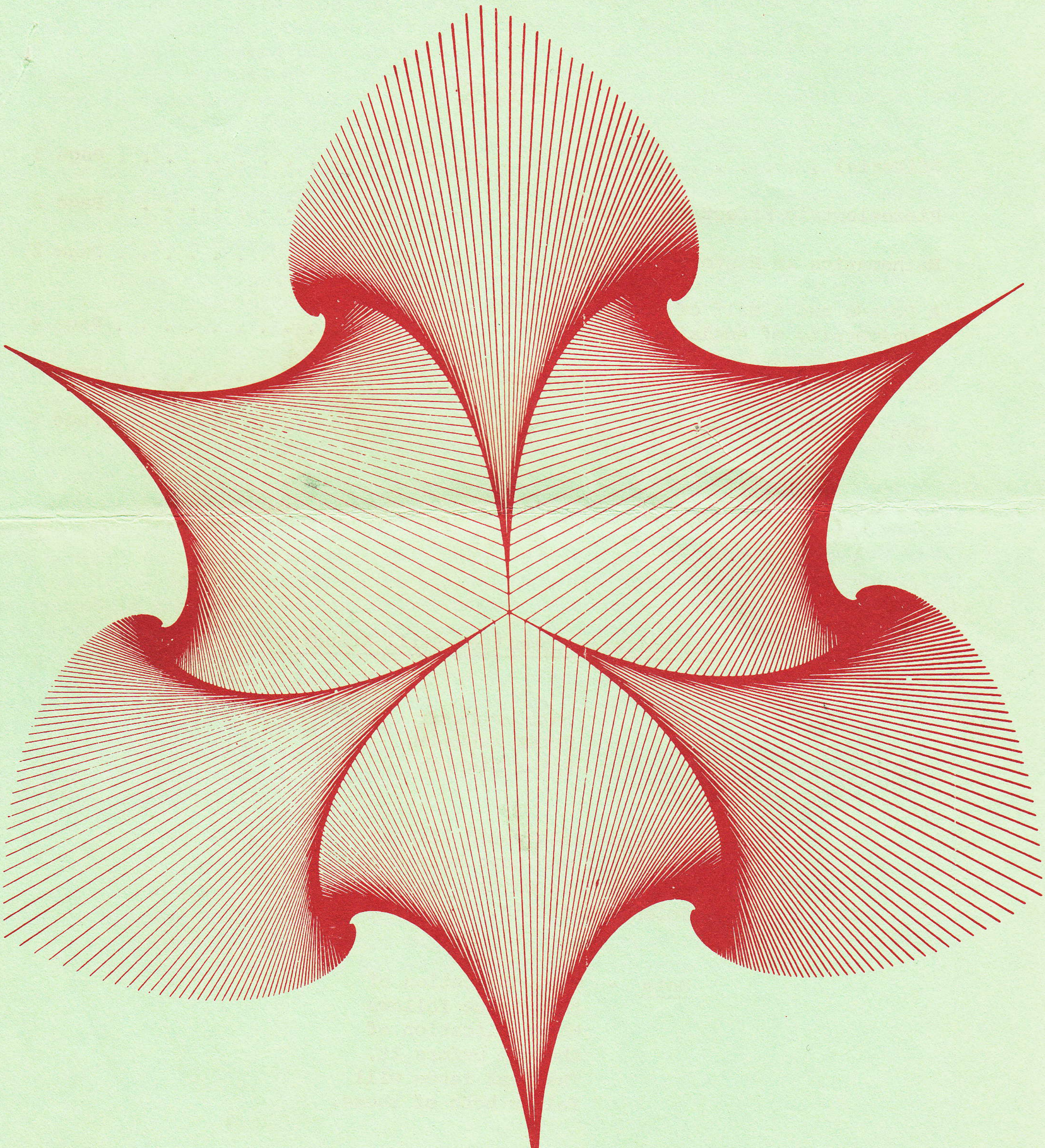
SCIENCE BULLETIN



Jane Gibson 5O

THE SCIENCE BULLETIN

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The Bulletin Committee Still Standing

Lachlan Peter
Peter Ashenden
Peter Liebich

The Committee would like to thank all who have helped to produce this edition of the Science Bulletin.

Note - The publication of this issue follows the publication of the one before it. The next issue will follow both of these.

EDITORIAL

Much has already been said about the impact of the use of modern technology in place of human workers. It is inevitable that there will be a sharp rise in unemployment. In fact, the consequences are already becoming evident.

However, unemployment of people in ordinary jobs is not a bad thing. One can see this by examining the changes in our society since before the Industrial Revolution. Before this time most people had to perform physical work to provide a living for themselves and their families. This left very little time for pursuit of interests and learning. During this time, rate of increase in knowledge was very low. The Industrial Revolution brought mechanisation of many of the tasks previously performed by people. By demanding a just share of the productivity most people were allowed more leisure time and there was an increase in the general standard of living. This included an increase in the general standard of education, and hence the rate of progress in learning accelerated. The trend continued through the period up to introduction of automation and increased in rate thereafter.

These continuing processes are now culminating in what many people refer to as the Technological Revolution. The distinguishing feature of the Technological Revolution is the use of the computer, a device which can be programmed to make decisions on given information and to control processes. This can potentially free people of most of the work involved in providing a living for themselves. A society which used computers in this capacity would have most of its time available for pursuit of interests, learning, advancement of knowledge and, most importantly, for providing a high standard of living for all people.

As I see it, the increasing use of technology today is an initial step towards this type of society. Each person need only work for the maintenance of the society for some relatively short time and only as he is able. Most of the work would be administrative or in the direction of the production processes. A person would then have time to become better educated, participate in community projects and recreational activities and fulfil personal ambitions. There would be less pressure on people, and this would be conducive to creative thinking, hence such a society would not be static. But in order for this society to arise, the people who now control production and directly receive its benefits must equitably distribute the wealth. If foresight and planning are not used liberally, the Technological Revolution could well occur in a revolutionary manner. It is up to us to act with wisdom, foresight, and justice, keeping in mind the goal for which we strive.

PETER ASHENDEN,
Assistant Editor.

Note - Letters to the Editor will be appreciated and, at the Editor's discretion, published in the Science Bulletin. Please post them C/- S.A.U.A. Office or place them in the Bulletin pigeon hole in Room S6. Thank You,

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PIEZOELECTRIC EFFECT IN POLYMERS - Peter Ashenden.

The piezoelectric effect is the generation of an electric potential across an object by the application of pressure. The effect was discovered by Pierre and Paul-Jaques Curie in 1880, and is found in many crystals. It is widely used in tranducers to measure pressure. Recent research by the American National Bureau of Standards has led to the discovery of a method of inducing the effect into synthetic polymers.

There are two similar theories to explain the effect. The first one says that dipole units in a polymer in a flowing state are oriented in one direction by application of electric field. With the field maintained, the orientation can be frozen by cooling the polymer. Thus a surface charge is caused, which depends on the net dipole moment divided by the volume. Pressure on the polymer changes the volume, and hence the surface charge, so that the potential depends on the pressure. The second theory says that there are actual charges seperated in the polymer, and that these are trapped in certain places on cooling, thus leading to the same properties.

The main advantages of polymer pressure transducers over ceramic or crystal transducers is their small mass and flexibility. They can be cut into any shape and simply glued onto curved or flexible surfaces. The films are virtually free of resonances and can be used to measure vibrations up to many Megahertz in frequency. They have a larger output for a given stress than conventional piezoelectric devices, and are practically immune to salt water, many solvents and mechanical shocks. Unfortunately, unlike ceramic or crystal devices, the polymers do not work too well in reverse. The change in shape for an applied voltage is much greater in conventional devices.

Another possible problem is that the voltage produced by a piezoelectric polymer depends also on the temperature difference across it. According to the application this may or may not be a real problem, and in fact use can be made of this property. By arranging the film so that heat radiation can fall on one side and not the other, a temperature difference is produced, giving a measurable voltage change. Such devices (called pyroelectric transducers) are extremely sensitive, and with some amplification a temperature difference of the order of one millionth of a degree can be detected.

An ever increasing number of uses for these devices are being devised, even though the theory of their operation has not been confirmed. The pressure guages are being used as impact detonators in explosives, impact measurement in car crash studies, pressure measurement in machinery and in living animals, and in microphones and hydrophones. Pyroelectric transducers can be used in intrusion alarms, fire sensing devices, mechanical fatigue measurement, and temperature monitoring in medical applications. It seems that we shall see much more of these devices as industry finds more uses for them.

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MATHEMATICS IN HISTORY - Eric Lord

Men began playing around with mathematics in early Biblical times, for we are told that Noah had his Arc, and that into this Arc animals went in ordered pairs. Later Arc. E. Medes added his bit of circle. And when Joan of Arc pitched in with her share the circumference was completed. Trigononmetry started in early Christian times when St. Paul gave his followers the sin of the cos. The other trig ratio did not come into existence until the famous sailor, H.O. Ratio Nelson, tanned the French at Trafalgar.

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Cleopatra taught Caesar a thing or two, including some mathematics. When he wanted to study the mensuration of the pyramid she told him he would learn more by studying her. So when this couple came vertically opposite, he analysed her curves of abnormal distribution. This was the first known study of statistics. After Caesar had sold Cleo this line, Mark Anthony sold her much the same line, so these two sides became the equal lines of the first eternal triangle. Cleo was at the apex looking down on those base Romans.

The inhabitants of North Germany must get the blame for much of our geometry, for it was from their shores that the Saxons, Jutes and Angles came. Now there were two main kinds of Angle. One was a fat male called Obtuse and the other was a sharp little dolly called a Cute Angle. They were an unordered pair who enjoyed all sorts of fun throughout a number of counties. The nature of their fun is not known for sure but can be reasonably deduced from the counties named after them - Middlesex, Sussex, Wessex and Essex. Surprisingly, the children of their union turned out all right, and so became known as Right Angles.

Believe it or not, Lady Godiva has an honoured place in the history of mathematics. It is well known that in her ride through Coventry she got down to bare facts, which led business men to shocks and stares, later transposed. Offended by her appearance, one resourceful clothier offered her one of his creations to cover her modesty. The name of this clever chap was Al G. Bra, and his work opened up a new field of mathematics which had some spin-off into anatomy.

Henry VIII had a flair for wives and mathematics. He ruled his wives and mathematics ruled him, as can be seen from a researcher's data.

Number of wives beheaded - two.
Number of wives not beheaded - four.
Number of wives - six.
Number of kings named Henry - eight.

From these figures, which have been thoroughly checked out by an IBM computer, it is clear that Henry was the discoverer of the Arithmetic Progression.

It is generally conceded that the arithmetic of fractions started with Oliver Cromwell, for when he had finished with Charles I, the worthy monarch was only a fraction of his former self. Charles, of course, considered himself a proper fraction, but Cromwell thought him improper and even a little vulgar. But who was Charles to argue, for he never had a head for figures.

Until the discovery of Australia the common white man had not been able to count beyond the ordered pair. So, when Captain Phillip arrived with X number of ships and Y number of convicts to visit a cove named Sidney, he was hoping to learn from the Aborigines how to count past two. But they were no help. This worried the squatter, John MacArthur, so much that he couldn't sleep at nights. So he went out and tried counting his sheep. He must have been successful in counting past two, and taught all and sundry his new system. The evidence for this is in the words of the jolly swagman who, upon seeing the troopers advance towards that jumbuck in his tucker bag, said loud enough for future generations to hear, "One, two, three!" Jumped-up officials all over Australia now wanted to show their education by counting past three. This led to the famous clash at Eureka Stockade. It was brought about by the police who, to compensate for their not being smart enough to find gold, made a show of their superior education. They did this by counting the miners' licences. Annoyed at such displays of erudition, one Italian digger shouted at a policeman, "You reeka!" This insulting remark led to a clash between LCM (Lowest Common Man) and HCF (Highest Colonial Fuzz). The result was that some miners were chained to trees with square roots, others to trees with cube roots, and so on.

Irrational as it may seem, this was the break-through into modern mathematics the world was waiting for. And if I had the time and the space to write about Time and Space I would discuss Einstein, a square who worked with the speed of light. I would talk about the fourth dimension, but as this page only has two dimensions I'll cut short such a discussion and merely say that modern mathematics

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is a game any number can play. There are no prizes for the right answers. In fact, there are no right answers. Or, to put it another way, the number of right answers forms an empty set.

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"Nothing is as ancient as progress." - Japanese proverb.

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A DECADE AND A HALF OF ROCKET RESEARCH AT THE UNIVERSITY OF ADELAIDE

B.H. HORTON, DEPARTMENT OF PHYSICS, UNIVERSITY OF ADELAIDE

(First printed in The Australian Physicist, August, 1977)

PART III

A further experiment in collaboration with scientists at the U.S.N.R.L. involved a package to observe electron energies and 630.0 nm airglow from the atmosphere and to study the distribution of Extreme Ultra Violet emission from the galaxy during a night flight while the U.S. observers took vacuum ultra spectra of selected stars. D. Gigney travelled with the Adelaide package to the U.S., funded by a U.S. grant for travel, and successfully completed the integration. It was dis ppointing, after a lot of ingenious design effor, construction of a removable door and the high density instrumentation, to hear of a vehicle failure in flight.

In parallel with these activities the Cockatoo rocket programme continued with day and night flights observing atmospheric molecular oxygen and ozone (Carver et.al., 1974a), (Carver et.al., 1974b). In 1973 there was a policy change relating to the construction of the Australian rockets for the Adelaide University Programme. Whereas previously only the payloads were constructed at the University, mounted in metal work from the W.R.E., after this time the whole responsibility for the rocket was given to the University. While the handling of motors and launch was contracted to W.R.E. the remaining metal work was designed at the University and contracted to outside firms. The complexity of the items and the obtaining of them presented a challenge and gave an education to those used to the mothering care previously given by W.R.E. With the background support from this guiding hand and one more staff member, D. Rose (later replaced by A. Jones) who handled the drawing and design stages, the programme went ahead. With the addition of G. Bibbo to the group and the assistance CSIRO Division of Chemical Physics, work expanded into the field of rocket borne mass spectrometry and Dr. Schaeffer as a Research Fellow supported by ARGC succeeded in the task of fitting forward viewing airglow photometers into the 12.5 cm diameter Cockatoo without requiring the complication of a removable nose cone. This design problem was met and solved for the mass spectrometers in a short time and proved satisfactory.

In 1975 the group was given the opportunity of taking a major part in the Goddard Space Flight Centre Woomera Expedition of 1977.

There had been participation in a previous expedition in 1974 but this was a minor exercise in providing a small instrumentation package. The 1977 exercise was based on the supply of a complete Aerobee 170 payload to be fired by the Goddard team while in Australia. These firings were undertaken for a number of U.S. institutions.

While it was known that acceptance would severely inhibit continuation of the Cockatoo-Lorikeet programme the chance to instrument a multi-purpose payload

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was eagerly accepted. During 1976, with considerable engineering advice from Goddard and work at Adelaide, a very comprehensive set of upper atmospheric experiments was assembled. The solar spectrum over the range from X-Rays to the near UV limit was investigated by X-Ray proportional counters, a grazing incidence scanning monochrometer, designed by J. Lean (looking at three EUV Bands), ion chambers for Lyman and other VUV Band intensity determinations and a scanning monochrometer covering the band 130.0 - 180.0 nm. A four band atmospheric airglow photometer completed the radiation detectors. Two mass spectrometers, one for neutral and one for positive ion species, were supplemented by a retarding potential ion energy analyser while electron energies were to be studied by electristatic and retarding potential analysers. The combined experiments made up one of the more detailed studies of solar radiation reactions with the atmosphere that has been flown on a rocket anywhere in the world. The rocket was fired successfully at 7.30 a.m. on February 22nd, 1977, a time well suited to the study of the developing ionoshpere. Despite the possibility that the removed nose cone appeared to have remained in view of the airglow photometers, all instruments performed satisfactorily and analysis of results is now proceeding.

To date the Adelaide University Rocket Group has instrumented some forty rocket payloads as well as playing a part in the preparation of Australia's satellite WRESAT I and several international programmes. The technology developed has also been applied to balloon payloads launched in Australia. Research students involved in the programme have obtained seven Ph.D. degrees with, it is hoped, more to come based on work already performed.

In common with most rocket groups around the world, since 1972 economic restrictions have severely curtailed operations. It is hoped that an improvement in the financial situation will permit these restrictions to be overcome and the present capabilities applied to the search for knowledge in this challenging field.

References:

Carver, J.H., Mitchell, P., (1964) Journal of Scientific Instruments, 41, 555.

Carver, J.H., Horton, B.H., Burger, F.G., (1967) p.1020 Space Research VII, North Holland Pub. Co., Amsterdam, Holland.

Carver, J.H., Edwards, P.J., Gough, P.L., Gregory, A.G., Rofe, B., Johnson, S.G., (1969) J. Atmos, Terr. Phys., 31, 563.

Carver, J.H., Horton, B.H., Lockley, G.W.A., Rofe, B., (1973) Solar Physics, 27,347.

Carver, J.H., Horton, B.H., O'Brien, R.S., (1974) Report Proceedings First General Assembly, Melbourne, I.A.M.A.P., Pub., 15a P. 63.

Carver, J.H., Horton, B.H., and Ilyas, M., (1974) Report Proceedings First General Assembly, Melbourne, I.A.M.A.P., Pub., 15a P.79.

Francey, R.J., Fenton, A.G., Harries, J.R., McCracken, K.G., (1967) Nature, 216, 773.

Francey, R.J., Fenton, A.G., Fenton, K.B., Cooke, D.J., Barnden, L.R., Boherty, L.E., Gregory, A.G., McCracken, K.G., Tuohy, I.R., (1967) Proceedings A.S.A., 1, 240.

Friedman, H., Chubb, T.A., Kupperian, J.E., Lindsay, J.C., (1958) Annals of the I.G.Y. Vol. 6, p. 316.

Heddle, D.W.O., (1962) Nature, 193, 861.

Lockey, G.W.A., Horton, B.H., Rofe, B., (1969) Nature, 223, 387.

Lockey, G.W.A., (1972) Ph.D. Thesis, University of Adelaide.

Malcolm, P.R., (1972) Journal British Interplanetary Society, 25, 61.

Mitchell, P., (1966) Ph.D. Thesis, University of Adelaide.

O'Connor, G.G., (1973) Ph.D. Thesis, University of Adelaide.

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SOLUTION TO LAST EDITION'S CROSSWORD

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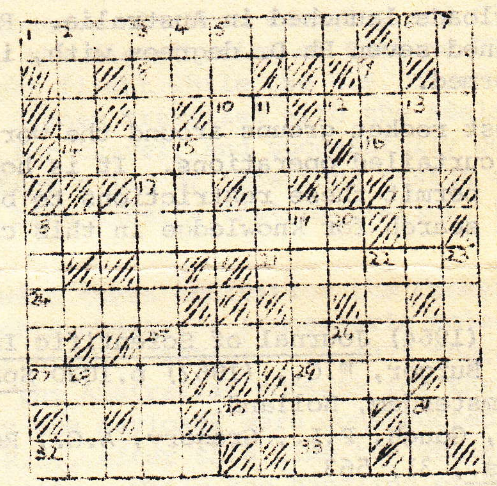
THIS EDITION'S CROSSWORD



CLUES

ACROSS

1) Gradual process of change.
6) On the condition that.
8) Anger.
10) Radio frequency (abbr.).
12) Medieval weapon.
14) Cycle having a perion of one day.
16) Periodic sexual excitement of male deer.
17) Osmium backwards
18) Revolving shaft with blades attached.
21) The condition of week-old bread, relative to day-old bread.
24) Island once rich in phosphate rock.
25) The study of freshwater environments.
27) Contra.
29) Land plan.
30) Rock shellfish.
31) Pronoun (masc.).
32) Region of New Zealand.
33) Nitrophenol (abbr.).

DOWN

2) Empty space.
3) Double Nobel Prize winner.
4) King of the Ancient Chaldeans.
5) Sea bird.
7) Prominant feature of macropods.
9) Not near.
11) That which happens to one who does not pass.
13) French husband and wife scientific team.
15) Fish eggs.
18) Chinese mammal.
19) Turkish rulers.
20) Papyrus raft which crossed the South Atlantic in early 1970's.
22) Electric circuit forms a current _______.
23) Business partner of Mr. Rolls.
26) Light.
28) Negative.
31) Semi Santa Claus.

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