RSGB

BULLETIN

NOVEMBER 1966
VOL. 42, No. 11

A report on the recent DXpedition to the Isle of Arran appears on page 740

ALSO IN THIS ISSUE

FET Converters for 2m and 4m

"Technical Topics" and many other technical articles

JOURNAL OF THE RADIO SOCIETY OF GREAT BRITAIN

RSGB INTERNATIONAL
Radio Communications Exhibition
1966

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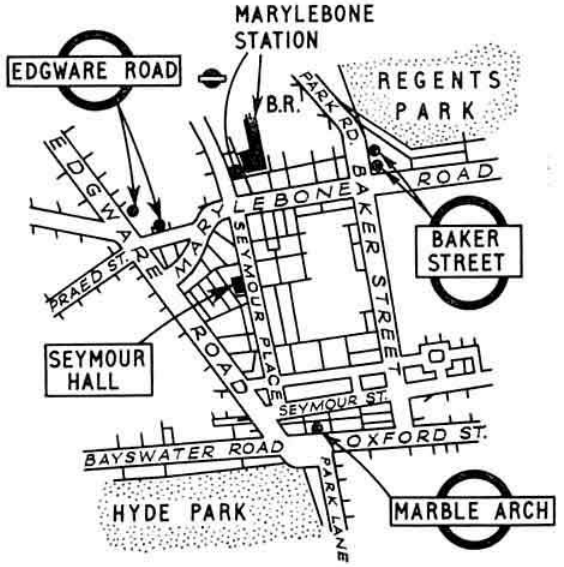
A special reception for foreign amateurs will be held on the evening of Friday, 28 October.

There will be a free draw for a communication receiver.



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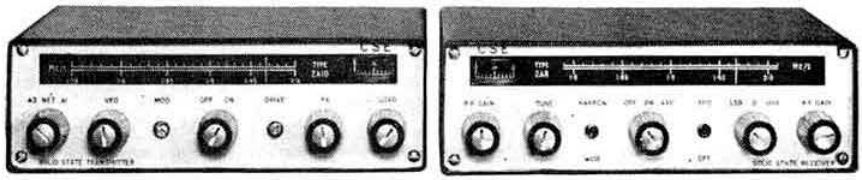

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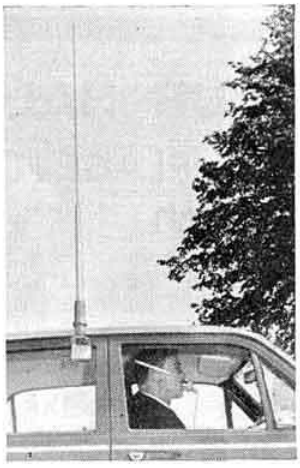

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R S G B BULLETIN

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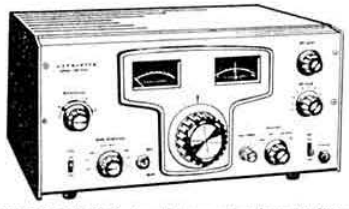

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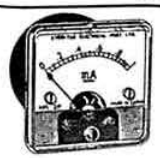

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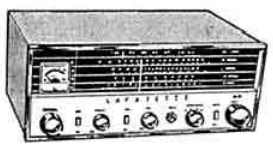

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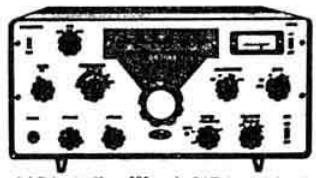

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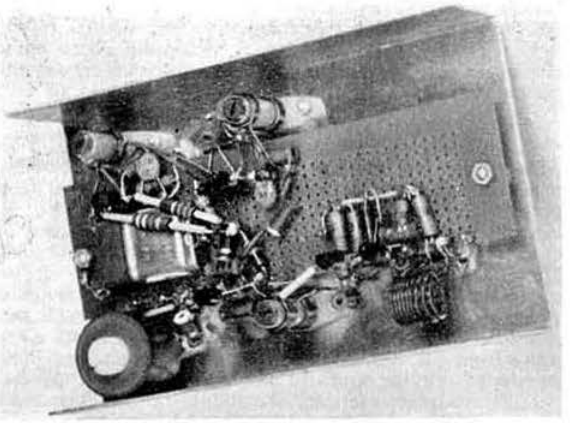
FET Converters for Four and Two Metres

By A. L. MYNETT, B.Sc., G3HBW *



A 4m FET converter with a cascode amplifier.

THIS is the first of a series of articles upon the topic of v.h.f. receivers. It describes the form and construction of two converters, using field effect transistors, one for 4m and one for 2m, which are simple in concept, relatively inexpensive and easy to construct, even for the beginner, and yet which exhibit a performance which is in all respects second to none. In particular, the noise level can only be bettered by the use of parametric amplifiers and even then not significantly. In spite of this, strong-signal effects are less than those shown by almost any valve converter and far less than for front ends using normal transistors. This is almost entirely due to the use of FETs in the r.f. and mixer stages.

This article will be followed at a later date by one dealing with v.h.f. converter and receiver design principles (including, of course, those used in developing the present converters), a description of a companion unit for 70cm and finally an article detailing the development, design and construction of an i.f. tuner suitable for use in a high-performance v.h.f. receiver.

* 10 Prior Grove, Chesham, Bucks.

The Two and Four Metre Converters

Both converters are almost identical in form. A common-source, neutralized r.f. stage, using a 2N3819 *n*-channel FET (Texas Instruments Ltd.) feeds, via double tuned circuits, into a common-source 2N3819 mixer (Fig. 1). For those anxious to avoid even the simple procedure associated with neutralizing the r.f. stage, a cascode variant is available for both bands, which does not appreciably alter the performance in any respect but does require another 2N3819. The local oscillator chain uses two very cheap silicon *n-p-n* planar transistors, type 2N3826 (Texas Instruments Ltd.), one as an oscillator with an HC-6/U overtone crystal, operating in the 30 to 35 Mc/s range, the other as a multiplier, doubling for 4m and quadrupling for 2m, with double tuned circuits feeding into the mixer. The total cost of all four transistors, incidentally, does not exceed £2 10s.

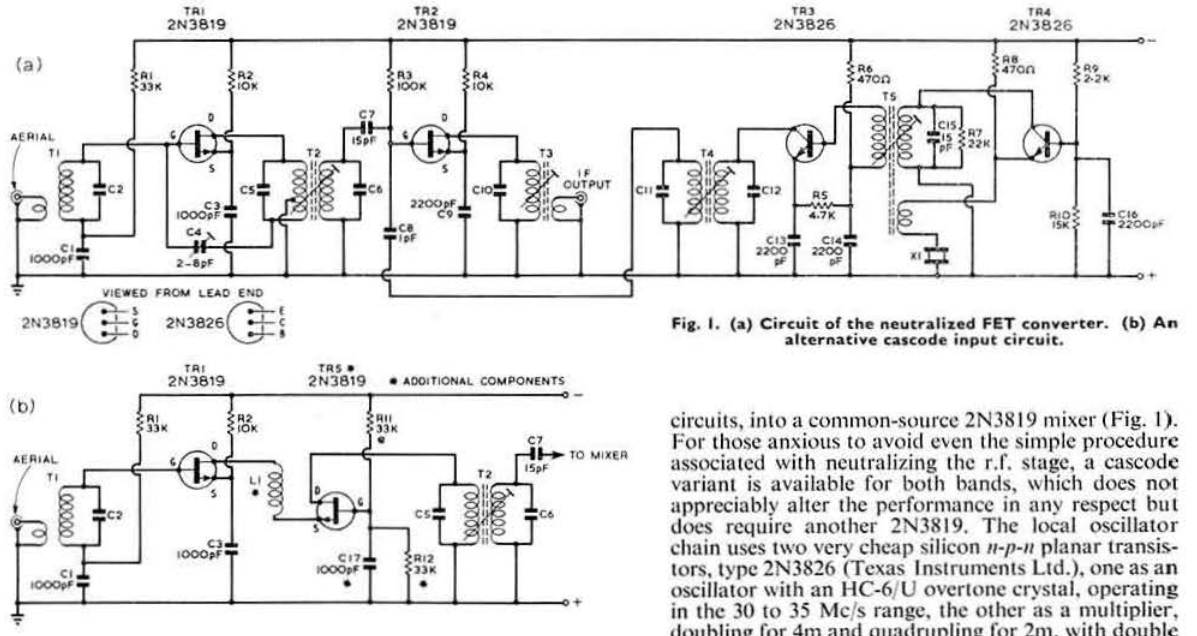


Fig. 1. (a) Circuit of the neutralized FET converter. (b) An alternative cascode input circuit.

The standard output i.f. for both converters is in the region of 3 Mc/s but design data is given for i.f's between 2 and 30 Mc/s for the 2m converter and between 2 and 10 Mc/s for the 4m. An Aladdin former, with enclosing Neosid pot core, is used to accommodate the output transformer for i.f's up to

16 Mc/s, but above this frequency, the Aladdin former only is required. To alter the i.f., it is only necessary to change the i.f. transformer coil and overtone crystal and perform a small amount of re-peaking.

Construction

The converters are wired on a piece of Lektrokit board, using wiring pins pushed into the holes to support most components, including the crystal and the transistors (see Fig. 3). A standard, square piece of Lektrokit laminate board may be cut into three, each part of which may then be used to build a converter, although two fixing holes must be drilled appropriately in the centre piece. The board is mounted inside a simple, trough section, 20 s.w.g. aluminium chassis, using two 6BA screws and nuts, standing the board $\frac{5}{16}$ in. away from the chassis. The four coil formers, i.e., those associated with the oscillator and multiplier stages, together with the r.f.-mixer interstage coil and the i.f. transformer are all mounted on the chassis (see Fig. 2.) The aerial coil is air-spaced and is supported by wiring pins on the board. As the converters are fundamentally intended for incorporation into a complete v.h.f. receiver, the aerial and i.f. terminations are, like the ground and input negative connections, made to wiring pins but, if required, two Belling-Lee co-axial sockets may be mounted on the chassis, after drilling an additional four holes. No extra shielding is required anywhere, the need for it being avoided by proper layout and coil positioning.

The logical steps for construction are:

1. Cut and mark out chassis.
2. Bend up chassis.
3. Drill all holes.
4. Fit earthing tags and two Belling-Lee sockets, if required.
5. Push pins into Lektrokit wiring board.
6. Connect leads on underside of board.
7. Mount Lektrokit board in chassis.
8. Mount crystal and its holder on board.
9. Manufacture all coils, fix Aladdin formers to chassis.
10. Attach all other components, input coil, etc. and wire up.

The metal work for the converters hardly needs any special comment, as Fig. 2 is self-explanatory.

Wiring pins should be pushed into the Lektrokit board from the underside so that about twice as much protrudes above the board as is left below. The best type of pin to use is that with a shoulder and longitudinal splines (Vero Electronics Type 2143). Otherwise, Lektrokit LK3011 pins may be used. The finished converter looks neater if some wiring is done underneath the board, prior to mounting it in the chassis. In particular, the h.t. wires and the earth wire from the crystal clip may be so inserted. If the cascode r.f. stage is to be used, the earth connection to the bottom of R2 may also be made under the board with advantage.

Mounting the Lektrokit board in the chassis requires the use of two 6BA × $\frac{1}{2}$ in. ch. hd. screws and nuts, spacing the board $\frac{5}{16}$ in. away from the chassis. The crystal holder is fixed to the board by soldering the connections to two wiring pins. The crystal is inserted and is then clamped in position by bending a 6BA tag carefully over it, after the tag has been soldered to the earthed wiring pin provided.

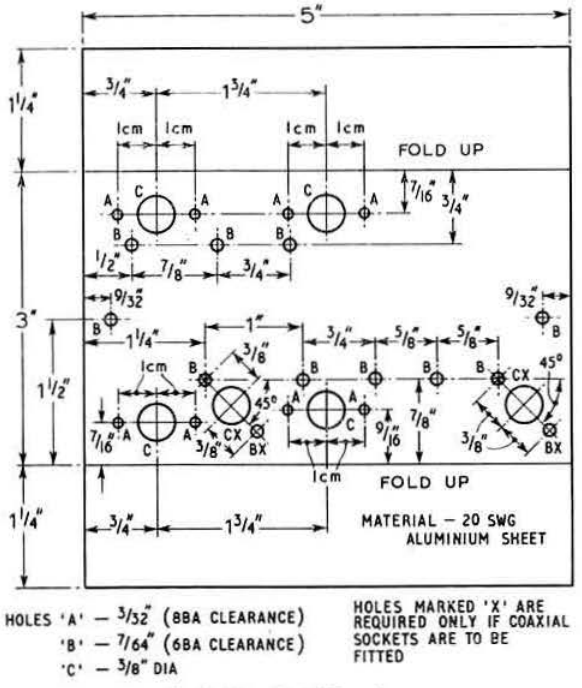


Fig. 2. Chassis drilling plan.

The coils for T2 and T4 are produced by close-winding 22 s.w.g. enamelled wire on the shank of a $\frac{1}{4}$ in. drill (wind one more turn than is required). If the wire is then pulled off carefully, it may be sprung, by rotation, on to the Aladdin former. Note that the earthed end of the secondary of T2 is nearer to the chassis. The primary is situated at the outer end of the former, with its " cold " end nearer to the secondary. The two coils are spaced by $\frac{5}{16}$ in. The earthed end of T4's primary is close to the chassis and the earthed end of the secondary (which is situated right at the other end of the former) is nearer to the primary. The cores for both T2 and T4 are prepared by cutting a standard core in half, and they are locked in position, inside the former by means of narrow strips of polythene sheet.

The main winding of the oscillator coil T5 is close wound near the chassis end of the Aladdin former, its earthed end being close to the chassis. A layer of adhesive Melinex

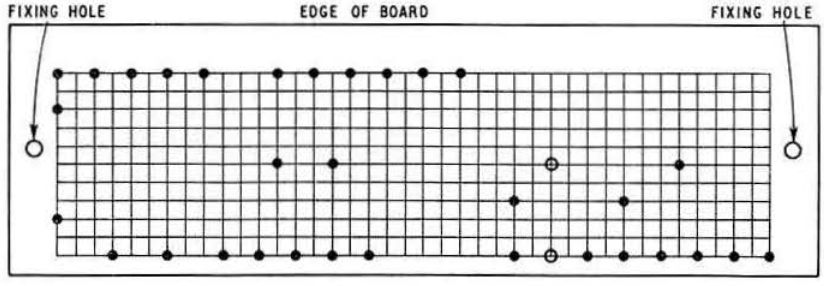


Fig. 3. Wiring pin arrangement.

tape facilitates putting the other windings on top, the feedback coil at the cold end and the output winding near the centre of the main winding.

The i.f. transformer T3 should have each half of its tuned winding wound in two adjacent coil former sections, leaving one section available for the output-coupling secondary.

Lining-up and Operation

Getting the converters going should present no difficulties. The output i.f. tuned circuit will not normally require peaking for i.f.'s below 10 Mc/s. The crystal oscillator will only oscillate strongly on the correct overtone frequency and probably will not oscillate at all unlocked, although some crystals having exceptionally high shunt capacitances may cause it to do so. If a receiver in the 35 Mc/s region is not available, correct operation of the oscillator may readily be checked by using the standard trick of searching for a spurious response to the oscillator on a v.h.f. receiver or even one covering the upper h.f. range. Needless to say, if the oscillator does not seem to work at all, try reversing the sense of the feedback winding.

An r.f. detector loop and diode and a set of calibrated absorption wavemeters will be found useful when tuning up the multiplier coils. However, if these are not available, the 1 pF oscillator injection capacitor lead may be temporarily moved to the multiplier collector and the multiplier coil tuned to give a noise peak. Then the injection capacitor should be re-connected to the secondary winding of the multiplier coil which may itself then be aligned, and the primary re-peaked.

It is now necessary to resonate the mixer gate circuit. For 2m i.f.'s below 6 Mc/s and 4m i.f.'s below 3 Mc/s, it may be found difficult to distinguish between the noise peaks due to operation above and below the local oscillator frequency. A very pronounced dip in noise between noise peaks probably indicates too much oscillator injection. This may be checked by measuring the mixer source current (0 to 10 voltmeter across R4). This current should not increase by even a few per cent when the local oscillator is switched on. If it does, reduce the coupling between the two parts of T4. Operation

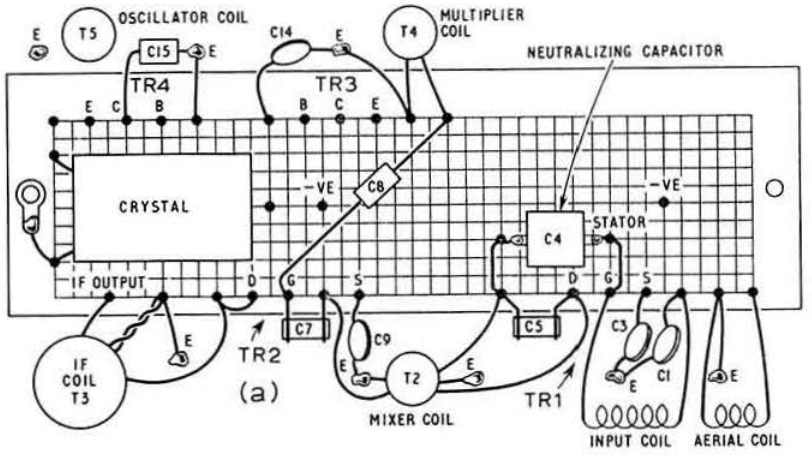
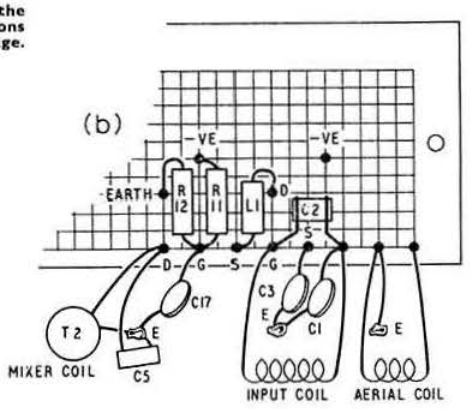


Fig. 4. (a) Wiring diagram for the two-FET converter. (b) Modifications for incorporating a cascode r.f. stage.



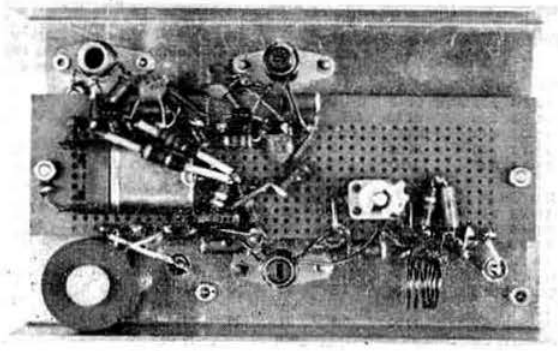
Coil Details

Four Metres

L1	30 turns, 36 s.w.g. enam., close wound on 100 K ohms ½ watt resistor (required for cascode only)
T1	Secondary: 8 turns, 22 s.w.g. enam., self-supporting (wound on ¼ in. mandrel) Primary: 3 turns, 22 s.w.g. enam., pushed into " cold " end of secondary
T2	Primary: 6 turns, tapped 2 turns from earthy end, 22 s.w.g. enam., close wound on 0·3 in. Aladdin former Secondary: 6 turns, 22 s.w.g. enam., close wound nearer chassis, spaced $\frac{1}{16}$ in. from primary
T3	See Table 1
T4	Primary: 4 turns, 22 s.w.g. enam., close wound near chassis on 0·3 in. Aladdin former Secondary: 4 turns, 22 s.w.g. enam., close wound, spaced ¼ in. from primary
T5	Main: 11 turns, 28 s.w.g. enam., close wound on 0·3 in. Aladdin former Emitter: 1 turn, 28 s.w.g. enam., overwound at " cold " end of main winding Output: 2 turns, 28 s.w.g. enam., overwound at centre of main winding

Two Metres

L1	10 turns, 28 s.w.g. enam., close wound on 100 K ohms ½ watt resistor (required for cascode only)
T1	Secondary: 4 turns, 22 s.w.g. enam., self-supporting (wound on ¼ in. mandrel) Primary: 2 turns, 22 s.w.g. enam., pushed into " cold " end of secondary
T2	Primary: 5 turns, tapped 2 turns from earthy end, 22 s.w.g. enam., close wound on 0·3 in. Aladdin former (ignore tap for cascode) Secondary: 5 turns, 22 s.w.g. enam., close wound nearer chassis, spaced $\frac{1}{16}$ in. from primary
T3	See Table 1
T4, 5	As for 4m



A 2m FET converter using the neutralized input stage.

of the mixer at too high a level of oscillator injection will produce a very poor strong signal performance.

With a 75 ohm load resistor (or an aerial) plugged into the input socket, it should now be found possible to tune the primary of T2 to resonance at signal frequency, at the same time adjusting the neutralizing capacitor for best stability, in the case of the single, earthed-source, r.f. stage. The input circuit may then be set up in the usual manner for valve(!) r.f. amplifiers and the entire converter finally peaked using a signal generator or external signals.

FETs and the Performance of the Converters

Although field effect transistors have in fact been in existence for many years, they have only comparatively recently come into general use. This was due mainly to problems in manufacturing suitable devices which have now been overcome.

FET's have " source " and " drain " electrodes which correspond roughly to the emitter and collector of normal transistors. However, the operation of the third electrode, the " gate," is rather unlike that of a transistor base as its control over the source-drain current is achieved without the injection of current carriers, by a purely electric-field effect. Consequently the input impedance, between source and gate, can be quite large and the design of r.f. input circuits is correspondingly eased. Operation is, in fact, very much like that of a normal hot-cathode valve. However, the FET has some operational advantages over valves for r.f. amplifier use, apart from the obvious ones of lower power-consumption and satisfactory operation at low h.t. rail voltages. The form of curvature of the mutual characteristics of FETs is such that most strong-signal effects are less than those shown by equivalent valve stages (and far less than for stages using conventional transistors). This is particularly true for frequency-changer stages, for which FETs may be almost ideal devices. It should also be true that the minimum achievable noise-levels of stages using devices operating at or near room-temperature are lower than those using devices with heated, emissive cathodes.

These theoretical expectations seem to have been realized for the most part in the converters described, for the strong-signal effects are negligible, in practice, even when several 100 mV signals are fed into the input simultaneously. The noise performance is also good; a noise factor of better than 3db will be realized on either band, provided that the NF of the i.f. tuner into which the converter is fed is not itself worse than about 10db. This latter proviso is a result of the converter gain having been held to a low value to minimize overall strong-signal effects. The design principles governing the choice of gain levels, etc., will be discussed in a later article. With the component values shown, operation is satisfactory, incidentally, at input supply voltages varying from 10 to 14 volts, but if operation from a 9 volt battery is desired, the following component modifications should be made:

Change R2 to 6·8 K ohms (10 K ohms)
R4 to 6·8 K ohms (10 K ohms)
R10 to 10 K ohms (15 K ohms)

The original values are in brackets.

The converters have acquitted themselves fairly well in actual service. The 4m converter itself and a very similar, prototype 2m one were used in conjunction with transistorized tuners, on the recent V.H.F. NFD, from an Oxfordshire hilltop. In spite of being assailed by multitudes of extremely strong signals, no appreciable overloading, cross-modulation or intermodulation effects were noticed, a very different state of affairs from that usually enjoyed when ordinary transistorized front-ends are in use on Field Day!

TABLE I

Data for I.F. Transformer T3

Tunable i.f.	i.f. centre	Crystal freq.	T3 primary inductance	Turns	S.w.g.	Former	75 ohm coupling turns	600 ohm coupling turns
Four Metres								
1·8-2·4	2·08 Mc/s	34·15	205μH	66	36	Pot-core	5	13
2·1-2·7	2·38	34·00	158	58	36	Pot-core	4	11
4·1-4·7	4·40	33·00	46·8	31	32	Pot-core	2	6
7·1-7·7	7·40	31·50	16·5	19	28	Pot-core	1	3
9·1-9·7	9·40	30·50	10·3	15	28	Pot-core	1	3
Two Metres								
1·8-3·8	2·62 Mc/s	35·55	369μH	88	36	Pot-core	6	17
2·0-4·0	2·83	35·50	316	82	36	Pot-core	6	16
4·0-6·0	4·90	35·00	105	47	34	Pot-core	3	9
8·0-10·0	8·95	34·00	31·6	26	32	Pot-core	2	5
14·0-16·0	15·0	32·50	11·3	15	28	Pot-core	1	3
20·0-22·0	21·0	31·00	5·8	29 c/w	26	Aladdin former	2	5
24·0-26·0	25·0	30·00	4·1	27 c/w	26	Aladdin former	2	5
28·0-30·0	29·0	29·00	3·0	25 c/w	26	Aladdin former	2	5

Components List

C1, 3	1000 pF disc ceramic
C2	4·7 pF ceramicon (4m), not required for 2m
C4	2-8 pF miniature trimmer, Plessey type 7365 (not required for cascode)
C5	10 pF ceramicon (4m), 2·2 pF ceramicon (2m)
C6	10 pF ceramicon (4m), not required for 2m
C7	15 pF ceramicon
C8	1 pF ceramicon
C9, 13, 14, 16	2200 pF disc ceramic
C10	22 pF ceramicon (4m), 6·8 pF ceramicon (2m)
C11, 12	33 pF ceramicon (4m), 6·8 pF ceramicon (2m)
C15	15 pF ceramicon
R1	33 K ohms
R2, 4	10 K ohms (10-14 volts), 6·8 K ohms (9 volts)
R3	100 K ohms
R5	4·7 K ohms
R6, 8	470 ohms
R7	22 K ohms
R9	2·2 K ohms
R10	15 K ohms (10-14 volts), 10 K ohms (9 volts)
T2, 4, 5	0·3 in. diam. nylon Aladdin former, with iron dust core
T3	0·3 in. diam. nylon Aladdin former, with iron dust core, for i.f.s above 16 Mc/s Neosid pot core on Aladdin former for i.f.s below 16 Mc/s
TR1, 2	2N3819 FET (Texas Instruments Ltd.)
TR3, 4	2N3826 (Texas Instruments Ltd.)
X1	HC-6/U crystal and holder, as required
The following additional components are required for the cascode modifications:	
C17	1000 pF disc ceramic
R11, 12	33 K ohms
L1	100 K ohms (see Coil Details)
TR5	2N3819 (Texas Instruments Ltd.)

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[2] *V.H.F. Tuned Amplifiers Using the TI 2N3823 FET*, Texas Application Notes, September, 1965.

[3] " The Field Effect Transistor at V.H.F.," U. L. Rohde, *Wireless World*, January, 1966.

[4] " Technical Topics," P. Hawker, RSGB BULLETIN, September, 1966, p. 581.

[5] " Technical Topics," P. Hawker, RSGB BULLETIN, November, 1966, p. 714.

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The G5RV Aerial — Some Notes on Theory and Operation

By LOUIS VARNEY, A.M.I.E.E., A.I.L., G5RV*

THE G5RV aerial is a multi-band dipole specifically designed with dimensions which allow it to be installed in most normal-sized back gardens, permitting effective operation from 1·8 to 30 Mc/s. As it does not make use of traps or ferrite beads, the " dipole " portion becomes progressively longer in electrical length with increasing frequency. This effect confers certain advantages over a normal or trap dipole because, with increasing electrical length, the major lobes of the vertical radiation pattern tend to be lowered as frequency is increased. Thus, from 7 Mc/s up, most of the energy radiated in the vertical plane is at an angle suitable for DX working. Furthermore, the horizontal polar diagram changes with increase of frequency from a more or less typical $\lambda/2$ horizontal dipole diagram to that of a typical " long wire " aerial at 14, 21 and 28 Mc/s.

Although the impedance matching of a suitable (non-critical) length of 75 ohm twin feeder (preferred) or 75 to 80 ohm coaxial feeder from the base of the matching stub to the transmitter or, preferably, to a suitable aerial tuning unit, is

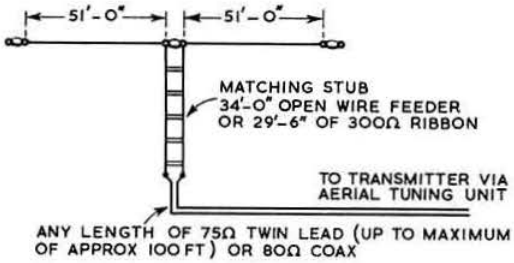

Fig. 1. Dimensions of the full-size G5RV Aerial. For the half-size version, the dimensions of the flat-top and matching stub are scaled proportionately.

approximate only for most bands, a very good match indeed is obtained on 14 Mc/s. It so happens also that the polar diagram on this band is that of a three half-wavelength long-wire which is particularly suitable for all-round DX working and gives an estimated gain of about 3db over a simple dipole in the directions of the four major lobes.

The above reasoning does not apply to its use on 1·8 Mc/s where it functions as a Marconi or T aerial with most of the effective radiation taking place from the vertical or near-vertical portions of the system, the " flat top " acting as a top-capacity loading element. However, with the transmitter end of the feeder strapped and with the system tuned to resonance with a suitable series inductance and capacitor circuit connected to a good earth, or a counterpoise, very effective radiation on this band is obtainable even when the flat top is as low as 25 ft. above ground.

Construction

The dimensions of the aerial and matching stub are as shown in Fig. 1. It should be noted that it is quite in order to " bend " the lower half of the matching stub if desired owing to relatively low height above ground of the flat top. The writer has used this aerial for many years at a height of only 25 ft. with excellent results on all bands from 1·8 to 28 Mc/s.

A word about the matching stub is in order. If this is of open wire feeder construction (preferred because of lower losses, especially at 21 and 28 Mc/s) its length should be 34 ft. (17 ft. for the half size version) but if 300 ohm ribbon is used, allowance must be made for the velocity factor of this type of twinlead. Since this is approximately 0·88, the actual physical length of the 300 ohm ribbon stub should be 29 ft. 6 in. It should be borne in mind that this matching stub is intended to resonate as a half-wave impedance transformer at 14 Mc/s, which was chosen as the design centre frequency for the G5RV aerial, thus giving a very good impedance match for a 75 to 100 ohm twin-lead or coaxial cable connected to the base of the stub.

If desired, due to lack of sufficient space to accommodate the 102 ft. long flat top, the ends of the aerial may be dropped vertically (or semi-vertically) for up to 10 ft. at each end, thus reducing the overall length to 82 ft.

An alternative arrangement to that of the matching stub and twin-lead or coaxial cable feeder is to use an 83 ft. length of open-wire feeder measured from the centre of the flat top to the terminals of the a.t.u. This arrangement permits parallel tuning of the a.t.u. on all bands from 3·5 to 28 Mc/s with very low feeder losses.

The spacing of either the open-wire stub or the 83 ft. long open wire feeder is not critical and may conveniently be anything from 2 to 6 in., using either 14 or 16 s.w.g. copper wire. Although the use of 14 s.w.g. is recommended for the flat top, 16 s.w.g. is adequate for the matching stub or tuned feeder and is easier to " hang " neatly.

It is recommended that attention be paid to making a sound mechanical job of the construction of the aerial. In particular, if 300 ohm ribbon is used for the matching stub, the ribbon should be looped over the centre insulator of the flat-top and secured with nylon thread or plastic tape, leaving " flying " ends about 9 in. long forming two loops for connection to each half of the aerial. This type of construction avoids breaking of the ribbon due to swinging and vibration in high winds. Alternatively, a suitable triangular shaped ceramic or plastic dipole centre insulator which is designed to secure the 300 ohm ribbon may be used.

Although it may be very convenient to use a length of, say, up to 100 ft. of coax direct from the transmitter to the base of the matching stub, it must be remembered that such an arrangement will tend to produce currents which will flow in the outer conductor of the coax, causing unwanted radiation from the coaxial feeder. This may be avoided by the use of either 75 ohm twin-lead and a suitable a.t.u. or the open-wire feeder and a.t.u. as already mentioned. However, the use of a suitable wide-band balun as suggested in the article by G3HZP in the July, 1966, RSGB BULLETIN would be preferable if coaxial cable is to be used. Nevertheless, in practice very satisfactory operation can be achieved by the simple use of co-ax direct from the transmitter to the base of the matching stub even though the v.s.w.r. may reach 10 to 1 or more on 3·5 Mc/s. This figure may be reduced to about 5 to 1 on 3·5 Mc/s by " pruning " the co-ax. On the higher frequency bands the v.s.w.r. on the co-ax lies between 5 to 1 and 1·5 to 1, the latter figure applying to 14 Mc/s where, as explained above, the matching is very good.

Contrary to general belief, a v.s.w.r. of up to 5 to 1 on a length of co-ax up to about 100 ft., at the frequencies considered here, results in negligible loss of power. However, this is not to say that it is not better to keep the v.s.w.r. figure as low as possible, especially where a low-pass TVI filter is to be used. It is mainly for this reason that the writer

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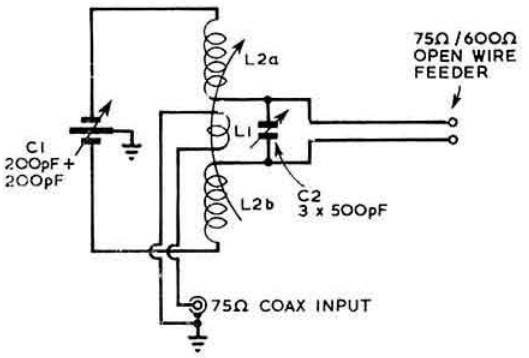


Fig. 2. A suggested aerial tuning unit for use with the G5RV aerial. C1 is a 200 + 200 pF split-stator transmitter capacitor, the plate spacing being determined by the power it will have to handle. The coupling capacitor C2 consists of three 500 pF broadcast receiver variable capacitors connected in parallel. If necessary, this combination may be supplemented by a bank of switched high voltage mica capacitors.

prefers to use a convenient length of 80 ohm co-ax from the transmitter to an a.t.u. and then 75 ohm twin-lead to the base of the stub. In this way, using a low pass filter and a v.s.w.r. meter in the length of co-ax, a perfect, or near perfect, match can be obtained for the transmitter and filter on all bands.

The Aerial Tuning Unit

As stated above, the writer prefers to use an a.t.u. for the reasons given. There are various satisfactory forms of a.t.u. but one which the writer has used for many years and which is extremely flexible electrically and yet does not require the coils to be tapped for optimum feeder loading, is shown in Fig. 2.

In any case, whatever form of a.t.u. is used, a suitable v.s.w.r. meter should be inserted in the co-ax feeder from the transmitter output to the a.t.u. Optimum loading and maximum harmonic suppression will be achieved by watching the *reverse* current in the v.s.w.r. meter and adjusting both a.t.u. tuning and loading capacitors for *minimum reverse current*. If the link-coupling coil is common for all bands (using plug-in a.t.u. coils) it is preferable that it be of the " swinging " type, i.e., adjustable coupling. It will be found that, starting with the link coil fully coupled, normally, after the a.t.u. tuning and loading capacitors have been adjusted to give the lowest possible reverse current, adjustment of the link-coil coupling will, in nearly all cases, permit a v.s.w.r. of virtually 1 : 1 to be obtained on the co-ax cable to the transmitter. However, if a.t.u. coils having individual link-coils are used, the number of turns on each link should be adjusted to suit the actual conditions applying to a particular installation for each of the bands. For a common, swinging, link-coil three turns is about as good a compromise as may easily be obtained.

Table 1 gives coil winding details for each band.

TABLE 1

Band Mc/s	Turns	Turns Spacing in.	S.W.G.	Coil I.D. (in.)	Fixed Link Coil Turns*
3·5	17 + 17	c/w	14	2·5 (former)	4 or 5
7	9 + 9	c/w	14	2·5 (former)	3
14	5 + 5	1/10	10	2·25 s/s	2
21 28	4 + 4	¼	10	1·75 s/s	1

c/w = close-wound. s/s = self supporting.
*Alternatively a common three turn swinging link coil 1⅞ in. i.d., 14 s.w.g. c/w; centre portion of coil formers cut away suitably to permit entry of swinging link coil.

Theory of Operation

The general theory of operation has been explained in the introduction. The theory of operation on each band from 3·5 to 28 Mc/s will now be given in turn.

3·5 Mc/s

On this band, each half of the flat-top plus about 16 ft. of each leg of the stub forms a fore-shortened or slightly folded-up dipole. The remainder of the stub acts as an unwanted but unavoidable reactance between the centre of the dipole and the feeder to the transmitter or a.t.u. The polar diagram, is similar to that of a horizontal dipole. See Fig. 3.

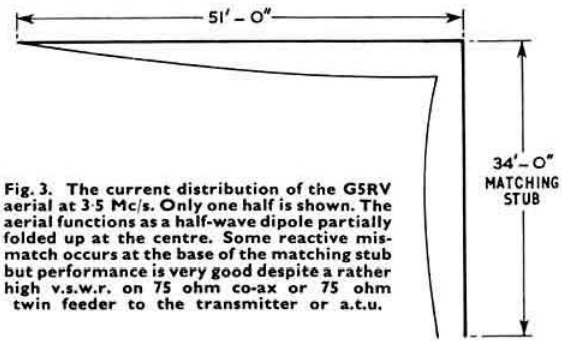


Fig. 3. The current distribution of the G5RV aerial at 3·5 Mc/s. Only one half is shown. The aerial functions as a half-wave dipole partially folded up at the centre. Some reactive mismatch occurs at the base of the matching stub but performance is very good despite a rather high v.s.w.r. on 75 ohm co-ax or 75 ohm twin feeder to the transmitter or a.t.u.

7 Mc/s

A similar arrangement exists at this frequency except that the flat top plus 16 ft. of the matching stub now functions as a partially folded-up " two half waves in phase " aerial giving a polar diagram somewhat sharper than a conventional $\lambda/2$ dipole and low angle vertical plane radiation. Again, the matching at the base of the stub is degraded somewhat by the unwanted reactance of the lower half of the stub, but despite this the system loads well. See Fig. 4.

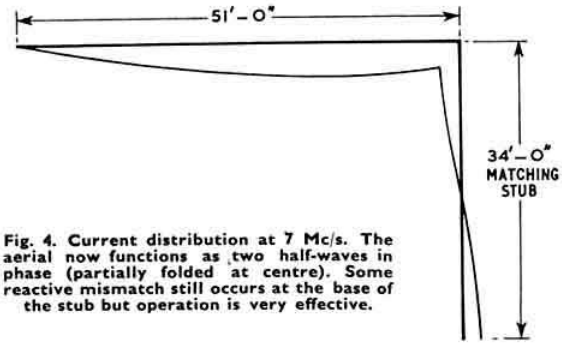


Fig. 4. Current distribution at 7 Mc/s. The aerial now functions as two half-waves in phase (partially folded at centre). Some reactive mismatch still occurs at the base of the stub but operation is very effective.

14 Mc/s

At this frequency the conditions are ideal. The flat top forms a three halfwave long-wire centre-fed aerial having six lobes of radiation, four major and two minor. As the centre impedance of a wire of this length at about 30 to 35 ft. above ground is approximately 90 to 100 ohms and the 34 ft. stub acts as a 1 : 1 impedance transformer, the match to an 80 or even 75 ohm feeder is quite acceptable. Most of the

radiation in the vertical plane is at an angle of about 14° which is very effective for DX working. See Fig. 5.

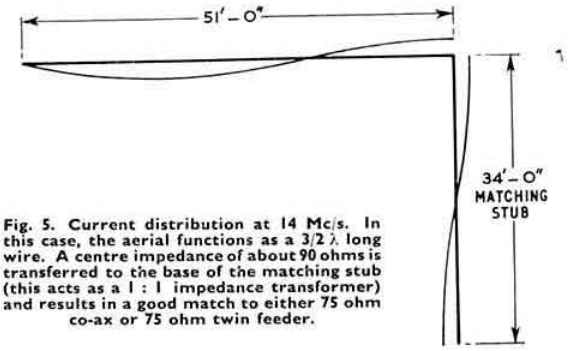


Fig. 5. Current distribution at 14 Mc/s. In this case, the aerial functions as a 3/2 λ long wire. A centre impedance of about 90 ohms is transferred to the base of the matching stub (this acts as a 1 : 1 impedance transformer) and results in a good match to either 75 ohm co-ax or 75 ohm twin feeder.

21 Mc/s

Here the aerial works as a five halfwave long-wire giving a very effective polar diagram and good low-angle radiation. Although a bad mis-match occurs at the base of the stub, the aerial loads well and performs very satisfactorily. See Fig. 6.

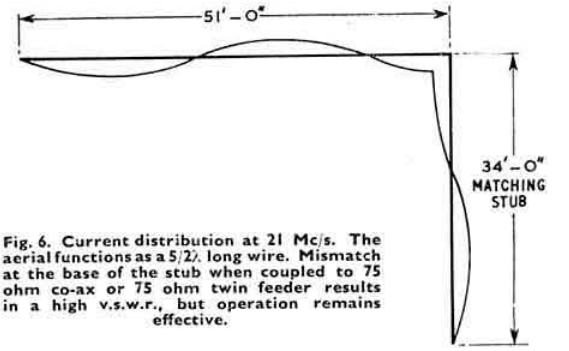


Fig. 6. Current distribution at 21 Mc/s. The aerial functions as a 5/2λ long wire. Mismatch at the base of the stub when coupled to 75 ohm co-ax or 75 ohm twin feeder results in a high v.s.w.r., but operation remains effective.

28 Mc/s

On this band the aerial functions as *two* 3/2 λ long wires fed *in phase*. The polar diagram is similar to that of a typical 3/2 λ long wire with slightly sharpened lobes and the radiation is at a low angle, good for DX working. Again, the mismatch at the base of the stub is considerable but, in practice, the aerial loads well and works very effectively. See Fig. 7.

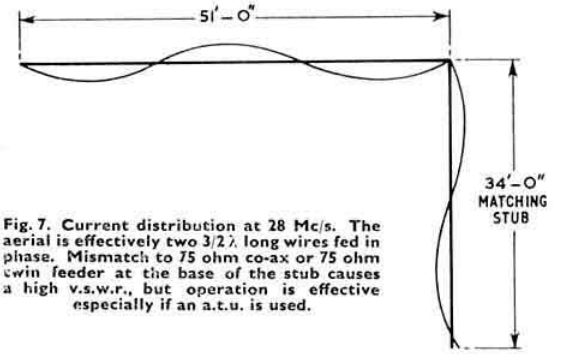


Fig. 7. Current distribution at 28 Mc/s. The aerial is effectively two 3/2 λ long wires fed in phase. Mismatch to 75 ohm co-ax or 75 ohm twin feeder at the base of the stub causes a high v.s.w.r., but operation is effective especially if an a.t.u. is used.

In connection with the above descriptions, reference should be made to the *Amateur Radio Handbook* or the ARRL or CQ *Antenna Handbooks* where the polar diagrams of typical long-wire aerials may be found.

The Half-size Version

Many requests have been received for information on the half-size version of the G5RV aerial for use in very restricted space. It is quite possible to scale all wire length dimensions (including that of the stub) down to exactly half-size and the resulting aerial will work from 7 to 28 Mc/s. Optimum performance and impedance matching will occur on 28 Mc/s, where the operating conditions will be as for the full-size version at 14 Mc/s.

WWV QSL Cards

Radio amateurs and listeners will have a chance to gain a special first day QSL card, bordered in gold, if they can receive the National Bureau of Standards' radio station WWV on its first day of broadcast from its new location at Fort Collins, Colorado. Each QSL card will have the date and time of WWV reception stamped on it. The three amateurs showing earliest reception time will receive also a framed 11 in. × 14 in. colour photograph of the transmitter site which appears on the QSL card. The broadcasts will begin at 00.00 GMT on 1 December, 1966, on frequencies 2·5, 5, 10, 15, 20 and 25 Mc/s. The schedule will be the same as at present, with continuous operation except for a 4 minute interruption each hour beginning at 45 minutes, 15 seconds after the hour.

Recipients of the WWV broadcast who wish to qualify for the QSL card must correctly quote the new WWV voice announcement and have the reports postmarked not later than 24.00 GMT, 2 December, 1966. Cards should be addressed to D. H. Andrews, Chief, Frequency-Time Broadcast Services Section, Radio Standards Physics Division, National Bureau of Standards, Boulder, Colorado, 80302.

RADIO AMATEURS' EXAMINATION

Wednesday, 7 December, 1966

MARY WARD HALL
5 TAVISTOCK PLACE
LONDON WC1

The examination will commence at 6.30 p.m.

Applications to sit the Examination at the above centre should be sent to the General Manager, Radio Society of Great Britain, 28 Little Russell Street, London, WC1, to arrive not later than **Friday, 4 November 1966.** Applications must be accompanied by a remittance for the City and Guilds of London Institute fee of £1.10.0, plus, in the case of non-members of RSGB, a local fee of 10s. **Remittances should be made payable to RSGB.**

Choosing Components

By B. Priestley, G3JGO*

Shop Assistant: " I'm sorry, we haven't got that value in silver mica. Will polystyrene do? "

Shopper: " What's the difference?"

The above conversation, overheard in a well known component shop, prompted this article. The object is to explain the pros and cons of the varieties of capacitors and resistors so that the amateur can select the best type for a particular circuit position.

Tolerance

To many people this simply means selection tolerance, or the colour of the band on the resistor. However, it is obvious that there is no point in selecting a component to an accuracy of say 2 per cent if a rise in temperature or the aging effect of six months would result in a change of 5 per cent. Consequently, for critical applications, such as s.s.b. audio phase shift networks or voltage multipliers, the use of anything but high stability resistors or capacitors is false economy. Some components are now being made with a design tolerance which is the sum of the selection tolerance plus the effect of 2000 hours life and the maximum effect of temperature. More often, the effect of all the environmental factors must be separately calculated and added to the selection tolerance to obtain the maximum deviation from nominal value for critical applications.

Temperature

The value of all components varies somewhat with temperature and this variation is expressed as a temperature coefficient, often in parts per million per degree centigrade (p.p.m.) or sometimes in per cent. per degree Centigrade. This is only possible when the variation is proportional to temperature. Exact proportionality is very rare so an average value over a certain range of temperature is often stated: for example, the —750 p.p.m. of N750K ceramic capacitors. As the figure of 750 has a tolerance of perhaps ± 50 and is an average over the temperature range, such a capacitor would not exactly compensate for a mica capacitor of + 15 p.p.m. and 50 times its value. For this and other reasons, temperature compensation should only be used as a last resort.

Construction

Although the active materials determine the electrical properties of a component, the construction also has a marked effect. Moisture must be sealed out, adequate mechanical stability ensured, and unwanted inductance or resistance minimized. Often these requirements conflict, so several versions of the same basic component are made. Generally, a one piece construction gives better stability: metallized mica capacitors are much more stable than stacked mica and metal plates.

* 43 Raymond Road, Langley, Slough, Bucks.

Electrolytic Capacitors

Aluminium electrolytic capacitors are of two types, plain and etched foil. The latter has, in effect, a corrugated surface, so that a much greater capacitance can be packed into a given volume, but conversely the safe current rating is reduced so that the plain foil types are more suitable as reservoir capacitors.

Tantalum capacitors are smaller than aluminium, deteriorate less in storage, have lower losses and will work at higher temperatures. Correspondingly, they are more expensive.

Metallised Paper Capacitors

These capacitors are made by depositing a thin film of metal on the paper dielectric. A short circuit simply burns away a little of the foil, i.e. the dielectric is self-healing and so can be much thinner, reducing the overall size drastically. They are only suitable for decoupling or filtering.

Plastic Dielectric Capacitors

Many types of plastic film have been tried as alternatives to paper and several are available, each with its own particular advantages and disadvantages. Confusion is added by

(*continued on page 732*)

Table 1 — Resistors

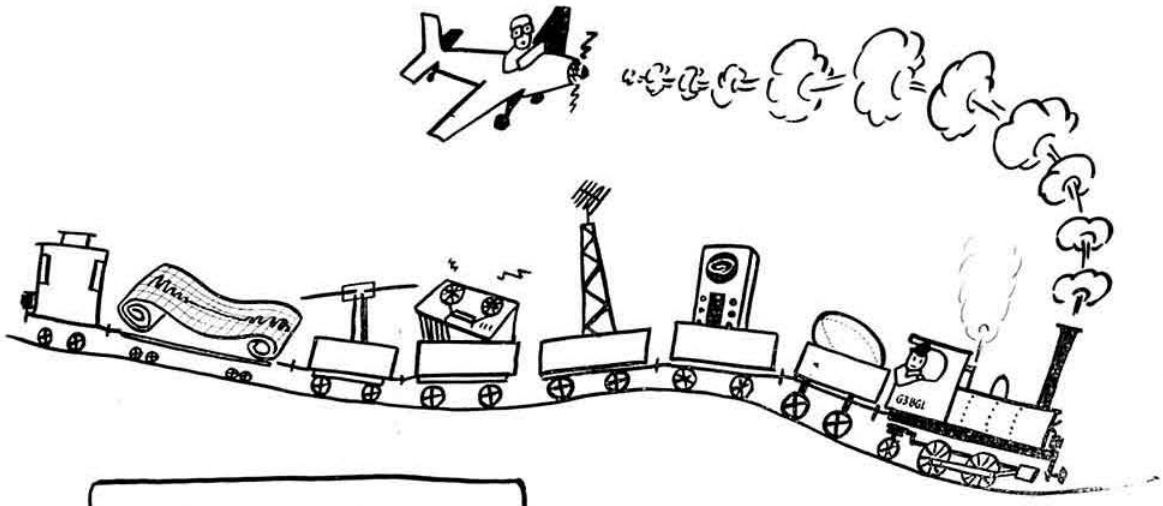
Resistor	Price	Stability	Temperature Coefficient per °C.	H.F. Performance	Noise	Application
Composition	low	poor	1200 p.p.m.	fair	bad	general non critical applications
Wire wound	moderate	good	100 p.p.m.	v. poor	good	higher power than composition
Carbon film	moderate	good	250 p.p.m.	good	good	low noise circuits and precise applications
Metal film or metal oxide film	high	good	250 p.p.m.	good	good	low noise circuits and precise applications

Table 2 — Capacitors

Capacitor	Price	Stability	Temperature Coefficient	H.F. Performance	Application
Mica	moderate	poor	NL	good	r.f. coupling and bypass
Metalised Mica	high	good	+10 p.p.m.	good	Tuned circuits
Polystyrene	moderate	fair	—150 p.p.m.	good	R.f. coupling and bypass also temp. compensation
Polycarbonate	moderate	poor	NL	fair	high temperature
Polyester	moderate	good	NL	fair	general non critical applications
Paper	low	poor	NL	fair	general non critical applications
Aluminium Electrolytic	low	poor	NL	poor	filtering
Tantalum Electrolytic	high	fair	NL	fair	filtering
Vacuum	high	good	low *	good	high power r.f.
Ceramic (normal)	low	good	+30 to —750 p.p.m.	good	R.f. particularly temp. compensating
Ceramic (high K)	low	fair to poor	—750 to —5000 also NL	good to fair	R.f. coupling and bypass

NL non linear, see published data

* depends on construction



a little Flutter on V.H.F.

Part I—Steam Trains

By P. W. Sollom, O.S.B., B.Sc.(Eng.), Ph.D., G3BGL*

A little flutter usually suggests a small bet, and although this article is actually about a certain type of flutter fading experienced on v.h.f. radio signals, it would be quite safe to bet that amateurs will very soon attempt DX contacts on the v.h.f. bands by consulting airline timetables and bouncing signals off aircraft flying along suitable routes. An explanation is given of the mechanism of flutter fading and this will provide background information for planning such contacts, besides indicating the extent to which aircraft may be responsible for causing interference between stations sharing the same frequency such as British and continental TV stations, or radio links and space communication systems.

Commuting with a Difference

IF ever there was a case of going to town on steam trains, this is surely a splendid example! You can imagine G3BGL in the engine cab with a train load of equipment behind—oscilloscope, dipole, Yagi, tape-recorder, roll of graph paper, and a rugger ball—chuffing along a switchback track. Or you can imagine G3BGL in the cockpit of an aircraft flying along amidst the puffs of smoke from the engine; it is all part of the story, especially the rugger ball! But it is not the whole story. You have to imagine a long standing sked on 2m with a station about 60 miles away hiding behind huge lumps of chalk (called the South Downs on the map), and during almost every QSO a steam train chuffing its way into the shack, stopping a moment, and then puffing away again. It is most realistic the way surges of background noise in the receiver, as the signal fades, can sometimes sound like an old steam train coming to a station and starting off again. Add a brief heterodyne now and again for a whistle and the picture is complete—almost! Because you must imagine, too, a small shack at Douai Abbey (a Benedictine Monastery; pronounce the OU as in *sound*, the AI as in *straight*) in the shadow of the Abbey Church, atop a hill dominating the surrounding Berkshire countryside for at least six miles in every direction. Above the shack a mast 60 ft. high sprouts aerials like decorations on a Christmas tree and inside the shack (besides the rig for the amateur bands) a rack of gear continuously records the strength of the TV sound channel from Lille in Northern France, 190 miles away. It was the very common occurrence of flutter fading on this reception that caused the author to borrow a rugger ball and " go to town " on steam trains.

Let's Not Talk about the Weather

The jargon of v.h.f. enthusiasts includes a lot of technicalities about the weather. This is only right and proper since the bread and butter DX comes on v.h.f. by kind disposition of the weather. Now it is very likely that any number of steam trains chuff into and out of QSOs under the *less kind* disposition of the weather (fronts, depressions, and so on), particularly the *slow* steam trains. One object of research at Douai Abbey is to relate reception conditions to their meteorological causes, but so far it has not been possible to *prove* that weather conditions also control a v.h.f. railway timetable. It will be shown that airline timetables have a special significance, so for the rest of this article the word " aircraft " will be used without excluding the possibility of similar effects being caused by turbulent weather, making allowance for the fact that wind movement is much slower than that of an aircraft.

Why Lille? Six Reasons

The reasons for choosing Lille TV were:

(i) It is at an interesting distance for assessing shared frequency interference.
(ii) It is not too far away for reception at all times by sensitive equipment.
(iii) Its frequency, 174·1 Mc/s, is free of QRM.
(iv) It transmits a continuous carrier during test and programme hours.

* Douai Abbey, Woolhampton, Reading, Berkshire.

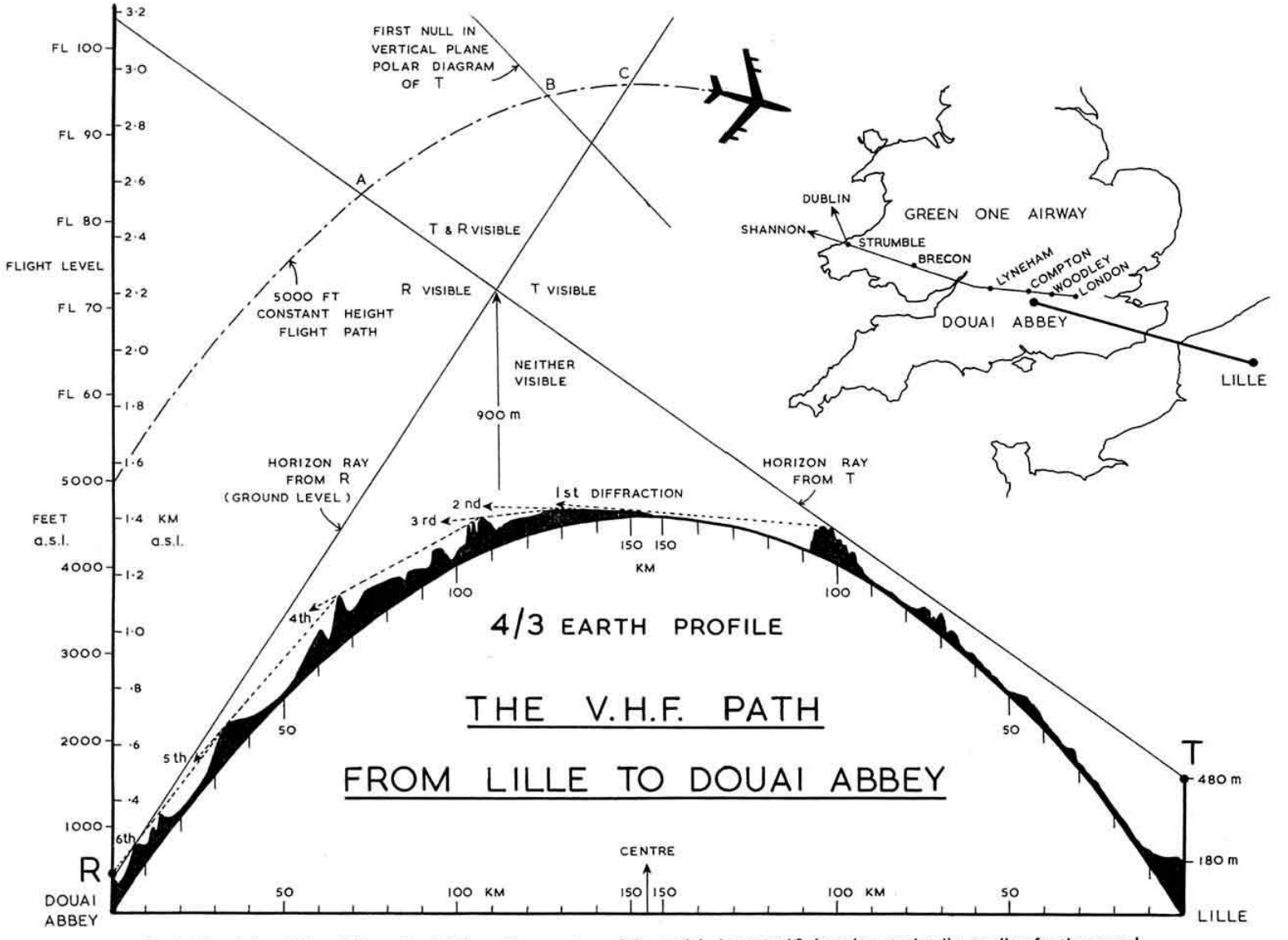


Fig. 1. The v.h.f. path from Lille to Douai Abbey. The curvature of the earth is drawn at 4/3 times its actual radius to allow for the normal effect of the atmosphere in bending v.h.f. signals. The inset map shows the radio path and the reporting points along the "Green One" airway which will be mentioned in Part II of the article. The detail of the diagram is discussed in the text.

(v) There is a radio-sonde station at Crawley, almost half way along the path.
(vi) Its frequency is near enough the 2m band to be of amateur interest.

It so happens that the radio path passes through a most complex network of air routes around London, Gatwick, and Lydd, but this was not at first thought to be important.

The Face of the Earth in Profile

The only method of showing on a diagram how a v.h.f. radio signal scrapes its way around the earth is to exaggerate the height scale out of all proportion to the scale of distance in a kind of worm's eye view, looking sideways at a slice through the earth made between transmitter, T, and receiver, R, as in Fig. 1. Allowance is made on the diagram for the normal bending of v.h.f. waves by the atmosphere (owing to its reduced pressure, temperature, and humidity with height) by drawing the earth less curved than is actually the case making its radius 4/3 times bigger. To this sea-level curvature is added, in silhouette, the height of the ground. The signal from the transmitting aerial, *T*, has a clear run to the hills at Cap Gris Nez where the first diffraction, or bending into the shadow of an obstruction, takes place. Having crossed the Channel, the signal is further diffracted until after the sixth diffraction it has a clear run to the aerial 55 ft. high at Douai Abbey. An aerial at ground level would receive a signal having suffered seven successive diffractions. Under suitable weather conditions some or all of the successive obstructions may become inoperative (the earth can then be considered as much less curved), or other modes of propagation may occur, such as reflection or scatter from a point where the horizon rays from *T* and *R* meet. In the diagram, *R* is shown as being at ground level.

Plane-Bounce

When reflection from an aircraft, or " plane-bounce," is considered, only the region of space in which *T* and *R* are both visible seems to be important; in the other regions the attenuation or loss due to diffraction makes the bounce-signal too weak. Thus an aircraft flying from Douai Abbey to Lille at a height of 5,000 ft. would be in the important zone between points *A* and *C* on its flight path. In the figure the flight path is curved to keep 5000 ft. above the curved earth. Since the aerials at *T* and *R* are at different heights the limit of the important zone is lower over *R* (10,300 ft.) than over *T* (19,000 ft.). The aircraft height is often quoted as a flight level, which is approximately one hundredth of its height in feet. The horizon rays from *T* and *R* meet at about 3000 ft. above sea level. Here almost all air traffic may give plane-bounce signals, whereas near the terminals of the path, *T* and *R*, only the higher altitude traffic will be effective.

Although the aircraft may be visible from *T* and *R*, it may not be illuminated by *T*, nor its bounce-signal be received by *R* because of the respective aerial characteristics; each aerial has its own vertical plane pattern depending mainly on its height above ground, and the smoothness and flatness of the ground for miles in front of it. The illumination of an aircraft at *B* might be almost zero due to the signal direct from *T* being cancelled out by another signal arriving after reflection from the ground. An aerial less than half a wavelength above ground would not have any null responses of this kind, but would not normally be regarded as suitable for DX reception! Aircraft using the " Green One " airway pass about five miles north of Douai Abbey. The unexpected way in which they influence the reception of Lille is described in the second part of this article.

Steam Trains on Paper

A pen-recorder is an instrument in which the needle of a milliammeter carries a small siphon-tube pen which transfers ink from a trough to graph paper that is continuously moved past the pen. A graph of current against time is drawn. When recording signal strength, the current is conveniently that of the diode detector, or of some valve in the receiver connected to the a.g.c. line. If calibration is required, a signal generator is used to inject a known signal into the aerial terminal of the receiver while the actual pen deflection is noted. Several hundred steam train fading instances have been recorded at Douai Abbey; serial numbers 86 and 87, recorded about five minutes apart, are typical. They are reproduced, in Fig. 2, juxtaposed so that their zero-beats (steam train at the station) appear at the same time for easy comparison. The steam train fading is recorded as a ripple of continuously varying frequency, whose amplitude reaches a maximum around the zero-beat position. This latter effect is partly due to the inability of the pens to follow the more rapid fading.

Owing to the movement of the aircraft the plane-bounce signal has a frequency slightly different from that of the diffraction signal direct from Lille, and the ripple on the recording is the very low frequency heterodyne between the two. It is not the actual speed of the aircraft which is important, but the rate at which the total bounce-path (transmitter-aircraft plus aircraft-receiver) is changing that determines the beat frequency. Each cycle of fading occurs for a change in the total bounce-path of one wavelength. It is really just a case of the Doppler effect.

Steam Train Performance

If one were to say that a car would do 0-80 m.p.h. in 30 seconds, one would say it had good *acceleration* (the glossy brochure about the car might impress you by quoting the acceleration as 2·93 ft./sec^2). Another car might do 0-45 m.p.h. in 20 seconds; is its performance better or worse than the first? A slide rule (or another glossy brochure) would show this to be an acceleration of 3·3 ft./sec^2, better than the first car. The braking power might also be compared: how long will the car take to stop from a given speed? What are the figures for retardation or deceleration?

Comparative performance figures for steam train fading may be obtained by counting the number of fading cycles from zero-beat over a certain time interval. If the speed at which the graph paper is moved past the pen is known a time scale can be marked on the graph. Recording No. 86 is typical of a *symmetrical* fading pattern on both sides of zero-beat; No. 87 is *asymmetrical*. An analysis of the performance of a large number of steam trains is shown in Fig. 3 where the number of wavelengths is plotted against the time from zero-beat, using logarithmic scales to obtain straight line graphs. The lines *P*, *Q*, *R*, *S*, *T*, and *U* each represent the analysis of many recordings; *R*, *S*, and *T* also correspond to the recordings No. 86 and No. 87. The graphs are not quite parallel lines, but all have a close approximation to a " square law " slope.

Chuff—Chuff!

The pull or force exerted by a steam locomotive depends on a number of factors like steam pressure, size of cylinders, and diameter of driving wheels, but it may be presumed that for a minute or so after the guard waves the green flag this force is reasonably constant. The train will, therefore, gather speed or accelerate smoothly. Each revolution of the driving wheels will move the train a distance equal to the circumference of the wheel. Once each revolution the piston will complete its stroke and the exhaust valve will release the used steam with a chuff! Actually any practical locomotive will " chuff " several times per revolution of its wheels, but this would confuse the present explanation unnecessarily. If each revolution of the wheels moves the train a distance of 5 ft. 8 in. (one wavelength at 174·1 Mc/s) and the number of revolutions is counted from the time that the guard waves the flag, then a graph is obtained for a real steam train exactly like *P*, *Q*, *R*, etc.; it would be a straight line with

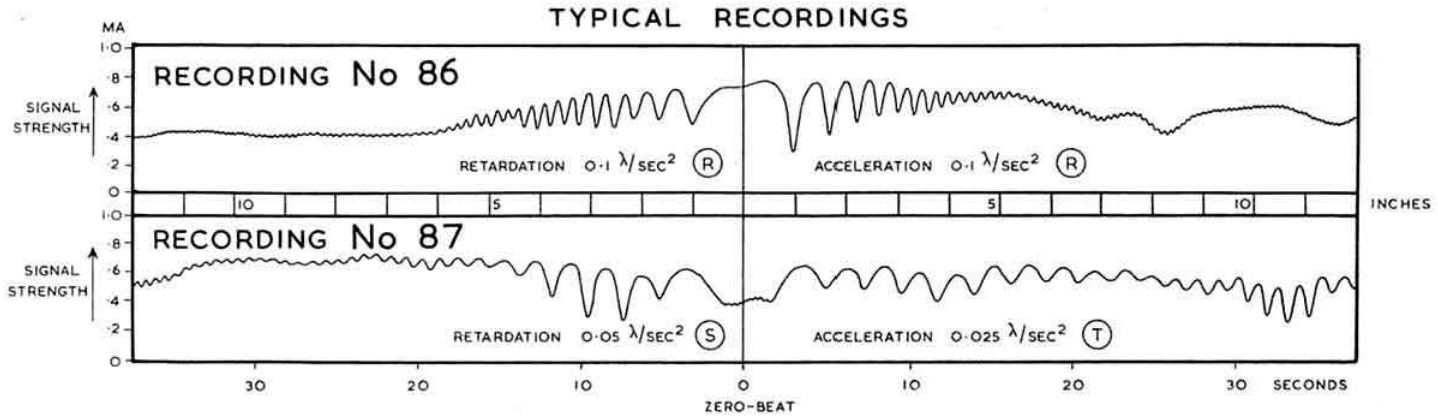


Fig. 2. Two typical recordings of "steam train" fading. The train halts briefly at the station where the variable frequency ripple passes through zero-beat. Each minimum in signal strength causes a surge of background noise in the receiver which sounds like the "chuff-chuff" of a steam train.

V.H.F. FADING OBSERVATIONS

ANALYSIS OF RECORDINGS

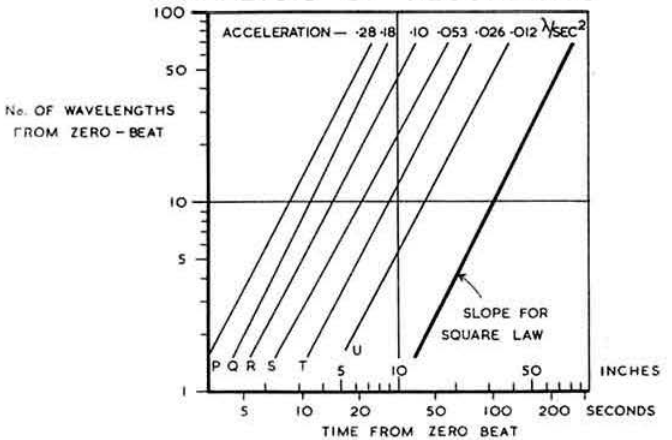


Fig. 3. An analysis of a large number of recordings of steam train fading. Each line P Q R S T U is representative of many recordings. All are seen to have a slope very nearly that of a "square law."

LILLE — DOUAI ABBEY

174·1 MCS

PATH LENGTH DATA CHART

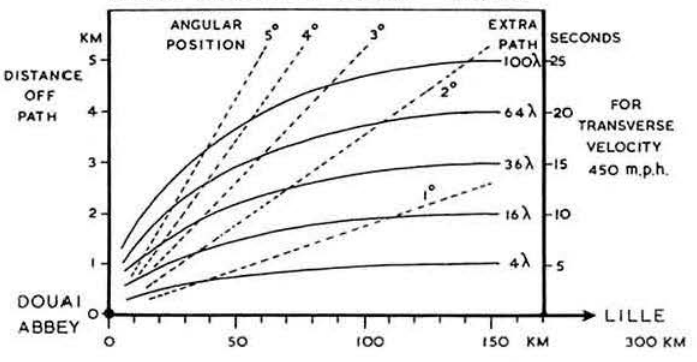


Fig. 4. Path length data chart showing how the length of the bounce-path increases as an aircraft moves off the direct path between Lille and Douai Abbey. The straight lines show the angular position of the aircraft from the receiver relative to the direction of Lille.

" square law " slope provided that the pull was constant. It is no wonder that the v.h.f. fading *sounds* like a steam train: it obeys the same law.

Up in the Clouds

The effect of the position of an aircraft on the length of the total bounce-path can be seen from the Path Length Data Chart, Fig. 4. The bounce-path is at its shortest when the aircraft is in line with Lille and Douai Abbey. If the aircraft is at the middle of the path, 150 km from the terminals, and moves off in a direction at right angles to the path, a distance of 1 km, the bounce-path will have become four wavelengths longer; a move to 2 km off will make it 16 wavelengths longer; at 3 km it will be 36 wavelengths longer. Here is where the square law operates. Square the distance off the path in kilometres and multiply by 4 (see Appendix), and the result is the extra distance in wavelengths by which the bounce-path has been lengthened. The wavelength of Lille is 1·72 metres or 5 ft. 8 in., and a kilometre is five-eighths of a mile.

If the aircraft is flying steadily at 450 m.p.h., it will move one kilometre every five seconds but the bounce-path will be lengthening at an ever increasing rate giving a steam train fade with an acceleration of 0·32 wavelengths/sec^2. This leads to the conclusion that the steam trains with the greatest accelerations recorded might have been caused by aircraft crossing the radio path somewhere near its centre. Lesser accelerations might be caused by aircraft crossing the radio path obliquely.

It is possible to count over 200 cycles of fading on some recordings. This suggests that the bounce-signal is effective for several minutes and that the angular position of the aircraft, its bearing from the receiver, may change several degrees as the steam train proceeds. The horizontal polar diagram of the aerials will therefore be important when considering the strength of the bounce-signal. It has already been shown how the vertical pattern will affect the illumination of the aircraft and the received signal. Yet another factor is the attitude of the aircraft: its efficiency as a reflector for bouncing signals will depend on how big a mirror it is when seen from the two aerials, and whether the mirror is tilted at a suitable angle.

Scrum down!

In the last section an aircraft was considered setting off sideways from the centre of the radio path, but the Path Length Data Chart is just as true in the vertical plane. It would apply equally to a balloon setting off from ground level at the centre of the path, rising vertically 1 km to increase the bounce-path by four wavelengths, 2 km vertically to increase it 16 wavelengths, and so on. It is a problem in three dimensions. However, if a steam train comes to a station and starts again, as in recording No. 86, this suggests an aircraft *crossing* the radio path; a balloon would have to be repeatedly raised and lowered to produce the same effect. But what is to be thought about the asymmetrical recordings like No. 87? And there have been recordings which look so asymmetrical that the station seems to be the terminus for the train—it arrives but never departs, or it departs without its arrival having been observed! Of course aircraft do change their height, speed, and direction from time to time, and must start and end their flights at ground level, but perhaps something should be blamed on the weather?

The *curves* on the Path Length Data Chart, Fig. 4, show the sort of track an aircraft would have to fly if it were to cause no change of bounce-path length. This kind of curve is called an ellipse. The total distance from one fixed point (a " focus," here the transmitter) to another fixed point (the other " focus," here the receiver) via any position on the ellipse is the same. The three dimensional version of the ellipse is the ellipsoid, a curved surface which is best imagined as having the shape of a rugger ball. The foci are *inside*, near

Fig. 5. A rugger ball and a stick explain where the steam train halts at a station: see text.

the ends, not at the ends. The actual size and shape of the rugger ball is determined by the distance apart of the foci, and the total length of the bounce-path (which is the same for *any point* on the *surface* of the ball). For extra realism the rugger ball may be imagined exactly half-buried in the earth, since transmitter and receiver are on the ground. A straight flight path of an aircraft may be represented by a straight stick laid against the ball, as in Fig. 5. It will touch the ball at *only one point*. This point is that at which the bounce-path via the aircraft is shortest. For *any* given flight path, not necessarily crossing between transmitter and receiver, there will always be *one* size of rugger ball that will just touch the stick once.

It should be noted that:

(i) The point of contact (where the stick is a " tangent " to the ball) is the station where the steam train halts at zero-beat.

(ii) Only when the stick is horizontal and at right angles to the line joining the foci will the tangent point be vertically above the radio path.

(iii) The acceleration of the steam train depends upon the curvature of the ball at the tangent point; it is greatest at the ends, i.e. for flight paths close to transmitter or receiver.

(iv) A bent stick would also have a tangent point, so curved flight paths will cause steam trains, but with accelerations depending upon both the curvature of the ball and that of the flight path.

(v) A flight path with curvature greater than that of the ball could touch it also from the *inside*: the bounce-path would then have its *greatest* value at the zero-beat point. A steam train caused by a circular flight would halt twice per circuit—once at maximum and once at minimum bounce-path length.

The normal manoeuvres of aircraft in South East England would seem sufficient to cause fading on the Lille-Douai Abbey path that would resemble Clapham Junction in the rush hour, but only if all the aircraft give rise to a significant bounce-signal. In fact, under normal reception conditions, a steam train fade can be recorded every few minutes, and quite often two or more trains can be observed simultaneously, the fading ripples beating with each other. The question is: are there really that many aircraft about at the same time? The second part of this article will describe two experiments

(continued on page 728)

TECHNICAL TOPICS By PAT HAWKER, G3VA

Amplifier Stability . Oscillator Stability . Double-balanced Valve Mixer . More FETs
Receiver Applications of FETs . New Japanese Equipment . Transistor Communications Receiver
Sterba Curtain . ZL-Special . 21 Mc/s Vackar . Transistor P.A. Precautions

THERE must be innumerable ways of going about the task of building Amateur Radio equipment—from the laudable technique of working out the whole unit in precise detail in advance, complete with design mathematics, to the adoption of a published design and parts list: or, what is probably the most common approach, simply starting out with some general idea of what one wants; sorting through the junk boxes to find what components and metalwork are available; and then trying, with the aid of " standard " circuits, to fashion something which meets at least some of the needs of the moment, at minimum expense and with little or no delay in collecting together the essential additional parts.

This latter system is perhaps not one to be recommended if one wants sure-fire, first-time results, or tidy looking gear—but it can prove an interesting exercise in appreciating technical compromises and one certainly learns something about what can and cannot be done to circuits, and how ex-equipment components can (and do) differ from their nominal characteristics and values. In our own case, it means, almost invariably, a unit which is initially unsatisfactory in one or more respects, but after being partially re-built comes somewhere near what we wanted, or alternatively gets less and less attractive until finally it gets consigned back to the junk boxes but with no harm done, except to our own self-esteem (and even that need not suffer too much since the blame can always be put on the antiquated components).

And sometimes, looking around some of the industry's most distinguished research and development laboratories, we have a sneaking suspicion that even the professionals indulge in a good deal of trial and error (even though, as we saw at a Racal establishment recently, some have computers to tell them what component values to use!).

Amplifier Stability

Surprisingly enough, one sees comparatively little comment in constructional articles on the problems of achieving good stability in h.f. (or v.h.f.) high-gain amplifiers (except power amplifiers in transmitters), though we find amplifiers still as ready to take off as they always have been. Perhaps the " lucky " ones among us are those who are content to use low Q input and output circuits and thus throw-away many of the inherent advantages of high slope valves—or alternatively take care to keep the aerial connected to the input circuit to keep it damped down.

A useful letter by F8AJ on this subject appeared in *QST* (July 1966) primarily concerned with making optimum use of the EF183 frame-grid vari-mu pentode. F8AJ emphasizes that careful shielding of the following mixer stage has an important bearing on the stability of the amplifier stage. He does not like the idea of using negative feedback in the form of unbypassed cathode resistors to hold down the stage but prefers to control stability by the inclusion of a resistor (R) in series with the anode choke (a technique said to come from the KWM2). He says that the value of the resistor may have to be as high as 1000 ohms but can often be reduced in value as shielding and bypassing the stage is made more effective.

He also comments: " Of course a high-transconductance valve deserves high-Q coils. If you have succeeded in putting an EF183 in your old receiver without instability, don't have too much pride in your ability until you have a look at the coils." F8AJ says he is using toroidal coils wound on powder-iron cores; this is only one of a number of references noted recently in favour of increased use of torodial and pot cores, which would seem to offer many advantages to the constructor in the confining of the magnetic fields, as well as in the high Qs obtainable.

F8AJ's circuit for an EF183 first stage is shown in Fig. 1. He points out that the rather unusual form of aerial input matching has proved very convenient for use with 50-75 ohm coax, although it is necessary for the value of the coupling capacitor to be adjusted and switched for each band; the value shown in Fig. 1 is for 3·5 Mc/s.

Oscillator Stability

Unlike amplifier stability, oscillator stability is very much an " in " subject these days. The recent letter by G3BIK (BULLETIN, September 1966), supported by the remarks from G5BB (see later), and some of the conclusions reached in the first of a series (" V.F.O. Stability—Recap and Postscript " by W1DF in *QST*, Part 1, September 1966) all underline the importance of temperature on the components, and particularly on the inductor, used in the frequency determining tank circuit of a variable frequency oscillator.

Although W1DF suggests that certain important practical aspects of v.f.o. performance are lacking in the literature, we would refer him and others to a most informative British

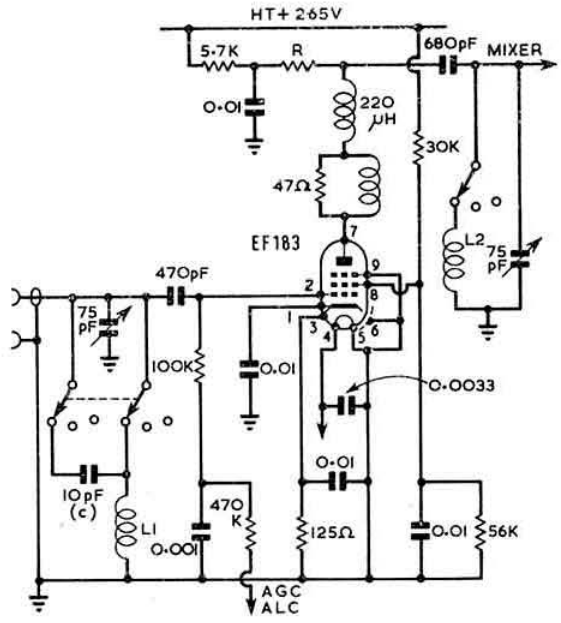


Fig. 1. F8AJ's suggested circuit for an EF183 r.f. amplifier.

book *Theory and Design of Valve Oscillators* by H. A. Thomas originally published in 1939 (but probably long out of print) which presented extremely detailed investigations into almost all aspects of frequency stabilization.

All these sources confirm beyond question the importance of the *Q* and temperature characteristics of the tank circuit, independently of the actual oscillator circuit, and that the internal effects of valve heat are less important than that of the heat reaching the tank circuit (and hence in transistor circuits the effects of draughts, etc.).

It would be pointless to try to summarize in a few words all the important information assembled by Dr. Thomas, but we would just mention that he describes the construction of a temperature compensated inductor and that this description inspired G6NA to produce an article on the subject in the BULLETIN many years ago.

In so far as non-compensated inductors are concerned, one particular form of coil was found to have a temperature coefficient of about plus seven parts/million/°C compared with around 35 p.p.m. for most forms of winding. This consisted of a silica former with the wire wound in grooves while hot, and allowed to contract: this particular 4·4 μH inductor consisted of 8 turns, 2·65 in. diameter, 0·064 in. diameter wire, with 0·2 in. turn spacing. A technique which offers an improvement of five is worth considering, particularly since inductors of roughly this type can be found in the surplus market.

W1DF comes up with some very practical points. He emphasizes that in amateur operation one is interested primarily in relatively *short-term* stability, since we are seldom concerned with staying on precisely the same frequency for more than an hour at the most, and thus amateur requirements tend to differ from those of other radio communications services where long-term stability is often of paramount importance.

He also believes that we tend to judge the suitability of a pentode valve for oscillator applications by its transconductance, but this in fact does not constitute a real figure of merit, which for most circuits involves the grid-to-screen transconductance which is not usually published: his proposed circuit uses a high-mu triode.

On many occassions in *TT* we have stressed the importance of heater variations (shown very clearly in Dr. Thomas's book). W1DF says: " in looking for ways to reduce heater-voltage effects it was found that a higher anode voltage (105 volts) and a lower grid leak (10 K ohms) effected a worthwhile improvement." He also found differences between valves, and noted that a 6U8A was considerably better than the earlier 6U8, presumably because the 6U8A was designed for controlled heat-up.

On tank circuits, W1DF states that slug-tuned coils are " worse than equivalent coils without slugs, since the iron has a rather poor temperature coefficient." He finds that silver-mica-moulded (" postage stamp ") fixed capacitors better than the dipped type.

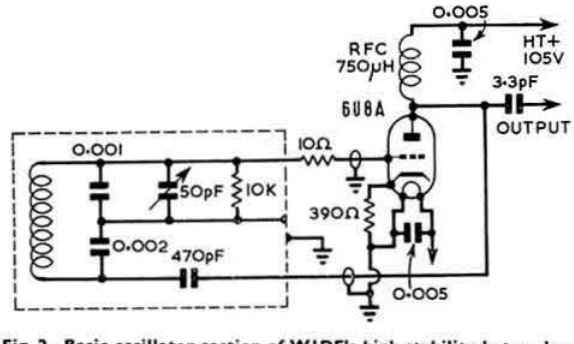


Fig. 2. Basic oscillator section of W1DF's high stability heterodyne v.f.o.

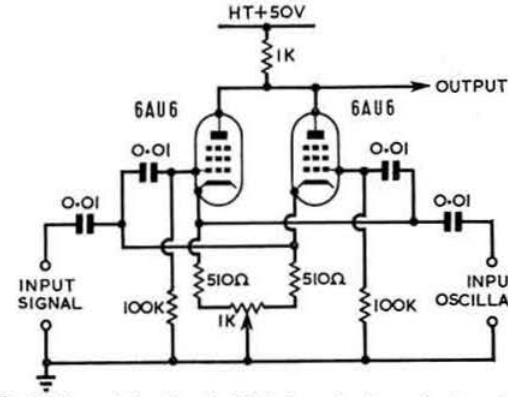


Fig. 3. Essentials of a double-balanced mixer circuit using two pentodes (*Electronics Industries*).

As part of this series, W1DF is presenting a design for a heterodyne type v.f.o. and in the first part gives the basic variable oscillator using the triode section of a 6U8A (Fig. 2), of which the pentode section will form the buffer. He stresses that " gain in either power or voltage " is the last thing that should be expected of a true buffer."

Double-balanced Valve Mixer

The increasing use of mixers in s.s.b. transmitters, heterodyne v.f.o.s and, potentially, in frequency synthesizers for both reception and transmission means that there is a rising demand for balanced mixer circuits which eliminate, or at least greatly attenuate, as many of the unwanted output signals as possible. The conventional balanced mixer eliminates the oscillator frequency from the output, leaving the input and the heterodyne products. In a double-balanced mixer both the local oscillator and the input signal frequency are cancelled out, leaving a much cleaner output.

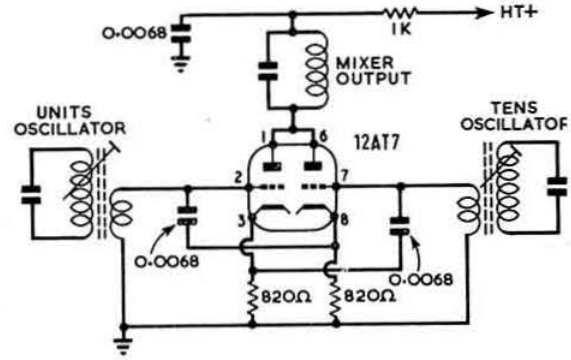


Fig. 4. W3QLV's variation of the double-balanced mixer using a double triode.

The circuit of a novel double-balanced mixer using valves was described back in October 1960 by H. T. McAleer in *Electronic Industries* and one version, using a double-triode subsequently turned up in a crystal-bank frequency synthesizer by W3QLV (*QST*, December 1964). Fig. 3 shows the more elegant version using two pentodes such as the 6AU6 complete with balancing potentiometer; and the simpler double-triode version used by W3QLV is shown in Fig. 4.

An advantage of these circuits is that unlike most standard

double-balanced mixers there is no requirement for push-pull drive for correct operation. The simpler double-triode version does not provide such good suppression of the fundamental frequencies since direct feedthrough from input to output can occur through grid-anode capacitances, but it can be more conveniently fashioned with a single double triode valve. The circuit can be thought of as a pair of grounded-cathode amplifier stages driven in parallel by a pair of grounded-grid amplifiers, with common anode load; since gain of the grounded-grid states is equal and opposite to that of the grounded-cathode stages, the net gain is zero at the input frequencies.

More FETs

Several points arise out of the notes on junction-gate r.f. FETs in the September *TT*. More and more semiconductor manufacturers are now offering field effect devices, and among the many articles now appearing is a series by K7HQN of Motorola starting in *CQ* (August 1966). This firm is marketing several of the devices about which we wrote, including the attractive 2N3823. But the firm also has a series of lower cost units including r.f. types 2N4223 and 2N4224 which appear to be retailing around 25s. apiece in the States and have a noise figure of about 5db at 200 Mc/s.

Fairchild in the States' have an SE5301 device for consumer applications, stated to be an *n*-channel depletion mode MOSFET for r.f. amplifier and mixer stages in h.f. and v.h.f. receivers (price unknown). WA1CCH (see later) also draws attention to a new Fairchild 2N4360 epoxy-cased *p*-channel FET which sells in the States for 95 cents (say 7s.) and under half this price if you should require them in lots of 10,000! WA1CCH says this device is promising for low frequency applications, and the makers do quote some parameters at 1 Mc/s. He also mentions the Texas Instruments TIS34 as the cheaper brother of the 2N3823.

G3JGO points out that not all FET devices can be regarded as low-gain units, since some devices have transconductances of up to 14,000 μmhos; he also mentions that the TI 2N3819 is being quoted at £1 6s. which is a few shillings more than the figure suggested by G3UMF, with the 2N3823 currently at £3 15s. In general, prices for semiconductor devices seem to have an elastic quality, as it all depends upon how many you buy.

G3JGO also wonders whether the capacitance of the junction gate varies with reverse bias as in a voltage variable capacitance (this seems to be suggested by a Ferranti application report) and if so whether this could not cause cross modulation effects which would presumably be absent in the insulated-gate varieties. We have not found any reference to this in the admittedly pro-FET reports that we have read; and it is perhaps worth noting the conclusion reached in a report on using FETs in high-fidelity v.h.f./f.m. tuners " the performance is as good as, if not better, than the performance of the best valve front ends, and is at least 20db better than the best transistorized front end using the best available bipolar transistors." This does not mean that all front-ends using bipolar transistors are necessarily bad in cross-modulation performance (certainly we found no sign of this in trying out the Plessey PR155) since there are ways round the problem; but it is an indication that with a straightforward circuit it should always prove possible to obtain lower crossmodulation with an FET than with a bipolar transistor.

Receivers with FETs

The references to the Davco DR30 receiver (*TT* September) brought two letters from across the Atlantic on the same day! One was from Paul Franson, WA1CCH, editor of *73 Magazine* who wrote the review of the original non-FET version (*73*, May 1965 and not 1966 as stated last time). The other was from Edgar Seeler, W1BDF who, as a purchaser, feels there are still a few bugs to be worked out (at least on his particular model, as delivered) but has high praise for some of the features.

WA1CCH is convinced that the FET front-end adds to the appeal of the set and believes the crossmodulation performance now stands comparison with highly respected valve receivers. He adds that K4BXO of Davco says that the only known cases of FET burn out are the result of direct application of r.f. energy to the aerial terminal—a test not to be recommended even with valve receivers.

WA1CCH sends along some pulls from the October *73* of a low cost FET 2m converter based on three TIS34 devices (two r.f. and mixer), plus a bipolar 2N3563 as crystal controlled oscillator, designed by K6HMO. Fig. 5 shows the middle portion of this design, with one of the r.f. stages and the mixer. In the States these Texas Instruments devices are selling around £1 and seem to be very close to the 2N3823 in performance. It is said, incidentally, that it is becoming much cheaper to buy semiconductor devices which have an individual maker's designation than one carrying a standard JEDEC (i.e., 2N——) designation.

Articles on FETs which have already been published in *73* include a long one on general theory and applications (December 1965), crystal oscillators (March 1966), r.f. applications of the 2N3823 and the cheaper TIS34 (May 1966), etc., and others are in the pipeline.

And you will already have read G3HBW's article in this issue!

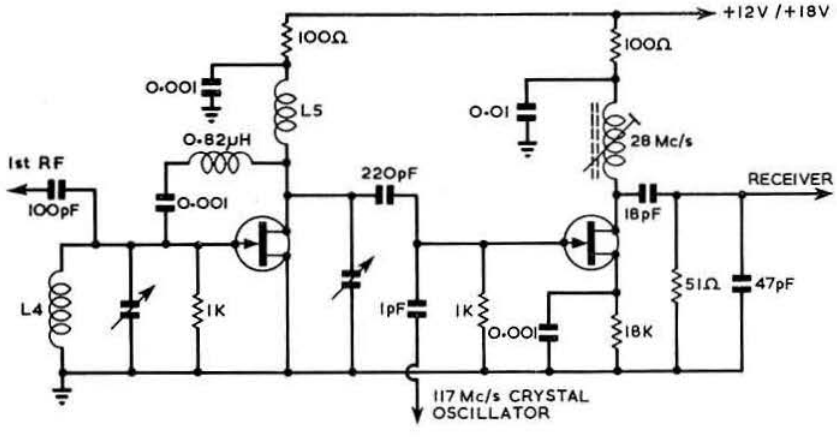


Fig. 5. Part of K6HMO's FET 144 Mc/s converter which claims a noise figure under 2·5db, a gain of 27db and very good rejection of cross-modulation products using TIS34 devices. It provides an interesting comparison with G3HBW's design in this issue.

The Japanese Scene

For many years, the American journals and magazines, with their large issues and apparently unlimited resources, have been the envy of those of us concerned with technical publishing. But at present for sheer bulk of information per issue there can be few Amateur Radio journals anywhere in the world that can match the Japanese JARL journal *CQ ham radio*. This currently runs to well over 250 pages per month, with literally hundreds of diagrams in each issue, and leaves one wondering what kind of editorial and advertising organization does JARL have to produce these bumper issues? And what are Japanese printing costs?

In *TT* (March 1966) we listed some of the communications receivers marketed by Japanese firms, and a number of these are now available in the U.K. These sets are pricewise extremely competitive, even though import charges, etc. mean that they are often offered here at roughly double the prices listed for domestic sale in Japan. Several interesting new equipments are reviewed in recent issues of *CQ ham radio* and are likely to reach the UK in the near future, if they are not already here.

FT100: This is a particularly interesting looking s.s.b./a.m./c.w. transceiver running some 120-watts p.e.p. on 3·5 to 28 Mc/s using all semiconductor devices with the exception of the transmitter driver (12BY7A) and power amplifier (two 6JM6s). There are about 35 transistors and a lot of diodes. Main filter is 3180 kc/s with six crystals, and the v.f.o. covers 8400 to 8900 kc/s. Although a full circuit diagram and pictures are included in the July issue of the journal, it does not appear to have been priced at this time, but is clearly an advanced piece of amateur gear.

ST700: This is a 3·5 to 28 Mc/s companion transmitter to the SR700A receiver (*TT*, March 1966). The output stage is two 2B46 tetrodes. Power is given as 200 watts p.e.p. for s.s.b. and c.w. and about 100 watts a.m. Valves are used for all purposes other than the power rectifier diodes. Each band covers 600 kc/s. Filter is at 455 kc/s. Price in Japan is apparently under £80.

A little rig, the Toyomuna " QRP-20 " covers all bands from 3·5 to 50 Mc/s with 6BA6, 6CL6, 2E26 transmitter and 12AX7 and two 6BQ5 modulator running some 25 watts and offered at under £30. There is also the TX388SB, a companion s.s.b. transmitter to the popular JR300S receiver which is usually known in the UK as the HA350. And these are only a very few of the many rigs featured in the advertisements—and the journals also contain much evidence that home-construction is equally flourishing.

The Redifon R408 all-transistor communications receiver covers 13 kc/s to 28 Mc/s without a break.

Transistor Communications Receivers

In the July *TT*, in commenting on the various high performance all-semiconductor receivers now being marketed by British firms, a brief reference was made to the Redifon design. Steve Gall, G3UCM has sent along some details of this receiver (model R408) mentioning that although this set is a general purpose receiver and not intended solely for marine purposes, a further version (R500) is being developed for point-to-point use.

The set is intended for all modes, including a.m., c.w., s.s.b., i.s.b., d.s.b. and f.s.k. and covers 13 kc/s to 28 Mc/s without a break. Up to 650 kc/s the i.f. is 80 kc/s, but another i.f. of 470 kc/s, 1·5 Mc/s or 4·5 Mc/s is switched in automatically on the higher ranges, and above 4 Mc/s the front-end is crystal controlled in 3 Mc/s-wide bands. The 80 kc/s filter is continuously variable in bandwidth from 8 kc/s to 800 c/s with a crystal filter giving a 160 c/s bandwidth. Shape factor is claimed as 1·4 : 1 (but this is presumably that measured in the most favourable conditions with minimum nose selectivity). High sensitivity, and resetting accuracy of 1 kc/s are among the features.

An interesting constructional feature is the use which is made of printed wiring boards, but these are made from fibreglass for good h.f. performance. Modular construction is used, with each r.f. stage, placed at 90° to the bandswitch, removable since the bandswitch is composed of several sections butted together in the manner of woodwork joints. The a.g.c. has four positions, on each mode.

After warm-up, drift is claimed to be less than 40 c/s in any half-hour period. A wide temperature range is possible by the use of silicon planar transistors. Weight is 55 lb. and the case measures 8¾ in. high, by 17½ in. wide by 19¾ in. deep.

G3UCM does not mention the price range, but we gather this is in the £600 category. He feels that several features of this design are of interest to amateurs.

Another British all-semiconductor receiver not mentioned in July is the R7020 by C & N (Electrical) Ltd., a double-conversion 0·6 to 32 Mc/s receiver which can be run from U2 cells and which was originally developed for use in the Antarctic.

Aerials for DX

Another new *QST* series, " Station design for DX " by W3AFM comes out firmly in favour of horizontally polarised h.f. aerials, basing his argument on the high ground losses of verticals. His estimate is that the radiation efficiency of a quarter-wave ground plane with the usual four earth radials is " probably less than 20 per cent " obtaining this figure by interpolation of figures given in 1939 by G. H. Brown of RCA (in fact this was an investigation into the direct ground wave of m.f. broadcast aerials and is probably not directly applicable to sky wave radiation). Certainly, the work by Brown did emphasize the tremendous importance of an extremely good earth system for vertical radiators, but we do not think that all users of ground planes will agree with W3AFM's views, though it must be admitted that verticals, even when correctly matched, can sometimes prove disappointing.

Less controversially, W3AFM draws attention to the many different ways in which manufacturers can state " aerial gain " (this subject is well covered in an article in *Wireless World*, October 1966). In an attempt to resolve some of these differences—which apply just as much to manufacturers of commercial transmitting aerials as to the firms catering for amateurs—the CCIR has recently proposed a new term e.i.r.p. instead of e.r.p.; this will stand for " effective isotropically radiated power " to clean up the ambiguity that arise since e.r.p. is sometimes with reference to a dipole and sometimes with reference to an isotropic aerial (the imaginary

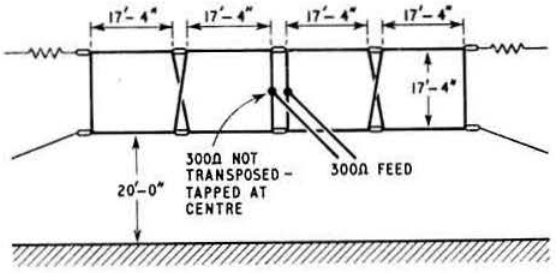


Fig. 6. 14 Mc/s Bruce array dimensions suggested by W2EEY (*73 Magazine*).

aerial which spreads its radiation out in all directions equally).

Sometimes one feels that the dominance of the directional aerial scene by Yagis and quads, good though they undoubtedly are, has tended to mean that to many newcomers the 8JK, Bruce, Sterba, etc., are little more than names dimly from the past. W2EEY/1 has some notes in *73* (August 1966) on curtain type aerials, which can make effective fixed beams, and makes the point that these are high-impedance arrays and so make the dimensions far less critical than, for example, with Yagi elements. This strikes a chord since for many years our own basic aerial has been the 300-ohm ribbon-type folded dipole (*TTftRA*, page 78) which is one of the least critical and most satisfactory forms of single-band dipole and capable of reasonable results when about 20 ft. above indifferent ground, or inside attics or jammed between buildings. Although most curtains tend to require a fair amount of real estate and high supports, the 20m array given by W2EEY (Fig. 6) is capable of fitting into many gardens and gives low angle radiation on either side of its axis.

A useful form of unidirectional aerial which has also been around a long time but has apparently never appeared in the BULLETIN is the " ZL-Special " which can be easily slung up as a fixed beam, or can be fashioned into a rotatable beam by using 1 in. tubing. Basically two folded dipole elements are driven with current 135° out of phase using transposed 300-ohm line as a $\frac{1}{8}$-wave phasing section. Figs. 7 and 8 show two slightly different forms of the ZL-Special, one from *Amateur Radio Antenna Handbook* (W6TYH) and the other from *Antennenbuch* (DM2ABK); the latter source also rpovides suggested dimensions for use where the spacing between the dipoles is reduced to about one-tenth wavelength.

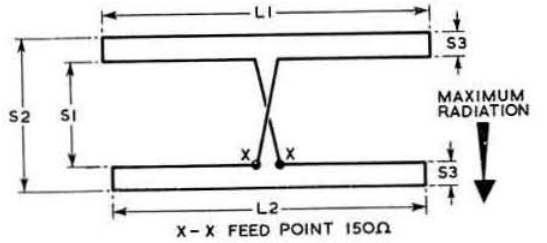


Fig. 7. The W6TYH version of the ZL-special undirectional aerial (1 in. aluminium tubing).

	14 Mc/s	21 Mc/s
L1	32 ft. 6 in.	21 ft. 8 in.
L2	31 ft.	20 ft. 8 in.
L3	7 ft. 1 in. (300 ohms)	5 ft. 9 in.
S1	7 ft.	5 ft. 8 in.
S2	8 ft. 6 in.	6 ft. 8 in.
S3	9 In.	6 in.

Gain of this aerial is usually given as about 6 or 7db better than a dipole, with a very good back-to-front ratio to cut down reception from unwanted stations.

21 Mc/s Vackar

A. H. Bruce, G5BB, has been experimenting with a transistorized Vackar directly on 21 Mc/s and confirms G3BIK's remarks in the September issue on the need to build transistor oscillators in a heavy metal box to keep out draughts. His breadboard 21 Mc/s emitter-keyed version is based on BRS25769's circuit with an OC170 buffer: see Fig. 9.

At this relatively high frequency, he finds it extremely sensitive to slight temperature changes (this is clearly a question of the tank circuit temperature coefficient rather

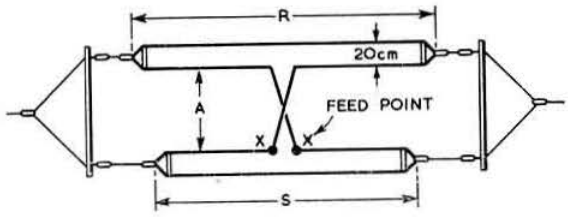


Fig. 8. DM2ABK's version of the ZL-Special (plan view). The feed impedance of 90 ohms is suitable for 70 ohm coax or 120 ohm balanced feeder.

	S	R	A	A
28 Mc/s	5·09m	5·39m	1·29m	$\frac{1}{4}\lambda$
	4·17m	4·42m	1·06m	$\frac{1}{5}\lambda$
21 Mc/s	6·85m	7·24m	1·72m	$\frac{1}{4}\lambda$
	5·62m	5·94m	1·41m	$\frac{1}{5}\lambda$
14 Mc/s	10·30m	10·85m	2·58m	$\frac{1}{4}\lambda$
	8·45m	8·90m	2·12m	$\frac{1}{5}\lambda$

than the oscillator circuit as such). He writes: " In fact if I breathe on it the frequency just whips away almost immediately some 25 kc/s lower—and returns when it cools off about 15 to 20 seconds later. It is quite fantastic, maybe I have invented a new f.s.k. system!

" This was first noted when sharp gusts of air were coming from the french windows. Thinking of G3BIK's letter I shut the window and the frequency became more stable. When some feet away from the oscillator drift is about 10 kc/s in half-an-hour, but creeps—apparently from body heat—when a foot or so away but beyond the influence of " hand capacity." But I feel convinced that with the oscillator in a small die cast box with buffer and about four OC170s as p.a. a QRP 21 Mc/s transmitter would be possible."

A suggestion arising from the earlier remarks might be to eliminate the slug tuned coil in favour of one with less temperature sensitivity.

Since the above notes were written, a further letter on this subject has come from Paul Harris, G3GFN, who has been working on Vackar-type transistorized oscillators as high as 70 Mc/s. He writes: " a number of points of interest have come to light: (1) maximum stability is achieved with any particular transistor when the working point is set so that it operates in Class A; (2) when greatest stability is required, the transistor should have a cut-off frequency of at least ten times the frequency of oscillation; (3) but selecting a transistor as in (2) does not necessarily imply that the best stability will be achieved, since certain h.f. types suffer badly from random internal changes which result in spasmodic changes in frequency and/or high rate of drift; (4) of the types checked so far, alloy-drift are superior, and particularly outstanding up to 70 Mc/s is the ADT140.

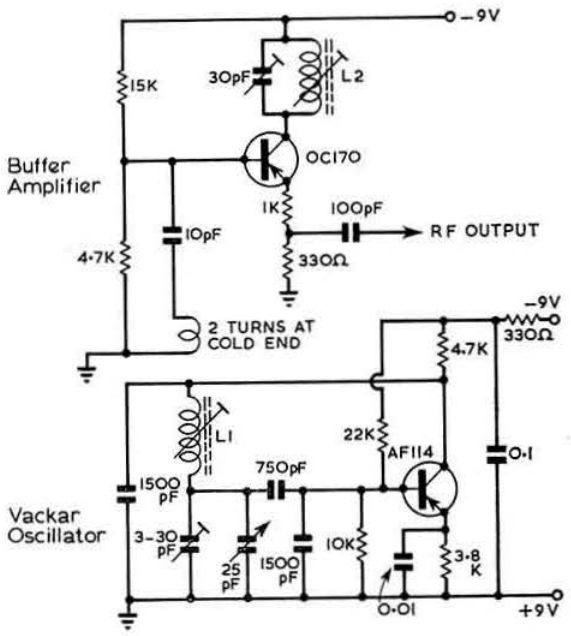


Fig. 9. G5BB's experimental 21 Mc/s Vackar oscillator and buffer amplifier. L1, 19 turns, 22 s.w.g. enam. on ¼ in. diam. Aladdin former, slug tuned. L2, 23 turns, 22 s.w.g. enam. on ¼ in. diam. Aladdin former, slug tuned.

G3GFN says he has developed oscillators covering 1·8 Mc/s to 30 Mc/s. A check against a 500 kc/s crystal checked with MSF and continuously checked at 2·5 Mc/s, shows that the 30 Mc/s oscillator has a drift of some 500 c/s in the first minute of switching on, but thereafter, and under constant temperature conditions, drift does not exceed 50 c/s an hour. G3GFN also suggests that capacitative coupling to the Vackar is not the way to obtain optimum stability.

G3GFN does not say how he obtains " constant temperature conditions " which would appear to be one of the most important considerations.

Transistor Power Amplifier

The interest in the use of transistors as h.f. and v.h.f. power amplifiers, either for low-power transmitters or for use in exciters continues to grow. But, as has been indicated in the past, this is a matter in which some caution must be exercised unless an unlimited supply of these relatively expensive devices is available.

R. C. Marshall, G3SBA recently drew our attention to some pertinent notes in the *Motorola Semiconductor Circuits Manual*, of particular interest to those who are trying their hand at designing their own amplifiers.

In traditional valve practice, there are only a few fairly straightforward limitations to what a valve can be expected to handle safely; the most important being maximum dissipation of the various electrodes. But rather different considerations apply to transistors and these have led to the concept of operating strictly within the d.c. *safe area*. It is most important to note, for example, that because of the limited base-width a transistor designed for operation in class C will be unsuitable for use in a d.c. biased class A circuit at even a fraction of its rated power output. The Motorola manual quotes as an example the 2N2947 which can be operated safely in class C with one amp collector current from a 25 volt supply; if a continuous d.c. voltage and current of this nature were applied the maximum device dissipation would not be exceeded *but* the transistor would be instantly destroyed due to exceeding the safe area.

A term which often crops up in h.f. power amplifier stages is *secondary breakdown*—this is a destructive condition which can occur when the ratings of the safe operating area are exceeded. Second breakdown seems to be due to a sudden concentration of energy into a small area of the transistor; this energy being a function of collector voltage, collector current, and time; and the practical effect is a collector-to-emitter short.

The point to note is that the factors which limit power output from a transistor p.a. are seldom power dissipation. An h.f. transistor in a typical class C circuit is usually limited by peak voltage or by peak current well before the dissipation limit is reached. Another feature is that the power gain of class C amplifiers (including doublers and triplers) decreases not only for low drive power but also for over high drive power.

Motorola point out that transistors will collector modulate akin to valves, with a few exceptions. However, since transistors are normally current and voltage limited, a device near its limits cannot be up-modulated from that power level; and in fact a collector supply voltage of only one-fourth the maximum rated voltage must be used. Since the peak current must double also, the carrier level of one-fourth maximum power output must be maintained in order to permit 100 per cent up-modulation.

Motorola stress that feed-through capacitance allows some carrier to pass through even if the downward peaks of audio reduce collector to emitter voltage to zero, and it is for this reason that some modulation of the driver is needed if good down modulation of the p.a. is to be achieved. There is less carrier feed-through when a common-base configuration is used.

There is a good deal more that needs to be said on this subject but, for the moment, it will have to suffice to stress that a class C h.f. or v.h.f. power amplifier can be tricky if it is being worked anywhere near its rated limits—and even greater care is necessary with linear amplifiers.

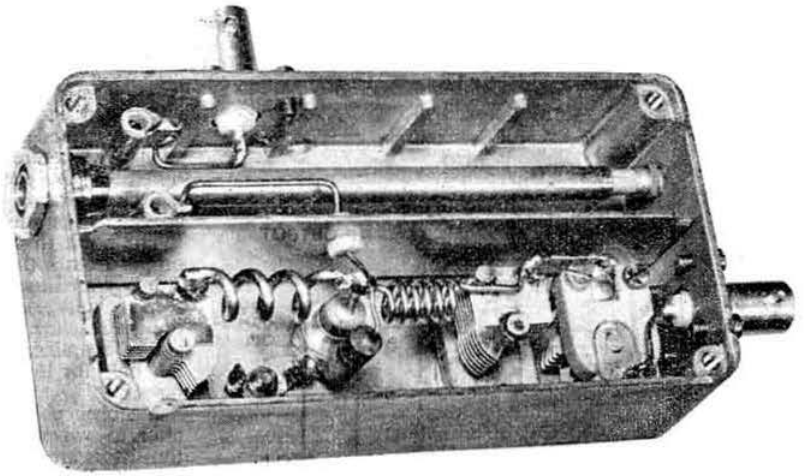
A recently introduced Telefunken output valve, type EL3010, may well have interest for s.s.b. output stages or drivers in rigs using transistorised exciters since it has a slope of 50 mA/V, according to a recent review in *DL-QTC*.

Here and There

G3JGO wonders whether any member knows what basic technique is being used in the compact h.f. bidirectional couplers now being marketed in the States by such firms as Anzac Electronics; he thinks it may be some form of wide-band transformer. Any ideas?

A most interesting letter from Mike Barlow (ex G3CVO of amateur TV fame) raises some points about using varactors as *linear* triplers (our immediate reaction is that it seems to be more common practice to use the up-converter technique) and also the possibility of amateur use of comb and inter-digital filters (these are a relatively new form of bandpass v.h.f. or u.h.f. filter using arrays of parallel rods between ground planes, and seem to offer a highly efficient filter with simple construction).

Mike Barlow is now in the Montreal area of Canada and notes that a rash of 2m repeaters on high points is springing up. He writes: " I am in two minds as to whether this is a good thing or not. For the listener it is fine—good strong signals from all stations and all on the same channel, so a listening watch is feasible. Against, however, is the fact that nobody needs gear better than the minimum to trigger the repeater transmitter and receive it—so some of the gear really is minimal." He reports plenty of jobs going in Canada —but perhaps we had better say nothing about that or we shall lose too many readers.



The 70cm tripler constructed by G6JP. It runs safely at 10 watts output.

A Varactor Tripler for 70cm

By G. R. JESSOP, G6JP*

THE advances made in semiconductors in recent times have not only made available transistors which will give up to 40 or 50 watts at 50 Mc/s or 15 watts at about 180 Mc/s, but have also led to the production of varactor diodes which can be used to double or triple output frequencies at high efficiency. It is obvious that suitable power varactor diodes for operation in the 150 to 450 Mc/s region at output powers of up to more than 20 watts with as much as 75 per cent efficiency offer an attractive means of getting on to 70cm using existing 2m equipment. Another notable advantage of the varactor is that it is entirely r.f. powered; no other power supplies are required for its operation.

This article does not propose to deal with the theoretical aspects of varactor diodes, but simply to provide the amateur with sufficient constructional details to produce a tripler that will provide an output of more than 10 watts on 70cm. The heart of this unit is a Mullard BAY96 varactor diode; this and all the other components are built in to a small diecast box, which doubles as an adequate heat sink.

Although frequency or similar modulation is the preferred method of modulation, certain types of varactor diode, of which the BAY96 is an example, will give good speech quality at the 70cm output when driven by an amplitude modulated 144 M/cs input. It should, however, not be assumed that all varactor diodes will give an equal performance in this respect, for many will not and hence frequency or similar modulation will have to be used.

Operational tests with the circuit of Fig. 1 have found 144 Mc/s a.m. drive satisfactory, and this good performance has been confirmed by the manufacturers so that a tripler using this particular diode can be relied on to be suitable for either frequency or amplitude modulated drive.

It can be seen in Fig. 1 that the diode is used in a shunt arrangement with an auto-bias resistor connected directly across it. This system is convenient as it allows one side of the diode to be fixed directly to the diecast box.

The Circuit

The three tuned circuits are tuned to the input frequency, 144 Mc/s, the idler (second harmonic) frequency, 288 Mc/s, and the wanted third harmonic, 432 Mc/s, the varactor diode being connected to the junction of these circuits. The input tuned circuit consists of C1, C2 and L1, the idler circuit is composed of C3, L2, and C4, L5 are tuned to 432 Mc/s. As all these circuits have a common point at the diode there is

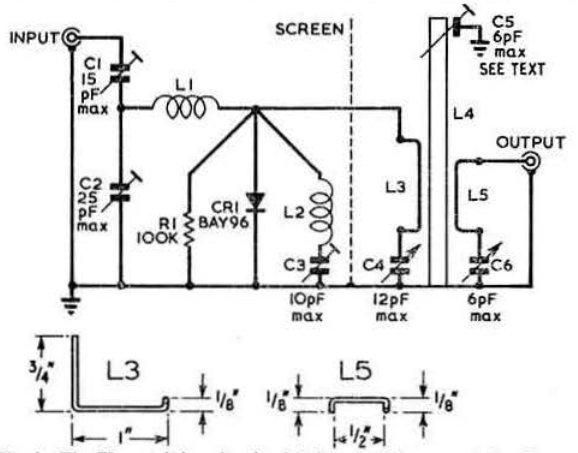


Fig. 1. The 70cm tripler circuit. L1, 6 turns, 18 s.w.g., $\frac{3}{16}$ in. diam., $\frac{1}{4}$ in. long; L2, 3 turns, 14 s.w.g., $\frac{3}{16}$ in. diam., $\frac{3}{4}$ in. long; L3, 18 s.w.g., shaped as shown, and spaced $\frac{1}{8}$ in. from L4; L4, $\frac{1}{4}$ in. o.d., $\frac{3}{16}$ in. i.d. copper table, $4\frac{1}{8}$ in. long; L5, 18 s.w.g., as drawing, spaced $\frac{3}{16}$ in. from L4.

* Member of RSGB Technical Committee, 32 North View, Eastcote, Pinner, Middlesex.

naturally some interaction between the circuits, and thus any adjustment to one must be followed by readjustment of the others.

As can be seen from the photograph and layout diagram the 432 Mc/s circuit is screened from the input and idler circuits by a screen running the length of the diecast box. The connection from the common junction of the three circuits passes through the screen, insulated with a small p.t.f.e. insulator, to its tuning capacitator C4. This circuit, comprising L3, C4, is coupled to the high *Q* circuit L4, C5, and the output circuit L5, C6 is in turn coupled to this high *Q* circuit.

Use of the high *Q* circuit enables a considerable degree of filtering to be attained and ensures that both input and idler frequencies are suitably attenuated in comparison to the wanted 432 Mc/s (third harmonic) output. Examination of the output on a spectrum analyser shows that the presence of the input (144 Mc/s) and idler (288 Mc/s) frequencies are barely noticed when compared to the 432 Mc/s signal, likewise, the outputs at fourth and fifth harmonics are very low, and the only output present at any significant magnitude is the sixth harmonic of the input frequency (twice the output frequency) at 864 Mc/s.

Construction

The construction is really self-evident from the illustrations, but the following information deals with various details which may not be apparent.

(i) C2 and C3 are standard chassis fixing capacitors.

(ii) C5 is made from a Mullard type COO4EA/12E tubular trimmer by removing the outer plate (fixed tube) and inserting the remaining insulator and movable inner plate into the end of the copper tube which forms L4.

(iii) The input and output connections used in the prototype are BNC 50 ohm types. The pattern is not critical.

(iv) Care should be taken to ensure that the inductors L1 L2 and L3 are terminated in a common point at the varactor terminal. It is convenient to include the lead of the auto bias resistor.

(v) The varactor diode should be firmly fixed to the diecast box to ensure good thermal contact.

(vi) L4 is fixed to the end wall of the diecast box by a spindle lock collet, adjusted to be a tight fit with the $\frac{1}{4}$ in. copper tube.

Alignment

The individual circuits should be adjusted for maximum power output at the wanted frequency, but any adjustment of one circuit must be accompanied by readjustment of the other circuits. Where maximum efficiency is required, adjustments must be made for optimum output whenever the drive power level is changed.

When correctly adjusted, an output power of 10 watts at 432 Mc/s should be obtained for a drive power of 15 watts at 144 Mc/s. The spurious output should be low enough for the unit to be connected directly to an aerial.

In adjusting the coupling between the input and output 432 Mc/s circuits and the high *Q* circuit, care should be taken to avoid too tight coupling which would reduce the effectiveness of the high *Q* circuit as a filter.

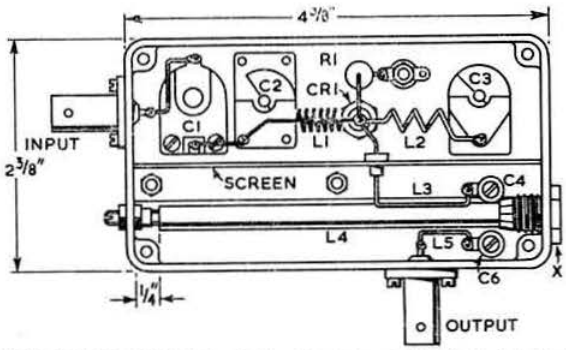


Fig.2. Layout of the tripler in the diecast box. The diode is bolted directly to the base.

Operation

The diecast box will reach a steady state temperature of 40-45°C when the diode is dissipating 5 watts (15 watts input, 10 watts output). If it is intended to operate the unit at a higher power level, up to the maximum rating of the diode, it may be necessary to increase the cooling area by adding fins to the box in the region of the diode fixing stud.

Modulation

As mentioned earlier, it is possible to obtain good modulation output when driven by an amplitude modulated 144 Mc/s signal. The actual level of the modulation should, however, be restricted to 80 per cent to avoid the introduction of distortion.

Although the varactor diode is called in this and similar applications a multiplier—in this case a tripler—it does not, however, function in the same manner as a valve multiplier. For the purpose of understanding how this "tripler" can be used and produce good amplitude modulation, it should instead be regarded as a parametric up converter. An indication of the suitability of a varactor diode to give a good audio modulation performance is indicated by the linearity of the input/output power characteristic, which in the BAY96 is particularly good.

Conclusion

This unit makes an attractive add-on unit to enable operation on 70cm from a 144 Mc/s transmitter for field and portable operation, or as a driver for a high power 70cm amplifier.

A varactor can be employed a as doubler, which, although unsuitable for use with an existing 2m transmitter, dispenses with the need for an idler circuit, This configuration is obviously less convenient, but there are probably several amateur applications where the improved efficiency would be advantageous.

Radio Club to be Formed in Taiping

K. Harvant Singh, BERS886, hopes to form a radio club in Taiping, Perak, and would be grateful for any old radio magazines and call books members may care to send him. His address is 31 (774) Upper Museum Road, Taiping, Perak, Malaysia.

Tape Correspondent Wanted

Dick Allisett, A5154, who is 14, would like to tapespond with another short wave listener of his own age. His tape-recorder will take reels up to 5$\frac{3}{4}$ in. (speed 3$\frac{3}{4}$ i.p.s.) but he will use small reels if requested.

Dick's address is Springbank, Oyouets Road, St. Peter Port, Guernsey, C.I.

Amateur Television in France

A new French Amateur TV Group has been formed in Paris with Bertrand Deshayes as President. A branch of the Central Radio Club of Paris the group is using a 50 watt transmitter on 437·5 Mc/s video with sound transmitted on 3·5 Mc/s and 144 Mc/s. The standard used is 625 line positive modulation suppressed sideband.

Sure Starting on "Four"

By W. A. SCARR, M.A., F.B.I.S., G2WS *

BRITISH amateurs enjoy a special privilege in being able to operate within a small frequency band in the region of 70 Mc/s. Although gradually on the increase, activity in this band remains well below average and in some areas of the country can only be described as slight.

As a band for portable work, 4m excels; the apparatus can be simple and the drain on batteries can be kept within reasonable proportions. Those nervous of using the band at home for fear of causing TVI may leave this worry behind by engaging in portable or mobile operation.

The purpose of this article is to suggest a number of ways in which simple and inexpensive gear may be assembled which will permit reliable and enjoyable operation on the band, special attention being paid to portable requirements.

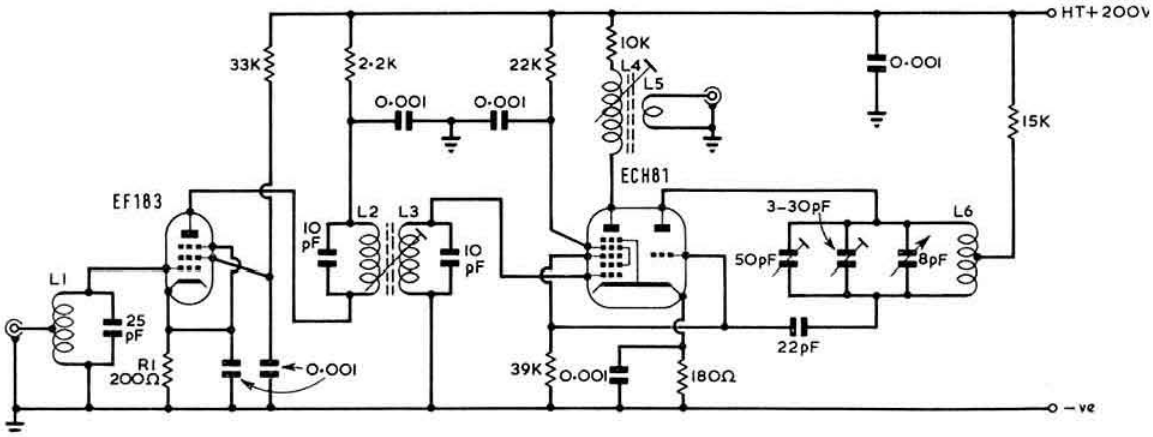


Fig. 1. Circuit of the 70 Mc/s converter originally developed by G3TR. Component details are identical to the original design, with the exception of the following: L4 (for 10 Mc/s i.f.), 28 turns, 34 s.w.g. enam. wound on ¼ in. diam. Aladdin former; L5, 8 turns, 30 s.w.g. wound over L4; L6, 3 turns, 18 s.w.g., ⅜ in. int. diam., turns spaced ½ in., self supporting, centre tapped. R1 is possibly rather a high value, being outside the manufacturer's recommended operating conditions; the value has been experimentally reduced to 100 ohms, but no difference was observed.

Reception

During the last few years, many articles have been written describing converters and complete receivers for the 4m band and it is not proposed in this article to add to their number.

Perhaps the simplest requirement is a two-stage arrangement of r.f. amplifier and mixer, such as the excellent circuit described by J. C. Graham, G3TR, in the September 1964 RSGB BULLETIN. The writer has constructed a tunable version of this converter which gives such excellent performance that, with G3TR's permission, it is briefly described here. In tuning the i.f. of the main receiver for listening on 70 Mc/s, one inevitably encounters some degree of interference either from "birdies," i.f. breakthrough or TV harmonics. In some areas, such as those served by Channel 4 television, the latter may be a real nuisance. However, by using the converter oscillator for tuning and making careful choice of fixed i.f., the desired signals may be received against an entirely quiet background. With a view to portable work, G3TR's circuit was further simplified for use with a single 200 volt h.t. supply, the oscillator being sufficiently stable to make stabilization of the h.t. supply unnecessary.

The writer's version of the circuit is given in Fig. 1, and this should be used in conjunction with the constructional directions given in G3TR's original article. The most important item is the oscillator, and the use of air-spaced padding capacitors is strongly recommended. The variable capacitor should be about 8 pF, while the two padding capacitors are a miniature 50 pF air-spaced trimmer and a Philips 3–30 pF tubular trimmer.

The i.f. finally chosen was 10 Mc/s and the oscillator was therefore designed to tune from about 59·5 Mc/s to 61·5 Mc/s, this giving adequate band-spread on the slow motion dial. The i.f. coil in the anode of the mixer valve (L4) consists of 28 turns of 34 s.w.g. wire close-wound on a ¼ in. former and the output coil (L5) of 8 turns, 30 s.w.g. wire, wound over L4.

The resistor in the h.t. supply lead to the oscillator is 15 K ohms which, with a supply voltage of 200, will place about 100 volts on the oscillator anode.

With a view to facilitating portable operation from a 12 volt accumulator as well as 6·3 volt use in the shack, a double-pole, double-throw switch was fitted to the panel and the heater wiring was arranged as shown in Fig. 2. It need hardly be added that every care must be taken to avoid connecting a 12 volt supply with the switch in the 6 volt position, and constructors would be well-advised to label the switch clearly.

In other respects the circuit is as originally devised by G3TR.

The tunable converter was built on a chassis 6 in. × 4 in. × 2¼ in., with a front panel of sufficient size to accommodate the slow-motion dial. Constructors will doubtless wish to vary the design to suit their own requirements, but if the ECH81 valveholder is mounted on the chassis with the oscillator coil and capacitors above the chassis, every care should be taken to keep the grid and anode leads as short and direct as possible, using stout wire and feed-through insulators of good quality.

The unit is linked to the main receiver input terminals by a short length of co-ax cable and the main receiver is left tuned to 10 Mc/s. For portable work the converter may conveniently be powered by a simple d.c.-to-d.c. transistor power

*2 Fairway Close, Worlebury, Weston-super-Mare.

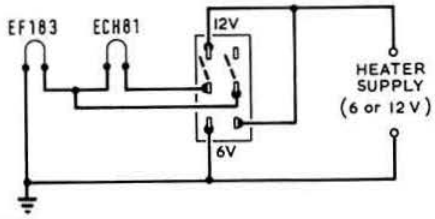


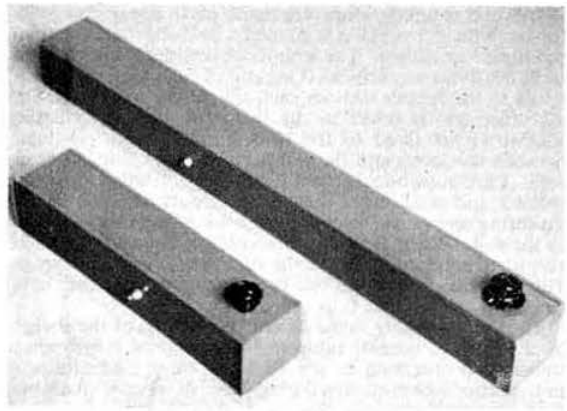
Fig. 2. Wiring of the d.p.d.t. switch which permits the 4m converter to be used with a 6 or 12 volt heater supply.

supply giving 180 to 200 volts output and working from the car accumulator.

TV Eliminator

Most of the converters described in amateur publications and those made commercially are crystal-controlled, the tuning being carried out at the i.f. in the main receiver. As mentioned earlier, such systems are very prone to interference from television transmitters, especially those operating in Channels 4 and 5.

Perhaps the most effective way of eliminating this and other types of interference is by the use of some form of high-Q filter. Properly designed, such a filter will reject all incoming signals except those in the very narrow band of frequencies required. Ideally, the high-Q filter consists of a machine-made coaxial-line circuit in heavy brass and with precision tuning arrangements, but such apparatus, to function at 70 Mc/s, is inevitably costly. Fortunately, however, it is possible to obtain almost 100 per cent efficiency



High-Q filters for 144 and 70 Mc/s.

without going to such expense and details are given here of a high-Q filter which the writer made in an hour or two at a total cost of about 10s.

Reference to the diagrams in Fig. 3 shows the method of construction. Three pieces of $\frac{1}{2}$ in. or $\frac{5}{8}$ in. plywood, 39 in. $\times$ $3\frac{1}{2}$ in., are screwed firmly together to form a trough, which is then lined throughout with aluminium foil of the kind sold at hardware shops for kitchen purposes. Strong glue should be used to fix the foil, which should preferably be all in one piece, but this is not essential provided there is generous overlapping. Apart from the inside, the foil should cover the thickness of the wood at the ends and base of the trough. Two rectangular plates of 16 or 18 s.w.g. brass, copper or aluminium, $3\frac{1}{2}$ in. $\times$ $4\frac{1}{4}$ in., are then prepared and screwed to the ends of the trough, care being taken to ensure good contact with the foil. A small bracket of 18 s.w.g. copper sheet is fitted to one of the end-plates, as shown.

The central conductor consists of a 3 ft. length of brass curtain rail. This has a double flange on one side and a single flange on the other.

A variable capacitor, preferably with wide-spaced plates and having a maximum capacity of 10 or 15 pF, is fitted to the trough as shown, and at such a distance from the "earthy" end so that, when one end of the 3 ft. rail has been soldered to the bracket, the other end may be soldered to a large tag attached to the fixed plate side of the capacitor. In fitting the capacitor to the trough, a small metal plate or large metal washer should be used to ensure good electrical connection between the spindle and the aluminium foil.

If the double-flanged side of the rail is used for the connections to the bracket and capacitor, the rail will be quite rigid and need no further support.

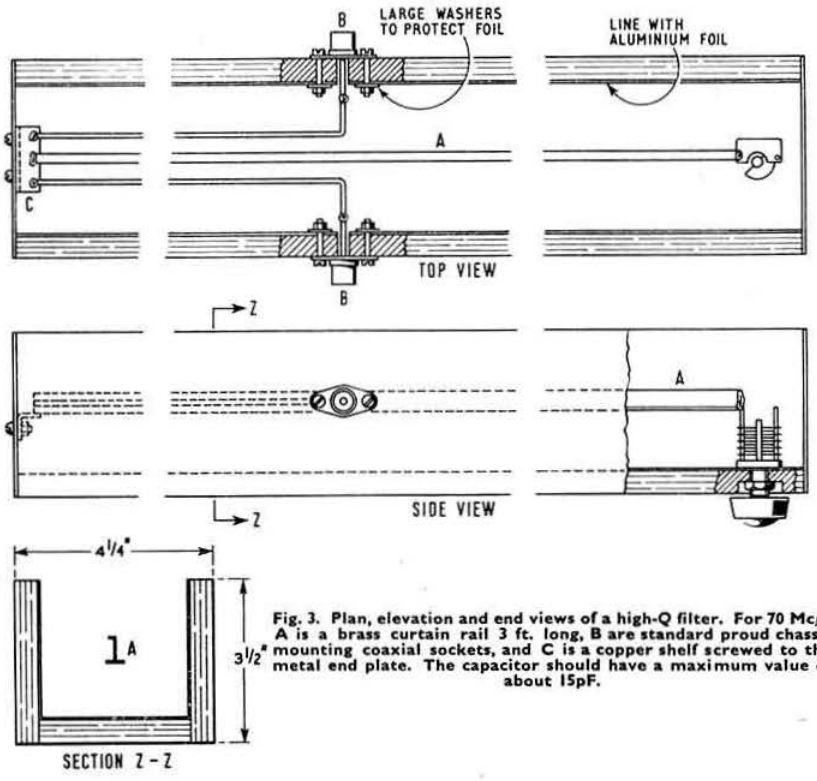


Fig. 3. Plan, elevation and end views of a high-Q filter. For 70 Mc/s, A is a brass curtain rail 3 ft. long, B are standard proud chassis mounting coaxial sockets, and C is a copper shelf screwed to the metal end plate. The capacitor should have a maximum value of about 15pF.

The two coupling loops are made of 16 s.w.g. enamelled copper wire (12 or 14 s.w.g. might be better if available), positioned as shown. The lengths of the loops, about 16 in. each, are in no way critical. One end of each loop is soldered firmly to the copper strip on each side of the central rail and the other end is taken to the spigot of a panel-mounting coaxial socket fitted to the side of the trough. Distance between the loops and the rail may be about $\frac{1}{4}$ in. to begin with. Care must be taken not to tear the foil when fitting the sockets, and small metal back-plates should be made to take the fitting screws and so clamp the back of each socket firmly to the foil. When assembly is complete, the unit should be varnished generously, especially on the inside of the trough. This will ensure that the foil is protected against accidental tearing when the unit is in use.

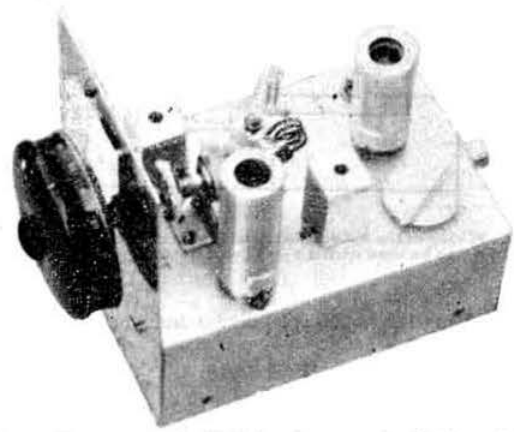
The unit is readily tuned by connecting one of the sockets by a length of coaxial cable to the output of a low-power transmitter operating in the 70 Mc/s band, and attaching to the other socket a coaxial plug wired in series with a torch bulb or car side-lamp bulb.

When the variable capacitor is tuned to resonance and the distance of the coupling loops from the centre conductor adjusted for maximum results, the r.f. output as indicated by the bulb should approximate to the normal output of the transmitter.

If now the unit is connected in the aerial lead to the 70 Mc/s converter, it should need little or no adjustment to give the desired results. Tune in to a weak 70 Mc/s signal on the converter, and then experiment with the coupling between the loops and the centre rail. This should be as loose as possible consistent with the maintenance of full signal strength. The variable capacitor should be carefully re-tuned as necessary and complete relief from interfering TV and other spurious signals should then be obtained.

Of course, the unit may with advantage be positioned on the aerial side of the RECEIVE/TRANSMIT switch, as here it will not only reject unwanted incoming signals but also attenuate considerably harmonic radiation from the transmitter which might affect nearby domestic broadcast and TV receivers.

Two-metre enthusiasts may like to note that an efficient filter for that band may be constructed on the same lines as the one just described. The trough, of the same cross-section and materials, is 19 in. long and the centre rail 17 in. long. A similar tuning capacitor is used and the wire loops may be between 8 in. and 10 in. long.



The tunable converter for 70 Mc/s, using a standard Muirhead slow motion dial.

A Portable Two-band Aerial

Aerials for 70 Mc/s are necessarily more cumbersome than those for the higher v.h.f. and u.h.f. bands, although the need for multi-element arrays is correspondingly less and most operators content themselves with 2, 3 or 4-element systems.

For portable work, some kind of collapsible array, which can be carried inside a car and erected on arrival at the chosen site, is obviously of advantage. The following notes describe a simple two-element aerial designed by the writer which has the added advantage that it can be readily adapted to work also on the 2m band.

The diagram, Fig. 4, shows the method of construction. Constructors may wish to choose their own design and materials for the frame, but lengths of $\frac{1}{2}$ in. × $1\frac{1}{2}$ in. deal will be found generally suitable, though the 16 in. cross-boom to which the mast is fitted should be rather more substantial. In the original, a short length of 1 in. diameter dural tubing, which forms the top section of the mast, is clamped to the cross-beam by two large shelf brackets as shown. The two long beams, screwed to the ends of the cross-beam, are 2 ft. 6 in. in length, while the two end sections which hold the elements are about 22 in. long, enabling the distance between the driven elements and the reflector to be adjusted to $20\frac{1}{2}$ in. Beehive-type insulators are used to support the elements, which are all of $\frac{5}{8}$ in. external diameter dural tubing. Connection from the dipole elements to the TRANSMIT/RECEIVE switch is by good quality 75 ohm coaxial cable.

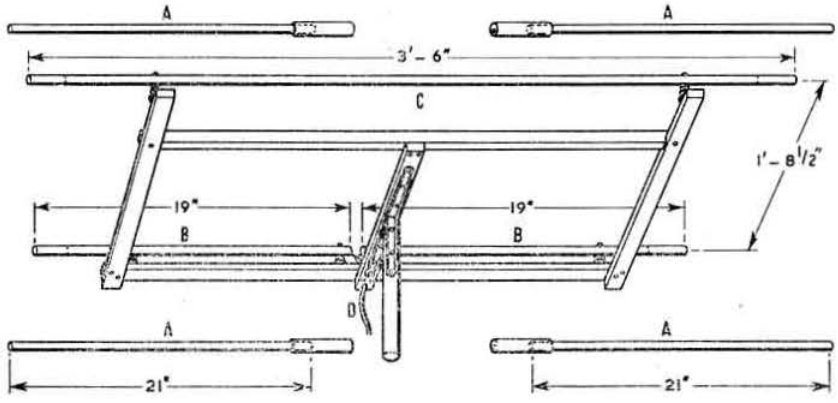


Fig. 4. Portable aerial suitable for 70 and 144 Mc/s. A, extension tubes for 70 Mc/s, each consisting of $\frac{5}{8}$ in. o.d. dural tubing 21 in. long (excluding sleeving); B, dipole elements $\frac{5}{8}$ in. o.d. dural tubing, 19 in. long; C, reflector, $\frac{5}{8}$ in. o.d. dural tubing, 3 ft. 6 in. long; D, 75 ohm coaxial cable. The spacing between B and C is 1 ft. $8\frac{1}{2}$ in., centre to centre.

As so far constructed, the aerial comprises a two-element array capable of satisfactory performance on 144 Mc/s. To convert it to 70 Mc/s use, four identical extension arms are added, each consisting of $\frac{5}{8}$ in. external diameter dural tubing, 21 in. in length, to which is screwed a length of dural or copper sleeving about 12 or 15 in. in length and of $\frac{5}{8}$ in. *internal* diameter. A good fit is obviously needed and,

(continued on page 728)

The Council's Annual Report on the Society's Activities

THE Council has pleasure in reporting on the more important activities and happenings during the year 1 July, 1965 to 30 June, 1966. Particularly noteworthy were the Conference of Region 1 IARU Societies in Yugoslavia and the commencement of reciprocal licensing.

The Opatija Conference

The Conference of Region 1 IARU Societies held in Opatija, Yugoslavia, from 23 to 27 May, 1966 was the most important Amateur Radio meeting held in recent years and the Council places on record its appreciation of the efforts of the Society's hard working delegation—Messrs. E. G. Ingram, GM6IZ, L. E. Newnham, G6NZ and G. M. C. Stone, G3FZL, led by the President, Mr R. F. Stevens, G2BVN.

The Council believes that the decisions taken at the Conference, particularly those relating to the Defence of the Amateur Bands, will help to strengthen the international Amateur Radio Movement at a time when pressures from other users of radio frequencies are at an unprecedented level. In the long run, the interests of all radio amateurs, wherever they may live, will be best served by a well briefed, well-organized and expertly run international organization. The IARU is such an organization.

In your Council's opinion, it is therefore all the more to be deplored that certain interests, purporting to serve the Amateur Radio movement, have chosen the present time to "rock the boat" with inaccurate comment on the standing of the International Amateur Radio Union, an organization with more than 40 years' experience of successfully representing the radio amateur at conferences all over the world. The Council urges all members to miss no opportunity to counter the false information at present in circulation.

It is not the intention to comment here on the decisions taken at the Conference but your Council is particularly gratified by the election of the President, Mr R. F. Stevens, G2BVN, to the office of Vice-Chairman of the IARU Region 1 Executive Committee. The Council considers that Mr Stevens' election is not only a personal honour for him but is indicative of the high regard in which your Society is held by the member societies of Region 1.

The proceedings at the Opatija Conference were reported in detail in the July and August, 1966 issues of the RSGB BULLETIN by Mr John Clarricoats, G6CL, who was again the Conference Secretary.

Installation of the President

Mr R. F. Stevens, G2BVN, was installed as the Society's thirty-second President at a General Meeting and Social Evening held at the Kingsley Hotel, London, on 7 January, 1965. The ceremony was performed by the retiring President, Mr E. W. Yeomanson, G3IIR, in the presence of more than 100 members and friends. A report was published in the February, 1966 issue of the RSGB BULLETIN.

Licensing Matters

During the year a number of important licence changes occurred, the most heralded being the issue of UK amateur licences to aliens. Most of the licences issued so far under reciprocal licensing arrangements have been to citizens of the USA and West Germany but the list of countries with which such agreements are in force is growing slowly but steadily.

In October, 1965 the GPO introduced an alternative method of measuring the power of amateur s.s.b. transmitters. The new arrangements have been generally welcomed by members.

The Council regretfully records that the segment 420-427 Mc/s was withdrawn from amateur use with effect from 1 January, 1966. The Society has been assured that the withdrawal is for a limited period only (probably several years) but a close watch is being kept on the use to which these frequencies are put in view of the intense pressure from business interests for more frequencies.

The Council is happy to record that the long awaited revised Amateur Maritime Licence was made available early in 1966. The licence authorizes operation in the 7, 14, 21, 28, 144 and 21,000 Mc/s bands. Although some of the conditions are still not so liberal as we should like, the new licence represents a great step forward in British amateur maritime operation.

During the year the Society supported a request from members in the Shetland Islands for a special prefix. It is a matter of regret that the GPO could not see its way clear to grant the request. (The reasons for the refusal were reported on page 409 of the June, 1966 issue of the RSGB BULLETIN.)

Your Council is concerned that a great deal of unlicensed operation is permitted to continue. Although the Post Office is successful in obtaining a reasonably large number of convictions each year, it is believed that this represents only a small proportion of the total illegal operation. It is particularly unfortunate that any illegal operation which comes to the notice of the Press seems to be automatically labelled amateur. The Council hopes that, in particular, steps will be taken to deal with the situation created by the sale of many thousands of imported transceivers intended for use in the American Citizens Band which are capable of causing interference, particularly TVI, for which licensed amateurs are likely to be blamed.

The number of UK amateur licences rose to more than 12,000 during the year, the number in force at 30 June, 1966 being: A—11,744; A Mobile—2110; B—397; B Mobile—5. In addition, 178 amateurs were authorized to transmit television.

Once again the Council wishes to place on record its appreciation of the help and assistance rendered by the GPO officials concerned with Amateur Radio matters. Throughout the year the most cordial relations continued to exist between P.O. Headquarters and the Society's Headquarters staff.

Radio Amateurs' Examination

The Society continues to be represented on the City and Guilds of London Institute's Advisory and Moderating Committees. In addition to the official representatives, several members of the Committee are also members of the Society.

During the year two examinations were held, one in December, 1965 and the other in May, 1966. On both occasions, the Society arranged an examination centre in Central London, a facility used by members from all over the country.

It is a matter for regret that many centres catering for other City and Guilds examinations still fail to accept candidates for the RAE.

Membership

During 1965 it became clear that the increasing costs of services made necessary an increase in subscription rates for

all grades of membership. The new rates—£2 10s.—p.a. for Home and Overseas Corporate members and £1 5s.—for Associates—came into force on 1 July, 1965 but as members pay their subscriptions more or less evenly throughout the year the full benefit of the increased rates will not be felt by the Society until the financial year 1966-67.

Although your Council anticipated that there would be some loss of members due to the changes, the total membership declined very little as the following table shows:

Grade	30 June, 1964	30 June, 1965	30 June, 1966	Gain or loss compared with 1965
Corporate Members				
Licensed	7748	7781	7872	+ 91
Not Licensed	3274	4180	4121	− 59
Associates	1382	1453	1293	−160
Totals	12,404	13,414	13,286	−128

The total of licensed membership is still far below the number of licensed UK amateurs and the Council urges every member to do all in his power to encourage non-members to join the Society. As part of the drive to increase the membership of the Society, the Membership and Representation Committee sends a congratulatory letter to all new licensees together with a complimentary copy of the RSGB BULLETIN. Members can help to make this effort even more effective by personally inviting new licensees to join the RSGB. It must be remembered that non-members enjoy the privileges obtained by the RSGB. Can we really afford to go on underwriting these benefits for those who do not make any contribution to the Society?

Affiliated Societies and Clubs

The Council has noted the increasing number of local societies and clubs becoming affiliated to RSGB. Almost every well established society is now in affiliation with the national society.

Committees of the Council

Without the hundreds of hours* of voluntary work performed each year by the many members of the Committees, it would be impossible for the Society's work to continue at its present level. The Council places on record the Society's thanks to all those members who give so generously of their time.

During the year the following Committees were set up:

	Chairman
H.F. Contests	Mr John C. Graham, G3TR
V.H.F. Contests	Mr J. C. Foster, G2JF
Education	Mr R. J. Hughes, G3GVV
Exhibition	Mr E. W. Yeomanson, G3IIR
Finance and Staff	Mr F. K. Parker, G3FUR
GPO Liaison and TVI	Mr L. E. Newnham, G6NZ
Membership and Representation	Mr John C. Graham, G3TR
Mobile	Mr F. K. Parker, G3FUR
RAEN	Mr G. A. Allcock, G3ION
Scientific Studies	Mr G. M. C. Stone, G3FZL
Technical	Mr R. F. Stevens, G2BVN
V.H.F.	Mr G. M. C. Stone, G3FZL

The IARU Preparatory Group, under the Chairmanship of Mr R. F. Stevens, continued its work in preparation for the Region 1 IARU Conference at Opatija.

* The Council itself was in session for 51 hours during the year under review—EDITOR

The two contests committees again organized a large number of successful contests covering the various interests of members. International events raised considerable enthusiasm throughout the world.

The Education Committee, in conjunction with Newark Radio Society, Magnus Grammar School Radio Society and Newark School Radio Society, held a highly successful weekend Symposium at the Ollerton Residential Centre on 11-12 September, 1965 (see page 658 of the October, 1965 issue of the RSGB BULLETIN) and mounted a most attractive stand at the *Daily Mail* Schoolboys' and Girls' Exhibition from 27 December, 1965 to 8 January, 1966 (see page 86, RSGB BULLETIN, February, 1966).

The Exhibition Committee was responsible for the Society's participation in the 1965 RSGB International Radio Communications Exhibition while Mr Fred Ruth, G2BRH, acted as the Stand Manager with the assistance of Mr D. C. French, G3HSE. A report on the Exhibition was published in the December, 1965 issue of the RSGB BULLETIN.

The Finance and Staff Committee met regularly throughout the year and exercised a most careful watch over expenditure and the Society's investments. This Committee is also responsible for the Lambda Investment Co. Ltd., which is controlled by the Society. The company has been formed to own the possible new Headquarters.

The GPO Liaison and TVI Committee dealt with a multitude of matters relating to licensing and to problems of interference. The Committee is particularly concerned at the present time with the increasing difficulties encountered by members as a result of the spread of wired relay television systems. The Committee is at a loss to understand why carrier frequencies in the Amateur Bands are frequently used and why the licensing authorities permit considerable radiation from such systems. The Committee is of the opinion that official action is overdue on the increasing interference from high voltage distribution systems, r.f. heating systems and similar industrial devices which cause interference to radio communication. The Society's Intruder Watch has now been added to this Committee's responsibilities.

The Membership and Representation Committee continued to give close attention to the interests of members. One important decision during the year was to recommend to the Council that Regional Representatives should be nominated only by members resident in the Region concerned and not by the Council, a recommendation accepted in time to be implemented in the elections held towards the end of 1965. The Committee also devoted considerable time to preparations for the Regional Representatives' Conference to be held in London in October 1966.

The Mobile Committee again organized a number of successful rallies which attracted large attendances. The RAEN Committee continued the essential work of supervising the Radio Amateur Emergency Network.

The Scientific Studies Committee continued to guide and inspire the Society's scientific activities in the fields of propagation research, satellite communication and allied subjects.

Much of the Technical Committee's work during the latter part of the year under review was connected with new editions of the Society's publications mentioned later in this report. During the year regular reviews of commercially manufactured equipment for the radio amateur were introduced.

The V.H.F. Committee was responsible for the very successful Twelfth International V.H.F./U.H.F. Convention held in London last April. The Committee was also responsible for revising the British Isles Two Metre Band Plan based upon a questionnaire completed by many members and a number of letters on the subject during 1965.

RSGB Certificates Manager

Mr C. R. Emary, G5GH, took over the work of Honorary Certificates Manager from Mr K. A. V. Hurrell, G3NBC, during the year.

Both Mr Hurrell and Mr Emary dealt with a great many applications for Society awards during the year and the Council records its gratitude to them.

RSGB QSL Bureau

Mr Arthur O. Milne, G2MI, and his excellent team of sub-managers again provided one of the most important privileges of membership. The Council is confident in claiming that the Society's QSL Bureau is the largest and most efficient in the world.

RSGB Recorded Lecture Library

During the year the Council received with great regret the resignation of Mr N. C. Ta'Bois, G3HWG, from the office of Honorary Curator. Mr. G. S. Milne, G3UMI, generously volunteered to take over from Mr Ta'Bois and to both the Council expresses its thanks.

RSGB Film Library

Mr C. W. Austin, BRS22019, continued to administer the loan of Society films and the Council records its thanks to him.

RSGB Slow Morse Practice Transmissions

This important service to those wishing to obtain licences was again organized by Mr M. A. C. McBrayne, G3KGU. The Council records its thanks to Mr McBrayne and his helpers.

Other members willing to take part in this important programme are invited to write to Mr McBrayne.

RSGB News Bulletin Service

The Society's news bulletins were transmitted each Sunday morning throughout the year.

All who helped to provide this much appreciated service—news readers and contributors—are thanked for their efforts.

RSGB Publications

The issues of the RSGB BULLETIN for the period contained a total of 860 pages, a small increase on the previous 12 months. Broadly, the editorial policy appeared to meet with the approval of members although a feature of the year was a series of letters which put the BULLETIN " under fire " for a period.

The Council again records its thanks for the work of the regular contributors: Mr F. G. Lambeth, G2AIW (*Four Metres and Down*), Mr M. E. Bazley, G3HDA, and Dr John Allaway, G3FKM (*The Month on the Air*), Mr G. R. B. Thornley, G2DAF (*Single Sideband*), Mr E. Arnold Matthews, G3FZW (*Mobile Column*), Mr John Clarricoats, O.B.E., G6CL (*News*), Mr Ken Smith, G3JIX (*QUA Associates*), and Mr Pat Hawker (*Technical Topics*). During the year, the Editor found it possible to publish a regular selection of *Letters to the Editor* and to all those who submitted letters for consideration the Council records its thanks.

Advertisements play an important part in the overall production of the RSGB BULLETIN and the Council expresses the Society's thanks to all advertisers for their support.

The Council is proud to record that well over 30,000 copies of the Third Edition of the *Amateur Radio Handbook* have now been sold. The response to this edition has exceeded all expectations since it was first published in November, 1961 and the Council thanks all members and friends for their support which has resulted in a considerable contribution to the Society's funds over the last five years.

Technical Topics for the Radio Amateur, published in October, 1965, was well received although it has not had quite so good a reception as would be expected from the popularity of Pat Hawker's feature of a similar name in the RSGB BULLETIN. It is possibly not realized that, although based on the BULLETIN series, the book is not merely a reprint but a new production with much new material.

It was found necessary to reprint the 1966 edition of the RSGB *Amateur Radio Call Book* early in 1966 and the print order for the 1967 edition was therefore substantially increased. At the same time the Council decided to accept a

Council Members' attendance at Council and Committee Meetings during the year 1 July 1965 to 30 June 1966

Council Members	Council	Contests H.F.	Contests V.H.F.	Education	Exhibition	Finance and Staff	G.P.O. Liaison and TVI	Membership and Representation	Mobile	RAEN	Scientific Studies	Technical	V.H.F.	IARU Working Group
H.A. Bartlett†	2/6													
N. Caws	11/12					5/5							6/7	4/5
J. C. Foster	11/12		11/11											
L. N. Goldsbrough	3/12							0/5						
J. C. Graham	11/12	12/12			11/11	5/5		5/5						
R. C. Hills†	4/6												3/3	1/2
E. G. Ingram	11/12													5/5
R. H. James†	3/6							3/3						
A. O. Milne†	5/6						1/1							0/2
L. E. Newnham	12/12			10/10	9/11	3/5	3/3			5/6				4/5
F. K. Parker	6/12					2/2	3/3	1/5	9/10					
A. D. Patterson	12/12							4/5						
J. F. Shepherd	11/12					1/2		4/5			1/1			
R. F. Stevens	12/12	2/6	1/5		3/4	5/5	3/3		2/6		7/7	5/5	2/4	5/5
G. M. C. Stone	12/12			8/10		3/3					7/7	1/2	7/7	4/5
J. W. Swinnerton	11/12			6/10			2/3							
L. Varney	7/12													
E. W. Yeomanson	11/12				11/11	2/2	3/3		4/6	6/6				5/5
J. Etherington‡	4/6								2/6					
W. A. Roberts‡	4/6						0/2							
G. Twist*	1/2													

The figures in each column indicate the number of meetings actually attended and the number of meetings held during the member's period of office.

† Retired 31.12.65. ‡ Elected 1.1.66. * Elected 1.5.66.

suggestion that the new edition should be printed on a paper similar to that used for the RSGB BULLETIN.

The number of overseas publications handled by Headquarters on behalf of members again increased. Members are clearly aware of the advantages of using their Society's services for the supply of publications.

During the year the Council also authorized work to commence on new editions of *A Guide to Amateur Radio*, *The Radio Amateur's Examination Manual* and the *Amateur Radio Circuits Book*.

Society Representatives on the Committees of Other Bodies

The Society is represented on a number of Government and other committees and the Council records its thanks to the members concerned.

Mr L. E. Newnham, G6NZ, is a member of the Postmaster General's Frequency Advisory Committee.

The Society is represented on a number of relevant committees of the British Standards Institution by Mr D. N. Corfield, G5CD, and Mr R. F. Stevens, G2BVN.

The GPO has a number of national committees and study groups concerned with the International Radio Consultative Committee (CCIR), the Society's representatives being as follows:

UK General Purposes Committee: Mr John A. Rouse, G2AHL.

Study Group IV (Space Systems): Mr G. M. C. Stone, G3FZL.

Study Group V (Propagation including Effects of Earth and Troposphere): Mr G. M. C. Stone, G3FZL.

Study Group XIV (Vocabulary): Mr A. D. Patterson, GI3KYP'

The Society is represented on the City and Guilds of London Institute's RAE Advisory Committee by Mr L. E. Newnham, G6NZ, and Mr J. W. Swinnerton, G2YS.

Lectures and Meetings

A well-attended Official Regional Meeting was held in Colwyn Bay on 26 September 1965. Regional Lectures were held at Derby on 24 September and 26 November and in Belfast on 20 November, 1966.

Only one London Lecture Meeting was held during the year: on 9 March the Rev. Paul Sollom, O.S.B., G3BGL, gave an illustrated talk entitled "Aerial Farming in a Monastery".

Mobile rallies were held at Oxford on 11 July, 1965 (the Tenth Anniversary Rally in association with Oxford and District Amateur Radio Society), at Woburn Abbey, Bedfordshire, on 12 September, 1965 and at Texas Instruments Ltd., Bedford, on 1 May, 1966.

British Amateur Television Club

The BATC has just issued a printed list of members in alphabetical order followed by lists of members by geographical location and in call-sign order. The club has a membership of 785 of which nearly 350 are licensed amateurs. Joint Honorary Secretaries are D. Mann, G6OUO/T and N. Hampton, G6OUH/T.

New British Standards

Two British Standards have recently been issued: BS 2135.1966. Capacitors for radio interference suppression, and BS 4054.1966. Methods for measuring and expressing the performance of radio receivers; receivers for a.m. and f.m. sound broadcast transmissions. The cost of these Standards is 15s. and 30s. each respectively, and they may be obtained from BSI Sales Branch, 2 Park Street, London, W1, postage being extra to non-subscribers. The RSGB was represented on both the Committees responsible for the production of these Standards.

A Little Flutter on V.H.F.

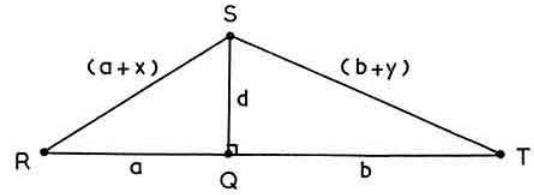
(Continued from page 713)

which were made at Douai Abbey to determine in detail the flight path of an aircraft causing steam train fading on the signal from Lille.

(Part 2 of this article will be published shortly)

Appendix

Calculating the amount by which the total bounce-path is longer than the direct path between receiver and transmitter.



$(x + y)$ = the extra length of bounce-path via S beyond that of the direct path $(a + b)$ between receiver R and transmitter T.

S is off the direct path by a distance d at a position Q which is a from R and b from T.

$$a^2 + d^2 = (a + x)^2$$
$$= a^2 + 2ax + x^2$$
$$d^2 = 2ax + x^2$$

Except near the terminals, x is small compared with a and so x^2 may be neglected compared with $2ax$

then $d^2 = 2ax$ and $d^2 = 2by$

so $x = d^2 \cdot \frac{1}{2a}$ similarly $y = d^2 \cdot \frac{1}{2b}$

$$(x + y) = d^2\left(\frac{1}{2a} + \frac{1}{2b}\right)$$

At mid path Lille-Douai Abbey: $a = b = 150$ km.

For Lille: $\lambda = 1{\cdot}72$ metres

so

$$(x + y) \text{ in wavelengths} = d^2\left(\frac{1}{150} \cdot \frac{1000}{1{\cdot}72}\right)$$ where d is in kilometres,

or $(x + y) = 4d^2$ very nearly.

Sure Starting on "Four"

(continued from page 724)

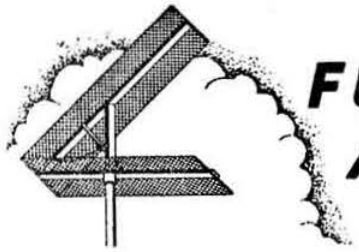
if necessary saw cuts can be made in the ends of B and C and the metal splayed open very slightly to obtain this. When the extension tubes are fitted, care should be taken to see that no gap is left between the $\frac{5}{8}$ in. tubing sections. The two dipole elements will then be 40 in. long each and the reflector 84 in. long.

Conclusion

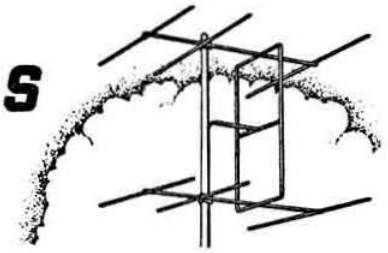
As stated earlier, 4m operation has its own particular attractions. For those who have of necessity to operate from unfavourable locations, the chance of working over considerable distances is greater than on 144 Mc/s or the centimetre bands.

For the portable enthusiast, a simple approach can be most rewarding. Time spent in selecting a really suitable location is always worthwhile and, in the writer's experience, a spot with good clear "take-off" in most directions is to be preferred to points of greater altitude in the midst of hilly terrain.

Finally, it is well to remember that, if we wish to retain our 4m allocation, we should not fail to show by our ever-increasing use of it that the privilege is appreciated.



FOUR METRES AND DOWN



By JACK HUM, G5UM*

ALFRESCO OCCASIONS

A SMALLER than usual " Four Metres and Down " this time, occasioned by an earlier-than-usual press date, occasioned in turn by the exigencies of the RSGB Communications Exhibition, itself one of the three major events in the metre-wave man's calendar (the Convention and V.H.F. NFD being the other two).

As it happens, field day events of one sort or another are our main topic for review this month, starting off with a report on the 1966 " Alderney Expedition."

First of all, a bare summary of the results achieved by this year's nine-man team:

On 4m: GB2GC worked 70 stations in 20 counties and two countries, G and GC. During V.H.F. NFD GC3POI/P worked G, GW, GC, GI and GM.

On 2m: GB2GC worked 276 stations in 42 counties and eight countries with the following breakdown: G, 201; GC, four; GW 11; GM, one; France 48; Belgium five; Holland four and West Germany two. During Field Day GC3SIT/P worked G, GW, GC, GI, GM, F, DL and SM.

On 70cm: GB2GC worked 25 stations in 18 counties and four countries, namely, G, GC, GW and F, while on " Seventy " during the contest GC3POI/P worked 11 G stations.

On 23cm: one contact with G3OBD/P on a good site on the south coast near Swanage for what was almost certainly the first G-GC contact on " Twenty Three." The date, for the record, 25 August.

The Alderney Expedition equipment was extensively transistorized, reception on all four bands being via semiconductors, and the modulator for the transmitters being a Class B push-pull OC28 design. On 2m and 4m input were 50W to a QQV03-20A. On 70cm a DET24 with 25 watts in was driven by an A2521. This transmitter was used for 23cm where it drove a further DET24 tripler, delivering 2 watts of r.f.

On 4m the team used what must have been the most gigantic aerial to be seen in the UK on this band, a 4-over-4-over-4-over-4 at $\frac{5}{8}$ wavelength spacing. On 2m the aerial was a 10-over-10, and at 70cm a 24-over-24, with a 4-over-4-over-4-over-4 also available. For 23cm a four-foot dish was fed with RG-9/U.

Power was derived from a couple of 1 kW GPO type p.e. sets which float charged the 12 volt accumulators extensively used to power the various transistor d.c. to d.c. inverters that provided h.t. for all equipments.

So much for the statistical and logistical details. What of the results? These indeed showed that a carefully planned and efficiently executed expedition of the GB2GC kind does much more than enable a lot of people to derive a lot of pleasure from working what in the normal way would be a pretty rare spot on the radio map, because it entails consistent surveillance of our v.h.f./u.h.f. bands over a period of many weeks it throws up a lot of information that is bound to be of value to the art in the future.

In saying this, one is thinking particularly of the fact that manifestations of an auroral opening were observed at GB2GC some days before the great excitements on the V.H.F. NFD weekend. As early as 28 August the first evidence of solar activity was noticed, for a check on the h.f. bands disclosed an extraordinary " blankitude." Then on the Tuesday (30 August) GM3TFY was heard on 2m calling CQ with a 58A signal between 18.50 and 19.10 GMT, but could not be raised. There was no sign of GB3LER, which added to the mystification. The log for 31 August reads " Nothing " but on 1 September there was GM3TFY again at 56A. On the 2nd, " Nothing "—then on that memorable Saturday, 3 September contact was made with GM3TFY at 57A out and 54A in, each station, as will be

Flashback to Field Day, 1: Two members of this year's nine-man Alderney Expedition team make adjustments to one of the aerial systems, G3POI up the mast and G8AHC at the foot.

* Send reports for the December issue by 14 November to G5UM at 28 Little Russell Street, London WC1, and not to Bulls Green, Knebworth.

seen from the tone report, being completely auroral to the other (and still no GB3LER).

Then as the clamour of the contest ensued there was little time for study except of the superb tropo conditions prevailing; yet it became apparent as the hours went by that auroral manifestations were intensifying. A whole string of stations worked by GC3SIT/P on " Two " and GC3POI/P on " Four " had " A " notes (they included the believed-first GC to GM on " Four " when GM3EGW of Dunfermline was contacted; and the first GC to GI on " Four " with GI3PGG—both auroral). On 2m at three in the morning of the Field Day Sunday there was a copybook example of an auroral QSO: DJ9CRA was worked with the beam 15 degrees east of north, or miles off Germany, and given 54A. The incoming report was 569, that is, non-auroral. Yet there was no sign of the German's tropo-assisted signal when he was sought with the beam east.

The last recorded " A " signal was GM3NHQ/P as late as 05.30 GMT on " Four", heard 55A but not worked.

And here is one of those curiosities that makes v.h.f. propagation a perenially intriguing subject for study: GM3RUF/P was worked by the 2m Alderney station *on tropo* when all the pointers were that such a northerly station *should* have been auroral! Phone reports of 57 both ways were exchanged.

Other Alderney highlights: the GC-GW " first " on " Seventy Cems", when GW3MFY of Bridgend was worked on 28 August; a 2m contact with F3XY/P who was using a 1 watt transistor rig at a holiday camp location (S9 both ways); and a series of meteor scatter/tropo tests with ZB2VHF, when several pings were heard but no positive identification of the Gibraltar station was made on account of the many other signals heard around the frequency.

In spite of the rigorous weather of Field Day Sunday, conditions produced a distinct " lift " afterwards, as all who were on at the time will recall, and they remained at an encouragingly high level for the better part of September. This prompted the Alderney men to keep their 2m transmitter going on Monday the 5th, although the 4m, 70cm and 23cm equipment had been packed up by then. They notched no less than 75 contacts that day, among which 35 were from France, including F9NL in the Pyrenees (later that month he made an unexpected Saturday afternoon appearance and worked a clutch of Gs on " Two").

Another portable operator encouraged by the improvement in conditions to stay on after Field Day was over was G8AGU whose foray to a 1620 ft. site on Exmoor brought him 105 contacts on 70cm with 32 counties and five countries. On 6 September alone, 42 contacts were had. Particularly interesting, remarks Paul, were QSOs with GW8ACG and GW8AHI in Flintshire, both badly screened by the Welsh mountains; the latter though using only 4 watts peaked at S8.

The power input at G8AGU/P was 70 watts from a petrol generator which disobligingly caught fire at 21.00 hours on 3 September, " so V.H.F. NFD came to an abrupt halt." The final was a QQV06-40A, the aerial an 18 element Parabeam at 18 ft., and the transistor receiver had a tunnel diode preamp stage ahead of it.

Noting how conditions continued to hold up so consistently during September, three members of the Dudley Amateur Radio Club decided to take G3RXK/P up into the Clee Hills. They were G3PWJ, G3UDY and G3UWK, who were soon kept busy on " Two." Operation was confined to Sunday, 25 September, producing a total of 71 contacts out as far east as DM2ADJ at 950 km. In all, their 30 watt 3/20 rig talked to 41 G stations, 12 DL/DJ/DM, nine PA, six F, one ON4, one GC and one GW, all at RS57 or better.

Transistorization included the EC10 i.f. strip and the 2 × OC35 modulator. Once again, as on so many other field day sorties, a 10-element " Skybeam " showed its worth.

Flashback to Field Day, 2: Vehicle-supported aerials were used by the three-man EI team which headed for the Slieve Bloom Mountains on 3 September. The picture shows EI7AF checking the security of the 2m one. The other members of the party were EI4AL and EI5BH. In spite of typical Field Day weather plenty of contacts were had on both " Two " and " Four."

To non-transmitting members the " lift " in conditions enjoyed lately can be rewarding indeed, as the indefatigable BRS15744 found at his site on the north face of the South Downs, at Storrington in Sussex. On one day, 22 September, he logged 29 counties on " Two " from Cumberland to Kent in little more than a couple of hours of listening.

BACK TO NORMALCY

In spite of the excitement of good autumnal conditions no metre wave man regards these as anything more than a bonus over and above the normal conditions most people experience in typical urban sites and using conventional equipment. It has always seemed to us to be a rather unbalanced situation that when the good conditions disappear most of the operators do, too.

Of course, everyone knows that a lot of them are still there, inaudible simply because conditions *have* reverted to normal. But what people also know is that a lot of them are *not* there, and won't be until the news gets around again that " conditions are good." Which means that for a large part of the year they won't be using their v.h.f. equipment!

Yes, you know what we are going to say, because we (and plenty of others) have said it before: sustained activity

should be maintained *every evening* on all three of the lower v.h.f./u.h.f. bands (within the limits of TVI of course). This was realized years ago in many urban areas with " Monday Night is Two Metre Activity Night " as one of the outcomes. But now, with so enhanced a level of metre wave activity compared with say ten years ago, every night should be activity night.

Point is lent to this discussion by complaints which were heard at the Region 9 ORM last month to the effect that activity was so sporadic, especially on 70cm, that contacts were hard to come by. Hearing this, Bill Scarr, G2WS, who in the past had done much to stimulate 70cm activity in the Midlands during his Coventry days, proposed that there should be a weekly activity night in the South West every Monday at 8 p.m. clock time, with everyone who can be on calling CQ at 15 minute intervals at least.

" We hope that all the South West and South Wales stations equipped for 70cm will participate," adds Bill.

Guaranteed activity of this kind will prompt operators outside the region to come on to see what may be around, and so the whole thing has potentialities to snowball.

Please let " Four Metres and Down " have details of other like activity projects especially on " Seventy " but on " Two " and " Four " as well, in districts where these bands seem to produce less activity than they should.

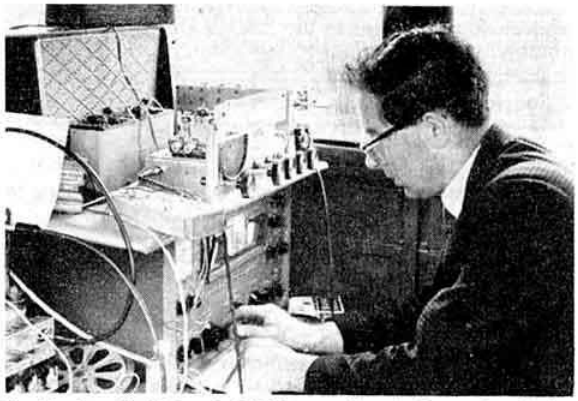
HAS HE THE CRYSTAL YOU WANT?

Members planning moves of QTH to areas where their existing 2m and 70cm crystals become redundant are invited to tell "Four Metres and Down" the frequencies of crystals they have for disposal and the frequencies of crystals they are in need of. We will resuscitate " Xtal Xchange " here to publicise this information.

In particular, members in the South West who have crystals in the 144·0 to 144·1 spectrum surplus to their c.w. needs will find ready exchangers—indeed purchasers—elsewhere in the country. Many men could use these low end " rocks " to help swell the amount of A1 now to be heard in the official c.w. segment, in spite of the few die-hards who still use phone there oblivious to the majority need.

BEYOND THE FRINGE

Although the Faeroe Islands are a long way away their situation in the " auroral belt " between the Shetlands and Iceland gives them a special interest to UK members. In particular, the beacon on a mountain near the capital, Tórshavn, could well prove to be a valuable marker to future auroral openings. Its frequency is 145·260 Mc/s, and its call-sign OY7VHF is sent continously. In addition, OY2BS and OY7X are regularly on 2m, and other Faeroese amateurs are building for that band.



Flashback to Field Day, 3: EI7AF operating the 2m station during the Slieve Bloom expedition (SCR522 transmitter and a transistor converter feeding an HQ180 receiver).

And on the reciprocal bearing to the Faeroe Islands (more or less) our friends the Yugoslavs continue to keep their country on the v.h.f. map, and others besides, if they get half a chance. They *did* get such a chance during the first weekend of September when in the European contest that ran concurrently with our own V.H.F. NFD they put YU3HIJ/M1 on 144 Mc/s from the Republic of San Marino. This call-sign belongs to the Piran Club in YU-land, and it was activated from San Marino by YU3JS, YU3UEP and YU3TGR. Four countries, I, YU, OE and HB, produced 103 contacts.

To sample European activity at first hand has been the enjoyable experience of many G-men during the past touring season. For instance, Bill Winsford, G4DC, passed through Europe wearing a number of different " reciprocal " call-signs on his way to the gigantic international caravan club rally in Hungary. And George Haylock has been to three Continental mobile rallies this season. His call-sign DJ0AA/M was allotted to him as far back as 1956. And if you worked ON8IR at the Knokke convention, that was George, G2DHV, again.

MOBILE ON " FOUR "

The 4m band continues to show its superiority for mobile working, and to produce quite a respectable degree of activity at "going to work " and " going home " times.

In the Malvern area this development has been turned to practical use. Every weekday at 08.20, 12.45 and 17.00 hours clocktime regular contacts are initiated between G2AFD/M, G3FHL/M and G3MTI/M on the mobile channel of 70·26 Mc/s, which is also continuously monitored by two auto-start recorders. All vehicle radio men are invited to check in if within range.

Aerials both on the Malvern members' vehicles and at their homes are vertically polarized.

THE VIDEO PICTURE

A request here for more news of what is happening on the amateur television front has brought a report from G6ABK/T, also well known as G8AKQ, of Barnsley. Steve has been transmitting 405 line pictures (interlaced) on 436 Mc/s with sound on 433·7 Mc/s. The picture source, a transistorized flying spot scanner, is shortly to be replaced by a Vidicon camera.

The 70cm transmitter runs 40 watts peak white to a QQV03-20A driven by a similar tripler. Sound modulation is either anode-and-screen from two EL84s, or grid modulation controlled carrier via the vision modulator. (We believe one or two Home Counties operators have tried this technique with success). The accompanying sound transmitter runs 7·5 watts to a QQV02-6.

The Yorkshire members who have followed the video progress of G6ABK/T will be sorry to lose him when he moves to a near ideal site at Sutton Coldfield. Their loss will be the Midland men's gain—and there should be plenty of *that* from Steve's new location. For the present he will welcome video-skeds weekends from Barnsley, weekdays from his " Stroke A " location near Sutton Coldfield. To those wishing to make a start with TV reception he recommends the transistor u.h.f. tuners now being advertised; with little modification they will, he says, work as a front-end converter into Channel 1 on any domestic television set.

TECH CORNER

From G8ARV

Midlands members who build the 2m Quickstarter converter and find breakthrough from television Channels 4 and

8 a problem can overcome it by using link coupling for both the oscillator and r.f. stages into the mixer. I believe G3LLS, who had a similar problem, changed the final oscillator coil to 120 Mc/s and cured it. He is now very pleased with the converter.

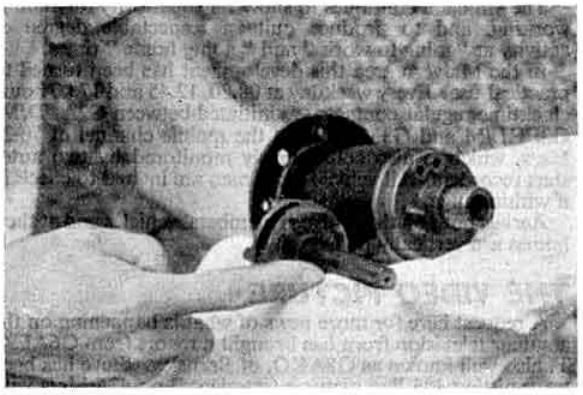
Further to semi-conductors, G8AEO is having an enjoyable time making a transistorized transmitter. He has remarked that " the high power stages are easy to get going, but it's the low power ones that need taming: the transistors are so gainy."

Information received from RCA and Ferranti shows that a 35s. transistor, the 2N3866, is a useful device to know about, having 10db minimum power gain at 70cm and capable of giving one watt out. Its performance at 2m gives promise of 1 watt out (typical) with 15db power gain. A 2m to 70cm tripler amplifier should be a practical proposition using this transistor. The power gain should be around 20db and the cost £4.

He would be grateful if any members who have done work on FET amplifiers at 70 cm would let him know.

From G8ACP

Those who suffer from cowl gill motors which after a few months (or years) turning the station aerials finally refuse to rotate should try opening them up to see if the final drive



spindle has seized solid in its bearing. This component, a steel shaft operating in a brass bearing, readily rusts, and increases its diameter sufficiently to stop it from turning.

Strip down the motor (a fairly long job), clean the shaft with emery cloth and grease it well before reassembling. The G8ACP finger in this picture points to the shaft.

Of course you can obviate any such troubles by mounting the motor in the first place in a weather proof metal box, bitumastic-painted, and located at the foot of the mast for ease of access should anything go wrong.

G5ADU/DJ700 2m Transmitter

The r.f. choke identifications for the 2m transistor transmitter published in last month's column went slightly awry. In order to correspond with the circuit, L9 to L14 in the caption should be read as CH1 to CH6.

HERE AND THERE

What it's like to be near the auroral belt: GM3HXF of Aberdeen heard 36 c.w. stations from GC to GI on *four metres*, plus another five phone, during V.H.F. NFD. Before that a year's listening had produced only two locals and GB3LER. " Being able to hear so many stations was very pleasing. Not having a 4m transmitter was extremely annoying," adds Steve.

V.H.F./U.H.F. BEACON STATIONS

Call-sign	Location	Nominal Frequency	Emission	Aerial Direction
GB3ANG*	Craigowl Hill, Dundee	145·985 Mc/s	A1	S
GB3CTC	Redruth, Cornwall	144·10 Mc/s	A1	North-East
GB3GEC	Hammersmith, London	431·5 Mc/s	F1	
GB3GI	Strabane, N.I.	145·990 Mc/s	A1	
GB3LER	Lerwick	145·995 Mc/s	A1	S
GB3LER	Lerwick	70·305 Mc/s	A1	N/S
GB3LER	Lerwick	29·005 Mc/s	A1	N/S
GB3VHF	Wrotham, Kent	144·50 Mc/s	F1	North-West

*Not operational

RSGB V.H.F. BEACON STATION GB3VHF

The frequency of the Society's v.h.f. beacon transmitter at Wrotham, Kent, when measured by the BBC Frequency Checking Station was as follows (nominal frequency 144·50 Mc/s):

Date	Time	Error
20 September	14.43 GMT	300 c/s low
27 September	15.00 GMT	210 c/s low
5 October	15.30 GMT	340 c/s low

All G8-plus-three men and v.h.f. listeners who would like to have slow-Morse-on-the-air services established should tell G3KGU, the Society's Slow-Morse Organizer, their requirements.

* * *

You will be getting your 1967 diary next month—or your XYL or YL will be getting it for you. Make the first entry " Saturday 13 May: V.H.F. U.H.F. Convention, Winning Post, Whitton."

* * *

Send this column details of your Skeds Wanted and/or Skeds Operative on all v.h.f./u.h.f. wavebands from 4m and down.

* * *

Finally, as your conductor has a change of QTH impending please send reports for the next BULLETIN to him c/o RSGB Headquarters, 28 Little Russell Street, London, WC1.

Visit by F8MW

On Saturday, 10 September, Andre, F8MW visited the Sutton Coldfield area. Five local amateurs G3BA, G3CNV, G3LNN, G3NCX and G6CC joined him for a most interesting and enjoyable afternoon. The Head Master of Bishop Vesey School loaned the group one of the school rooms where yarns and information were exchanged. The afternoon concluded with a visit to the BBC V.H.F. Radio and TV transmitting station, Sutton Coalfield.

Choosing Components (continued from page 708)

the various trade names for the same dielectric. The following short list of alternatives names is aimed at reducing the confusion:

Polytetrafluorethylene (P.T.F.E., Teflon, Fluon)
Polystyrene (Styraflex, Trolitul)
Polyester (Mylar, Melamine, PET)

Tables

Tables 1 and 2 are an attempt to set out the important properties of the various types of resistors and capacitors. They are intended to represent typical components but more information can be obtained from the manufacturers' data particularly on temperature variations.

Wideband Aerial Structures

By C. R. FRY, M.Sc., Grad. IEE, VE2ARO, G3MTI*

DURING the last few years the use of aerials having a wide bandwidth has rapidly increased in military and commercial fields. Their application for amateur purposes should not be overlooked, however, owing to the desirable characteristic of functioning on a number of bands without retuning, yet giving similar performance on each band. This is achieved by having the resonant portion, or active region, of the structure change its position relative to the feed point. When this occurs the physical size of the resonant portion relative to the wavelength does not change. Those readers who may be interested in the historical development of these radiators will find the first two references of interest[1,2].

It is not the intention here to give in great detail the theories of their operation presented in the literature, but to describe instead the physical construction and bring together various design charts that have been published in different journals.

In the middle 1950s the planar spiral aerial was developed and found to have a bandwidth of over 10:1. Studies showed that this equiangular or logarithmic spiral structure would have properties independent of the operating frequency, as it could be completely described in terms of angles without making recourse to linear measurements. Structures such as this can extend theoretically to infinity—a property incompatible with most amateurs' gardens! Fortunately truncation of the structure to more reasonable dimensions just limits the final bandwidth attainable, by fixing the lowest operating frequency. Shortly afterwards the proposal was made that periodic discontinuities in a structure would also give wideband operation. This was the logarithmic periodic aerial (l.p.a.) whose characteristics repeat periodically with the logarithm of the frequency.

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Angular Structures

The planar spiral is not perhaps of much interest to the radio amateur and will therefore only be looked at briefly. Some typical forms are given in Fig. 1. It is fed at the centre by bringing a coaxial cable along one of the arms, the braid being soldered to that arm. A dummy cable is placed on the other arm to balance the structure electrically, at least for frequencies in the microwave region. The upper and lower cut-off frequencies f_1 and f_2 are determined by the radius of the feed region and the overall radius respectively. The pattern is bidirectional with the maxima lying on the normal to the plane and the radiation field is circularly polarized. If one wraps the arms around a conical surface, however, the radiation can be eliminated on one side, for a suitable value

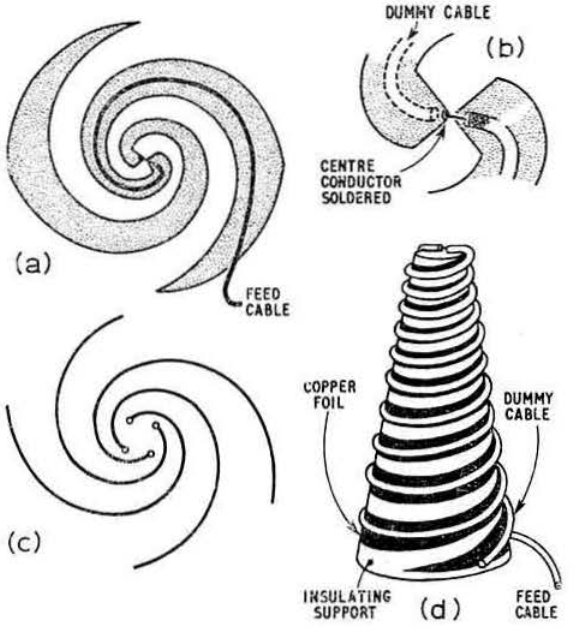

Fig. 1. In (a) is shown the planar equiangular spiral with the feed cable running along the centre of one arm; (b) shows the feed-point detail. A wire spiral is shown in (c), the input impedance of which is a function of the connection of the four input terminals varying in the range 95-270 ohms. If (a) is "projected" on to a cone, the aerial in (d) will result. The main lobe lies off the apex along the cone axis.

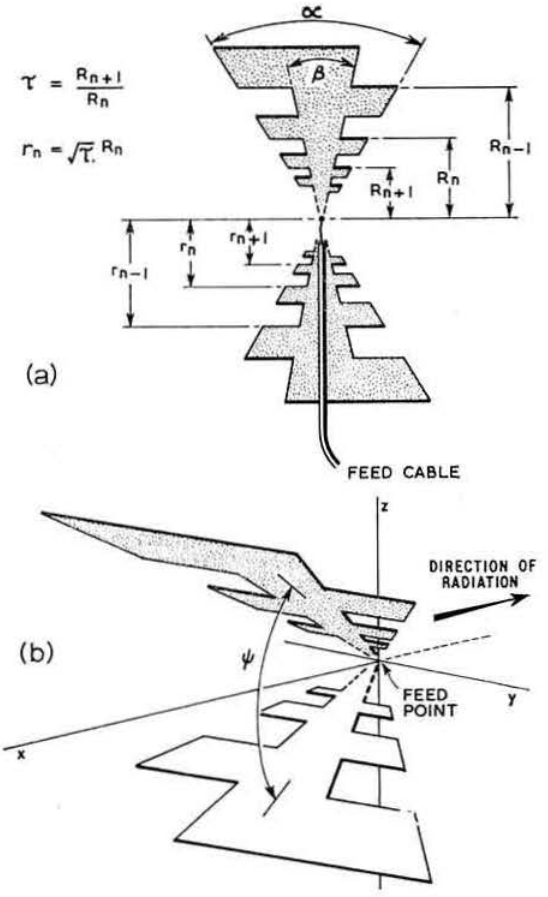

Fig. 2. A trapezoidal-tooth log periodic aerial is shown in (a), the teeth of which may take on other shapes besides that pictured here. If the two halves are bent towards the reader the pyramidal structure of (b) is formed. The *H* plane is the *xz* plane. As an alternative to coaxial cable feed, twin transmission line may be placed along the axis.

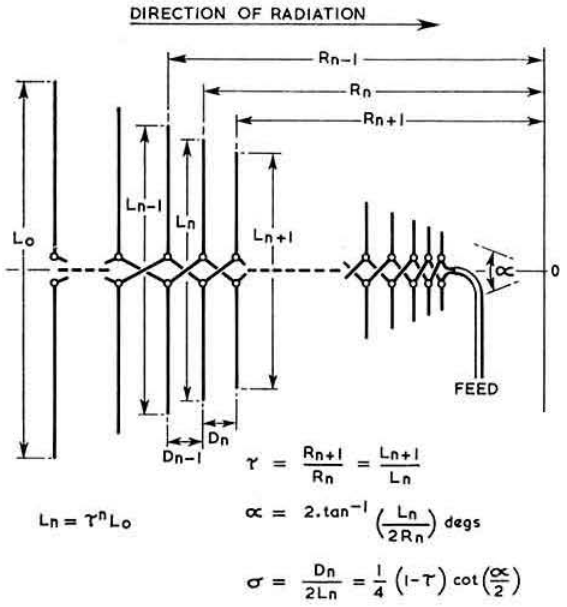

Fig. 3. A planar l.p.a. with dipole elements. The feed cable is transposed between each dipole.

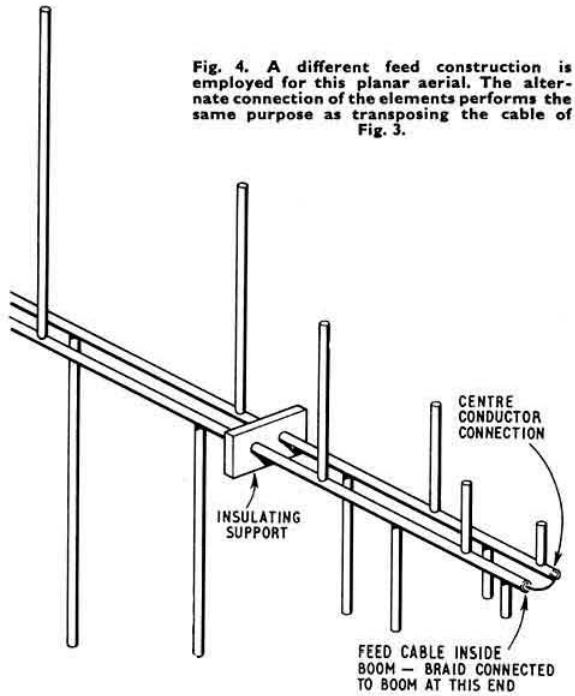

Fig. 4. A different feed construction is employed for this planar aerial. The alternate connection of the elements performs the same purpose as transposing the cable of Fig. 3.

of the included angle of the cone. Design information for these structures has been published [3-5], and bandwidths of over 40:1 have been quoted in the literature.

Successful structures can be formed from wire as well as metal sheet. The beamwidths, θ_{3db}, are quite broad for these angular arrays, the 3 db points being separated typically by 70-80°. The input impedance lies in the region of 120-170 ohms.

Metal Sheet Structures

In 1957 DuHamel found that the l.p.a. form shown in Fig. 2(a) was a suitable radiator, producing two linearly polarized lobes along the normal to the plane in which the structure lies. It was also found that other aerials were possible with either triangular " teeth " or "teeth" which were segments of annuli. The reasoning given for the operation of these aerial structures is that, due to the periodicity of the structure, i.e. the repetition of the " teeth", being a function of τ, if the frequency f is changed by τ to τf the structure looks electrically the same to the transmitter connected to the feedpoint. Also, the radiation pattern and the input impedance remain the same. The aerials' characteristics vary by an amount dependent on τ over the period f to τf, but if τ is appropriately chosen near to unity this variation is small and the aerials become to all intents and purposes frequency independent over a very wide band. The next frequency at which the characteristics repeat is $\tau^2 f$, and so on; the repetition occurs at all frequencies $\tau^n f$, where n is integral.

The aerials are easy to construct from copper sheet or aluminium, though in the latter instance a good contact must be ensured for the braid. Alternatively, from studies made on the current distribution the aerials may be made out of heavy gauge wire bent to follow the outlines of the aerials shown in Fig. 2, with little deterioration in performance[3]. Such a version is illustrated in Fig. 6(b).

If the two halves are bent out of the diagram towards the reader a structure shown in Fig. 2(b) results. For a suitable value of ψ the pattern becomes uni-directional and the pyramidal structure forms a backfire aerial. It should be noted that if this is done the maximum directivity usually occurs in the H-plane rather than in the E-plane; the latter having a 3 db beamwidth in the region of 50-60°. Achievement of higher gains is possible by constructing another pyramidal array and placing it at 90° to the first so that all four sides of the pyramid contain a log-periodic element. The two arrays are fed 90° out of phase.

Linear Element Dipole Structures

If the aerials of Fig. 2 are so modified that the " teeth " become dipole elements and β and ψ are zero then the log periodic dipole version shown in Fig. 3 is the result; if $\psi \neq 0$ then the dipole l.p.a. illustrated in Fig. 6(a) is obtained.

These aerials are somewhat similar in appearance to a Yagi-Uda but with more than the usual number of elements. All the elements are normally driven compared to just one, or perhaps two, as is the case with the Yagi-Uda.

Fig. 3 shows the basic l.p.a. dipole structure. A necessary requirement, as before, is that related dimensions form a geometric sequence with the ratio $\tau = R_{n+1}/R_n$. Such a parameter can be defined for the lengths or spacings of the elements. One can see that the feed line is transposed between adjacent elements to ensure the correct phase relationship in the currents flowing along the elements. This array is inconvenient to build in practice because of the necessity to insulate each element from the supporting boom. However, such aerials are produced commercially in Canada and the USA and are designed to cover many TV channels.

A more convenient method of construction is the sketch in Fig. 4. The dipole half-elements are supported alternately on the two separate insulated booms which act as the transmission line of Fig. 3. The feed coaxial cable is brought down the inside of one boom thus forming a balun and

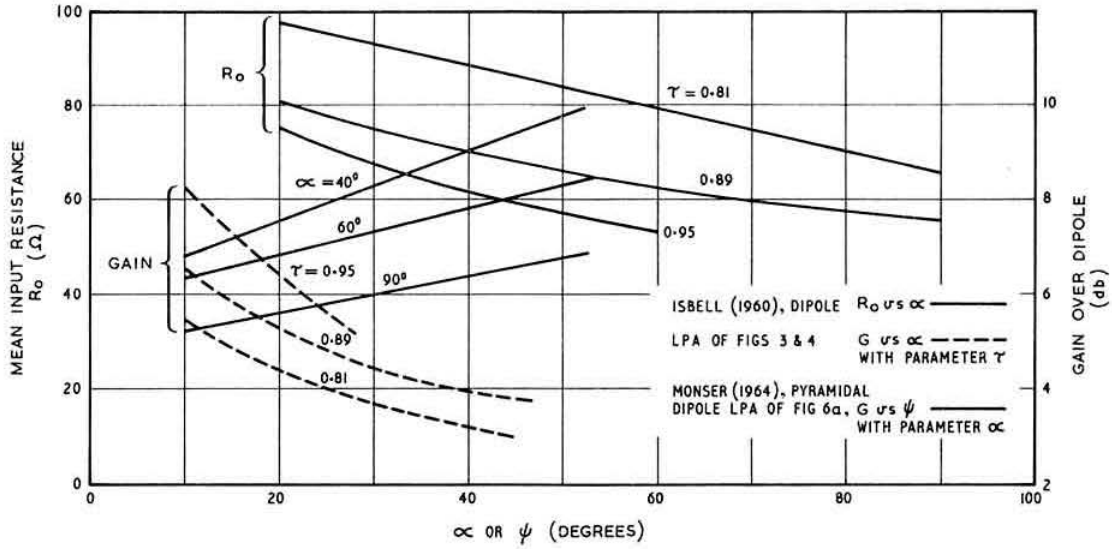

Fig. 5. This graph shows typical variation in input resistance and gain for the dipole arrays.

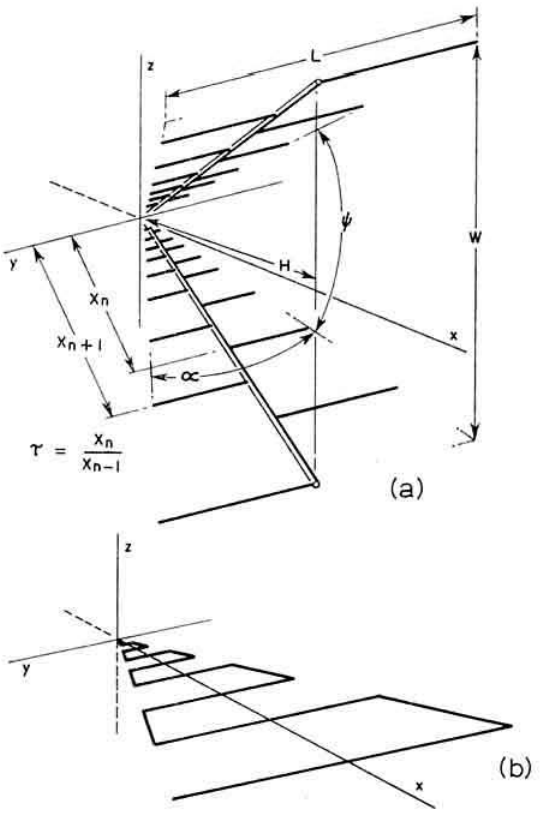

Fig. 6. The pyramidal dipole array attained by separating the array of Fig. 4 is illustrated in (a). The structure in (b) is a wire trapezoidal tooth "half-element," but alone it is practically unusable and requires another element against which it may be fed. The other element is identical, but rotated 180° around the x-axis producing a similar array to Fig. 2 (b).

connected as shown. In other words reversion has been made to the two halves of the version of Fig. 2(b), but in dipole form with β and ψ equal to zero.

By allowing the half-elements of Fig. 4 to slope forward in the direction of maximum radiation, to form in effect an array of V-dipoles, the bandwidth may be increased even further[6]; or what amounts to the same thing the overall length of a given dipole array can be shortened appreciably for a given bandwidth. This is achieved, as the frequency increases, by the active region moving towards the shorter elements and then "jumping" to the rear of the array, the elements there being of such a length as to resonate in the 3 $\lambda/2$ mode. This is repeated for higher modes.

Design Details and Data

The following graphs pertinent to this section summarize results that have been published in recent literature [7.8.9] and should make a reasonable basis for any experimental investigations by interested amateurs. The results of Isbell's investigation, Fig. 5, concern the type of l.p.a. shown in Fig. 4. The measurements were made with the two booms forming a 105 ohm rigid transmission line shorted together at a distance $L/4$ behind the last dipole element, whose length is L. The shorted portion does not seem to be mandatory in practice as other authors have apparently terminated the booms at the longest element. A 75 ohm cable fed the array from inside one boom. Monser has also considered this type, but with the additional parameter ψ obtained as shown in Fig. 2(b) or Fig. 6(a) by separating the two elements of the structure to form a pyramidal l.p.a. In the former case the aerial is also termed a trapezoidal-tooth H-plane array, the other is a dipole H-plane array. The term H-plane is used because separating the elements narrows the beam width in the x-z or H-plane. Another paper by the same author [9] gives the nomograph shown in Fig. 7 for the particular value $\alpha = 60°$. The values H and W, using Monser's formulae, become more accurate as $\psi \rightarrow 0$ and so should only be used for obtaining the preliminary size of the array, gauging clearances, etc., at large values of ψ. More accurate formulae are simply obtained as,

$$H = \frac{246}{tan\left(\frac{\alpha}{2}\right) f_{Mc/s}} \cdot cos\left(\frac{\psi}{2}\right) ft. \qquad \ldots (1)$$

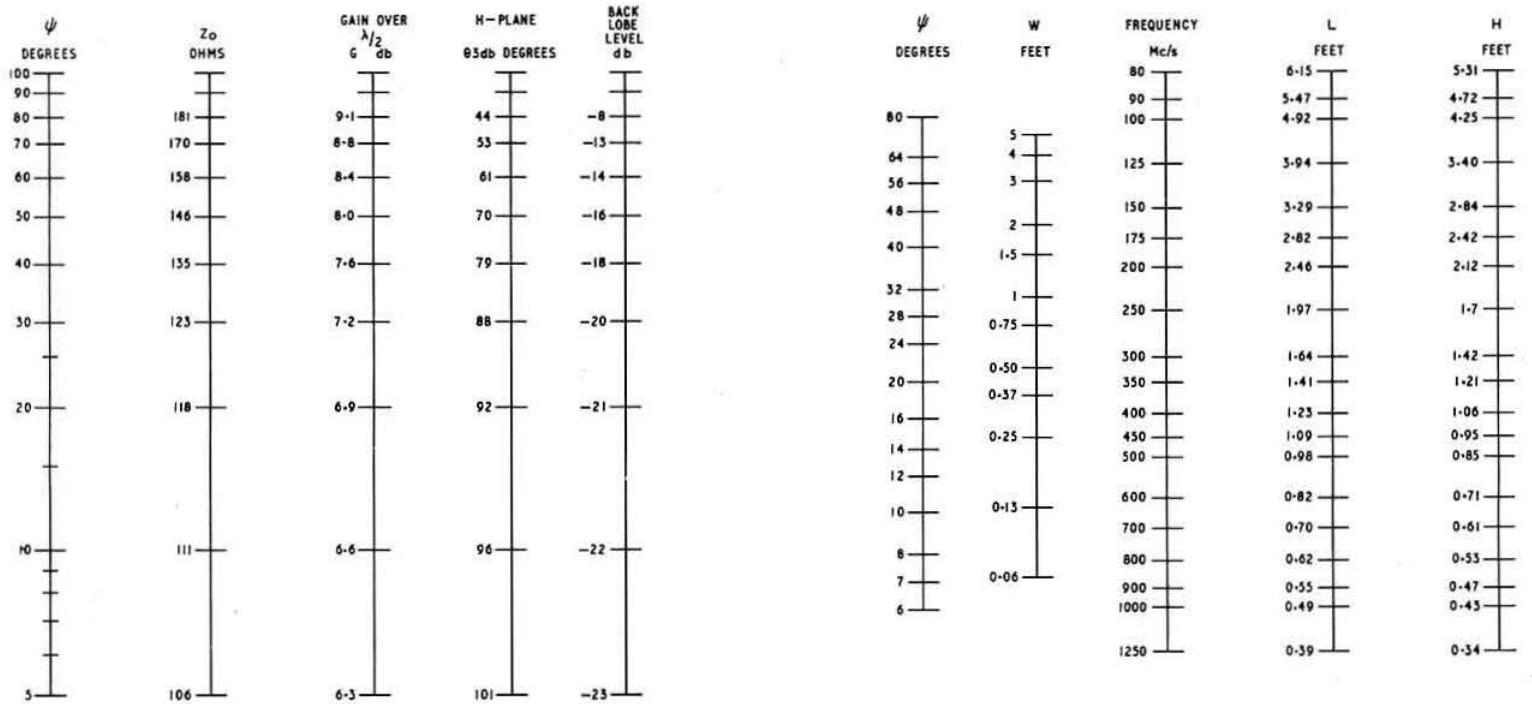

Fig. 7. A nomogram for the construction of an l.p.a. of the type shown in Fig. 6(a), for $\alpha = 60°$ [9].

$Zo \simeq 100 + 1{\cdot}16\,\psi$ ohms Width at base of pyramid, $W \simeq (7{\cdot}4\,\psi)/\text{freq (Mc/s) ft.}$

$\text{Gain, } G \simeq 4 + {\cdot}0585\,\psi$ db Height of pyramid, $H \simeq 425/\text{freq (Mc/s) ft.}$

$\theta_{3db} \simeq 105 - {\cdot}87\,\psi\,°$ Full width of last section, $L \simeq 492\ /\text{freq (Mc/s) ft.}$

For 10 Mc/s < freq < 100 Mc/s, W, L and H are × 10

1 Gc/s < freq < 10 G c/s, W, L and H are × 0·1

$$W = \frac{492}{\tan\left(\frac{\alpha}{2}\right) f_{Mc/s}} \cdot \sin\left(\frac{\psi}{2}\right) ft. \quad \ldots (2)$$

The straight line in Fig. 9 relating to the optimum pair of values, for maximum gain, of τ and σ for the array of Fig. 3 was obtained by means of the equation,

$$G = \frac{41253}{(\theta_{3db})_E \cdot (\theta_{3db})_H} db \quad \ldots (3)$$

the 3 db beamwidths coming from Fig. 8. A more recent formula than this,

$$G = \frac{32600}{(\theta_{3db})_E \cdot (\theta_{3db})_H} db \quad \ldots (4)$$

for aerials having sidelobes no better than –10 db has been suggested as better suited to the frequency independent aerials. However, of the many patterns shown in the literature in nearly all cases negligible sidelobes appear. The largest secondary lobe is almost always the back lobe. For this reason the curve has not been recalculated.

Generally speaking the following points are true for the various parameters τ, ψ, etc., that have been introduced. For a given l.p.a. the value of τ determines the number of elements and hence controls the cost, weight and wind loading of the aerial. The range $0{\cdot}70 < \tau < 0{\cdot}90$ is sufficient for most designs; also too small a value should be avoided otherwise the wideband performance is effected by pattern breakup. A reasonable compromise for α is around 60° for the same reason. In choosing ψ one must consider the backlobe level produced as $\psi \to \pi$, for $\psi = 70°$ the front-to-back ratio is roughly 8 db, increasing as $\psi \to 0$. One would not want usually to exceed $\psi = 70°$ for the pyramidal structure. The parameter β can be ignored for most purposes for the dipole array.

An equation for the mean input resistance of a dipole array is quoted in Mittra and Dyson[5],

$$R_o = Z_o \left[1 + \frac{Z_o \tau^2}{4 Z_a \sigma} \right]^{\frac{1}{2}} ohms \quad \ldots (5)$$

where, $Z_a = 120\ log_\epsilon \left(\frac{L}{a}\right) - 2{\cdot}25\ ohms$

a = *radius of element, assumed constant.*

and Z_o is the impedance of the transmission line. The relation is probably satisfactory for the modification of Fig. 3 shown in Fig. 4. Due to the range of values that could be taken by Z_o, Z_a and σ in practice, no attempt has been made at tabulating results. A few moments work with tables and slide rule will give an answer. Curves for Z_a will be found in the *RSGB Amateur Radio Handbook* (p. 356) or the ARRL *Antenna Handbook* (p. 81). The latter also describes an l.p.a. for 140-450 Mc/s of the type illustrated in Fig. 4.

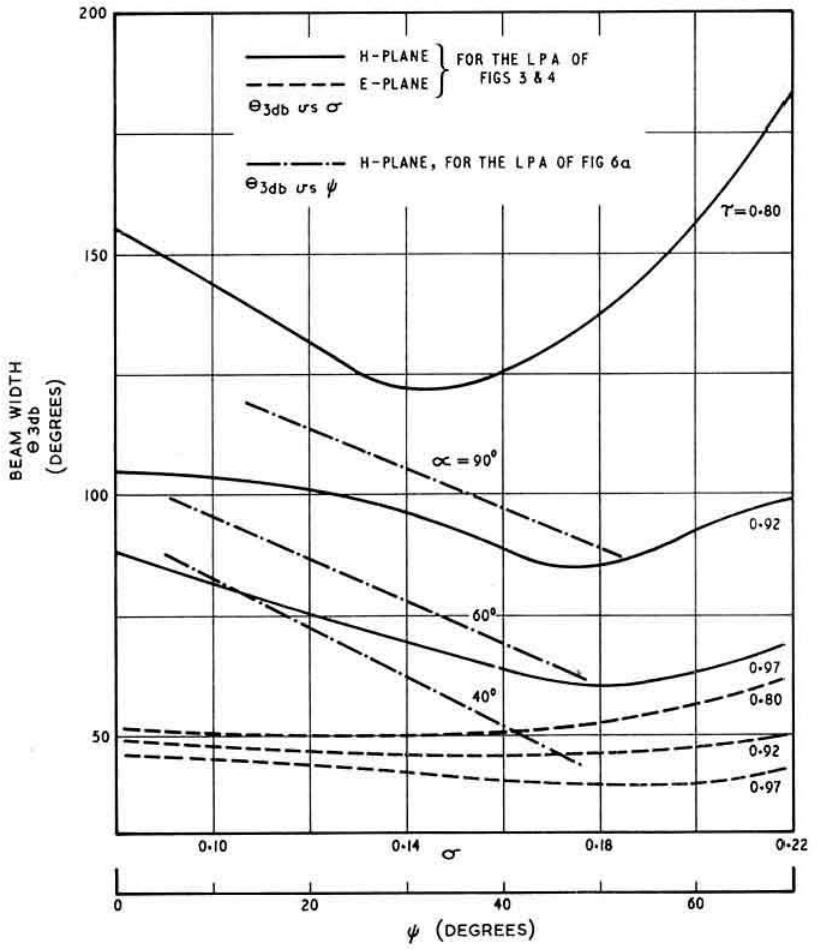

Fig. 8. Variation in the 3db beamwidth as a function of σ or ψ for dipole arrays

The *E*-plane (*xy*-plane) 3 db beamwidth for the trapezoidal wire-tooth aerial of Fig. 6(b) changes little, for $0{\cdot}6 < \tau < 0{\cdot}9$ and for $10° < \alpha < 70°$, lying in the region of 60-75°. At the same time the *H*-plane value has a mean value going from 80° ($\alpha < 10°$) to 165° ($\alpha < 70°$) Other types of "half-structures" or one-element arrays perform in a similar fashion. These are not practical structures in themselves and special methods are required to demonstrate these characteristics [3]. It may be possible to feed the structure, however, against a ground plane. If two of these half-structures are made and one is rotated through 180° around the *x*-axis then an *H*-plane wire-tooth l.p.a. analogous to Fig. 6(a) or Fig. 2(b) is formed. Having done this a gain of 5·5–7·5 db over a dipole may be obtained with $\alpha = 60°$ and $\tau = 0{\cdot}6$, for the range $15° < \psi < 80°$; however, at the same time the front-to-back ratio decreases from 23 db to 5 db as ψ increases. The value for the *E*-plane stays at approximately 60°. The two-element array just described and the one shown in Fig. 2(b) have an input impedance increasing

from 70 ohms to 240 ohms for ψ taking the same range. It should also be noted the impedance increases with τ and a decrease in x.

Using wire for the construction affects the pattern but little, the impedance decreasing by some 30 per cent for a 10:1 increase in wire gauge. The impedance is also a little higher than the corresponding metal sheet structure. Wire and sheet thickness should taper linearly to the feed point but for bandwidths of 10:1 or less Jasik states that this can be ignored. An alternative method of construction lies in the use of mesh instead of sheet, which will lower the weight and wind loading. The mesh could be soldered to heavy copper wire or thin tube for rigidity.

An approximate upper frequency limit to all the l.p.a.s is 10 Gc/s due to the difficulty of construction in the region of the feed point. It is also feasible for the microwave bands to etch an l.p.a. on printed circuit board, which makes a convenient multi-band feed for a parabolic dish. If necessary one can make the feed point with a printed circuit and use metal sheet or wire elements to continue the structure at lower frequencies. If double sided board* is available then a dipole array can be etched taking the form of Fig. 3.

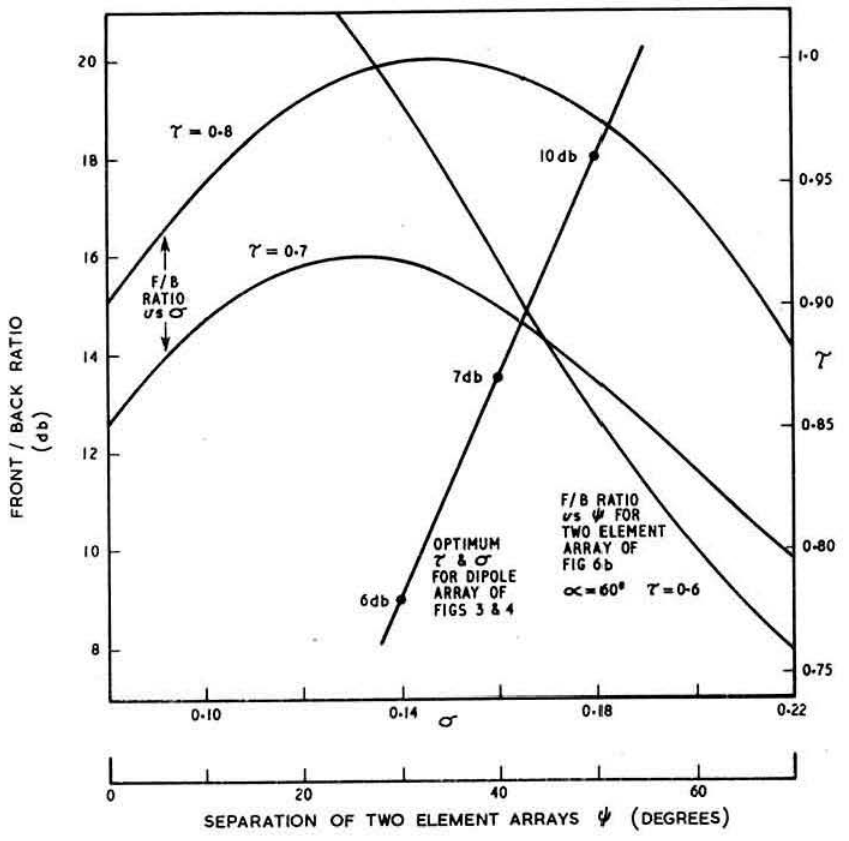

Fig. 9. Front-to-back ratio for the planar dipole and trapezoidal tooth array of Fig. 6(b). The straight line gives a guide to the optimum τ and σ to choose.

At the lower frequencies employed in amateur communication the longest elements become somewhat unwieldy. DiFonzo[10] has found it possible to reduce their size by some 30-40 per cent using loading techniques. It is not restricted, of course, to the low frequency bands, but v.h.f. sized arrays do not usually require reduction. These techniques include discs, T- and U-shaped elements. Another variation[11] of the array in Fig. 4 uses one or two parasitic elements between each driven element. These parasites are not coupled to the transmission line but pick up energy from the other elements. This type of l.p.a. may be cut down the centre and the resulting array of monopoles may be fed against a ground plane with the parasitic elements all connected to the plane to give the correct element current phasing for backfire radiation.

Design Examples

For the first example assume an l.p.a., using the design of Fig. 6(a), is required to cover the range 27-150 Mc/s. Note that the extreme frequencies are such as to more than enclose the 10m and 2m bands. The reason for this " overdesign " is that any variation in the characteristics due to truncation of the structure to a finite size are, as far as possible, outside the frequencies of interest.

A choice of $\tau = 0{\cdot}85$ is reasonable and using Fig. 7, α is fixed to be 60°. A value $\psi = 30°$ can be arbitrarily picked, for a front-to-back ratio of 20db, which gives at the same time for G and θ_{3db} the values 7·2 db and 88°. The mean input impedance will be near to 123 ohms, which is suitable for matching to Uniradio 6 (100 ohms), RG—62 A/U (93 ohms) or RG—63 B/U (125 ohms), with due respect being paid to cable power rating, etc. This is not to say 75 ohm cable will not work at all, but the higher impedance cables are naturally better.

The lowest frequency determines the value H, W and L which are,

H = 15·34 ft. (15·74 ft. with Fig. 7)
W = 8·21 ft. (8·25 ft. with Fig. 7)
L = 8·21 ft. at 27 Mc/s

using Eqns (1) and (2) and the nomogram. Employing the formula for L once more, a length of 3·28 ft. is obtained for 150 Mc/s. Now using the formulae given in Fig. 3, Table 1 may be calculated to give the element lengths and spacings. The value of n is incremented by unity until the resulting length $L_n \leqslant 3{\cdot}28$ ft; then $n+1$ is the number of dipole elements on each half-structure.

It will be realized that as the element lengths are derived from repeated multiplication with τ, the final value satisfying the upper resonant frequency is not likely to be exactly 3·28 ft. As is seen in the Table, the nearest values to the arbitrarily chosen upper frequency of 150 Mc/s are 3·59 ft. and 3·05 ft.; these correspond to frequencies of 137 Mc/s and 162 Mc/s, so naturally the shorter length must be chosen. Alternatively the design may be continued to a higher frequency if desired.

The length of either boom from the initial specification is

* Formica Ltd. produce a p.t.f.e./glass fibre laminate for low loss microwave applications. See *Electronics & Power*, p. 97, March, 1966.

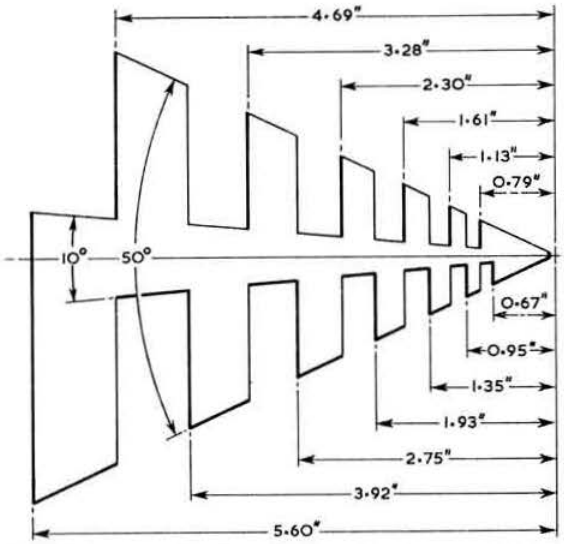

Fig. 10. The structural outline, with dimensions, for the aerial of the second example.

15·8 ft. (= 9·11/tan 30°). However, if the spacings between elements 11 and 0 are added, a length of 13·54 ft. is the result. The booms may be shortened by this difference, 2·26 ft., or elements for higher frequencies can be included.

Summarizing then, assuming shortened booms: $\psi = 30°$, $\alpha = 60°$, $\tau = 0{\cdot}85$, $L = 18{\cdot}22$ ft., $W = 7{\cdot}06$ ft., $H = 13{\cdot}1$ ft., boom length = 13·54 ft., $G = 7{\cdot}2$ db and an H-plane beam width of 88°.

The microwave amateur bands are gaining some adherents and they will no doubt increase. If say, for the second example, the four adjacent bands above 1 Gc/s are to be covered, the frequency limits are 1·215 Gc/s and 5·85 Gc/s. A suitable structure is the pyramidal trapezoidal tooth of Fig. 2(b). A typical value of β appears to be 10°. Let $\tau = 0{\cdot}7$, $\psi = \alpha = 50°$. It is assumed in this calculation that the rear of the longest tooth has a length equivalent to a dipole resonant at the low frequency design limit, 1·1 Gc/s.

Using once again the appropriate formulae, the following can be derived,

$W = 4{\cdot}86$ in. $\quad H = 5{\cdot}22$ in. $\quad L = 5{\cdot}37$ in.

The spacing of the rear and front edges of the teeth are derived from the formulae in Fig. 2(a). The values are shown in Table 1. The gain of this structure will be in the region of 6 db, but it can be used as a feed for a parabolic dish when the resulting gain will be much higher. The design of such combinations will be found in most microwave engineering handbooks or in Jasik[3]. The form of the half-element is shown in Fig. 10.

TABLE I

n	Example 1		Example 2	
	L_n ft.	D_n ft.	R_n in.	r_n in.
0	18·22	2·37	5·60	4·69
1	15·50	2·01	3·92	3·28
2	13·18	1·71	2·75	2·30
3	11·20	1·45	1·93	1·61
4	9·52	1·24	1·35	1·13
5	8·10	1·05	·95	·79
6	6·88	·89	·67	·56
7	5·85	·76	·48	·40
8	4·97	·64	—	—
9	4·23	·55	—	—
10	3·59	·47	—	—
11	3·05	·4	—	—
12	2·59	·34	—	—

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Book Reviews

HINTS AND KINKS FOR THE RADIO AMATEUR. Compiled and published by the American Radio Relay League. 128 pages, 9½ in. × 6¼ in. Available from RSGB Publications. Price 10/- post paid.

Volume 7 of this series contains the best of the ideas submitted during the last six years to the *QST* monthly feature *Hints and Kinks*. This edition is the same size and format as its predecessor but the contents are completely changed. Examination of the chapter headings show that s.s.b. no longer has its own section and that there is a new 13 page portion entitled *For equipment construction*. In common with previous volumes there is a complete index. Naturally a number of the items relate to modifications to US commercial equipment but an interesting addition to a piece of UK equipment enabled direct frequency calibration of the well-known Eddystone dial and logging scale. An invaluable addition to the amateurs' library R.F.S

RADIOAMATEUR'S VOCABULARY. Compiled by Christian Zangerl, OE9CZI, Nachb. 28, Dornbirn I, Vorariberg, Austria. 70 pages 8¼ in. × 11¾ in. Available from RSGB Publications. Price 9/3. post paid.

This vocabulary contains some 4000 words, indexed in a German to English translation, which are in common use in QSOs, letter writing and technical articles. Also included are several useful conversion tables, e.g. metric units to miles and feet. Designed to be of assistance to amateur operators and technicians this Vocabulary will be of interest to readers wishing to acquire knowledge of technical German. R.F.S.

DXpedition to the Isle of Arran

By P. J. HOLLAND, G3TZO*

THE first suggestion of a DXpedition to one of the rarer counties of Scotland understandably met with little consideration, for few members of the Chester Group imagined such a journey feasible. The problems of finding nine or ten members, the majority of whom were married, who could take five days holiday in the middle of September, seemed to rule the venture out before any of the other points could be considered. However, the vision of what lay ahead enthused the members to such an extent that the minimum number needed to undertake the venture was very readily attained, and the more practical details then came under consideration.

Portable operation had been a feature of the club's activities for many years, and hence there were several members, particularly G3ATZ, who could advise on requirements. The primary intention of the DXpedition, it was agreed, was to give as many people as possible a chance of working one of the few remaining rare GM counties, and Bute seemed to fit the bill very well. As the Island of Arran seemed to be the principal land mass in Bute, it was selected without argument.

The first step was to arrange for permission to set up station, and this was readily given by the National Trust for Scotland and the Forestry Commission, who own a very large part of the Island. As a definite site could not be selected without actual inspection, it was arranged to have a number from which to choose on arrival.

The next step was to select suitable equipment for the bands to be used. Top Band was the favourite, and the gear chosen had to have maximum efficiency for this operation, but it was agreed that 2m gear should also be carried to find out exactly how it felt to be sitting on the other end as it were. The gear picked for 160m was GW3TOW's KW2000A, using a 520 ft. wire to be slung between two 45 ft. masts. A minimum of nine members in the party was essential, incidentally, to facilitate manhandling the masts, particularly in the inclement weather anticipated on the island.

The 2m gear was less commercial, with a home-brew transmitter belonging to G3ATZ running a QQV06-40 in the p.a. at 20 watts input. The A2521 converter, also built by G3ATZ, and G3TZO's AR88D, were used as the v.h.f. receiver. The aerial for 2m was a J-Beam 8-over-8 at 25 ft. Power for all activities, including shaving, was provided by a 1½kW 240V a.c. petrol generator.

The overnight trip north was uneventful, except that on reaching the ferry at Ardrossan at 9 a.m., the party was told that owing to the rough weather the ferry would leave from Fairlie, nine miles further on. The crossing was particularly rough, the writer failing to find his sea legs before disembarking, rather flushed, 70 minutes later at Brodick, the principal town on Arran. After a couple of hour's reconnaissance the group was lucky enough to find a very suitable site for a station on the southern tip of the Island; a point approximately 500 ft. a.s.l. near the village of Kilmory. After leaving Chester at 11 p.m. the previous evening (by this time it was about 3.30 p.m.), no one felt like putting two stations into operation, but more like collapsing on the spot. Nevertheless, with the last dregs of energy left, the test was completed, and GM3GIZ/P was on the air by 9.30 p.m., despite the aerial snapping once and having to be replaced. The excessive time taken to assemble the gear was due to a very high wind which had sprung up during the early evening.

* 19 Kingsley Road, Great Boughton, Chester.

As anticipated, the flow of contacts on 160m did not begin to abate until the very early hours, and this was the pattern every night using either s.s.b. or c.w. Contacts were not short and snappy as a whole, but more the light-hearted, informative type, as plenty of time was available. Operation usually commenced about 6 p.m. on 160m c.w. and moved on to s.s.b. later in the evening. During the day when 160m was quiet, 80m to 20m were tried with varying success. Two metres proved a disappointment as nothing was worked until the Saturday, when EI2A appeared at 5 and 9 both ways. In order to prove that it was indeed the band conditions and location that were making contacts few and far between, GM3UGB kindly loaned his AR88 and converter, but the same stony silence was encountered. The last day proved the most successful on 2m, when five stations were worked, including GD3FOC, GM3FYB, GI5AJ and EI9BC, covering four separate call areas. The only G station heard was G3KMS in Macclesfield, Cheshire, but unfortunately no QSO resulted despite calls. The breakdown of QSOs on the l.f. bands was 144 contacts on 160m and 48 on 80m and 40m making a total of 192. Apologies are due to all those who still require Bute on 160m but for those who did work the station; special QSLs will be printed and despatched via the RSGB QSL Bureau.

Operators on the trip were G3ATZ, G3TZO, G3DRB, GW3LDH, GW3TOW, G3UWV, GW8AOC, together with Geoff and Frank, two very able short wave listeners.

Can You Help?

● G. O'Conner, BRS27855, 61 Steep Hill, Lincoln, who requires information on a USA Signal Corps Receiver/Transmitter type BC-620-F?

Written Long Ago

"The Hissing Phenomena" are certainly worth investigating. We have had evidence that at the time of a "fade out" the F Layer rises rapidly to an abnormal height, due to the thermal expansion of the gas, probably by bombardment of some sort from the sun. Can it be that this rapid movement of the electrified layer is the cause of the noise?

Hissing on 28 Mc/s was reported on 19, 29 March, 6, 26, 28 May, 3 June, 1926, by G6DH, and G2YL.

T & R Bulletin, July 1936.

"Dr. Smith Rose (at the Fourth Annual Dinner of the London UHF Group) went to on mention that Radio Astronomy was based on 'The Hiss Phenomena' first observed by a British Amateur—Denis Heightman (G6DH)—in 1935. Little attention was paid to these observations by Heightman until the war years when it was noticed that noise increased if directional aerials were pointed towards the sun."

RSGB Bulletin
January 1956
J.C.

THE MONTH ON THE AIR

By JOHN ALLAWAY G3FKM*

FIRST an apology to readers for the scarcity of information in this month's article, partly on account of the early deadline due to the early publishing date of the November BULLETIN. It is hoped that the December column will be more comprehensive.

Some statistics quoted in a letter from 6Y5FH concerning QSL return percentages make disappointing reading as far as British amateurs are concerned. Frank has only received cards so far from 18 per cent of G stations worked. The best return figures came from ZL, PA, HB, HP, and XE, with the USA also well up the list. As nearly every QSO contains promises by both parties to QSL this must mean that the word of four out of five British amateurs means nothing! It would be an excellent idea if all stations decided to be completely honest about their QSL intentions, and had the good manners to either QSL as promised, or say outright that they were unwilling or unable to QSL. A great deal of stationery, postage, and QSL Bureau manager's time would be saved thereby.

Whilst on the subject of QSL cards it is noted that W2CTN has removed the following from the very long list of stations for whom he acts as QSL manager: CP3CN, CP5EZ, FG7XC, FG7XD, FG7XJ, HK2YO, HK3RQ, HP1AC, HP1IE, KV4CI, OA4FM, OA8D, OA8D/3, OX3UD, PJ2ME, PZ1AX, PZ1CM, VP2MV, VP6AK, VP6AP, VP6BW, VP6PJ, VP7NS, VP7NW, VP9BY, ZB2AP, ZS2SS, ZS4OF, ZS6CN, and 9HIR. QSL all these direct *not* via W2CTN in future please.

Apologies from G3PAI who intended to operate from Luxembourg with a G3PAI/LX call during September; he was unfortunately taken ill on arrival there and did not manage to get on the air.

News from Overseas

The latest information on the locations and call-signs of stations in the VP8 areas has been received via G2RF. The facts were recently checked with VP8HJ, who at present looks after the VP8 QSL Bureau (but QSL's via W2CTN himself!). It seems that VP8's CW, HJ, HZ, IQ, and JA are all on the Falkland Islands. VP8EG is in the South Orkneys, and operates on c.w. VP8IY will be active from the South Shetlands after December, but at present there is no activity from there, or from South Georgia or South Sandwich. All other active VP8's are in Antarctica; these include VP8IK (who was erroneously stated in last month's *MOTA* to be in S. Shetlands) and VP8IU who are both on Argentine Is. VP8IY is at present on Adelaide Island, and formerly held the call VP8IV (until April 1966). VP8IN is on Stonington Is. Other bases, including Port Lockroy, Hope Bay, and Halley Bay, have no amateur population at the moment.

A notice has been sent out by the Director of the Telecommunications and Electronics Branch of the Canadian Department of Transport granting permission to all Canadian Amateurs to use a special prefix during 1967, to commemorate Canada's Centennial Year. This will be 3C for VE stations, and 3B for VO stations, thus VE1AA may become 3C1AA and VO1AA 3B1AA if they so desire. This should be of interest to prefix hunters as 11 new ones will be available.

Another letter from CT3AS (G3SJ) to G2MI points out that 10m is often wide open to Europe from Madeira. Harold says that the German Geophysical Year station is often a good signal on c.w. but that there is no sign of any other activity. How about turning those beams towards CT3?

Top Band News

The first news of VK5KO being heard during his published 160m schedules was received from A4776 who had been monitoring the frequency of VK5KO for some days before having the thrill of hearing his first 160m Australian station. No reports of G/VK QSOs taking place have so far been received.

During his recent operation from Jersey, GC2LU/P made contact with 9HIAE. This is believed to be the first Top Band contact between the Channel Islands and Malta. Congratulations to both parties.

According to W1BB it is expected that in spite of the increasing sunspot activity there should be some excellent DX activity during the coming season. He cheers up Top Band enthusiasts by pointing out that DX was worked even at the last sunspot *maximum*, and that *that* was a much higher one than the current one is expected to be. Stew reports a letter received from DL9KRA describing his experiences with a balloon aerial. After considerable difficulty the balloon was raised to 260 ft, and the first CQ resulted in a call from 9M4LP. However, this was followed by an increase in the wind speed which caused the aerial to become almost horizontal so the project was abandoned for the night and resumed the following evening. On this occasion no replies were obtained, but on switching to the horizontal aerial good DX was worked. Jan believes that the results were due to the fact that the base of the antenna aerial was the flat balcony and not a good ground.

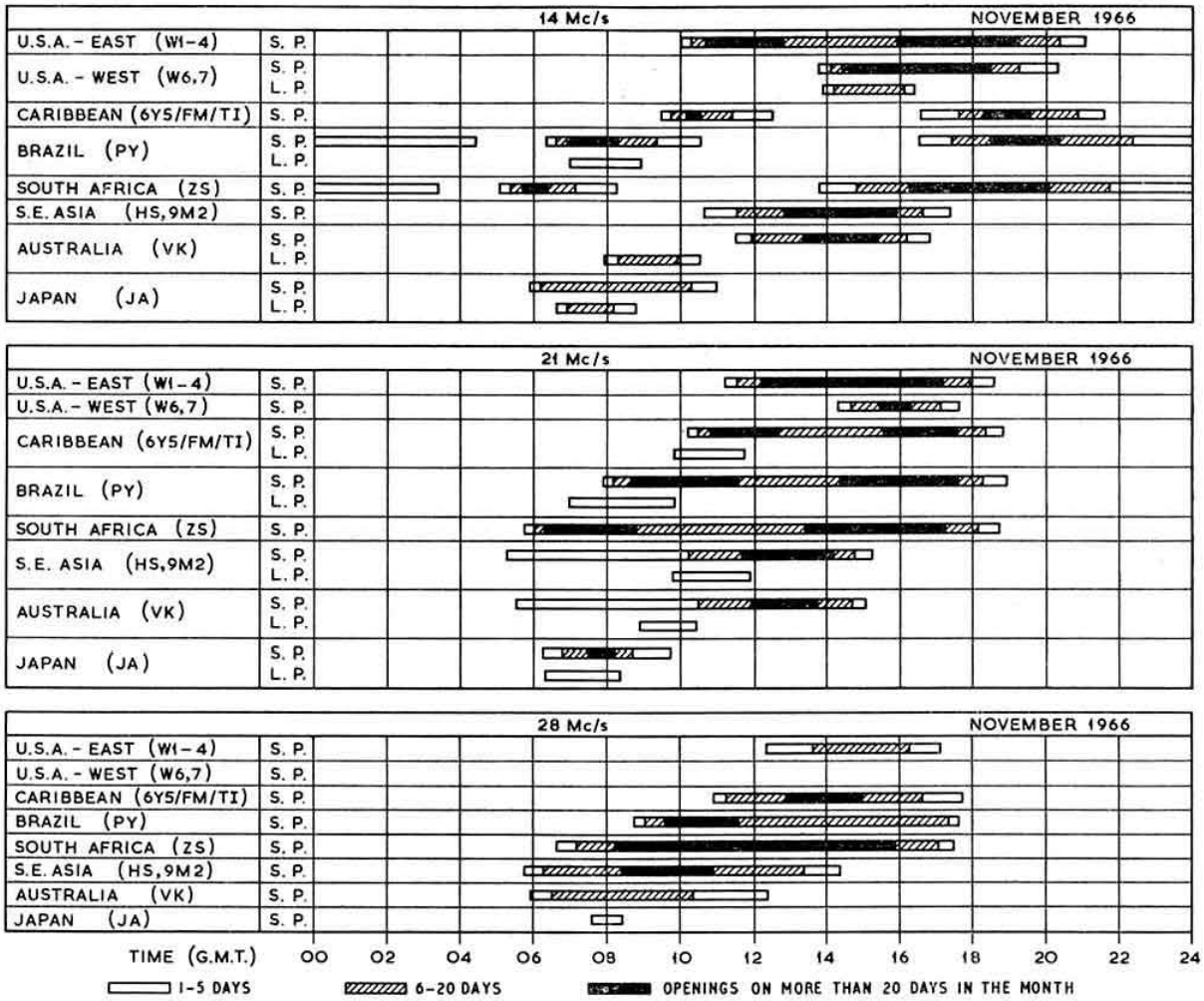
Apologies to W1BB for the absence of credit for the recent

The landing site and operating location on Navassa Island (K1IMP/KC4).

(Photo by W9WNV)

* 10 KNIGHTLOW ROAD, BIRMINGHAM 17. Please send all reports to arrive by **16 November** for the **December** issue, and **9 December** for the **January** issue.

PROPAGATION PREDICTIONS



The propagation conditions on the h.f. bands are at their seasonal best in November. Because of the rapid increase in sunspot activity this year, it will now be possible after a long break, to work Central and South America, Africa South and South East Asia on 28 Mc/s. Eastern North America will only come through on favourable days (i.e. on day with above average F2 m.u.f.'s) and there is a remote possibility of working Japan on this band in the hours before noon. The band will normally close shortly after 17.00 GMT. As before, all continents should be workable with certainty on 21 Mc/s, and Western USA should come through for short periods. With the approach of winter the band will generally close shortly after 19.00 GMT especially in the latter half of the month. In contrast to the equinoxes (March and September) the midwinter months are more favourable for contacts via the long path. These contacts, which in the present phase of the sunspot cycle are more likely on 14 Mc/s usually take place when the great circle through both stations lies in the twilight zone (the borderline between night and day). 14 Mc/s will continue as the second DX band after 21 Mc/s but will generally close down shortly before midnight. 7 Mc/s will take over as the main DX band from shortly before midnight until well into the morning. During the day this band will still be ideal for local traffic without a dead zone and also for European contacts. In comparison with the summer months contacts will be possible over greater distances during the day on 7 and 3·5 Mc/s, though sometimes very changeable from day to day. DX opportunities on 3.5 Mc/s during the hours of darkness will continue to increase. Interruptions to local traffic by the dead zone will repeatedly occur on this band in the latter half of the night.

The provisional sunspot number for September was 49·3 with the greatest activity occurring in the second half of the month. The predicted smoothed sunspot numbers for January, February and March are 62, 64 and 67.

The Zurich Solar Observatory is now able to give new predictions on which the monthly forecasts are based; date of coming sunspot maximum May 1968: highest smoothed monthly sunspot number, 110.

pictures of ZP9AY and CX3BH. Most of the photographs of 160m stations are very generously supplied by W1BB to the Society, entirely at his own expense, and are, of course, greatly appreciated.

Awards

Information on all current certificates and awards will be found in the **Directory of Certificates and Awards,** which is a must for the keen sheepskin hunter. It contains up-to-the-minute details of over 600 awards from all over the world, including those available to SWLs. This volume is produced in loose leaf form, suitable for insertion into a three ring binder. It is produced quarterly from 1 January each year by Clif Evans, K6BX, each issue being self contained and amendments are not issued. Stocks of this publication are not held by HQ to ensure that only current copies are dis-

tributed, but orders for direct delivery from K6BX may be placed with G2BVN. The non-profit cost per issue is 18s. 6d. post paid, and a suitable binder can also be supplied for a further 7s. 6d. if required.

The Northern California DX Club offers an attractive certificate—the **California Award**—for contacting 220 different Californian stations, including at least 20 members of the N.C.DX.C. A special arrangement has now been made whereby intending applicants who still need W6 QSL cards from stations worked may submit a list of the unconfirmed contacts together with a list, certified by their radio society, of QSLs in their possession. The N.C.DX.C. will spot check contacts on this list. N.C.DX.C.'s address is: PO Box 75, Oakland, California, USA.

From time to time your scribe is asked for details of the ARRL **DX Century Club** rules. This is one of the world's premier awards, membership now being in the region of 10,000. The basic certificate requires the submission of QSL cards from at least 100 different countries, together with a special form listing the QSLs (which is supplied on request by ARRL), and sufficient IRCs for return postage to: DXCC Awards, ARRL Headquarters, 225 Main Street, Newington, Conn, USA, 06111. The administration of this award is excellent, and cards may be safely trusted to ARRL—which unfortunately is more than can be said for cards sent to some other organisations. One point needs emphasising—*no alteration of any kind*, whether made by sender or recipient, should appear on a QSL sent for DXCC credit. This could result in the applicant being disqualified.

Contests

Full results of the 1966 ***CQ* WW 160 Metre Contest** have now been received. It may be remembered that conditions for this event were very much down on those obtaining for the 1965 event. The world winner was **W8HGW**, who scored 35,880 points from 207 contacts with 11 countries in all.

QTH Corner

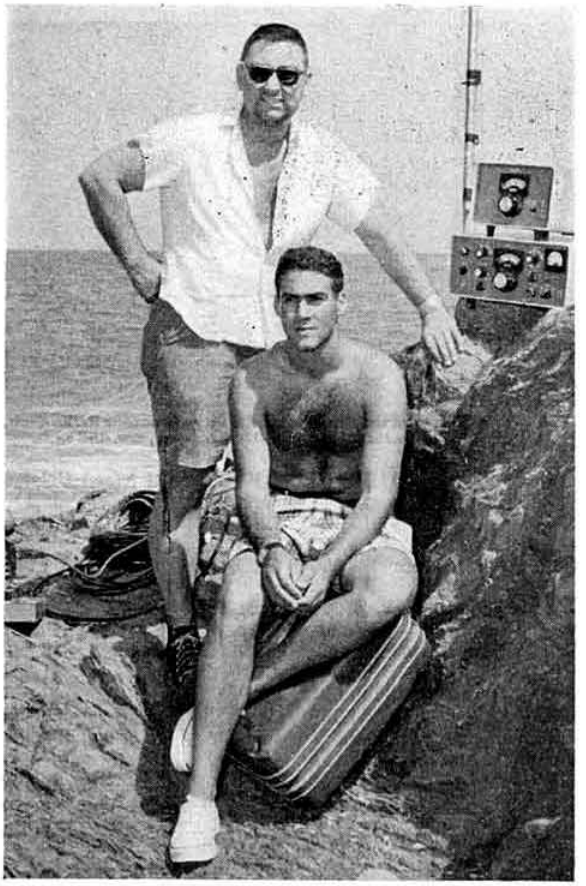
CT2YA	via YASME.
CT3AU	via YASME.
EA8EX	DJ2YJ, Wolfgang Sommerkamp, Aderstr. 43, 4 Dusseldorf, Germany.
EL8B	via SM5MC, Sten Larsson, Sandelsgatan 25, Stockholm, No. Sweden.
ET3GB	via K5LRE, Margaret Bunce, 713 Glendale, Midwest City 10, Okla, USA.
FK8BK	PO Box 35, Noumea, New Caledonia.
HS4AK	PO Box 11-121, Bangkok, Thailand.
W5VMU/KJ6	via W5HJ, Thos. G. Banks Jr, 6500 Mossman Place NE, Albuquerque, NM, USA.
MP4DAN	via DJ4AB, Hans Puffer, Aegidistr. 178-A, 425 Bottrop, Germany.
MP4QBB	via W7VRO, Dick Moen, 2935 Plymouth Drive, Bellingham, Wash, USA.
MP4QBR	via W8ZCQ, Daniel Umberger, 2753 Elliott Av, Columbus 4, Ohio, USA.
VP2AC	via WA4AYX, Peter Eaton, 804 Nassau Drive, Mobile, Ala, USA, 36608.
VP6PJ	via WB2UKP, 50 James St, Shrewsbury, NJ, USA.
VS9HRV	via G2MI.
YA5RG	via DL6ME, Hermann Gerls, Schillerstr. 18, 34 Goettingen, Germany.
ZD8BUD	via K4DEN, Ishmael Mason, 6246 SW Tenth Terrace, Miami, Fla.
ZD8WK	via K8WNU, William Knotts, 7325 Roshon Av, Reynoldsburg, Ohio, USA.
ZF1EP	via W4PJG, PO Box 1647, Fort Myers, Fla. 33902.
5H3JR	via W2SNM, 2483 Third Avenue, East Meadow, NY, USA.
5N2AAW	via K5OQO, Carl Fox, 818 Sutton Ct, Irving, Texas, USA, 75060.
9A1DFD	I1DFD, Vicenza, SETAF, APO New York, NY, USA 09221.
9Y4AR	92 Sapphire Drive, Diamond Vale, Trinidad.

QSL Managers

W4ECI	3103 4th Avenue Sth, Birmingham 5, Ala, USA.
YASME	PO Box 2025, Castro Valley, Calif, USA.
DOTM	W2GHK, PO Box 7388, Newmark, NJ, USA, 07107.

* * *

RSGB QSL Bureau: G2MI, Bromley, Kent.



W9WNV and K1IMP at the operating position of PYOXA.
(Photo by W9WNV)

Top European was Armin, **DL1FF**, who produced a very creditable total of 27,540 points, thereby scoring fourth highest world score. He worked 19 countries, and made 190 contacts. There was a quite large entry from the UK—scores were as follows (certificate winners in heavy type):

G8NF	**14,835 points**	G2DC	5,328 points
G3IGW	13,240 ,,	GW3GWX	4,972 ,,
GW3PMR	**11,550** ,,	G3JVJ	4,368 ,,
G3GBU	10,755 ,,	G3GHN	3,570 ,,
G4MH	9,401 ,,	**GI3OTV**	**2,544** ,,
G3KLH	8,073 ,,	G3HZL	2,390 ,,
GM3KMR	**7,488** ,,	**GD3HQR**	**1,239** ,,
G8FC	6,097 ,,	G3SVD	1,225 ,,
G3FVA/A	5,904 ,,	G3MWZ	385 ,,
G5RP	5,760 ,,		
GM3OXX	5,670 ,,		

Complete details of the 1965 **CQ WW DX Contests** have also now been received. The Telephony scores in the UK were as follow:

		Points			Points
G3DYY	**All band**	**138,649**	**G3HDA**	**(14 Mc/s)**	**146,176**
G3RHM	,,	128,522	**GM3JDR**	,,	**34,112**
G3UML	,,	115,588	**GW3OCD**	,,	**24,180**
G3TWV	,,	97,730	GM3SFH	,,	20,706
GM3BCL	,,	**58,935**			
GW3PSM	,,	**38,962**			
G3TKK	,,	31,390	**G3NLY**	**(7 Mc/s)**	**20,440**

W5UZX, President of the Aeronautical Centre Amateur Radio Club, Oklahoma, operates all bands 80-10m. on a.m., c.w. and s.s.b.

G2AJB	**All band**	30,804	**G3PEU**	**(21 Mc/s)**	**103,410**
GW3SFC	,,	18,542	G3CAZ	,,	55,126
G3SEP	,,	13,184	G3PZO	,,	6,552
G3MWZ	,,	4,180	**G3OHP**	**(28 Mc/s)**	**6,681**
GW3PMR	**(1·8 Mc/s)**	360	G3OAD	,,	1,045

Scores in the **C.W. Section** were:

		Points			**Points**
G3FKM	**All band**	**246,959**	G3MWZ	All band	12,388
G2DC	,,	178,640	G3JKY	,,	11,767
G3DYY	,,	140,694	G3RJB	,,	2,688
GC3KCE	,,	**54,366**	**G3HCT**	**(21 Mc/s)**	**80,276**
G3TWV	,,	46,872	**G3HDA**	**(14 Mc/s)**	**155,290**
G6VC	,,	45,152	G3IRM	,,	240
G2AJB	,,	35,136	**G3POI**	**(7 Mc/s)**	**28,161**
G3SEP	,,	31,832	G3EYN	,,	21,948
GC4LI	,,	**31,248**	G8DI	,,	5,144
GM3JDR	,,	**30,450**	G3TMA	,,	3,813
GW3MRI	,,	**18,644**	**G3ESF**	**(3·5 Mc/s)**	**19,317**
G3NVK	,,	17,633	G3JVJ	,,	8,580
			G3IGW	**(1·8 Mc/s)**	**1,760**

Congratulations to the winners for winning, and congratulations to all the other participants for taking part! In the multi-operator single transmitter section (phone) the three British entries all won certificates: **GW3NWV (515,134** points), **GI3SXG (155,040** points), and **G5BK (123,354** points). In the c.w. section of the same category **G3SSO** scored **530,944** points, **GM3GUJ (80,730)**, **GI3GAL (57,936)**, GM3SFH (35,776), and G3TGK 20,475 points.

A **Canary Islands Contest** is being held between 21 December and 20 March, 1967. No rules are available, but interested parties may obtain more information from: Tenerife Eterna Primavera, PO Box 215, Tenerife, Canary Islands.

Log forms have now been received from *CQ Magazine* for the *CQ* WW DX Contest, and are available from G3FKM. Please send a large envelope, and if possible intimate how many sheets will be required—each log sheet has space for details of 40 QSOs.

A reminder that the **RSGB 7 Mc/s C.W. Contest** takes place on 12 and 13 November—see page 413, June 1966 BULLETIN for full details.

DXpeditions

The latest movements of **Lloyd** and **Iris Colvin** involved their departure from Madeira, where they used the call **CT3AU**, on 8 October. It is understood that they made over 4000 QSOs from there with more than 100 different countries. Their next stop was scheduled to be in the Azores Islands, where their call-sign was to be **CT2YA**. From there they intend to proceed to the Caribbean area on their way back home to the United States. They hope to be home in California early in the new year, and then to resume their tour of Africa.

Don Miller, W9WNV, sent out a large number of letters to known DXers setting out details of possible future movements. At the time they were written the financial state of the expedition was said to be some $1600 in the red, and it was estimated that $6000 would be needed for the projected extension of the trip. At the time of writing it has just been announced that sufficient financial support has been forthcoming and that Don was in Kenya preparatory to moving out into the Indian Ocean area. During a lightning visit to London on 27 September, Don obtained the call **G5AEW**. From London he travelled to Madrid to try to obtain permission to operate from a number of Spanish territories, and it is rumoured that he was successful. Possible countries to be visited include Rio de Oro (EA9), Annobon Island (EA0), Albania (ZA), Tunisia (3V8), Iraq (YI), Turkey (TA), Glorieuse Is (FR7G), Tromelin Is. (FR7T), Aldabra (VQ9), Chagos (VQ8C), Desroches Is. (VQ9D), Laccadive Is. (VU), and two other unspecified places which have never been activated before. Donors of $25 or more are promised direct air-mail QSL cards, and it is promised that W4ECI will QSL all other stations contacted as soon as logs and printed QSLs are to hand. It is expected that Don will be accompanied by another amateur throughout part of his journey. All QSLs for any of these operations should be sent *via* W4ECI, and any donations should be made payable to the World Radio Propagation Study Association.

It is reported that PY1CK and PY2CQ will visit Fernando de Noronha during the *CQ* WW DX Contest, and that they would be on all bands 10 to 80m. Their call-sign may be **PY0AB**.

DXpedition of the Month report that LA1EE/P logs have not yet been received, but that together with the missing ZD8AR and YV9AA logs they are expected at any moment. ZD9A QSLs are now due to be in the mail, and QSLing for DJ6QT/LX, 3A0EB, and PX1YR is now up to date. Some idea of the enormous amount of work done by DOTM as QSL " fairy godmother " is given in a list of logs on hand on 29 July this year. This includes some 109 different call-signs, some current, some dating back to 1963. Calls of currently active stations mentioned include CN8FF, CN8FS, CN8FV, CR5SP, I1RB, I1RBJ, LX2UW, OY7ML, VE8CO, VK9DR, VK9MD, VK9XI, VP7CX, VP7NY, ZD8AR, ZD9BE, and 7Q7PBD. Applications for QSLs from any of these stations should be sent to DOTM (address in *QTH Corner*). For HK0AI QSL's W9WHM should be approached (John Leary, 438 Hamilton St, Fortville, Ind, USA).

The proposed trip by OD5EE and OD5BZ to Qatar, scheduled for last month, was delayed by Customs difficulties and was expected to materialise on 13 October. OD5EE's call was to be MP4QBB, and OD5BZ's MP4QBR. After this sortie OD5BZ hoped to accompany Smitty, 6O1AU, to Jordan, there to operate JY1AU for six days from 21 October.

HK1QQ is now in Cameroon, and expects to be there for about two years. He hopes to be on the air with a TJ call very soon, and also to manage trips to other rare African countries, including Spanish Guinea.

As mentioned in last month's *MOTA*, the Royal Signals expedition to Kuria Maria is scheduled for the period 6 to 20 November. The call-sign will be VS9HRV.

Band Activities

Another fairly good month has been recorded on all bands, the highspot of DX news being the reception of VK5KO's signals on 160m. So far only one report has been received of them being heard, and no reports of VK/G QSOs having taken place. Anyone with further information is asked to contact your scribe. Eighty metres is following its usual autumn pattern with quite good signals from New

Zealand being heard daily around 06.00, and with the Ws beginning to break through again. Forty metres would be an excellent DX band if only it were left to it's rightful users, those who have selective receivers are managing to make contact with almost all parts of the world at some time during the day. Twenty is certainly taking on its autumn look, with few long distance signals audible in the early mornings, and 15 and 10m are now providing a great deal of interest although it is certain that they would prove to be even better than they appear to be if more experimental CQ calls were made when they are apparently closed.

Thanks are extended to the following loyal supporters who heeded your scribe's plea for early reports for this issue: G2BOZ, G2LB, GW3AX, G3HCT, G3HDA, G3UML, G3VJG, G4MJ, G8JM, G8VG, BRS20317, A4038, A4182, A4568, A4776, A5125, and A5141.

1·8 Mc/s C.W.: OK1KKF (23.39), UA1SZ (21.33-? legal), VK5KO (RST 339, 20.11), 9M8DD/MM (? QTH-18.13).

3·5 Mc/s C.W.: UL7GW (23.30).

3·5 Mc/s S.S.B.: CN8AW (21.35), FM7WQ (22.12), KG1FR (23.25), I1AUM/MI (23.35), ZL4BO, 4LM, 4LZ (06.00-07.15), W0GTA/8F4 (23.08).

7 Mc/s C.W.: CO2KG (01.00), CR6IK (22.40), CR7AR (19.10), FG7XC (22.30), FP8CA (21.15), JA1EAA (19.07), JX6XF (18.59), KV4CI (21.28), VP2SJ (22.22), VP5AR (06.44), UW0AF (17.45), UH8DG (18.10), VK5KO (21.06), 9Y4AR (06.07).

7 Mc/s S.S.B.: CR6's CN, FW, HG, IK, IV (20.00-21.30), EL2A (21.26), ET3AC (22.20), FM7WQ (21.30), JA6YB (20.15), JX6XF (Jan Mayen. 22.30), MP4MAW (21.13), OD5BZ (19.10), PY6WA (21.29), UD6BR (21.42), VK4EQ, 7SM (20.40), VP2LS (21.30), VP3's JR, YG (21.45), VP6KL (21.05), VS6AJ (20.00), VS9ARV (21.02), VS9OC (20.35), ZD8ARP (20.30), ZS1XX (21.23), K3LZC/4X (20.00), W0GTA/8F4 (19.55), 6O6BW (20.00), 9M2DW (20.18), 9Y4TX (22.15).

14 Mc/s C.W.: EA9EA (08.50), FK8AH (11.30), FL8RA (19.15), FP8CA (21.18), JT1KAE (Op. by DM3OCN-15.45), KR6JZ (07.32), KS4CC (19.35), TA2AC (12.29), VK9GW (T.N.G. 10.50), VK0MI (07.15), VP8IQ (21.40), VP8JD (Antarctica, 22.35), VS5JC (15.40), XR2A/MM (" QSL via NARL " ??? 22.15), ZD8J (09.15), 7Z3AB (16.15), 9M8RS (16.25).

14 Mc/s S.S.B.: CT3AU (20.34), CX9CO (20.30), FB8YY (07.57), FK8BK (07.00), FR7ZD (16.30), HS4AK (17.50), KB6CZ (07.55), KC4USB (08.30), KC4USJ (07.16), KC6BO (15.00), KG6AAY (07.00), KG6ALW (16.43), KG6IC (Bonin Is., 13.45), KL7FGH (08.58), KS6BH (09.00), KW6EJ (08.10), KX6BU (10.51), KX6FU (10.20), PY7ACQ/ (F. de N. 19.20), VK9AG (T.N.G. 06.30), VK9DJ (Papua, 14.50), VK9XI (Christmas Is. 12.42), VQ8AX (16.45), VS6FR (16.02), XW8AY (16.05), YA1HD (15.42), ZD9BE (17.25), ZL4CH (07.00), ZS3E (19.04), 5W1AZ (07.25), W0GTA/8F4 (16.30), 9M6NQ (17.55), 9N1MM (14.11).

21 Mc/s C.W.: CE2BC (19.30), CT3AJ (11.12), DU1CL (13.10), HZ1AB (08.03), HZ2CN (11.06), HM9BZ (09.09), JA's (08.00-10.00), KG4CX (20.50), KZ5CV (17.58), OA4UZ (17.36), SU1DP (18.20), TT8AR (18.00), VK6RU (10.14), VP9BY (21.40), VU2NAZ (11.09), XE1ZV (20.10), 6Y5BB (17.00), 9V1MY (15.20), 9M2LO (10.50).

21 Mc/s A.M.: CT3AS (17.10), EP2RJ (13.40), FL8AO (18.05), HK8BGA (21.33), MP4BGD (13.23), ST2SA (? Legit. 13.45), VE5RP (14.50), XE1IIK (13.43), ZD3E (18.45), 9G1FV (12.50), 9L1JP (18.14).

21 Mc/s S.S.B.: CT3AU (15.35), CR9AH (12.37), W6FHM/ DU1 (13.02), FB8XX (11.40), FP8CA (14.12), FR7ZD (10.38), HI8XAL (11.50), HR1KS (20.15), KG6AQA (09.05), KZ5MB (20.57), TG9DX (17.36), TN8AA (11.12), VK9DR (Christmas Is. 13.08), VK9DJ (12.23), VK9JK (10.58), VK9KJ (T.N.G. 10.05), VP5RB (14.10), VQ9EF (17.46), VS6FS (10.36), VS9AJA (09.58), VS9OC (15.18), XE3JD (13.25), YA5RG (15.31), ZP3AB (18.02), ZS8L (15.21), 6O1PF (17.59), 9M8RS (13.17), 9V1MY (16.18).

28 Mc/s C.W.: CR6EI (09.13), CR7IZ (15.55), CT3AU (17.57), CX1JM (18.00), LU1DEN (17.55), PYs (18.00-20.00), ZC4GB (13.50), ZD7IP (12.30-16.00), ZD8J (15.45), ZSs (14.00-18.00), 4X4UL (15.41), 6W8DD (17.25), 9J2GJ (19.05).

28 Mc/s A.M.: CX's (12.50-19.45), EA8CR (17.48), LUs (12.50-20.00), PY8MA (17.57), PZ1BK (19.04), UA9WA (08.45), ZEs (11.30-17.00), ZSs (11.00-17.00), ZS9G (13.25), 9Y4VS (19.40).

28 Mc/s S.S.B.: CE6EF (19.56), CX9AAN (17.12), EL8B (17.50), KP4AXC (19.45), KZ5JW (19.26), PY2PA (17.20), VK9KJ (09.35), VP3AA (18.18), VP8CW (Falkland Is. 18.23), VS9AAN (17.16), Ws (17.00-19.00), ZD8RB (14.08), ZD8SKI (19.13), ZP5KT (17.05), ZP5OG (19.42), ZS1JA (17.58), ZS8L (08.30), 4U1ITU (17.47), 5N2AAW (16.10).

1966 Countries Table

	1·8 Mc/s	3·5 Mc/s	7 Mc/s	14 Mc/s	21 Mc/s	28 Mc/s	Total
G8JM	5	—	14	222	110	17	368
G3UML	3	33	54	172	89	72	423
G3NMH	—	—	—	177	93	48	318
G3IIS	15	40	54	108	59	26	302
5N2AAF	9	14	23	137	68	29	280
G8VG	5	28	29	93	69	45	266
G3IAR	7	30	43	77	64	30	251
GM3SVK	8	4	43	59	101	22	237
G3IGW	19	43	46	58	55	1	222
G3LHJ	5	20	20	81	33	4	163
G3KSH	8	20	36	63	38	11	176
GM3KLA	3	38	45	44	70	15	215
G3PQF	—	24	58	18	6	21	127
G3WZ	2	4	27	26	2	—	61
9J2BC	1	1	5	46	44	21	117
G3JVJ	16	23	30	20	9	—	98
9V1LP	6	12	20	27	23	14	102
G3MWZ	7	13	1	42	8	—	71
A4038	8	18	29	241	133	83	514
A4568	4	38	42	202	127	37	450
A4886	6	29	42	193	116	39	425
BRS26222	5	39	22	201	91	51	409
A4489	21	59	76	157	25	1	339
G8API	2	17	47	161	138	56	422
A3942	12	36	65	109	47	1	270
A4048	9	39	52	118	72	26	316
BRS25605	9	39	47	113	71	24	303
A5105	2	19	22	138	79	17	278
A4609	18	35	52	107	117	35	364
A4182	5	21	25	129	43	28	251
A4370	4	30	10	137	39	1	212
A4431	6	25	40	104	108	30	313
A4552	2	25	12	127	84	30	280
A4311	—	15	13	115	37	23	203
A3699	7	24	27	76	63	16	213
A4955	9	22	33	51	60	22	197
A5025	11	17	30	50	22	14	144

(This month's table is in order of 7 Mc/s plus 14 Mc/s totals.)

DX Briefs

It is reported that WA2PTQ will be on **Easter Island** for about three months from mid-October. It is hoped that he will have a CE0 call, and that he will be on the air on both c.w. and s.s.b.

VP5AR was due to leave the Turks and Caicos Islands on 1 November for the Seychelles Is. (VQ9). No doubt he will soon be on the air with a VQ9 call.

Bob Snyder, W0GTA/8F4 continues to put in an excellent signal from Sumatra. However it seems that clearance from FCC for the W stations to be permitted to contact him has

The shield presented by Ainsdale Group in memory of the late G2CIP.

Region 1 (North West) Events

The v.h.f. contest organized by the Ainsdale Group on behalf of Region 1 was held on 17 July. The Cumberland and Westmorland V.H.F. Group, G3RHE/P, was the winner with 8128 points, well ahead of Ainsdale's own station who were second with 2776 points. An entry from South Manchester Radio Club, G3FVA/P, was unfortunately received well after the closing date. Nevertheless they deserve honourable mention with 4168 points, which would of course have placed them second.

A photograph of the shield presented by Ainsdale Group in memory of the late G2CIP is shown on this page.

The Regional Representative's trophy for the highest placed North Western station in NFD goes this year to the Macclesfield District Radio Society, G3LDT/P, who were nineteenth in the National event.

Region 1's own Field Day on 11 September was won by Liverpool and District Amateur Radio Society, G3AHD/P, who amassed 144 points. Chorley and Leyland were second, 122 points, with Wirral third, 118 points.

Swindon Mobile Picnic

The Swindon and District Amateur Radio Club held its annual Mobile Picnic on Sunday, 4 September, in the grounds of the ancestral home of the Bolingbroke family, Lydiard House, near Swindon—now the property of Swindon Corporation.

Despite pouring rain in the morning, talk-in stations on 160m and 4m were set up by 12 noon. Alas, almost immediately the 160m station was put off the air by a voltage surge from the generator blowing the transmitter silicon rectifiers. However, while repairs were being carried out, G4UZ arrived from Bristol and very kindly loaned his mobile equipment, complete with car, as a temporary talk-in station.

The rain abated at 1 p.m. and sunshine appeared, to last for the rest of the day. About 200 visitors arrived in just over 60 cars. Mobiles totalled 39, of which 19 were worked on 160m and one on 4m.

Refreshments were served by wives of Swindon Club members, and a Junk Sale did a brisk trade during the afternoon. A cake-weight guessing contest, and a " Guess the Number of Diodes in the Jar " contest were popular attractions, the prize for the latter being a printed-circuit etching kit. A raffle was also held, the first prizes being the 1966 edition of the ARRL Handbook, and an attractive travelling clock for the ladies. The children had a Lucky Dip, and Frank, G3JOT and his XYL also organized games and races for them during the afternoon. Many visitors toured the staterooms in the House, and also the attractive fifteenth century parish church close by.

It was generally agreed that the afternoon's get-together was very successful, and the club already has plans afoot to repeat the occasion in 1967

Derby Mobile Rally

Once again the weather was kind for the ninth Mobile Rally held at Rykneld School, Derby, on Sunday 14 August. The first to arrive were three enthusiastic short wave listeners who had travelled overnight from Cornwall and Devon. The estimated attendance was some four thousand which included more call-signs than ever previously recorded. The car parks were filled to capacity very early in the afternoon and once again parking space became very scarce. The majority of the talk-in activity was on 160m, although 2m and also 4m were used this year for the first time. A comprehensive programme, with something for everyone, old and young, commenced at 2.15 p.m. The Junk Sale, with Tom Darn, G3FGY, as auctioneer proved as popular as ever, as did the raffle with over 40 prizes. The major prize of a washing machine went to G3UBU of Stoke-on-Trent. The programme prize of an electric food mixer was handed to G3OZN of Worksop, and the mobile prize of a travelling wardrobe was won by G3TTZ/M from Bristol. A new feature was the " Pop Star " competition for the younger visitors

John Smith, G3SMV, operating G2DJ/A, the 4m and 2m talk-in station at the Derby Mobile Rally.

(Photo by G3SZJ)

The Derby rally 160m talk-in station.
(Photo by G3HXN)

and by now they should have received a photograph of their favourites.

As far as is known, everyone enjoyed the time spent at Derby, but one criticism was directed at the operators of walkie-talkies, particularly during the radio controlled model aircraft demonstrations. Radio silence while in the school grounds is essential and notices to this effect were posted in the grounds and published in the programme, yet in spite of repeated requests on the public address, operation continued, causing serious damage to one aircraft which, in descending out of control, demolished a nearby television aerial. It is disheartening for these enthusiasts and mars the enjoyment of their followers when entertainment on this scale is spoilt by the action of a very limited few. This could mean the end of these flying attractions as we understand other rallies suffer the same troubles.

RSGB QSL Bureau Sub-Managers

The following is a list of the RSGB QSL Bureau Sub-Managers showing the call-sign groups for which they are responsible:

G2:	J. W. Russell, G2ZR, 45 Shakespeare Avenue, Bath.
G3, 4 and 5 two-letter calls and GC:	E. G. Allen, G3DRN, 65a Melbury Gardens, London, SW20.
G6 and G8:	A. J. Mathews, G6QM, 62 Ashlands Road, Hesters Way Estate, Cheltenham.
G3AAA-BZZ:	C. C. Olley, G3AIZ, 157 Wanstead Park Road, Ilford, Essex.
G3CAA-DZZ:	C. A. Bradbury, BRS1066, 13 Salisbury Avenue, Cheltenham.
G3EAA-HZZ:	W. J. Green, G3FBA, "Meadway," Links Avenue, Brundall, Norfolk, NOR86Z.
G3IAA-KZZ, BRS and A numbers:	G. L. V. Butler, G2BUL, 995 London Road, Thornton Heath, Surrey.
G3LAA-NZZ:	C. R. Emary, G5GH, Westbury End, Finmere, Buckingham.
G3OAA-PZZ:	J. H. Brazzill, G3WP, 43 Forest Drive, Chelmsford, Essex.
G3RAA-RZZ:	K. Walden, G3OLN, 250 Gloucester Road, Cheltenham, Gloucestershire.
G3SAA-TZZ:	E. G. Allen, G3DRN, 65A Melbury Gardens, London, SW20.
G3UAA-WZZ:	P. R. Cox, G3RYV, 38 Ridgway Crescent, Tonbridge, Kent.
G5AAA series:	E. G. Allen, G3DRN, 65a Melbury Gardens, London, SW20.
GD:	T. R. Moore, GD3ENK, "Glyn Moar," St. John's, Isle of Man.
GI:	R. R. Parsons, GI3HXV, 45 Erinvale Avenue, Finaghy, Belfast.
GM:	D. Macadie, GM6MD, 154 Kingsacre Road, Glasgow, S4.
GW:	J. L. Reid, GW3ANU, 28 Waterston Road, Gabalfa, Cardiff.
DL2:	Cpl. C. Thomas, DL2CT, Box 125A, RAF Butzweilerhof, BFPO 19.

Cards must be sent to G2MI but envelopes may be sent to the appropriate Sub-Manager or to G2MI. Printed, gummed labels are obtainable from G2MI by sending an s.a.e.

Postage, letter rate: 2 oz. 4d., and 2d. for each additional 2 oz.

The address of the QSL Bureau Manager (Mr A. O. Milne, G2MI) is 29 Kechill Gardens, Bromley, Kent.

News from Headquarters

Mr A. D. Patterson, BASc, GI3KYP/EI4BC to be President during 1967.

Apropos the announcement on page 670 of the October issue of the BULLETIN, Mr Patterson will be President during 1967 and not as the heading incorrectly stated.

Region 3 Representative

The Council has appointed Mr R. W. Fisher, G3PWJ, to the office of Region 3 Representative.

Region 11 Representative

The Council has appointed Mr M. Williams, GW3LCQ, to the office of Region 11 Representative.

Affiliation

The following societies are now affiliated to RSGB:

CHIPPENHAM AND DISTRICT AMATEUR RADIO CLUB, A. Hargreaves, G6NV, 20 Lords Mead, Chippenham, Wilts.

PAINTON RADIO CLUB, R. W. G. Green, Brooklyn, Thorpeville, Kettering Road North, Northampton.

NAILSWORTH AND DISTRICT AMATEUR RADIO SOCIETY, J. W. Dudbridge, G3UUO, "Grey Gables," Amberley, Stroud, Gloucestershire.

UNIVERSITY COLLEGE OF SWANSEA RADIO SOCIETY, A. N. Morgan, B.Sc., Room 605, Applied Sciences, Tower Block, University College, Swansea, Glam.

London Dinner Club

The Society has pleasure in announcing the formation of the London Dinner Club whose inaugural Dinner will take place on Friday, 18 November, at 6.30 for 7 p.m. at the Kingsley Hotel, Bloomsbury Way, London, WC1.

It was with regret that the Society saw the suspension of the meetings of the London Members' Luncheon Club earlier this year and it was felt that another form of regular social event was needed.

The choice of an evening event was made because of its obvious advantages: there are no parking problems, visitors can enjoy a leisurely meeting and members from out of London who are planning a weekend in Town would find the Dinner Club a perfect start for their visit.

The cost of the dinner will be 25/- per person and it is hoped that members will support this new venture. Reservations may be made to Headquarters either by letter or telephone.

Amateur Licences

On 30 September 1966, the number of amateur licences in force in the United Kingdom was as follows:

Amateur (Sound) Licences A:	11,923
Amateur (Sound) Licences B:	476
Amateur (Sound Mobile) Licences A:	2,173
Amateur (Sound Mobile) Licences B:	8
Amateur (Television) Licences:	177

Radio Amateur's Examination

The following college is running a RAE course.

Boreham Wood. Boreham Wood College of Further Education, Elstree Way, Boreham Wood.

Thursdays 7-9 p.m. Course commenced 19 October, 1966.

New Post Office Director of Research

Mr W. J. Bray, M.Sc. (Eng.), A.C.G.I., D.I.C., M.I.E.E., Deputy Director of Research, has been appointed Director of Research at the Post Office in succession to Dr G. H. Metson, M.C., D.Sc., who retired in August.

Another Pirate Fined

As a result of Post Office enquiries into the unlicensed use of wireless telegraphy transmitting equipment, the following conviction has been obtained.

On 1 August at Harlow Magistrates Court, John Wesley Evelyn of 253 Willow Field, Harlow, Essex was convicted of a charge of using wireless telegraphy transmitting apparatus without the appropriate licence, contrary to the provisions of Section 1 of the Wireless Telegraphy Act, 1949. He was fined £20 and ordered to pay £3 3s. towards the costs.

The International Amateur Convention, Knokke

The second Convention organized by Belgian amateurs took place over the weekend 16 to 18 September. There was an attendance of nearly two hundred from at least 10 different countries. The formal sessions of the Convention took place in the Casino, a magnificent building in the centre of the town. Amongst the lectures given was one on Moonbounce by Peter Blair, G3LTF, which was very well received. Other activities included a demonstration of radio controlled boats, a 3·5 Mc/s Mobile Rally (receivers only being required), a Fox Hunt together and a suitable Ladies' Programme.

Presidents of National Societies who attended the Convention included F3FA (REF), ON4AK (UBA), SM0AZO (SSA) and G2BVN. There was strong representation from the UK and the contingent numbered about thirty.

The Convention station ON6HC was active on the h.f. bands and 144 Mc/s during the weekend, in addition many visitors had obtained Belgian calls and were able to operate their own mobile equipment.

The International Amateur Radio Club Convention

The 1966 Convention was held over the weekend 26 to 28 August and was attended by nearly a hundred members and visitors. The Presidents of the National societies of Liberia (EL2S), Austria (OE3CL), France (F3FA) and the United Kingdom were present together with representatives from the USA, Italy, Czechoslovakia, New Zealand, East Africa and Switzerland.

An inaugural reception was held on the Friday evening

GB2RS SCHEDULE

RSGB News Bulletins are transmitted on Sundays in accordance with the following schedule:

Frequency	Time	Location of Station
3600 kc/s	9.30 a.m.	South East England
	10 a.m.	Severn Area
	10.15 a.m.	Belfast
	10.30 a.m.	North Midlands
	11 a.m.	North West England
	11.30 a.m.	South West Scotland
	12 noon	North East Scotland
145·10 Mc/s	9.30 a.m.	Beaming north from London
	10.00 a.m.	Beaming west from London
145·8 Mc/s	10.15 a.m.	Beaming south from Belfast
145·30 Mc/s	10.30 a.m.	Beaming north west from Sutton Coldfield
	11.00 a.m.	Beaming south west from Sutton Coldfield
145·50 Mc/s	11.30 a.m.	Beaming north from Leeds
	12 noon	Beaming east from Leeds

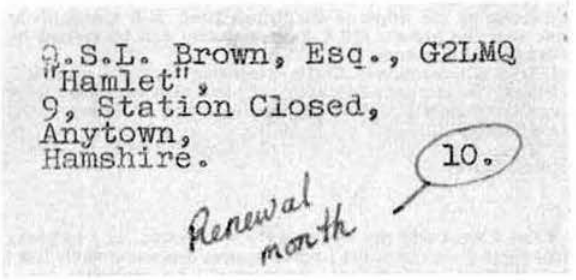
News items for inclusion in the bulletins should reach Headquarters not later than first post on the Thursday preceding transmission. Reports from affiliated societies and from non-affiliated societies in process of formation will be welcome.

followed by technical sessions on the Saturday and a banquet in the evening. The technical meetings continued on the Sunday morning and many informal discussions took place during the afternoon. The IARC station 4UIIITU was on the air during the period of the Convention and many contacts were made on the h.f. bands.

The Convention will be fully reported in the 1966 edition of *Interradio*. It is understood that the IARC do not intend to hold a Convention during 1967.

Council Elections

Corporate members voting in the election of Council members are asked to mark on their ballot paper the month



in which their subscription falls due. The month is indicated by a figure in the bottom righthand corner of the address on their BULLETIN wrapper.

Ballot papers are enclosed in this issue of the BULLETIN sent to Corporate members.

Woburn Abbey Mobile Rally

The Mobile Committee gratefully acknowledges a donation of £8 received from Mr L. Taylor, G3JMU.

Silent Keys

We record with sorrow the passing of the following amateurs.

J. H. Boyce, G4NI, of Burgess Hill, Sussex.
M. G. Jones, GW3JLI, of Llanelly, Caerns.
L. Dukes, VE3EID of Ontario, Canada.
H. Layton, K6JBP, of Thousand Oaks, California, USA.
E. J. Wilde, BRS316, of Halstead Hill, Cheshunt, Herts.
P. J. Sproat, BRS13439 of Little Witley, Worcestershire.

Obituaries

H. Hilton, G3LWQ

We regret to report the death, suddenly on 15 September of Harold Hilton, G3LWQ.

A former GPO and World War I Telegraphist, Harold had, over the past 30 years, helped most local amateurs through the Morse Test, and later became a keen and well-known Top-Band and 80m operator, although he operated most bands on the key. During the summer months, his QTH was a regular meeting place for visitors to Southport district.

He was a founder member of the Ainsdale Club, taking part in all events, on all bands despite poor health.

His presence will be very much missed, and we extend our deepest sympathy to Mrs Hilton in her loss. N.H.

Yugoslav Air Crash

It is with deep regret that we report the death of Mr and Mrs P. J. Sproat in the Yugoslav air crash on 1 September. Mr Sproat, BRS13439, was a member of the Society for many years.

Our deepest sympathy is extended to their son and daughter.

Attending at the IRTS-RSGB Convention held on 25 September were: back row, left to right, M. O'Dwyer, Colin Dewes, G3EDD, GI4RY; front row: GI3KYP, Mrs Patterson, G2BVN, Mrs McNamara, EI9F (President IRTS), GI3CDF, GI2KR.

Letters to the Editor

Neither the Editor nor the Council of the Radio Society of Great Britain can accept responsibility for views expressed by correspondents. Letters for inclusion in this feature should be concise and preferably not more than 200 words in length.

NFD Power Rating

Club secretaries who are worried by the problem of obtaining a transmitter for NFD, now that the new power rule has banned all the usual p.a. valves, may like to know that the RCA 2E26 has an anode dissipation of 13·5 watts (no coincidence I should imagine), and is a plug-in replacement for the 6146. 807 users do not appear to be so fortunate, but most club funds should be able to support the construction of a 10W all band p.a. that could take its power and drive from the p.a. valve socket in the usual rig.

Whilst I would agree that clubs should be encouraged to build special portable rigs (preferably battery operated) for emergency use, and for events like NFD, we must face the fact that the smaller ones cannot afford to finance such a project. Although I applaud the motives of the new rule, I cannot help doubting that a club secretary who persistently perjures himself when specifying the operating conditions of his p.a. is going to be any more honest when saying what type of valve he is using.

A. J. SHEPHERD, G3RKK

Coulsdon, Surrey

NFD 1966

Congratulations to the H.F. Contests Committee for their very fine effort in producing the NFD results for publication in the August BULLETIN.

Congratulations also to my friends in Exeter who have so convincingly carried off the NFD Trophy. To those members of the winning group who have persevered for so many years with varying degrees of success, the 1966 result must be very gratifying indeed.

Until now the H.F. Contests Committee has wisely allowed competing stations to use any equipment provided that the stations perform in accordance with the rules, and it is to be hoped that this principle will prevail. Now, two groups have made suggestions on the use of p.e. generators and transistor equipment. It must be appreciated that for some groups NFD is only possible if a mechanically driven generator can be used, even if it is only in a car, and suitable batteries may not be easy to come by. Many groups have to use whatever equipment can be scraped together, and transported to the site, and few have coffers deep enough to make even economical equipment, special for NFD, a possibility. As for a bonus for using transistor gear, forsooth, there might as well be a bonus for using cubical quads, or for the XYLs new hat, "because it's up to date." Except for personal satisfaction, the writer can see no particular virtue in using solid state devices exclusively in NFD. If bonuses or prizes are to be offered, there would need to be special rules, as there are sure to be some guys who are wiser than others, and with such rapidly changing progress, it would need more than a crystal ball to publish suitable rules 12 months in advance.

W. J. GREEN, G3FBA
Sometime Zone D and Region 9 Rep.

Brundall, Norfolk

QRA Locators

Cliff Sharpe's letter (September issue) about the use of the QRA Locator system brings out some controversial points.

I agree that the system is based on an illogical method of subdividing areas of latitude and longitude and that if used for every type of contact, boring, automated QSO's will result. But for contest working, I consider the QRA locator system works well. From the point of view of exchanging QTHs it is fairer. The contestant transmitting a QTH, e.g., five miles NW of Rockhampton, Oxbridgeshire, is at a disadvantage to the contestant with a QTH, of, say, York. Measurement of distance with accuracy is a drawback. Perhaps the V.H.F. Contests Committee could make a cross check on a small number of QRA Locator exchanges in a Contest and publish the margins of error found. Other methods of site identification using longer codes may give greater accuracy, but would require the amateur to keep comprehensive stocks of large scale maps in order to use the accuracy attained, but for the purpose of distance calculation only, this may not be necessary.

I cannot agree with Cliff Sharpe's comment about the QRA locator disguising the geographical site of a station. A locator map suitably sited in the shack provides easy positioning of the distant station after a little practice. At our 2m club (SRCC) station in the recent V.H.F. NFD, the QRA Locator map was given a prominent position in front of the operator and quick checks on direction and distance were possible without bothering to divide the final square. In fact, unless you know the area well into which you are working, the QRA Locator sites are quicker to find than looking for place names.

So let us keep the QRA Locator system for contests only. Each contact is only really a snappy exchange of symbols anyway and personalities hardly come into it especially with multi-operator set-ups. We need better QRA locator maps, especially one including the whole of the British Isles. Is it too much to hope that the present QRA locator system can be revised by international agreement?

I have not mentioned Cliff's comments on "out of zone" working. To me, trying to keep the band plan working during a contest is useless. QRM, contest fever and operating tactics are all against it.

TONY NAYLOR, G3GHI

Kenley, Surrey.

I feel I must add my views on QRA Locators, as I feel very strongly that the use of the Locator system detracts severely from the enjoyment and efficient operation of v.h.f. contests.

The use of QRA locators should surely be restricted to the purpose for which they were invented—the simplification of international QSO's under DX opening conditions. Contests become extremely boring without exchange of location in English. I might add that I have yet to hear a favourable comment from keen v.h.f. operators on the contest use of locators—with the notable exception of G2JF, who, of course, has a vested interest.

In the above I agree with G2HIF but in another respect I must disagree. Please let us not be bound by the Zone plan in contests. This again is a restriction on operating efficiency working against the better equipped station and should be used where it is valuable—under conditions of low activity and when making CQ calls.

Let us not blindly follow these highly artificial systems beyond their spheres of usefulness.

JOHN BUTCHER, G3LAS

Berkhamsted, Herts.

I have read with pleasure the letter from Cliff Sharpe, G2HIF, in the September BULLETIN. He has not only set out with commendable clarity the reasons why the QRA locator is unsuitable for the measurement of inter-G contacts but has also stressed the point I made in the June BULLETIN ("Four Metres and Down") that the system takes away much of the interest of working other G stations—especially on field-days.

But what is really astonishing is the letter from G2JF, Chairman of the V.H.F. Contests Committee, in which he asserts that "there appears to be a minority opinion against the exchange of QRA locators during contests."

Does he know, one wonders, how many stations are refusing to send in contest entries when QRA locators are demanded or are refusing to take any part in such contests?

The report of the third 144 Mc/s Contest, 1966, in the August BULLETIN left little doubt that the *majority* of contestants disliked the locator system and from comments I have myself received from v.h.f. operators, it seems abundantly clear that the system is thoroughly disliked as an inter-G distance measuring device.

The only valid point that has been made by the Contests Committee in favour of the system is that it saves *them* time in checking claims. But it is suprising that the Committee is prepared to advocate a system which at best is very inaccurate and in which the smallest slip usually results in major errors of measurement—as has been demonstrated in this year's 2m portable contests.

W. A. SCARR, G2WS

Weston-super-Mare, Somerset.

Class B Licences

It is now over a year since the GPO authorized the use of the u.h.f. bands above 2m by amateurs holding the Amateur (Sound) Licence B. In that year we have seen the 70 cm band in particular grow in popularity enormously, active every evening and week-end. As in all the amateur bands, signals vary in quality but the general standard of operating is extremely high, with no lack of helpful criticism of any signal that may be of inferior quality.

Now that we have proved ourselves capable of operating amateur stations within the terms of the licence, possibly the time has come for an expansion in the terms of the Amateur (Sound) Licence B, namely that we may be allowed to operate on the 2m and, possibly, the 4m bands.

I would like to point out that I have a great respect for the Morse code and appreciate its superiority over other modes in certain conditions. I realize that, in granting the " B " licences the GPO have made a great concession. I feel that the G8's on 70 should be looked upon as a pilot scheme which has proved, without a doubt, successful. Many reading this will feel " Give them an inch and they want a mile," others will feel, as I do, that this is a natural progression.

Morse will always be a respected means of communication on the h.f. bands and knowledge of this essential to the man who wishes to operate alongside government and commercial stations, to whom interference might cause a major disruption. To amateurs who wish to operate on the v.h.f. and u.h.f. bands only, Morse is, in general, only a means of getting the required licence.

I hope that all who read this will take it as it is intended, not as a slight on c.w. nor as an " easy way out " to getting a full amateur licence, but as an opinion acquired, after a year of operating on 70cm, and endorsed by many fellow G8's, that v.h.f. and u.h.f. construction and operating is a specialist branch of Amateur Radio and as such calls for a separate set of regulations.

T. R. WILTSHIRE, AIPRE, G8AKA

Bournemouth

(Under the Geneva Regulations 1949, a Morse test is obligatory for amateur licences for frequencies below 144 Mc/s. The views of other members on G8AKA's letter will be appreciated. —EDITOR.)

Who is the Oldest Active Amateur?

VK6WS may be the oldest active amateur alive today, but this record was equalled, or surpassed, by at least two others, since deceased.

The late K6CRA, notified as a Silent Key in *QST* May 1966, would have been 92, and possibly 93, at that time.

The late K2AE, aged 93 at the time of his death, was described by *QST*, October 1959 as ". . . the oldest active radio amateur. . ."

Basingstoke, Hampshire. F. A. HERRIDGE, G3IDG (Life Member)

Technical Correspondence from QST

Hertzes? Why Not?

Let's see now; we have Mr Ohm's ohm for resistance. Monsieur Ampere's amps for current, Mr Faraday's farads, Mr Henry's henrys for inductance, and for all I know, Monsieur Voltaire's volts for potential, so I guess it is perfectly logical to have Hertzes.

After all, there is certainly no point in making electronics simple. If we did that, any old citizen could understand it, and then where would the status be in the statement " I'm in *Electronics*"? So why use an understandable word like " cycles " when we can use a mysterious word like " hertzes?" Why don't we track down the discoverers of lots of other phenomena electronicana and use their names for the descriptions of the things they discovered or first investigated?

For example: Let us suppose Herr Schultz discovered the short circuit, Mr Fink invented the switch, Monsieur Pernoud discovered radiation, old prehistoric Ug discovered heat, Mr Smythe discovered spark, and Mr Ginsberg invented the key. Mr Bolyznewitz, we shall assume, discovered electrical shock, and Mr Valisloff first successfully used the electrostatic shield. If this had been so, just think of the soaring verbosity possible in a simple description. Try this for size:

" The technician must exercise great care in installing the valisloffed fink in the area of the pernoud section. The ug generated by the intense smythe can easily schultzify into the ginsberg and produce a severe bolyznewitz."

Makes perfect sense, doesn't it? Another advantage of this principle is that practically no one outside the electronic fraternity could understand it. Think of the job security! Ordinary conversation would be unintelligible to the average man, and the prestige of those in the know would skyrocket. It might even permit the TV-service man to get an extra buck or two out of his unenlightened customer. Finally, there is justification in other professions for this sort of verbal snow job. Medicine has done it for centures. Law is loaded with such gook, so why not electronics too?

Think about it. Isn't that sensible? Or is it!—*August F. Huge, Jr., WA5BTO*, in *QST*, September 1966.

Writing to Headquarters?

When writing to Headquarters please use separate sheets of paper for:

- Changes of Address (return a wrapper from the *Bulletin* if possible)
- Orders for Publications
- Queries
- *Bulletin* Items
- Committee items

When paying your subscription please return the reminder card sent to you by Headquarters or quote the date on which your subscription falls due.

Whenever you write to Headquarters please write your name in block letters and quote your call-sign, BRS or A number.

CLUBROOM

A Monthly Survey of Club and Group Activities

For further information on membership or the activities of a particular club, application should be made to the person whose call-sign is indicated at the end of the item. Full addresses may be obtained from the RSGB Amateur Call Book.

AERE (Harwell) ARC found that V.H.F. NFD was full of adventures, near calamities, and one particular instance which could have been catastrophic. This related to an accumulator on which some cheerful Charlie had painted the negative terminal red. Fortunately the transistorized equipment suffered no damage by some miracle. Perhaps this puts the case very well for including a silicon diode in the supply line of transistor equipment, the high back resistance of which will protect the equipment in the event of incorrect polarity of the supply. The clerk of the weather wryly indicated what he had in store by laying on a high wind during the setting up operation. Then in the early hours of the morning came the full treatment. By 08.00 those at the " B " station were devoting their entire efforts to preventing the tent from becoming airborne. A similar pantomime was being enacted at the " A " station. Then the " B " tent took off, causing a quick transference of the station into the rear of a landrover. Then the storage tent disintegrated, followed by a panic to get the valuables under cover. By teatime even the stoutest heart had had enough of the contest, weather and soggy sandwiches. *G2HIF.*

Belfast and District Group held its AGM on 16 September, when the reports presented showed the group to be in a flourishing position. After the election of the officers, a programme of lectures for the season was considered. *GI3SKH.*

Bristol ARC had a busy September during which the AGM was held and the new committee elected. Two D/F hunts were much enjoyed by the participants. There is soon to be a return Skittles match with the sharpshooters from Bath. *G3SXY.*

Chippenham and District ARC is very pleased to announce that the call-sign G3VRE has been allocated to them. The station will be operated from Chippenham Boys' High School, and it is hoped to be able to work all bands. The club meets every Tuesday and visitors and prospective members are assured of a warm welcome. *G6NV.*

Cornish ARC reports that its s.s.b. group has got off to a good start, and that there are about 20 people interested in constructing an exciter designed by G3LPB. On 4m, the club reports some 20 active stations of which eight are equipped for mobile working. Sunday the 11th will be remembered as the evening when G3AET, G2AYQ and G2BHW/M had a 4m four way with GC3OMB. *G3OCB.*

The Cheshunt and District Club held a local field day on 13 August at Goffs Lane Playing field, Cheshunt, Herts. This did not assume the usual race for contacts however, but was simply intended to be an enjoyable day out, which is perhaps an equally meritorious motive. Equipment was taken for Top Band, 4m and 2m, and while 4m was particularly quiet, the other bands provided some interesting semi-local contacts. The photo illustrates the erection of the 2m beam.

Crawley ARC is another club which suffered during V.H.F. NFD. By 11.30 a.m. on the Sunday a force 9 gale put paid to any further activity. As they say, better luck next year. At the meeting held on 12 October, G3NVB gave a talk under the title " Communications in the 70's." *G3FRV.*

East London District held its first meeting on 18 September at its new venue. While there was a good attendance, there is ample room to accommodate more, and it is hoped that a greater number of locals will support future meetings. G3PEN gave a description of the building of the new Post Office Tower, made all the more fascinating by a considerable number of slides. *G2ABC.*

Echelford ARS finds that there is a lot of support for a 4m net, but at the moment is having a little difficulty as there is some confusion as to who is on what frequency. With the idea of all arriving on the same frequency, there is talk of purchasing a bunch of crystals all having the same frequency—and the best of luck. In practice this is easier said than done owing to manufacturing tolerances, and if all stations must be very close, experience indicates that the only way to achieve this is to place a trimmer across the higher frequency crystals and pad them down to that of the lowest frequency of the series. In the September *Newsletter* under review is a useful Practical Propagation Guide by G3NYY and G3JUL complete with a world map and an associated time/frequency/zone table. *G3RHF.*

Edgware and District RS has been estchewing the problems associated with producing transmitters for the 1967 NFD. By giving such early consideration to the equipment to be used, plenty of time should be available for proving the gear prior to the event. *G3RAA.*

First Class Operators' Club has wholeheartedly decided to perpeptuate the memory of the late G6QB (Tommy) by presenting to the RSGB a " Thomas Memorial Cup " for awarding to the leading British station in the annual 7 Mc/s C.W. contest, the cup to be held by the winner for one year. Your conductor, doubtless along with many others, feels that this is a fine and fitting tribute. *G3JLB.*

Great Yarmouth ARC has recently installed a transmitter and receiver in the clubroom which is, rather aptly we feel, at the Old Power House, Swanston Road. All bands, except Top, will be worked, and the station will be on the air most Friday evenings from 19.30 under the call-sign G3VLK. *G3HPR.*

Midland ARS cleared its AGM in September and are now once more settling down for another year of progress. In the editorial of the Newsletter under review, comment is made concerning the lack of technical contributions, there having been only three in the previous 12 issues. Alas, MARS is not alone in this experience, and at times one wonders if the art of home-brewing is dying. While not everybody is gifted in the art of composition, one of the jobs of an editor is to beat into shape interesting material, and your conductor is sure that even if the barest worded details are provided and supported by circuitry, then interesting articles will result. Often the fear of criticism deters those who would otherwise be moved to submit material, and, lets face it, in large societies in particular, not everybody sees eye to eye. Human nature being what it is this is inevitable. Surely the short answer is that progress has always been faced by critics, *3SCG*

North Kent RS continue to be as active as ever. Perhaps the highlight of relatively recent activities was a visit to the Shell Centre Communications division. *G3PUI.*

Peterborough and District ARS is going in for amateur TV in a big way from the HQ at the Old Windmill behind the Peacock Inn on the London Road, and soon will be seen as well as heard. The club meets every Friday at 8 p.m., and visitors are always very welcome. *G3KPO.*

Plymouth RC has a red letter day on Saturday, 3 December, when members are holding their Annual Dinner. Early applica-

G6CJ examining an aerial radiation pattern—at 3000 M/cs—during his lecture to the Verulam Amateur Radio Club.

tion for tickets is strongly advised. Another important occasion is the lecture in the Plymouth Library Lecture Theatre on 4 November: " An introduction to Amateur Radio." *G3SGV.*

Radio Invalid and Bedfast Club's crack of the month—to be hung in every shack—" Ensure that the brain is connected before opening the mouth." The issue of **Radial** under review is called a bumper issue, and not without good reason, and as always, it strikes an excellent balance between keen humour and seriousness. If you do not subscribe to this publication—then its time you did. *G3LWY.*

Saltash and District ARC seems to have sent " Stinker " on a journey to Casablanca. Mind you, his excuse is that he needs a rest, but, being ourselves versed in the art of persuasion, no doubt the impetus was the boot of the SADARC chairman in an arc of constant velocity. On a more sober note, *Tamar Pegasus* contains full information on a home constructed transistor d.c. to d.c. converter using easily obtainable components, and which is simple to construct. *G2DFH.*

South Birmingham RS is another club which enjoys considerable support. Despite this members are always happy to welcome visitors and prospective members to their meetings. *G3OMG.*

Surrey Radio Contact Club has found a new, more suitable venue for monthly meetings: the "Blue Anchor," just a few hundred yards from the "Blacksmith's Arms." The dates will be the *third* Tuesday in each month in future. *G3KGA.*

Sutton and Cheam RS filled in a blank in the August calender with a mobile treasure hunt. The outward and homeward course covered 30 miles, and there was a threat of a booby prize for the rearguard. Control was on 2m, and it is hoped that this will be better next year when all stations are on the same frequency. The next meeting will be on 15 November when G2HN will be talking about the Heathkit Linear Amplifier. *G3HQT.*

Torbay ARS had great pleasure in congratulating three members on securing their G3 call-signs at the September meeting. This really swells the ranks of the licence holders and should inspire those still striving. Of particular interest was a talk by Mr M. A. Ball of Sifam Instruments Ltd., and many were much the wiser on the mysteries of moving a pointer across a scale. *G3LKJ.*

Verulam (St Albans) ARC. Highlight of recent club activities was the September meeting when G6CJ held an audience of over 100 members spellbound with his lecture and demonstration of aerial characteristics. Using a copper clad table to simulate earth reflections, Dud explored around scaled down aerials and succeeded in bringing to life those hard to grasp polar diagrams. *G3GJX.*

* * *

Deadline for the December issue will be 11 November and in order to ensure that copy is included in this feature, it is suggested that it is posted not later than 8 November.

To ensure that your club, society or group obtains the fullest advantage from this feature, please ensure that a call-sign is included.

CHANGES OF ADDRESS

Four weeks' notice is required to effect changes of address. When notifying Headquarters, please give the old as well as the new address. Advise changes promptly so that you receive every issue of the BULLETIN without interruption.

yet to be received. Indonesia is one of the few countries still on the FCC " banned " list—the others being Thailand (HS), Cambodia (XU), and Vietnam (3W8). Contacts with stations in these countries do not count for DXCC. The sole exception at present is K1YPE/XV5, who has been specially permitted to QSO Ws.

VK5XK is rumoured to be making a trip to **Lord Howe Island** sometime in late November or early December. It is believed that no s.s.b. will be available unless gear is loaned before departure date.

There is a new station active from Kure Island—K5QFH/KH6. He is said to be an ex-KP6. According to the *DX'er's Magazine* there is a possibility that KH6IJ may be moving to Kure to live. This should remove its rareness!

VK2AUS will be opening up from New Guinea about 8 November. He will be there for about two years and will use the call VK9KS.

Further activity by I0RB was scheduled for mid-October. The DXCC status of this UN building has not yet been settled. QSL via DOTM Paul is also reported to be about to operate from Albania as I1RB/ZA or ZA1RB.

K4CAH reports that he will be visiting Anguilla during November, and that he also hopes to visit Cocos Island (TI9) in April 1967.

All correspondents are once again thanked for their assistance, and particular thanks and acknowledgements are due to the *West Gulf DX Bulletin* (W5IGJ), the *L.I.DX.A. Bulletin* (WA2EFN), *DX'press* (PA0FX), *The DX'er* (W6HVN), *Florida DX Report* (W4MVB), *DX News Sheet* (Geoff Watts), and *VE News* (VE3AML). Please send all news items for the **December** issue to arrive no later than **16 November**, for the **January** issue no later than **9 December**.

CONTESTS DIARY

29-30 October	—VU/4S7 Contest (C.W.)
29-30 October	—RSGB 7 Mc/s DX Contest (Phone) (See page 413, June 1966)
12-13 November	—RSGB 7 Mc/s DX Contest (C.W.) (See page 413, June 1966)
13 November	—OK DX Contest (C.W.)
19-20 November	—Second Top Band Contest (See page 673 October, 1966)
26-27 November	—CQ WW DX (C.W.)
4 December	—Fourth 70 Mc/s Contest (C.W.)* (See page 606, September 1966)
	1967
14-15 January	—Affiliated Societies' Contest
29 January	—First 144 Mc/s Contest (C.W.)*
12 February	—First 70 Mc/s Contest (Open)*
18-19 February	—First 1·8 Mc/s Contest
4-5 March	—Second 144 Mc/s Contest (Open)* and 144 Mc/s Listeners' Contest*
2 April	—Low Power Contest
15-16 April	—Second 70 Mc/s Contest (Open)* and 70 Mc/s Listeners' Contest*
7 May	—Third 144 Mc/s Contest (Portable)*
27-28 May	—First 432 Mc/s Contest (Open)*
28 May	—First 1296 Mc/s Contest (Open)*
3-4 June	—National Field Day
2 July	—Fourth 144 Mc/s Contest (Portable)*
8-9 July	—1·8 Mc/s Summer Contest
23 July	—Third 70 Mc/s Contest (Portable)*
2-3 September	—V.H.F. NFD/IARU Contest*
10 September	—80 Metre Field Day
23-24 September	—RSGB 21-28 Mc/s Phone Contest
14-15 October	—Second 432 Mc/s Contest (Open)*
15 October	—Second 1296 Mc/s Contest (Open)*
28-29 October	—RSGB 7 Mc/s DX Contest (Phone)
11-12 November	—RSGB 7 Mc/s DX Contest (C.W.)
18-19 November	—Second Top Band Contest
3 December	—Fourth 70 Mc/s Contest (C.W.)*

*Qualifying contests for V.H.F./U.H.F. Listeners' Championship

Forthcoming Events

Details for inclusion in this feature should be sent to the appropriate Regional Representatives by the first of the month preceding publication. A.R.s and club secretaries are reminded that the information submitted must include the date, time and venue of the meeting and, whenever possible, details of the lecture or other event being arranged. Standing instructions cannot be accepted.

REGION 1

Ainsdale (ARS).—2, 16, 30 November, 8 p.m., 77 Clifton Road, Southport.

Allerton (Liverpool) (SRHS).—Thursdays, 8 p.m., 3rd Allerton Scout Group Headquarters, Church Road, Woolton, Liverpool.

Ashton-under-Lyne (AUL & DARS).—4, 18 November, 2 December, 8 p.m., Ashton-under-Lyne Technical College.

Blackburn (ELARC).—3 November, (" Amateur TV Transmission " by G3OTA and G6SXC/T), 1 December (AGM), 7.30 p.m., YMCA, Limbrick, Blackburn.

Blackpool (B & FARS).—Every Monday, 8 p.m., Pontins Holiday Camp, Squires Gate, Morse tuition from 7.30 p.m.

Bury (B & RRS).—8 November (" Beginners Guide to S.S.B. " by Jim Heath), 13 December (AGM), 8 p.m., Old Boars Head Hotel (private room), Crompton Street.

Chester (C & DARS).—Tuesdays, 8 p.m., YMCA. Except first Tuesday in each month.

Crewe & District.—7 November, 5 December, 8 p.m., Earl of Crewe Hotel, Nantwich Road.

Eccles (E & DRC).—Tuesdays, 8 p.m., Patricroft Congregational Schools, Shakespeare Crescent, Patricroft. Every Thursday, Club Top Band net 20.30 hours.

Liverpool (L & DARS).—Tuesdays, 8 p.m., Conservative Association Rooms, Church Road, Wavertree.

(ULARS).—7, 21 November, 5 December, 7.30 p.m., Students' Union, 2 Bedford Street North, Liverpool 7.

Macclesfield (M & DARS).—8, 22 November, 6 December, 8 p.m., The George Hotel, Jordongate.

Manchester (M & DARS).—Wednesdays, 7.30 p.m., 203 Droylsden Road, Newton Heath, Manchester 10.

(SMRC).—Fridays, 7.45 p.m., Rackhouse Community Centre, Daine Avenue, Northenden.

Morecambe.—2 November, 7 December, 125 Regent Road.

Preston (PARS).—8 November, 13 December, 7.30 p.m., St. Paul's School, Pole Street.

St. Helens (SES).—1 November (Sale of Surplus Equipment), 15, 29 November, 13 December, 7.30 p.m., IVS Centre, 55 College Street.

Southport (SRS).—Wednesdays, 8 p.m., and Sundays, 4 p.m., Sea Cadets Camp, The Esplanade.

Stockport.—2, 16, 30 November, 14 December, The Blossoms Hotel, Buxton Road.

Wirral (WARS).—2, 16 November, 7 December, (3 December—Annual Dinner), 8 p.m., Harding House, Park Road West, Claughton, Birkenhead.

REGION 2

Bradford (BRS).—15 November (Surplus Equipment Sale), 7.30 p.m., Bradford Technical College, Great Horton Road, Bradford. 22 November (Mullard Film Show), Queen's Hall, Bradford.

Durham (DCARS).—3 November (Beginners' Meeting—Test Gear and Receiver Alignment Demonstration), 17 November (Stag Party, Buffet), 1 December (" Construction Techniques " by G3SFL of SS & DARC), 8 p.m., Bay Horse, Gilesgate, Durham.

Hull (H & DARS).—Fridays, Unity Hall, Hessle Road, Hull.

Northern Heights.—9 November (" Electronics Unusual " by Mr G. E. Craven), 22 November (Mullard Film Show at Bradford), 23 November (" Aerials " by Arthur Bailey, G3IBN).

REGION 4

Burton-on-Trent (ARC).—23 November (Annual Dinner—Midland Hotel: contact H. Harrison, G3ACR, 38 Baker Street, Stapenhill, Burton-on-Trent).

Derby (D & DARS).—2 November (Bring and Buy Sale), 9 November (General Discussion on new rules for NFD 1967), 12-13 November (MCC Contest), 16 November (Film Show), 30 November (" My visit to China "—D. Stanners, G3HEJ), 7.30 p.m., Room 4, 119 Green Lane, Derby.

Heanor (H & DARS).—1 November (Sale), 8 November (" Further developments of the Electronic Organ "—E. E. West, G3KTP), 15 November (Components Quiz), 22 November (Films, Room 3), 29 November (" Using the Oscilloscope "—R. Harrod, G3RWN), 7.30 p.m., Club Room, South East Derbyshire College of Further Education, Ilkeston Road, Heanor, Derbyshire.

Leicester (ARS).—Mondays, 7.30 p.m. (Slow Morse Practice), Sundays 10.30 a.m., Club Rooms, Old Hall Farm, Braunstone Lane, Leicester.

Loughborough (LARC).—Fridays, 8 p.m., Club Rooms, Bleach Yard, Wards End, Loughborough.

Melton Mowbray (ARS).—17 November, 7.30 p.m., St. John's Ambulance Hall, Asfordby Hill, Melton Mowbray.

Newark (NSWC).—Mondays, Thursdays, 21 November (" Fifty Years of Radio "—F. C. Ward, G2CVV), 7.30 p.m., The Hall, Guildhall Street, Newark.

Nottingham (ARCN).—Tuesdays, Thursdays, 7.30 p.m., Room 3, Sherwood Community Centre, Woodthorpe House, Mansfield Road, Nottingham.

Peterborough (P & DARS).—Fridays, 4 November (AGM), 8 p.m., Old Windmill behind The Peacock Inn, London Road (opposite Murkitts Garage).

Worksop (NNARS).—Tuesdays (RAE Class), Thursdays (Lecture Night), 7.30 p.m., Club Room, 13 Gateford Road, Worksop.

REGION 5

Bedford (B & DARC).—3 November (Annual General Meeting), 17 November (Film Show), 1 December (Social Evening), 7.45 p.m., Westfield School, Queen's Road, Bedford (Meetings commence with Slow Morse).

Cambridge (C & DARC).—4 November (Informal), 11 November (Film Show), 18 November (Activity Evening), 25 November (Informal), 30 November (Committee Meeting), (20 January Annual Dinner at University Arms with President of the RSGB as Guest of Honour). Fridays, 7.30 p.m., Club Headquarters, Corporation Yard, Victoria Road, Cambridge.

Cambridge University (CUWS).—Alternate Tuesdays during Term, 8 p.m., Psychology Department, Downing Site.

Luton (L & DARS).—8 November (Home Brew S.S.B.), 15 November (Tektronix Films), 22 November (70 Mc/s Demonstration), 29 November (Talk arranged by Belling Lee), Tuesdays 8 p.m., ATC Headquarters, Crescent Road, Luton, Bedfordshire.

March (M & DRAS).—Tuesdays, 7.30 p.m., rear of Police Headquarters, March, Isle of Ely.

Royston (R & DARC).—Wednesdays, 8 p.m., Manor House Social Club, Melbourn Street, Royston, Hertfordshire.

Shefford (S & DARC).—3 November (Talk by Mr Howlett), 10 November (Quiz), 17 November (" Industrial Electronics "—Mr R. W. Williams), 24 November (Preparations for Annual Dinner), 1 December (Annual Dinner), 7.45 p.m., Church Hall, High Street, Shefford, Bedfordshire.

REGION 6

Cheltenham Group.—First Thursday each month, 8 p.m., Great Western Hotel, Clarence Street, Cheltenham.

REGION 7

Acton, Brentford & Chiswick (ABCRC).—15 November (Comparison tests on receivers), 7.30 p.m., AEU Club, 66 High Road, Chiswick.

Ashford (Mddx) Echelford ARS.—30 November (Visitors Night), 7.30 p.m., Links Hotel, Ashford.

Bexley Heath (NKRS).—10 November (" Air Traffic Control " by John Graham, G3TR), 24 November (" V.H.F. Equipment " by G. M. C. Stone, G3FZL), 8 p.m., Congregational Church Hall, Chapel Road, Bexley Heath.

Chingford (SRC).—Fridays (except first in Month), 8 p.m., Friday Hill House, Simmons Lane, Chingford, E4.

Croydon (SRCC).—15 November, 7.30 p.m., Blue Anchor, South End.

Dorking (D & DRS).—7 November (Informal Meeting), 8 p.m., Wheatsheaf. 22 November (Formal Meeting), 8 p.m., Star & Garter, Dorking.

Ealing (E & DARS).—Tuesdays, 7.30 p.m., Northfields Community Centre, Northcroft, Ealing, W5.

East Ham.—First and third Tuesdays, 7.30 p.m., 12 Leigh High Road, East Ham.

East London District.—Third Sunday each month, 20 November (" Transmitter to Aerial " by R. C. Hills, G3HRH), 18 December (AGM followed by " RAEN " by W. J. Perkins), 2.30 p.m., Wanstead House, The Green, Wanstead, E11.

East Molesey (TVARTS).—First Wednesday each month, Prince of Wales, Bridge Road, East Molesey.

Edgware & Hendon (EADRS).—14 November (Construction Contest), 28 November (Police Radio System), 8 p.m., John Keble Hall, Church Close, Deans Lane, Edgware.

Gravesend (GRS).—Third Wednesday each month, 7.30 p.m., RAFTA Club, Overcliff Road.

Guildford (G & DRS).—11, 25 November, 8 p.m., Guildford Model Engineering Society in Stoke Park.

Harlow (DRS).—Tuesdays, Thursdays, 7.30 p.m., Mark Hall Barn, First Avenue.

Harrow (RSH).—Every Friday, 8 p.m., Roxeth Manor School, Eastcote Lane.

Holloway (GRS).—Monday (RAE), 7 p.m., Wednesday (Morse), 7.30 p.m., Friday (Club), 7.30 p.m., Montem School, Hornsey Road.

Hounslow (HADRS).—14, 28 November, Canteen, Mogden Main Drainage Department, Mogden Works, Isleworth.

Ilford.—Thursdays, 8 p.m., 579 High Road, Ilford, Essex.

Kingston.—10, 24 November, fortnightly, 8 p.m., YMCA, Eden Street, Fridays (weekly Morse classes), 2 Sunray Avenue, Tolworth.

Leyton & Walthamstow.—1, 15, 29 November, 7.30 p.m., Leyton Senior Institute, Essex Road, London, E10.

London U.H.F. Group.—3 November (Post Office Research on Aerial Noise by D. Lisney, G3MNO), 1 December (Technical Films), 7.30 p.m., Bull & Mouth, Bloomsbury Way, Holborn.

Loughton.—Alternate Fridays, 4 November, 7.30 p.m., Loughton Hall (Nr. Debden Station).

Maidenhead (M & DARC).—15 November, 7.30 p.m., Victory Hall, Cox Green, Maidenhead.

New Cross.—Wednesdays, Fridays, 8 p.m., 225 New Cross Road, SE14.

Norwood & South London (CP & DRS).—19 November, CD Centre, Catford, London, SE6.

Paddington (P & DARS).—Wednesdays, 7.30 p.m., Beauchamp Lodge, 2a Warwick Crescent, W2.

Purley (P & DRC).—18 November, 8 p.m., ("Woomera Rocket Range in Australia" by Ian Newcombe), Railwaymen's Hall, Side Entrance, 58 Whytecliffe Road, Purley.

Reigate (RATS).—17 November, 7.30 p.m., George & Dragon, Cromwell Road, Redhill.

Romford (R & DRS).—Tuesdays, 8.15 p.m., RAFTA House, 18 Carlton Road.

Science Museum (CSRS).—First and third Tuesdays, 6 p.m., Science Museum, South Kensington.

Scout ARS.—17 November, 7.15 p.m., Baden

Powell House, Queens Gate, South Kensington, SW7.

Sidcup (CVRS).—3 November, 7.30 p.m., Congregational Church Hall, Court Road, Eltham.

Slough (SDR Group).—First Wednesday every month, 8 p.m., United Services Club, Wellington Street.

South London Mobile Club.—5 November, 8 p.m. (Region 7 and RSGB by G4KD), 19 November, 8 p.m., Clapham Manor Baths, SW4.

Southgate & District.—10 November, 7.30 p.m., Parkwood Girls School (behind Wood Green Town Hall).

St. Albans (Verulam ARC).—16 November, 7.30 p.m., Cavalier Hall, Watford Road, St. Albans.

Sutton & Cheam (SCRS).—15 November, 8 p.m., The Harrow Inn, High Street, Cheam.

Welwyn Garden City.—10 November, 8 p.m., Vineyard Barn, Digswell Road.

Wimbledon (W & DRS).—11 November, 8 p.m., Community Centre, St. George's Road, Wimbledon, SW19.

Wembley (GECARS).—Every Thursday, 7 p.m., Visitors ring ARNold 1262 first.

REGION 9

Bath.—18 November, 7.30 p.m., RNR Training Centre, James Street West, Bath.

Bristol.—25 November, 7.15 p.m., New Lecture Theatre G44, Royal Fort, Bristol University, Woodland Road, Bristol 8.

Bristol (BARC).—Mondays and Thursdays, 7.30 p.m., 43 Ducie Road, Barton Hill, Bristol 5.

Burnham-on-Sea (BoSARS).—Second Tuesday in each month, 8 p.m., Crown Hotel, Oxford Street.

Camborne (CRAC).—First Thursday in each month, Staff Recreation Hall, SWEB Headquarters, Pool, Near Camborne.

(CRAC V.H.F. Group).—First Thursday in each month, 7.30 p.m., The Coach and Horses, Ryder Street, Truro.

Exeter.—First Tuesday in each month, 7.30 p.m., George and Dragon Inn, Blackboy Road, Exeter.

Plymouth (PRC).—Tuesdays, 7.30 p.m., Virginia House, Bretonside, Plymouth.

Saltash (S & DARC).—Alternate Fridays, 7.30 p.m., Burraton Toc H Hall, Warraton Road, Saltash.

South Dorset (SDRS).—First Friday in each month, 7.30 p.m., Labour Rooms, West Walks, Dorchester.

Taunton.—Alternate Thursdays, 7 p.m., Lecture Theatre, Taunton Technical College.

Torquay (TARS).—26 November (Sale of surplus equipment), 7.30 p.m., Club HQ, Belgrave Road, Torquay.

Wells (WARS).—Mondays, 8 p.m., EMIE (Wells) Sports and Social Club, Chamberlain Street, Wells, Somerset.

Weston-super-Mare.—4 November (Films and sale of surplus equipment), 2 December (AGM), 7.30 p.m., Main Engineering New Block, Weston Technical College.

Yeovil (YARC).—Wednesdays, 7.30 p.m., Park Lodge, The Park, Yeovil.

REGION 13

Edinburgh (LRS).—10 November (Film Show), 24 November (Surplus Sale), 7.30 p.m., YMCA, South St. Andrew Street, Edinburgh.

REGION 14

North Ayrshire (NAARC).—First Sunday in every month, 7.30 p.m., Ardrossan ATC HQ, The Academy, Sorbie Road, Ardrossan.

REGION 15

Belfast and District RSGB Group.—Third Friday in each month, 8 p.m., Ulster Tape Recording Society Clubroom, 44 Dublin Road, Belfast.

REGION 16

Basildon (BDARS).—Details from G3IJB.

Chelmsford (CARS).—6 December, 7.30 p.m., Marconi College, Arbour Lane, Chelmsford.

Great Yarmouth (GYRC).—Fridays, 7.30 p.m., The Manager's Office, The Old Power Station, Swanstons Road, Great Yarmouth.

Ipswich (IRC).—30 November, 7.30 p.m., Red Cross HQ, Gippeswyk Hall, Ipswich.

Norwich (NARC).—Meetings alternate Mondays, 7.30 p.m., Old Lakenham Hall, Mansfield Lane, Norwich. Details from G3TLC.

LOOKING AHEAD

26-29 October.—RSGB International Radio Communications Exhibition.

9 December.—RSGB Annual General Meeting.

13 May, 1967.—RSGB Annual V.H.F. Convention.

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Antenna Roundup Vol. 2.	30/–
CQ Anthology, 1952–59	23/6
CQ Anthology, 1945–52	16/–
CQ Mobile Handbook	23/–
CQ New Sideband Handbook	24/–
RTTY Handbook	30/–
Shop and Shack Shortcuts	29/6
73 MAGAZINE PUBLICATIONS	
Care and Feeding of a Ham Club	8/–
Index to Surplus	12/–
Parametric Amplifiers	15/–
Simplified Maths for the Hamshack	4/6
Test Equipment Handbook	4/6
V.H.F. Antenna Handbook	15/–
RADIO PUBLICATIONS INC.	
Beam Antenna Handbook	28/–
Better Short-wave Reception	24/6
Cubical Quad Antennas	22/–
Electronic Construction Handbook	22/6
S-9 Signals	8/6
EDITORS AND ENGINEERS	
Transistor Radio Handbook	42/–
AMERICAN MAGAZINE SUBSCRIPTIONS‡	
CQ (*Cowan*) Monthly (p.a.)	44/–
†*QST* (*ARRL*) Monthly (p.a.)	43/6
Institutions, groups, etc. (p.a.)	50/–
†*73 Magazine* Monthly (p.a.)	30/–
† *Sample Copy 2/6*	
‡ *Mailed direct from USA*	
MISCELLANEOUS PUBLICATIONS	
Basic Electronics (*Dover*)	23/6
Foundations of Wireless (*Iliffe*)	22/3
Ham's Interpreter (5th Edition)	8/6
How to Listen to the World	20/–
Log Book, 150 pages, opens flat (*Martins*)	22/6
Manual of Transistor Circuits (*Mullard*)	13/6
Outline of Radio and Television (*Hawker*)	34/6
Radio Amateur Operator's Handbook (*Data*)	5/6
Semaphore to Satellite (I.T.U.)	70/–
Short Wave Radio and the Ionosphere (*Iliffe*)	12/–
Short Wave Receivers for the Beginner (*Data*)	6/6
Transistor Radios, Circuitry and Servicing (*Mullard*)	5/9
Understanding Television (*Data*)	40/–
Wireless World Radio Valve Data	10/6
World Radio-TV Handbook (1966)	29/–
MORSE COURSES	
G3HSC Rhythm Method of Morse Tuition	
Complete Course with three 3 speed L.P. records + books	84/–
Beginner's Course with two 3 speed L.P. records + books	60/6
Beginner's L.P. (0-15 w.p.m.) + book	50/–
Advanced L.P. (9-42 w.p.m.) + book	50/–
Three speed simulated GPO test. 7 in. d.s. E.P. record	11/6
RSGB Morse Instruction Tape (900 ft.)	35/–
RSGB Morse Practice Tape (450 ft.) (both at 3¾ i.p.s., up to 14 w.p.m.)	20/–
SHACK AIDS	
Easibinders, round backed, gold blocked, for RSGB Bulletin	16/6
Easibinder Year Stickers (1965 or 1966)	1/6
Admiralty Great Circle Map (In Postal Tube)	8/–
QRA Locator, Western Europe	5/6
RSGB Countries List	1/–
Panel Signs, transfers (*Data*)	
Set 3: White Wording	4/9
Set 4: Black Wording	4/9
Set 5: Dials (Clear Background)	4/9
Set 6: Dials (Black Background)	4/9
Decalet Panel Lettering Transfers (Black or White)	1/–
Blick Dry Print Lettering (Letters and Numerals, Black)	2/6
RSGB MEMBERS ONLY	
Car Badge (De Luxe with call-sign)* (*Postage on overseas orders 5/6 extra*)	25/–
Car Badge (RSGB Emblem with call-sign)*	18/–
Car Badge (RSGB or RAEN Emblem)	9/–
Leather Key Fobs, with RSGB Diamond attached —Black, Natural, Red, Green, Blue	7/–
RSGB Terylene Tie (Maroon or Dark Blue)	16/–
RSGB Blazer Badge (Black or Dark Navy Blue)	8/-
Stereo Block (RSGB or RAEN Emblem)	10/–
Area Representatives Badge (ARs only)	10/–
Members Headed Qto. Paper (100 sheets)	10/6
Call-sign Lapel Badge (with RSGB or RAEN Emblem, pin or stud fitting)*	7/6
Call-sign Lapel Bar*	6/–
Tie Clips (with RSGB Emblem)	5/–
RSGB Lapel Badge (½ in. size) stud or pin fitting	2/–
Plastic Window Sticker (RSGB or RAEN Emblem)	1/3

**Delivery 6-8 weeks*

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Radio Society of Great Britain

(Incorporated 1926)

Patron: H.R.H. THE PRINCE PHILIP, DUKE OF EDINBURGH, K.G.

Application for Corporate Membership

Radio Society of Great Britain
28 Little Russell Street
London, W.C.1

I hereby apply for election as a Corporate Member of the Society and enclose a remittance for £2. 10s. 0d. being the amount of my first annual subscription.

I, the undersigned, agree that in the event of my election to Membership of the Radio Society of Great Britain, I will be governed by the Memorandum and Articles of Association of the Society and the rules and regulations thereof as they now are or as they may hereafter be altered; and that I will advance the objects of the Society as far as may be in my power; providing that whenever I shall signify in writing to the Society addressed to the Secretary that I am desirous of withdrawing from the Society I shall at the end of one year thereafter after the payment of any arrears which may be due by me at that period be free from my undertaking to contribute to the assets of the Society in accordance with Clause 8 of the Memorandum of Association of the Society.

Date..... ***Signed***.....

PERSONAL DETAILS TO BE COMPLETED BY THE APPLICANT

Surname (BLOCK LETTERS).....

Christian Names in full (BLOCK LETTERS).....

Address for all correspondence (BLOCK LETTERS).....

.....

Nationality..... Age (if under 21).....

Current Call-sign (if any).....

Details of previous membership (if any).....

DETAILS TO BE COMPLETED BY THE PROPOSER*

I wish to propose.....for Corporate Membership.

Proposer's Name (BLOCK LETTERS).....

Address (BLOCK LETTERS).....

Call-sign (or BRS No.).....

Signed .....

*If the applicant is not acquainted with a Corporate Member willing to propose him for election he may submit a suitable reference in writing as to his interest in Amateur Radio.

FOR HEADQUARTERS USE ONLY

Approved by Council .....Region Coding.....

BRS Number Issued ..... First Subscription paid .....

The first subscription of 50/- should be enclosed with this application.

Radio Society of Great Britain

NEW RUSKIN HOUSE, 28 LITTLE RUSSELL STREET, LONDON, W.C.1

Patron:

H.R.H. THE PRINCE PHILIP,

DUKE OF EDINBURGH, K.G.

COUNCIL, 1966

President
R. F. STEVENS, G2BVN

Immediate Past President
E. W. YEOMANSON, G3IIR

Executive Vice-President
A. D. PATTERSON, BASc, GI3KYP

Honorary Treasurer
N. CAWS, FCA, G3BVG

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General Manager and Secretary
JOHN A. ROUSE, G2AHL

Assistant Secretary
P. C. M. SMEE

Auditors
EDWARD MOORE & SONS
Chartered Accountants

Bankers
BARCLAYS BANK LTD.

REPORT ON BEHALF OF THE HONORARY TREASURER

The Society's Honorary Treasurer, Mr Norman Caws, F.C.A., is at present in hospital and I am accordingly reporting on his behalf on the Balance Sheet and Income and Expenditure Account for the year ending 30 June, 1966.

The Income and Expenditure Account shows an excess of expenditure over income of £1,198, a decrease of £2,595 compared with the previous year's surplus of £1,397. Although subscription rates were increased with effect from 1 July, 1965, the Society will not receive the full benefit until the next financial year because subscriptions are spread over the 12 months. It is anticipated that the increased income will be sufficient to cover the current deficit and other increasing costs.

The Profit on Sales of Publications shows a gratifying increase of £537. This could not have been achieved without the support of Members who purchase books and magazines through their Society.

There was a fall in revenue from advertising in the RSGB BULLETIN and I must again stress the importance of Members informing advertisers when enquiries and purchases are a result of advertisements in Society publications. Competition for advertising is very keen at all times and particularly so under present financial conditions. Members are therefore asked to encourage advertisers to use the RSGB BULLETIN.

The cost of printing and posting the BULLETIN increased by £3,070. Although most of this increase was due to conditions beyond the Society's control, larger issues are now being published.

The increases in Rents, Salaries and General Overheads are very much as anticipated in the statement published in the June, 1965, issue of the RSGB BULLETIN. Postage has, however, shown a considerably greater rise than was forecast at that time.

The cost of sending the Society's delegates to the Region 1 IARU Conference at Opatija was £405 but was well justified by the results obtained.

The RSGB International Radio Communications Exhibition again made a significant contribution to the Society's funds, thanks to the efforts of the Exhibition Committee and many other volunteers. The continuing excellence of this event is a tribute to all concerned.

In accordance with the resolution passed at the Annual General Meeting in December, 1965, funds made available by the redemption of investments have been re-invested through the Society's subsidiary, Lambda Investment Company Limited, in which RSGB holds 75 of the 87 £1 shares issued. The Headquarters Trust Fund has also been invested through Lambda. At 30 June, 1966, the accounts of the subsidiary showed a small profit of £16 14s. 9d., which has been carried forward and does not appear in the Society's accounts.

Finally, Members are asked to let the Honorary Treasurer have notice of questions they wish to raise at the Annual General Meeting so that all the information required may be available.

JOHN A. ROUSE, *Secretary.*

RADIO SOCIETY OF GREAT BRITAIN

(COMPANY LIMITED BY GUARANTEE)

New Ruskin House, 28 Little Russell Street, London, W.C.1

INCOME AND EXPENDITURE ACCOUNT
for the year ended 30th June, 1966

1965 £	1965 £			1966 £	1966 £	
			INCOME			
	21,693		Subscriptions (including proportion of Life Members' Subscriptions)			26,320
	5,823		Profit on Sales of Publications, etc.			6,360
	14		Profit on Sale of Furniture			17
	1,085		Interest on Investments (Gross Amount before deduction of Income Tax)			1,226
	64		Deposit Interest			132
	28,679		**Total Income**			34,055
			EXPENDITURE			
1,187			Rent, General and Water Rates, Cleaning, Lighting and Heating		2,034	
6,357			Salaries, National Insurance and Staff Pension Premiums		7,894	
226			Payments to Past Employees		226	
207			Telephone		276	
774			General Postages		1,336	
1,180			Printing and Stationery (including Articles of Association and Publicity Leaflets)		1,158	
254			Staff Luncheon Vouchers		383	
189			Insurances		236	
100			Bank Charges		100	
226			Repairs and Maintenance		262	
22			Legal Expenses		68	
131			Audit Fee		131	
374			Sundry Expenses		459	
—			Contribution to EuOscar Fund		25	
402			Depreciation of Furniture and Equipment		453	
163			Membership Certificates and Badges		143	
131			Awards, Trophies and Contests		178	
9			Tape Recorded Lectures		12	
616			Cost of QSL Bureau		716	
243			Contribution to I.A.R.U. Region I Division		243	
25			Provision for Doubtful Debts		—	
7			Bad Debts written off		—	
52			General Meetings (Cost of Printing and Hire of Hall)		162	
436			New cost of Exhibition (Note 1)		441	
—			Cost of "Daily Mail" Exhibition		275	
18			I.Q.S.Y. Newsletter		8	
8			Equipment for Technical Development		—	
89			Cost of Beacons		108	
—			IARU Conference, Opatija		405	
			Bulletin distributed free to Members—			
17,094			Printing, Postage, etc.	20,164		
5,327			*Less* Receipts from Advertising	4,884		
	11,767				15,280	
			Travelling, Entertaining and Meetings—			
372			Council and Committee Meetings	347		
994			Council and Committee Members	1,104		
271			Regional, Club, Overseas and Foreign Meetings including net cost of various rallies and conventions	335		
67			R.A.E.N. Committee Meetings and Expenses	75		
41			Representatives' Expenses	46		
19			London Lectures	21		
—			Net Cost of Radio Amateurs Examination Centres	3		
325			Sundries	310		
	2,089				2,241	
		27,282	**Total Expenditure**			35,253
	(Surplus)	£1,397	**EXCESS OF EXPENDITURE OVER INCOME FOR YEAR ENDED 30th JUNE, 1966**			£1,198

BALANCE SHEET 30th June, 1966

1965 £	1965 £	1965 £		1966 £	1966 £	1966 £
			CURRENT ASSETS			
3,358			Cash at Bank and in Hand			
1,500			On Current Account and in Hand	2,922		
	4,858		On Deposit Account	4,500		
	2,136				7,422	
	611		Debtors, *less* Provision for Doubtful Debts		1,720	
	3,481		Payments in advance		1,808	
		11,086	Stock of Publications, etc. (as certified by the General Manager)		3,856	
						14,806
			FIXED ASSETS			
14,795			Investments at Cost			
			Quoted at Stock Exchange (Note 2)	10,774		
			Middle Value £8,439 (*1965* = *£12,410*)			
3,000			5 per cent. Defence Bonds	3,000		
8,000			Luton Corporation—Loan on Mortgage @ 5½ per cent.	9,000		
	25,795				22,774	
—			Investments in Subsidiary Company			
—			75 Shares of £1 each fully paid (see Note 4)	75		
	—		Loans	5,225		
					5,300	
			Furniture and Equipment			
3,079			At Cost	3,381		
1,242			*Less* Depreciation	1,622		
	1,837				1,759	
		27,632				29,833
		£38,718	**Total Assets**			£44,639
			BEVAN SWIFT MEMORIAL LECTURE FUND			
75			Balance at 1st July, 1965		70	
5			*Less* Prize Awarded		5	
		70				65
		301	**LIFE MEMBERS' SUBSCRIPTIONS RESERVE ACCOUNT**			364
			CURRENT LIABILITIES			
—			Headquarters Trust Fund—Loan		2,225	
5,909			Sundry Creditors and Accrued Expenses		5,805	
12,053			Subscriptions in advance		17,538	
154			Taxation		73	
		18,116				25,641
		18,487	**Total Liabilities**			26,070
			ACCUMULATED FUND			
19,320			Balance at 1st July, 1965		20,231	
—			*Less* Loss on Sale of Investment		21	
					20,210	
			Less Excess of Expenditure over Income for the year ended 30th June, 1966	1,198		
(Surplus) 1,397			Income Tax on Investment Income	443		
—486					1,641	
	911					18,569
		20,231				
		£38,718				£44,639

R. F. STEVENS, *President*

A. D. PATTERSON, *Executive Vice-President*

JOHN A. ROUSE, *General Manager and Secretary*

REPORT OF THE AUDITORS TO THE MEMBERS OF RADIO SOCIETY OF GREAT BRITAIN

We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit. In our opinion proper Books of Accounts have been kept by the Society so far as appears from our examination of those Books. We have examined the above Balance Sheet and Income and Expenditure Account, which are in agreement with the Books of Account. In our opinion and to the best of our information and according to the explanations given us, the said Accounts in conjunction with the notes annexed hereto give the information required by the Companies Act, 1948, in the manner so required, and the Balance Sheet gives a true and fair view of the state of the Society's affairs as at 30th June, 1966, and the Income and Expenditure Account gives a true and fair view of the excess of Expenditure over Income for the year ended on that date.

Thames House, Queen Street Place, London, E.C.4.
14th October 1966

EDWARD MOORE & SONS
Chartered Accountants

NOTES

(1) International Radio Communications Exhibition

Held In 1964 £		*Held in 1965* £
805	Profit on Sales of Publications, etc.	848
236	Subscriptions of New Members enrolled	330
£1,041		£1,178

(2) Investments

Middle Value at 1st July, 1965 £			Middle Value at 30th June, 1966 £	Cost Price £
4,000	*£4,000* 3 per cent Savings Bonds 1955/65	*(a)*	—	—
3,650	*£5,000* 3 per cent Savings Bonds 1965/75	..	3,675	5,219
3,192	*£4,145 1s. 6d.* British Transport 4 per cent Guaranteed Stock 1972/77	..	3,161	4,055
1,568	*£1,751 9s. 6d.* 3½ per cent Conversion Loan 1969		1,603	1,500
£12,410			£8,439	£10,774

(a) Redeemed at par in August 1965.

(3) Capital Commitments

There are no outstanding commitments for capital expenditure (*1965—NIL*).

(4) Subsidiary Company—Lambda Investment Co. Ltd.

The Subsidiary Company made a profit for the period from 26th March, 1965 (date of Incorporation) to 30th June, 1966 amounting to £16 14s. 9d., no part of which is included in these accounts.

THE PILOT OFFICER NORMAN KEITH ADAMS PRIZE TRUST FUND

BALANCE SHEET 30th JUNE, 1966

	£ s. d.		£ s. d.
TRUST FUND	165 0 0	**INVESTMENT**	
Creditor:		£165 5 per cent National Development Bonds..	165 0 0
Prize to be awarded under the terms of the Trust Deed for year ended 30th June, 1966	8 5 0	**CASH AT BANK**	13 10 5
ACCUMULATED FUND			
Balance at 1st July, 1965 .. —			
Prize for the year ended 30th June, 1965, not awarded 5 5 0			
Surplus Income 5			
	5 5 5		
	£178 10 5		£178 10 5

INCOME AND EXPENDITURE ACCOUNT for the year ended 30th June, 1966

	£ s. d.		£ s. d.
Provision for prize for the year ended 30th June, 1966..	8 5 0	Interest on Investment for the year ..	8 5 5
Surplus to Accumulated Fund	5		
	£8 5 5		£8 5 5

R. F. STEVENS, *President*

JOHN A. ROUSE, *General Manager and Secretary*

REPORT OF THE AUDITORS

We have audited the Balance Sheet and Income and Expenditure Account as set forth above and have obtained all the information and explanations we have required. In our opinion such Balance Sheet and Income and Expenditure Account are properly drawn up so as to exhibit a true and correct view of the state of affairs of the Prize Trust Fund as at 30th June, 1966, according to the best of the information and explanations given to us.

Thames House, Queen Street Place, London, E.C.4.
14th October, 1966

EDWARD MOORE & SONS
Chartered Accountants

HEADQUARTERS' TRUST FUND AT 30th JUNE, 1966

	£ s. d.	£ s. d.		£ s. d.
ACCUMULATED FUND			**LOAN**	
Balance at 1st July, 1965	2,131 17 0		Radio Society of Great Britain ..	2,225 0 0
Contributions and Deposit Interest received during the year ..	120 6 7		**CASH AT BANK**..	27 3 7
	2,252 3 7			
Less Taxation on Deposit Interest to date	61 10 9			
		2,190 12 10		
CREDITOR				
Taxation due on Deposit Interest to date		61 10 9		
		£2,252 3 7		£2,252 3 7

R. F. STEVENS, *President*

REPORT OF THE AUDITORS

We have examined the above Statement including Contributions to the Headquarters' Trust Fund and report that it is in accordance with the records.

Thames House, Queen Street Place, London, E.C.4.
14th October, 1966

EDWARD MOORE & SONS
Chartered Accountants

Printed in Great Britain for the RADIO SOCIETY OF GREAT BRITAIN, New Ruskin House, Little Russell Street, London, W.C.1
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ACP4	6/-	EC52	4/-	GM4	45/-	QP21	6/-	UL41	7/6	3A4	4/-	6BQ7A	8/-	8D2	2/6	368AS	30/-
AC6PEN	5/-	EC73	12/6	GZ32	10/-	QP25	5/-	UL84	5/6	3A/108A	20/-	6BR7	9/-	9D2	3/-	393A	7/6
AL60	5/-	EC70	4/-	GZ34	10/-	QP230	5/-	UU5	7/-	3A146J	55/-	6BW6	7/-	9D6	2/-	446A	8/-
ARP3	3/-	EC90	2/-	H63	7/-	QS95/10	5/6	UU9	8/6	3A/167J	55/-	6C4	2/-	10F9	9/-	703A	30/-
ARP12	2/6	EC91	3/-	HK54	22/6	QS150/15	10/-	UY21	7/6	3B7	5/-	6C5G	2/6	12A6	2/6	705A	10/-
ARP24	3/6	ECC81	4/-	HL2K	2/6	QS1202	8/-	UY41	6/6	3B24	5/-	6C5GT	6/-	12AH7	5/-	715B	60/-
AR8	5/-	ECC82	5/-	HL23	6/-	QV04/7	8/2	UY85	5/-	3D6	4/-	6C6	4/-	12AT7	4/-	717A	3/-
ARTP1	6/-	ECC83	6/-	HL23DD	5/-	R3	8/-	V1120	4/-	3E29	50/-	6C6G	3/-	12AU7	5/-	724A	15/-
ATP4	2/3	ECC84	5/6	HL41	4/-	R10	9/-	V1507	5/-	3Q4	6/-	6C8G	3/-	12AX7	6/-	801	6/-
ATP7	5/6	ECC85	6/6	HVR2	9/-	RG4/1250	60/-	V1924	20/-	3Q5GT	7/-	6CH6	4/6	12AY7	10/-	803	2/6
AU7	55/-	ECC88	9/-	K3A	60/-	RK72	6/-	VP23	3/-	3S4	5/-	6C21	80/-	12BA6	5/-	807	8/-
AZ31	9/-	ECC91	4/-	KT8C	22/-	S130	25/-	VP133	9/-	3V4	5/9	6CL6	9/-	12BE6	7/-	808	8/-
B6H	15/-	ECF80	7/-	KT32	8/-	SL30P	15/-	VR99	8/-	3X2	3/-	6D6	3/-	12BH7	7/-	813	65/-
BD78	40/-	ECF82	7/-	KT44	5/9	SP2	8/6	VR105/30	5/-	4C27	35/-	6E5	6/-	12C8	3/-	815	35/-
BL63	10/-	ECH42	9/6	KT33	4/-	SP41	1/6	VR150/30	5/-	4D1	4/-	6F5G	5/3	12H6	2/-	829B	50/-
BS4	8/-	ECH81	5/-	KT66	16/-	SP61	1/6	VU33A	4/-	5A173G	5/-	6F5GT	5/9	12J5GT	2/6	830B	4/-
B85	20/-	ECH83	7/6	KT67	25/-	SP210	6/6	VU39	6/-	5A174G	5/-	6F6G	4/-	12J7GT	6/6	832A	45/-
BS84	37/6	ECL80	6/-	KY76	8/6	STV280/40	24/-	VX3256	4/-	5B251M	25/-	6F7	6/-	12K7GT	2/-	843	5/-
B2134	16/-	ECL82	6/3	KT88	22/-	X66	7/6	VX8122	5/-	5B/253M	15/-	6F8G	6/6	12K8M	10/-	866A	14/-
BT19	25/-	ECL83	10/-	KTW61	4/6			VX8124	5/-	5B254M	40/-	6F12	4/-	12Q7GT	3/3	884	10/-
BT35	25/-	ECL86	10/-	KTW63	5/-			W21	5/-	5B255M	35/-	6F13	5/-	12SA7	7/-	954	4/6
BT45	150/-	EF36	3/4	KTZ41	6/-			W118	8/-	5R4GY	9/-	6F14	5/-	12SC7	4/-	955	2/6
BT83	35/-	EF37A	7/-	KTZ63	5/-			W119	8/-	5T4	7/-	6F32	4/-	12SG7	4/6	956	2/-
CC3L	2/-	EF40	8/-	M8100	9/-			X66	7/6	5U4G	4/6	6F33	20/-	12SH7	3/-	957	5/-
CL33	9/-	EF50	2/6	M8141	12/-							6G6G	2/6	12SJ7	5/-	958A	4/-
CV71	3/-	EF52	6/-	M8161	7/-							6H6M	1/6	12SK7	5/-	1612	5/-
CV77	5/-	EF53	4/6	MH4	5/-							6J4WA	10/-	12SN7GT	5/9	1616	3/-
CV102	1/-	EF55	8/-	MHLD6	10/-							6J5	6/-	12SR7	5/-	1619	5/-
CV103	4/-	EF71	7/6	ML6	6/-							6J5G	2/-	12Y4	2/-	1625	6/-
CV4004	7/-	EF72	5/-	N78	15/-							6J6	3/6	12L7	7/-	1626	3/-
CV4014	7/-	EF73	5/-	NE17	7/-							6J6W	6/-	15D2	6/-	1629	4/6
CV4015	8/-	EF74	4/-	OA2	6/-							6J7G	5/-	19E2	15/-	2051	5/-
CV4025	7/-	EF80	5/-	OB2	6/-							6J7M	8/-	19G3	40/-	4043C	35/-
CV4049	6/-	EF81	6/-	OB3	7/-							6K6GT	5/6	19G7	5/-	4063	8/-
CY31	6/6	EF85	4/6	OC3	5/-							6K7G	2/-	19H1	18/-	4313C	20/-
D1	1/6	EF86	6/6	OD3	5/-							6K7GT	4/9	19M1	5/-	5704	9/-
D41	6/-	EF89	5/-	OZ4A	5/-							6K8G	3/-	20P4	13/-	5726	7/-
D61	6/-	EF91	3/6	P21-35	14/-							6K8GT	8/3	21B6	7/-	6060	5/-
D77	3/3	EF92	2/-	PC86	9/-							6K8M	6/6	25L6GT	5/-	6064	7/-
DA30	12/6	EF95	5/-	PC88	9/-							6K25	24/-	25Y5	6/-	6065	6/-
DAF96	6/-	EF183	6/6	PC900	12/-							6L5G	6/-	25Z4G	6/6	6080	22/-
DD41	4/-	EF184	6/6	PCC84	5/6							6L6GA	7/6	25Z5	7/6	7193	1/9
DET5	8/-	EH90	7/6	PCC89	10/-							6L6M	11/-	25Z6GT	8/6	7475	2/-
DET20	2/-	EHT1	300/-	PCF80	6/3							6L7G	4/-	25D7	6/-	8013A	25/-
DET25	15/-	EL32	3/9	PCF82	6/6							6L34	3/-	30	5/-	8020	15/-
EF73	5/-	EL34	10/-	PCF84	6/-							6LD20	5/9	30C15	9/6	9001	3/-
DF91	3/-	EL36	5/-	PCF86	9/-							6N7	6/-	30F5	8/6	9002	4/6
DF92	3/-	EL38	17/6	PCF802	9/6							6N7G	5/9	30FL1	10/6	9003	6/-
DF96	6/-	EL41	8/-	PCL81	9/-							6P25	12/-	30P12	9/-	9004	2/6
DH63	5/-	EL42	8/-	PCL82	7/-							6Q7G	5/-	30P19	13/-	9006	2/6
DK92	8/-	EL50	8/-	PCL83	8/6							6R7	5/6	30PL1	8/-		
DK96	6/6	EL81	8/-	PCL84	7/-							6SA7	7/-	30PL13	12/-	**C.R. Tubes**	
DL92	4/-	EL84	4/3	PCL85	8/6							6SA7GT	6/6	3516GT	7/-	CV1596	
DL93	4/-	EL85	7/6	PCL86	9/-							6SK7GT	4/-	35T	17/6	(09J)	55/-
DL94	5/9	EL91	4/6	PEN25	4/6							6SC7	7/-	35W4	5/-	E4504/B/16	28/-
DL96	7/-	EL95	5/-	PEN46	3/-							6SG7GT	5/-	35Z3	10/-	VCR97	40/-
DLS10	8/-	EL360	20/-	PEN200A	3/-							6SFGT	5/6	35Z4GT	6/-	VCR138A	40/-
DLS19	15/-	EM80	6/-	PFL200	17/6							6SH7	5/6	35Z5GT	6/-	VCR517	50/-
DY86	7/6	EM81	7/-	PL36	9/-							6SJ7	5/-	37	4/-	VCR517B	55/-
E80F	23/-	EM84	6/3	PL38	16/-							6SJ7G	6/6	38	4/-	VCR517C	60/-
E88CC	12/-	EN31	10/-	PL81	7/-							7Y7	5/6	2158G	6/-	3FP7	45/-
E90CC	10/-	ESU74	80/-	PL82	5/-							7GT	5/6	50L6GT	8/-	3EG1	40/-
E1148	2/6	ESU208	6/-	PL83	6/-							7	3/6	53A	7/6	5PC1	30/-
E1266	50/-	EY51	5/6	PL84	6/6							6sQ7GT	6/-	57	6/-	5FP7	12/6
E1415	30/-	EY86	6/6	PL500	13/6							6SS7	2/-	58	6/-	88D	4/-
E1524	12/6	EY91	3/-	PM24A	5/-							6U4GT	9/6	59	6/-		
EA50	1/-	EZ40	6/6	PT15	13/-							6V6G	5/-	75	5/6	**Photo Tubes**	
E173	7/-	EZ41	6/6	PT25H	7/6							6V6GT	7/6	76	5/-	GS16	12/6
EABC80	5/9	EZ80	5/6	PT25M	7/6							6V6M	8/-	77	6/6	931A	55/-
EA91	3/6	EZ81	3/6	PX4	14/-							6X4	3/6	78	5/-	6097	350/-
EAF42	8/-	F/6057	5/-	PX25	12/6							6X5G	5/-	80	5/6		
EB34	1/6	F/6061	5/-	PY33	8/6							6Z5GT	5/3	81	9/-	**Special Valves**	
EB91	3/-	F/6063	4/-	PY80	5/6							6Y6G	6/-	84	8/-	ACT6	£8
EBC23	6/-	FW4/500	6/6	PY81	5/6							6-30L2	10/-	85A2	8/-	K301	£4
EBC41	8/6	FW4/800	8/6	PY82	6/-							6Z4	5/-	88D	80/-	KRN2A	£3.10.0
EBC81	5/-	G1/236G	29/-	PY83	6/-							7B7	7/6	210VPT 7-pin	2/6	1B24	25/-
EBF80	6/6	G1/370K	20/-	PY800	8/-							7C5	10/-	22SPA	7/	2J22	£2.10.0
EBF83	7/6	G50/2G	5/-	PZ1-35	9/-							7C6	7/-	220TH	4/-	2J54	£3
												7C7	6/-	225DU	9/-	417A	30/-
												7H7	7/3	307A	5/6	3J/92/E	£37.10.0
												7Q7	7/-	310C	25/-	7144Y	£4
												7V7	5/-	350B	8/-	725A	30/-
																726A	19/-

TRANSISTORS

OC16	20/-	OC81D	5/-	OC201	12/6	XC141	10/-		
OC22	23/-	OC81M	5/-	OC202	15/-	XC142	15/-		
OC25	9/6	OC82	10/-	OC203	12/6	XC155	20/-		
OC35	12/6	OC82DM	5/-	OC204	17/6	XC156	22/6		
OC44	6/-	OC83	5/-	OC206	22/6	2N247	9/6		
OC45	5/-	OC83B	5/-	AAZ12	6/-	2N404	7/6		
OC71	4/6	OC122	5/-	AC128	7/6	2N502	47/-		
OC72	5/-	OC170	6/-	BCZ11	7/6	2N585	10/6		
OC73	9/-	OC200	10/6	BY38	7/6	2N1090	20/6		
OC81	5/-					2N1091	29/-		

SU2150A	10/-	X118	8/-	5V4G	8/-				
S11G12	10/-	X145	8/-	5X4G	8/6				
T41	12/6	Y63	5/-	5Y3G	4/6				
TDOX-20	70/-	Y65	4/-	5Y3G'	5/-				
TP22	5/-	Y66	8/-	5Y3WGTB	9/-				
TP25	15/-	Z800U	20/-	5Z4G	6/6				
TT11	5/-	Z801U	10/-	5Z4GT	8/-				
TT15	35/-	1A3	8/-	6AB6	4/-				
TTR31	45/-	1A5GT	5/-	6AC7	3/-				
TZ0520	4/-	1B22	30/-	6AG5	2/6				
TZ20	16/-	1C5GT	6/-	6AG7	6/-				
U81	30/-	1D8GT	6/-	6AH6	10/-				
U12/14	8/-	1E7G	7/6	6AJ7	2/-				
U17	5/-	1P2	2 6	6AK5	5/-				
U18	6/-	1G6GT	6/-	6AK7	6/-				
U25	11/-	1L4	2/6	6AK8	5/9				
U26	11/-	1LA6	6/-	6AL5	3/-				
U27	8/-	1LC6	7/-	6AL5W	7/-				
U50	4/6	1LH4	4/-	6AM5	2/6				
U52	4/6	1N91R	4/-	6AM6	4/-				
U191	11/6	1N43	4/-	6AQ5	7/-				
U801	18/-	1N70	4/-	6AQ5W	9/-				
UABC80	6/-	1R4	5/-	6AS6	4/-				
UAF42	9/-	1R5	3/6	6AS6W	9/-				
UBC41	6/-	1S4	5/-	6AS7G	15/-				
UBF80	5/6	1S5	4/6	6AT6	4/-				
UBF89	6/6	1T4	3/-	6AU6	6/-				
UBL21	11/-	2A3	5/-	6AX4	8/-				
UCC85	6/6	2C26	7/-	6B4G	17/-				
UCH42	8/-	2C26A	3/-	6B7	6/-				
UCH81	6/-	2C34	7/-	6B8G	2/6				
UCL82	8/-	2C45	22/6	6BA6	5/-				
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