IONOSPHERIC NETWORK ADVISORY GROUP (INAG)

Ionosphere Station Information Bulletin No. 15

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I. Introduction

by

W. R. Piggott, Chairman

As reported elsewhere in this Bulletin, the meeting of station operators and scientists at Sodankyla May 16—17, 1973, was very successful. Proposals were adopted to improve the liaison between the Scandinavian stations so that they should be able to act as an efficient regional network during the International Magnetospheric Study (INS). This initiative could be copied with advantage in other regions, particularly where the region is important for INS studies. Many sequences of ionograms were considered and their interpretations agreed. It was notable that, at first glance, complex ionograms from different types of equipment appeared very different. However, when the effects of the characteristics of the ionosonde, level of recording dynamic range, degree of differentiation, etc., were recognized, standard procedures could be applied and all present agreed that a unique interpretation was possible. This exercise gave those present confidence in interpretation of ionograms both from their own and collaborating stations.

This meeting of Scandinavian ionospheric workers was only one of a series of meetings covering different fields and in many different countries which are being held to plan and prepare for the great international effort in the INS. It is important that the V.I. network. the associated ionospheric ground based networks, A1, A2, A3 absorption, incoherent scatter, drifts, whistlers, and the corresponding networks in magnetism, aurora, airglow, cosmic rays, etc., revise their standards of operation and exploit their possibilities as far as possible. We have a major part to play in clarifying the morphology of the phenomena to be studied in the INS in identifying similar or dissimilar occurrences and in using our techniques in new ways. The latter can involve either using existing techniques for new applications, modifying and expanding our techniques or deploying new methods to supplement our existing system.

As your Chairman, I would like to encourage more groups to consider these possibilities, both for those with few facilities and those with many. As an example, the British Antarctic Survey Group, which is very small, have been comparing absorption measured by riometer, and shown by fmin and fm2. This has provided a powerful technique for separating absorption in the F region, which is often a large part of the absorption seen by riometers and that in the D and E regions.

There is much interest at present in the forces which maintain the F layer at night. In some zones the effects of winds are quite clear, in others there seems to be a downward flow of plasma or particles from the magnetosphere and in some electric fields may be important. The composition of the F region is now known to vary considerably with position both by day and night causing corresponding changes in both foF2 and total content. In all of these cases comparisons between data from stations in different areas or between V.I. data, airglow, or new types of data from satellites form the basis for research. We must anticipate that such efforts will be increased in the INS and prepare accordingly.

While a number of typing errors have been discovered in the Handbook and there seems to be a general feeling that one or two paragraphs need clarification, the consensus of expressed opinion is that the Handbook is satisfactory. *INAG therefore proposes to issue corrections and amendments in the next issue of this Bulletin and to recommend that all stations use the Handbook as amended as the official URSI guide for interpretation and reduction of ionograms.* If you wish to raise any points or have objections please inform INAG as soon as possible. Progress on the translations is good but the job is a very large one. Some authorities have made translations of parts of the Handbook for local use and INAG wishes to encourage such action. *It would be helpful if INAG were informed of the existence of any translations, however partial or rough. I therefore ask you if you have such material, to let me know:*

(a) language used,
(b) sections or chapters translated, Cc) whether and from whom copies can be obtained.

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Please remember that you may have a compatriot working in a different country who would like the material in your language — at present he does not know whether it exists or not.

Looking through the previous issues of this Bulletin, I note that *all topics which are raised in INAG meetings* have been mentioned, usually in these introductions, reports of the meetings or in contributions from INAG members. These *are still very alive end you ore invited to comment on any of them.*

As Chairman, I would like to encourage you to contribute to the Bulletin either by asking questions, stating new results or techniques of interest to the network or by discussing your training aids. We would like to have contributions from scientists who need network data for new types of research particularly so that their needs are understood by administrations and operators.

I must apologize for this issue being later than would be expected for a quarterly sequence. Unfortunately your Chairman did not have time to prepare the material in time and your Secretary has been away from her base attending a conference. The next issue may also be delayed as your Chairman may not be available when it should be prepared. Extra contributions from you would minimize such delay!

II. Comments on Letter from A. S. Besprozvannaya — INAG—14 p.11

3.2. Use of letter *Q*

There appears to be general agreement that range spread should be denoted by *Q* in both section 3.2 and section 12.34. The proposal is, therefore, to change 12.34 to be consistent with 3.2. This could also allow the use of a capital *Q* if preferred to lower case q on f plots when range spread is present (6.3(g) p144, 6.86 p158 Handbook) thus keeping a uniform nomenclature for all range spread entries, I concur that the two sections should be in agreement.

<u>12.34 Spread F classification</u>

I must apologize for not publishing Dr. Besprozvannaya's earlier letter. Unfortunately a reply in which I asked to split this letter into material for INAG and material for the Handbook went astray so that no action was taken. The appropriate sections are reproduced, slightly edited below. I had written to Dr. Besprozvannaya discussing the possibility of getting a physical significant classification of spread F and was also considering basing spread F classification on one of three possible schemes:

(a) The appearance of the ionograms using only a few simple distinctions, i.e., the sporadic—E type approach.

(b) A classification, particularly for use at high latitudes, based on whether the spread was gain sensitive or not. This would be interpreted using the difference between the traces for the gain run sequence of ionograms.

(c) A combination of (a) and (b).

The advantage of (b) was that it distinguished between small scale scattering, from clouds and reflection from field aligned or tilted surfaces, of (a) that it could be used everywhere without knowledge of gain sensitivity. Penndorf's scheme is given on p.280 of the Handbook.

<u>Extract from Besprozvannaya letter dated 28 November 1971</u>

I fully agree with you that Penndorf's classification is by no means complete, being at the same time extremely complicated. I would like to propose that it seems desirable to have a spread—F classification similar to that of Es, i.e., not physical. Obviously it would have been perfect to develop a classification based on physical origin of spread F. However, I am afraid, that we would wait for the solution of the problem for a long tine. It is a well known fact that any classification ignores the understanding of the physics of events and is used as a means for contributing to the understanding of the phenomenon. Therefore, I believe it reasonable to attempt to use an existing classification until a perfect one is developed.

I like your idea to divide spread-F traces into two types: those which depend on the gain and those which do not. Earlier this principle was taken as a basis for classification by Renau (JGR, 1960, 65, 3219). He suggested that spread F be divided into type A and type B. But I am afraid the boundary conditions would be difficult to define.

I feel that Penndorf's classification contains some scientific information. I have tried to use it in my work introducing certain simplifications. First, I rejected the quantitative differentiation (in species). In my opinion it is quite useless. Then I have determined the spread-F type by the trace which was used to scale the fxI parameter. For instance, if fxI was type β and foF2 also showed spread of type α, the latter was ignored. Thus, instead of αβ (Penndorf's classification) I marked only β type. Similarly, if there are δ and β and δ was scaled by the trace with a range spread, I gave symbol δ. Using this

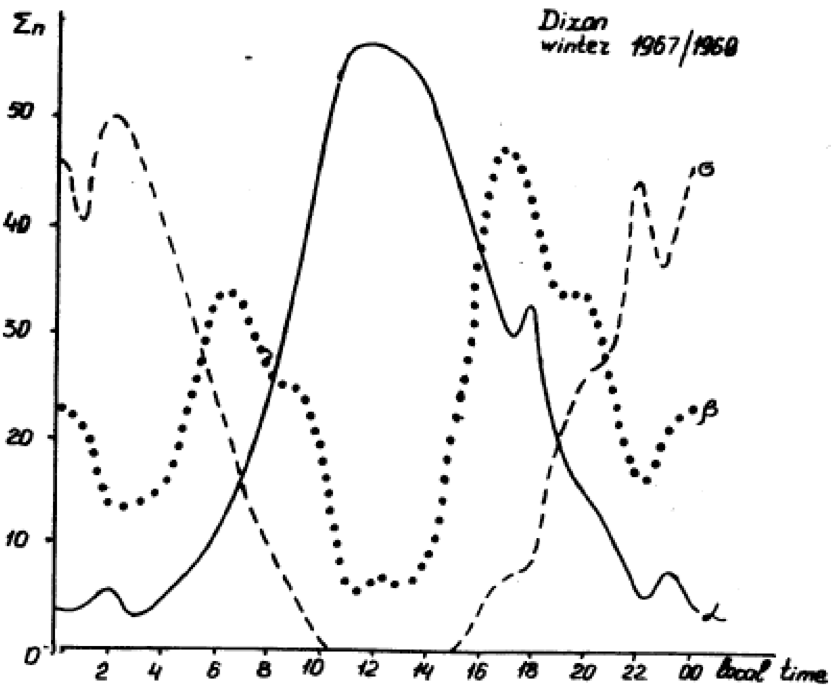


Fig 1

principle the spread—F classification for each hour for the Dixon Station data of the four winter months 1967—69 was made. The result obtained was interesting (Figure 1).

The abscissa shows local time, the ordinate shows the number of cases, when fxI was scaled by the spread-F trace corresponding to types α, β, δ. (The number of Y cases was so small, that no statistical analysis was attempted.)

It is seen that each type predominates at different hours of local time. At night it is δ type, at noon it is α type, and at sunrise and sunset hours it is β type. It is interesting to note that

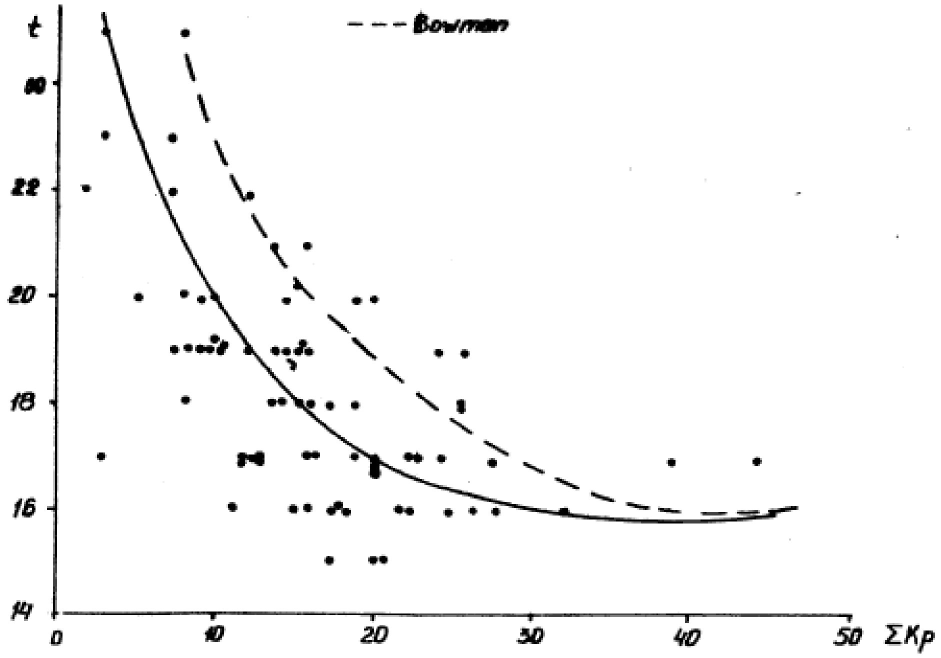


Fig 2

there is a connection between the occurrence of spread F of β type and magnetic activity during evening hours. The α type, prevailing in the day time is replaced by β type and the higher is magnetic activity during that day the earlier it happens. Figure 2 shows a plot of the local mean time at which β type is first seen as a function of the sum of Kp. The broken line indicates Bowman s

relationship between the onset of the trough over the station and magnetic activity *(Planet. Space Sci., 1969, 17,* 777). It appears that Penndorf's type β is connected with those events in the ionosphere which are associated with the station position under the trough, that is with tilts in the ionosphere.

I am sure you would understand that the results are only preliminary, but they indicate that Penndorf's classification is worthwhile studying and it might be used as a basis for the development of the classification acceptable for our routine data scaling. By this I do not mean to discourage you in any attempt to develop an absolutely new classification of spread traces based on our current understanding of the spread-F nature.

Comment on this letter

(1) This gives a nice example of how a spread-F classification could be used in practice and the analysis could be repeated with advantage at other stations.

(2) It seems to me that the Es—type rule should be applied to spread—F typing. In Es the first type given is that for the trace used to give foEs, fbEs and h'Es. The other types present, up to three, are then given in order of their top frequencies. The analogue for spread F is that the first type to be tabulated should always be that which gives fxI, the second, if present, that which has the

next highest top frequency. This enables both the type of analysis discussed by Dr. Besprozvannaya to be used (using the first entries only) and also other researches in which, for example, the spread of the overhead layer or the presence of range spread at frequencies below fxF2 can be studied. There are requests for facilities for such analyses.

In order to give confidence to the users that the spread—F classification is complete and that cases have not been accidentally lost in tabulation, it has been suggested that cases of no spread F (fxI ≡ fxF2), or with no spread on foF2 and fxF2 but a spur giving fxI present, should be noted by descriptive letter X. If this proposal has general support it would mean that there would always be at least one entry for every hour in the spread F-classification table: — F, H, 5 or X, with multiple entries when more than one structure was present. The first entry would always describe the fxI traces. *Your views are requested.*

(3) The precise type of spread F which is associated with a particular magnetospheric or ionospheric phenomena depends on the local geometry of the magnetic field and the position of the station. Thus rules which would give a better geophysical relation at one station need not apply at another. In this example for Dixon, Pendorf's type β correlates with the trough. At Halley Bay, with a different geometry, the poleward side of the trough is given by a polar spur (Handbook type 5) which jumps to type F as the edge moves over the station. INAG has to stick to rules which are reasonably widely applicable, allowing and encouraging local corrections where these are valuable.

12.34 Comments on INAG—14. p. 11

The problem is whether spurs and noses superposed on a normal F or H pattern should be classified under 5 or under F. Physically, particularly when well developed, they are oblique traces which, at some stations, have some link with polar spur phenomena. However, the distinction is difficult for operators in borderline cases — this is the main objection to Penndorf's classification scheme. The logical difficulty is that all cases of multiple critical frequencies necessarily involve some oblique reflections, that there can be a continuous gradation of types as the horizontal gradients increase but that in practice important phenomena e.g., the plasmapause trough structure and equatorial anomaly, frequently show large differences in electron density with position and thus characteristic distinct ionogram patterns. In view of the importance of keeping any classification as simple as possible there is a case for omitting (iv)(a) "Spurs or noses superposed on an F or H pattern," thus restricting 5 to polar spurs.

INAG would like to have your views on this proposal and your views on whether up to three types should be tabulated or not. So far the consensus of opinion has been to adopt up to three types with the type giving fxI always to be put first. I feel that this is most likely to be the more useful but wish to get as many opinions as possible.

4.83 Use of letter K

Proposal (D) of Leningrad, INAG—4, p.[6] modified by the agreement to use K for night E, was as follows:

D. Results of the analysis of retardation Es and night E show that the present tabulation of these phenomena is inconvenient and increases the work at the stations. On successive ionograms, Es type r can be replaced by night E or vice versa and these are tabulated in different tables.

The Seminar proposes:

(a) That night E be classified with Es type r and that its parameters be entered in the Es tabulations, e.g., values of night foE are placed in both of the tables of foEs and fbEs; h'E is placed with h'Es.

(b) That values of night E, foE, in the foEs and fbEs tables be identified by a descriptive letter K.

(c) That the current practice of entering night E in the foE tables be made voluntary.

(d) That where night E is tabulated, values of foE deduced using the retardation of the low frequency end of the F trace (Es—r trace present) should be included in the foE table as well as in the fbEs table.

Some consequential changes are needed in the f—plot:

(i) Open circles representing adjacent fob values should be linked together with adjacent conventional fbEs values (solid dots) whenever fbEs = foE.

(ii) That an open circle (foE value) be entered at the value of foE deduced from group retardation at the low frequency end of the F trace when fobs foE (Es type r traces with retardation at fbEs).

Proposal D(c) has the difficulty that it differs from current practice, in which night E parameters are always entered in the foE, h'E tables. When discussed at other INAG meetings there was a general desire to keep to the old rules, partly for training reasons — the distinction between thick and thin layers is critical, partly to maintain continuity with past data, partly because of difficulties at high latitudes where normal E may be present at all hours. The general feeling was that we might introduce confusion if the Leningrad proposal D(c) was adopted. There were also strong feelings amongst the scientists that the value of night E critical frequency was more significant for the actual ionization present overhead than the value of foEs when retardation Es was present and that they would naturally look for it in the normal F table when a thick F layer was present. Thus the general feeling was that the development of night E overhead could only be studied efficiently if all the night E values were put in the normal E table — the growth data would be missing when retardation Es or auroral Es is also present if the proposal is adopted.

The real difficulty in distinguishing between night E and retardation Es arises when fbEs > foF2. In all other cases the retardation of the low frequency end of the trace from the higher layer gives foE for night E. This case is not difficult in practice, however, as night F is totally reflecting and gives clean traces, often with multiple orders showing retardation whereas any multiple traces for retardation Es fade out before foEs is reached. In general there is also a distinct change in the spread, retardation Es usually shows some spread on frequencies just below foEs, night E seldom shows any. In the few cases of difficulty foE and foEs are likely to be within accuracy rule limits so K is appropriate. A decision on this point must be made shortly so that the Handbook text can be amended and frozen. *Please state your views quickly.*

It should be noted that the local option of omitting night E from normal E tables could be operated without danger of confusion as the appearance of K in the foEs, fbEs, ~ tables and not in foE tables clearly shows that this convention is in use when might E is present. The omission of K from Es types would, however, largely destroy the value of these tables at stations where night E is seen and is not acceptable.

Handbook

It is, of course, possible to add either to the Handbook or to the proposed High Latitude Supplement if there is a general desire for additional information. *Please let us know by letter or through the Bulletin of your views and INAG will examine the possibility of meeting them.*

III. The Relations Between Characteristic Modes and the z, o, and x Traces

Mlle. Pillet has raised the question of the correct nomenclature for the trace which shows a critical frequency at or near fB, the first dashed trace in Handbook p.1O, Fig. 1.4(a), and has also asked for clarification of the relations between the two magnetoionic modes, o, x and the three traces z, o, x.

The extraordinary wave below the gyrofrequency suffers from abnormal group retardation as it passes through the lower part of the ionosphere, this retardation increasing as the frequency approaches fB. The electron density at which it is imposed decreases to zero at fB. The condition of reflection is the extraordinary mode condition, $X = 1 + Y$,p.9 Handbook. The wave is definitely an x—characteristic wave at all heights so there are advantages in calling it an x—mode reflection instead of z as shown in the Handbook. I concur and propose that Fig. 1.4(a) be modified by replacing the “z” for the dashed trace below fB by an

Traces showing the infinity at fB are, in practice, very rare at most stations showing that the x—characteristic wave incident from below is often weakened so much in passing through the zone of high refractive index that it is not observed. For ionogram interpretation purposes, it is most convenient to consider the condition of reflection at the critical frequency, as set out in the Handbook. The

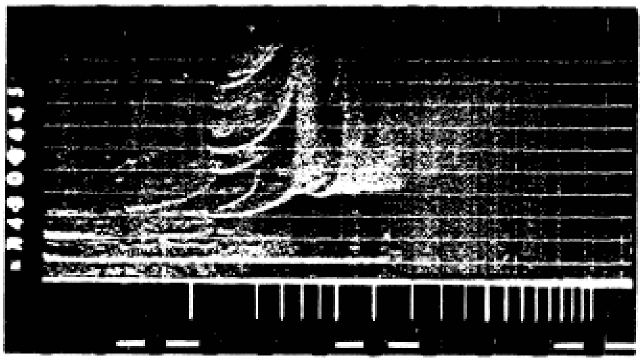


Figure 1

z—mode trace can be due to a coupled, o to x mode, to an x mode when fz is less than fB or to a mode scattered into the direction of the magnetic zenith. The absence of group retardation near and below fB when fz is greater than fB suggests that the z reflection is seldom a true x wave at all heights so that it is more valuable to identify it in terms of its reflection condition than in terms of its magnetoionic mode of reflection.

Mlle. Fillet has provided a nice example of an ionogram from Kerguelen at 0445 LMT (LMT = UT + 5 hours) on 30 April 1970 which is reproduced in Figure 1. The frequency scale is logarithmic from

0.25 MHz to 20 MHz with frequency marks showing at 0.75, 1.25, 1.5, 1.75, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0 .... MHz. fB is 1.225 MHz. The three traces with h’ values near 300 km are, in order of frequency:

(i) An extraordinary wave trace showing group retardation low in the ionosphere. This would, if seen complete, extend to near fB but gives an apparent critical frequency near 0.9 MHz.
(ii) The z—mode trace fzF2 = 1.3
(iii) The o—mode trace foF2 = 1.7—F

The x mode has an h’ value near 390 km. fxF2 = 2.6—F. In practice the ionogram was scaled to give foF2 = 1.8ZF since fo — fz = 0.5, fx — fo = 0.7 for those frequencies at Kerguelen, a value which was the best possible in the circumstances. There is also a clear polar spur present which can be seen on the original to disappear into interference and to give fxI = 6.0 US. F types are 5 F. This ionogram could easily be misread to give traces (i), (ii), (iii) as a z, o, x triplet. However, this interpretation cannot be true as the x trace (iii) would then show strong retardation and be seriously weakened near f B.

Mlle. Fillet reports that the true x mode is often seen at Kerguelen and Mr. Armstrong, now at Tromsk, reports that it was often seen in Jamaica also. The apparent critical frequency of this mode is determined by the retardation at low heights and so is not a measure of the maximum density of the layer. Thus it is important that it be identified correctly. In practice it tends to be present for several hours consecutively on nights when it is seen but the separation between this trace and the o trace usually varies with time. The sequence for this night will be reproduced in the next INAG Bulletin.

IV. Spread F Typing

There is much support amongst scientists who are studying spread F for a simple spread-F classification to be produced and tested, on a voluntary basis, over a wide range of latitudes. A draft proposal was included in the Handbook Chapter 12.3 "Spread F," in particular section 12.34 on p. 282. Discussions based on this proposal show that it has gained general support but that certain modifications are desirable.

1. There is now agreement that the symbol for range spread should be *Q* and not R as given in the Handbook. *INAG therefore adopts symbol q.*

2. Discussions, such as those reproduced elsewhere in this Bulletin, show that the inclusion of spurs and noses in type 5 is controversial and may give trouble in practice. Provisionally and subject to further discussion, *INAG proposes that paragraph (iv) on p. 282 be modified* by omitting:
"There are two main groups: (a) Spurs or noses superposed on a normal F or M pattern (Penndorf type y).
(b) A spread trace" and inserting "Spurs give a spread trace

3. There is a *typing error in line 2 of section 12.34* where 'amplified' should read 'simplified.'

4. The following provisional text should be added after paragraph (iv): —

(v) The type of the spread trace used to evaluate fxI should always be given first followed by the types for any other forms of spread present, up to three, in order of decreasing top frequency for each form.

(vi) Where no spread is present letter X should be used for the first entry.

With these changes, there appears to be sufficient agreement to justify a trial operation of this proposal on a voluntary basis.

INAG invites administrations, particularly those operating stations of high latitude, to try out the proposed spread—F classification system and to include a spread—F type table in their data publications on a voluntary basis. *INAG would like to encourage any station which is willing to try a test for a short period, e.g., a month, to do so and to send their results and comments to INAG. INAG would also like to have the views of scientists who have tested the usefulness of these types or wish to propose changes.*

V. Some General Comments Concerning the Deduction of hmF2

by

J. R. Dudeney
British Antarctic Survey

At present there is considerable international effort directed to developing simple methods for accurately estimating hmF2 from routinely scaled ionospheric data. It is therefore very desirable to clarify some basic principles concerning group retardation in the underlying ionospheric layers (E and Fl).

The effects of underlying ionization may best be understood by considering the group retardation suffered by an electro—magnetic wave (frequency f) in traversing a simple model layer of critical frequency fo (f ≥ fo). The effect of energy losses due to collisions can be ignored and initially the earth's magnetic field will be neglected. Three cases are considered:

a. Electron concentration (N) invariant with height.

In this case the group retardation, Δh', expressed as the difference between the virtual and true heights of reflection and normalized by the slab thickness Y, is

where x = f/fo.

Obviously, the total electron content, ∫Ndh, of the slab is $Y_m N_0$, where N_0 is the maximum

$$\frac{\Delta h'}{Y_m} = \left[1 - \frac{1}{x^2}\right]^{-\frac{1}{2}} - 1$$

electron concentration of the layer.

b. N obeys a parabolic law with height up to the height of maximum.

Here, Y_m is the semithickness of the parabola and

These normalized group retardations are given in the figure (solid curves) as functions of x for $1 \leq x \leq 2$. When x is greater than about 1.3, the three curves are very nearly the same shape.

$$\frac{\Delta h'}{Y_m} = x \tanh^{-1}\left(\frac{1}{x}\right) - 1.$$

It is a simple matter to show

$$\int N dh = \frac{2}{3} Y_m N_0.$$

c. N increases linearly with height up to the height of maximum.

$$\frac{\Delta h'}{Y_m} = 2x^2 \left[1 - \left(1 - \frac{1}{x^2}\right)^{\frac{1}{2}}\right] - 1,$$

where Y_m is the thickness of the wedge.

Also,

$$\int N dh = \frac{1}{2} Y_m N_0.$$

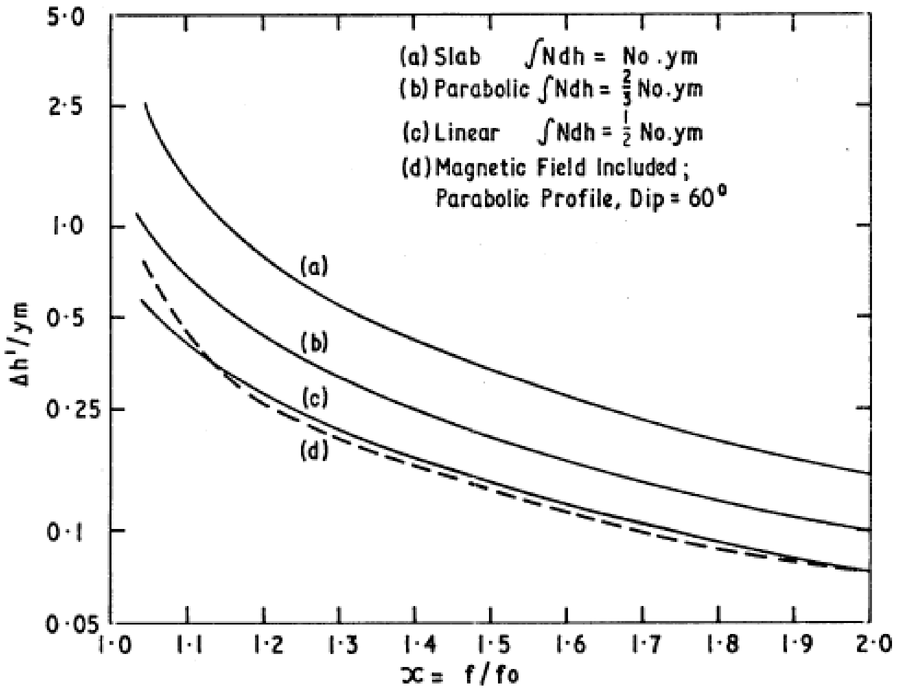
Furthermore, to a first approximation above this limit, the values for a particular x are in the ratio of the total electron contents. This result is the crux of successful empirical methods. It implies that for group retardation on frequencies close to foF2, the shape of the underlying profile is secondary and only the total content is important when x is above the limit value. This means that any convenient model for the underlying Ionization can be used to correct hpF2, provided that the total content is approximately right. As a corollary to this, perturbations in the shape of the observed N(h) profiles, for example, the occurrence of an F1—ledge, are unimportant.

The effect of including the earth's magnetic field is shown in the figure for the parabolic layer case by the dashed curve (from Becker, 1960; dip = 60°). The inclusion of the field causes $\Delta h'/Y_m$ to decrease more rapidly with x when x is small; its effect therefore, is to move the limit value closer to the cusp (x = 1.1 in this case); a practical advantage.

The uncorrected value of the height of maximum of the F2—layer, found by measuring h' at 0.834 foF2 (Booker and Seaton, 1940; symbol hpF2), should be approximately equivalent to that deduced from the measured M(3000)F2 (Appleton and Beynon, 1940; Shimazaki, 1955), provided x(for f = 0.834 foF2) is well above the critical value. For other cases, since M(3000)F2 is always measured at a higher frequency than is hpF2, empirical methods for determining hmF2 based on M(3000)F2 will be less model sensitive than those based on hp.

<u>References</u>

Appleton, E. V., and W. J. G. Beynon, *Proc. Phys. Soc.,* 52, 402, 1940.
Becker, W., *Mitteilw~gen, Max-Planok—Insti-tut f2~r Aeronomie,* 4, 1960.
Booker$_0$ H. G., and S. L. Seaton, *Phys. Rev.,* 57, 87, 1940.
Shimazaki, T., *J. Radio Res. Labs., Japan,* <u>2</u>, 85, 1955



<u>Normalised Group Retardation Suffered by Wave of Frequency f in Traversing Layer of Critical Frequency fo, f >fo</u>

VI. Night E

From Dr. Besprozvannaya — 28 November 1971

Thank you for your kind letter with explanations. Now I see what you mean by night E. However, there are some points of which I am still uncertain: Whether Brussels Meeting clarified the concept of a "thick" E layer, since the former definition of night E was connected with a group retardation at the low frequency end of the trace in F layer. That definition caused certain difficulties since cases of completely blanketing E_5 layer with group retardation were not covered by the classification. Therefore, it seems to me that we should clarify the "thick E layer" concept.

Only then your definition that “any thick E—layer trace at night giving a value of foE greater than the value of normal E at that hour is night E” may be considered sufficient for simple and exact determination of E night trace.

Comment

The difficulty probably arises because the case of a single thick layer, section 1.02 Fig. 1.1 p. 7 Handbook is usually applied to an F layer whereas this case also applies to a thick night E layer with critical frequency greater than foF2. In its simplest form, Fig. 1.3 p. 8, it produces clear group recorded o and x traces or z, o and x traces, Fig. 1.4 p. 10. The distinction between night E and retardation Es type r depends on evidence for transparency — this allows scattered echoes to be seen above and running into the main trace near the critical frequency, Fig. 4.2 (b) p. 91. Night E shows a solid trace with no scatter, Fig. 4.3 (c) p. 91 or with scatter at frequencies above foE only.

When writing the Handbook, I felt that the distinction really belonged in the Es chapter where the reader might be expected to be clearer on the difference between thick and thin or scattering layers but it would be possible to meet this point by adding a sentence to section 1.15 p. 17 “When night E screens all higher layers it may be identified by the presence of solid group retarded traces for o and x or z, o and x modes. The distinction with strong retardation Es is given in section 4.24”.

A clarification sentence could also be added on p. 92:

“Case (iv) fbEs > foF2

“In this case no traces will be observed from the F layer but the E-layer trace will resemble Fig. 4.2 (a) or (b) when Es type r is present and Fig. 4.2 (c) when night E present. Note that when the characteristic scattered traces above the main traces are only present over a frequency range below foEs less than that given by the accuracy rules for an uncertain value, the distinction Es type r or night E is valueless and the trace should be regarded as a night E trace.”

INAG would like to know whether these clarifications are needed.

VII. A Peculiar Problem in h’F

The attached sketch shows the main traces of an ionogram taken at Slough at 1200 UT on 27 November 1970. The E layer is rather complex, fbEs corresponds to a thick layer and the multiple traces show that the layer is horizontally stratified. A maximum is clearly seen in the 2F trace.

The maximum most probably corresponds to foFO.5 as its ratio with foE is rather low. The lower frequency trace gives h' = 225, the upper h' = 210 km.

Two questions were raised: —

a. What should be recorded as h'F?

b. Is this an abnormal case at h'F greater than h'F2?

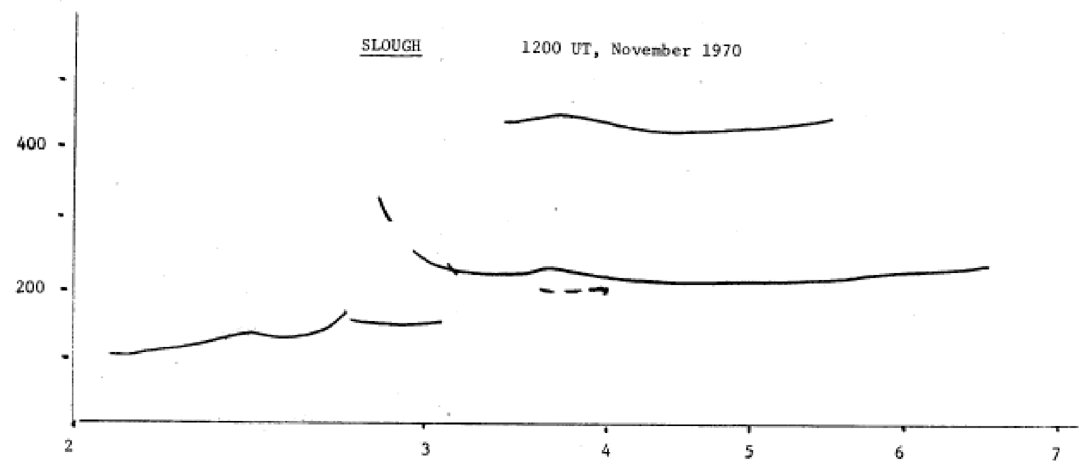
a. From the definition of h'F (Handbook p. 20) h'F = 210 UH is the correct entry, the UH being necessary because of interpretation difficulties.

b. This is most likely to be a transient condition in which there is abnormally large electron densities in the lowest part of the F layer. While in principle it is possible for a regular layer to give this type of ionogram it has never been reported as a regular phenomena.

INAG—15 October 1973

VIII. N(h) Profile Improvement

World Data Center A for Solar—Terrestrial Physics at Boulder, Colorado, USA, has for several years provided a service to convert ionograms into electron—density profiles. The computer program used for this is based on the program described by Howe and McKinnis *(Radio Science,* 2 (new series), 1119—1282, October 1967). The service is described in the new *Catalog of Data on Solar—Terrestrial Physics* issued in October 1973 as Report UAG—30.



Recently Dr. Newbern Smith has initiated an effort to provide a better representation of the "unseen" ionization (plasma frequency less than fmin, or in the valley between E and F regions) by using the considerable body of data now available derived from rocket probes, incoherent scatter, partial reflection, and VLF sounding, to fill in the unseen ionization on the profile, and provide more accurate inversion of the ionogram.

Another improvement being sought is in digitizing the ionogram data prior to computation of the N(h) profile. To scale the needed virtual height data by hand from an ionogram makes each N(h) profile cost about $10. Semiautomatic digitizing, when developed, should reduce the cost to $3 to $5 per profile.

IX. Canadian N(h) Profile Reduction

Carl Robinson of the Telecommunications Engineering Laboratory, Ottawa, Ontario, Canada, wrote recently:

"You will know that there is considerable demand for ion (electron) density profiles. To meet this need, we recently completed a method of calculating ion density versus height values from digitized ionograms. We plan to generate tables of hourly values to accompany the other hourly ionospheric data; however, our financial situation will delay this plan until 1974. In the meantime we will meet any specific requests.

"We recently compared our calculations with measurements taken from a rocket. The rocket measurements showed a density maximum of 60,000 at 170 km at a point 50 miles south of Churchill, while our calculation from a Churchill ionogram indicated a density of 57,900 at a height of 175.4 km. Unfortunately, the height calculation depends on "D" region data and the accuracy is therefore related to the quality of the "D" region data. As soon as time permits we will compare our method with the URSI method to determine the relative merits."

X. Ionogram Interpretation Meeting Sodankyla, Finland May 14—16, 1973

A meeting to discuss ionogram interpretation high latitude soundings problems and methods of improving the collaboration between the Scandinavian chain of stations was organized by the Observatory Committee of the Finnish Academy of Sciences and Letters in conjunction with the Director of the Geophysical Observatory at Sokankyla, Mr. E. Kataja, The program was arranged by Mr. T. Turunen.

The 17 participants included both scientists and those actually analyzing the ionograms, many of whom had many years experience in the field. Good preparations had been made for the meeting, the participants having prepared their problems and selected ionogram sequences to illustrate them. The result was that the standard of discussion was exceptionally high, problems were properly identified and conclusions reached.

The meeting opened with a review of ionospheric conditions over Scandinavia pointing out some of the scientific problems, a comparison of the statistical data and a discussion on the effects of different scaling practices. The main part of the meeting was occupied by detailed consideration of the interpretation of particular sequences of ionograms, their possible use in IMS problems, clarifications of the rules given in the new Handbook and explanations of why these rules had been adopted by INAG. In this zone ionospheric conditions vary rather rapidly with position so that the patterns seen at the different observatories were often very different. The types of ionosondes in use were also very different. Thus there was much difficulty for workers from one station to interpret ionograms from another.

In view of the need to use the network as a unit for studies associated with the IMS and, in particular, with the GEOS satellite, it was agreed to supplement the meeting with an interchange of technical details of the equipments and antennas in use, frequency and height scales of ionograms, proposed programs of operation, and special facilities available at the stations. Recommendations were made to interchange ionograms amongst the collaborating stations so as to improve the interpretation of each others ionograms and thus facilitate regional research.

The new or changed rules given in the new Handbook were discussed, approved and recommended for use in the network.

The new parameters were discussed and in most cases adopted. The parameter h’I appears to have little value in this sector where magnetic latitude makes a considerable angle to geographic latitude.

Recommendations were also made proposing regional studies and some special experiments designed to improve the interpretation of the data or its application to INS and ionospheric problems.

A good start has thus been made in organizing the Scandinavian chain for the special problems of the INS and, if the recommendations are properly followed up, it should be able to produce some valuable scientific data. The meeting of operators was valuable in clarifying their problems, showing that they were solvable and reminding them that their data were valuable to other groups. INAG hopes that this initiative will be copied in other parts of the world.

XI. Training Programs URSI Recommendation III 17 Warsaw

There have already been a number of responses to the URSI Commission III recommendation on training (INAG—12 p. 10) and in particular the following offers have been made.

United Kingdom. A training school for British Antarctic Survey staff going to Antarctica is held every year at the Radio and Space Research Station, Slough, Bucks, England, usually between July and September. Ionogram interpretation is taught by RSRS staff, equipment by B.A.S. Students who can speak English have been accepted from several countries in the past and a few places are available. Request to join for all or part of the course should be made by the end of May.

Australian Training and Discussion Scheme. Discussion meetings with operators are arranged in Australia every two years. Other groups are invited to attend. The next meeting is expected to be in 1975. For further information contact:

Mr. D. G. Cole
I.P.S.
P. 0. Box 702
Darlinghurst N.S.W. 2010
Australia

New Zealand Training Scheme. New Zealand operates a chain of vertical incidence sounding stations which, in combination with those operated by Australia, cover the South Pacific and much of the sub—Antarctic regions.

The New Zealand stations are operated under the control of the Officer—in—Charge, Geophysical Observatory (DSIR) Christchurch, New Zealand. Comprehensive training courses for our own operators have been run for many years. In future these courses will be based on the URSI Handbook of Ionogram Interpretation and Reduction published in November 1972. The Geophysical Observatory would be very happy to assist with training or advice and to participate in any regional training organization. It is presumed that because of our geographical location this would most likely be for the South East Asia and South Pacific area.

Offer from Huancayo. An offer to help train staff in ionogram interpretation and reduction has been received from the ionospheric group at the VI station at Huancayn. The staff at this station have many years experience of interpretation of low latitude ionograms and the station is, as is well known, one of the earliest stations to be set up. For further information apply to:

The Director
Observatorio de Huancayo
Instituto Geofisico del Peru
Apartado 46
Huancayo
Peru

Argentine. The organizers of the Argentine program of Ionosphere and Radiopropagation (PNIR) plan to hold a meeting for sounding station staff when the Spanish Edition of the URSI Handbook is available (INAG—14 p. 10).

Inquiries should be made to:

Comite Radio Cientifico Argentino
Av Liberatador 327
Vicente Lopez
Buenos Aires
Argentina

INAG requests groups who are operating training schemes or discussion meetings on ionograms interpretation to notify INAG so that others interested can be informed through the Bulletin.

XII. Program of Observations

An inquiry into a station practice shows that the majority of the stations sampled make 15 minute observations on all days, and do not increase recording on RWD's, a considerable minority make observations hourly, with 15 minutes on RWD's and sometimes S.W.I.'s. The use of gain runs at the hour has spread from high latitude stations to temperate and low latitude stations. The production of five minute recordings on RWD's is very restricted, so much so that they can only be used for local studies at the stations taking them.

These results suggest that, in practice, recordings at closer intervals than 15 minutes on a network basis are only available during eclipses.

INAG wishes to inquire whether the recommendation to make 5 minute recordings on RWD 'a *be withdrawn and restricted to eclipse periods only? Please give your opinion.*

The success of gain runs at lower latitudes suggests that the quality and ease of interpretation of the data could be improved if the recommendation to make gain runs was made worldwide. In practice, of course, some stations would not have the technical means to respond, but it appears that many of those who have the facilities are now voluntarily using them. *Your views and comments are requested.* It is desirable that INAG gives a lead in matters of this type but it is also necessary that the majority feel that the lead given is desirable. *What are your views?*

XIII. Millstone Hill Recording System for Digisonde 128

The article below discusses the presentation of ionograms for general use where the originals are held in Digisonde magnetic tape format. It may be interesting to others using this system. It is INAG's policy to try to inform all users of the main features of new methods of presentation which are being used in routine observations so as to facilitate general use of such ionograms. *INAG wishes to take this opportunity to request stations who have changed the scales of their ionograms or have not sent a scale to the WDCs recently to send copies of the scales in use as soon as possible.* Much time is wasted in trying to identify frequency scales on ionograms held at WDCs or sent to illustrate particular points.

D—128 Film Recorder System
by J. V. Evans

The Millstone Radar's C—4 Ionospheric Recorder has provided continuous film recordings since February 1966. Copies, or the originals, of the records have been sent to the World Data Bank at Boulder, Colorado, on a quarterly basis until June 1972. In April of 1972 a digital sounder, a Digisonde 128, was installed at Millstone and has been operated alternately with the site's C—4 film

recorder. As the "D—128" only provided a magnetic tape and a paper printout of the ionogram, no ready way was available to supply the World Data Bank with records of the digitized ionograms without relinquishing the original copy. With this restriction in mind a parallel film output from the D—128 system was developed to permit transmittal to the World Data Bank of ionograms made at the Millstone Field Station.

The D—128, by design, provides 192 characters of complex data preceded by 24 characters called a preface for identification purposes. The data characters are composed of 128 samples of digitized integrated amplitude with 2 amplitude samples separated by 1 phase measurement; the latter being the phase of the complex amplitude from the median value.

In order to take advantage of the D—128 system, certain parameters were established as normally fixed but with the flexibility of identification if a change is desired. These include the following:
start and stop frequencies, frequency resolution, transmitted pulse width and repetition rate, the number of integrated pulses per frequency, range resolution, range location of the first data sample and the receiver's gain at the time of the sampling.

The 24 characters of identification normally supplied by the D—128 were replaced with 15 LED displays, a 24—hour GMT clock, a frame counter and a data card. The 15 LED displays are 3 H.P. 5082—7400 7 segment numerical indicators driven by 15 BCD thumbwheel switches via a 5% duty cycle selector. This approach was employed to permit future LED control directly from the D—128. These LED's were mounted on the face of a Tektronic 604 display oscilloscope for photographing with a Fairchild 0—15 35 mm single frame camera. The 24—hour GMT clock has built into it a 3—digit day counter. The data card permits the station identification and location to be easily read without "decoding".

For compatibility with the D—128 preface, the LED format is as follows:

Therefore with Millstone's D-128 settings

$$h_t = 1.5\ [3\ .\ 15 + 0 + 250\ .\ 2^2\ .\ (0 + 1.0)]\ \text{km}$$
$$= 67.5\ \text{km}$$

12th	digit	M = 1	Spare
13th	digit	D = 2	Determines receiver diurnal
14th	digit	E = 8	gain changes as follows:
15th	digit	G = 2	

1st digit	B = 1	B times 1	Start frequency MHz
2nd digit	E = 6	E times 2	Stop frequency MHz
3rd digit	Q = 2	Q =	No. of steps/100 kHz
4th digit	W = 2	W times 50 μsecs	Xmt pulse width
5th digit	R = 2	2^R times 50 Hz	Xmt rep rate
6th digit	N = 2	2^N times 80 Hz	No. of integrations
7th digit	N = 3	K times 1.5 km	Range resolution
8th digit	Z = 0		Determine range of first data sample, h_t, according to the following:
9th digit	X = 0		
10th digit	I = 1		
11th digit	J = 3		

$$h_t = 1.5\ [J \cdot A(I) + B(J,K) + 250 \cdot 2^R \cdot (X + BZ)]\ \text{km}$$

where normally A(I) = 15

A(I)	for I
5	0
15	1
40	2
90	3

where normally B(J,K) = 0

	K = 1	2	3	4
for J = 2	0	+1	+1	+2
3	-1	0	0	+1
4	-1	0	0	+1

The 15th digit, G, times 10 is the number of dB attenuation set into the receiver manually. The 13th and 14th digits are the times the receiver's gain is varied by 10 dB steps during the day. As set at Millstone at this time of the year.

13th = 2 remove 10 dB attenuation at 0200 EST
14th = 8 add 10 dB attenuation at 1800 EST

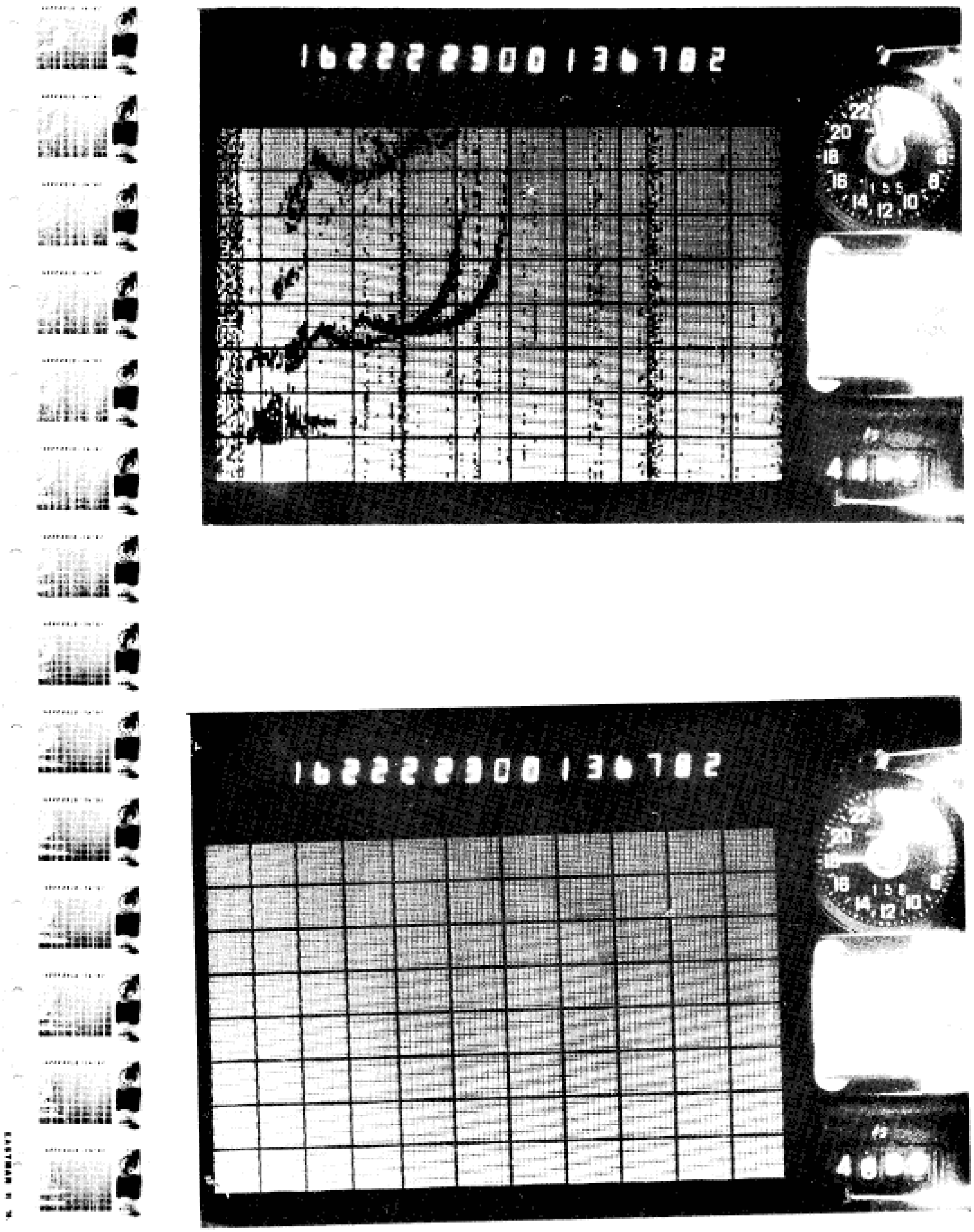
Thus for Millstone's receiver gain settings of 2, 8, 2, a minimum of 20 dB attenuation exist from 0200 EST to 1800 EST. While this may cause some overloading during the daytime, it maximizes the detectability during the pre—daylight hours when radar echoes are minimal.

In the accompanying photo, frame #4656, the 15 LED numerical displays are shown at the top, the clock, with the GMT day of 158 showing, data card and frame counter are on the right. The clock's hour hand shows as 1800, the minute hand is blurred from 0059 to 0006; this is the length of time for a complete sweep from 1 MHz (digit #1) to 12 MHz (digit #2) 6:2 MHz. The second hand does not show except as a light circle in the center.

With *Q* (digit #3) = 2 steps/l00 kHz, the D—128 will step in 50 kHz steps from 1 to 12 MHz and remain at each frequency for N (digit #6) = 2^2:80 = 320 pulses at a rate of R (digit #5) 2^2:50 200 Hz. This provides 220 discrete frequency steps. A horizontal ramp generator was built which is clocked by the D—128's advance frequency command. In order to identify frequencies, at every MHz a blanking pulse is applied to the CR1. The vertical trace represents the 128 range boxes inherent for the D—128 system. In order to identify height markers, a blanking pulse is applied for every 16th range box. Thus the grid as shown on frame 4656 results, video removed, of course. Each dot represents a distinct range/frequency window, with a total of 28,160 identifiable positions minus 1536 dots for frequency marks and 1520 dots for range marks. The lower row of dots represent echoes from a height ht = 67.5 km as determined by the 7th, 8th, 9th, 10th and 11th digits. The upper row of dots represent echoes from a height of 67.5 + 127 . 4.5 — 4.5 = 634.5. The first column of dots on the left represent a frequency of 1.05 MHz and the last column of dots represents a frequency of 11.95 MHz.

The video of the D—128 applied to the paper printer represents 4 bits of a possible 6 bits as determined by an interface Digicoder. For the film recording system the full 6 bits of the 192 characters of the data are independently applied to a D/A converter, are then sampled and held at the proper time to eliminate the phase data, and are then multiplexed with the combined range and frequency marks. This composite signal is then applied to the CRT's Z input. An offset control is provided for overall intensity and another for relative noise suppression. An increasing signal, even a normally overloading one causes no problems as the CRT is merely held off during the overload.

The accompanying picture, 4406, shows the composite signal as recorded at 2259 to 2306 GMT on the 155th day of the year, 1973. foF2 can easily be read as 6.10 MHz. F layer is present from 1.70 to 2.60 MHz. The broadcast band is apparent at the left. Millstone's license prohibits radiation below 1.70 MHz and at 2.50, 5.00 and 10.00 MHz. The latter two frequencies are obscured by frequency marks but the former two conditions are obvious. This system of film recording is controlled by the D—128 and has the flexibility of the D—128 thumbwheel controls. For instance, if increased frequency resolution was desired over a smaller frequency band, *Q* (digit #3) could be increased to 4, 25 kHz resolution, B and E (digits #1 and 2) could be set for B = 3 and E = 4 for a 3 to 8 MHz spread. Additionally the master clock of the D—128 controls the camera's shutter and film advance so as to take a single 35—mm frame whenever the printer is commanded to record data.



The accuracy of the D—128's frequency control circuitry and the accompanying controls have been verified with stability teats since March of this year. The 1 to 12 MHz choice was selected to permit uniformity of data without sacrificing resolution. If desired a blowup of such a negative will show easily readable data. Slight variations of beam position as indicated by variations of vertical traces on edges of columns result from AC coupling directly to the CRT. Removal of this minor problem is in progress.

XIV. Ionosondes

New Japanese Ionosonde

A new type of the ionosonde (see picture) was recently installed at the Radio Research Laboratories, Tokyo for routine observations of the ionosphere. Major differences from the older one which has been used is that it is almost completely solid state and is easily operated by pushing the selectors on the switch board. The ionosondes engaged now at the local ionospheric stations in Japan will gradually be replaced by this type of ionosonde. General characteristics of the new ionosonde are mentioned as follows:

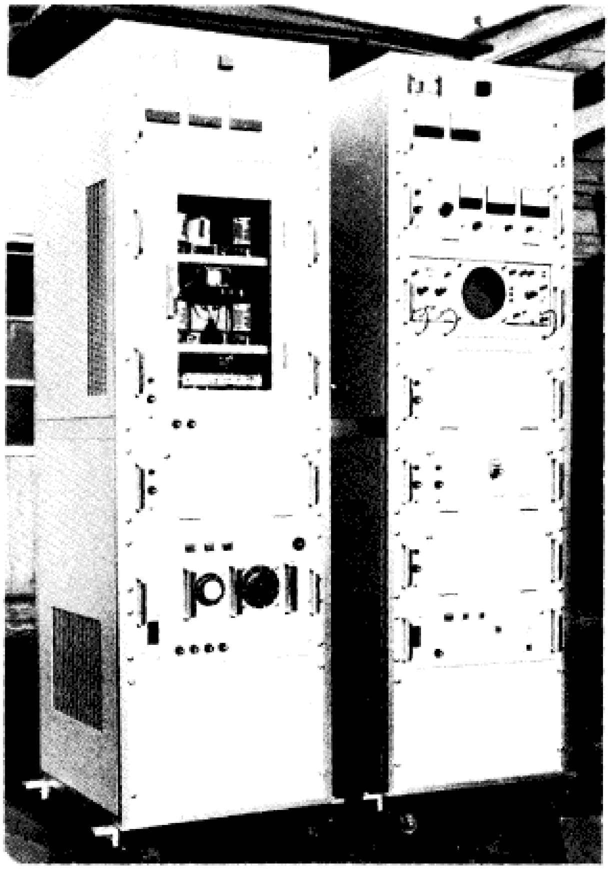
General Electrical Performance

Transmitting Frequency:	550 kHz to 20 MHz. Frequency range can be set as follows: a. 500 kHz to 20 MHz linear. b. 550 kHz to 20 MHz logarithmic linear
Height measuring range:	800 km ± 10%
Observation time:	30 seconds.
Observation time intervals:	Every 1, 5, 15 and 30 minutes, and continuous.
Peak power output of transmitter:	10 kW, normal.
Pulse width:	50 μs—l00μs.
Pulse repetition frequency:	Line frequency, 50/60 Hz.
Over—all gain of receiver:	More than 110 dB.
Frequency marker:	Every 1 MHz.
Virtual height marker:	Every 50 km.
Film length:	Approx. 50 mm and 100 mm for each observation.
Output impedance of transmitter:	600 ohms, Balanced.
Input impedance of receiver:	600 ohms, Balanced.
External master clock accuracy:	Within 1 second a day.
Power required:	220 volts, 50/60 Hz, 1.5 kVA approx.
Dimensions:	1,620 height, 520 width, and 630 depth in mm. x 3.

The ionofax —— the facsimile recorder which automatically records the Ionograms —— is used in conjunction with this ionosonde.

New Australian Ionosonde

The following progress report on the new Australian Ionosonde has been received. The new ionosonde uses TTL and MOS integrated circuits to eliminate vacuum tubes except in the display and transmitter final. Electro—mechanical components are confined to camera, switches, plugs and sockets. Technical improvements have been achieved in the areas of signal generation, identification, control reception and processing of signals. The size has been minimized with consequent reductions in transport and installation costs, accommodation and power requirements. Maintenance requirements should be such so as to allow for unattended operation in remote areas for long periods. Power consumption is under 100 watts.



The ionosonde is now in a fairly advanced state of development. Two pre—production units have been produced and a group of four are now being developed simultaneously in a form suitable for field use. It is this task which is taking some time as our engineers are very conscious of the need to produce an instrument that has predictable performance, no critical adjustments and is as trouble—free as possible. Coupled with this is the requirement that the ionosonde be cheap to produce, needing a minimum of attention from highly skilled staff.

An idea of the cost may be obtained from the figure of approximately $2400 for parts only for this ionosonde. To this must be added the cost of a 16 mm camera. Naturally, labor overheads and developmental costs are many times the cost of parts in a project such as this.

A paper describing this ionosonde has been prepared and will be presented shortly at the IREE Convention in Melbourne.

INAG—l5 October 1973

New Japanese Ionosonde

XV. Letters from INAG Members Hlle. Pillet

The end of section 1.04 reads, “It is convenient to make a table or graph of values of fo corresponding to given values of fx, fz using the local value of f B”.

It would be useful to define in the Handbook the procedure to determine the local value of fB.

Do we have to consider that the fB value is the same at the different levels of the E and F regions?

On the other hand, it seems to us not very easy to refer to such a table or graph when making the reduction and we wonder if such a table or graph is worthwhile if the accuracy rules are taken into consideration.

One could propose that each station determines, from selected ionograms, the “mean” value of the differences fx — fo and fo — fz. These values could be considered as constant at a given station.

If this proposal is adopted, the formula given page 81, 2nd line of the 3rd paragraph of z would be changed to foF2 = (fzF2 + (fz — fo))ZF. So the foF2 value would be more accurate.

The items J and 0 on page 52 would also have to be changed to indicate that we are not allowed to assume fx = fo + fB/2 when fo is not large compared with fB.

On page 81, 3rd paragraph of z reads “this is valuable when there is no main trace or a series of main traces”.

Our comment is that this is valuable also when the z trace is more solid (or complete) or less spreaded than the o trace. This is often the case at high latitudes.

As it is needed for propagation studies and predictions, the rules have been modified in order to get a numerical value of foEs *in case of total blanketing.* Would it not be convenient to do the same for foF2 and to propose to write foF2 = (foEs) EA instead of xxx—A? This would be easier for the computer analysis.

I have begun to check the draft translation in French of the Handbook. I will let you know if I feel the wording of the English text needs modifications or clarifications.

<u>Comments by Chairman</u>

1. The B calculation is given on p. 317, but I concur it would be better here too —— I picked up a lot of these points but no one could pick them all up. I propose to add to 1.04: “The value of fB can be calculated from the local ground value of B using the inverse cube variation with height

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

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."

2. Re use of table, we found it O.K. — the operators objected at first but refused to use the approximation when they found that they got smooth time variations with the correct formula and discrepancies with the approximation! I concur that the accuracy limit enables you to go fairly low but the error is, in fact, easily detectable and may be seriously misleading as A is a large fraction expressed as a percentage. I prefer a table at 0.05 intervals of the observed trace parameter. The difficulty with your suggestion is that fx — fo, fo — fz vary with fo significantly. We have used it successfully by taking advantage of the fact that we have only a limited range of possible fz or fx values so that a representative value for this range can be adopted. Our operators, once they had appreciated the difficulty, preferred the table.

3. I concur that the wording on p. 52, J, 0, Z and p. 81 could be changed and suggest adding "or when fo is near or below fB, the appropriate value of fx — fo (p. 9)" for J and 0 entries.

"or when fo is near or below fB, the appropriate value of fo — fz (p.9)" for the Z entries on p. 52 and 81.

Is it generally felt that these changes be made?

4. I am willing to add this wording on p. 81.

5. The main difficulty of the suggestion to include blanketed values of foF2 by using (foEs)EA is that it makes the first median too large and the second median too small with no clear indication that the final median will be altered significantly or correctly. The fact is that we do not know where foF2 really is and are making a guess that it is close to the center of the distribution. If this is true we have effectively increased the count, if not, our median looks more reliable than it really is. If the guess is right we gain information, if not we lose it. Thus unless the probability of a good guess is high we are better off doing nothing, as at present. *INAG invites comment on this point and encourages groups to examine cases where blanketing occurs at some hours and not others to see whether the interpolated value, if adopted in the table, would have the same effect as using (foEs)EA. Please let us know your conclusions.*

XVI. Contributions from Stations

Millstone Hill

As of 1 June the C—4 films from Millstone Radar have been discontinued in favor of 35—mm records of our Digisonde sounder. As in the past we shall send positives of our records to the World Data Bank. Being unaware of any standard form of film presentation for digitized ionograms, we have established the procedure as outlined in the description of our D—128 Film Recorder System on pages 14—18. Needless to say this seems to us a retrogressive step but the cost of sending, storing, copying and redistributing the digital tapes seems prohibitive at present.

The film can readily be read using any 35—mm frame—by—frame or strip viewer. As the scales for frequency and height are linear, no overlays are needed to read them. The dependability and accuracy of the Digisonde eliminates the need for ground pulse checks. The frequency range selected of 1 to 12 MHz was intended to provide uniformity of displays and at the same time cover routine conditions. As explained on pages 14—18, variations from this standard are self—evident from the parameter indicators.

Our machine employs identical, crossed, vertical, terminated rhombics for transmitting and receiving, supported on a 200—foot steel tower. They are cut for optimum F2 region measurements (7 MHz design frequency). Some effort is underway at Lowell Technological Institute Research Foundation to develop a computer analysis program, and we hope ultimately to be able to profit from this.

Swiss Station at Sottens

The Swiss National Committee of URSI has informed INAG that the ionosonde at Sottens is to be closed down, at least for the time being. This is due to technical difficulties at the station.

Proposed New Stations

The possibility of opening new stations in Iceland, Bear Island, and Spitzbergem for operation for the IMS is being actively explored by the C.C.0.G. Committee. Any administration prepared to operate the ionosondes if provided, or analyze the data obtained should inform the Chairman of INAG of their interest.

Australia

Your secretary was able to visit the Ionospheric Prediction Service in Sydney while attending the International Astronomical Union General Assembly. We discussed the need for their submission of high latitude ionogram samples for the Handbook Supplement. Leo McNamara was studying 48 ionospheric storms during the 1969—72 period. They have placed all of their Australian data for 1966 through 1972 on magnetic tapes and will furnish them to World Data Center A for Solar—Terrestrial Physics in return for other ionospheric data on tape.

Hong Kong

In Hong Kong your secretary visited Professor Lyon and Dr. D. 0. Walker and discussed the reduction of ionospheric data. They scale the ionograms on an analog—to-digital reader and feed the output paper tape directly into their computer. They are still having a few software problems in converting the median program from the Boulder Colorado CDC3800 program to their computer.

In the meantime they promise to furnish copies of their ionograms to World Data Center A for Solar—Terrestrial Physics. We also discussed their sending to Boulder for critique copies of complicated sunrise ionograms.

Japan

Before attending the IAGA meeting in Kyoto, your secretary spent an enjoyable day at the Radio Research Laboratories with Dr. Isao Kasuya and his staff. I found them in the midst of translating the Handbook into Japanese. You see below a copy of page 7. To my knowledge this makes the fifth language into which the Handbook is being translated.

I, of course, enjoyed the opportunity of visiting their World Data Center C2 for the Ionosphere and saw the new ionosonde, described on page 18, under test.

1 基本的考察と定義

1.0 総説

1.01

電離層とは自由電子が電波の伝搬にかなりの影響を及ぼす程度の密度に達している大気の部分をいう。電離層は便宜上、D、EおよびFの三つの領域に分類される。

D－地上、約75～95 kmの高さにある電離された領域であって、この領域より高い層から反射される短波帯の電波を主に吸収する領域。

E－地上、約95～150 kmの高さにあり、正規の層間E層が通常現われる領域。この領域の他の層は頭にEをつけて、例えば、厚い層をE2、また、変化の激しい薄い層をEsのように書く。

F－約150 km以上にあり、最も重要な反射層であるF2層が通常現われる領域。この領域の他の層も頭にFをつけて、例えば、中緯度の重要な層F1

23

Maui

Your INAG Secretary was able to spend a day with Sadami Katahara inspecting the Maui ionosonde station. To her amazement she found that a copy of the Handbook had never reached Maui, which is operated by her own organization! *If any others of you who receive these Bulletins have not as yet received a copy of the Handbook, Report [IAG—23, please let us know.* The mails continue to give us problems. I found the ionosonde operating efficiently in the midst of a large sugar cane plantation. However, the workshop building back on the shore of the island I found being inundated by sand! Periodically we have to dig ourselves out.

XVII. Reports from World Data Centers

A. World Data Center A for Solar—Terrestrial Physics, Boulder, Colorado, U.S.A.

From July 1972 through June 1973 ionospheric data were requested in greater volume than data from any of the other fields of interest at World Data Center A. There were 55,550 station months of data disseminated in reply to 314 requests. The requests covered data from all years from 1957 onwards. However, about 35% of the data requested were for 1970—1973.

B. World Data Center C2 for Ionosphere, Radio Research Laboratories, Japan

Activities for the period April 1972—March 1973:

1. Data received from WDCs A, B, C1 and Ionospheric Stations:
   Booklets: 2500
   Microfilms: 80 rolls of 1000 feet each
   69 rolls of 100 feet each
2. Data send and lent to users:

To	Other Centres	Domestic Researchers	Foreign Researchers	Total
Booklets	197	2794	100	3091
Microfilms (roll)	112	249	5	366

3. Adjustment and compilation of microfilm data in office:

Microfilm from WDC—A Ionograms (27)rolls (1000 feet each)
Other (0) " (100 ")
Microfilm from WDC—B2 Ionograms (53) " (1000 ")
Other (35) " (100 "
Microfilm from WDC—C1 Ionograms (30) " (100 ")

4. WDC—C2 Catalog of Data for Ionosphere:

Cumulative catalog of ionosphere data for the period 1 July 1957—31 December 1972 issued in August 1973.

5. Daily—hourly values of Japanese ionospheric data are stored on magnetic tape from June 1968 onwards, and we are preparing a compiled tape which will be available in spring of 1974.

XVIII. Translations of INAG Bulletins

Mlle. Pillet has prepared a French version of INAG—14 which may be obtained from her. The Spanish version of INAG—14, translated by Profesora M. C. Bustos, has been printed and distributed by the World Data Center A for Solar—Terrestrial Physics.

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