

Materiaal : Obx PPN : 310625033,830768572  
 Titel : Journal of mental science  
 :  
 Auteur :  
 Deel / Supplem. :  
 Corporatie : Externe Database :  
 Jaar / Editie : 200X Extern Nummer :  
 Uitgave : Stanford HighWire Press  
 Serie / Sectie :  
 Pag-ISSN / ISBN : 1472-1465

830768572 ; MB M3 Tz c 1277 ; ; 1949 V95 - 1962 V108 ~eH889075~eV~c

Jaar : 1957-00-00 Datum Indienen : 08-05-2013 15:24  
 Volume : 103 Datum Plaatsing : 08-05-2013 15:24  
 Aflevering : 430 Datum Rappel : 05-06-2013  
 Leenvorm : KOPIE Particulier : N  
 Leveringswijze : E Geplaatst bij : 0023/0006  
 Cooperatiecode : R Indiener : 0004/9999  
 Aanvrager : 0004/0450UKB Eindgebruiker : 4692  
 Aanvragerident. : CENTR MED BIBL-2 Aanvragerident. :  
 Auteur : Gour, K.N.  
 Artikel : Study of calcium metabolism in electric convulsive therapy (  
 Bladzijden : 275 - 285  
 Bron :  
 Opmerking : 1301617 Klein, H.C.

Indiener : 0004/9999 Stuur rekening : N  
 Aanvrager : 0004/0450 Eindgebruiker : 4692  
 Aanvragerident. : CENTR MED BIBL-2 Aanvragerident. :

Afleveradres Post UMCG - O&O / FC41  
 Centrale Medische Bibliotheek /FC41

Postbus 30001  
 9700 RB Groningen

NL

Fax 050-3637373  
 E-mail iblomb@med.umcg.nl  
 Ftp  
 Ariel  
 Telefoon 050-3633048

Faktuuradres Clearing House

[1] origineel gestuurd  
 [2] kopie gestuurd  
 [3] overige

[4] nog niet aanwezig  
 [5] niet aanwezig  
 [6] niet beschikbaar

[7] uitgeleend  
 [8] wordt niet uitgeleend  
 [9] bibliografisch onjuist  
 [0] bij de binder

Aantal eenheden : 11X  
 Aanvraagnummer : A09817049X

# STUDY OF CALCIUM METABOLISM IN ELECTRIC CONVULSIVE THERAPY (E.C.T.) IN CERTAIN MENTAL DISEASES

By

**K. N. GOUR, M.D., M.R.C.P.Ed., F.R.F.P.S.G., D.C.H., D.P.H.**  
*Professor of Medicine*

and

**H. M. CHAUDHRY, M.B., B.S.**  
*Department of Medicine, Medical College, Agra, India*

FOR this study, calcium level in the blood was studied in 20 normal individuals between the ages of 20 and 25 years to find out the normal serum-calcium level in them in order that this finding might serve as a control. It was found to vary from 8·9 to 11·0 mg. per cent. (see Table I).

TABLE I  
*Serum-Calcium Levels in Normal Healthy Individuals*

Sl. No.	Name	Serum Calcium in mg./100 c.c.
1	A.K.S. .. .. .	9·7
2	B.S.M. .. .. .	9·1
3	R.L.B. .. .. .	9·3
4	K.P.M. .. .. .	9·8
5	K.P.G. .. .. .	10·2
6	H.S.L. .. .. .	9·6
7	H.L.K. .. .. .	8·9
8	P.C.A. .. .. .	10·5
9	I.M.S. .. .. .	10·0
10	S.R.A. .. .. .	10·9
11	M.H. .. .. .	9·5
12	Z.I. .. .. .	9·8
13	S.C.S. .. .. .	9·4
14	R.V. .. .. .	11·0
15	S.R. .. .. .	9·8
16	C.M.K. .. .. .	9·4
17	P.L.T. .. .. .	9·1
18	R.L. .. .. .	9·0
19	C.L. .. .. .	8·9
20	C.K. .. .. .	9·0

The study of calcium metabolism in electric convulsive therapy was carried out in 15 patients. These cases had been admitted to the Mental Hospital, Agra, where E.C.T. was given for their treatment. These cases belonged to three different diseases—Schizophrenia, Manic Depressive Psychosis and Melancholia. All these cases were males and they had no other disease excepting their mental disorder. During the period of the E.C.T. they were given normal vegetarian diet. No calcium was administered by mouth or by parenteral route.

## METHOD

Six to seven c.c. of blood was drawn from a vein in the ante-cubital fossa by a dry, sterilized syringe and the separated serum analysed. Samples of blood were collected immediately before, immediately after E.C.T., then 2 hours after E.C.T., 4 hours after E.C.T., 10 hours after E.C.T., then 24 hours after the first E.C.T., and finally 2 days i.e. 48 hours after the 10th E.C.T. These timings were chosen arbitrarily to study if any change was brought about in the calcium level by the E.C.T., how long these changes persisted and if there was any cumulative effect of these shocks on blood calcium. For the latter purpose calcium level was estimated after 48 hours of the 10th shock as it was thought that a result after less than the 10th shock might not give a true index of the cumulative effect on blood calcium.

It might be mentioned that E.C.T. was given on alternate days in almost all the cases studied. So the 10th shock was given roughly on the 22nd day of initial E.C.T. No treatment being given on the intervening Sundays.

The technique employed for the estimation of serum calcium was that of Kramer and Tisdall.

Seven cases belonged to the Schizophrenic group, six cases to Manic Depressive Psychosis and two cases to the Melancholic group. (See Table II.)

TABLE II

Diagnosis	No. of Cases
Schizophrenia .. .. .	7
Manic depressive psychosis .. .. .	6
Melancholia .. .. .	2

Results of calcium estimation at different times in different cases (Table III).

The maximum, minimum and average values of serum-calcium level in 7 cases of Schizophrenia, 6 cases of Manic Depressive Psychosis, and 2 cases of Melancholia were as shown in Table IV, Table V and Table VI.

The maximum, minimum and average values in normal cases and mental patients are shown in Table VII.

## OBSERVATIONS

Schizophrenic cases (see Graphs 1, 2, 3, 4, 5, 6 and 7).

Immediately after E.C.T. there was a rise in the serum-calcium level in all the cases. The deviation from the initial level varied from +0.6 to +1.6 mg. per cent.

Two hours after the E.C.T. there was a decline in the serum-calcium level in 5 cases (71.43 per cent.). The deviation was to -0.6 mg. per cent. In 2 cases (28.6 per cent.), however, a rise was noticed to +0.6 mg. per cent. above the initial level.

In all these cases, 4 hours after E.C.T. serum-calcium level was below the initial level. The fall varying up to -1.4 mg. per cent.

The fall was maximum at 10 hours after E.C.T. in all the cases except 3, in one of which the level had slightly risen from the level obtained at 4 hours after shock and in the other two, the lower level was maintained at the same figures as was obtained at 4 hours after E.C.T.

The fluctuation in the serum-calcium level that occurred between the highest rise and the lowest fall, varied between 1.2 to 2.4 mg. per cent., giving an average of 1.9 mg. per cent.

TABLE III

Time of Collecting Specimen	Serial Numbers of the Case															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Immediately before shock	..	10.4	10.8	9.2	9.5	10.0	9.2	9.0	8.8	10.4	8.6	9.4	9.8	10.0	9.3	8.8
Immediately after shock	..	11.6	11.4	11.1	10.9	11.2	10.8	11.3	10.1	11.0	9.8	11.2	10.8	11.5	9.4	9.4
After 2 hours	..	9.8	10.4	10.6	9.1	9.8	9.8	10.6	9.6	10.2	8.4	10.4	10.7	10.2	10.7	8.9
After 4 hours	..	9.0	10.2	10.0	8.8	9.6	9.0	8.8	9.2	9.6	8.2	10.0	9.6	9.6	9.8	8.6
After 10 hours	..	9.2	10.2	9.6	8.6	9.4	8.6	8.4	8.6	9.2	8.0	9.2	9.4	9.6	9.0	8.6
After 24 hours	..	10.4	10.8	9.2	9.4	10.0	9.4	9.0	8.8	10.2	8.6	9.4	9.6	10.0	9.2	8.8
After 10 shocks	..	10.4	10.8	9.2	9.6	10.2	9.4	9.0	9.0	10.4	8.6	9.4	9.8	10.0	9.4	9.0

Serum Calcium in mg./100 c.c.

TABLE IV

Schizophrenia	Immedi- ately Before Shock	Immedi- ately After Shock	After 2 Hours	After 4 Hours	After 10 Hours	After 24 Hours	After 10th Shock
Values in mg./100 c.c.							
Maximum .. ..	10.8	11.6	10.2	10.2	10.2	10.8	10.8
Minimum .. ..	9.2	10.8	9.1	8.8	8.6	9.4	9.4
Average .. ..	10.02	11.1	9.9	9.4	9.2	10.0	10.1

TABLE V

Manic Depressive Psychosis	Immedi- ately Before Shock	Immedi- ately After Shock	After 2 Hours	After 4 Hours	After 10 Hours	After 24 Hours	After 10 Shocks
Values in mg./100 c.c.							
Maximum .. ..	9.8	11.5	10.7	10.2	9.6	9.6	9.8
Minimum .. ..	8.6	9.4	8.4	8.2	8.0	8.6	8.6
Average .. ..	9.0	9.8	9.8	9.3	8.8	9.0	9.1

TABLE VI

Melancholia	Immedi- ately Before Shock	Immedi- ately After Shock	After 2 Hours	After 4 Hours	After 10 Hours	After 24 Hours	After 10 Shocks
Values in mg./100 c.c.							
Maximum .. ..	9.4	11.3	10.6	10.0	9.2	9.4	9.4
Minimum .. ..	9.0	11.2	10.4	8.8	8.4	9.0	9.0
Average .. ..	9.2	11.25	10.5	9.4	8.8	9.2	9.2

TABLE VII

*A Comparative Chart Showing the Maximum, Minimum and Average Serum-Calcium Levels in Normal Individuals and Mental Patients*

Serum-Calcium Level	Normal Cases	Mental Patients
Maximum .. ..	11.0 mg./100 c.c.	10.8 mg./100 c.c.
Minimum .. ..	8.9 mg./100 c.c.	8.6 mg./100 c.c.
Average .. ..	9.5 mg./100 c.c.	9.4 mg./100 c.c.

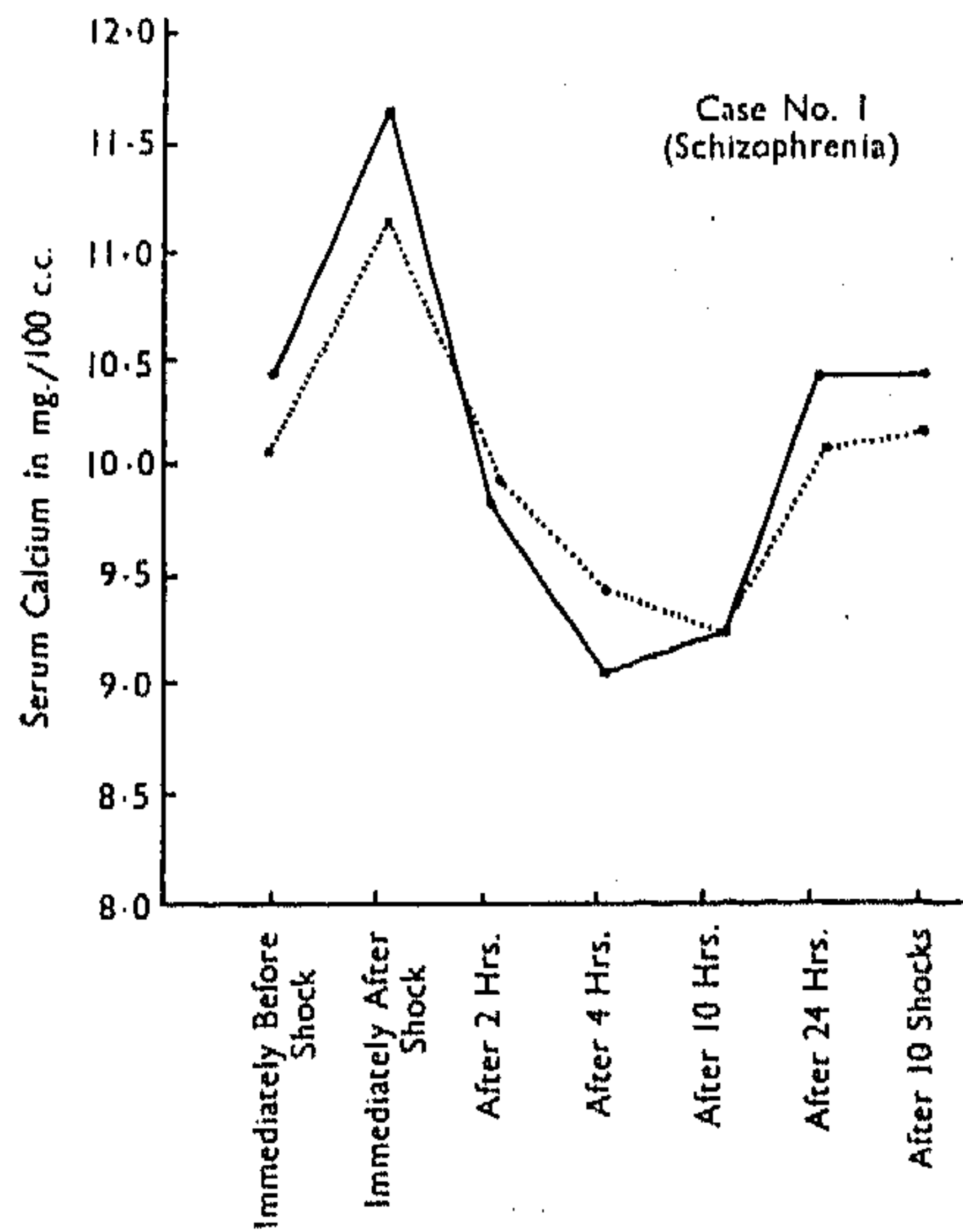
In all these cases, after 10 hours of the E.C.T. a rise was noticed in the serum-calcium level till 24 hours after the E.C.T. At 24 hours, the values returned practically to the initial level. In only one case, the level was slightly higher than the initial, and in two cases it was slightly lower, the deviations varying from +0.2 to -0.1 mg. per cent.

After 10 shocks, i.e. after 22 days of the initial E.C.T. the deviation from the initial level varied only but little from +0.1 to +0.2 mg. per cent.

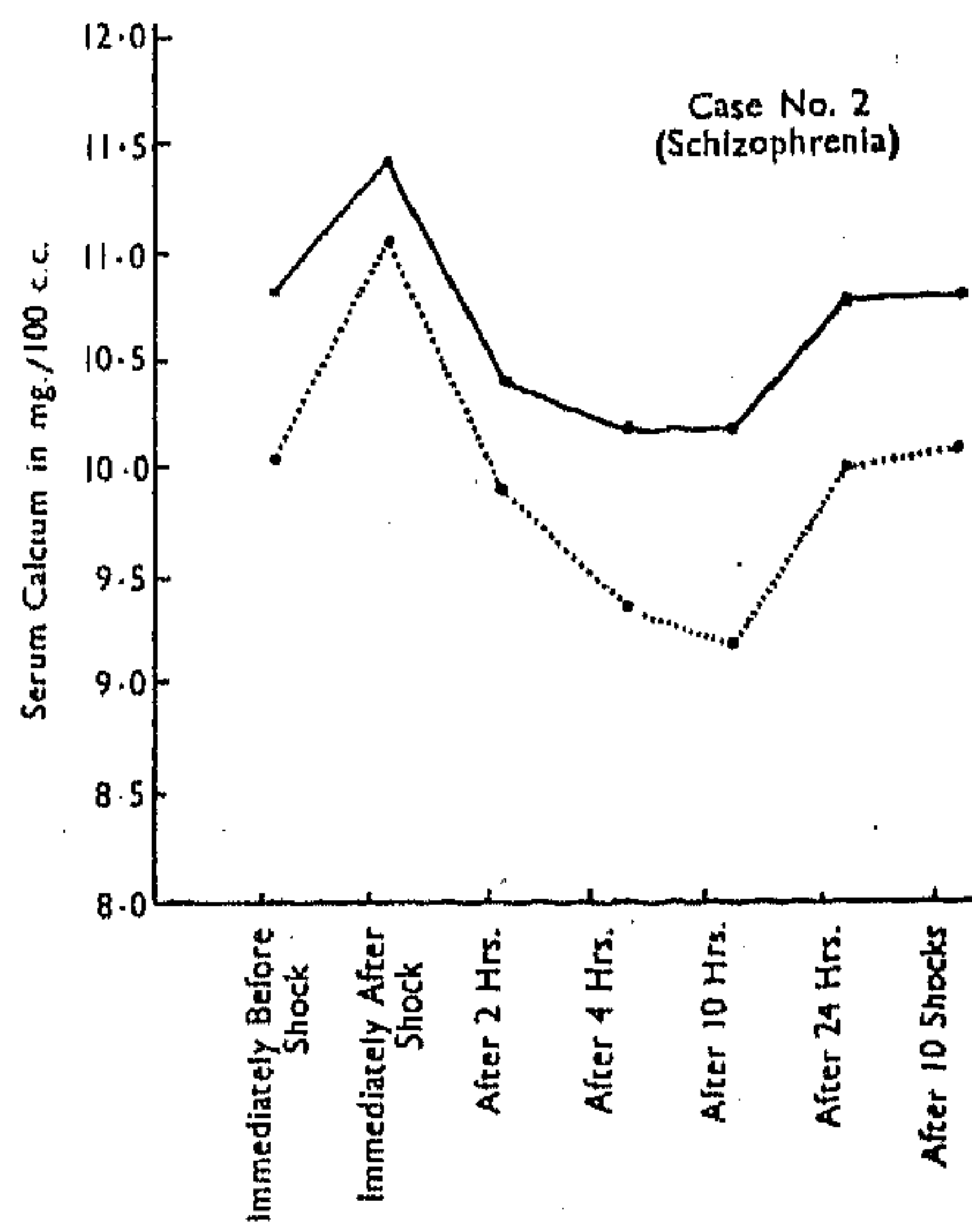
Manic Depressive Psychosis group (see Graphs 8, 9, 10, 11, 12 and 13).

Immediately after the initial E.C.T. there was a rise in the serum calcium in all the cases of this group. The deviation from the initial level varied from +0.6 to +0.3 mg. per cent.

Two hours after the E.C.T., there was a decline in the serum-calcium level but the serum-calcium level at this stage was higher than the initial in 5 cases (83.3 per cent.) and low in one case (16.6 per cent.). The deviation from the initial level varied from  $-0.2$  to  $+1.4$  mg. per cent.

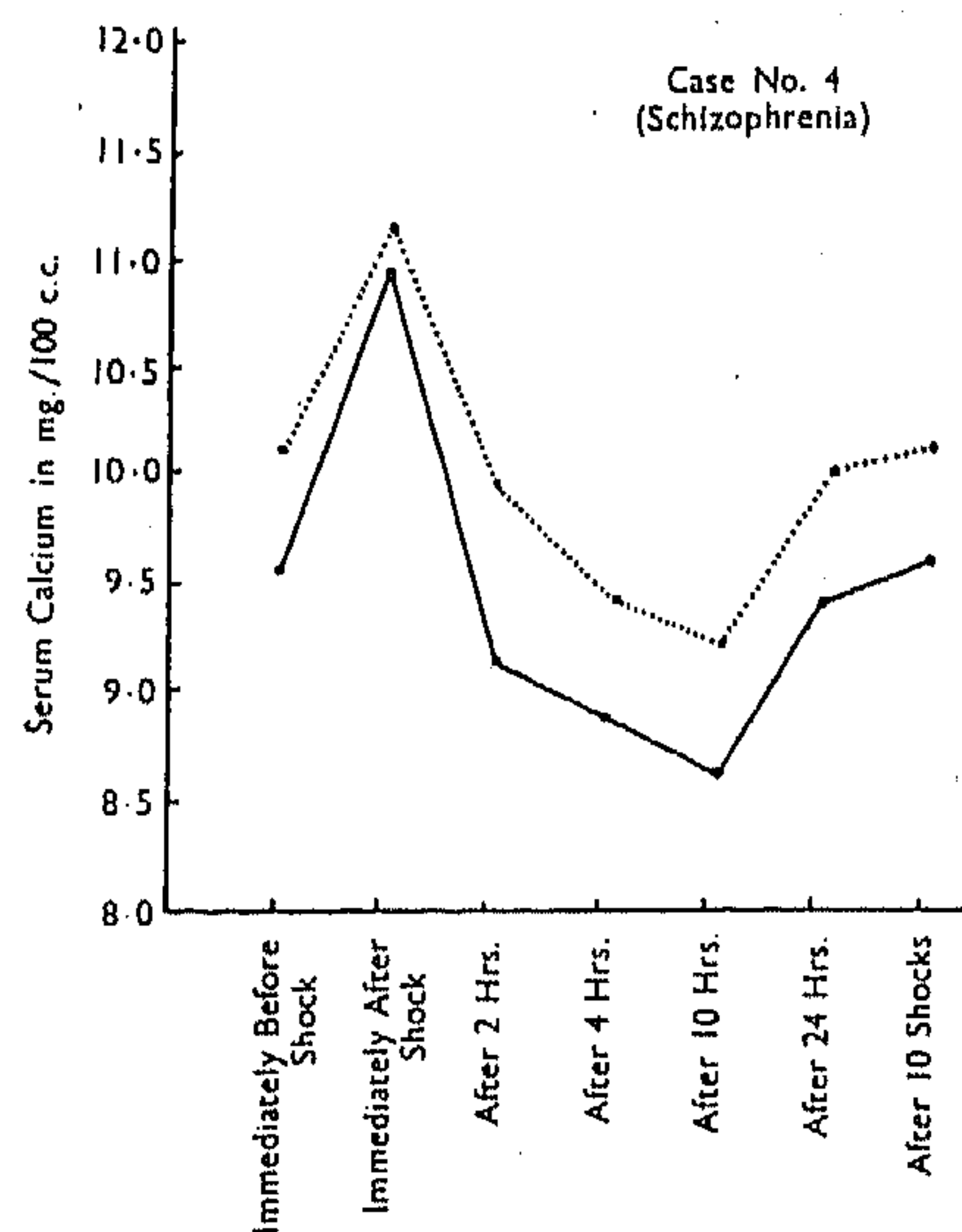


GRAPH 1

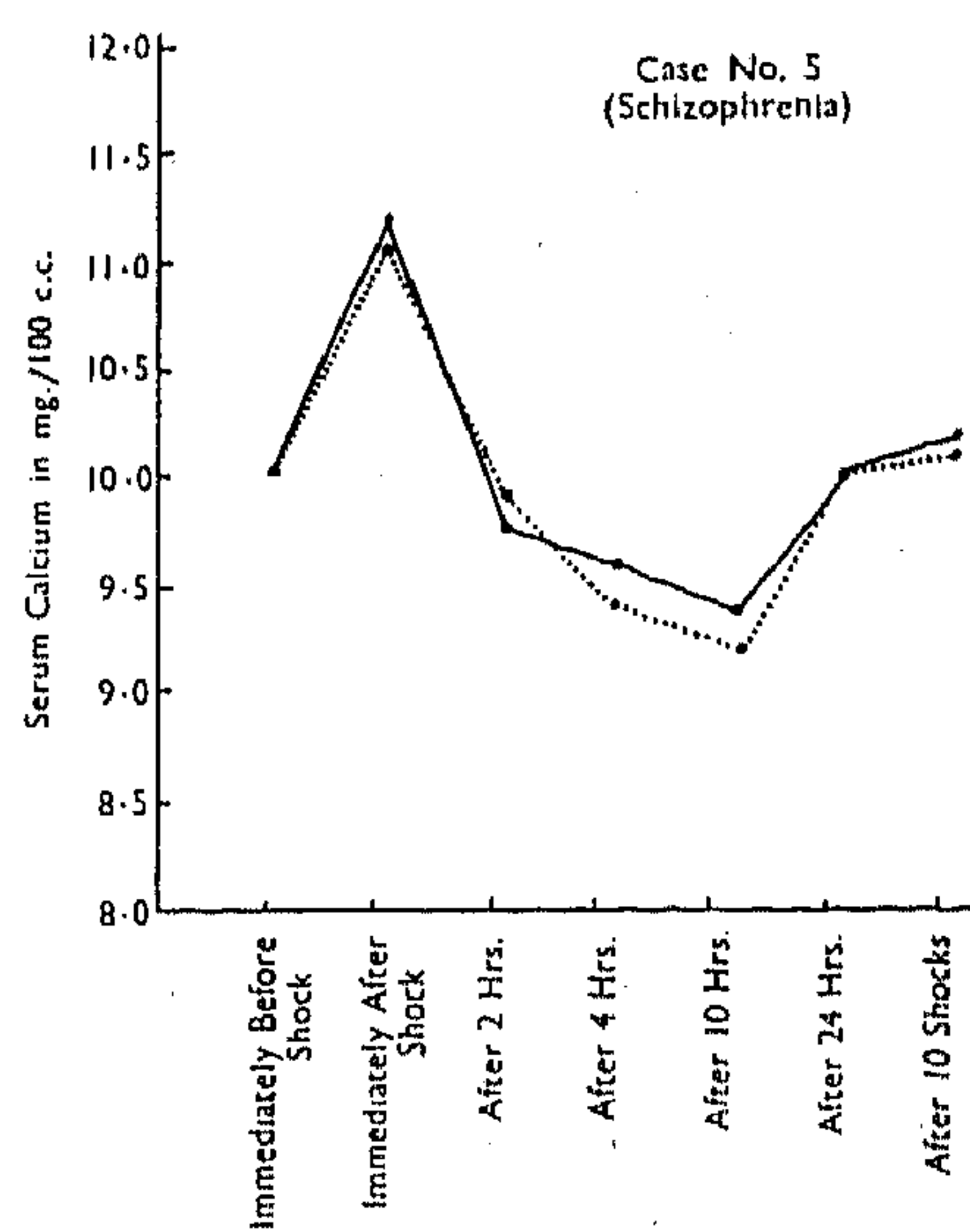


GRAPH 2

At 4 hours after the E.C.T. the serum-calcium level was lower than that observed at 2 hours, but it was higher than the initial level in 4 cases and lower than the initial level in 2 cases. The deviation from the initial level ranged from  $-0.2$  to  $+0.8$  mg. per cent.



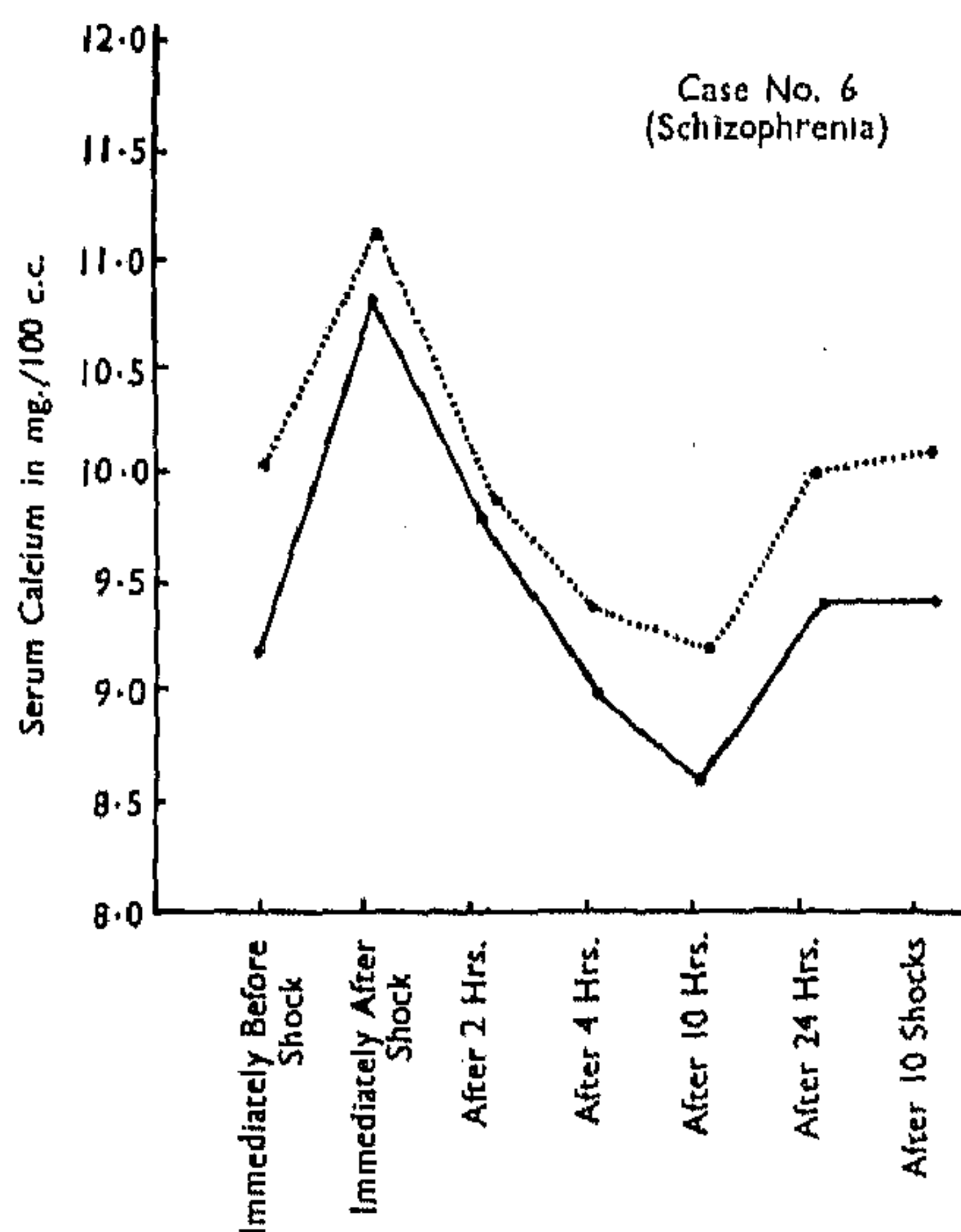
GRAPH 3



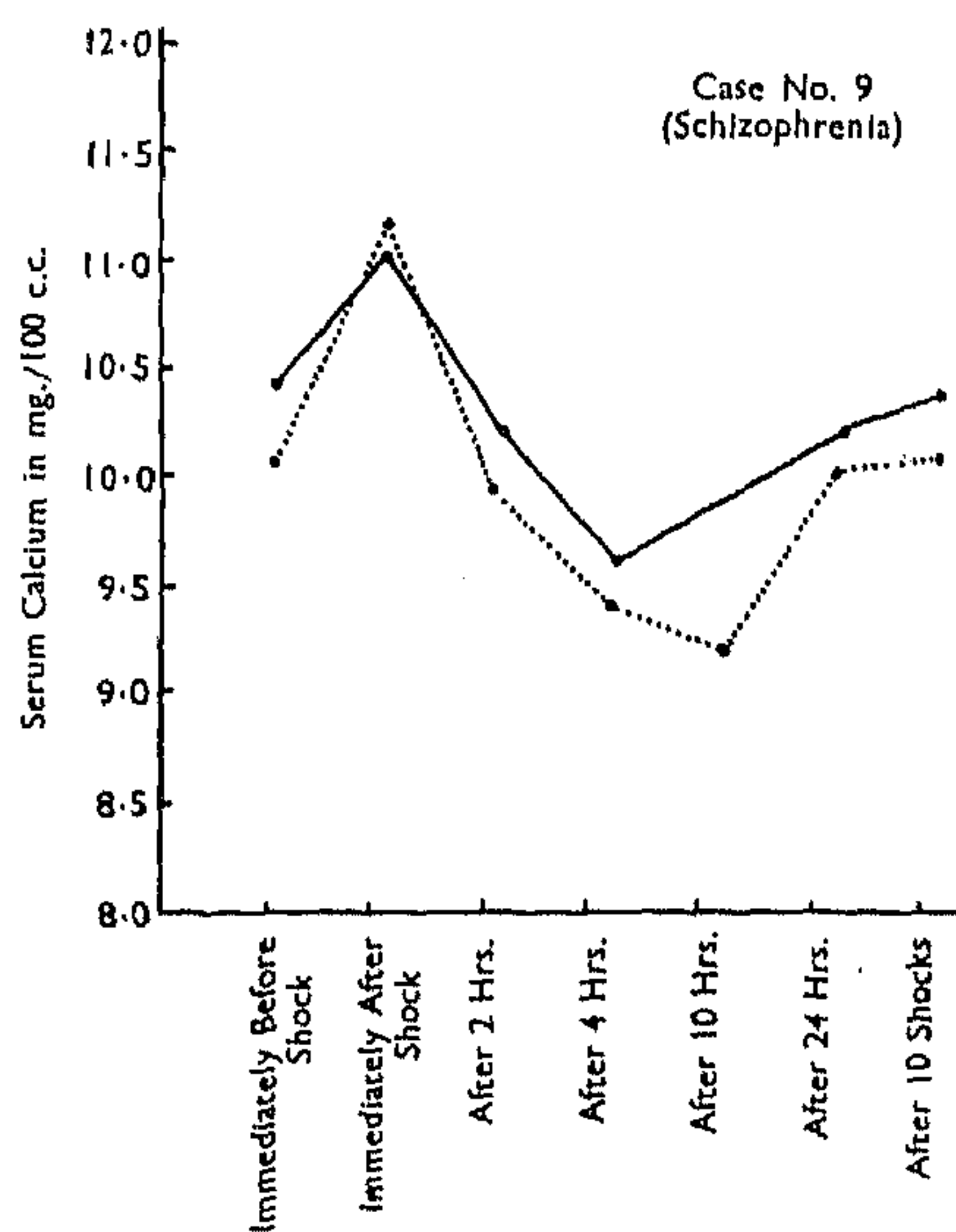
GRAPH 4

At 10 hours after the E.C.T. the fall in the serum-calcium level was noticed in 5 cases and in one case where the maximum fall had been observed at 4 hours after E.C.T. that level was still maintained up to this time. The serum-

calcium level was observed to be lower than the initial level in 5 cases excepting in one case where the level was higher than the initial. The deviation from the initial ranged from +0.4 to -0.6 mg. per cent.

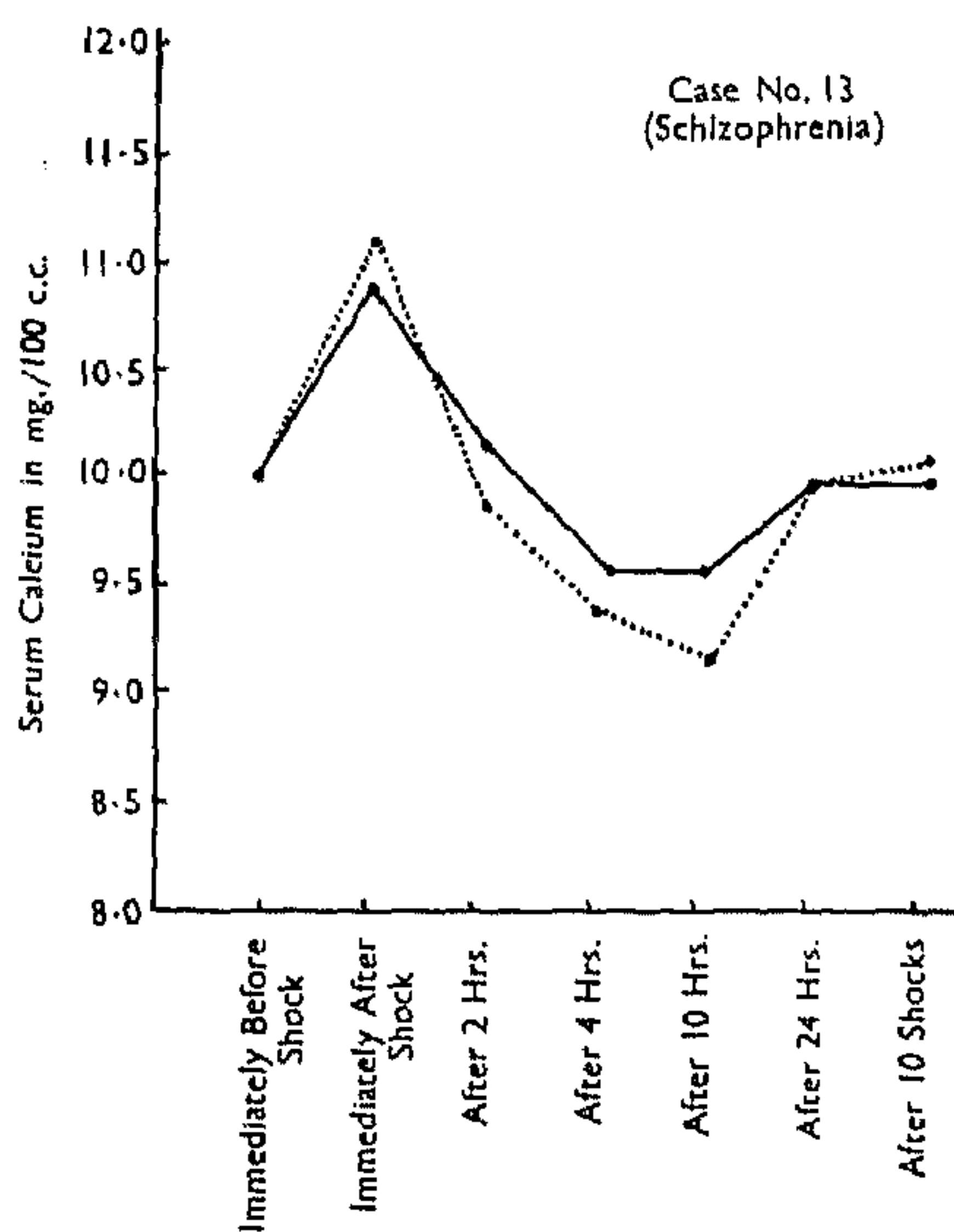


GRAPH 5

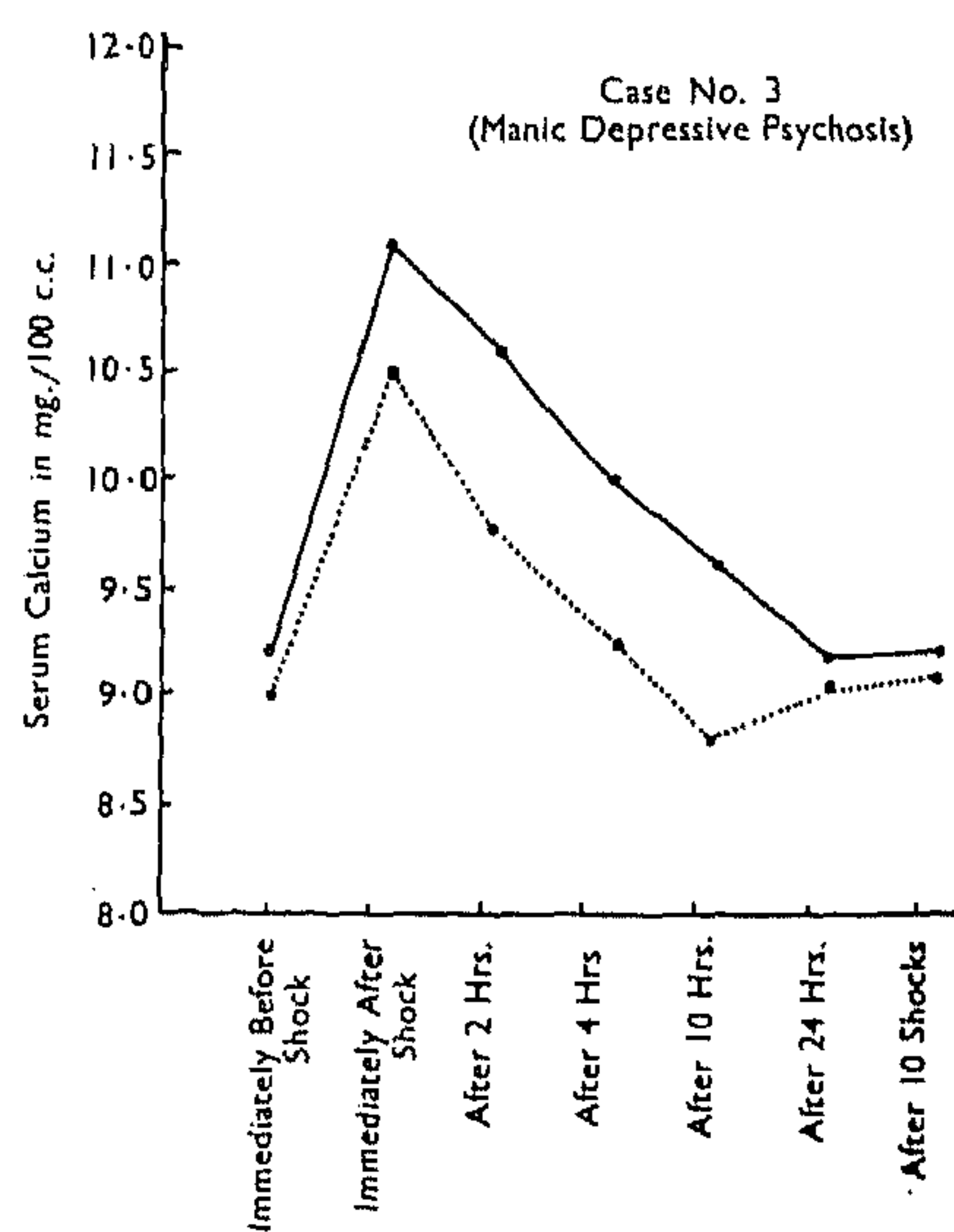


GRAPH 6

The fluctuation in the serum-calcium level that occurred between the highest rise and the lowest fall varied between 1.5 to 2.5 mg. per cent. giving an average of 1.7 mg. per cent.



GRAPH 7

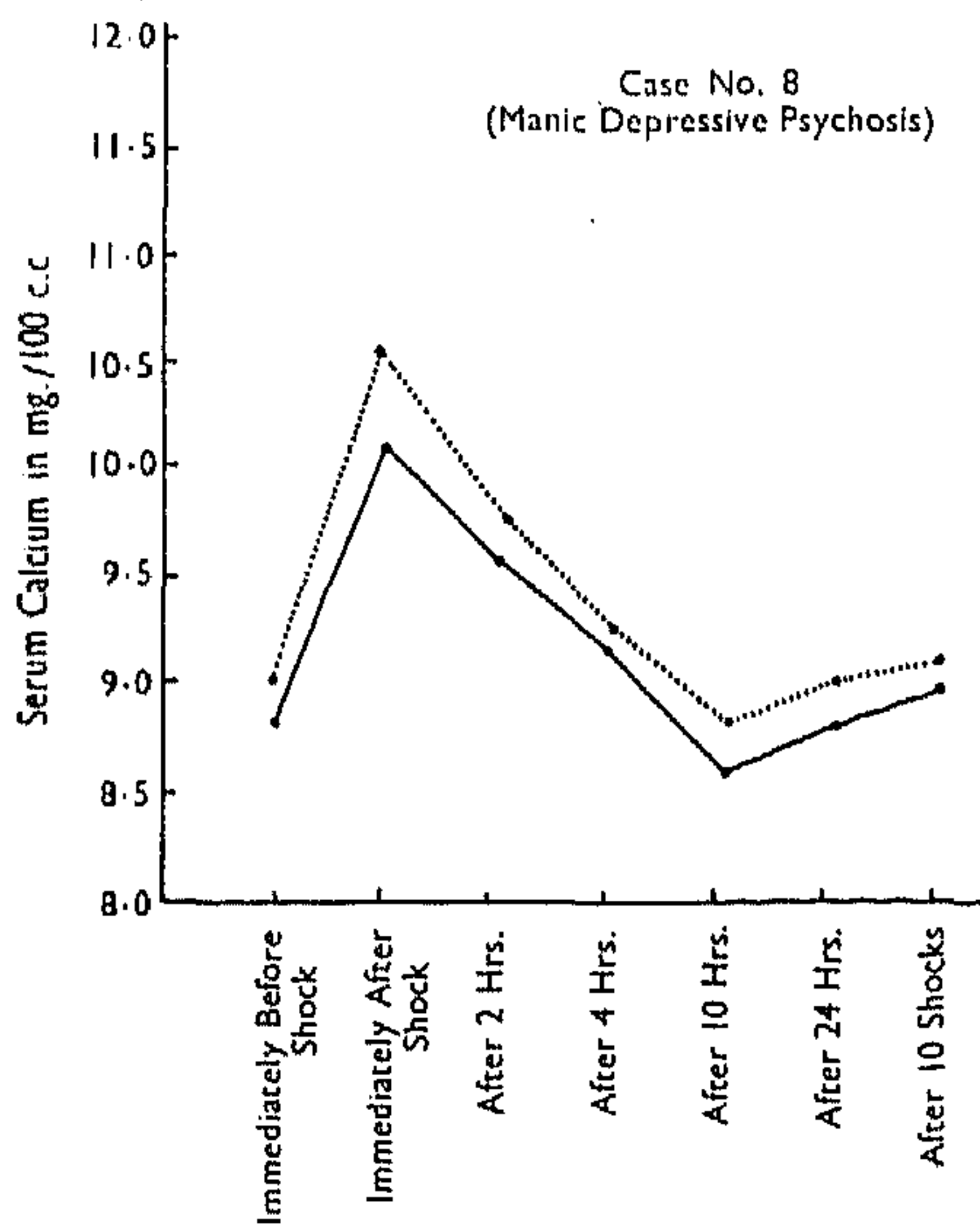


GRAPH 8

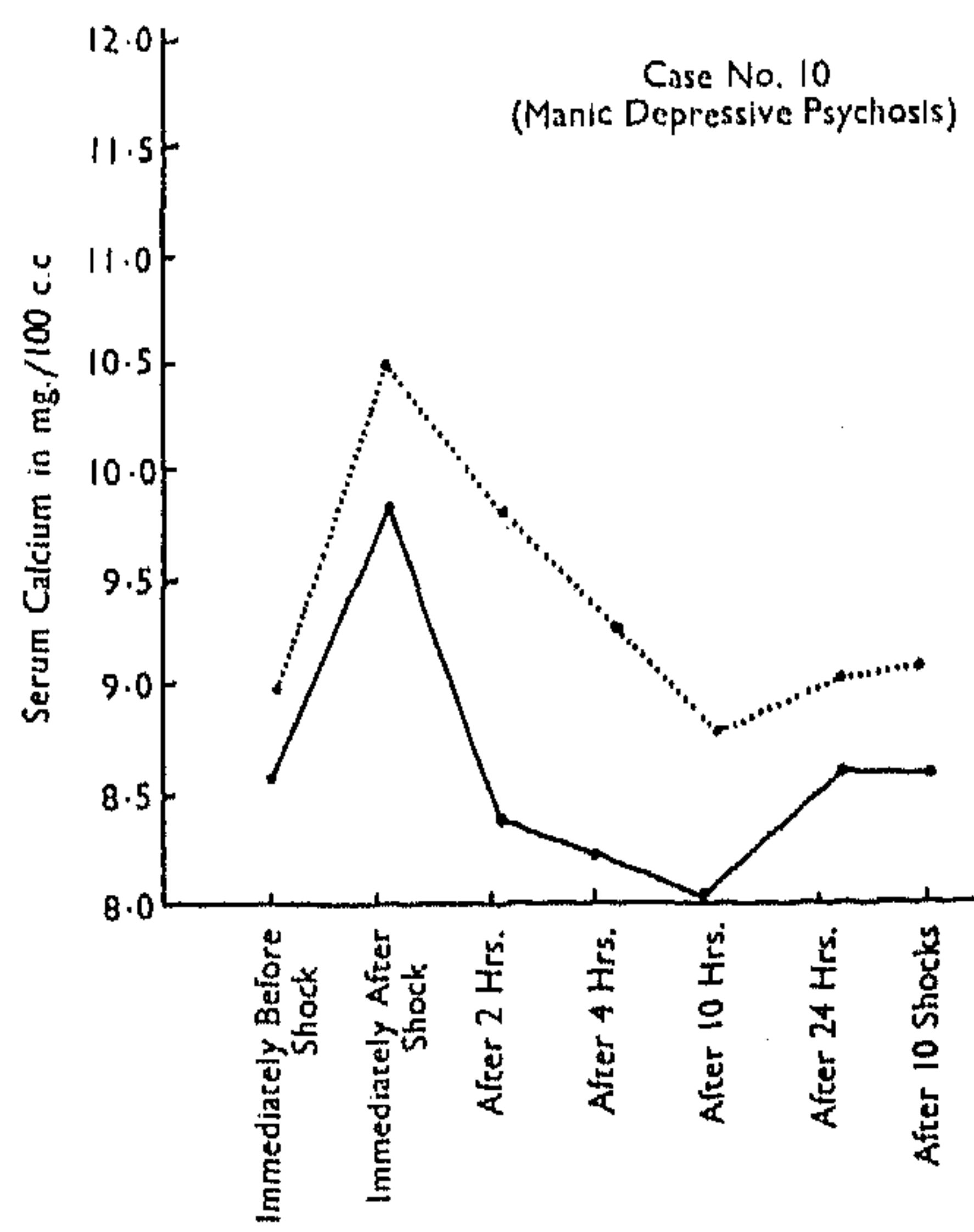
After 24 hours, it was noticed that there was a rise in the serum-calcium level from that observed at 10 hours after E.C.T. except in one case where there was a further fall. As compared with the initial level, there was a slight decrease in the serum-calcium level in 2 cases while in others it was at the same level as the initial one. The deviation was up to -0.2 mg. per cent.

After 10 shocks, the deviation from the initial level varied from +0.1 to +0.2 mg. per cent.

Melancholic group (see Graphs 14 and 15).

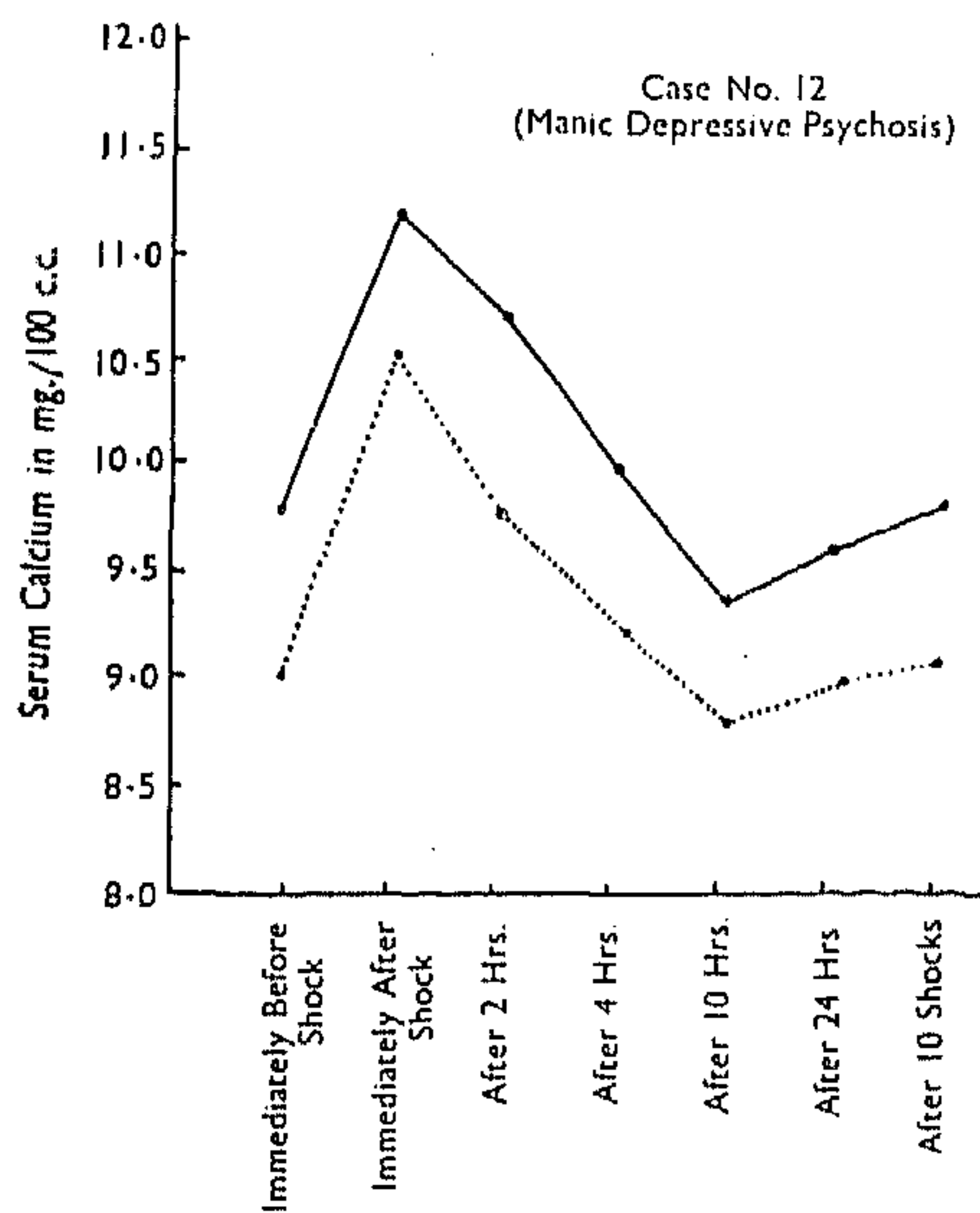


GRAPH 9

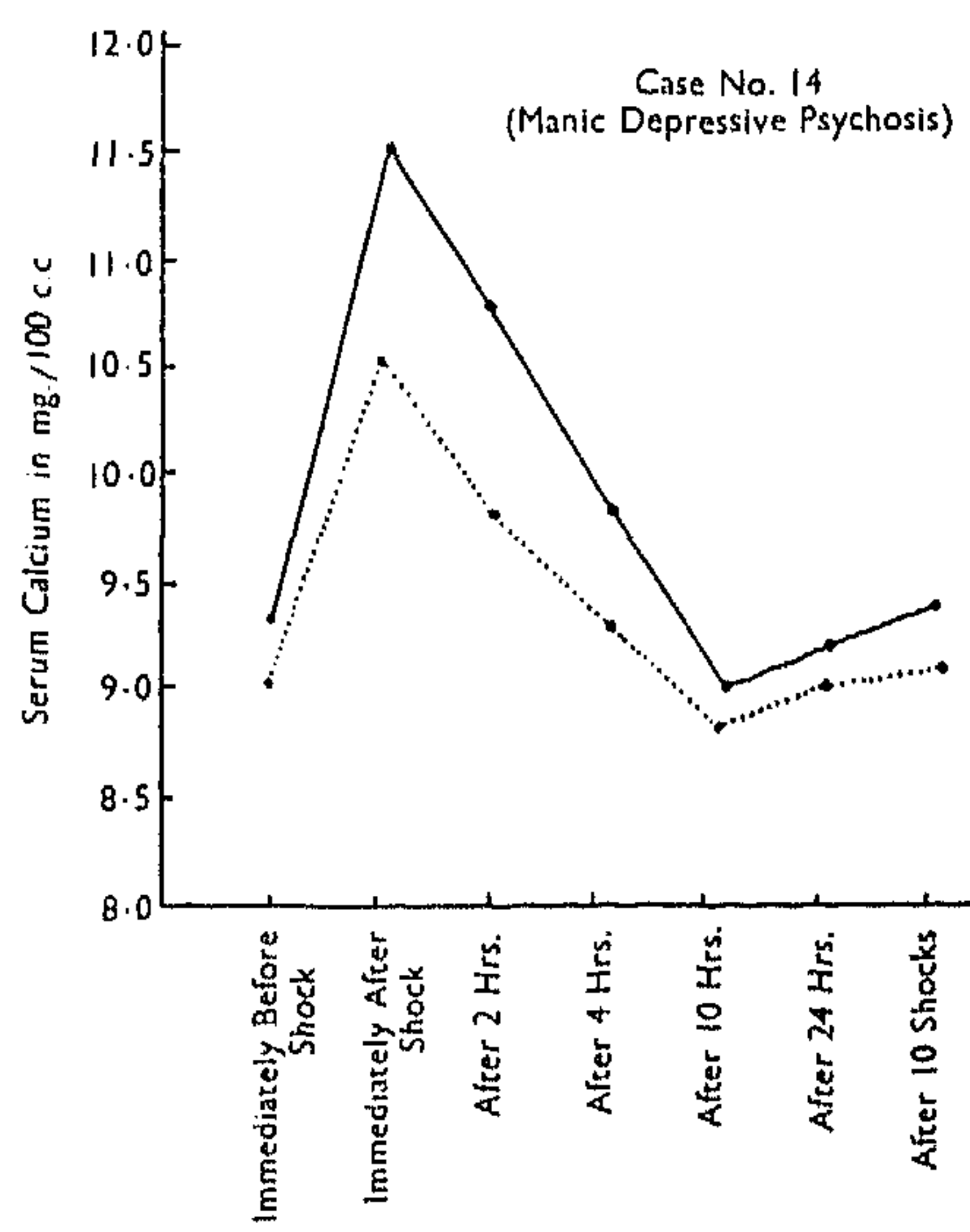


GRAPH 10

Immediately after E.C.T. there was a rise in the serum-calcium level in all the cases. The deviation from the initial level varied from +1.8 to +2.3 mg. per cent.



GRAPH 11



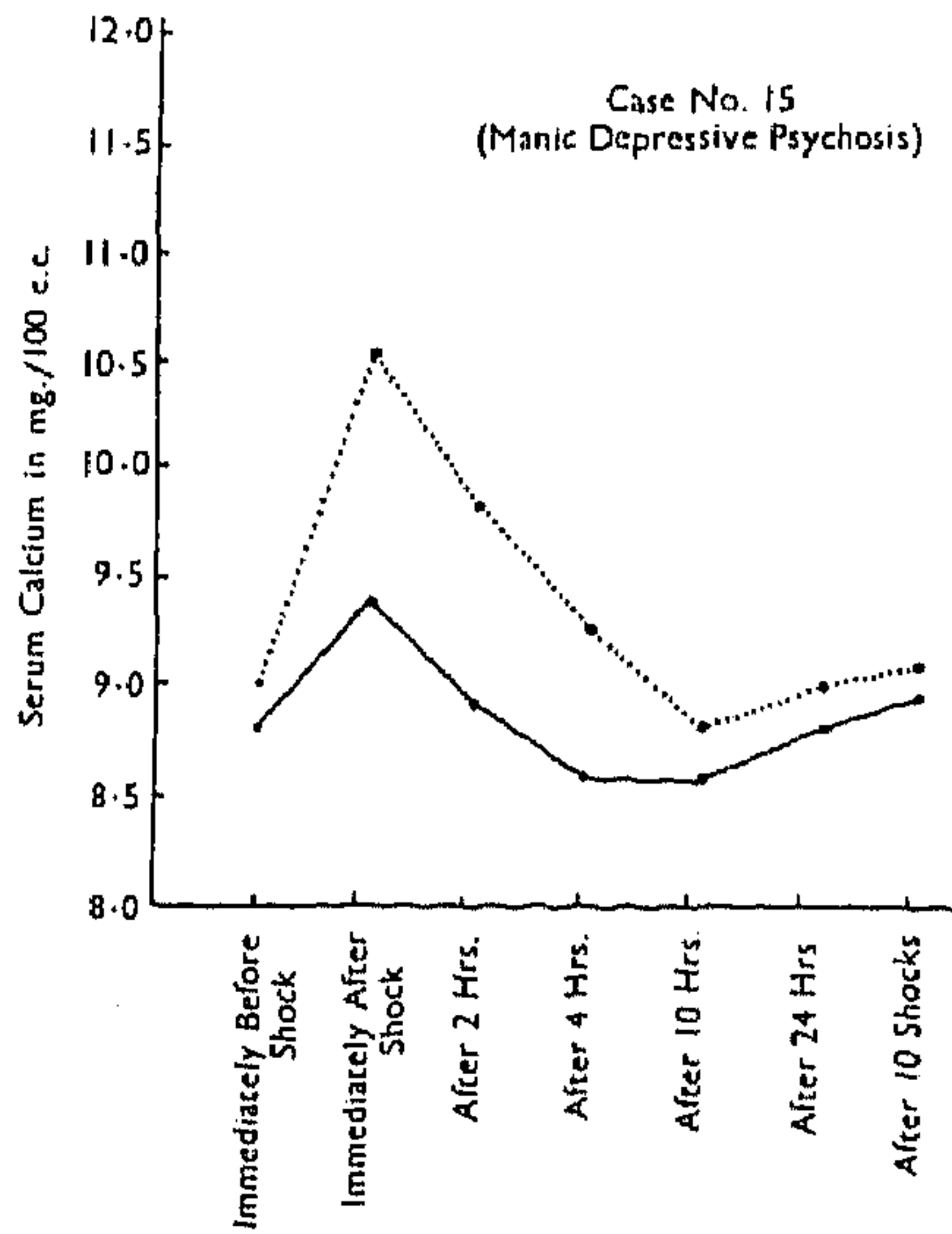
GRAPH 12

Two hours after the shock, there was a decline but the serum-calcium level was higher than the initial. The deviation from the initial level noticed was from +1.0 to +1.6 mg. per cent.

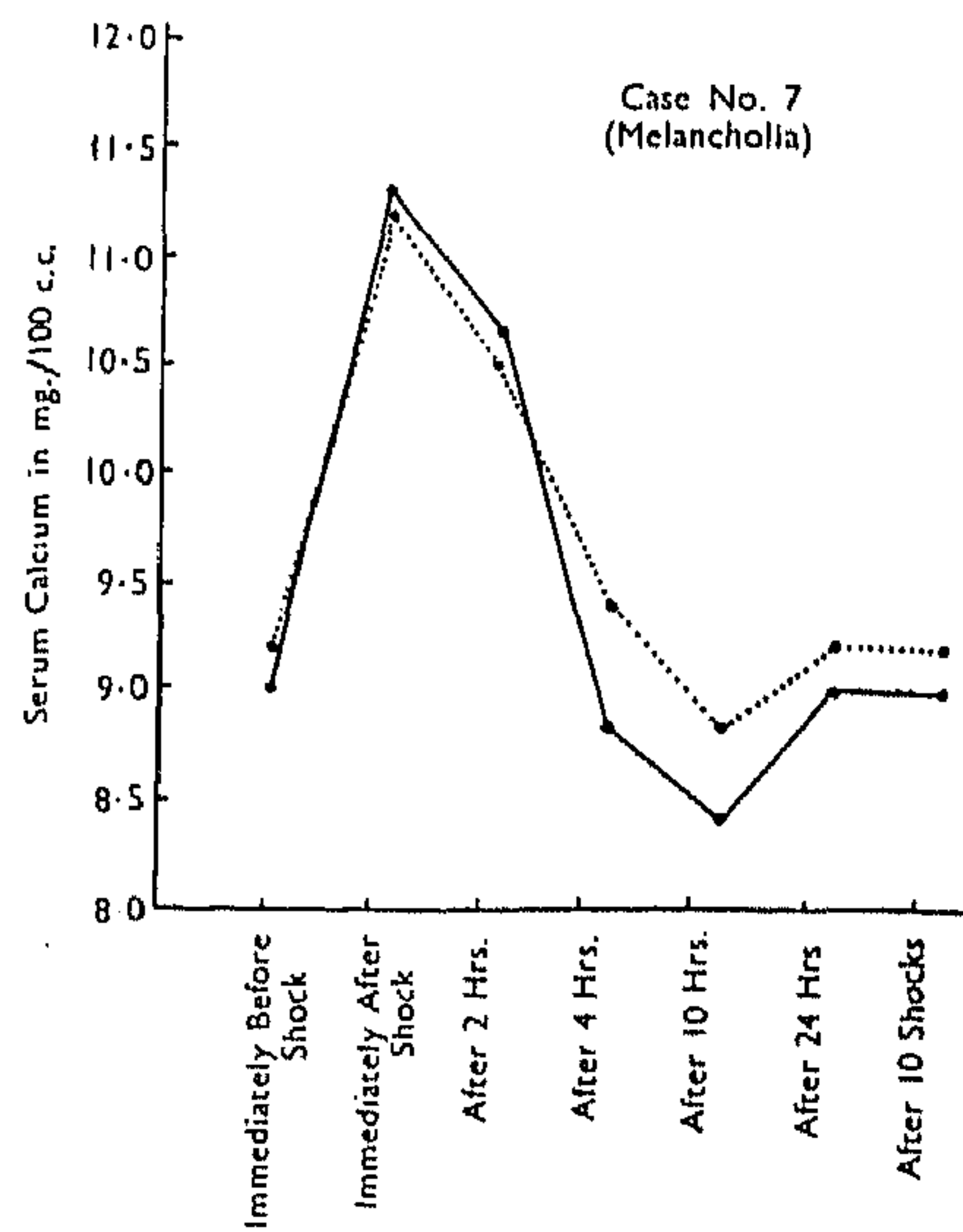
After 4 hours of E.C.T. although the serum-calcium level was lower than that observed at 2 hours, it was higher than the initial level in one case and lower



in one case. The deviation from the initial level ranged from  $-0.2$  to  $+0.6$  mg. per cent.



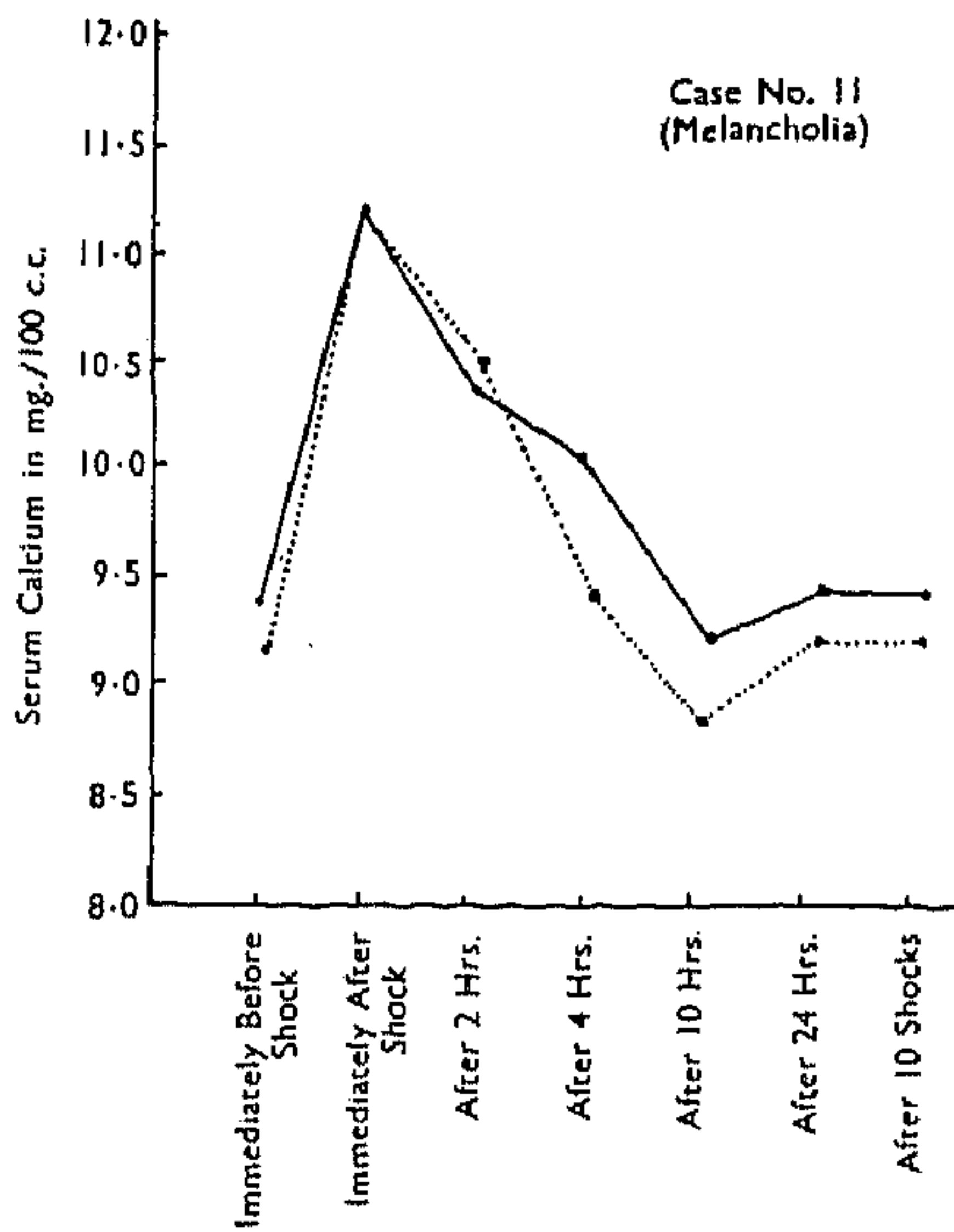
GRAPH 13



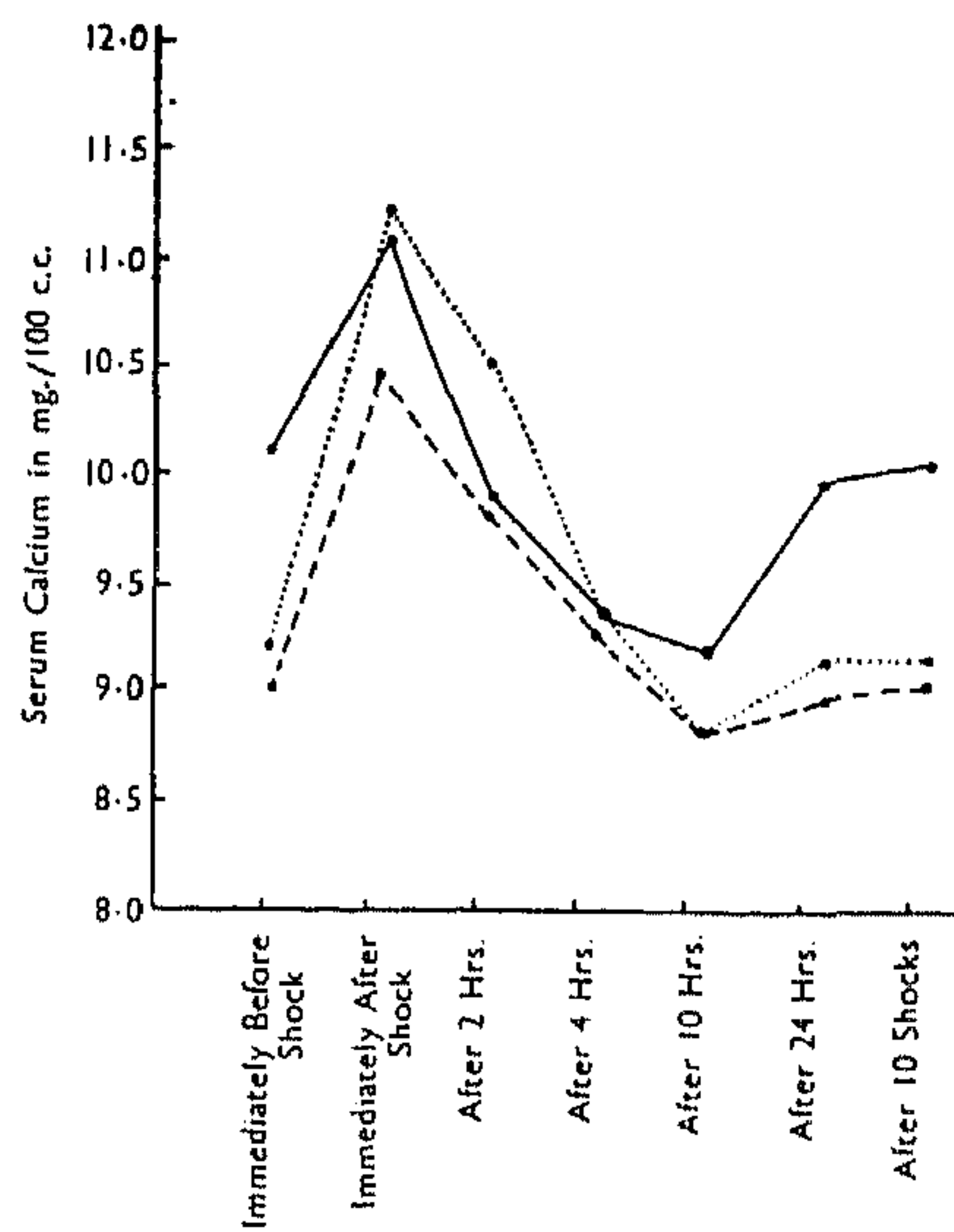
GRAPH 14

The fall was maximum at 10 hours in all the cases. The values at this time were  $-0.2$  to  $-0.6$  mg. per cent. below the initial level.

The fluctuation in the serum-calcium level that occurred between the highest rise and the lowest fall varied from  $2.0$  to  $2.9$  mg. per cent.



GRAPH 15



GRAPH 16

..... Average cover in Melancholia  
 — Average cover in Schizophrenia  
 - - - Average cover in Manic Depressive Psychosis

After 10 hours there was a rise in the serum-calcium level till 24 hours when it reached the initial level.

After 10 E.C.T. the serum-calcium level was the same as the initial one.

#### RESULTS

From a comparison of the changes observed in the serum-calcium level during E.C.T. in the three groups of cases (see Graph 16) we find that:

1. The average initial level of calcium in the Melancholic and Manic Depressive Psychosis groups was almost the same, but that in the Schizophrenic group was slightly higher although all of them were within normal limits.

2. The average rise in serum-calcium level that occurred immediately after the shock was maximum in the Melancholic, then in the Manic Depressive Psychosis, and least in Schizophrenic group. This more or less correlated with the improvement that the patients showed as a result of E.C.T. For example, in Cases Nos. 3, 7, 11 and 24 where the rise averaged 2.05 mg. per cent., the patients had shown very marked improvement as compared to Cases Nos. 2, 4, 6, 9, 10, 13 and 15 where the average rise had been 1.1 mg. per cent. and who showed little or no improvement.

3. The maximum fall, which occurred 10 hours after shock from the peak rise was greatest in the Melancholic group, next in the Manic Depressive Psychosis group and least in the Schizophrenic group. This also more or less correlated with the improvement as observed clinically. For example, in Cases Nos. 7, 11, 12 and 14 who showed the greatest improvement, the average fall was by 2.3 mg. per cent., whereas in Cases Nos. 9, 10, 13 and 15 where the average fall was by 1.4 mg. per cent., the improvement was negligible.

#### DISCUSSION

From the study of 30 normal healthy individuals and the values obtained in the mental patients before shock therapy, it was observed that the serum-calcium level in the latter differed in no way from those of the former (see Table VII).

The various mental disorders from which the patients were suffering were Schizophrenia, Manic Depressive Psychosis and Melancholia. There was no difference observed in the serum-calcium levels of patients of these disorders. Probably the mental disorders do not produce any significant changes in the blood-calcium level or they are so minute that with the common techniques employed they are not detectable.

A study of calcium metabolism during E.C.T. reveals that E.C.T. leads to an immediate hypercalcaemia but after 2-4 hours, there is a decline, the maximum decrease being after 10 hours of the E.C.T. By the next day, the levels reach practically the initial levels.

In a previous study on "Biochemical and Haematological changes during E.C.T." (2) done in this department, it was observed that E.C.T. probably acts as a stress agent which sets forth the changes which Selye described as "Stress response" of the General Adaptation Syndrome. Thus E.C.T. stimulates the anterior pituitary which secretes A.C.T.H. and this in turn acts on the bone-marrow and calcium is mobilized from there. This leads to an increase in the serum-calcium levels as observed in our studies also. As the levels of serum calcium regain initial levels within 24 hours, it is believed that E.C.T. acts as a brief stress only.

One very interesting finding in our study was that although the pattern of response to E.C.T. was the same in all the cases, the degree and the extent

of fluctuations in the serum-calcium level varied in different cases. Thus, the average rise in serum-calcium level that occurred immediately after the shock was maximum in the Melancholic group, then in Manic Depressive Psychosis group, and least in the Schizophrenic group. This more or less correlated with the clinical improvement noticed as a result of E.C.T. For example, in Cases Nos. 3, 7, 11 and 14 where the rise in serum-calcium level averaged 2.05 mg. per cent., the patients had shown very marked improvement as compared to Cases Nos. 2, 4, 6, 9, 10, 13 and 15 where the average rise had been by 1.1 mg. per cent., and who showed little or no improvement.

Again, the maximum fall which occurred at 10 hours after E.C.T. from the peak rise (observed immediately after shock) was greatest in the Melancholic group, next in Manic Depressive Psychosis group and least in Schizophrenic group. This is also more or less correlated with the clinical improvement. For example, in Cases Nos. 7, 11, 12 and 14 who showed the greatest improvement, the average fall was by 2.3 mg. per cent., whereas in Cases Nos. 9, 10, 13 and 15 where the average fall was by 1.4 mg. per cent. the improvement was negligible.

This leads us to a very important conclusion which may be of immense value in assessing whether a particular patient who is undergoing E.C.T. is likely to improve with it or not. Thus, if we study the range of fluctuations in the serum-calcium level during the first 2 or 3 shocks and compare it with a "minimal standard fluctuation curve", we might be able to assess whether this particular patient is going to improve with E.C.T. or not, and thus save him from unnecessarily risking the hazards of this drastic procedure.

#### CONCLUSIONS

Immediately after E.C.T. a transient hypercalcaemia occurs. This rise in serum-calcium level is followed by a gradual fall and values even less than the initial level occur at 10 hours after the E.C.T. Multiple shocks do not lead to any significant change in the serum-calcium level. This pattern of response to E.C.T. is seen in all the cases but varies in the degree of fluctuation in different cases. It was observed that the degree of fluctuations was more in cases who showed marked clinical improvement and less in those who showed little or no improvement.

It has been tentatively suggested that by studying the pattern of response to E.C.T. during the first 2 or 3 shocks and comparing it with a "Minimal Standard Fluctuation Curve", it may be possible to assess whether that particular patient is likely to improve with E.C.T. or not and thus be saved from the hazards of such a drastic procedure.

#### SUMMARY

The study was undertaken with a view to study the changes in the calcium metabolism during E.C.T. in certain mental diseases.

No literature was available on the subject. The material selected and the technique employed for calcium estimation has been mentioned.

A study was undertaken in 20 normal cases to find the average normal values for serum calcium. Fifteen cases suffering from various mental disorders, who were given E.C.T. at the Mental Hospital, Agra, were selected for this study. Serum-calcium levels were estimated immediately before and immediately after E.C.T., 2 hours after, 4 hours after, 10 hours after and 24 hours after the initial E.C.T. and finally 2 days after the 10th E.C.T.

It was observed that E.C.T. leads immediately to hypercalcaemia, followed by a relative hypocalcaemia after 2-4 hours and a return to the initial levels 24 hours after the shock.

The possibility of avoiding the risks of the drastic procedure like E.C.T. in a patient, by studying the degree of fluctuation in the serum-calcium levels during the first 2 or 3 shocks and comparing it with a minimal standard fluctuation curve, has been suggested.

## ACKNOWLEDGMENTS

We are highly indebted to Dr. R. S. Lal, Superintendent, Mental Hospital, Agra, for permitting us to carry on this work on his patients. We are thankful to Dr. M. G. Chakravarti, Reader in Biochemistry, for permission to do the calcium estimations in his laboratory. And last, but not the least, we feel obliged to Dr. H. N. Bhatt, Principal and Superintendent, S.N. Medical College and Hospital, Agra, for permitting us to publish this work.

## REFERENCES

1. HARRISON, G. A., *Chemical Methods in Clinical Medicine*. 2nd edition, reprinted 1943. J. & A. Churchill, Ltd., London.
2. GOUR, K. N., and BHARGAVA, S. P. Unpublished data.