

USE OF ^{65}Zn AS A RADIOACTIVE TRACER IN THE BIOACCUMULATION
STUDY OF ZINC BY POECILIA RETICULATA

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SUMMARY

The bioaccumulation of zinc by Poecilia reticulata from the water as well as the elimination of the metal previously absorbed were determined by using ^{65}Zn as radioactive tracer.

The exposure time varied from 5 days, short term experiment, to 30 days, long term experiment. The results obtained show that the absorption and elimination of zinc by Poecilia reticulata is slow, 30 days being necessary for the elimination of 70% of the previously absorbed zinc.

The same experiment was also carried out by feeding the fish with ^{65}Zn contaminated food. The results obtained show that in 30 days only 40% of the zinc previously absorbed is eliminated by the fish.

INTRODUCTION

It is known that several metal ions (such as Co, Cu, Fe, Mn and Zn) in low concentration play an important role as enzyme activators and are even considered as essential nutritional components of a variety of animals⁽¹⁾. For that reason these animals tend to accumulate metals to such an extent that they may even become toxic for themselves and for men, if the complete food chain is considered^(2,3,4).

Although several publications throughout the world have been concerned with the zinc accumulation by fish^(5,6,7) this study is still relevant since zinc is one of the serious pollutants present in the aquatic environment of the urban area of São Paulo city.

The purpose of the present work is to study the absorption and elimination of zinc by Poecilia reticulata by using ^{65}Zn contaminated water and food.

MATERIALS AND METHODS

Fishes ranging in size from 15 to 35 mm and weighing between 50 and 350 mg were obtained from a pond located in the city of Arujá, 30 km away from the urban area of São Paulo. The species employed was Poecilia reticulata. The fishes were incubated at normal temperature in a water bath during 15 days. Natural lighting occurred throughout the experiment. The animals were placed in a 10L aquaria containing soft aerated water (hardness = 44 mg/L CaCO_3 ; pH = 6.6 ;OD = 7.0 mg/L; temperature = 23°C) and 10 ml of radioactive zinc solution. The top of each aquaria was covered with aluminum foil to prevent splashing and also to protect the fish from external stimuli so as to avoid over-exciting them. The final concentration of zinc was around 2 mg/L and the activity did not exceed 3000 cpm/ml.

The fishes were washed free of external activity with running tap water at appropriate time intervals and placed in plastic tubes containing 3 ml of water. They were counted by using a NaI(Tl) detector coupled to a monochannel analyzer during 1 minute and results were computed on the basis of counts per minute per grams of fish over counts per minute per milliliter of water.

Whole body clearance was carried out by transferring fishes from the aquaria to zinc-free water. The activity was measured as already described and the

results were computed by comparing the activity present in the fish at fixed time intervals with the activity present in the fish in the beginning of the experiment.

Two series of experiments were undertaken to evaluate the absorption and elimination of zinc by the whole fish: the short term experiment lasted 96 hours and the long term experiment 18 to 30 days.

For the study of zinc elimination after ingestion of contaminated food the fishes were placed in a 10L aquaria containing soft aerated water and were fed over a period of 30 days with food contaminated with ^{65}Zn . After this period they were transferred from the aquaria to zinc-free water and were fed with uncontaminated food. The activity was measured as already described and the results computed by comparing the activity present in the fish at fixed time intervals with the activity present in the fish in the beginning of the experiment.

RESULTS AND DISCUSSION

The short term experiment was carried out by measuring the activity of 19 fishes at time intervals of 24, 48, 72 and 96 hours. The results obtained are presented in figure 1 for male and female, separately. The highest zinc content in fish was achieved after 72 hours. Furthermore, no considerable variation was observed in the accumulation of zinc by male and female, separately.

The results concerning the short term elimination study, presented in figure 2, were obtained by transferring fishes to aquaria containing zinc-free water, after a period of 96 hours of contact with radioactive zinc. Each point represents the activity of 20 fishes. The results show that in 120 hours only 15% of the absorbed zinc are eliminated.

Such information is relevant if we consider that in the natural environment the fishes can move from an area contaminated to others free of pollutants without elimination of the previously absorbed zinc.

The results presented for the elimination of zinc by Poecilia reticulata are in good agreement with results obtained in the literature for the accumulation of zinc by other species (S.S.G). Furthermore, the elimination of zinc by Poecilia reticulata is slow if compared with the

elimination of other toxic elements, such as mercury, which is totally eliminated after 120 hours (5 days) of experiment^(10,11).

The long term experiment was carried out by measuring the activity of 30 fishes at fixed time intervals during 18 days.

The results obtained (figure 3) show that the zinc is absorbed throughout the duration of the experiment. From the tenth day onwards it seems that the absorption has reached an equilibrium. Such behaviour was observed also for the absorption of mercury by the same species ^(10,11).

Although several papers have been published concerning the absorption of zinc by different organs of edible fishes ^(12,13,14,15) the whole body absorption and clearance by a small species is important since it should be considered in the food chain.

The results concerning the long term elimination experiment are presented in figure 4. The experiment lasted 30 days and each point represents the average of 24 activity measurements. It is concluded that 30 days are necessary for the elimination of 70% of the previously absorbed zinc.

The results obtained for the zinc elimination, after 30 days of exposure to ⁶⁵Zn contaminated food, are presented in figure 5. It is concluded that in 30 days only

about 40% of the previously absorbed zinc is eliminated by the fish.

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Figure 1 - Uptake of zinc by Poecilia reticulata in 96 hours of exposure. Points indicate average content of 19 fishes, bars indicate one standard deviation.

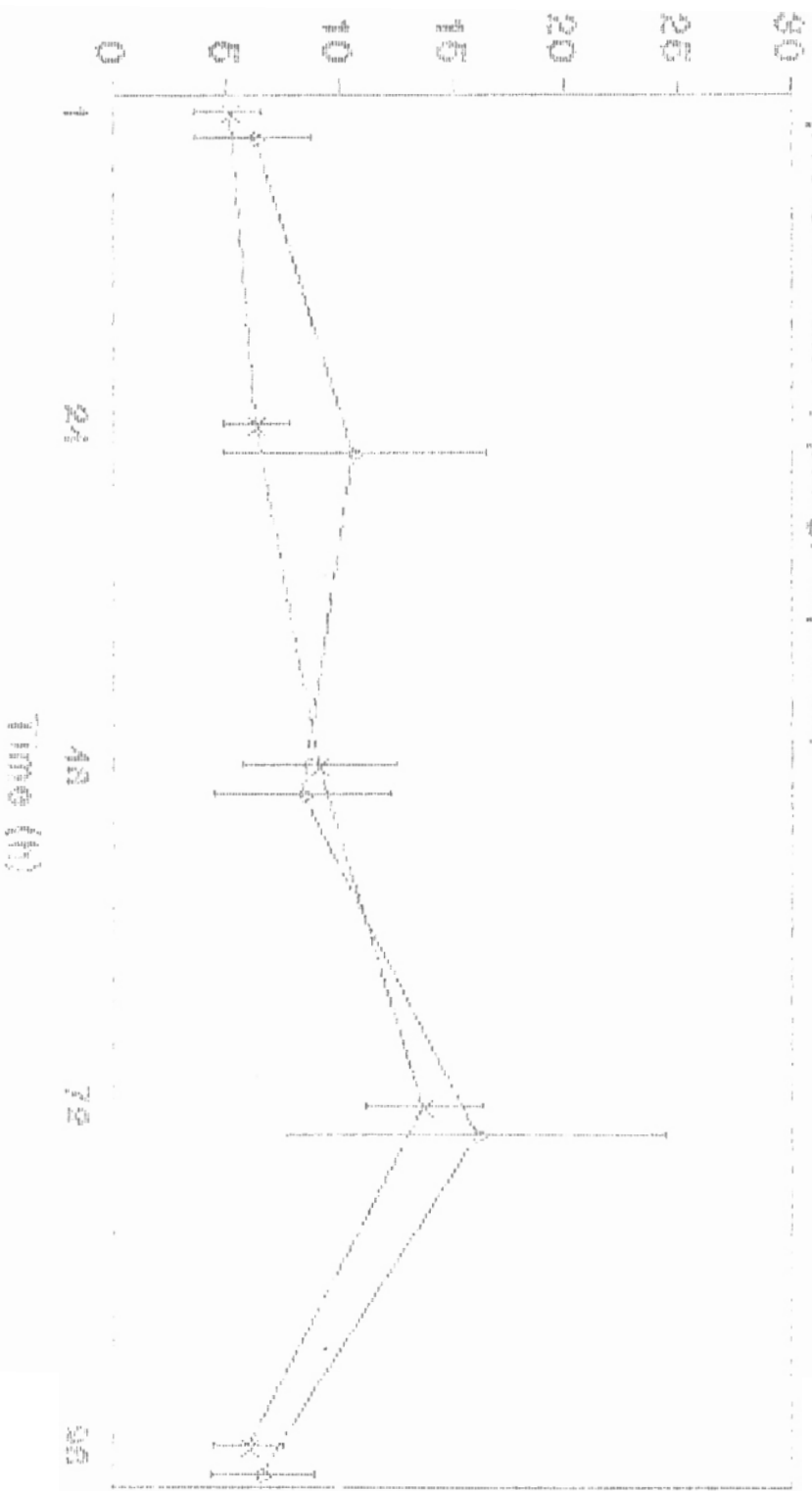
Figure 2 - Elimination of zinc by Poecilia reticulata in uncontaminated water, after a period of 96 hours of contact with radioactive zinc. Points represent the average content of 20 fishes.

Figure 3 - Uptake of zinc by Poecilia reticulata in 18 days of exposure. Points represent average content of 30 fishes, bars represent one standard deviation.

Figure 4 - Elimination of zinc by Poecilia reticulata in uncontaminated water, after 18 days of exposure. The experiment lasted 30 days. Points represent average content of 24 fishes.

Figure 5 - Elimination of zinc by Poecilia reticulata in uncontaminated water, after 30 days of exposure through contaminated food. Points represent average content of 10 fishes with a standard deviation of 15%. Weight of fishes: · 50 to 80mg, + 80 to 190mg, * 190 to 350mg.

Uptake of Zinc (con/d)/equival



x Control
o Treated

FIGURE 1

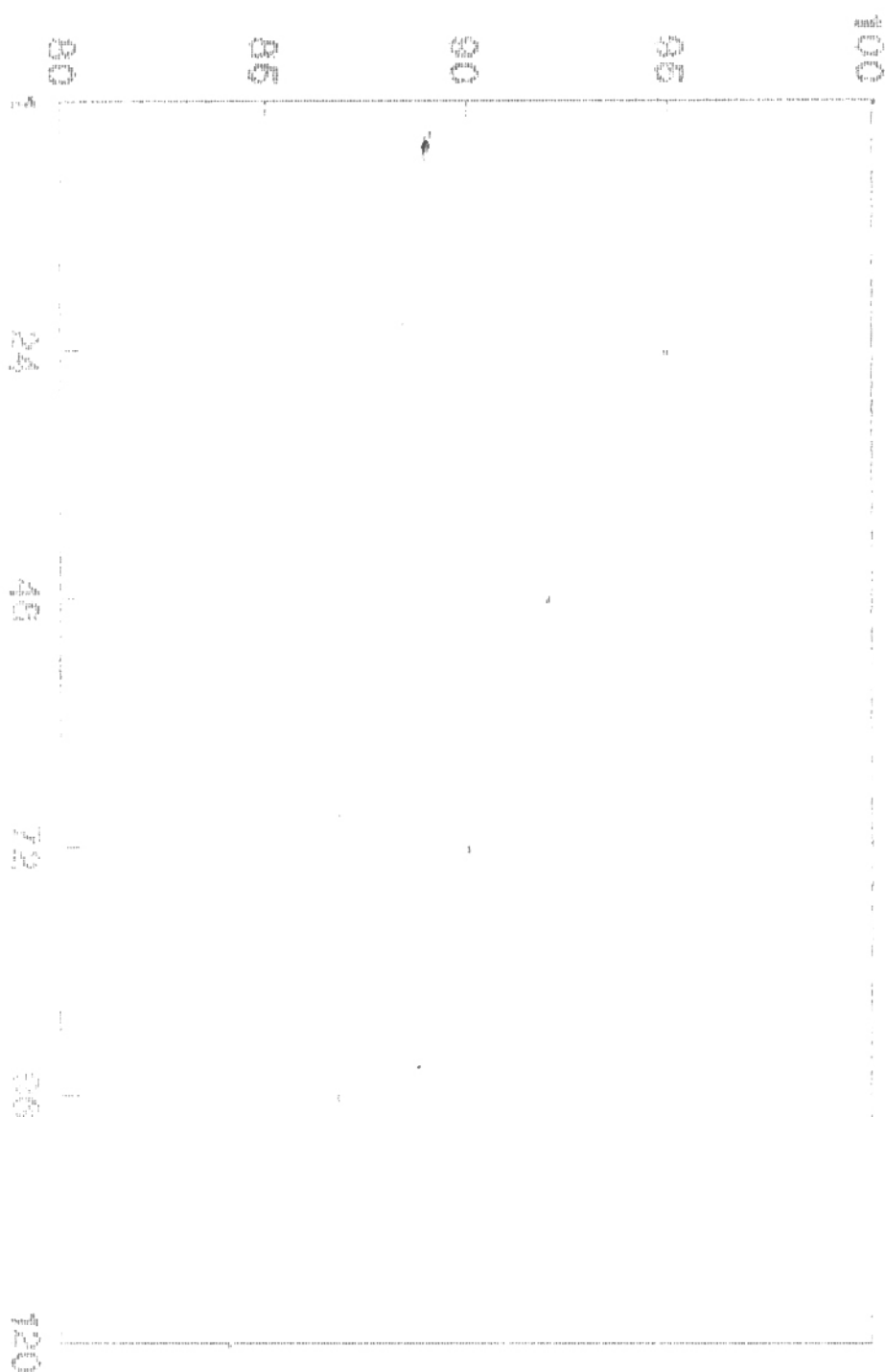


FIGURE 2

Uptake of Zinc (ppm/g dry weight)

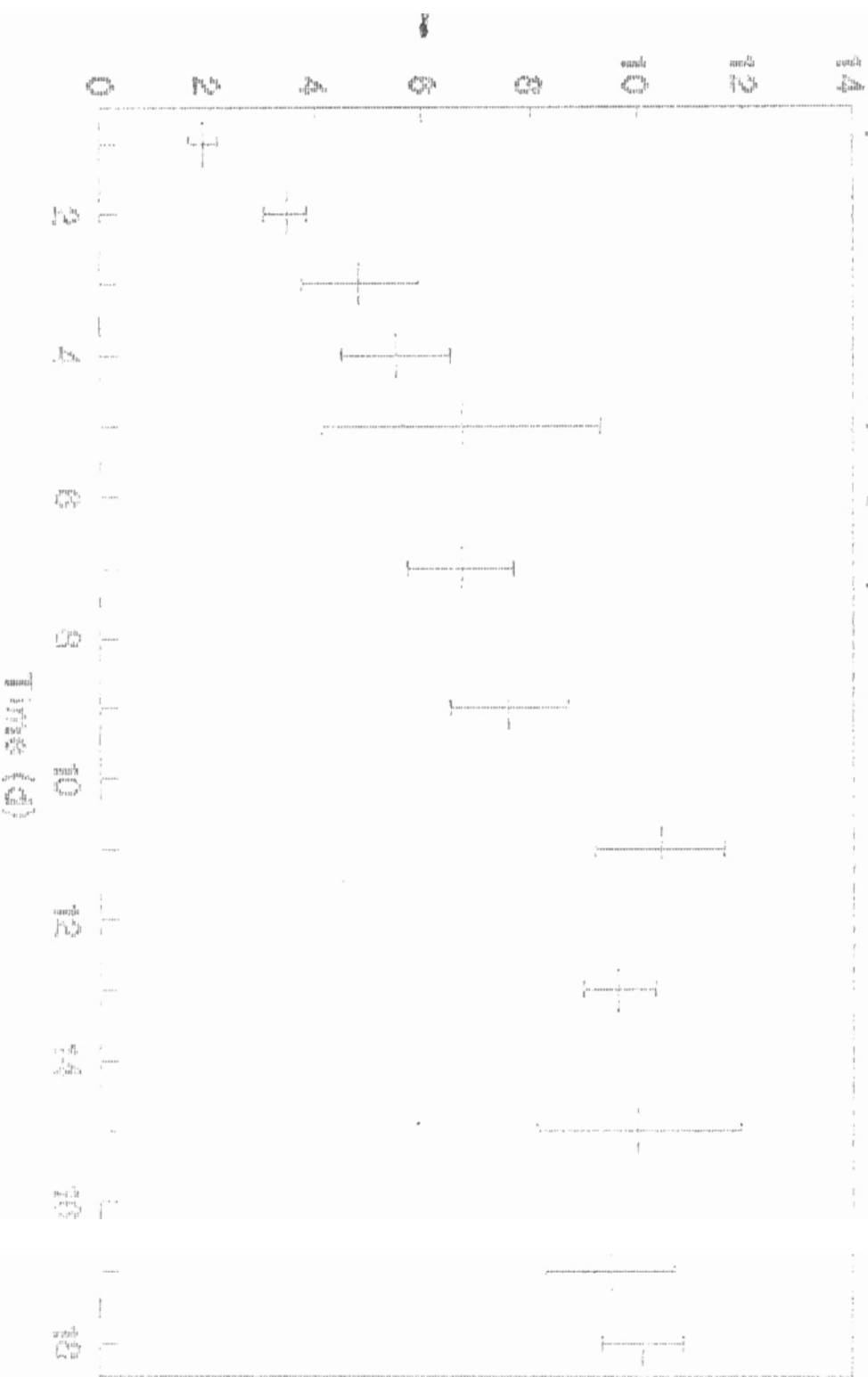


FIGURE 3

100 90 80 70 60 50 40 30 20 10 0
 0 10 20 30 40 50 60 70 80 90 100

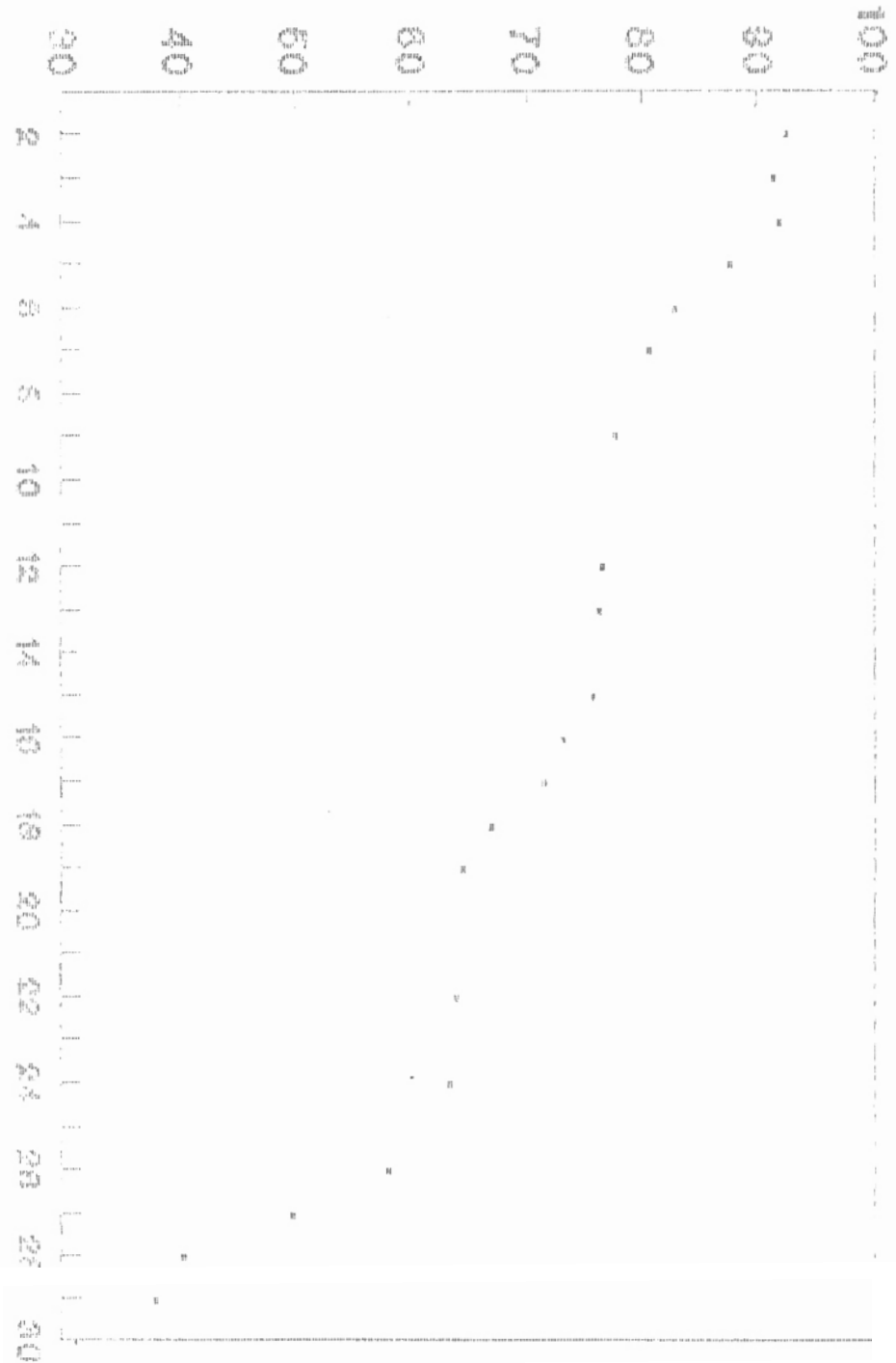


FIGURE 4

Figure 5: A line graph showing the relationship between Time (h) and a variable ranging from 60 to 100. The graph includes data points marked with asterisks and a legend at the top.

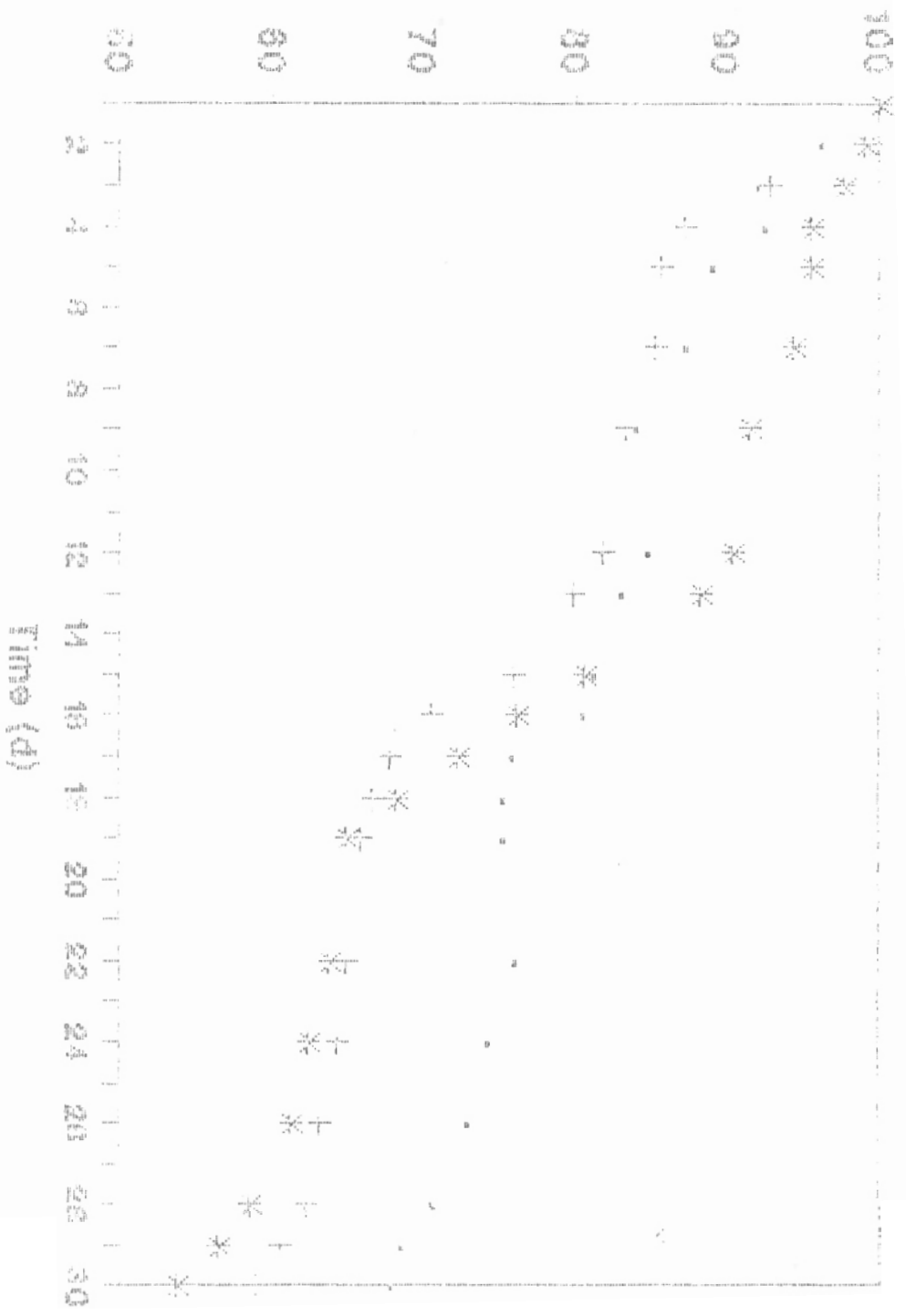


Figure 5