INAG-16 December 1973

IONOSPHERIC NETWORK ADVISORY GROUP (INAG)*

Ionosphere Station Information Bulletin No. 16 **

* Under the auspices of Commission III Working Group III.1 of the International Union of Radio Science (INAG).

** Issued on behalf of INAG by World Data Center A for Solar-Terrestrial Physics, National Oceanic and Atmospheric Administration, Boulder, Colorado 80302, U.S.A. The bulletin is distributed to stations by the same channels (but in the reverse direction) as their data ultimately flow to WDC-A. Others wishing to be on the distribution list should notify WDC-A.

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I. Introduction

by

W. R. Piggott, Chairman

This issue of the Bulletin is mainly concerned with corrections to the Handbook. For completeness, those discussed in previous Bulletins have been collected and included. The Editors of the Handbook wish to thank the INAG members and other colleagues who have pointed out errors or omissions. They trust that you will all find the Handbook useful and will let them know of any inconsistencies, ambiquities or remaining errors. Such comments will be published in the INAG Bulletin so as to allow discussion and, if thought desirable, adoption of a revised text.

As proposed at the URSI General Assembly at Warsaw there will be a meeting of INAG at the CCIR Headquarters in Geneva on January 31, 1974, February 1, and 4, First floor, ITU Tower. This will immediately precede the CCIR Study Group 6 Ionospheric Propogation Meeting February 5 - 20, 1974. All interested in INAG matters are invited to attend for all or part of the meeting. We hope, in particular, that those who will attend CCIR will be able to join us. Informal meetings will probably be possible on Saturday or Sunday.

There will be opportunities to discuss your problems and it would be useful if you could bring a list of them, preferably illustrated by ionograms. Your Chairman would be happy to receive your suggestions for the Agenda. The main items will include discussions on the new High Latitude Supplement, CCIR problems involving the vertical soundings network; use of the VI Network in the I.M.S.; new ionosondes and stations; use of IF2, Spread F typing, night E. A special invitation is also issued to our colleagues in associated fields of absorption measurements, drifts, incoherent scatter, etc.

INAG wishes to stress the importance of bringing examples of ionograms proposed for inclusion in the High Latitude Supplement so that their interpretation can be generally agreed. If you are unable to attend but wish to raise a problem inform the Chairman or Secretary not later than January 20, 1974.

If you have found any errors or omissions in the Handbook which have not been corrected in this issue of the Bulletin, please inform the Chairman or Secretary as soon as possible or bring them to the INAG meeting at Geneva.

I wish to take this opportunity of wishing you all a Happy and Prosperous New Year and hope that INAG may be able to serve you in the future as well or better than you have been served in the past.

II. Comments of French Ionospheric Group on INAG Bulletin No. 14 Questions, and Handbook

Answer to questions asked in INAG Bulletin No. 14:

(a) The distinction between lower case and capital letters: is not important, even in training. (But handwriting is more readable when capital) therefore we would agree for the international symbols to be altered as well for Es or F types as for symbols (foF2, fmin, etc..) and we do not feel it would cause confusion to operators.

(b) Distinction between qualifying and descriptive letters: We strongly feel it is very important to keep this distinction clear and we would not agree to use the descriptive letters as qualifying (as proposed for example by J. K. Olesen for YR), and the qualifying letters as descriptive (as proposed for the letter U, in INAG-14, page 7). The qualifying letters give the indication of the inaccuracy and the descriptive letters give the reason of this inaccuracy.

(c) Extending use of qualifying letters: Actually we are not in favor of increasing the number of qualifying letters because it is important to keep their original meaning (e.g., indication of inaccuracy).

Comments on Kaliningrad questions:

Question 1: We agree with Mr. Piggott's comment (INAG-14, p. 7) that unlimited extrapolation can easily lead to meaningless data.

Question 2a. Night E: It is often difficult to read the critical frequency of night E within the accuracy rules. Therefore the numerical value is often followed by a descriptive letter. If we keep only one descriptive letter, it seems more valuable to have the descriptive letter indicating the reason for the uncertainty (e.g., A, F) instead of K as K indicates only that the value corresponds to night E. Would it not be enough to tabulate the numerical value of the critical frequency of night E in the foE table (without K) and to keep K for night E, in the Es types only?

Chairman's comment:

We will discuss this at Geneva as the question is controversial. I am surprised that you found it difficult to read foE for night E within the accuracy rules. It is rare in my experience. Do others also find this? It would seem appropriate to prefer other letters to K in the foE table. For foEs, fbEs, is it more important to show that the layer is thick or that the value is doubtful? Uniformity would suggest keeping K in the Es type tables only but many stations do not make this table or the foE table. In such cases we lose all evidence that night E was present. Thus no alternative is clearly best. *INAG would like to have as many views as possible.*

Question 2b. Certain and uncertain classification of Es type: We agree with Mr. Piggott's comment and his proposal to add the sentence in Handbook, p. 152, sec. 6.6.

Letter Y: In your letter dated April 27, 1973, you asked me if we want to keep I for Es intermittent traces. We would prefer not to, and to have the word "intermittent trace" deleted on page 32 of the Handbook in consideration of sec. 4.41 (b) "Ignore all very weak intermittent reflections".

Comments on the Handbook

Handbook: - Fig. 2.18, page 48, F1 Lacuna: We would like to point out that second order F traces have never been observed in case of F1 lacuna, in Terre Adélie.

Chairman's comment:

Please can we hear whether this result is general? Do you see one or more than one F trace when F1 lacuna is present?

Handbook: - page 52, under Z: The last sentence of the Z paragraph reads "The qualification is necessary because the z trace is always oblique ..." Now, near the magnetic pole, where the magnetic field is almost vertical, the z trace is a zenithal trace.

Chairman's comment:

Concur. There are only a few stations in the world where this is important and I felt it better to keep the English as simple as possible. However the text could be changed by adding after 'always oblique, except near the magnetic pole, ..'

Handbook: - page 83: The last line above Fig. 3.38 reads "fxI should be scaled from the normal gain ionogram except when this shows total blackout".

Our question is: "what to do when there is no F2 trace on the low and medium gain ionograms but when we can see an F2 trace on the high gain ionogram, we understand foF2 is read on the high gain ionogram but fxI on the medium gain ionogram. That gives fxI < foF2. Is this not awkward for the computer checks?

Chairman's comment:

I do not agree. When the low and medium gain ionograms show no traces the fxI entry cannot be less than foF2. It should be B, an exact description of the medium gain ionogram. If fxI is deduced from the high gain ionogram, it would be (foF2 + fB/2)DB.

Handbook: - Sec. 3.34, page 87, Use of z-mode trace: In the first sentence it seems "foF2" has to be replaced by "fxF2" as the paragraph deals with fxI. Is it correct?

Chairman's comment:

We are dealing with the case where fxI and fxF2 are missing. Normally we would go to foF2, section 3.33 'B' (b)(c), but this is missing. If fxI or fxF2 were present, the fact that foF2 was missing would not be significant. The text is correct but not as clear as is desirable.

III. fxI

It would be useful to have some discussion on the behavior of fxI at the INAG meeting at Geneva, particularly from the point of view of its use for CCIR purposes. In the past your Chairman has often done the necessary research for this type of problem on your behalf. This may not be possible on this occasion and he wishes to provoke others to attempt some analysis. The most immediate problems include the following:

1. It is claimed that fxI can be significantly different from fxF2:

   (i) when foF2 is low at night
   (ii) at high latitude stations
   (iii) at low latitude stations affected by equatorial spread F.

   Is this true? If so, how big is the difference in median fxI - fB/2 and median foF2? What percent difference will this make in MUFs assuming the factor is unaltered, i.e.,

$$\frac{fxI - fB/2 - foF2}{foF2} \times 100\%$$

2. It is claimed that regular high latitude ridges occur sufficiently frequently to effect the median MUF during sunspot maximum winter nights in certain areas.

   Is this true? If so, which areas and which times? What is the ratio of (fxI - fB/2) to (foF2)?

3. There are many occasions when foF2 is based on a low count.

   Does this cause a significant distortion of the diurnal variation? For example, does fxI - fB/2 differ significantly from foF2 (or fxI from foF2 + fB/2)?

4. NOAA and some other groups only record fxI when foF2 is qualified or nonnumerical. Does this cause a significant distortion in fxI?

5. Tables of fxI should be complete apart from C, B and EE. Does this give useful scientific information where foF2 is missing? If so, where and when?

6. fxI should be sensitive to the presence of ridges within about 500 km radius from the station and should therefore be better than the VI parameters for studying incidence of ridges. Some work on this has been done by Bowman. Data from a chain, e.g., the Scandinavian chain, could be used to check this.

7. fxI indicates the maximum electron densities near the station during a storm. Are there regularities in this at nearby stations?

IV. Reports from Stations

Ionosphere Station at Slough

In view of the response to enquiries about the usefulness of the data from the Station at Slough, it has been decided to maintain this Station in the future. The address of the Station is now:

S.R.C. Appleton Laboratory
Ditton Park
Slough SL3 9JX
Bucks
England

Telephone: Slough 44234
Telex: Radsearch 848369

Boulder

Our Boulder ionosonde for some time has been coexisting with an extremely powerful HF ionospheric modification transmitter at nearby Erie. In many cases the modifications caused by the modifier are simply superimposed on the normal ionosphere record and can be recognized readily. However, interpretation of the Boulder ionograms at times become difficult, ambiguous, or impossible depending upon the frequency, polarization and orientation of the transmitting antenna.

Our present scaling rules do not give a satisfactory way to describe this situation adequately. We can only make scaling notes to indicate the modification is taking place, but scaling notes do not always stay with the data sheets so the scaled information can be very misleading.

To solve this problem partially we have adopted the local convention of using the descriptive letter "P" to indicate the measurement is influenced or impossible due to the effect of the modifier. In this way even if the data user does not know immediately what the descriptive letter means, he will know something out of the ordinary is being seen.

INAG IS ASKED FOR ADVICE ON THIS PROCEDURE.

W.D.C. C1 for Ionosphere, Rockets and Satellites

The address of the World Data Centre C1 at Slough is now:

W.D.C. C1
S.R.C. Appleton Laboratory
Ditton Park
Slough SL3 9JX
Bucks
England

V. Medians - Replacement Letters

by

R. W. Smith
Appleton Laboratory
Slough Bucks

The treatment of replacement letters for median determination, as described on p. 180 of the revised edition of Piggott and Rawer, appears to require some modification. As an illustration, let us take "G - for M(3000) and MUF(3000) count as equal to or less than the median". We have first to find a median excluding G from the count. Then we must decide whether to make G equal to or less than this value. In the first case the median will be unaffected, whereas in the second case the median will most likely be reduced: in both cases, the quartile range may be reduced.

To overcome this difficulty, I would like to suggest that G for M(3000)F2 be replaced by a value less than the corresponding M(3000)F1 except in those cases where foE is greater than foF2 when G should be omitted from the count. Further suggested modifications to the list of replacement letters are as follows:

A - For fbEs count as greater than the highest value in the count (Now obsolete).

B - For fmin count as greater than the highest value in the count.

D - No change

E - For frequency characteristics, no change

E - Omit

G - For foF2 count as less than foF1 or less than foE when foE is greater than foF2.

G - For foEs and fbEs count as less than foE. (When foEs or fbEs are less than foE, which may occur when low type Es is dominant, the numerical values are described by G and treated as less than foE for median determination.)

G - For M(3000)F2 count as less than M(3000)F1.
For MUF(3000)F2 count as less than MUF(3000)F1.
Where foE is greater than foF2, omit G from count.

G - For h'F2, hmF2, hpF2, hc, qc count as greater than the highest value in the count.

W - Omit

W - Omit

The reason for omitting E (for height characteristics) and W is that the possible slight improvement in the final median is not justified by the extra work involved.

Similar considerations should apply to the quartile range in section p. 184.

VI. A Computerized Data Base for Selected Periods in 1964

WDC-A, Boulder, has been asked to provide ionogram copies for selected periods in 1964 for more than 25 vertical sounding stations mainly in the western hemisphere for a major ionospheric modeling project. Other WDCs may also have become involved. The ionograms are to be used in a plan, partially complete, to compute many thousands of electron density profiles (N(h)). The periods under special study in 1964 are: Quiet, March 17-19 and June 16-18; Disturbed, Sept. 19-24 and Dec. 10-17. The ionograms for some of these periods for many stations are available at the WDC in accord with the data exchange recommendations for World Days. WDC-A has collected others through special requests to stations. Some of the N(h) derivations have been done by new techniques involving semi-automatic scaling of h'(f) traces and quantity calculations of N(h). The computerized data base for 1964 for this modeling project also includes topside soundings from satellites, selected incoherent scatter data and collated solar-geophysical data. Further information can be obtained from WDC-A, which is especially interested to know of any unpublished analyses of these 1964 periods. WDC-A has also provided many ionograms for other years and stations for similar major N(h) projects.

VII. An Example of CUSP Type Es in the Presence of Night-E

by

J. Dudeney, D. Binney and P. Fitzgerald
The British Antarctic Survey
30 Gillingham Street
London SW1V 1HY

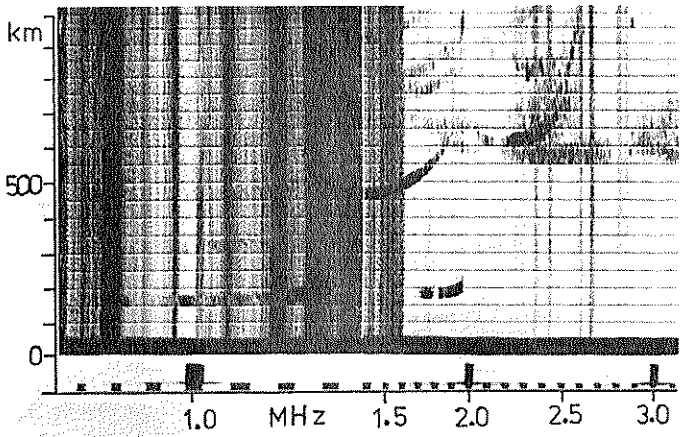
The "URSI Handbook of Ionogram Interpretation and Reduction" makes no reference to the possibility of "daytime" types of Es (cusp or high type) occuring with Night-E. However such cases can occur in principle and are in fact observed. This short note illustrates the point with a sequence (see Figure) of night-time ionograms recorded at Argentine Islands (65°15'S, 64°16'W; dip=60°) during a magnetic storm in September 1972.

We may firmly identify the presence of a thick overhead Night-E layer, rather than r-type Es, because both o and x traces are clearly visible and two or more orders (multiples) of equal separation are present throughout the sequence. The sequence commences just prior to local midnight with Night-E and no observable Es. 15 minutes later an Es-layer, giving both o and x echoes, has appeared, which can only be scaled as h-type. After a further lapse of 15 minutes, the E-layer has moved up in height, making the Es into cusp type. Some diffuse a-type echoes also appear at this time. Thus the correct scaling of Es types for this sequence is: 2345LT, k_2; 0000LT, h_1,k_3; 0015LT, c_1,a_1,k_2.

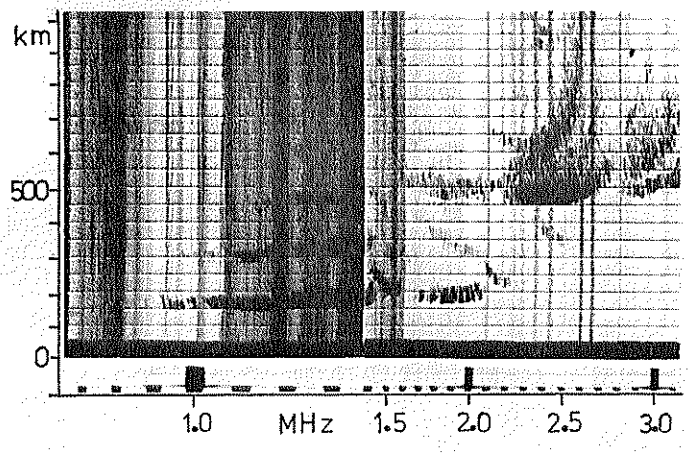
In addition to this sequence, two similar events have been observed at Argentine Islands at other times in 1972. It seems therefore, that another case for which foEs is greater than foE for Night-E should be added to those already considered in the Handbook.

It is interesting to note that h'E varies between 150 and 160 kms during the sequence. This is abnormally high for a night-E layer and allows us to place upper limits (~100ev for electrons and 1~10kev for protons) on the energy spectra of the precipitating particles causing the ionization. These limits are confirmed by the absence of increased absorption, as indicated by fmin, compared with quiet conditions. A similar class of high Night-E is also frequently observed at South Georgia (54°16'S, 36°30'W).

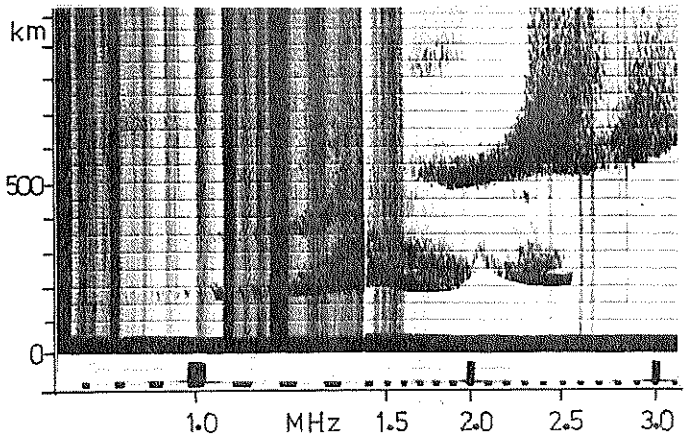
2345 LT
fmin = 009
foE = 130-K
foEs = 130-K
h'E = 150-K
h'Es = 150-K
foF2 = 019



0000 LT
fmin = 009
foE = 145-K
foEs = 016
h'E = 150-K
h'Es = 190
foF2 = 026-F
'h' type Es



0015 LT
fmin = 010
foE = 150-K
foEs = 018
h'E = 160-K
h'Es = 185
foF2 = 025UF
'c' & 'a' type Es



Sequence of Ionograms for 13-14 Sept. 1972 Showing 'h' and 'c' Type Es with Night-E Recorded at Argentine Islands

VIII. Symposium on Solar-Terrestrial Physics, Sao Paulo, 1974

The above Symposium is being organized jointly by the interested Unions and COSPAR and will be held from 17-22 June in Sao Paulo just before the COSPAR Meeting. The provisional timetable for the Symposium is as follows:

June	Morning	Afternoon
17	Atmospheric Physics - Review I Interplanetary Medium - Contributions I	Atmospheric Physics - Contributions I Interplanetary Medium - Reviews I
18	Atmospheric Physics - Reviews II Interplanetary Medium - Contributions II	Atmospheric Physics - Contributions II Interplanetary Medium - Reviews II
19	Atmospheric Physics - Reviews III Magnetosphere - Contributions I	Atmospheric Physics - Contributions III Magnetosphere - Reviews I
20	CINOF Magnetosphere - Contributions II	Solar Topics I Magnetosphere - Reviews II
21	Flare Build-up Study Quiet Magnetosphere - Contributions	Solar Topics II Magnetosphere - Reviews III
22	Overflow contributions, etc. Business Sessions of URSI Working Groups.	

The Chairman of the Programme Committee is Prof. S. A. Bowhill and the Secretary is:

Dr. E. R. Dyer, Jr.
National Academy of Sciences,
2101 Constitution Avenue,
Washington, D. C. 20418, USA.

IX. URSI-STP Committee

The 4th Meeting of the URSI-STP Committee was held in Warsaw on 23 August 1972. The members present were W. J. G. Beynon (Chairman), K. Bibl, G. M. Brown (Secretary), S. A. Bowhill, D. Carpenter, W. Dieminger, J. W. King, E. A. Lauter, G. M. Pillet, K. Rawer, A. Spizzichino, K. Sprenger, J. Taubenheim, J. W. Wright. In addition, 33 delegates to the General Assembly of URSI attended by invitation.

The minutes have been circulated to the members of the Committee by the Secretary. The principal points discussed and decisions reached are summarized below:

1. Ionospheric Network Advisory Group.

Mr. Piggott (Chairman, INAG) stated that the present distribution of the INAG Bulletin was 320 copies and that it appeared at intervals of about three months. It appeared to meet a real need.

He pointed out that many stations found that it was too expensive to produce ionograms of the standard required for high-quality data.

2. Ionospheric Drifts.

It was noted that Resolution III.9 (Warsaw 1972) of URSI referred to the problems of drift measurements.

3. Whistlers.

The Working Group on Whistlers (Chairman, Dr. Carpenter) expected to be concerned mainly with the problems of flow in the magnetosphere. Work is in progress on the links between whistler and ionospheric data arising from ionosphere-magnetosphere coupling.

4. Digital Data Pre-processing.

Dr. Bibl (Chairman of the Working Group) referred to the wider applications of the work done on ionospheric data handling. (See Resolution III.19 (Warsaw 1972)).

5. Guides to Data Exchange.

A revised version of the Guide relating to data in the field of solar-terrestrial physics is expected to be issued in 1973 by IUCSTP.

6. Handbook of Ionogram Interpretation and Reduction.

The revised English version is to be published early in 1973. It was recommended that French, Russian and Spanish editions be prepared. (See Resolution III.4 (Warsaw 1972)).

7. Manual on Absorption Measurements.

Prof. Rawer reported delays in the preparation of the text and hoped that publication would be possible by the end of 1972.

8. International Reference Ionosphere.

Prof. Rawer referred to the preliminary report dated August 1972, but stated that it was only tentative and that certain points were still under investigation.

9. Retrospective World Interval.

A recommendation was made for the designation of an RWI to cover the period 26 July - 14 August 1972. (See Resolution III.5 (Warsaw 1972)).

10. IUCSTP.

Prof. Bowhill summarized the programmes planned by the Commission in March 1972. The main programme will be the International Magnetospheric Study but there will also be studies relating to the build-up of solar flares, terrestrial and planetary atmospheres, etc. A small group consisting of Profs. Bowhill, Rawer, Lauter, Kazimirovsky and Evans was formed to discuss other programmes suggested by IUCSTP.

Mr. Piggott and Dr. King were designated to represent URSI interests in the IUCSTP Working Group on Solar-Terrestrial Monitoring and the IMS Steering Group respectively.

11. Future of URSI-STP Committee.

The Chairman stated that the majority of the members agreed that it would be logical to transfer the main activities of the Committee to Commissions III and VIII. Prof. Rawer agreed that the Commissions should be more active between Assemblies and stated that Commission III intended to create several Working Groups to deal with specific topics. With such a structure, most of the work of the URSI-STP Committee could be taken over by Commissions III and VIII.

Commissions III, IV and VIII later recommended that the sole function of the URSI-STP Committee in future should be to act as a link between URSI and IUCSTP. The membership will be the Chairmen of URSI Commissions III, IV and VIII with, as Chairman, the URSI representative on the Bureau of IUCSTP. (See Resolution III/IV/VIII.1 (Warsaw 1972)).

X. Beacon Satellites

A satellite carrying a beacon transmitter radiating at four coherent frequencies will be launched in the first half of 1974 as part of the INTERKOSMOS programme. The frequencies used will be 20.004 MHz (unmodulated), and 40.008, 180.036 and 360.072 MHz (all modulated). On each frequency the output power will be 300-400 mW and the radiation will be linearly polarized.

Persons wishing to cooperate in the reception of the beacon signals are invited to ask for further information from:

Ionospheric Observatory,
Geophysical Institute, Czechoslovak Academy of Sciences,
Panska Ves,
47141 Duba, Czechoslovakia.

(Telex No. 17382 IONV C).

XI. Corrections to Handbook (Report UAG-23)

The corrections are identified as follows:

(a) page number as given on bottom of page
(b) section number
(c) (i) paragraph number (in brackets) from top of page if section starts on an earlier page
    (ii) paragraph number (in brackets) in section if section starts on the page
(d) line in paragraph

Displayed equations are regarded as part of the preceding paragraph when counting. Otherwise, a blank line implies a new paragraph.

For typing errors: The incorrect expression is given first, then a gap, followed by the correct expression.

Comments on corrections marked with a * will be found listed separately.

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
piii	I.N.A.G. Members change chairman's address:			
			W. R. Piggott (Chairman) British Antarctic Survey % S.R.C. Appleton Laboratory Ditton Park Slough, Bucks SL3 9JX England	
		and	Dr. L. E. Petrie 22 Barron Street Box 4A Rural Route 3 Ottawa, Ontario, Canada	
p iii	Foreword	(5)3	4-chrome	4-chome
p 5	0.4	(1)2	modity	modify
p 7	1.02	(1)1	Insert after [A70D]	(see foreword p. i and p. iii)
p 9	1.04	(2)2	$1T = 10^6 Gs$	$1T = 10^4 Gs$
		(5)3	$fx^2 - fxfB \quad fo^2$	$fx^2 - fxfB \fallingdotseq fo^2$
		(5)5	$fx - fo = fB/2$	$fx - fo \fallingdotseq fB/2$
p 9	1.04		at end of section insert:	

The value of fB can be calculated from the local ground value of B using the inverse cube variation with height

$$B(h) = B_o \left(\frac{r_o + h}{r_o} \right)^{-3} \fallingdotseq B_o \left(1 - \frac{3h}{r_o} \right)$$

where r_o is the local radius of the earth.

If this is not available, use the dipole approximation p. 317 (e). By convention, h = 100 km is used for E layer, h = 300 km for F layer, h = 200 km when one value is used for both.

p 17	1.14		Insert at end of section:

By convention entries of foE are omitted at hours when foE is usually below the lower limit of the ionosonde.

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
p 17	1.15	3	Insert: Night E always causes group retardation in any traces from higher layers, and such retardation near foE is sufficient to identify foE for night E.	
p 17	1.15	8	Omit: Normal E is not seen in these conditions.	
p 17	1.15	8	Insert: see section 4.24, p. 90.	
p 19	1.19	(2)4	in all tables	in all other tables
p 19	1.22	(1)4	Insert after section 7.34: which seems to have fallen out of use and may be ignored.	
p 20	1.26	(1)1	Insert: foI: before foI is.	
p 20	1.38	(1)1	fo1.5	foF1.5
p 21	1.50	(4)8	Fig. 1.14	Fig. 1.15
p 27	2.0	(c)1	weak trace	weak traces

p 26 New section after section 1.8:

1.9 Computer Output

Parameters reproduced in computer form are usually identified by the standard characteristic codes given in section 7.3 of the Handbook. These may be supplemented or replaced if desired by the corresponding parameters in computer printout form, e.g., FOF2 for foF2, FMIN for fmin, etc. All lower case symbols are replaced by capitals for computer reproduction and are regarded as equivalent to the international conventions. Other use of the capital letter forms is permitted on a voluntary basis. The use of capitals rather than lower case symbols for Es types is under discussion at the time of writing, mainly because capitals are used in computer output and in practice the lower case letters are often difficult to read. Any decision will be announced in the INAG Bulletin. Originally lower case symbols were devised for Es types so as to avoid confusion with letter symbols which have quite different meanings. This is important to trainees but not important to fully trained operators who easily recognize the different context.

p 31 Insert after "The rules for frequencies are summarized in Fig. 2.1":

2.23. Accuracy rules in total range of uncertainty forms: Operators who prefer to consider the total range of uncertainty may use the following rules which are equivalent to these given above.

(a) If the total range of uncertainty does not exceed 4% or 2Δ whichever is the greater, then the numerical value is unqualified.

(b) If the total range of uncertainty exceeds 4% or 2Δ whichever is the greater but does not exceed 10% or 4Δ whichever is the greater, the value is considered doubtful and the qualifying letter U is used with the most probable value together with the descriptive letter which most nearly represents the reason for the uncertainty.

(c) If one boundary is certain and the other possible boundary lies within 10% or 3Δ whichever is greater, from it, the most probable value is taken as being midway between the observed limits, and the qualifying letter U is used with this value and the appropriate descriptive letter.

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct

(d) When the total range of uncertainty exceeds that in paragraph (b) but is less than 20% or 5Δ whichever is greater, of an observed boundary of possible positions of the principal echo trace, then this observed limit is tabulated with the qualifying letter D or E, whichever is applicable, and the appropriate descriptive letter.

(e) When the total range of uncertainty exceeds 20% or 5Δ whichever is greater, a descriptive letter only is tabulated without a numerical value.

The application of these rules to F-region frequency parameters Δ = 0.1 MHz and E-region parameters with Δ = 0.05 MHz are shown graphically in Figs. 2.1 (a) and (b), respectively.

2.24. Historical Note:

Insert: Figs. 2.1a and 2.1b between pages 30 and 31.

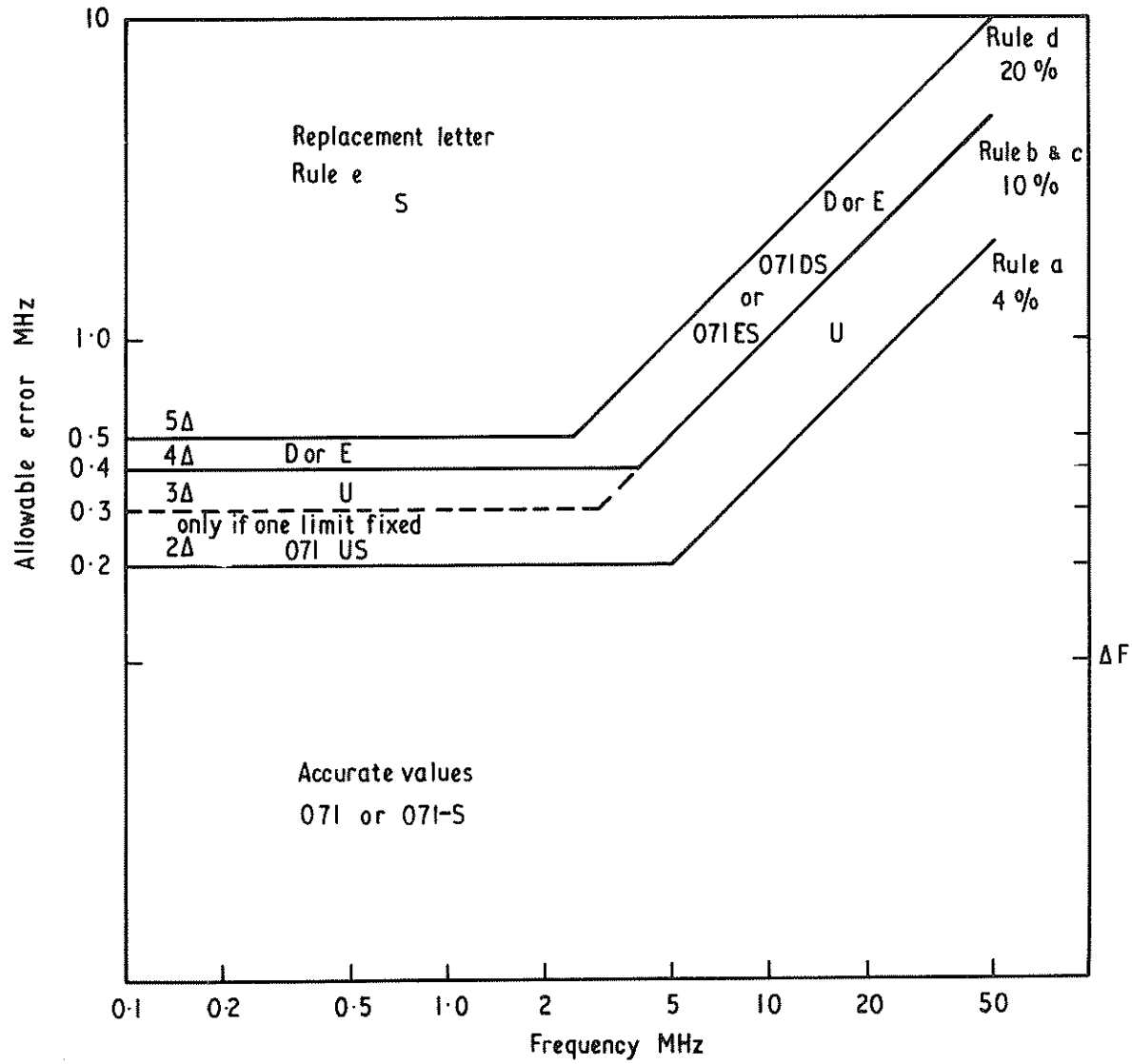


Fig. 2.1a Accuracy rules for F region frequencies Δ = 0.1 MHz in terms of total range of error.

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct

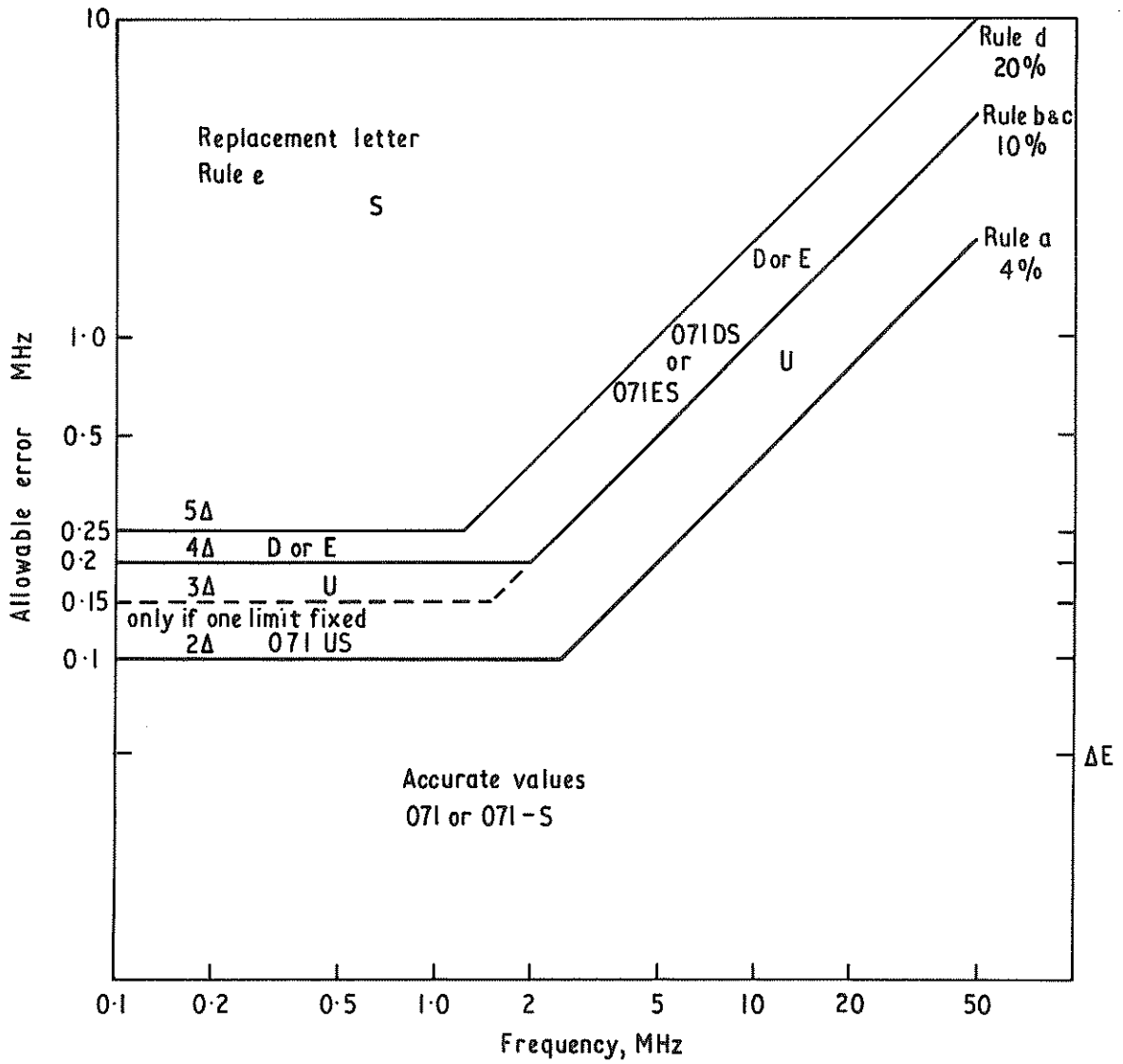


Fig. 2.1b Accuracy rules for E region frequencies Δ = 0.05 MHz in terms of total range of error.

p 37	2.70	Equation below Fig. 2.6	h'(02) ≠ h'(01)	h'(02) ≠ 2h'(01)
p 48	2.75	(3)4	reapprears	reappears
p 48	2.75	(3)4	strenght	strength
p 48	2.75	(6)2	(cometimes	(sometimes

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
p 48	2.75		Replace text by the following:	

2.75. Lacuna phenomena: Under certain circumstances, traces reflected from a certain range of true height disappear although the remaining traces show that the absorption is either normal or only slightly increased. The name Lacuna (lacune in French) has been proposed for this phenomenon, Lacuna being the Latin word for 'gap'. The explanation of Lacuna is still controversial though it is generally agreed that the reflected signal is greatly weakened by scattering or defocussing processes occurring over a limited range of reflection heights. When the equipment sensitivity is high or the phenomenon weak it is possible to see weak reflections spread in frequency and height over parts of the range where normal reflections have disappeared.

Lacuna appears to be closely associated with activity along the auroral oval and is also found at the magnetic poles. It may therefore prove to be a useful tool for studying activity in these zones. It is also closely associated with slant Es seen at high latitudes and has been discussed under the title Slant E condition (J. K. Olesen, AGARD CP97, 1972, pp. 27.1-27.19, NATO Paris, INAG 12, pp. 14-19).

The distinguishing feature of Lacuna is that the amplitude of signals reflected from a certain range of heights is abnormally small. In contrast absorption causes greater losses on the lower frequencies and on the x-mode relative to the o-mode traces. Similarly when Lacuna affects a trace near a critical frequency the signal suddenly disappears or reappears at normal strength, abnormal absorption would cause a gradual change with frequency. When absorption is low, slant Es is common during Lacuna. The F traces disappear suddenly when Lacuna occurs and reappear suddenly, with relatively little change in shape over the interval. In practice the Lacuna is most often seen on the F1 trace, Fig. 2.18, causing a gap from foE to foF1 (sometimes the E-trace retardation is also cut off giving a trace at normal height but looking like an Es trace). This is called F1 Lacuna. It can effect all F-layer traces -- total F-Lacuna. When the sensitivity is high, weak diffuse traces can be detected over part or all of the perturbed height range.

The presence of Lacuna phenomena is indicated by letter Y. Care must be taken to distinguish between Lacuna and the effects of increased absorption and of blanketing by Es. (See Figure 1, p. 12).

p 48	2.75	Fig. 2.18 caption - Insert:		
		(e) At some stations the second order trace is not seen during Lacuna conditions.		
p 43		Fig. 2.12	Omit Lacuna present on fxE2	
p 43		Fig. 2.12	Caption line 14. Insert badly. If x trace badly distorted. . . .	
*p 51	3.0	(1)4	Insert after (1). The old WWSC convention, with qualifying letter before the number and descriptive letter after it was dropped for general use as it was found to cause trouble when the data were punched for computer use. This convention is convenient for manual work and is allowed where the data also exist in computer form. When letter symbols are printed above the number the convention is that the qualifying letter, if any, is placed above the first figure of the number and the descriptive letter above the third figure.	

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
p 51	3.0	(4)3.	(fxEs)-x	(fxEs)-X
p 51	3.1	Insert between A - , D - new paragraph: Letter E implies a limit value which is less than the numerical value. These values must be moved to the bottom of the distribution when forming the second median. Letter A also implies a less than limit value but this value is expected to be abnormally large and hence should not be moved to the bottom of the distribution when forming the second median. The connotation "less than" is thus ignored in forming the medians.		
p 51	3.1	letter A, line 3.	Insert after fbEs = foEs: see section 4.6, p. 108.	
p 52	3.1	letters J and O.	Insert after equation: or when fo is near or below fB the appropriate value of fx-fo (section 1.04, p. 9).	
p 52	3.1	letter J, line 3.	fo = fx-1/2fB	fo = fx -fB/2
p 52	3.1	letter Z, line 3.	Omit: and indirectly to M(3000).	
p 53	3.2	letter A, para. (6), line 3.	Omit the value of foEs deduced from.	
*p 53	3.2	letter A, para. (c)	Omit this paragraph.	
*p 53	3.2	letter A	Insert after first paragraph: When an Es trace is such that foEs cannot be distinguished and must be deduced from fxEs letter A is used. foEs = (fxEs -fB/2)JA. Historically, this case was treated using letters JX but this is misleading and obsolete. A is not used when foEs cannot be evaluated directly because of interference (use JS) or instrumental trouble (use JC).	
p 54	3.2	Fig. 3.1 caption (iv)	Add: (see section 2.4, p. 32., Fig. 2.2).	
p 55	3.2	Fig. 3.2	Omit: paragraph (iv).	
p 56	3.2	Fig. 3.5 (ii)	fof1	foF1
p 56	3.2	Fig. 3.5 (iv)	Add: In most cases there will be no doubt that ftEs ≡ foEs but doubt may arise when ftEs>>fmin.	
p 67	3.2	Fig. 3.20	form, E	form G
p 69	3.2	letter K (1)6	Omit: Night E is seen only on disturbed days. Insert: The primary indication that night E is present is the presence of group retardation at the low frequency end of the trace from the higher layer. (Fig. 4.2, p. 91).	
p 69	3.2	letter L (a)	foF1	foF1
p 71	3.2	letter L (b)	M(3000)F1	M(3000)F1
p 73	3.2	letter Q, line 2	h'f	h'F
p 78	3.2	(1)5	Omit R	A, B, F and H
p 78	3.2	letter B (b)(iii)	value of fmin	value of fm2

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
p 78	3.2	letter B (b) line 10	h'F1	h'F
p 78	3.2	last paragraph (b)1	F layer	F2 layer
p 80	3.2	Fig. 3.34	(foF2 + fB/2)OY	(foF2 + fB/2)EY
p 80	3.2	Fig. 3.34	N-S or E-W	E-W or N-S
p 81	3.2	letter Y Insert new paragraph at end: Note the use of Y to identify severe layer tilts is restricted to tilts in the F2 layer for physical reasons. Tilts near F1 are better described by H. Only tilts giving the type of ionogram illustrated in Fig. 3.34 should be identified by Y. H is more appropriate in other cases.		
p 81	3.2	letter Z (3) end Insert: When fz is near or below fB the appropriate value of fo-fz (p. 9) must be used.		
p 81	3.2	letter Z (4)2	transmissiion	transmission
p 87	3.34	(1)2 Interpose text.		A missing value of fxI in these cases can be ....
p 90	4.0	(2)1	station is	station are
p 93	4.31	(1)2	magneto ionic	magneto electronic
p 93	4.31	(3)4	ftEs ≥ fB	ftEs > fB
p 102	4.42	(3)3	described by X	described by A
p 103	4.42	(f) letter G	Omit: "or night"	
p 108	4.6		Omit: paragraph (c)	
p 131	5.63	(1)4	f1S, fxS, f2S	foS, fxS, fzS
p 137	5.91	Symbol FHS	MHz/sec	MHz
p 143	6.3	b(2)4 Insert at end: fzE may be plotted to show when it occurs if it is seen only rarely. This should be done if there is likely to be local or regional study of the phenomenon.		
p 163	7.25	(1)3 Insert: See note in section 3.0, p 51.		
p 178	8.2	Characteristic foEs (4)1	O66JX J X O66	O66JA J A O66
p 178	8.2	Characteristic h'F (1)3	Omit: but the error is unknown.	
p 180	8.33	(3)2 Insert:	A, C	A (new rule) C
p 180	8.33	(b) letter B (2)2	Omit: logical	
p 180	8.33	Insert at end: The phrases equal to or greater than and equal to or less than a median are treated as greater than or less than the median unless the median is itself a limit value when they are taken as equal to this value.		

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
p 182	8.36	(iii)(a)	D	A, D
p 182	8.36	(vi)1	D	A or D
p 182	8.36	(vii)	D	A or D
p 182	8.36	(viii)	D	A or D
p 183	8.36	(1)1	D	A, D
p 183	8.4	(4)1	D	A, D
p 183	8.4	(4)3	D	A, D
p 183	8.4	(5)1	D	A or D
p 183	8.4	Note (iii)1	D	A, D
p 183	8.4	Note (iii)2	D	A, D
p 183	8.4	Note (iii)3	D	A or D
p 183	8.4	After (iv) Insert:	(v) The quartiles are not as important as the medians and therefore second quartile values are not calculated. Similarly if the quartile lies between a qualified and unqualified value, it is more useful to know the value unqualified than qualified - at the lower accuracy possible it is unlikely to be significantly changed.	
p 184	8.5	After Table Insert:	Note (i): Strictly the cases D, D; E, E are indeterminate but it is often useful to give an idea of the scatter of the numerical values. The fact that the median is a limit value shows that U is used as a convention and has not its usual accuracy implications. Note (ii): For fbEs the above rules apply when qualifying letter A replaces qualifying letter D, or A and D values are mixed. Use A as equivalent to D in this case.	
*p 187	9.0	Last paragraph 5 Insert:	Omit text starting with "However" and In 1972 the status of the former Inter-Union Commission on Solar-Terrestrial Physics was changed into that of a Special Committee of ICSU (SCOSTEP) the principal responsibility of which is the organization of the International Magnetospheric Study in 1977-1978. This project requires the cooperation of the many national groups that are concerned with regular astronomical and geophysical observations. Within SCOSTEP, a steering committee for MONSEE (Monitoring of the Sun-Earth Environment) has been set up to coordinate, on an international scale, series of observations required for the IMS and other projects being organized by SCOSTEP.	
p 188	9.0	(2)1	COMSTEP	SCOSTEP
p 188	9.0	(Last paragraph)1	COMSTEP	SCOSTEP
p 188	9.0	(Last paragraph)5	COMSTEP	SCOSTEP
p 190	9.14	(1)1	Omit: generally	WDC's are not responsible for the accuracy of data...

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
p 191	9.31	(2)4	RGD	RWD
p 194	9.44	(i)2	h'F, h'Es	h'F, h'F2, h'Es
p 200	10.11	Equation 10.4	$\frac{dr}{dh}$	$\frac{dN}{dh}$
p 200	10.11	3 lines below equation 10.4	$\frac{dr}{dh}$	$\frac{dN}{dh}$
p 201	10.12	(5)2	[Paul and Smith, 1968]	[Paul and Smith, 1968, Radio Science, 2, p. 163-170].
p 201	10.12	(5)6	[Becker, 1959]	[Becker, 1959, J. Atmos. Terr. Phys., 16, p. 67-83].
p 203	10.13	(last paragraph)2	μ	μ'
p 203	10.14	(1)4	sample	simple
p 204	10.14	(1)2	sample	simple
p 207	Table 10.2		There are a number of errors, identified by block, i.e., value of ϕ, line and column in line:	
		10° 2 1	0.900	0.990
		3 1	0.950	0.980
		3 3	2.2708	2.2707
		5 2	1.2173	1.2175
		7 2	0.3827	0.3862
		7 4	0.3807	0.3867
		30° 2 1	0.900	0.990
		4 4	1.5526	1.8526
		40° 3 3	2.4552	2.4882
		6 4	0.8191	0.8199
		50° 5 1	0.830	0.880
		54° 9 3	0.0621	0.0721
		60° 1 2	3.7005	3.7095
		67° 3 5	3.2688	3.2668
		5 5	1.1551	1.5511
		70° 5 1	0.850	0.880
		5 3	1.3552	1.3882
		6 1	0.700	0.760
		6 4	0.9019	0.9010
		7 1	0.5800	0.580
		7 3	0.4228	0.4328
		10 3	0.126	0.0126
		11 1	0.0400	0.040
		80° 4 5	2.5852	2.5882
		8 3	0.4976	0.1976
p 216	10.30	Table 10.6	00	∞
p 217	Fig. 10.6	Caption 3	h(0.45 foF2)	h(0.95 foF2)
p 222	10.43	(last paragraph)1	f3/fc =	f3 =

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
p 224	10.45	last line	h'o = o	h'o = 1
p 224	10.45	last line	meximum	maximum
p 253	11.33	(2)3	a SID	an SID
p 258	Fig. 11.9	Insert: The amplitude is shown by the blackness of the entries.		
p 267	Fig. 11.17	caption	of Fig. 12.16	of Fig. 11.16
p 278	12.31	Insert after last line of text: INAG's proposals for a spread F index are given in section 12.34, p. 282.		
p 282	12.34	(1)2	amplified	simplified
p 282	12.34	(ii)1	symbol R	symbol Q
p 282	12.34	(iii)5	R	Q
p 282	12.34	(iii)6	R	Q
p 282	12.34	(iii)9	R	Q
p 282	12.34	(iii)10	R or R ... F,R	Q to Q ... F,Q
p 282	12.34	(iv) Omit: There are two main groups: (a) Spurs or noses superposed on a normal F or M pattern (Penndorf type γ). (b) A spread trace and Insert: Spurs give a spread trace . . .		
p 282	12.34	(iv)(2)6 (iv)(2)7 (iv)(2)8 (iv)(2)9	R R F,R;...;RS;RM F,R,S; M,R,S	Q Q F,Q;...;QS;QM; F,Q,S; M,Q,S.
p 308	14.21	(b)(1)2	GINZURG	GINSBURG
p 309	14.21	(b)(2)2	V. SUCHY	K. SUCHY
p 311	14.21	(e)(6)1	Mcgraw-Hill	Mc Graw-Hill
p 311	14.21	(e)(11)1	Comite Consultative	Comité Consultif
p 321	14.82	8 Omit: Radio and Space Research Station Ditton Park, Slough SL3 9JX, England. Insert: S.R.C. Appleton Laboratory Ditton Park Slough Bucks SL3 9JX, England.		
p 323	14.9	(7)2	K. Kondo	T. Takiguchi

Notes on Corrections

p 53 3.2 letter A, paragraph c.

This rule causes some confusion in making f-plots and the groups which originally requested that it should be included have withdrawn this request, feeling that rules (a) (b) are adequate for all practical purposes.

It is INAG's policy to keep the rules as simple as possible and therefore this rule is now formally withdrawn.

Page number at bottom of page	Section number	Paragraph and line number	Incorrect	Correct
p 53	3.2	letter A after first paragraph.		
			Use of A as a descriptive letter with J. The old WWSC convention was to use JX when the o and x traces of Es were indistinguishable. However letter X means that an x-mode characteristic is included in an o-mode table so that this use is not logical. foEs = (fxEs - fB/2)JA removes this difficulty. foEs = (fxEs)-X implies that fxEs has been written in a table which is normally foEs. This point has been made by several groups and appears to be generally accepted.	
p 187	9.0		The organization of COMSTEP has been changed since the Handbook was written and the new text (provided by the Secretary General of URSI) brings the Introduction up-to-date. This text is already incorporated into the French text.	
p 282		Spurs symbol S.		
			There has been some discussion in INAG meetings and the INAG Bulletin on whether this class should be called Oblique structures, letter O. However some groups feel that all spread conditions are oblique and, in particular, range spread is always oblique. Pending clarification of this controversy it seems better to keep to the Handbook Text in which the distinction is quite clear. INAG invites further discussion.	