Effects of Whole and Half Body Irradiation in Human Beings with Cancer

by

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Third International Congress of Radiation Research
Cortina d'Ampezzo, Italy

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ABSTRACT

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Whole body irradiation has been given to 48 patients and partial body (1/2) to 6 patients with various solid neoplasms (excluding lymphomas). Doses of 50 - 200 rad (absorbed midline) were given with Cobalt 60 at rates of 2-6 r/min. Each individual serves as his own control.

Patients were divided into 4 groups, those receiving less than 125 rad without previous therapy, those receiving less than 125 rad with previous therapy, those receiving more than 125 rad without previous therapy and those receiving more than 125 rad with previous therapy.

In those patients receiving 1/2 body radiation up to 200 rad, there was no significant fall in white cell count and no prodromal symptoms. In patients receiving whole body irradiation, symptoms, signs and hematological changes were proportional to dose and previous treatment. Ten of the 48 patients receiving whole body radiation died within about 1 month following irradiation. The significance of these observations will be discussed.

Table 1 **Incidence of Prodromal Symptoms in Total Body Radiation** *

	No Previous Treatment	Previous Treatment
125 rad	2/12	2/T
125 rad	7/11 9/23	7/8 9/15

* Patients with symptoms/total patients

Introduction

This paper summarizes certain experiences gained in our laboratory in evaluating the clinical and hematological course of a group of human beings receiving whole and partial body irradiation as part of the treatment of cancer. It is our belief that information concerning radiation effects in the human being can be determined as well or better in these subjects as in the laboratory animal even though the characteristic of cancer must be kept in mind in the evaluation of the data. The rationale of the treatment method is based on the tenet that this modality is similar in effect to other forms of palliation for metastatic carcinoma.

Design of the Study: Each patient serves as his own control. A pre-irradiation period of one to two weeks is utilized to provide at least five observations of most parameters. All patients receive one or two episodes of sham irradiation to permit accurate dosimetry and obtain cooperation. There is no discussion of possible subjective reactions resulting from the treatment with the patients before or after treatment.

Selection of Patients: Only patients with metastatic or incurable neoplasms are eligible. Patients with radioresistant tumors are sought. All lymphomas are excluded. Relatively good nutritional status (ability to maintain weight during the study), normal renal function and a stable hemogram are required.

In general we have tried to confine these studies to individuals who have not had previous chemotherapy or radiation. This goal has not always been attained.

Radiation Technique: The radiation is delivered by a cobalt 60 teletherapy unit with the beam directed horizontally at the wall 338 cm away with the patient midline at 282 cm from the source. The beam area for the 50% isodose curve at the patient midline distance is a square about 67 cm by 67 cm.

Half the dose is given laterally through each side. In the individuals receiving partial body radiation, the beam is restricted by the teletherapy collimator. The field for this latter case is shown in Fig. 1. The relative doses for upper body radiation is shown in Fig. 2; that for lower body is shown in Fig. 3. For partial body radiation, the xiphoid was used as the boundary.

Clinical Observations: Only a few of the more interesting clinical details can be described in this communication.

Patients receiving total body radiation were divided into 4 groups to determine effects of previous radiation and/or chemotherapy. Earlier radiation therapy was regional but chemotherapy was usually systemic. Table 1 shows that the incidence of prodromata rises with increasing dose being far more frequent above 125 rad. This incidence is also increased in those patients who received previous therapy irrespective of dose.

In the small group of seven patients receiving partial body irradiation, no prodromata were found at doses of 100 and 150 rad (2 patients). One of 3 patients receiving 200 rad had transient nausea and vomiting. Both patients receiving 300 rad to the lower body had nausea and vomiting. It was not possible to determine effects of prior therapy nor of the difference between upper and lower body radiation.

Recently several patients have received sham irradiation within 2 weeks after their partial or whole body radiation. In the absence of radiation, no nausea or vomiting were observed in spite of their presence after actual radiation. This observation suggests that these symptoms have an organic basis since the patients would anticipate experiencing the same symptoms with the same apparent treatment regimen.

Of the 53 patients in whom the treatment protocol could be completed, 10 patients have died within 37 days following treatment. Five of these patients had received much radiation therapy either before or after whole or partial body treatment. Since in most of these patients, the terminal

event was marked by severe leukopenia, thrombocytopenia and hemorrhage, beginning in 1964 bone marrow has been stored for possible use after the exposure. Reinfusion has been employed in two cases. In one (#053) it was of no value (Figure 4). In the other (Figure 5) a definite response was elicited. In this latter case marrow was given on the 25th day when the white cell count was 850/cm mm. By the 48th day it had risen to the pretreatment level.

Hematological Observations: Patients receiving whole body therapy showed a hematological response quite similar to those reported many times in the literature (Fig. 6). Of particular interest in these studies is the comparison of hematological findings in those patients who received partial body radiation. A typical hemograms for upper body exposure (Fig. 7) in a patient receiving 200 rad shows little change in total white count platelet level or hematocrit. These observations were also noted in the two patients receiving 300 rad. Although if one had pretreatment counts a downward trend could be noted, at no time did the total white count fall below 4500. If one had only 2 or 3 observations following this type of partial body radiation and no baseline values, it would be difficult to determine the presence of radiation.

If, however, one followed the absolute lymphocyte count one observes a marked and persistent lymphopenia ranging from 800-200, often remaining low for 40-60 days. In two of the partial body cases, the lymphocytes did not begin to fall for 48-72 hours after exposure and it would have been difficult to detect radiation in this manner. (These cases received 100 and 200 rad respectively to the lower 1/2 of the body).

If one compares the hematological changes in partial body radiation to those of whole body radiation one is struck by the paucity of change in total white count, platelets and hematocrit particularly since 3 of the 5 patients receiving 200, 300 and 300 rad had prodromal symptoms. We have not yet established the partial body radiation dose which produces the degree of change seen at 100-150 rad of whole body radiation in the human being.

COBALT 60 FIELD FOR PARTIAL (HALF) BODY IRRADIATION

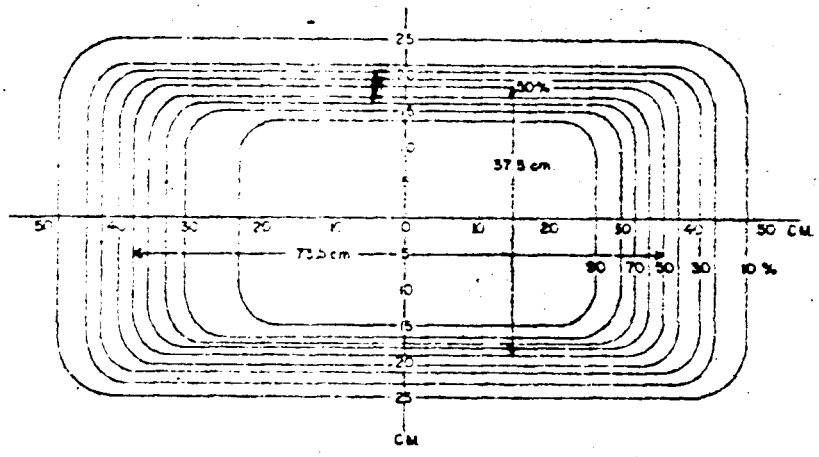


Fig 1

RELATIVE DOSES FOR ^{60}Co PARTIAL BODY (UPPER) (HALF) IRRADIATION AS MEASURED WITH TL-100 POWDER AT CENTER OF RANDO PHANTOM LATERAL IRRADIATION

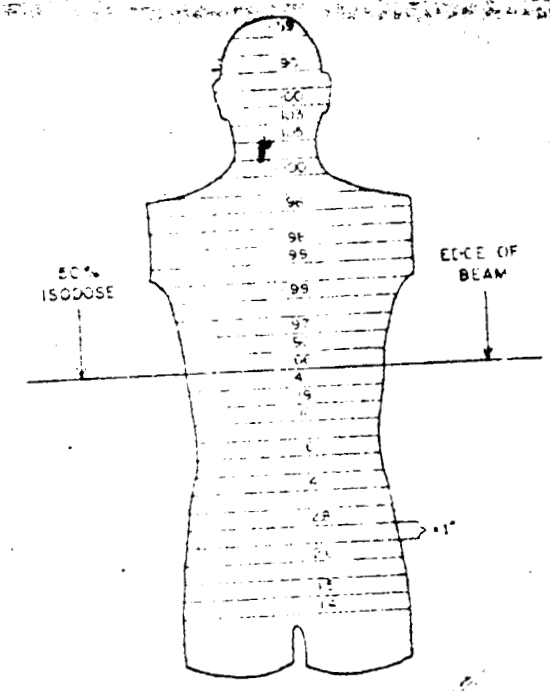


Fig 2

RELATIVE DOSES FOR ^{60}Co PARTIAL BODY (LOWER) (HALF) IRRADIATION AS MEASURED WITH IL-100 POWDER AT CENTER OF RANDO PHANTOM LATERAL IRRADIATION

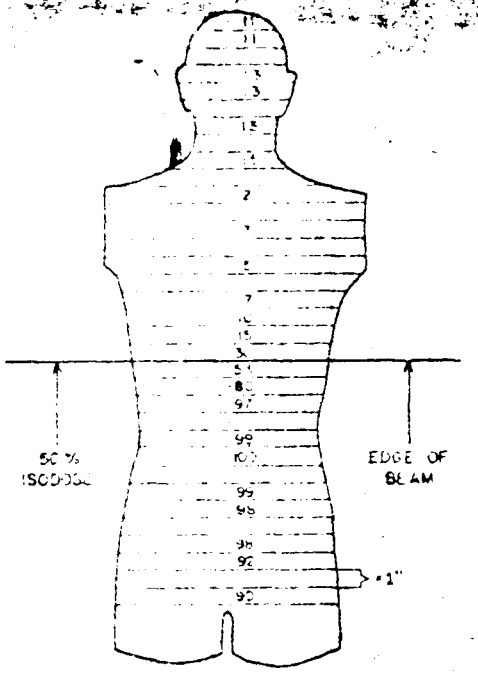


Fig 3

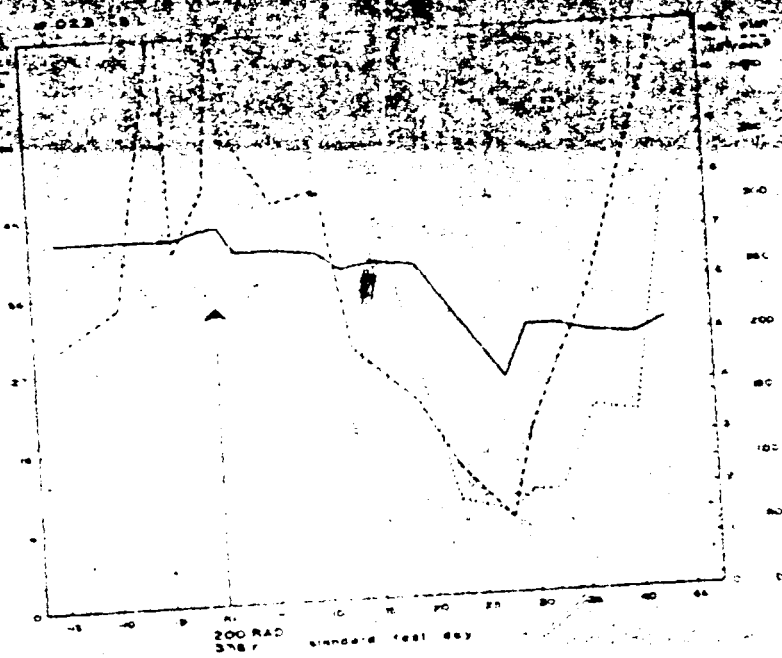


Fig 4

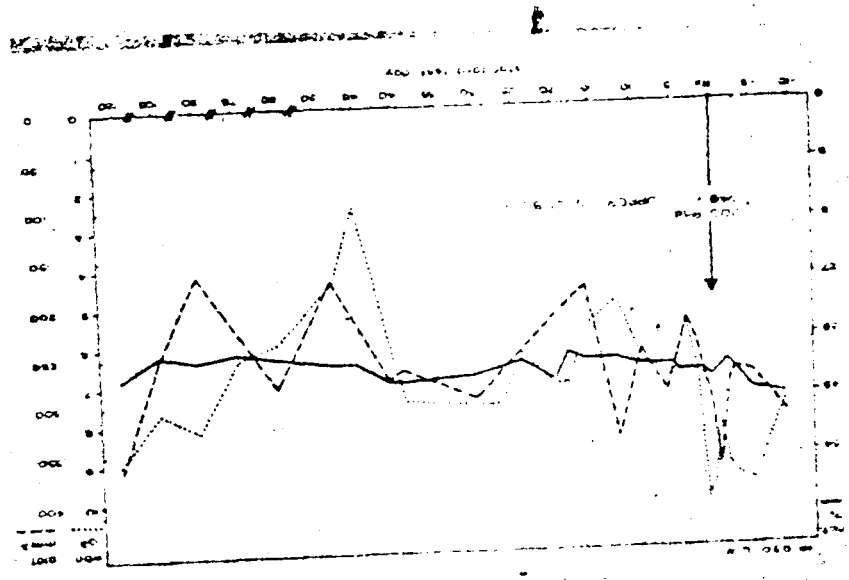
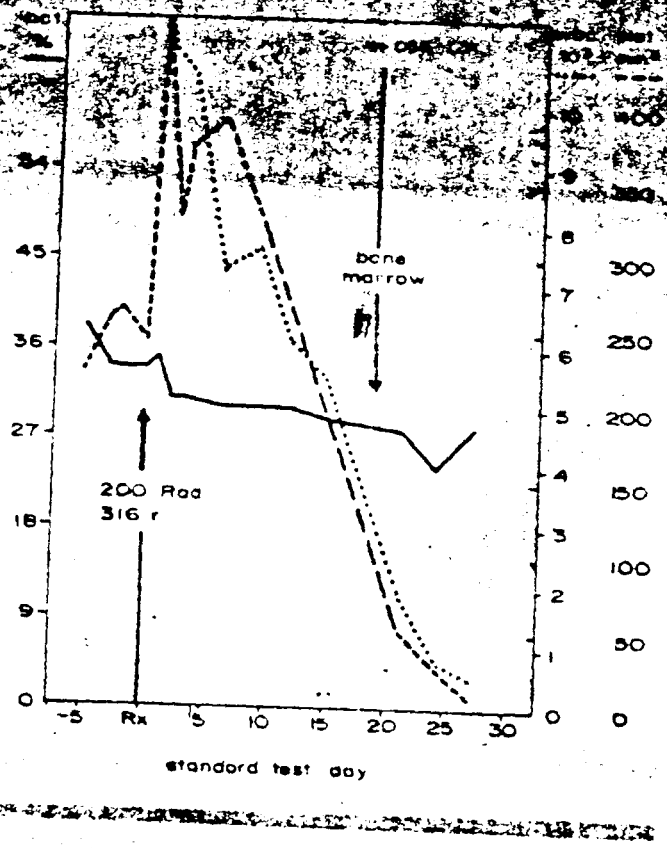


Fig 5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27
18
9
0
8
7
6
5
4
3
2
1
0
300
250
200
150
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50
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bone marrow
200 Rad
316 r
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5
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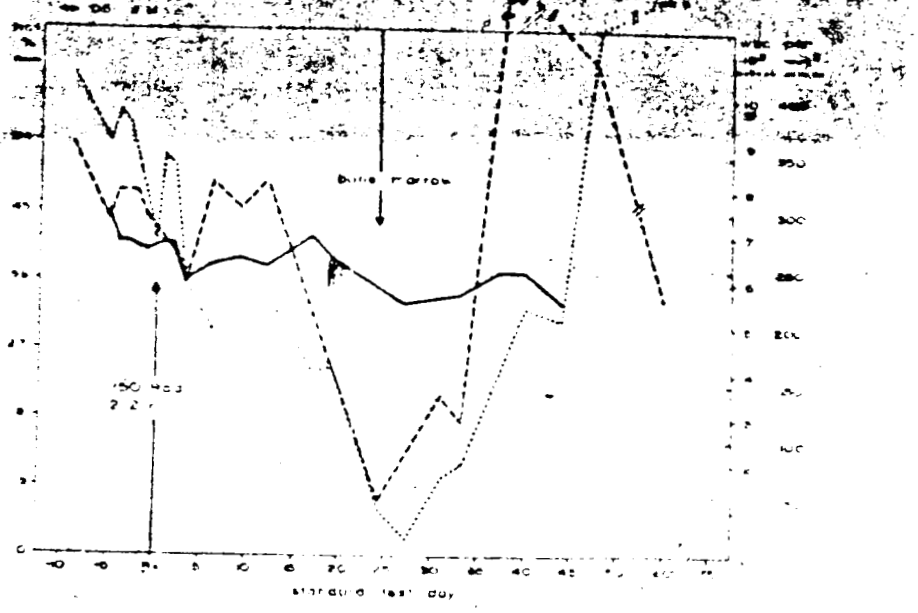
15
20
25
30
standard test day

Fig 6



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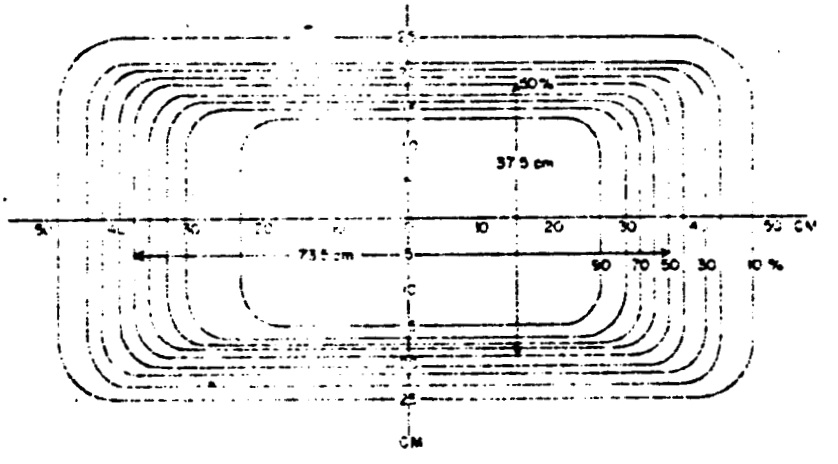

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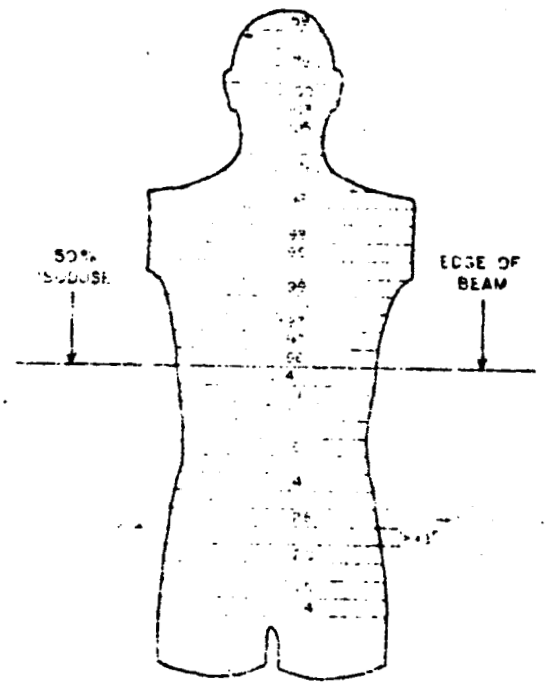

Fig. 2

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(HALF) IRRADIATION AS MEASURED WITH TL-100
POWDER AT CENTER OF RANDO PHANTOM
LATERAL IRRADIATION

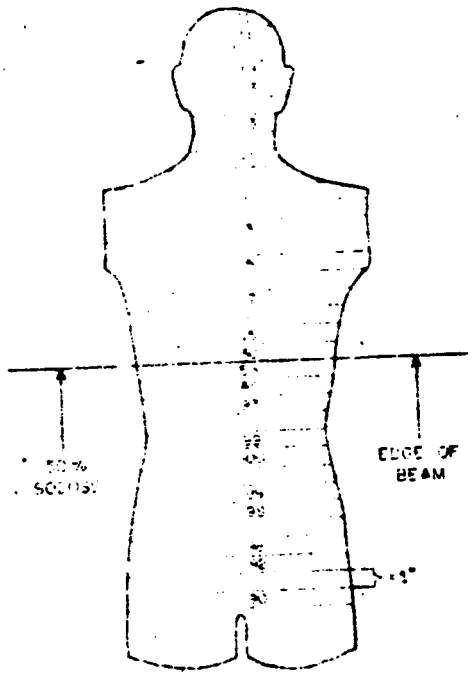
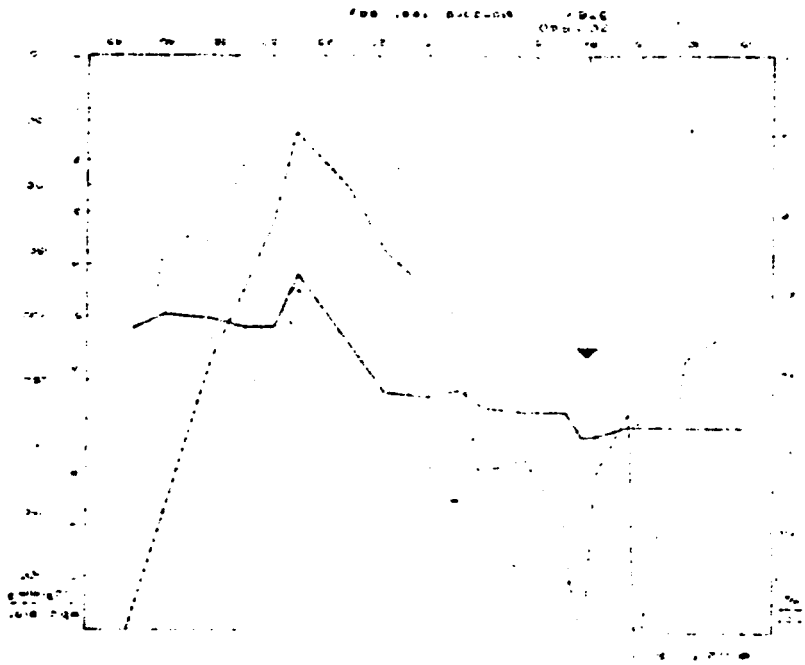


Fig 3



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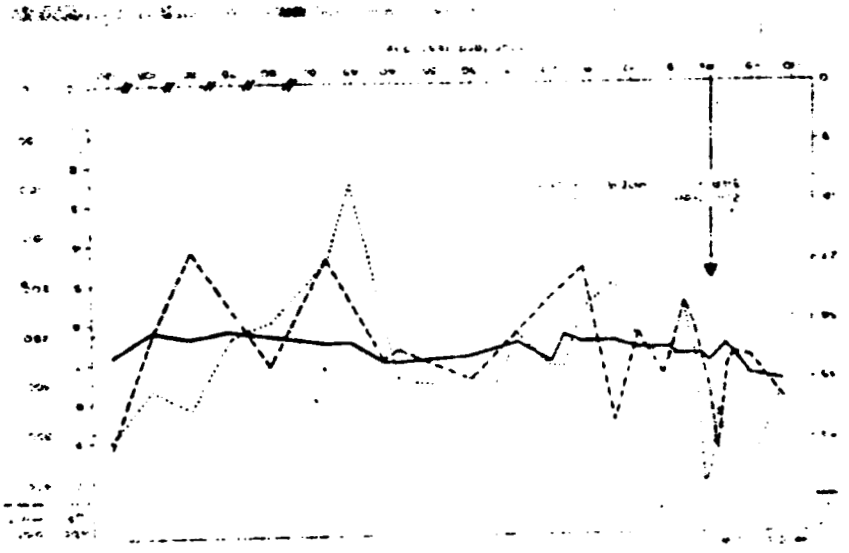

Fig 5