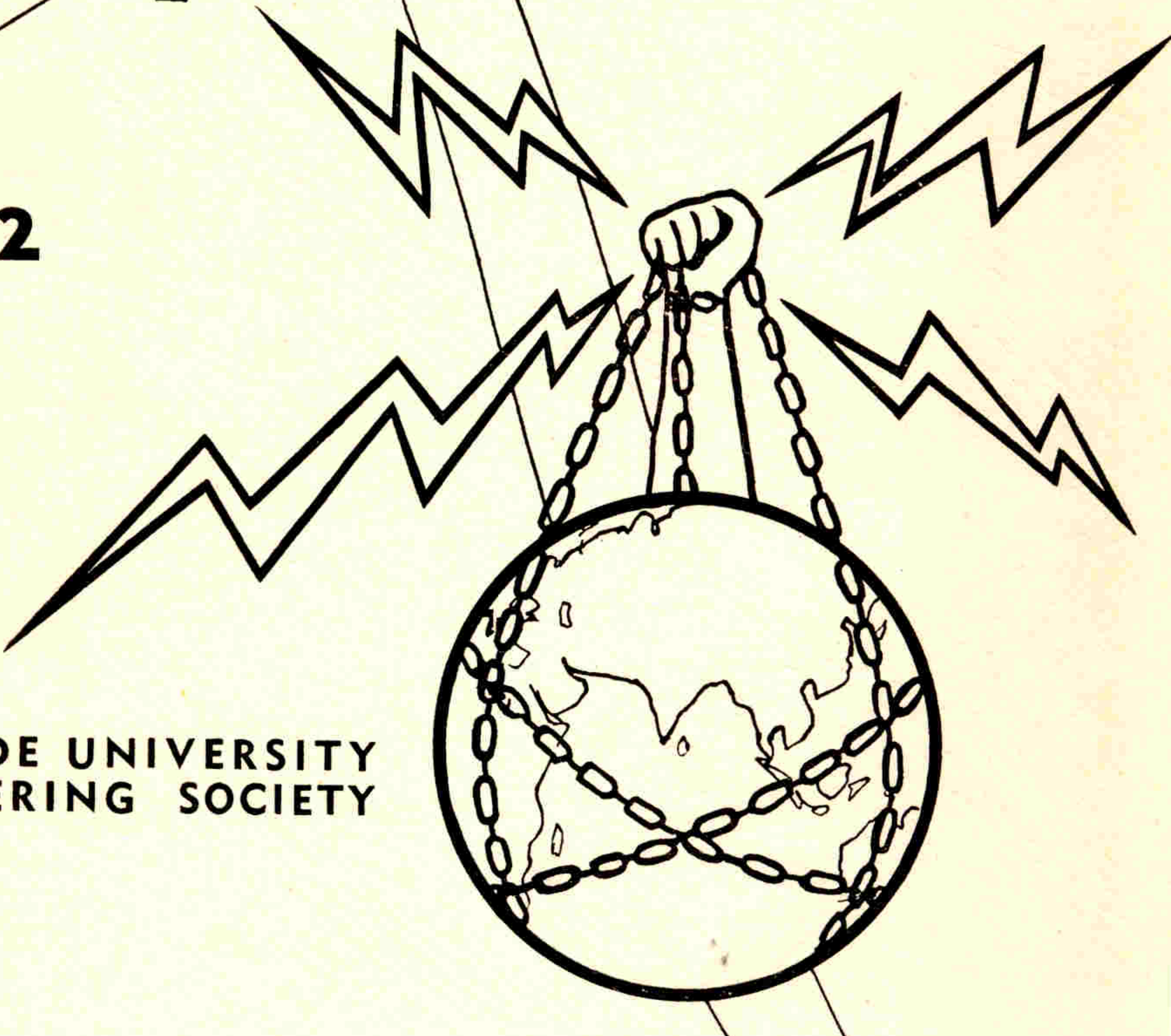
Hysteresis

1962



ADELAIDE UNIVERSITY
ENGINEERING SOCIETY

HYSTERESIS

1962

Official Journal of the Adelaide University Engineering Society,
University of Adelaide,
South Australia.

Editor:
BERNARD SMITH

CONTENTS

EDITORIAL . . .

Another year has passed. And another Hysteresis makes its appearance.

Although somewhat reduced by the prevailing economic climate, it fortunately did not meet the difficulties alleged to have been experienced by a previous edition —it was reputed to have been "written hazily on the back of five beer bottle labels with a thumb nail dipped in vodka and was lost somewhere between the Richmond and the Watchhouse."

Turning to matters of greater import, we see that in the customary fashion greater and higher pinnacles of success are predicted for engineering armed with the discoveries of science.

Civil engineers will overcome natural obstructions, while the mechanical engineers will give unlimited power; a wide array of new materials will appear from the chemists and metallurgists and finally electronics will provide the control and supervision of these processes, and may remove some of the mental work of man himself.

There seems to be no reason why at least some of these dreams may not be partially fulfilled in the near future.

However, this rosy picture must be kept in perspective. Two thoughts emerge —will man be basically happier? (the answer to this is not for engineers to decide) and, how will engineers measure up to the responsibilities of the "brave new world"?

One thing is certain: the demands of our increasingly complex civilization will place great burdens on his ingenuity and intellectual qualifications.

The added importance and dependence on the engineer is bringing wider recognition of the profession, but because of a rather unfortunate linguistic accident, the image of an "engineer" in some sections of the public differs somewhat from our conception of its meaning.

One popular conception of the engineer is a romantic looking fellow bossing a construction gang or keeping company with a surveying instrument. Another is the blue-garbed, gauntleted hero who peers from beneath his long, level visor at the converging rails ahead and confidently holds at arms length in his left hand subject to his will the whole power of a locomotive.

This misconception has appeared in modern dress under the glorification of the scientist and an accompanying, if subtle, downgrading of the engineer. Even C.P. Snow says that scientists "have been in certain respects just perceptibly more morally admirable than most other groups of intelligent men."

Surely if engineering is to attract its share of better students, it must create a more realistic image of itself in the eyes of the non-technical public.

It is inevitable that changes will be made in the training of engineers of the future to accommodate to the far reaching extensions of technology that will occur if advances continue to be made at the present rate.

What additional degrees of specialization will exist in undergraduate training? How much time will be spent on the humanities and social sciences (if any)? (The Grinter Report on engineering education suggests about 20 per cent.). How much emphasis will be placed on science rather than technology?

THE DEAN'S PAGE

Engineers have certainly been much in the headlines of the press during recent weeks. Perhaps, in fairness to some of my colleagues, I should say it is the Civil Engineers who have been giving the journalists such a field day; for it is not often that a major undertaking such as the King Street Bridge fails in such a dramatic manner.

It is too early (as this article is being written) to say what was the cause of the collapse of the bridge. Whatever the cause, however, the accident brings home several facts not always appreciated—at least, not always appreciated by the non-engineer.

The public as a whole conceives an engineer as applying the exact laws of mathematics and science to a precisely defined problem. The public is astonished, therefore, when the engineer's works misbehave. It concludes that the engineer has made a mistake. Up to a point, I suppose, this view is correct; the engineer has made a mistake. The mistake is not necessarily a culpable one; for the view of engineering expressed above is far from the truth—at least, so far as Civil Engineering is concerned, and I suspect it is equally far from the truth in the other branches of our profession. Engineering is not an exact science. The bridge designer, for example, can never be absolutely certain of the loads his bridge may be called on to carry; he cannot be absolutely sure of the properties of the materials used, or of the excellence of the craftsmanship in fabricating them. In complex cases he may even be uncertain of the precise stresses and strains set up in the material. Using the best knowledge available, the designer makes his decisions as to material and sizes. Up to a point it is rather like a gamble, with very long odds against trouble. The engineer increases these odds even further by testing his materials, and by careful supervision of the work during construction.

So long as the engineer follows along conventional lines, the chances of trouble are very small indeed, because all the problems have already been encountered. We cannot, however, afford to stay in the conventional path if we are ever to make progress. The engineer must (as he did in King Street Bridge) introduce new materials and new methods; it is then that he is most likely to encounter troubles.

It is easy to be critical from the ivory towers of an academic chair (if I can somewhat mix a metaphor), but I am reminded of a statement by George Bernard Shaw:

"He who can, does; he who can't, teaches."

The engineer in real life must get on with the job. Sometimes he gets a little in front of the research workers, and then there is trouble.

My sympathy is very much with the designer who gets caught in this way. It is certainly a spur for us in the Universities to push forward research, and so make it safer for the engineer to progress into relatively unknown territory.

From the photographs in the press it appears that the failures in the girders of the King Street Bridge started at a particular detail, relatively insignificant in itself. How often this is the case. Many of the world's spectacular engineering failures have been triggered off by some weakness at a detail. It may be that there is some predisposing cause for the failure, but it takes a weakness somewhere to trigger it off. The failure of the Tay Bridge, the disasters with Comet aircraft, and the breaking up of some welded ships are all cases where a weak detail started collapse. In machines, too, how often is it the failure of a split pin, or some minor component, which leads to a major catastrophe? As engineers, we must learn this lesson early—details matter. The trouble with details is that they are not easy to assess. In structures, the stresses around details will often be too complex to analyse by conventional methods, and it is there that we must develop the "art" side of our profession, what Freyssinet (the great French engineer who died recently) called "a feeling for the living stresses in structures."

It is distressing when an engineering project fails, but such failures are the price we pay for progress. It would be sad indeed if we ignore the lessons which each failure teaches, not only the limited technical lessons associated with each particular case, but also the general lessons which apply to all engineering.

PROF. F. B. BULL.

PRESIDENT'S REPORT

This year, as in preceding years, the Engineering Society's Activities have followed the pattern of events which have become important occasions in the students' programme. We have endeavored to cater for all tastes and to benefit all students, and I hope our efforts have been successful.

The Society numbers were somewhat reduced this year with the formation of the Technology Society. However, with our increasing enrolments this setback is only temporary, and the Society will continue to flourish and prosper in the future.

This year's committee took office in September last year, and the Fresher representatives were elected in March of this year.

The last Annual General Meeting was held on September 8, 1961, when the retiring President, Secretary, and Treasurer handed over to the new Committee for 1961-62.

FRESHERS' WELCOME

The Society held the Annual Freshers' Welcome for 1962 in the Chapman Lecture Theatre. The bright atmosphere of the newly-painted theatre, coupled with the new students' enthusiasm, made it a most enjoyable evening for everyone. The Society's activities were outlined, and then the heads of each department were introduced to the students. The staff replies, amid much merriment, contained sound advice for all students, emphasising the need for a balanced student life.

Two brief films were screened, the first dealing with helicopters used to transport an entire oil rig, and the second on the ever-popular subject of motor racing. To conclude the evening, the staff and students mixed informally over supper, held in the Seminar Room of the Electrical Department.

Graeme Evans was responsible for the organisation of this hightly successful welcome.

COCKTAIL PARTY AND BALL

This year a determined effort was made to advertise the Ball more than ever before. From the drawing-board of the bespectacled Mr. G. L. Brown emerged the design of a gigantic ball. The structure and its multi-coloured coat were manufactured by Mr. Brown, who watchfully kept costs below an astronomical level. Complete with portable amplifier, the ball was towed by a magnificent T-model, and displayed before the lunch-time crowd.

The ball had the desired effect, and a good crowd attended the Ball. The pre-ball cocktail party, which was again held in the Institution of Engineers' new building, proved even more successful than last year—the liquor supply lasting a good deal longer.

Unfortunately, the number of staff members present was disappointingly small. Perhaps they had visions of a "twist" night, and considered it a little too strenuous. Nigel Barham and David Dungey were responsible for this sterling effort.

Second-year student Ken Moxham convened the Ball, and his ingredients of success were two bands, a startling floor show, and free drinks. Few people realise just how much work is involved in the Ball, and the success was due to the untiring efforts of a small group who worked on Friday, Saturday, and Sunday. Many thanks to those involved.

FILMS

This year, as usual, the Films at 1.10 p.m. on every Tuesday in the Chapman Lecture Theatre have been one of the most appreciated and well attended activities of the Society.

Bruce McLeod again did a great job in selecting and screening these films.

SYMPOSIUM

A sizeable party of Adelaide Engineers hastened to Hobart for the Annual Symposium. Every member really lapped up the Tasmanians' friendliness, and many friendships were made, although not all of these were with fellow Engineers. Next year's Symposium, in Sydney, will be of the same calibre, so start saving now!

CAR TRIAL

This year, for the first time, the Society organised a car trial. No entry fee was charged, and a £5 first prize was offered. Approximately 25 cars took part, and the drivers were very enthusiastic about the prize. The eventual winner

was Garry Brown, who seemed to have a little more luck than others. The event culminated in a barbecue at Tony Simpson's home, and an enjoyable evening was had by all. Colin Palm and Wayne Phillips were responsible for the organisation.

TUG-O'-WAR

Unfortunately, just when the time was ripe for the annual Meds. versus Engineers tug-o'-war, the A.C.C. removed the plug from our river, and we have had to postpone the event until a future date. We aim to keep this event as a sporting challenge this year, rather than as a disorganised brawl, as was the case last year.

PRAM PUSH

A group of Engineers has gallantly accepted the challenge from the Medical and Dental students to a pram race from Melbourne to Adelaide. The aim is to collect funds for W.U.S.—a very worthy cause. The Society is partially subsidising the Engineers' team. Wayne Phillips and Trevor Stafford are organising the team.

S.R.C.

This year we were again looking forward to having a strong representation of Engineering students on the Men's General. However, unfortunately not enough first and second year Engineers voted, and we will have to rely on the faculty representatives to maintain our interests.

SOCIETY TIE

Following complaints of the dowdiness of the Society tie, suggestions were put forward for a new design. Peter Chapman and the committee have been censoring the designs put forward, and we hope to have a new, modern tie by the commencement of next year.

COMMITTEE

The number of committee members this year has been down compared with last year, but, fortunately, everybody has pulled their weight, and we have been able to organise all the regular Society activities. Next year we hope to see a lot of new blood on the committee, with plenty of enthusiasm and new ideas.

I would especially like to bring to your notice the way in which Mr. Garry Brown has so capably looked after the Society's finance, and also at this stage I would like to thank Mr. J. H. Fowler who, as in past years, audited our books.

THE FUTURE

The Annual Dinner will be held at the Gresham Hotel this year—the Finsbury Hotel was reluctant to serve us again. This year I am hoping that people will remain gentlemen, whether sober or otherwise.

The now annual event—the Engineers and Nurses' Barbecue—is being organised by Barry Stacey and Chris Coxan. It seems that the nurses look forward to this event as much as the Engineers, and I have no doubt that this year's Barbecue will be the best ever.

HYSTERESIS

Editor Bernie Smith has borne the responsibility of Hysteresis alone this year. Congratulations for a job well done, Bernie, and I hope that the worries involved in chasing up articles, etc., have not been too great.

FINAL WORD

Once again I would like to thank all those who have helped carry out the Society activities. Next year I would like to see a change in policy, so that financial members receive concessions for various functions. I am sure that this would strengthen the Society, and could be carried out by issuing membership cards. Every student should be a member, as it is the students' society for students.

A liaison is being formed with the Students and Graduates' Division of the Institution of Engineers, Australia, whose activities are of much interest to students.

I would also like to thank Professor Bull and the staff for their support throughout the year.

As a final word, I would like to say how honored I am to have been associated with such a fine Society.

D. PATTERSON.

A wedding march and a military march have this in common—both suggest a call to battle.—Heine.

King David and King Solomon
  Led merry, merry lives,
With many, many lady friends,
  And many, many wives.
But when old age crept onward,
  With all its heavy qualms,
King Solomon wrote the Proverbs,
  And King David wrote the Psalms.
—James Ball Naylor.

Here's a good rule of thumb:
Too clever is dumb.

The sudden entry of a wife has made many a secretary change her position.

MEN AND MACHINES

By ADRIAN VLADCOFF

Ever since man began to harness energy and build machines the question has been raised of whether man can build a machine more clever than himself. Can a mechanical chess player defeat its designer? Descartes answered this in a different way, saying that there must be at least as much reality and perfection in the cause as in the effect. Kant, too, thought that man could not build such a device: "How can work full of design build itself up without a design and without a builder?"

In the time of Descartes and Kant this question was mainly of philosophic interest. Today this question is becoming more and more of practical importance. It is therefore very important that we know exactly what can be achieved with a machine—theoretically, anyway. If it is true what Kant and Descartes declare, then we are wasting our time trying to build a device exceeding the human brain in intelligence. It is the purpose of this short article to show that maybe it is possible to build such a device. Of course, no one has the complete answer to such a difficult question, and this article is merely a look at one particular aspect of the problem.

The answer to this problem has been compared with the very similar situation of man being able to build machines of much greater power than that possessed by the human body. Surprisingly, the principles involved are usually very simple—for example, the lever. Hundreds of years ago, I suppose, men declared it was impossible to build a device of greater power than the human body, and similarly, not very long ago, people were saying that it is not possible to build a device of intelligence greater than that of the human brain. Yet man was proved wrong in the first case, for today we see machines of thousands of horsepower, while man is capable of producing but a fraction of a horsepower. So it is that it is not at all ridiculous imagining a device capable of solving the complex social and economic problems of today, which are beyond man's intellect. The answer as to whether Britain should or should not join the European Common Market would be an explicit yes or no. And at this stage it is interesting to note that the answer to any problem can be broken down into such decisions—"yes" or "no." Such a "yes" or "no" is called a BIT of information by electrical engineers. Information theory has proved very valuable in other fields of electrical engineering, and certainly it is a foundation whenever we are talking about intelligence. In fact, it is now possible to define intelligence explicitly on the basis of information theory, but I do not propose to do this here.

Returning to the analogy between amplification of power and amplification of intelligence, the important thing in the case of power is that, although there is amplification of power, yet we require the necessary amount of energy in the process. We cannot perform any task unless the required amount of energy is available for the task. And so it is in the solution of a problem. It is not possible to obtain a solution of a problem unless all the necessary amount of information is already present. For example, to solve, say, a geometry problem, we need the necessary theorems, and this is what is meant by the necessary amount of information. Yet even if the necessary information is already present, the solution will only result if the stored information is in a suitable form to select the solution from all the other possibilities. (Ashby has shown that the solution of a problem is a matter of selection.) Intelligence, then, seems to be the ability to transform the information to a form so that selection of the appropriate solution can take place, from all the other possibilities. But even if such a device could be built, it must always be remembered that it still must already have the necessary amount of information stored in it. It is seen, then, that there is this very close analogy between energy, when speaking of power machines, and information, when speaking of intelligence machines. So there seems the possibility of constructing machines more intelligent than the human brain, just as there are machines more powerful than the human body. However, there are many principles yet to be discovered—principles that may even be as simple as the ordinary lever.

At first sight it may appear that evolution has violated the law that there must be the necessary amount of information for such an intelligent process to occur. (Evolution is indeed an intelligent process, because the essence of the evolutionary process is selection from all the randomness, and this we have seen is the key of an intelligent process.) We see around us a richness and complexity of design so wonderful that even the greatest of all agnostics must pause in reverence to so rich a creation. It seems at first that appropriate selection has occurred without the necessary amount of information. But this is not so. There is indeed present all the information necessary for such a creation, but it is in a hidden form. The law that information cannot be created is not violated by evolution, for the evolving system receives an endless stream of information in the form of mutations. I like to look at this in the following way: There seems to be in life a primary goal for survival, amongst many other goals, of course. Living organisms, then, are continually trying to attain this goal, despite changes in environmental conditions. A comparison of the state of the organism with this ultimate goal results in a "feed-back" message, which is passed on to the next generation in the gene structure.

So, looking at it in this way, the necessary amount of information is present in the form of feed-back messages. There is no creation of information in evolution, just as there is none in any other such intelligent process. The information is merely changed to a different form, just as in a power machine, where energy is changed to a different form. However, in an intelligent process the information is usually changed to a more convenient form, whereas in a power machine the energy is changed to a less convenient form (as a result of the natural tendency for entropy to increase). In the first case, chaotic information becomes more ordered, whereas in the second case the energy become more chaotic.

It is seen, then, that as far as natural evolution is concerned, anyway, information is not created. The question which follows must be to ask where this information came from in the first place. Naturally, it was put there by the same person who put all the energy (or matter) in this universe. There are certainly some things which man cannot do—for example, he cannot create energy or information. But does this stop him from making a machine more powerful or more intelligent than himself? God has provided man with all the necessary materials, but at the same time He has given man the privilege of assembling these materials to serve their useful purpose. It is a fallacy to think that if a machine more intelligent than the human brain were constructed then there is no God. On the contrary, it is man's responsibility to see his limitations, and strive to achieve what is within his ability. It is a real privilege to have been given a life on the face of this earth, and a chance to share in the work which has yet to be done. My hope is that we may all use this very precious time with great zeal and enthusiasm.

ADELAIDE UNIVERSITY ENGINEERING SOCIETY
SPECIAL PURPOSES ACCOUNT

RECEIPTS

	£	s.	d.
Bank Balance, 1/9/61 -- --	103	0	4
Interest -- -- -- -- --	1	16	0
A.U.E.S. General Account -- --	50	0	0
	£154	16	4

PAYMENTS

	£	s.	d.
Bank Balance, 2/8/62 -- --	154	16	4
	£154	16	4

The A.U.E.S. Special Purposes Account exists as a fund from which to finance future Engineering Faculty Bureau Symposiums held in Adelaide.

G. L. BROWN, Hon. Treasurer.

TASMANIA

"HOORAH AT LAST"

By G. L. BROWN

The 1962 Engineering Faculty Bureau Symposium was held in Hobart. And what a show!

It was 2.30 a.m. when the alarm went. I struggled with the bed clothes. Yes, I must arise. With baggage packed, I waited in the darkness for a pair of headlights. "Whose mad idea was this?" "Hope in." By 3.30 a.m. the little Prefect was on her way to Melbourne, packed with cases and four fellows. It was just as well we had to go east instead of west, because we omitted to consider that we had to advance our watches, which luckily made us early for the ferry ("Princess of Tasmania"), instead of watching from the wharf as it steamed away.

We duly arrived at the ferry, and met the rest of the boys. Once aboard, we quickly became acquainted with the comforts and luxury of the boat. On occasions like this, which call for celebration, the bar seems to have a powerful attraction. By half-past ten we had passed through the Port Phillip Bay Heads, and this fact was quickly felt. The trip was not particularly rough, but as we sat in our overnight seats, dozing, I heard a whisper: "What price would you pay to be on 'terra firma,' G.L.?" "Oh, ten shillings, perhaps." "Cripes, no! Thirty bob at least." No, Barrie Stacey was not sick, but . . . I understand that those who were on a later trip did not only feel sick. The pleasures of an ocean cruise were not obvious to many.

Our group drove to Hobart via the east coast, and another via the west coast. Col Palm's 1948 Morris 8/40 was not to be deterred by mountainous and, in many places, unsealed roads. This trip required two days, and therefore a night's sleep. Classy hotel accommodation was suggested. One, however, more mercenary than the others, suggested a night on the hay. There was some dissension in the camp,, but soon we saw a suitable barn, and the farmer was approached. He was not at home, but we were informed that he had a daughter in the town. Many were elated. Permission was not only granted, but early morning tea was suggested. At half-past eight that night you would have seen seven fellows 12 feet in the air on a haystack playing penny poker by torchlight. What a night! Alas, the rains came and the winds blew—a near blizzard, in fact—and the wisdom of the proposer of the idea was questioned. It was thought that Bob Boas would not recover.

"A NIGHT ON THE HAY"—BEFORE THE BLIZZARD

Up hill and down dale we went. Great gorges, rushing rivers, giant trees and ferns were what we saw. Tasmania is beautiful!

We soon settled in at our flats in Hobart. Money was of great concern to us all, and so stocks of food were bought so that we could cook for ourselves. By this time we were ready to meet the Tasmanian chaps at the "Travellers' Rest." Sandy the Scotsman introduced himself, and we proceeded to more congenial surroundings nearer to our flats—namely, St. Ives. This delightfully English hotel, with its glowing fire, dim light, and dark wood furniture was to become the haunt of many engineers.

The first night of the Symposium proper will not soon be forgotten by many. The funniest part was trying to get people home. The social programme organised by the Tasmanian engineers was a credit to them, and they could not be blamed if one could not find someone to say good-bye to when we left. Those who were lucky obtained some names and addresses before they went and experienced Tasmanian hospitality. "Oz" Oaten seemed to use the fact that he had been to Hobart before to advantage.

The barbecue was a great success for the S.A. camp. By this stage food supplies were low, and it seemed that the others had drunk our share of beer, so we were entitled to portion of their share of chops and sausages. Skilful work was performed by many, and from this day until we left we had chops for breakfast, chops for lunch, chops for tea, and chops for supper. This may account for the sudden appearance of strings of sausages from under the V.W. bonnet when Dick Cox smashed his car. Often in the small hours of the morning we all met in one flat for supper (chops) and a yarn. Loud was our singing. Jack Wastell led the way, and a dozen fellows sang the chorus loud and clear. Never in bed before two and never up before ten was our policy. If you ask Chris Coxon, he may say this was the reason for the landlord's revenge.

During the day those who were able attended the Symposium lectures on Antarctica. Every one was really first class, and it was a privilege to meet great men, all of whom had experienced many seasons in Antarctica. The very excellent films that accompanied these lectures are also worth a mention.


MT. WELLINGTON—A TOUCH OF ANTARCTICA

The last organised social functions were the Ball on Friday night and the river cruise all day Saturday. "Woof" Phillips is the man to see concerning the river cruise. We crossed the river to a quiet beach, and later sailed around the harbour. What was it on the window, and even worse, what came through the broken window? I understand Dick Cox found a substitute for petrol for the car on board, and I think Jack must have been too skilful for Sally—she did not even know. Surely a day to remember!

At last we turned for home. Each car went a different way, but most saw the hydro-electric scheme and the fantastic engineering associated with it. Two cars went to Poatina, where a new giant scheme is under construction, which will double the electrical output of Tasmania.

Finally, we boarded the ferry. Melbourne—"hooray at last." Adelaide—"hooray at last."

It was a wonderful trip, and all of us would recommend that all engineers attend at least one Symposium, and perhaps I could clear one point—do not think you will not enjoy yourself unless you are fond of beer. It's a mighty holiday for all.

BOOKS OF REFERENCE

Death in a Haystack -- -- --	R. Boas
Bonny England for Ever! -- --	M. Porter
Silently Succeeding -- -- --	Snake
Too Many to Count -- -- --	Oz Oaten

BOOKS OF REFERENCE (Continued)

The Cream of Youth Went Sour --	F. James
An Inspiration for Future Occasions	G. Brown
Men of Cox's Tours -- -- --	R. Cox
The Landlord's Revenge -- --	C. Coxon
Why Couldn't I Stop Laughing? --	C. Palm
All the Way from Snug to Hobart --	B. Stacey
Photography for Ever - -- --	B. Crews
The Funniest Man Aboard -- --	Woof
Is 5.30 Too Late? -- -- --	J. Wastell

Woman's intuition is the result of millions of years of not thinking.—Rupert Hughes.

Simple Simon met a π man
Going to the Fair.
Said Simon to the π man,
"What have you there?"

"Square π," said the π man tartly,
"Would you like a bite?
Round π affects me heartily,
So I make the angles right."

"Square π?" cried Simon loudly,
As incredulous he stared;
"That's right," said the π man proudly,
"All my πR^2."

THE MULTIPLE ENGINEERS

Who is the man who designs our cars with judgment, skill, and care?
Who leaves it to the serviceman to keep them in repair?
Who estimates their useful life at just about a year?
The bearing - wearing, gearing - tearing auto engineer.

Who is it takes a transit out to find a sewer to tap?
Who then with care extreme locates the junction on a map?
Who is it goes to dig it up, and find its nowhere near?
The mud - bespattered, torn and tattered civil engineer.

Who thinks without his product we would all be in the lurch?
Who has a heathen idol which he designates "Research"?
Who tints the creeks, perfumes the air, and makes the landscape drear?
The stink - evolving, grass - dissolving chemical engineer.

Who is the man who'll draw a plan for anything you desire,
From a trans-Atlantic liner to a hairpin made of wire,
With "if" and "and", "howe'er" and "but" he makes his meaning clear?
The work - disdaining, fee - retaining consulting engineer.

Who builds a road for fifty years that disappears in two,
Then changes his identity so no one's left to sue?
Who sprinkles all the travelled road with filthy, oily smear?
The bump - providing, rough - on - riding highway engineer.

Who penalises zinc, and steels his silver and his lead?
Who is it that the farmer likes to bang upon the head?
Who poisons every living thing that happens to be near?
The sulphur - belching, miner - welching smelting engineer.

Who is the man who views the mines and promptly turns them down?
Who is the one who thinks this is the short cut to renown?
Who is it gives the dud advice to the dumb financier?
The knowledge-feigning, theory-straining mining engineer.

Who takes the pleasure out of life, and makes existence hell?
Who fires the real good-looking one because she cannot spell?
Who substitutes a dictaphone for. coral-tinted ear?
The penny - chasing, dollar - wasting efficiency engineer.

CHANNEL LINK: BRIDGE AND TUNNEL

The two main proposals for a permanent crossing of the English Channel are a tunnel and a bridge. However, each suffers from a serious drawback—the tunnel from ventilation problems, and the bridge from the navigational problem to shipping. Under no reasonable conditions is it practicable to provide the degree of ventilation that would allow road traffic through the tunnel.

However, one prospect that has been considered is a combination of bridge and tunnel. The sponsors of this proposal suggest that a bridge would be used for the greater part of the route, but that a tube or tunnel should be provided below the main shipping routes. Such a route might provide rail and road facilities, because the length of the tunnel could conceivably be sufficiently short that it could be ventilated adequately.

MACHINE DESIGN TRENDS

JAMES H. FOWLER

Design in engineering is a creative activity in which the systematic development of an idea is dependent upon the application of scientific knowledge, mathematics, and the range of experience of the designer. Until recently, design methods had remained comparatively static, but there has been a revival of interest in the design field, and a critical examination of many of the traditional procedures. This has been caused by the realisation that statistical methods may be used to evaluate the variable nature of material properties, loadings, environments, etc., and that also the techniques of linear programming can be applied to design optimisation.

If these new methods are to be applied successfully in industry, they will require the "feedback" of much detailed performance information from production, inspection, and testing, and most important, from the consumer or user of the created device. Many industrial organisations have set up their own sales and service organisations "to give greater customer satisfaction," and also to provide a valuable information channel back to the design office for data on the behaviour of the product in service.

The tedious reduction of statistical data can now be undertaken by high-speed computers, and the designer need only concern himself with the application of the results of analysis. Provided that sufficient statistical data can be provided, the design objective of the future will not be a vague factor of safety, but rather the achievement of an economic statistical survival of the product in service. At the present time the manufacturers of ball and roller bearings are giving designers quite accurate statistical data regarding their products, but it should be realised that this is only made possible by large numbers of tests and the reduction of vast quantities of data. As an example, it would require the assembly and reduction of the results of no less than 60,000 tests to provide the minimum statistical information concerning the characteristics of the British standard range of ball and roller bearings.

Design research in other parts of the world has been concerned with application of statistical methods to a wide variety of failure phenomena, and in some simple cases it is now possible to make satisfactory predictions of the life in service of components. Rapid developments in these procedures are impossible because of the large amount of time involved in repeated experiments, and although in some cases the methods of analysis are established, it will be many years before sufficiently reliable information is available to apply the techniques in design.

The objectives in design should be to minimise the most significant undesirable effects and to maximise the most significant desirable effects in order to achieve a desired optimum design, both from the point of view of the manufacturer and the customer. When it is possible to analyse a design and express the influence of these effects mathematically, it has been shown that some problems can be optimised using the techniques of linear programming. At the present time linear programming can only be applied to relatively simple problems, and great care should be exercised to ensure that the mathematical expressions involved truly represent the physical problems to which they are applied.

It seems that in a decade from now the nature of design courses in engineering could change significantly, and that the necessary prerequisite subjects may have to include such topics as statistics and a knowledge of some of the special branches of mathematical analysis. The concepts of statistical reliability and design for economic service life will probably be established by then, and will give both manufacturers and consumers greater confidence in engineering products.

I am the very model of a modern engineer;
To avoid misunderstanding, let me make my meaning clear.
You cannot puzzle me with odontoidal interference,
I know the snags relating to compressors and their clearance,
I'm a most accomplished draughtsman, having failed E.D. & D.,
I can still project truncated cones upon the plane V.P.
The adjustments of a transit I consider very easy.
I'm familiar with the formulae of Bazin and De Chezy,
I understand the theory of the throttling calorimeter,
There's nothing I don't know about the slide rule or planimeter.
I'm considered an authority on flux and hysteresis,
On rotary converters I have just completed a thesis;
Although I've no affection or equations differential,
I have many other attributes which might be called essential.
I can swear for thirty seconds without pause or repetition
(With a very special phrase consigning professors to perdition),
And to crown the whole caboozle, I've acquired a taste for beer,
So I am the very model of a modern engineer.

By W. S. Gilbert.

ADELAIDE UNIVERSITY ENGINEERING SOCIETY

GENERAL ACCOUNT

RECEIPTS

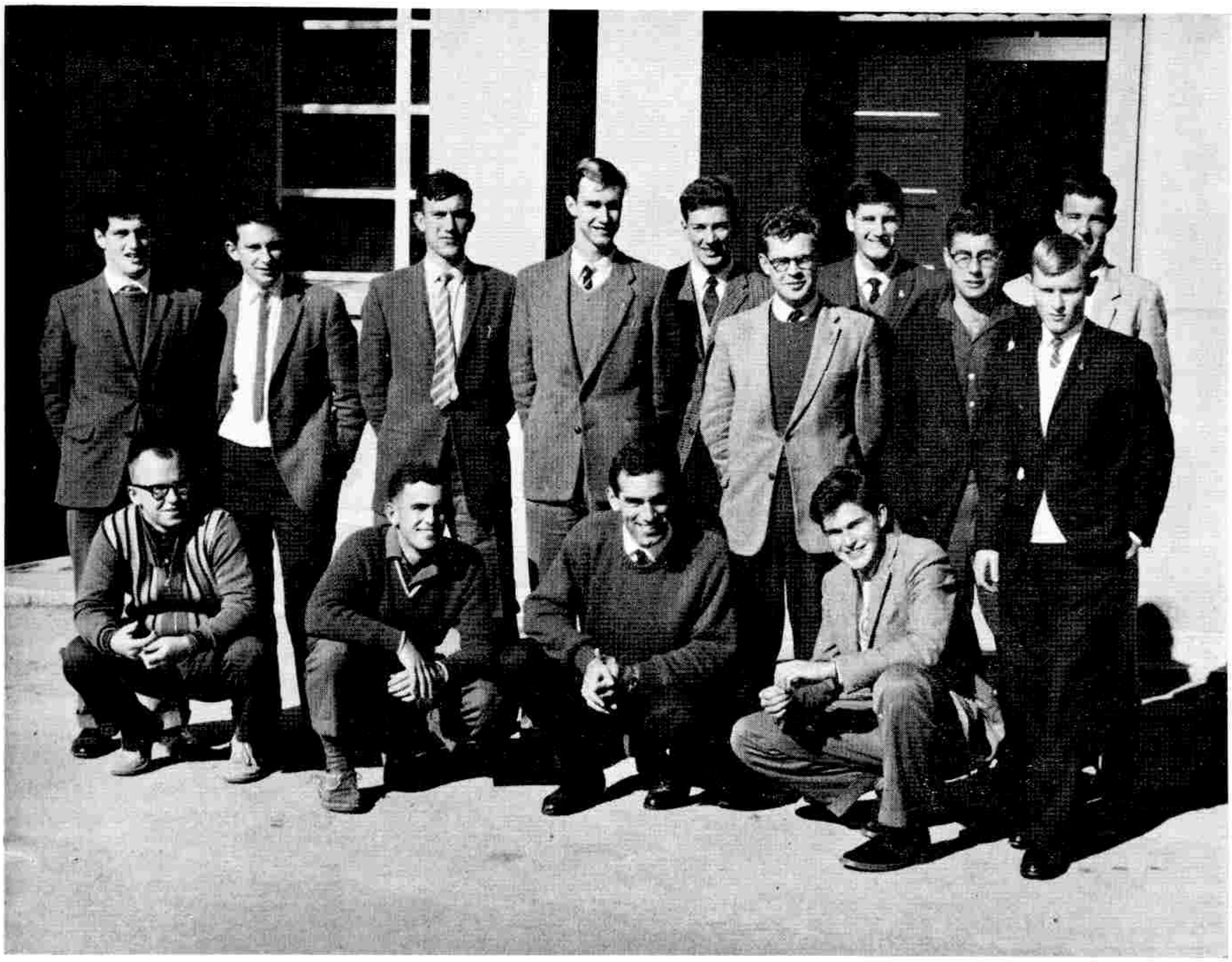
	£	s.	d.
Bank Balance, 1/9/61 -- --	234	12	2
Subscriptions -- -- -- --	41	0	0
Badge Sales -- -- -- --	27	0	0
S.R.C. Grant -- -- -- --	60	0	0
1961 Dinner -- -- -- --	25	0	0
Social Functions, 1960 -- --	3	0	0
Ball Receipts -- -- -- --	254	19	8
Tie Sales -- -- -- -- --	5	0	0
Magazine Sales -- -- -- --	38	2	6
Magazine Advertisements -- --	310	14	1
Donations -- -- -- --	12	1	0
Symposium -- -- -- --	171	2	0
Miscellaneous -- -- -- --	7	2	7
	£1189	14	0

PAYMENTS

	£	s.	d.
Badges -- -- -- -- -- --	17	10	0
Ball -- -- -- -- -- --	237	4	2
1961 Dinner -- -- -- -- --	23	7	2
Barbecue and Car Trial -- --	15	11	0
Social Functions, 1960 -- --	9	10	9
Postage -- -- -- -- -- --	4	8	6
Petty Cash -- -- -- -- --	0	17	3
Magazine Printing -- -- --	415	7	0
Transferred to Special Purposes Account -- -- -- --	50	0	0
Symposium -- -- -- -- --	171	2	0
Graphics Prize, 1960, 1961 -- --	171	2	0
Freshers' Welcome -- -- --	4	18	1
"Torque" Paper - -- -- --	11	3	0
Miscellaneous -- -- -- --	1	15	0
Bank Balance, 2/8/62 -- --	197	0	1
	£1189	14	0

This statement is not entirely complete, because the 1962 Engineering Society Dinner has not been taken into account.

G. L. BROWN, Hon. Treasurer.



FRONT ROW: B. McLeod. G. Evans, D. Patterson, P. Chapman.
BACK ROW: K. Moxam, J. Andrews, A. Webster, G. Brown, D. J. Patterson, C. Palm, P. Ingleton, W. Phillips, G. Caird, D. Dungey.
ABSENT: N. Barkham.

ADELAIDE UNIVERSITY ENGINEERING SOCIETY 1961 - 62

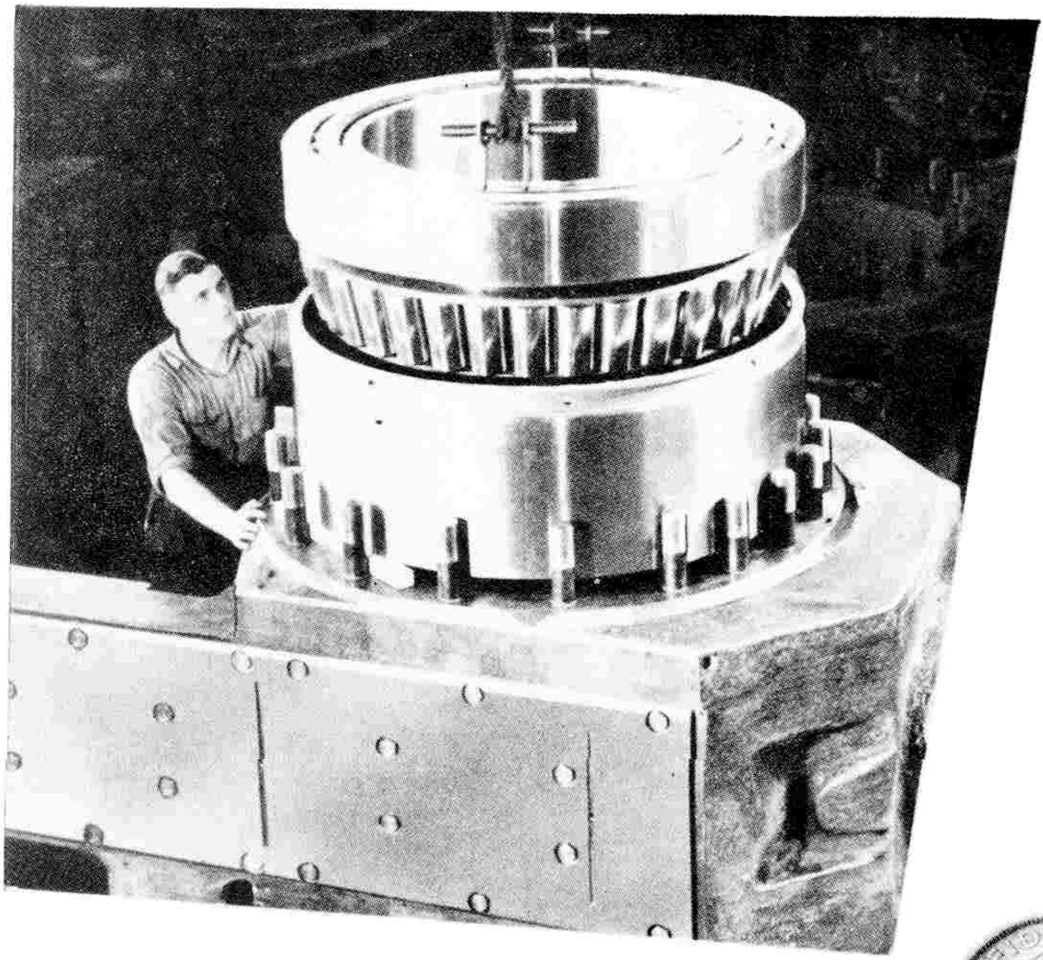
EXECUTIVE:

President: D. Patterson.
Vice-President: G. Evans.
Secretary: W. Phillips.
Assistant Secretary: C. Palm.
Treasurer: G. Brown.

REPRESENTATIVES:

Fourth Year: J. Andrews, C. Coxon.
Third Year: P. Chapman, B. McLeod.
Second Year: D. Dungey.
First Year: G. Caird.

S.R.C. Representatives:
P. Ingleton. Men's General.
D. Patterson, P. Waters, Fac. Reps.
Ball Convenor: K. Moxam.
Films Officer: B. McLeod.
Magazine Editor: B. Smith.



Left: *Assembling a Timken balanced proportion back-up roll bearing in its chuck. B.S.C. supply 2½ ton bearings of this type to a steel slabbing mill in Australia.*

High precision miniature bearings by Hoffmann. These weigh .004 ozs. and are used in scientific equipment where extreme sensitivity and miniaturization are required. B.S.C. has supplied many such bearings to the C.S.I.R.O

BEARINGS

.004 ozs. up to 2.5 tons.

Bearing Service Company stocks the largest range of ball and roller bearings in Australia. It backs these stocks with unsurpassed technical service, the result of 35 years' specialisation. If you need one bearing, or many, of any size, or any type, a 'phone call to B.S.C. is all that is necessary to put this large, but very friendly organisation to work on your behalf . . . without cost. Why not ring next time a bearing problem arises?

BEARING SERVICE CO.

OF AUSTRALIA PTY. LTD.

66 GROTE STREET, ADELAIDE. TELEPHONE LA 5632, LA 4285

Also at Sydney, Melbourne, Brisbane, Perth and 8 Provincial Cities.

TIMKEN • HOFFMANN • F.A.G. • FAFNIR • TORRINGTON • NICE • McGILL • R.B.C. • M.R.C.

A DAY IN THE LIFE OF A STUDENT IN THE YEAR 2012 A.D.

That morning Joe Parkinson woke at seven o'clock. The Song of the "Hypertexas" University was heard in the students' rooms, distributed by the local millimetric wave network. He switched on his luminescent wall panels, which reconstituted natural light and, wanting a rural atmosphere, chose the "Park" light combination which turned the panels into a perspective of green leaf and flower pretty well in their natural colours. The only two panels which remained dark were that reserved for telephone communication and that for college instruction, brought round by television.

Gathering his spirits, Joe realised he had a slight headache, and remembered that a new vaccine had been pricked into him the previous day. The diseases of former times, tuberculosis, polio, and even cancer, had been suppressed by preventive vaccines which were compulsorily supplied, as was shown on his identity card registered with a series of eleven figures and three letters. A mere look at this arithmetic group gave the complete story of the individual, from his blood group to the results of his vaccinations, his diseases, and operations. In the University's central register a punched card in his name, processed by the specialised computers, was to forecast Joe's behaviour in his varying states of health. But from a few months back an unknown virus was playing havoc, especially among young people, in the form of mental troubles, which had become the principal plague of man.

The first symptom was an almost complete loss of memory, and the new disease was attended by an insensitivity to colour. These deficiencies had first been attributed to a system of television reception in which the nerves were directly excited by electrodes connected to the receiver and placed on the temples at points fixed by the electrical topology of the brain: vision by means of panels had thus been done away with, the optic nerves being brought directly into action. This system had had a considerable application, but had finally been prohibited.

And so students were subjected to special vaccination, and Joe directed a troubled eye on his registration number, to which another group of two figures had been added: now three letters and thirteen figures. What was the outlook in 50 years time?

Throwing these dark thoughts to one side, Joe dressed, went to his kitchenette where, by pressing the "breakfast" button on his automatic cooker, he received, after an interval of 30 seconds, a balanced, practically tasteless, but medically perfect meal.

The signals physics course was due to begin at eight o'clock. Joe was one of the nine hundred and fifty students entered for this special course, among so many others, between which the thirty-six thousand students of the Hypertexas University were spread out. The university buildings and grounds extended over a wide area, formerly desert land, so that it had been possible to plan the layout in a completely rational way. Utilisation of solar energy and of the natural underground water resources had transformed the area not only into parkland, but also into cultivated land and breeding farms, scientifically conducted in hot houses at constant temperature and illumination cycles.

The Hypertexas students were thus brought up, intellectually and physically, under perfectly definite conditions, in accordance with standards gradually perfected many years back. Many countries were represented at the University.

Joe gave another look at the syllabus. The signal physics course was transmitted over Channel 23 of the milimetric network, distributed by dielectric cables to all the students' rooms. He pushed down key 23 on the keyboard mounted on his desk; the title of the lecture appeared on the television wall panel. On the dot of eight o'clock Joseph A. H. Faraway, the outstanding professor, began the sixteenth lecture on cable matching for a given rate of information. These masterly lectures were recorded on magnetic tape, and transmitted from the University's Technical Centre, an extensive centre, from which all basic instruction was distributed. For lecture theatres had long been abandoned; this system had been rendered preffective due to the increasing number of students, and had been replaced by broadcast lectures and by grouping students in teams of 30, or so round a task master. The task master's role had become fundamental, through his explanations of the course, his choice of subjects of application, and the conduct of practical work in the laboratories and workshops set aside for the course. Professor J. A. H. Faraway himself collected the task masters around him—thirty in this particular case—to discuss the way the course was going with the students, and to decide on such adjustments as might have been shown to be necessary in the light of observations made by his groups.

And so Joe was in task master A. 17's group. During Faraway's lecture he took notes on his coded typewriter. With the telewriter, which was also coded and permanently connected with the task master, he raised questions on points which did not seem clear, either at the time or on reading over his notes. At the other end, in the office of task master A. 17, the questions raised were recorded on magnetic tape, to be examined as a whole.

At nine o'clock the lecture ended. Joe scanned over his notes, which he easily decoded, since from his earliest youth he had been trained to substitute groups of letters for the propositions of normal language; thus the proposition, "the wave is propagated at phase velocity v," took the form WPv, this code having been internationalised. As he came to it he verified on his miniature algebraical computer, which had taken the place of grandfather's slide rule, the solution of an equation given by the professor without justifying development, since the solution of even the most complex equation, including partial derivatives, was obtained by machine, and no longer by the old methods, taught only to advanced students anxious to dig into the history of sciences, or to specialists engaged on the construction of computers.

For some ten minutes or so Joe was engaged on physical drill recommended for his health according to a perfectly definite daily routine. That particular day he had some difficulty, perhaps because of his recent vaccination, in pedalling a stressed spring into tension in a set time, so that he had to have recourse to the immediate absorption of an irradiate vitamin tablet.

At ten to ten Joe walked out for the first time that day, and proceeded by the travelling platform, after a number of changes, to the buildings of the signals laboratory and workshops, and on to room A. 17. At ten o'clock the thirty students of A. 17, standing around their task master, discussed and exchanged views on the fifteenth lecture in the light of questions raised by the students during the lecture. This was followed by practical work on that lecture. The laboratory and workshop were provided with perfect equipment; over the last ten years it had finally been realised that the most productive national investment was that applied to teaching the young in all kinds of subjects: scientific, technical, or "literary."

In the same way, past differences between "workmen" and engineers had changed in their nature. On the one side, automatic machines had levelled aptitude and functions of the personnel in carrying out their separate tasks; for instance, the automatic machines for the production of signal receivers delivered the product, with its cost, the value of stocks, and all other items of management, so that the staff was almose entirely occupied in maintenance. And steps had had to be taken to arrange for the training of the staff set apart for scientific research, for instruction, and for development, and to see about the corresponding machines and the way in which use should be put to them. The class of engineers and physicists, who on their part were in a position to design and operate the larger systems, such as telecommunication system, had considerably increased in numbers.

Joe was preparing for that class, as well as others in his group, and the practical work for the day consisted in determining with three of his fellow students the best way of utilising a given bandwidth to provide the individual television links between individuals geographically distributed in accordance with a given law of population density.

At one o'clock, practical work being finished for the day, Joe stepped once more on the travelling platform on his way to the cafeteria, an immense building, with a capacity of thirty thousand meals per hour, thanks to the automatic self-service system, which dealt out four menus prepared in a few seconds by the electronic cooker. Joe hurried on more than usual, for the Hypertexas-Hypercolumbia baseball match transmitted throughout the world was due to begin at two o'clock. But the signals department had been unable to reproduce the atmosphere of the stadium of fifty thousand seats, so that from the dim past circus acts remained the permanent feature of human culture. Players were carefully picked after repeated tests, and specially trained on appropriate diet, so that the match should end honours all—a most satisfactory result from everybody's point of view.

At four o'clock Joe was sitting in his personal study room following a lecture on the history of industrial techniques: the subject was the construction of television receivers in the year 1960. Joe marvelled at his ancestors' expert handling, their nimble positioning of the most diverse parts, the way they handled enormous vacuum tubes, and the deft handling of the old-fashioned soldering iron. All this recalled films he had seen on the building of the Pyramids, or the work of the lace makers, with their long pins stuck in taut-drawn cushions.

At five o'clock he passed to another workshop of group A. 17, where the group was to produce, by its own means, but using modern processes, a working stage of a micro-module amplifier. The work had been in hand for some time, but on that particular day it had been cut short, for Joe wanted to return to his room to watch on his screen an automatic news item transmitted at 18:30 hours by a satellite engaged in the examination of Saturn. Actually, several events of this kind had already been broadcast from other planets, and these had rather upset our views on these things; but Saturn had so far always resisted investigation, perhaps on account of the nature of its rings. In point of fact, reception was disappointing, jammed as it was by incomprehensible signals. The question remained open.

After a short rest Joe proceeded to an outdoor feast, which was the rage among the youth of both sexes. It was called "Antique Barbecue"; it was actually an outdoor meal at which students roasted whole sheep spitted on a wooden pole, so that the beast could turn in front of fires which they themselves had prepared. That evening some five hundred students were in the clearing, and twenty sheep prepared and wrapped in "Do it yourself" plastic bags were turned over to the twenty groups. The occasion was a merry one, for there was a roasting and carving dexterity competition.

The laughter and joyful shouting which, so we are told, reproduced old world atmosphere, was smited when attention turned to a large television screen, visible to all, where the finals of a rally of rockets to the moon were being displayed; ten rockets, flying the colors of the ten world universities which had successively completed successive heats were competing. Unfortunately, the Hypertexas rocket had to drop out, one of its ionic engines having died half way. The American continent had two representatives, so far well placed, but there was a certain amount of anxiety on account of the unknown characteristics of certain foreign competitors. The race was something like the regatta of former days. The rockets had to assemble at a given moment at a particular point of space, and move around so as to be in a favourable position at the starting signal. The arrival of rockets launched from various points on earth was easily followed, thanks to transmissions from fixed satellites, which broadcast every launching. Each rocket was manned by two operators—keen racing men ready to win by all recognised means.

The moon's very surface had to be reached in the shortest possible time, measured from the earth by Doppler equipment on nearing the time of arrival, while the tapes were checked with the utmost care. The entrants remained in communication with the public, and strove their utmost in the clamour of their supporters.

The race was well up to its reputation. Contrary to all expectations, it was a so-called small country whose rocket was the winner, the resourcefulness and daring of its pilot having overcome some technical weakness. The return was uneventful, each team having this time been able to return to its base.

And the day ended as in old times. The lucky ones received their winnings, the others made the best of it, while some rather abnormal types decided to get home on foot, their eyes turned to the heavens, where they tried to distinguish between true stars and false planets.

Back in his room Joe slept. He dreamed. And in his dreams he saw what a former reading had taught him: a stream, a modest house, standing quiet in its surroundings of green leaf and flowers, far from everywhere, he felt his own master.

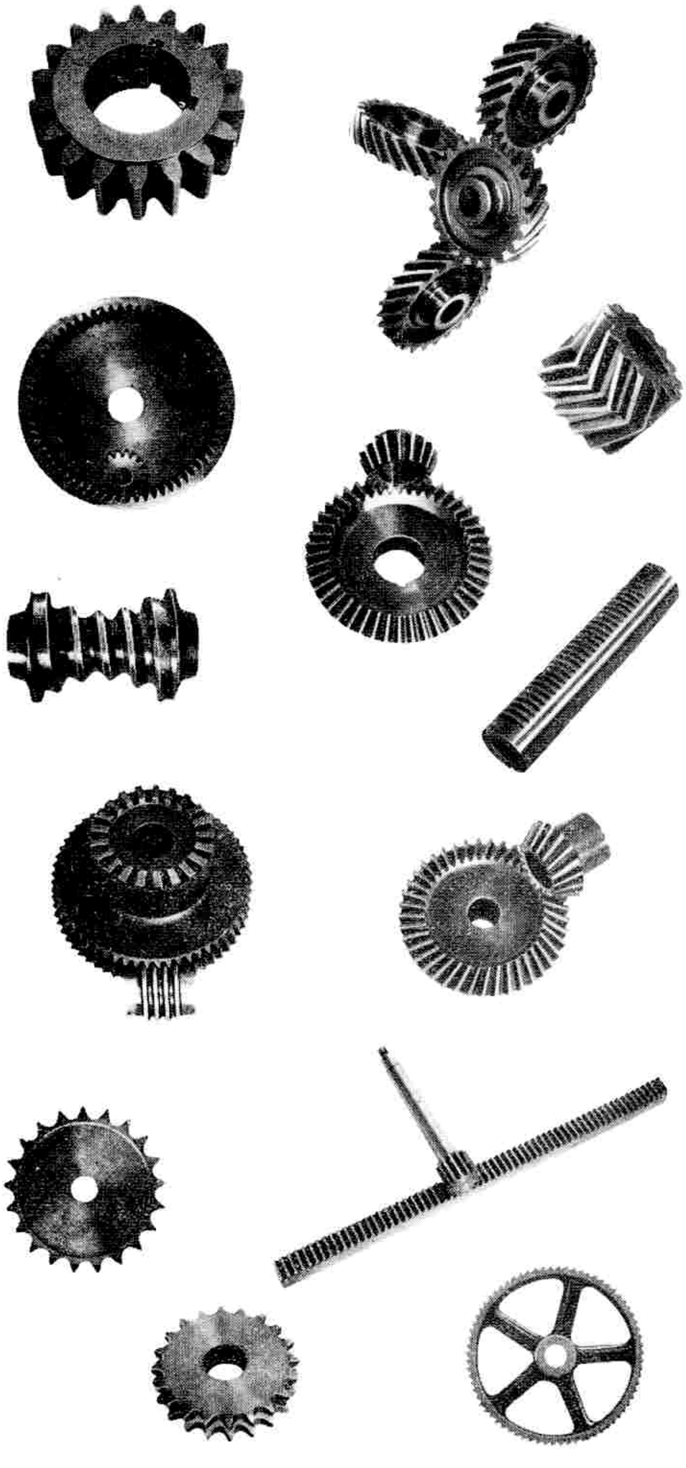
BON MOT

Did you hear about the dumb blonde who thought bacteria was located at the rear of a cafeteria.

He who is ridden by a conscience
Worries about a lot of nonscience;
He without benefit of scruples
His fun and income soon quadruples.

HERCUS

Specialists in all types of gearing



SPUR GEARS

SPIRAL GEARS

DOUBLE HELICAL GEARS

INTERNAL GEARS

CONICAL INVOLUTE GEARS

BEVEL GEARS
(Straight or Spiraloid)

WORMS

WORM WHEELS

RATCHET WHEELS

RACKS

SPROCKETS

SPLINE SHAFTS

F. W. HERCUS MFG. CO. LTD.

LU 6273 ANDERSON STREET, SOUTHWARK, S.A. LU 6273

WHAT IS AN ENGINEER?

The following conversation is no doubt very familiar to you all. The lass, usually charming, has prised from the engineering student, usually silent, the fact that he is at the University.

She: "What are you doing at the University?"

He: "Engineering."

She: "Oh, engines, bridges, and things."

Heaven knows what conglomeration of ideas the "things" includes, most probably plumbing and engine drivers and numerous mechanics, and that quaint chap at the top of the crane, but anyway, the conversation usually lapses there, and once again the engineer allows his profession to be wrongly represented in the public's mind.

Unfortunately, the impression as held by the lass is common, in fact, almost universally accepted, and perhaps this is to be expected, since every mechanic who tends an engine, whether stationary or moving, adopts the title of engineer. The plumber has become the sanitary engineer, the electrician the lighting engineer, and so it goes on.

But the next time this conversation piece occurs, as it inevitably will, I want you, as an engineering student, to assert yourself and, however painful it may be for our charming lass, I want you to say: "I'm sorry, but that is not quite correct."

For, in truth, very few of the Civil Engineers will ever see a bridge, nor will the Mechanical Engineer design high-speed diesels or gas turbines.

"Well," she may ask, "if you are not going to build bridges, what are you going to do?"

Your reply could well be: "I'm training to be a genius."

This would no doubt put an end to the conversation for quite some time; but do not relent in that time, for you may go to a dictionary, and find:

English: ENGINE, French, engin; from Latin Engenium, a genius, an invention.

Engineer: English, ingin-er; old French, enginer; French, ingenieur. A person of genius or ingenuity.

In the Latin: Ingeniosus-a-um (ingenium). Naturally clever, talented, acute, able, ingenious.

Although you may already be aware of your claims to the title of genius, it may be well to be ready to substantiate your claims for the engineering profession in general.

A good engineer must possess:

Ability, education, training, and experience. This in itself will not raise an eyebrow, but in addition he must be:

1.—An Economist.
2.—An Accountant.
3.—A Scientist.
4.—A Leader of Men.
5.—A Philosopher.

And if he is to be successful he must be of inflexible integrity, sober, truthful, accurate, resolute, discreet, of cool and sound judgment, must have command of his temper, must have courage to resist and repel attempts at intimidation, quick to decide, prompt to act, must be fair and impartial as a judge on the bench, must have experience in his work and dealing with men, must have business habits and knowledge of accounts.

He, the successful engineer, is essentially an economist who has been entrusted with the world's resources—water (hydro), coal, minerals, man-power, liquid fuels. These are his responsibility. He must see that they are used to add to comfort of our civilisation with the minimum waste, and this includes waste of man-power, since it is also his duty to see that risks to human life should be as little as possible. So perhaps the claim of genius is not quite so fantastic, for a man who can fulfil these conditions is one. He is a person greatly in demand, and when found, he is worth his price—rather is he beyond price, and his value cannot be estimated in money.

Unfortunately, not all of us will be successful, but we should know for what we are striving. The way will be made easier for those who follow if all engineers strive to erase the public's present impression of our profession, and install the idea that the engineers are the controlling profession of this civilisation. For they are.

To achieve this, each student should take a pride in his work, in his profession, and this logically starts with his faculty.

Since your position in the worlds of industry, civil life, in war, will be that of the leader, it is your responsibility that you should be fit for such a position. Educational credentials are but a fraction of the required qualifications and, strangely enough, the remainder may all be learnt from your neighbours.

If you pick up the threads that have been dropped as we have gone through this article, and tie them together, they offer the conclusion that if the student who is asked "What are you doing?" is:

1.—An engineering student.
2.—Proud of his faculty,
3.—Proud of his work,
4.—Actively interested in his fellow students,
5.—Able to learn,

he may then honestly say: "I am training to be a genius."

A girl's best friend is her mutter.—Dorothy Parker.

IS CHRIST OUT OF DATE TODAY?

By D. GUNARATNAM

To the minds of many people today Christ was a good man who lived some 2,000 years ago, who did and said some good things, and set up a high ethical code of life, was martyred, then appeared to some of His followers, and then vanished. To these people He is totally irrelevant. One has only to mention about the Bible and they would straight away say that that book is out of date, and that modern science, etc., etc. . . has most of the answers to our problems in life. It reminds me of a biologist who recently said that God started the world spinning and then left it to continue spinning and take its own course.

The Christ who lived 2,000 years ago lives today. It is impossible to believe, but it is true, and there are many who know Him, and can testify of Him this day. Even head hunters, cannibals and murderers, harlots, etc., have been instantly transformed into new men and women when Christ has taken possession of their lives today. There are thousands of Christians in China and India and in many places in the East, despite the starving conditions, because Christ has not only made Himself real to them, but because He cares for them.

We have progressed in the last 60 years far more than in all of history put together before 1900. In spite of all these advances in mathematics, physics, biology, engineering, etc., etc., there is yet no $y = f(x)$, or even crude engineering experienced guesswork, that can tell us what path one should follow to treat a broken home, an alcoholic, or even a hypocrite, or a liar or a pig-headed person, or a person with a fiery temper. But the Christ of 0 A.D. can treat each one of these persons.

Some say that we today live very much more civilised lives. We do not go round killing people if we dislike them as they did in the past. Does this mean that man has changed? We have become like "whitened sepulchres"—clean outside, but corrupt inside, which is just as bad, or an even worse condition.

After all, what is murder? It is another form of anger, malice, or even pride. What is adultery? It is another form of lust. We could go on listing the various forms of evils of men today.

Is Christ out of date? He who died 2,000 years ago lives today to restore men to what He created them for—to glorify Him.

THE HARBOURS OF AUSTRALIA

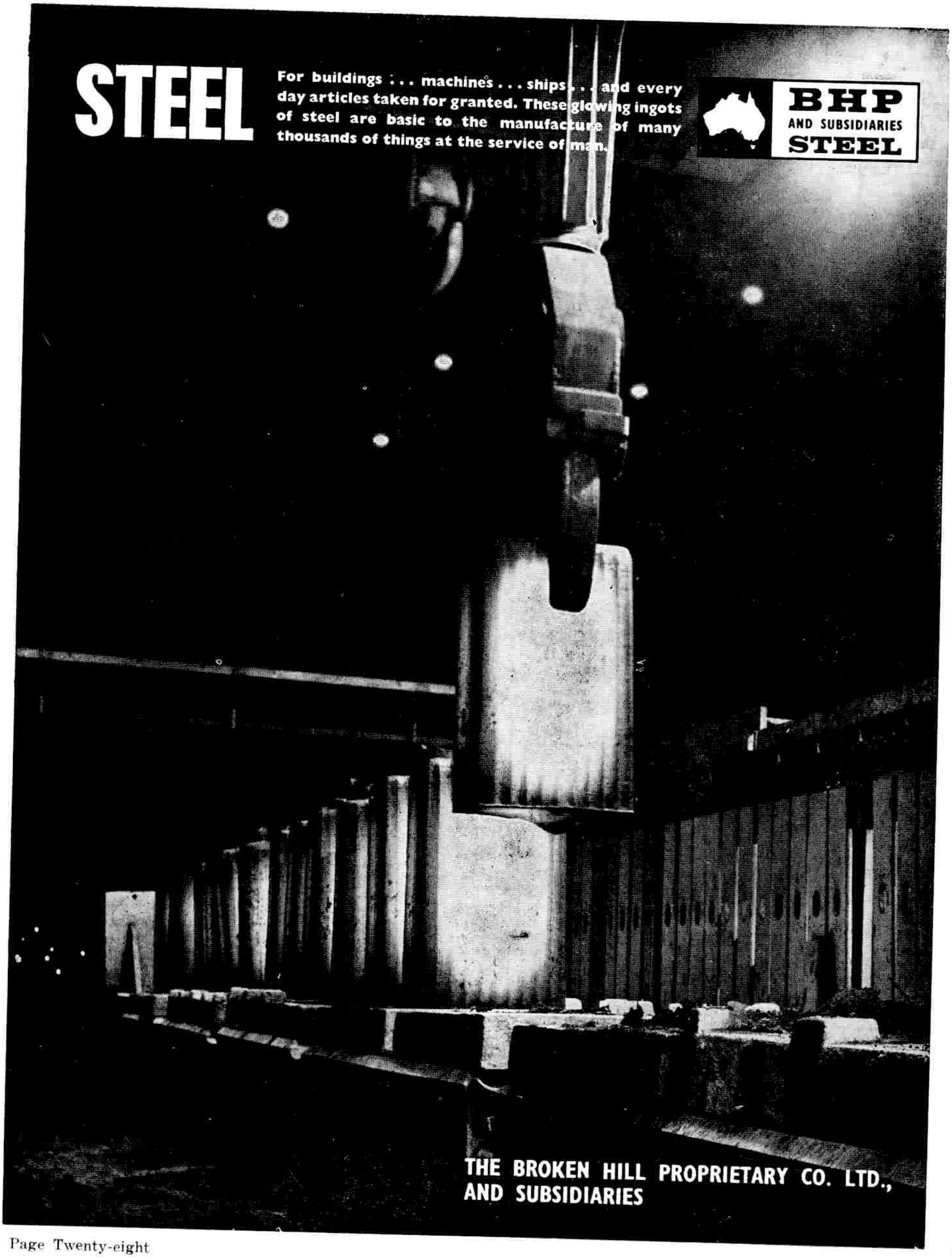
"And seas but join the regions they divide."—Pope.

Possibly the greatest challenge man has experienced is the sea. In ancient time it represented a barrier between him and the end of the world—or so he thought. The desire to cross the sea, and to see what was really on the other side, led to ventures further and further from the river mouths and bays in the frail craft of the times. Thus it came that larger and more seaworthy ships were built, and finally the seas were crossed, trade with the distant countries started, and the need for adequate harbours became essential.

There are several words used to describe places where ships may remain in safety for any purpose. "Port," "harbour," "haven," are three words that have different meanings in different countries. However,. taking the Latin meaning of "port" as an entrance or gateway, and linking that with the passage of traffic from the sea to the land, it is logical to give to the word "ports" the meaning, "a place to which vessels may resort to discharge or receive their cargoes." (Webster.) "Harbour" and "haven" have been used indiscriminately, but a distinction can be made with advantage—a "haven" being "a place where a ship may find shelter from a storm" (Fowler), and a "harbour" as a place giving accommodation for ships for any purpose whatever. Thus a haven is a natural shelter, whereas a harbour need not be, and in general offers conveniences additional to that of protection from the elements or the sea.

It can be seen that "harbours" can become "ports" by the addition of facilities for discharging and receiving ships' cargoes. Here it is intended to deal only with "ports." There are again some words that have several meanings when used in referring to a port—"dock," "quay," "wharf," "pier." A dock, in English use, is an area of water surrounded by walls, either tidal, or closed by a system of locks, and the ancillary sheds and stacking areas for the discharge or reception of cargo. In other words, ships enter this enclosed area, and there, either while berthed alongside the walls or moored in stream, work cargo. The word "dock" is also used in the sense "dockyard"—a place where ships may be repaired, either out of the water (dry dock), or not (wet dock).

A "quay" is a berth constructed of solid masonry or concrete, as opposed to a "wharf," which is constructed of open pile-work. A further distinction is that a "pier" or "jetty" projects out into the sea or waterway. It can be seen that


STEEL
For buildings . . . machines . . . ships . . . and every day articles taken for granted. These glowing ingots of steel are basic to the manufacture of many thousands of things at the service of man.
BHP
AND SUBSIDIARIES
STEEL
THE BROKEN HILL PROPRIETARY CO. LTD., AND SUBSIDIARIES

a "pier" can either be of solid or pile construction, although in all cases it is generally known as a "pier." A "jetty" is much longer than a "pier," and can refer to a light pier for the discharge of passengers—i.e., from a ferry boat.

A port is a man-made structure consisting of quays, piers, wharves, docks, warehouses, rail and road transport facilities, cranes, and other cargo-handling equipment. It might necessitate costly dredging and construction work, and always presupposes a sufficient volume of traffic, either inward or outward, or both. Before a port is built trade for that port must exist—a port is built for trade, and never can trade be made for a port. The attraction of trade from another port can be, and is done. The fierce competition of the English ports before the war for the Midland trade, and the rival claims of Boston, New York, Philadelphia, and New Orleans for the rich Middle West industrial trade, are examples. This competition compels port authorities to spend large sums of money on improvements and equipment, and thus causes the changes that are so essential to progress. However, it is not always the expenditure of further capital that is the cure-all for loss of trade. The law of diminishing returns operates in port management, as elsewhere.

Australia has some good natural harbours, but in general, port facilities are neither adequate nor modern. Intrastate coastal trade rapidly deteriorated with the advent of the rail and road systems, and now air transport must take much of the interstate passenger trade. Railway competition is not easy to overcome—differential and tapering freight rates cannot apply to shipping. Rail and road transport is much more flexible, and except for bulk freights like coal and ore, can handle freight more quickly.

It was when most of the small ports in Australia were due for rebuilding that the opposition of the land transport became most pressing. Thus these ports were allowed to fall into disuse, and now are not suitable to handle much trade. It is only in the larger ports that any modern developments have taken place. Timber is still largely used, although Australian waters abound in such destructive marine organisms as Terodo, Chelura, and Sphaeroma. In Western Australia and South Australia jarrah is largely used, whilst in the eastern States turpentine is most popular. Both these timbers are somewhat resistant to attack from marine organisms, but protective measures must be taken. Concrete is still in the experimental stage, and is not yet in general use.

The development of ports in Australia has in general been haphazard. Sydney, of course, provided a natural haven that soon became a busy port. On the discovery of coal at Newcastle trade developed, and in the absence of any opposition from rail or road, a port was built. Similar beginnings can be found for every port in Australia—sometimes wheat, sometimes timber, sometimes a natural product like coal or iron ore or limestone, and always a port associated with the main administrative centre of the area. However, rail and road transport have provided strong opposition, which in several cases has killed the coastal sea trade, and led to the abandoning of the ports. Due to the flat coastal plain and lack of natural harbours, the railways soon captured most of the coastal trade from the small ports on the east coast. It is only in Queensland, where the railways were developed later and to a different plan, that there are any number of ports. South Australia has an advantage in the two gulfs and the almost total absence of coastal railways, and so has many small ports.

Australia was divided into States without much regard for the natural development of the country—particularly the provision of harbours. There are few natural havens and no large coastal rivers, and with the early advent of the railway, there was not the incentive to build costly port structures. Australia differs from most other countries in this respect. Of the capital cities, only Sydney and Hobart are natural havens—and only Sydney can compare with the great ports of the world.

The tidal range in the principal ports of Australia is not sufficient to require the building of docks with entrance locks. As mentioned previously, there are very few natural harbours—Sydney, Hobart, Albany, Port Lincoln, and Gladstone are the main examples. The water in these harbours is deep, and berths are of the timber pile type—either piers or wharves. Sydney, of course, possesses the most extensive wharfage system, but Hobart has the greatest depth of water having over 60 feet at some wharves. Several of the other ports of Australia have been developed at river mouths, necessitating the use of much dredging and breakwater work.

Of the Queensland ports, Townsville is an artificial harbour with two long breakwaters projecting into Cleveland Bay. Some berths (served by rail) are provided alongside the eastern breakwater, but there are also two piers. The deep-sea port of Rockhampton (Port Alma) provides an interesting example of an island wharf. Due to the shallow depth of water, the wharf was constructed some distance from the shore, and connected thereto by a piled approach. The wharf is of timber, and the piles are protected from attacks by marine organisms by a cyprus pine cylinder filled with sand. The wharf is completely isolated from the city, and the only connection is by rail.

The small New South Wales ports are nearly all river ports. They have timber wharves, and a limit is placed on the size of ships using the ports by the natural sand-bar at the entrance. Although Newcastle was built on a river, it has now become almost an artificial port. Much dredging and reclamation work have been carried out, and a large swinging basin built. The wharves are timber pile structures. At Sydney there are both wharves and piers. Many berths have been rebuilt with concrete decks, and some new construction is to be built on reinforced concrete piles. In general, Sydney wharves are not

AERIAL VIEW OF INNER HARBOUR, PORT ADELAIDE

modern, but they compare favourably with the other Australian ports.

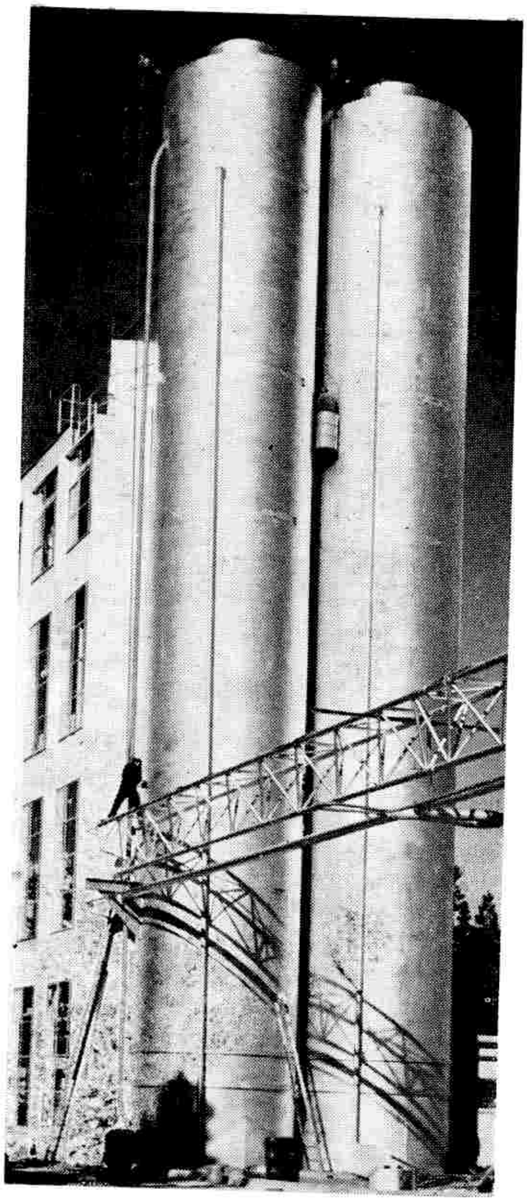
Port Kembla is an entirely artificial harbour, being built by arrangement with the Australian Iron and Steel Company. Two breakwaters enclose several piers, but the harbour is still open to weather from some directions, and work at the port is frequently delayed on account of this.

Melbourne is a combination of river and bay ports. Large tidal docks have been built, and are designed to increase the area of the river. Melbourne is one of the few ports in Australia where any planning on the "dock estate" idea has been introduced. There are also some riverside wharves and several piers at Port Melbourne. They are all of timber construction, but have recently had their timber decks replaced by concrete. The berths at the other Victorian ports are timber piers, including the bulk wheat pier at Geelong.

Hobart has a large natural harbour, but there are very few berths. They are of the pier type, and the more modern have concrete decks. Difficulties have been experienced in construction, due to the great depth of water. Launceston is about 35 miles from the mouth of the River Tamar, but the overseas wharfage is at the entrance, and of pier type. Timber has been used, but recently work is being constructed of reinforced concrete piles. Burnie is an artificial harbour, with timber piers. Devonport is another river port, and again timber was used in wharf construction.

The harbours of South Australia, built around the two gulfs, needed very little protective works. The smaller ports consist of a jetty projecting directly out to sea in the general direction of the prevailing weather. The larger ports, such as Thevenard and Port Lincoln, are built in bays. Both ports have piers—at Thevenard an ambitious concrete pier was built, but due to lack of cover on the reinforcing steel, much maintenance work has been necessary. Whyalla is an artificial harbour, but the main ore loading berth is in the open sea.

Port Adelaide wharves have been developed on a scheme first introduced on a large scale in Hamburg and other European ports. Very wide piers are featured, separated by narrow docks. In Port Adelaide the docks have been cut out of the river bank, leaving the piers of solid ground. This gives a semi-marginal wharf arrangement for an area of land some 1,800 feet by 1,000 feet, surrounded on three sides by wharves accommodating up to seven ships. On this land (really the pier) are the wharf transit sheds and warehouses, as well as a large open stacking area. Three of these docks have been constructed on the eastern bank of the river, but only two are in use. This method of development permits of a type of wharf unique in Australia. The wharf design is also an adaptation of a European idea, with an "L"-shaped reinforced concrete structure supported at low water level on a system of timber piles, with a solid sand fill behind. The piles are



Masters in Concrete and Steel

Established in Adelaide as manufacturers of steel fences and gates, Walter and Ernest Hume, in February 1910, developed the now world-famous patent for centrifugally spun reinforced concrete pipes. The 'Hume Process' as it became known, almost completely swept aside all previous methods of concrete pipe making providing a vastly cheaper and more efficient method of manufacture.

By 1920 Hume Pipe Company (Aust.) Ltd. operated factories in every Australian State and also New Zealand with companies operating under licence in the U.S.A., England, Japan, Germany, South Africa and Hawaii.

In October 1923, as a result of patents for steel pipes, Hume Steel Limited was formed. This Company again made industry headlines by originating the concrete lining of steel pipes — now an accepted practise throughout the world.

In 1952 Hume Pipe Company (Aust.) Ltd. merged with Hume Steel Ltd. to form the present company — Hume Ltd. — a modern, progressive organisation manufacturing steel and concrete pipes and products for all phases of industry.

Left: Steel Bins at Cadbury-Fry-Pascal's Milk Condensing Plant
The steel division of the Humes Organisation has extensive facilities for the manufacture of a wide range of general steel fabricated products in addition to pipes. Included in the range are mild steel wine storage vessels up to 15 ft. in diameter and 24 ft. high; petrol and oil storage tanks; Beer Fermenting vessels; circular grain silos and rectangular bins for the flour milling trade; dust collectors, Air Receivers, Smoke Stacks, piles, circular and rectangular ductwork, cement silos and all manner of pipe specials and fittings.

Below: Humes reinforced concrete pipes
Humes manufacture a wide variety of concrete and steel pipes, for drainage or water supply — including culvert pipes, socketed drainage pipes with mortar joints, socketed sewerage pipes with rubber ring joints and pressure pipes of all kinds. The standard sizes of pipes range from four inches to seventy-two inches diameter.

HUMES LIMITED

Masters in Concrete and Steel

Railway Terrace, Keswick — Phone 57-5142

FACTORIES AT:
Keswick, Loxton, Pooraka.

HEAD OFFICE:
Hume House, 185 William St., Melb., Victoria

1774/G25a/S

in solid ground, retained on the river side by a wall of sheet steel piling. The result is a solid wharf, protected from marine organisms, and able to take considerable loading.

The Western Australian outports are all built on bays or inlets from the sea. The piers are of timber, and in the North-West provision had to be made for the large rise and fall of tide. Fremantle is built on the entrance to a river, and the wharves are of timber. The entrance is protected by two moles, but no sand-bar forms. Albany harbour is built on a small islet from King George's Sound. Although the Sound is a natural harbour, much work has been necessary in this inlet to provide wharves and piers. They are of timber, and in most cases very old. Bunbury and Busselton have jetties, and are protected on the side of the prevailing weather by breakwaters.

The science of engineering is for ever changing, and in particular harbour engineering continues to advance. In the past century great changes have been made in the design of vessels and the method of propulsion, and as can be expected, harbours have changed likewise.

The draught of ships has increased, and the amount of cargo they carry has grown to such proportions that a single ship can now carry as much as a fleet of ships did a hundred years ago. The increased draught has set its own problems—channel deepening and widening, and increased depths at wharves. However, it is the amount of cargo now carried in each ship that causes most of today's problems. Due to the slow "turn round" of ships, and increased trade, more wharves are required, and old wharves need constant modernising to take the latest mechanical aids considered so essential to present-day cargo handling. Although the provision of wharf cranes is still an open question, and authorities are almost equally divided on both sides, the facts are that ships are larger, and carry more. They remain in port longer, and more mechanical handling equipment is demanded. On the passenger side, increased facilities for Customs and immigration authorities are necessary, as well as provision for the many visitors witnessing a ship's arrival or departure.

In Australia at the presnt time, as well as much modernising and enlarging, several new ports are under consideration. At least one in each of Queensland, New South Wales, Victoria, and South Australia. Each has its own problem—in some cases, as at Iluka, on the New South Wales coast, and Portland, in Victoria, the provision of breakwaters, and at Cape Jaffa, on the south-east coast of South Australia, long causeways are necessary in order to provide adequate depth of water.

Whether Australia will rise to the heights of nationhood dreamed of by the statesmen of the past rests to a large degree on her harbours—to an island continent they are an essential, and represent both the front door for visitors and the back door for traders.

MECHANICAL ENGINEERING DEPARTMENT ACTIVITIES, 1961-62

The following staff and student projects give an indication of present departmental activities in the longer range category:

Applied Dynamics: Synthesis of lineal dynamical system to meet response requirements when subjected to steady-state and transient disturbances is proceeding. In particular, lineal control theory applied to passive and active vibration isolation systems is being used to synthesise systems to meet ride-quality criteria for vehicle suspensions. Experimental and analogue studies of non-linear controlled passive vehicle suspension systems is proceeding.

Engineering acoustics applied to noise control has become an important branch of vibration studies. A new applied acoustics laboratory is being planned, to include large anechoic, reverberation, and source chambers to international standards, which, together with a comprehensive range of instrumentation (mostly electronic), will greatly extend our facilities for teaching, research, and consulting work on machine, engine, flow, impactive, and other noise problems, as well as providing a facility of use in electro-acoustics, and some aspects of architectural acoustics.

Studies of flow and attenuation in engine exhaust systems are being undertaken. The possibilities of attenuation of shock-waves in silencing systems are being investigated—the first stage by means of a two-dimensional water-table analogue.

Mechanics of Materials: The mechanism of plastic deformation and fracture in metal cutting has been studied. The existing dislocation theory has been investigated in relation to strength of metal crystals, and a new theory put forward to account for a range of phenomena associated with deformation and fracture, and explaining the difference between theoretical and actual metal strength properties.

Thermodynamics: Heat transfer is a study of major importance in a great variety of problems. Experimental investigations are proceeding on heat transfer in unusual flow situations, including pulsating flow and flow with superposed shock-waves. Equipment is being developed to produce repetitive shock-waves for this work.

A feasibility study is being made, and an experimental rig developed for a new approach to a rotary internal-combustion engine, with certain possible advantages over the Wankel engine.

Fluid Mechanics: Bearings and lubrication are a continuing study, and work is being undertaken on tapered hydrodynamic bearings, and on gas lubricated bearings.

Experimental data of value in the design of jet-type ejectors, injectors, and mixers for various fluids has been obtained in a series of projects.

Fundamental studies of existing marine propulsion systems, and feasibility studies of newly-suggested forms of propulsion for improved efficiency or overcoming serious flow-induced propeller vibration problems, is proceeding. The research water tunnel is producing valuable model-scale results on propeller water-entrainment factors and damping, which are necessary for the evaluation of dynamic torsional characteristics, and of asymetric flow-generated propeller vibration components. Full-scale tests on instrumented B.H.P. ships in shallow and deep-sea conditions have produced a great range of dynamic data awaiting analysis. A new automatic chart data evaluator has been designed to expedite data collection for feeding to the digital computer for analysis.

In addition to these and other internal projects, the range of advisory and consulting activities has extended considerably over the last few years —both to private industry and governmental organisations.

H. H. DAVIS.

SERVICES RENDERED CORNER

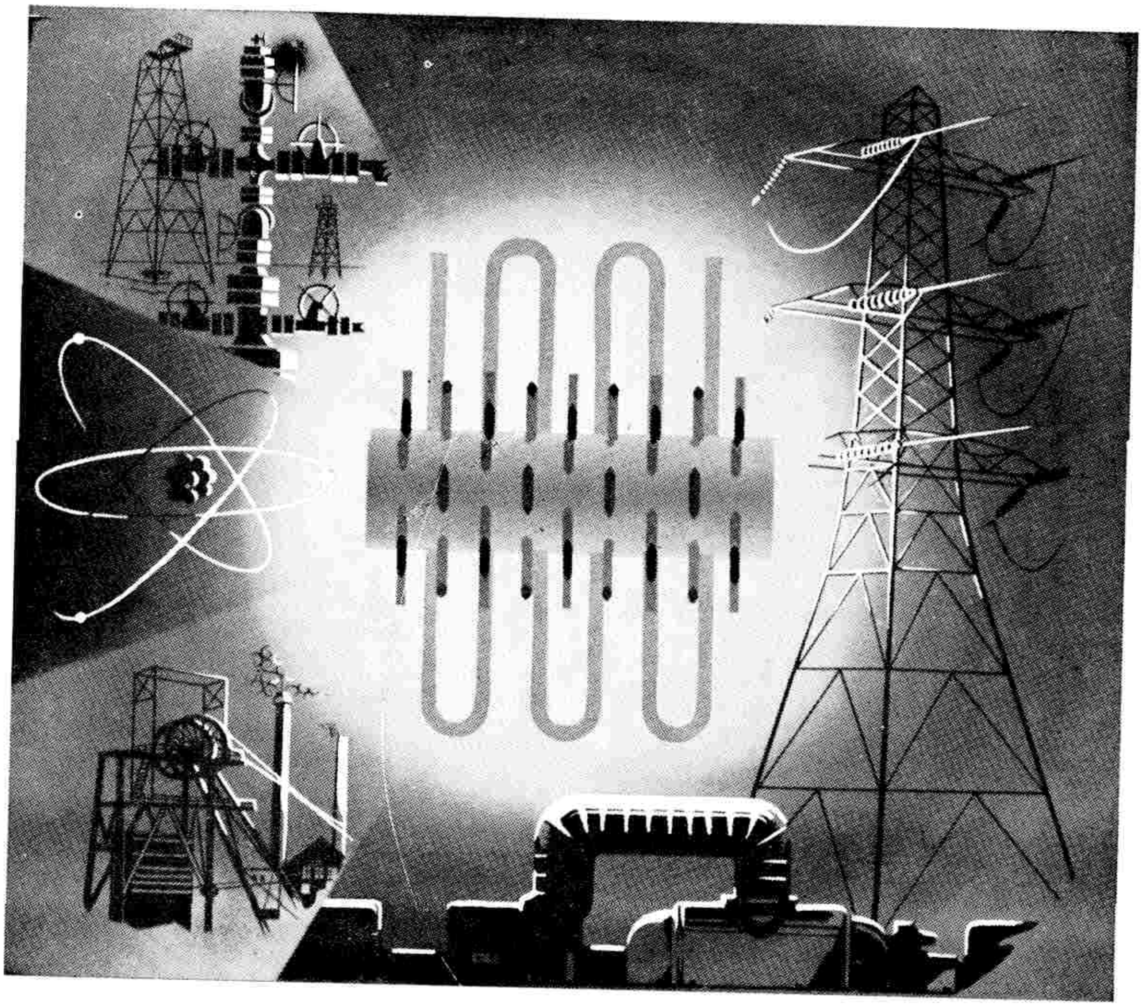
The Editor wishes to thank everybody who has helped in any way with the production of the magazine.

Garry Brown, who, as last year's Editor, gave valuable advice and assistance.

Our advertising agents, **Charles F. Brown and Associates,** and all the firms which supported our magazine in a practical way by taking advertising space.

The printers, **E. J. McAlister & Co.,** who have patiently overcome our problems.

John Hutchinson, who attended to the photographic needs in a capable manner.



Power from heat is our business

Man's material progress depends directly on his ability to use the world's fuel resources to produce power from heat. He produces over 90% of his electricity by using the heat from burning coal and oil in conventional steam-raising plant. He drives his largest and fastest ships with steam from oil-fired boilers. Now he is using his new-found knowledge of nuclear fission to produce heat, and power, from nuclear fuels. In industry, heat is power for a thousand processes.

Increasingly aware of the finite limitations of his fuel supplies, he has become increasingly more resourceful in using fuels efficiently, and in reclaiming heat that once was wasted through careless and inefficient methods. For over 75 years Babcock & Wilcox have pioneered new methods and equipment for just these purposes.

Power from heat is our business **BABCOCK**

Conventional and nuclear STEAM-RAISING PLANT and equipment for heat-exchange and waste-heat utilization.

BABCOCK & WILCOX OF AUSTRALIA PTY. LIMITED, Head Office & Works: Regents Park, N.S.W.

BRAIN TEASERS

These are sensible questions, with reasonable answers.

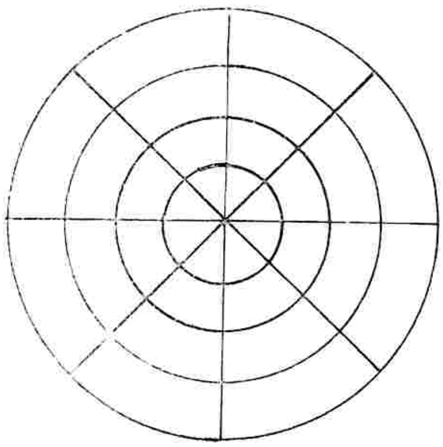
1.—Find the greatest number that will divide 364, 414, 539, and leave the same remainder in every case. It can be done by trying successive numbers, but there is a better method than this.

2.—How many sheep has a farmer if he can divide his sheep into two parts so that the difference between the two numbers is the same as the difference between their squares?

3.—A robber broke into a church, and though he had nothing to assist him but his pocket-knife, he managed to steal nearly the complete lengths of the two bell ropes, which passed through holes in the lofty boarded ceiling. Of course, there was no ladder to assist him. It is easy to see that he might steal one rope and slide down the other, but how did he manage to cut nearly the complete length of both ropes without falling?

4.—There are nine coins of equal dimensions, and all of the same weight except one. Find the coin which weighs less in only two weighings.

5.—Place eight dots on the diagram so that there are two dots on each straight line and two dots on each circle.



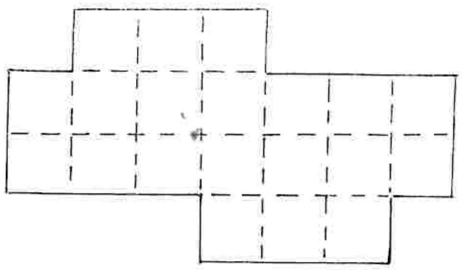
6.—Two soldiers were posted at a certain point to watch for snipers. One kept his eyes fixed on a big tree straight ahead of him, and the other maintained a steady watch in the opposite direction. Between them they commanded a clear view of the terrain in both directions. Suddenly, without turning his head, one of the soldiers exclaimed: "What are you smiling at?" to the other. How did he know, without turning his head, that the other was smiling?

7.—Eight letters, each standing for a particular digit, are involved in this simple addition. 4 and 5 do not occur, and M E L O N, naturally, is bigger than L E M O N. Find the corresponding number for each letter:

```
  M E L O N
  L E M O N
-----------
O R A N G E
```

8.—A certain country invariably has its currency notes bearing serial numbers which are perfect squares. Presenting notes numbered 100,489, 004,761, 109,103, 019,187, 111,192 at a post office, a tourist soon got into trouble, and finished with a prison sentence for forgery. Which were the forged notes? And how did the post office clerk identify them without finding the square root of any of them?

9.—In how many ways can the figures shown below be divided up into four pieces identical in size and shape? Each division must occur along a dotted line.



(Answers on page 64)

RESEARCH ELECTRICAL ENGINEERING DEPARTMENT

LOW NOISE COMMUNICATIONS

As the volume of information to be transmitted over longer and longer distances increases, it becomes increasingly more important to be able to provide efficient communications systems at reasonable cost. At present most transcontinental communications are via submarine cables, which, however, are not capable of meeting the demand, nor have they sufficient band-width to handle television signals.

With the advent of artificial satellites it has been suggested that world-wide communication may be accomplished by transmitting radio signals via these satellites. The most satisfactory proposal uses a network of three satellites in an equatorial orbit. They are arranged to have a period of exactly 24 hours (altitude of 22,300 miles), and hence appear stationary above the earth. This system is capable of covering over 95 per cent. of the earth's surface. The cost is said to be more favorable than that of submarine cables of equal capacity.

Due to the long path lengths, there is considerable loss in signal strength, and so, to minimise transmitter requirements, it is necessary to have efficient receiving circuits. This may be separated into two problems.

The first is to minimise the effect of receiver noise, which may be sufficient to completely swamp weak signals. This may be accomplished by amplifying the received signal with a special low noise preamplifier, and then applying the amplified signal to the receiver. The signal is then much larger than the receiver noise, which therefore has a negligible effect.

The second problem is to discover the optimum type of modulation and the method of detection of this modulation. It is found that the most efficient modulation methods are those which give a signal to noise improvement factor, such as frequency modulation and pulse code modulation. Special detection circuits, such as frequency feedback in F.M. systems, and phase-locked detection in P.C.M. systems, improve the performance at low signal levels.

Research has been carried out on different forms of low noise preamplifiers, such as the maser, the parametric amplifier, and in particular, the tunnel diode amplifier. A study of modulation systems and detection methods is proceeding at present, with emphasis on the negative feedback frequency modulation system, which promises to be one of the most efficient systems yet designed.

B. R. DAVIS.

Research Supervisor: Prof. E. O. Willoughby.

SELF-ORGANISING SYSTEMS

By S. KANEFF

(Electrical Engineering Department)

To a greater extent than we are normally aware, machines* are influencing our everyday affairs and our destinies.

Obvious are the many applications of machine aids and devices in transport, communications, commerce, entertainment, primary and secondary industry, and defence, involving in some degree utilisation, amplification, control, transmission of power and/or signals.

Less obvious, however, are the rapid developments in complex systems, and their influence on man-machine relationships. Thus the appearance, hourly, of an ever-increasing number of new devices, and the combination in infinite variety of such devices into systems, is imposing a mounting strain on human resources, mental and physical. Automatic control and data processing systems, coupled with many other technological and scientific advances, are changing the whole pattern of activity, with accompanying inevitable changes in productivity and employment structure, at the same time causing uneasiness and concern for the future. To cope with new developments, new fields for study have appeared, among these, for example, cybernetics (steersmanship) is particularly concerned with the inter-relationships between men and machines.

The previous decade has ushered in a new phase in the application of machines in our affairs, resulting from the need, real or imagined, to assist us with more and more complex tasks. It is relevant to mention briefly some of the affected fields:

Biology: Electronic instrumentation has quickly widened the scope for study of living things. The field of medical electronics is expanding rapidly. The tremendous volume of information becoming available is taxing severely the capabilities of medical practitioners. There is consequently serious effort directed towards the realisation of mechanised medical diagnosis.

Information Retrieved: The astronomical numbers of words each year contained in the hundreds of thousands of journals and books which represent the record of progress in all fields present superhuman tasks to those wishing to follow even quite narrow disciplines. A significant proportion of the overall cost of scientific and technological projects must now be used up in a search, understanding, and evaluation of existing information. It is not surprising that much effort should be devoted to develop automatic information retrieval systems, necessarily affecting the general problem of keeping records.

Language Translation: As a problem in information retrieval, material published in other languages presents an even greater challenge to mechanisation; nevertheless, world-wide effort is being applied to this purpose. The aim of achieving mechanical translation from any one language to one or more others has not yet been satisfactorily realised.

Scientific Research and Engineering Design: Electronic computers in their various forms are making possible the solution of problems hitherto considered intractable through complexity, and are removing the drudgery from much routine engineering design, at the same time giving better products.

Commerce: Data processing systems are performing more effectively such tasks as calculation and preparation of pay cheques; stock control; keeping bank accounts; insurance policies; making air-line passenger reservations; as well as many other accounting duties.

Education: In addition to the common audio and visual aids employed in the past, we are now entering the era of the teaching machine—in its present developmental form, a device which enables some routine teaching and learning tasks to be mechanised. Because each student can have individual attention, teaching rates can be adapted to his particular capacity and motivation. By very frequent and thorough feed-back between machine and student, learning can progress rapidly and effectively. The role of the human teacher is, then, that of supervisor, guiding the student in obtaining his education.

Industrial process control, weather forecasting, space exploration, defence are further fields relying on machines to an ever-increasing extent. The list could easily be extended further.

Clearly, then, many situations arise where it is desirable, profitable, or essential to provide

* "Machine" is used in the general sense of any device constructed by man to aid in performing some task. The term "artefact," or artificial construct, is sometimes employed in this context.

mechanical assistance for a human operator. Considerations may involve safety, applications requiring an operator of inexhaustible patience, precision, reliability, speed of operation, or endurance perhaps, under adverse or hazardous conditions. For many of the duties mentioned above machines are being called upon to perform tasks and behave in ways hitherto considered as exclusively characteristic of living beings; moreover, required performance may be more exacting than that realisable by people. As a natural consequence of these trends some are asking: "Is man necessary?" This shocking question need fortunately be seriously considered only with regard to man's presence in present-day control systems. Even here human sensory capacities, perceptual ability, alertness for change (present or impending), and flexibility are superior, while man's judgment and reasoning are essential if it is impossible to reduce all operations to logical preset procedures. Future developments may change this situation.

Much has been said recently about thinking machines. Such talk generates almost as much heat in argument as use of the term "electronic brain" in the lay press to indicate an electronic computer. We are told in no uncertain terms that programmed computers do only what they are instructed to do, that they lack imagination, are incredibly dull, and must be programmed in the most minute detail. Certainly computers perform only according to instruction, and their ability depends on their initial structure, but then, human beings depend on initial structure, and on information reaching them from their environment, but they do not do only what they are told.

Why, then, are machines so dull but humans so imaginative? Scientists and technologists working on the problem of artificial intelligence consider that perhaps machines are not by nature dull, but that they have not been informed properly: if we can only find out what to tell the machines they may turn into intellectual giants. We have had power amplification for a long time—why not intelligence amplification? It is not intended here to enter into semantic and philosophical controversy. In engineering, the proof of the pudding . . . is in the effectiveness of the hardware produced. In this case we must suspend judgment, because not even an acceptable list of ingredients has yet been compiled, neither is progress lacking. Suffice to say that an essential attribute of people is their capacity to self-organise—a feature completely lacking in machines, except in a very primitive manner in some experimental devices.

If certain principles of self-organisation can be understood, developed, and applied, then machines may be endowed with the ability to perform tasks at present able to be carried out only by human beings. It may then be but a small step to obtain superior performance.

The terms, intelligence and amplified intelligence, deserve further comment, which can, however, be only brief. When confronted with a problem, a person will consider this in relation to his previous experience and education, duly influenced by his very structure. His organising ability enables him to select the relevant information, apply this to the special problem at hand, and select the right answer. This is an intelligent process. Sometimes the decision reached is that the information available is insuffiicent; then the person's self-organising capacity is taxed to remedy the inadequacy. This might be done by reading, discussion with others, or by initiating and carrying out original research. Ultimately an answer may be found, or the problem may be beyond human intellect. Relating intelligence to problem-solving ability is a useful method of approach, avoiding specification of this rather elusive quantity.

That human intelligence is severely bounded is suggested by results of intelligence quotient (I.Q.) tests which, although open to considerable criticism, at least gives some indication of the situation—very few people have an I.Q. greater than 150; none have an I.Q. above 200. Recent studies on the brain have suggested that human dynamic memory is restricted to the storage of probably less than 10 "chunks" of information (a "chunk" of information can be considered one stimulus, e.g., a word, a simple picture, a sound, and so on—its value may be greater than is apparent, however, as it may be rich in association), and that the only way a person can manipulate complex idea is by first abstracting and recoding detailed information to reduce the number of "chunks" which must be dealt with simultaneously to less than 10. This obviously limits problem-solving ability in humans, while suggesting that if a machine can incorporate human problem-solving features it might be able to handle more than 10 "chunks" of information simultaneously, and so solve problems outside human capacity—effectively, intelligence amplification.

In order to discover essential features and principles of self-organisation, it is clearly advantageous to study existing examples, as found in living creatures. In spite of the obvious difficulties in performing research on brain organisation and functions, a great deal of effort has been so directed for many years, with fruitful results which, however, will not be discussed here. The term organisation in this discussion relates to increase in order which may be achieved by securing additional information and/or arranging information into a form more readily accessible for the problem at hand, so enabling the selection of an answer, or the making of a correct decision.

So far, no clear-cut description of the essentials of a self-organising system has herein been given, because no generally accepted definition seems yet available. However, a simplified account of what may constitute a self-organising system will be attempted. Necessary structure would include a built-in goal (the machine should preferably DO something), motivation to obtain this goal, a means for communicating with its environment (the outside world), a memory system for storage of information, which may include stored facts, useful processes, actions, and associations learned through experience (this capacity for learning seems necessary—it would involve a modification of behaviour in the light of past events, a running score of which could be kept, for example, by storing the probability of certain events occurring or resulting, given certain others, subject to continual readjustment by further experience). In accomplishing self-organisation, the filtering and coding of stored and afferent information and appropriate communication between the various parts of the system should be possible. Finally, means should be available for assessing the actual performance in relation to the goal, and of modifying behaviour in order to approach this goal as directly as possible.

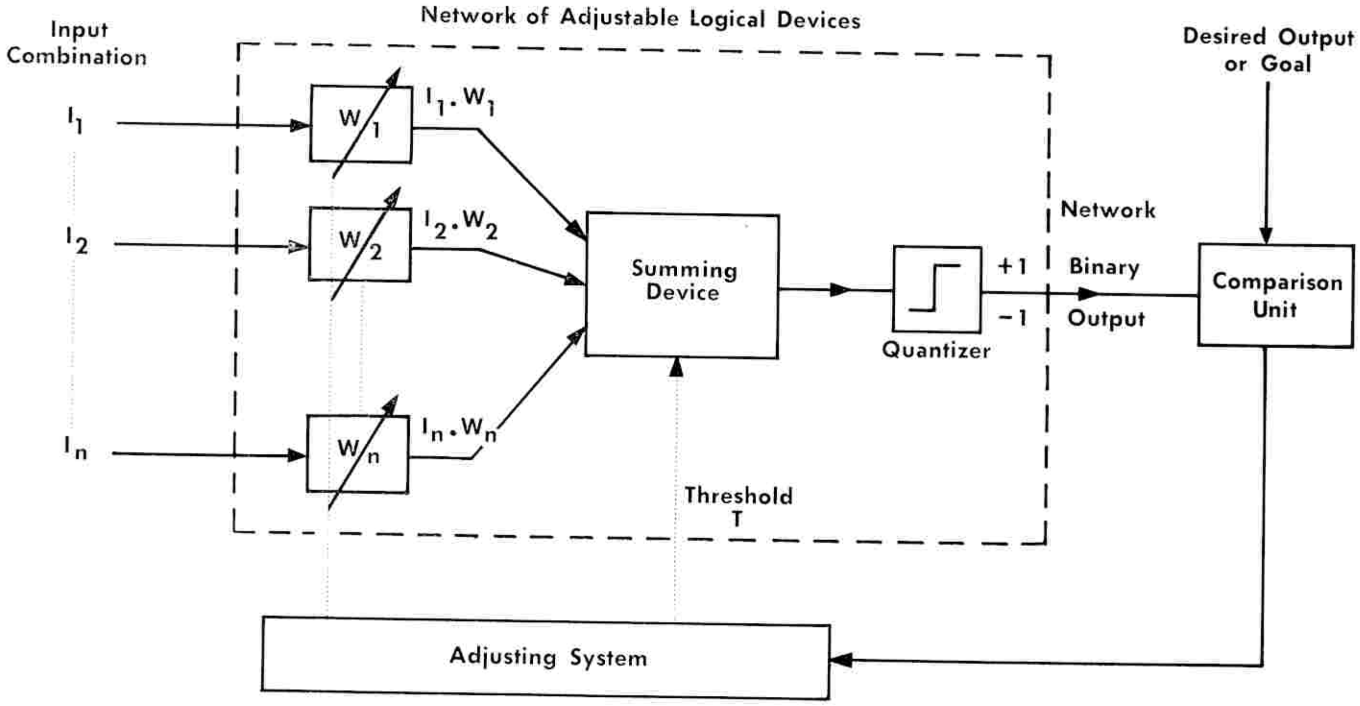
It will be recognised that for any device to deserve the title of "self-organising," some part of its behaviour should be subject to free choice by the device itself (albeit within the limitations of its structure). If, on the other hand, every action can be identified as the result of an external instruction, then self-organisation is not present—this obvious distinction affects many recent devices and digital computer programmes termed "learning machines," in which learning is achieved through complete specification of the learning process (programmed learning), but it is also possible to achieve learning through self-organisation.

A clear distinction should be made between self-organising systems and automatic control systems; in the latter the relationship beteen input and output is rigidly fixed by the designer, whereas in a self-organising system the designer may not even be able to predict an output, given an input, because the machine can of itself alone define part of its behaviour.

Allowing a system some free choice also allows it to make mistakes, something which seems necessary for self-organisation to proceed, in the same way as human brain action seems to depend on this feature, which has often allowed new insight, and resulted in new discoveries. In practice, completely random choice is not desirable, because this is an uneconomical and generally slow procedure. From human problem-solving experience it appears profitable to make use of relevant information obtained in past attempts, and this suggests that self-organising systems should be allowed also to learn and be taught as much as possible. Subsequent problem-solving attempts would then be performed more quickly and effectively.

How can self-organisation be actually achieved in a machine? An obvious method of approach is to make a close simulation of known relevant functions of a biological self-organising system. This might be achieved by building a special model, or by producing a digital computer simulation programme whereby the general purpose computer is converted into a special purpose device behaving like the model or actual biological system. Another course of action is to create a machine which, while employing the same general principles and producing the same results, realises such behaviour by means which may be quite different functionally from the original. This may be difficult to envisage, but may be more suited to practical realisation with existing technology once the functional specification has been developed. (A third suggestion of a human brain devising a thinking machine operating in a manner completely different from any biological self-organising system seems remote.)

The diagram shows a model for a self-organising logical system which determines, by an iterative trial-and-error procedure, the proper Boolean function for a process. As is well known, any data which are measurable can be coded into a binary representation without loss of information. Then one form of useful logical system would transform this block of binary data into a single binary decision—for example, a binary representation of a character would be transformed into a binary decision, say, "either it is an 'S' or it is not an 'S'." The necessary Boolean function then represents the method by which the decision is to be determined. Combinations of such devices could then be used to make higher order decisions than binary.



SELF-ORGANISING LOGICAL SYSTEM

To illustrate the relationship between the above approaches, consider the problem of flight, and how this has been solved. Early efforts, based on too close a simulation of bird action, failed not only because an understanding of essential principles involved was lacking, but also on account of inadequacies in technology to realise even the functions attempted. When aerofoil action was understood progress was made by using a method of propulsion more suited to technology than the flapping of wings. Again, by using a different principle from that used by living flying machines, lighter-than-air craft were developed.

Consider now an elementary device which shows how some self-organising features may be obtained in practice.**

** R. Mattson, "A Self-Organising Binary System," Lockheed Missiles and Space Division Technical Report, LMSD-288029, September, 1959.

The system is essentially in two parts—one a network of adjustable logical devices wherein the effective weight of each binary input can be continuously adjusted through the real variables, W, together with a summing devise whose threshhold, T, is also adjustable as a continuous real variable (both W and T may take positive or negative values); the other a system for determining what logical function should be assigned to each device. Suppose the unit is required to recognise an "S" in the presence of other possible characters. Blocks of binary data corresponding to this "S" and other characters is then fed in, the desired output is set, and the adjusting system allowed to operate such that each adjustment is determined by the performance of the network for the previous adjustments, and finally, the network realises the desired Boolean function. After this learning process has been completed.

every time an "S" or other character is presented, a correct binary decision is given, that is, an indication is given as to whether it is or is not an "S."

The device is more versatile than might be apparent, for by presenting it with wanted and unwanted signals subject to various distortions, it is possible to still effect correct binary decision, even in the presence of considerable noise: moreover, output valves will be assigned to input combinations which have not been previously presented because those input combinations which have previously been given have established logical functions which will, with high probability, give correct decisions for newly presented variations. Combinations of devices such as this can give more complex functions.

It is interesting to note in passing that all quantitative information, as in arithmetical arguverbal arguments) can be reduced in form to binary statements (Boolean logic), and that all quantitative information ,as in arithmetical arguments) can also be reduced to binary statements by scalar transformation.

Consequently, binary "bits" can be used to convey any information; then, remembering that any random sequence, if long enough, will contain all the answers, all complex problems may be reduced in essence to making a selection for the right answer from perhaps some generated random sequence. This suggests a method of approach for problems too complex to solve by other means. The broad principle is to allow the machine to go ahead by trial and error, having been supplied with information on what constitutes a useful result; difficult problems must be analysed, separated into easier partial problems, tests made on simplified models of the actual situation, plans must be made for the probably most useful lines of atttck; eventually a solution may be obtained. This technique, often including self-organising functions, has been used with some success in programming digital computers. Results achieved by such programmes include the writing of music which is original and likeable, the out-playing of the programmers at difficult games, solving elementary problems in calculus, geometry, and logic. While these solutions have been usually obtained by brute force, and techniques of learning, only, have often been used, as more self-organisation can be imported, so more powerful results can be expected from both self-organising digital computer programmes and special purpose machines.

This introduction to some aspects of self-organising systems has been presented because it concerns post-graduate research in the Electrical Engineering Department. It will be appreciated that real progress in the field of self-organising systems depends on knowledge from several disciplines.

Consequently, it is apparent that interests of researchers in the field must be very broad. Projects involve an attempt to develop an adequate theory for self-organising systems, application of self-organising systems to teaching machines and investigations with a view to developing an associative memory, this latter being a key to the solution of a large number of outstanding present-day problems.

In conclusion, with projects of this nature it seems almost obligatory to raise some moral issues. Unlike certain other professions (for example, the medical and legal), engineers do not render their services directly to the general public; consequently thoughts of how the fruits of their labours may affect the well-being of the community in general are probably not very strong, if present at all. Even a pure scientist may rightly argue that his task is to gather facts and information, items which are morally neutral unless they are put to use, and he does not put them to use, but the engineer, on the other hand, by the very nature of his profession, applies scientific facts and information to creat things to be used by men—this very much involves morality, as each new item developed becomes part of our environment, whether we like it or not. The engineer should not be blamed for subsequent misuse of his creations by others, but he must take full responsibility for the exercise of his own talents. Things technically feasible are not necessarily desirable. It is well to keep in mind a proposed definition of engineering by the U.S.A. Recognition Committee of the Engineers' Council for Professional Development, which includes the words, "Engineering is the profession in which knowledge is applied with judgment for the progressive well-being of mankind."

While there is no reason to suppose that results of work on self-organising systems will change the essential dignity of man, even if the more unrestrained speculations are realised, considerable uneasy attention will certainly be focussed on the first machine which is given the task of increasing its own capabilities.

ENTRE NOUS

Do you like bathing beauties?
Personally, I've never had the chance.

Women have a wonderful sense of right and wrong—but little sense of right and left.—Don Herold.

"Owls do their courting only when the weather is fine," says a nature note. When it's raining, of course, it's too-wet-to-woo!

ENGINEERING IN THE ARMY

By LT. S. A. GOWER

In today's modern Army the operation, development, and maintenance of equipments, and the movement and supply of an Army in the field cause problems that can only be overcome by the employment of professionally qualified engineers. An Army engineer may be called upon to perform a diversity of tasks, but the basic requirement is a sound general engineering knowledge, directed to the technical aspects of the tasks likely to be met on operations.

Most Corps in the Australian Army have requirements for technically qualified officers. Such officers are normally graduates of the Royal Military College, Duntroon, who attend full-time university or diploma courses immediately after their graduation. Additional engineers are provided also from the Officer Cadet School, Portsea, or university students assisted through the final years of their courses by the Army.

The work undertaken by such officers will depend on the Corps to which they belong. The functions of the technical Corps of the Army, which employ the majority of engineers, may be summarised as below.

The Royal Australian Engineers are concerned mainly with civil and architectural engineering fields, although this is by no means the limit of its activity, which may extend from port construction to the building of aerodromes. In time of war the R.A.E. would be by far the biggest construction authority in Australia, and in peace it maintains the framework for expansion, and ensures that requisite techniques are kept up to date. The Corps also has a requirement for electrical and mechanical engineers.

Communications are essential for the command and control of an Army, and the role of the Royal Australian Signals is to provide and maintain them. As such, R. Aust. Sigs. has a requirement for electrical and electronic engineers. Electrical as well as mechanical engineers are also required for the Royal Australian Electrical and Mechanical Engineers, who deal with the repair of all vehicles, weapons, and equipments used in the Army. Other Corps, such as Artillery, Survey, and Service, have some requirement for engineers, and it is of some interest to know that even Infantry has a need for Service graduates.

The main difference between an Army engineer and his civilian counterpart is that the work undertaken is of a different pattern. Operations can be prevented by engineering difficulties, and, in fact, engineering factors can dictate the type of tactics. Work of the highest priority is hence undertaken first, regardless of time and resources available. These factors lead to improvisation and designs that, although often not sophisticated, are adequate under the circumstances.

The Army engineer must be able to sum up a situation quickly, and offer a solution using the basic designs and equipment he has at his disposal. One example of such an equipment is the well-known Bailey bridge. He must use his professional background to know the limitations of such equipments, and the extent to which they may be used. Provided that principles of safe practice are not violated, it is not necessary to design within code specifications on operations.

The Army has been responsible for much development in some engineering fields, notably in soil mechanics, demolitions, and plant operations, to mention a few. It has also investigated work-time studies fully. Officers are not divorced from civilian practice, and attachments to civil firms enable any new techniques to be studied and introduced, if practicable. The Army also encourages its technical officers to be members of relevant professional groups such as institutes and associations.

A complete military background, coupled with engineering knowledge, is hence the basic requirement of an Army engineer. The Army is then able to gain the maximum advantage from his technical knowledge and skill.

This is a copy of a letter actually sent to a member of the staff by an Asian student. It is printed without comment (sic.):

My most learned, respected, and beloved master,

Humbly Sir, I beg to offer my profound apologies for not being able to have the pleasure to submit to your honour the Mech. IA design project in time; in spite of the unwillingly granted however much appreciated extended seven suns. The reason Sir, is that some of my kinsmen from the great far north had shamelessly and quite uninvited turned up to live on my expense. They are still here at this very moment Sir sucking away my very spirit energy and soul though I had repeatedly and very politely hinted my desire of their taking leave. So you see Sir I shall not be able to complete the errand your highness had entrusted to me.

May the Monkey God and the Dragon God bless you and the devil himself keep out of your way.

Your most obedient and humble student,

A STUDENT.

SLIP-STICK SNIGGERS

Chivalry is the desire of the male to protect the female from the advances of everyone but himself.

Beneath this slab
  John Brown is stowed.
He watched the ads.,
  And not the road.

They wear pyjamas in the Bahamas,
but in Bangkok some kind of a smock.
I hear they're nuder in Bermuda,
and down in Haiti not even a naiti.

Sure, deck your lower limbs in pants;
  Yours are the limbs, my sweeting.
You look divine as you advance—
  Have you seen yourself retreating?

Said a man to his wife down in Sydenham:
"My trousers, now, where have you hydenham?
  It's perfectly true
  That they weren't very new,
But I foolishly left half a quidenham."

Woman! Without her, man is a brute.
Woman, without her man, is a brute.

Temptation is woman's weapon and man's excuse.—H. L. Mencken.

When two women kiss it always reminds one of prize-fighters shaking hands.

Then there's a story about the doctor in the District Hospital at Bourke-or-Beyond. He was chatting with the squatter's wife, who had just given birth to her sixteenth child. As he left he said:

"Well, I suppose I'll be looking out for you again in a year or so."

When she said "No," he expressed surprise at the idea of no more children from this source, and asked her why.

"Ah," she replied, " 'cause me and the old man's found out what's causin' them."

SONG OF THE ENGINEERS

I'm a helluva, helluva, heluva, helluva, helluv' an engineer,
A helluva, helluva, helluva, helluva, helluv' an engineer.
Like every honest greaser, I likes me lager beer,
I'm a rambling wreck of poverty, I'm a 'Varsity Engineer.

Oh! One day a lighthouse keeper was looking out to sea,
He gave a yell, and he cried, "Oh, hell! A ship in distress I see."
But the captain of that gallant crew knew he had nought to fear,
For the man below in the engine-room was a 'Varsity Engineer.

I'm a helluva, etc.

Oh, we work away, and slave all day upon the road to hell,
We blast the hills to smithereens with dynamite and gel.,
We find our Eldorado, and have our pot of beer,
And when we're broke we tell the joke to a 'Varsity Engineer.

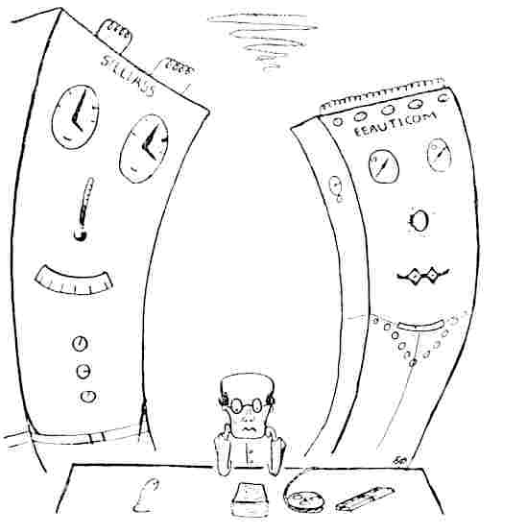
I'm a helluva, etc.

Oh, we run the sewer system, and the Tramways Trust as well,
And many of us who've left this earth are firing down in hell.
We write our name in scrolls of fame for many and many a year,
And still we'll sing the song about the 'Varsity Engineer.

I'm a helluva, etc.

And so, wherever you may roam, on land or sky or sea,
You'll find a 'Varsity Engineer wherever you may be.
And when you've left this mortal earth to singe for ever more,
You'll hear the 'Varsity greasers sing the songs they sang before.

I'm a helluva, etc.



"Ar, don't worry about him—he's only a high-grade moron."

The ant has made himself illustrious
Through constant industry industrious.
So what?
Would you be calm and placid
If you were full of formic acid?

CIVIL ENGINEERING DEPARTMENT ACTIVITIES

The research and investigation studies carried out in the past year in the Department have contributed to fundamental engineering knowledge in some measure, as well as to a number of Government and industrial projects.

Much of the Civil Engineer's activities are spent in planning and development. In this field the surveying staff has been assisting the development of the Bedford Park site for the new University. The whole 300 acres was surveyed last vacation in four blistering heat-stained weeks, and from this survey has come two excellent relief models of the site—a most vital aid to its effective planning. The surveyors have added a most impressive portable quartz clock (for astronomical observations) of high accuracy 1 in 10^6 and a prismatic astrolabe to their equipment. The mercury surface in the latter is disturbed by almost anything, overhead aircraft, etc.—general despair on its successful use anywhere, ever.

Some of the structural activity in the Department has been directed towards new buildings in the University. Considerable effort was put into the development of novel forms of construction, showing dramatic economies for the new Engineering Annexe Building. A special sprung floor for the main gymnasium of the new Physical Education Department Building on McKinnon Parade was developed. The final proving of this was on a section cfthe proposed floor set up in the Testing Laboratory: tested with jumping bodies: curious to behold.

The early studies on dam design have progressed well, and a complete digital computer analysis has been developed for the analysis of concrete and dams. The speed and ease of analysis has allowed considerable economy in design to be effected. Further model studies are being carried out now to verify this work, much of which will result in great economies in two arch dams to be constructed in this State shortly.

Post graduate study is also active in the stresses in pipes over supports which, in this State, with over 9,000 miles of main pipeline, is of great engineering concern.

Much of the activity in the Soil Mechanics Section has been in examining the foundations of the University. This is not in a fundamental academic sense, but in a practical one, in that advice has been given on the foundation problems of the new Arts Building, the new Physical and Inorganic Chemistry Block, and for the Physical Education Department's new accommodation. A general assessment has also been made of the likely foundation problem at the new University site at Bedford Park.

Research activity is developing in studying the effects of electro-osmosis on selected soil types, and in methods of assessing the various parameters influencing the strength of soil.

The Hydraulics Section of the Department has completed the ventilation studies of the proposed Jervois Tunnel, and then on wider terms of reference from the Public Works Standing Committee, examined with the Structures folk various further proposals for effecting the crossing: these were reported in evidence to the Committee. A tunnel was not recommended, on economic grounds.

Model studies are active on a new flood control dam on the Sturt Creek as a further section of the South-Western Suburbs Drainage Scheme. A special dissipator valve of the Howell-Bunger type is also being developed for possible incorporation in the dam. Channel control structures for the South-Western Suburbs Scheme have also been examined.

The Irrigation Research Studies have continued further, and research has shown that even greater improvements seem possible. A grant from the Reserve Bank of Australia has enabled a full-time Research Fellow to be appointed, together with a Technical Officer, and the whole programme of Irrigation studies is being widened. A totally automated irrigator field testing station is now being established to enable rapid field proving of new developments. This will be one of the most modern in the world.

The wind loading studies are active, and at present a tall tower is fully instrumented, and the fast gust anemometer installed on it. As usual, the project is waiting for wind!

Water hammer activity is high, and some of the laboratory work has given way to full-scale studies on pipe lines made available for testing. These studies are yielding data of the greatest value, and will continue for some while.

LETTER TO THE EDITOR

Dear Sir,—

I have not noticed by lab. partner in Elec. II to move for several weeks. Does this mean he is worried, or is there something wrong? In any case, what shall I do?

Dear Mate,—

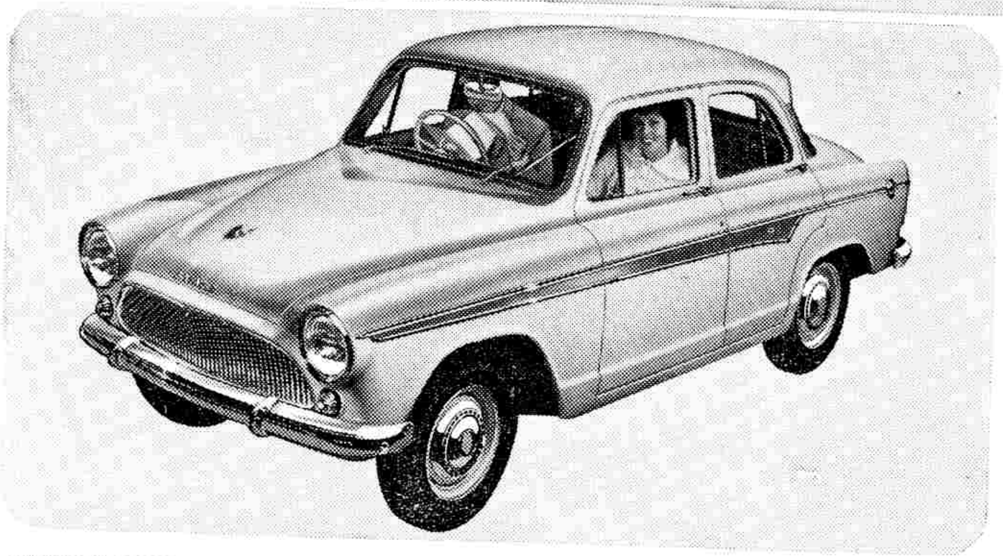
Your partner may be dead. However, because of the close resemblance between death and various people's working attitudes, I would do nothing for the present. Try connecting 400 volts in star across him. If this does not move him, I suggest you paint him grey and leave him in a corner.

Dear Sir,—

Recently my Maths. lecturer smiled and told me that I was a Public Benefactor; furthermore, that it was a (blinking) pleasure to have me in the (blinking) class. What does this mean, and how can I pass?

Dear Neddie,—

There is no hope. You will be back next year.



THE RADIO CLUB

By E. BARTON GLIDDON (VK5GZ)

The University of Adelaide Radio Club has members interested in the construction and operation of electronic equipment. The club tries to balance its outlook, and provide interest for most of the major different classes of electronic equipment. There are three main classes, which are: (a) Equipment concerned with audio frequencies, i.e., pick-ups, amplifiers, loud speakers, and so on. (b) Test equipment, comprising cathode ray oscilloscopes, audio generators, and so on. (c) Equipment concerned with the propagation and communication via radio waves, using receivers and transmitters.

Due to the huge range and complexity of audio and test equipment, these fields cannot be adequately covered by the Radio Club, which therefore concentrates more on propagation.

There has grown up from the advent of radio a hobby of amateur radio operation, sometimes called "ham" radio, which enables a properly qualified person to conduct experiments in radio transmitting and receiving. The rules of operation are laid down by the Radio Branch of the P.M.G.'s Department, which governs the use and operation of all transmitters in Australia. Amateur operated transmitters throughout the world are known as the "Amateur Service. The Radio Club has a number of these qualified operators in its ranks; they have satisfied the P.M.G. that they have sufficient knowledge of radio theory and regulations.

Partly due to the compactness with which transmitting and receiving sets can be built, and partly due to the pleasure and wonder of being able to talk to a similarly qualified person anywhere in the world, the Radio Club has for its main concentration the operation of an amateur radio transmitter at the top of the Engineering Building. All transmitters have an allocated call sign, that belonging exclusively to the Radio Club being VK5UA.

Whilst the main activity is "ham" radio, the Club does provide other services to its members. The use of the transmitter is restricted to licensed personnel, or any member while a licensed person is present, but the receiver can be used to listen to any station on the shortwave bands. The Club also prints a technical magazine called "Splatter," supported by contributions from members. There are a considerable number of technical magazines which are in very good use, and are available to all members. Technical queries can usually be answered by some of the "hams," who can, if necessary, see some of the staff of the Electrical Engineering Department. Thanks to the co-operation of the Department, it is possible to obtain and use test instruments for a short time in the testing of any member's equipment.

In the Institute of Technology Radio Club the operation of television cameras and control units by hams is successfully transmitting an amateur television signal on one of the U.H.F. amateur bands.

At the present time the receiver at VK5AU is a war disposals type BC.348. This was once a very good receiver, and even now performs tolerably, having picked up many stations in different countries, but in these years there are many amateur stations within the very narrow amateur band segments of the radio spectrum, and this present receiver is not capable of separating them or being able to pick up very weak signals. To this end we have been selling some pieces of disposals equipment to obtain sufficient money to buy a suitable commercial receiver, because the time required to build a good communications receiver is much greater than the University courses allow.

Since radio is a mysterious wonder, few people are sufficiently interested, and so the number of experimenters is small. It is interesting, however, to notice that the number of licensed members of the Club is growing. There are ten times more operators now than in 1954. I feel that this is one of the effects of commercial radio and television—making people ask why it works.

To those members of the University doing electronic courses I recommend joining the Radio Club, because it can demonstrate the practical side of electronic theory. This, from my own experience, helps largely to make courses easier and lectures more interesting.

EXECUTIVE FOR 1962-3

The following have been elected to the executive of the A.U.E.S. for 1962-3:

President: P. Chapman.

Vice-President: G. Marlowe.

Secretary: W. Phillips.

Assistant Secretary: D. Linn.

Treasurer: D. Dungey.

A device called "the biggest little capacitor in the world" has been designed and constructed at the National Bureau of Standards, U.S.A., as the first step in a high voltage calibration programme. A seven feet high, seven feet diameter aluminium can encloses the sphere and disc which form the capacitor plates.

NUTS and BOLTS

MORE EFFICIENT COOLING

Normally, a car radiator is adequately cooled by the draught of air caused by the car's motion. Fan cooling is only necessary when travelling slowly, or idling, but it still remains coupled, even at high speeds. The fan is not only unnecessary, but because the power required to drive it increases with speed, it may even need several h.p. at the higher velocities.

To overcome this, an electrically driven and thermostatically controlled fan motor could replace the usual engine-driven fan. This would give a reduction in noise, increased power at high speeds, better fuel economy, and a quicker engine warm-up from cold.

A rolling mill has been installed for very accurate cold rolling of metal strips down to .0001 in. thick.

ELECTRON BEAM WELDING

A new method of fusion welding, in which the required heat is derived from the kinetic energy of an intense beam of high velocity electrons, has been developed by a British firm. The beam from an electron gun is directed on to the joint to be welded, and the kinetic energy is converted into heat upon impact with the work-pieces, causing melting and coalescence.

Since a vacuum of the order of 1×10^{-4} mm. Hg. is needed to maintain a stable electron, it follows that the welded joints must be extremely pure and free from absorbed gases. Therefore electron beam welding is specially suitable for welding refractory metals (such as tungsten, tantalum, etc.), oxidised metals, and the vacuum melted alloys. The adoption of a relatively low accelerating potential of 30 kv. ensures freedom from the hard X-rays associated with bombardment by ultra-high voltage equipment, thereby permitting large viewing ports to be incorporated in the chamber, and obviating the necessity for thick lead shielding.

TIME SCALE FOR METRIC CHANGE

There is an increasing volume of opinion in the U.K., says the British Standards Institution, that regards a change to the metric system as essential, and even inevitable, although the costs and difficulties to the country, and some industries in particular, would be formidable.

If the change is to be made, time will be required for each industry to make its own individual plans, suited to its own needs. But it is only on the basis of a firm assumption that such a change is to be made—which nothing less than a Government directive can induce—that most individual industries can, or will, take any decisive action.

The Institution has proposed a general sequence of events for the complete change-over; the suggested period to make the change complete, starting from the moment of a Government decision, is twenty years. The first essential would be to encourage metric and decimal thinking by the parallel use of lb., ft., and metric units. Which out of the several variants of the metric system that will be adopted is still undecided. Electrical engineers especially view this choice with some interest.

Converting dimensions, however, is only the beginning of the problem. Clearly, if the change is to achieve its object, there must be alterations in sizes and design, leading in many instances to extensive re-tooling.

PUSH TOWING

When push towing was recently introduced experimentally on the Ruhr-Weser Canal, the operators had the difficult problem of steering the "dumb lighter" through narrow channels, sharp bends, and dense traffic. To keep the lighter in line as it was being pushed by the barge, a 200 b.h.p. "Schottel Navigator" was installed in the forward section of the lighter to enable a transverse force to be exerted on it. The "Navigator" is controlled quite independently of the pushing craft, being operated by a man standing in the bow of the lighter, whose communication with the pilot in the barge is maintained by telephone.

HIGH ALTITUDE TUNNEL

The 2.5 mile Grand St. Bernard Tunnel to link Italy and Switzerland has been constructed at an elevation of 6,000 feet above sea level. Although this gives the twin advantages of a 50 per cent. reduction in length and the need for only short ventilation shafts, it introduces the problem of maintaining access to the tunnel entrances throughout all the seasons of the year. The solution to this has been the adoption of covered roads leading more than six miles up to the Italian entrance, and almost 3.5 miles up to the Swiss entrance.

ROCKET PRESS

In order to obtain the high pressures and working areas necessary to handle large one-piece forgings, the size of presses has had to be increased until they are now extremely expensive and large. A new technique has been suggested in this field, which will greatly reduce the weight of the structure that is required. The idea is to use a force produced by combustion or controlled explosion, rather than by the normal method, which uses hydraulic means.

Vitreous enamelled silencers and exhaust pipes, now fitted to the "Rambler" car, are guaranteed for the life of the car. Vitreous enamel was chosen as a protective coating because of its high resistance to corrosion and thermal shock. The vitreous enamelled silencers are slightly more expensive, but the additional cost is said to be fully justified by a proportionately greater increase in the life of the silencer.

"MOLECULAR" SLIDE RULE

Essentially consisting of a solid slice of silicon about the size of the head of a drawing pin, and a few hundredths of an inch in thickness, a new electronic device, described as a "molecular slide rule," can carry out multiplication and division without conventional electronic components or circuitry. The device multiplies or divides by adding or subtracting voltages which are logarithms of the quantities to be multiplied or divided, so that essentially it performs in a similar way to a conventional slide rule.

In the molecular slide rule operations are effected by means of semiconductor junctions, an electric current fed into a junction giving a voltage across the junction proportional to the logarithm of the current. An input of two currents into two junctions gives a voltage which is their logarithmic sum, and the antilogarithm, measured at the output of the functional block, gives their product.

A new idea in springs has been found which has many applications. It is a spring that exerts a constant force independent of its extension. Some of the uses that have been suggested for it include commutator brush springs, supporting windows in different positions, and long hoses that are wound on drums, such as service station air hoses.

By replacing an overhead girder travelling crane made of steel with one made of aluminium alloy, a German shipyard increased their lifting capacity from 20 to 30 tons without increasing the load on the foundations or track supports.

GERMAN-ENGLISH DICTIONARY

Being fully aware of the influence of German scientists and engineers, we bring forth these excerpts from a German-English dictionary—"Wurdt Buke."

Guided Missile—Das skientifiker geschutenwerkes firenkrakker.

Rocket Engine—Firenschpitter mit schmoken und schnorten.

Liquid Rocket—Das skwirten jucenkind firenschpitter.

Solid Rocket—Das schtick kindlikercigaretten firenschpitter.

Guidance System—Das Schteerenwerke.

Celestial Guidance—Das schroballische schtargazen peepenglassey mit kontputenrattracen schteerenwerke.

Pre-set Guidance—Das senden offen mit ein pattenbacker und finger gekrossen schteerenwerke.

Computing System—Das schmordtallkwerke mit schruballische elektronik rattracen und allesgekinden tubenkrap.

Control System—Das pullen—un—schoven werke.

Warhead—Das laudenboomer.

Hydrogen Device—Das eargesenplitten laudenboomer mit ein grosse hollengraund und alles kaput.

Reliability—Machienze sodat alles mek anische parten nicht ben schoppen und gepttein a pardten.

Air to Surface—Fromische uppen schteres geschuten daunondekker bullzei.

Management—Das ulzurenbalden grupe.

Project Engineer—Das schwettenoudter.

Drafting—Das rounscholders und reddischeize grupe.

Electronics—Das tubenkrap grupe.

Wind Tunnel—Das huffenpuffen grupe.

Production—Das schoppen bunche.

Contract Administrator — Das tabelgepaunden grupe.

Preliminary Design — Das uppen-das-klauden grupe.

Support—Das garterbelten grupe.

—From W.R.E. "Missile."

ENGINEERING CURVED SURFACES

Geometry is so familiar to the engineer as a fundamental tool by means of which his theoretical concepts can be represented for ready comprehension by others that it is rarely singled out as a topic of direct as opposed to indirect interest in engineering application. It is true that since the Greeks formulated the system of geometry which we use for practical purposes today, others have developed its theory to a high degree, and have even found the subject sufficiently fascinating to invent new systems, and to add to the number of dimensions. If you are one who, upon first acquaintance with compass and rule, found some of that fascination in discovering the properties of plane figures, then you might also find a similar interest in the properties of curved surfaces, and their economic implications in the field of sheet metal construction.

The curved surface is, of course, most frequently used to represent, by means of lengths, a relationship between three quantities, involving all the fundamental dimensions concerned in a physical problem. In such cases the relationship referred to is usually fixed by factors independent of the geometric representation. By the location of points in a co-ordinate system, either algebraically, graphically, or with the aid of a model, the surface is defined. For many, at least the significance of the relationship is clarified by actual inspection or visualisation of such a surface.

On the other hand, some knowledge of the properties of curved surfaces and dependent practical techniques is required in order to define and construct in sheet metal a curved surface having arbitrarily curved boundary lines in space, possessing at the same time satisfactory aesthetic appearance or aerodynamical characteristics, and being capable of economic manufacture. This is the type of problem that arises in the automobile, aircraft, and shipbuilding industries, in each of which design involves the definition of the outer surface of the unit, in addition to strength, aerodynamical or hydraulic considerations. In the case of the automobile, the definition and construction of the outer surface forms the major part of the designer's, and certainly the body builder's, task. In each of these fields the medium of construction is normally flat sheet metal, which much be mechanically worked into a system of panels giving the desired overall body shape on assembly.

The process of designing a curved surface is often called "development," a term loosely applied to the design of all types of surface. The usual and long established practice is to set about drawing full-size, on metal or masonite sheets with specially prepared surfaces, the desired sections of the surface by three mutually perpendicular planes. It is then necessary to develop or define the surfaces joining these principal sections, so that they give adequate clearance on internal obstructions, such as engines or mechanical gear. They must also be free from bumps and flats, which give objectionable discontinuities in the highlights of a polished panel, and must lend themselves to practical manufacture. From this last point of view the body as a whole must be subdivided into sections, or panels, each of which is considered separately.

A number of considerations may determine the control outlines mentioned above. In the automobile, appearance, particularly in side elevation, largely controls the situation. Preliminary side elevations are prepared on vertical boards, and the control outlines are viewed, criticised, and modified to a final form. In aircraft and shipbuilding most external surfaces, such as aerofoils and submerged hull, are defined by aerodynamical or hydraulic considerations, although the fuselage of an aircrafe leaves room for a certain amount of arbitrary choice of line. To remove the arbitrary nature of some of these control curves, parabolas, ellipses, and other curves, whose algebraic equations are known, may be used in combination as control curves. This often permits the whole surface to be algebraically defined, which is a

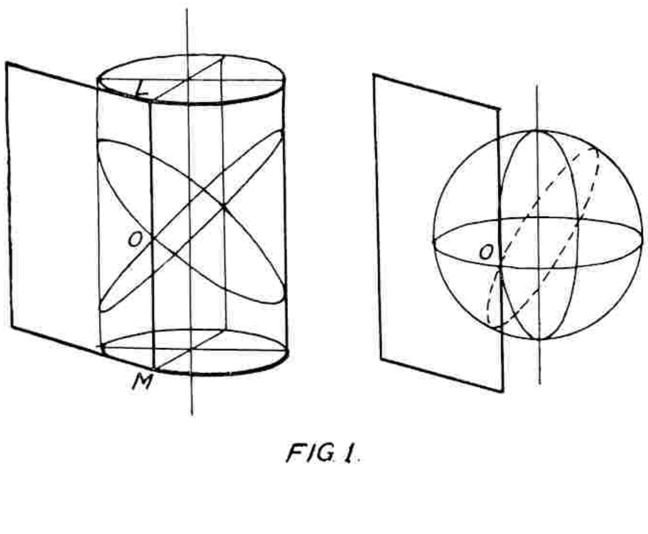


FIG. 1.

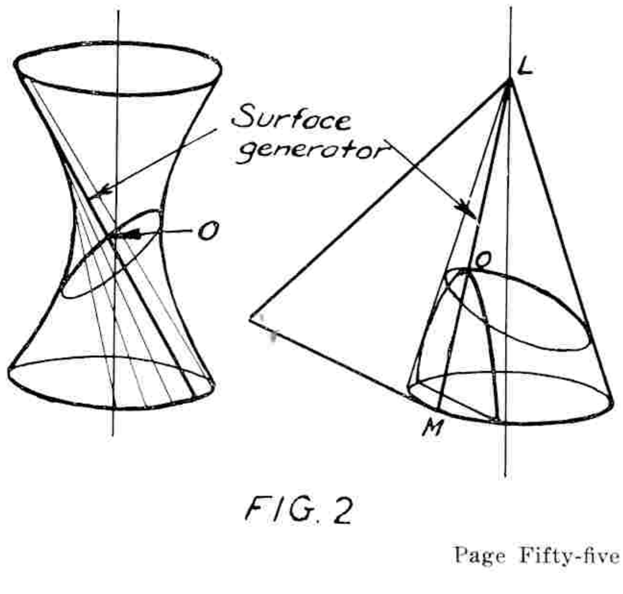


FIG. 2

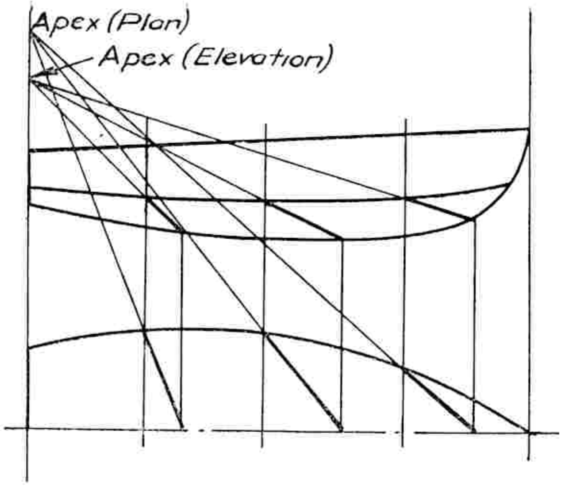


FIG. 3

great advantage in large bodies, and is a method widely used by American aircraft builders. With the automobile, however, the demanded complexity of the control curves calls for graphical or even trial and error methods.

In naval architecture the method of defining the shape of a ship's hull by means of buttock, water, and station lines has been well established. The curvature of the hull is, in the main, so small that the frame can be largely sheathed with flat plates. Spherically curved surfaces do not assume the importance, or offer the problems they have done with aircraft and automobiles, where spherical curvature is more often called for than not. On this account these latter industries have within recent years borrowed the shipbuilders frame of reference, and many of his terms and design techniques, and have devised new graphical and algebraic means of defining the curved surfaces.

To indicate some of the major considerations in this field of study, some simplified examples have been selected. For practical purposes, surfaces may be classified into two types, often called "developable" or "non-developable," but more appropriately described as "cylinderically curved" or "spherically curved." These are represented in their basic form by the cylindrical surface and spherical surface of Fig. 1. The first surface is characterised by the fact that the tangent plane to the surface at O touches the surface along a line LM, the generator of the surface, whilst the second is characterised by the fact that the tangent plane at O touches the surface at this point only. The first surface can be developed or formed by wrapping the tangent plane in the form of a sheet of metal round the instantaneous tangent line until the surface is completed. The second surface is a special case along a wide variety of surfaces having curvature in all directions. It cannot be formed from a flat sheet of material by means similar to the previous example, but demands means of stretching the sheet in the vicinity of the point of tangency by plastic flow. The tools and equipment required in the former case are standardised and relatively inexpensive, but the latter involves a large capital outlay in machine tools, presses, and dies to produce such a surface in quantity. If, therefore, means exist for bridging an area between specified boundary curves with a developable surface instead of an undevelopable one, the advantages are obvious.

It should not be concluded that a surface containing one straight line through a selected point, and therefore having no curvature in this direction, is necessarily developable. Consider the cone and hyperboloid of revolution in Fig. 2. The first mentioned, a developable surface, has no curvature in the direction of the slant height, which is also the line of contact of the tangient or wrapping plane. The second, a surface of some importance in gearing, is generated by either the rotation of a hyperbola about an axis, or by the rotation about an axis of a line skew to that axis. Hence this straight line generator will in turn pass through all the points on the generated surface, always lying within the surface. The surface is not developable, however, for a tangent plane does not contact the surface along this line.

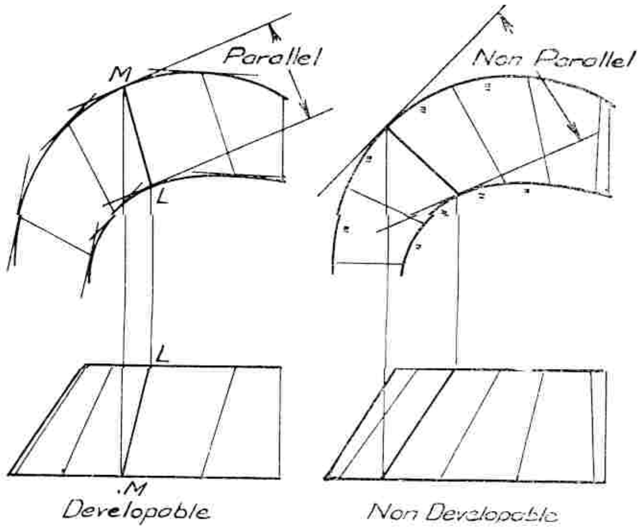


FIG 4

Fig. 3 shows one construction which could be used to define the bottom of a so-called V-bottom boat as portion of a conoid (or irregular cone), permitting its construction in unworked sheet material. As with other cases, the control curves between which the surface extends are not entirely independent. In this instance the plane of the keel line and the transom have been fixed, together with the plan and elevation of the chine. The geometric construction consists simply in representing successive positions of the generators of a conoid, with apex at A, so that they define the position of the surface in the two views, and enable the cross-section or station shapes to be deduced. Transverse and longitudinal sections (buttock lines) will both be curved lines. By making the generators parallel, the bottom could be made part of a cylindrical surface, with the same chine but different keel line in elevation.

Fig. 4 will serve to illustrate how two arbitrary boundary curves in parallel planes can be spanned by either a developable or non-developable surface. In the left hand construction the location of the line of contact of the tangent plane to the surface is determined by noting that such a plane cuts the boundary curve planes in parallel lines, which must appear as such in the plan view, and must also be tangential to the boundary curves. By trial, the points of tangency of these two lines can be found, and the generating line to the surface located for the position considered. A series of such lines in two views defines the surface. In the right hand construction the same boundary curves are joined by a series of lines between points equally spaced along each of the two curves. Here the surface so defined is not developable by the wrapping of a flat sheet, but is similar in nature to the hyperboloid of Fig. 2.

In an aircraft wing the boundary curves of the wing surface are usually the root and tip aerofoil sections, located as shown exaggerated in Fig. 5. These shapes are determined from aerodynamical considerations. A washout angle is often applied between root and tip, resulting in

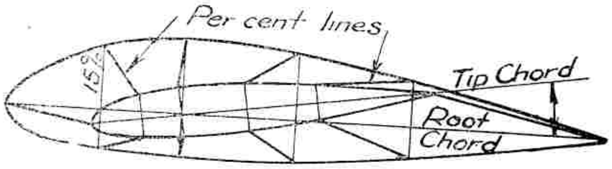


FIG. 5.

an end view of the type shown. The surface is then defined by a system of straight lines joining common per cent. lines, and results in one which, in the strictest sense, is non-developable. However, it is usually in the leading edge or nose skin only that the departure from developability is significant. A given case could, of course, be tested by the method of Fig. 4, but aerodynamical considerations must here come before manufacturing difficulty.

This last example has given an indication of the fact that many cases exist where the spherically curved surface must be accepted. Fig. 6 shows how the surface of an aircraft engine nacelle can be determined by means other than the conventional trial and error methods often employed for such a case. The boundary curves of the shaded surface in two transverse planes, and in one or other of the vertical or horizontal centre-line planes, may be arbitrarily fixed or made to conform to some regular geometric forms. The construction for finding the outlines of stations XX and YY can be followed from Fig. 7, in which the intersections of these planes on the fixed longitudinal boundary curve are first located in this view. It is now necessary to determine the outline of sections XX and YY such that the surface which they define in conjunction with other similar sections is spherically curved and free from bumps, flats, or unacceptable lines. Points A and B are selected in one of the transverse boundary curves, and points A' and B' corresponding to

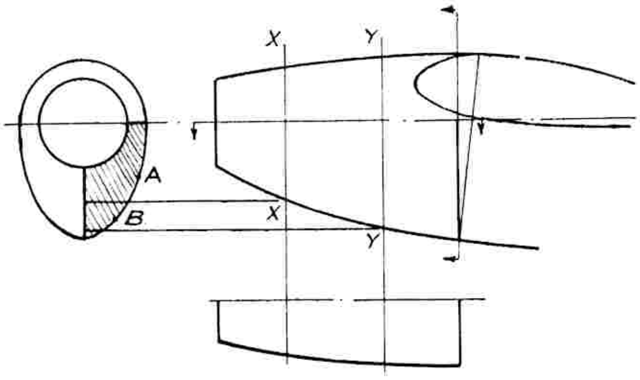


FIG 6

them in section XX, and A" and B" in section YY, are then found by means of the proportioning scales depicted, which make width and depth of corresponding points proportional to the overall width and depth of corresponding sections. The curves AA'A" and BB'B" are typical "radial development curves," and A'B' and A"B" are sections of the derived surface at stations XX and YY. Sections along BL on this surface will yield a conventional buttock line profile, and section WL a water line profile. It will be found that, with accurate full-size construction, all sections of this surface will be fair curves. The boundary curves control the form of the surface in conjunction with the method shown, but in this case the resulting surfaces are acceptable. From what has been said, it will be noted that the surface could have been made developable if the boundary

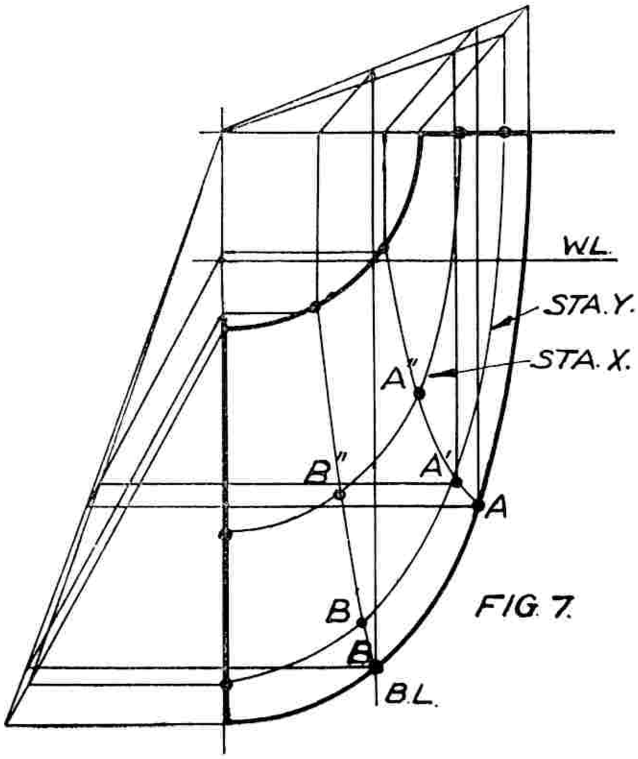


FIG. 7.

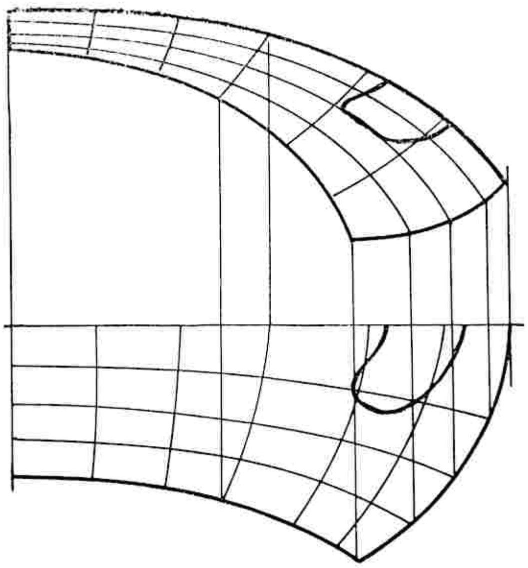


FIG. 8.

curves in vertical and horizontal planes had been straight lines, but as they are specified as curves, spherical curvature cannot be avoided.

Automobile panels demand a high standard of surface accuracy. Bumps and flats in the surface quickly show up in the highly polished finish as interrupted highlights. For this reason, and the fact that boundary curves are arbitrary and more complex, as will be seen from the root panel shown in Fig. 8, graphical constructions along the lines of the previous example, and extensions of that approach, are usual.

The layout of the outer surface of the units referred to is but a preliminary step in the complete process of producing the surface in physical form as a panel, and it is not the purpose of this article to enter upon a discussion of that process, and the great variety of techniques and equipment used to impart the necessary curvature. It is hoped, however, that sufficient has been said to indicate that the geometry of curved surfaces has both technical and economic application wherever sheet metal is the major medium of construction.

ENGINEER'S WHISKY TEST

Connect 20,000 volts across a fifth. If the current jumps it, the product is poor.

If the current causes a precipitation of rye, tin, arsenic, iron slag, and scum, the whisky is fair.

If the liquor chases the current right back to the generator, you have good whisky.

The weaker sex is the stronger sex because of the weakness of the stronger sex for the weaker sex.

We ask you to read the advertisements and to patronise our advertisers.

Their patronage enables us to produce this fine magazine.

A.U.M.C. NOTES

By B. McLEOD

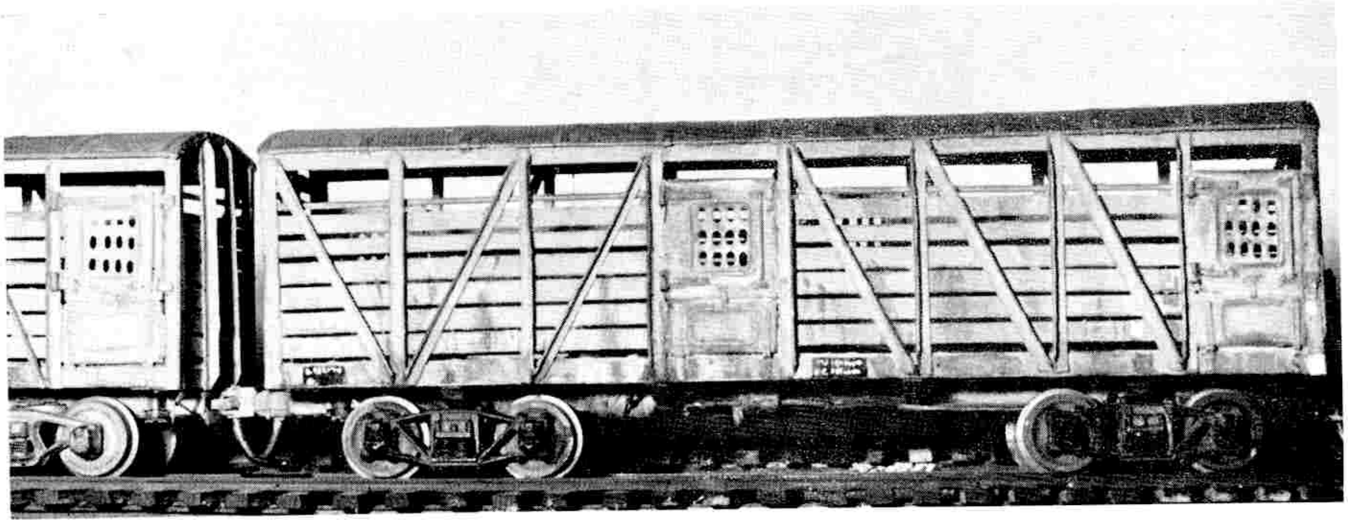
If, on a visit to the George Murray Basement, you have noticed two red doors at the northern end of the basement, and wondered what lies behind those doors, then this article may stimulate your curiosity some more. Behind those doors exists the most energetic club in the University, namely, the Adelaide University Modellers' Club. The object of the club is not in feminine bodies, but strictly neutral and lifeless hand-made articles.

We are not (perish the thought) an "artistic" club, but very technical. The types of modelling indulged in are: (1) Aero-modelling, (2) Model Boat Building, (3) Model Railroading. This year the Modellers' Club is ten years old, and furthermore, it is the only club of its type in Australia.

Aero-modelling has in the past been the most popular activity. Flying, however, is severely restricted by the authorities, and thus club flying is limited to picnic days in National Park. Most, if not all the aero-modellers are or have been engineering students. Most prominent of the "Aeros" is Roger Duance (Tech.), who is S.A. Stunt Champ., and a leading exponent of radio building an R.C. model with a fibreglass fusilage.

Overlapping with the Radio Control Section is Model Boating. Nowadays all boats in the club are radio controlled, but a couple of years ago all boats were free-running. Only a few members have an active interest in this field, as it is exacting, and involves many hours of building and testing. The club's most notable exponents are Roger Duance, Brian Devitt, and Rory Thompson. Boat outings are usually conducted on the Torrens (when it's full!), and on picnic days. The radio equipment used by the R.C. members is all of modern design. A great portion of the equipment is factory made, but there is a tendency towards "home-made" equipment of good, simple, and modern design.

It should be noted that motors used in model aeroplanes and model boats are probably the most efficient internal combustion motors on the market, bar nothing. For larger size models "glo-plug" motors, running on methanol, are preferred, but where small motors only are needed, diesels, running on ether, are used. The abuse that the motors stand during normal use is unbelieveable,



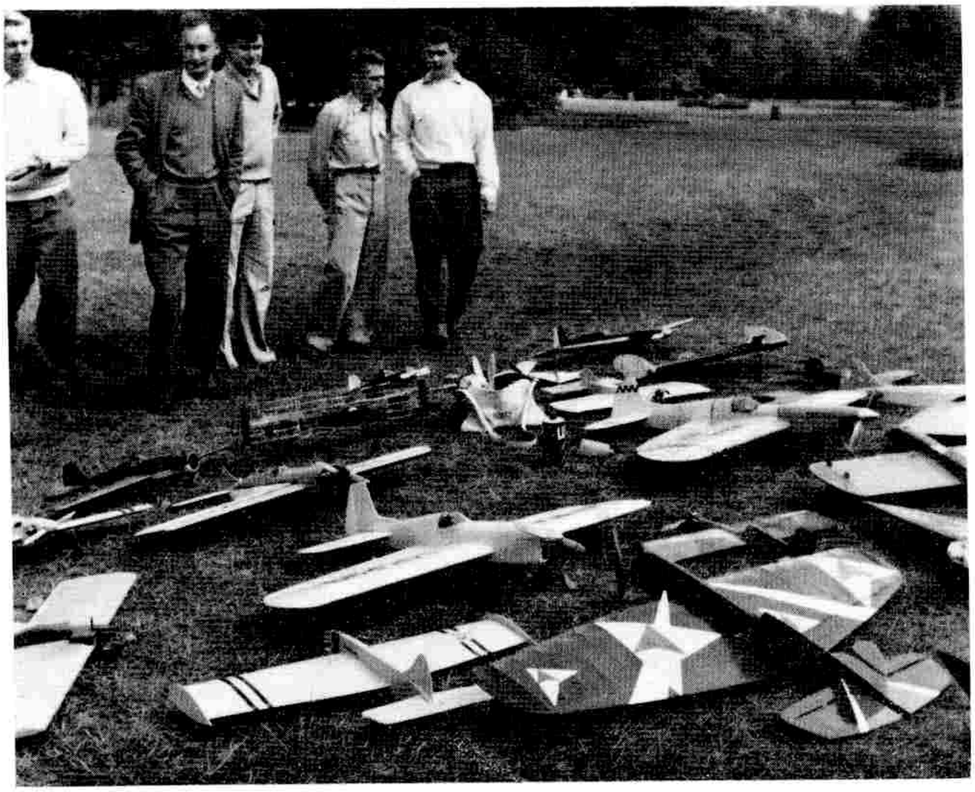
S.A.R. CATTLE CAR IN 35 MM./1 FT. SCALE

control and scramble flying in this State. Other experts in this field include A. Carpenter, P. Lyas (Tech.), and M. Mildren (all engineers). Roger Duance stunt flies a "monster" with a wing-span in excess of 5 ft., and an 8 cc. motor, which all adds up to some spectacular maneouvre, particularly on windy days.

Radio control flying is gradually becoming more popular. This is very specialised, and very exacting. Two of this year's fresher members from Engineering, Rory Thompson and Ross Patterson, are very keen enthusiasts. Ross Patterson is and the overall quality of the design and construction would put a lot of hand-built racing motors to shame.

At the moment the Model Railroading Section of the club is by far the most active, and has the most members. This is more of a club activity than Aero-modelling and Boat-building, as operation of members, models, and equipment is achieved on club premises. A railway system in miniature is under construction within the clubrooms.

The magnitude of the system has to be seen



LINE-UP OF MODELS AT A CLUB PICNIC

to be believed. It has been under construction for four years, and will not be finished for some years to come. By dividing the system into sections which can be used as complete units, both building and operation can be carried out at the same time. To attempt to describe the finished system in this article would be hopeless—only visual inspection could give any idea of the system.

Members involved in this project are a mixed lot (studies-wise), but one common interest draws them together. As the club layout is modelled on S.A.R. lines, and it is hoped to eventually use only S.A.R. locomotives and rolling stock on the layout, most of the members are producing models of S.A.R. equipment. These are built from general arrangement diagrams obtained from the S.A.R., and used in conjunction with good pohtographs and hand-measurement. A minimum of commercial parts is used in the construction of these models, and a wide variety of materials is employed. The railroaders' private modelling interests differ considerably, and on the operating night a great variety of locos and rolling stock is seen on the layout. Types range from C.R. Budd cars to vintage English trams. Model Railroaders are not well known outside of railroading circles. In the A.U.M.C. prominent model railroaders are John Nicolson, Clive Huggan, and club secretary Roger Wyatt.

The A.U.M.C. is always looking for keen genuine modellers. You don't have to be a "Da Vinci" to be a good modeller. Most of the present members work hard to make a model that is presentable, and performs its designed function. Standard of workmanship increases as the modeller becomes more experienced. So if you're interested in taking up a hobby, come down to see us one lunch time. If you'd just like to have a look around, come down and do so. Ask for Roger Wyatt or Clive Huggan to show you around and explain.

A word of advice for those people who think modelling takes up too much of their valuable time. It has been proved over the years that the keen and genuine modeller always manages to pass his exams.

ANSWERS

(For problems, see page 37)

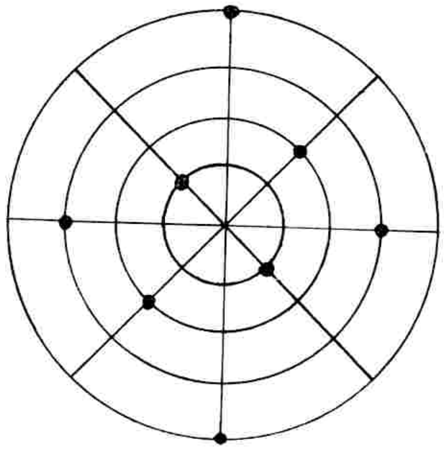
1.—Subtract 364 from 414 and from 539, also 414 from 539, and you get 50, 175, and 125. The greatest common divider of these numbers is clearly 25. And this is the number we want, for in every case, after division, there is a remainder of 14.

2.—The farmer has only one sheep. If he divided the sheep into two parts, making one part two-third and the other part one-third, then the difference between the two numbers is the same as the difference between their squares.

3.—Call the two ropes A and B. First tie the ends of A and B together, then climb A and cut off B, leaving sufficient to tie a loop. Hanging with your arm through this loop, cut off A, and pull the severed A through the loop until you come nearly to the knot joining B. Descend by the doubled rope, and then pull through the loop.

4.—Take six of the coins and place three on each scale. If the scales balance, the lighter coin will be in the remaining three. Of these, place one in each scale, and if they balance, the lighter coin is the one that remains. If, however, the coin should be among the first six weighed, eliminate the heavier three, and then, of the remaining three, place one on each scale, as above, etc.

5.—

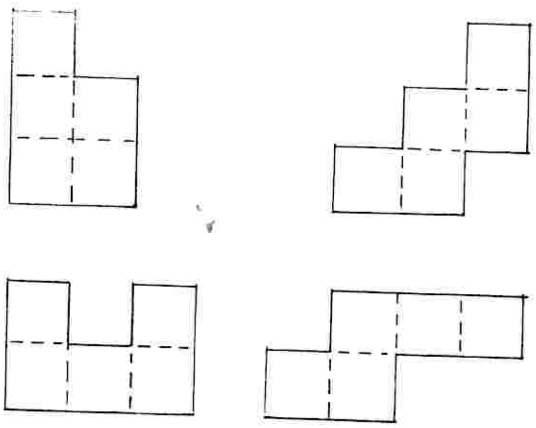


6.—The two were facing each other.

7.—One possible solution is:

```
 78219
 28,719
-------
106938
```

8.—The forged notes were numbers 109,103, 019,187, 111,192. The clerk knew at a glance because square numbers cannot end in 2, 3, 7, and 8.



Printed by E. J. McAlister & Co., 24 Blyth Street, Adelaide