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NEW YORK UNIVERSITY

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Wave Spectra Estimated from Wave Records Obtained by
the OWS WEATHER EXPLORER and
the OWS WEATHER REPORTER (I)

By

L. Moskowitz

W. J. Pierson, Jr.

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Technical Report Prepared for U.S. Navy Oceanographic Office under contract N62306-1042

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As a part of the problem of developing numerical wave forecasting procedures for the North Atlantic Ocean, selected sequences of the weather maps for the North Atlantic for which wave data were known to be available were studied in detail for the five year period beginning in April 1955 and ending in March 1960.

Certain dates and times of observations were selected for a variety of reasons for study. For these dates and times, the National Institute of Oceanography provided copies of the wave records that were obtained by the OWS Weather Explorer and by the OWS Weather Reporter.

In total, about 800 wave records were provided, and a complete spectral analysis is planned for about 400 of these records.

This report is the first of a series of reports to present in tabular and graphical form the results of these analyses. The total number of spectra given is 114.

Analysis procedures

The original wave records varied in length, but almost all of this first set were 15 minutes long. The crest to trough heights of the highest waves in a particular record (uncorrected for calibration effects) varied from a few feet to more than 60 feet in the complete set of records. Bounds were set on each record just above the highest wave crest and just below the lowest wave trough, and the records were read to an accuracy of one part in a thousand (nominally) over this range at an interval of 1.5 seconds throughout the record. Thus a 15 minute record was reduced to a time series



of 600 points. Where gaps or irregularities occurred, the records were smoothed by hand as accurately as possible.

The time series of 600 points was then analyzed on the CDC 1604 so as to estimate the energy spectrum of the waves at 60 points over the frequency range from zero to 0.333 cycles per second by means of the procedures given by Tukey (1949) as explained in detail by Blackman and Tukey (1958). The smoothing operation that was used to go from L to U in the equations of Blackman and Tukey was

(1)
$$U_{h} = 0.25L_{h-1} + 0.50L_{h} + 0.25L_{h+1}$$

with suitable corrections at the ends of the range.

The spectral estimates so obtained still had to be corrected for the response of the shipborne wave recorder (Tucker, 1956) and for the introduction of noise in both the original record and in the digitization procedure. The calibration of the shipborne recorder depends on the ship, and the calibration curves were provided by Mr. D. E. Cartwright for this purpose. The calibration curve for the Weather Explorer is given by Table 1. The calibration curve for the Weather Reporter is given by Table 2.

As in another investigation (Bretschneider, Crutcher, et al (in press)), it was found that the application of the above calibration curves to the spectra that were originally computed resulted first in a decrease and then a rapid increase in the spectra at high frequencies due to the presence of noise and other irregularities (possibly from nonlinear effects in the original wave records) at the high frequency end of the spectrum. To eliminate this effect,



the last part of the spectrum was smoothed by a three point running weighted mean (0.25, 0.50, and 0.25) and then the last ten values were averaged.* This average was treated as white noise and subtracted from all spectral estimates. When the reduced values were multiplied by the appropriate calibration curves, the usual result was a fairly smooth spectrum that decreased regularly toward zero values at high frequency. By such a procedure some of the spectral values at high frequency will be negative. These values were automatically set equal to zero in the rest of the computations.

Inadvertently, Table 1 was applied where Table 2 ought to have been applied to some of the spectra. The result was exceptionally high values at high frequencies. Thus the calibrations given in these two tables do distinguish between the characteristics of the two ships as, when done correctly, reasonable results were obtained.

Even with these corrections, there were a few spectra that still became exceptionally large for frequencies greater than about 0.25 cycles per second. This behavior was apparently caused by the original quality of the record and not by the digitization procedure. These spectra were further modified by arbitrarily setting the calibration curve equal to one above a certain frequency that was selected by inspection of each spectrum.

The result of such a sequence of computations should yield fairly reliable spectral estimates for frequencies ranging from zero to 0.25 cycles per second, but the values at high frequencies should not be used to decide on any features of the high frequency end.

^{*}See p. 6 for details.



Sample parameter estimates

The spectral estimates that resulted from this sequence of operations were then processed further to obtain some additional useful information. Let U_h^* , for $h=0,\ 1,\ 2,\ \cdots, 60$, represent the spectral estimates (after subtraction of the noise and multiplication by the calibration for the shipborne recorder) in terms of the resolution of the variance of the wave record into frequency intervals. The following quantities were then also computed and tabulated with each spectrum.

(2) CORR VAR = corrected variance =
$$\Sigma U_h^*$$

(3) SIG HGT =
$$\overline{H}_{\frac{1}{3}}$$
 = 2.83 (2 ΣU_h^*)^{1/2}

(4) AVER
$$T = \tilde{T} = \left[\sum U_h^{*} / \sum f_h^{2} U_h^{*}\right]^{1/2}$$

(5) TOTAL DF = Total degrees of freedom = $10 \left[\sum U_h^* \right]^2 / \left[\sum U_h^2 \right]$ (for 600 points, 60 lags; i.e., 20 degrees of freedom per spectral estimate)

The confidence intervals on the corrected variance and on the significant height are given by

Upper 95% on CORR VAR =
$$(10^{+1/\sqrt{TDF}})$$
 CORR VAR

(6)
$$\text{Lower 5\% on CORR VAR} = (10^{-1/\sqrt{\text{TDF}}}) \text{ CORR VAR}$$
 and by



Upper 95% on
$$\overline{H}_{\frac{1}{3}} = 10^{+1/2\sqrt{TDF}} \overline{H}_{\frac{1}{3}}$$

(7)

Lower 5% on
$$\overline{H}_{\frac{1}{3}} = 10^{-1/2\sqrt{\text{TDF}}} \overline{H}_{\frac{1}{3}}$$

in terms of the total degrees of freedom (TDF) to a high degree of accuracy since the total degrees of freedom are large.

The corrected variance, the significant height, and the total degrees of freedom are relatively insensitive to changes in the noise level and in the high frequency behavior of the spectrum.

However, the average period can properly be viewed with caution.

The winds near the ship at the time of observation are also given to the nearest five knots as read directly from weather maps. These values are subject to later correction in terms of the logs of the weather ships.

Explanation of tables and graphs

The body of this report consists of supplementary tables, of tables that give the appropriate results for each of the original wave records, and of graphs of each of the estimated spectra along with the confidence intervals on the spectra.

The supplementary tables consist of Tables 1 through 4.

Tables 1 and 2 have been described above.

Table 3 gives either the on station position of the ship,

A, I, J, or K, or the latitude and longitude of the ship if it is going
on or off station. The speed and direction of the ship is given.



Position A corresponds to 62°N, 33°W.

Position I corresponds to 59°N, 19°W.

Position J corresponds to 52.5°N, 20°W.

Position K corresponds to 45°N, 16°W.

If the record was not 15 minutes long, less than 600 points were read. For these records, Table 4 gives the actual number of points used and the corrected total degrees of freedom. A correction to the upper and lower confidence limits, which would be quite small, would also be needed to be exact.

Spectral tabulations

A tabulated spectrum can be interpreted as follows:

- la) Supplementary data for each spectrum consist of the date, hour, wind speed, total degrees of freedom, average period, significant height, corrected variance, noise level, and record number. Some tables give the confidence limits for the height according to equation (7).
- 1b) In the first column, the spectral lag numbers (H) are given.
- 2) In the second column (FRE) the frequency according to the equation $f = H/180 \text{ (sec}^{-1})$ is given.
- 3) In the third column (UNIT = FT^2), the spectrum as computed from the original data is given in units of (ft)².
- 4) In the fourth column (FILTERED), a smoothing operator for H > 40 is applied. It is actually

$$F_H = 0.25U_{H-1} + 0.50U_H + 0.25F_{H+1}$$

(where $F = Filtered$, and $U = Unit$)

5) In the fifth column (LESS NOISE), the noise level shown at the top is subtracted from each estimate.



- 6) In the sixth column (CORR FT 2), the LESS NOISE column is multiplied by the calibration curve for the shipborne record according to either Table 1 or Table 2. If this column agrees with the previous column, at high frequencies, the calibration curve has been arbitrarily set equal to one to avoid extreme values at high frequency.
- 7) In the last two columns, the upper and lower 95% and 5% confidence bounds are shown.

The graphs of the spectra

The graph that accompanies the spectral tabulation shows the spectrum and the 95% and 5% confidence bounds. The scale is chosen so that the highest 95% confidence value is at the top of the graph and the vertical axis of the coordinate system shows the spectral values for that spectrum in units of (feet)². The scales change with each spectrum and comparisons between spectra by means of the graphs should be made cautiously.

Acknowledgments

We wish to thank the National Institute of Oceanography of the United Kingdom for providing us with the wave records. Dr. J. Darbyshire sent some of the records to us from South Africa. Mr. D. E. Cartwright and Mr. L. Draper were most helpful in assembling other records at N. I. O. having them copied and forwarding the records to us. The records were digitized at Johns Hopkins University and at Davidson Laboratory of Stevens Institute of Technology.



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 Physical Problems. Woods Hole, Massachusetts, 13-14 June,

 1949. pp. 47-67, 1950.



Table 1. Calibration factors for the Weather Explorer.

| 1.0000 | | | | | | |
|------------|----------|----------|----------|----------|----------|---|
| 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.6157 | |
| 1.3740 | 1.2452 | 1.1746 | 1.1399 | 1.1291 | 1.1343 | |
| 1.1547 | 1.1870 | 1.2304 | 1.2845 | 1.3504 | 1.4277 | |
| 1.5193 | 1.6241 | 1.7444 | 1.8828 | 2.0415 | 2.2243 | |
| 2.4349 | 2.6765 | 2.9523 | 3.2725 | 3.6414 | 4.0714 | |
| 4.5654 | 5.1490 | 5.8190 | 6.6136 | 7.5383 | 8.6336 | - |
| 9.9169 | 11.4459 | 13.2691 | 15.4245 | 18.0095 | 21.1086 | |
| 24.8366 | 29.3522 | 34.8079 | 41.4485 | 49.5464 | 59.4548 | |
| 71.5502 | 86.5947 | 105.1503 | 128.1186 | 156.7723 | 192.5202 | |
| 237.3987 | 293.8682 | 365.1736 | 455.5306 | 570.2699 | 716.8705 | |
| | | | | | | |

Table 2. Calibration factors for the Weather Reporter.

| 1.0000 | | | | | |
|---------|---------|---------|---------|---------|---------|
| 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.5755 |
| 1.3277 | 1.1908 | 1.1099 | 1.0630 | 1.0375 | 1.0257 |
| 1.0260 | 1.0350 | 1.0514 | 1.0633 | 1.1034 | 1.1384 |
| 1.1805 | 1.2280 | 1.2817 | 1.3424 | 1.4105 | 1.4871 |
| 1.5731 | 1.6684 | 1.7736 | 1.8918 | 2.0229 | 2.1704 |
| 2.3321 | 2.5169 | 2.7181 | 2.9479 | 3.2018 | 3.4899 |
| 3.8088 | 4.1715 | 4.5826 | 5.0408 | 5.5616 | 6.1512 |
| 6.8201 | 7.5845 | 8.4517 | 9.4439 | 10.5785 | 11.8784 |
| 13.3689 | 15.0856 | 17.0596 | 19.3530 | 22.0055 | 25.0761 |
| 28.6529 | 32.8206 | 37.6868 | 43.3807 | 50.0432 | 57.8872 |
| | | | | | |



Table 3. Position and speed of ship for each record.

| Record No. | Position | Heading | Speed (kts) |
|------------|----------|---------|-------------|
| DL 1 | I | | stopped |
| 2 | I | | stopped |
| 3 | I | | stopped |
| 4 | I | | stopped |
| 5 | I | | stopped |
| 6 | I | | stopped |
| 7 | I | | stopped |
| 8 | I | | stopped |
| 9 | I | 345° | 1 |
| 10 | I | 360° | 2 |
| 11 | I | 360° | 1 |
| 12 | I | | stopped |
| 13 | I | | stopped |
| 14 | I | | stopped |
| 15 | J | 280° | 1 |
| 16 | J | 280° | 1 |
| 17 | J | | stopped |
| 18 | J | 290° | 1 |
| 19 | J | 290° | 1/2 |
| 20 | J | | stopped |
| 21 | J | | stopped |
| 22 | J | 280° | 1 |
| 23 | J | 280° | 1 |
| 24 | J | | hove to |
| 25 | J | | stopped |
| 26 | J | 260° | 1/2 |
| 27 | J | 280° | 0 |
| 28 | J | 280° | 1/2 |
| 29 | J | | stopped |
| 30 | J | | stopped |



Table 3. (cont.)

| Record | d No. Pos | ition H | leading S | peed (kts) |
|--------|-----------|---------|-----------|----------------|
| DL 31 | | I | | stopped |
| 32 | , | I | | stopped |
| 33 | 3 | I | 190° | 1 |
| 34 | <u> </u> | I | 190° | 2 |
| 35 | ; | I | 250° | 1 |
| 36 | | I | 230° | 1 |
| 37 | , | I | 230° | 1 |
| 38 | 3 | I | 240° | 1/2 |
| 39 | | I | 240° | 1/2 |
| 40 | • | I | 240° | 1 |
| 41 | | I | 250° | 1 |
| 42 | | I | | stopped |
| 43 | | A | 070° | 2 |
| 44 | • | A | | stopped |
| 45 | | A | | stopped |
| 46 | | I | 250° | 1 |
| 47 | | ı | 250° | $1\frac{1}{2}$ |
| 48 | | r | 250° | 2 |
| 49 | | I | 250° | 2 |
| 50 | | ı | 250° | 1 |
| 51 | | r : | 260° | 1 |
| 52 | | ı | 265° | $1\frac{1}{2}$ |
| 53 | | I | 260° | 2 |
| 54 | | ı | 265° | 1 |
| 55 | | I | 280° | 2 |
| 56 | | I | | stopped |
| 57 | | r | 305° | $1\frac{1}{2}$ |
| 58 | | I | | stopped |
| 59 | | I | | stopped |
| 60 | | I | | stopped |



Table 3. (cont.)

| Record No. | Position | Heading | Speed (kts) |
|------------|----------|---------|----------------|
| JH l | A | 040° | 1 |
| 2 | A | 090° | 2 |
| 3 | A | 050° | 2 |
| 4 | Α | 040° | 1 |
| 5 | Α | 040° | 1 |
| 6 | A | | stopped |
| 7 | Α | | stopped |
| 8 | K | | stopped |
| 9 | K | | stopped |
| 10 | K | | stopped |
| 11 | K | 290° | 1 |
| 12 | K | 280° | 1/2 |
| 13 | K | 275° | 1/2 |
| 14 | K | 275° | 1 |
| 15 | K | 275° | $1\frac{1}{2}$ |
| 16 | K | 270° | 1 |
| 17 | K | 275° | 1 |
| 18 | K | 275° | 1 |
| 19 | K | | stopped |
| 20 | A | 085° | 2 |
| 21 | A | l 40 ° | 2 |
| 22 | A | 160° | 1 ½ |
| 23 | A | 240° | 1 |
| 24 | A | 200° | 2 |
| 25 | A | 200° | 2 |
| 26 | Α | 220° | 2 |
| 27 | A | 250° | 1 |
| 28 | Α | 240° | 2 |
| 29 | A | 235° | $1\frac{1}{2}$ |
| 30 | A | 240° | 2 |
| | | | |



Table 3. (cont.)

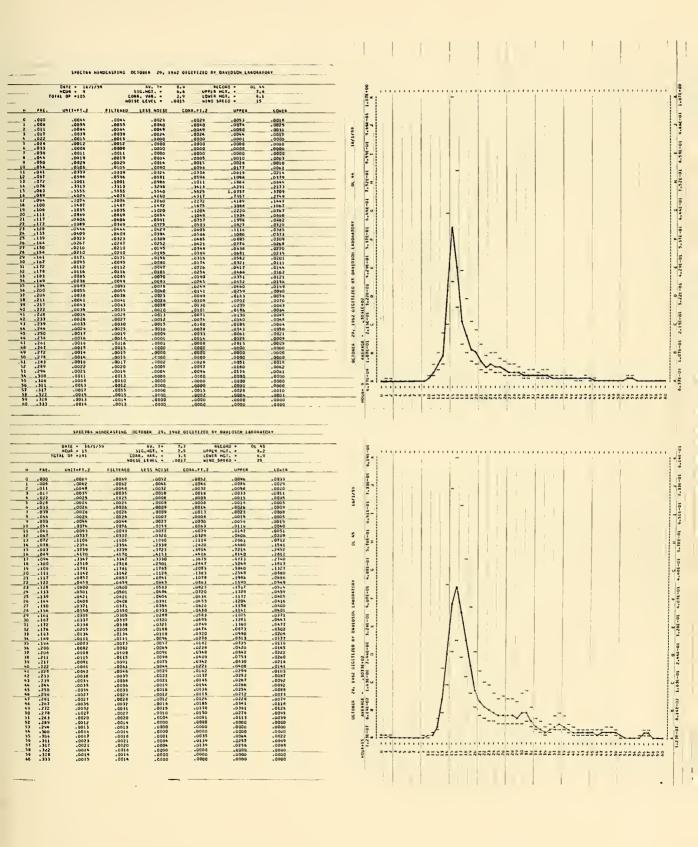
| Re | cord No. | Position | <u>Heading</u> | Speed (kts) |
|----|----------|------------------|----------------|-----------------|
| JH | 31 | A | 230° | l 1/2 |
| | 32 | A | 190° | 2 |
| | 33 | A | 190° | 2 |
| | 34 | Α | 180° | 2 |
| | 35 | A | | stopped |
| | 36 | A | 230° | $l\frac{1}{2}$ |
| | 37 | Α | 240° | 2 |
| | 38 | A | 230° | $l\frac{1}{2}$ |
| | 39 | A | 230° | 2 |
| | 40 | A | 220° | 1 |
| | 41 | J | 080° | 1 |
| | 42 | J | 090° | 1 |
| | 43 | J | 070° | 1 |
| | 44 | 52°42'N,19°W | 065° | 3 |
| | 45 | 53°N , 18°W | 060° | 7 |
| | 46 | 52°54'N, 16°54'W | 060° | 7 |
| | 47 | 53°01'N, 16°36'W | 050° | 4 |
| | 48 | 53°06'N, 16°20'W | 350° | 4 |
| | 49 | 53°08'N, 16°15'W | 050° | 5 |
| | 50 | 53°18'N, 16°16'W | 340° | 1 |
| | 51 | 53°18'N, 16°16'W | | hove to |
| | 52 | 53°17'N, 15°56'W | 120° | 11 |
| | 53 | 52°48'N, 14°26'W | 120° | 10 |
| | 54 | 52°30'N, 13°35'W | 120° | $11\frac{1}{2}$ |



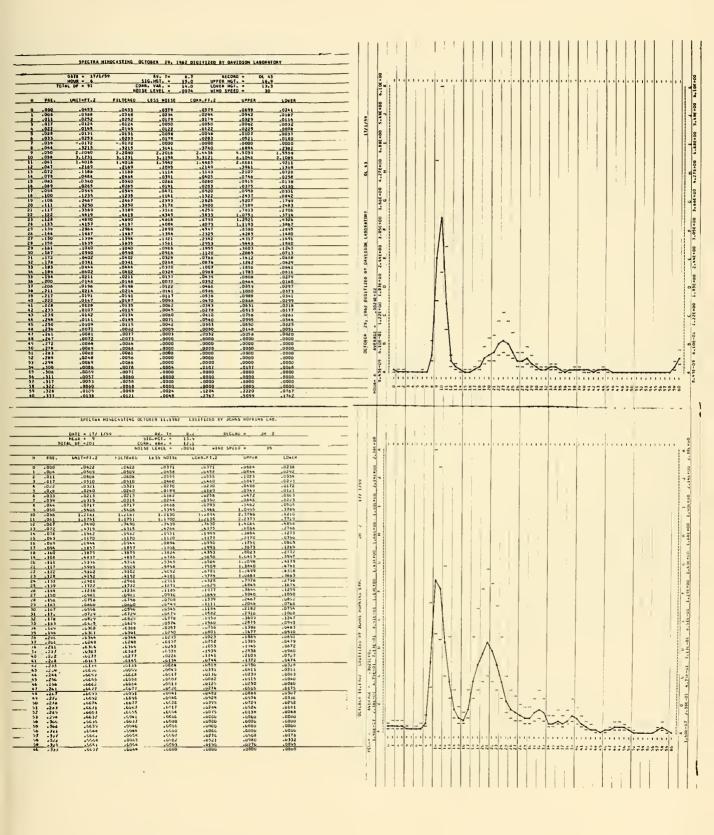
Table 4. Data on short records for which less than 600 points were available.

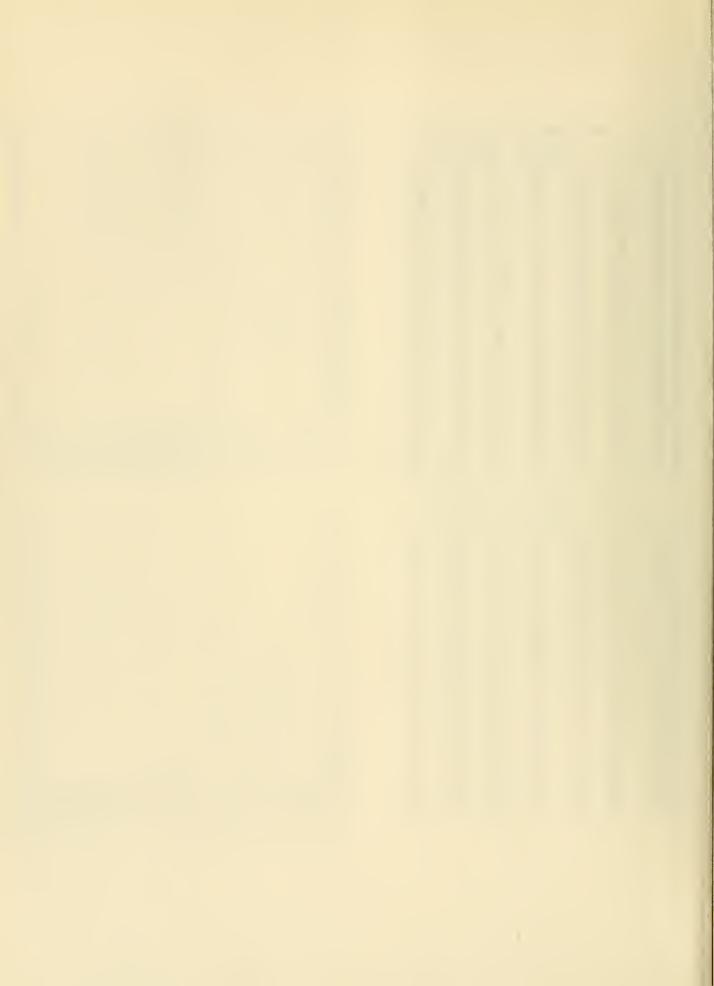
| Record No. | no. of points | Original TDF | Corrected TDF |
|------------|---------------|-----------------|------------------|
| DL 50 | 592 | 144 | 142 |
| JH 4 | 561 | 150 | 140 |
| JH 16 | 591 | 134 | 132 |
| JH 17 | 592 | 101 | 100 |
| JH 18 | 590 | 128 | 126 |
| JH 19 | 581 | 133 | 129 |
| JH 24 | 586 | 151 | 147 |
| JH 36 | 585 | 204 | 199 |

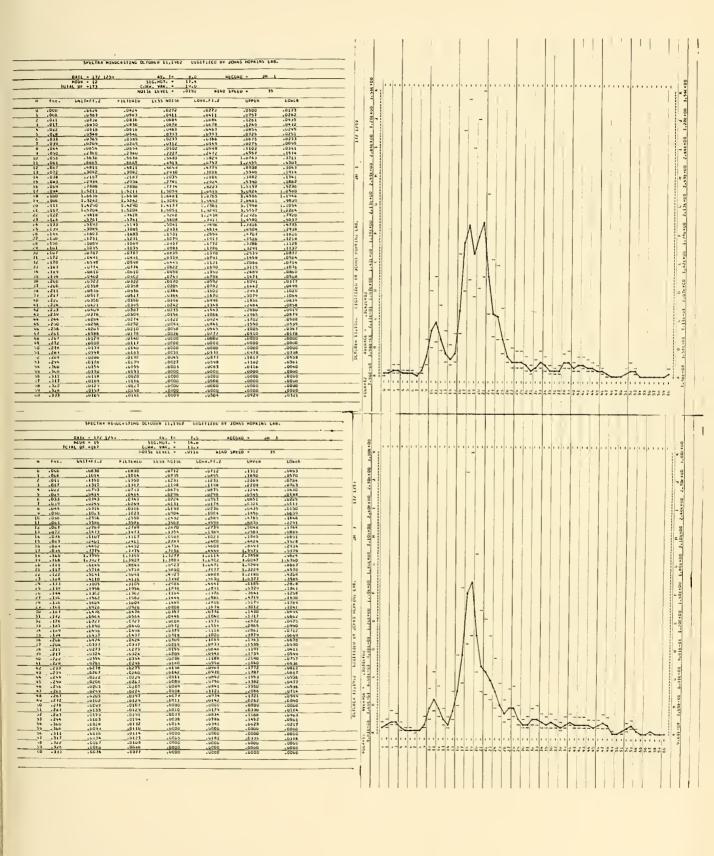




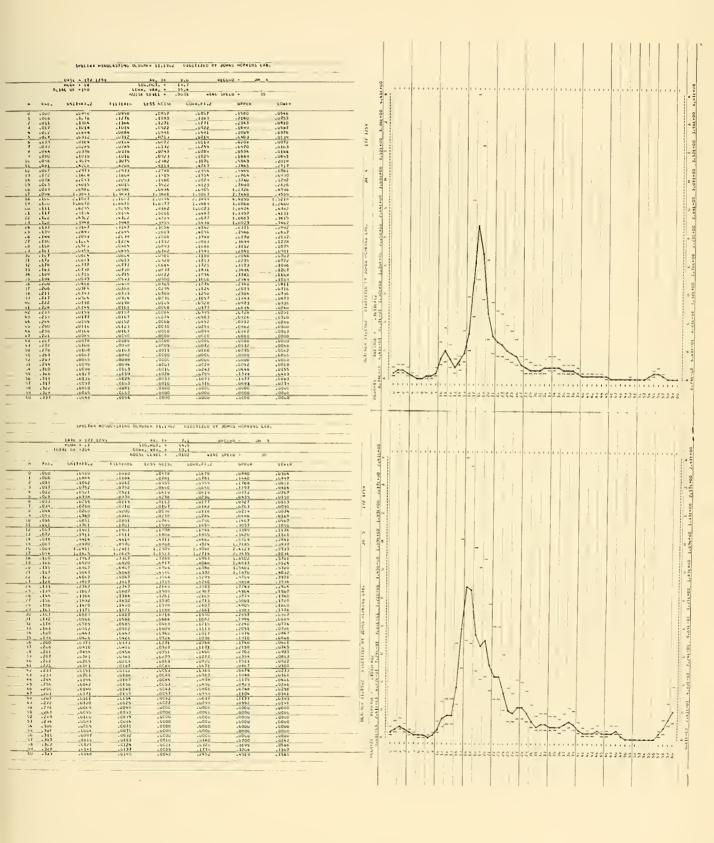




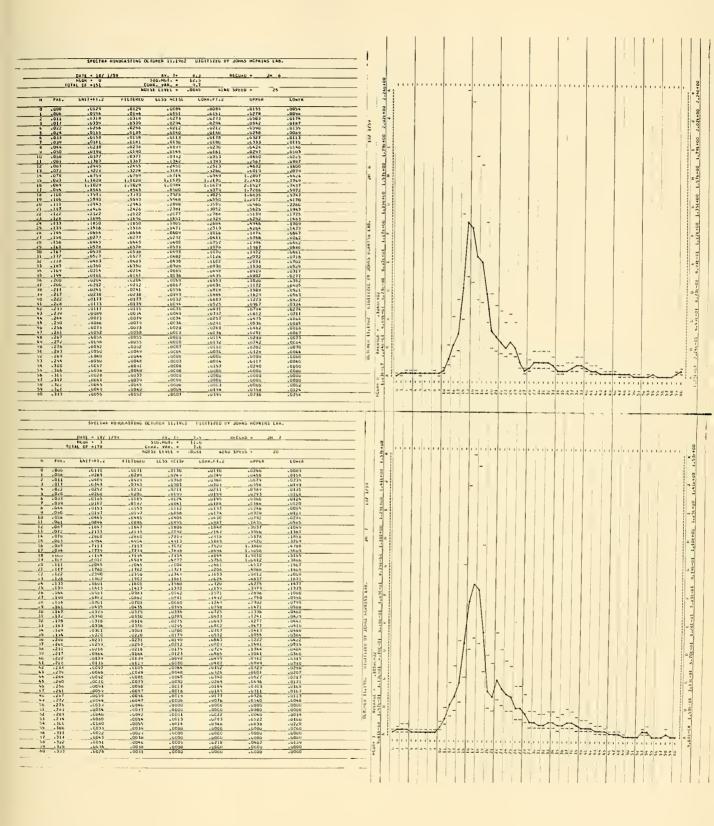




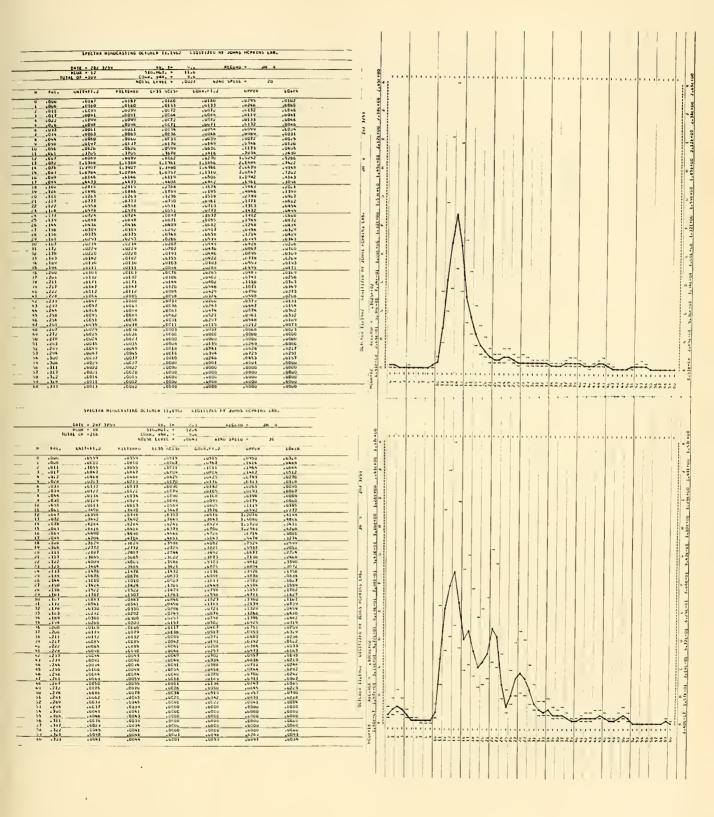




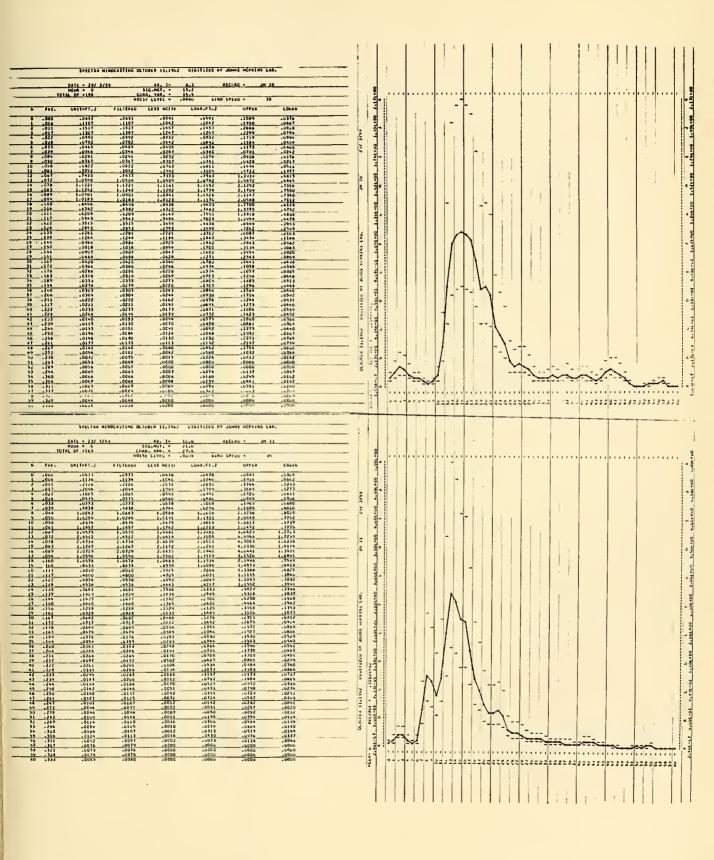




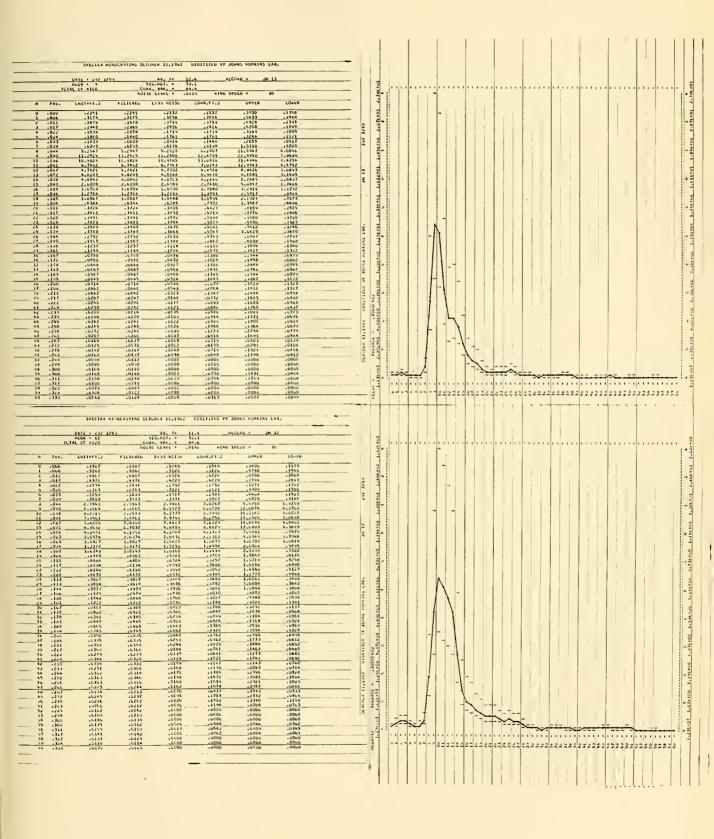




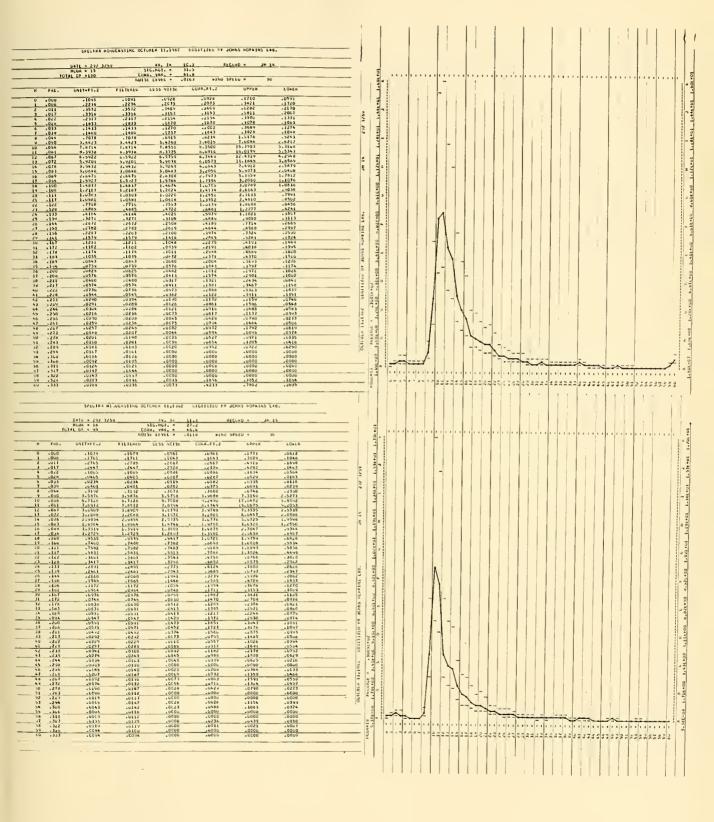




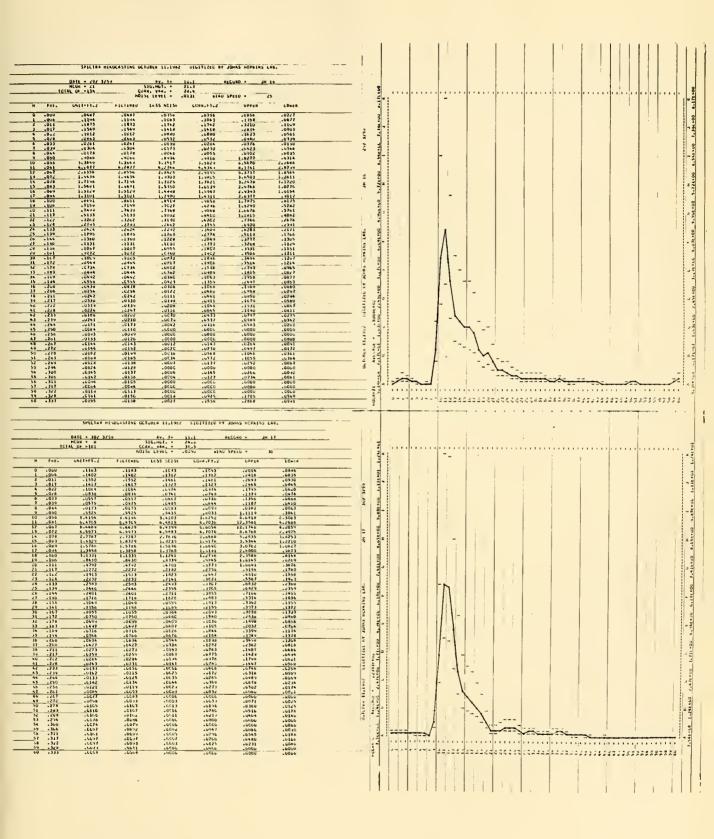




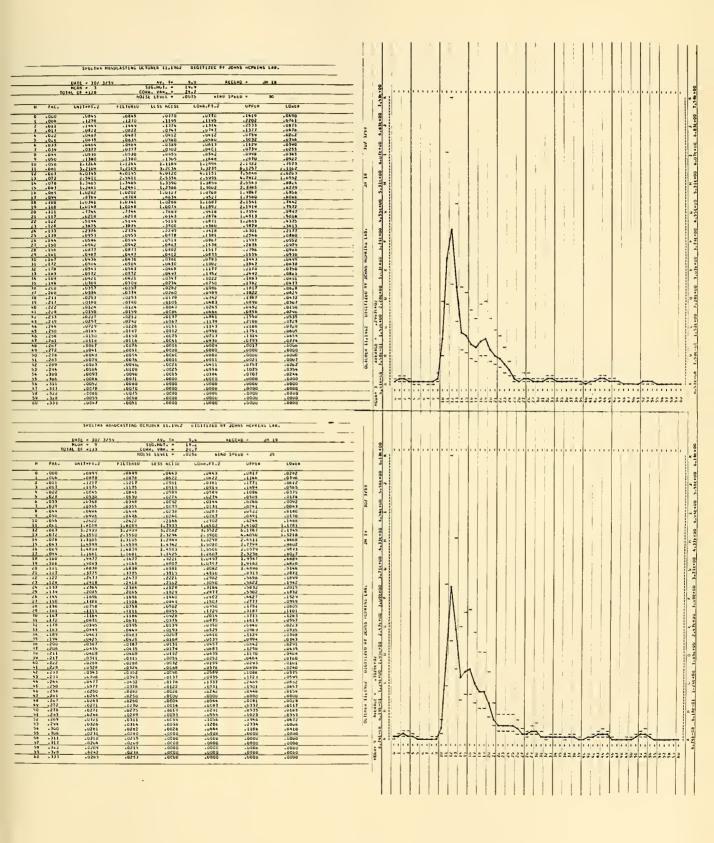




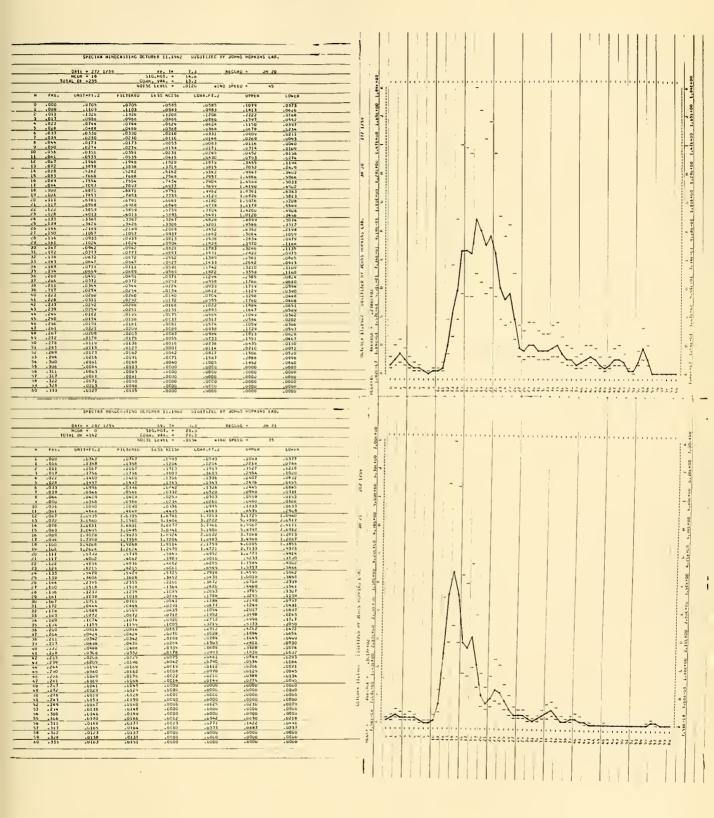




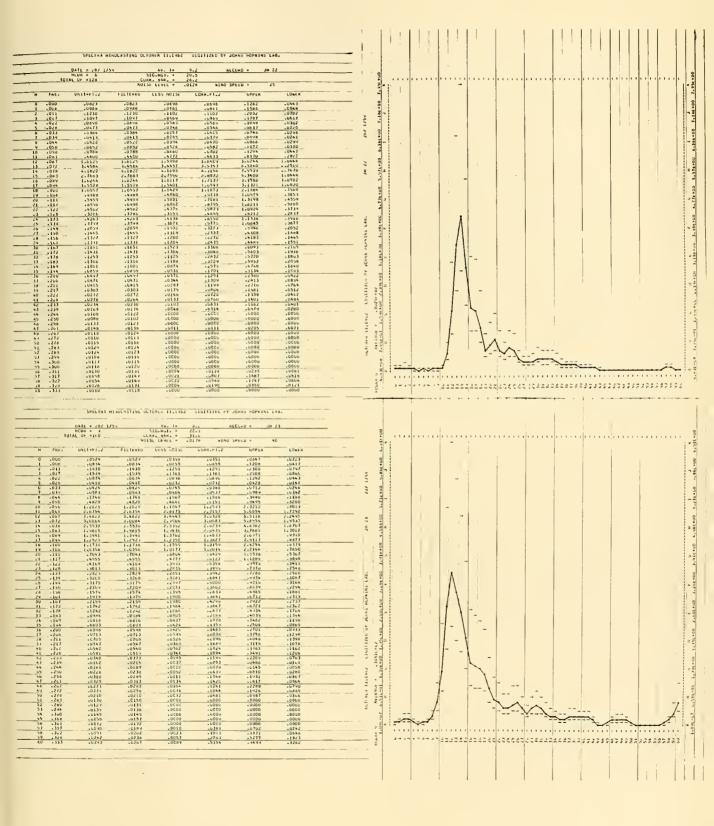




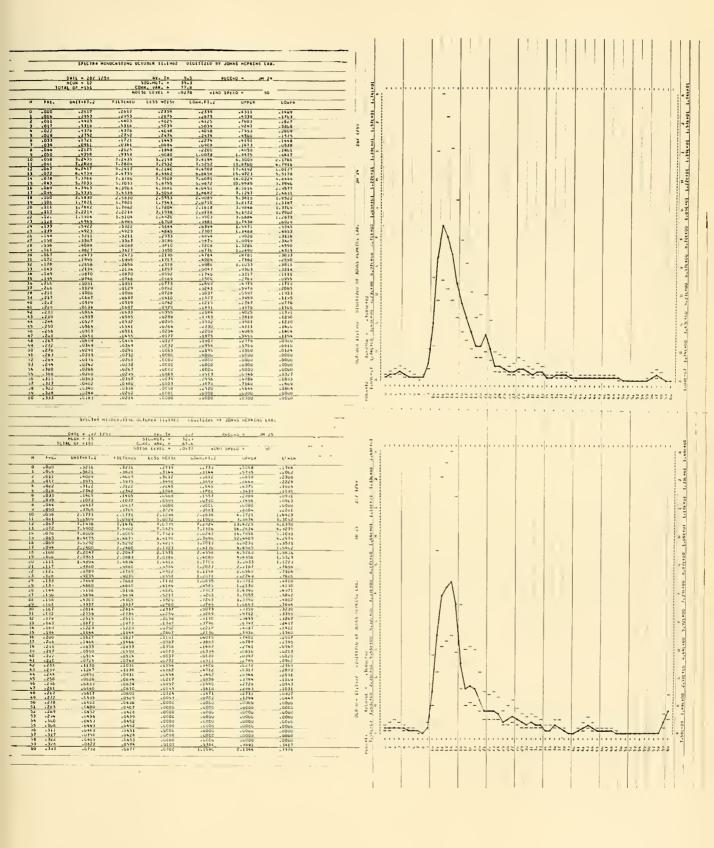




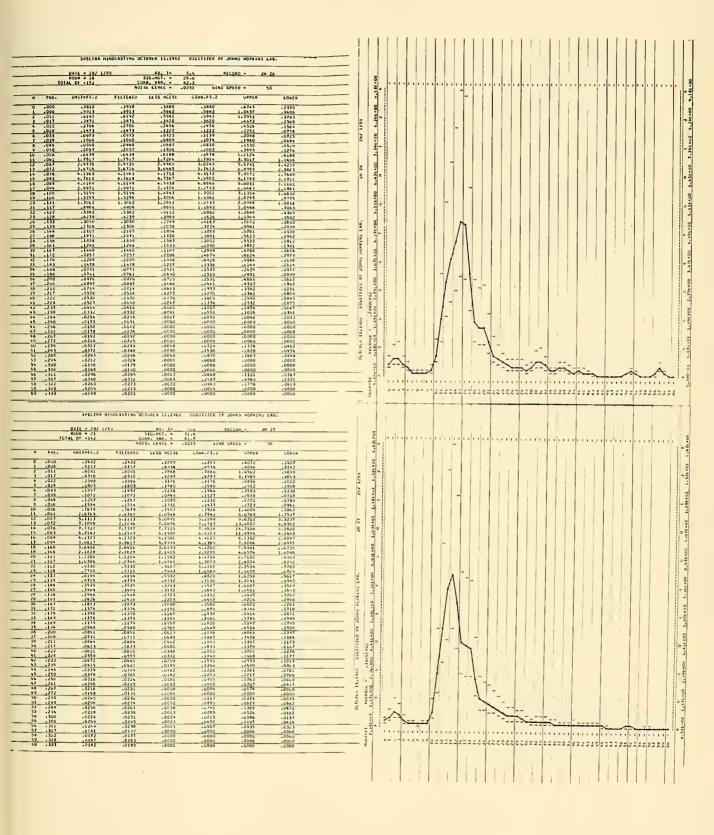




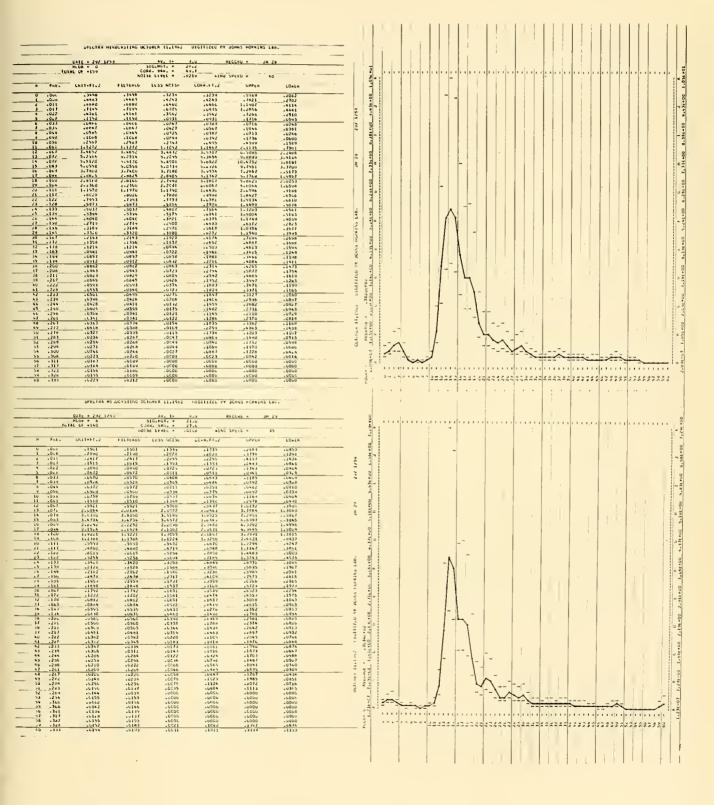




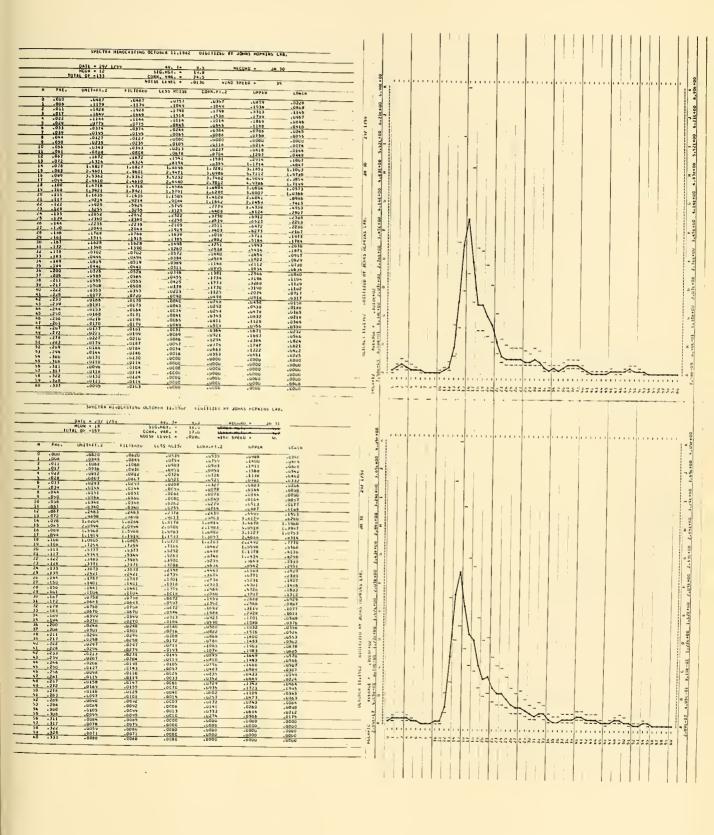




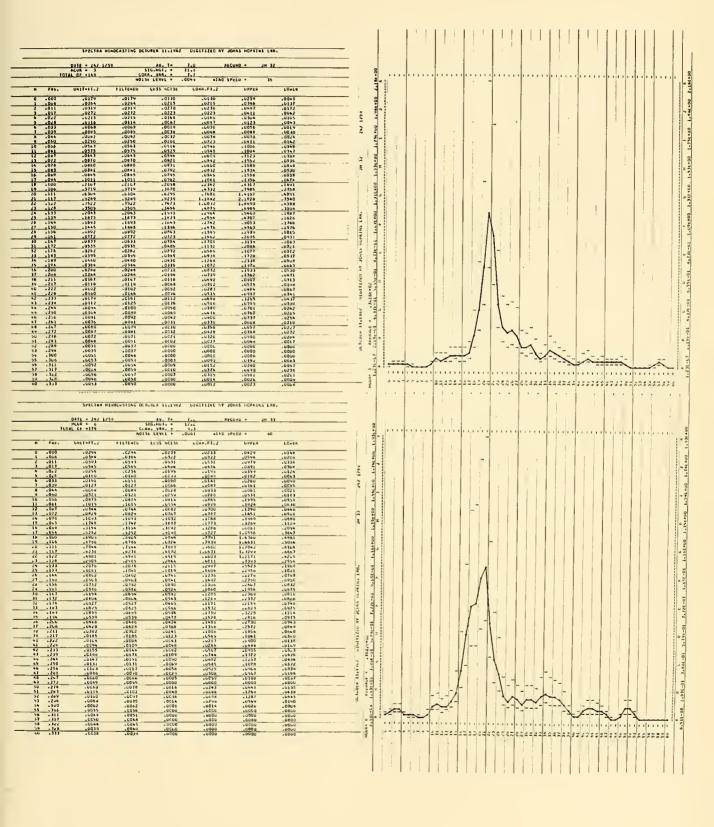




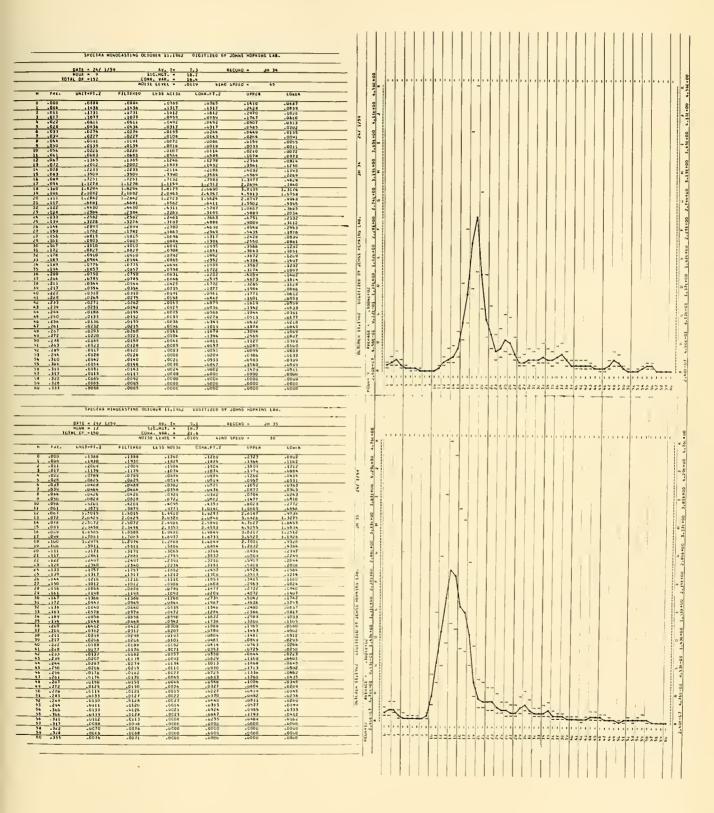




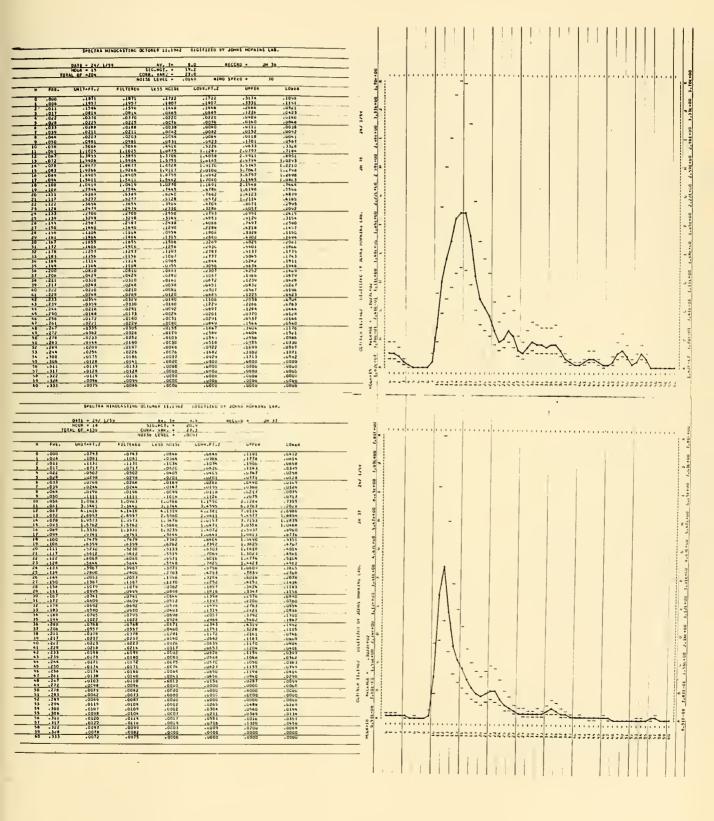


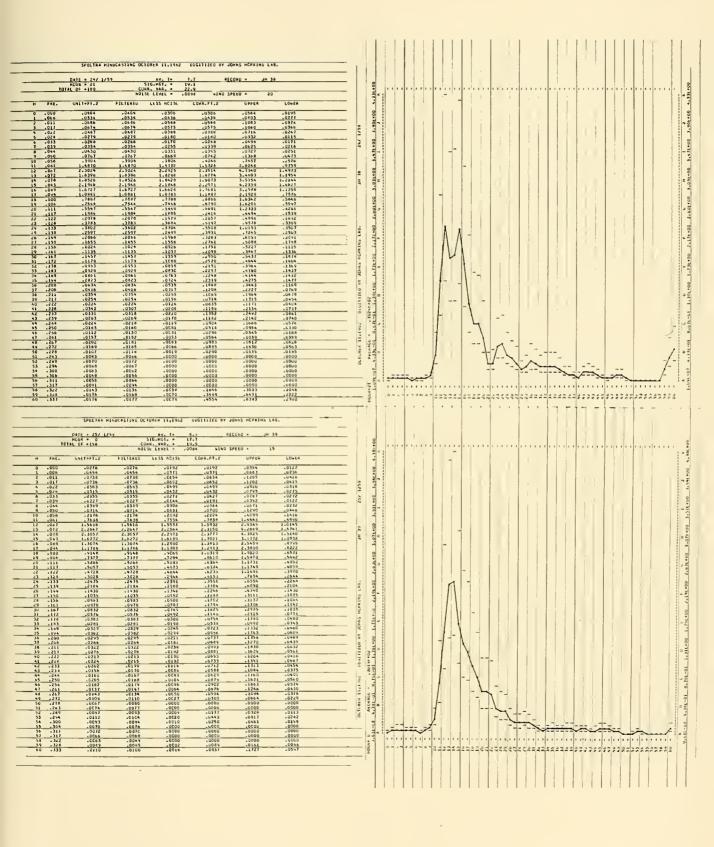




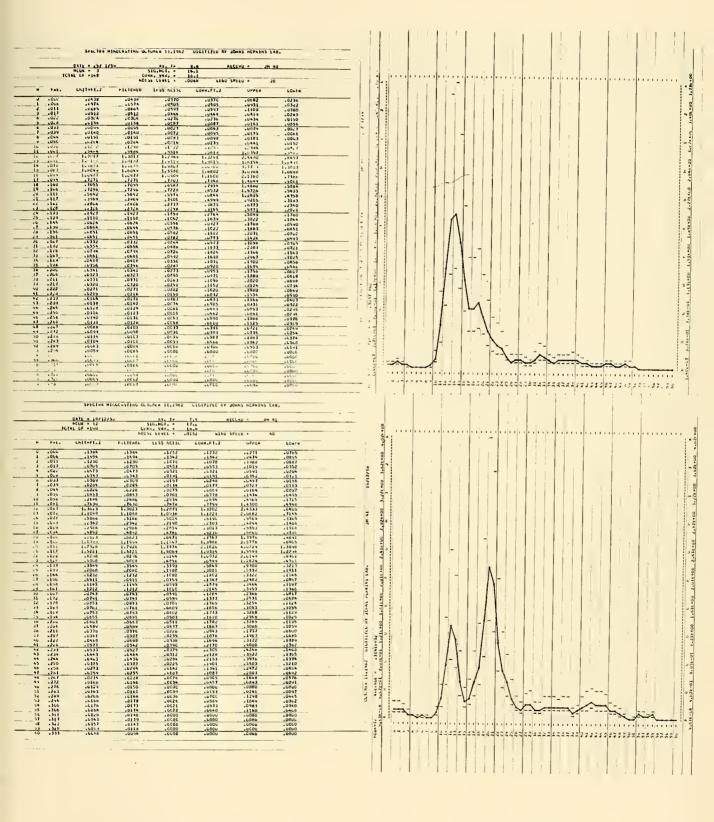


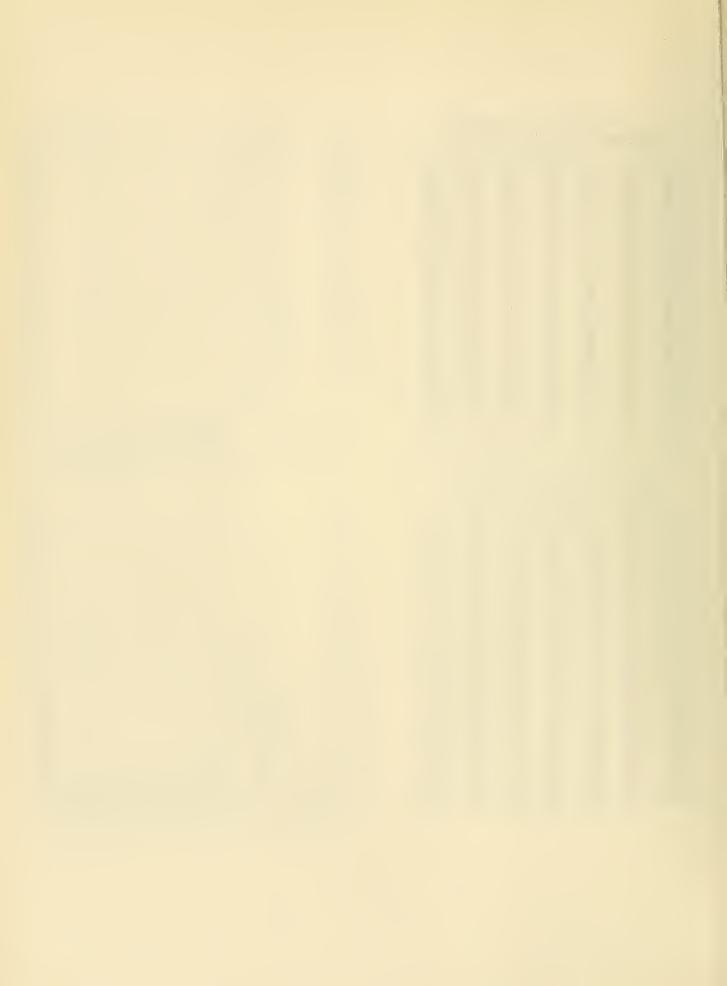


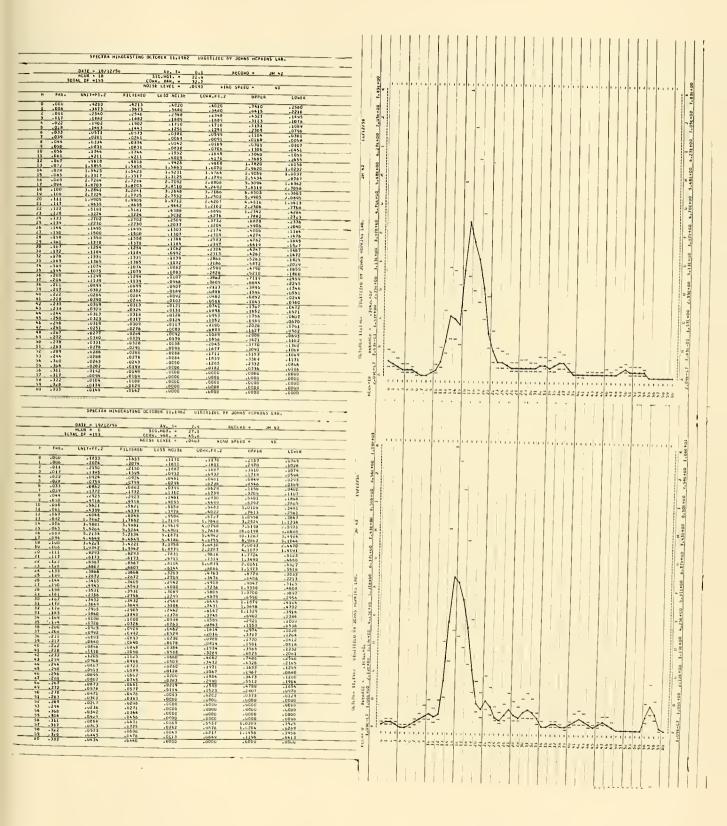




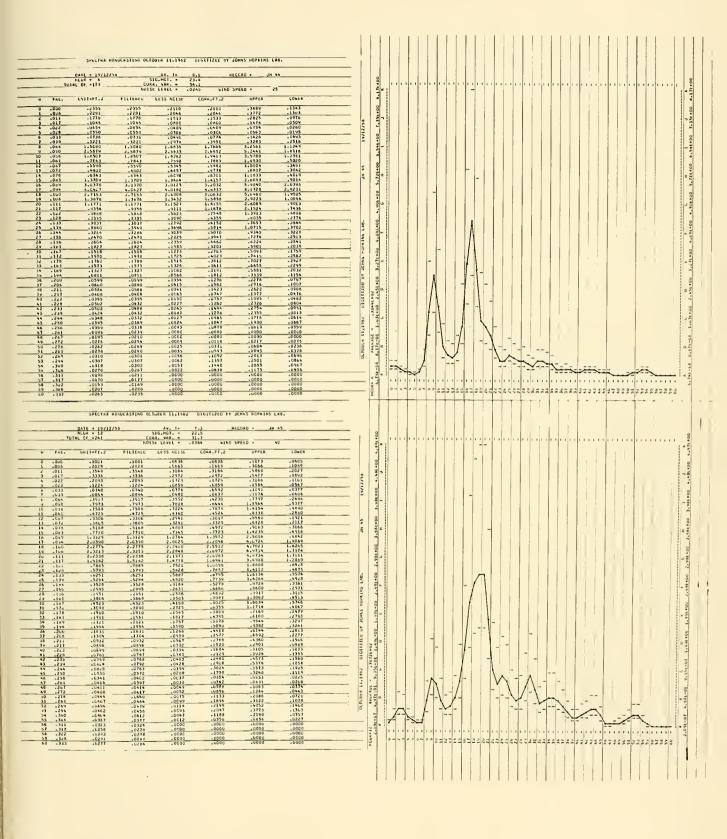


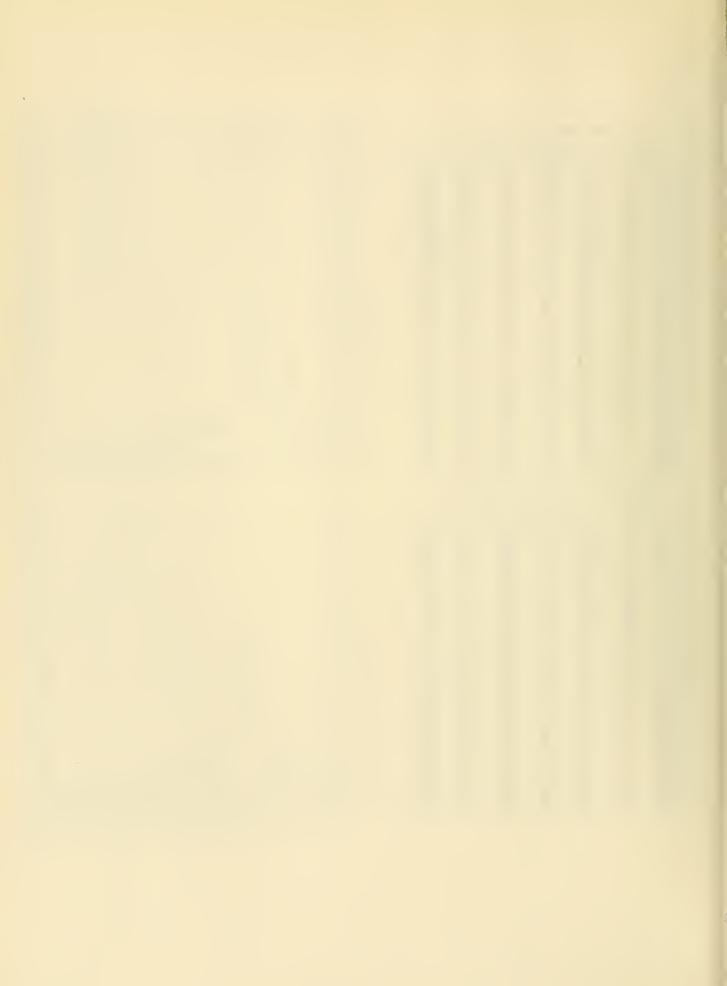


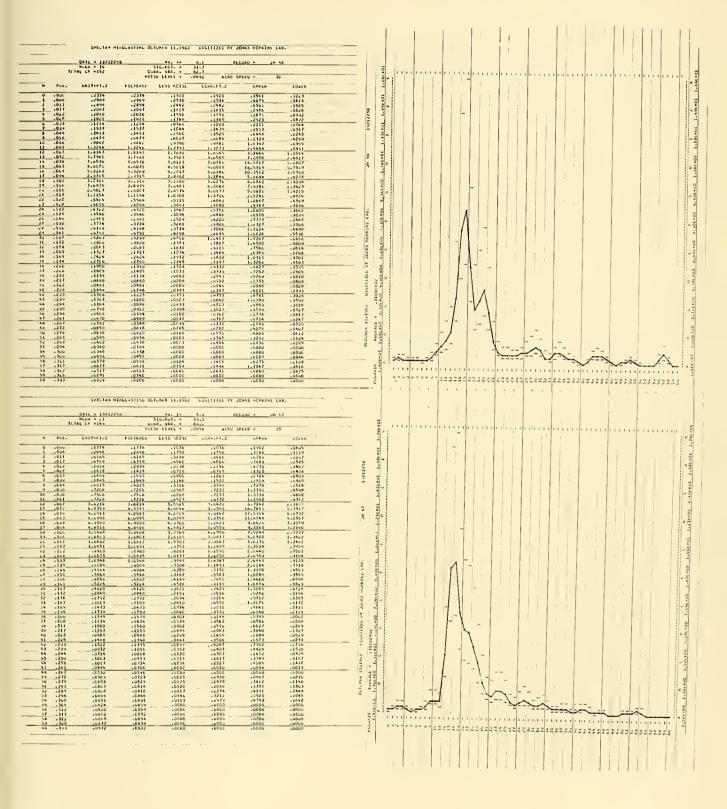








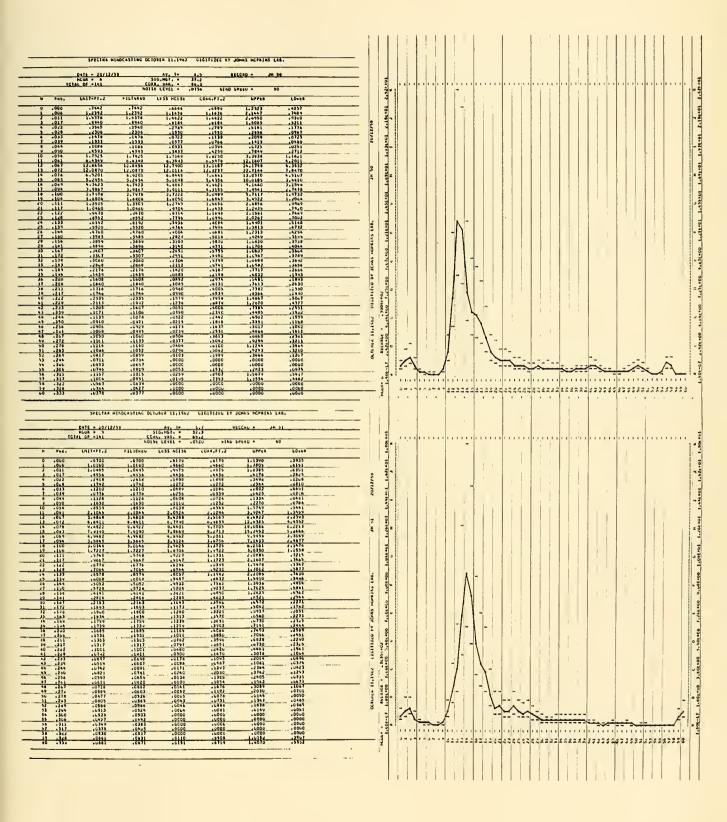




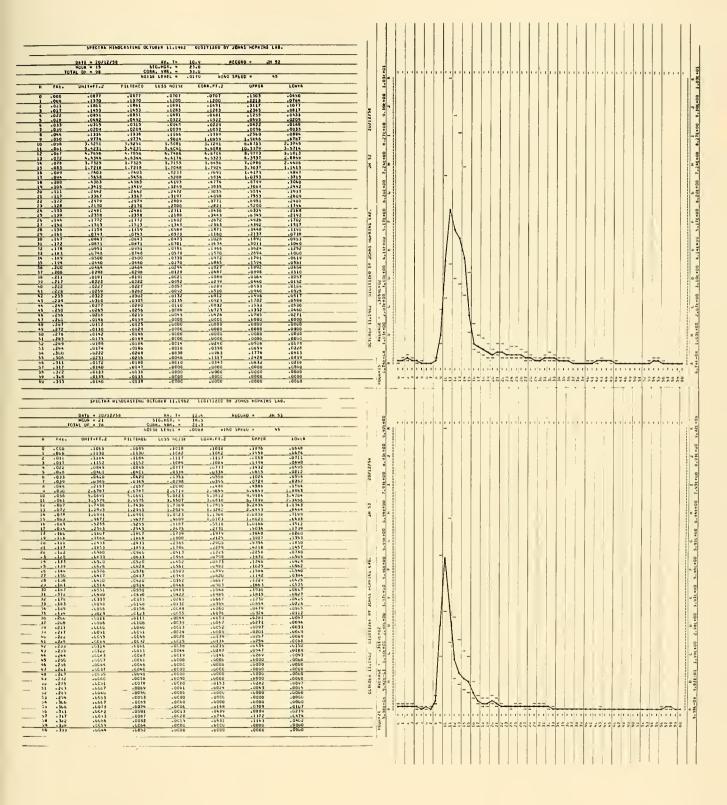


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|--|--|--|---|--|--|--|--|----------|-------|---|------------|-----------|--------|------|------|------|-----|---------|----------|-----|
| H FAL. | UN11=F1-2 | FILTERED | LESS ACISE | CONR.FT.2 | GPPER | LONER | | | | | - | 1 | 1 | | 1 | | | | | |
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| 4 1022 | .4862 | .4862 | | | 1,5784 .8099 | .5453 .2746 .2246 | 20112738 | | 11 | | | | | | | | | | | |
| \$.033 7 .039 | .1974 .1089 .1005 | .3433 .1974 .1069 .1005 | ,3465 ,1507 ,0621 ,0732 | ,3465 .4374 .4825 .4640 | ,4375 ,4375 ,1520 ,1160 | .2206 .1512 .0945 | | | | 1 | | | | | | | | | | |
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| 12 .067 | 9.1350 | 3.6344 9.1350 | 3.5676 9.0683 | 1.0061 3.7222 9.3219 | 6.8605 17.1816 | | - | | | | | | | | | | | | | |
| 15 .072 | 11.2840 7.3161 4.7115 3.4546 | 7,3101 4,7115 3,4546 | 11.2372 7.2693 4.6646 3.4078 | 11-5294 1-5237 4-4045 | 21.2504 13.8674 9.0398 6.6787 | 7,3412 4,7907 3,1229 4,3012 | - H4 48 | | | | | | | | | | | | | - |
| 17 -094 | 3-4546 2-2220 2-1111 | 2,2220 2,1111 | 3.4C18 2.1752 2.0643 | 3.4245 2,4002 2.3500 | 6.6787 4.4238 4.3314 | 1,5283 1,4964 | | | 11 | | - | | | | | | | | | |
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| 11 .172 12 .170 13 .183 | .2331 .1875 .1692 .1404 | .2331 .1675 .1692 | .1663 .1486 .1225 | .4346 .3543 .3329 | .6010 .6531 | .2747 .2256 .2120 .1756 | 3014 | | | | | | | | | | | | | |
| 16 200 | | .1404 .1660 | .0716 .1192 .1432 | .2761 .3818 .4999 | .6136 .5086 .7036 .9214 | .1756 .2431 .3163 | | | | 1 - | 41 | | | | | | | | | |
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| 39 .217 40 .222 41 .44 | .1344 .0956 .0763 | .1344 .0956 .0867 | .0877 .0458 .0339 | .4018 .2462 .1887 | .7406 :4537 :3478 | .2558 .15a8 .1201 | 0161812c0 | 1 | | 15 | | | | | | | | | | |
| 41 .2.6 42 .233 43 .237 | .0763 .0741 .0741 | .0807 .0746 .0740 .0737 | .0334 .0274 .0272 | .1087 .1713 .1857 | .3478 .3158 .3424 .3760 | .1201 .10v1 -1183 .12vv | _ 69 1 | 1 | | | - √ | - | | | | | | | | |
| 43 .237 44 .244 45 .250 46 .258 | -0636 | -0676 | 8050* | .1758 .1874 | .3240 | .1117 | 797 | | | | | - - | | | | | | | | |
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| 5 .046 6 .013 7 .019 8 .044 9 .050 11 .001 12 .007 13 .077 14 .078 15 .083 16 .009 17 .094 18 .106 14 .117 21 .117 22 .122 23 .146 | .2603 .3477 .4852 .6334 3.1740 7.0321 9,7766 8.4131 5.7323 3.5649 2.6376 2.0331 2.4354 1.6500 1.1271 1.1492 | .2603 .3497 .4652 .8334 3.1740 7.5321 9.7766 8.4131 5.7323 3.5829 2.6376 2.6976 2.6926 1.6500 1.1271 1.1492 9.9664 | . 1847 . 4241 . 4C96 . 7578 3.0984 7.5565 9.7010 8.3375 5.6567 2.5620 2.0175 2.3620 2.0175 2.3620 1.5754 1.5754 1.0736 8.6928 | | , 5380 1.4647 5, 9250 14.2875 18.1453 15.9051 10.90621 6.4737 5.2105 4.2332 5.1814 5.7770 3.7193 | ,2845 ,5124 6,1312 6,1312 6,1312 6,1316 5,446 3,7870 6,146 1 | Leg. 1.786c0 | | | λ. | - | | | | | | | | | |
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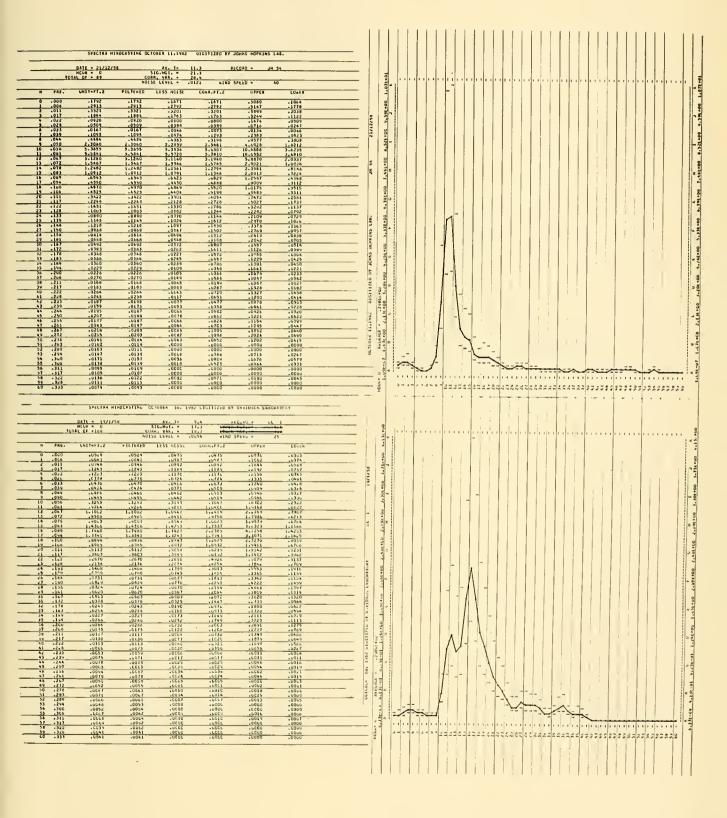




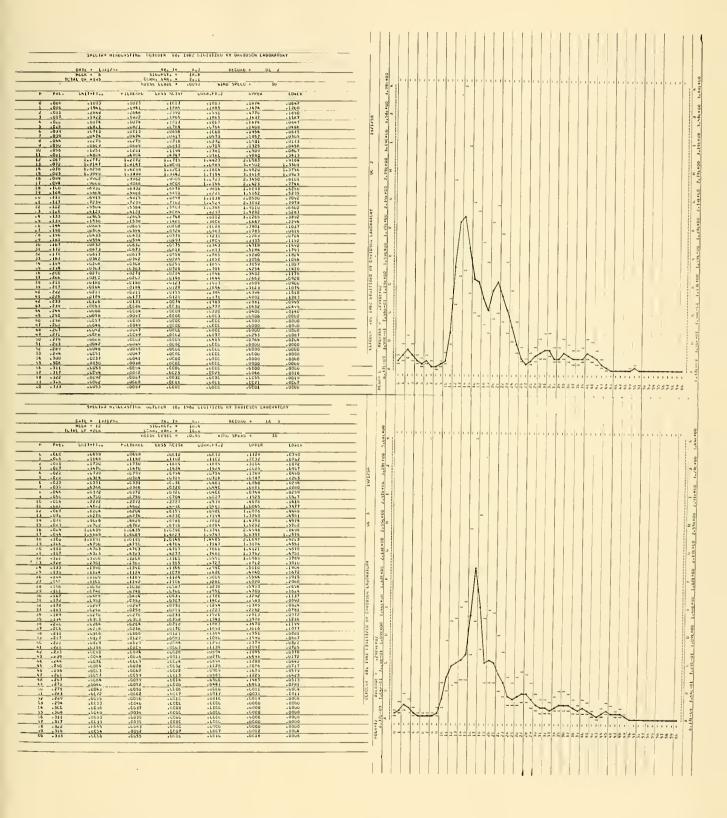




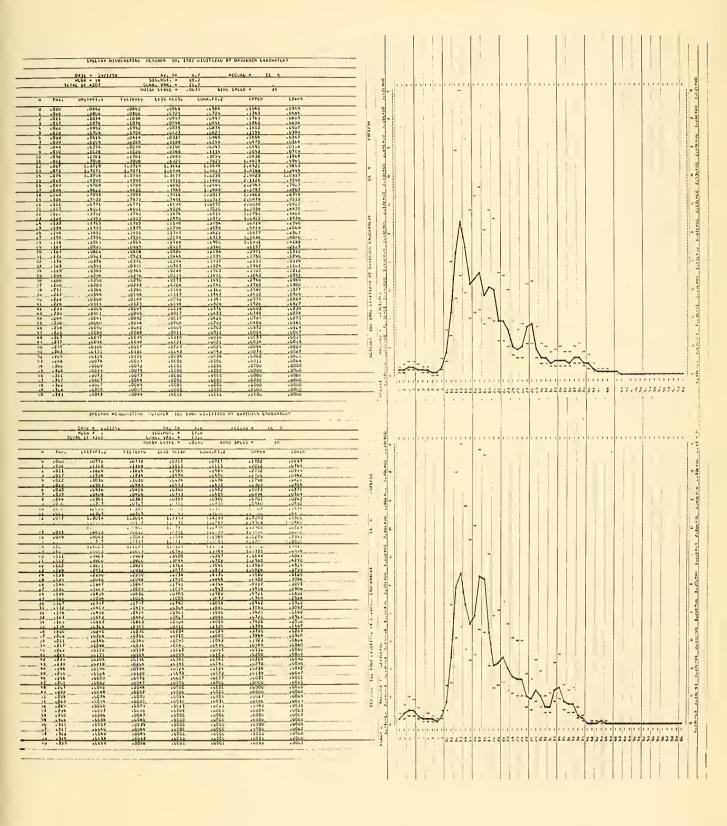




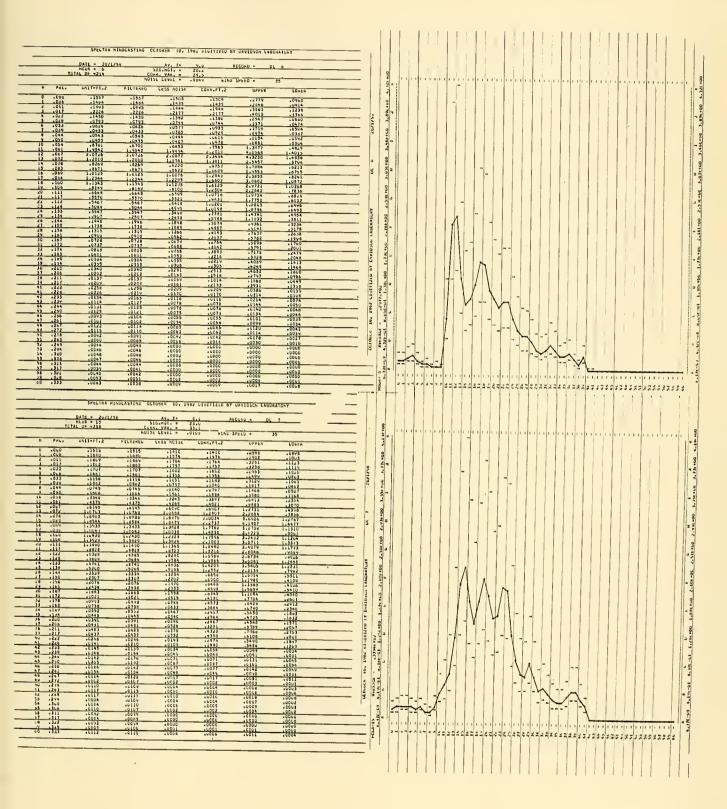


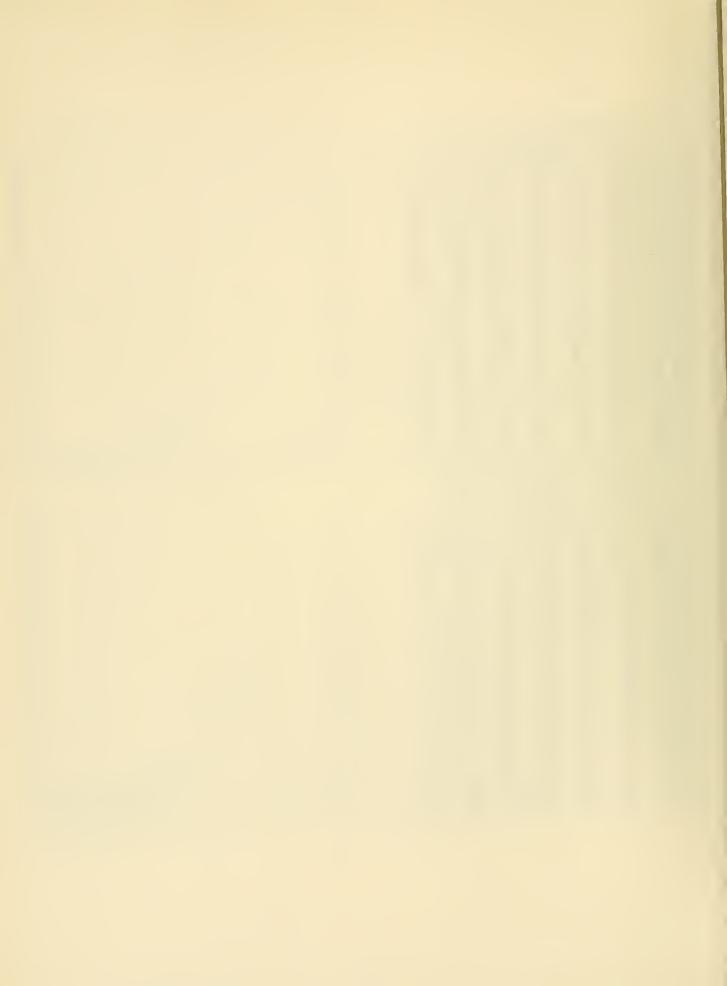


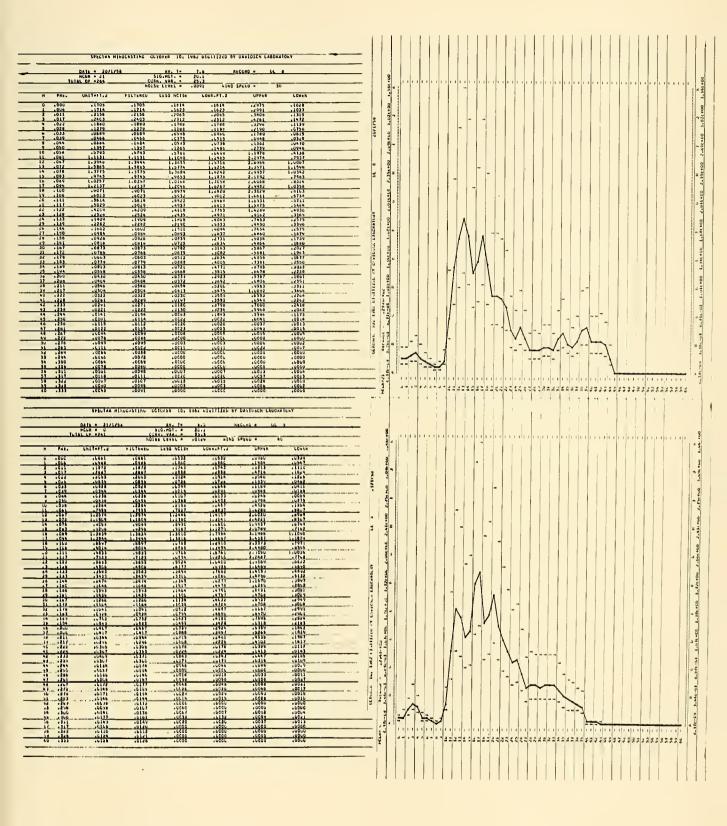




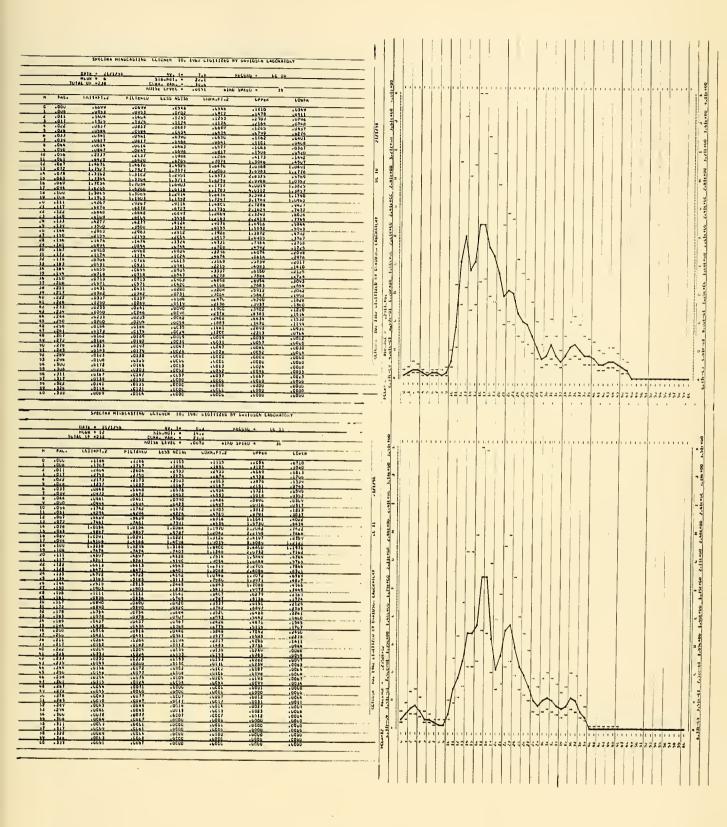




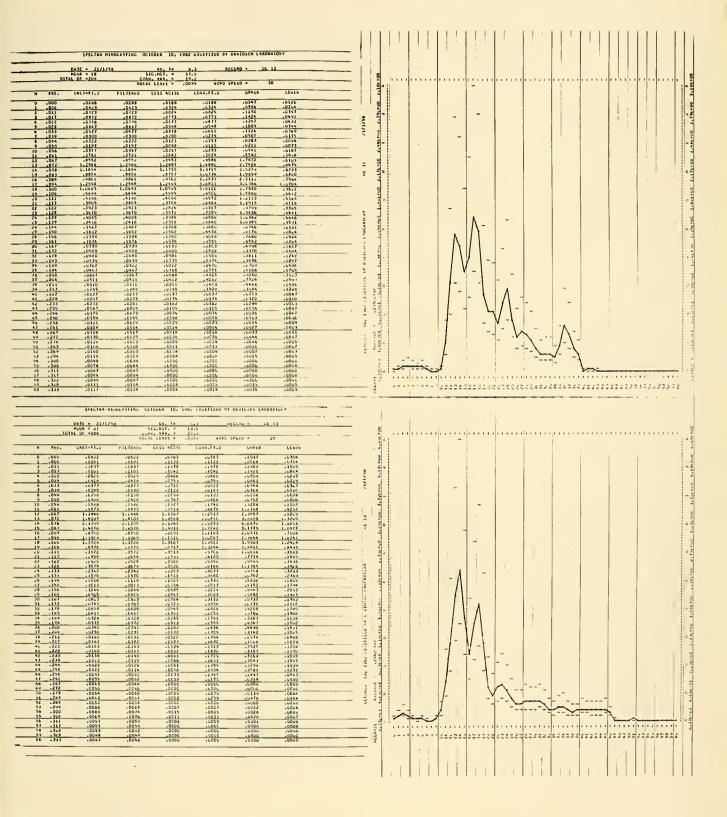




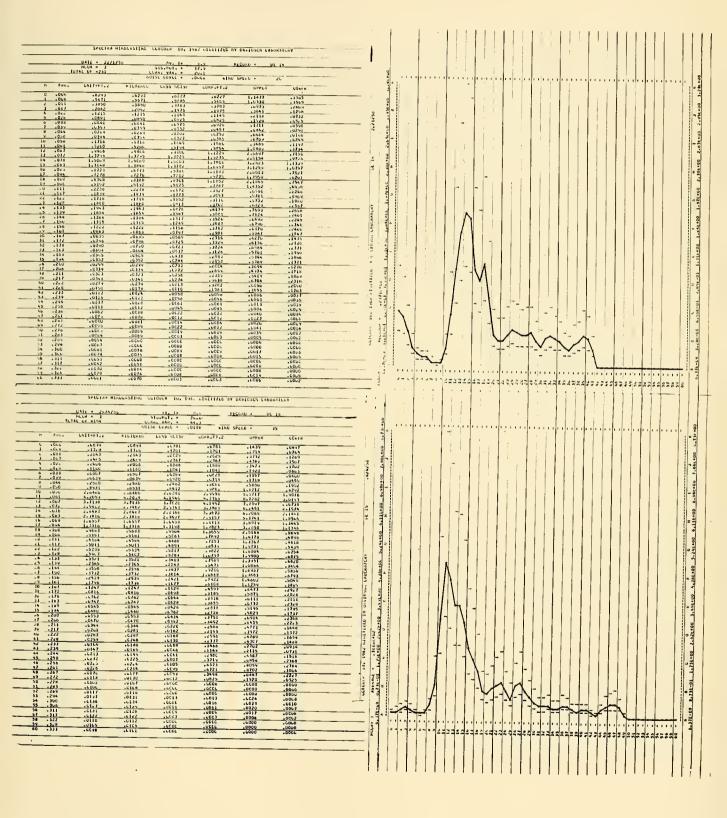




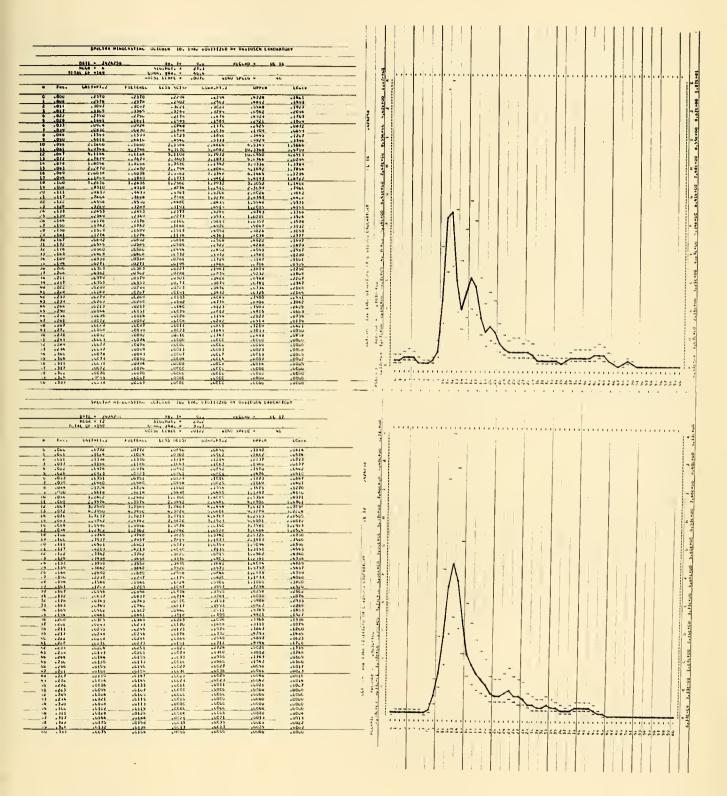








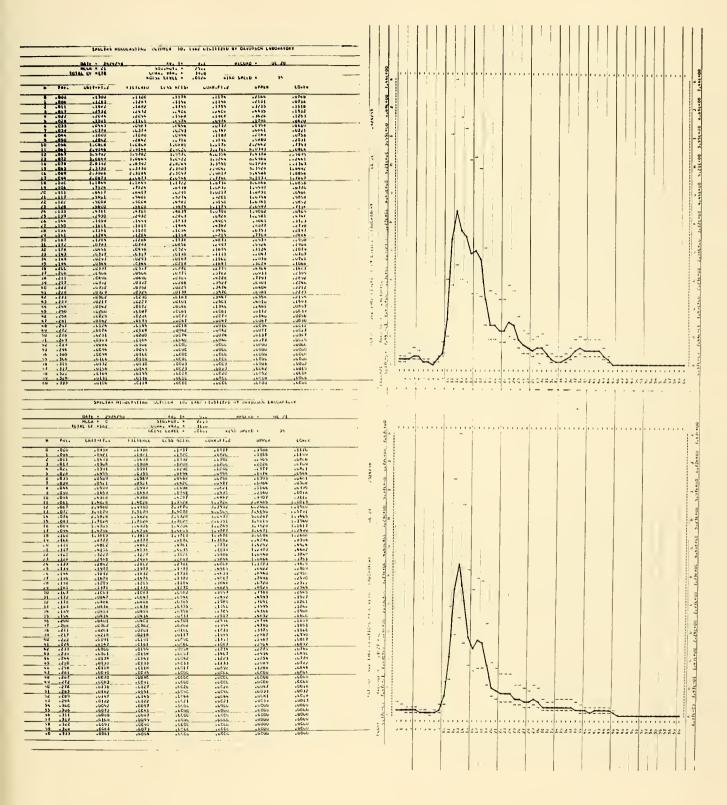


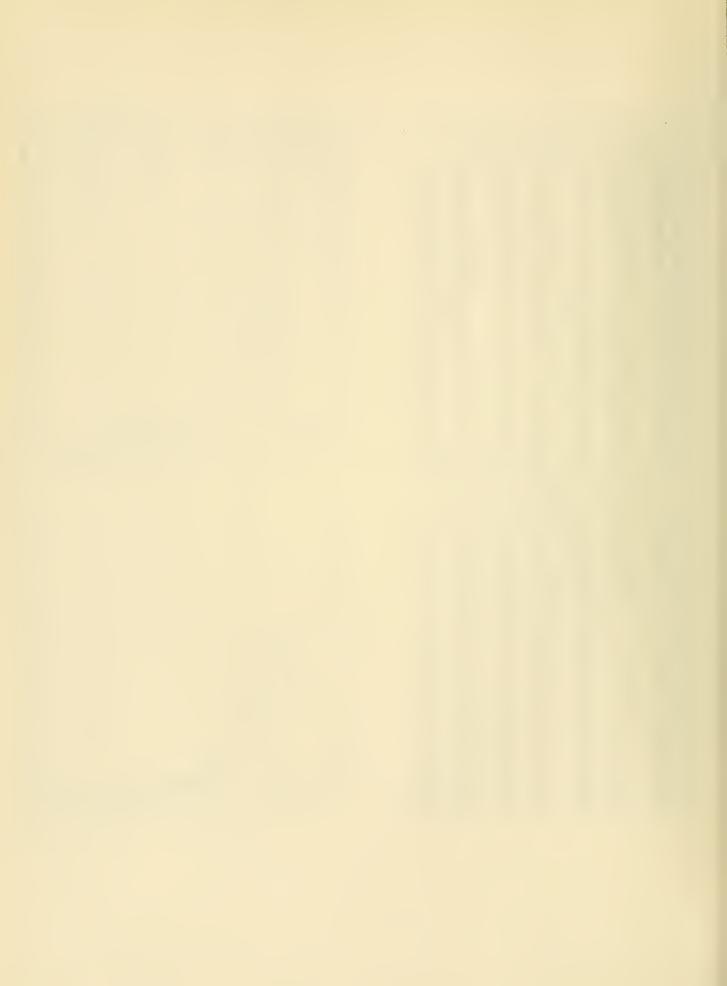




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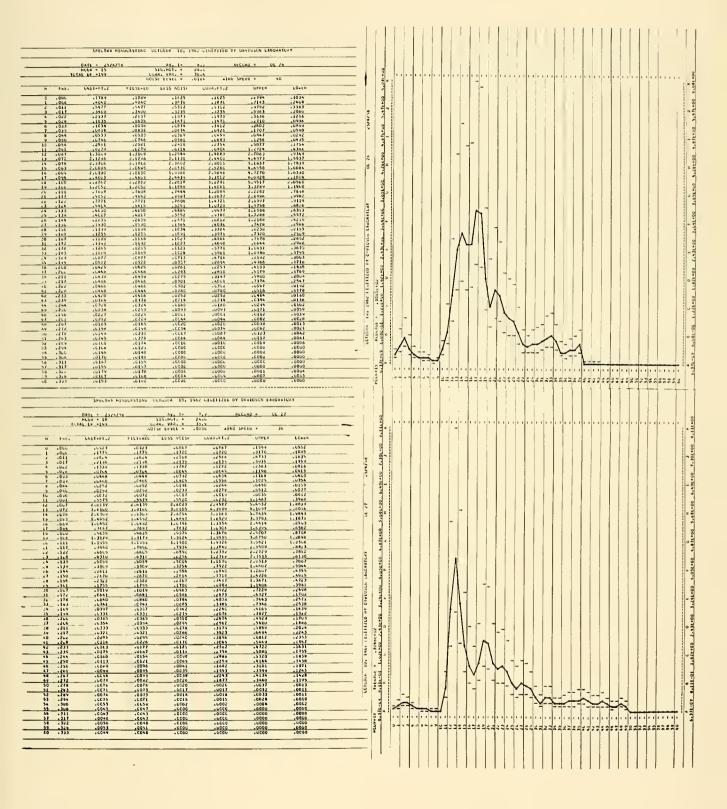


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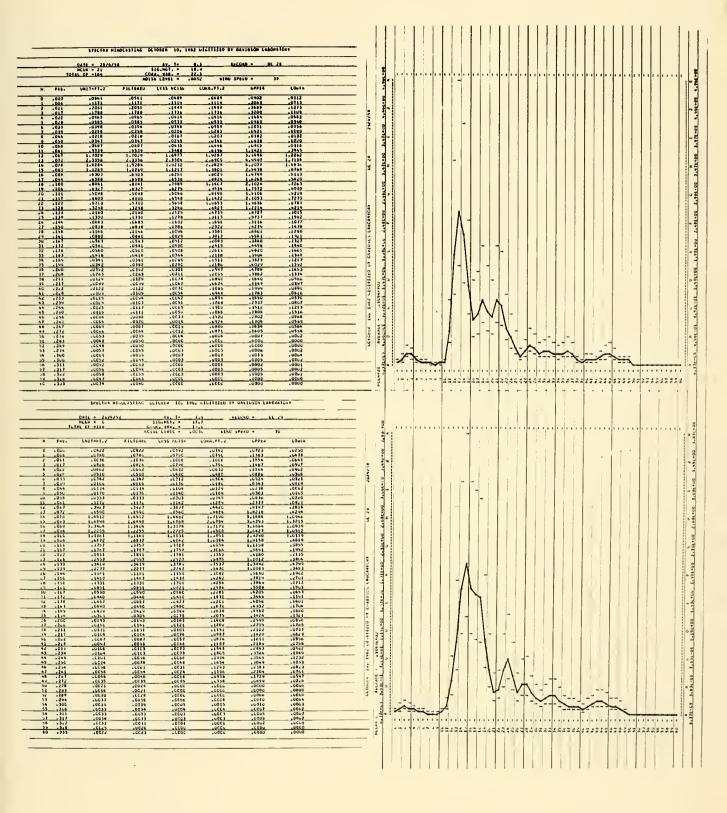


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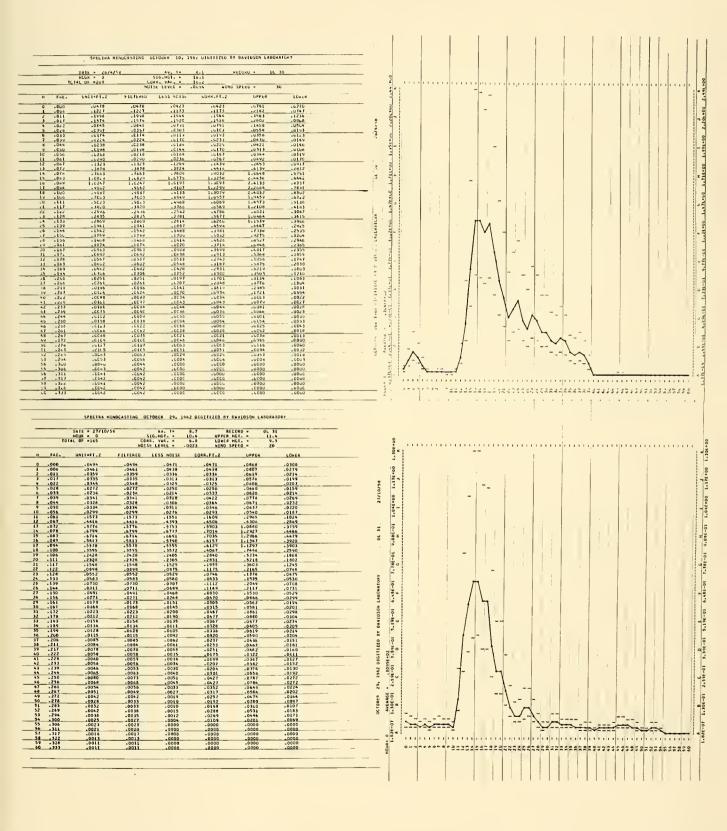














| M FRE. 0 .000 1 .008 2 .011 3 .017 4 .022 5 .028 8 .033 7 .034 9 .044 9 .050 10 .058 | DATE * 27/10/58 HOUM * 9 TOTAL OF *17.4 UNITI-F1.2 FISH 1227 1003 -0332 -0338 -0388 -0277 0278 0279 0279 0274 -0286 -0244 -0244 -0244 -0244 -0244 -0244 | 1287 .1289 1003 .0936 2932 .0844 2038 .0270 2037 .0262 2077 .0200 2077 .0200 2077 .0200 2077 .0200 2077 .0200 2077 .0200 2077 .0200 2078 .0100 2078 .0100 208 .0100 208 .0100 208 .0100 208 .0100 208 .0100 | 8-1 14-0 UPP 12-3 LOW -0058 WIN | BECORD - C | 00A1GAY D1 32 15.1 15.1 15.1 15.1 15.1 15.1 15.1 15. | 32 27/10/54 6:00 1.ele100 2.01/400 | - - | | | |
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| 14 .078 15 .003 16 .083 16 .083 17 .094 18 .100 18 .100 19 .101 20 .101 21 .117 22 .132 23 .128 24 .133 25 .139 26 .144 27 .150 28 .150 29 .150 30 .167 31 .172 32 .178 33 .183 33 .183 35 .183 36 .720 37 .206 36 .211 | 1.1381 1.1281 1. | 1348 1.1846 1.000 | 1.225) 1.1894 1.1052 1.1052 1.1052 1.1072 1. | 1,4902 2,2003 1,49573 1,49573 1,49573 1,49573 1,49573 1,4935 1 | | 10 1961 00+41*1 10-30*0 10-34*4 10-30*0 10-34*4 10-30*1 10-34*1 10-30*1 10-30*1 | \[\langle \] | - | 1 | |
| 39 .217 40 .222 41 .226 42 .233 43 .239 44 .224 46 .224 47 .226 48 .247 49 .227 50 .278 51 .283 52 .289 53 .794 53 .794 54 .307 57 .317 58 .322 59 .328 69 .333 | .0206 | 10181 -01182 2026 -0132 2026 -0132 2027 -0132 2028 -0132 2028 -0132 2028 -0132 2028 -0132 2028 -0132 2029 -002 | 0475 0415 0717 0746 0400 0101 0115 0117 0117 0117 0117 0107 0587 0459 | | | GCTORER 79, 1962 USCITIZED AVESTED 1, 2264-01 6-264-01 6 | | | | |
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| H FAE, 0 .000 1 .000 2 .011 3 .017 4 .027 5 .028 6 .033 7 .039 8 .044 9 .050 10 .055 11 .001 12 .067 13 .072 14 .028 16 .008 11 .001 17 .004 | 0ATE - 27/10/58 HGUB - 15 TAL 07 +180 | 11MG DETOBER 29, 11 | 7.9 11.5 10.9 11.5 10.9 10.9 10.9 10.9 10.9 10.9 10.9 10.9 | 87 DAVISON LAR RECORD - 0 68 HG1 - 0 58 HG1 - 0 10 SPED - 0 10 SP | 300A10RY 3h | | | | | |
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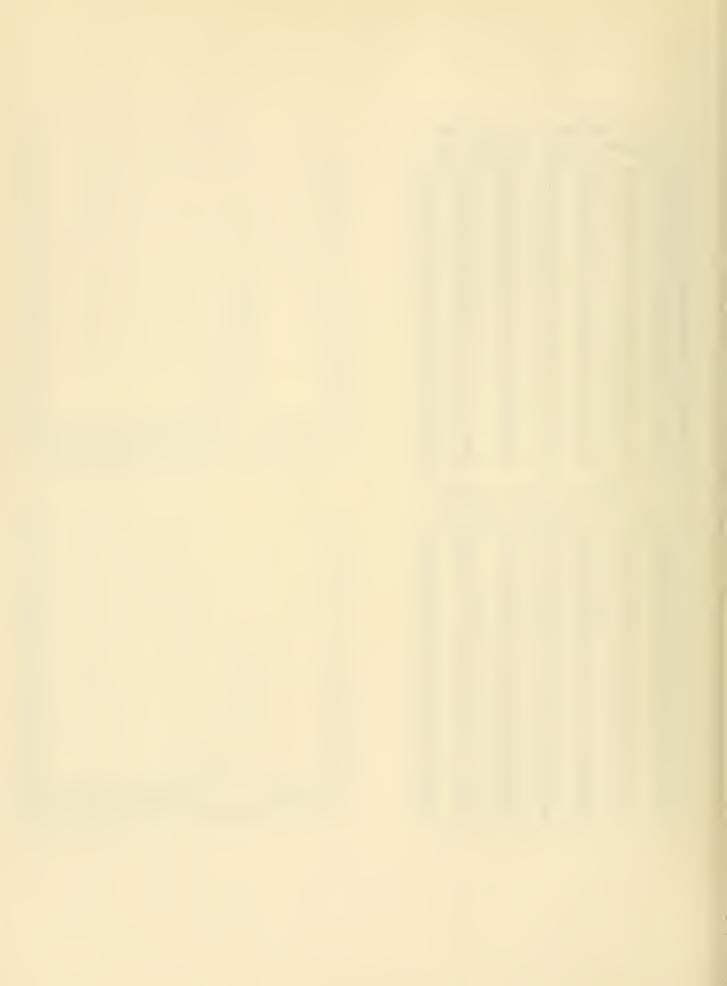
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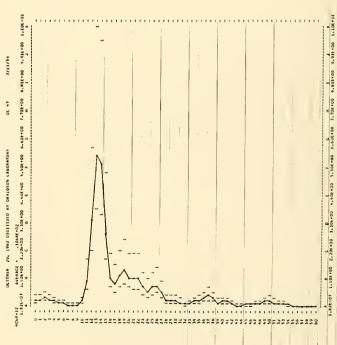
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| SPECIAR MINOCASTING OCTOBER 29, 1962 CIGITIZEO BY DAYLOSON LABORATORY CORR. **14.** 1.0 | |



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| 38 .211 .0500 .0510 .0515 .0514 .1372 .2524 .0814 .1578 .2 .0514 .1578 .2 .0514 .1578 .2 .0515 .0515 .0514 .1578 .2 .0515 .050 .1000 | 0 |
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| 38 | |
| | |
| SPECTAG MINDCOSTING OCTOBER 20, 1962 DIGITIZED BY DAVIDSON LABORATORY DATE • 30/10/58 AV. T. 9.4 RECORD • DL 41 | 8 |
| SPECTAG HINDCASTING OCTOBER 29, 1962 DIGITIZED BY DAVIDSON LABORATORY | 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - |
| SPECIAL MINOCASTING OCTORER 20, 1932 DIGITIZED BY OAVIDSON LEMORATORY DATE * 307/10/58 | 7 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 |
| SPECIAL MINOLASTING OCIOREA 29, 1942 DIGITIZEO AY OAVIDSON LENGRAFORY OATE * 107/10/58 | 2. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. |
| SPECIAL MINOLASTING OCIOREA 29, 1942 DIGITIZEO 27 OAVIDSON LENGRAFORY | 100 100 11 11 100 11 11 11 11 11 11 11 1 |
| SPECIAL MINOCASTING OCTOREA 20, 100, 20 CITILEO AT OAVIDSON LABORATORY | No. 44 No. 64 No. 64 |
| SPECIAL MINOCASTING OCTOREA 20, 104, 0 10, 1150 AT 04VIDSON LABORATORY | 100 3157600 10 41 30710/10 1728100 31281 |
| SPECIAL MINOCASTING OCTOREA 20, 100, 20 CONTROL CONT | 2.62800 3.138100 3.138100 4.13810.0 4.13810.0 3.2381 |
| SPECIAL MINOCASTING OCTOREA 20, 10%, DIGITIZED AT OAVIDSON LABORATORY | 2004/05/00 Lasceador 10. 14 100 12/2/2/100 12/2/100 12/2/100 12/2/100 12/2/2/100 12/2/2/100 12/2/2/2/2 |
| SPECIAL MINOCASTING OCTOREA 20, 104, 0 10, 110, 0 10, 110, 0 10, 110, 1 | 1. 2016/12/0 0 1/1/1/10 0 1/1/1 |
| SPECIAL MINDESTING OCTOBER 29, 1942 DIGITIZED AT OAVIDSON LANGRAFORY DATE 30/10/58 | 1. 2016/12/0 0 1/1/1/10 0 1/1/1 |
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| SPECINA MINOCASILING OCTOBER 29, 1002 DISTILEGO BY DAYLOSON, LARCANJONY | OCTUBER 24, 1942 DIGITATO NY GARDON L'HORNIGHT THE COLUMN CONTROL THE COLUMN CO |
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| Detail D | MATCHES 29, 1992 DIGITIZED BY GAVIDSON LANGENINGY OL VICTOR AVAILABLE DESCRIPTION AVAILA |



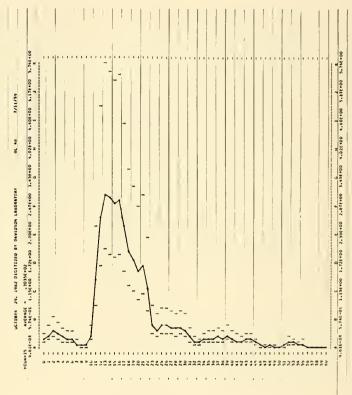
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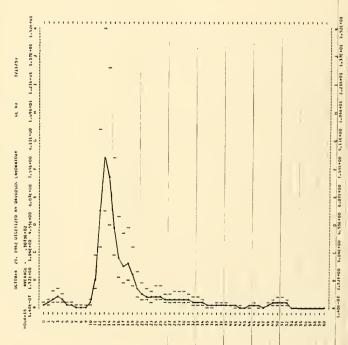


| | | DATE . 7/11/ | 10 | 4v. 7• | 8.9 | RECORD . | OL 48 |
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| | | HQUA - 15 | | SIG. HGT. | 23.7 UPP | ER HGT | 25.0 |
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| | | | NOI | SE LEVEL . | -0174 bin | O SPEEO . | . 40 |
| н. | FRE. | UHITOFT.Z | FILTERED | LESS HOISE | CONN.FT.2 | UPPER | LOWER |
| 0 | .000 | .1628 | . 1628 | . 1459 | -1959 | .2879 | .0926 |
| 1 | 4006 | .2563 | .2563 | .2389 | -2389 | -4404 | . 1521 |
| 2 | .011 | .3613 | .3613 | . 3439 | .3439 | .6339 | .2190 |
| - 3 | .017 | - 3086 - 2221 | .3088 | -2913 | -2913 | .5368 | .1855 |
| | .028 | -1910 | -1910 | -2047 | .1738 | .3774 | .1304 |
| | .033 | .1432 | -1432 | .1258 | -1982 | .3853 | -1262 |
| 7 | .039 | .0771 | -0771 | .059a | .0793 | -1462 | -0505 |
| | -044 | .0548 | -0548 | .0374 | .0445 | .0821 | .0284 |
| 10 | .050 | .0542 .2389 | .0542 .2389 | .036B | .0409 | .0754 | -0280 |
| 11 | .0el | 1.3204 | 1.3204 | 1.3030 | 1,3519 | 2.4918 | .0408 |
| 12_ | -067 | 6804.5 | 2-6086 | 2.5912 | 2.6570 _ | 4.8987 | 1,6923 |
| 13 | -012 | 3.0549 | 3.0549 | 3.0375 | 3.1165 | 5.7441 | 1.9844 |
| .14 | .078 | 2.9359 | 2.9359 | 2.9185 | 3.0206 | 5.5675 | 1.9234 |
| 15 | .083 | 2.8041 | 2.8041 | 2.7857 | 2.9299 2.982T | 5.4003 5.4976 | 1.8556 |
| 17 | .094 | 2-2553 | 2.2553 | 2+2319 | 2,4693 | 4.5513 | 1,5723 |
| 18 | .100 | 1.7379 | 1.7319 | 1.7205 | 1.9586 | 3.6100 | 1.2471 |
| 19 | -105 | 1.5181 | 1.5181 | 1.5007 | 1.7716 | 3.2653 | 1.1280 |
| 20 | *111 | 1.2804 | 1.2804 | 1.2610 | 1.5510 | 2.8581 | 9876 |
| 22 | -122 | . 4132 | 1 - 32 03 - 91 32 | 1.3029 | 1.8899 | 3.0778 | 1.0633 |
| 23 | +128 | ,3508 | -35QB | 13335 | 14703 | .8669 | . 2995 |
| 24 | -133 | -2816 | .2616 | .2442 | . 36 32 | .6695 | .2313 |
| 25 | -139 | - 2996 | *5996 | .2822 | .4440 | .0184 | .2827 |
| 25 | -144 | -2800 -2479 | -2800 -2479 | -2627 -2305 | -4382 | .8077 | |
| 28 | .156 | .2196 | .2196 | -2022 | .3825 | .7050 | .2436 |
| 5.6 | .161 | .2197 | .2197 | -2023 | .4093 | .7543 | .2608 |
| 30 | -167 | +1882 | .1882 | -1708 | .3706 | .6832 | .2360 |
| 31 32 | -172 | .1091 .0616 | *1091 *160* | .0917 | -2139 | .3943 | -1362 |
| 33 | .105 | -0532 | .0518 | .0359 | -1114 | .2053 .1796 | -07D9 -0621 |
| 34 | .189 | .0725 | .0725 | -0551 | 11624 | 12993 | .1034 |
| 35 | .194 | .0749 | -6749 | + 0575 | .1841 | .3394 | .1172 |
| 36 | -200 | .0729 | .0729 | .0955 | .1937 | .3569 | .1233 |
| 37 | .204 | .0731 | .073L | .0557 | -2123 -1947 | .3912 | -1352 -1240 |
| 19 | .217 | .0690 | -0690 | .0516 | -2366 | .4360 | 1506 |
| 40 | .222 | .0564 | .0564 | .0390 | -1965 | 13621 | .1251 |
| +1 | .228 | .0376 | .0429 | .0255 | -1418 | .2613 | -0903 |
| 42 | -233 | -0408 -0426 | .0400 | .0226 | -1391 -1597 | .2564 | .0886 |
| 44 | .239 | .0428 .0382 | .0372 | .0234 | -1597 | .2943 .2776 | .1017 |
| 45 | -250 | -0300 | .0300 | .0126 | .1066 | ,1989 | .0680 |
| 46 | .25b | .0192 | .0220 | .0048 | .0435 | -0802 | .0277 |
| 47 | -261 | 10141 | -0146 | .0022 | .0236 | .0434 | .0150 |
| 48 | -267 | - 0233 | .0211 | -0037 -0012 | .0439 .D159 | .0808 | -0279 |
| 50 | -278 | +0130 | -0157 | .0000 | .0159 | .0293 | .0101 |
| 51 | -283 | .0204 | .0192 | .0016 | .0310 | -0571 | .0197 |
| 52 | .289 | .0253 | .0231 | -0057 | -1105 | .2037 | .0704 |
| 53 | -294 | -0202 | -0214 | -0000 | .0880 | +1638 | .0566 |
| 55 | .300 | -0199 | -0200 | .0027 | .0825 | .1220 | .0424 |
| 58 | .311 | .0170 | -0173 | .0000 | -0000 | .0000 | .0000 |
| 51 | -317 | .0124 | -0135 | .0000 | .0000 | .0000 | .0000 |
| 5.8 | .322 | .0118 | 0122 | .0000 | -0000 | 0000 | -0000 |

| SPECTRA HINGCAST | ING DETOBER | 29, 14 | 2 DIGITIZED | въ | 0AV1050N | LAGORATORY |
|------------------|-------------|--------|-------------|----|----------|------------|
|------------------|-------------|--------|-------------|----|----------|------------|

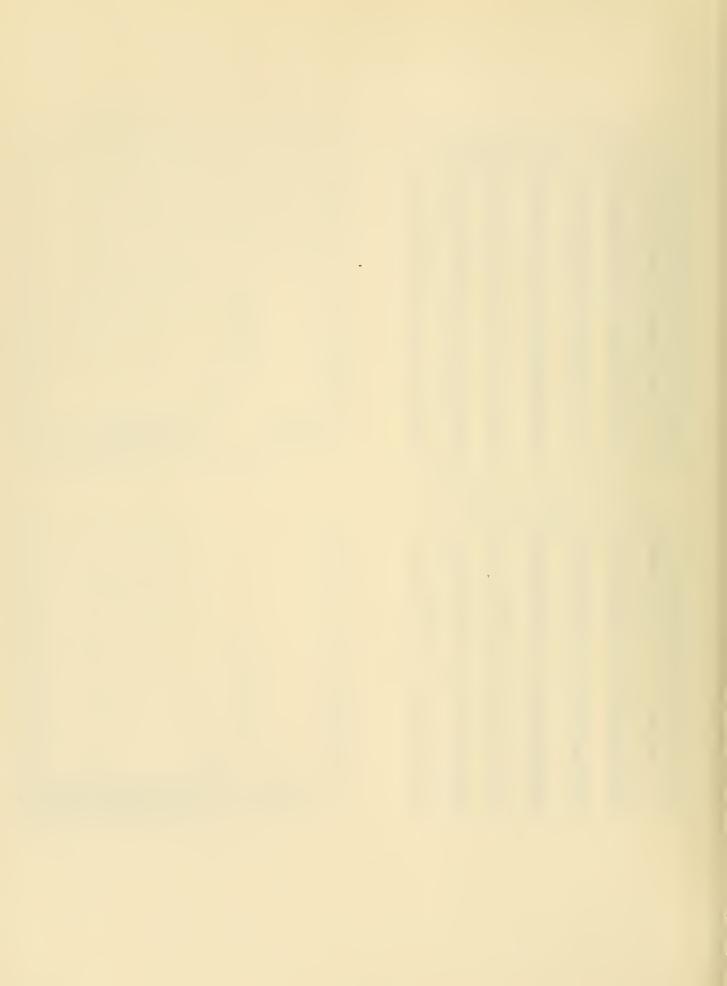
| | | OATE = 7/11/59 HCUR = 18 | | 51G.HGT | 9-3 26-1 UPP 49-2 LOW -0264 NIN | R HGT | 31.1 |
|-----|--------------|--|--|----------------------------|---|---|--------|
| | 10 | TAL OF +123 | cc | ORR. VAR | 49.2 LOW | R HGT. « | 25.3 |
| | | | NO | SE LEVEL . | -0264 NIN | SPEE0 - | 35 |
| н | FRE. | | | | | | |
| 0 | .000 | -1873 | -1873 | -1589 -2520 | .1589 | -2928 | -1012 |
| 1 | .006 | .2804 | .2804 | .2520 | .2520 | .4645 | +1605 |
| 2 | .011 | -5192 | .5192 | -4908 | .2520 .4908 | 1.0930 | .3125 |
| 3 | .017 | -6214 | .6214 | -5930 | .5430 | 1.0930 | |
| 4 | +022 | -4136 | .4136 | .3852 | .6920 .9908 .9930 .1952 .1969 .0867 .0443 .9018 .2167 5.2801 8.2316 7.0829 4.4613 | .7899 | +2453 |
| 5 | .028 | ·2253 | .2253 .1539 .0787 .0656 .0841 .2511 | -1969 | .1969 | .3630 | .1254 |
| 6 | .033 | -1539 | .1539 | -1255 | -1978 | .3646 | .1259 |
| 7 8 | .039 | .0787 | .0787 | .0503 | -0667 | -1230 | .0425 |
| 9 | . 050 | -0656 -0841 | -0656 | .0372 | +0443 | .0817 | .0282 |
| 10 | 1956 | | .0841 | ,0557 | .0618 | -1134 | .0394 |
| 11 | | 12311 | -2511 | 1333. | -2167 | **363 | .1507 |
| | .067 | 6 1643 | 5 1547 | 1.3082 | 1.3047 | 2.8841 | 3.3493 |
| 13 | .072 | 8 0575 | 6 0573 | 0.1203 | 9 7374 | 16 1833 | 5.2452 |
| 14 | .076 | A-8717 | 4-8717 | 6.4633 | 7 0828 | 13.0568 | 4.5099 |
| 15 | .083 | 6.2771 | 4-2773 | 6.2689 | 6.6673 | 8.2338 | 2.8445 |
| 10 | | 1.5360 5.1567 8.0573 6.8717 4.2773 2.5967 | 2.5987 | 2.5703 | 2.7110 | .4363 2.8841 9.6951 15.1832 13.0548 8.2338 5.0373 | 1.2402 |
| 17 | .D94 | 2,0760 2,1618 1,5873 -8901 -6324 -4730 | 2.9780 | 2.0496 | 2.7330 2.2615 2.4287 1.6403 1.0581 .7741 .5968 | 4.1683 | 1.4400 |
| 18 | .100 | 2.1618 | 2.1616 | 2.0496 | 2.4287 | 4.4764 | 1.5464 |
| 19 | -106 | 1.5873 | 1.5871 | 1.5589 .8617 .8040 | 1.0403 | 3.3926 | 1.1718 |
| | -111 | -890L | .8901 | .8617 | 1.0581 | 1-9503 | .6737 |
| 21 | .117 | -6324 | .6324 | .8040 | .7741 | 1.4264 | |
| 2.2 | -122 | .4730 | .4730 | .3793 | .5968 | 1.0999 | |
| 23 | | | | | .5350 | .9862 | |
| 24 | .133 | .4694 | .4594 | -4410 | +6558 | 1.2088 | .4176 |
| 25 | -139 | .4273 | .4273 | .3989 | -6274 | 1.1565 | . 1995 |
| 26 | -144 | .2886 | .2886 | - 2602 | .4341 .4251 .5027 .4758 | .8000 | .2764 |
| 28 | -150 -156 | .2681 | .2681 | .2397 | -4251 | .7636 | .2707 |
| 20 | +130 | .2941 | - 2941 | . 2057 | -5027 | -8769 | . 3029 |
| 26 | -101 | .2592 | .2592 | -2308 | -5010 | .9234 | . 3029 |
| 31 | +172 | .222b | -2228 | .1942 | -4528 | . # 346 | -2863 |
| | -176 | .1688 | .1688 | 11404 | | | . 2730 |
| 33 | -185 | .1588 .1582 1145 .0641 | .1562 | .1278 | 34.73 | +8402 | |
| 34 | .189 | -1145 | -1145 | - 1278 - 0861 - 0357 | .3473 .2539 | .4680 | -1517 |
| | | -0641 | -0541 | .0357 | -1143 | -2107 | .0726 |
| 36 | | | -0545 | | | -1678 | .0560 |
| 37 | -206 | *D649 | .0849 | .0365 | 1141 | .2563 | .UBes |
| 38 | -211 | .0669 | .0689 | -0385 | .1504 | .2957 | -1021 |
| | .217 | .0578 | .0578 | . DZ 94 | -1348 | .2484 | .0858 |
| 40 | .222 | +D529 +D498 | .0529 | .0245 | - 1234 | 2274 | .0766 |
| 71 | -233 | 10376 | -0481 | .0113 | -1094 | -1280 | .064E |
| 44 | .239 | -0288 | .0336 | .0052 | .0356 | -1280 -0856 | .0221 |
| 7, | -244 | .0411 | .03vz | .0108 | 40518 | -1508 | .0541 |
| 45 | .250 | 10513 | +0457 | .0173 | 1461 | .2892 | .0930 |
| 46 | .25b | -0362 | .0389 | .0105 | .0994 | -1632 | .0633 |
| 42 | 1201 | .0262 | -0319 | . 0035 | .0375 | 1980. | .0239 |
| 48 | -267 | .0467 | +0391 | .0107 | . 1273 | -2346 | *081 |
| 49 | | -0520 | -0468 | -0204 | - 2722 | -5017 | .1753 |
| 20 | | . 6564 | +0502 | .0218 | -3296 | .4075 | .2099 |
| 51 | | .0509 | -0481 | -0197 | .3363 | -6197 | -2142 |
| 52 | | .0411 | +0403 | -0119 | -2100 | .4240 | .1465 |
| 53 | | .0250 | -0280 | .0000 | .0000 | .0000 | .0000 |
| 55 | .300 | .6191 | .0209 | .0000 | 40000 | -0000 | +0000 |
| 55 | -306 | .0200 | -0206 | .0000 | .0000 | .0000 | .0000 |
| 57 | -311 | .0238 .0274 | -0235 | -0000 | .0000 | -0000 | 0000 |
| | | .0289 | | | .0000 | | |
| | | | | | | | |
| 58 | -322 | .0249 | -0276 -0254 | -0000 | .0000 | - 0000 | 0000 |





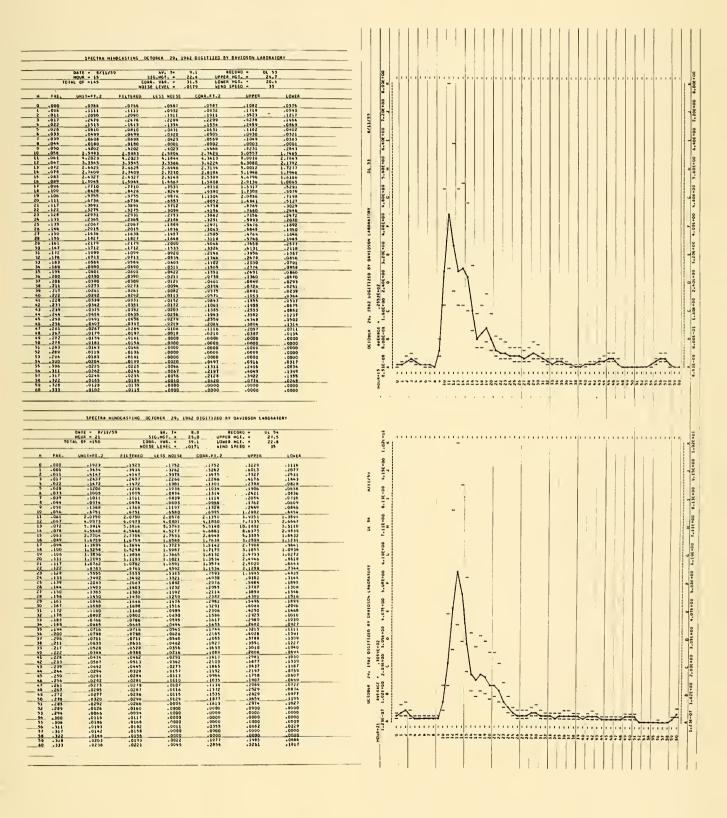


| SPECTRO MIMOCASTING DCTOBER 20, 1002 DIGITIZED BY DAVIDSON LEBORATORY | | |
|--|--|--|
| DATE - 1/11/59 AV. T- 9.0 ASCORD - OL 40 | 8 | 90 |
| MQ15E FEAST - '05FT PINO 24560 + '00 | 88.81 | 4 |
| 0 .000 ,1425 ,1425 ,1213 ,121) ,2236 ,0773 | 0.1.30 | 8047 |
| 3 -011 -4550 -4550 -4550 -4350 -4350 -6032 -2775 -5030 -5024 -5024 -4013 -4413 -5021 -3005 | | • |
| 7 039 -1100 -1000 | 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - | 9E +00 |
| 9 1020 1087 1087 1087 1087 | | 1 |
| 12 .007 3.254 3.255 3.255 3.252 3.3256 5.1276 2.1175 13 .072 3.1700 3.0700 3.0800 3.0900 7.2704 2.3146 | 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 6.2 a£ +00 |
| 17 .004 9.5527 3.5627 3.563 4.5745 8.7845 3.1030 | | 1 1 |
| 14 100 1-805 1-805 1-805 2-100 3-972 3-377 10-100 1-812 3-107 | 00.18 (1.0 | 9.3u£+00 |
| 22 -122 -6293 -6293 -6293 -1004 -101 | | |
| 28 -144 -4299 -4299 -4000 -8020 1.2571 -4343 27 -150 -3340 -3340 -3340 -3129 -2550 1.0270 -3514 | | 4.446.00 |
| 30 -167 -1703 -1203 -0992 -2152 -3967 -1570 | 00 J | 00 • 3 |
| 32 -178 -1974 -1974 -1753 -4437 -8178 -2023 33 -195 -1300 -1300 -1000 -2959 -1653 -1664 | | 1.3 |
| 36 -200 -1045 -1045 -1034 -2009 -5381 -1552 37 -206 -0912 -0912 -0701 | 99 90 90 90 90 90 90 90 90 90 90 90 90 9 | 2.70£ 000 |
| 38 .211 .0576 .0376 .0355 .1321 .2004 .0593 1521 .2004 .0593 1521 .0576 .0593 1521 .0576 .0593 1521 .0576 .0593 1521 .0576 .0593 1522 .0576 .0 | 20.7 | 7 |
| 43 .239 .0471 .0468 .0254 .1725 .3176 .1007 44 .244 .043) .0417 .0268 .0254 .1735 .3109 .1105 | 25. 1051 1050 1050 1050 1050 1050 1050 10 | 1.606400 |
| 46 -236 -021 -0230 -0319 -0317 -0641 46 -236 -021 -0230 -039 -0367 -0274 | * · · · · · · · · · · · · · · · · · · · | - |
| 4 . 24 | 100 | 6.48E-01 |
| 57 -280 -0165 -0167 -0000 -0000 -0000 -0000 53 -294 -0174 -0181 -0000 -0000 -0000 54 -200 -9173 -0182 -0000 -0000 | | |
| 57 -317 -0213 -0225 -0011 -0350 -0845 -0223 | 12 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 7.568-00 |
| 59 .322 .0265 .0230 .0018 .1568 .3024 .1002 59 .326 .0240 .0235 .0043 .2175 .4010 .1385 | | 1 . |
| 59 .326 .0260 .0255 .0043 .2175 .4010 .1365 60 .333 .0209 .0234 .0023 .1329 .2430 .0046 | § | |
| .502) .1329 .2430 .0846 | | |
| SPECIAL MINDESTING OCIONER 29, 1982 O[GITIEGO OF DAVIOSON LABORATORY | | |
| SPECING MIMOLASTING OCTOBER 28, 1902 OLGITIZED 89 DAVIOSON LABORATORY OATE - 0.711/55 AV. 1- 0.0 SECOND - 0.00 MOUR - 0 SIGMAIL - 29.2 DAVES OCTO - 0.30 | 5 | 26.03 |
| SPECING MINDESSING OCTOBER 28, 1982 OLGITIZEO EV DAVIGODO LABORATORY CATE - \$111/59 | In account of the contract of | 1.3% |
| 1329 | 10.45.1 10.41 | 1.926 |
| SPECIES MIND(457 INC OCIONES 29, 1942 O[GIJIECO 07 DAVIDODA LADORATORY | TOTAL LISTON | 1.376.01 1.976.1 |
| SPECIRE MIND(4571MC OCIDECE 75, 1947 O[GII] (CO 07 OAN) ODA LADORATORY | TOTAL LISTON | 1.372.01 1.372.1 |
| SPECIES MINDLESTING DELOSES 29, 1002 OLGITICO 97 DAVIDON LADDRADOST SPECIES MINDLESTING DELOSES 29, 1002 OLGITICO 97 DAVIDON LADDRADOST SPECIES MINDLESTING DELOSES 29, 1002 OLGITICO 97 DAVIDON LADDRADOST ROUR | 10 Legitud 1.230-04 | 1.216.01 1.374.01 1.324 |
| SPECIRA MINDLESTING OCIDER 29, 1942 OIGILIECO 87 DAVIDODA LADDRAIDET | 11-96-01 1-21-01 1-38-01 | 1.216.01 1.376.01 1.526 |
| SPECIRA HIMOLASTING DCIDATE 27, 1942 OIGILIZED & DAVIDOM LABORATORY | 69 1-884-01 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1 1-1-1-1-1-1 1-1-1-1-1-1 1- | 1.00 1.006rol 1.21erol 1.37erol 1.526 |
| SPECIAR MIND(457 MC OCIONER Pt. 1982) O[GII]ECO 07 OANIOODA LADORATORY | 1 1 10 10 10 10 10 10 10 10 10 10 10 10 | 9.10£+00 1.00£+01 1.21£+01 1.31£+01 1.52 |
| SPECINE MIND(4571MC DC1004E 71, 1502) 0[G11] SPECINE MIND(4571MC DC1004E 71, 1502) 0[G11] SPECINE MIND(4571MC DC1004E 71, 1502) 0[G11] SPECINE MIND(4571MC DC1004E 71, 1502) 0 SPECINE MIND(4571MC DC1004E 71, 1502) 0 SPECINE MIND(4571MC DC1004E 71, 1502) 0 SPECINE MIND(4571MC DC1004E 10, 1502) 0 SPECINE MIND(| 1 10 10 10 10 10 10 10 10 10 10 10 10 10 | #80 9-104-00 1.004-01 1.214-01 1.374-01 1.524 |
| SPECINA MINDLESTING DCIDER 29, 1942 DIGITIZED 87 DAVIDODA LANDRAIDET OATE = 8/11/55 | 10. 10. 10. 10. 10. 10. 10. 10. 10. 10. | 7.54e-80 9.10e-90 1.06e-01 1.21e-01 1.37e-01 1.526 |
| SPECIRA HIMDLASTING OCIDAE 29, 1982 OIGILIECO AT DAVIDODA LADDRAIDAT | 10. 10. 10. 10. 10. 10. 10. 10. 10. 10. | 7.54e-80 9.10e-90 1.06e-01 1.21e-01 1.37e-01 1.526 |
| SPECING MINOCASTING OCIDAGE 29, 1962 OIGILIEGO 87 DAVIDON LANDGALDAY | 0 | 4.014.00 7.592.00 9.104.00 1.004.01 1.214.01 1.314.01 1.514 |
| SPECING MINOCASTING OCIDAGE 29, 1962 OIGILIEGO 87 DAVIDON LANDGALDAY | Collision in surface to service training lateral later | 4.5% epo 6.014.00 7.544.00 9.104.00 1.084.01 1.214.01 1.314.01 1.54. |
| SPECING MINOCASTING OCIDAGE 29, 1962 OIGILIEGO 87 DAVIDON LANDGALDAY | Collision in surface to service training lateral later | 4.5% epo 6.014.00 7.544.00 9.104.00 1.084.01 1.214.01 1.314.01 1.54. |
| SPECING MINOCASTING OCIDAGE 29, 1962 OIGILIEGO 87 DAVIDON LANDGALDAY | Collision in surface to service training lateral later | 4.5% epo 6.014.00 7.544.00 9.104.00 1.084.01 1.214.01 1.314.01 1.54. |
| SPECING MINOCASTING OCIDAGE 29, 1962 OIGILIEGO 87 DAVIDON LANDGALDAT | Collision in surface to service training lateral later | 4.5% epo 6.014.00 7.544.00 9.104.00 1.084.01 1.214.01 1.314.01 1.54. |
| SPECING MINOCASTING OCIDAGE 29, 1962 OIGILIEGO 87 DAVIDON LANDGALDAT | United 1-1 1911-101 Indicated 1-1 Indic | 4.5% epo 6.014.00 7.544.00 9.104.00 1.084.01 1.214.01 1.314.01 1.54. |
| SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING OCIDAGE 29, 1962 OICHIEGG 87 DAVIDON LANDRAIDET SPECING HINDLESTING AND LANDRAIDET SPECING HINDLESTIN | STATUS. 1-15 FOR OUTLIES NY DAVIOUS LANGEST LANGEST LANGEST 10-10-10 LANGES. 1-10 FOR OUTLIES NY DAVIOUS LANGEST 10-10-10-10-10-10-10-10-10-10-10-10-10-1 | 4.9% e00 4.014.00 7.544.00 9.104.00 1.084.01 1.244.01 1.314.01 1.54 |



| Diff = 8/11/59 Sec. 14. | More 27, 1982 0-01100 0 1-2000 0 1-2000 1 1-2000 |
|---|--|
| SPECIAL MINOCASTING OCIDAR 20, 1922 DIGITIZED BY DAVIDSON LABORATION CATE * PAINTS9 | STATES LANCOS LA |







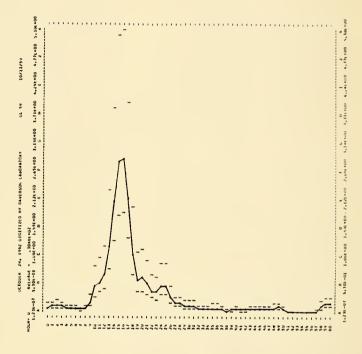
| SPECIAL MINOCASSING OCTOBER 29, 1802 DIGITIZED BY DAVIDSOM LABORATORY | |
|--|--|
| OATE • 9/11/59 Av. 1 = 9.3 ACCORD • DL 55 MOUN • 0 SIG.MCT • 24.9 UPPER MCT • 27.3 TOTAL DF =152 CORR. + VAR. • 30.6 LOWER MGT • 22.7 | |
| MOISE LEVEL - DIDS MIND SPEED - 40 M PAR, UNIT-FT.2 FILTERED LESS NOISE COMP.FT.2 UPPER LOWEN | |
| 0 .000 .1078 .1078 .0013 .0913 .1063 .0914 1 .006 .1464 .1464 .149 .1491 .1272 .0943 2 .011 .2044 .2044 .1873 .1872 .1412 .2711 .0937 3 .011 .1837 .1837 .1837 .1412 .1412 .2711 .0937 | 60) |
| 4 -027 -1433 -1433 -1256 -1256 -2337 -0007 5 -020 -1193 -1193 -1027 -1027 -1027 -1093 -0054 | |
| 8 .044 .0981 .0981 .0981 .0971 .1790 .0081 | 0.000 |
| 10 .056 | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |
| 15 .083 3.6936 3.6938 3.6711 3.8661 7.1258 2.4617 | |
| [8 -100 1.2816 1.2816 1.2850 1.4401 2.6564 .0170 19 -100 1.5807 1.5607 1.5532 1.6336 3.3705 1.1675 | 00-15(-1, -1) |
| 80. -111 1,2153 1,2153 1,1099 1,4721 2,7194 ,0774 21. 11. -6651 -666 1,0010 2,0006 -6925 22. -122 -0240 -9240 -9075 1,2162 -2,2453 -7941 23. -126 -6780 -6780 -6780 -6780 -6781 -5941 | - 100 00 F; |
| 25 (137 -4075 -407 | 11.16.00 |
| 28 -156 -1415 -1415 -1250 -2365 -4359 -1506 29 -161 -1506 -1506 -1340 -2711 -4997 -1726 | |
| 30 -167 .1170 .1170 .1100 .1005 .2181 .4020 .1199 | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |
| 34 180 1012 1012 2044 12405 15500 1550 1 | |
| 39 -217 -0128 -0128 -0162 -0164 -1311 -0474 - 40 -222 -0416 -0416 -0251 -1266 -2333 -0006 | 0 |
| 42 - 233 - 0461 - 0473 - 0308 - 1894 - 3492 - 1206 43 - 239 - 0450 - 0433 - 0268 - 1675 - 3363 - 1162 | 10 10 10 10 10 10 10 10 10 10 10 10 10 1 |
| 45 -250 -0285 -0286 -0121 -1024 -1888 -0652 46 -256 -0302 -0285 -0120 -1130 -2002 -0719 | |
| 45 - 60 - 6199 - 6212 - 6044 - 6050 - 1037 - 6057 49 - 272 - 6146 - 6166 - 6000 - 6064 - 6075 - 6026 50 - 278 - 6187 - 6181 - 6015 - 6242 - 6445 - 6154 | 2 |
| 52 .289 .0196 .0197 .0031 .0609 .1123 .0368 53 .294 .0106 .0177 .0012 .0267 .0493 .0170 54 .300 .0129 .0141 .0000 .0000 .0000 | ; <u></u> ; |
| 55 306 -0105 -0121 -0000 -0000 -0000 -0000 56 311 -9155 -0166 -0000 -0000 -0000 -0000 57 317 -0103 -0173 -0000 -0205 -0564 -0188 | ; |
| 58 .322 0122 0122 022 000 000 0557 0146 0557 0146 0557 0146 0567 0000 0000 0000 0000 0000 | = >-\\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\- |
| | |
| SPECIAR MINOCASTING SCISSER 29, 1902 OLGITIZEO, BY DAVIOSON LABORATORY OATE | 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - |
| PARE - 9/11/59 AV. 1= 9.4 DECEMB - 01.50 HOUN - 5 SIG.MCI 26.3 DEPER MCI. = 30.9 TOTAL OF - 157 CDRA. MAR. = 50.0 LEVER MCI. = 25.9 MOISE LEVEL | 10° 7 |
| OATE - 9/11/59 AV. 1 | 100.00 00.00 00.00 100. |
| OATE - 9/11/59 SV. - 9.4 UPER UCL. 30.9 | 100-17-0 00-17-10 00- |
| ORIG - 9/11/59 SV. 1= 9.4 DECOMD - 01.50 | 1.232.00 0.444.00 0.402.00 0.4 |
| ORIG | 1.232.00 0.444.00 0.402.00 0.4 |
| ORIG | 100-11 - 00-12 |
| OATE O/11/59 SIG_MCI_ 24.3 UPERA MCI_ 30.4 | 100.0 0.184.0 0.184.0 0.194.0 0.194.0 0.194.0 0.194.0 0.194.0 |
| OATE O/11/59 SIG_MCI_ 24.3 UPERA MCI_ 30.4 | 10 1 10 1 10 1 10 1 10 1 10 1 10 1 10 |
| MAIGNE MAIN | 1. (1.1797) 1. (1 |
| DATE = 9/11/59 SIG_MCI_ = 24-3 | 1.16(10) 1.16(24)(24) 1.16(1) |
| DATE = 9/11/59 SIG_MCI_ = 24.3 DATE DATE | 100 3-144-00 4-154-00 5-444-00 6-144-00 1-144-00 6-144-00 7-144-00 |
| DATE = 9/11/59 SIG_MCI_ = 24.3 DATE DATE | 10111120 07 141130 14120 14120 141130 141130 141130 141130 141130 141131 |
| DATE = 9/11/59 SIG_MCI_ = 24.3 DATE DATE | 10111120 07 141130 14120 14120 141130 141130 141130 141130 141130 141131 |
| DATE 9/11/59 SIGN 12-23 DECEMBER 20-3 DECEMBER 20- | 1-11-200-1-201-1-20 3-1-2-20 4-1-2-20 3-1-4-1-20 3-1-4-1-20 1-3-2-20 5-1-4-1-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2- |
| DATE 9/11/59 STG_MCI_ 24.3 DPER MCI_ 30.9 | 1-11-200-1-201-1-20 3-1-2-20 4-1-2-20 3-1-4-1-20 3-1-4-1-20 1-3-2-20 5-1-4-1-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2- |
| DATE 9/11/59 STG_MCI_ 24.3 DPER MCI_ 30.9 | Sequence 24, 1862 DIGITIES BY MATISSEW (ANGEATIGN) 60, 54 VILLES BANGETO TANGETO TANGE |
| MAIL SALE SALE SALE MECGGG DL 50 | 1-11-200-1-201-1-20 3-1-2-20 4-1-2-20 3-1-4-1-20 3-1-4-1-20 1-3-2-20 5-1-4-1-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-20 1-3-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2- |



| SPECIAL MINDCASTING OCTOBER 20, 1902 DIGITIZED BY DAYIDSDM LABORATORY OATE = 9/11/59 | 00- May- |
|--|--|
| ## FRE. UNITEFLY FILESCH (155) NOTES. (DBLAT) ## 1000 1200 1200 1200 1200 1200 1200 12 | ## Osabet Octobet Octo |
| DATE = 9711/55 | OCTOBAL 29 1982 DICITION 1781 OF |



| | | DATE . 10/11/59 | | AV. I. | 8.7 | RECUMO . | OL 59 |
|----------|-------|-----------------|----------------|---------------------------|----------|----------------|--------|
| | | HEUN - O | | 51G.HGT. * | 14.1 U | PPER HGI | 50.0 |
| | "" | TAL OF -138 | | CORM. YAR DISE LEVEL . | 20.5 L | Ches HGT | 16.4 |
| | | | - 4 | DISE CEASE . | .0077 | ING SPECO . | |
| — н | FHE. | UNI T-FT.2 | FILTERED | LESS NOISE | COMR.FT. | 2 00018 | LOwex |
| 0 | -000 | .0671 | .0871 | .0794 | .0794 | +1484 | .0506 |
| 1 2 | *00# | .1062 | 1005 | -0985 | .0985 | | 1540. |
| 5 | .017 | .0948 | -1222 | -1145 | .1145 | | .0729 |
| | -043 | .0865 | .0863 | .058# | . 4588 | | .0375 |
| | .028 | .0334 | .0538 | .0401 | -0461 | | .0293 |
| ۵ | .01) | .0384 | .0364 | 10101 | .0444 | | -0348 |
| 7 | -034 | .0331 | -0333 | .0256 | .0140 | 4540. | .0210 |
| | -044 | -0488 | US+D. | -0411 | .4489 | | .0311 |
| 10 | .056 | .4354 | -1687 | 1110 | .1707 | | .1118 |
| 11 | 140. | .5371 | .53/1 | . 5294 | .4447 | | .2895 |
| 12 | -067 | .4630 | .6630 | . 6553 | 12141 | | . 4240 |
| 13 | .012 | 1.2005 | 1-2005 | 1.1928 | 1-2738 | 2.2554 | ,1142 |
| 14 | +078 | 2.0065 | 2.0085 | 2.000a | 2.0708 | | 1.3188 |
| 15 | .083 | 2.4926 | 2.6928 | 2.6849 | 2.0224 | | 1.7974 |
| 18 - | -089 | 2.7100 | 2.7100 | 5.1053 | 2.6733 | | 1.8246 |
| 18 | .094 | 1.9474 | 1.0414 | 1.9397 | 2.1403 | | 1.382M |
| 19 | -100 | -5116 | .5110 | .5039 | 1.0720 | 1.4763 | .4928 |
| 20 | .111 | ,5108 | -5100 | .5031 | - 61 78 | 1.1388 | .3934 |
| 21 | -117 | .0196 | . 41 94 | -4119 | .5279 | . 4131 | .3162 |
| 25 | -122 | 4885 | .5886 | -2809 | . 3771 | . 6951 | -244) |
| 53 | +128 | .2585 | .2565 | .2508 | .3537 | .6520 | . 2252 |
| 24 | +113 | .3372 | -3372 | . 3295 | .4401 | .9012 | *3120 |
| 20 | . 139 | .1697 | .3149 | .3092 | -4864 | .8966 .8982 | -3047 |
| 27 | -150 | .0909 | .0409 | .0812 | .1475 | .2718 | .17/1 |
| 28 | -158 | -0614 | +150 | -0737 | .1194 | .2570 | .0116 |
| 29 | .101 | -0864 | +840. | .0407 | .1227 | .2362 | .0761 |
| 70 | -167 | .0041 | -0841 | .0564 | .1223 | .2255 | -0119 |
| 31 | -172 | .0555 | .0555 | -0478 | -1114 | .2054 | .0109 |
| 33 | -103 | .0256 | .0234 | .0178 | .U715 | .1319 | .0056 |
| 16 | +149 | .0278 | -0278 | .0200 | .0591 | 1982 | 4510 |
| 35 | -194 | .0319 | .0319 | . 0242 | -4775 | -1420 | -0443 |
| 36 | -200 | -0243 | .0293 | .0218 | .0754 | .1340 | . 4440 |
| 37 | -204 | .0199 | -0199 | .0122 | .0466 | .085# | .0243 |
| 38 | 115. | .0120 | .0120 | .0041 | .0174 | .6330 | -0114 |
| 19 | -513 | .0148 | -0148 -0163 | -0071 | .0126 | .0398 | .0207 |
| 41 | .248 | .0140 | .0148 | .0000 | . 0184 | .0708 | -0245 |
| 42 | .233 | .0144 | .0142 | . GC65 | -0402 | .0741 | 9450 |
| 43 | 538 | .0143 | -0142 | .0065 | .0443 | .0617 | *05P5 |
| 44 | . 244 | .0135 | .0139 | .0062 | .0471 | .0880 | .0100 |
| 45 | .250 | .0150 | .0143 | .5086 | .4550 | .1030 | .0358 |
| - 46 | .256 | -0136 | .0138 | .0061 | .0578 | .1065 | -0348 |
| 71 | .207 | .0150 | .0126 | .0051 | .0518 | .0992 | -0343 |
| 4.9 | .272 | .0159 | .0146 | -0003 | .0921 | -1109 | .0540 |
| 50 | .278 | -0112 | .0117 | .0040 | .0002 | .1116 | .0165 |
| 51 | .283 | .0000 | +0085 | .0008 | .0111 | .0245 | -0684 |
| 52 | -289 | .0086 | -0068 | .0000 | .0000 | .0000 | .0000 |
| 53 | -244 | .0059 | .0060 | .0000 | .0006 | .0000 | .0000 |
| 54 55 | .300 | +0052 +0044 | -0054 | .0000 | .0000 | .0000 | .0000 |
| 54 | -311 | -0001 | -0051 | -0000 | .0000 | .0000 | .0000 |
| 57 | .317 | -0001 | *00*3 | .0006 | 4620 | .0435 | .0000 |
| 58 | 322 | -0108 | -0101 | -0024 | .1020 | .1845 | -0455 |
| 59 | .328 | -0108 | -01CP | .0029 | .1414 | .2843 | .0913 |
| 60 | . 333 | 4600* | -0102 | . 6025 | -1413 | .2642 | .0413 |
| | | | | | | | |



| OATE > 10/11/19 | av. Ie | 9.3 | RECOND . | DE AG |
|-----------------|---------------|-------|--------------|-------|
| HCUR . 8 | \$16.461 | 17.0 | UPPER HGI | 19.1 |
| 101AL OF -159 | CORR. VAR | 19.3 | LOWER HGT | 16.1 |
| | NOISE LEVEL . | .0015 | MIND SPEED . | 15 |

SPECTRA HINDCASTING OCTORER 29, 1902 GIGITIZED BY DAVIDSON LABORATORY

