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QUALITY ASSURANCE REPORT

Atlanta Central Laboratory

Denver Central Laboratory

By

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QUALITY ASSURANCE REPORT

INTRODUCTION

Standard reference materials taken from the U.S. Geological Survey Standard Reference Water Sample (SRWS) Program (Schroder and others, 1980; Skougstad and Fishman, 1975), and non-Central Laboratory sources are prepared in the Ocala Water Quality Service Unit (QWSU), Ocala, Florida, disguised as routine samples, and distributed to Water Resources Division (WRD) offices. The reference materials are then submitted to the Central Laboratories by the WRD offices on a specified schedule for the determination of major constituents, nutrients, and trace metals. The analytical schedules are chosen to reflect the frequency of analyses for the various constituents. The program is designed so that at least one reference sample should be sent to each laboratory each day for constituents that are determined daily. All constituents in reference materials used to date have been in the dissolved phase; data designated as "total" or "total recoverable" are from samples which have undergone a digestion process, rather than from unfiltered or "whole-water" samples. All samples designated as "total" were analyzed by atomic absorption spectrometry. For the period of this report, analyses were limited to major constituents including specific conductance, nutrients, trace elements, precipitation level analyses and selected organic constituents.

For the period of this report, the following terms are defined:

Major constituents - Alkalinity, boron, calcium, chloride, dissolved solids, fluoride, magnesium, potassium, silica, sodium and sulfate.

Trace Metals - Aluminum; antimony; arsenic; barium; barium, total recoverable; beryllium; cadmium; cadmium, total recoverable; chromium; chromium, total recoverable; cobalt; cobalt, total recoverable; copper, copper, total recoverable; iron; iron, total recoverable; lead; lead, total recoverable; lithium; manganese; manganese, total recoverable; molybdenum; nickel; nickel, total recoverable; selenium; silver; silver, total recoverable; strontium; zinc and zinc, total recoverable.

Nutrients- Ammonia; ammonia plus organic nitrogen; carbon, organic; nitrate plus nitrite-nitrogen; nitrite-nitrogen; phosphorous and phosphorous, ortho.

Precipitation samples - Specific conductance and low detection level analyses of: Calcium, chloride, fluoride, magnesium, nitrate-nitrogen, phosphorous, potassium, sodium and sulfate.

Organic constituents - Chlorophenoxyacid herbicides, organochlorine insecticides and organophosphate insecticides.

ICP - Analyses done by inductively coupled plasma spectrometry.

AA - Analyses done by atomic absorption spectrometry.

Once the analysis has passed through the laboratories' quality control and quality assurance routines, the data are permanently stored in WATSTORE. These data reflect the typical quality of results produced by each laboratory and received by each district.

The purpose of this program is to document the quality of data that is generated by the laboratories. The program is not intended to replace the internal quality assurance programs administered by the laboratory chiefs.

Tables 1 and 2 summarize the results of major constituents including specific conductance and trace elements, respectively for the Atlanta and Denver Central Laboratories. Expectation of a normal distribution implies that about 68 percent of the results would be within 1 standard deviation of the most probable value (MPV) and about 95 percent would be within 2 standard deviations. Analyses are considered acceptable if they are within 2 standard deviations of the MPV.

Table 3 through 6 list each individual value which exceeded the two most probable standard deviation (MPSD) criteria.

Table 7 lists the means and standard deviations for each nutrient mixture submitted to each laboratory.

Table 8 shows the results of a *t* statistic evaluation on the data in table 7.

Table 9 lists the means and standard deviations for each precipitation level mixture submitted to each laboratory.

Table 10 shows the results of a paired *t* test on the data in table 9.

Table 11 lists the means and standard deviations for each organic mixture submitted to each laboratory.

Figures A1 through A54 and D1 through D54 are control charts of each constituent with time and give a pictorial view of the precision, bias, and possible trends of the data for each laboratory. The ranges given in the legend are approximate and represent the lower, middle, and upper thirds of the range of reference materials available. Data are now plotted by log-in dates which is causing a slight problem. Some samples are supposed to be shipped to the laboratories daily and therefore each log-in date would be unique. However, it appears that three or more samples are receiving the same log-in date and the points are frequently plotting on top of one another. If tables 3 through 6 are used in conjuction with the plots, any confusion should be cleared. Those samples which take a longer than average time in the laboratory will no longer be plotted until the annual report is published.

Evaluation and statistical criteria

Many of the reference samples were prepared by mixing together two or more SRWSs. The most probable values (MPV) were calculated using a volume-weighted average of the known MPVs. Although a theoretical specific conductance which is calculated by simply averaging the individual specific conductance values may not always be accurate, this approach has been shown to be acceptable for these samples (Peart & Thomas, 1983a). Mixtures that do not behave in a linear fashion have not been used.

The means and standard deviations for all parameters are now taken from the results of the interlaboratory, method specific analyses of SRWS No. 24 through 83. In conformance with WRD Memorandum 81.79, an individual value was considered acceptable if it was less than or equal to 2 standard deviations from the most probable value. The MPSD for each constituent was calculated using a least squares regression analysis of the means and standard deviations obtained from the stated sources. In certain situations, this criterion was impossible to meet. An administrative decision was made to establish a minimum standard deviation for each constituent equal to three-quarters of the value of the reporting level to allow at least one reportable value on each side of the MPV to be accepted. For example, the minimum standard deviation for copper reported to the nearest 10 µg/L is set to 7.5 µg/L and for silver reported to the nearest 1 µg/L is 0.75 µg/L.

Because of an insufficient supply of SRWSs for nutrients (ammonia, ammonia plus organic nitrogen, nitrate plus nitrite, nitrite, orthophosphate, phosphorus, and organic carbon), most of the reference materials used during this period were made from reagent chemicals in the Ocala facility. Methods for preparing these samples are essentially the same as those used in preparing the nutrient samples for the SRWS program; however, stability is uncertain and there are no data from which a list of most probable values can be determined. Therefore, the samples were treated as split samples of unknown concentrations and statistical tests were performed to determine if significant differences existed between the performance of the two laboratories.

In tables 7, 9 & 11 where a standard deviation is indicated and the number of values (N) is 2, the approximate difference between the values can be calculated by multiplying the standard deviations by 1.4. The standard deviations themselves are not very meaningful when N = 2 but they do provide a basis for gathering other important information about the spread in the values.

As more fully described in WRD Memorandum 81.79 and Friedman, Bradford and Peart, 1983, a binomial distribution was used to evaluate the overall analytical precision for each major and trace constituent. The criteria used gave less than a 1 percent chance that a determination will be considered "unacceptable" solely due to random errors.

Similarly, bias was determined by first examining the number of values which were greater than and less than the MPVs. A binomial probability distribution (at the 50 percent level) was then used such that there was less than a 1 percent chance that a determination would be considered biased solely due to random errors.

To determine a measure of comparability between the two laboratories, the raw data for each major and trace constituent were evaluated using a modification of the Wilcoxon Rank-Sum test (Crawford, Slack & Hirsch, 1983). Each mixture was ranked separately so that the actual concentration differences between mixtures did not affect the outcome of the test. By using this method, the undesireable effects of outliers are eliminated without eliminating the outliers themselves from the data under consideration.

ANALYTICAL PRECISION

Determination of the following constituents showed statistically significant lack of precision:

Atlanta Central Laboratory - barium(ICP); chromium, total recoverable; fluoride; iron (ICP); iron, total recoverable; lead (AA); lead, total recoverable; molybdenum (AA); and strontium.

Denver Central Laboratory - chromium, total recoverable and strontium.

ANALYTICAL BIAS

Determination of the following constituents showed statistically significant bias:

Atlanta Central Laboratory

Positive bias: alkalinity; cadmium (AA); cadmium, total recoverable; chloride; chromium, total recoverable; cobalt (AA); cobalt, total recoverable; iron, total recoverable; lead (ICP); sodium (ICP); and specific conductance.

Negative bias: potassium and zinc(AA).

Denver Central Laboratory

Positive bias: alkalinity; barium (AA); barium total recoverable; chloride; chromium; iron (AA); iron, total recoverable; lead (ICP); silica; sodium (ICP); specific conductance; sulfate; zinc (ICP); and zinc (AA).

Negative bias: aluminum; arsenic; boron, nickel; potassium; and silver.

COMPARABILITY BETWEEN LABORATORIES

The following constituents showed statistically significant differences with respect to the means of the ranked data, indicating lack of comparability between the laboratories. Alkalinity; barium(ICP); barium (AA); barium, total recoverable; cadmium, cadmium, total recoverable; chloride; chromium; cobalt(ICP); cobalt (AA); cobalt, total recoverable; dissolved solids; iron(AA); lithium; manganese(ICP); molybdenum(AA); nickel; potassium; silica; silver; zinc (ICP); and zinc(AA). This represents a little over 40% of all parameters tested for comparability.

Data in table 8 show that both laboratories are performing similarly on all nutrient parameters except ammonia plus organic nitrogen, in which the means are similar but the standard deviations are significantly different. The laboratories have had similar means on all nutrients parameters for the past three quarters.

Data in table 10 show that both laboratories are reporting similarly on all precipitation level constituents except nitrate-nitrogen where inconsistent "less than" (minimum reporting level) values made a comparison impossible.

DISCUSSION AND RECOMMENDATIONS

No data for mercury are presented here. We will resume our quality-assurance efforts for mercury following a resolution of the preservation questions discussed in previous reports.

It appears that both laboratories are consistent and in compliance with the Quality of Water Branch policy of reporting "less than the lower limit of detection" rather than zeros for major constituents and trace elements.

Analyzing the data for this report revealed several parameters where the laboratories tended to agree with each other but not with the MPV. This shows up very well in table 4 and 6 for iron(ICP) (MPV of 352), iron (AA) (MPV of 151), iron, total recoverable (MPV of 151), and strontium (MPV of 953). The SRWS reports were checked and no reason could be found to indicate an error in the MPV. A third laboratory was asked to analyze these same mixes and the results were similar to those produced by the laboratories. Because of this, the lack of precision in both laboratories for strontium and the lack of precision in Atlanta for iron (ICP) may not reflect the true performance of the laboratories.

Some samples with large concentrations of pesticides were inadvertently sent to the laboratories during this reporting period. Therefore table 11 listing a comparison of each organic sample from the two laboratories is given, but no table showing the results of any test to determine comparability is provided. The wide ranges for the parameters have made the tests meaningless. Table 11 does show that the standard deviations frequently are very large, showing the precision is very poor. For example the individual values which make up mix 4 for Diazinon for Atlanta are <.01, <.01, 980 and 3400 and for Denver are 740 and 640. These values give a mean of 1095 and standard deviation of 1604.6 for Atlanta and a mean of 690 for Denver. Atlanta's standard deviation is so large that the mean is of little value. If we try to use the rank-sum test, the Atlanta data are ranked 1, 2, 5, 6 and Denver's data rank 3, 4. The test indicates that the data are comparable, which obviously is not the case. Another problem with testing the pesticide data was that Atlanta frequently reported a value as <.01 while Denver reported the same sample as <10. This was largely due to the large-concentration samples which required large dilutions for quantitation. The <.01 values from Atlanta came from the pre-dilution analysis while the <10 values from Denver came from the diluted analysis. There is no established protocal for this situation and the differences will not recur once these large-concentration samples have been worked through the system.

The precipitation level samples for February were inadvertently not prepared and half of the March samples were lost; therefore, only half of the total data expected was received for this quarter. Two constituents, chloride and nitrate-nitrogen, had inconsistencies in the way that minimum-reporting levels (detection levels) were reported. The Atlanta laboratory reported <.2 mg/L for a single value for chloride. According to the parameter code dictionary, the current detection level of the ion chromatography method requested is 0.01 mg/L; however, the Laboratory Services Catalog shows .2 mg/L as the detection level. For nitrate-nitrogen the Atlanta laboratory reported two values of <0.05 mg/L and the Denver laboratory reported two values of <0.01 mg/L for the same samples with identical analytical requests (laboratory codes). During this time some changes were being made in the ion chromatography methodology. It appears that the Atlanta laboratory reported values under the old methodology and Denver reported under the new methodology, at the same time. Apparently, both old and new methodologies are still available. The new methodology will be the only methods listed in the next Laboratory Services Catalog and at that point the lower detection limits will be correct; but until then some inconsistencies may recur. When a change in methodology is taking place, however, the laboratories should coordinate with each other and establish a single date on which both laboratories change to the new methods.

Paired t tests, at the 95% confidence level, were used to compare the means of each mix from one laboratory to the corresponding means from the other laboratory and also to the MPVs (table 10). The data for nitrate-nitrogen (mix 3) was discarded because of the inconsistent reporting of detection limits which made it impossible to compare this constituent. Other data reported as "less than" was used, disregarding the "less than" remark for these tests. These results are presented in table 10. To evaluate the extremes of the values reported with "less than" remarks, the tests were redone taking all "less than" values at zero. There were no differences in the results with the exception of chloride. It showed significance between the laboratories but neither laboratory showed significance with the MPV. Had the Atlanta laboratory used the new detection limits, and reported any value less than .11 mg/L, a significant difference between the laboratories would have been indicated.

Each of the statistical tests applied to the data as well as the information displayed in the figures (figs. A1-D54) shows a different aspect of the data and may produce results which appear confusing and even contradictory at times. However, a careful evaluation will allow the correct conclusion to be reached. One example is a situation where a constituent shows no lack of precision or bias in either laboratory, but the Wilcoxon rank-sum test indicates a significant difference between the two laboratories. One can then look at the figures and may see that one laboratory has a slight (though not statistically significant) bias in one direction while the other laboratory has a slight bias in the other direction; or in a much less obvious situation, the figures may look almost identical. One would then conclude that one laboratory has a general tendency to produce data that is slightly biased with respect to the other, although this bias would not affect data interpretation because neither laboratory is producing data that can be classified as biased or imprecise.

In a second example, neither laboratory shows lack of precision, one laboratory shows bias but the rank-sum test indicates no significant differences and the figures look very similar. The fact that one laboratory shows significant bias and the other does not is probably due to the fact that it is a borderline situation. There are frequent instances where a constituent misses being classified or is classified as biased by one or two data points. The figures are important in this situation to determine the magnitude of the bias and its resultant effect on data interpretation. If the data are clustered together very close to the zero line, but enough are on one side to indicate a significant bias, this bias would probably not affect data interpretation. It is also important to remember that the standards used here are "most probable values" not a series of "true values", and that they were determined empirically. Consistent or frequently recurring bias of this type may then be interpreted as method or operator related. One must conclude that the two laboratories are producing comparable data.

SUMMARY AND CONCLUSIONS

Many constituents passed all the statistical tests and can therefore be classified as having acceptable precision, bias and comparability between the laboratories. Others have shown some statistically significant difference but in a way that would not affect data interpretation (see discussion and examples in the previous section). And others do indeed have notable differences.

Constituents for which no statistically significant difference was found for any test applied during this quarter include: antimony; beryllium; cadmium(ICP); calcium(ICP); calcium(AA); copper(ICP); copper(AA); copper, total recoverable;

magnesium(ICP); magnesium(AA); manganese(AA); manganese, total recoverable; molybdenum(ICP); nickel, total recoverable; sodium(AA); and zinc, total recoverable. This represents about 1/3 of all the constituents.

Constituents for which a significant difference was found for at least one test but where the difference(s) is considered to be of minimal importance include: aluminum; arsenic; barium(AA); barium, total recoverable; boron; chromium; cobalt(ICP); cobalt(AA); dissolved solids; iron(ICP); iron(AA); lithium; manganese(ICP); nickel; silica; silver; strotium; sulfate; zinc(ICP); and zinc(AA).

Constituents for which both laboratories show bias in the same direction but where over 95% of the data fall within two standard deviations from the MPV and therefore the bias is of minimal importance include: alkalinity, chloride, lead(ICP), potassium, sodium(ICP) and specific conductance.

Constituents for which a significant difference was found for at least one test but where the influence of the difference(s) on data interpretation is questionable include:

Cadmium(AA) – Atlanta shows a positive bias and the rank-sum test indicates data are not comparable. Atlanta has less than 40% of data within one standard deviation from MPV while Denver has over 65%.

Cadmium, total recoverable – Atlanta shows a positive bias and the rank-sum test indicates data are not comparable. Atlanta has less than 35% of data within one standard deviation from MPV while Denver has over 70%

Chromium, total recoverable – Atlanta shows a positive bias, the rank-sum test indicates data are comparable and both laboratories show lack of precision. Atlanta has 50% of data within two standard deviations and Denver has 63.6%.

Cobalt, total recoverable – Atlanta shows a positive bias and the rank-sum test indicates data are not comparable. Atlanta also had a positive bias in the 83 annual report (Peart and Thomas, 1984).

Lead(AA) – Atlanta shows a lack of precision but the rank-sum test indicates data are comparable. As indicated in table 4, Atlanta's lack of precision was caused by one mix (Denver's analyses of the same mix was acceptable). Atlanta also showed a lack of precision during the first quarter of 1984 water year which was the first time the ICP and AA methods for lead were reported separately.

Lead, total recoverable – Atlanta shows a lack of precision but the rank-sum test indicates the data are comparable. This constituent is analyzed using the AA method and Atlanta seemed to have a problem with one particular mix (as indicated in Table 4.) on both the AA and total recoverable analyses. Denver's data for the same mix was acceptable.

Constituents for which significant differences were found for at least one test and that appear to warrant some corrective action include:

Barium(ICP) – Atlanta shows a lack of precision and the rank-sum test indicates data are not comparable. Atlanta has only 45% of data within two standard deviations. The first quarter of 1984 water year was the first time the ICP and AA methods were reported separately for barium. Barium (ICP) showed a lack of precision for that quarter also. More control of precision in Atlanta is warranted.

Fluoride - Atlanta shows a lack of precision but the rank-sum test indicates data are comparable. Atlanta has seven data points where the number of standard deviations from the MPV is less than -6, as indicated in Table 3. Denver had no problem with the two mixes involved. Some of these very low values may have been key punch errors. Atlanta showed no lack of precision in the 82 and 83 annual reports (Peart and Thomas, 1983b, 1984).

Iron, total recoverable - Atlanta shows a lack of precision, both laboratories show a positive bias and the rank-sum test indicates the data are comparable. Table 4 shows that four of the values over two standard deviations are from the same mix. The total recoverable analyses are analyzed using the same method as AA analyses and the AA analyses for these samples were acceptable. The extra handling required for the total recoverable analyses may have been the cause. Atlanta has shown a lack of precision and a positive bias in the 82 and 83 annual reports (Peart and Thomas, 1983b, 1984).

Molybdenum(AA) - Atlanta shows a lack of precision and the rank-sum test indicates data are not comparable. Better control of precision in Atlanta is warranted for this constituent. Atlanta did not show a lack of precision during the first quarter of 1984 water year which was the first time the ICP and AA methods for molybdenum were reported separately.

REFERENCES

Crawford, C. G., Slack, J. R., and Hirsch, R. M., 1983, Non-Parametric Tests for Trends in Water-Quality Data Using the Statistical Analysis System. U.S. Geological Survey Open-File Report 83-550. 102 p.

Friedman, L. C., Bradford, W. L., and Peart, D. B., 1983, Application of Binomial Distributions to Quality Assurance of Quantitative Chemical Analyses. J. Environ. Sci. Health, A18(4). pp561-570.

Peart, D. B., and Thomas, N. A., 1983a, Quality-Assurance Data for Routine Water Analysis in the Laboratories of the U.S. Geological Survey: 1981 Annual Report. U.S. Geological Survey Water-Resources-Investigations Report 83-4090. pp3-5.

Peart, D. B., and Thomas, N. A., 1983b, Quality-Assurance Data for Routine Water Analysis in the Laboratories of the U.S. Geological Survey for Water-Year 1983. U.S. Geological Survey Water-Resources-Investigations Report 83-4264. pp. 9-13.

Peart, D. B., and Thomas, N. A., 1984 (in review), Quality-Assurance Data for Routine Water Analysis in the Laboratories of the U.S. Geological Survey for Water-Year 1983. U.S. Geological Survey Water-Resources-Investigations Report 84- .

Schroder, L. J., Fishman, M. J., Friedman, L. C., and Darlington, G. W., 1980, The use of standard reference water samples by the U.S. Geological Survey: U.S. Geological Survey Open-File Report 80-738, 11 p.

Skougstad, M. W., and Fishman, M. J., 1975, Standard reference water samples: Proceedings, AWWA Water Quality Technology Conference, December, 1974, American Water Works Association, p. XIX-1 - XIX-6.

SUPPLEMENTAL DATA

Table 1 --Summary of results for major constituents and specific conductance
[All constituents were in the dissolved phase]

Determination	Atlanta			Denver		
	No. of samples	Percent ≤ 1 standard deviation	Percent ≤ 2 standard deviations	No. of samples	Percent ≤ 1 standard deviation	Percent ≤ 2 standard deviations
Alkalinity	50	100	100	58	50	100
Boron	18	100	100	24	100	100
Calcium(ICP)	38	84.2	94.7	43	79.1	97.7
Calcium(AA)	10	100	100	13	100	100
Chloride	50	60.0	98.0	58	89.7	96.6
Dissolved solids	48	93.8	100	54	81.4	90.7
Fluoride	50	50.0	82.0	58	74.1	93.1
Magnesium(ICP)	38	92.1	100	43	95.3	100
Magnesium(AA)	10	90.0	90.0	13	92.3	100
Potassium	48	93.8	100	56	96.4	98.2
Silica	50	96.0	100	58	100	100
Sodium(ICP)	38	71.1	100	43	95.3	100
Sodium(AA)	10	90.0	100	13	69.2	100
Specific Conductance[1]	50	70.0	100	58	79.3	98.3
Sulfate	50	98.0	100	58	100	100

[1] See Discussion and Recommendations.

Table 2.--Summary of results for trace metals
[All constituents were in the dissolved phase; data designated as "total recoverable" are from samples which have undergone a preliminary digestion]

Determination	Atlanta			Denver		
	No. of samples	Percent ≤ 1 standard deviation	Percent ≤ 2 standard deviations	No. of samples	Percent ≤ 1 standard deviation	Percent ≤ 2 standard deviations
Aluminum	22	81.8	90.9	26	92.3	100
Antimony	2	50	50	3	66.7	66.7
Arsenic	46	89.1	97.8	48	77.1	100
Barium(ICP)	20	0	45.0	20	80.0	80.0
Barium(AA)	13	100	100	11	90.9	100
Barium, total recoverable	12	100	100	11	90.9	100
Beryllium	21	85.7	95.2	20	90.0	100
Cadmium(ICP)	20	90.0	95.0	22	86.4	95.5
Cadmium(AA)	33	39.4	90.9	32	68.8	93.8
Cadmium, total recoverable	12	33.3	100	11	72.7	90.9
Chromium	34	85.3	100	37	81.1	86.5
Chromium, total recoverable	12	41.7	50	11	63.6	63.6

Table 2.--Summary of results for trace metals--Continued

Determination	Atlanta			Denver		
	No. of samples	Percent ≤ 1 standard deviation	Percent ≤ 2 standard deviations	No. of samples	Percent ≤ 1 standard deviation	Percent ≤ 2 standard deviations
Cobalt(ICP)	20	100	100	20	100	100
Cobalt(AA)	13	53.8	92.3	11	90.9	90.9
Cobalt, total recoverable	12	50.0	75.0	11	90.9	100
Copper(ICP)	20	90.0	95.0	22	100	100
Copper(AA)	33	87.9	97.0	32	81.3	93.8
Copper, total recoverable	12	91.7	100	11	72.7	81.8
Iron(ICP) [1]	20	50.0	75.0	22	59.1	81.8
Iron(AA) [1]	33	63.6	93.9	32	62.5	90.6
Iron, total recoverable [1]	12	33.3	50.0	11	36.4	81.8
Lead(ICP)	20	60.0	95.0	22	63.6	100
Lead(AA)	33	66.7	81.8	32	62.5	93.8
Lead, total recoverable	12	41.7	66.7	11	72.7	100
Lithium	21	85.7	90.5	20	100	100

Table 2.--Summary of results for trace metals--Continued

Determination	Atlanta			Denver		
	No. of samples	Percent ≤ 1 standard deviation	Percent ≤ 2 standard deviations	No. of samples	Percent ≤ 1 standard deviation	Percent ≤ 2 standard deviations
Manganese(ICP)	20	70.0	90.0	22	72.7	95.5
Manganese(AA)	33	97.0	97.0	32	93.8	96.9
Manganese, total recoverable	12	83.3	100	11	72.7	100
Molybdenum(ICP)	20	85.0	100	22	81.8	100
Molybdenum(AA)	21	42.9	61.9	21	66.7	95.2
Nickel	34	88.2	100	37	51.4	86.5
Nickel, total recoverable	12	91.7	100	11	81.8	100
Selenium	26	100	100	25	100	100
Silver	14	71.4	78.6	14	85.7	92.9
Silver, total recoverable	12	75.0	91.7	11	100	100
Strontium[1]	21	71.4	76.2	20	75.0	75.0
Zinc(ICP)	20	80.0	95.0	22	54.5	86.4
Zinc(AA)	33	100	100	32	93.8	100
Zinc, total recoverable	12	83.6	100	11	81.8	100

[1] See Discussion and Recommendations

Table 3.--Tabulation of data over 2 standard deviations from the most probable value for the Atlanta laboratory: major constituents and specific conductance

[All constituents were in dissolved phase]

Determination/ Percent > 2 standard deviations/ Total Analyses	Concentration range of reference samples (mg/L)	Reported value (mg/L)	Most probable value (mg/L)	Most probable standard deviation (mg/L)	Number of standard deviations
Calcium(ICP)/ 5.3/38	6.9-107	7.3	6.9	0.07	5.20
		7.1	6.9	.07	2.53
Chloride/2/50	1.3-99	32	24.3	1.44	5.34
Flouride/18/50	0.29-1.99	0.1	1.99	0.07	-25.20
		.2	1.99	.07	-23.87
		.4	1.99	.07	-21.20
		.1	1.99	.07	-25.20
		1.3	1.56	.07	-3.47
		1.4	1.56	.07	-2.13
		.1	1.00	.07	-12.00
		.1	1.00	.07	-12.00
		.1	1.12	.07	-13.60
Magnesium(AA)/ 10/10	20-53	14	20.3	1.26	-4.99

Table 4.--Tabulation of data over 2 standard deviations from the most probable value for the Atlanta laboratory: trace metals

[All constituents were in dissolved phase; data designated as 'total recoverable' are from samples which have undergone a preliminary digestion]

Determination/ Percent > 2 standard deviations/ Total Analyses	Concentration range of reference samples ($\mu g/L$)	Reported value ($\mu g/L$)	Most probable value ($\mu g/L$)	Most probable standard deviation ($\mu g/L$)	Number of standard deviations
Aluminum/9.1/22	60-478	350	478	58.5	-2.19
		640	478	58.5	2.77
Antimony/50/2	1-5	1	5.0	0.9	-4.55
Arsenic/2.2/46	1.8-30	19	3.6	1.3	11.95
Barium(ICP)/ 55/20	80-229	140	120	8.3	2.42
		67	80	6.1	-2.18
		67	80	6.1	-2.18
		68	80	6.1	-2.02
		67	80	6.1	-2.18
		180	150	9.9	3.02
		180	150	9.9	3.02
		200	150	9.9	5.04
		180	150	9.9	3.02
		67	102	7.3	-4.80
		260	229	14.3	2.17
Beryllium/4.8/21	0.5-36	0.5	13.5	2.7	-4.83
Cadmium(ICP)/5/20	0.9-7.5	1	5.7	0.8	-6.21
Cadmium(AA)/ 9.1/33	2.5-13.3	8	5.6	1.1	2.22
		8	5.6	1.1	2.22
		7	4.3	.8	3.35
Chromium, total recoverable/ 50/12	3.9-14	30	10.5	7.2	2.71
		20	3.9	7.2	2.24
		20	4.3	7.2	2.17
		20	4.3	7.2	2.17
		20	4.3	7.2	2.17
		30	14.0	7.2	2.22
Cobalt(AA)/7.7/13	2.3-14.5	7	3.2	1.6	2.39
Cobalt, total recoverable/ 25/12	2.3-5.68	7	3.2	1.6	2.39
		6	2.3	1.6	2.31
		7	2.3	1.6	2.94

Table 4.--Tabulation of data over 2 standard deviations from the most probable value for the Atlanta laboratory: trace metals--continued

[All constituents were in dissolved phase; data designated as 'total recoverable' are from samples which have undergone a preliminary digestion]

Determination/ Percent > 2 standard deviations/ Total Analyses	Concentration range of reference samples (µg/L)	Reported value (µg/L)	Most probable value (µg/L)	Most probable standard deviation (µg/L)	Number of standard deviations
Copper(ICP)/5/20	8.9-57	10	56.1	7.5	-6.15
Copper(AA)/3/33	14-264	5	54.1	7.1	-6.90
Iron(ICP)[1]/25/20	15-551	460	352	24.4	4.43
		460	352	24.4	4.43
		470	352	24.4	4.84
		460	352	24.4	4.43
		3	170	24.4	-6.84
Iron(AA)/6.1/33	15-551	120	188	31.0	-2.19
		330	20	19.9	15.58
Iron, total recoverable[1]/ 50/12	15-352	240	151	28.5	3.12
		140	16	19.6	6.35
		130	16	19.6	5.84
		170	16	19.6	7.88
		170	16	19.6	7.88
		460	352	41.8	2.58
Lead(ICP)5/20	1.7-8.4	50	2.4	7.5	6.34
Lead(AA)/18.2/33	1.7-22	8	4.4	1.5	2.44
		8	4.4	1.5	2.44
		8	4.4	1.5	2.44
		2	16.7	4.3	-3.41
		14	8.4	2.4	2.33
		17	8.4	2.4	3.59
Lead, total recoverable/ 33.3/12	1.7-8.4	8	4.4	1.5	2.44
		8	4.4	1.5	2.44
		8	4.4	1.5	2.44
		9	1.8	.9	8.41
Lithium/9.5/21	24-394	53	110	13.7	-4.16
		31	77	10.7	-4.30
Manganese(ICP)/ 10/20	5-420	270	127	23.1	6.19
		1	136	23.1	-5.84

Table 4.--Tabulation of data over 2 standard deviations from the most probable value for the Atlanta laboratory: trace metals--continued

[All constituents were in dissolved phase; data designated as 'total recoverable' are from samples which have undergone a preliminary digestion]

Determination/ Percent > 2 standard deviations/ Total Analyses	Concentration range of reference samples (µg/L)	Reported value (µg/L)	Most probable value (µg/L)	Most probable standard deviation (µg/L)	Number of standard deviations
Manganese(AA)/ 3/33	79-420	100	274	23.6	-7.36
Molybdenum(AA)/ 38.1/21	1-50	11	27.5	3.2	-5.17
		36	27.5	3.2	2.66
		34	27.5	3.2	2.04
		16	10.9	2.1	2.47
		5	1.0	1.4	2.88
		4	1.0	1.4	2.16
		60	49.7	4.7	2.19
		70	49.7	4.7	4.32
Silver/21.4/14	0.5-3.2	4	1.3	0.8	3.67
		3	1.3	.8	2.33
		1	3.1	.8	-2.84
Silver, total recoverable/ 25/12	0.5-1.4	4	1.3	0.8	3.67
		3	1.3	.8	2.33
		3	1.3	.8	2.33
Strontium[1]/ 23.8/21	60-953	750	953	43.8	-4.64
		750	953	43.8	-4.64
		750	953	43.8	-4.64
		740	953	43.8	-4.87
		740	953	43.8	-4.87
Zinc/5/20	11-130	3	103	14.0	-9.07

1 See Discussion and Recommendations

Table 5.--Tabulation of data over 2 standard deviations from the most probable value for the Denver laboratory: major constituents and specific conductance

[All constituents were in dissolved phase]

Determination/ Percent > 2 standard deviations/ Total Analyses	Concentration range of reference samples (mg/L)	Reported value (mg/L)	Most probable value (mg/L)	Most probable standard deviation (mg/L)	Number of standard deviations
Calcium(ICP)/2.3/43	37-87	7.1	6.9	0.07	2.53
Chloride/3.4/58	1.3-98.8	110	98.8	3.45	3.24
		35	31.3	1.63	2.27
Dissolved solids/ 9.3/54	43.8-926	882	789	30.2	3.08
		885	789	30.2	3.18
		892	789	30.2	3.41
		258	224	16.7	2.04
		1040	926	33.5	3.40
Fluoride/6.9/58	0.29-1.99	1.5	1.14	0.07	4.80
		1.4	1.14	.07	3.47
		1.5	1.14	.07	4.80
		1.6	1.14	.07	6.13
Potassium/1.8/56	0.94-5.6	1.1	0.9	0.07	2.07
Specific conductance[1]/ 1.7/58	69.3-1306	484	402.3	17.9	4.58

1 Units are µmhos/cm at 25° C.

Table 6.--Tabulation of data over 2 standard deviations from the most probable value for the Denver laboratory: trace metals

[All constituents were in dissolved phase; data designated as 'total recoverable' are from samples which have undergone a preliminary digestion]

Determination/ Percent > 2 standard deviations/ Total Analyses	Concentration range of reference samples (μg/L)	Reported value (μg/L)	Most probable value (μg/L)	Most probable standard deviation (μg/L)	Number of standard deviations
Antimony/33.3/3	1-5	1	5.0	0.9	-4.55
Barium(ICP)/ 20/20	80-180	58	80	6.1	-3.66
		57	80	6.1	-3.82
		59	80	6.1	-3.49
		56	80	6.1	-3.99
Cadmium(ICP)/ 4.5/22	0.9-7.5	2	7.0	1.3	-3.91
Cadmium(AA)/ 6.2/32	2.2-13.3	1	2.6	0.8	-2.17
		3	5.6	1.1	-2.40
Cadmium, total recoverable/ 9.1/11	2.6-3.07	1	2.8	0.8	-2.40
Chromium/13.5/37	3.9-25	80	6.5	7.2	10.21
		20	3.9	7.2	2.24
		20	3.9	7.2	2.24
		70	8.7	7.2	8.51
		50	8.7	7.2	5.74
Chromium, total recoverable/ 36.4/11	3.9-10.5	30	3.9	7.2	3.63
		20	3.9	7.2	2.24
		20	3.9	7.2	2.24
		20	4.3	7.2	2.17
Cobalt(AA)/9.1/11	2.3-3.2	6	2.7	1.6	2.06
Copper(AA)/6.2/32	21-264	130	106	11.5	2.09
		35	120	12.6	-6.72
Copper, total recoverable/ 18.2/11	21-100	140	100	11	3.65
		96	54.1	7.1	5.89

Table 6.--Tabulation of data over 2 standard deviations from the most probable value for the Denver laboratory: trace metals--continued

[All constituents were in dissolved phase; data designated as 'total recoverable' are from samples which have undergone a preliminary digestion]

Determination/ Percent > 2 standard deviations/ Total Analyses	Concentration range of reference samples (µg/L)	Reported value (µg/L)	Most probable value (µg/L)	Most probable standard deviation (µg/L)	Number of standard deviations
Iron(ICP)[1]/18.2/ 22	15-551	280	551	24.4	-11.11
		430	352	24.4	3.20
		440	352	24.4	3.61
		430	352	24.4	3.20
Iron(AA)[1]/9.4/ 32	15-551	210	151	28.5	2.07
		210	151	28.5	2.07
		170	31	20.6	6.74
Iron, total recoverable[1]/ 18.2/11	15-188	240	151	28.5	3.12
		250	188	31.0	2.00
Lead(AA)/6.2/32	4-22	4	9.8	2.7	-2.12
		8	16.7	4.3	-2.02
Manganese(ICP)/ 4.5/22	5-420	25	420	23.1	-17.10
Manganese(AA)/ 3.1/32	79-420	170	274	23.6	-4.40
Molybdenum(AA)/ 4.8/21	1-50	4	10.9	2.1	-3.35
Nickel/13.5/37	4.9-17	1	10.5	4.3	-2.21
		1	10.5	4.3	-2.21
		7	16.8	4.3	-2.28
		5	16.8	4.3	-2.74
		4	16.8	4.3	-2.98
Silver/7.1/14	1-3.1	1.0	3.1	0.8	-2.84

Table 6.--Tabulation of data over 2 standard deviations from the most probable value for the Denver laboratory: trace metals--continued

[All constituents were in dissolved phase; data designated as 'total recoverable' are from samples which have undergone a preliminary digestion]

Determination/ Percent > 2 standard deviations/ Total Analyses	Concentration range of reference samples (µg/L)	Reported value (µg/L)	Most probable value (µg/L)	Most probable standard deviation (µg/L)	Number of standard deviations
Strontium[1]/25/20	60-953	770	953	43.8	-4.18
		740	953	43.8	-4.87
		760	953	43.8	-4.41
		740	953	43.8	-4.87
		760	953	43.8	-4.41
Zinc(ICP)/13.6/ 22	11-130	21	87.6	14.0	-4.76
		180	130	14.0	3.57
		91	60.9	14.0	2.15

1 See Discussions and Recommendations

Table 7.--Comparison of results for nutrient samples

		Atlanta			Denver		
Constituent	Mix	N	Mean	Standard deviation	N	Mean	Standard deviation
Ammonia	1	12	1.4	0.12	10	1.5	0.06
	2	10	.61	.024	10	.56	.184
	3	6	.33	.037	14	.34	.085
	4	12	.85	.025	12	.89	.052
	5	12	.59	.105	12	.49	.095
	6	8	.26	.017	16	.23	.020
	7	6	1.1	.04	6	1.0	.05
	8	8	.43	.027	24	.41	.029
	9	10	.19	.062	10	.16	.047
	10	12	1.2	.03	10	1.2	.20
	11	6	.92	.090	12	.83	.089
Ammonia plus organic nitrogen	1	12	2.9	0.51	10	3.0	0.34
	2	10	.82	.230	10	1.0	.16
	3	6	.58	.417	14	.86	.150
	4	12	1.2	.22	12	1.7	.21
	5	12	1.3	.50	12	1.1	.13
	6	8	.99	.155	16	.78	.211
	7	6	2.3	.22	6	2.4	.16
	8	8	1.3	.18	24	1.2	.14
	9	10	.96	.448	10	.80	.067
	10	12	1.6	.56	10	1.5	.13
	11	6	2.0	.13	12	1.9	.15
Carbon, organic	2	10	14	0.8	10	13	1.5
	3	3	5.9	.47	2	4.0	.14
	6	6	9.4	1.42	10	9.3	.38
	7	3	20	.6	3	21	3.2
	8	2	24	1.4	3	31	12.4
	9	10	16	.5	10	13	3.1
	10	3	3.3	.21	1	3.6	---
	11	3	6.8	.00	2	7.7	.71
Nitrite plus nitrate nitrogen	1	12	3.7	0.11	10	3.4	0.10
	2	10	.79	.016	10	.79	.018
	3	6	2.9	.06	14	2.8	.06
	4	12	1.6	.05	12	1.3	.39
	5	12	.71	.012	12	.63	.157
	6	8	1.4	.04	16	1.3	.03
	7	6	2.0	.26	6	2.0	.05
	8	8	1.1	.11	24	1.0	.01
	9	10	.34	.037	10	.33	.031
	10	12	2.1	.08	10	2.0	.05
	11	6	1.1	.04	12	1.2	.48
	12	4	2.5	.10	4	.65	1.100
	13	4	1.7	.00	4	1.5	.00
	14	2	4.6	.35	4	4.0	.00

Table 7.--Comparison of results for nutrient samples--continued

Constituent	Mix	Atlanta N	Atlanta Mean	Atlanta Standard deviation	Denver N	Denver Mean	Denver Standard deviation
Nitrite-nitrogen	2	10	0.10	0.005	10	0.09	0.029
	6	7	.21	.005	13	.22	.009
	9	10	.14	.015	10	.16	.005
	10	3	.08	.006	3	.08	.000
Phosphorus	1	12	0.92	0.784	10	1.2	0.13
	2	10	.44	.010	10	.40	.029
	3	3	1.[illegible]	.31	11	1.4	.21
	4	12	1.3	.11	12	1.3	.26
	5	12	.57	.010	12	.56	.013
	6	8	.30	.016	16	.29	.014
	7	3	.74	.294	3	.94	.026
	8	8	.70	.024	24	.72	.016
	9	10	.99	.012	10	.98	.011
	10	9	.50	.167	8	.54	.012
	11	6	.79	.005	12	.77	.012
	12	4	.63	.022	4	.61	.024
	13	4	1.0	.00	4	1.0	.06
	14	2	.87	.014	4	.86	.028
Phosphorus, ortho	2	10	0.28	0.022	10	0.25	0.061
	6	8	.14	.019	16	.13	.017
	9	10	.69	.012	10	.77	.066
	10	6	.42	.015	6	.39	.026

Table 8.--Results of statistical evaluation for nutrients

Constituent	Comparison of means	Comparison of standard deviations
Ammonia	A	A
Ammonia plus organic N	A	B
Carbon, organic	A	A
Nitrite plus nitrate N	A	A
Nitrite N	A	A
Phosphorus	A	A
Phosphorus, ortho	A	A

A = No significant difference
B = Significant difference

Table 9.--Comparison of results for precipitation level analyses

Constituent	MPV	Mix	N	Atlanta Mean	Atlanta Standard Deviation	N	Denver Mean	Denver Standard Deviation
Ammonia	--	1	1	0.038	---	1	0.035	---
	--	3	2	<.008	.009	2	.006	.002
Calcium	1.90	1	1	1.90	---	1	1.70	---
	.82	2	3	.710	.035	3	.627	.032
	.55	3	2	.505	.078	2	.430	.057
Chloride	0.60	1	1	0.480	---	1	0.520	---
	.81	2	3	.440	.017	3	.477	.029
	.106	3	2	<.200	.000	2	.125	.007
Fluoride	0.10	1	1	0.110	---	1	0.120	---
	--	2	3	.023	006	3	.070	.072
	.023	3	2	<.015	.007	2	.020	.014
Magnesium	0.32	1	1	0.340	---	1	0.300	---
	.10	2	3	.097	.012	3	.097	.006
	.144	3	2	.135	.007	2	.135	.007
Nitrate-nitrogen	0.19	2	2	0.140	0.000	2	0.135	0.007
		3	2	<.050	.000	2	<.010	.000
Phosphorus	--	1	1	<0.001	---	1	0.006	---
	--	3	2	.023	.011	2	<.014	.013
Potassium	0.19	1	1	0.190	---	1	0.210	---
	.09	2	3	.060	.000	3	.063	.012
	.075	3	2	.070	.000	2	.075	.007
Sodium	0.66	1	1	0.660	---	1	0.660	---
	.19	2	3	.187	.021	3	.180	.000
	.25	3	2	.240	.000	2	.250	.000
Specific conductance	18.6	1	1	15.0	---	1	21.0	---
	8.6	2	3	8.67	1.16	3	9.00	1.00
	5.5	3	2	6.00	1.41	2	8.00	.000
Sulfate	3.24	1	1	2.91	---	1	2.70	---
	1.55	2	3	1.14	.021	3	1.23	.159
	1.12	3	2	1.10	.106	2	1.25	.198

Table 10.--Results of statistical evaluation for precipitation level analyses

Constituent	Comparison of means between labs	Comparison of MPV and Denver mean	Comparison of MPV and Atlanta mean
Ammonia	A	-	-
Calcium	A	E	A
Chloride	A	A	A
Fluoride	A	A	A
Magnesium	A	A	A
Nitrate, nitrogen	C	C	C
Phosphorus	A	-	-
Potassium	A	A	A
Sodium	A	A	A
Specific conductance	A	A	A
Sulfate	A	A	A

A = No significant difference
B = Significant difference
C = Inconsistent minimum reporting values
\- = No MPV available for this constituent

Table 11.--Comparison of results for organic samples

		Atlanta			Denver		
Constituent	Mix	N	Mean	Standard Deviation	N	Mean	Standard Deviation
2, 4-D	1	3	8.0	0.87	4	17	1.0
	2	3	4.9	.99	4	13	.5
	3	4	.21	.033	4	.16	.008
	4	4	.40	.022	3	.28	.047
	5	1	.29	----	3	.80	.150
	6	1	.28	----	3	.96	.156
2, 4 5-T	1	3	73	14.2	4	118	5.0
	2	3	42	9.0	4	86	1.7
	3	4	.04	.029	4	.02	.005
	4	4	.03	.006	3	.03	.006
	5	1	.02	----	3	.03	.006
	6	1	.02	----	3	.03	.006
Aldrin	1	3	13	3.1	4	<10	0.0
	3	4	18	6.6	4	31	4.2
	4	4	45	20.9	2	60	18.4
	5	1	.05	----	4	.14	.010
	6	1	.05	----	3	.12	.026
DDD	1	3	17	2.1	4	<11	0.8
	5	1	.51	----	4	.23	.017
	6	1	.45	----	3	.19	.056
DDE	1	3	100	86.6	4	<10	0.00
	2	3	102	7.2	4	<10	.00
	5	1	.95	----	4	.153	.005
	6	1	.89	----	3	.123	.029
DDT	3	4	253	64.0	4	365	54.5
	4	4	593	217.0	2	690	70.7
	5	1	.95	----	4	.23	.015
	6	1	1	----	3	.19	.060
Diazinon	3	4	<118	135.7	4	303	12.6
	4	4	<1095	1604.6	2	690	70.7
	5	1	.05	----	3	.05	.006
	6	1	.06	----	3	.05	.000

Table 11.--Comparison of results for organic samples--cont.

Constituent	Mix	Atlanta N	Atlanta Mean	Atlanta Standard Deviation	Denver N	Denver Mean	Denver Standard Deviation
Dieldrin	1	3	37	52.2	4	88	8.5
	2	3	4.9	.35	4	63	2.1
	3	4	31	6.7	4	44	2.4
	4	4	96	44.2	2	88	2.8
	5	1	.11	----	4	.55	.059
	6	1	.12	----	3	.50	.160
Endrin	1	3	43	6.0	4	40	3.4
	2	3	26	.6	4	28	1.3
	3	4	27	4.4	4	28	1.4
	4	4	86	38.0	2	62	3.5
	5	1	.26	----	4	.23	.048
	6	1	.24	----	3	.18	.061
Ethion	1	3	75	4.9	4	75	5.0
	2	3	57	10.8	4	52	8.5
	5	1	2.8	----	3	.46	.156
	6	1	3	----	3	.44	.026
Heptachlor epoxide	1	3	53	2.9	4	52	4.0
	2	3	33	1.0	4	37	.8
	5	1	.02	----	4	.23	.028
	6	1	.02	----	3	.21	.075
Heptachlor	1	3	43	3.1	4	40	4.5
	2	3	25	.0	4	30	1.9
	3	4	9.95	3.268	4	29	1.9
	4	4	41	16.7	2	67	18.4
	5	1	.02	----	4	.18	.013
	6	1	.03	----	3	.12	.036
Lindane	1	3	102	31.2	4	89	5.0
	2	3	46	1.5	4	63	2.8
	3	4	22	10.1	4	37	1.4
	4	4	80	34.0	2	79	.707
	5	1	.03	----	4	.03	.005
	6	1	.03	----	3	.03	.012

Table 11.--Comparison of results for organic samples--cont.

		Atlanta			Denver		
Constituent	Mix	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Malathion	1	3	125	93.9	4	545	38.7
	2	3	227	49.3	4	<288	185.5
	5	1	<.01	----	3	<.01	.006
	6	1	.02	----	3	<.01	.000
Methoxychlor	1	3	48	16.1	4	74	10.0
	2	3	18	4.0	4	52	1.3
	5	1	2.1	----	4	.50	.048
	6	1	2.4	----	3	.44	.117
Methylparathion	1	3	190	10.0	4	150	0.0
	2	3	106	5.8	4	102	5.2
	5	1	.06	----	3	.04	.006
	6	1	.06	----	3	.04	.006
Mirex	5	1	0.02	----	4	<0.01	0.000
Parathion	1	3	69	3.1	4	150	0.0
	2	3	44	6.0	4	67	5.9
	5	1	.09	----	3	.10	.015
	6	1	.09	----	3	.09	.006
Silvex	1	3	76	3.1	4	99	8.7
	2	3	35	7.5	4	72	2.2
	3	4	.26	.230	4	.05	.005
	4	4	.12	.008	3	.10	.015
	5	1	.04	----	3	.09	.015
	6	1	.04	----	3	.10	.012

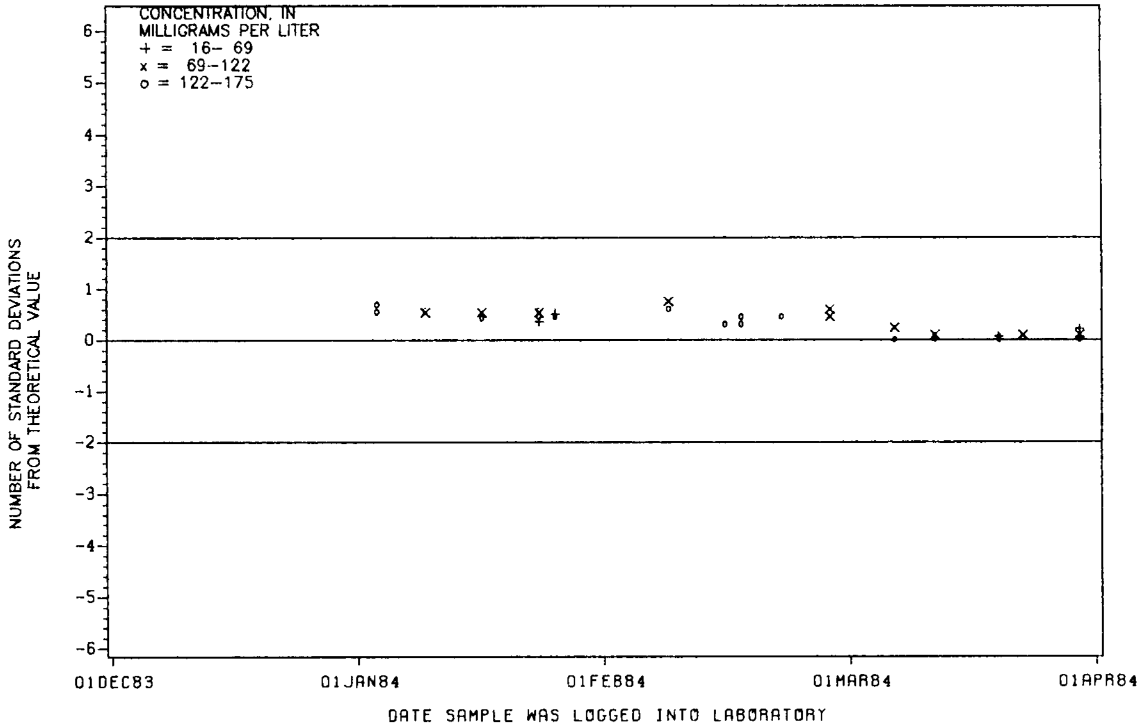

Figure A1.—–Alkalinity data from the Atlanta laboratory.

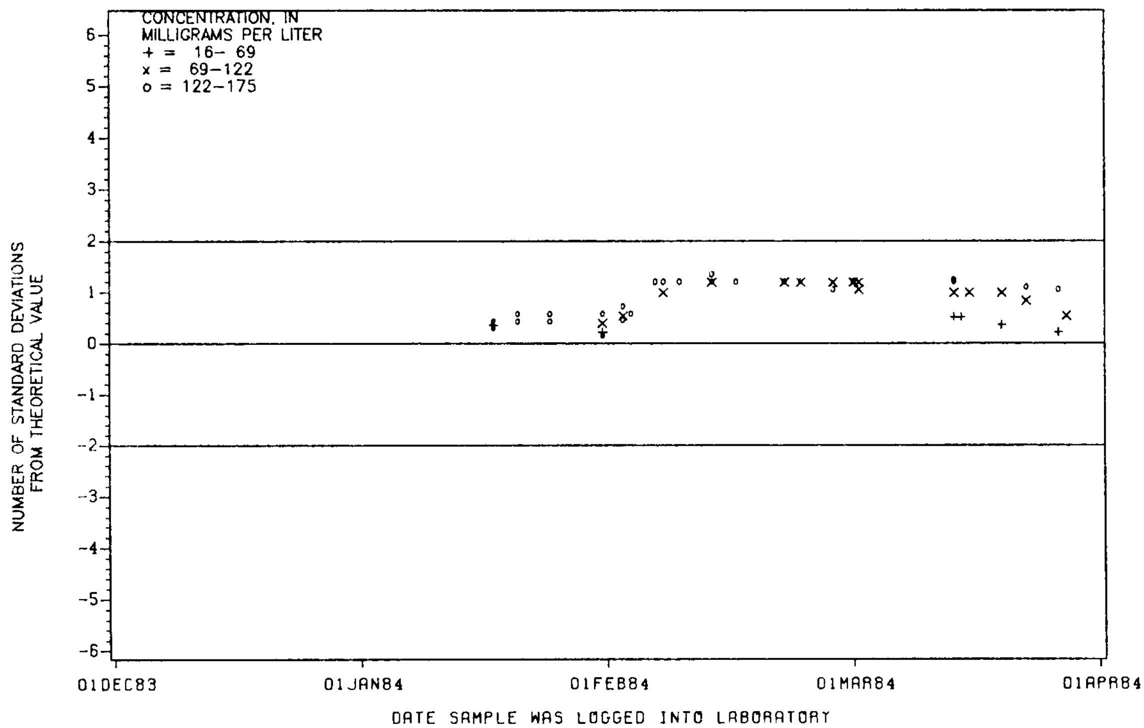

Figure D1.—–Alkalinity data from the Denver laboratory.

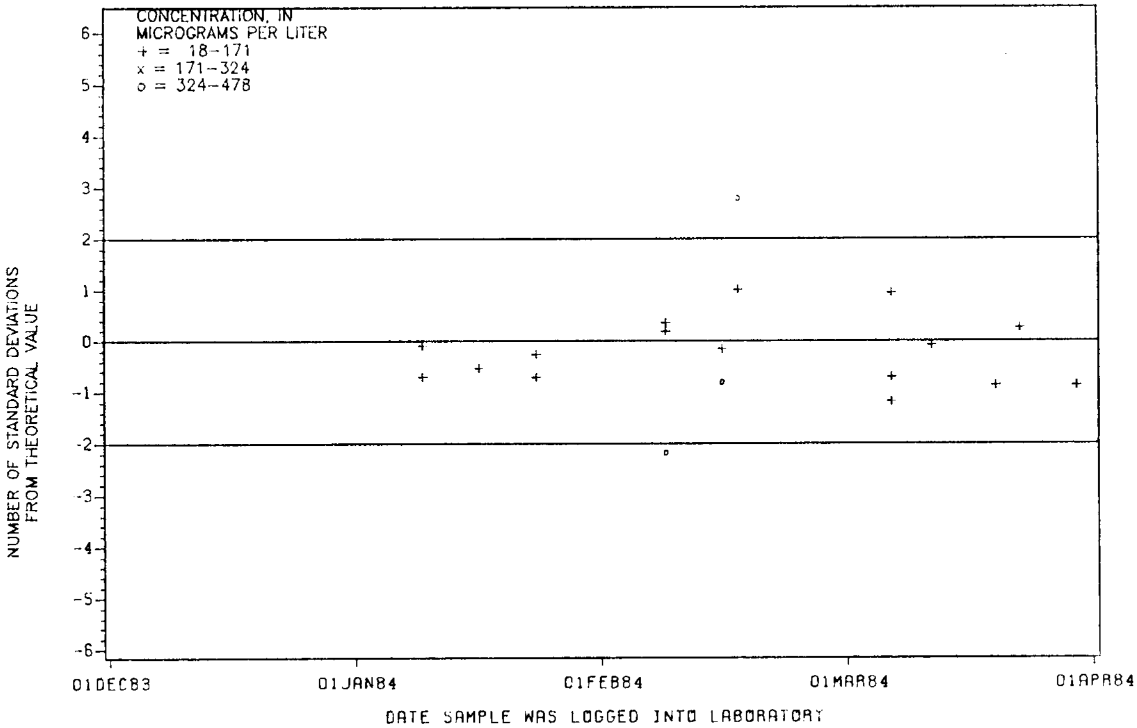

Figure A2.—–Aluminum data from the Atlanta laboratory.

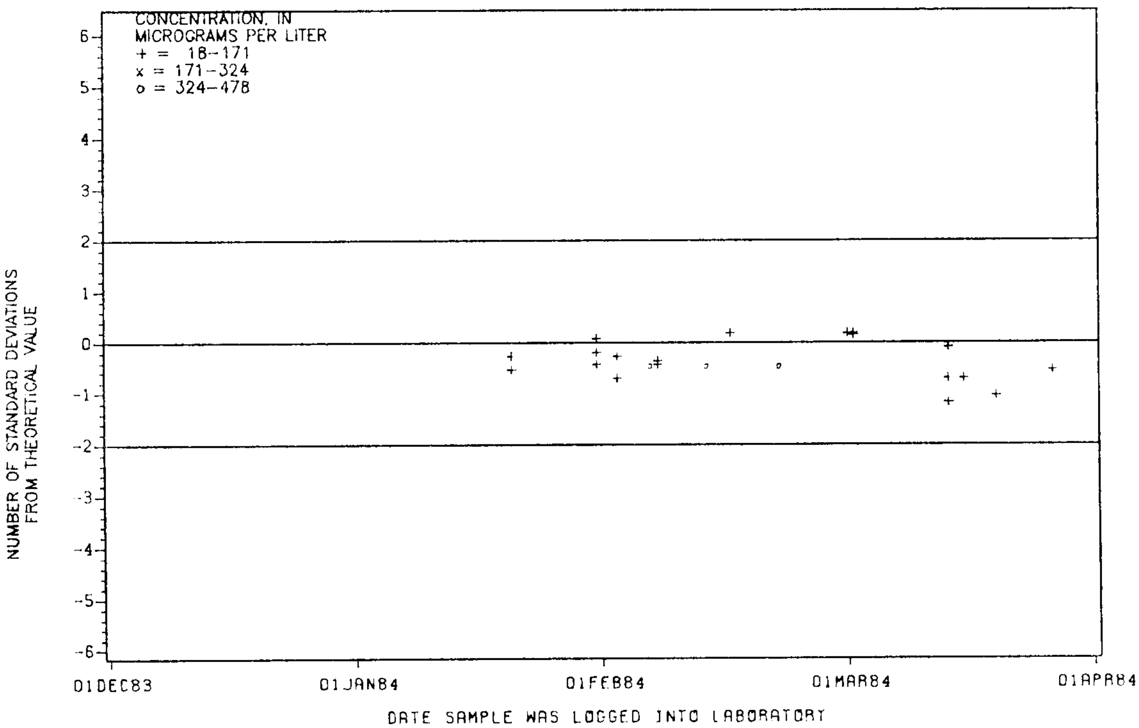

Figure D2.—–Aluminum data from the Denver laboratory.

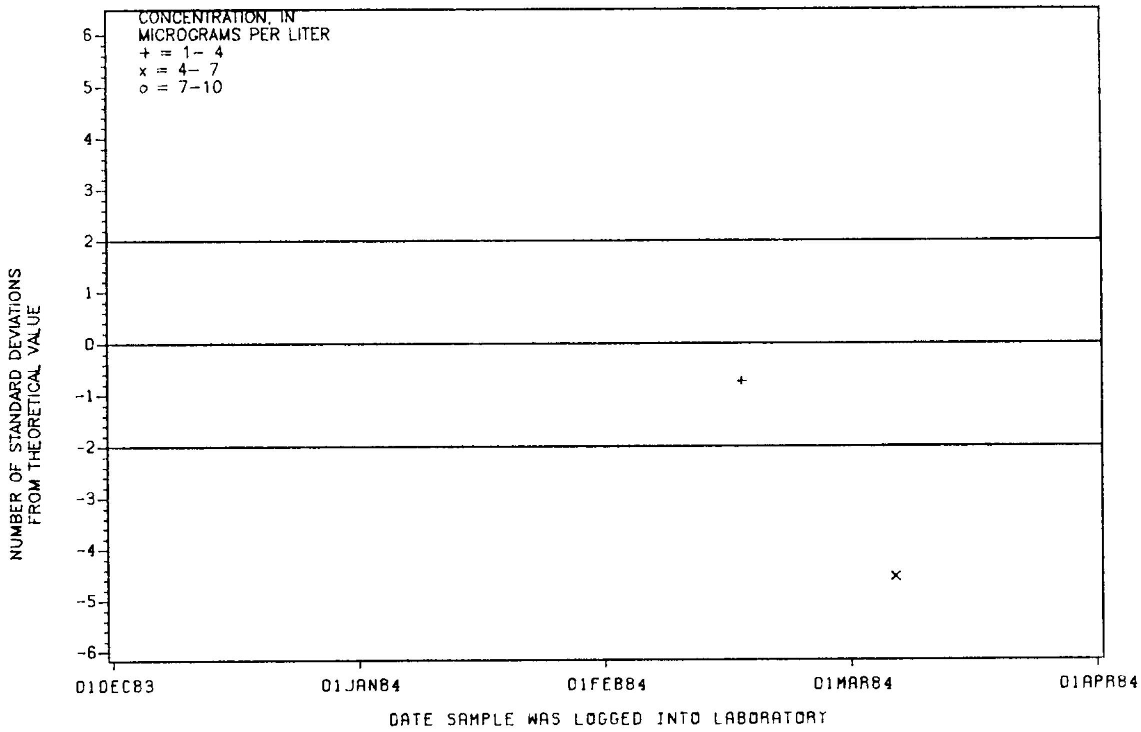

Figure A3.--Antimony data from the Atlanta laboratory.

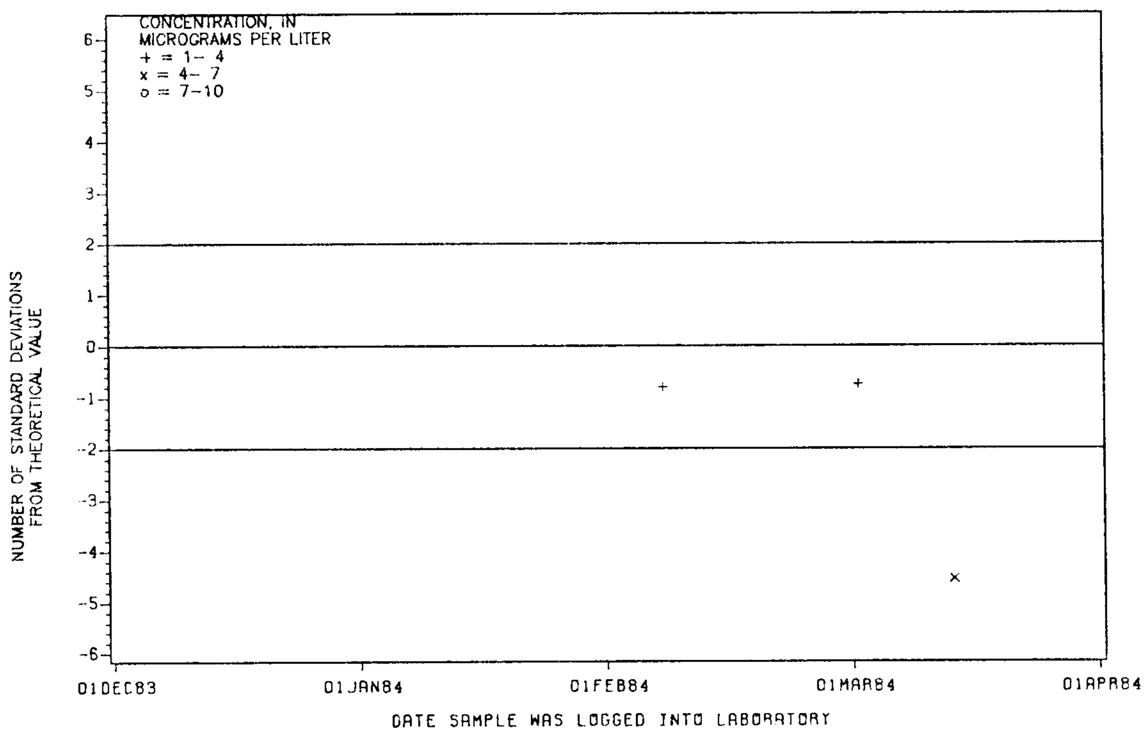

Figure D3.--Antimony data from the Denver laboratory.

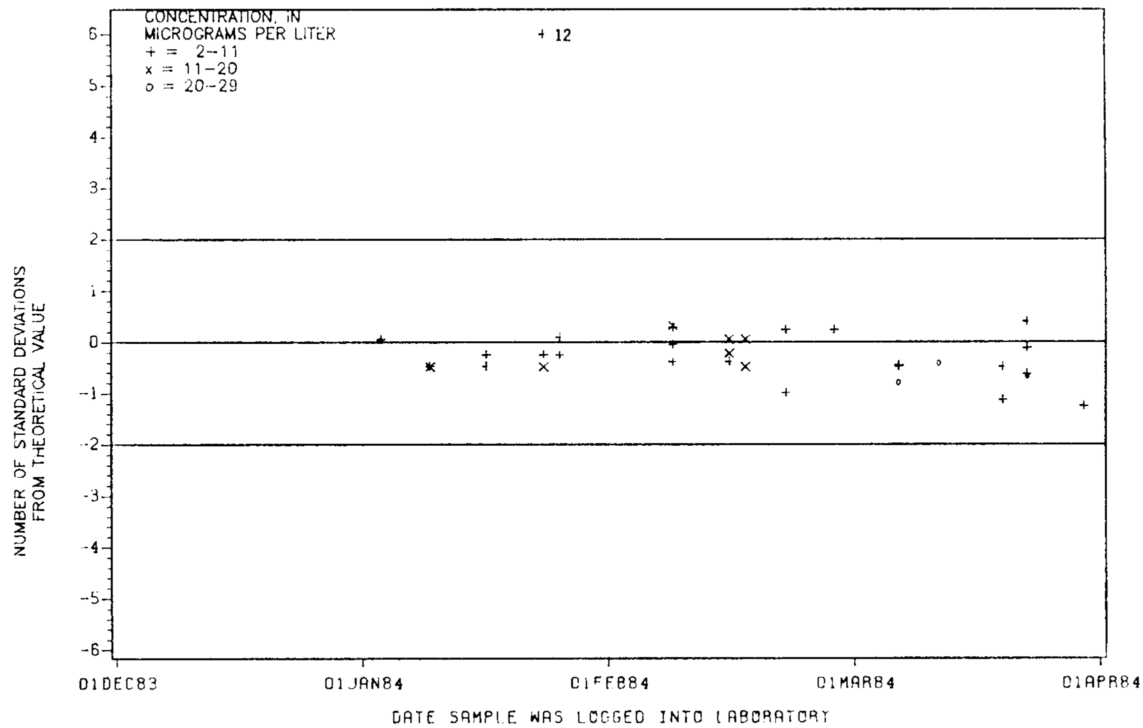

Figure A4.--Arsenic data from the Atlanta laboratory.

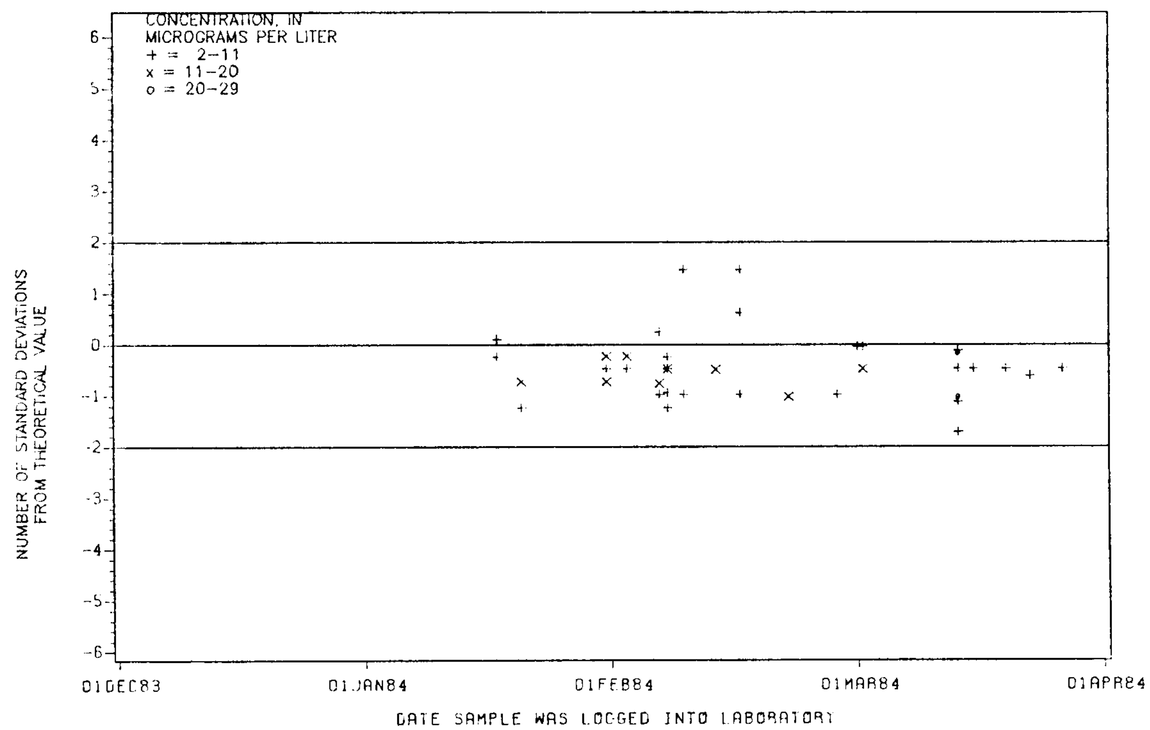

Figure D4.--Arsenic data from the Denver laboratory.

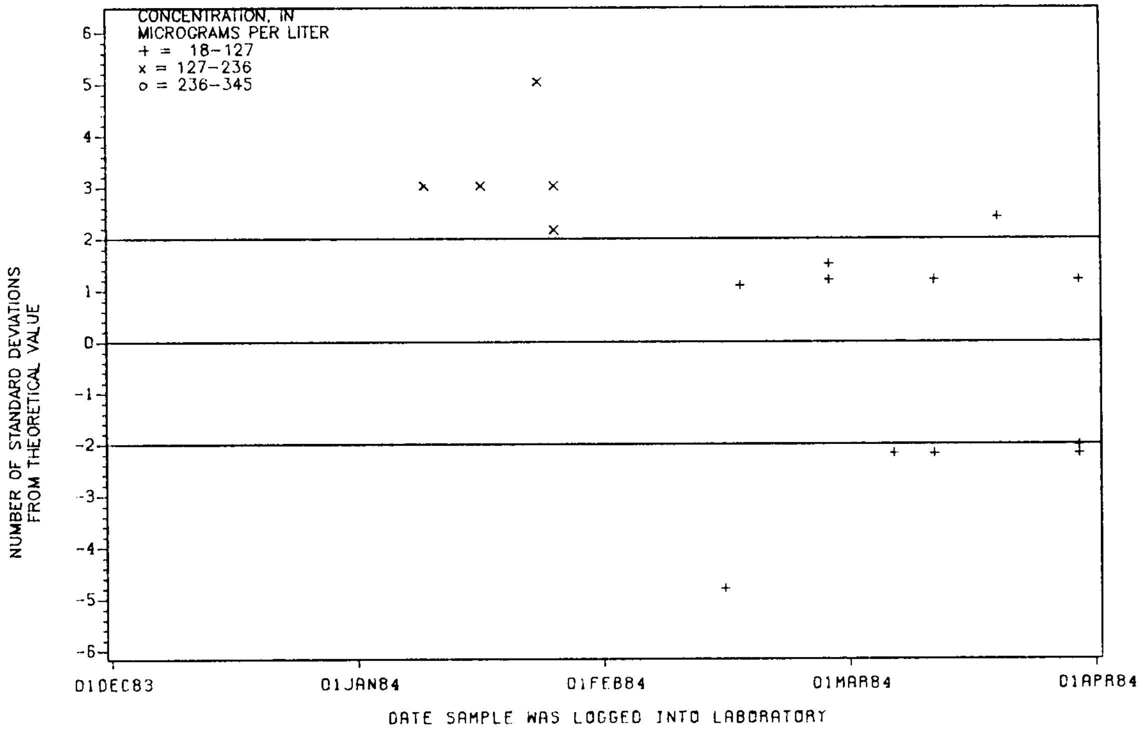

Figure A5.--Barium(ICP) data from the Atlanta laboratory.

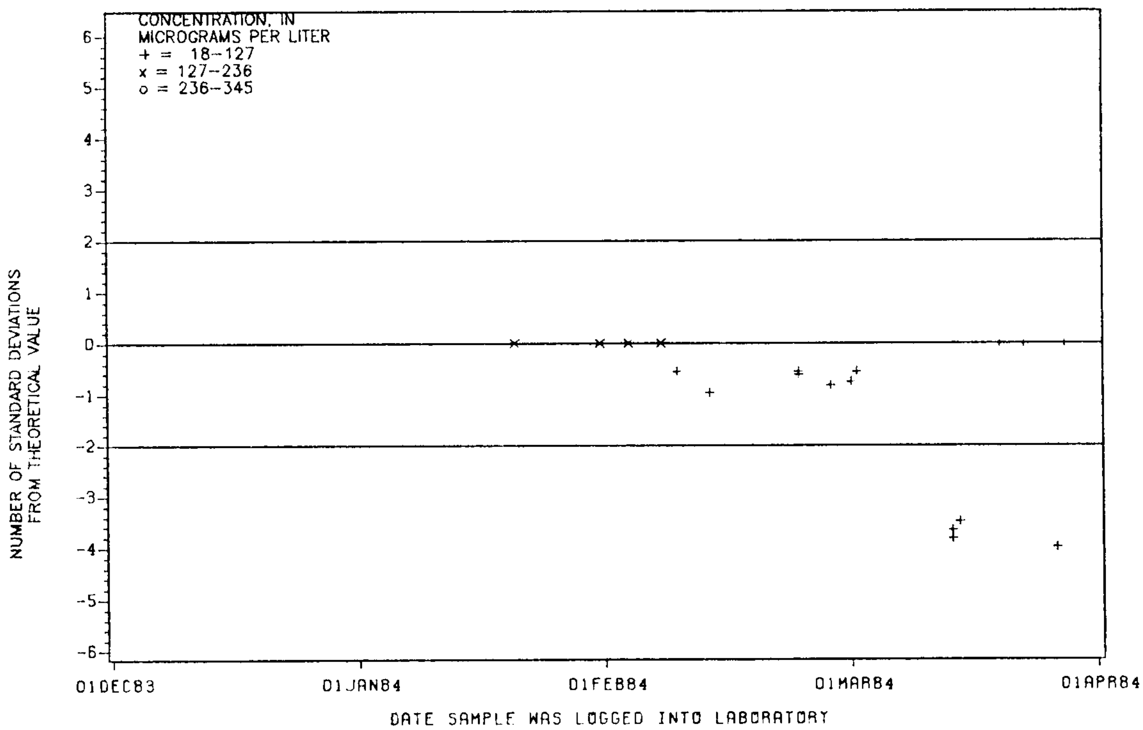

Figure D5.--Barium(ICP) data from the Denver laboratory.

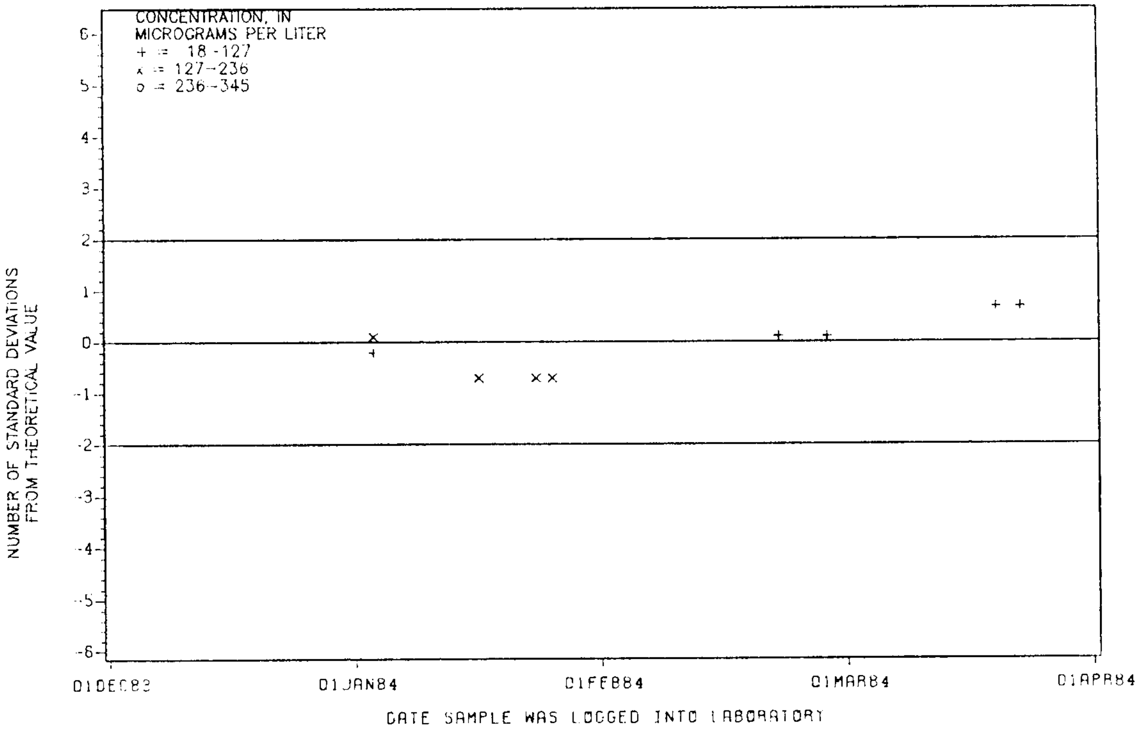

Figure A6.--Barium(AA) data from the Atlanta laboratory.

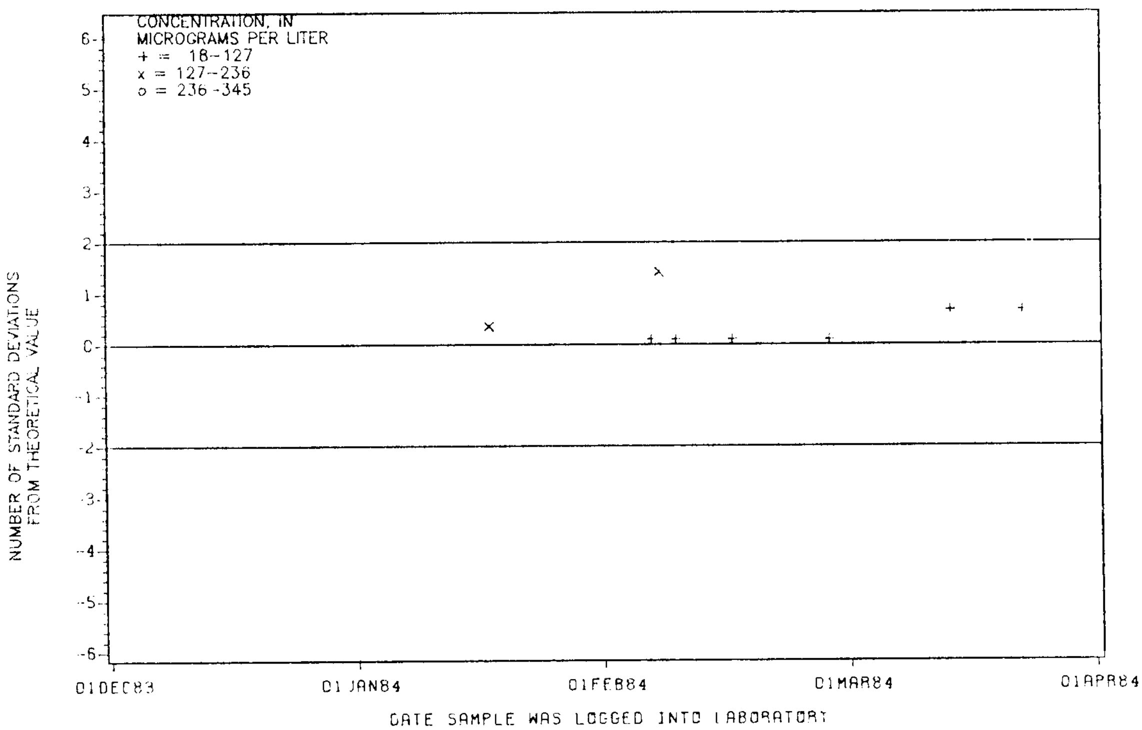

Figure D6.--Barium(AA) data from the Denver laboratory.

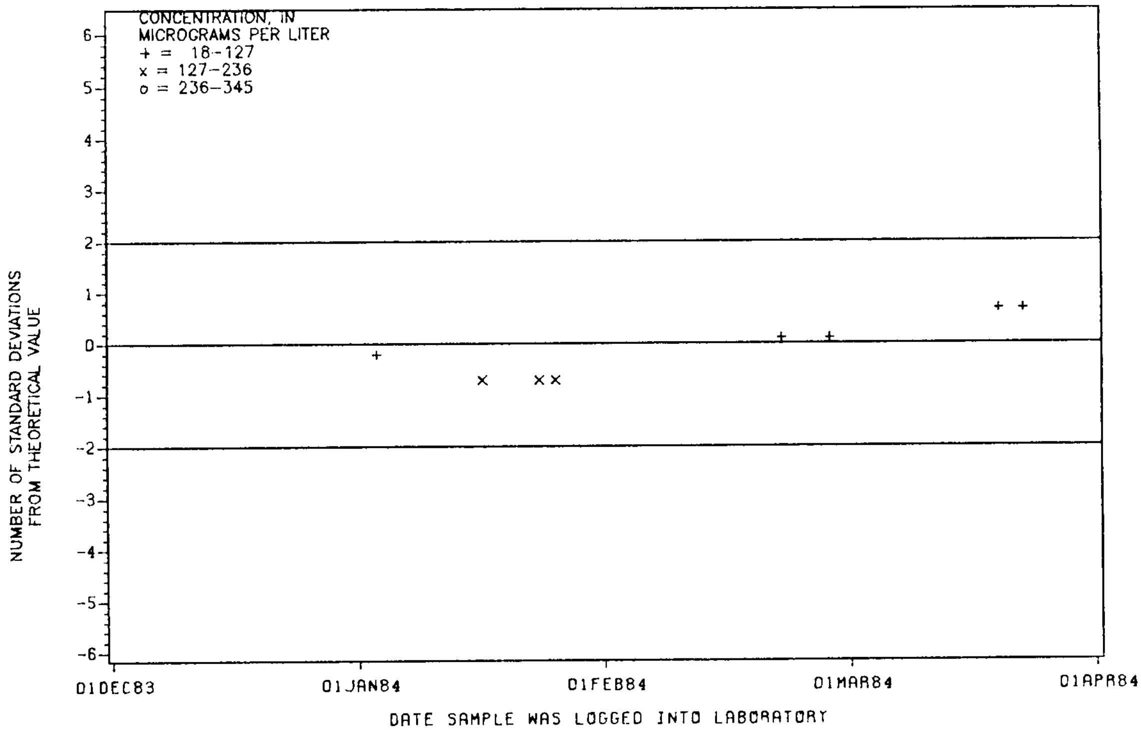

Figure A7.--Barium, total recoverable data from the Atlanta laboratory.

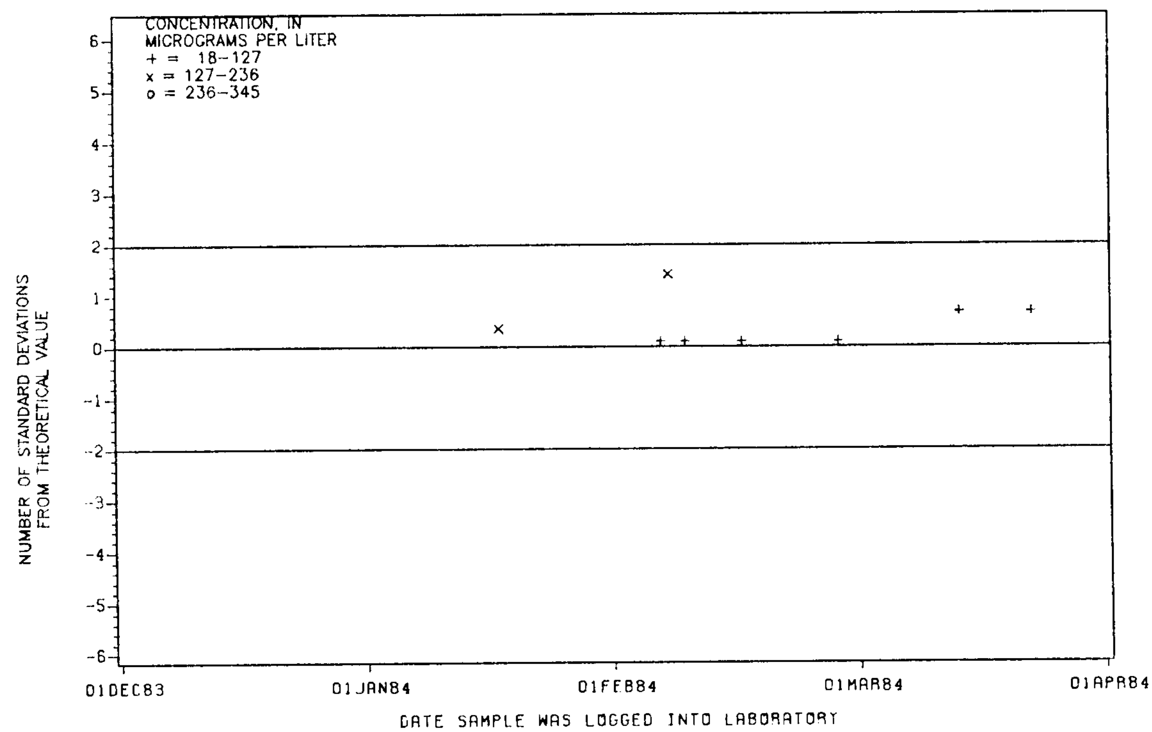

Figure D7.--Barium, total recoverable data from the Denver laboratory.

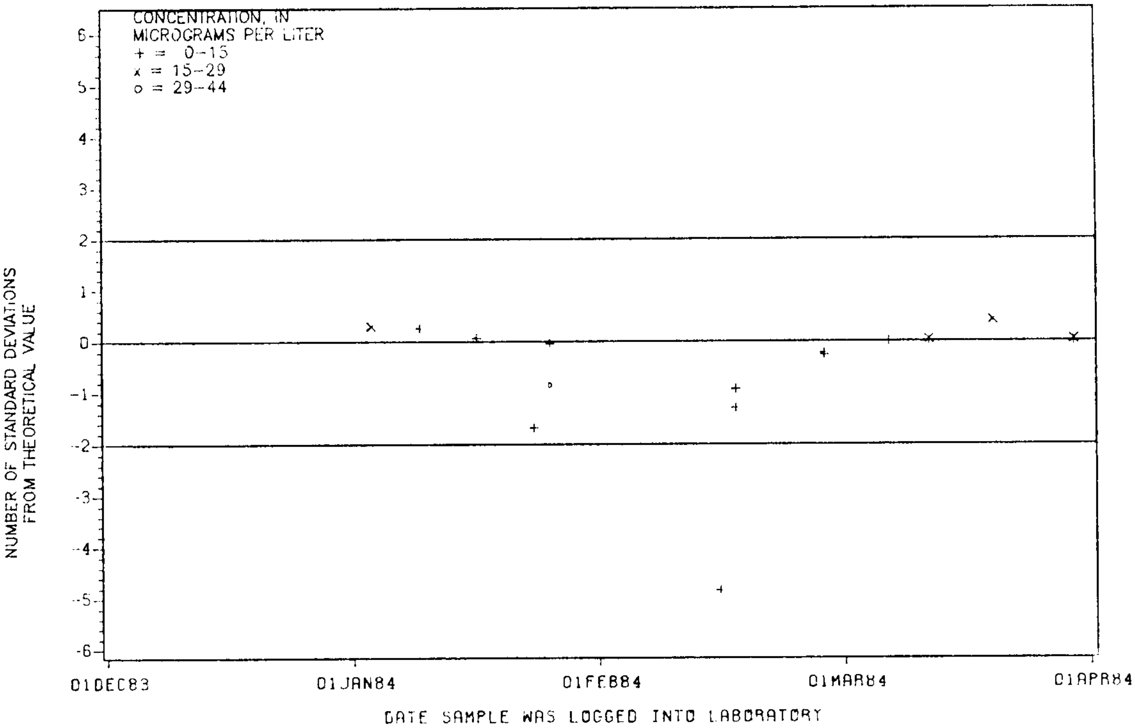

Figure A8.--Beryllium data from the Atlanta laboratory.

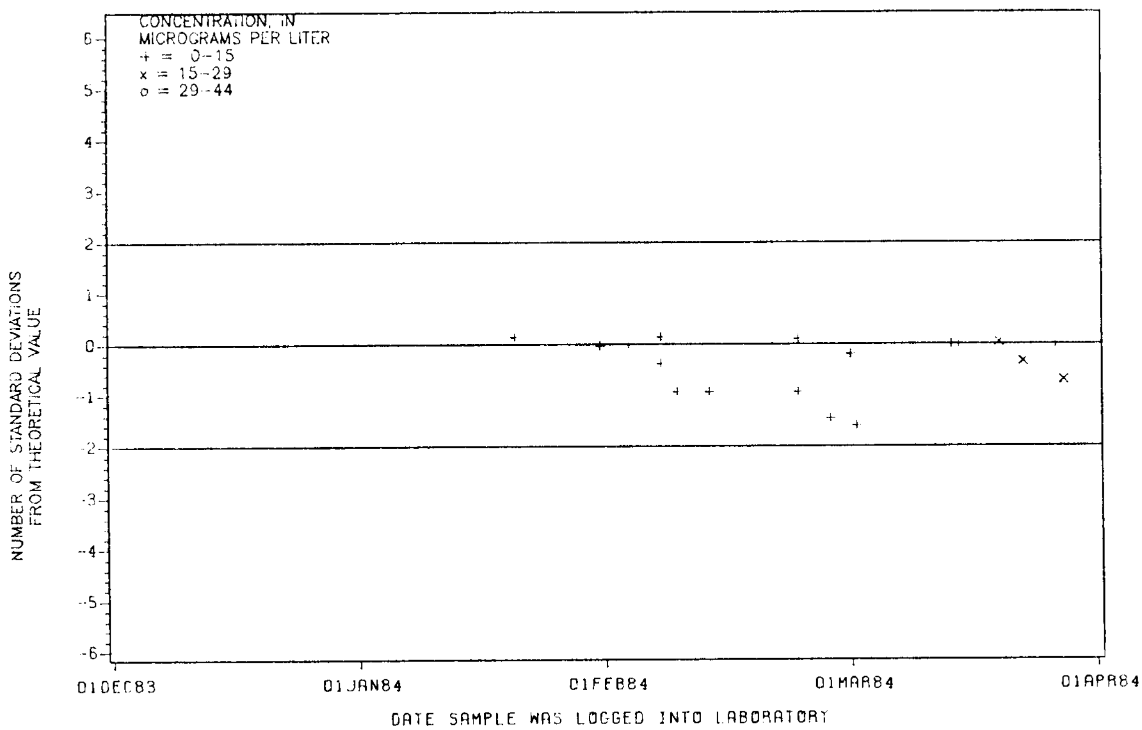

Figure D8.--Beryllium data from the Denver laboratory.

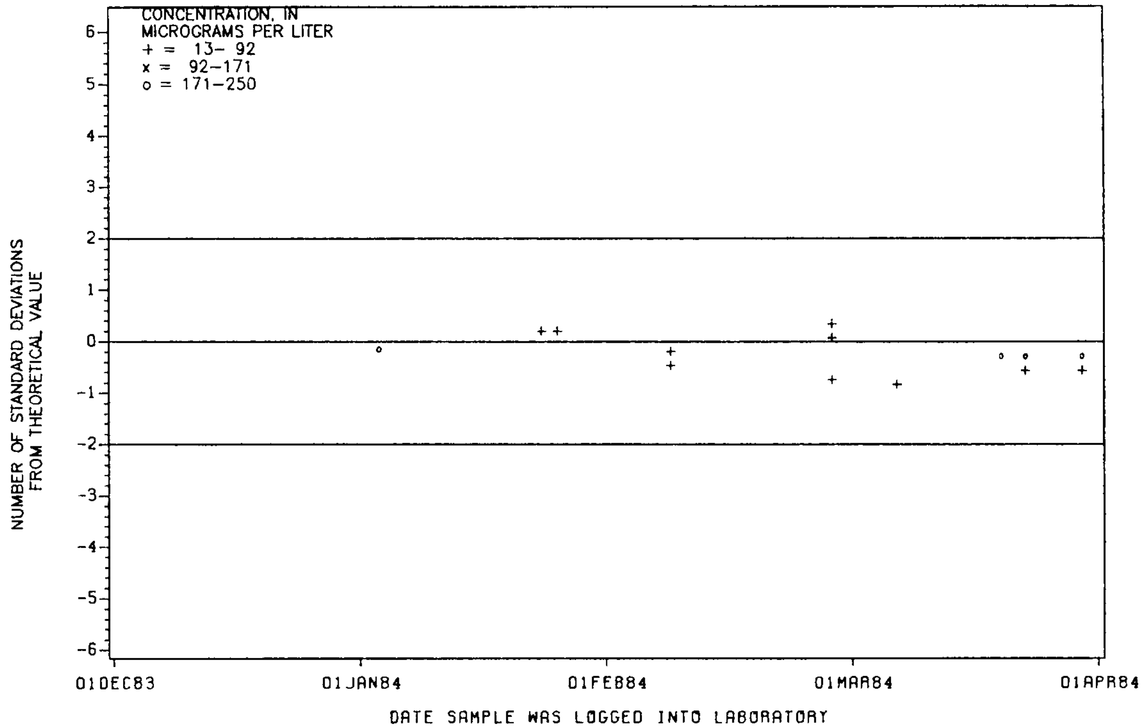

Figure A9.--Boron data from the Atlanta laboratory.

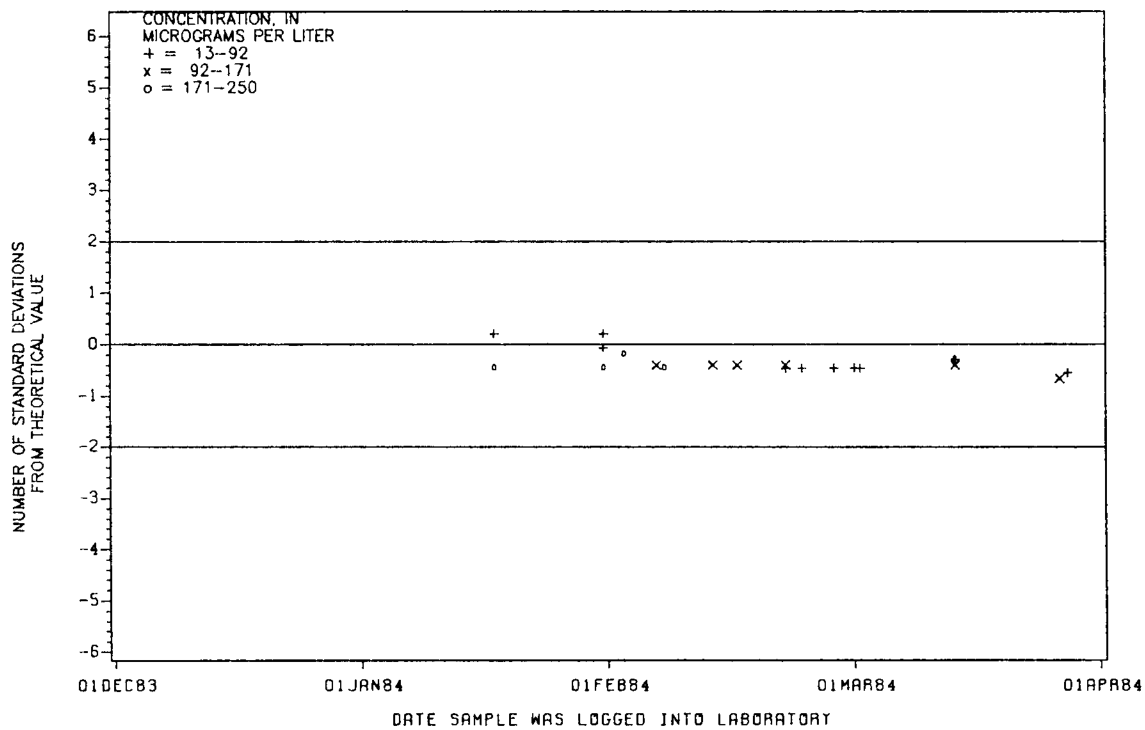

Figure D9.--Boron data from the Denver laboratory.

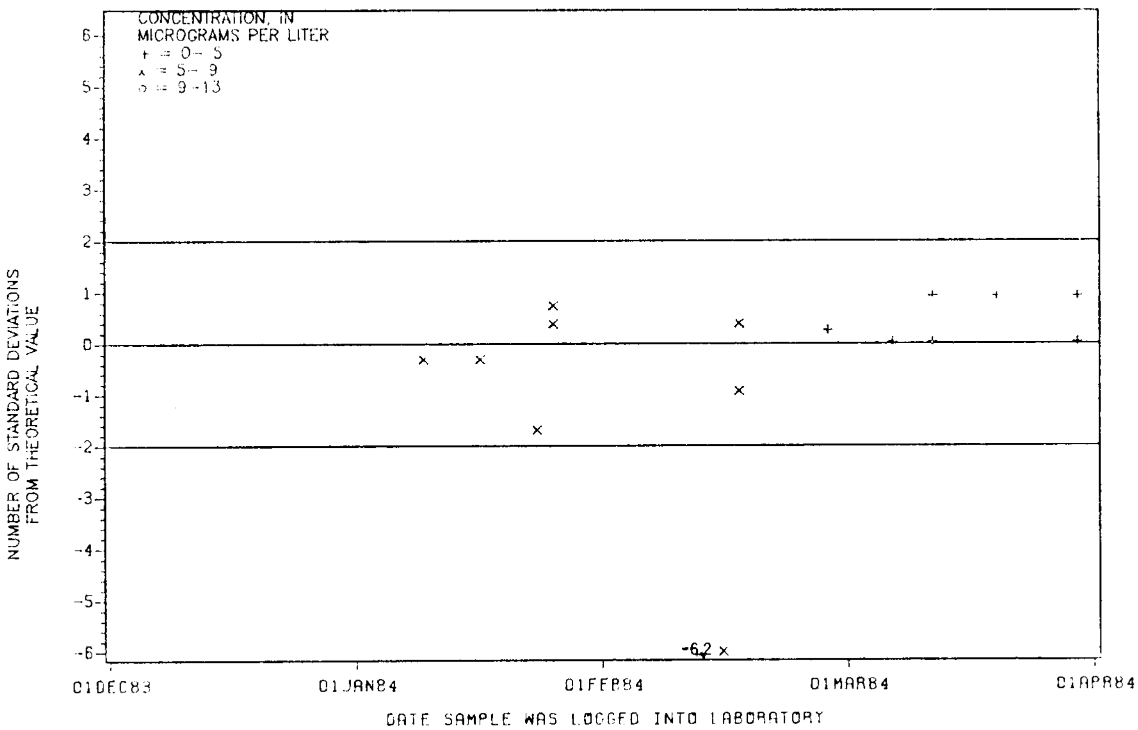

Figure A10.--Cadmium(ICP) data from the Atlanta laboratory.

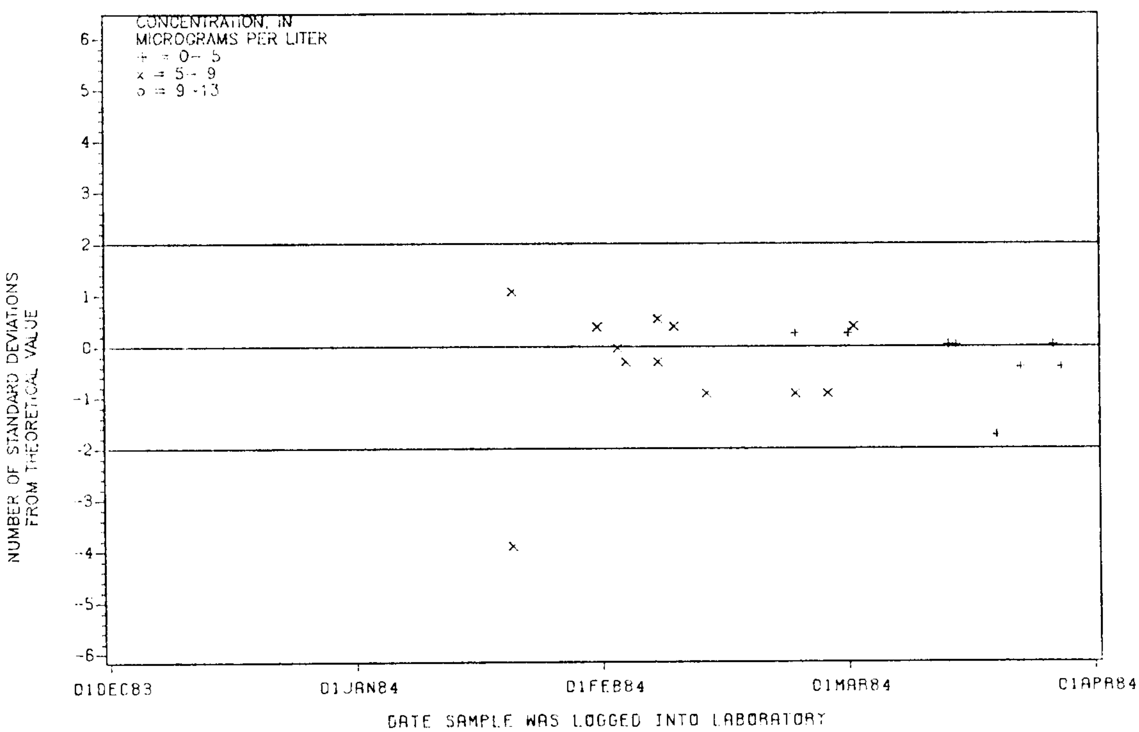

Figure D10.--Cadmium(ICP) data from the Denver laboratory.

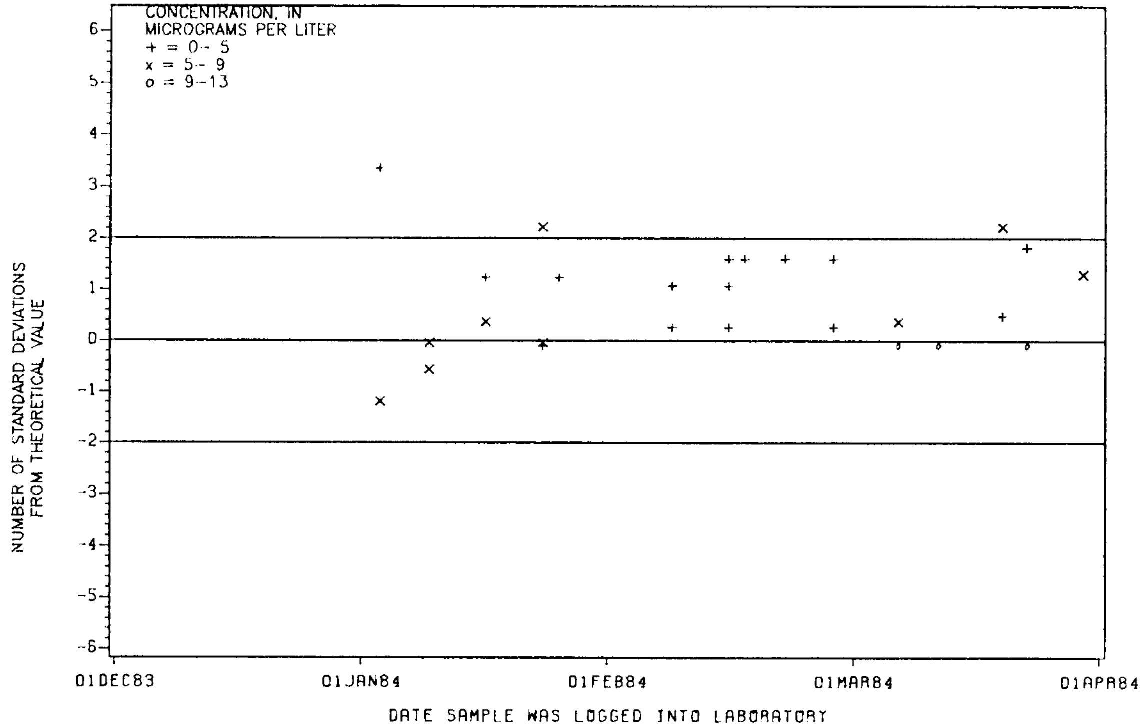

Figure A11.--Cadmium(AA) data from the Atlanta laboratory.

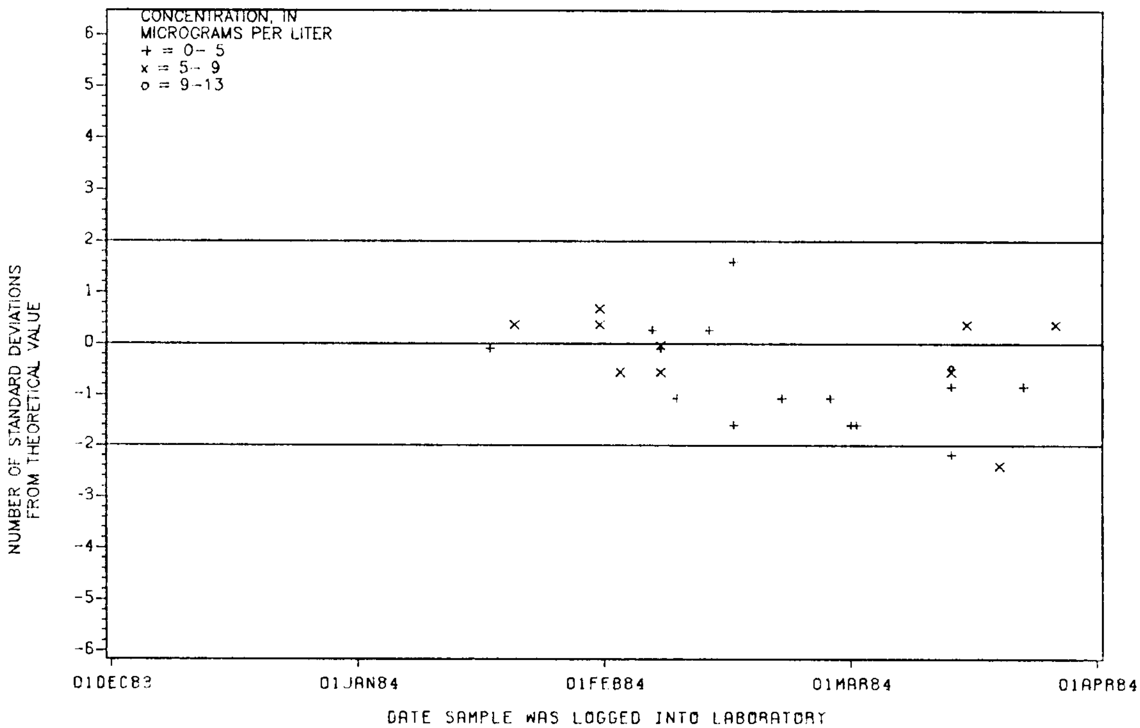

Figure D11.--Cadmium(AA) data from the Denver laboratory.

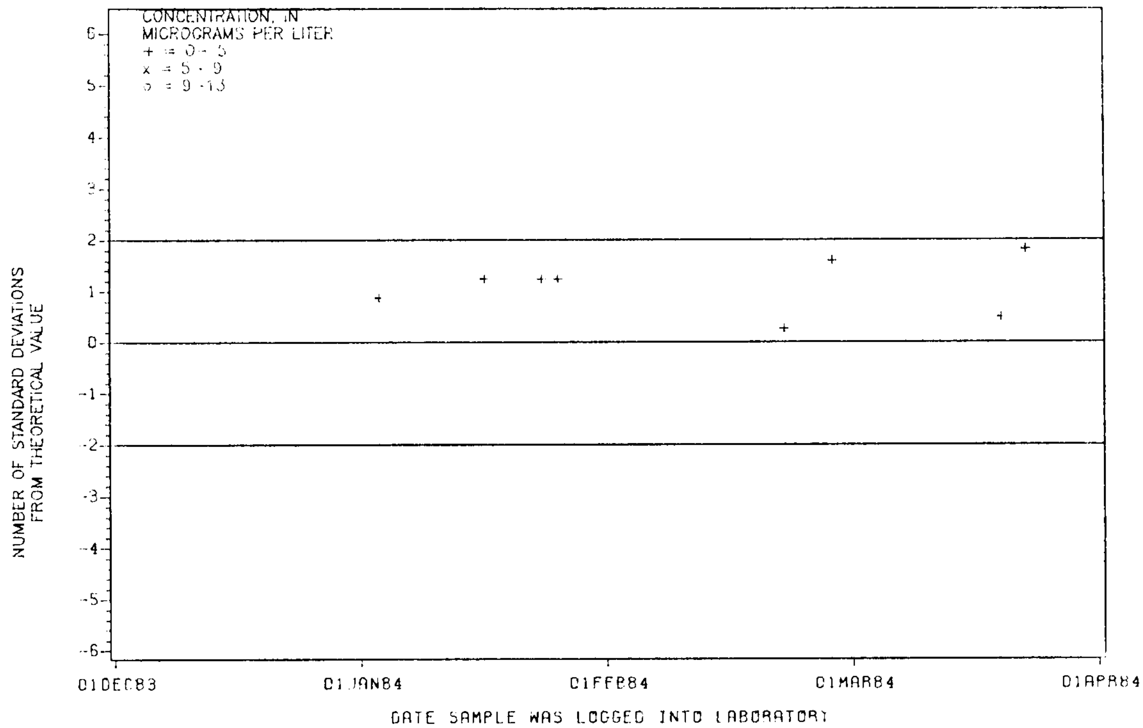

Figure A12.--Cadmium, total recoverable data from the Atlanta laboratory.

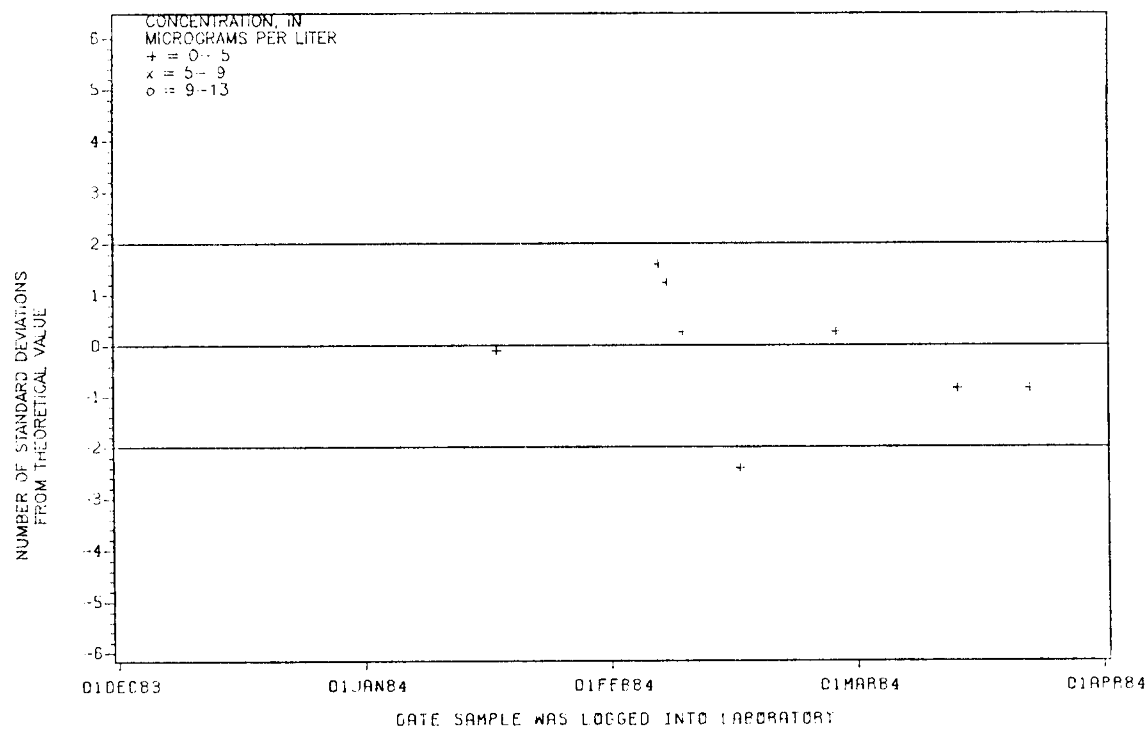

Figure D12.--Cadmium, total recoverable data from the Denver laboratory.

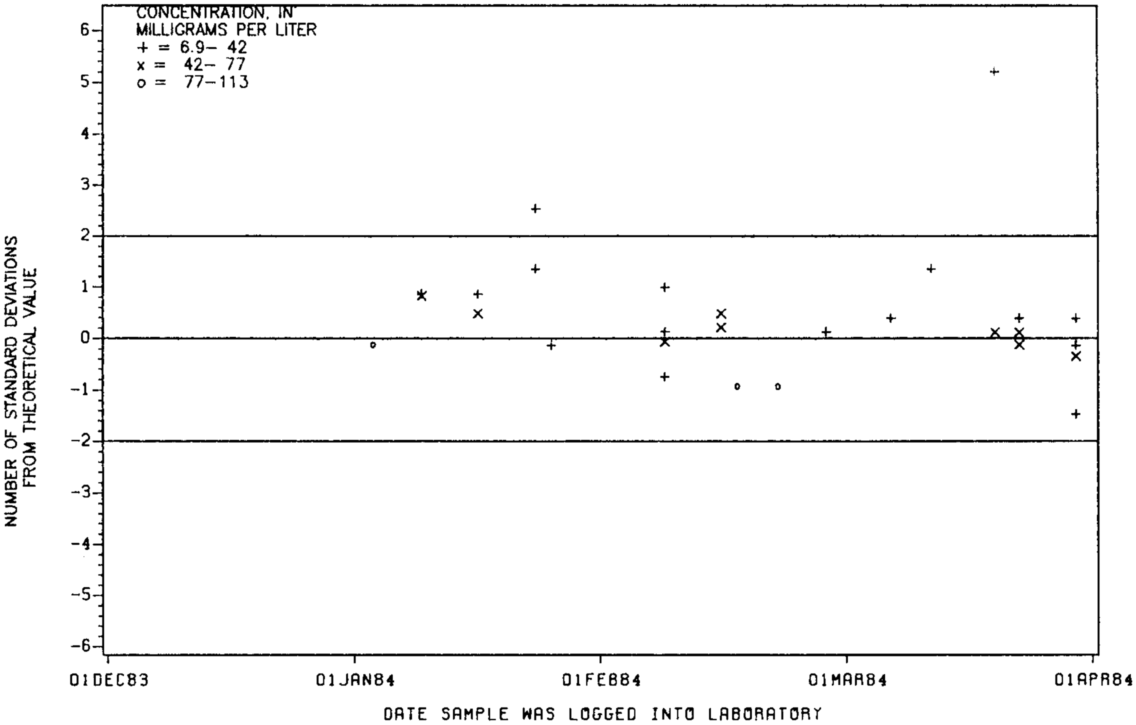

Figure A13.--Calcium(ICP) data from the Atlanta laboratory.

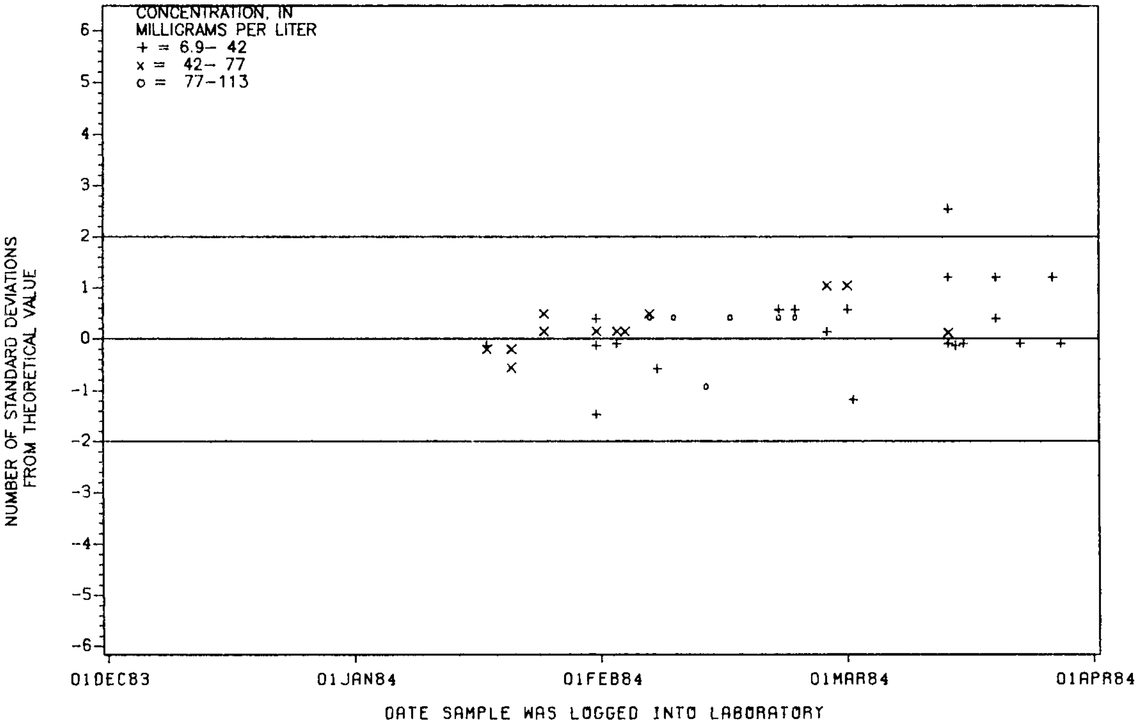

Figure D13.--Calcium(ICP) data from the Denver laboratory.

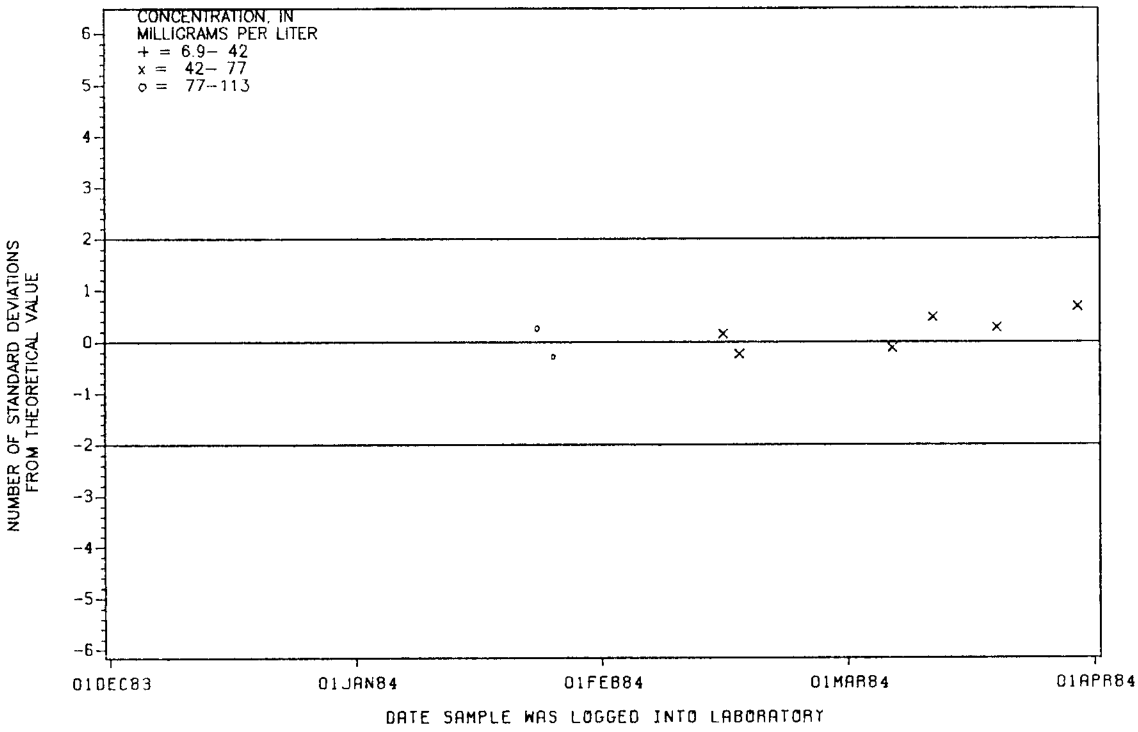

Figure A14.--Calcium(AA) data from the Atlanta laboratory.

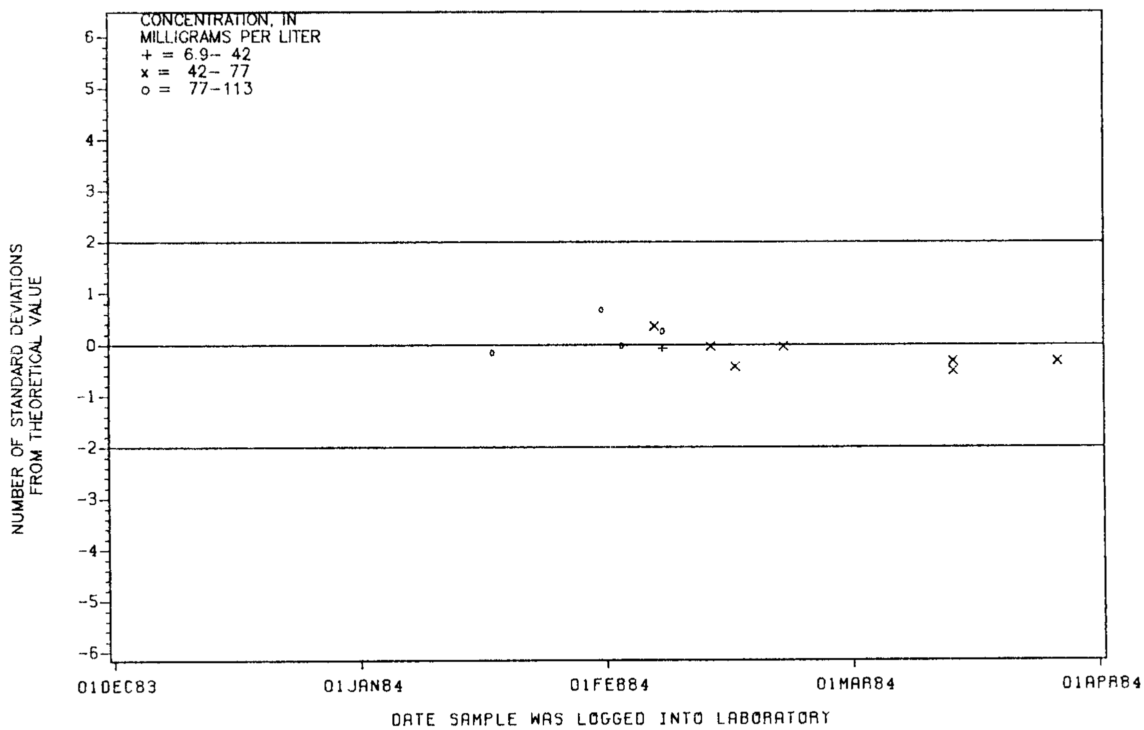

Figure D14.--Calcium(AA) data from the Denver laboratory.

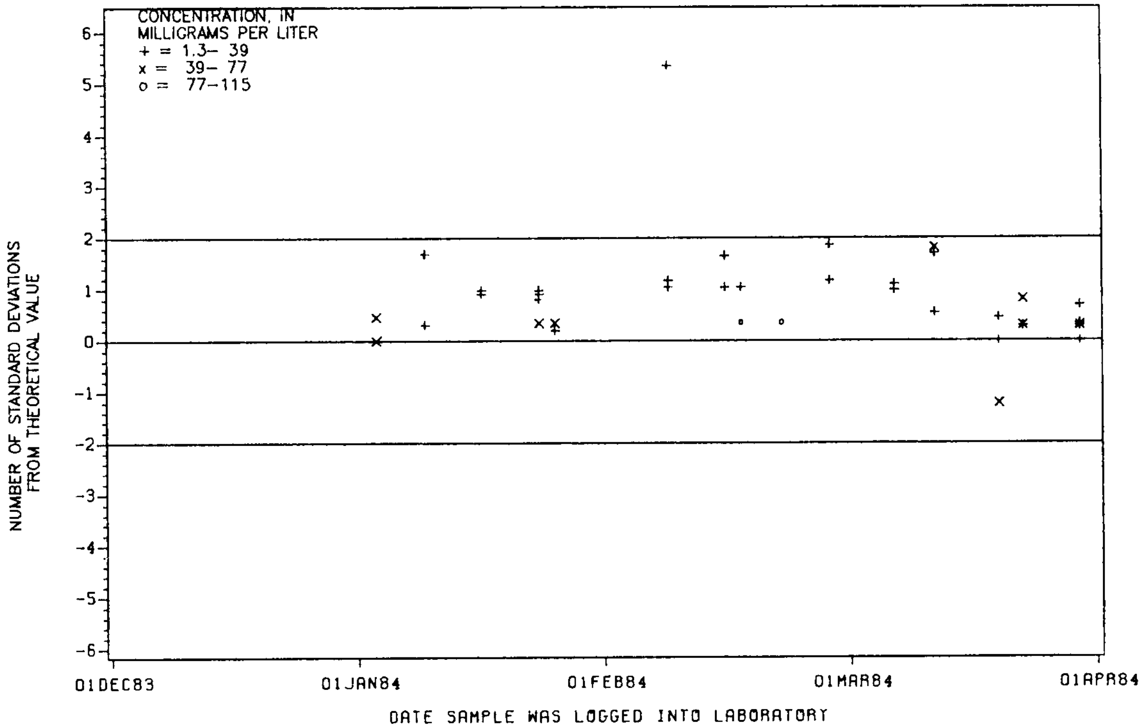

Figure A15.––Chloride data from the Atlanta laboratory.

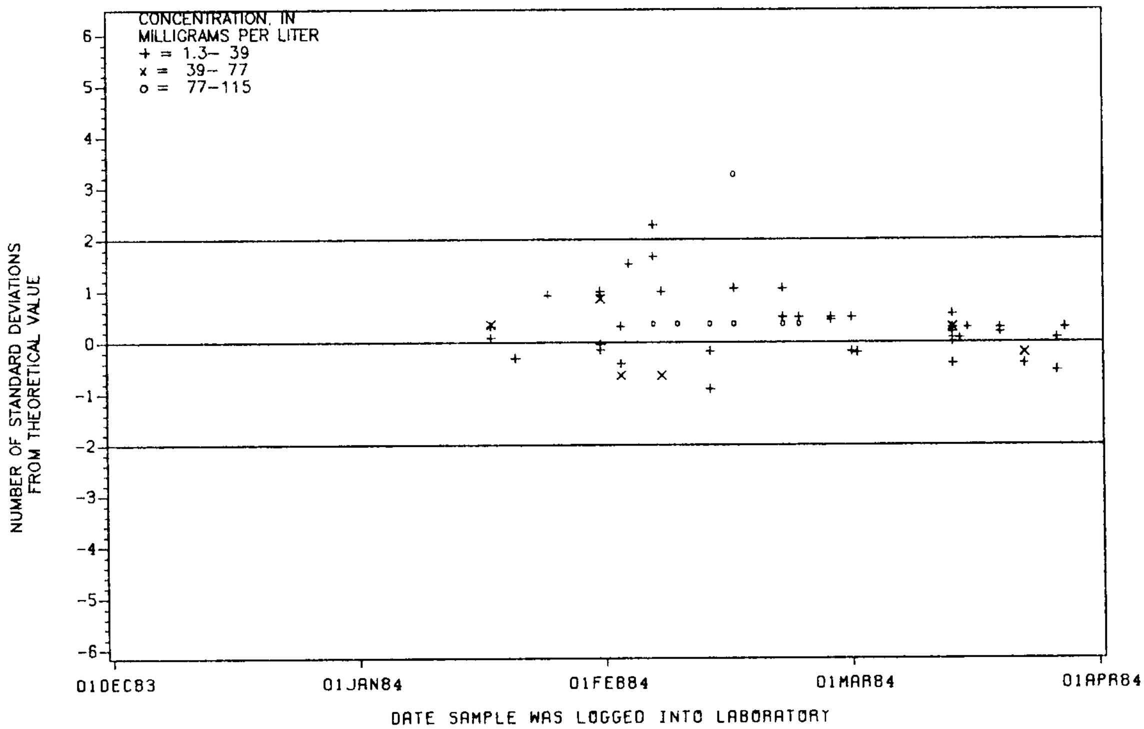

Figure D15.––Chloride data from the Denver laboratory.

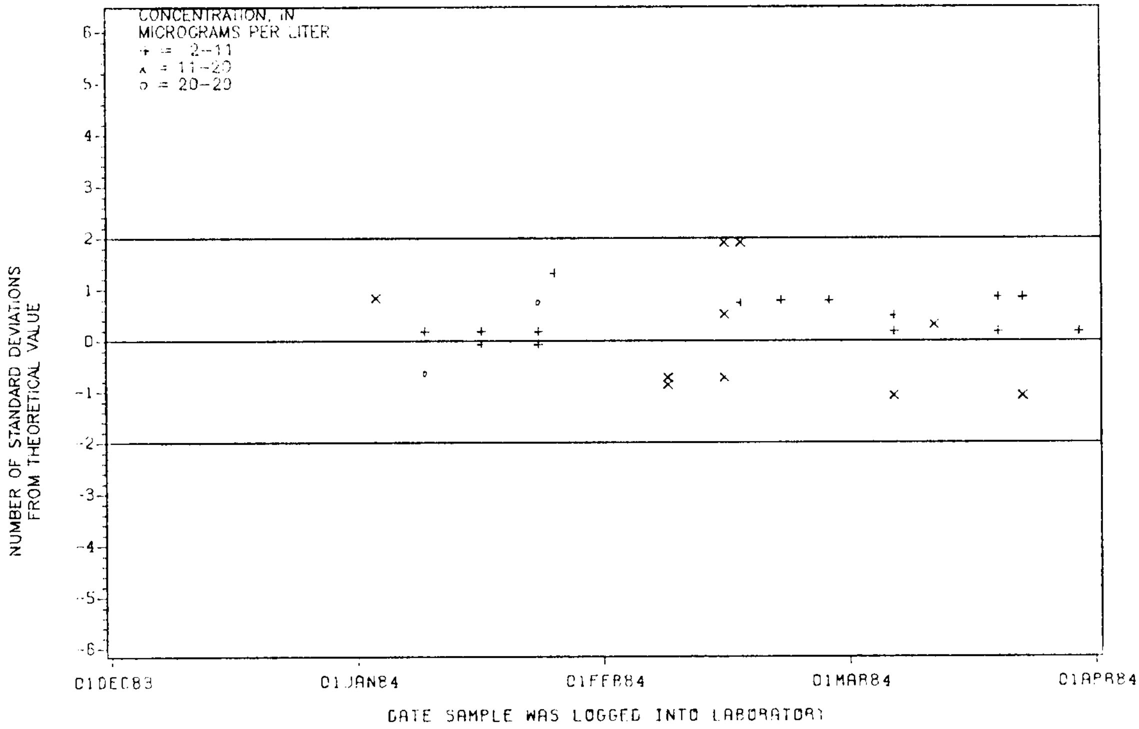

Figure A16. --Chromium data from the Atlanta laboratory.

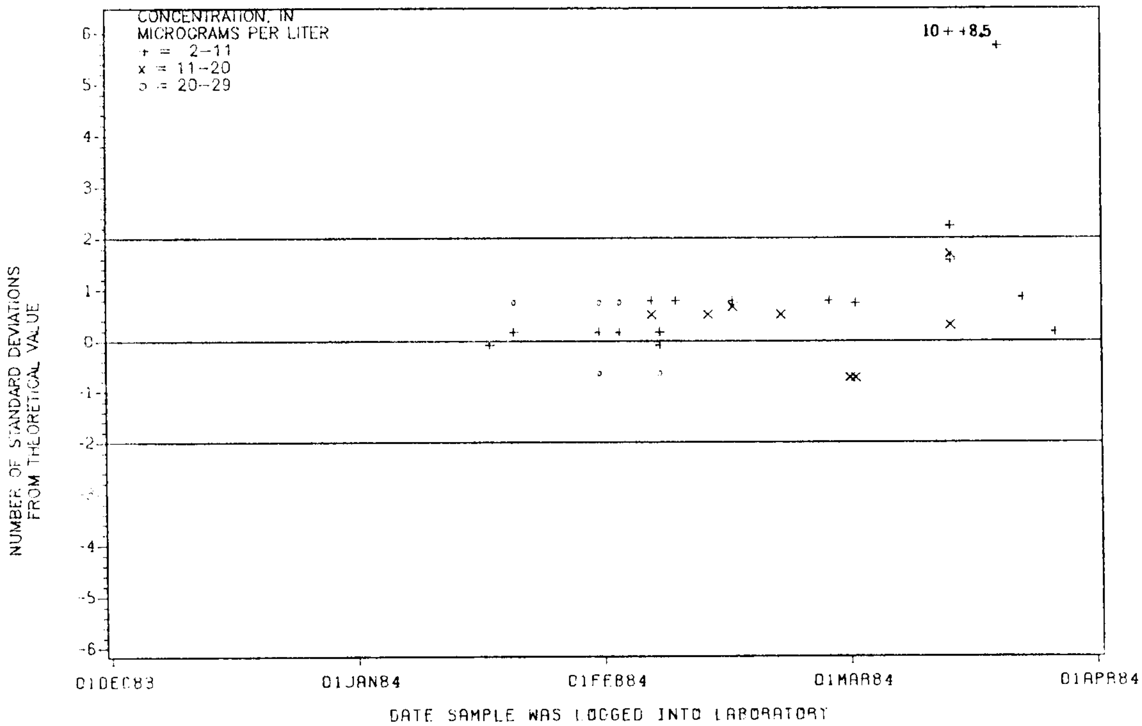

Figure D16. --Chromium data from the Denver laboratory.

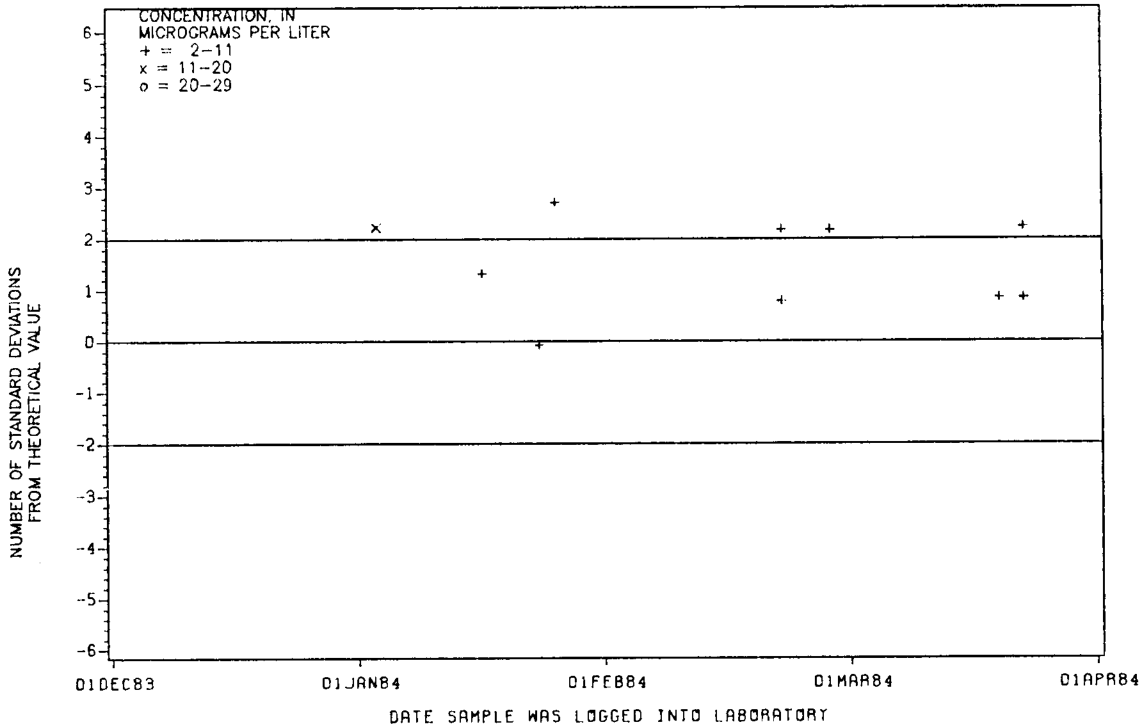

Figure A17.--Chromium, total recoverable data from the Atlanta laboratory.

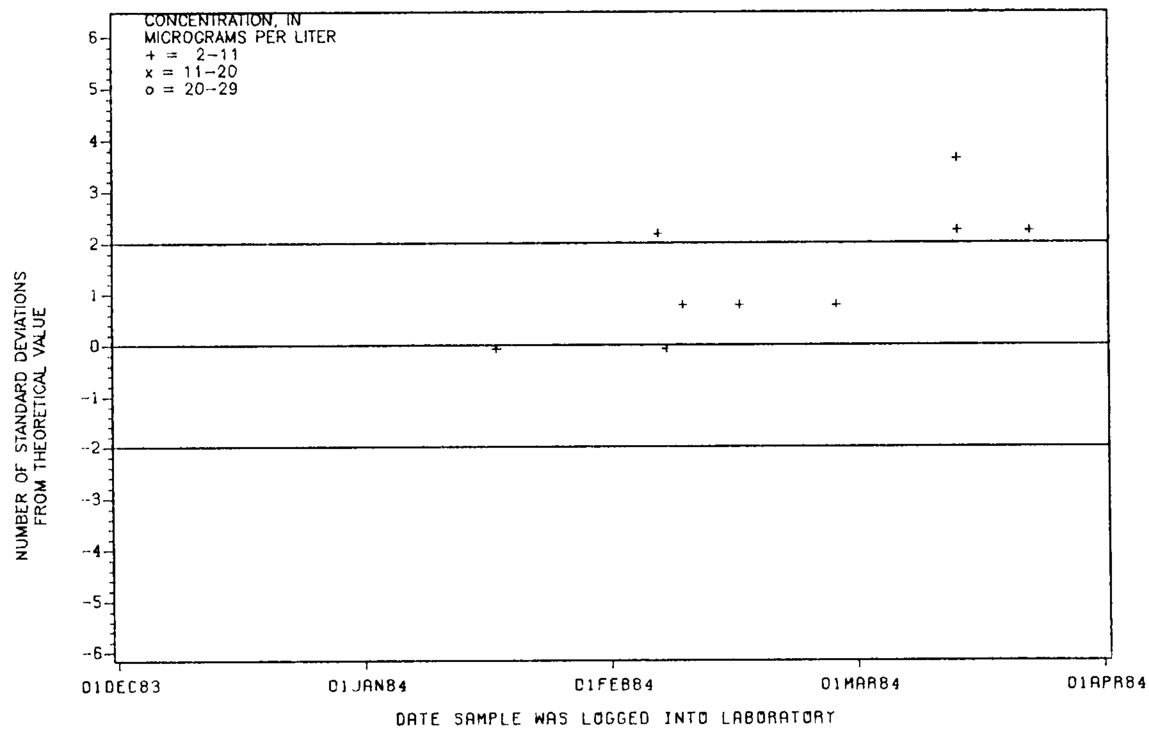

Figure D17.--Chromium, total recoverable data from the Denver laboratory.

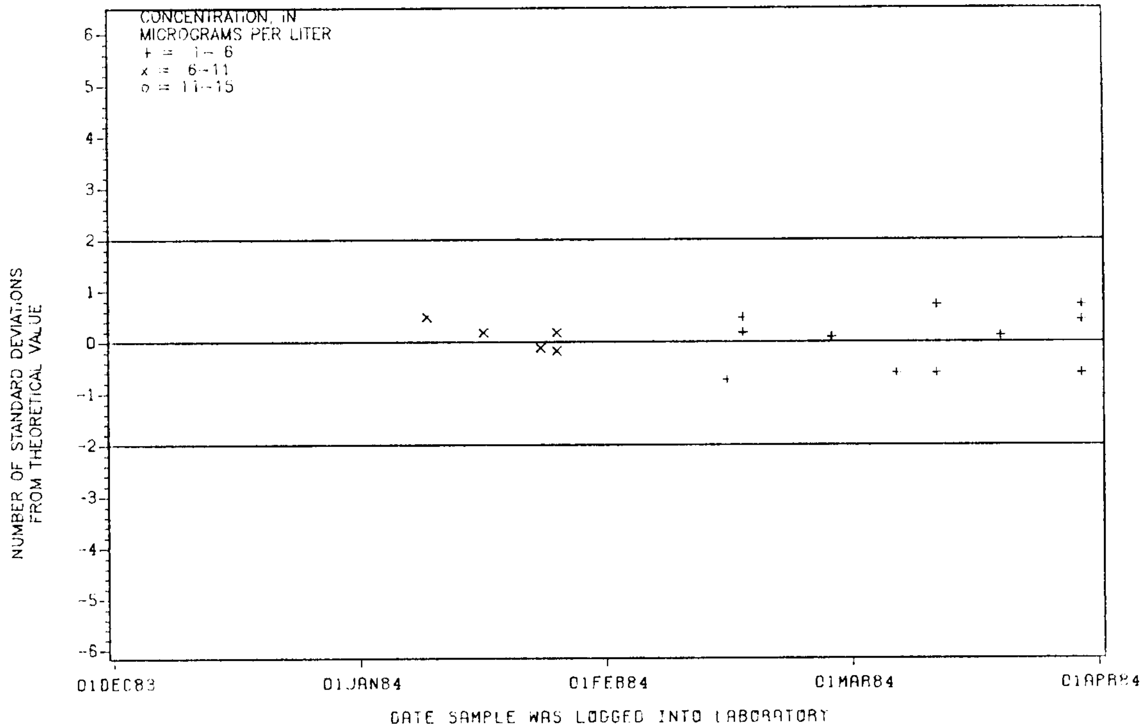

Figure A18.--Cobalt(ICP) data from the Atlanta laboratory.

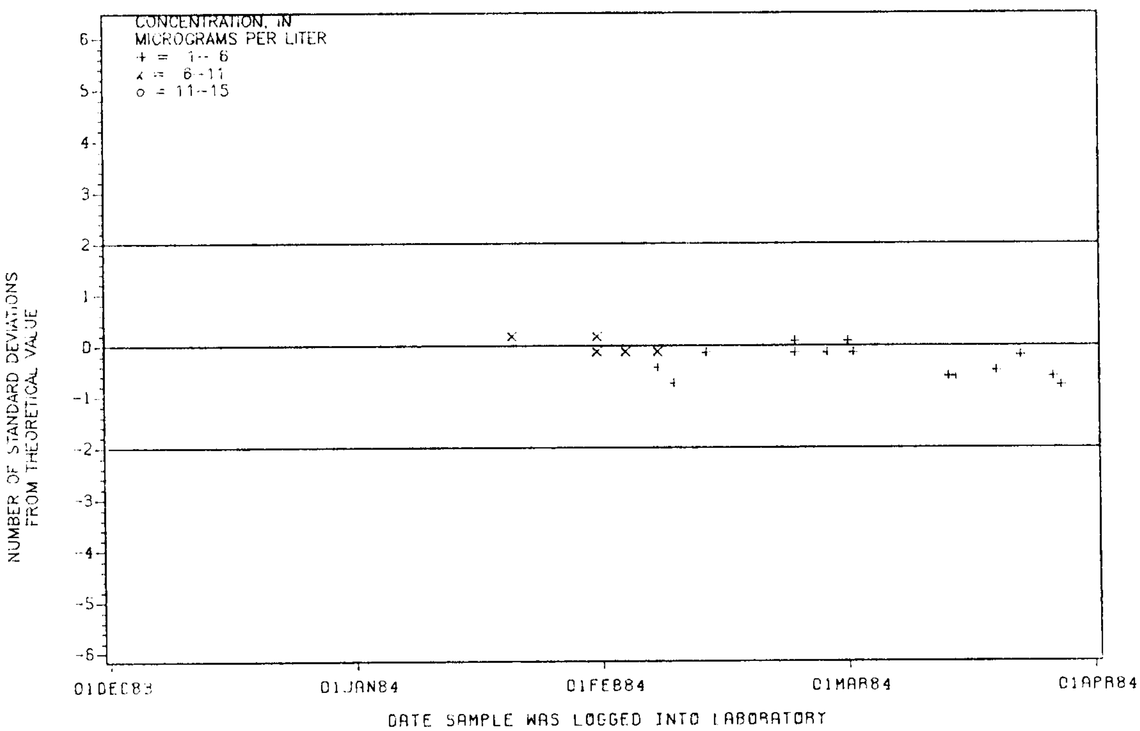

Figure D18.--Cobalt(ICP) data from the Denver laboratory.

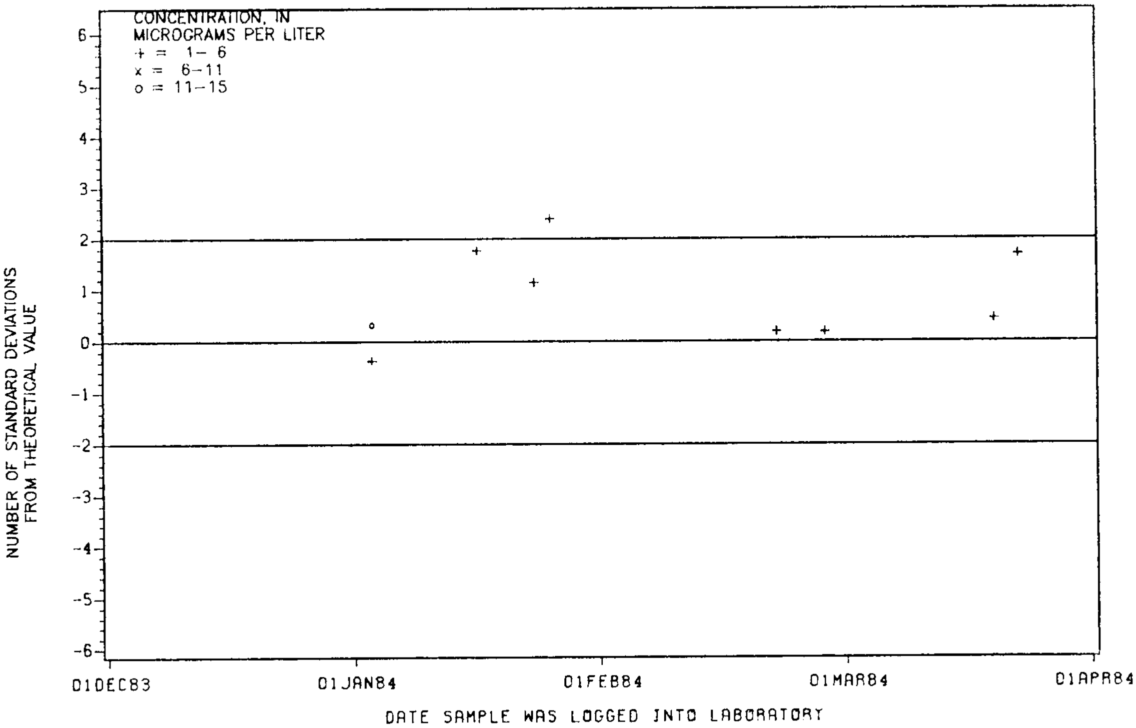

Figure A19.--Cobalt(AA) data from the Atlanta laboratory.

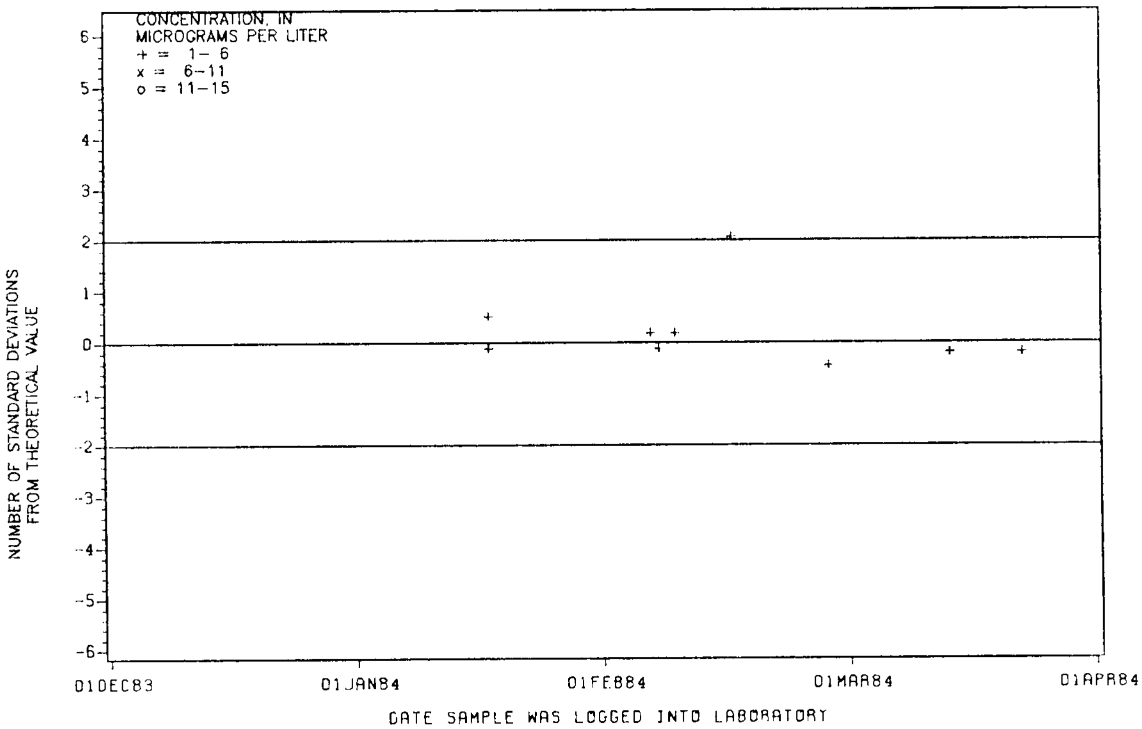

Figure D19.--Cobalt(AA) data from the Denver laboratory.

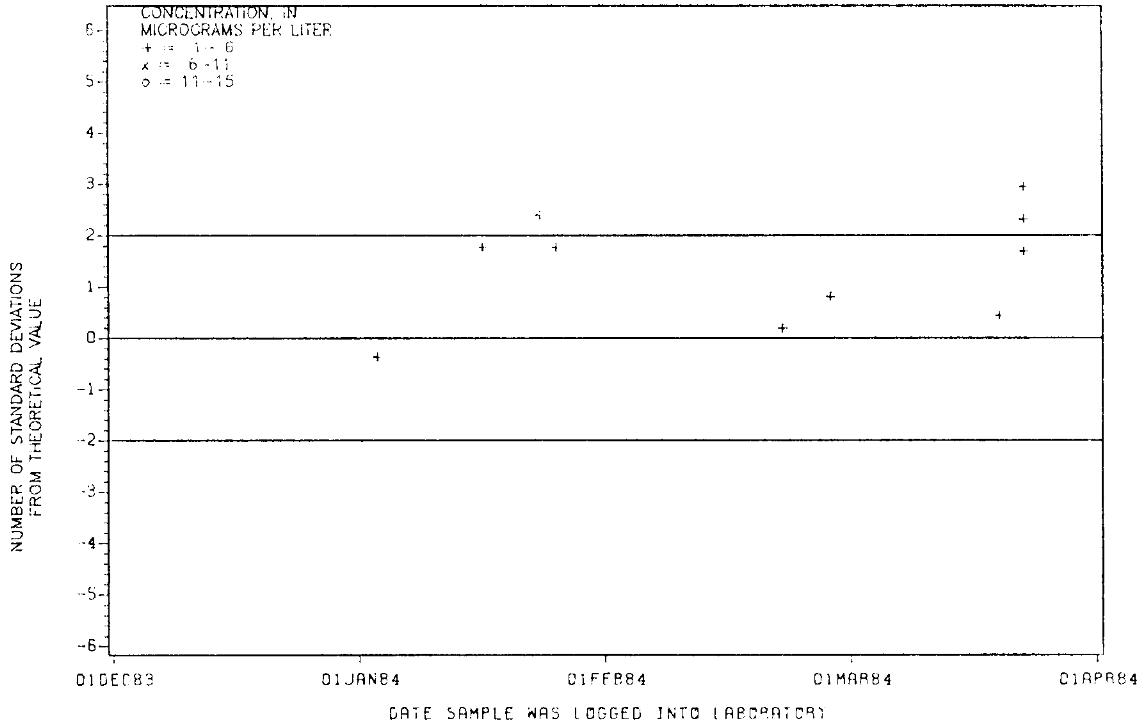

Figure A20.--Cobalt, total recoverable data from the Atlanta laboratory.

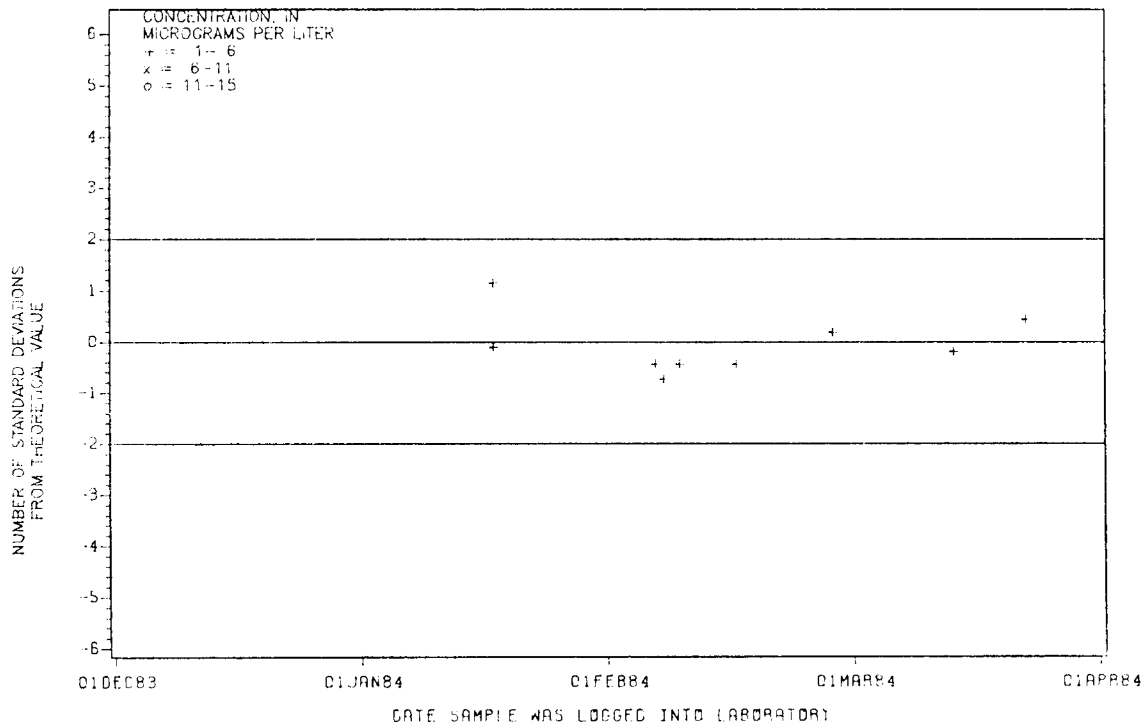

Figure D20.--Cobalt, total recoverable data from the Denver laboratory.

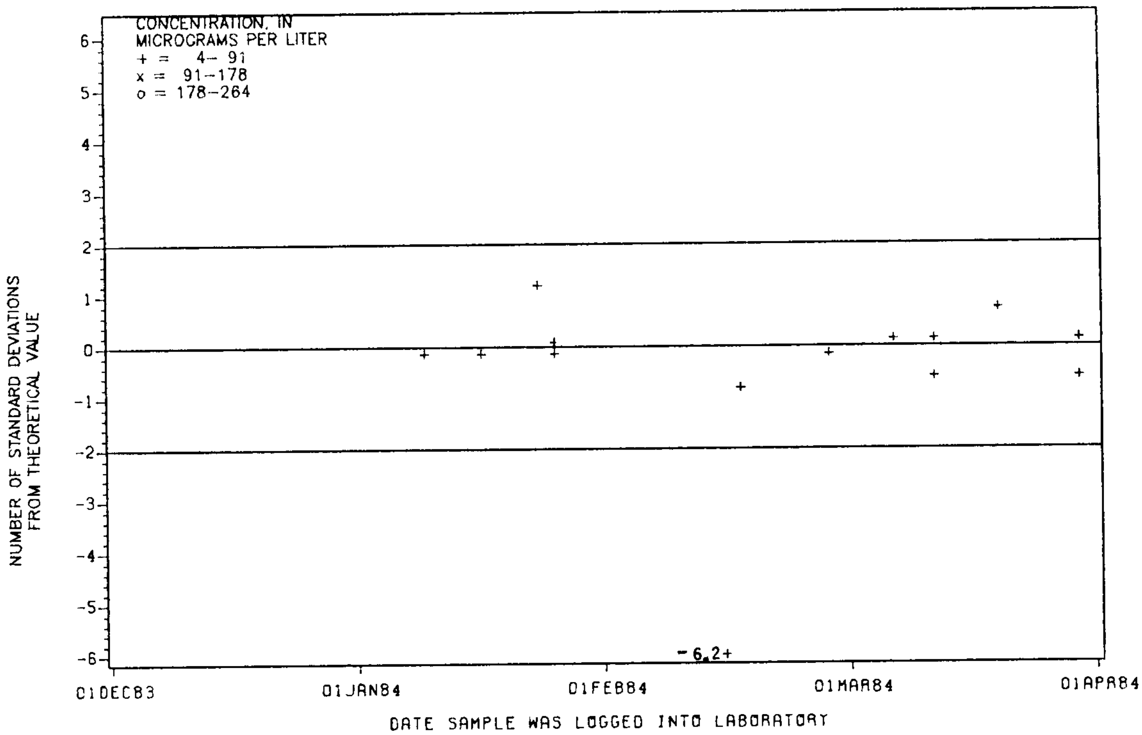

Figure A21.--Copper(ICP) data from the Atlanta laboratory.

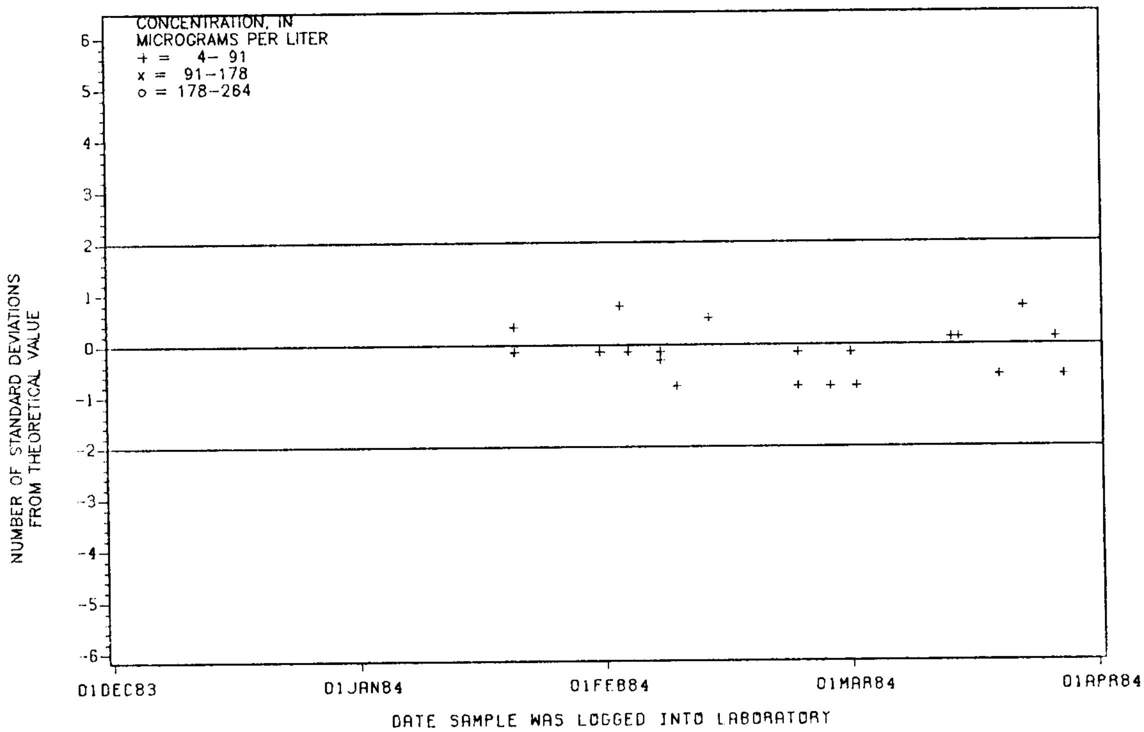

Figure D21.--Copper(ICP) data from tne Denver laboratory.

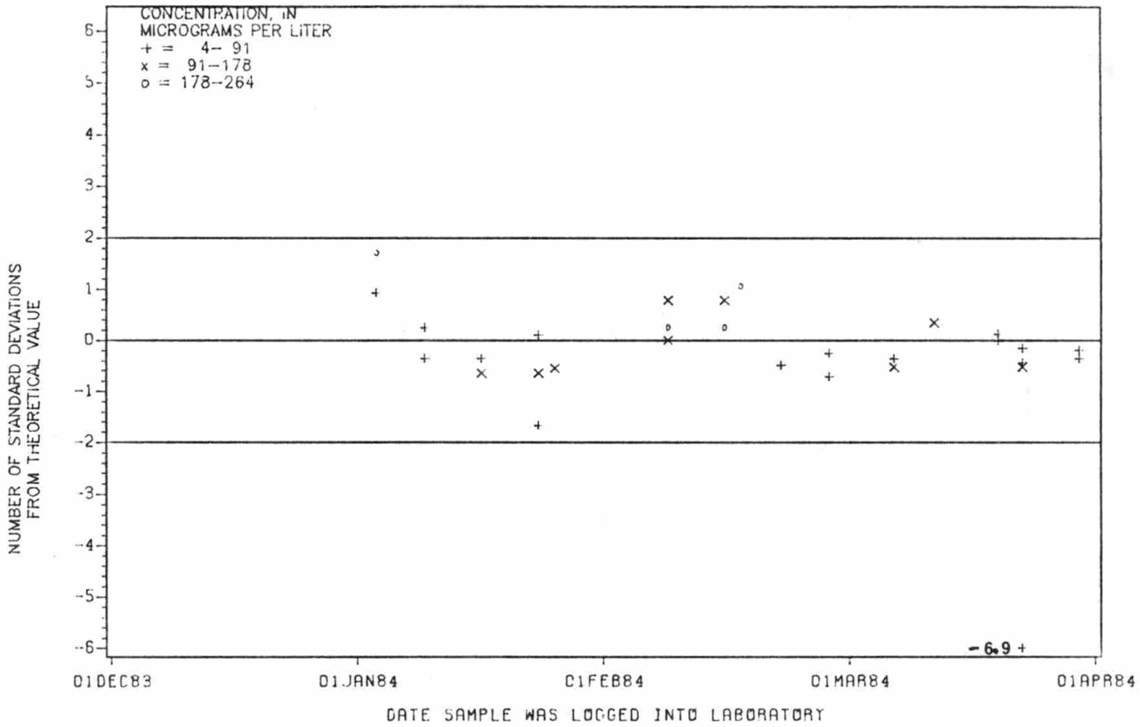

Figure A22.––Copper(AA) data from tne Atlanta laboratory.

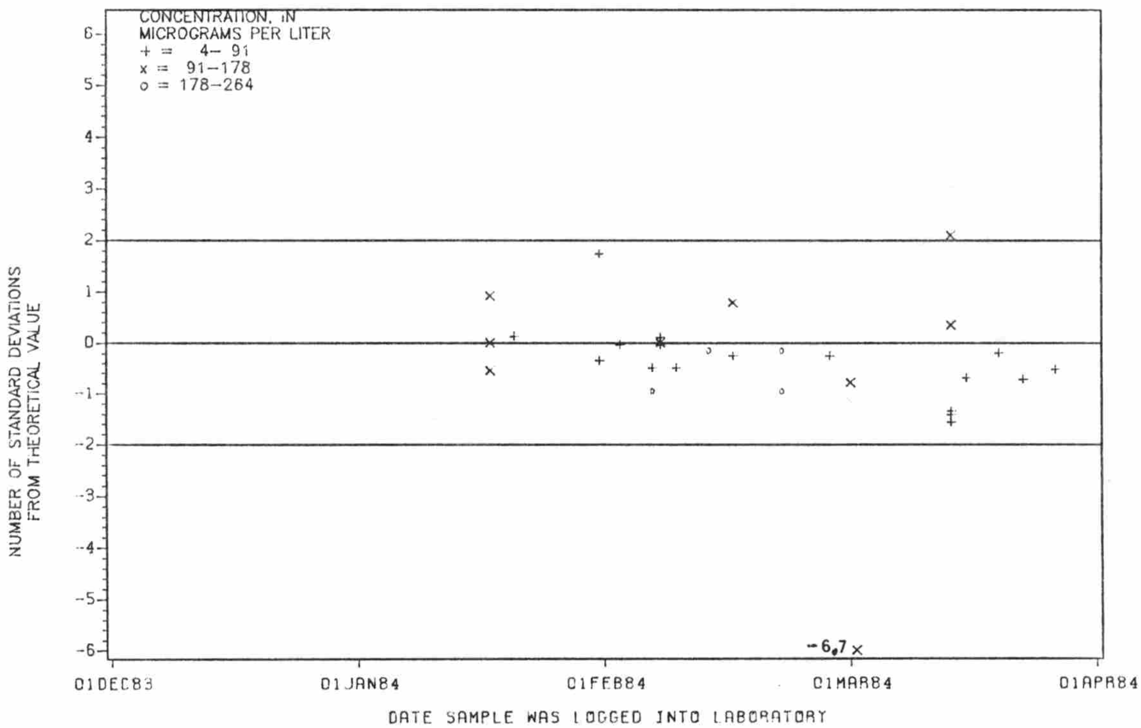

Figure D22. ––Copper(AA) data from the Denver laboratory.

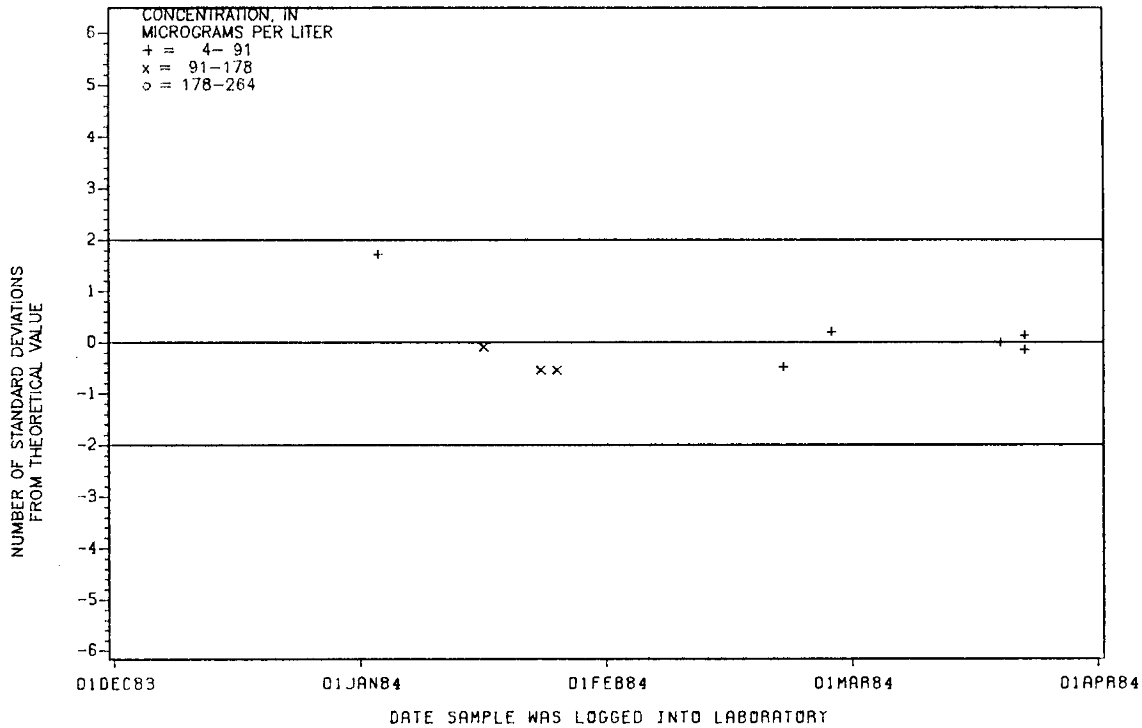

Figure A23.--Copper, total recoverable data from the Atlanta laboratory.

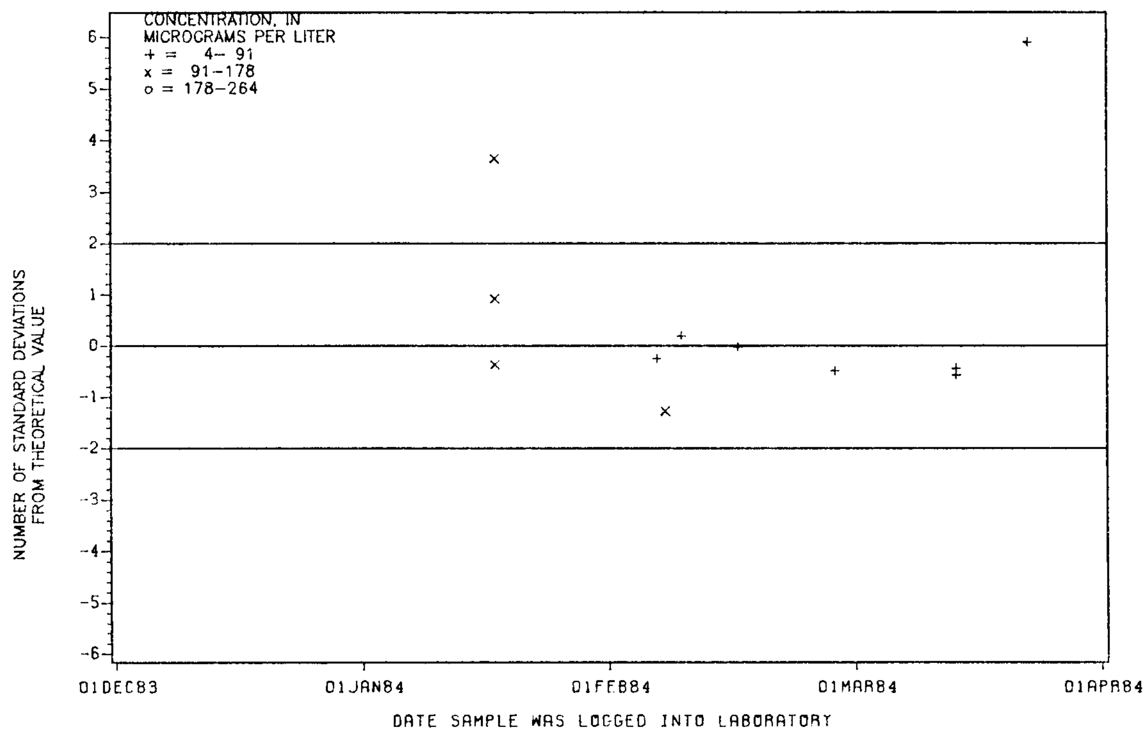

Figure D23.--Copper, total recoverable data from the Denver laboratory.

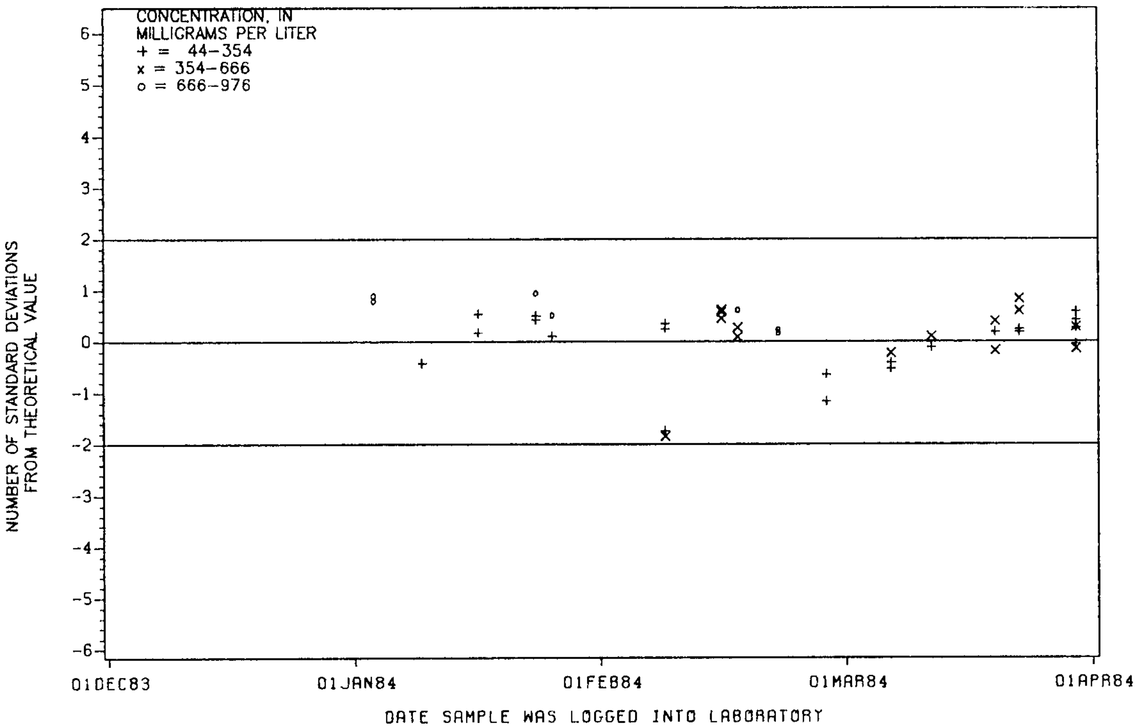

Figure A24.--Dissolved Solids, data from the Atlanta laboratory.

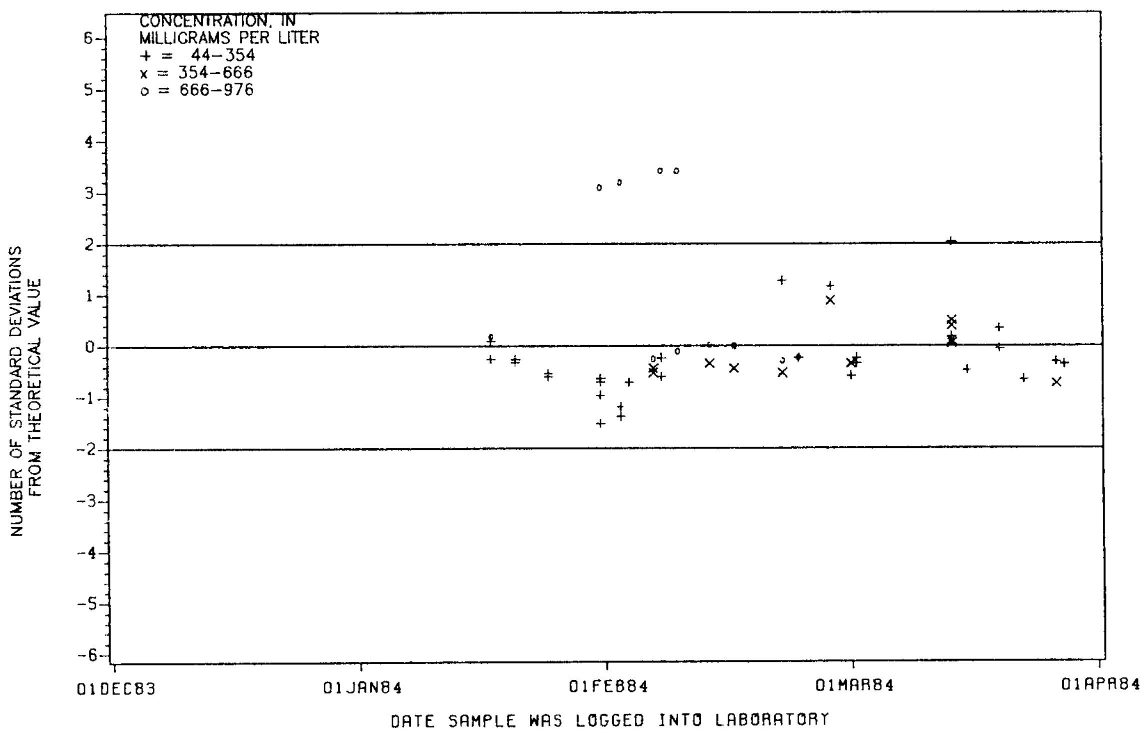

Figure D24.--Dissolved Solids, data from the Denver laboratory.

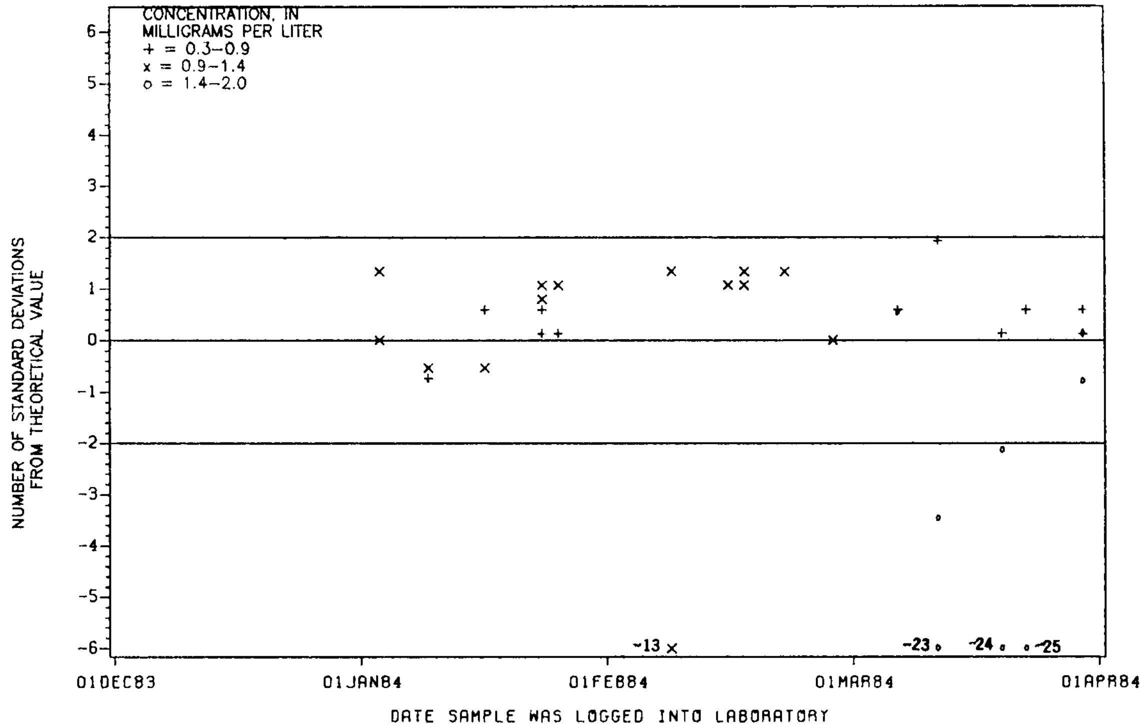

Figure A25.--Fluoride data from the Atlanta laboratory.

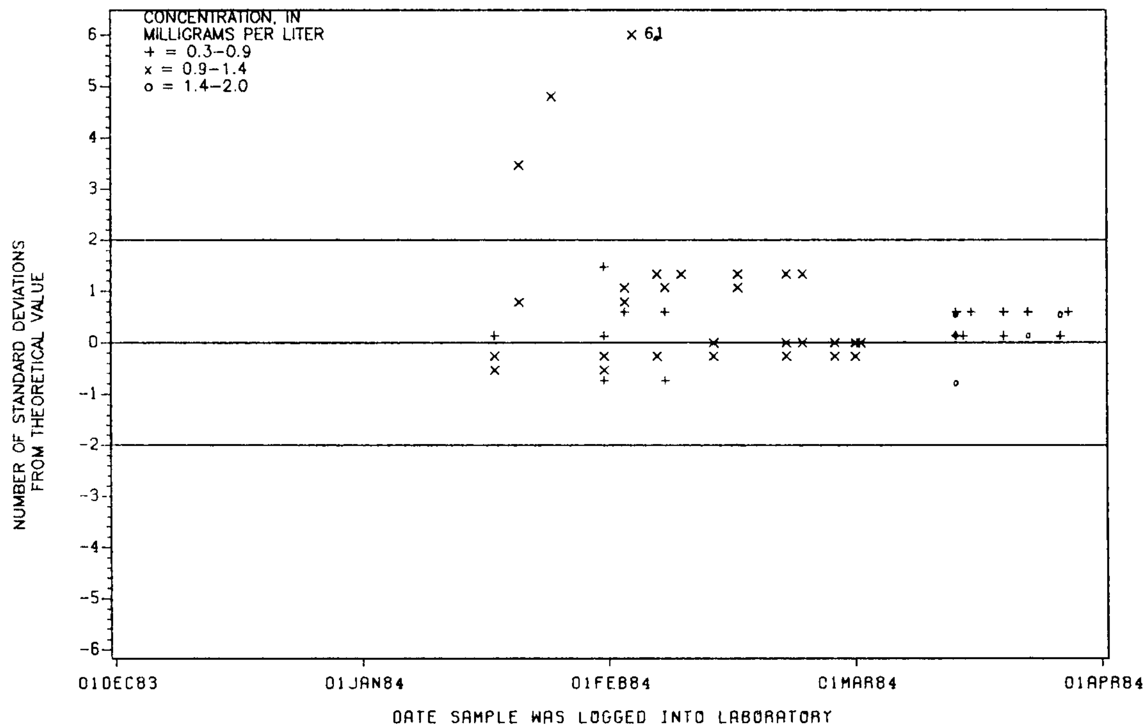

Figure D25.--Fluoride data from the Denver laboratory.

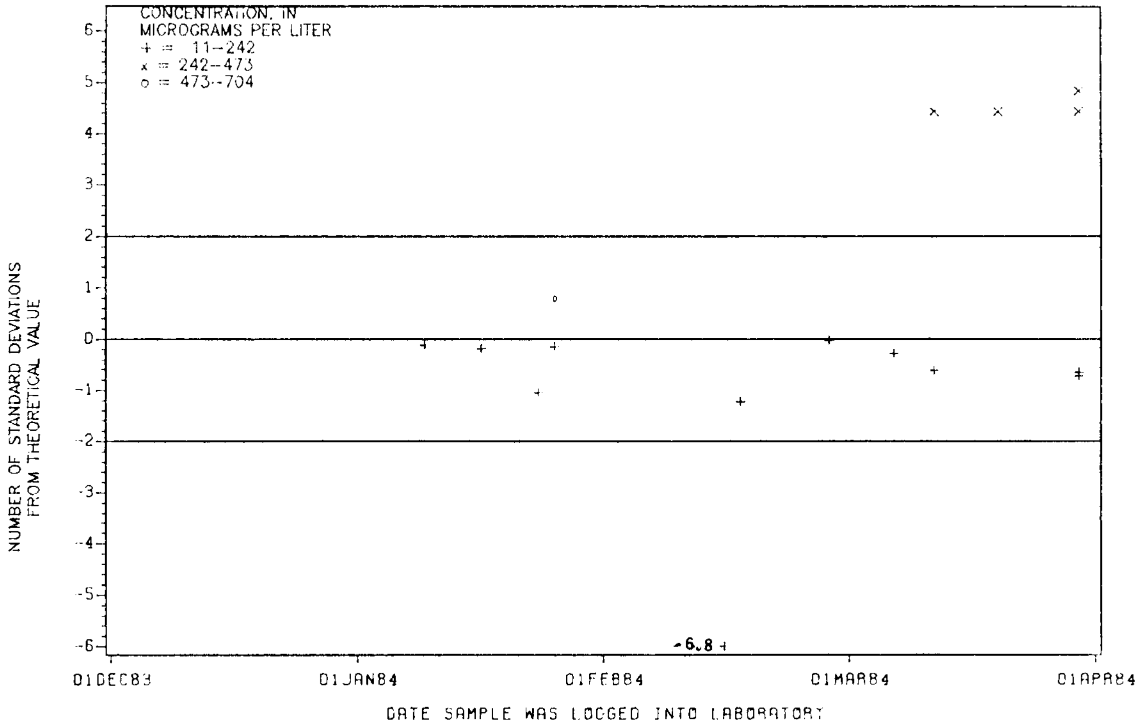

Figure A26.--Iron(ICP) data from the Atlanta laboratory.

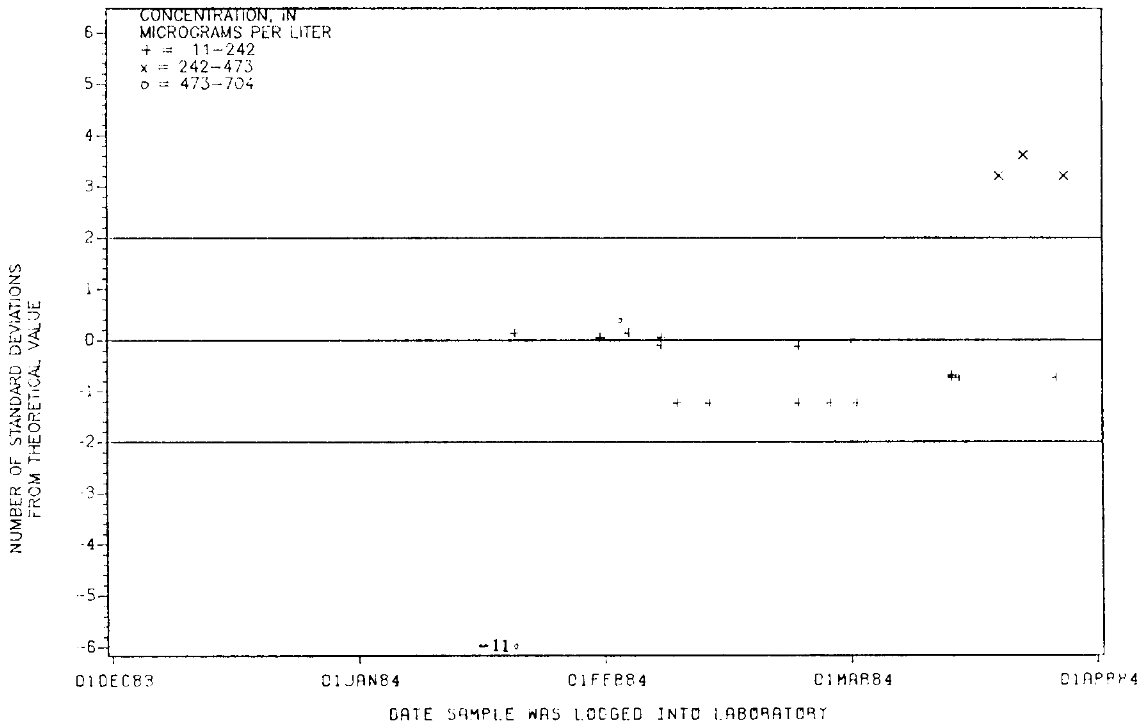

Figure D26.--Iron(ICP) data from the Denver laboratory.

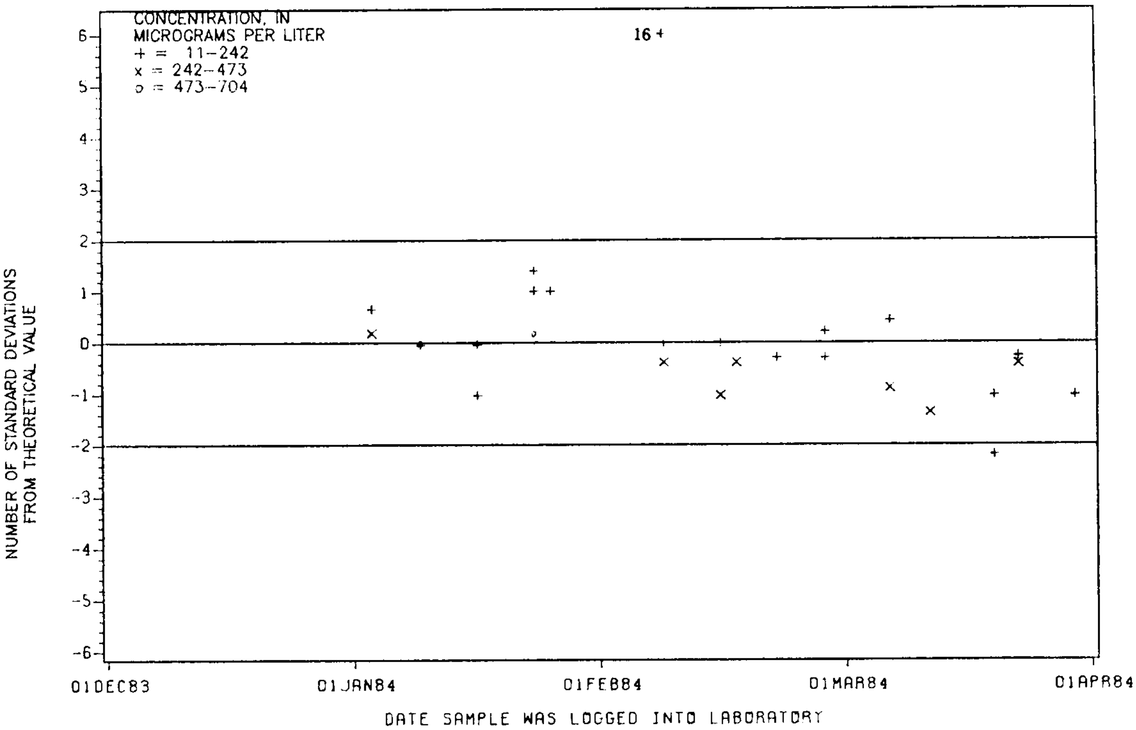

Figure A27.---Iron(AA) data from the Atlanta laboratory.

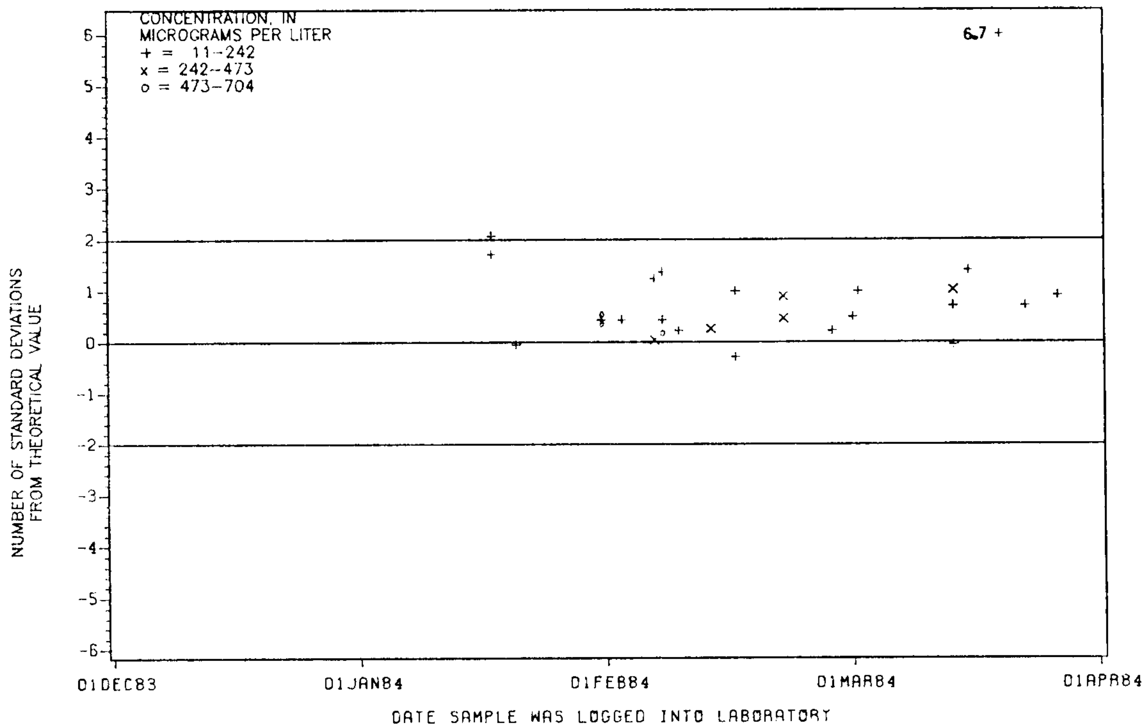

Figure D27.---Iron(AA) data from the Denver laboratory.

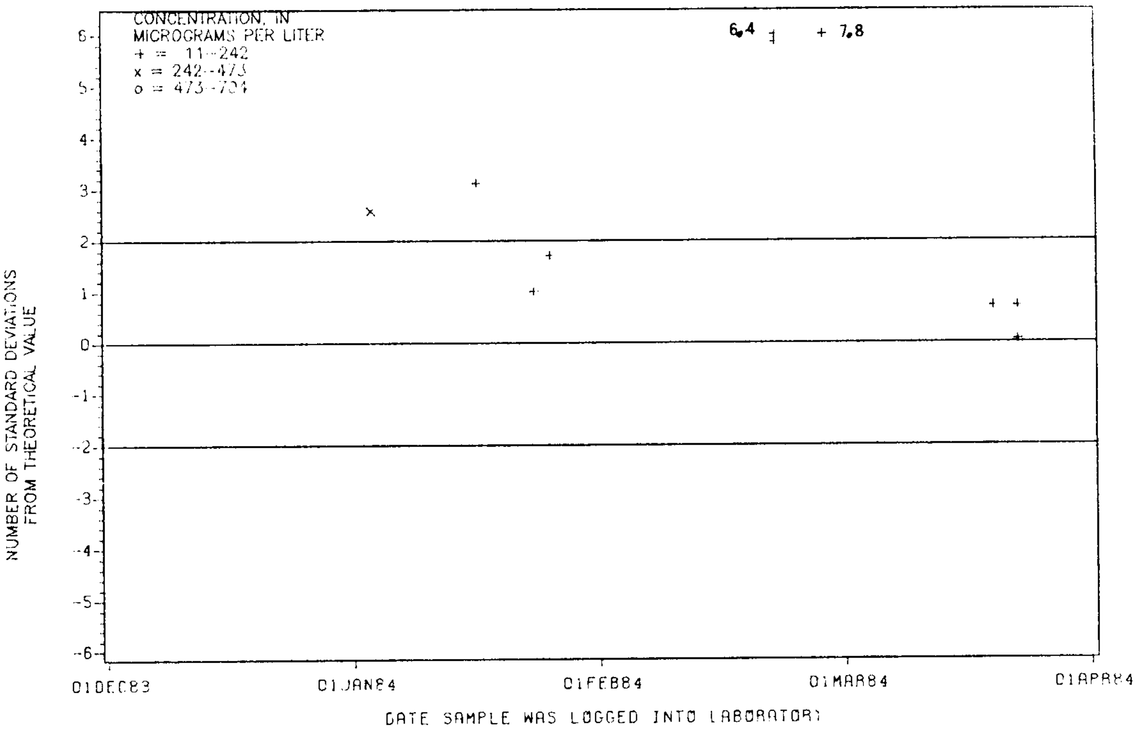

Figure A28.--Iron, total recoverable data from the Atlanta laboratory.

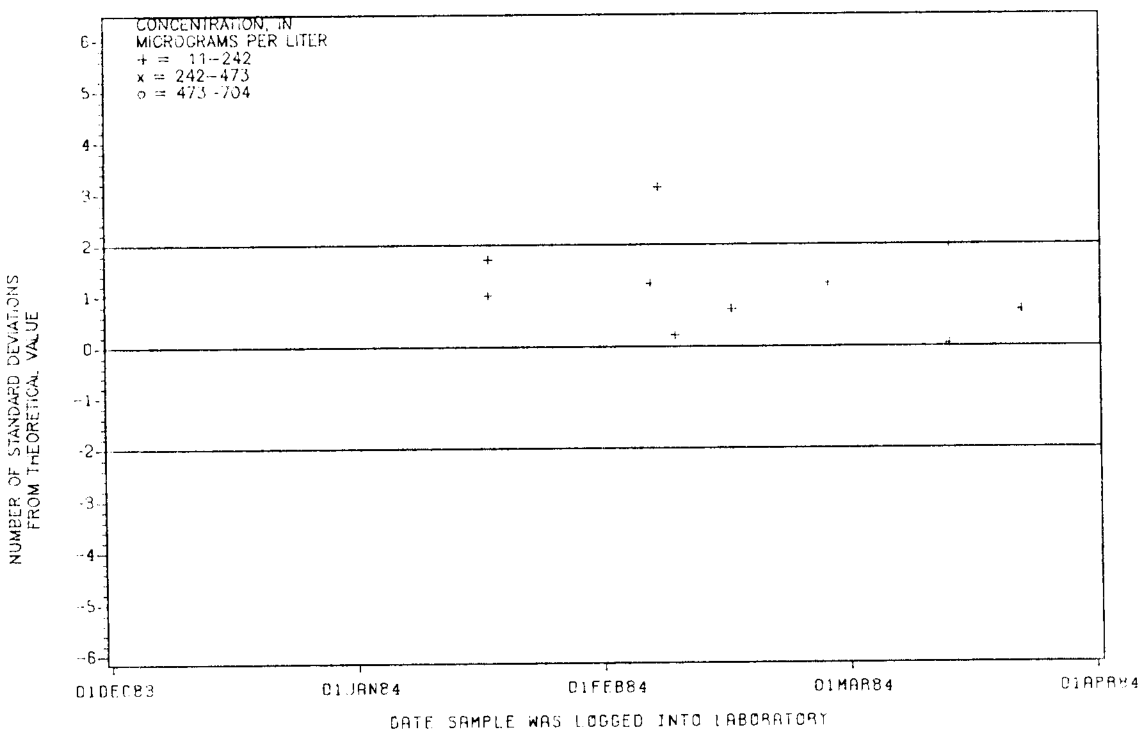

Figure D28.--Iron, total recoverable data from the Denver laboratory.

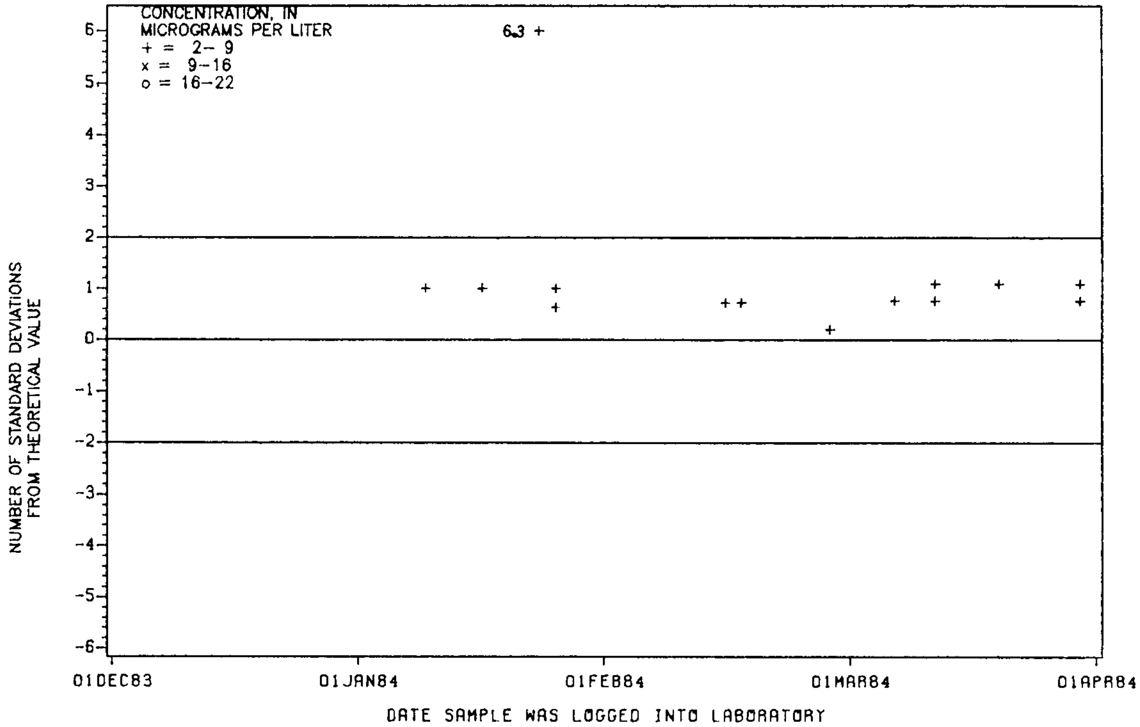

Figure A29.--Lead(ICP) data from the Atlanta laboratory.

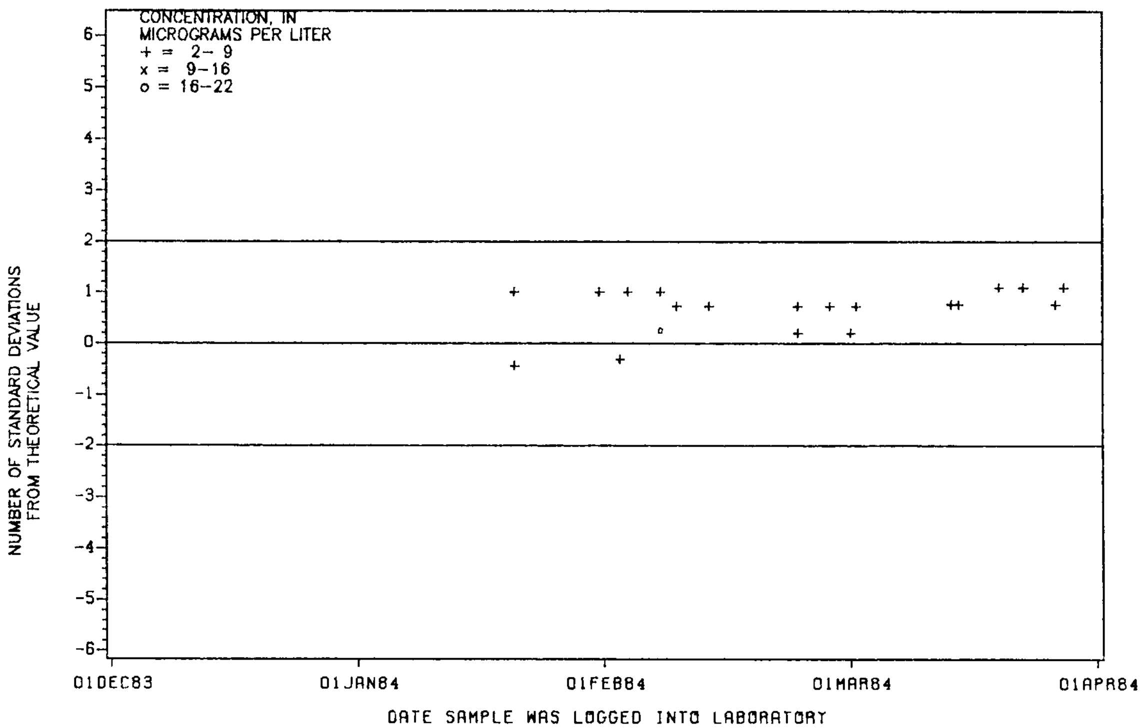

Figure D29.--Lead(ICP) data from the Denver laboratory.

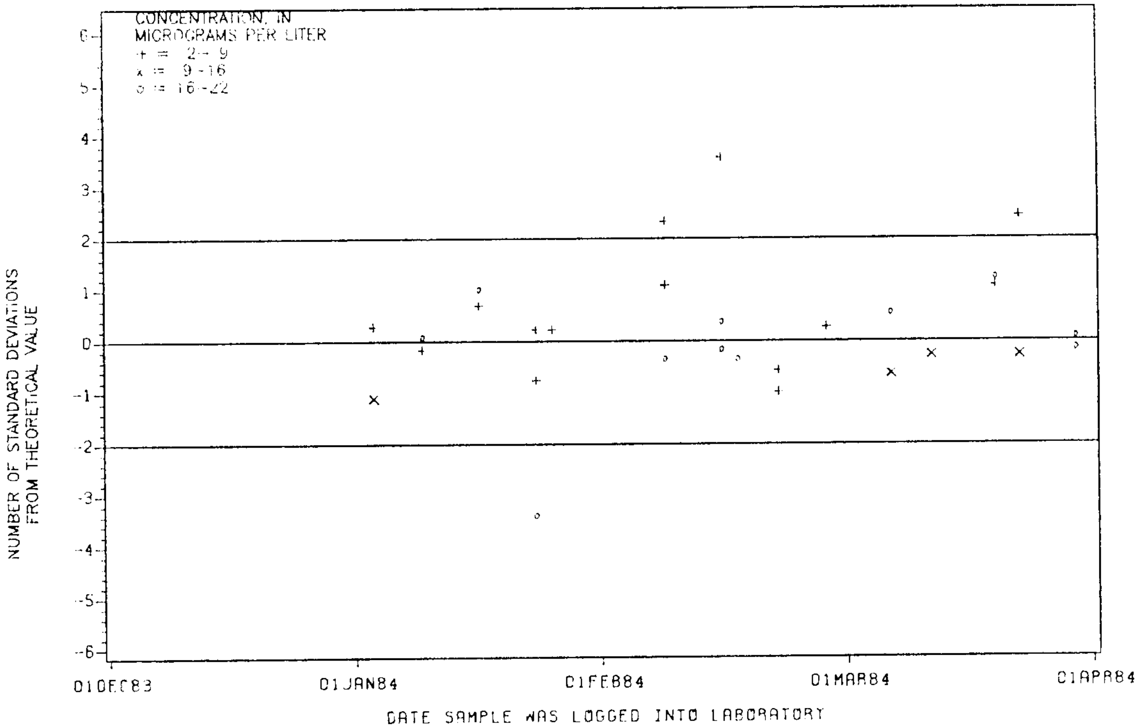

Figure A30.--Lead(AA) data from the Atlanta laboratory.

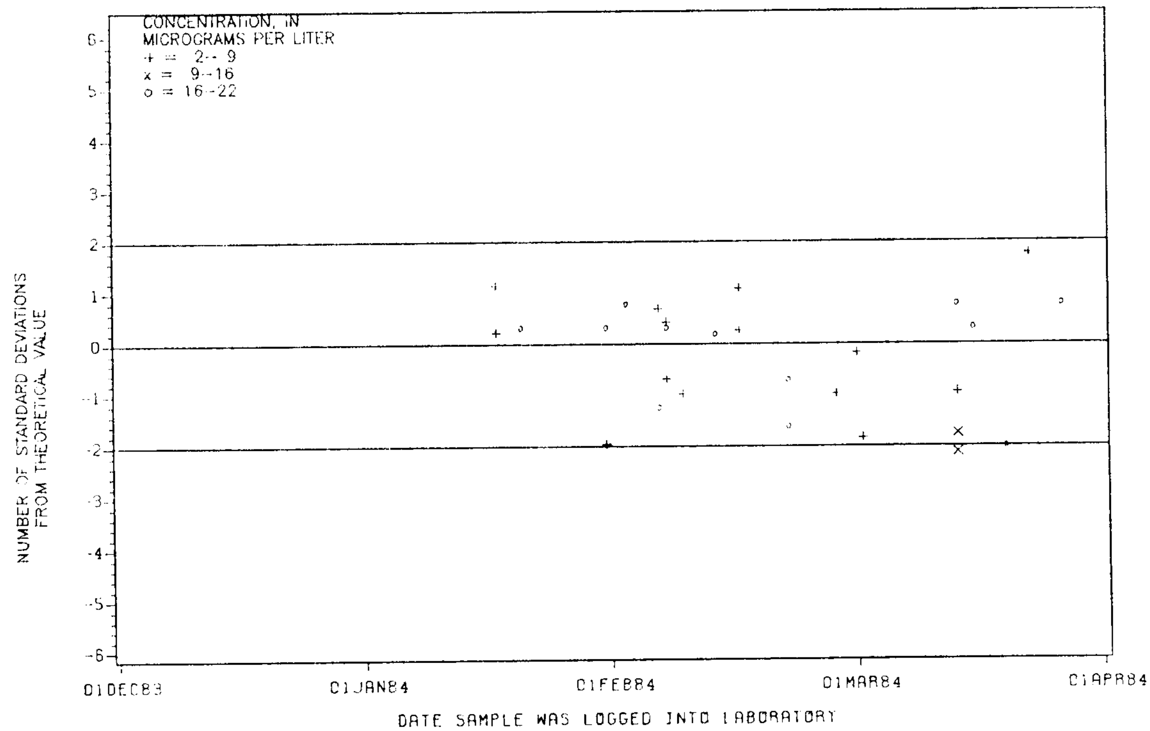

Figure D30.--Lead(AA) data from the Denver laboratory.

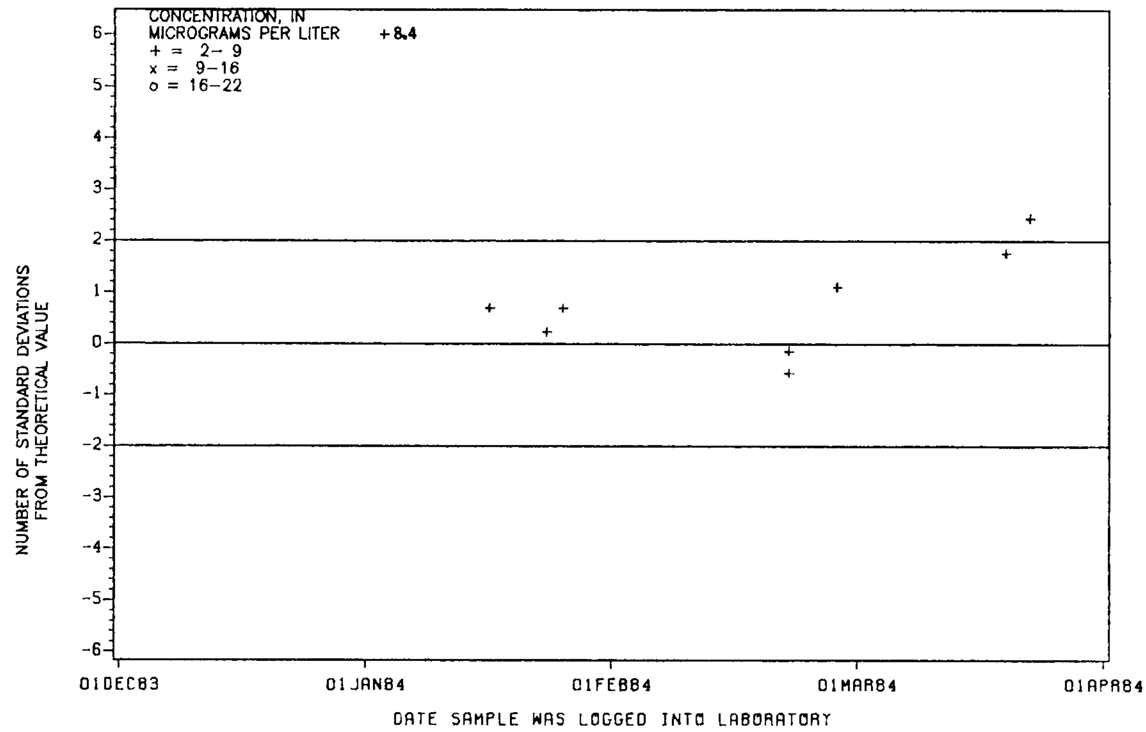

Figure A31.--Lead, total recoverable data from the Atlanta laboratory.

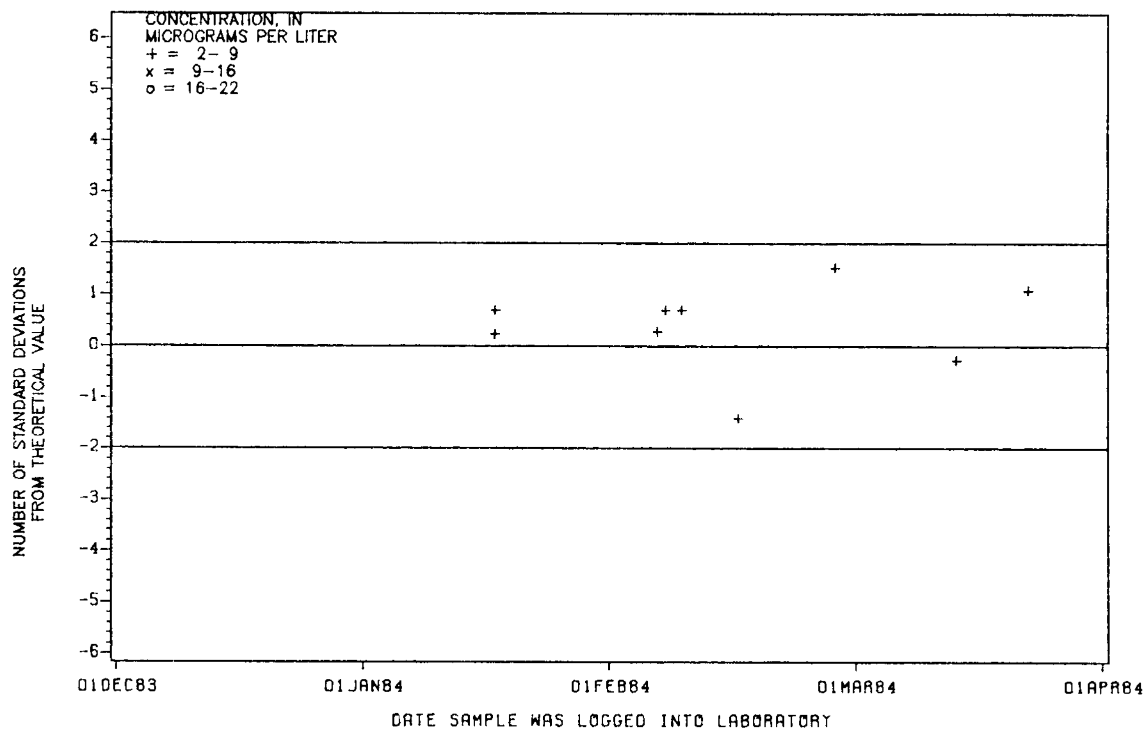

Figure D31.--Lead, total recoverable data from the Denver laboratory.

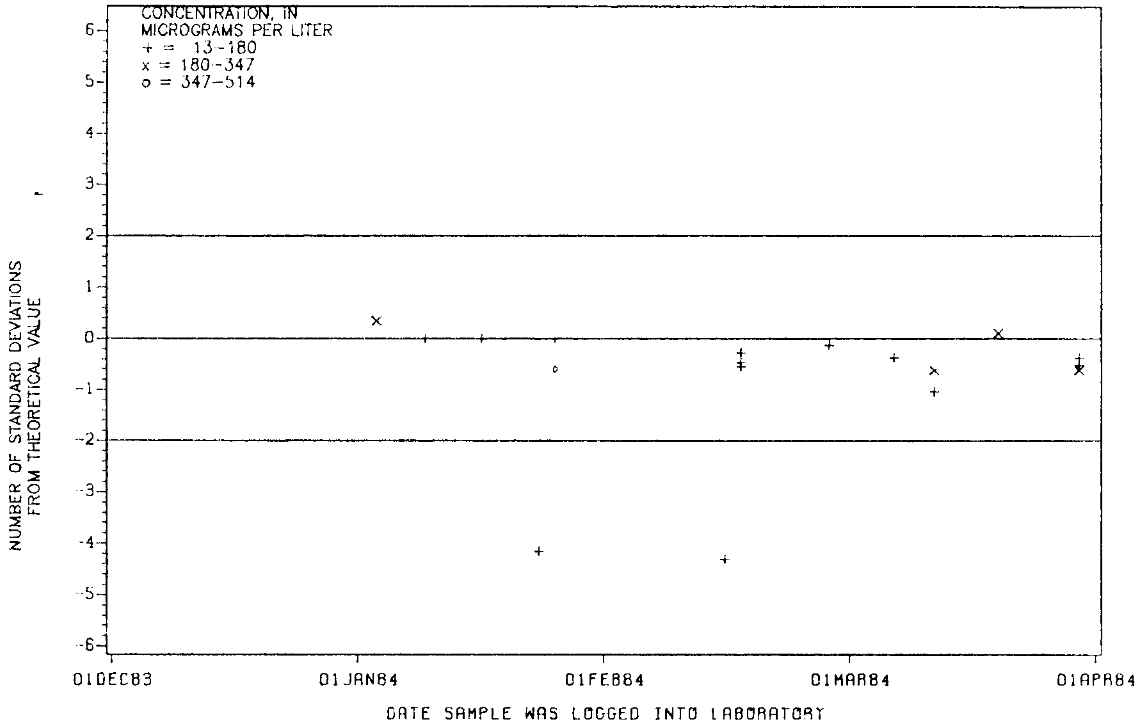

Figure A32.--Lithium data from the Atlanta laboratory.

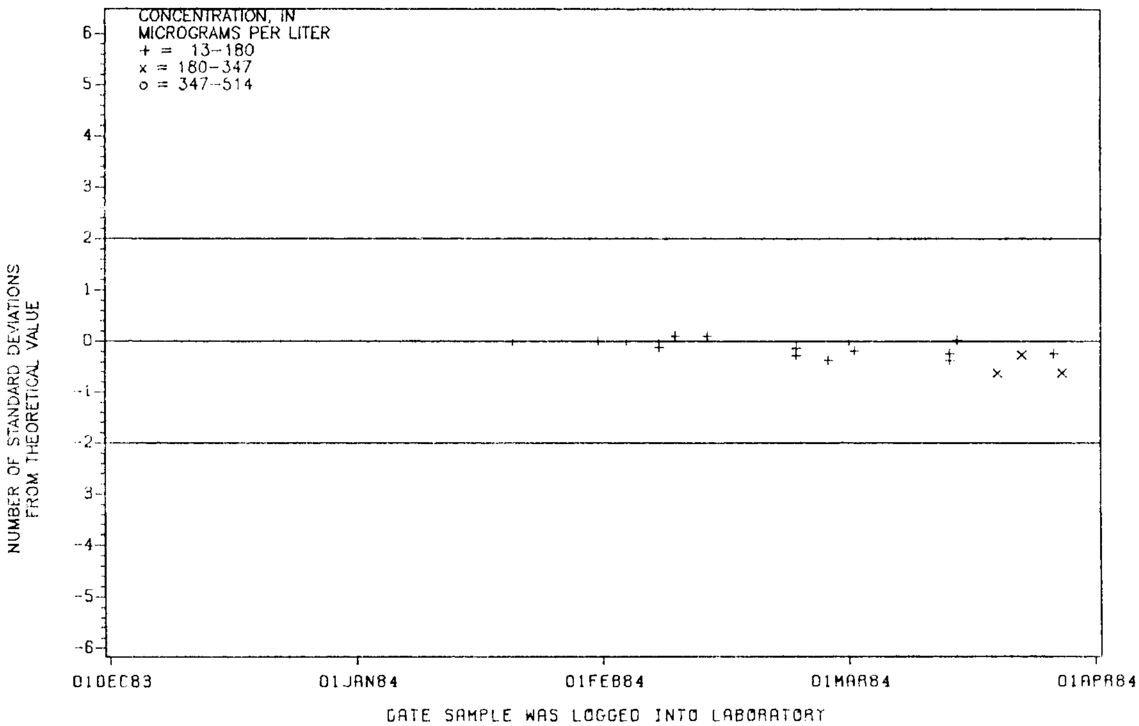

Figure D32.--Lithium data from the Denver laboratory.

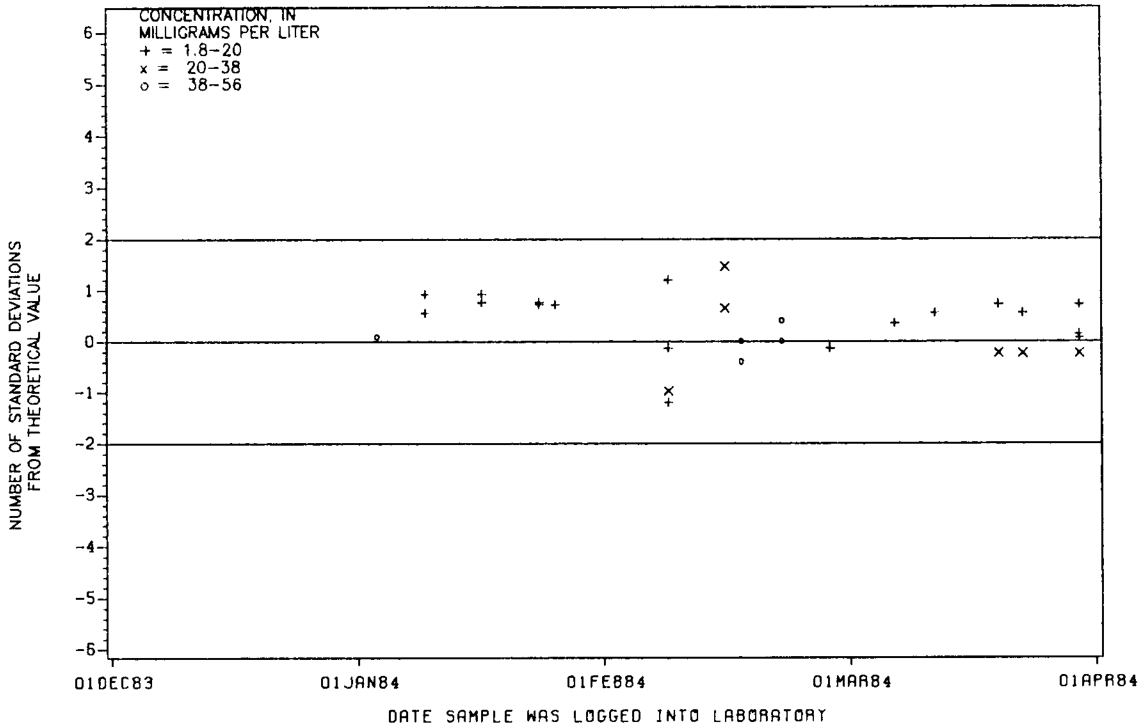

Figure A33.––Magnesium(ICP) data from the Atlanta laboratory.

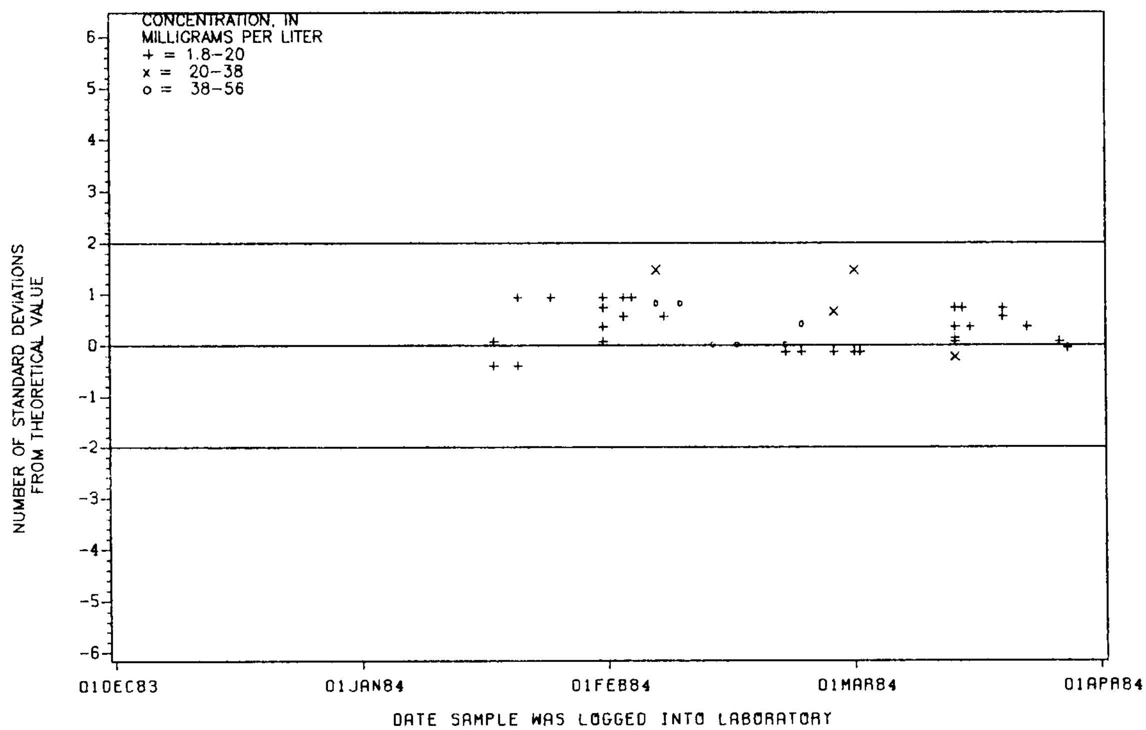

Figure D33.––Magnesium(ICP) data from the Denver laboratory.

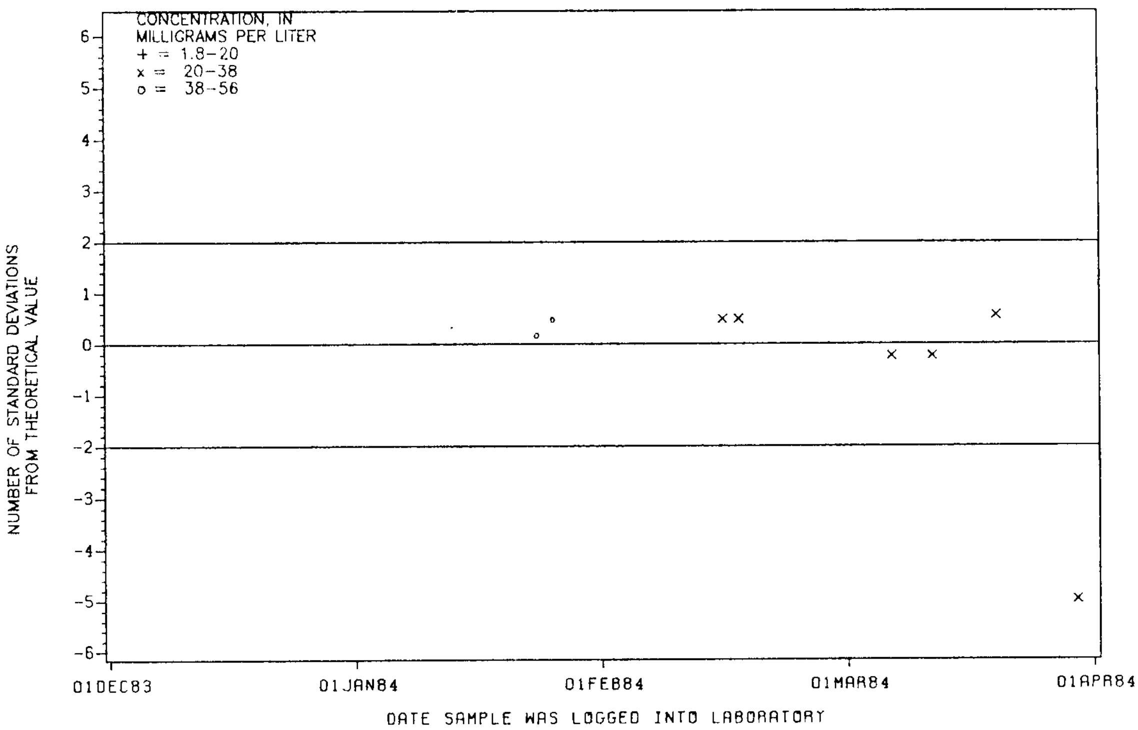

Figure A34.--Magnesium(AA) data from the Atlanta laboratory.

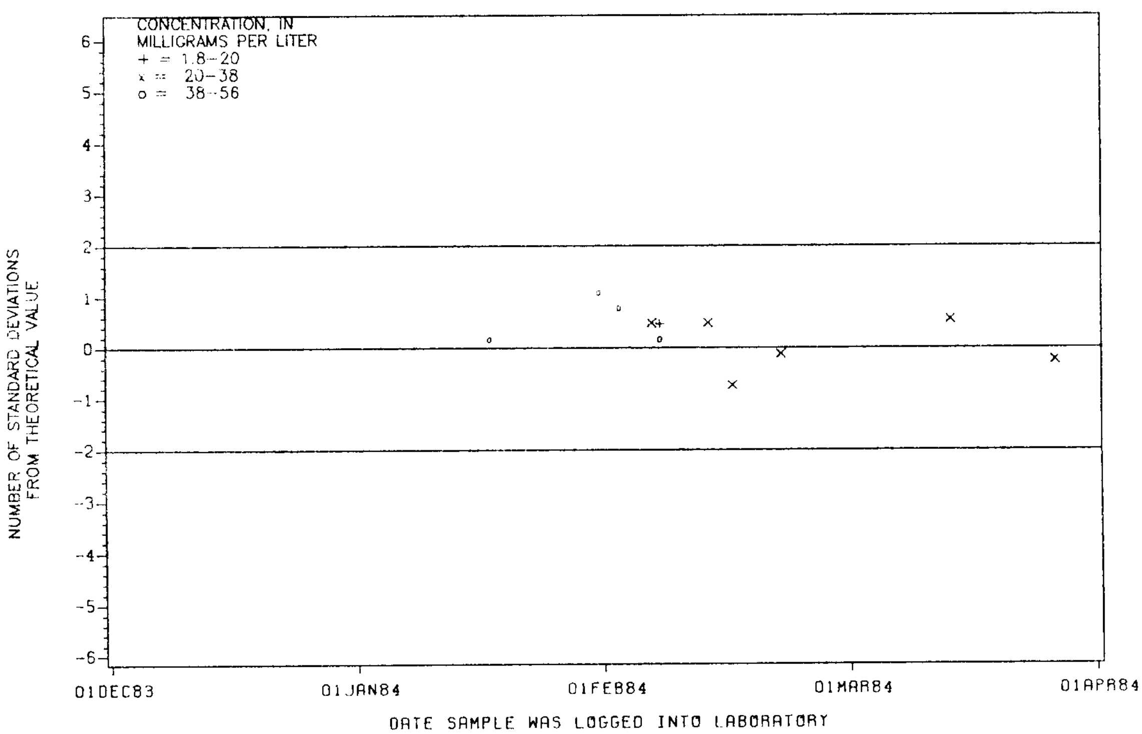

Figure D34.--Magnesium(AA) data from the Denver laboratory.

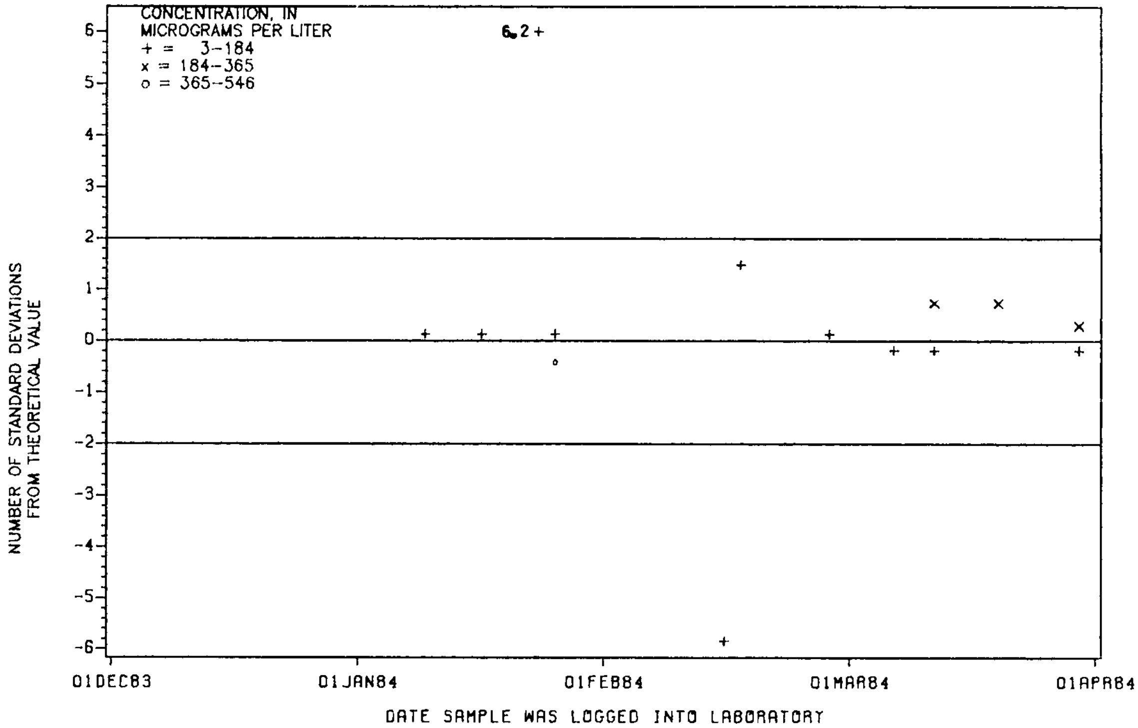

Figure A35.--Manganese(ICP) data from the Atlanta laboratory.

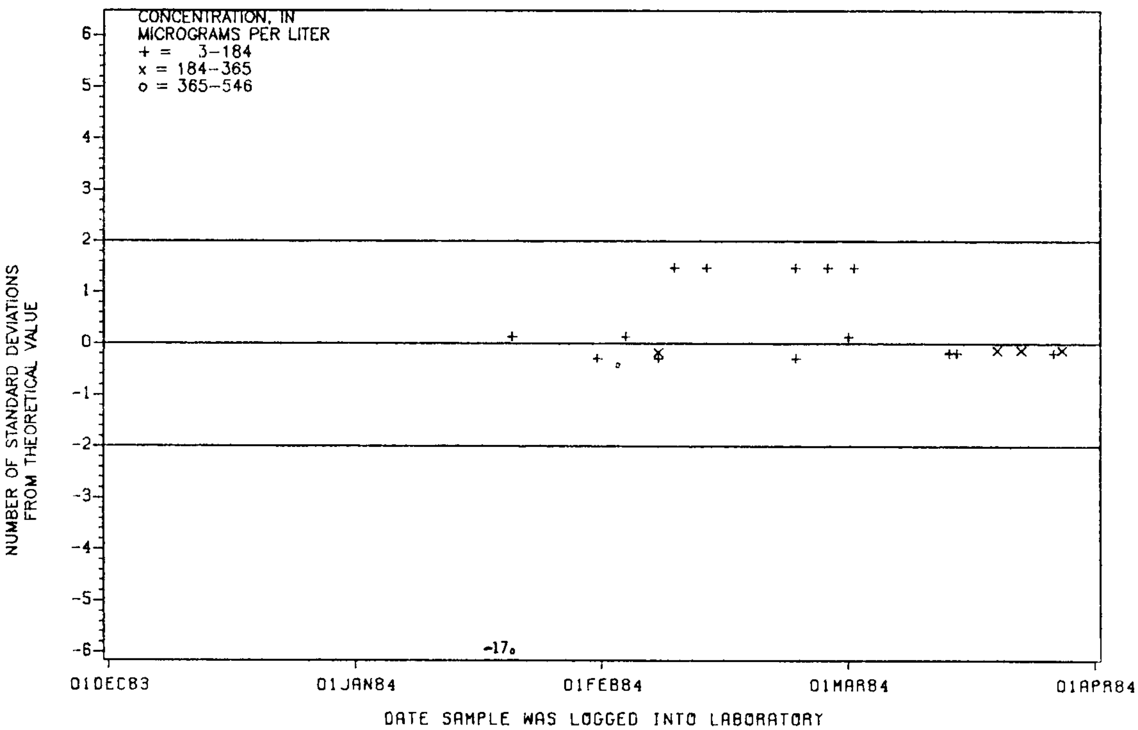

Figure D35.--Manganese(ICP) data from the Denver laboratory.

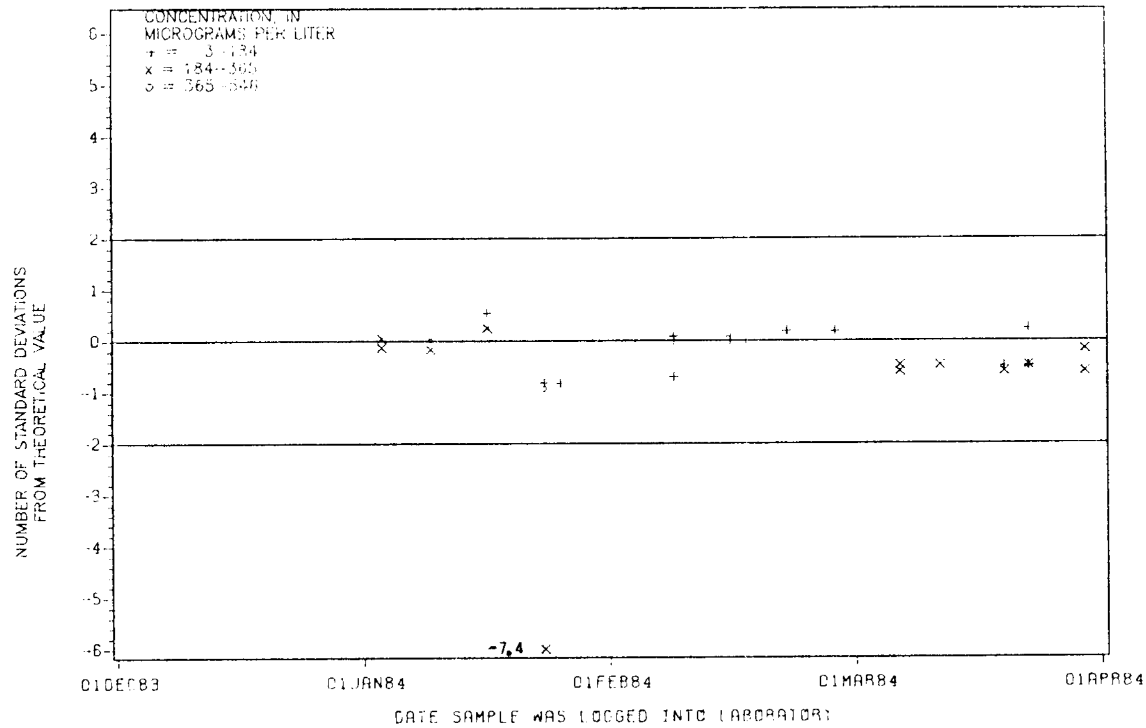

Figure A36.--Manganese(AA) data from the Atlanta laboratory.

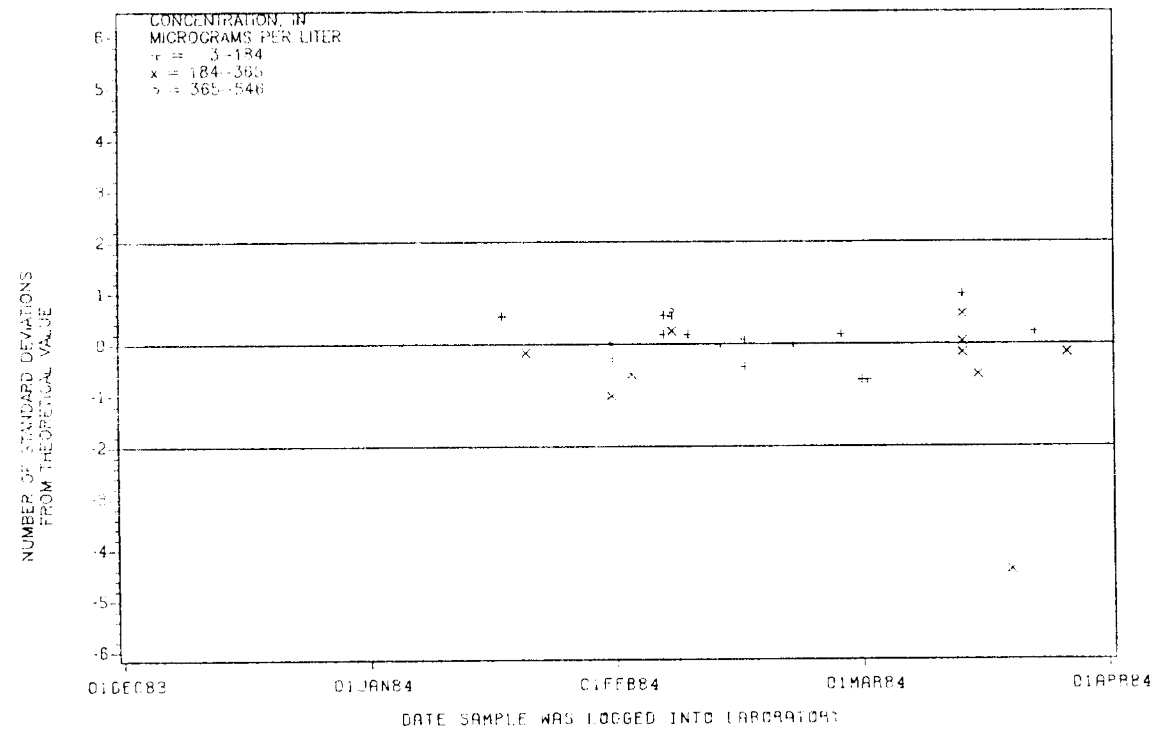

Figure D36.--Manganese(AA) data from the Denver laboratory.

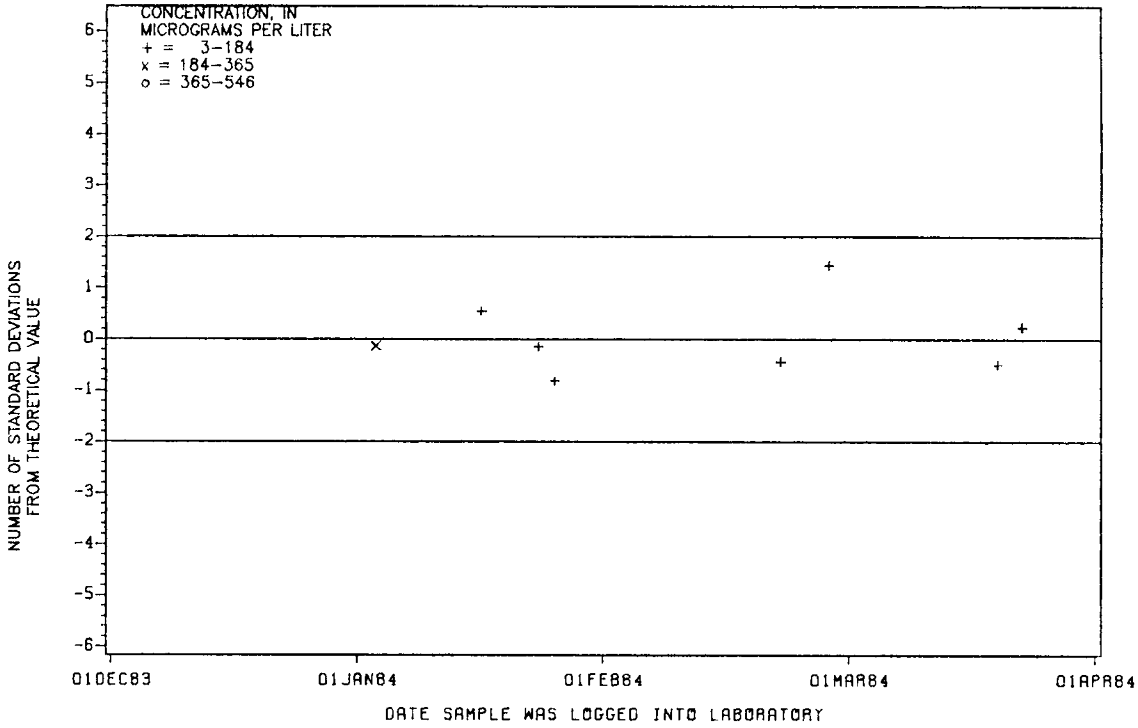

Figure A37.--Manganese, total recoverable data from the Atlanta laboratory.

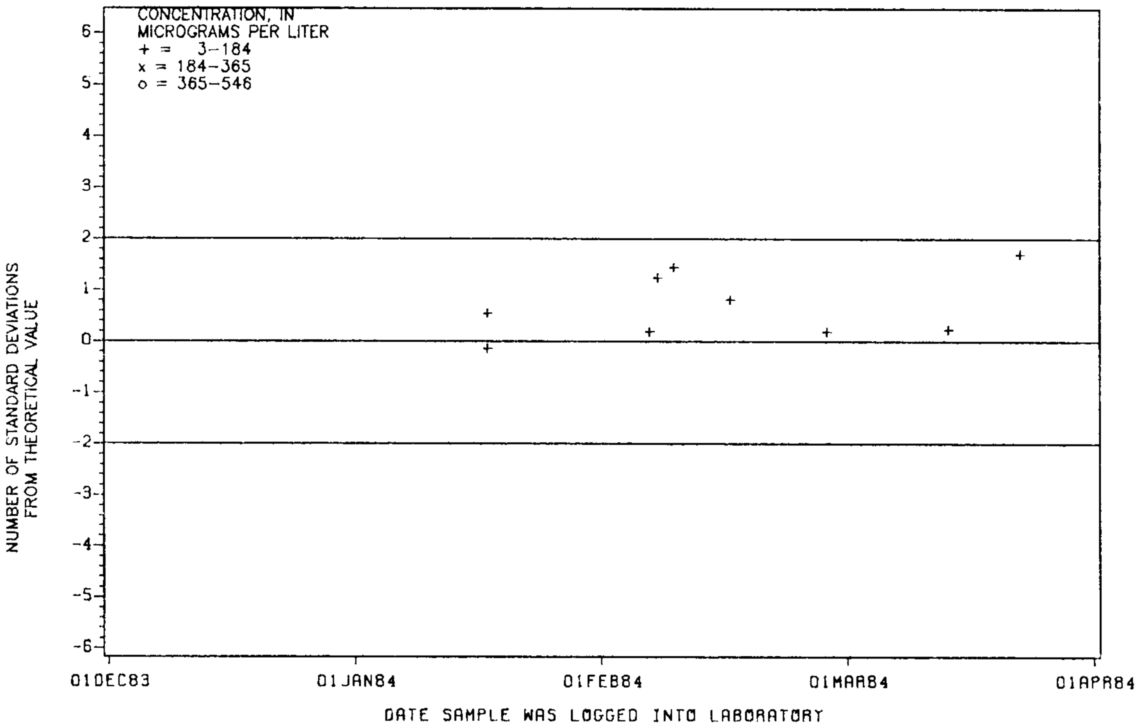

Figure D37.--Manganese, total recoverable data from the Denver laboratory.

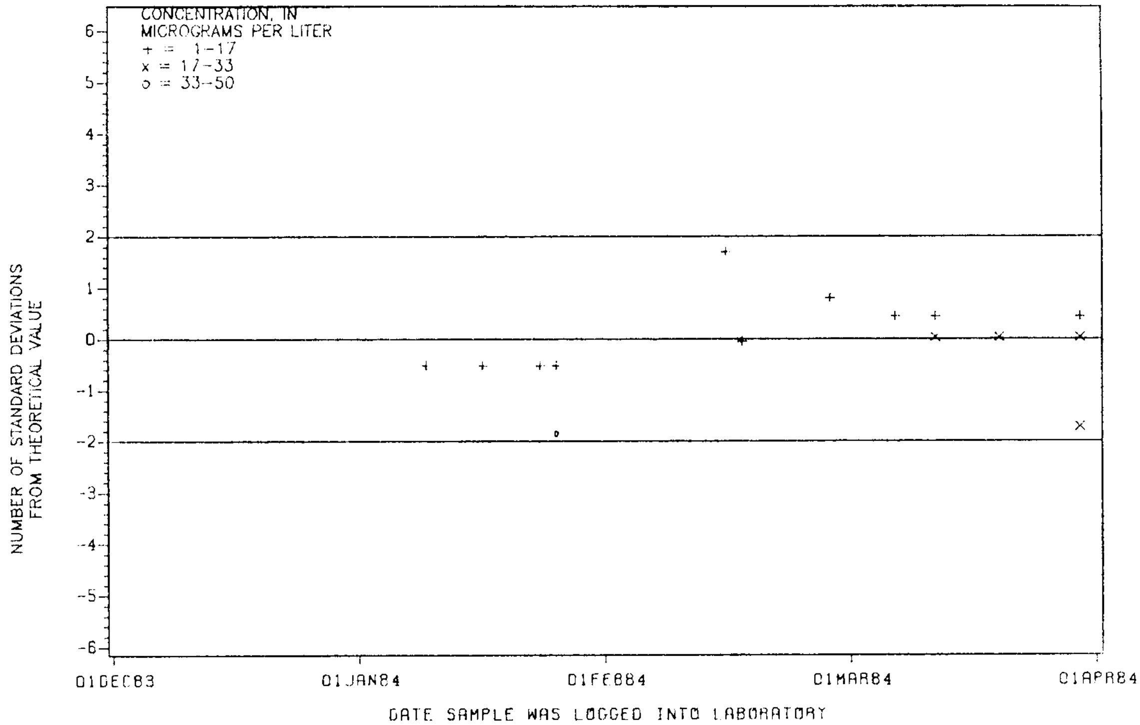

Figure A38.--Molybdenum(ICP) data from the Atlanta laboratory.

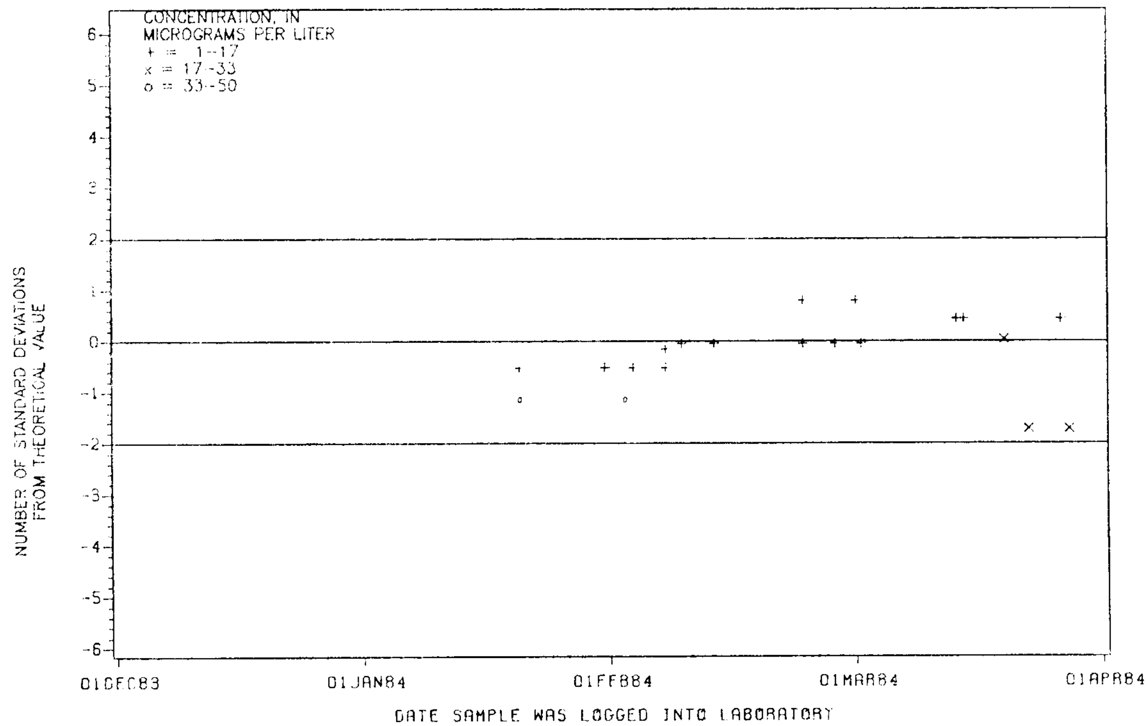

Figure D38.--Molybdenum(ICP) data from the Denver laboratory.

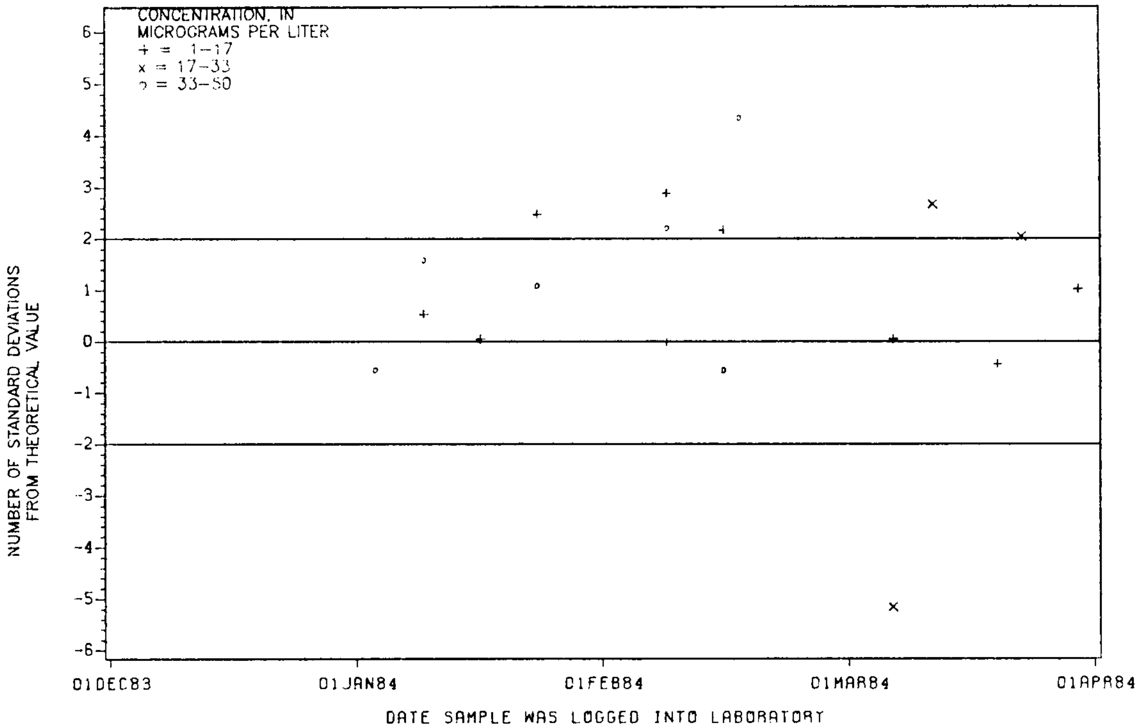

Figure A39.--Molybdenum(AA) data from the Atlanta laboratory.

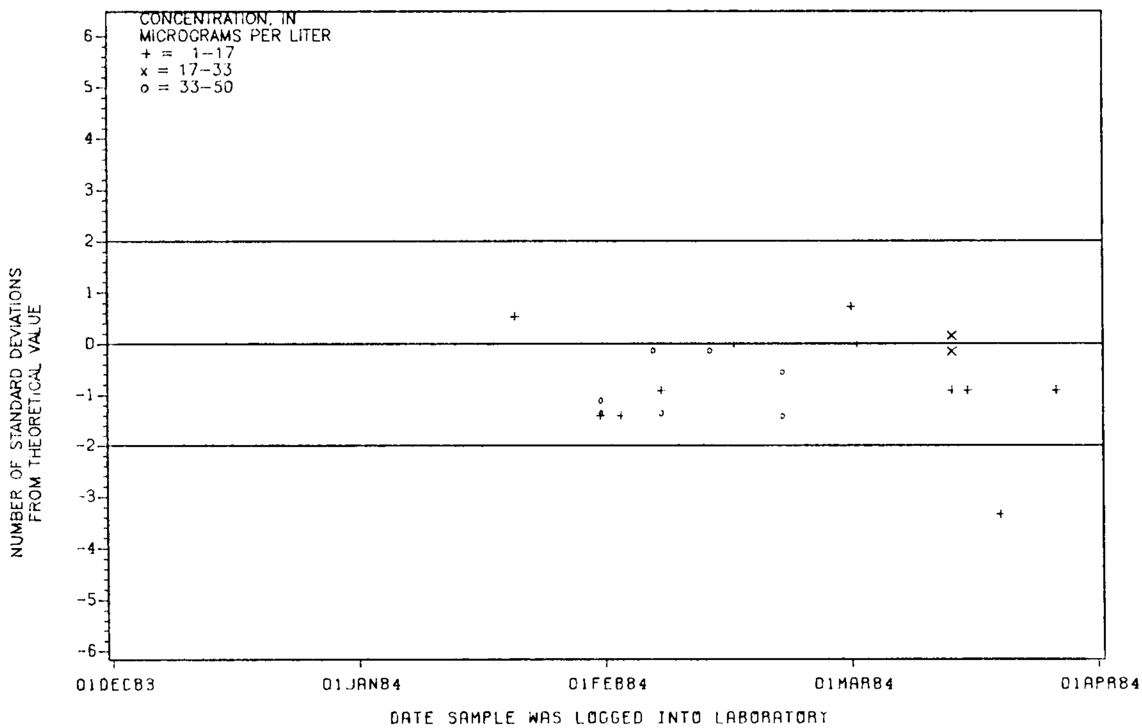

Figure D39.--Molybdenum(AA) data from the Denver laboratory.

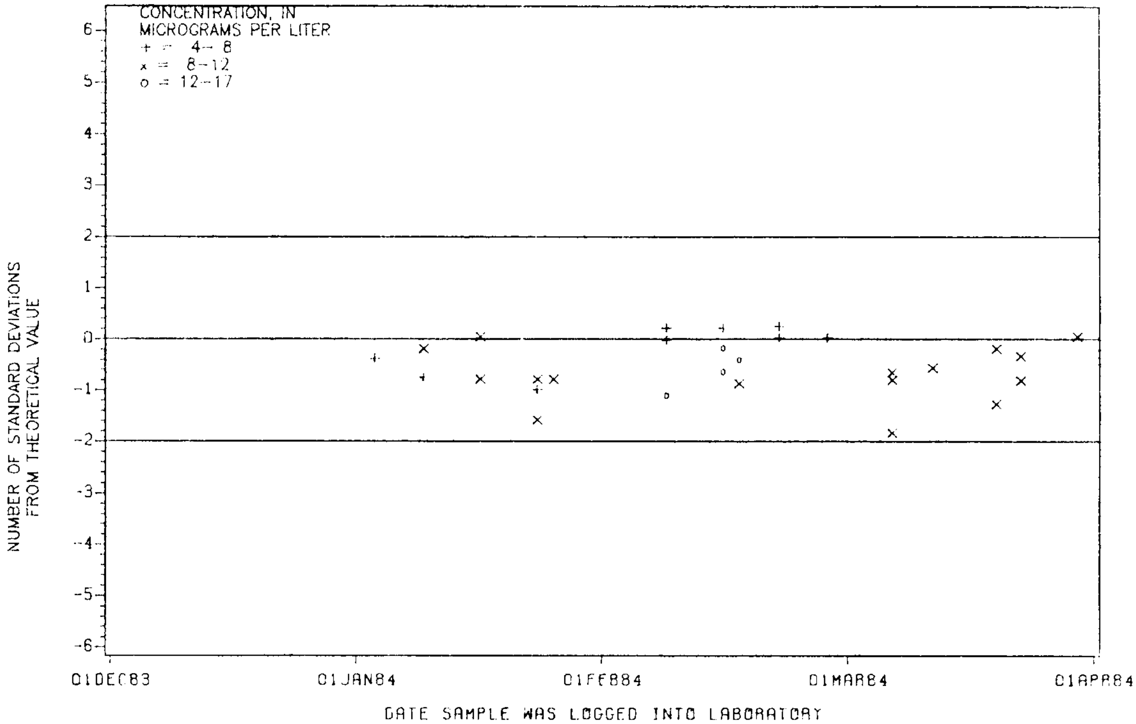

Figure A40.--Nickel data from the Atlanta laboratory.

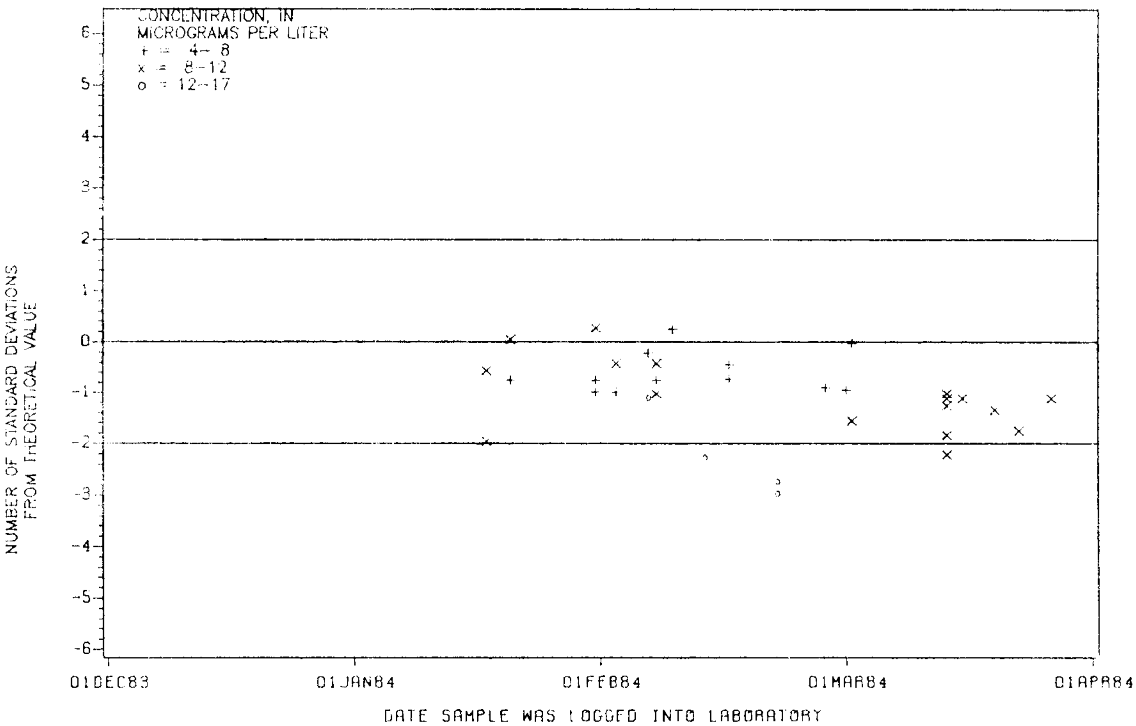

Figure D40.--Nickel data from the Denver laboratory.

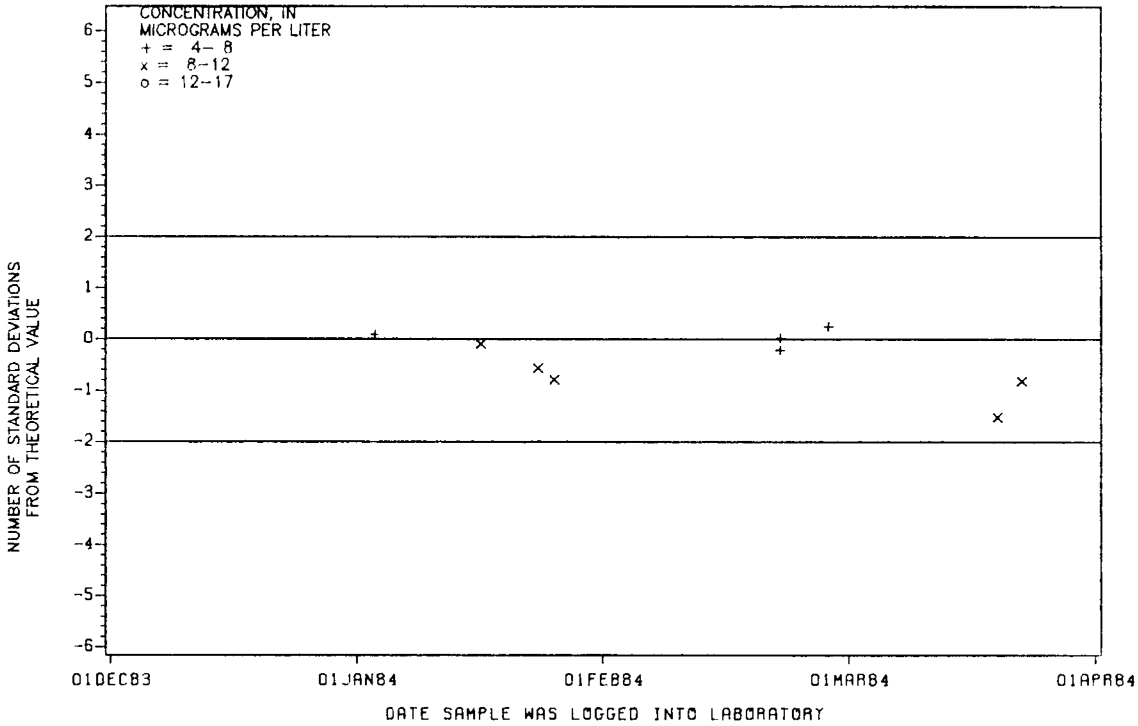

Figure A41.--Nickel, total recoverable data from the Atlanta laboratory.

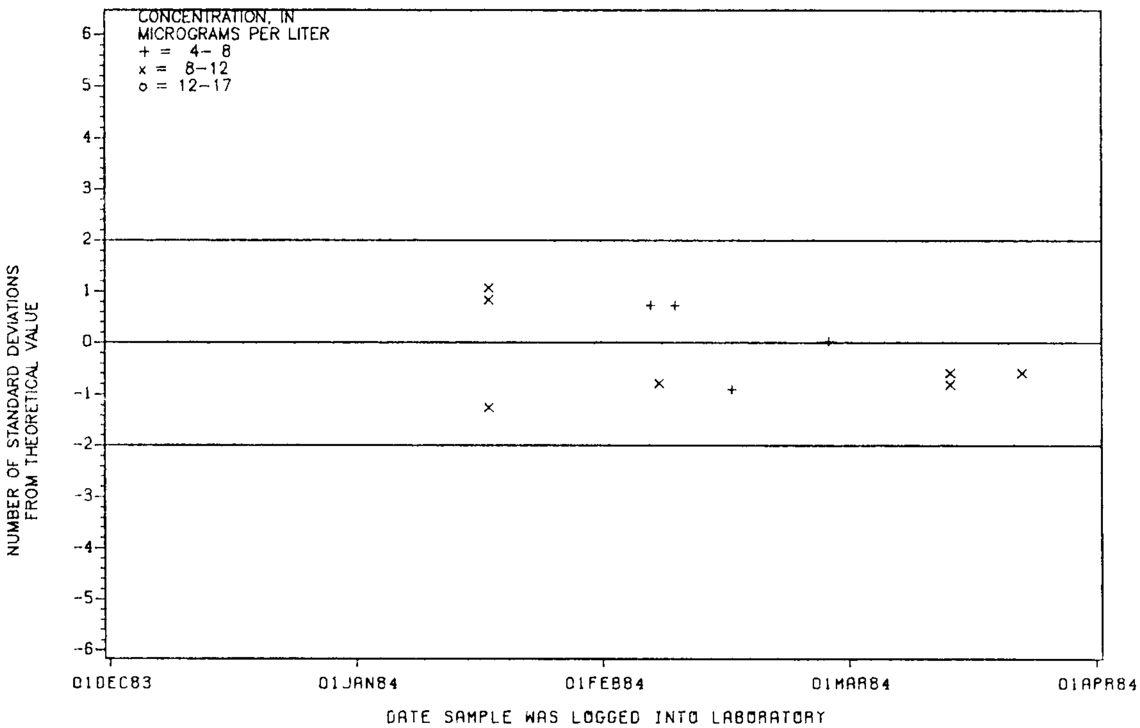

Figure D41.--Nickel, total recoverable data from the Denver laboratory.

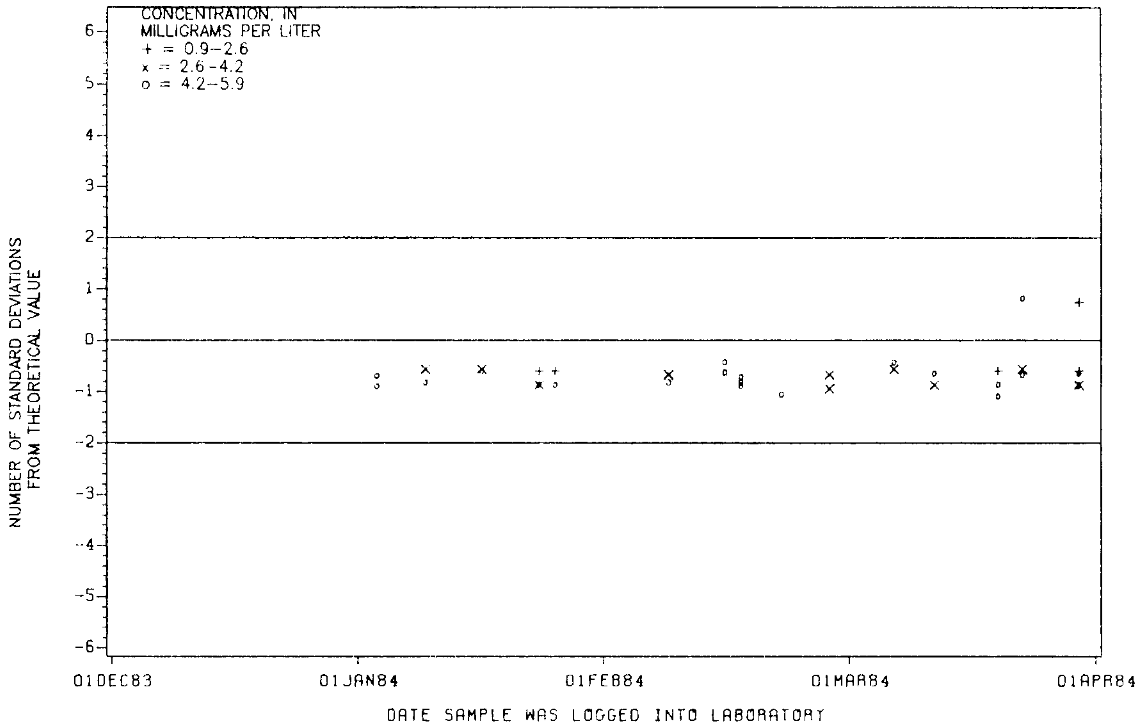

Figure A42.—Potassium data from the Atlanta laboratory.

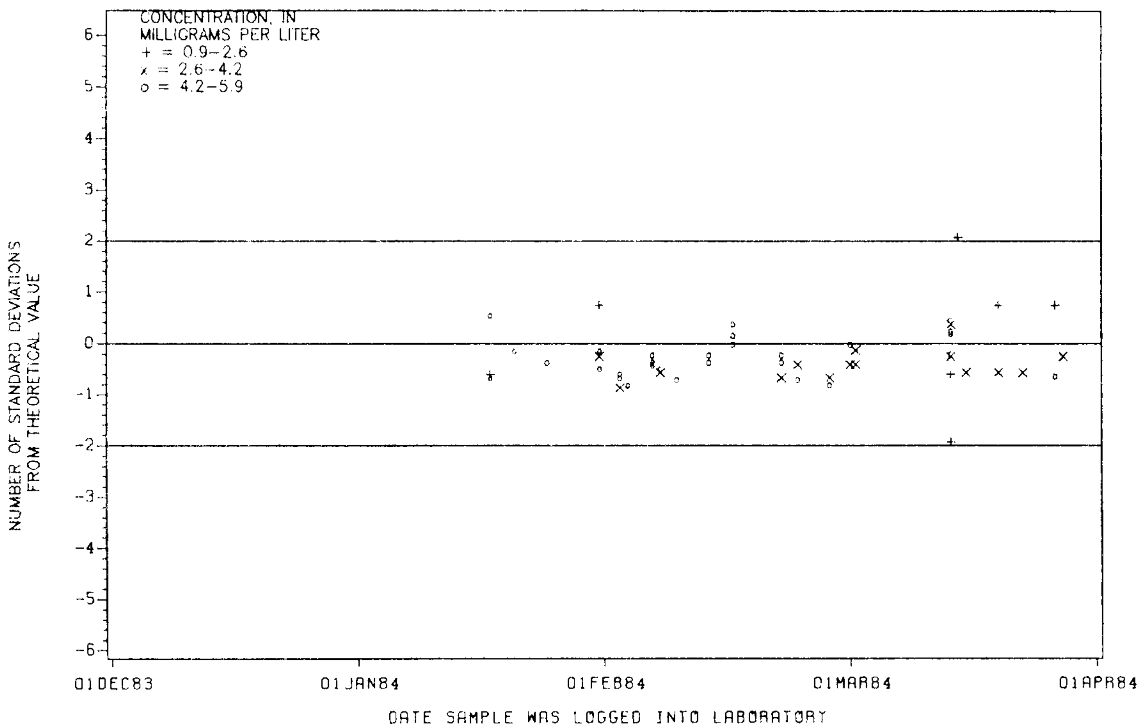

Figure D42.—Potassium data from the Denver laboratory.

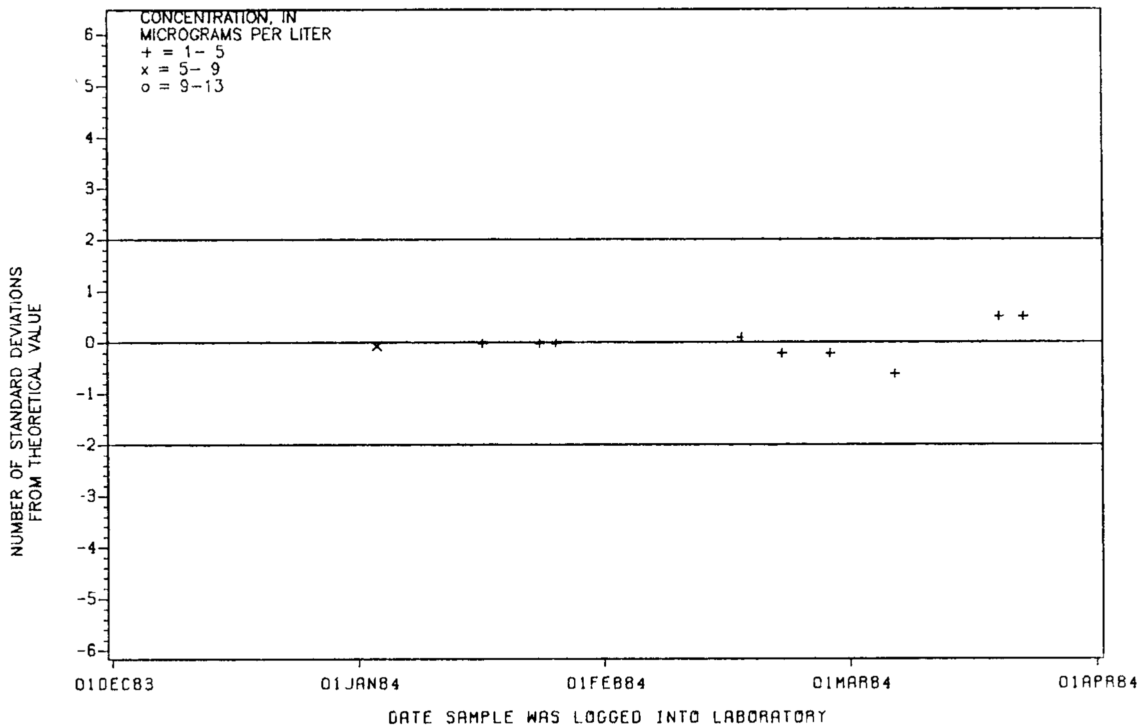

Figure A43.--Selenium data from the Atlanta laboratory.

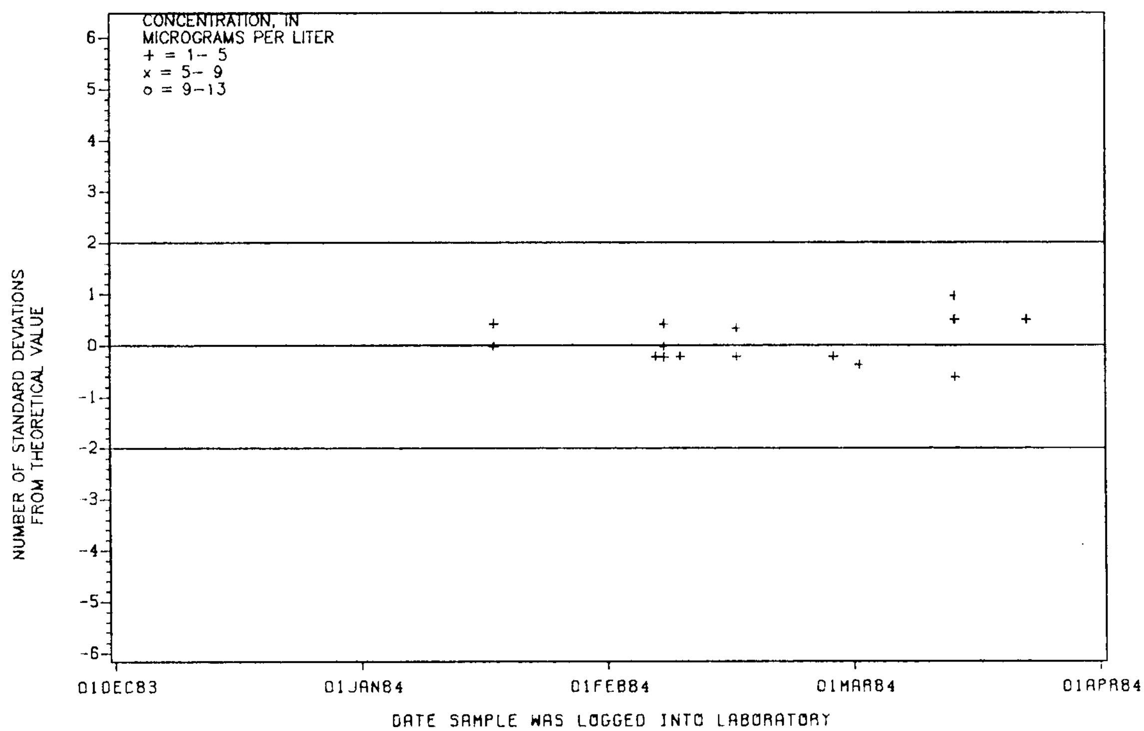

Figure D43.--Selenium data from the Denver laboratory.

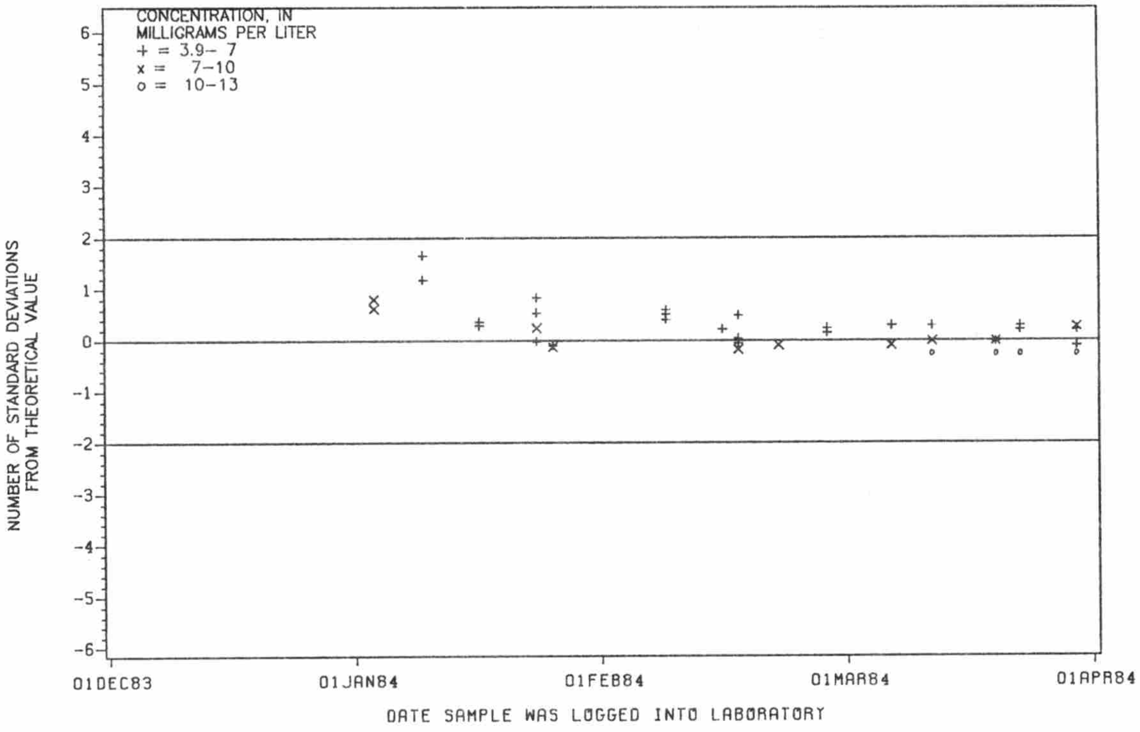

Figure A44.––Silica data from the Atlanta laboratory.

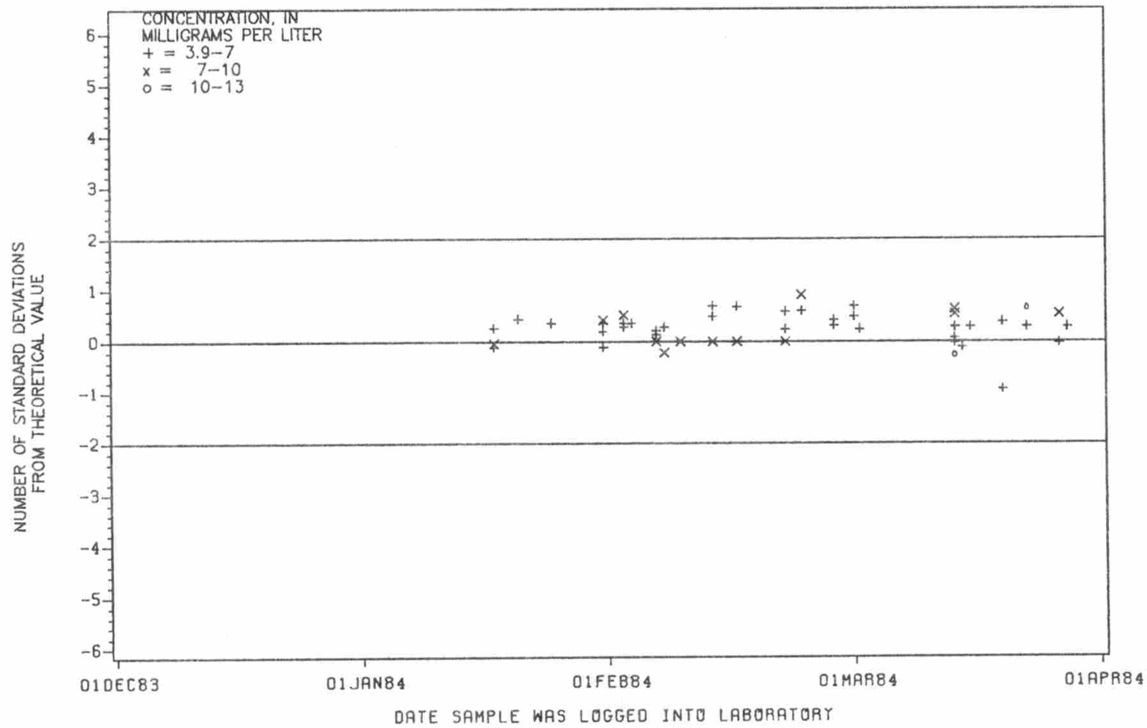

Figure D44.––Silica data from the Denver laboratory.

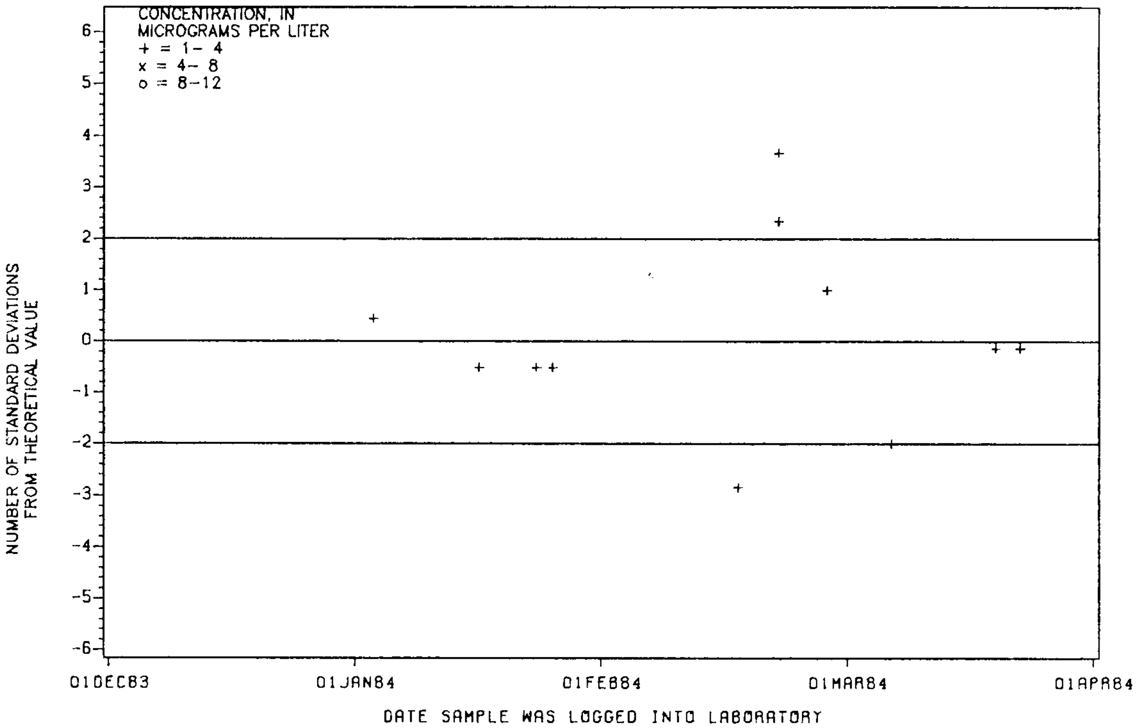

Figure A45.--Silver data from the Atlanta laboratory.

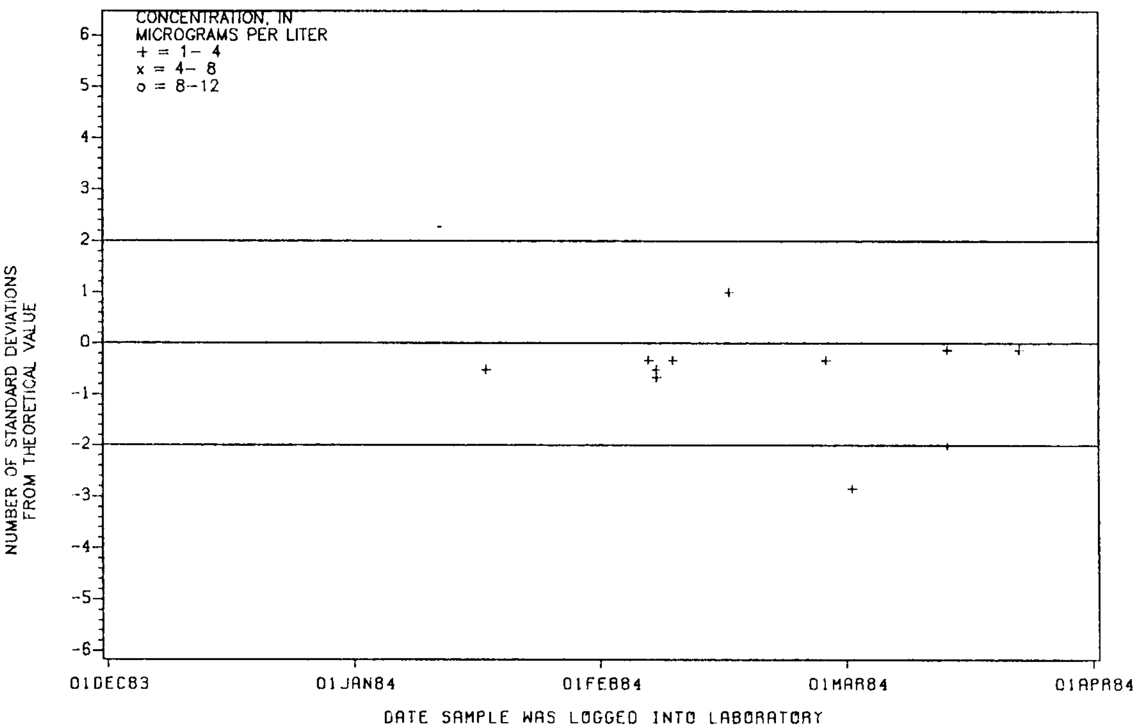

Figure D45.--Silver data from the Denver laboratory.

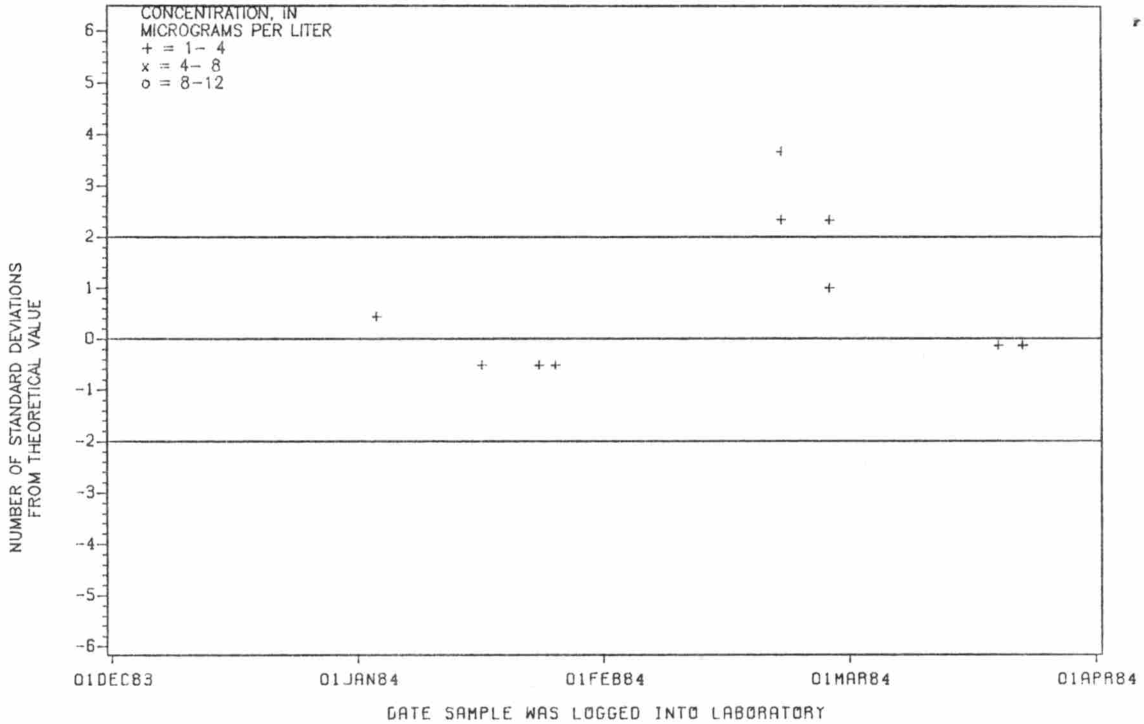

Figure A46.--Silver, total recoverable data from the Atlanta laboratory.

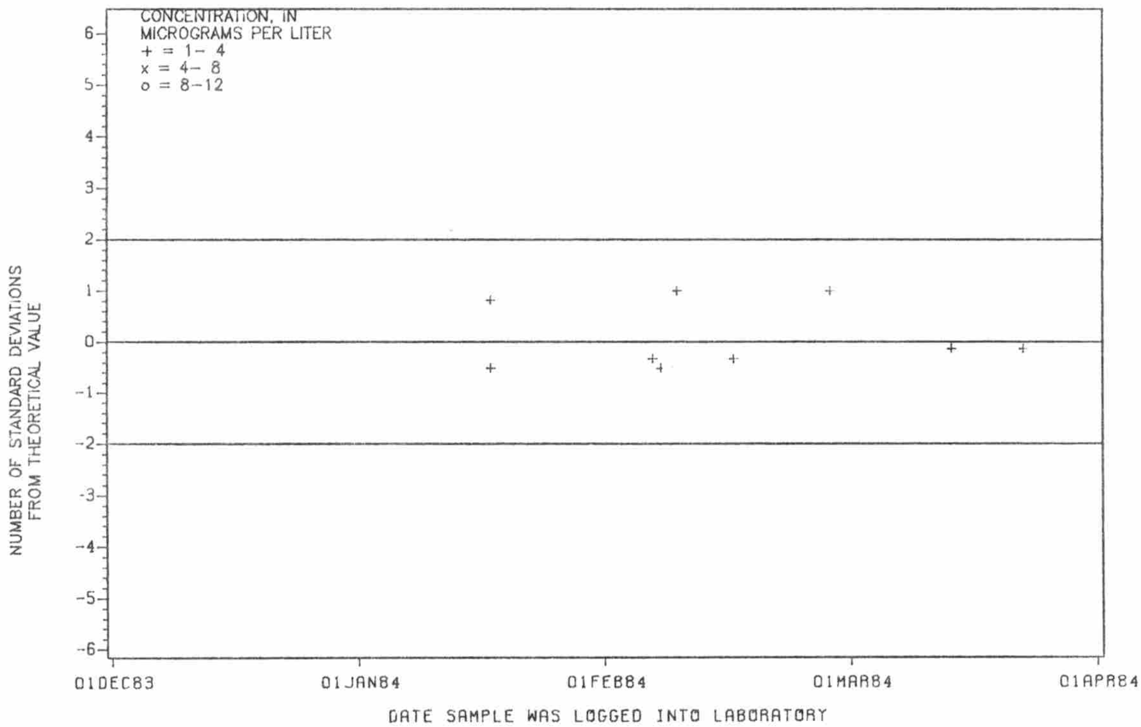

Figure D46.--Silver, total recoverable data from the Denver laboratory.

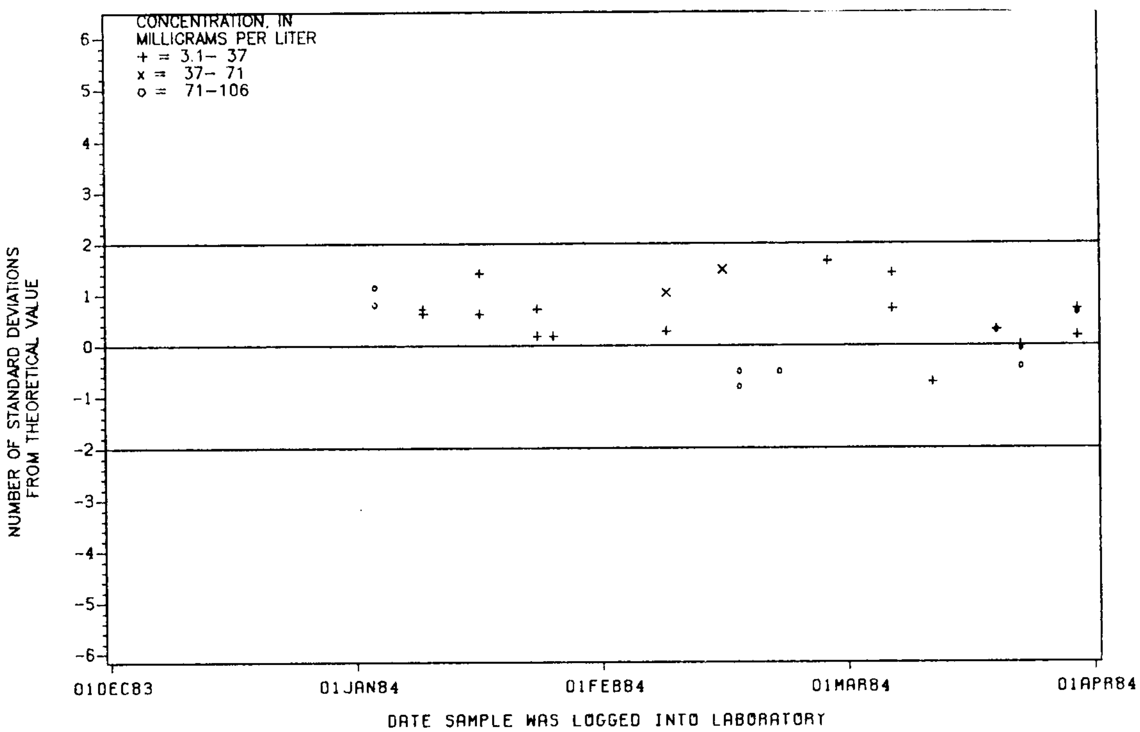

Figure A47.--Sodium(ICP) data from the Atlanta laboratory.

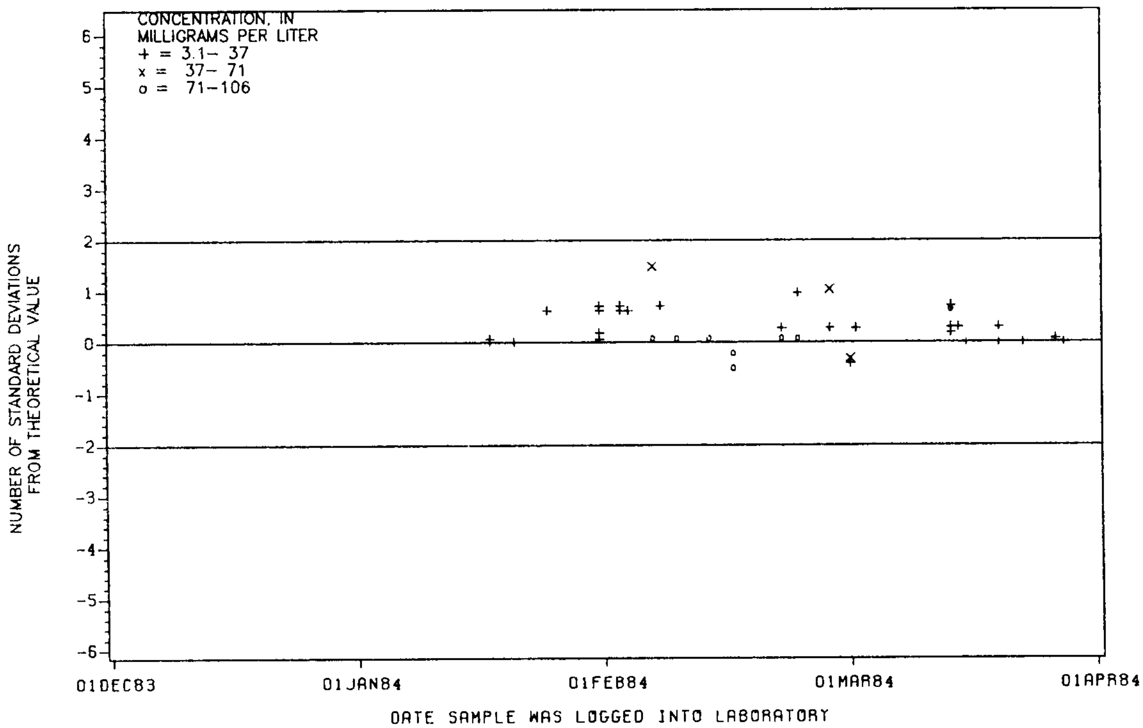

Figure D47.--Sodium(ICP) data from the Denver laboratory.

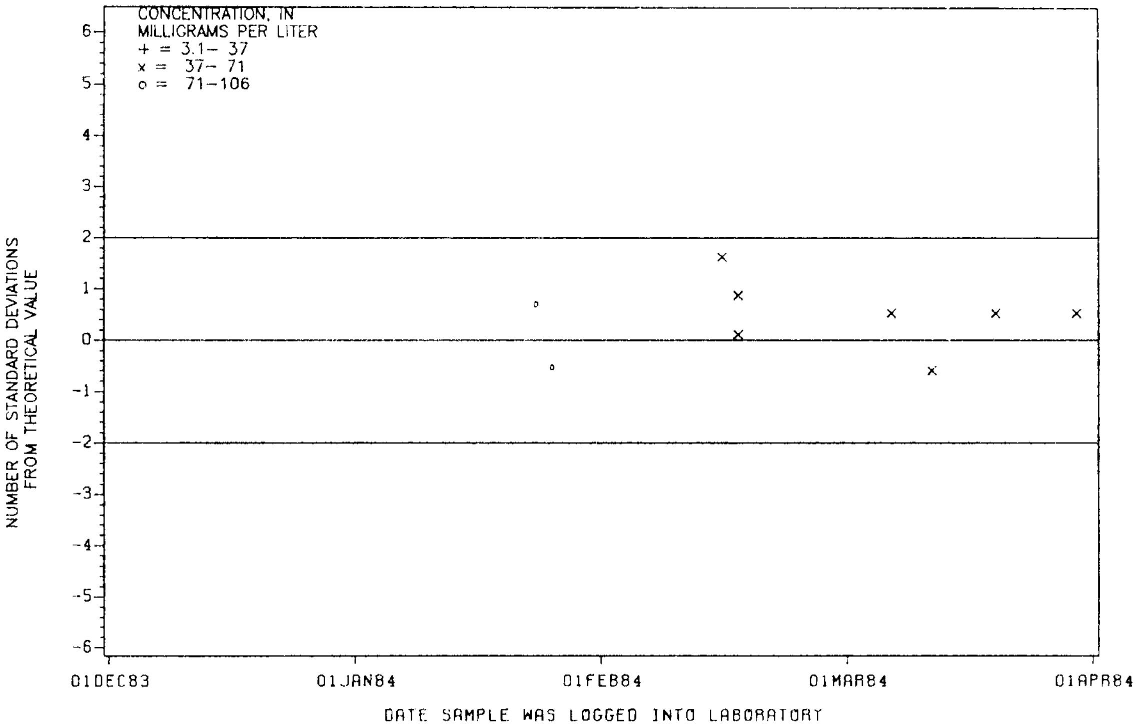

Figure A48.--Sodium(AA) data from the Atlanta laboratory.

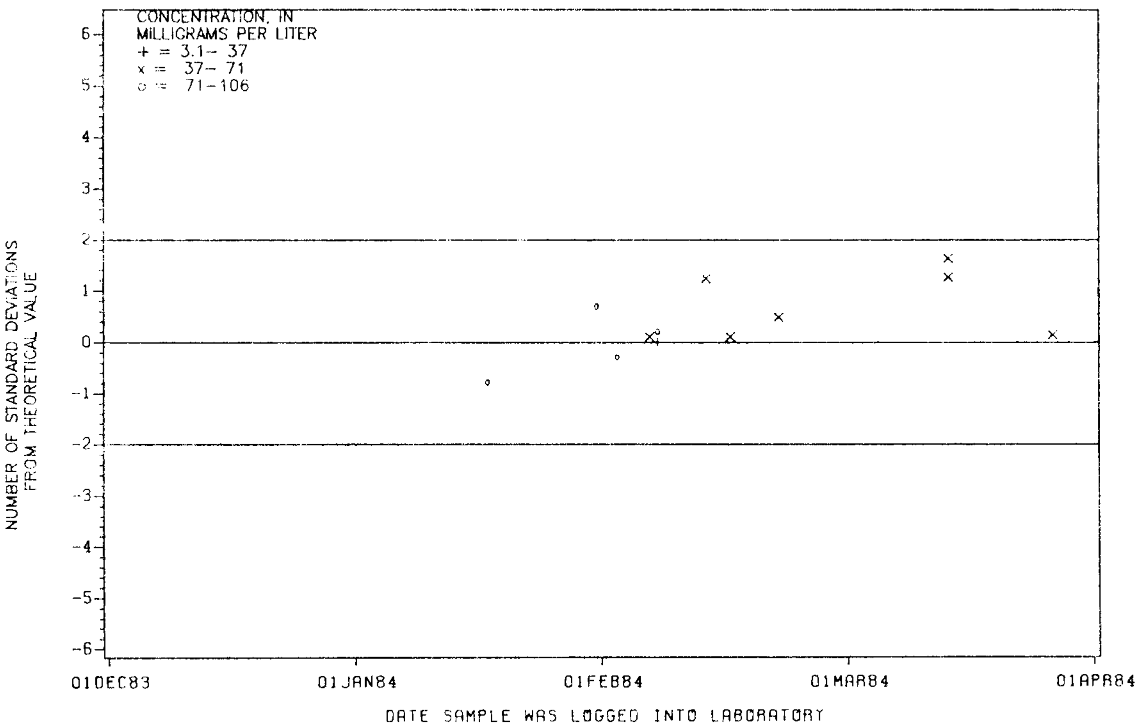

Figure D48.--Sodium(AA) data from the Denver laboratory.

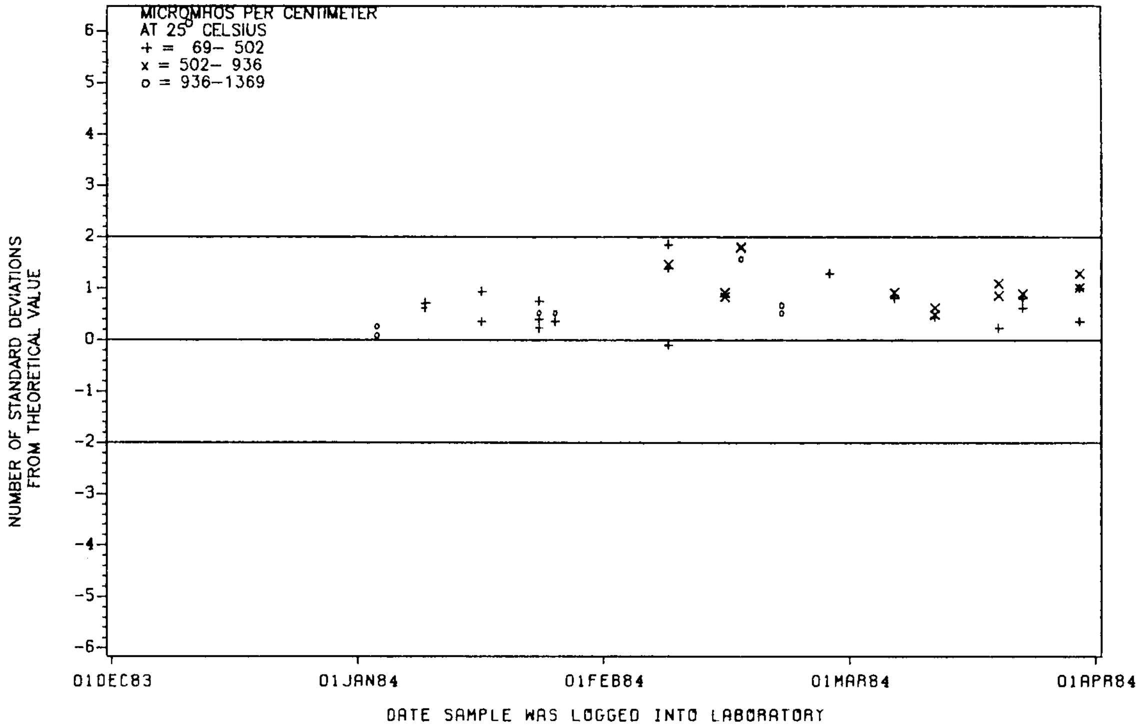

Figure A49.--Specific conductance, data from the Atlanta laboratory.

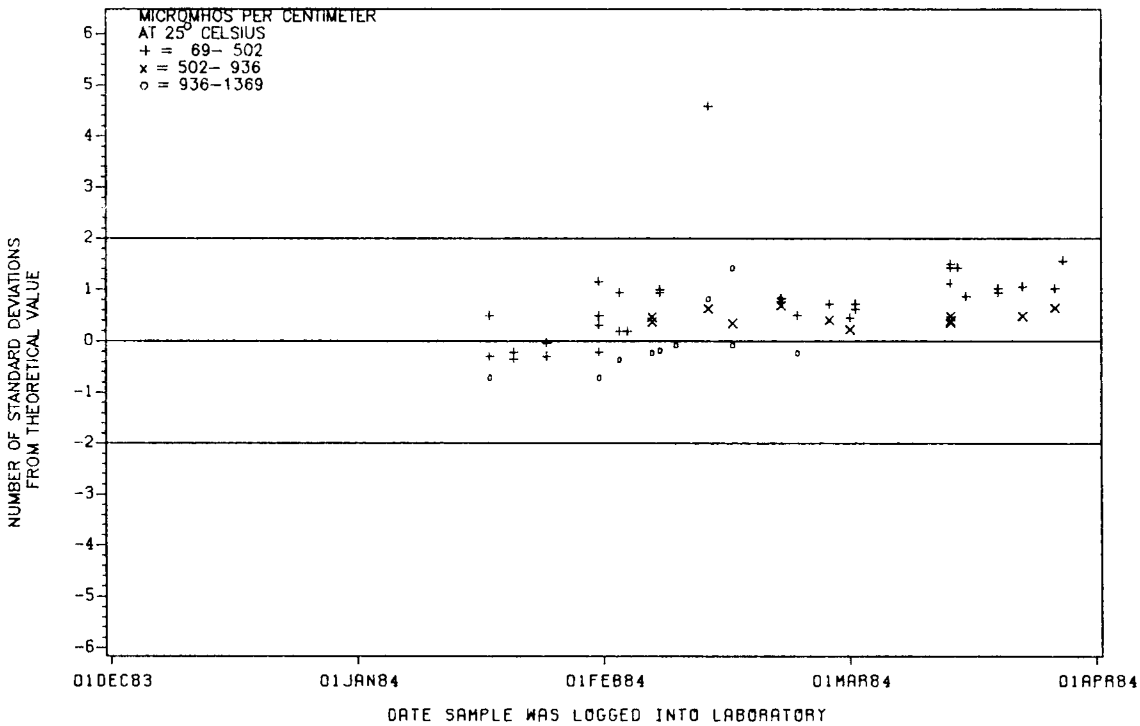

Figure D49.--Specific conductance, data from the Denver laboratory.

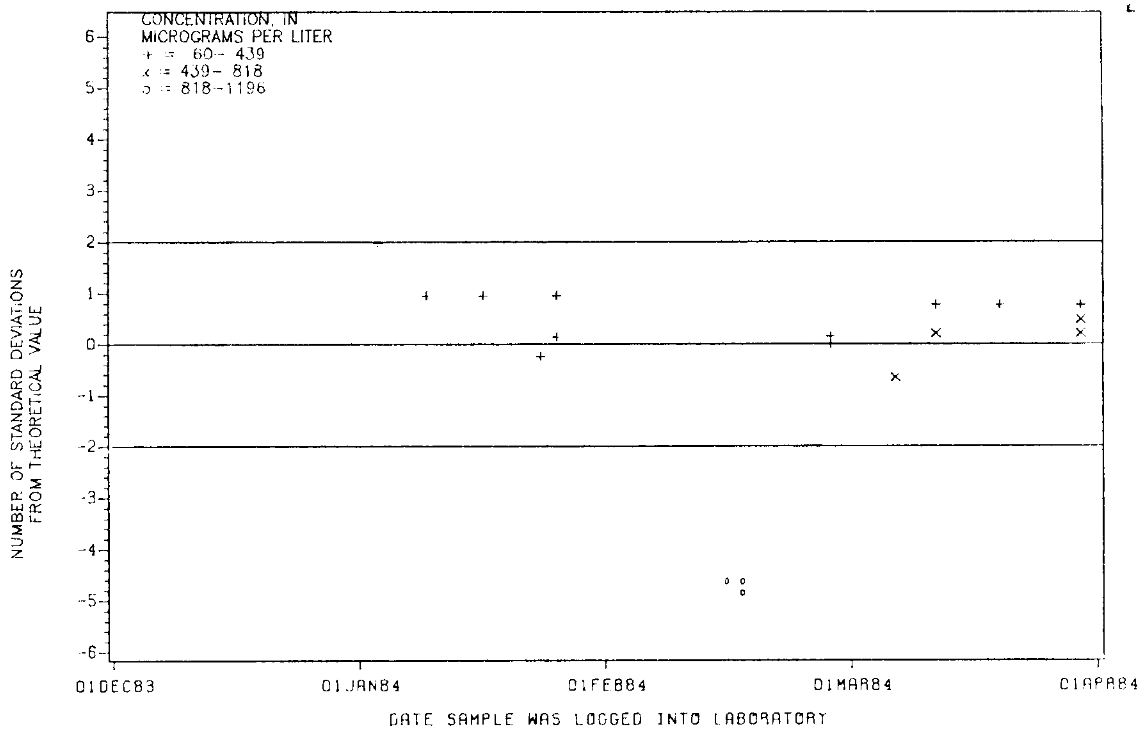

Figure A50.--Strontium data from the Atlanta laboratory.

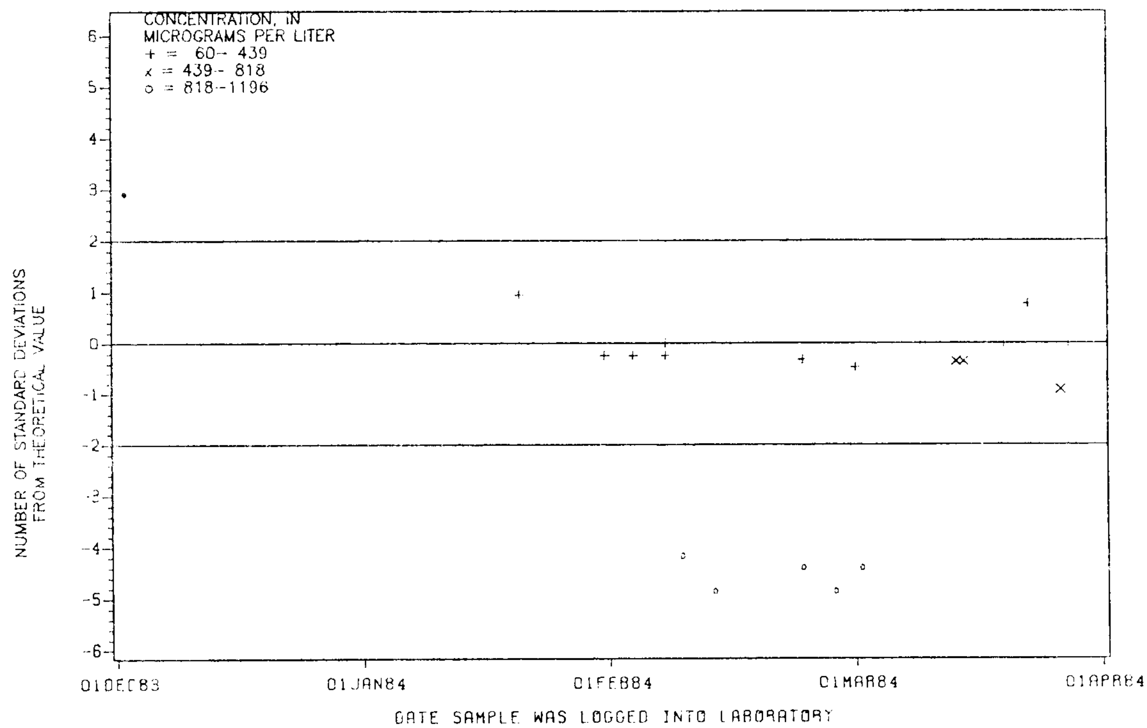

Figure D50.--Strontium data from the Denver laboratory.

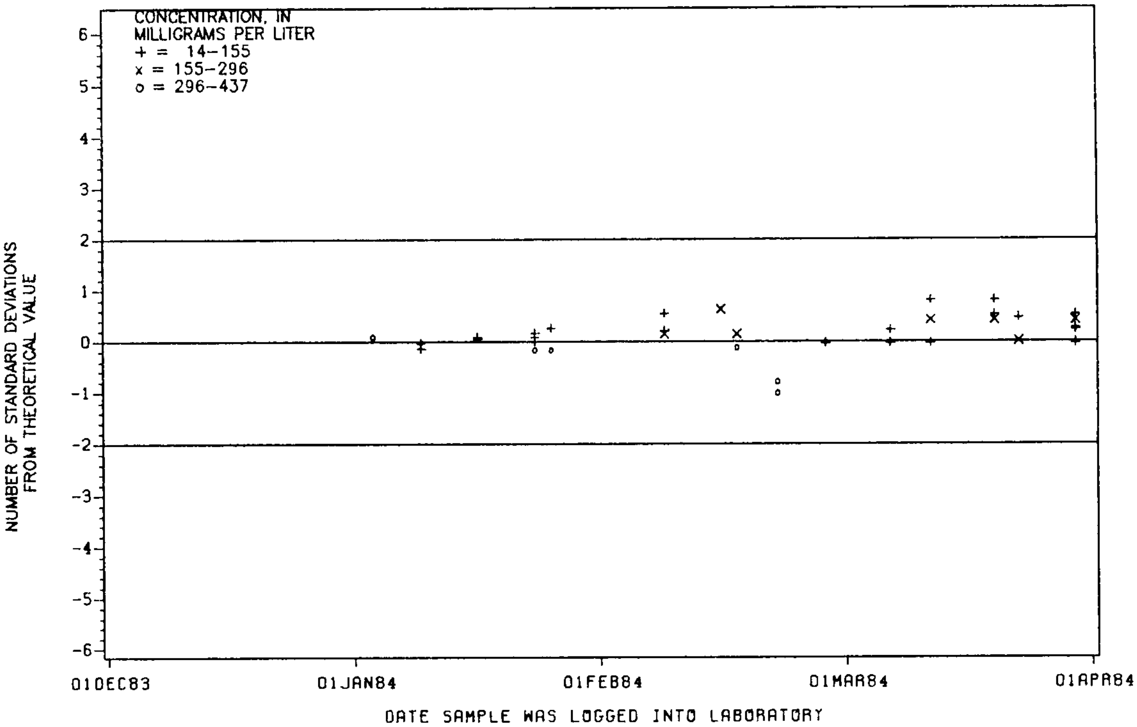

Figure A51.--Sulfate data from the Atlanta laboratory.

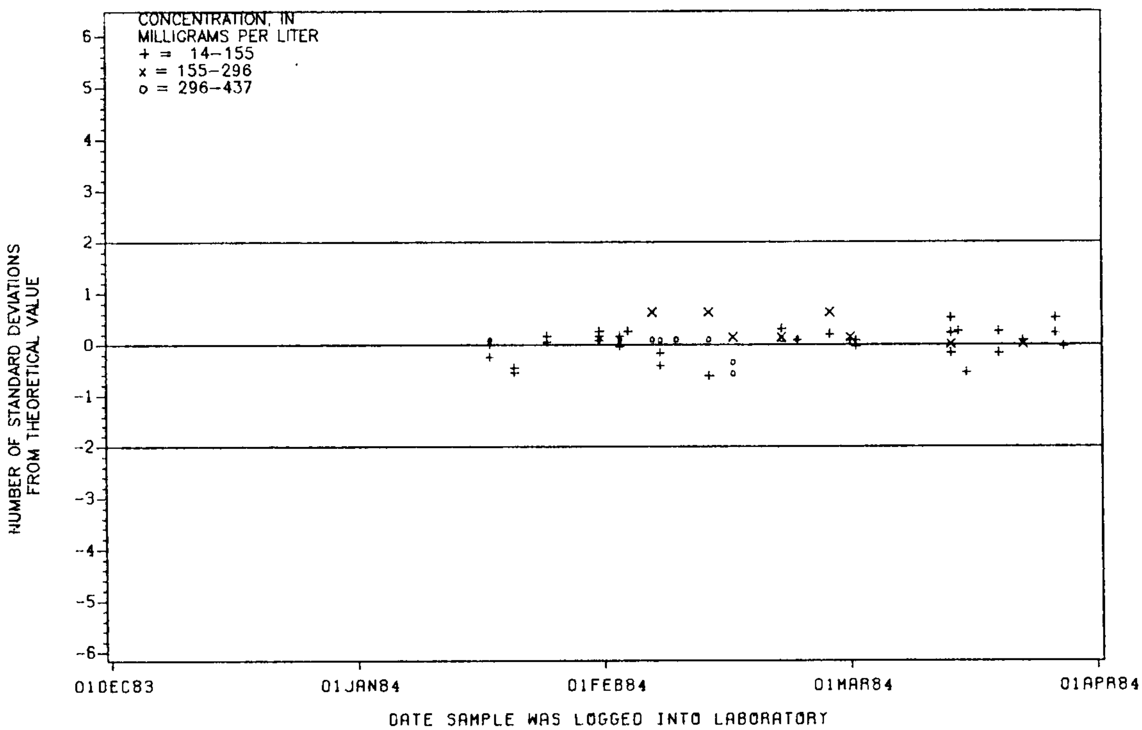

Figure D51.--Sulfate data from the Denver laboratory.

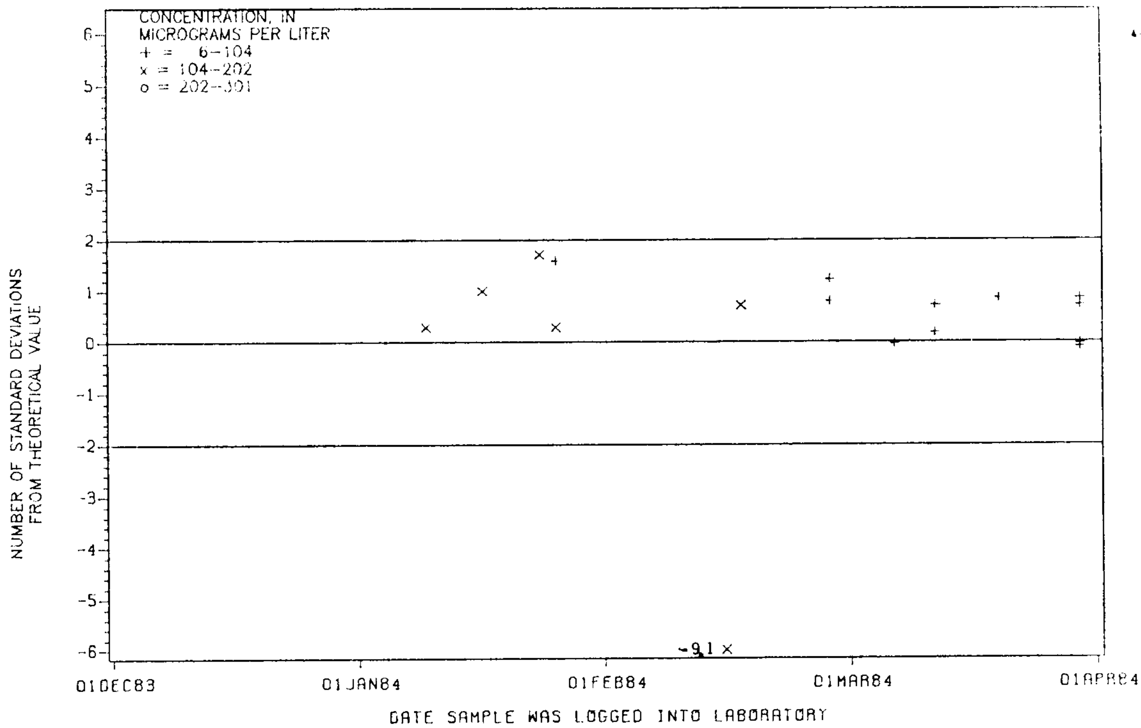

Figure A52.--Zinc(ICP) data from the Atlanta laboratory.

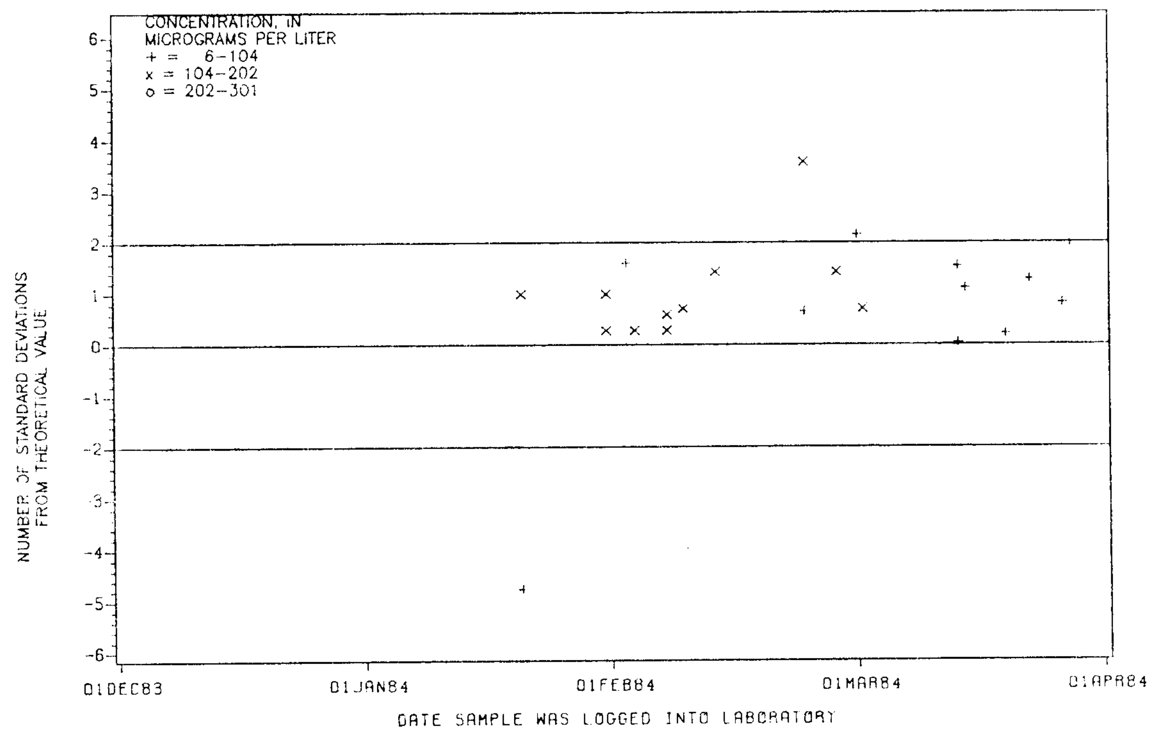

Figure D52.--Zinc(ICP) data from the Denver laboratory.

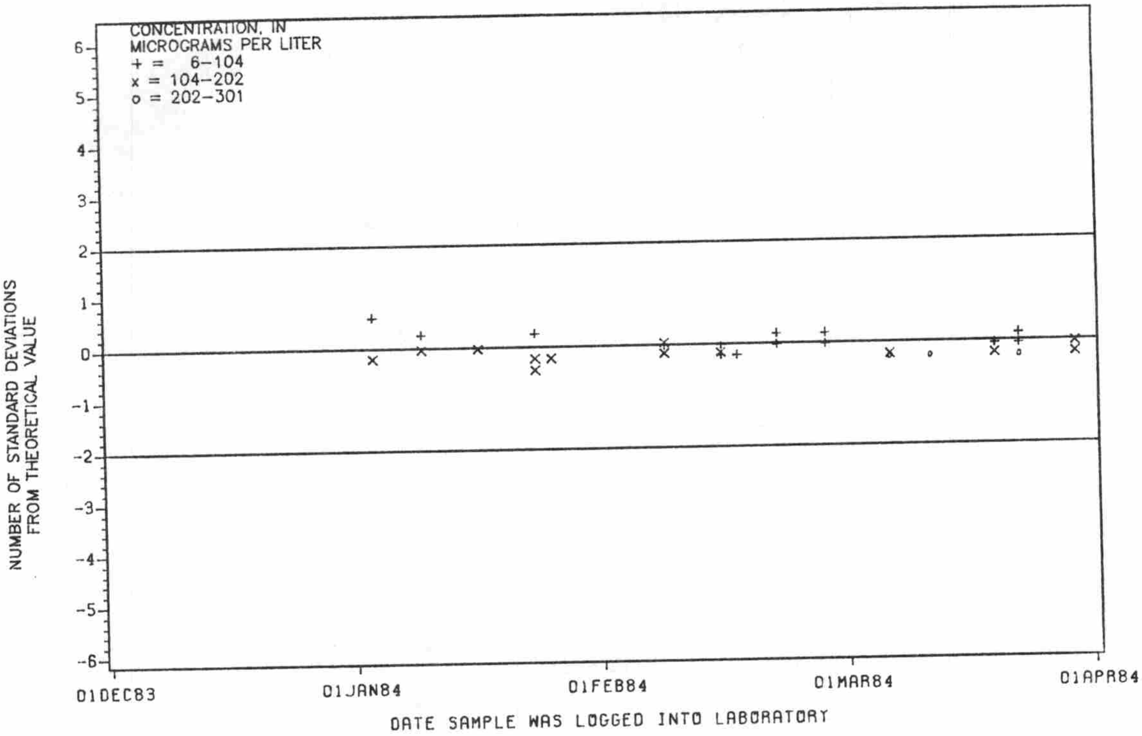

Figure A53.--Zinc(AA) data from the Atlanta laboratory.

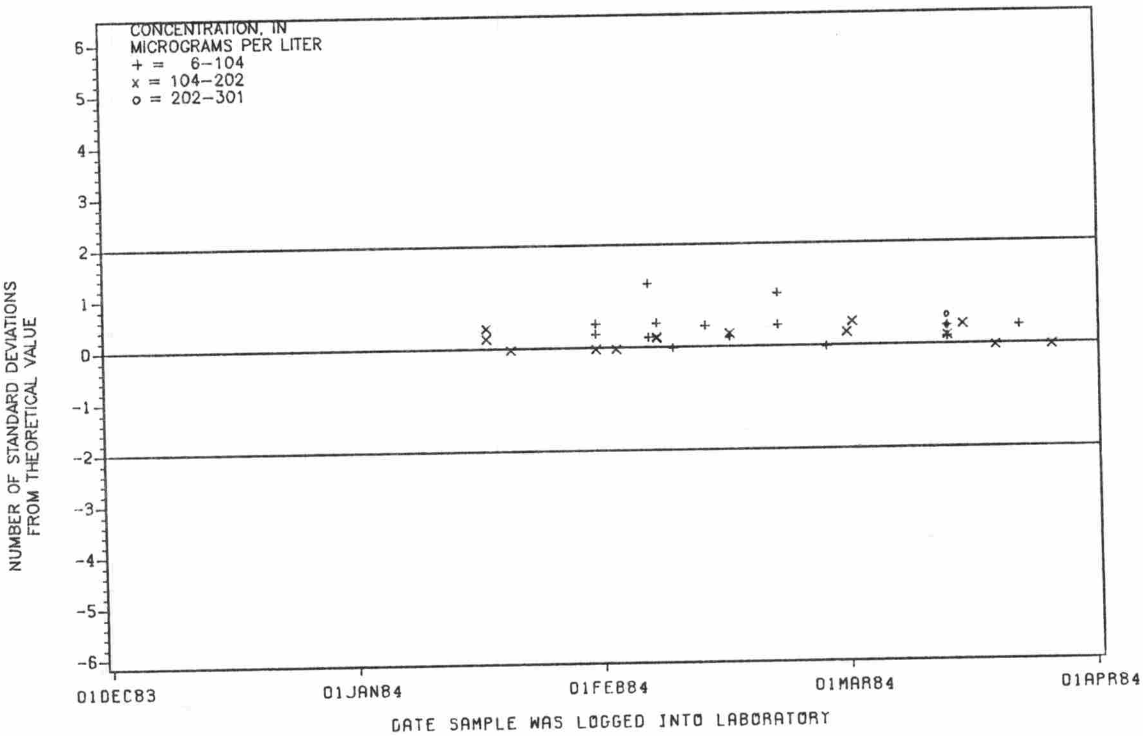

Figure D53.--Zinc(AA) data from the Denver laboratory.

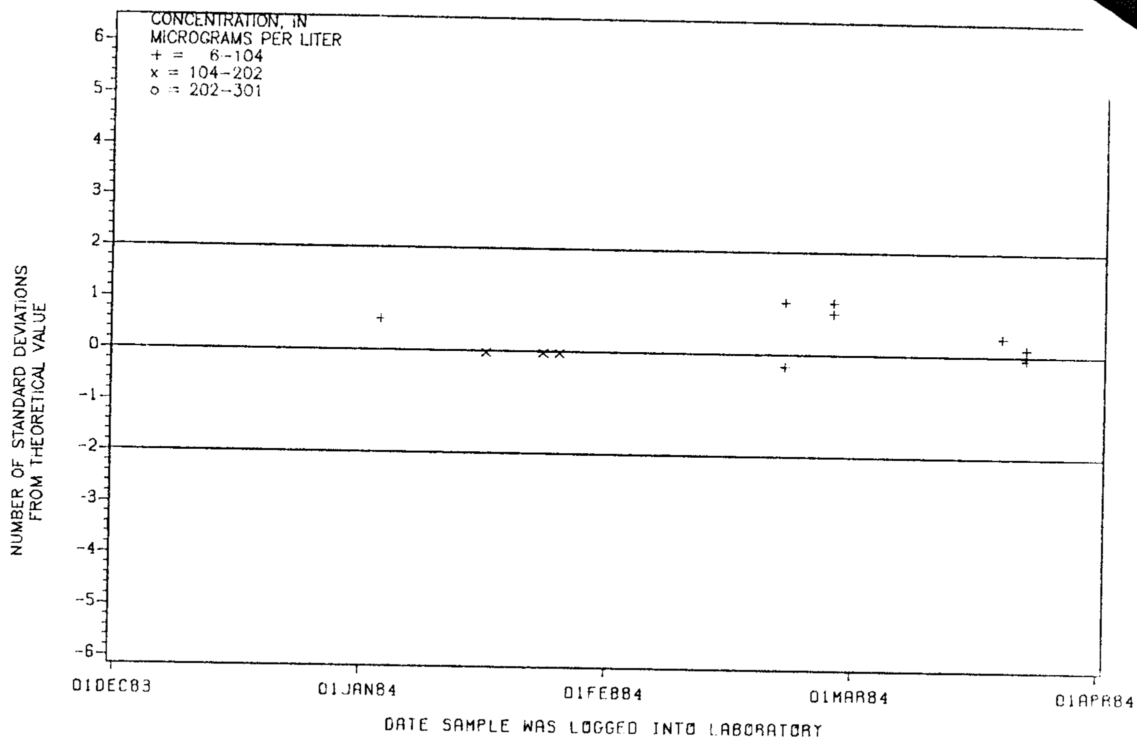

Figure A54.---Zinc, total recoverable data from the Atlanta laboratory.

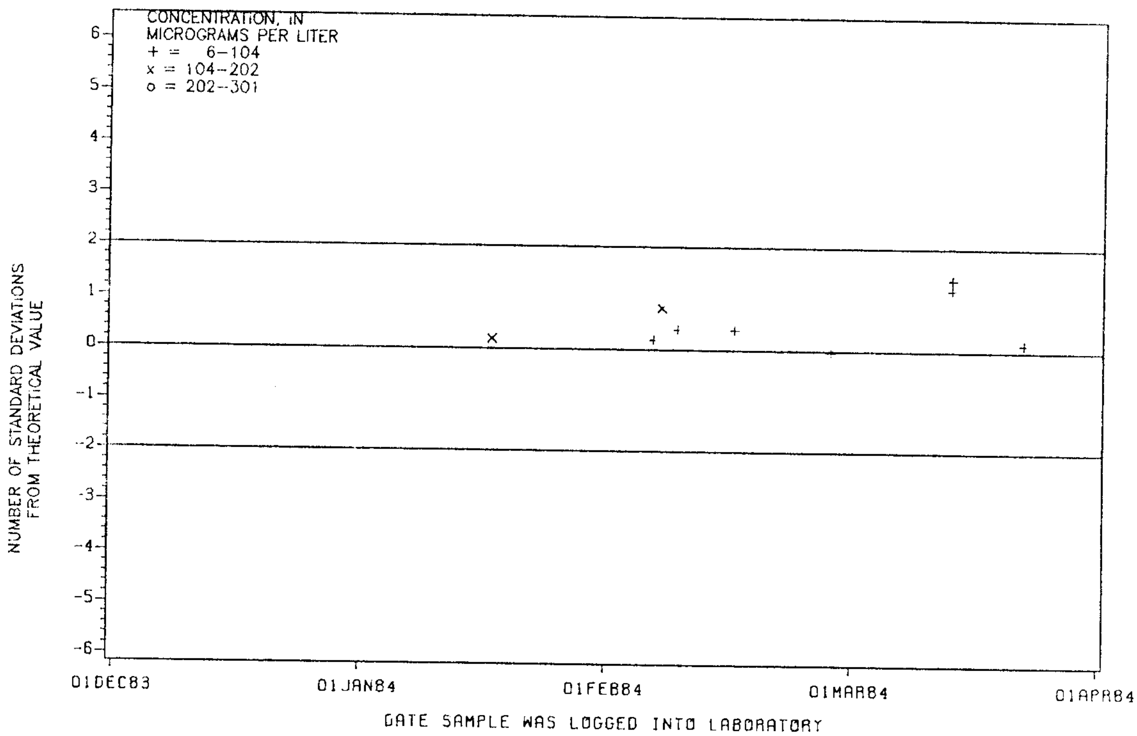

Figure D54.--Zinc, total recoverable data from the Denver laboratory.