RRS Newsletter

(For the Use of R.R.S. Staff Only)

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SUB-MILLIMETRE WAVES

This is the popular, and somewhat obvious, name given to the decade of the electromagnetic spectrum lying just below one millimetre wavelength. It is the subject of a great deal of research at present. It has always been comparatively unknown and therefore fascinating, and it is worthwhile starting from a historical view-point to see why.

In 1888 Hertz, like Columbus, set foot boldly on an unknown shore in an unknown land: this land was the radio spectrum and the landing point was a wavelength of 66 centimetres, in what we now call the UHF region.

This discovery was unique in that Hertz had set out deliberately to do what he did. He wanted to find Maxwell's electromagnetic waves at much longer wavelengths than those of light and he wanted to prove that he had found them, which he did conclusively. So much so that, like the Spanish nation after 1492, the scientific community of the time set off to explore the treasures of this unknown land. They repeated Hertz' experiments; they improved his equipment or invented new in the course of an explosion of ideas and, most important of all they set off eagerly to explore the shore on either side of his landing point of 66 centimetres.

At first the work was done by physicists keen to carry out beautifully designed experiments to show the optical properties of the new waves.

This was more easily done at the shorter wavelengths and they concentrated on these so that by 1895 wavelengths as short as 5 mm. had been reached - so near to sub-millimetres. The early pioneers were Lebedew in Germany, Righi in Italy, Bose in India and our own Lodge and Fleming - a truly international expedition.

At the same time other men were having a look at these new waves. Men with money and a keenness to experiment and (it must be said) not limited by the up-bringing and ideas of a physicist. Men with an eye on practical uses and able to achieve the impossible because they did not know it could not be done.

Such a man was Marconi.

He went the other way, towards the longer wavelengths and showed that communication over a distance was possible. Eventually he convinced the British Government who, remarkably enough, saw its possibilities for contact with ships and for political and military advantage.

/The

The story of the growth of Marconi's wireless telegraphy is out of place in this article. The main point for us is that the furious interest it started in long wave communication completely swamped any interest in the shorter wavelengths. They were forgotten by all but a few for more than three decades.

After about 1910 isolated experimenters started work and eventually two main streams came about.

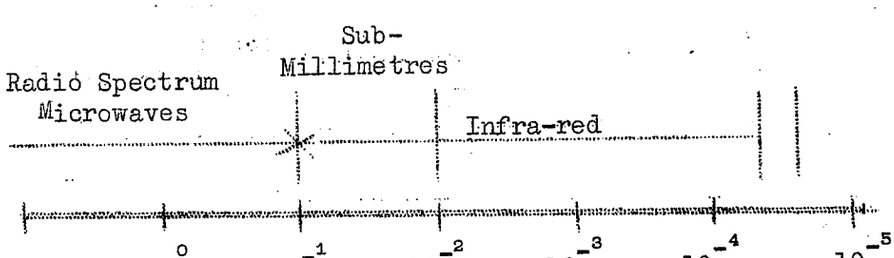
One stream, of which George Southworth is the inspiration, went via the invention of waveguides and the magnetron, through the intense wartime effort on radar, to the settled sophisticated centimetric techniques as we know them today.

The other stream went to shorter wavelengths still. They were the Gap closers - workers interested in generating and experimenting with wavelengths between the shortest radio waves and the longest infra-red waves. This untidy region which no one used and of which little was known, was a challenge because of its very existence. Thus they wanted to close the Gap and many claims to have done so have been made.

Their researches are interesting to follow. Their ingenuity was remarkable but they are most fascinating for the glimpses they give of the flesh-and-blood behind it all.

Take the Arkadiews in Russia. In 1912 Professor W. Arkadiew wrote on short radio waves. In 1924 a woman, A. Glagolewa-Arkadiewa invented a sub-millimetre generator, the mass-radiator. She wrote until 1941, then in 1951 V. K. Arkadiew published a thesis on the same subject. Then there were the two American gentlemen who appear to have indulged in the well known scientific technique of running the other fellow down then pinching his apparatus and calling it their own. They shall remain unnamed.

These early Gap closers tried hard but, despite their claims, they failed because they could not provide good generators. Even now this is still the most urgent and dominating need and the man who can produce a stable, c - w, tunable, high-power, narrow-band generator will be well on the road to fame. But this still seems far off.



Wavelength Cms.	10	10^{0}	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}
Microns			1000	100	10	1	10^{-1}
Frequency Gc/s.	3	30	300	3000			

1 Gc/s = 1 Gigacycle = 1000 Mc/s.

Much has been done but no one generation technique seems outstanding.

/Lasers

Lasers have leapt the gap and are gradually attacking it from the other side - for example, Dr. Gebbie's water Laser at NPL. Conventional microwave techniques have been miniaturised to an unbelievable extent and the French have reached well below one millimetre with their Carcinotron. Harmonic generation has proved the most successful solution so far and Dr. Froome at NPL has produced 0.3 millimetre from 8 millimetre fundamental. In addition many exciting new techniques have been tried of which generation by Cerenkov radiation seems the most promising.

One reason for the present-day interest in sub-millimetre wavelengths is their possibilities for communication. The standard illustration of this is to point out that they have high enough frequencies to carry the whole of the present usable RF spectrum as modulation. A serious difficulty is that they are absorbed more or less highly by atmospheric gases, in particular water vapour. Thus, terrestrially, they must either be used over short optical paths or conveyed in suitable pipes. The former has interesting possibilities for short-range secret military uses (in battle for example) or where a system of spaced aerials can be used, but pipes seem likely to be the method of the future. Thus, after generation, the problems of transmission seem most in need of solution and, indeed, much work is being done on overmoded circular waveguides and on optical lines.

In outer space transmission will be much easier because of the absence of absorption and that is where these wavelengths may have most application.

As part of the transmission problem, a good deal more needs to be known about absorption by atmospheric gases. This also has interesting applications to molecular spectroscopy of these gases and, in particular, to the problem of line width. Using a Froome generator, some measurements of this type are to be made at RRS by direct transmission measurement of absorption.

The design of suitable sub-millimetre receivers, or even mere detectors, is still in a rudimentary stage. The most popular detector now in use is a pneumatic one developed 18 years ago for infra-red work. More sensitive detectors have been designed recently, but there is need for receivers which will provide amplification and demodulation to recover information. However, successful amplification usually follows successful generation, so we are back at the original need.

Thus, although we have gone a long way since Hertz, there is still a great deal more to do.

J. Pearson

JOURNEY TOWARDS THE QUIET SUN

REPORT ON A VISIT TO ISRAEL

Part 4

The journey to Jerusalem takes just over an hour by express coach from Tel-Aviv's turbulent Central Bus Station which is no longer big enough to cope with the teeming masses so that coaches, buses and queues spill over into the neighbouring streets. Our route follows that of the ancient road which thousands of years ago carried building materials for King Solomon's Temple from Jaffa to Jerusalem. Once having left the concrete wilderness of Tel-Aviv we can enjoy the colourful variety of the countryside in April. The blue sky you may already take for granted, and the vivid green of the meadows is set off to perfection by the rows of tall, dark and handsome cypresses sheltering the citrus plantations. Heavily gilded mimosa and yellow

/daisies

daisies are brilliant rivals in the same part of the spectrum, and the wild poppies will delight any colour-photographer's emulsion. The graceful and varied eucalyptus tree, a successful Australian "immigrant", provides a pleasing sight on hilltops, on former malarial swamps it helped to drain, and along the roads it shades and screens from the sun and hostile observers across the never-far borders. The story that the tree's name was derived from the complaint allegedly uttered by branches after they had been cut down ("You clipped us!") sounds too far fetched even if it originated "down under".

An ubiquitous plant rearing its spiny heads in hedges and on open ground is the flat-jointed cactus which produces the aptly named prickly pear. This orange-yellow fruit ripens in the late summer, is very refreshing but needs skilful handling. Its Hebrew name "sabra" is also applied to the native Israelis who, like the eponymous fruit, appear prickly on superficial acquaintance, but are quite sweet inside.

We pass through Ramla, a busy Arab-built market town, home of Joseph of Arimethea and former headquarters of Richard Coeur de Lion - with a fine thousand-year-old Saracen tower and numerous minarets like old-fashioned rockets forgotten on their launching pads. Food always plays an important part in and around the market. Sweetmeats and pastries are on not-too-hygienic display, but for a quick snack there is nothing more appropriate than a peeta stuffed with felafel.

Peeta is the pancake-shaped Arab bread slit to form a pocket into which are stuffed felafel - small balls of ground chick peas, deep-fried and rather pungent - with pickled vegatables. Sabras love it and crowd round stalls serving such food even in the civilized centres of cities. Accompanied by our invaluable Arab-speaking friend we had bravely ventured into a small restaurant to try some other local dishes. Shashlik - charcoal-grilled pieces of lamb on long iron skewers and humus, which is much better than it sounds or looks: a highly seasoned oily puree of finely ground peas to be liberally wiped up with peeta. After this you feel in need of genuine Turkish coffee poured from a long-handled pot into minute cups. Finely powdered coffee has been boiled up three times with sugar - the result is thick, brown, sweet and strong and the residue in the cup has a fortune-telling potential equalled only by tea leaves.

Our bus now approaches the region where in bitter fighting during the Israel/Arab war the old road and thus the only link with Jerusalem was cut. An emergency road by-passing Arab-held territory was built and many lives were lost in keeping supplies flowing to the beleaguered city. We pass the rusty remains of battered army vehicles, some carrying wreaths, left to serve as a war memorial where they were ambushed. The winding road climbs into the Judean hills, an area of extensive afforestation. The six million trees of the Martyr's forest not only commemorate the victims of Nazi persecution but help future generations by breaking up the rocks and retaining the precious moisture.

We are about 2,500 ft. above sea level when we enter the outskirts of Jerusalem, Israel's capital with nearly 200,000 inhabitants. Modern in appearance it forms by far the largest sector of this divided town; the Old City unchanged for centuries on a hill across a strip of no-man's land lies in Jordan.

/Much

Much of the Israeli sector, however, resembles a vast building site as it expands westwards across the Judean hills and valleys. The vast new campus of the Hebrew University has replaced that on Mount Scopus, now an enclave in Jordan, which is still being guarded under U.N. supervision. The hospital which also had to be abandoned up there has arisen again, well inside Israel territory, as one of the most modern in the world, overlooking the attractive village of Ein Karem, birthplace of St. John the Baptist. A Museum City is under construction which will include the Shrine of the Book to house the famous Dead Sea Scrolls. They are now on show at the University. Easily legible, the text can be read and understood by any Israeli schoolchild so little has the language changed over the many centuries since the scrolls were written.

Among olive trees in the valley stands a 6th century fortress, the Monastery of the Cross, on the site of the tree from which the Cross was made. It took us some time to find the opening in the outer wall and even I had to duck to enter. A maze of courtyards, passages and stairs led to a Byzantine church opened for us by a small woman with a large key and nothing but Greek which it was to us too. The circular hole in the floor, however, was clearly the place where the infamous tree had once stood.

Just off the busy main road you enter the relative quiet of the Orthodox Quarter, dilapidated houses and narrow streets where men with long beards and long coats have retained their centuries-old appearance as in the former ghettos of Eastern Europe. Fanatically religious they profoundly dislike the modern state of Israel and the profanation of the sacred language of the Bible, and they still fervently pray and wait for the arrival of the Messiah.

Not many yards further on, a yellow trilingual notice faces you: Stop Frontier! Beyond the barbed wire the blue U.N. flag indicates the occasional meeting place of the Mixed Armistice Commission, and houses near there are already "on the other side". A new block of flats is windowless at the back which is the border. A U.N. field car stands by the famous Mandelbaum Gate, the only passage between Israel and its neighbours. Not that they recognise the existence of a state of this name. The pilgrim or tourist who after complicated formalities is allowed to enter Jordan at this point puts away his passport with the Israel visa on leaving the Israel frontier control, walks across to the Jordan post and presents his second passport (unsullied by any reference to Israel) which is then duly endorsed "arrived at Jerusalem airport". His luggage has meanwhile been put down by an Israeli halfway between the frontiers and an Arab porter will go out to collect it from there.

We who cannot enter the Old City in this way have to be content to view it from afar. From the tower of the magnificent Y.M.C.A. building, perhaps, or the terrace of the luxury King David Hotel opposite, whose right wing was blown up during the bitter days of "underground" warfare (literally so in this case) against the British authorities.

Hopefully we follow a road towards the east but soon a wall blocks our progress and a double fence cuts across the valley at our feet. However, the magnificent view tempers our frustration: in the distance the Mount of Olives and Garden of Gethsemane slope towards the walled City on the hill opposite us. The Moslem

/sanctuary

sanctuary with the shimmering Dome of the Rock (over the rock whence Mohammed ascended to heaven) stands on the site of the ancient Jewish temple. To the left the Church of the Holy Sepulchre and in front Mount Zion in Israel territory - a unique panorama of places holy to so many millions.

We come closer to the City walls on our way up Mount Zion. Here lies the tomb of King David, venerated by Jew and Arab, and, close by, the room of the Last Supper next to the Dormition Abbey where the earthly life of the Virgin Mary ended. The sandbags in the belfry of the Abbey are a reminder that fighting in and about the Holy City, a recurrent feature throughout its singularly long history, still has not ceased in our day.

A short bus ride brings us to the southern outpost of the so-called Jerusalem Corridor. In brilliant sunshine with a full westerly gale blowing to make it rather chilly at this altitude, we struggle up to an observation platform. To the south, across the barbed wire on a distant green hill we can see Bethlehem, where the Manger stood, and turning north we recognise again the Dome of the Rock and Golgotha, the site of the Sepulchre.

In the east a massive wall of cumulus clouds not far from us appears unusually low above the horizon. They are rising from 4,000 ft. below, the lowest point on the earth's surface, the Dead Sea - only 15 miles away, but we shall have to make a long detour to get there.

(To be concluded)

W. S. Newman

STAFF NEWS

Congratulations to:-

Maureen Armstrong and Michael Bethell who were married on 25th July at St. Ethelbert's Church, Slough.

Pat Dannahy on her marriage to Michael Galindo on 15th August at St. James' Church, Fulmer.

Mr. & Mrs. Ray Kellsher (now in Nairobi) on the birth of their daughter

Miss Anthea D. Arman on her promotion to T/C.O.(Sec.)

Welcome to:-

New Staff

Mrs. F. Richards	Part-time Typist II
R. S. Davies	T./S.A.
Mrs. P. M. Drakeford	T./C.A.
R. L. T. Street	College based Sandwich Course Student
I. Grimes	T./Specialist Teleprinter Operator
J. M. Gailer	T./A.E.O.

Resignations:-

Mrs. M. J. Baber	T./A.E.O.
D. Brooks	T./S.O.
Miss M. A. Armstrong	S.A.
Mrs. J. M. Johnstone	A.E.O.
R. D. Eberst	T./A.E.O.

SPORTS AND SOCIAL CLUB

This month the committee has been sadly depleted owing to the lure of the sun at holiday time.

However we do have two dates for your diary. Firstly the annual Motor Rally, John Reed has very kindly offered to organise this, and plans that it will take place on September 6th, police permitting, of course. I am told by him that for those intending to take part, Ordnance Survey sheets 168 and 169 are necessary.

The second date to note is September 26th, when we shall be holding a dance in the refectory. The final details are not yet settled, so watch the Notice Board!

J. Juleff

Tennis

There are sufficient members for both a mens and ladies singles tournament this year. Details of the draw are on the Notice Board and players are requested to arrange their matches without delay. To give everyone a good chance of at least two matches there is a plate tournament for those losing their first match.

The Smith-Rose cup matches will be arranged shortly and details will be posted on the Notice Board.

P. A. Smith

Cricket

This season interest in cricket has declined. A start in lunchtime cricket was made after "Open Week" but the number participating has disappointed. London are unable to find any Smith-Rose teams this year. A further effort will be made to arrange a North v South match towards the end of August.

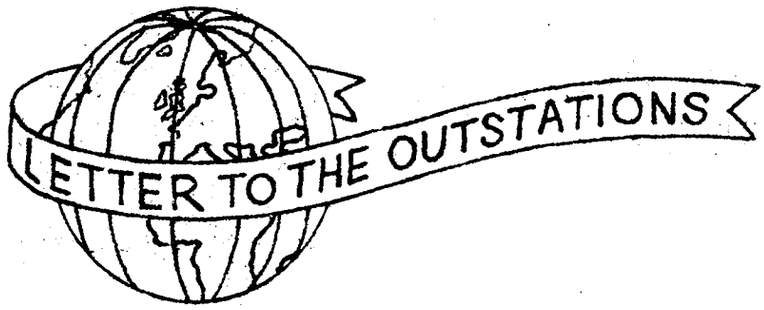
D. E. Page

Did you know .....

The Co-operative Permanent Building Society is "Always prepared to make advances to Women".

It is an offence to sell a second hand anchor to a person under sixteen before 8 a.m.

J. N. Tyler



Dear Colleagues,

The Radio Research Station could not be described as a deserted village; but there is at present a fashionable lack of inhabitants. It suggests that the Season is well past and that many of us have left Town to indulge in rural sports. Indeed one spur boasts only two or three ardent researchers at present.

The reason is indeed the season - with a small "s". Holidaymakers re-create themselves on summer leave. Thinkers confer at conferences (let RRS delegates beware the Grecian gifts, hemlock at tea-break constitutes a short way with garrulous philosophers). Mechanicals carry the search for truth, if not to the bottom of a well, at least into the bosom of Nature in the form of field work; pleasant enough this un-English summer.

The station recently had the pleasure of congratulating Maureen Armstrong on her marriage to Mike Bethell. On the other side of the coin, however, we are sorry that this means that she has left to join him in Manchester. She will certainly be missed, in her work; as a ministering angel of the first aid squad; but most of all as a most pleasant member of the staff.

Many who remember David Froome will be pleased to know that he still progresses in his usual cheerful and typical way. He is shortly to take a party of Senior Scouts to Norway, where they hope to form a survey team. Compared with his Morroccan adventures a few years ago, this should be easy; but no doubt difficulties of a different sort will present themselves, and be overcome.

Earlier in this letter field work was mentioned, as one who is at present enjoying Services' hospitality in this cause, there is a temptation to end this message with an address to the ladies, using those cabalistic initials scrawled by the soldiery. These denoted sentiments ranging from the simple Victorian declaration, through amorous forewarnings, to the unashamedly, and sometimes wittily, bawdy. But perhaps these are now out of date, and anyhow it will avoid awkward questions if the usual form of closure is used in this letter from,

Yours sincerely,

the Editor.