

|                        |             |
|------------------------|-------------|
| C. N. E. A. Biblioteca |             |
| ARCHIVO PUBLICACIONES  |             |
| NO<br>1                | AÑO<br>1966 |

## Strontium in Children

(Progress Report - 1965)

by D. Beninson

E. Ramos

R. Touzet

Argentine Atomic Energy Commission

### INTRODUCTION.

In the former reports (1,2) information on the following points were summarized:

(a) Strontium-90 and natural levels in the diets of children of different age groups.

(b) Strontium-90 and natural strontium in bones of children. A part of these data relate to a "controlled" group, namely children having lived almost their entire life in Pediatric Hospitals and for which individual diet information is reasonably acceptable.

(c) Strontium to calcium observed ratios at several ages, derived from Sr-90 and stable strontium data. It should be pointed out that these observed ratios were computed on the basis of a very naive model, implying no turnover of bone minerals.

This report presents an updating of Sr-90 levels in diet and new data on bone levels in children. Special emphasis is placed on the estimation of skeletal turnover from specific activity (Sr-90/Sr) data. Discrimination factors are in turn derived, with allowance made for bone turnover.

Except where specifically mentioned, sampling, pooling, and analytical routines are those described in previous reports.

### STRONTIUM IN THE DIET.

Analysis of food items for Sr-90 was continued in 1964. The estimation of Sr-90/Ca ratio in total diet of a given age group requires additional information, namely the contribution of different food-stuffs to the calcium intake. In a former report, a breakdown of the diet was presented, but breast feeding contribution remained as one of the main uncertainties.

Families and pediatricians in several localities of Buenos Aires Province were interviewed in an attempt to estimate the contribution of breast feeding to the calcium intake of infants. From this study we estimate that breast feeding supplies 1/3 of the calcium intake from birth to 6 months of age. This estimate supports the values used in former Progress Reports, which were informed guesses made by the Institute of Pediatrics of Buenos Aires University.

The samples of mother's milk were collected and analyzed for stable strontium, averaging  $0.24 \pm 0.04$  mg per gram of calcium. As the adult diet level in the area is 1.78 mg/g Ca, the OR (mother's diet  $\rightarrow$  breast feeding) turns out to be 0.13, again supporting the previously used value (0.12).

Table I presents the levels of stable Sr and Sr-90 levels in total diet for different age groups. Diet relative compositions used in the calculations are those included in former Progress Reports.

Stable strontium values are a little lower than those estimated before, particularly in younger age groups. Strontium-90 concentrations have increased steadily during the past years and the trend with age has not varied significantly.

Values shown in Table I apply to Buenos Aires Province and the Argentine Litoral Area. In the case of infants they may probably apply to other regions because a large fraction of the dietary calcium is provided by specially prepared products (based on milk), which are mostly of national distribution.

The average Sr-90/Ca ratio in total diet during the first year of life is very close to the mean level measured in milk in the years covered by the survey. Daily intakes for this age group in the area are a little less than 1 mg of natural strontium and a few picocuries of Sr-90. Milk and milk-based products, together with breast feeding, contribute about 80% of these intakes.

#### STRONTIUM IN BONE.

This Report presents only data not included in previous Progress Reports (with the exception mentioned below), amounting to about 140 analyses of bone samples from children. These data have been assembled in two categories: (a) bone samples from the "controlled" population, for which the diet "history" could be estimated with some degree of certainty, and (b) other bone samples.

Discussion on turnover and discrimination is based only on the first category of data. Tables IIa, IIb, IIc, and IId present these data, including Sr/Ca ratios and specific activities Sr-90/Sr in bone, together with relevant diet levels (Sr-90/Ca). These diet levels were computed mainly from dietary information and Sr/Ca ratios in food items during the corresponding period. When the dietary information assembled was only qualitative, the diet level was taken to be that of the general population of the same age group (Table I).

Bone turnover can "a priori" be calculated from specific activity (Sr-90/Sr) data and information on stable strontium accretion in the skeleton

as a function of age. Bone specific activity in any period  $j$  is related to that of the previous period  $i$  and the diet levels by the following expression:

$$B_j = \frac{B_i \cdot m_i (1-K) + D_j (\Delta m + K m_i)}{m_j}$$

where  $B$  is specific activity in bone (Sr-90/Sr)

$m$  is the total content of stable strontium in skeleton

$D$  is the specific activity in the diet

$\Delta m$  is the net stable strontium increment ( $\Delta m = m_j - m_i$ )

$K$  is the fraction of the amount of stable strontium present at  $i$  which is replaced by new strontium (turnover)

Stable strontium contents in the skeleton were computed from calcium contents and from Sr/Ca ratios in bone reported previously. The estimates are shown in figure 1 and are thought to be representative for Buenos Aires Province.

From figure 1 and the data of Tables IIa to IIId, the relation shown above allows the estimation of turnovers. However, since in our situation specific activities are not strikingly different for different ages, errors in the estimates are substantial. Calculations were made using mean bone values at different age groups, which may be debatable. However, the near constancy of both daily intakes and skeletal strontium accretion supports averaging assuming linearity.

The specific activity (Sr-90/Sr) of the relevant diets were computed from Sr-90 data of Tables IIa to IIId and the mean levels of stable Sr shown in Table I. A check on the mother's diets is provided by the fact that its specific activity should "a priori" be equal to that of fetal bone. Means of Table IIa (which includes also a few data already reported) are: Fetal bone 4.7 pc/mg and Mother's diet  $\frac{7.12 \text{ pc/g Ca}}{1.78 \text{ mg/g Ca}} = 4.0 \text{ pc/mg}$ , the difference between the two values not being significant.

With the approach described, turnovers have been estimated. It should be pointed out that, with data so far collected, calculations tend to increase their uncertainty in older age groups, and we feel that only estimates in the first year of life have any meaning.

The values shown below are "total" turnovers, defined as the fraction of fetal strontium which is replaced by new strontium, up to a given age.

From 0 to 1.5 months..... 12%

From 0 to 3.5 months..... 21%

From 0 to 8 months .....40%

From 0 to 1 year.....46%

It is not possible at present to estimate the uncertainties of these numbers. The annual turnover value found agrees satisfactorily with an estimate of J. Rivera based on U. S. data. (3)

Information is too scanty so far to allow significant calculations of turnover rates as a function of age. Values shown above, however, give a qualitative impression of a fast turnover rate in very young infants which slows down during the second semester of life.

Mineral turnover in bone has to be taken into account in the calculation of bone-diet discrimination factors. Estimates of discrimination included in former reports were derived on the basis of a model implying no turnover. This tends to overestimate the discrimination between Sr and Ca, particularly at young ages.

Using the same type of formulation as in previous Reports, but including turnover, the Sr/Ca ratio in bone in an age group  $j$  is related to that of the previous period  $i$  and with the diet by the expression:

$$L_j = \frac{L_i C_i (1-K) + D_j F_j (\Delta C + K C_i)}{C_j}$$

where  $L$  is the bone Sr/Ca ratio

$C$  is the calcium content in skeleton

$D$  is the diet Sr/Ca ratio

$F$  is the discrimination factor

$\Delta C$  is the net calcium increment ( $C_j - C_i$ )

$K$  is the turnover in the period  $i - j$

Appropriate turnovers for given age periods were obtained by differences of "total" turnovers defined before.

Using this expression the discrimination factors can be worked out from diet and bone data. In the calculations, all data available were used (including those of former reports), resulting:

- (1) Average discrimination factor  
for the first semester of life .....0.48

(2) Average discrimination factor  
for the second semester of life.....0.26

The significance of these results is qualified by the uncertainties involved. As the net calcium accretion in both semesters of the first year of life is about the same, the annual average discrimination factor can be taken as the arithmetic mean of the two numbers shown, namely 0.37; this value is again in close agreement with Rivera's estimate. (3)

A number of bone data obtained during the year have not been used in the estimations shown above because no adequate information on their diet "history" could be assembled. These bone data are compiled in Table III (Natural Strontium) and Table IV (Strontium-90).

References

- (1) "Strontium-90 Levels in the Diets and Bones of Children - Progress Report - 1962-1963", by D. Beninson, H. Migliori, and E. Ramos, Argentine Comision Nacional de Energia Atomica, HASL 149, p. 105.
- (2) "Strontium-90 Levels in the Diets and Bones of Children - Progress Report - 1964" by D. Beninson, E. Ramos, and R. Touzet, Argentine Comision Nacional de Energia Atomica, HASL 149, p. 105.
- (3) "Radiation to Bone From Sr-90 in New York City Residents", by J. Rivera, Health and Safety Laboratory, USAEC, 2nd AEC Conference on Radioactive Fallout from Nuclear Weapons Tests, CONF 765.

TABLE I

Stable Strontium and Strontium-90 in Total Diet

| <u>Age Group</u> | <u>Stable Sr</u><br>(mg/g Ca) | <u>Sr-90</u><br>(pc/g Ca) |             |             |             |             |
|------------------|-------------------------------|---------------------------|-------------|-------------|-------------|-------------|
|                  |                               | <u>1960</u>               | <u>1961</u> | <u>1962</u> | <u>1963</u> | <u>1964</u> |
| 0 - 6 months     | 0.60                          | 1.62                      | 2.01        | 2.28        | 3.20        | 4.28        |
| 6 - 12 months    | 0.87                          | 2.33                      | 2.61        | 3.28        | 4.63        | 6.87        |
| 12 - 24 months   | 1.06                          | 2.46                      | 2.76        | 3.48        | 4.45        | 6.55        |
| 24 - 36 months   | 1.10                          | 2.62                      | 3.59        | 4.11        | 5.20        | 8.50        |
| Adults           | 1.78                          | 3.15                      | 3.88        | 5.97        | 6.88        | 9.19        |

TABLE IIa

Strontium in Bones and Diets (Stillbirths)

| Date of<br>Death | B O N E                   |                           |                            | DIET                                  |
|------------------|---------------------------|---------------------------|----------------------------|---------------------------------------|
|                  | <u>Sr-90/Ca</u><br>(pc/g) | <u>Sr / Ca</u><br>(mg/ g) | <u>Sr-90/Sr</u><br>(pc/mg) | <u>Sr-90/Ca</u><br>(pc/g)<br>Mother's |
| 5/63             | 0.99                      | 0.37                      | 2.67                       | 5.27                                  |
| 5/63             | 0.92                      | 0.31                      | 2.97                       | 5.27                                  |
| *5/63            | 0.62                      | 0.25                      | 2.48                       | 5.27                                  |
| 6/63             | 0.45                      | 0.20                      | 2.25                       | 5.23                                  |
| *6/63            | 0.46                      | 0.10                      | 4.60                       | 5.23                                  |
| *8/63            | 0.57                      | 0.12                      | 4.75                       | 5.49                                  |
| *8/63            | 0.86                      | 0.21                      | 4.09                       | 5.49                                  |
| *8/63            | 0.74                      | 0.20                      | 3.70                       | 5.49                                  |
| *7/63            | 1.04                      | 0.20                      | 5.20                       | 5.62                                  |
| *9/63            | 1.15                      | 0.21                      | 5.48                       | 5.62                                  |
| *10/63           | 1.12                      | 0.16                      | 7.00                       | 5.80                                  |
| *10/63           | 1.30                      | 0.46                      | 2.83                       | 5.80                                  |
| *10/63           | 1.21                      | 0.22                      | 5.50                       | 5.80                                  |
| 10/63            | 0.86                      | 0.21                      | 4.09                       | 5.80                                  |
| 10/63            | 0.63                      | 0.20                      | 3.15                       | 5.80                                  |
| 10/63            | 1.02                      | 0.25                      | 4.08                       | 5.80                                  |
| 11/63            | 0.85                      | 0.20                      | 4.25                       | 5.80                                  |
| 6/64             | 1.12                      | 0.19                      | 5.89                       | 8.31                                  |
| 6/64             | 1.28                      | 0.27                      | 4.74                       | 8.31                                  |
| 6/64             | 1.87                      | 0.27                      | 6.93                       | 8.31                                  |
| 6/64             | 1.75                      | 0.25                      | 7.00                       | 8.31                                  |
| 6/64             | 1.76                      | 0.42                      | 4.19                       | 8.31                                  |
| 6/64             | 0.91                      | 0.26                      | 3.50                       | 8.31                                  |
| 7/64             | 1.01                      | 0.36                      | 2.81                       | 8.40                                  |
| 7/64             | 0.76                      | 0.23                      | 3.30                       | 8.40                                  |
| 7/64             | 1.47                      | 0.23                      | 6.39                       | 8.40                                  |
| 7/64             | 1.95                      | 0.22                      | 8.86                       | 8.40                                  |
| 7/64             | 1.24                      | 0.26                      | 4.77                       | 8.40                                  |
| 7/64             | 0.54                      | 0.16                      | 3.37                       | 8.40                                  |
| 8/64             | 0.97                      | 0.10                      | 9.70                       | 8.40                                  |
| 8/64             | 1.53                      | 0.24                      | 6.37                       | 8.40                                  |
| 8/64             | 1.17                      | 0.33                      | 3.55                       | 8.40                                  |
| 8/64             | 1.12                      | 0.28                      | 4.00                       | 8.40                                  |
| 8/64             | 1.42                      | 0.31                      | 4.58                       | 8.40                                  |
| 9/64             | 1.28                      | 0.38                      | 3.37                       | 8.40                                  |
| 9/64             | 1.18                      | 0.28                      | 4.21                       | 8.40                                  |
| 10/64            | 1.38                      | 0.26                      | 6.00                       | 8.40                                  |
| 10/64            | 1.42                      | 0.23                      | 6.17                       | 8.40                                  |

\* - Data on these samples were already included in former progress reports.

TABLE IIb

Strontium in Bones and Diets (0-6 Months Group)

| Age<br>(days) | Date of<br>Birth | <u>B O N E</u>             |                         |                            | <u>D I E T S</u>                       |                   |
|---------------|------------------|----------------------------|-------------------------|----------------------------|----------------------------------------|-------------------|
|               |                  | <u>Sr-90/Ca</u><br>(pc/ g) | <u>Sr/Ca</u><br>(mg/ g) | <u>Sr-90/Sr</u><br>(pc/mg) | <u>Sr-90/Ca</u><br>(pc/ g)<br>Mother's | <u>0-6 Months</u> |
| 7             | 7/64             | 1.32                       | 0.31                    | 4.26                       | 8.71                                   | 4.06              |
| 15            | 9/63             | 1.42                       | 0.33                    | 4.30                       | 6.25                                   | 2.73              |
| 24            | 1/64             | 0.83                       | 0.42                    | 1.98                       | 7.03                                   | 4.06              |
| 29            | 4/64             | 2.06                       | 0.27                    | 7.63                       | 7.79                                   | 4.06              |
| 39            | 5/64             | 1.18                       | 0.29                    | 4.07                       | 7.95                                   | 4.06              |
| 40            | 5/64             | 1.27                       | 0.15                    | 8.47                       | 7.95                                   | 4.06              |
| 50            | 2/64             | 1.42                       | 0.23                    | 6.17                       | 7.03                                   | 4.06              |
| 56            | 9/63             | 0.90                       | 0.22                    | 4.09                       | 6.25                                   | 2.73              |
| 60            | 11/63            | 2.41                       | 0.33                    | 7.30                       | 6.43                                   | 4.06              |
| 60            | 2/64             | 1.60                       | 0.34                    | 4.71                       | 7.03                                   | 4.06              |
| 60            | 7/64             | 1.49                       | 0.40                    | 3.73                       | 8.71                                   | 4.06              |
| 68            | 6/64             | 1.64                       | 0.31                    | 5.29                       | 7.03                                   | 4.06              |
| 69            | 3/64             | 2.27                       | 0.37                    | 6.13                       | 7.03                                   | 4.06              |
| 71            | 3/64             | 1.40                       | 0.33                    | 4.24                       | 7.03                                   | 4.06              |
| 72            | 4/64             | 1.73                       | 0.37                    | 4.68                       | 7.03                                   | 4.06              |
| 73            | 2/64             | 1.97                       | 0.33                    | 5.97                       | 7.03                                   | 4.06              |
| 90            | 9/63             | 1.87                       | 0.32                    | 5.84                       | 6.25                                   | 2.73              |
| 90            | 10/63            | 1.42                       | 0.35                    | 4.06                       | 6.25                                   | 2.73              |
| 90            | 1/64             | 1.50                       | 0.27                    | 5.55                       | 6.58                                   | 4.06              |
| 95            | 1/64             | 2.10                       | 0.35                    | 6.00                       | 7.03                                   | 4.06              |
| 96            | 7/63             | 1.84                       | 0.31                    | 5.93                       | 6.25                                   | 2.73              |
| 106           | 2/64             | 1.89                       | 0.35                    | 5.40                       | 7.03                                   | 4.06              |
| 108           | 1/63             | 0.53                       | 0.25                    | 2.12                       | 6.25                                   | 2.73              |
| 118           | 2/64             | 1.87                       | 0.29                    | 6.45                       | 7.03                                   | 4.06              |
| 120           | 9/63             | 1.24                       | 0.40                    | 3.10                       | 6.25                                   | 3.28              |
| 120           | 9/63             | 1.77                       | 0.36                    | 4.92                       | 6.25                                   | 3.28              |
| 132           | 3/64             | 1.19                       | 0.28                    | 4.25                       | 7.03                                   | 4.06              |
| 144           | 12/63            | 2.13                       | 0.39                    | 5.46                       | 6.25                                   | 2.73              |

TABLE IIc

Strontium in Bones and Diets (6-12 Months Group)

| Age<br>(Months) | Date of<br>Birth | <u>B O N E</u>             |                        |                            | <u>D I E T S</u>           |          |           |
|-----------------|------------------|----------------------------|------------------------|----------------------------|----------------------------|----------|-----------|
|                 |                  | <u>Sr-90/Ca</u><br>(pc/ g) | <u>Sr/Ca</u><br>(mg/g) | <u>Sr-90/Sr</u><br>(pc/mg) | <u>Sr-90/Ca</u><br>(pc/ g) |          |           |
|                 |                  |                            |                        |                            | Mother's                   | 0-6 Mos. | 6-12 Mos. |
| 7.6             | 7/63             | 2.90                       | 0.37                   | 7.84                       | 5.97                       | 3.67     | 5.86      |
| 8.0             | 10/63            | 1.41                       | 0.30                   | 4.70                       | 5.97                       | 3.67     | 5.86      |
| 8.0             | 3/64             | 0.95                       | 0.25                   | 3.80                       | 7.05                       | 4.06     | 7.25      |
| 8.3             | 9/63             | 1.16                       | 0.28                   | 4.14                       | 5.97                       | 3.67     | 5.86      |
| 8.6             | 9/63             | 2.29                       | 0.35                   | 6.54                       | 5.97                       | 3.67     | 5.86      |
| 9.0             | 11/63            | 1.47                       | 0.26                   | 5.65                       | 5.97                       | 3.67     | 5.86      |
| 9.3             | 9/63             | 2.08                       | 0.40                   | 5.20                       | 5.97                       | 3.67     | 5.86      |
| 9.8             | 9/63             | 2.47                       | 0.31                   | 7.97                       | 5.97                       | 3.67     | 5.86      |
| 10.2            | 10/63            | 1.42                       | 0.41                   | 3.46                       | 5.97                       | 3.67     | 5.86      |
| 10.3            | 1/63             | 1.85                       | 0.32                   | 5.77                       | 6.58                       | 2.57     | 4.73      |
| 10.5            | 11/63            | 1.51                       | 0.37                   | 4.08                       | 5.97                       | 3.67     | 5.86      |
| 12.0            | 8/62             | 0.91                       | 0.40                   | 2.27                       | 5.19                       | 2.73     | 3.71      |

TABLE IIc

Strontium in Bones and Diets (12-24 Months Group)

| Age<br>(Months) | Date of<br>Birth | <u>B O N E</u>             |                        |                            | <u>D I E T S</u>           |          |           |            |
|-----------------|------------------|----------------------------|------------------------|----------------------------|----------------------------|----------|-----------|------------|
|                 |                  | <u>Sr-90/Ca</u><br>(pc/ g) | <u>Sr/Ca</u><br>(mg/g) | <u>Sr-90/Sr</u><br>(pc/mg) | <u>Sr-90/Ca</u><br>(pc/ g) |          |           |            |
|                 |                  |                            |                        |                            | Mother's                   | 0-6 Mos. | 6-12 Mos. | 12-24 Mos. |
| 15.2            | 5/63             | 1.09                       | 0.36                   | 3.03                       | 5.69                       | 3.28     | 5.86      | 7.67       |
| 16.0            | 5/62             | 1.24                       | 0.43                   | 2.88                       | 5.19                       | 2.73     | 3.71      | 5.00       |
| 16.0            | 1/63             | 2.13                       | 0.22                   | 9.68                       | 5.52                       | 2.57     | 4.73      | 6.20       |
| 16.2            | 11/62            | 1.95                       | 0.32                   | 6.09                       | 5.43                       | 2.65     | 4.73      | 5.00       |
| 17.8            | 12/62            | 1.36                       | 0.27                   | 5.04                       | 5.43                       | 2.65     | 4.73      | 5.00       |

TABLE III  
STABLE STRONTIUM IN BONE

| Age<br>(Months) | Ca<br>(in ash)<br>% | Sr<br>(in ash)<br>p.p.m. | Sr/Ca<br>mg/g |
|-----------------|---------------------|--------------------------|---------------|
| 0.2             | 34.7                | 45                       | 0.13          |
| 1.1             | 32.0                | 102                      | 0.32          |
| 1.2             | 29.1                | 32                       | 0.11          |
| 2.9             | 30.6                | 91                       | 0.30          |
| 3.0             | 28.6                | 102                      | 0.36          |
| 3.5             | 27.8                | 127                      | 0.46          |
| 4.0             | 33.0                | 95                       | 0.29          |
| 4.0             | 24.8                | 70                       | 0.28          |
| 4.0             | 25.1                | 90                       | 0.36          |
| 4.8             | 22.0                | 59                       | 0.27          |
| 5.3             | 34.3                | 121                      | 0.35          |
| 5.4             | 31.3                | 97                       | 0.31          |
| 7.5             | 36.8                | 166                      | 0.45          |
| 8.5             | 33.0                | 96                       | 0.29          |
| 8.9             | 30.8                | 92                       | 0.30          |
| 9.0             | 34.7                | 90                       | 0.26          |
| 9.0             | 20.5                | 58                       | 0.29          |
| 12.0            | 32.0                | 70                       | 0.22          |
| 12.0            | 31.4                | 96                       | 0.30          |
| 16.0            | 31.0                | 100                      | 0.32          |
| 17.9            | 29.2                | 129                      | 0.44          |
| 18.1            | 23.1                | 76                       | 0.33          |
| 19.0            | 26.6                | 120                      | 0.45          |
| 20.0            | 36.8                | 70                       | 0.19          |
| 31.0            | 33.3                | 110                      | 0.33          |
| 31.2            | 34.1                | 219                      | 0.64          |
| 34.0            | 34.2                | 140                      | 0.41          |
| 34.0            | 29.7                | 116                      | 0.39          |

TABLE IV  
STRONTIUM-90 IN BONE

| <u>A g e</u><br><u>(Months)</u> | <u>Date of</u><br><u>Birth</u> | <u>Ca</u><br><u>(in ash)</u><br>% | <u>Sr-90/Ca</u><br><u>p.c./g</u> |
|---------------------------------|--------------------------------|-----------------------------------|----------------------------------|
| 0.5                             | 10/63                          | 37.3                              | 0.89                             |
| 0.9                             | 7/62                           | 29.6                              | 0.73                             |
| 1.2                             | 7/62                           | 18.9                              | 0.91                             |
| 1.6                             | 1/62                           | 36.7                              | 0.67                             |
| 1.7                             | 1/64                           | 25.3                              | 2.94                             |
| 3.1                             | 9/63                           | 26.1                              | 1.90                             |
| 4.0                             | 8/63                           | 25.9                              | 1.89                             |
| 6.0                             | 10/63                          | 24.6                              | 1.65                             |
| 6.1                             | 2/62                           | 30.7                              | 1.06                             |
| 7.1                             | 1/62                           | 27.3                              | 1.29                             |
| 7.2                             | 7/63                           | 20.5                              | 2.95                             |
| 9.3                             | 3/63                           | 25.9                              | 2.68                             |
| 10.2                            | 9/61                           | 30.7                              | 1.93                             |
| 10.2                            | 5/63                           | 25.3                              | 1.65                             |
| 12.0                            | 2/62                           | 28.3                              | 1.25                             |
| 12.0                            | 5/62                           | 33.4                              | 1.82                             |
| 13.3                            | 7/61                           | 30.0                              | 1.03                             |
| 15.6                            | 10/62                          | 24.3                              | 1.57                             |
| 17.9                            | 2/63                           | 29.2                              | 1.51                             |
| 18.1                            | 12/62                          | 23.1                              | 1.66                             |
| 19.0                            | 10/62                          | 26.6                              | 1.65                             |
| 20.0                            | 1/61                           | 26.4                              | 0.87                             |
| 20.0                            | 1/62                           | 36.8                              | 1.42                             |
| 36.0                            | 5/59                           | 34.2                              | 1.15                             |
| 36.0                            | 8/59                           | 26.6                              | 0.95                             |
| 36.0                            | 7/60                           | 32.4                              | 0.98                             |
| 36.0                            | 7/60                           | 35.0                              | 1.07                             |
| 36.0                            | 8/60                           | 36.7                              | 0.93                             |

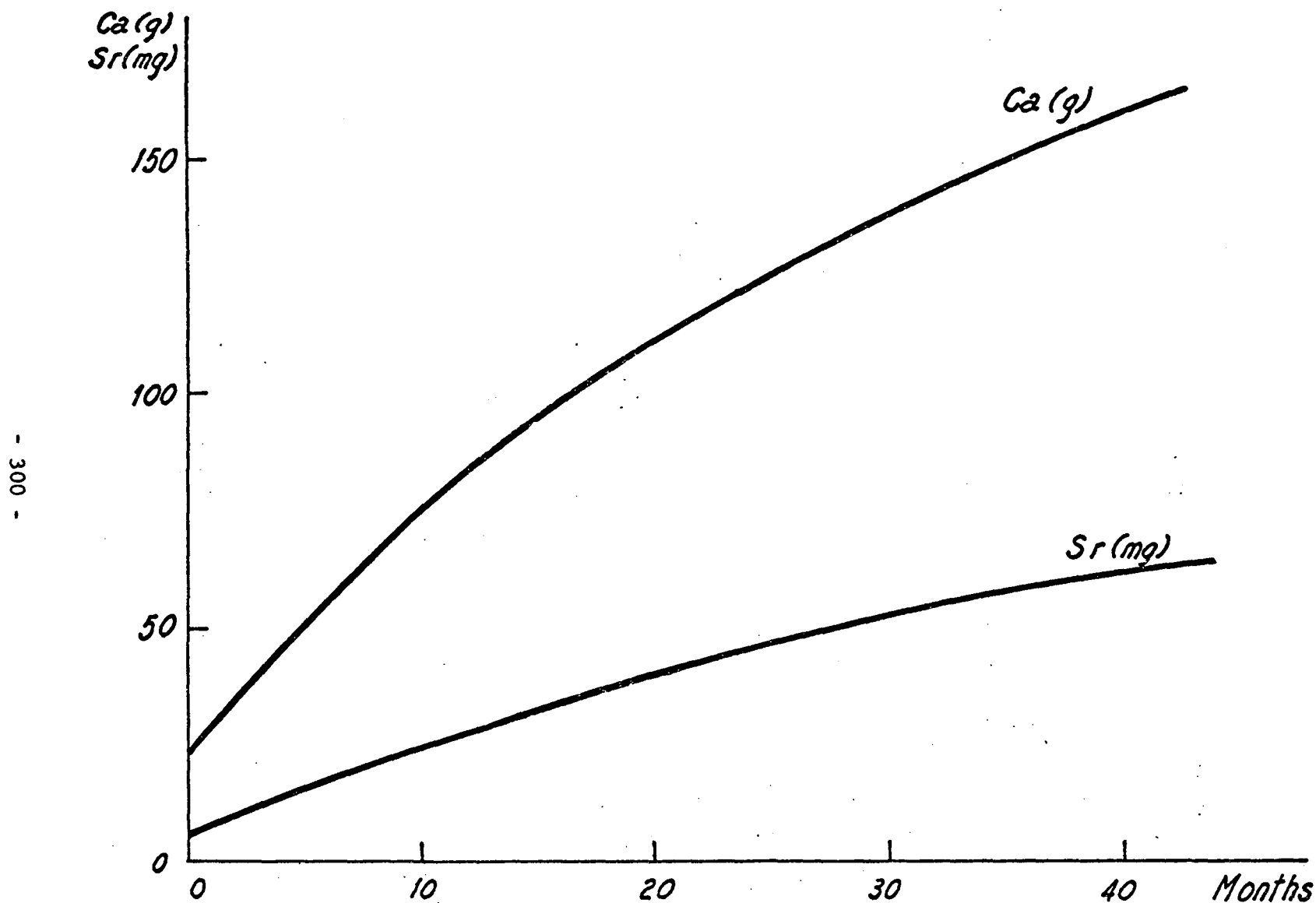


Fig. No 1  
STRONTIUM AND CALCIUM CONTENTS IN CHILDREN SKELETON