A survey of…

THE USE OF QUARTZ CRYSTALS IN THE AMATEUR RADIO SERVICE

Bliley CRYSTALS

Produced July 1936
by
THE BLILEY ELECTRIC COMPANY
Union Station Building
Erie, Pennsylvania, U.S.A.

Interested in the history of Bliley Electric?

Contents

Published by: Charles A. Bliley, K3NAU
1736 Bel Arbor Trail
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www.Bliley.net

INTRODUCTION

In 1936, the Bliley Piezo-Electric Company a manufacturer of radio frequency control devices was six years old and the Great Depression was seven years old. The company was successful by most common standards, and definitely doing better than many other companies in the radio-electronics industry. The company was starting to branch into the commercial broadcast business, but the revenues from the hobbyist—licensed amateur radio operators—was still dominant. The company had developed a new type of crystal unit, the variable frequency crystal, and decided to do a marketing survey before its formal introduction to determine the reception for this product and what would be the optimal price. For a company employing less than 20 people, no one with a business degree, this survey represented uncommon sophistication and a real adventure.

The following material was transcribed from the original report produced by the Bliley's. It was sent out to a significantly large number of radio amateur operators (ham radio operators)—in total 481 with responses from 263 that had arrived in the time of the data analysis.

The survey provides significant insight into the use of the ham radio's shortwave bands, commonly used transmitter power levels, the distribution of operating frequencies, and how few crystals the average operator owned. The number of crystals that most hams owned was five or fewer, of course, this was the tail end of the Depression and crystals were still very expensive.

THE ORGANIZATION AND FORMAT OF THE REPORT

The original report consisted of a cover page, nine double-spaced typewritten pages, a copy of the survey and 10 pages of detailed graphs displaying the frequency usage information. The body of the report (9 pages) has been converted from the typewritten Courier face to a serif font for easier reading. Photocopies of the original questionnaire, summary sheet and all of the graphs are included in this file. There was one extra graph found on the rear of page six opposite a relevant question (#20).

The first graph in the series is signed and dated by Frank Dawson Bliley, W3GV, the founder and president of the company. I believe this survey was the product of his hand. The handwriting/printing on the graphs appear to be his and the survey was found in his personal papers at his home

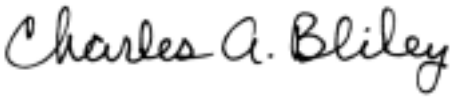
The reviewers were: George E. Wright (V.P. of Sales), Frank A. Lennberg (Engineer), John M. Wolfskill (V.P. of Engineering), Wilber Mong (Production Department), Charles C. Collman (Purchasing), and Frank Dawson Bliley (President).

A NOTE FROM CHARLES A. BLILEY, K3NAU

I hope this report provides you with a glimpse of the amateur radio practices in 1936 and the efforts of the management of the Bliley Electric Company to bring some of the very best products to this unique community.

Even in the Year 2001, when this new version of the survey is being prepared, I can report that in recent years, many old-timers have written me to say they still recall with great pleasure the selection, buying and use of the crystals they purchased from Bliley's.

For additional information on the history of the company and related product information for the period of 1930 to 1955, please stop by my Internet Web site at www.Bliley.net.



Son of Frank Dawson Bliley
July 12, 2001
Pittsford, New York, U.S.A.

P.S. For the record, the company "logo" found on the cover page was built from elements found in advertisements and on company products. The company does no appear to have an "official" and consistently used logo until around1940.

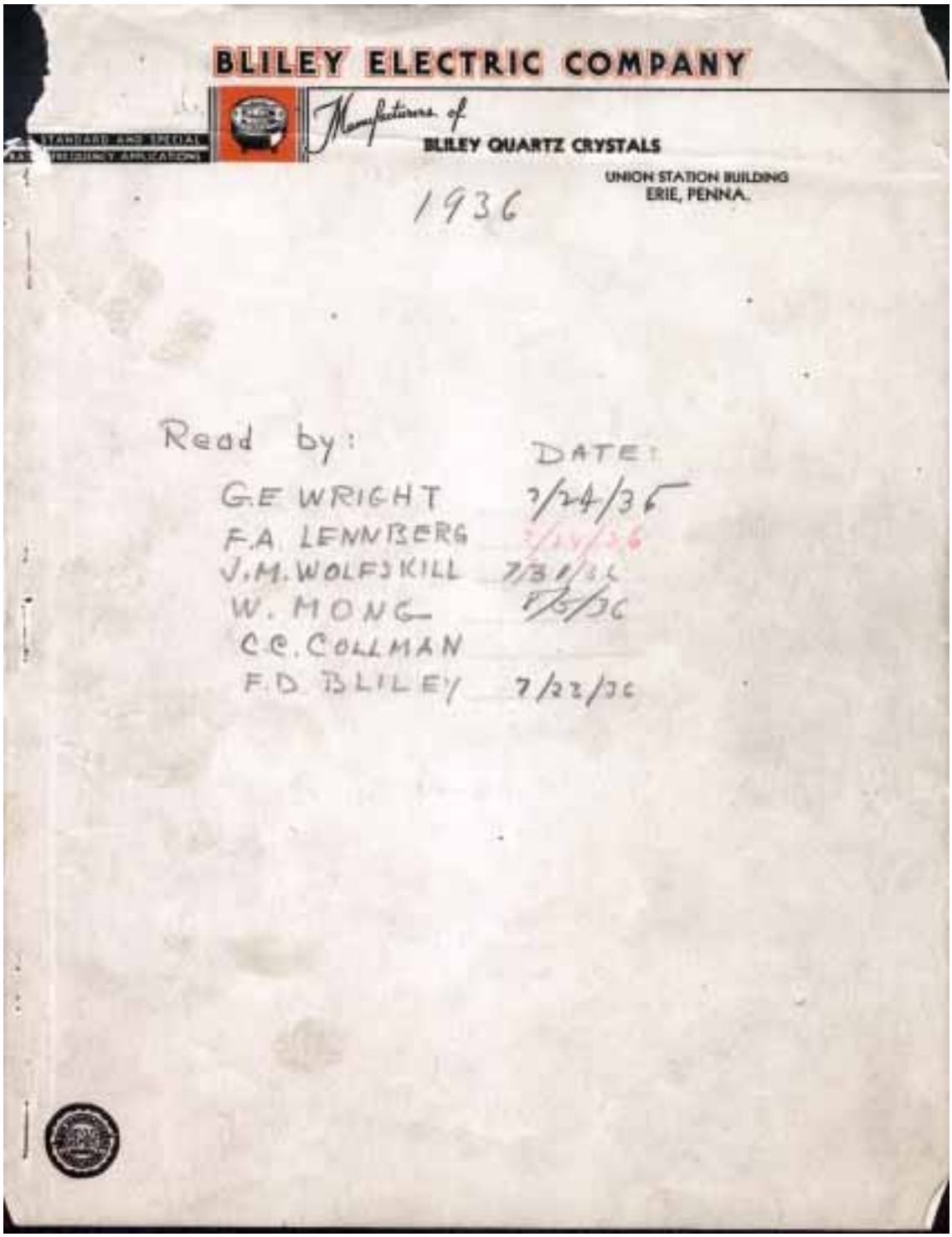
TERMINOLOGY

This report uses jargon/terminology in common use among radio amateurs. Below is a list of the one that I am able to define.

TERM	DESCRIPTION
Code	Refers to those using CW (continuous wave) transmitters with Morse code.
Fone	Shorthand for radio-telephone operators using voice communications.
Doubling	Oscillator in which the second harmonic of the crystal used as the output.
GR Plugs	High quality two-pin connectors commonly used in test equipment manufactured by General Radio Corporation.
Final Stage	The last tube and circuit in a transmitter that produces the RF power for the output.
AT/X/Y/CX-Cut	Shorthand for crystals blanks cut at a particular angle relative to the center axis of the raw crystal.
SSF	Single-Signal Filter. Crystal used as an IF filter.
BC2, BC3, HF2, LD2	Model numbers of Bliley crystal units
Tri-tet Circuit	Popular oscillator circuit used in amateur radio transmitters.

REPORT COVER PAGE

SCAN OF FIRST PAGE OF THE ORIGINAL QUESTIONNAIRE (70% OF ORIGINAL SIZE)
Total of 30 questions on all pages



BLILEY ELECTRIC COMPANY

STANDARD AND SPECIAL FREQUENCY APPLICATIONS

Manufacturers of
BLILEY QUARTZ CRYSTALS

UNION STATION BUILDING
ERIE, PENNA.

1936

Read by:

	DATE:
G.E WRIGHT	7/24/36
F.A. LENNBERG	7/24/36
J.M. WOLFSKILL	7/31/36
W. MONG	8/6/36
C.C. COLLMAN	
F.D. BLILEY	7/22/36

REPORT BODY

BLILEY RADIO AMATEUR QUESTIONNAIRE

The purpose of this questionnaire was to find out the desires of the average phone and active code amateurs, especially in regards to crystals.

On June 27, 1936, 481 questionnaires were sent to three different groups of classified amateur radio stations. Results were actually tabulated from 263 of the questionnaires received up to July 10. (There has been 30 received since that date which have not been counted in the results, making a total of 62% returns.

Up to July 14, there were received 65.6% returns from 243 "code" stations, 52.8% from 80 "radio-phone" stations, and 33.3% from 144 stations picked at random from the Call Book representing the "average" radio amateur. The greatest majority of returns were received on June 29, reaching a peak of about 80 questionnaires in one day. A grand total of 62% of the questionnaires were received up to July 20. Of this number, the first 55% were actually tabulated.

Based on the fact that an average of 60% of the selected active code and phone groups returned their questionnaires, would indicate that approximately 60% of the average radio amateurs who are active returned their questionnaires. This would further indicate that approximately 56% of the average hams are active. The other 44% (22,000) of the radio amateurs can be considered as "dead wood". If any of these figures are used, it must be remembered that QST surveys have shown that amateur radio has a turnover of approximately 40% per year, which would indicate, actually, about 10,000 new radio amateur prospects every year.

The number of crystals which an amateur owns is roughly proportional to the number of years on the air and, also, is roughly proportional to the watts input to the final stage. It has been shown that the watts input to the final stage is also proportional t o the number of years of operation. Of course, amateurs with a large number of years, or a large watt output, have accumulated their crystals over a period of years rather than in large numbers at any one time; for it has been shown that during the period of the past six months, of all amateurs in our survey, only 45% purchased one or more crystals.

In going through the questionnaire, we find that graphical analysis of question #1, "What single frequency do use most?", is shown on graph #1, which indicates that the majority of amateurs still prefer the 80 meter band (40%) and that the 40 (32%) and 20 meter bands (24%) are, respectively, the second and third most popular. Of course, all these stations are crystal controlled, as are 90% of all code stations, 93% of radio-phone stations, and 95% of all average stations.

The breakdown of graph #1 into the various groups is shown by graphs #2, 3 and 4. Graphical analysis for the three groups for question #2, "On what frequency in each amateur band do you operate most?", is shown on graphs #5, 6, and 7. This shows that phone men are, apparently, interested only in phone. Only a very small percentage of them spend any time with code, and those in the 40 meter band (phone doubling region around 7100KC). The average radio amateur apparently has very little desire to use radio phone in either the 80 or 20 meter bands, indicating that a very small percentage of radio amateurs

have special radio-phone stations. The code group analysis is very interesting and indicates a large percentage of the amateurs use crystals on the high edge of the 80 and 40 meter bands. This will be commented on farther under question #3.

In question #3, amateurs were requested to, "List the frequencies of all the crystals you now own." It was found that the average code stations owned 4.8 crystals, the average phone stations 5.0 crystals, and the "average amateurs" owned 3.5 crystals. Very few owned more than 10 crystals. One, only, as many as 27 (Dr. Simpson).

Graphical analysis of question #3 is shown on graph #8, which is to be compared with graph #9 (sales distribution of our crystals during mouth of May for BC3 and LD2 40 and 80 meter units). There is a marked similarity between the graphs #8 and #9; and, in fact, the graph of the 40 motor "crystals sold" nearly coincides with the 40 meter "crystals owned" by radio amateurs. This Is shown on graph #10.

There is one outstanding difference in this group, as shown by arrows, at 7250KC and 7290KC. In these regions there is, apparently, a large concentration of crystals owned, which is believed to be due to the fact that amateurs buy our crystals and grind them themselves to the higher edge of the band. The only suggestion here is that we stock our dealers with crystals particularly in the 7290KC region. This may possibly be an outlet for our over-production in the 7200-7300KC region.

In graph #10, the red line represents the 40 meter crystals owned by radio amateurs. Bliley May 1936 sales have been divided by three and superimposed upon the red graph. No definite conclusions can be derived from the 80 meter crystals sold and owned by graphical analysis, except that it shows a very large market in proportion to our present sales. It also shows a trend towards 40 meter crystals rather then 80 meter, due to the fact that on our own chart, graph #9, there is less tendency to buy near the edge of the band, since both the 3505KC and 3645KC purchases (for doubling) are now made at 7005KC and 7295KC. Graph #8, between 3650KC and 3900KC checks with our own figures of actual sales as being very thinly populated. It is believed that the smallest number of crystal controlled stations are operated in this region; and, inasmuch as out-of-band operation would naturally be rare, this is probably to be expected. It is supposed that a large percentage of the stations here must be using electron-coupled oscillators as their signals indicate by listening in.

Graph #11 is plotted from actual sales of LD2 and BC3 units which can be used for comparison analyses.

In question #4, we asked, "Are you using crystal control on either 10 or 5 meters?", and it is found that an average of 4% are using crystal control on 5 meters, 26% are using crystal control on 10 meters, and 70% are not using crystal control, or operating at all in either of these bands.

In question #5, we asked, "Do you contemplate using crystal control in these bands in the near future?", and it is found that approximately 15% expect to operate with crystal control on 5 meters in the future, 52% will use crystal control on 10 meters, and 35% have no plans for the future.

Question #6, "What fundamental crystal frequency would you use for operation on 20 meters?" First choice of the code group - 40 meter crystals, second choice - 80, and third - 20; first choice of the phone group is 20 meters by a great majority. The average group

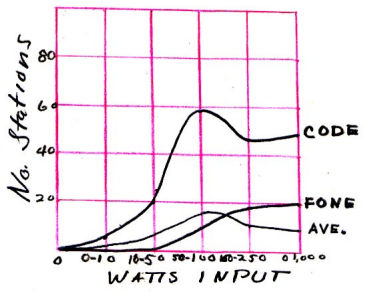
chooses 40 meters and their second choice is 20 meters. This would indicate that the average radio amateur is 20-meter-conscious and that the phone group are already "sold" on 20 meter crystals. For operation on 10 meters, most of the code men chose 40 meter crystals, while the phone and average men have voted 20 meter crystals as preferrable. For 5 meters, there seemed to be some difference of opinion whether it should be 20 meter crystals or 40 meter. Very few even thought of using 80 meter crystals for use on 5 meters.

Question #7, "What crystal out do you find most satisfactory for your needs?" It is surprising that the majority chose X-cut crystals. This might be due to the fact that X-cuts have been so popular for the last six years. The second most popular group is the LD2 group, and the third is the A-cut. Of course, these two should be combined and are together approximately as popular as the X-cut crystal. This proving the fact that very definite gains have been made in the introduction of A-cut crystals on the market.

There were no votes at all for the B-cut. Three of the total questionnaires preferred the C-cut. A surprisingly large number chose Y-out crystals, but moot of these hams either chose Y-cuts because they stated they could not afford better, or becuase they ground their own. In either case, they apparently took the necessary good care to see that the crystals were operating properly to prevent frequency jumps. (In the code group, there were as many as 11% that chose Y-cut crystals.)

Question #8, "When purchasing a crystal, what is your first consideration?" All the different groups were unanimous In choosing "characteristics" as the most important consideration.

Question #9, "What particular factor of crystal control is most important to you?" All the groups chose "frequency drift" as being the most important factor. Second to this was "precision"; third, "power". Mounting was thought to be of importance only in very rare cases and yet in question #10, "What material would you prefer to be used in your crystal holder?", isolantite was by far the most preferred of all different insulations. Bakelite was a weak second and Victron G third. I doubt, however, if it came to actual choice the average amateur would buy isolantite at the necessarily high prices.



Question #11, "What is your preference in mounting connections?" The preference for mounting connections was for tube pins. GR plugs, however, came in as a close second. No other types were even considered.

Question #12, "Have you ever considered or attempted to incorporate several crystals in your transmitter for rapid frequency change?" Approximately 45% of the amateurs have tried 2 or more crystals in a transmitter. Of this number, the average quantity is around 4 crystals for code and phone amateurs and 3 crystals for the average amateur. Apparently there is no great trend in this direction.

AVE. MAX. CODE 50-100 W.
FONE 250-1,000 W.
AVE. 50-100 W.

Question #13, "What tubes and circuits are you now using in your oscillator stages?" No comments are necessary other than that the 47 tube in the Tri-tet circuit is still, by far, the most popular.

Question #14, "Do you consider temperature control an important aid to frequency stability?" About one-half of the code and average amateurs thought that temperature-control was helpful. Of the phone group, only 36% thought that temperature-control was an important aid. This latter is due to the fact that the phone man is, necessarily, more frequency conscious and uses a monitor for frequency checking; as well as a better grade of crystals.

Question #15, "Is there any phase of crystal control that would be helpful to the amateur if more detailed information concerning it were available?" Under question #15, a large number of amateurs suggested some kind of a booklet giving complete information on crystals including history, theory, methods of manufacture, circuits, various cuts, drifts, possibility of high power crystal control, and every phase of crystal control which would better educate the consumer. It would be beat to read through all the suggestions under question #15, as it is not possible to give a brief summary.

Question #16 and #17, "From what distributor do you buy most of your parts?" and "Does your distributor stock a sufficient range of frequencies to meet your needs?" 64% said yes; 21% no; 15% no answer. These are principally for the use of the Sales Department. Very few had any comments about dealers.

Question #18, "If you care to, please list the different makes of crystals you have purchased since January 1, 1936.0 33 1/3% of the total radio amateurs say that they have purchased Bliley crystals since January 1, indicating that we were supplying approximately 75% of the market. However, this is to be discounted as the results are not necessarily accurate. A total of 45% said that they had purchased crystals of all makes (including Bliley).

BLILEY	33 1/3 %
HI POWER	5 1/3 %
VALPEY	2 1/2 %
EIDSON	2 1/4 %
FISHER	1 %
PREMIER	3/4 %
GENERAL	3/4 %

Table found on the back of Page 5 opposite Question 18.

Question #19, "Please check all the bands in which you operate fairly consistently." Question #19 is more or less a repetition of #1, 2, and 3, and is principally useful if the questionnaire is repeated to show a change or trend in the use of the bands.

Question #20, "What is the greatest power input used to final stage?" Question #20 is best represented by a graph which shows that the greatest number of code amateurs operate between 50 and 100 watts input to final stage. The greatest number of phone amateurs operate with upwards of a 1000 watts and the greatest number of average amateurs operate around 50 watts to final stage. A comparison between watts input to the number of crystals owned shows that the amateurs with the greatest watts input owns the greatest number of crystals.

Question #21, "If you own any factory-built amateur transmitters, please answer the following:" Only a total of 10 factory-built transmitters were recorded - about 4%. Most of these were phone stations. This is surprising considering the fact that there are quite a few transmitter manufacturers doing a considerable amount of advertising; but, apparently,

factory-built transmitters for radio amateurs are just getting started. One radio amateur said, "No real ham can answer this question!"

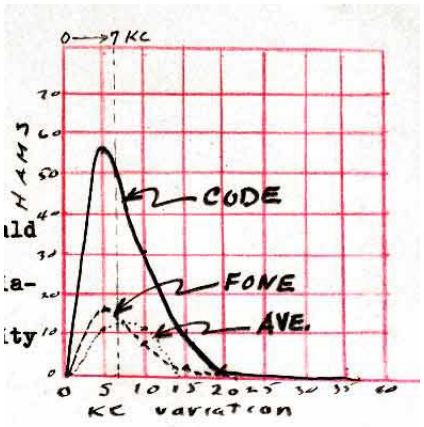
Question #22, "If you own any factory-built receivers, please answer the following:" Practically every radio amateur owns at least one factory-built receiver. Peculiarly enough, the "average" amateur has a larger percentage of factory-built receivers than the "phone" or "code" man.

Question #23, "Do any of your receivers have crystal filters?" 29% of the code men said that they now own crystal-filter receivers, 44% of the phone men own crystal-filter receivers, and only 18% of the average amateurs own these receivers. This indicates a decided trend towards their use by phone men.

Question #24, "If not, will your next receiver be a crystal single-signal receiver?" Of the amateurs who do not own crystal-filter receivers, 68% to 87% state that their next receiver will be a crystal filter. Approximately 5% radio amateurs who do not own crystal-filter receivers said they do not expect to buy them in the future.

Question #25, "Do you feel that it would be an important advantage to have a frequency control unit with a continuously variable adjustment over a limited range in the 80 meter or doubling bands?" 79% to 85% of the radio amateurs say that a variable frequency unit was an important advantage. Many made emphatic remarks approving the idea.

Question #26, "If so, what is the minimum variation, of the fundamental frequency in the 80 meter band, which would be necessary for practical application?" 50% of the amateurs felt that up to 5KC variation would be necessary and 70% to 80% felt that up to 10KC variation would be sufficient, showing that a large majority preferred crystals with a variation within practical limits (0-7KC). [Graph from report on the right.]

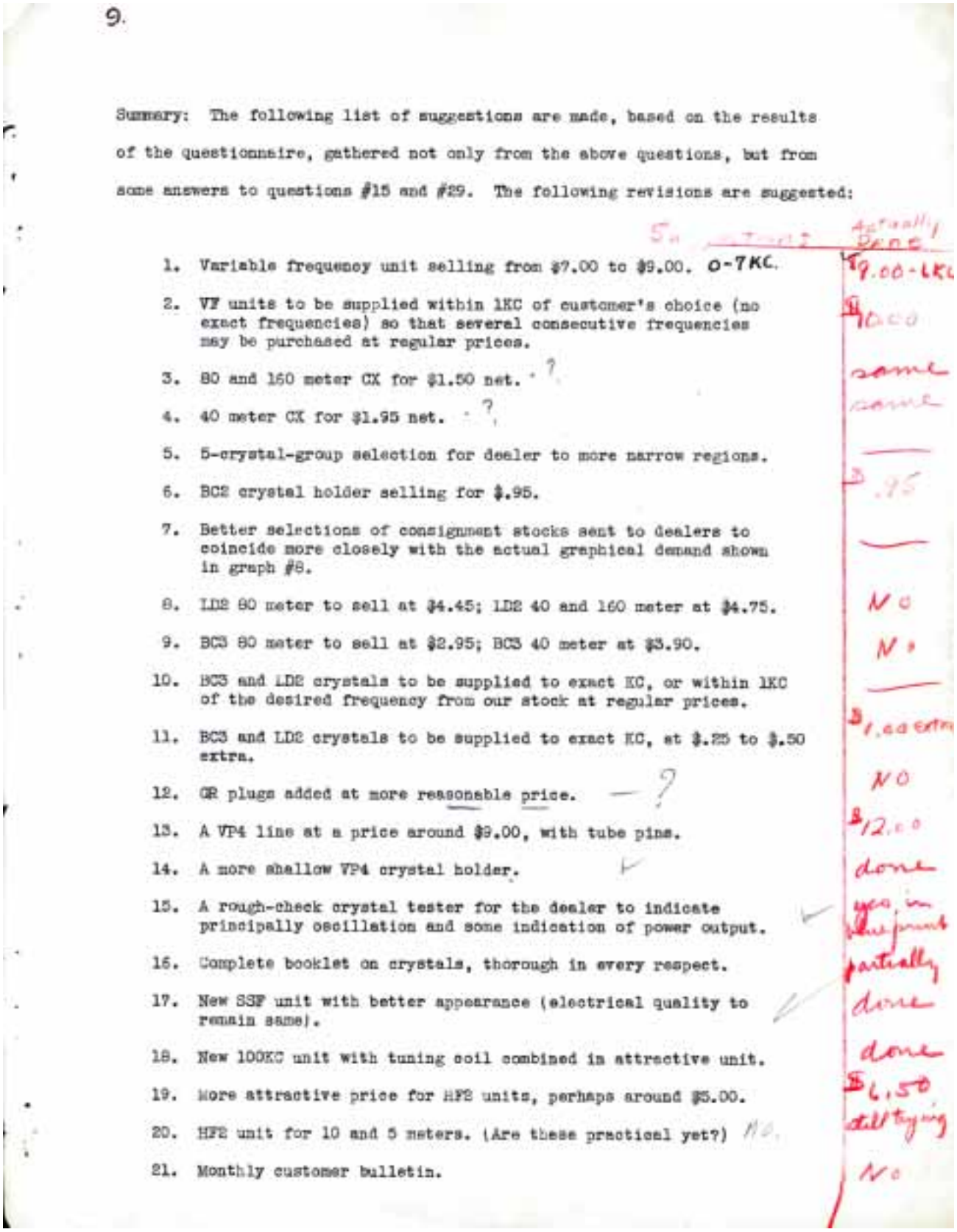


Question #27, "Do you use a 100KC standard frequency unit for checking your monitor?" 11% of the radio-phone amateurs use a 100KC frequency standard. This is twice as many as used by the average or code groups, farther indicating that the radio-phone man is more frequency conscious. It is interesting to point out that less code men own frequency standards than the average group. This is probably due to the fact that the code men have operated only a few years and are relatively new hams. The trend, however, I believe, is towards 100KC standards as shown in the next question.

Question #28, "If not, considering the many advantages of this instrument, do you expect to make one in the near future? From 27% to 45% of all the amateurs indicated their desire to own a 100KC frequency standard. The largest majority who desired this instrument was the "average" ham; but it is believed that they did not fully understand this question, as these results do not check closely enough with answers to question #27. It does show, however, that more "phone" stations than "code" stations, by percentage, wish to add a 100KC frequency standard to their equipment.

Question #30 "First licensed 19.." "Years operated ...." The average code station has operated 6 years, the average phone station 8 1/2 years, and the "average amateur" 7 years.

SCAN OF ORIGINAL SUMMARY PAGE (80% OF SIZE)



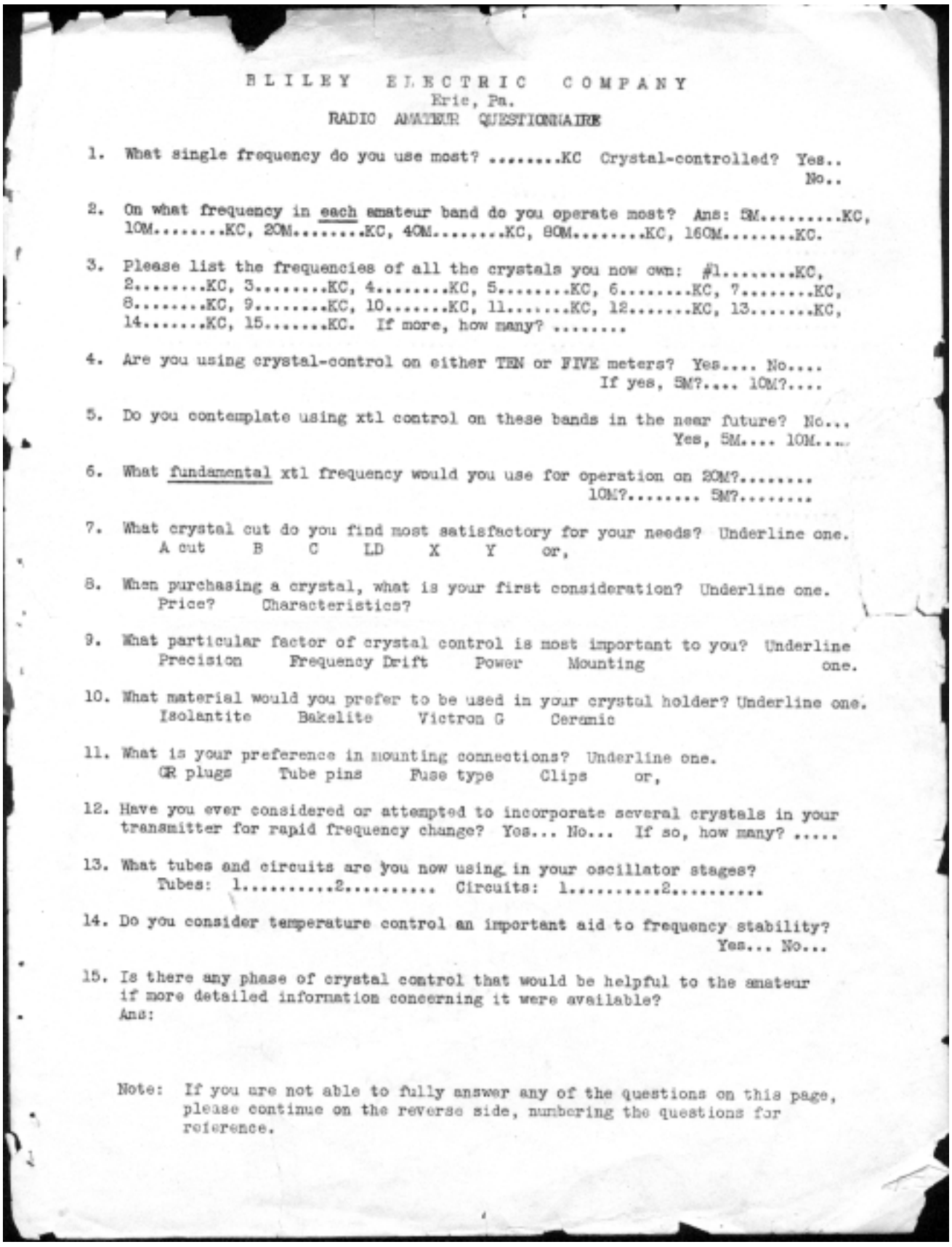
9.

Summary: The following list of suggestions are made, based on the results of the questionnaire, gathered not only from the above questions, but from some answers to questions #15 and #29. The following revisions are suggested:

1. Variable frequency unit selling from $7.00 to $9.00. 0-7KC.
2. VF units to be supplied within 1KC of customer's choice (no exact frequencies) so that several consecutive frequencies may be purchased at regular prices.
3. 80 and 160 meter CX for $1.50 net. ?
4. 40 meter CX for $1.95 net. ?
5. 5-crystal-group selection for dealer to more narrow regions.
6. BC2 crystal holder selling for $.95.
7. Better selections of consignment stocks sent to dealers to coincide more closely with the actual graphical demand shown in graph #8.
8. LD2 80 meter to sell at $4.45; LD2 40 and 160 meter at $4.75.
9. BC3 80 meter to sell at $2.95; BC3 40 meter at $3.90.
10. BC3 and LD2 crystals to be supplied to exact KC, or within 1KC of the desired frequency from our stock at regular prices.
11. BC3 and LD2 crystals to be supplied to exact KC, at $.25 to $.50 extra.
12. QR plugs added at more reasonable price. — ?
13. A VP4 line at a price around $9.00, with tube pins.
14. A more shallow VP4 crystal holder.
15. A rough-check crystal tester for the dealer to indicate principally oscillation and some indication of power output.
16. Complete booklet on crystals, thorough in every respect.
17. New SSF unit with better appearance (electrical quality to remain same).
18. New 100KC unit with tuning coil combined in attractive unit.
19. More attractive price for HF2 units, perhaps around $5.00.
20. HF2 unit for 10 and 5 meters. (Are these practical yet?) No.
21. Monthly customer bulletin.

SCAN OF FIRST PAGE OF THE ORIGINAL QUESTIONNAIRE (80% OF ORIGINAL SIZE)

There are a total of 30 questions were in the complete survey.



BLILEY ELECTRIC COMPANY
Erie, Pa.
RADIO AMATEUR QUESTIONNAIRE

1. What single frequency do you use most? .....KC Crystal-controlled? Yes.. No..

2. On what frequency in each amateur band do you operate most? Ans: 5M.....KC, 10M.....KC, 20M.....KC, 40M.....KC, 80M.....KC, 160M.....KC.

3. Please list the frequencies of all the crystals you now own: #1.....KC, 2.....KC, 3.....KC, 4.....KC, 5.....KC, 6.....KC, 7.....KC, 8.....KC, 9.....KC, 10.....KC, 11.....KC, 12.....KC, 13.....KC, 14.....KC, 15.....KC. If more, how many? .....

4. Are you using crystal-control on either TEN or FIVE meters? Yes.... No.... If yes, 5M?.... 10M?....

5. Do you contemplate using xtl control on these bands in the near future? No... Yes, 5M.... 10M....

6. What fundamental xtl frequency would you use for operation on 20M?..... 10M?..... 5M?.....

7. What crystal cut do you find most satisfactory for your needs? Underline one.
   A cut B C LD X Y or,

8. When purchasing a crystal, what is your first consideration? Underline one.
   Price? Characteristics?

9. What particular factor of crystal control is most important to you? Underline one.
   Precision Frequency Drift Power Mounting

10. What material would you prefer to be used in your crystal holder? Underline one.
    Isolantite Bakelite Victron G Ceramic

11. What is your preference in mounting connections? Underline one.
    GR plugs Tube pins Fuse type Clips or,

12. Have you ever considered or attempted to incorporate several crystals in your transmitter for rapid frequency change? Yes... No... If so, how many? .....

13. What tubes and circuits are you now using in your oscillator stages?
    Tubes: 1.....2..... Circuits: 1.....2.....

14. Do you consider temperature control an important aid to frequency stability? Yes... No...

15. Is there any phase of crystal control that would be helpful to the amateur if more detailed information concerning it were available?
    Ans:

Note: If you are not able to fully answer any of the questions on this page, please continue on the reverse side, numbering the questions for reference.

GRAPHS

Photocopies of graphs inlcluded with report. Original size 8 x 10 inches.

GRAPH 1: Occupancy of Amateurs Throughout all bands
Question 1—All Groups

GRAPH 2: Frequencys used most by all Hams in all bands
Question 1—CodeGroup

GRAPH 3: Frequencies used by al hams in all bands
Question 1—Group: Fone

GRAPH 4: Frequencies used most by all Hams in all bands
Question 1—Average Group

GRAPH 5: Frequencies used by Hams in all bands
Question 2—Fone Group

GRAPH 6: Frequencies used by Hams in all bands
Question 2—Average Group

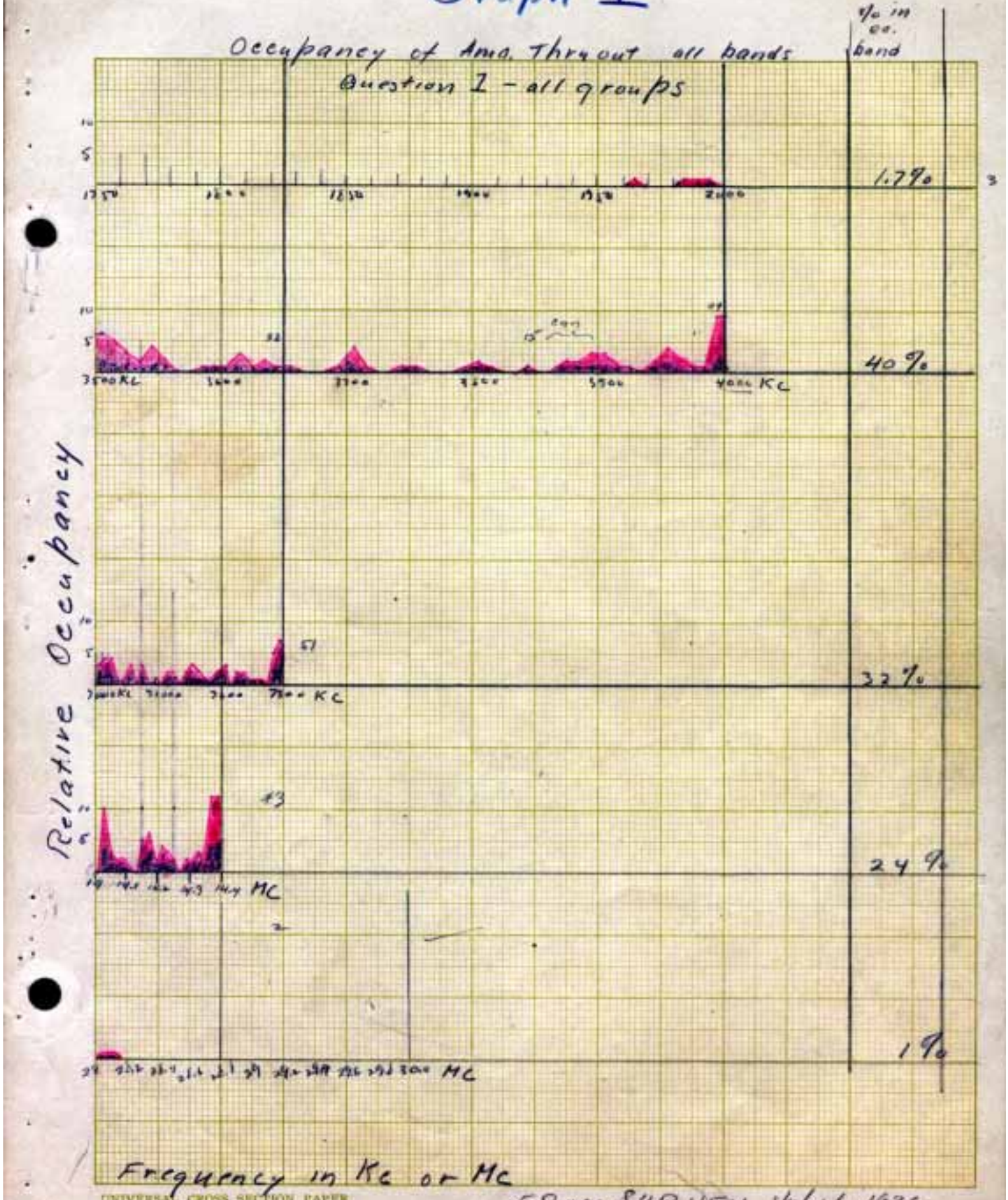
GRAPH 7: Frequencies used by Hams in all bands
Question 2—Code Group

GRAPH 8: Frequencies of all crystals owned by all hams
Question 3

GRAPH 9: Total sales of BC3 and LD2 Crystals during May 1936 in 40 and 80 meter bands

GRAPH 10: Comparison of “Crystals Owned” and May 1936 “Bliley Sales”

Graph 1

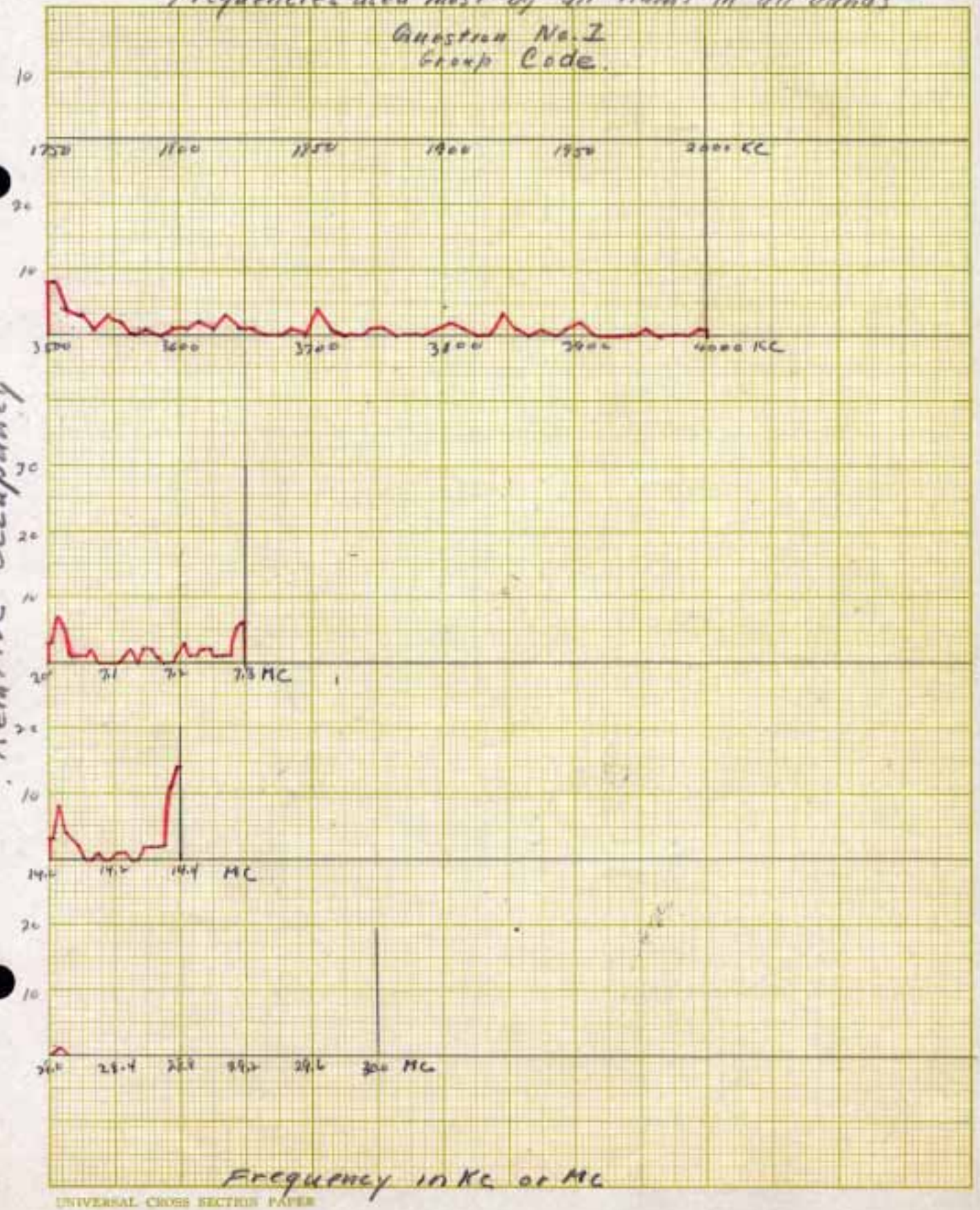


UNIVERSAL CROSS SECTION PAPER

FROM SURVEY July 1, 1936
By [illegible]

Graph 2

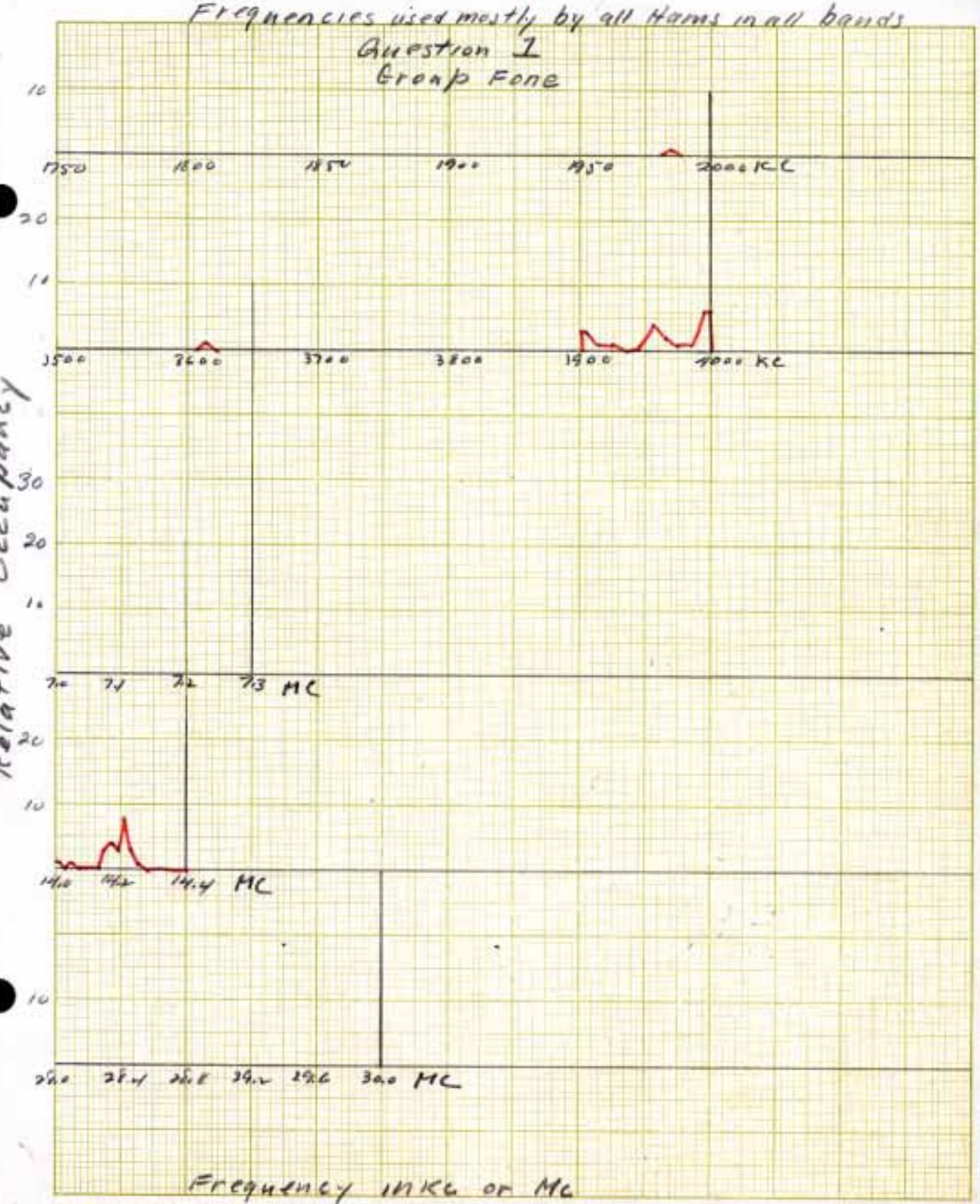
Frequencies used most by all Hams in all bands



Graph 3

Frequencies used mostly by all Hams in all bands

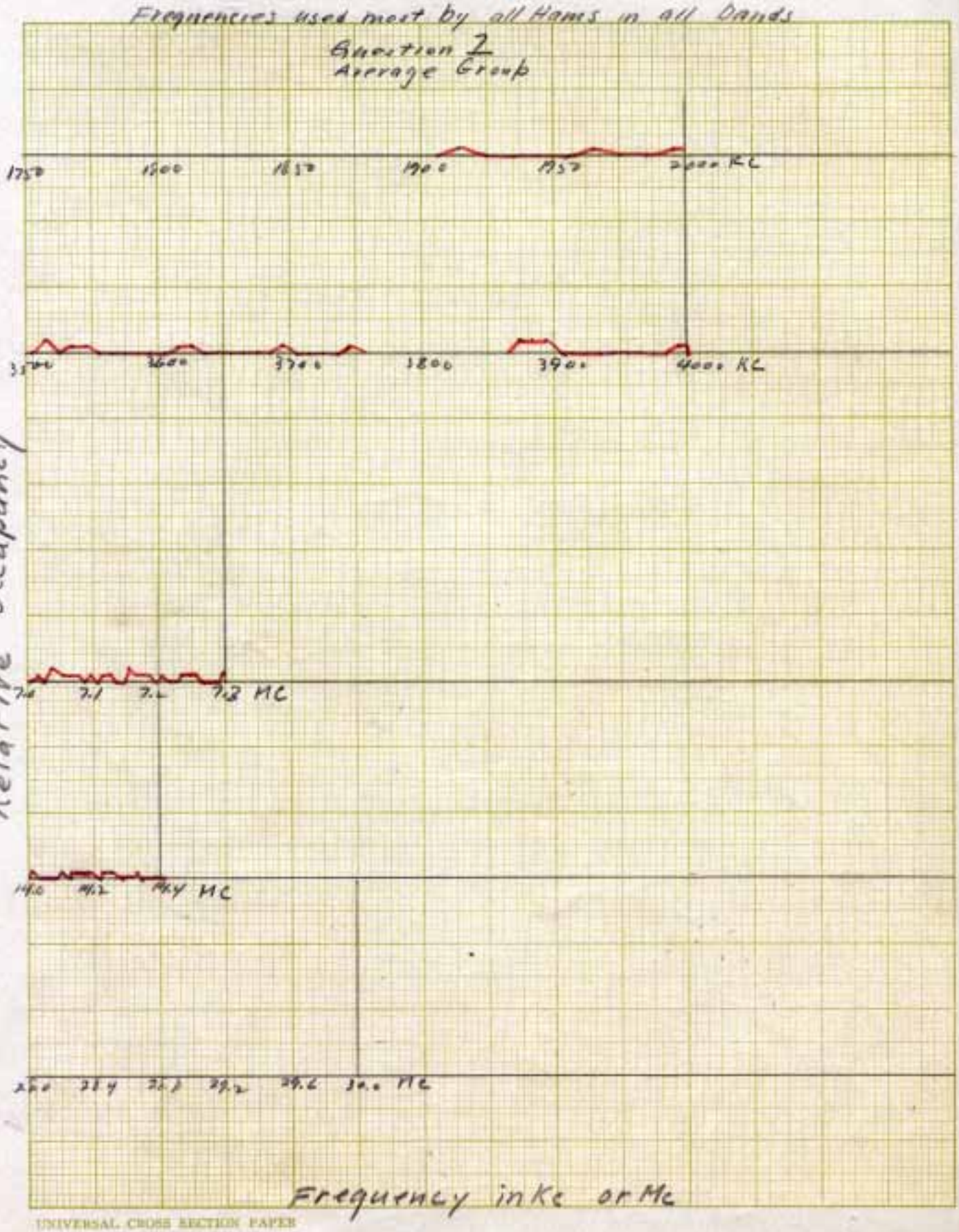
Question 1
Group Fone



Graph 4

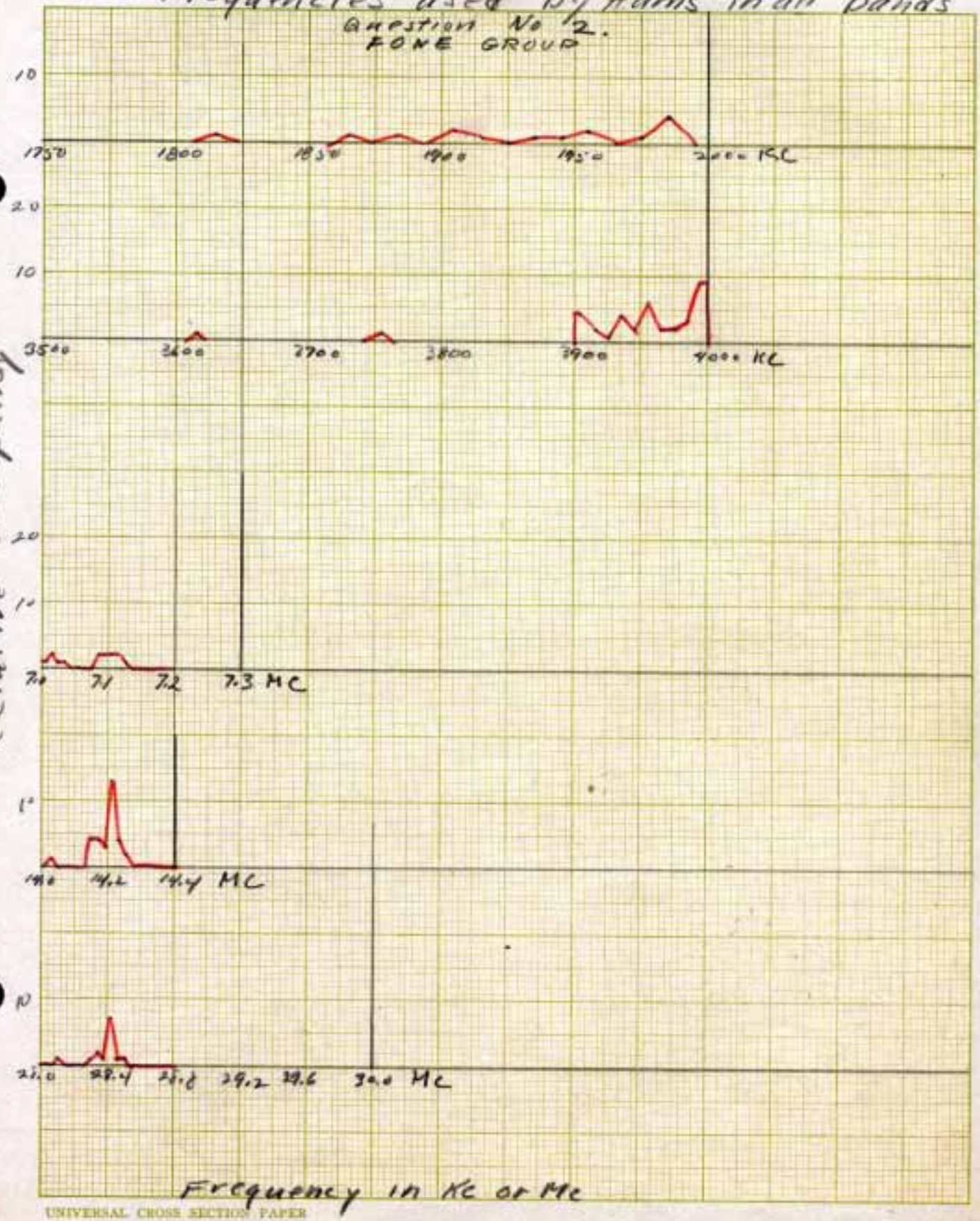
Frequencies used most by all Hams in all Bands

Section 7
Average Group



Graph 1

Frequencies used by Hams in all bands

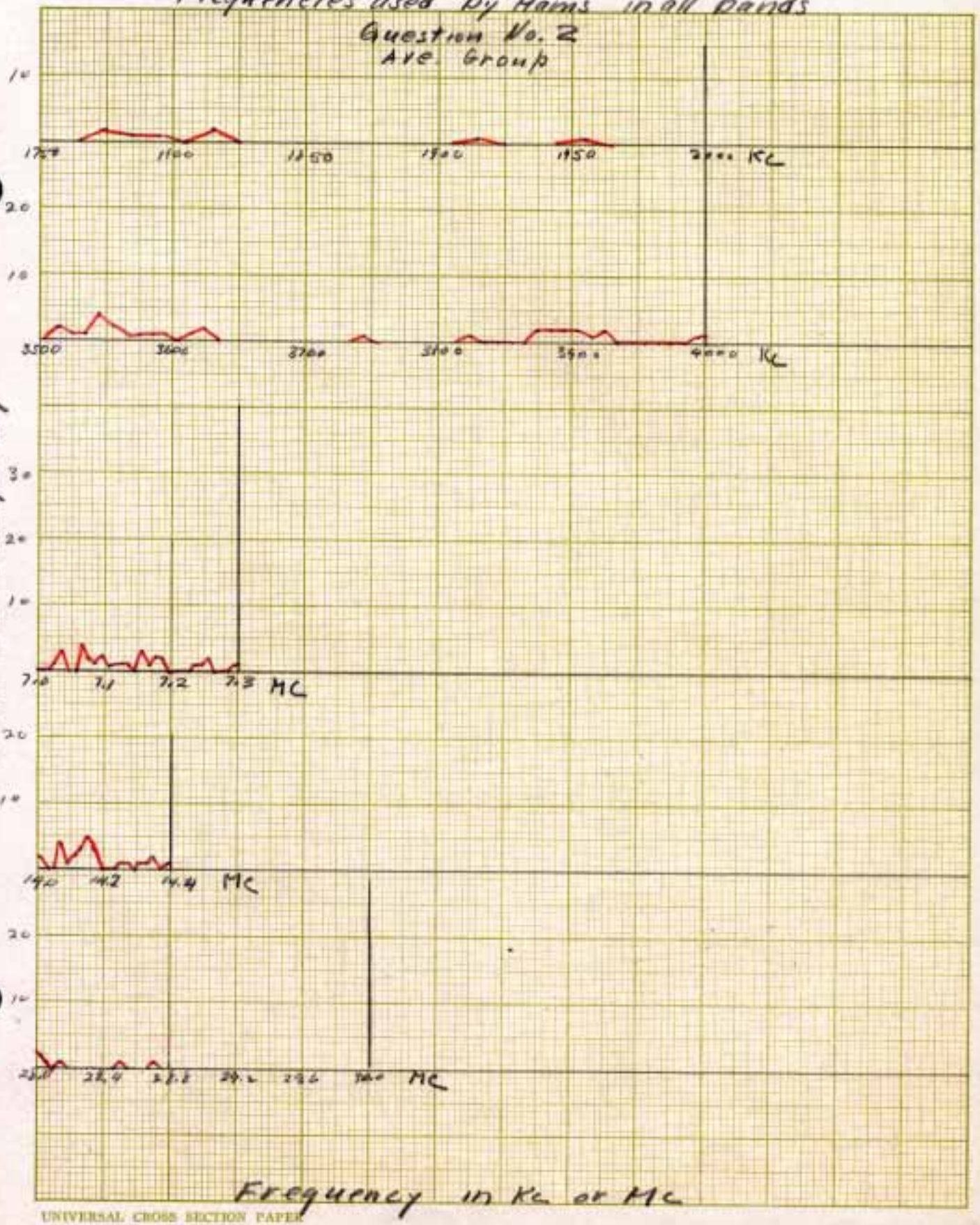


UNIVERSAL CROSS SECTION PAPER

Graph 6

Frequencies used by Hams in all bands

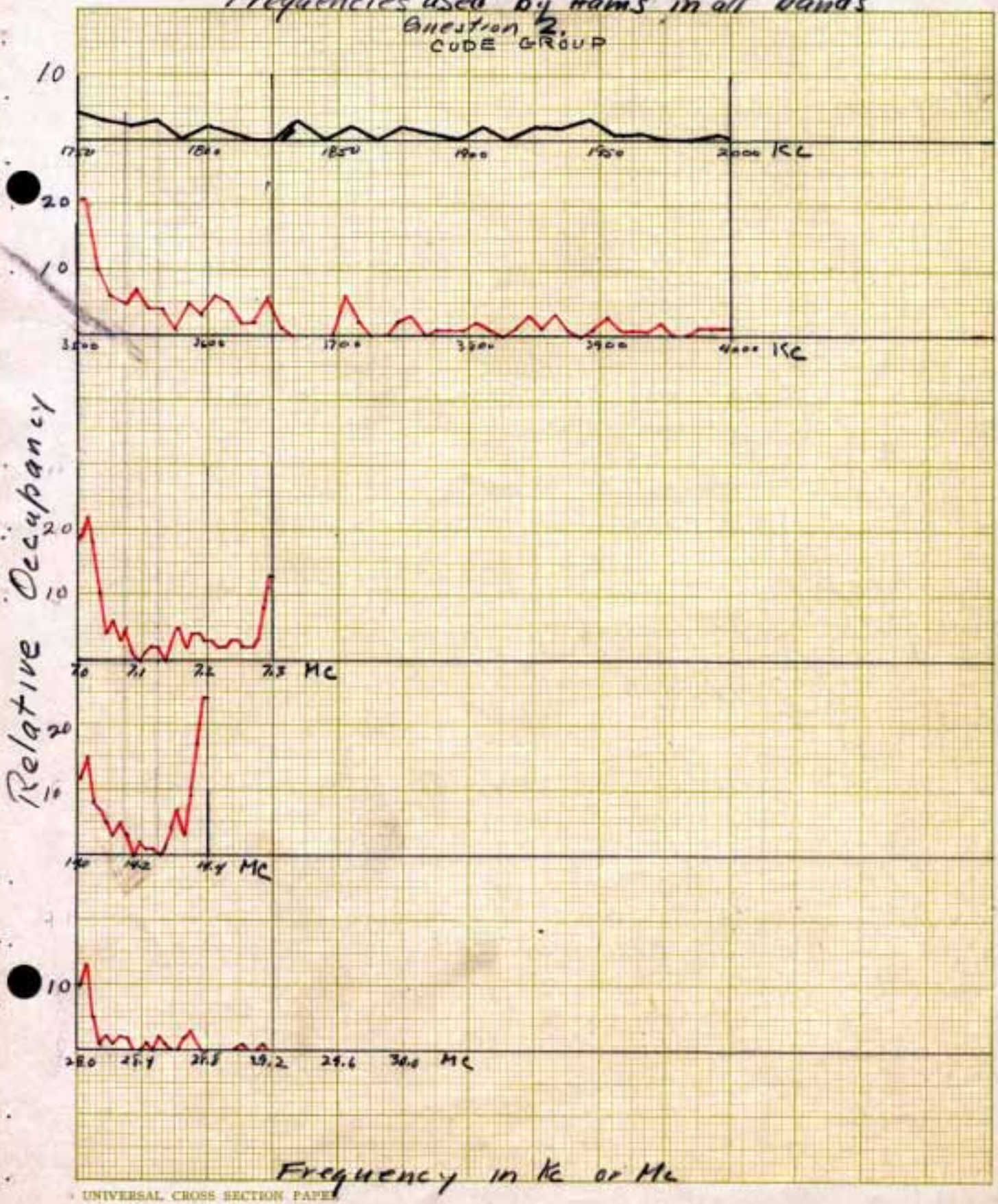
Question No. 2
Ave. Group



Graph 7

Frequencies used by Hams in all bands

Question 2.
CODE GROUP



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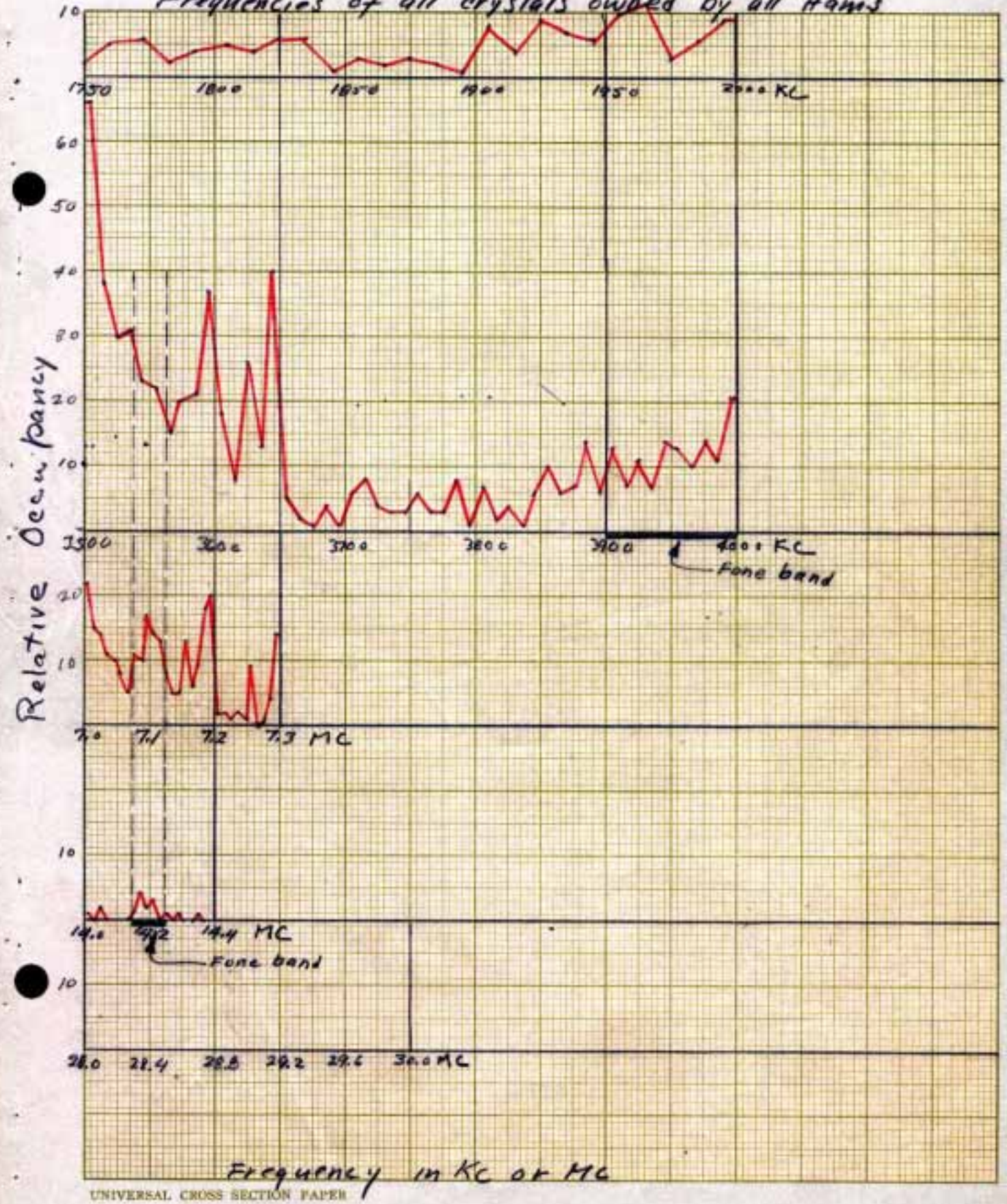
Graph 8

Question No. 3

Frequencies of all crystals owned by all Hams



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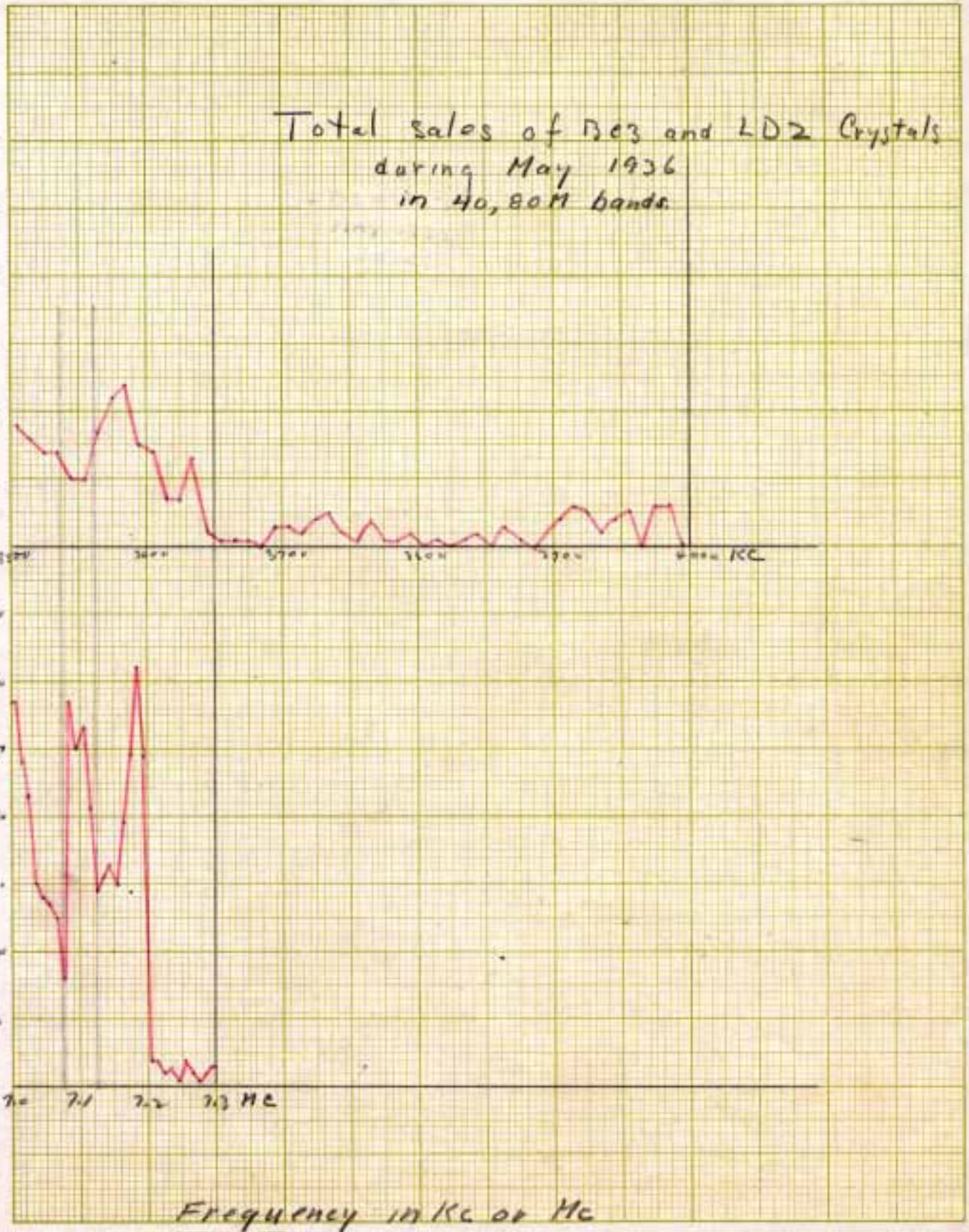
Graph 9



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Graph 10