LESSONS FROM CRUISING SERIES BLUE WATER SAILORS

MARINE RECEIVERS FOR WORLD-WIDE CRUISING

JOHN CAMPBELL tells what to listen for — and how to hear it!

ALL OF US who sail in British coastal waters are used to having our lives ruled by the shipping forecasts. We all know how to tune into the local radio stations or 'the Beeb' to get a weather forecast. We can even listen to the nine o'clock news and set the chronometer. Even the greenest (in my sense of the word) neophyte can point his Seafix at a series of radio beacons and come up with some semblance of a fix. But what happens when we get off the Continental Shelf? What radio information can we get on a blue water passage?

To come to grips with radio communications, it is helpful to understand a little of how it works. A radio signal is an electromagnetic wave. Before you turn over the page in horror, let me point out that light, too, is an electromagnetic wave, and the two are similar in many ways.

Though these waves travel in a straight line from one point to another, they are both capable of being refracted (bent) and reflected, before finally being absorbed. This will be important to remember later. A radio wave is often shown diagramatically as a sine curve (Figure 1). Back in the good old days, a radio wave was determined by the distance between two peaks on the curve, or its 'wavelength'. (Figure 2). The Shipping Forecasts come on fifteen hundred metres. This means that the distance between two adjacent peaks was 1,500 metres, or not too far off a mile. This is quite a long distance in anybody's book, and to this day this area of the radio spectrum is called *'Long Wave'.*

In electronic terms it is easier to count the number of peaks that pass a point in a second, rather than the distance between them. So now we refer to a given wave by its frequency. A radio wave of a wavelength of 1,500 metres will have two hundred thousand peaks, or cycles, pass a given point in one second.

In metric jargon, we substitute kilo for thousand, so fifteen hundred metres became two hundred kilocycles a second. Before we had time to get used to that, the word Hertz was substituted for cycle per second, and we now find Radio 4 on two hundred kilohertz (200kHz).

We still talk about long wave, medium wave, and short wave, yet the tuning information for a station is always given as its frequency. From Figure 3 it should be fairly obvious that two waves, A and B, are travelling at the speed of light, then Wave A, with a Longer wavelength, will have fewer peaks (or cycles) passing a given point than Wave B. So, a long wavelength means low frequency, and a short wavelength means high frequency.

Thus:

Long Wave = Low Frequency, 140kHz to 300kHz
Medium Wave = Medium Frequency, 500kHz to 1,600kHz.
Short Wave = High Frequency, 4MHz (4,000kHz) to 28MHz (28,000kHz).
VHF = Very High Frequency, 88MHz to 175MHz.

(The related wavelengths and their frequencies are tabulated in Reed's by the way.) Between Long and Medium Waves are the Marine and Aero radio beacons. They mostly operate between 270 and 400kHz. Between Medium and Short Waves are the MF (medium frequency) communication bands, between 2 and 4.5MHz.

Radio waves will travel in a straight line from transmitter to receiver, unless they are refracted or reflected by something. That *something* is usually a combination of atmospheric layers. The atmosphere around the earth has a number of distinct layers which can refract, reflect, or absorb the radio waves, and the degree to which that is done is largely dependent on the frequency of the wave.

The heights of these layers change with the seasons and with the time of day. The layers we are interested in are the D, E, and F Layers, in which the sunlight has split the particles to give negatively-charged electrons and positively-charged ions. This process is called ionisation, and these layers make up the region in the atmosphere called the ionosphere.

The D layer is about 40 to 50 miles above the earth, where the atmosphere is comparatively thick. As soon as the effect of the sunlight decreases, the particles quickly re-combine and the layer vanishes. Likewise, the E layer, about 60 to 70 miles above the earth exists only from dawn to dusk, with its ionisation at a maximum at noon. However, the F layer, which ranges from 130 to 260 miles above the earth, is in a region where the atmosphere is very thin, and it is not so easy for the particles to re-combine because they are so thinly spread. This ionised layer is always present, although it reaches a minimum at dawn, and it is greatly affected by sunspot activity as well as the season and time of day.

Waves of a frequency above 30MHz are rarely reflected at all but pass out into space. This limits VHF to what is usually taken as *'line of sight.'* So, on a blue water passage, VHF will be limited to contacting other vessels, or for use before departure, or upon arrival, in port.

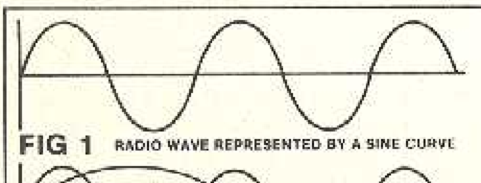


FIG 1 RADIO WAVE REPRESENTED BY A SINE CURVE

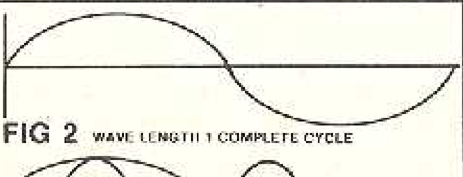


FIG 2 WAVE LENGTH 1 COMPLETE CYCLE

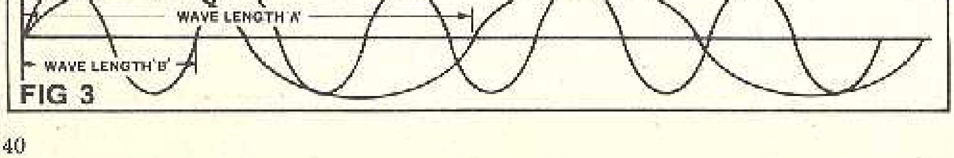


FIG 3

All other radio waves below 30MHz are affected by the ionosphere to a greater or lesser extent. The D layer is the villain. It absorbs everything of a frequency below about 10MHz (that includes all the long, medium, and half the short waves.) This means that while the D layer exists, these waves don't get a chance to be reflected by the other layers. The lower the frequency, the greater the absorption.

Those waves with a frequency between 10 and 30MHz (the top half of the short wave band), can pass through the D and the E layers to be reflected back to earth by the F layer. This means that they can be received a great distance from the transmitter (Figure 4).

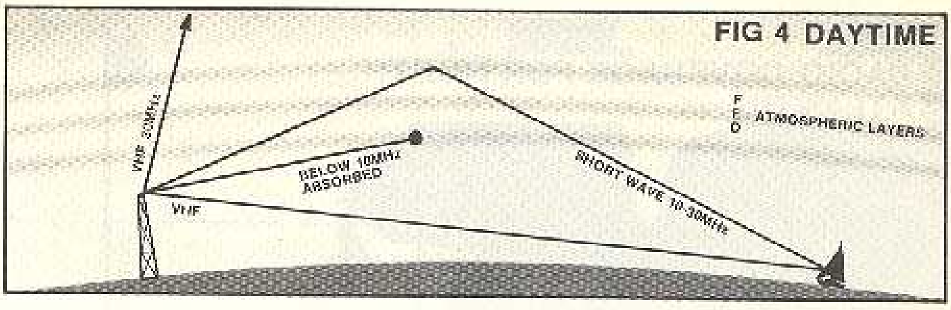


FIG 4 DAYTIME

At night the D and E layers disappear, so the lower frequencies are not so readily absorbed. However, the ionisation in the F layer is also reduced, which in turn reduces its ability to refract and reflect the radio waves. The waves of a higher frequency now pass through the F layer unreflected, but the more easily refracted lower frequencies are reflected back to earth.

What does all this mean in practice? Low frequency signals, i.e., long wave stations, may have a range of around five hundred miles by day, but could have a range of up to a thousand miles by night, since the signals are not absorbed by the ionosphere and may even be reflected back. At night it is often possible to receive BBC Radio 4 as far away as Gibraltar or the Azores; under good conditions, even as far as the Canaries. The synopsis before the shipping forecast can be very useful and time checks can be obtained at the start of each news bulletin.

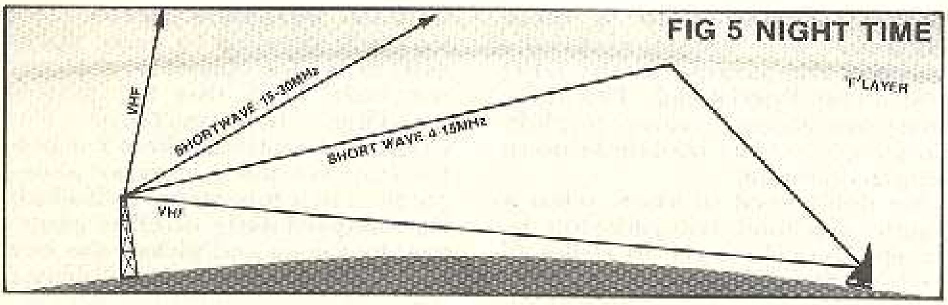


FIG 5 NIGHT TIME

Medium wave stations, including radio beacons, will have a normal range of 50 to 250 miles, depending largely on the power of the transmitter. Under freak conditions at night, the range may be greatly increased. It is not all that uncommon to suddenly pick up local late night pop stations from the States while in Mid-Atlantic, but such conditions cannot be relied upon.

As far as radio beacons are concerned, we have been spoilt around Britain. Few other places in the world can boast so many beacons, so well-maintained. It is never wise to place too much reliance on a radio aid, particularly so when it is maintained by a developing country, or a small island state. Still, radio aids can be very useful for confirming the identity of an island or one's position on a featureless coast, particularly when visibility is poor.

Some countries have an annoying habit of changing the frequency of a beacon, and it can be several months before the change is noted in the lists of radio signals. Three times I have left on a passage with the latest information available, to find a beacon on a different frequency upon arrival. Because of this, I would strongly recommend that the cruising yachtsman choose a radio direction finder that is infinitely tuneable, rather than one that needs the frequency punched into a calculator-type keyboard. With the latter type it is impossible to search for a beacon if its frequency is unknown.

Beyond the range of Radio 4 and outside the range of radio beacons, nearly all our radio listening will be restricted to short wave. What we need to be able to hear are time signals for navigation and severe weather warnings. And, it is nice to be able to listen to the news from time to time.

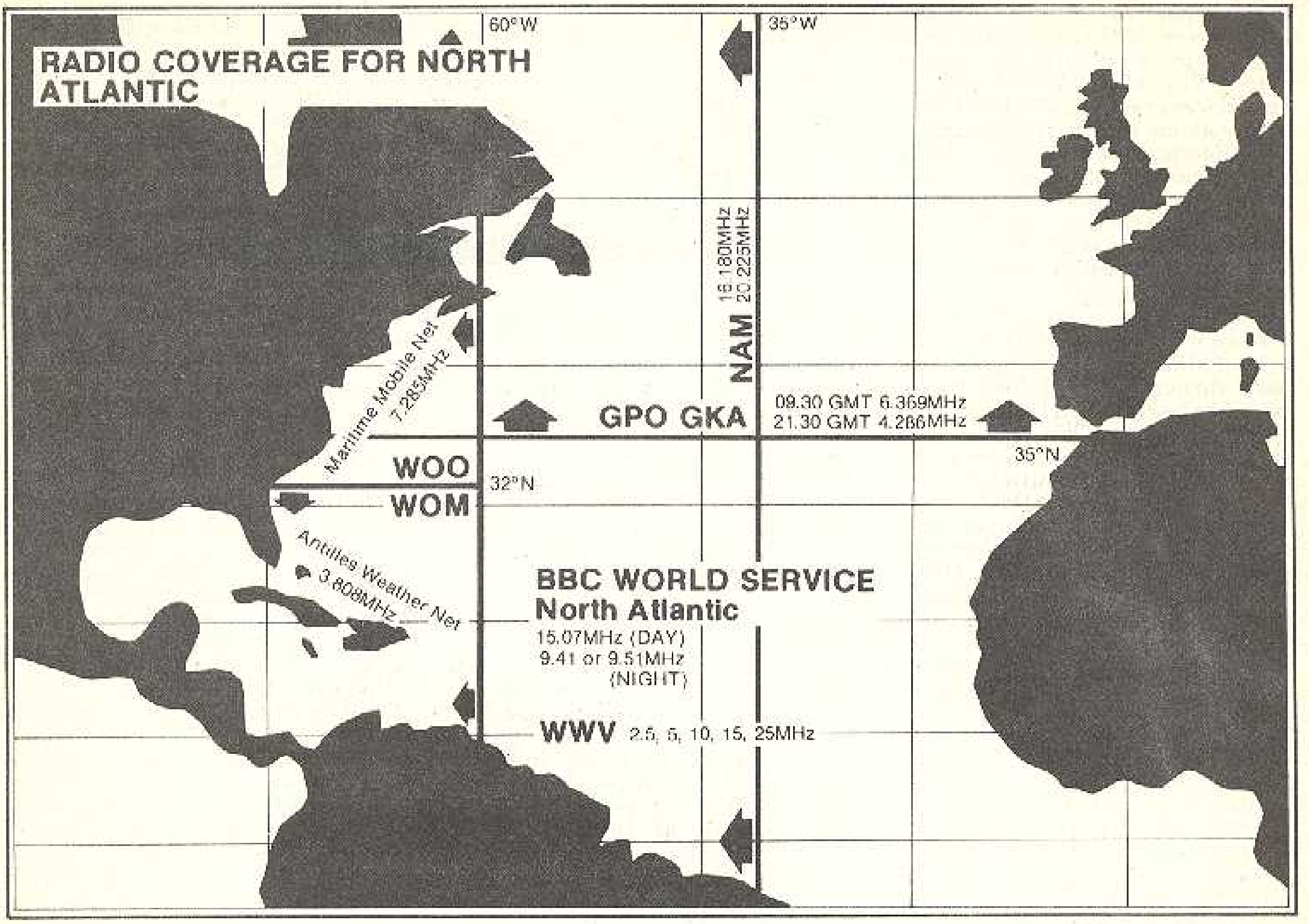
The BBC World Service provides a valuable service, not just to cruising yachtsmen. It provides a time signal on the hour, almost every hour, together with news and a variety of other programmes on a number of frequencies. The frequencies used change with the time of day, season and geographical position. The BBC publish a monthly magazine called *London Calling* which not only lists the programmes but also gives the best frequencies for different areas at various times. It can be obtained by writing to BBC *London Calling*, Box 76, Bush House, London WC2B 4PH. A year's subscription costs £4 to an address in Europe and £6 to all other addresses. We have also found that most British Embassies receive regular supplies of the magazine and are willing to hand out single copies free.

Good frequencies to start off with, in the North Atlantic, are 15.07MHz by day and 9.41 or 9.51MHz by night. Don't expect to receive these in Britain though. Because the signals go all the way to the ionosphere and back, there is an area called the skip zone where no signals are received. One has to be two or three hundred miles away before the signals can be received, or, very close to the transmitter. With very few exceptions, the programmes are designed for a world-wide audience, so it would be impossible to put out weather information. The area covered is just too large. This need is covered by other short wave stations.

In the United States, the National Bureau of Standards runs a station called WWV at Fort Collins, Colorado. This station runs 24 hours a day on 2.5, 5, 10, 15 and 25MHz. It gives a time signal every minute. From the earlier theory, one should be able to pick the best frequency for any given time and area.

At eight minutes past every hour, WWV broadcasts a weather synopsis for the whole of the North Atlantic. The synopsis is brief, but it gives the position of any major depressions and the expected wind forces at various distances from the centre. It can provide early warnings of any extreme weather conditions that are forming.

At 18 minutes past each hour, an announcement is made concerning solar activity. This can give a forecast of short wave radio conditions to be expected. The only one to really concern us would be the solar flux figure. This is on a scale of 60 to 260. The higher the figure, the more sunspot activity. This in turn means the better the reception on higher frequencies. Sun-



spots run on an eleven year cycle and we are just entering one of the peak periods. Within the eleven year cycle there is a 27½ day cycle as the sun revolves. When most sunspots face us, we get the best short wave reception on higher frequencies.

Other stations that put out long range weather forecasts include the GPO Station GKA at Portishead. This provides a forecast for the North Atlantic north of 35°N at 09-0 GMT on 6.369MHz, and at 2130 GMT on 4.286MHz. The only snag is that it is in Morse! The speed is around 19 to 20 words per minute, and the forecast is in plain language.

The Americans put out a similar forecast from Norfolk, Virginia, Station NAM. This gives a forecast for the North Atlantic west of 35°W at 0630 and 1900 GMT on 16.180MHz and 20.225MHz. Again, the forecast is in plain language Morse. Both of these stations can usually be received anywhere in the North Atlantic if conditions are reasonable.

There are two powerful stations on the east coast of the USA. WOO at Ocean Gate, New Jersey gives forecasts for north of 32°N and west of 60°W. WOM at Miami, Florida, covers the Caribbean, Southwest North Atlantic and the Gulf of Mexico. Both of these stations are communications stations comparable to the GPO station at Portishead. The forecasts are given in voice, in plain language, but the transmission in single sideband.

We don't need to know what a single sideband transmission is, except that if we try to listen to such a transmission on an *'ordinary'* radio it will sound like Donald Duck speaking, and be unintelligible to us humans. The transmissions are supposed to be received on a marine single sideband communications receiver, which is expensive. There are other ways to receive it, and we will look at those in a moment.

For an up-to-date list of times and frequencies for WOM and WOO, plus many other weather forecasting stations world-wide, it is worth consulting the *Admiralty List of Radio Signals, Volume 3. Volume 2*, of course, covers the world wide radio beacons.

Last, but by no means least, there is amateur radio. A ham radio can be a very useful piece of equipment to have on board. The US Government has a much healthier attitude toward amateur radio than ours. Provided certain conditions are met, it is possible for a ham ashore to patch one into the national telephone service. This makes it possible to make phone calls at sea for almost no cost, and we have used this for getting weather information. For example, on passage from Tahiti to Hawaii, we made regular phone patches to a forecaster in Hawaii. He analysed daily satellite photographs for us and picked the best spot for us to cross the doldrums. His weather-routing perhaps saved us almost a week, and saved us unknowingly crossing the doldrums at a wider spot.

Our own Government does not take such a liberal view. Perhaps because the GPO has a monopoly on almost all forms of communication. The use of ham radio is much restricted in the UK. The passing of even such safety information as weather forecasts to a yacht by ham radio would be illegal here.

There are several so-called *'nets'* that operate in the Atlantic area, where groups of stations meet regularly to exchange help or information. For the reasons already outlined, these tend to be US or Caribbean stations.

Between 1000 and 1100 GMT there is a Maritime Mobile Net on 7.285MHz. There is a so-called Waterways Net that operates on the east coast of the USA on

14.313MHz most of the day. Another useful source of weather information is the Antilles Weather Net on 3.808MHz at 1030 and 2230 GMT. Because of the low frequency used, this will not be received over great distances except under ideal conditions.

To receive amateur radio stations, the best equipment to use would obviously be a ham radio. Then, provided the operator has the required license, he will be able to speak back to the other stations and request the desired information. However, it is perfectly feasible to listen in using less specialised equipment, because the amateur broadcasts, in the frequencies we are considering, are similar to any other short wave broadcast, except that once again they are single sideband.

Let's look now at what sort of radio receiver is required and what sort of capabilities to expect. The first requisite for any short wave receiver is some kind of fine-tuning device. The stations are often close together and with the ordinary coarse-tuning dial, often impossible to separate. If you want to listen to single sideband transmissions, then the magic switch to ungarble Donald Duck is a BFO switch. BFO stands for beat frequency oscillator. This bit of electronic wizardry primarily makes Morse easier to hear, but it also makes single sideband transmissions intelligible.

Plate 1 shows about the most basic radio that would be useful. It is actually a National Panasonic RF1100 which has crossed several oceans with us already. It has four wavebands. FM is in the VHF area and is for short range reception of local stations — harbour entertainment. Next is long wave, which gives us BBC Radio 4 and the shipping forecasts down to the Canaries, but since we left there, the band has only produced a few squeaks and crackles. Not many areas of the world have broadcasts on long wave. Then there is the medium waveband. This, of course, is where people in Britain are used to finding Radio 1, 2 and 3. Here in the Virgin Islands, it is filled with local stations putting out never-ending steel band and reggae music, and something with the unlikely name of *'Rasta Music'*. Finally there is the short wave band which goes from 6.0 to 18.0MHz. This covers the most commonly used international broadcast frequencies. The stations are very close together though, and it sometimes takes a bit of searching with the fine-tuning control to isolate the chosen station. It has no BFO switch, so it is not possible to understand any single sideband transmissions received with this radio.

We recently treated ourselves to a more sophisticated radio, and selected a Panasonic 2200 shown in Plate 2. This does have a BFO switch which facilitates Morse reception and opens up the world of single sideband transmissions. It also has eight wavebands. It has the identical FM and medium wavebands as the smaller radio. The remaining six wavebands are all in the short wave area, covering from 3.9 to 29.0MHz. Because so much more space *'on the dial'* is given over to shortwave, the stations are more widely separated. Tuning is also helped by being able to select fine or coarse adjustment on the tuning knob, and a separate dial marked every 10kHz (or 0.01MHz). The calibration of the dial can be very accurately adjusted by using the built-in crystals for calibration. It is possible with this radio to dial the published frequency and find the station without searching. But nothing in this world is perfect this radio has no long wave band. This means that the little radio has to keep sailing with us until we decide to return to Europe and the land of Radio 4.

With both these radios, we have had adequate reception on short wave using the built-in extending antenna. However, in marginal conditions, reception can be improved by using a backstay as an additional antenna, or in our case, with a junk rig, by hoisting a long wire on the burgee halyard. Many radios have a socket or a terminal for an external antenna, Failing this, fasten the wire to the built-in extending antenna.

There are a number of 'ham-radios' suitable for installation in a yacht. We have a Japanese Yaesu, and another popular ham radio for yachts is made by Atlas in the USA. Probably the main factor to consider in choosing a ham radio for a yacht is the power requirement. Both the Yaesu and the Atlas can be made to run off 12 volts.

Now you have some idea about the vast numbers of radio waves flying around free for the taking, and a reasonable idea how to trap them. I hope this knowledge will make your blue water cruising a little safer, and perhaps a little more enjoyable. ●

PLATE. 1. This is the RF 1100DLBE — to give it it's full title — and it is just about the most basic set to consider.

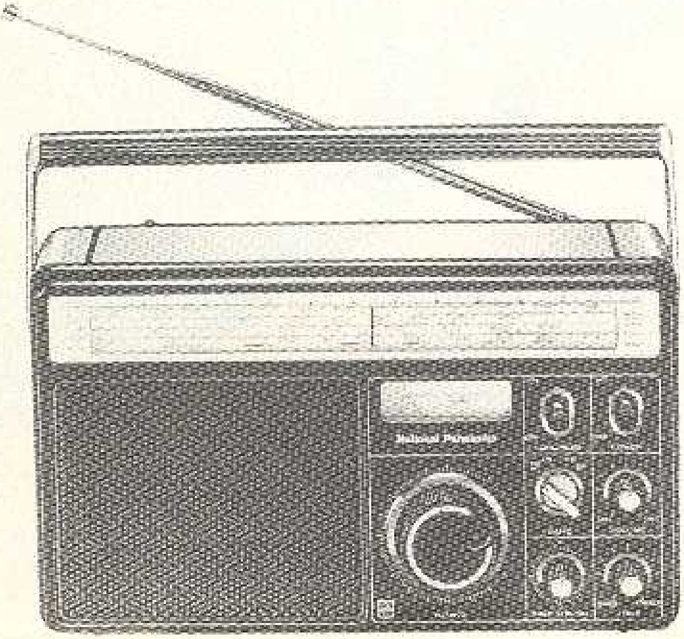


PLATE. 2. The 2200 (above) has been discontinued and replaced in the range by models DR26, DR29 and DR49. Further details of these radios may be had from Elaine Maitland, National Panasonic (UK) Ltd, 107 Whitby Road, Slough, Berkshire, SL1 3DR. (Tel: Slough 27516).