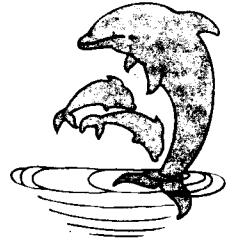


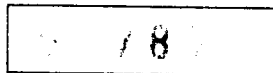


# Q S X P E



THIS NEWSLETTER IS PUBLISHED BY THE  
PORT ELIZABETH BRANCH OF THE SOUTH  
AFRICAN RADIO LEAGUE.

P.O. BOX 10402  
LINTON GRANGE  
6015





**PORT ELIZABETH BRANCH**  
**NOTICE OF MONTHLY MEETING.**

MEMBERS ARE REMINDED THAT THE MONTHLY GENERAL MEETING OF THE PORT ELIZABETH BRANCH OF THE SOUTH AFRICAN RADIO LEAGUE, WILL BE HELD AT ST. MARTIN'S CHURCH, GREAT WEST WAY, KABEGA, ON FRIDAY, 19TH JUNE, 1987 AT 8.15P.M.

HOPEFULLY, IF IT ARRIVES IN TIME, MIKE BOSCH ZS2FM WILL BE PRESENTED WITH THE AMATEUR OF THE YEAR AWARD WHICH IS PRESENTED ANNUALLY BY THE AMATEUR RADIO DEVELOPMENT TRUST.

LYNN, ZS2MM, WILL PROVIDE THE ENTERTAINMENT AFTER THE MEETING.

**COMMITTEE**

<u>CHAIRMAN:</u>	BRIAN WELLER ZS2AB	303498
<u>VICE CHAIRMAN:</u>	LIONEL COOMBE-DAVIS ZS2DD	321770
<u>SECRETARY:</u>	MARGE WELLER ZS2OB	303498
<u>TREASURER:</u>	LYNN CROTHALL ZS2MM	354671
<u>SPECIAL EVENTS AND</u>	BEAVAN GWILT ZS2RL	306968
<u>SOCIAL ACTIVITIES:</u>	OWEN WHEELER ZS2HZ	381310
<u>AWARDS:</u>	BILL HODGES ZS2-157	512580
<u>EDITOR QSX-PE:</u>	MARGE WELLER ZS2OB	303498
<u>MEMBERS:</u>	DICK SCHONBORN ZS2RS	322111

<u>LIBRARIAN</u>	COLIN ASHWELL ZS2AO	312471
------------------	---------------------	--------

**BULLETIN ROSTER**



	40 METRES	0 M	80 M
28 JUNE	ZS2AB TOP DOWN	ZS2RS	ZS2DD
5 JULY	ZS2DD BOTTOM UP	ZS2MM	ZS2RL
12 JULY	ZS2OB TOP DOWN	ZS2HZ	ZS2DD
19 JULY	ZS2MM BOTTOM UP	ZS2RL	ZS2AB

**SUNDAY BULLETINS**

HF 40M - 7098KHZ (LOWER SIDEBAND)  
80M - 3640KHZ (LOWER SIDEBAND)  
VHF 145,700 AND 145,75MHZ

**BRANCH FREQUENCIES**  
P.E. REPEATER 145,05/65  
GRAHAMSTOWN 145,15/75  
LADY'S SLIPPER 145,10/70  
COCKSCOMB 145,00/60  
RTTY MAILBOX 145,35  
VHF BEACON 144,910MHZ

**WE LIKE BEING YOUR BRANCH**

THIS AND THAT.

SILENT KEY. IT IS WITH REGRET THAT WE ANNOUNCE THE PASSING OF PERCY (BUCK) BUCKLEY ZS2RM, A LONG-TIME MEMBER OF THE P.E. BRANCH. BUCK WAS FIRST LICENSED IN 1960 AS ZS6VK AND FROM THE START WAS A VERY KEEN CW OPERATOR AND DX-ER. HE DID EXCEPTIONALLY WELL IN LOCAL AND DX CONTESTS AND RECEIVED A PLAQUE FOR THE HIGHEST SCORE IN AFRICA FOR THE CQ WW DX CW CONTEST. ALTHOUGH THE RECIPIENT OF MANY CERTIFICATES, AWARDS AND PLAQUES, BUCK'S GREATEST TREASURE WAS HIS DXCC AWARD. SADLY, TWO DAYS AFTER HIS DEATH, THE STICKERS FOR 320 COUNTRIES (MIXED MODE) AND 225 (CW ONLY) WERE RECEIVED. BUCK WAS A VERY PATIENT CW TUTOR TO MANY NEW AMATEURS. ALTHOUGH CONFINED TO CW ONLY FOR THE LAST FEW YEARS, HE CONTINUED HIS DX ACTIVITIES. HE WAS ALSO AN ACCOMPLISHED MUSICIAN AND HAD A LARGE COLLECTION OF 78 RPM RECORDS AND ANTIQUE MUSICAL INSTRUMENTS. HE WILL BE MISSED BOTH LOCALLY AND BY HIS MANY DX FRIENDS. R.I.P. TO HIS FAMILY AND FRIENDS WE EXTEND SINCERE CONDOLENCE.

SUBSCRIPTIONS.

THE SUBSCRIPTION RATES FOR 1987/88 ARE AS FOLLOWS:

ENTRANCE FEE	R15.00
ASSOCIATE	36.00
ORDINARY	39.00
PENSIONER	18.00
INCAPACITATED	18.00
STUDENT	21.00
SPOUSE	15.00

PLEASE PAY YOUR SUBS DIRECTLY TO THE BRANCH TREASURER - DO NOT SEND THEM TO HEADQUARTERS.

MEMBERSHIP RENEWAL ACCOUNTS WILL BE POSTED WITH THE JUNE ISSUE OF RADIO ZS. PLEASE BE EXTREMELY CAREFUL WHEN OPENING YOUR ENVELOPE AS THE ACCOUNT WILL BE INSERTED IN THE MAGAZINE.

EXTENDED PAYMENT FACILITIES:

ONCE AGAIN THE BRANCH IS MAKING THE FACILITY AVAILABLE TO MEMBERS AS FOLLOWS:

1 PAYMENT	R39
2 PAYMENTS	R20 AND R19.
3 PAYMENTS	R13 EACH.
4 PAYMENTS	R10 EACH!

PLEASE ADVISE THE TREASURER WHEN PAYING WHICH FORM YOU WILL BE USING. MANY THANKS FOR YOUR SUPPORT OVER THE PAST YEARS AND WE HOPE THAT WE WILL HAVE YOUR VALUED MEMBERSHIP AND SUPPORT FOR MANY YEARS TO COME.

RADIO AMATEURS AS COMMUNICATORS MANY PROBLEMS TODAY STEM FROM A BREAKDOWN IN COMMUNICATION SOMEWHERE ALONG THE LINE. RADIO AMATEURS THE WORLD OVER USE SOME OF THE MOST SOPHISTICATED "HARDWARE" AVAILABLE WHEN COMMUNICATING WITH OTHERS. HOWEVER, IT IS THE WRITERS OF INOPINION THAT THE PERSONAL "SOFTWARE" USED LEAVES A LOT TO BE DESIRED. WE HAVE THE MEANS AT OUR DISPOSAL, ARE WE GETTING OUR MESSAGE ACROSS EFFECTIVELY AND EFFICIENTLY? PAUSE FOR A MOMENT AND CONSIDER THE POSSIBILITIES AVAILABLE TO US AS RADIO AMATEURS - BETWEEN INDIVIDUALS - BETWEEN INDIVIDUALS AND THEIR BRANCH OR PARTICULAR INTEREST GROUP - BETWEEN BRANCHES AND/OR INTEREST GROUP AND THE S.A.R.L. HEADQUARTERS. GOOD COMMUNICATION IS A TWO-WAY BUSINESS. SO CONSIDER THE LAST PARAGRAPH IN REVERSE AS WELL. FROM S.A.R.L. HEADQUARTERS RIGHT DOWN TO THE NEWEST MEMBER OF THE LEAGUE? WHY ARE THERE SHORTCOMINGS? WHAT CAN AND SHOULD BE DONE TO IMPROVE AND OVERCOME THESE PROBLEM AREAS? INITIALLY WE RECOMMEND THAT YOU USE THE WRITTEN WORD, ANOTHER FORM OF COMMUNICATING. LET'S HAVE YOUR VIEWS ON THE SUBJECT.

(TAKEN FROM H.Q. BULLETIN 31 MAY, 1987 WRITTEN BY VIC HUGO ZS1LY).

MINUTES OF THE GENERAL MEETING OF THE PORT ELIZABETH BRANCH  
OF THE SOUTH AFRICAN RADIO LEAGUE HELD AT ST. MARTIN'S CHURCH,  
PORT ELIZABETH ON FRIDAY 15TH MAY, 1987.

**PRESENT:** 24 MEMBERS AND VISITORS.  
**APOLOGIES:** ZS2MJ, JJ, LW, AAN, HB, MG AND ZS2-157.

THE CHAIRMAN WELCOMED ALL TO THE MEETING, ESPECIALLY JULIE SCARR, TINA WHEELER AND ANDREW ZS2G.

**MINUTES:** THE MINUTES OF THE MEETING HELD 24TH APRIL, 1987, HAVING BEEN PUBLISHED AND CIRCULATED IN QSX-PE WERE TAKEN AS READ; PROPOSED BY ZS2MC AND SECONDED BY ZS2BY.

**ARISING:** A REPLY HAD BEEN RECEIVED FROM THE POSTMASTER GENERAL TO OUR LETTER RE MOBILE OPERATION IN THE HOMELANDS. IT WAS REQUIRED THAT PERMISSION BE OBTAINED FROM THE POSTAL AUTHORITIES IN THE AREA TO BE TRAVELLED IN. DIVISION 2 AMATEURS WHO TRAVEL FREQUENTLY THROUGH THE CISKEI AND TRANSKEI SHOULD APPLY AT THE BEGINNING OF EACH YEAR FOR PERMISSION FOR THE WHOLE YEAR.

THE NEW TOWN REPEATER WAS AVAILABLE FOR VIEWING BY MEMBERS AT THE MEETING. IT WOULD BE INSTALLED AS SOON AS POSSIBLE.

NO DONATION HAD BEEN RECEIVED BY THE BRANCH FOR THE RECENT NAVEX. DISCUSSION THEN ENSUED ON THE QUESTION OF RALLIES AND EXPENSES AND DONATIONS BY THE ORGANISATIONS CONCERNED TO THE BRANCH. IT WAS FELT THAT WHEN THE QUESTION OF EXPENSES AROSE, THE NORMAL A.A. RATE WOULD APPLY, A CERTAIN PERCENTAGE BEING PAID TO THE OPERATOR TO COVER EXPENSES AND THE BALANCE TO BRANCH FUNDS. MEMBERS WERE ASKED TO CONSIDER THE MATTER AND PRESENT THEIR VIEWS AT THE NEXT MEETING.

**CORRES:** (1) LETTER FROM EAST LONDON BRANCH RE LINKING OF E.L. AND GRAHAMSTOWN REPEATERS, PARTICULARLY WITH A U.H.F. LINK.

(2) COPY OF REPLY SENT TO E.L. BRANCH. THIS WAS HANDED TO THE CHAIRMAN OF THE REPEATER WORKING GROUP FOR THEIR ATTENTION.

(3) LETTER FROM P.M.G. RE MOBILE OPERATION AND LICENSING.

(4) SEVERAL BRANCH NEWSLETTERS.

**ARISING:** BILL BROWNE ZS2BY SAID HE HAD A COMPLETE U.H.F. REPEATER AVAILABLE WHICH HE WOULD LIKE TO DONATE TO THE BRANCH. THE GRATEFUL THANKS OF THE BRANCH WAS UNANIMOUSLY EXPRESSED.

**GENERAL:** (1) IT WAS REGRETTED THAT THE AMATEUR OF THE YEAR AWARD WAS NOT YET AVAILABLE, BUT IT HAD BEEN STATED THAT IT WOULD BE READY IN TIME FOR THE JUNE MEETING.

(2) JOHN ZR2AAA HAD NOW RECEIVED HIS CALL OF ZS2AAN AND EXPRESSED HIS THANKS TO LANGLEY ZS2LW FOR HIS HELP WITH THE C.W.

(3) GREETINGS FROM PETER EX ZS2PD WERE PASSED ON TO ALL HIS FRIENDS IN THE BRANCH.

(4) LIONEL ZS2DD SAID THAT ON 11TH JUNE, HANS ZS6AKV WOULD BE IN P.E. TO ADDRESS AN AMSAT MEETING AT A VENUE TO BE NOTIFIED LATER. ALL WERE INVITED.

(5) MITCH ZS2DK HAD DONATED SOME I.R.C.'S FOR BRANCH FUNDS AND THESE WERE AVAILABLE AT 40C EACH.

(6) OWEN ZS2HZ SAID THAT ON SUNDAY 7TH JUNE HE WOULD HAVE A STATION OPERATING AT THE WESTVIEW SPORTS STADIUM WHERE THERE WAS TO BE AN ALL-DAY SOCCER TOURNAMENT.

(7) SEVERAL MEMBERS OF THE BRANCH HAD DONE VERY WELL IN THE RECENT V.H.F. CONTEST. OWEN ZS2HZ WAS THE WINNER OF THE SINGLE OPERATOR HOME STATION SECTION AND MIKE ZS2FM ACHIEVED THE LONGEST DISTANCE OF 829KM ON 6M WITH ZS6BTL. CONGRATULATIONS TO BOTH.

THERE BEING NO FURTHER BUSINESS, THE MEETING WAS CLOSED AND TEA WAS TAKEN. THEREAFTER AN INTERESTING VIDEO OF MOTOR RALLYING WAS SHOWN. THIS AROUSED MUCH INTEREST IN VIEW OF THE FACT OF OUR FORTHCOMING PARTICIPATION IN A MOTOR RALLY.

SGD: B.A. WELLER ZS2AB  
CHAIRMAN

SGD: M.T. WELLER ZS2OB  
SECRETARY

# How to Build and Use Balun Transformers

Understanding baluns will help you to apply them properly.  
Building your own unit can be simple and inexpensive.

By Doug DeMaw, W1FB

DO I NEED A BALUN TRANSFORMER? HOW SHOULD I INSTALL THE DARNED THING? WILL IT CURE T.V.I.? THESE COMMON QUESTIONS ARE ASKED BY AMATEURS WITH REGARD TO THE SOMETIMES MYSTERIOUS BALUN.

LET'S BEGIN BY CONSIDERING WHAT THE TERM "BALUN" MEANS. THE WORD IS A COMPOSITE OF "BALANCED TO UNBALANCED". IF WE ADD THE WORD "TRANSFORMER" AFTER IT, THE EXPRESSION BECOMES DEFINITIVE. A *BALANCED-TO-UNBALANCED* TRANSFORMER IS THE RESULT, AND IT IS SELF-EXPLANATORY. BALUN IS ONE OF THE MOST MISPRONOUNCED WORDS IN AMATEUR RADIO. FREQUENTLY IT COMES OUT AS "BAYLON, BAL-DOON, OR BALLUM" I RECENTLY HEARD AN AMATEUR SAY ON 75 METERS, "I THINK I NEED ONE OF THEM BAYLONS IN MY DIPOLE SO THAT I CAN GET OUT BETTER". THIS AND SIMILAR STATEMENTS INDICATE THE GENERAL LACK OF UNDERSTANDING ABOUT THE PURPOSE AND USE OF BALUN TRANSFORMERS. THERE IS PROBABLY MORE MISUSE OF BALUNS THAN CORRECT APPLICATIONS OF THE DEVICE. LET'S LEARN HOW TO USE THEM, AND WHAT THE COMMON PITFALLS OF INCORRECT USE MIGHT BE.

## TYPICAL APPLICATIONS

SUPPOSE YOU ARE USING A BALANCED ANTENNA, SUCH AS A HALF-WAVELENGTH DIPOLE. THE ANTENNA'S AVERAGE HEIGHT ABOVE GROUND IS 40 TO 60 FEET FOR MOST AMATEUR INSTALLATIONS, WHICH PROVIDES A FEED IMPEDANCE BETWEEN 40 AND 75 OHMS, DEPENDING ON THE DIPOLE FORM (INVERTED V OR STRAIGHT DIPOLE) AND ELECTRICAL HEIGHT ABOVE GROUND. FOR THE PURPOSE OF THIS EXERCISE, LET'S ASSUME WE HAVE A 50-OHM FEED IMPEDANCE. THE USUAL PRACTICE UNDER THIS CONDITION IS TO FEED THE DIPOLE WITH 50-OHM COAXIAL CABLE. IN EFFECT, WE NOW HAVE AN UNBALANCED FEED LINE CONNECTED TO A BALANCED ANTENNA. WILL THIS IMPAIR THE ANTENNA PERFORMANCE? NOT REALLY, BECAUSE THE ANTENNA IS CLOSE TO GROUND IN TERMS OF WAVELENGTH (A HEIGHT OF 0,5 WAVELENGTH OR GREATER ENSURES THE BI-DIRECTIONAL FIGURE-8 PATTERN), THE PATTERN IS PRETTY MUCH OMNIDIRECTIONAL AND IS AT HIGH RADIATION ANGLES (GREAT FOR CLOSE-IN COMMUNICATIONS). IF THE ANTENNA WERE 0,5 WAVELENGTH OR GREATER ABOVE GROUND, WE COULD MEASURE THE FIGURE-8 PATTERN WITH A FIELD-STRENGTH METER, AND WITH THE UNBALANCED FEEDER WE MIGHT NOTICE A SLIGHT DISTORTION OR SKEW IN THE PATTERN. BUT WITH THE WIDE LOBES OF A DIPOLE, IT WOULD MAKE NO PRACTICAL DIFFERENCE IN OUR COMMUNICATION ABILITY. THEREFORE, A 1:1 BALUN TRANSFORMER IS NOT NEEDED. ON THE OTHER HAND, IF WE WERE RICH AND FORTUNATE ENOUGH TO HAVE A TWO- OR THREE-ELEMENT 75-METER YAGI ANTENNA AT 120 FEET OR GREATER, THE BALUN WOULD BE WORTH INCLUDING IN THE SYSTEM, AT THE ANTENNA FEED POINT IN ORDER TO HELP PRESERVE THE CLASSIC RADIATION PATTERN OF THE ANIENNA. BALUN TRANSFORMERS ARE ALSO HELPFUL WHEN WE USE TRIBAND YAGI ANTENNAS, SINCE THEY DO EXHIBIT A WELL-DEFINED RADIATION PATTERN.

NOW, LET'S SUPPOSE WE ARE USING A 300-OHM FOLDED DIPOLE (HEIGHT ABOVE GROUND NOT CONSIDERED) AND WANT TO FEED IT WITH COAXIAL CABLE (FIG1A). NOT ONLY DO WE HAVE A BALANCED-TO-UNBALANCED FEED CONDITION, WE ALSO FIND A CONSIDERABLE DIFFERENCE BETWEEN THE FEED IMPEDANCE OF THE ANTENNA AND THAT OF AVAILABLE COAXIAL CABLES. HERE WE CAN EFFECTIVELY APPLY THE CONCEPT OF BALUNS. IF WE INSTALL A 4:1 BALUN TRANSFORMER AT THE ANTENNA FEED POINT, WE CAN USE 75-OHM COAXIAL FEED LINE FROM THE ANTENNA TO THE SHACK. NOT ONLY HAVE WE CONVERTED A BALANCED FEED POINT TO UNBALANCED LINE, WE HAVE MATCHED THE 300-OHM IMPEDANCE TO 75 OHMS. IS THIS DESIRABLE? DEFINITELY, YES.

*There is probably more misuse of baluns than correct applications of the device.*



*A saturated core produces square waves, and these cause harmonic currents...*

*...make sure there is ample core size to handle the power from your transmitter.*

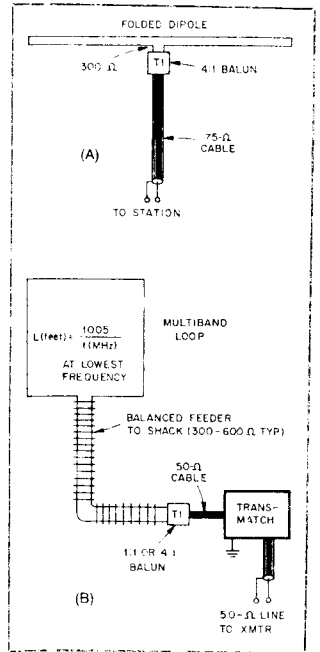


Fig 1—A 4:1 balun is used (A) to convert the 300-ohm feed to 75 ohms, while providing balanced feed to an unbalanced line. The system at B shows the typical arrangement for a multiband loop. T1 may be a 1:1 or 4:1 balun for converting the balanced feeder to coaxial line (see text). A 4:1 balun is preferred in this system.

DO BALUNS CURE T.V.I.?

A FAIR AMOUNT OF MUMBO JUMBO HAS BEEN SPREAD ABOUT CURING T.V.I. THROUGH THE ADDITION OF A BALUN TRANSFORMER AT THE ANTENNA FEED POINT. FIRST, LET'S REMEMBER THAT T.V.I. IS CAUSED BY HARMONIC OR SPURIOUS RADIATIONS, AND BY FUNDAMENTAL OVER-LOADING OF THE FRONT ENDS IN TV RECEIVERS. ALTHOUGH A BALUN CAN CAUSE HARMONIC CURRENTS (MORE ON THIS LATER), IT DOES NOT CURE T.V.I. THE EXCEPTION IS WHEN THE AMATEUR ANTENNA FEED LINE IS CLOSE TO THE TV ANTENNA OR ITS FEEDER. IF THERE IS UNBALANCE IN THE AMATEUR ANTENNA FEEDER, IT WILL RADIATE CONSIDERABLY (USUALLY WITH VERTICAL POLARIZATION), AND THIS MAY INDUCE RF ENERGY INTO THE NEARBY TV-ANTENNA SYSTEM TO CAUSE FUNDAMENTAL OVER-LOADING. IF THE AMATEUR SIGNAL HAS SIGNIFICANT HARMONIC ENERGY IN IT, THE PROXIMITY OF THE TWO ANTENNA SYSTEMS MAY LEAD TO HARMONIC T.V.I. THAT WOULD OTHERWISE NOT BE OBSERVED. A BALUN MAY HELP RESOLVE THESE PROBLEMS.

TO BE CONTINUED NEXT MONTH.

A ROSE BY ANY OTHER..... IN TERMS OF AN I.A.R.U. RECOMMENDATION, THE USE OF THE COLLOQUIAL TERMS "HAM RADIO" AND "RADIO HAMS" IS TO BE VEHEMENTLY DISCOURAGED. REFER TO YOURSELVES AS RADIO AMATEURS AND TO YOUR HOBBY AS THE RADIO AMATEUR SERVICE. LET'S KEEP IT ALL KOSHER FROM NOW ON!

# Antennas

Design, construction, fact, and even some fiction

KARL T. THURBER, JR., W8FX

AT THE RISK OF OFFENDING OUR MORE ADVANCED BROTHERS, WHO MIGHT LIKE A LITTLE REFRESHER COURSE, IN ANY CASE, WE ARE SETTING OUT A SET OF TERMS THAT ARE IMPORTANT TO ACQUIRING A BROADBASED KNOWLEDGE OF ANTENNA DESIGN, CONSTRUCTION AND USE. INCLUDED ARE FACT, FICTION AND EVEN SOME SLANG TERMS.

AMMETER, R.F. - CURRENT-SENSITIVE DEVICE THAT RESPONDS TO RADIO-FREQUENCY (R.F.) ENERGY, FLOWING THROUGH A TRANSMISSION LINE.

ANTENNA PATTERN - GRAPHIC DEPICTION OF ANTENNA'S MAGNITUDE OF RADIATION, STATED IN TERMS OF DIRECTION AND DISTANCE FROM THE ANTENNA. PAPER REPRESENTATION MAY BE CALLED A POLAR PLOT.

ATTENUATE - TO REDUCE IN POWER OR STRENGTH. AN ELECTRICAL DEVICE THAT PERFORMS THIS FUNCTION IS KNOWN AS AN ATTENUATOR.

BANDPASS FILTER - A SELECTIVITY-ENHANCING DEVICE THAT ALLOWS ONLY A CERTAIN FREQUENCY RANGE TO PASS THROUGH UNATTENUATED.

BANDWIDTH - THE RANGE OF FREQUENCIES OVER WHICH AN ELECTRICAL CIRCUIT OR ANTENNA WILL WORK EFFICIENTLY. ALSO REFERS TO THE UPPER AND LOWER LIMITS OF A BAND OF FREQUENCIES.

BEAMWIDTH - ANGULAR DISTANCE BETWEEN THE DIRECTIONS AT WHICH RECEIVED OR TRANSMITTED POWER IS ONE-HALF THE MAXIMUM POWER.

BROADSIDE ARRAY - A DRIVEN ANTENNA ARRAY USUALLY CONSISTING OF TWO PARALLEL ELEMENTS LYING IN THE SAME PLANE.

CAPACITIVE REACTANCE - RESISTANCE OFFERED BY A CAPACITOR TO THE FLOW OF ALTERNATING CURRENT, AS MEASURED IN OHMS. STATED AS  $X_C$ .

CHARACTERISTIC IMPEDANCE - THE 'APPARENT' RESISTANCE OR IMPEDANCE OF A TRANSMISSION LINE. COMMONLY REPRESENTED BY THE SYMBOL  $Z_0$ . SEE SURGE IMPEDANCE.

COAXIAL ANTENNA - AN ANTENNA THAT USES COAXIAL CABLE FOR CONSTRUCTION FOR ALL OR PART OF ITS LENGTH. USUALLY VERTICALLY POLARIZED.

COLLINEAR ARRAY - A GAIN-TYPE, DIRECTIVE ANTENNA OPERATED WITH ITS ELEMENTS IN PHASE TO PRODUCE MAXIMUM RADIATION AT RIGHT ANGLES TO THE LINE OF THE ANTENNA. A ONE-WAVELENGTH DIPOLE COULD FUNCTION AS A COLLINEAR ARRAY OPERATED AS TWO HALF-WAVES IN PHASE.

COLLINEAR ANTENNA - (V.H.F.) - LONG, PHASED VERTICAL WHIP ANTENNA DESIGNED TO PRODUCE A LOW ANGLE OF RADIATION AND SUBSTANTIAL POWER GAIN OVER A QUARTER-WAVELENGTH ANTENNA. USUALLY CONSISTS OF 1/4 AND 5/8-WAVE RADIATING SECTIONS.

DECOUPLING COIL - AN INDUCTANCE THAT ELECTRICALLY ISOLATES ONE ELECTRICAL CIRCUIT OR DEVICE FROM ANOTHER.

DELTA MATCH - A METHOD OF MATCHING A LOW-IMPEDANCE ANTENNA SUCH AS A DIPOLE, TO HIGHER-IMPEDANCE PARALLEL-CONDUCTOR (OPEN-WIRE) TRANSMISSION LINE. THE OPEN-WIRE LINE IS FANNED OUT AS IT APPROACHES THE ANTENNA ELEMENT IN ACCORDANCE WITH PREDETERMINED DIMENSIONS.

DISCONE ANTENNA - VERY BROADBAND ANTENNA, VERTICALLY POLARIZED AND CONICAL IN SHAPE, NORMALLY USED AT V.H.F. AND U.H.F. FREQUENCIES. VERY POPULAR AS A V.H.F./U.H.F. MONITOR ANTENNA.

DRIVEN ARRAY - AN ANTENNA IN WHICH ALL OF THE ELEMENTS ARE DRIVEN (DIRECTLY EXCITED) ELEMENTS.

DUMMY LOAD-WATTMETER - COMBINATION INSTRUMENT THAT CONTAINS A POWER-ABSORBING DEVICE, USED IN LIEU OF AN ANTENNA, AND A WATTMETER TO READ A TRANSMITTER'S OUTPUT POWER. PRIMARILY A SERVICING AND TEST INSTRUMENT.

ECHELON ANTENNA - A SPECIALIZED, LONG PARALLEL-WIRE ANTENNA WITH THE WIRES SPACED ONE-HALF WAVELENGTH OR MORE. THE WIRES ARE STAGGERED AT THEIR ORIGINS TO FORM A PARALLELOGRAM RATHER THAN A RECTANGLE AS IS USUAL WITH OTHER PARALLEL-WIRE ANTENNAS.

ELECTRICAL LENGTH - EQUIVALENT LENGTH OF AN ANTENNA WIRE OR TRANSMISSION LINE AS DETERMINED BY THE VELOCITY OF PROPAGATION THROUGH IT. WILL NOT CORRESPOND WITH THE LINE'S PHYSICAL LENGTH.

END-FIRE ARRAY - A BROAD CLASS OF ANTENNA THAT CONSISTS OF A NUMBER OF PARALLEL ELEMENTS IN ONE PLANE. MAXIMUM RADIATION TAKES PLACE ALONG THE ARRAY'S AXIS AND IT MAY BE UNIDIRECTIONAL (ONE-WAY) OR BI-DIRECTIONAL (TWO-WAY).

EXTENDED DOUBLE ZEPH - AN ANTENNA CONSISTING OF TWO COLLINEAR ELEMENTS SLIGHTLY LONGER THAN ONE-HALF WAVELENGTH - TYPICALLY 0.64 WAVELENGTH. THIS ANTENNA EFFECTIVELY GIVES MORE GAIN THAN ITS COUSIN, THE 2 ELEMENT-IN-PHASE COLLINEAR.

FEED IMPEDANCE - IMPEDANCE, EXPRESSED IN OHMS, AT THE POINT AT WHICH AN ANTENNA IS CONNECTED TO THE TRANSMISSION LINE. SOMETIMES REFERRED TO AS INPUT IMPEDANCE, ESPECIALLY AS APPLIED TO THE EFFECTIVE IMPEDANCE EXISTING AT THE END OF A TRANSMISSION LINE.

FLATTOP - SLANG FOR A WIRE ANTENNA, SUCH AS A DIPOLE OR SINGLE-WIRE.

FLAT LINES - UNTUNED LINES, SUCH AS COAXIAL CABLES, THAT ACT STRICTLY AS TRANSMISSION LINES. IN TRULY FLAT LINES, LINE LENGTH DOES NOT AFFECT THE INPUT IMPEDANCE THE TRANSMITTER 'SEES'.

FOLDED DIPOLE - A TWO-WIRE DIPOLE-TYPE ANTENNA THAT HAS A HIGHER FEED IMPEDANCE THAN A STANDARD DIPOLE. FOLDED DIPOLES ARE FREQUENTLY USED TO OBTAIN A GOOD MATCH TO 300OHM TWIN-LEAD TRANSMISSION LINE. THEIR CONSTRUCTION ALLOWS SLIGHTLY INCREASED BANDWIDTH OVER THAT OF A SIMPLE DIPOLE.

HALO ANTENNA - A HORIZONTAL DIPOLE BENT INTO A CIRCLE. USED TO ATTAIN HORIZONTAL POLARIZATION IN MOBILE WORK.

HIGHPASS FILTER - A CIRCUIT THAT REJECTS FREQUENCIES BELOW A GIVEN CUT-OFF FREQUENCY. OFTEN USED ON TV RECEIVERS TO REDUCE OR ELIMINATE TVI (TELEVISION INTERFERENCE) FROM AMATEUR H.F. TRANSMITTERS.

IMPEDANCE MATCHING - PROCESS OF ADJUSTING ('MATCHING') IMPEDANCE SO THAT MAXIMUM POWER FLOWS THROUGH A CIRCUIT. AS APPLIED TO ANTENNAS AND TRANSMISSION LINES, MINIMUM S.W.R. WILL ALSO EXIST.

INDUCTIVE REACTANCE - RESISTANCE OFFERED BY AN INDUCTOR TO THE FLOW OF ALTERNATING CURRENT, MEASURED IN OHMS. STATED AS  $X_L$ .

"J" ANTENNA - CONSISTS OF A HALF-WAVELENGTH VERTICAL RADIATING ELEMENT FED BY A QUARTER WAVE MATCHING SECTION. OFTEN USED IN MOBILE WORK AS IT OFFERS SOME GAIN OVER THE USUAL QUARTER-WAVELENGTH WHIP.

LAZY H ANTENNA - A FOUR-ELEMENT BROADSIDE ANTENNA ARRAY, NORMALLY CONSISTING OF FOUR, HALF-WAVELENGTH ELEMENTS SPACED ONE-HALF WAVELENGTH, IN THE FORM OF THE LETTER 'H'.

LOG-PERIODIC ANTENNA - HIGH-GAIN, USUALLY LARGE MULTIPLE-ELEMENT BEAM ANTENNA THAT IS DESIGNED TO OPERATE OVER A BROAD RANGE OF FREQUENCIES.

LONGWIRE ANTENNA - AN ANTENNA, USUALLY CONSISTING OF A SINGLE WIRE, AT LEAST SEVERAL WAVELENGTHS LONG. THE LONGER THE ANTENNA, THE GREATER THE GAIN. (THIS TYPE OF ANTENNA IS FREQUENTLY CONFUSED WITH THE SINGLE-WIRE. A SINGLE-WIRE ANTENNA ISN'T A "LONGWIRE" UNLESS IT IS, IN FACT, LONG IN TERMS OF THE OPERATING WAVELENGTH.

LOOP- A "CLOSED CIRCUIT" TYPE OF ANTENNA, IN WHICH A CONDUCTOR IS FORMED INTO TURNS SO THAT THE ENDS ARE CLOSE TOGETHER. MOST LOOPS ARE HIGHLY DIRECTIONAL, AND ARE THEREFORE POPULAR IN CERTAIN RECEIVING AND DIRECTION-FINDING APPLICATION.

TO BE CONTINUED NEXT MONTH.

---

28TH ALL ASIAN PHONE DX CONTEST 1987 THIS CONTEST WILL TAKE PLACE FROM 0000U.T.C. ON 20/6/87 TO 2400 U.T.C. ON 21/6/87 ON THE AMATEUR BANDS UNDER 30MHZ. THE BANDS ARE IN GOOD SHAPE AND YOU SHOULD BE ABLE TO IMPROVE YOUR DX SCORE CONSIDERABLY. GIVE IT A GO.

---

**SUPPORT  
OUR  
ADVERTISERS**

---



---

**SUPPORT  
OUR  
ADVERTISERS**

---



# REMOTE CONTROL IN ASTRONOMY

## USE OF TELESCOPES.

BEFORE DESCRIBING HOW AN OPTICAL TELESCOPE IS OPERATED REMOTELY, LET US LOOK AT HOW IT IS USED.

A TYPICAL LARGE PROFESSIONAL TELESCOPE WITH A MIRROR OF ABOUT 4M DIAMETER IS USED BY SOME 100 ASTRONOMERS PER YEAR; THEIR EXPERIENCE VARIES ENORMOUSLY FROM STUDENT TO PROFESSIONAL TYRO. THE TELESCOPE IS OPERATED FROM A CONTROL DESK SOME 10M FROM THE TELESCOPE BY A PROFESSIONAL TELESCOPE OPERATOR: THE TRADITIONAL NAME FOR THIS PERSON IS "NIGHT ASSISTANT" BUT THE RADIO ASTRONOMY TERM "TELESCOPE DRIVER" IS ALSO USED. ON A PROMPT FROM THE ASTRONOMER, THE NIGHT ASSISTANT CAUSES THE TELESCOPE TO SLEW TO THE NEXT STAR TO BE OBSERVED. A PICTURE THROUGH THE TELESCOPE IS PRESENTED TO THE ASTRONOMER WHO THEN IDENTIFIES IN DETAIL THE OBJECT HE WISHES TO OBSERVE AND THE TELESCOPE IS ADJUSTED TO POINT DIRECTLY TO IT. THE PICTURE IS, TYPICALLY, PRESENTED FROM A TELEVISION CAMERA VIEWING THE PHOSPHOR OF AN IMAGE INTENSIFIER. ON LA PALMA, THE 2,5M ISAAC NEWTON TELESCOPE OPERATED BY THE ROYAL GREENWICH OBSERVATORY USES INTENSIFIED TELEVISION CAMERAS TO ACQUIRE STARS AND THE PICTURES CAN BE INTEGRATED BY ALLOWING CHARGE TO ACCUMULATE ON THE TARGET FOR SEVERAL SECONDS BEFORE IT IS READ, AND/OR BY AVERAGING SUCCESSIVE PICTURES IN A 512 PIXEL X 512 PIXEL X 16 BIT MEMORY. ALTHOUGH THE PICTURE CONTAINS HALF A MEGABYTE OF DATA, THERE ARE USUALLY ONLY A FEW SIGNIFICANT FEATURES IN IT, SO ITS INFORMATION CONTENT IS MUCH LESS. IT MAY BE THAT A LIST OF, SAY 10 STARS, INCLUDING THEIR POSITIONS AND BRIGHTNESS IS ALL THAT IS NEEDED TO RECONSTRUCT THE PICTURE. A KILOBYTE WILL DO THIS.

AFTER THE TELESCOPE IS POSITIONED ACCURATELY, IT IS KEPT TRACKING ACCURATELY BY CLOSED-LOOP SERVOS TO FOLLOW THE STAR IN ITS RISING AND SETTING ACROSS THE SKY. NO DATA IS SENT TO ANY REMOTE POINT IN THIS PROCESS, WHICH IS ALL RELATED LOCALLY TO THE TELESCOPE. BUT ITS PERFORMANCE IS MONITORED BY VIEWING REFLECTED STARLIGHT FROM THE ENTRANCE PLATE OF THE INSTRUMENT THAT IS BEING USED TO ANALYSE THE STAR, AND THIS IMAGE IS TRANSMITTED BACK TO THE ASTRONOMER. THE INSTRUMENT MIGHT BE A SPECTROGRAPH FOR MEASURING THE WAVELENGTHS AND INTENSITIES OF SPECTRAL LINES IN THE STAR. DATA IS PRODUCED BY THE SPECTROGRAPH IN THE FORM OF ANOTHER IMAGE WHICH IS READ BY A DETECTOR. IT WOULD NOT BE UNUSUAL FOR THE TELESCOPE TO FOLLOW A STAR AND FOR THE DETECTOR TO INTEGRATE ON ITS SIGNAL FOR MINUTES OR HOURS. NOT ALL THIS INTEGRATION TIME IS AVAILABLE TO TRANSMIT PREVIOUSLY-ACQUIRED INFORMATION.

IF THE DETECTOR IS AN INTENSIFIED TELEVISION SYSTEM, THE SIGNAL ACCUMULATES IN A MEMORY AND IS AVAILABLE FOR INSPECTION DURING THE INTEGRATION. ON THE BASIS OF A PRELIMINARY ANALYSIS OF A PARTIAL INTEGRATION THE ASTRONOMER CAN DECIDE WHAT TO DO: FOR EXAMPLE, HE MAY ABORT BECAUSE WHAT HE WANTS TO MEASURE IS NOT PRESENT, OR INTEGRATE UNTIL THE SIGNAL-TO-NOISE RATIO OF A FEATURE HIDDEN IN THE SPECTRUM BECOMES LARGE ENOUGH. THE ROYAL GREENWICH OBSERVATORY'S LA PALMA TELESCOPES AND THE ANGLO-AUSTRALIAN TELESCOPE LOCATED NEAR SYDNEY USE AN IMAGE PHOTON COUNTING SYSTEM (IPCS) TO RECORD DATA. THE IPCS FEATURES IMAGE SHARPENING TECHNIQUES AND FORMS IMAGES MADE BY ACCUMULATING THE SIGNAL OF INDIVIDUAL PHOTONS. IT IS CAPABLE OF GENERATING IMAGES 2048 X 512 PIXELS IN AREA AND AT LEAST 16 BITS IN DEPTH AND PRODUCES MORE DATA MORE OFTEN AND WITH MORE REQUIREMENT FOR INTERACTION; IN FACT, THE IPCS IS THE CRITICAL TEST FOR A REMOTE OPERATION CENTRE.

AT THE END OF THE INTEGRATION THE DATA ARE PASSED INTO A STORAGE MEDIUM. MANY ASTRONOMERS WOULD LIKE, IN THEIR EXCITEMENT, TO BEGIN DETAILED ANALYSIS IMMEDIATELY, AND THE SCIENTIFIC ADVANTAGES ARE OBVIOUS: DISCOVERIES ARE MADE WHEN THE ADRENALIN IS FLOWING.

## VARIOUS PROBLEMS.

IN REMOTE OPERATION OF TELESCOPES, EACH OF THE PARTS OF THE OBSERVING SEQUENCE PRESENTS DIFFERENT PROBLEMS TO BE SOLVED WITHIN THE MONETARY SCALE SET BY THE STAFF TRAVEL BUDGET WHICH WOULD BE SAVED, UNLIKE A BUDGET COMMENSURATE WITH THE LAUNCH OF A ROCKET. POSITIONING OF THE TELESCOPE IS WITHIN THE CAPACITY OF A LOW-BANDWIDTH COMMAND CHANNEL (EVEN OF VOICE

INSTRUCTION!) AND THE ONLY POINT OF ISSUE IS SAFETY OF PERSONNEL AND EQUIPMENT. ALTERING THE EQUIPMENT CONFIGURATION AND MONITORING ITS STATUS ALSO REQUIRES ONLY A LOW BANDWIDTH. ACQUIRING THE STAR FIELD, FINELY POSITIONING THE TELESCOPE AND MONITORING ITS POSITION NEED A HIGHER BANDWIDTH BUT IMAGE CONDENSATION TECHNIQUES ARE AVAILABLE TO PRESENT A DIGEST OF STAR FIELD TO THE ASTRONOMER WITHIN THE 60 SECONDS THAT IS THE LONGEST HE WILL TOLERATE. THE KITT PEAK OBSERVATORY 2.1M TELESCOPE IN ARIZONA CAN BE REMOTELY OPERATED BY WHAT IS KNOWN AS A TRAVELLING OPERATION STATION, WHICH USES A VIDEO EXPANDER TO RECEIVE THE ACQUISITION FIELD AFTER IT HAS BEEN COMPRESSED FOR TRANSMISSION OVER TELEPHONE LINES. THE UNIT, PART OF AN ANALOGUE DEVICE THAT GENERATES, TRANSMITS AND RECEIVES SLOW-SCAN PICTURES, WAS DEVELOPED TO MEET A NEED FOR REMOTE SURVEILLANCE BY SECURITY STAFF. DIGITAL COMPRESSION AND TRANSMISSION IS EVEN BETTER ADAPTED TO HIGH-MODULATION STAR PICTURES.

SO, REMOTE CONTROL OF TELESCOPES FROM 1000 KM AWAY IS EASY, A SIMPLE EXTENSION OF WHAT IS ALREADY DONE OVER 10M. THE BOTTLENECK IN REMOTE OPERATION OF OPTICAL TELESCOPES LIES IN DATA GENERATION: THE DYNAMIC RANGE IN ASTRONOMICAL DATA, WHICH CONTAINS INFORMATION FROM THE VERY BRIGHT TO THE VERY FAINT, RAISES A PROBLEM IN THE PROCESS OF DATA COMPRESSION WITHOUT CLIPPING, AND THE ANALOGUE TRANSMISSION TECHNIQUE USED IN THE KITT PEAK VIDEO DISPLAY IS NOT SUITABLE. HOWEVER, OVER A 12 HOUR NIGHT WITH A 9.6 KBIT/S CONNECTION BETWEEN LA PALMA AND THE UK, ANY OF THE AMOUNTS OF DATA LISTED IN THE TABLE, OR AN APPROPRIATE MIXTURE OF THEM, CAN BE SENT. THIS IS JUST ENOUGH TO OPERATE A PRODUCTIVE, MOUNTAIN-TOP OPTICAL TELESCOPE FROM A HOME STATION IN THE UK.

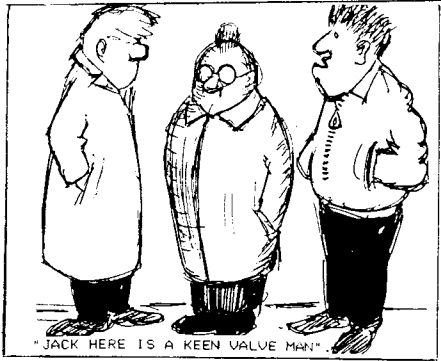
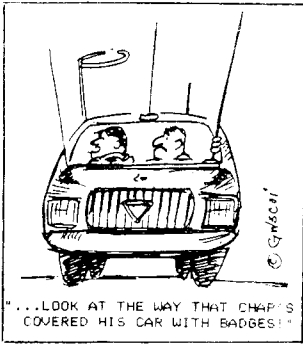
ONCE REMOTE OPERATION AT A CENTRAL HOME STATION IS ESTABLISHED, ONE OF THE NEXT STEPS IS TO EXTEND THE NUMBER OF STATIONS, THEREBY MAKING IT POSSIBLE TO LINK MANY UNIVERSITIES INTO A COMMON PROGRAMME OF ASTROPHYSICAL ENQUIRY, EACH USING ITS SPECIALIST KNOWLEDGE TO INTERACT WITH THE DATA AND ENSURE THAT THE PROGRAMME SUCCEEDS. UK ASTRONOMERS ALREADY HAVE ACCESS TO A SYSTEM KNOWN AS STARLINK, WHICH USES NINE LINKED COMPUTERS. SOME 90 PER CENT OF BRITISH ASTRONOMERS HAVE ACCESS TO THIS SYSTEM WHICH PROVIDES COMMON DATA-REDUCTION SOFTWARE FOR ANALYSING ASTRONOMICAL IMAGES. ONCE DATA FROM THE TELESCOPE ENTERS THE SYSTEM, HUNDREDS OF MAN-YEARS WORTH OF ASTRONOMICAL DATA REDUCTION SOFTWARE CAN BE BROUGHT TO BEAR ON IT, WRINGING THE LAST BIT OF INFORMATION FROM THE VERY LAST PHOTON.

#### PROGRAMME FLEXIBILITY.

REMOTE OPERATION OF TELESCOPES IS STIMULATED BY ITS TECHNOLOGICAL TIMELINESS, BY FREQUENTLY RISING TRAVEL COSTS AND BY THE EFFICIENCY IT BRINGS. IT ALSO AFFORDS PROGRAMME FLEXIBILITY. AT PRESENT, ASTRONOMERS ARE SCHEDULED TO USE A BIG TELESCOPE FOR NOMINATED NIGHTS AND THEY USE IT 'COME RAIN OR SHINE'. EVEN IF THE SKY IS CLEAR, IT IS LARGELY A MATTER OF CHANCE WHETHER THE WEATHER CONDITIONS ARE EXACTLY MATCHED TO THE TYPE OF OBSERVATION THE ASTRONOMER WISHES TO MAKE; CERTAIN PARTICULARLY CRITICAL OBSERVATIONS MAY NEED SPECIAL AND INFREQUENT CONDITIONS. IT IS NOT PRACTICAL TO HOUSE DOZENS OF ASTRONOMERS ON A MOUNTAIN FOR WEEKS AT A TIME AND MOVE THEM ON AND OFF THE TELESCOPE AS CONDITIONS CHANGE, BUT IF THEY CAN OBSERVE REMOTELY, FROM THEIR UNIVERSITY OFFICES, THEY CAN BE SCHEDULED FLEXIBLY AND AT SHORT NOTICE WHENEVER SUITABLE WEATHER CONDITIONS BECOME AVAILABLE.

THE 4.2 WILLIAM HERSCHEL TELESCOPE BEING BUILT ON LA PALMA BY THE ROYAL GREENWICH OBSERVATORY, IS THE FIRST TELESCOPE TO BE DESIGNED WITH THIS IN MIND. ITS PARTICULAR OPTICAL DESIGN, CALLED AFTER ITS VICTORIAN ENGINEER INVENTOR JAMES NASMYTH, INCORPORATES A MIRROR WHICH CAN SWITCH THE LIGHT BEAM FROM INSTRUMENT TO INSTRUMENT AT A MINUTE'S NOTICE. AT LEAST FOUR INSTRUMENTS CAN STAND BY FOR DEVELOPMENT AS WEATHER CONDITIONS AND ASTRONOMICAL PROGRAMMES CHANGE.

IT MAY BE THAT THE NEXT GENERATION OF ASTRONOMERS WILL LOOK BACK WITH AMUSEMENT AND PERHAPS ENVY AT OUR PRESENT TRAVEL TO DISTANT, EXOTIC PLACES. AFTER THE AGE IN WHICH AVIONICS TECHNOLOGY HAS BROUGHT THE ASTRONOMERS TO THE MOUNTAIN, INFORMATION TECHNOLOGY WILL INSTEAD BRING THE MOUNTAIN TO THE ASTRONOMERS.



## Instant Printing

TELEPHONE 22614

9 ST. PATRICK'S ROAD  
PORT ELIZABETH  
6001

**FOR ALL YOUR COMMERCIAL PRINTING REQUIREMENTS  
TRY US FOR YOUR OSL CARDS!**

## LAIDLAW'S SERVICES

**MOWING OF LAWN  
AND  
EDGE TRIMMING  
GENERAL  
MAINTENANCE  
REPAIRS  
e.g. Welding etc.**

Phone: \_\_\_\_\_

**After Hours: 71-1336**

## PET BOUTIQUE

6th Avenue, Walmer (Pick 'n Pay)  
PHONE 512772

**DO YOU REQUIRE OR NEED ASSISTANCE IN CHOOSING ANY OF THE FOLLOWING:**

- Fish Tanks and Accessories
- Birds, Cages and Accessories
- Rabbits, Hamsters, Cages and Accessories
- All foods and bird seed at low prices
- Travelling cages for pets and rabbit hutches (available on order)

Kindly contact or call and have a chat to **STEVE CODD** who will be very happy to assist you

**WE LOOK FORWARD TO SEEING YOU**



## PETERSEN & SMITHIES

### THE Engine Rebuilders

Specialists In Veteran car engines.

3 HANCOCK STREET, NORTH END

☎041-543669/0

ASK FOR LEO SMITHIES

## HENROSE PRODUCTS (PTY.) LTD (EDMS) BPK

MANUFACTURERS OF PLASTIC BAGS  
PRODUCERS OF FRUIT JUICES  
"ORANG-U-TANG"  
AND "LEKKA LIKS" FROZEN SUCKERS

VERVAARDIGERS VAN PLASTIEKSAKKE  
VERVAARDIGERS VAN VRUGTE SAPPE  
"ORANG-U-TANG" EN  
"LEKKA LIKS" VERVRIESTE YSBLOKKE

TEL. 546470

5-7 EDGAR LANE

NORTH END

PORT ELIZABETH, 6001

# Computer Park

Rink Street, Port Elizabeth

Phone (041) 52-1634

*We Guarantee Success*

**E. P. MUFFLERS**

YOUR  
**Mr. Khout**  
EXHAUST FITTING AND PIPE BENDING  
SPECIALISTS.

ALSO:  
TOWBARS  
BATTERIES  
SHOCK  
ABSORBERS

MILD STEEL  
FULLY  
GUARANTEED

STAINLESS  
STEEL  
LIFETIME  
GUARANTEE

**54-5420**

29 EMBASSY STREET, NORTH END, P.E.

# BAMBOO SNACKERS

FOR DELICIOUS CHINESE TAKE-AWAYS  
IN THE WESTERN SUBURBS.

OLD CAPE ROAD  
HARBOR PARK, PORT ELIZABETH

PHONE 50 4390

## Express Number plates & 'SIGNS'

INC  
**FLEKTI-PLATE**

REG. NO. 02/18/07

Tel 54 2834 / 54-1501 / 54 1652

23a De Villiers St

PO Box 2587

Port Elizabeth

North End 6056