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R.S.R.S.
NEWSLETTER

N°86

June 1968

S.I. Units

Scientists have long desired to simplify the systems of units in which the results of their work are expressed. How this should be done has been a matter of controversy, but it has come to be recognised that the following two features should be present in a system of units.

(1) Different units of the same quantity should differ by a factor which is a power of 10.

(2) Units of different quantities should be related in a simple manner. The ideal here is that each quantity should have a principal unit, and that when a quantity is formed by combining two others, the principal unit of the new quantity should be formed if the principal units of the other two are used to derive it. A system of units built up in this way from a few basic units is said to be coherent.

A major step forward was taken in the latter part of the 19th century, when the metric system was universally adopted for scientific work. The CGS system was then used in physics, with the centimetre, gramme, and second as basic quantities. It worked very well in mechanics, but because of the complications of electromagnetism it became associated with three different systems of electrical units. The troubles caused by this proliferation were soon recognised, and as early as 1901 Georgi showed that a single system of units could be obtained by using practical units in electricity (the ampere, volt etc.) and taking the metre, kilogramme, and second as the basic units in mechanics. This became known as the MKS system, and later the MKSA system when the ampere was selected as the basic unit of electricity to be added to the other three.

Despite the considerable advantages of the MKS system many years elapsed before it came into general use. Electrical engineers were its most enthusiastic supporters at first, and the MKS system was adopted internationally by the International Electrotechnical Commission in 1935. This body accepted the MKSA system in 1950. From that time its progress was more rapid and in 1954 the latter system was adopted by the Conférence Générale des Poids et Mesures (C.G.P.M.), an international body of great authority. A number of organisations

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then supported a policy of incorporating MKSA into a wider system which would eventually cover all units used in science and technology. The C.G.P.M. adopted such a system in 1960 and gave it the name Système International, officially abbreviated to S.I.

S.I. units are all derived from six basic units - the four in MKSA with the addition of the degree Kelvin and the candela. This enables the whole of physics to be covered by a coherent system. S.I. units are rationalised (as indeed was the most commonly used form of MKSA) to banish the annoying factor 4π to equations which are not used so frequently. In particular, Maxwell's equations take a very simple form after rationalisation. Another feature of S.I. is the standardised method for forming multiples and sub-multiples of quantities.

In this country there is now a considerable drive in progress to bring S.I. units into use and to discard other systems. Institutions of engineering and physics are encouraging their use, and editors of scientific journals are recommending them. Schools, universities, and examining boards are changing over to S.I., so that in a few years we should be receiving recruits who are not familiar with other systems. Even in fields outside science S.I. will become prominent as the British Government intend to make it the primary system of weights and measures in the country.

It was therefore felt that some effort should be made to familiarise R.S.R.S. staff with these units, and to encourage the use of S.I. in the work and publications of this station. An I.M. (No. 309) entitled 'Guide to S.I. Units' has been produced and is available. It has received a fairly wide circulation, but staff who do not have their own copy, and wish to receive one, should enquire at Registry, where some additional copies will be available for distribution.

Undoubtedly inconvenience will be caused in changing to S.I., but the advantages of having a single coherent system in all disciplines are so great that the difficulties should be quite tolerable.

W. C. Bain

Review Notes

It is hoped to include, as frequently as possible, information about the various aspects of the Station's work. This will, in general, be based on data prepared by groups for use in current progress reviews.

Editor

Refractive-Index Variations in the Troposphere

The objective of this project is to measure the small-scale variations of refractive-index in the troposphere and to relate these to the scattering of radio and optical waves and to changes in the vertical distribution of temperature, humidity and wind velocity. Apart from their relationship to theories of turbulence and fine structure, the results are important in evaluating the magnitude of gain degradation on very large antennae, bandwidth limitations on microwave links, and phase and amplitude fluctuations on space communication systems. Recent experimental work, carried out at Cardington and at Wallops Islands in the U.S.A., has concentrated on the determination of the spectral characteristics of the refractive-index fluctuations and these have been related quantitatively to clear-air echoes observed on centimetric radar. New refractometer and data-processing equipment has been built to extend these measurements to provide data on the three-dimensional structure of refractive-index variations and the relationship between space and time spectra. Particular interest is attached to soundings by balloons in layers of large variance at heights of 1-2 km. Later in the summer collaborative experiments with a group from the Norwegian Defence Research Establishment will be carried out in which the R.S.R.S. refractometer will operate simultaneously with rapid-response humidiometer and thermometers made by the Norwegian group. These investigations will be conducted at Cardington, Bedfordshire, using large tethered balloons and will be combined with soundings of the troposphere by laser radar (LIDAR). Work in the U.S.A. and at R.S.R.S. has indicated that lidar echoes can be obtained from haze layers associated with temperature inversions in the troposphere and joint soundings with the instruments on the Cardington balloon should provide interesting data on the structure of the troposphere. There is already much evidence from recent R.S.R.S. work that some degree of stratification is present for a much larger fraction of the time than many workers had thought likely.

Tropospheric Wave Propagation Group

An outline of the work of this Group was given at a recent information meeting, but your Editor has requested something rather more specific arising from the last progress review.

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The main effort at the present time is in setting up an experiment near Chilbolton using four wet-and dry-bulb psychrometers mounted on four 100 foot masts in a line over one and a half miles. The sondes are automatically raised and lowered on these masts every fifteen minutes, and the wet-and dry-bulb temperature information is telemetered back to Cardington so as to produce information on the change of radio refractive index with both height and distance. This is an extension of work done at Cardington using radiosonde psychrometers on (normally!) tethered balloons. When the Chilbolton dish is available again the sondes will be used to compare refractive index profiles with multipath interference effects seen on a line of sight link near Chilbolton last year, and at Widley/Green Hailey in the past.

Preparations continue for other tropospheric experiments to be carried out using the Chilbolton dish in due course, and some effort also goes in supervising a G.E.C. contract on tropospheric scatter on behalf of Ministry of Technology. Contact is maintained with a U.K/N.A.S.A. liaison committee which coordinates the experiments of British groups working with A.T.S. (navigational) satellites.

Particular consideration has been given recently to a proposed joint tropo-scatter experiment with the C.N.E.T. (France); the 85 ft. diameter dish at Chilbolton would be used to receive 2.2 GHz transmissions from Lannion, the French equivalent to Goonhilly. The objective would be to examine gain degradation on the large dish by comparison with the signal received on a smaller dish. The experiment might well be linked with work already proposed, to receive 2.6 GHz transmissions from Hemsby at Chilbolton.

STATION NEWS

Recent Happenings

The Chilbolton Aerial. The new bearing was installed satisfactorily and although rehabilitation is not finally complete, it looks as though the completion is all over bar the shouting. We still hope for a resumption of experimental work at the end of August.

Dr. Bain is attending the U.R.S.I. Symposium on Electromagnetic Waves held at Stresa, Italy from June 24 - 29 1968.

Dr. Dickinson attended the E.S.R.O. Symposium on Calibration Methods in the U.V. and X-Rays, held at the Max Planck Institute, Munich from 27th - 30th May.

STAFF NEWS

The degree of D.Sc. of the University of Manchester has been conferred upon Dr. Horner. May we, on behalf of the Staff of R.S.R.S., offer congratulations on this well-merited appreciation of his work.

Congratulations to:

Dr. D. A. Bryant	now	P.S.O.
Dr. D. L. Groom	"	P.S.O.
Dr. D. T. Llewellyn-Jones	"	S.S.O.
Dr. I. A. Parkin	"	S.S.O.
Mr. R. Christie	"	S.E.O.
Mr. F. D. G. Bennett	"	E.O.
Mr. V. J. G. Brown	"	E.O.
Mr. C. M. Comer	"	E.O.
Mr. P. L. Ooi	"	E.O.
Mr. A. E. Smith	"	E.O.
Mr. S. J. Thompson	"	A.E.O.

Miss Clare Seabrook (Ex. R.S.R.S.) and Mr. A. Bishop on their marriage on 1st June.

Welcome to:

D. S. Hall	Perm S.O.
P. A. Eggett	Perm S.A.
Mrs. E. R. Wright	P/T Tracer
J. G. Bartlett	Non Perm A.E.O.
A. Anderson	Unskilled Labourer
J. Garrett	Vacation worker
B. G. W. Colls	Vacation worker
P. R. Thornton	Vacation worker
P. H. Woollacott	Vacation worker

Resignations:

H. F. C. Cutler	Non Perm C.O.
J. D. Stroud	A.E.O.
Mrs. M. Hunt	P/T Tracer
Mrs. S. M. Lowes	P/T S.A.
G. D. Smith	A.E.O.
W. J. Campbell	Painter

THE R.S.R.S. VISIT TO HERSTMONCEUX

After touring Dorking and other towns en route the coach party were greeted on arrival at Herstmonceux by other R.S.R.S. visitors who had travelled by car. The party was split into two groups, one touring the Equatorial Group of Telescopes, the other, parts of the Castle.

The castle, dating from the 15th century, is realy a fortified manor house and would never have stood a siege, even though it was the largest brick building in Northern Europe, with outer walls about three feet thick. Having fallen into ruins, the house was restored by Sir Geoffrey Lowther at a cost of about half a million pounds. The buildings are built against the outer wall round a single central courtyard. Many of the interior fittings came from a similar Derbyshire house, one intricate bannister panel being carved by Grinling Gibbons from a single piece of oak. The moat is water-filled for three-quarters of its length and is spanned by a picturesque brick bridge. The formal gardens lie behind the castle and require the services of five gardeners.

The observatory library has an excellent collection dating from Newton's time, of which the earliest works are housed in the gallery of the main hall which has become the library. Many earlier works are in the library of the Royal Astronomical Society.

During lunch, the first of the afternoon's rain started to fall. This was not allowed to interfere with the sporting events which started at the appointed time. In fact, one tennis player was heard to say that they could not stop since the cricket was still continuing.

The cricket was played in an excellent setting with the castle in the background. The game had an added interest as it was rumoured that there was a bottle of whisky for anyone who hit the ball into the moat, a feat thought by one R.S.R.S. playe to be just about possible.

R.S.R.S. elected to bat first and made a total of 122 (Boulton 29, Hussein 40, Bramley 29). The Director came in to bat soon after the Astronomer Royal had put himself on to bowl. After a few lusty strokes, the Director was out to their accurate fast bowler whose analysis was 14 overs, 3 maidens, 4 wickets for 20 runs. After tea R.G.O. fairly rapidly knocked off the required runs to win by 7 wickets. Our fast bowlers were hampered by a wet and rather soft ball which made accuracy difficult.

The tennis was to have been four mixed doubles matches, both couples from each side playing both opposing couples. In the event, one match was completed and lost, and one not played. Both the remaining matches were abandoned in the second set, R.S.R.S. having lost the first.

After tea there were also further conducted tours of the Castle and Equatorial Group of Telescopes. These six telescopes were originally at Greenwich and are of both reflecting and refracting types with apertures up to 36 inches, each housed in a separate dome. We saw one reflector and one refractor. One of these telescopes has a 13 inch telescope mounted parallel to it, to be used for initial sighting. One of the domes housing these telescopes had a moveable floor, a fact which caused consternation to a few members of party who had decided to examine the dome exterior first.

The principle of mounting the telescopes is the same, but different methods are used. The telescope is mounted so that it can rotate about two axes. The first (polar) axis is parallel to the earth's axis with the second (declination)

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axis perpendicular to it. To observe a particular star, the telescope is set at the correct right ascension (longitude) by rotation about the polar axis and declination (latitude) using the declination axis, and then followed by rotation about the polar axis at the same rate as the earth's spin.

The whole party then re-assembled for the visit to the impressive Isaac Newton Telescope. This is housed in a 60 ft. tall dome so as to be above much of the ground-level atmospheric turbulence. The 98 inch mirror weighs four tons and its mounting ninety tons. The mirror itself is mounted on air cushions so as to reduce the distortion caused by its own weight. The polar axis bearing consists of a large diameter steel plate on which the telescope is mounted, and resting on a number of steel "pads", through holes in which oil is forced between pad and steel plate. Thus in fact the telescope rests on a thin film of oil which forms a virtually frictionless bearing.

Our thanks must go to Bob Fitchew and Tony Dagnall for organising the trip, to members of the R.G.O. staff for acting as guides and opponents, and not least to over seventy members of R.S.R.S. staff and families for coming.

Robert Pratt

THE NEW BOOK-COPIER

Those of you who are regular visitors to the library will have been aware of the new device which has recently been installed, and which sits humming quite quietly in a corner. This is not, I hasten to add, a new computerised librarian, but an electrostatic copier. Its appearance is not unlike a piano, with modifications of course. It is capable of copying single sheets of paper as well as books up to 3½ inches thick, even with a thick volume there is very little distortion of the printing. Very easy to operate, it has push button control and can be set to produce ten copies at one time. So if you do not want to have large bound volumes piled on your desk make a copy of the article you require.

E. Knight

WHICH

Subscriptions are due for renewal when the July issue arrives at the beginning of the month. If you wish to renew your subscription or start one, but will be away in July, please send me a note to this effect, preferably with the money, before you depart. All subscriptions not paid up by Friday July 19th will be cancelled (cheques should be made payable to R.S.R.S. Sports & Social Club).

Veronica Lovell

LETTER TO THE EDITOR

Dear Editor,

May I be permitted to congratulate you on the latest edition of the R.S.R.S. Newsletter? The inclusion of much more station news, particularly in the brief, readable form of the last issue or two, helps to make the Newsletter more interesting and, I am sure, more useful.

I think it would also be pertinent to mention your "Letter to the Outstations", which constantly enlightens the dull hours of those of us posted to distant parts across the grass from the main building. May inspiration never fail you!

Yours sincerely,

Chris R. Boulton

COMING EVENTS IN JULY

Wednesday 17th July S.R.C. Sports Day
Saturday 20th July Hop
Tuesday 30th July Rowing Evening.

Details will be posted on the Sports and Social Club notice boards prior to the events.

Bob Fitchew

S.R.C. SPORTS DAY

On Wednesday, 17th July, an event of major significance for the Sports and Social Clubs of S.R.C. establishments will take place - the fist S.R.C. Sports Day. Teams from the different establishments will compete against each other in cricket, tennis, and possibly bowls. Matches will start at 2 p.m. at the Civil Service Sports Ground, Chiswick, and will be followed by a social evening at the clubhouse there. Subject to official confirmation, it is expected that participants and spectators will be allowed time off, and that participants will be allowed expenses also. The Sports Day thus provides a unique opportunity for R.S.R.S. members to meet fellow S.R.C. workers from the other laboratories and observatories, and it is hoped that a strong contingent of both players and supporters from R.S.R.S. will attend.

Bob Fitchew

CRICKET SECTION

Since the last report three matches have been played, with mixed results for R.S.R.S. Our first external match of the season, against I.C.I., took place on 22nd May, at R.S.R.S. Our visitors batted first, and revelled in the bowling, the boundary being cleared five times. At the end of their 20 overs they had 108 for 7 wickets on the board, Nightingale having compiled 43 of them,

mostly in boundaries. Against somewhat mixed bowling - I.C.I. bowled everybody - R.S.R.S. found runs harder to come by, although Bellchambers (32) and Martin (16) did their best. Twenty overs found our score at 58 for 6, and the match lost by 50 runs.

On 28th May, as part of the "Sports Evening" with A.C.O., we had better fortune. Eric Dunford lost the toss (again!) and A.C.O. elected to bat. They proceeded quietly, contained by some tight bowling. Few wickets fell in the early part of the innings, but Flynn (3 for 9) and Hussain (2 for 14) in a Brian Close-like position in the gully, were a great encouragement. Replying to the A.C.O. total of 42 for 7 wickets, R.S.R.S. again found runs a little difficult to get, and after 10 overs only 13 were scored. Some most unprofessional strokes from the middle order helped things along, however, and aptly enough it was Eric Dunford who hit the winning run with two overs to spare. Moosajee (10) was the only person on either side to achieve double figures.

London Office produced a strong, if depleted, side to play us on 6th June. R.S.R.S., batting first, made their usual slow start. This was not for want of trying, but it was not until Johnson (14) and Moosajee (24) came together that the score began to really mount. Even so, our 68 off 25 overs was not enough to pit against our opponents' good batting. The bowlers tried hard to keep the runs down, but London Office passed our score after 19 overs, for the loss of only four wickets.

A practice net should have arrived by the time you read this. We would like to see it used as much as possible, so if you have not tried your arm yet, please come along.

C.R.B.

R.S.R.S SPORTS AND SOCIAL CLUB

Vigilant readers of the Estimates for 1968/69 will have noted the entry "excess income over expenditure - £97. 8s. 1d". The main reason for this rosy financial situation is the recent doubling of the Civil Service Sports Council subscription rate, and the consequent increase in the rebate which we receive from the C.S.S.C. In subsequent years, after repaying the final instalment of the loan for the tennis court, our income will increase by a further £70 per annum.

However, it is not the policy of the club to amass large sums of money, and the problem arises of how to dissipate at least part of our new-found wealth. The committee, of course, has some views on this, but we would appreciate the suggestions and comments of <u>individual club members</u> as to how money should be spent to improve the facilities of the club. Consideration should be given both to immediate and long-term expenditure. For the former it is likely that certain items would qualify for C.S.S.C. grants (probably on a £ for £ basis); for the latter C.S.S.C. loans may be available (interest-free and repayable over several years).

If you have any views on this subject (and remember that it is <u>your</u> money we are talking about) please communicate them to the committee.

Graham Thomas
On behalf of the Committee

MUSES' MEMORANDUM

The Editor's really horrid
To talk of Union hours,
When we worked in heat so torrid
That we wilted, - like the flowers.

The scientist will tell you
He can't work by the book,
That when an idea grips you
It holds you like a hook.

Your nose is to the grindstone
Your shoulders to the wheel,
Your back is up against the wall
And you socks aren't down at heel

We worked beyond the daylight
Into the evening gloom,
Until the lights were all put out
Up in our first floor room.

We blamed our Mr. Savage
For leaving us in the dark,
But in spite of all these troubles
We managed to make our mark -

By appearing in the paper
Which gives the Station's news,
Where the Editor's always appealing
For the staff to give their views.

Now take a lesson from us
And all pick up your quills,
(To stop the Editor taking
His tranquiliser pills.

He eats them by the score you know
To calm his shattered nerves),
And help produce the paper,
Which he so nobly serves.

Dear Colleagues,

Now we are on 'offset'. Our bold, brazen (and temporary) heading is all of a piece with the fact that we offer our wares no longer blushing pink and virginal. You may well say that some six years is an unconscionable time a-getting used to receiving your attentions, well, maybe so; anyway here we are, full of hopes that future issues may be illustrated from time to time. Let the Illustrated London News tremble, not to speak of Playboy.

We are all sorry to learn that ill-health has forced Bill Campbell to retire. His shop has long provided a finishing school wherein many a slovenly and unhandsome thing of our making has been translated into a gleaming professional-looking production. For this deceit much thanks, Bill. May you long enjoy your retirement.

Remember those ducks? They're still around; indeed within the fecund ambience of this, a propagation laboratory, one pair has given the lead in productivity increase. Hatched hard by the workshop wall, a collection of youngsters appeared, eventually to be lead, by mother, in line ahead, to that great world the moat.

Elsewhere in this issue is the account of our visit to the Royal Greenwich Observatory. Most enjoyable despite the weather. There was the backdrop of the Great House, the inner Court and walled garden, the croquet lawn and landscaping. Downstage moved the white-clad figures, flitting to and fro and, of course, there was the rain. The whole affair was splendidly, wairdly, British; well worth a visit by even so inept a sportsman as,

Yours sincerely,

The Editor

REPRINTS MAY 1968

V. H. F. Radio Propagation by double-hop reflection from a tropospheric layer, by M. E. M. Hall, published I.E.E., Vol. 115.

The motion of a charged particle in a twisted magnetic flux tube, by D. M. Willis, published J.A.T.P., Vol. 16 pp. 395-408.

Normal and abnormal absorption at high latitudes by W. R. Piggott, reprinted from Ionospheric Radio Communications (Plenum Press 1968).

INTERNAL MEMORANDA

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308	Radio interference from I.C.T. 1905 computer at R.S.R.S.	F. V. Bale & S. T. C. Quek
309	Guide to S.I. Units	W. C. Bain
310	Papers presented at COSPAR, Tokyo, May 1968	J. W. King
311	Attitude determination of the Ariel III satellite	R. B. Bent