thought that many would have ceased to be such long before a revised List was printed.

To maintain the List at a rational size each member has been allowed listing in not more than two categories. This will be followed rigidly, and members should bear it in mind when seeking to divide such categories as "Analyst" into water analysts and forensic analysts. In general the aim of dual listing is to provide the basic discipline and a professional activity. Thus "Polymer Chemist" and "Applied Chemist" is logical as is "Theoretical Chemist" coupled with "University Teaching".

The parturition of the "Occupational" List kept the committee busier than usual, and there is an awareness of birth scars. Some will disappear with maturity, but closer examination may show some in need of cauterization. To this end comment is sought from everyone interested.

To be of any use a membership list must be continually updated. The practice of showing each member how the individual listing will appear in print works well, but it is surprising the number who don't know (or don't care) what their correct title is, or for that matter, what is the correct title of their place of work. Thus do they work for "N.Z. Dairy Products Ltd.", or "New Zealand Dairy Products Limited", or even "Dairy Products (NZ) Ltd.".

Over some years an attempt has been made to shape the List into a positive style, and such variations as the one quoted look slovenly, particularly if differing versions appear on the same page.

Wherever possible the place of work is the preferred listing. The List is primarily for professional purposes, and a professional man without a professional address and no listed activity may justifiably be supposed unemployed.

Members with overseas degrees can help by ensuring that they quote the correct official abbreviation. Those with unusual qualifications can assist an ignorant chairman by noting at the bottom of the card just what the initials stand for. At present he is struggling with A.N.Z.I.M.L.T. and F.A.A.A.S.

Notes are better made on the front of the card rather than on the back or on separate pieces of paper. Notes get lost and one can fail to turn a card over. The revisions are all transcribed on to a master set of cards held by the committee and the List is set only from the latter.

It is hoped that members will bear with any sins of omission or commission until next printing. Those who cannot and wish to relieve their frustrations are asked to write to the Chairman, for he, not the Registrar, was responsible.

J. S. POLLARD, Chairman,
List of Members Committee.

CURRENT CHEMISTRY . . .

BREAD QUALITY

P. Meredith, M.Sc., Ph.D.(Birm.)

Wheat Research Institute, Christchurch

THE quality of bread is dependent on the formation by fermenting yeast of gas bubbles whose walls have optimum visco-elastic properties. The bubble wall is a complex mixture of hydrated proteins and of starch granules in process of gelatinization. Probably there are two reasons for the complexity of the mixture. Wheat is an additive descendent of three primitive grasses and so contains three complete sets of chromosomes and genes controlling metabolism. The proteins and starches are storage compounds of the seed and their composition is probably not critical to the plant. Variation in composition is caused by weather and soil-nutrition. Therefore, bread quality varies.

This variation has intrigued many famous men. Humphrey Davey, Berzelius, Gay-Lussac, Dumas, Liebig, Millon, Kjeldahl, Van Slyke, Ostwald and Sorensen have all worked on the problem. [These men did not become famous by solving this problem, but by applying their thoughts elsewhere.] Today cereal chemists are still plugging away at the same problem.

The Wheat Research Institute, D.S.I.R., Christchurch, has been continuing this tradition since 1928, in addition to its load of "applied" research and direct assistance to industry. Three examples of the areas in which we work will suffice.

Every schoolchild learns that yeast ferments sugar to yield alcohol and carbon dioxide. Sugars are present in flour in limited amounts and additional sugar is an expensive ingredient for the baker. It is better to rely on a continuous breakdown of flour starch to yield fermentable sugar. The starch granule is relatively inert to the action of the flour beta-amylases that would yield sugars. However, in the course of milling wheat into flour a proportion of the starch granules are squeezed and mechanically damaged. These granules are then susceptible to enzyme attack. Thus, a dough may not rise well because of gas shortage if insufficient starch damage occurs. Too much starch damage may be harmful by upsetting the water balance of the dough. Starch granules, whether entire or damaged, are susceptible to attack by alpha-amylase, an enzyme absent from mature, sound wheat. In a wet harvest the grain may commence to grow, giving dramatic evidence of alpha-amylase activity. Flour from such wheat gives a bread crumb that is sticky to slice and unpleasant to chew. The damage caused by slight incidence of such alpha-amylase activity is dependent not only on the level of enzyme attained but on the susceptibility of the starch to amylase attack and on the inherent gel strength of the baked starch—another prime variable.

Fifty years ago it was normal to store flour for some months to "mature" it, and to ferment bread doughs from 12 to 24 hours to "mature" them. Nowadays, we use flour within a few days and have three hours or less fermentation time. The natural maturing actions are replaced by the use of minute traces of oxidising agents. In this country potassium bromate is added to doughs. Apart from the economic advantages, chemical oxidation enables much better control of the maturing process. The maturing of flour is believed to be an atmospheric oxidation process and the maturing of dough an oxidation which proceeds by means of the dehydrogenases of yeast. Both actions ultimately effect the proteins. Dough "work-hardens", as does metal, and then slowly relaxes, because its peculiar properties combine viscous flow and elasticity. The relaxation of dough is by a 'disulphide interchange' mechanism similar to those postulated for certain other biological systems. The interchange of the disulphide bonds that cross-link the protein chains is mediated by relatively few sulfhydryl groups acting similarly to "free radicals" in a chain reaction. The effect of oxidation, whether atmospheric, enzymic or by added oxidant, is to effectively remove a proportion of the sulfhydryl groups and so make the dough less able to relax. The oxidation-reduction balance in a fermenting dough is critical. It is reflected not only in the texture and size of the loaf but also in crumb colour. Indeed some wheat varieties are notorious for giving a grey coloured crumb if slightly over-matured. This is a reaction between protein and polyphenols, catalysed by traces of iron, to give intensely coloured polymer pigments. The reaction is very similar to the formation of a precipitate in beer known to the trade as "chill-haze".

The optimum visco-elastic properties of the rising dough naturally depend on the amount of protein present as well as its oxidation condition. However, the peculiar visco-elastic properties of the protein also vary in a qualitative manner not yet explained. There is a complex spectrum of proteins varying from an infinite-sized cross-linked gel down to molecules of only about 15,000 molecular weight. These interact amongst themselves and with lipids and pentose and hexose polymers. As yet we are nowhere near explaining quality in terms of these interactions. Those proteins which we have separated so far seem to occur in related triplets, suggesting their primitive grass origins, and have properties quite unique amongst biological polymers.

In these interacting properties we appear to have sufficient work for the next hundred years.

BRANCH NOTES

AUCKLAND

For the final meeting of 1967 an afternoon visit was made to Sterling Pharmaceuticals (N.Z.) Ltd. The Company entertained about thirty members and guests who were shown something of the varied manufacturing operations in progress in its new factory and control laboratories at Manurewa.

During November a two-day conference for chemistry tutors from technical institutes throughout the country was held at Lopdell House, Titirangi, under the auspices of the Department of Education.

Dr G. T. Mills, Reader in Enzymology at the University of Newcastle upon Tyne since 1964, has been appointed Professor of Biochemistry in the new Medical School at Auckland.

THE REGISTRY

The following were elected on 15/11/67.

Fellows

AGGETT, Frederick John, M.Sc., Ph.D., Chemistry Dept. Auckland University (Senior Lecturer).

BAKER, Lewis Charles, M.Sc., W. Gregg & Co. Ltd., Dunedin (Works Director).

HUNTER, George John Ernest, M.Sc., F.R.I.C., Biochemistry Dept., Medical School, Dunedin (Senior Lecturer).

JACKMAN, Richard Harry, B.Sc., Ph.D. (Iowa), Grasslands Division, D.S.I.R., Palmerston North (Head, Soils and Plant Nutrition Section).

LONGBOTTOM, Herbert Leslie, B.Sc., Glendermid Tanneries Ltd., Dunedin (Managing Director).

THOMSON, Thomas Alexander, B.Sc., Thomsons Ltd., Dunedin (Managing Director).

Associates

ALLEN, Michael Leslie, B.Sc. (Hons.)(Lond.), Amalgamated Brick & Pipe Co. Ltd., Auckland (Chemical Engineer).

BECKINGHAM, Ian James, Otago Boys' High School, Dunedin (Chemistry Teacher).

BERRY, John Arthur, B.Sc.(Hons.)(Cantua.), Christchurch Gas, Coal & Coke Co. Ltd. (Works Control Chemist).

CLARK, Brian Ronald, M.Sc.(Auckland), Melville High School, Hamilton (Chemistry Teacher).

CIBULSKIS, Jurgis Arimantas, B.Sc., A.N.Z.I.M., Fibremakers N.Z. Ltd. (Production Controller).

COLE, Richard Burton, B.Sc.(Hons.)(Cantua.), N.Z. Sea Products Export Ltd., Port Nelson (Development Assistant).

DODGSON, Michael George, B.Sc., Aerosol Products Ltd., Auckland (Development Chemist).

FULLER, Maurice John Arthur, M.Sc.(Auckland), Dominion Yeast Co., Auckland (Chemist).

GREENALL, Brian John, B.E.(Chem.), W. Graham Hitchins Ltd., Blenheim (Chemical Engineer).

JOERIN, Michel Marcel, A.R.I.C., Dairy Laboratory, Wallaceville A.R.S., Upper Hutt (Chemist).

KIRKMAN, John Henry, B.Agr.Sc., B.Sc.(Hons.) (Newcastle - upon - Tyne), Ph.D. (Aberdeen), Massey University, Palmerston North (Lecturer in Soil Science).

LEONG, Kah-Nam, B.Sc., University of Toronto, Toronto 5, Canada (Ph.D. Student).

McELROY, Peter James, B.Sc.(Hons.)(Otago), Chemistry Dept., Otago University, Dunedin (Ph.D. Student).

MASON, Miss Penelope Cuff Rutherford, B.Sc. (Hons.)(Otago), Wool Research Organisation, Lincoln (Research Chemist).

MUNNS, Robert John, B.Sc., Bay of Plenty Co-op. Dairy Assn. Ltd., Te Puke (Chemist).

PORTER, Lawrence James, M.Sc., Chemistry Division, D.S.I.R., Private Bag, Petone (Scientist).

ROBERTSON, John Maxwell, B.Sc.(Hons.) (Otago), Chemistry Dept., Otago University, Dunedin (Ph.D. Student).

RUSSELL, Graham John, B.Sc., Merck, Sharp & Dohme (N.Z.) Ltd., Lower Hutt (Production Supervisor).

SEAKINS, John Medgley, B.Sc., Joint Industries Ltd., Auckland (Chief Chemist).

SEWELL, Jasper Robert, B.Sc., Chemistry Division, D.S.I.R., Private Bag, Petone (Scientist).

SIMONS, Miss Patricia Marian, B.Sc., Rutherford High School, Te Atatu (Chemistry Teacher).

SMITH, Robin Andrew James, B.Sc.(Hons.) (Otago), Chemistry Dept., Otago University, Dunedin (Ph.D. Student).

THOMSON, Miss Mary Russell, B.H.Sc., 21 Monaghan Ave., Wellington, 3 (Graduate Student, School of Home Science).

WADDELL, Ronald Barclay, B.Sc., Hamilton Technical Institute (Principal).

WHITE, Gordon Wesley, B.Sc., Chemistry Dept., Auckland University, Auckland (Junior Lecturer).

INSTITUTE OFFICERS 1967-68

PRESIDENT, 1967-68:

D. R. Llewellyn, D. Phil., D.Sc., F.R.I.C., F.R.S.A., graduated Hons. B.Sc. from the University of Birmingham in 1941 and D.Phil. from the University of Oxford in 1943. After time spent at the Clarendon (Oxford) and Cavendish (Cambridge) Physics Laboratories he became Lecturer in Chemistry at University College of North Wales, then at the University of London. He came to the University of Auckland as Professor of Chemistry in 1957, and was appointed Vice-Chancellor, University of Waikato in 1964.

During the war he worked on the separation of uranium isotopes and the preparation of the pure metal. After the war his interest was extended to the separation of stable isotopes of carbon, oxygen, nitrogen and hydrogen—particularly those of oxygen where high enrichments were obtained. This opened up a new field for the study of reaction mechanisms and investigations on the position of bond fission.

He has served on a number of committees in New Zealand including The Council of the Pottery and Ceramics Research Association, The Council of the Fertiliser Manufacturers Association, The Atomic Energy Committee of New Zealand and the N.Z. Vice-Chancellors Committee.

FIRST VICE-PRESIDENT

Professor J. Vaughan, born and educated in Wales, worked in government and industrial laboratories before becoming a university teacher in 1947. He came to New Zealand in 1949 as Lecturer in Organic Chemistry, University of Canterbury, and became Professor of Chemistry in 1963. He was chairman of the Canterbury Branch Committee which inaugurated the highly successful "Chemistry in Action" series and maintains a very active interest in this and the Junior Chemical Society. His published work has been mainly concerned with the mechanisms of organic reactions. He has wide interests outside his subject and is Pro-Rector of the University of Canterbury.

SECOND VICE-PRESIDENT

Mr T. A. Rafter, O.B.E., M.Sc., F.R.S.N.Z., A.N.Z.I.C., Director of the Institute of Nuclear Sciences, Department of Scientific and Industrial Research, Gracefield.

He joined the Dominion Laboratory of D.S.I.R. in 1940 working for a time on coal chemistry then became interested in the chemistry of uranium and its extraction from uranium minerals. He worked on these and on the chemical analysis of rocks and minerals until 1947.

During 1948/1949 he studied the applications of both radioactive and stable isotope techniques at the Massachusetts Institute of Technology, Boston, and Columbia University, New York, and visited many Nuclear Centres in America, Canada and England.

The Isotope Section of the Dominion Laboratory was established under Mr Rafter's direction and prior to his appointment as Director of the Institute of Nuclear Sciences in 1959 he was Divisional Head of the Isotope Division of the Dominion Physical Laboratory.

Mr Rafter was a New Zealand delegate to the Atoms for Peace Conference at Geneva in 1958; has been invited to lecture on his scientific interests in America, Italy and Australia, and in 1967 was a member of the New Zealand and Australia Nuclear Power Mission to Canada.

He is D.S.I.R.'s representative to the New Zealand Radiological Advisory Council and attends all meetings of the New Zealand Atomic Energy Committee.

In 1959 he was awarded he O.B.E. for his contribution to nuclear science in New Zealand and made a Fellow of the Royal Society of New Zealand in 1961. He is author of 45 scientific papers and meets many requests to lecture to scientific societies and colleges within New Zealand.

BRANCH CHAIRMEN

MANAWATU

Dr R. C. Lawrence is Senior Biochemist at the New Zealand Dairy Research Institute. He graduated B.Sc. (Hons.) in Chemistry from London University in 1949 and after 5 years in the Navy as a meteorologist and 2 years in Canada, came to New Zealand, being appointed to the Biochemistry Department at Massey University in 1957. He transferred to the Dairy Research Institute in 1960, completing a Ph.D. at Massey in 1964. He has recently spent 18 months study leave at the National Institute for Research in Dairying. His main research interests are in the systems of extracellular enzymes of bacteria and the germination of fungal spores, particularly with regard to their effect on the flavour of cheese.

AUCKLAND

The new Chairman of the Auckland Branch is **Dr D. F. Nelson.** Dr Nelson was born at Te Awamutu, and went to school in Gisborne. His professional career with D.S.I.R. began in 1940 in the Dunedin Branch of the Dominion Laboratory, while studying part-time at Otago University where he graduated B.Sc. and later gained M.Sc. in chemistry in 1948.

After a short interval with the Wellington Branch of the Dominion Laboratory, during which he also trained in aspects of dairy science at Massey University College, Dr Nelson returned to Dunedin where he remained as deputy to the Government Analyst until 1959. His interests, initially in dairy and food analyses, came increasingly to be concerned with toxicology and forensic science and lead to his spending a three-year period at the University of California, Berkeley, under Professor Paul L. Kirk of the School of Criminology. This study lead to his receiving the degree of Doctor of Criminology, with high graduate attainment testified by his election to the fraternity of Sigma Xi. Since 1962 Dr Nelson has been in Auckland where he is currently in charge of the Forensic Section of the D.S.I.R. Chemistry Division.

Elected a Fellow of the Institute last year, Dr Nelson has served on branch committees in Otago and Auckland where he was recently branch editor. Dr Nelson is married with three daughters.

WAIKATO

Dr. D. E. Wright graduated M.Sc. with First Class Honours in Chemistry from Otago University in 1954. He was commissioned in the N.Z. Defence Scientific Corps and studied bacterial metabolism in the Otago Medical School, graduating Ph.D. in 1958. He was seconded to Plant Chemistry Division until 1960 when he joined the staff of McGill-Montreal General Hospital Research Institute studying amino-acid metabolism in plants. From 1961-64 he was Senior Lecturer in Biochemistry, Lincoln College, and since then has been Section Leader at Ruakura working on ruminant metabolism and fungal toxins. During 1965-66 he spent a year at the Department of Bacteriology, University of California as a U.S. Public Health Service International Post-Doctoral Fellow.

WELLINGTON

Mr McDonald is a Divisional Officer at Chemistry Division, D.S.I.R. He joined the Department in 1942, on leaving Scots College (Wellington), and started reading for his degree at Victoria University of Wellington. After a short break in his studies due to the war, he graduated B.Sc. in 1947 and M.Sc. (Hons.) in 1948. He then spent two years at the Forest Product Research Laboratory in England working on wood chemistry and continued this work on returning to Chemistry Division. Mr McDonald is particularly interested in chemical products of New Zealand trees and their industrial potential. He was elected an Associate of the Institute in 1950 and won the Morcam Green, Edwards Prize in 1956. He is the Corresponding Secretary for the Royal Institute of Chemistry.

Mr I. R. C. McDonald

OTAGO

Dr G. N. Malcolm

Dr G. N. Malcolm, M.Sc., Ph.D., F.N.Z.I.C., was educated at Feilding Agricultural High School and Canterbury University College. He graduated M.Sc. with First Class Honours in Chemistry in 1953. He was awarded the Rutherford Memorial Fellowship, and the 1851 Exhibition Science Research Scholarship for New Zealand, and went to Manchester University to study polymer science. He graduated Ph.D. in 1956, and after a short period on the staff at Manchester University, returned to New Zealand as Lecturer in Chemistry at Otago University. In 1964 he was awarded a Nuffield Foundation Fellowship, and studied further aspects of Polymer Science at Imperial College, University of London. Dr Malcolm is now an Associate Professor in Chemistry at the University of Otago.

CANTERBURY

Mr T. A. Mitchell was born in Dunedin and educated at Southland Boys' High School and the University of Otago. He graduated M.Sc. (Honours in Chemistry) in 1949 and joined the staff of the Rukuhia Soil Research Station in Hamilton. In 1955 he became manager of the Plastics Division of H. C. Urlwin Ltd., Christchurch, but a year later returned to research work, this time at the Wheat Research Institute. His present interest is in baking technology, a field more allied to physics and engineering than to chemistry.

Mr T. A. Mitchell

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Branch Editor: M. J. Taylor.
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Committee: Dr P. K. Grant, Mr R. H. McKeown, Mr R. McNaught, Mr C. W. Thomson.
Auditor: Mr T. A. Thomson.

BOOK REVIEWS

Fundamentals of Chemistry: A Modern Introduction, by F. Brescia, J. Arents, H. Meislich and A. Turk. Academic Press, New York and London. 1966. $U.S.8.90.

Readers of "Journal of Chemical Education" and "Education in Chemistry" who are also interested in introductory chemistry texts will already have had the opportunity to consider two excellent and detailed reviews of this book. In general terms it is sufficient to say that the present reviewer agrees that this text is a fine addition to the small group of authoritative works which should be available to able students of chemistry in the Upper Sixth Form or at Stage I level.

As is implied by the title, its concern is with chemical principles rather than a systematic exploration of the chemistry of the elements. Notwithstanding this, the development of ideas is firmly supported by an appeal to practical situations. Much information about chemical substances commonly set out as a methodical treatment in traditional texts will be found here as illustrative material. For example, the occurrence of metal ores is considered as a consequence of the thermodynamic stability of the ore relative to its oxidation by acid or reduction by water.

The new prescription for New Zealand University Scholarship and Bursary is covered most adequately except in two respects. Since there is no systematic treatment of the elements, the comparative chemistry of Group IV and of Group V elements or of the transition metals is not done as such. But well known situations such as the contrast between silicon tetrachloride and carbon tetrachloride in the presence of water are discussed under the heading "Nucleophilic displacement on atoms able to acquire more than an octet of electrons". If the student is prepared to search, he will find a significant proportion of the information he needs for descriptive chemistry.

Organic chemistry, except for the hydrocarbons and aspects of bonding, is in general inadequately treated. A very brief summary of some of the properties of the better known functional groups and an extensive chapter on polymers do not correlate with the importance accorded this branch of subject in New Zealand. In this respect "Fundamentals of Chemistry" is like all the other introductory American texts known to the reviewer. It therefore shares this limitation with the books at present in use.

Several of the topics and features introduced are relatively new ones at this level. The properties of metals are explained on the basis of a simple form of the band theory rather than by the use of the more limited "electron gas model". Systematic use of the method of dimensions in numerical calculations gives a precision hitherto regarded as unimportant. Chapter 24 outlines a brief introduction to the symmetry elements of molecules. It is followed by a comparison of valence bond and crystal field theories to explain transition metal ion bonding.

Reactions at covalent bonds in terms of electrophilic and nucleophilic displacements on σ or π bonded atoms are discussed as well as additions and rearrangements. A masterly discussion of solubility and colour precedes the section on qualitative analysis. This is rationalised by readily apparent principles and is followed by an outline of spectrochemical and chromatographic techniques. The whole chapter gives a judicious and lucid balance of classical "wet" analyses and new instrumental procedures.

The overall level is perhaps too sophisticated for most sixth formers. But for the able few who may become candidates for direct entry to Honours classes and to their teachers, the book must be highly commended.

T. R. Hitchings.

Physical Chemistry. Third edition, 1966, by Farrington, Daniels and Robert A. Alberty. Published by John Wiley and Sons Inc., New York, 767 pages. Price N.Z. $8.95 (Regular Edition), $5.65 (Wiley International Edition).

The level of the third edition of this well-known book is slightly above the levels of the previous editions. There is a greater emphasis on the mathematical background to physical chemistry, some of the more elementary material of the preceding edition has been deleted, while new material, such as the chapters on "Symmetry" and "Molecular Electronic Structure" has been added. More than 300 new problems have been incorporated.

The organisation of the material has been changed, and for the better. The book is now divided into five parts: Part 1, "Thermodynamics", has chapters on gases, the first law, the second and third laws, one-component systems, phase equilibria, chemical equilibria, electromotive force and surface chemistry. Part 2, "Dynamics", is subdivided into kinetic theory, chemical kinetics and irreversible processes in solution. Part 3, "Quantum Chemistry", consists of chapters on quantum theory, symmetry, molecular electronic structure, spectroscopy, statistical mechanics and theories of kinetics and photochemistry. Part 4, "Structure", contains chapters on crystal structure and other structural methods, and Part 5 deals with "Nuclear and Radiochemistry".

According to the authors "the book is intended for a comprehensive first course in physical chemistry" and to this end it covers a wide range of topics, some of which would rarely be discussed in a "first course". Consequently, some topics are discussed much less fully than the reviewer would wish. For example, equilibrium electro-chemistry is treated virtually in a single chapter "Electromotive Force" which covers electrochemical cells, e.m.f. measurements, reference electrodes, notations for electrical cells, junction potentials, thermodynamics of electrochemical cells, the derivation of the Nernst equation, activity of electrolytes, the Debye-Hückel theory, ionic strength, cells without liquid junctions, electrode potentials, conventions for electrochemical cells and electrode reactions, concentration cells, determination of solubility products using e.m.f. cells, determination of pH, the glass electrode, overvoltage, polarography, batteries and fuel cells—all in only 29 pages. Numerous electrochemical applications are not discussed; an introductory treatment of electrode kinetics would have been welcome.

Many worked examples appear throughout the text and generous collections of problems are included at the end of each chapter. A minor but annoying feature of the problems is that answers are provided for only about one-third of them. The book has an appendix containing a summary of some useful mathematical manipulations, and a table of the most recent values for physical constants.

The style is clear and concise throughout and the book is reasonably priced. On the whole, as a textbook it has few defects and is warmly recommended as a very useful basis for undergraduate courses in physical chemistry, particularly at about the second year level.

A. J. Easteal.

Inorganic Chemistry, by R. B. Heslop and P. L. Robinson. 3rd Edition 1967. Published by Elsevier. NZ$6.50.

Modern texts of inorganic chemistry often fall into one of two categories—those in which more than half of the space is devoted to transition metal chemistry and those in which a more balanced treatment is presented. The third edition of Heslop and Robinson falls into the second category as a well-balanced textbook. Nine years have elapsed since the first edition was prepared and the rapid expansion of chemical knowledge during that time, together with the consequent impact on teaching methods, has necessitated the rewriting of earlier editions. The text of these has been revised with some rearrangement and several additions which include new chapters on bonding in transition metal complexes, organometallics, and reaction mechanisms. There has also been a change of emphasis in the treatment of bonding from valence-bond description to the crystal field and molecular orbital approaches thus eliminating most of the deficiencies in the earlier editions.

Since the first two editions of this book are reasonably well-known as teaching texts there is little need to comment further, except to say that the authors have preserved the same informative concise style so characteristic of the earlier editions. Another extremely satisfactory feature of the book is its price. In the field of comprehensive inorganic texts this one, containing 760 pages covering the material in most undergraduate and some honours courses, is significantly cheaper than several other popular books. It is certainly a worthwhile purchase for students specialising in inorganic chemistry and for graduates requiring a comprehensive reference book.

R. M. Carr.

Chemistry of Solids, by A. K. Galwey. Published by Chapman and Hall, 1967. NZ$5.00 or $2.80 paperback.

This book is an introductory monograph in non-mathematical language. In just over 200 pages the author describes the salient features of a specialist field which has demanded much attention from chemists in recent years.

The subject matter is presented under five chapter headings. The first classifies the known types of solid; this is followed by a description of the structures of crystal lattices. Chapter three describes theories of the solid state and the ways in which real solids differ from the idealised models which have been proposed. The final two chapters are concerned with the reactivity of solid surfaces, chemisorption and catalysis, and with chemical reactions which involve penetration of the reactant interface into the solid.

In recent years many chemists have noted the lack of suitable texts for a course in solid state chemistry. In general books written by crystallographers omit the more chemical aspects, while physicists elegantly describe the theories in a manner often unintelligible to chemists and then apply this knowledge in terms of electrical and magnetic properties only. Galwey presents an account which is essentially chemical, relating theory to experiment in a simple manner. Any author embarking on a work of this nature must be confronted with the problem of presentation of the theories. This author has chosen the non-mathematical treatment and has achieved success. However any description of band theory which does not include the Schrodinger wave equation in the form of the Bloch function could be regarded as an unwarranted simplification, but references are given to texts which provide mathematical treatment. Despite some oversimplification this book is a welcome addition to the literature on solid state chemisry.

R. M. Carr.

Sulfonation and Related Reactions, by Everett E. Gilbert, Interscience, John Wiley and Sons, 1965. ix + 529 pages. N.Z. price $14.85.

This book is one of a series of Interscience Monographs under the editorship of George A. Olah. In this series we expect a high standard and range of coverage, and this text meets these specifications adequately. The individual chapters deal with a discussion of individual sulphonating reagents, the various means of introducing the —SO_2X group into an organic molecule, including indirect methods, and the allied processes of sulphation and sulphamation. The final chapter deals with desulphonation and its importance. In addition there is an adequate subject and author index.

Throughout the text there has been great emphasis upon exhaustive and detailed coverage of the material, and the references quoted extend to the year 1964. The inclusion of recent work has made the book valuable, and has shown how far the subject has advanced in the twenty-five years since it was last reviewed.

The author has presented his material well and concisely; the publishers have evidently assisted him well and the result is a book which should be available to any chemist who is considering a study of these important organic reactions.

R. Bolton.