and sea water, obtaining d.c. resistance of 1500 to 5000 ohms on coating it with water by a quick dip in the sea, but if a constant drizzle of sea water is aimed at the insulator, it is possible to go down to 400 or 500 ohms. In the case of the ship's insulator this resistive film will not be required to dissipate any power if none can be radiated. Some vessels are sometimes equipped with rather inefficient 'spray shields,' seldom entirely satisfactory, and in some cases where insulators go through a wall rain can wash salt from the superstructure onto the insulator despite any shield that may be fitted.

If any reader has had any experience of this phenomenon, or can direct me to any research which may have been done on it, I would be extremely interested to hear and I would also like to know if any firm is interested in the design of an improved spray shield. No thought has been given to this question for about 70 years!

John Wiseman
107 Antill Road
London E3

MILITARY ELECTRONICS

Congratulations on your editorial "The death delivery business" in the January issue. I never expected to see such sentiments expressed in a technical journal, at Christmas. Miracles continue to happen.

However, while being wholly with you in your distaste of the application of our professional work we must be aware of the alternatives. Could we, for instance, stand by and see defenceless people (our own families?) become the victims of force?

The real crime is that of insensitivity to one's "neighbour" and his needs. Jesus Christ had much to say about those who neglected the needs of others.

Presumably, those in the death business are not prepared to sacrifice their career prospects by seeking employment elsewhere, and few will blame them. In any case, the blame is not only theirs but all who contribute to the country's defence, both financially (by taxation) and by their political vote.

War is a terrible thing in whatever form, but so are greed and selfishness, and these also bound in all professions. Only when man is prepared to sacrifice his own needs and put those of others first will such things be defeated.

J. Skinner
Melsham
Wilts

F.M. TUNER DRIFT

Following your articles on the Nelson-Jones Mk II f.m. tuner (September and November 1978 issues), I feel some readers may be interested in a possible source of drift which I found in the Mk I (varicap tuned) version, and which may also apply to the Mk II and probably other designs as well.

The tuning voltage is applied to pairs of varicaps through 1MΩ resistors on the assumption that the leakage current of the varicaps will be very small. This is normally true – the ZC101 has a typical leakage current of 1nA at 20°C, but it has a maximum, specified value of 2μA, which would drop 2V through 1MΩ! In my tuner, I was suffering from drift on warm-up (on a time switch in a cold house) equivalent to something like a 50mV drift in tuning voltage. This could be produced by a 50nA change in leakage current which, being a highly temperature sensitive parameter, seems quite possible. Though I have no means of measuring such a current, parallelling the 1MΩ resistors with 100kΩ does seem to have done the trick.

P. J. Le Riche
Harpenden
Herts

The author replies: Yes I agree, and I have done some quick calculations which show that a value of feed resistor down to 47kΩ rather than the present value of 1MΩ is quite acceptable. The limitation of value in this downward direction is set by the need to avoid unduly loading the oscillator tuned circuit at the h.f. end of the band.

Assuming that the capacitance total in the circuit is around 10pF at 108MHz, the impedance of the tuned circuit unloaded would be around 16kΩ. The varicaps in fact provide a tapping at 50% so that the impedance of such a tuned circuit at that point would be around 4 to 5kΩ in an unloaded state ($Q = 200$-250). However, the tuned circuit is connected in an oscillator circuit and thus has a 'Q' greater than infinity in effect. Thus any loading is merely a l oad on the oscillator and will only serve to lower the oscillation level slightly unless it is so heavy as to stop the oscillator altogether. Thus a value of 47kΩ seems quite in order.

L. Nelson-Jones

"SOFTWARE DABBLERS"

As one of Professor H. Barker's "dabblers" I would like to add to the comments already made by M.A.I. Wilson in your February issue (letters). Yes, modern technology has made it possible for mechanical control engineers to use single chip microcomputers and low chip-count systems. It has made it possible for mechanical engineers to design better systems using microprocessors. In the recent past the operational amplifier has had a similar effect on analogue systems. Is it so bad that mechanical engineers and others should be able to step over the so-called boundaries? Control engineers using electrohydraulic systems have been crossing the boundaries every day. Test and development engineers think nothing of using electronic equipment for test purposes. Most modern engineers are quite familiar with computing, and software in the form of BASIC or FORTRAN.

I agree wholeheartedly with Mr Wilson in his call for unification of hardware and software. The design engineer, in whatever discipline he may work, who can understand the whole of his system and know when to call in specialists to help him is just what this country needs. What we don't want is a demarcation attitude of "who drills the holes" when the holes happen to go through metal and wood.

Extensive commercial exploitation will come from installation in all manner of equipment. To use equipment one does not need to be a specialist in its design but only to be aware of the characteristics which affect the remainder of the design.

In the teaching profession, to which Professor Barker belongs, the specialist often cannot bring himself down to the level of the people he is teaching. Articles written in *Wireless World*, when they are written by the people who have made the equipment, perhaps even classed as dabblers, often provide the reader with a better understanding of the topic than ever a specialist could.

The microprocessor revolution is upon us and Professor Barker might do well to remember what has happened to the elite in some of the revolutions of the past.

G. A. Jones
Kidderminster.

THE MILLIBEL

May I enter a private and personal plea for an hitherto unused "unit" the millibel or mB.

This little fellow is, of course, 0.01 of the familiar decibel and represents the smallest part of a dB with which one is likely to be concerned. In its favour it can be shown to save space and writing effort; and it also removes any ambiguity in the placing of a decimal point. I have used it myself, unofficially, in lab notebooks.

Still on the subject of decimal points I draw your attention to the current practice of giving values of resistance and capacitance without them. Thus 4.7μF is shown as 4μ7 and 2.2Ω as 2k2. It seems to me that this economical method might usefully be extended to other electrical units in the form of 1kW5 for 1.5kW or 11mA3 for 11.3mA. Where power or current is clearly meant the W or A can be omitted, as Ω or F are for resistance or capacitance.

As a by-product this stifles any controversy over whether one should write 4.7, 4·7 or 4,7.

Philip D. R. Marks
Bourne End
Bucks

RELATIVITY AND TIME SIGNALS

All of us would like to know more about the workings of the universe, hence our interest in relativity, whose object is to unravel those workings. Relativity readily gives rise to contradictions and its current protagonists seem to echo R. A. Houston in the 1930s, who wrote, "It is inadvisable to devote attention to its paradoxical aspects." Dr Essen (October 1978 and April 1979 issues) has testified to this "inadvisability."

A recent television documentary in the USA quoted experimental evidence for the slowing of light in the vicinity of the sun. The scientists on the programme hastened to save relativity by claiming that an observer on the sun would find the same light moving at its (full) velocity c. I wonder where this leaves the statement of Dr Griffiths (December 1978 letters) that "the velocity of light is the same for all observers." (I might point out that these words are not the same as nor, in my opinion, are necessarily equivalent to the words used by Einstein in his famous Principle 2.)

Whether any experiment has ever been performed to measure the speed at which light from a source S approaches an object moving at velocity v towards S I do not

know. If not, I am impressed by Dr Griffiths' faith. In his original paper, Einstein, in deducing the Lorentz quotations from his postulates and his synchronisation procedure, used the commonsense relative velocity of $c + v$ for Dr Griffiths' example and, wonder of wonders, came up with a different formula for compounding two velocities. The logic is equivalent to, "If $A = B$, if follows that A is not equal to B."

R. J. Diamond
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California State University
Los Angeles, USA

FERRITE ROD AERIALS

Professor Sutcliffe's article on the effective length of ferrite rod aerials in your December issue is sub-titled "A topic that has received almost no treatment in the literature". This may be true of recent years but there is a rather full treatment in the reference given below*. The approach is more general but the design equations are entirely consistent with those of Prof. Sutcliffe.

However, an expression for effective aerial height which depends on guessing an effective dipole length is of limited value. The suggestion that manufacturers might include the effective dipole length in the literature is helpful only if there is a standardized winding configuration, but this is not so in practice. In the above reference the expression for effective height, h_e, is given as

$$h_e = \mu_{rod}\, \omega A N F_A / c$$

The rod permeability, μ_{rod}, is a function of the material permeability and the length/diameter ratio, so, together with the cross-sectional area A, it is specific to a given rod type and could be quoted as data. However, the factor F_A is only unity for a short coil in the centre of the rod. In practice the windings usually occupy an appreciable length of the rod and are not centrally placed. The above reference gives data for estimating F_A and has graphs giving μ_{rod} as a function of permeability and the length/diameter ratio.

Another consideration is that the designer is mainly interested in optimising the signal/noise ratio and this, it is shown, involves maximising $h_e^2 Q/F_n$, where Q is the unloaded Q factor and F_n is the noise factor of the r.f. amplifier.

I am grateful to Prof. Sutcliffe for raising this subject and thus providing an opportunity for discussion.

E. C. Snelling
Haywards Heath
Sussex

* Snelling, E. C. "Soft Ferrites", Butterworth, London 1969, (Chap. 10)

WANTED — FOR THE SCIENCE MUSEUM

Next March the Science Museum is mounting a retrospective exhibition on television, and although offers of exhibits are coming in from industry and collectors alike I should like to enlist your help in finding two items that are proving elusive: a notable type of pre-war receiver, and a valve needed for the restoration of another receiver.

The receiver I am trying to trace is the Scophony large-screen projection set of about 1937, which employed mechanical scanning and modulated the light from a mercury vapour lamp by means of a 'supersonic light control'. The video signal was modulated onto a carrier at the resonant frequency of a quartz transducer and propagated through a liquid as an ultrasonic wave! The velocity of the wave was offset by the scanning process to give a stationary image that comprised, at each instant, something approaching fifty picture elements; this technique, it was claimed, gave much brighter pictures than could be obtained with conventional light controls transmitting only one picture element at a time.

Scophony produced several domestic models, with screen widths ranging from 18 to 48 inches, as well as a theatre model giving a six-foot picture from a 3kW arc. The price of the 24-inch model was 220 guineas, so not many can have been sold, but it was undoubtedly an advanced piece of engineering and I should very much like to exhibit a specimen if one survives in anything like complete condition.

At the other end of the price range was the Pye 817, a five-inch model selling for 23 guineas; this was a 'vision only' set, the detected output of the sound receiver being fed out to the pick-up sockets of the owner's radio. One of these little sets is being restored to working order for the exhibition, but the restorer is stuck for one valve: a Hivac AC/TZ, which was a triode tetrode and served as line oscillator and output stages. Again, any offers of help will be gratefully received.

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CITIZENS' BAND

Why are so many people against c.b.? It appears that somehow they are afraid it's going to degrade or lower the position of that almighty being, the licensed transmitting amateur. Surely this cannot be, as any citizens' band would not be connected with, or in, any amateur band. I am in full agreement with the people who argue about the interference caused by operation on a.m. in the 27MHz band. This is, as anyone with basic radio knowledge should know, useless for local or short-haul contacts, the all-round answer being the use of u.h.f. and f.m. An Australian friend of mine tells me that since the introduction of a u.h.f. c.b. band in his country they get better range; also the operating standards of stations seem to have improved.

I do not like the emphasis placed on the American system on 27MHz in most letters, and in recent programmes on the radio and television. All this talk of "Rubber Ducks", "Smokey Bears", "10-4" etc. has gone a long way to putting people against c.b. It may sound romantic to some, but in my opinion does nothing to help.

In reply to Mr Riley's letter in the January issue, in the controlled experiment it is apparent that the driver was compelled to answer the questions put to him while trying to negotiate a difficult course. Fair enough, but surely in an actual "on the road" situation any sane driver would firstly be moving very slowly, and if called on the radio could say "stand by, I'll call you back". Personally in bad traffic conditions I even turn off my car set to avoid distraction. As to the reference to inexperienced c.b. users vs. experienced communicators, I think driving experience comes first. Anyway, one only gains experience by being able to do a thing in the first place.

In conclusion, on the arguments that a citizens' band could be misused, you find in all walks of life there are always a few who try to spoil things for others; one can even hear this at times on the amateur bands. Also I think a good c.b. band could be a source of income for the government, i.e. licence fees, VAT on equipment, possible c.b. magazines, etc.—even, as some people have suggested, compulsory membership of a society, such as the RSGB, so there can be some check that you're not being a bad boy. Finally, if anyone does not like c.b., he need not buy any equipment, or even listen on the band, need he.

J. Berry
Bristol

DISPLACEMENT CURRENT

The pattern of magnetic field made when a very sharp edge of voltage propagates along any TEM wave structure is the same as that obtained if the wave front is replaced by a thin sheet of uniform conductor and the current of the wave is applied as a balanced d.c. on one side only of this sheet.

If this experiment is performed it will be found that there is no magnetic field whatever beyond the sheet and no longitudinal magnetic field at any point, despite the fact that lateral current is clearly flowing in the sheet. On page 67 of the March issue this result is described as being absurd, but it is nevertheless true.

Since the field pattern is just the same for the propagating edge as for the d.c. case it seems only reasonable to talk of a "displacement current" when a magnetic field is caused by change of the vector D rather than by real current. There is no question whatever of "displacement current" not causing magnetic field in some particular cases, and neither Maxwell nor Heaviside have overlooked a discrepancy in this matter.

K. C. Johnson
Cheadle
Cheshire

The authors reply:

In Mr Johnson's first paragraph, when he writes "uniform conductor" he must of course mean "uniform resistor."

When a TEM signal advances at the speed of light, there is a close mathematical correlation between the E field and the H field at every point.

When a TEM signal glides through a dielectric edged by a perfect conductor, there is a close mathematical correlation between the H field and the electrical current in the surface of the conductor.

D being a mathematical function of E and i also being a mathematical function of E, it is not surprising that the two mathematical derivations from the same source, E, correlate, even to the extent that there is a con-