C O N T E N T S.

A P P E N D I X.

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INTRODUCTION.

While the part played by stress in the aetiology of mental illness has long been recognised, increasing interest is being taken at present on its importance as a causal factor. There are perhaps two main reasons for this. Firstly the abnormal stresses inflicted on humanity during World War II presented investigators with abundant clinical material. Secondly, the work of Hans Seyle and others in relating stress to physical illnesses has naturally acted as a catalyst to psychiatric research, particularly the physiological aspect of mental disease. The autonomic nervous system has received special attention, being recognised as a connecting link between psychic activity and visceral function. As a result the literature to-day includes many publications on the autonomic responses to stress in the psychoses and the psychoneuroses. Schizophrenia appears to have received most attention, no doubt because physiological abnormalities have been observed in this illness particularly. Vasomotor regulation is a common method of study, but a review of the literature for the past twenty years reveals a marked inconsistency in the findings of those who have by this means investigated autonomic function in mental illness.

Kanner (1) in a study of 34 cases of dementia praecox and 9 cases of manic-depressive psychosis described two types of blood-pressure response to the intramuscular injection of adrenaline:- (a) a typical sympathicotonic curve yielded by the cases of manic excitement and depressive agitation,

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and (b) a typical vagotonic curve yielded by all the cases of dementia praecox and cases of stuporous melancholia. He stated that the degree of vagotonia as pictured by the curves did not depend upon the 'types' of dementia praecox, but upon the degree of emotional indifference. Freeman & Carmichael (2) observed that no characteristic syndrome of autonomic inbalance was found in Schizophrenia, although there was a diminished response to adrenaline in psychotics. In an earlier publication Freeman, Hoskins & Sleeper (3) had suggested that the response to adrenaline was less in schizophrenics than in normals, but that the individual variation was such that the reliability of this suggestion was open to doubt. Myerson, Loman & Dameshek (4), noting the blood pressure responses to cholinergic drugs in 18 cases of Schizophrenia of various types, found that the reactions were essentially similar to those observed in non-psychotics. Kraines & Sherman (5) believed that the differences in response between normals and psychoneurotics were not statistically reliable. Olkon (6) stated that observations on 1,047 Schizophrenics and 1,058 normals indicate the presence in the former of capillary inadequacy and disharmony and that the degree of derangement varies with the severity of the illness. Gellhorn (7), who has made many noteworthy contributions on the physiology of the autonomic nervous system appears to have been rather undecided on the question. Following investigations on schizophrenics treated with insulin, he concluded that the whole autonomic system is hyperexcitable, and that the preponderance of

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sympathetic or parasympathetic activity at any time depended upon the momentary changes in the patient's environment. In the same year (8) he stated that schizophrenia involves hypofunction of the sympathetic nervous system, and improvement or cure may be brought about by suitable and sufficient stimulation of sympathetic centres. Some years later, experimenting on the injection into rats of the blood of emotionally excited normals and psychotics, Gellhorn (9) concluded that the balance of the autonomic centre in psychotics under stress is shifted towards the vagoinsulin side, whereas in normals under the same conditions the sympathetico-adrenal system greatly predominates. Parker (10) agreed with Gellhorn's first conclusion and suggested that this might explain the diversity of views arising from the conflicting results of other workers. About the same time, however, Dynes & Tod (11) in a publication of their results on the responses of 10 schizophrenics and 6 controls to adrenaline and 'Doryl', showed that the peripheral action of the latter drug was slightly greater in the psychotics. Although they did not mention the fact their graphs suggest that the controls showed a greater response to adrenaline. Gold (12), noting the responses in cases of Schizophrenia to parasympathetic stimulation before and after insulin therapy, argued that in this illness sympathetic activity is decreased. In a more recent publication, Rowntree, Levin & Wilson (13) observed that schizophrenics, in marked contrast to manic depressives, (and in a lesser degree to normals), showed a remarkable tolerance to

"D.F.P." (diisopropylfluorophosphonate), a compound similar in action to acetylcholine. On the other hand Funkenstein et al. (14) in a comprehensive psychophysiological study of mentally ill patients, together with controls, and employing both adrenergic and cholinergic drugs, classified 7 different groups according to the pattern of the blood-pressure responses. They found that acute cases of schizophrenia can fall into any group, while chronic schizophrenics fall into 3 groups, some giving a response similar to the controls. Finally, in a recent study of blood pressure in psychiatric patients under stress, Malmo & Shagass (15) found that the chronic schizophrenic group resembled controls in their systolic blood-pressure responses. They remark that this finding is inconsistent with the view that schizophrenic patients are abnormally sluggish under stress.

These conflicting results are rather unsatisfactory, and it would appear that in this line of investigation little progress has been made since Kanner's work in 1928. Nevertheless, lack of agreement on any subject is an incentive for further study, and thus a stimulus was provided for the present work.

Furthermore it has long been accepted that mental stress is the most important factor in the causation of mental illness. But why one individual should show a schizophrenic reaction, another an anxiety reaction, another a depressive reaction and so on we do not know. Nevertheless, with the rapid advances made in neuroanatomy, neurophysiology, and neurosurgery etc., a stage of discernment is being reached which, in Seyle's words (16a) - "fills

"us with the insatiable desire to see more". It was with these thoughts in mind that this work proceeded.

It was decided to select patients suffering from the various common types of mental disorder and measure each individual's vasomotor responses to adrenergic and cholinergic stimulants. By this means each patient's autonomic pattern (based on blood-pressure responses) to a form of controlled stress might be ascertained. Upon these findings the following 3 questions presented themselves:-

(1) In the various types of mental illness were there any similarities in the vasomotor responses of the individuals comprising each group which could be termed as being characteristic of that type of illness?

(2) Could any significant alterations in the responses be correlated with changes in the clinical picture?

(3) If such similarities and relationships did exist what were the possible associated psychophysiological factors?

MECHANISM OF BLOOD-PRESSURE REGULATION.

The tone of the arterioles, which is maintained by the antagonistic action of vasoconstrictor and vasodilator nerve fibres distributed throughout the muscle walls of the vessels, is regulated by vasomotor centres in the spinal cord and medulla. While these centres can be directly influenced by chemical and hormonal action, they are in part subject to control by the hypothalamus. Ranson et al. (17), experimenting on cats, have shown that direct electrical stimulation of cells in the posterior and lateral hypothalamic nuclei causes a rise in blood pressure. Furthermore, by carrying out

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similar experiments on curarized animals they demonstrated that such a rise was not the result of somatic muscular activity. Gellhorn (18) and Masserman (19) have obtained similar results. Keller & Hare (20) demonstrated the presence in the hypothalamus of the centre for the maintenance of body temperature, a mechanism in which the tone of the blood vessels is all important.

A similar relationship holds between the cerebral cortex and the vasomotor centres. Hoff & Green (21) obtained a rise in blood pressure following electrical stimulation of areas 4 and 6 in lightly anaesthetised animals, showing at the same time that these responses were purely cortical in origin. They also observed that closely adjacent to these pressor areas were more discrete points which on stimulation produced a fall in blood pressure. Delgado & Livingston (22) obtained certain blood pressure responses following electrical stimulation of the orbital surface of the frontal lobe in dogs and monkeys, while Ward (23) and Kremer (24) reported similar changes after stimulation of area 24 (cingular gyrus). Christiansen, Fog & Vangaard (25), in a study of the finger temperatures of normals and of patients with cortical lesions, demonstrated a cortical control of vasomotor centres in man.

It may be presumed, therefore, that the medullary vasomotor centres, while 'enjoying' a certain measure of autonomy, are subservient to the desires of (a) the hypothalamus, and (b) the cerebral cortex. The exact functional relationship of these three centres is not fully known but it can reasonably be

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suggested with the support of Fulton's 'levels of function' (26a), that the hypothalamus, in the regulation of blood-pressure, does when necessary influence the medullary centres, but in turn is itself subject to cortical control, again only when essential to the welfare of the individual. To quote 'Ward & McCulloch (27) - "Cortical regions of autonomic representation project through the more rudimentary centres of the hypothalamus and medulla and represent a level of higher control", or as Fulton states (26b) - "there can be no doubt..... that the autonomic system is under domination from the cortical level".

MATERIAL.

One hundred patients, all of them admitted to Hospital either on a Voluntary or Certified status, were subjected to the tests. In the selection of the cases the following points were borne in mind:-

(1) That there should be an adequate representation of the various common types of mental illness. It was realised at the outset that the test precluded (a) those patients suffering from an acute excited condition and (b) the severely agitated depressive and anxiety states - it is naturally impossible for such subjects to offer the necessary cooperation.

(2) That each case should be fairly typical of the illness. To this end all the patients were independently 'vetted' by three psychiatrists of experience, while in addition the cooperation of the nursing staff in noting day to day

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behaviour was sought and enthusiastically given. In the assessment of a patient's mental state the observations of experienced trained nurses were considered to be of great value.

Ages ranged from 19 to 60 years and all were free from any obvious physical disease, particular attention being paid to the cardiovascular system.

Diagnostic criteria.

(1) Schizophrenic states.

All members of this group showed the typical signs and symptoms of the illness and no attempt to classify them into the various sub-divisions was made. In each case, however, either emotional apathy or emotional incongruity was a prominent feature.

(2) Affective states.

(a) Manic.

As stated above it was found impracticable to carry out the tests on restless overactive patients. No special grading was used to denote the severity of the symptoms; each individual was definitely euphoric, yet sufficiently controlled to be cooperative.

(b) Depressive.

The difficulty of classification here was immediately appreciated, but it was felt that for the purpose of this work the type of depression, about which there has been so much recent controversy (Partridge - (28a) was of less importance than

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the degree of affective change. Accordingly it was decided that the most useful classification was that suggested by Henderson & Gillespie (29a), viz., -

(1) Simple depression.

(11) Acute depression, and

(111) Depressive stupor,

each person being graded according to the prominence of the triad of symptoms common to these three grades - difficulty in thinking, depression, and psychomotor retardation.

(3) Paranoid states.

The individuals selected here, apart from their prominent delusions, were otherwise well integrated and showed no obvious schizoid traits.

(4) Agitated melancholic states.

All in this group were obviously depressed, harboured delusions either of a nihilistic or self-abnegatory nature, and showed hyperkinesia. Again, however, one had to exclude those who were too restless to be cooperative.

(5) The Psychoneuroses.

It is generally accepted that there is no clear-cut division between the psychoneuroses and the psychoses. While there are wide differences between a classical manic-depressive psychosis and an allegedly typical neurosis "to say that black differs from white does not imply a denial of the possibility of a wide band of grey in between" (Sargent & Slater) (30). Henderson & Gillespie (29b) state that transitions occur

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and that a patient may react psychoneurotically at one time and in a psychotic manner at another. Tredgold (31) reports his experiences of neurotic patients becoming psychotic and vice versa. Again, there is no complete agreement on the various divisions of the psychoneuroses, partly, as Ross (32) states, because the patient's individuality blurs the picture and all sorts of cross currents are provided thereby. Nevertheless, in the present work these difficulties were lessened by the fact that the patients could be selected, and thus any case in which the diagnosis was questionable was not considered.

Most psychiatrists agree on the three broad sub-divisions of the neuroses; Anxiety states, Hysterical states, and Obsessional states. The large number of 'mixed types' which occur is responsible for the difficulties in further subdivision, resulting in the use of vague terms such as - Neurasthenia, Anxiety hysteria, Organ neuroses, etc. Fully developed straight-forward obsessional and hysterical states offer few difficulties in diagnosis.

(a) Anxiety states.

The symptoms here are so polymorph and the intensity of anxiety so variable that one was forced to consider further diagnostic criteria. To this end use was made of Cameron's Patterns of Anxiety. Cameron (33) subdivides anxiety states into 6 different tables of pattern according to the predominating signs and symptoms, viz.,

(i) Simple increase in tension (tremor, increased tendon reflexes).

(ii) Simple derivatives (fatigue, aching, head pressure, head constriction).

(iii) Complex derivatives (facial tics, blurring of vision, stuttering, clicking in the ears, teeth grinding).

(iv) Cardiovascular derivatives (precordial pain, palpitation, flushing, rapid pulse, hypertension).

(v) Gastrointestinal derivatives (nausea, epigastric sensations, weight loss).

(vi) Higher level complaints (apprehension, irritability, feelings of unreality, fears - "losing my mind", "dying", "brain disease", etc.).

All the patients in this group fitted into one or other of these patterns.

(b) Hysterical states.

These patients showed the two characteristic features of hysteria:-

(1) A physical manifestation without structural lesion.

(11) Absence of any manifest mental anxiety.

(c) Obsessional states.

This small group consisted of patients who showed what Hunt (34) terms 'anankastic' reactions in the form of either obsessional thoughts, phobias, or compulsions.

For control purposes 10 healthy male members of the hospital staff with no family or personal history of mental disorder agreed to undergo the test.

TEST METHOD.

All patients were subjected to the test at approximately the same hour of the day - 3 o'clock to 4 p.m., (i.e. $2\frac{1}{2}$ to $3\frac{1}{2}$ hours after the mid-day meal). In addition no patient had had any form of sedative during the previous 24 hours. They were put to bed in quiet surroundings, under observation, at least one hour before the resting blood-pressure was recorded. For all readings an ordinary Beaumanometer with an arm band was used, the mercury level being checked before each test. The resting blood-pressure was estimated 5 times at minute intervals in order to eliminate any degree of hypertension due to 'nerves' associated with the procedure. In most cases the last two readings were approximately similar, and in those cases where the difference in the final two readings was greater than 5 mms., the mean level of these was used. The patient was given an intravenous injection of $\frac{1}{2}$ c.c. sterile normal saline, an antecubital vein being the site of injection in each case. In this way the patients were 'conditioned' to intravenous injection. Blood-pressure readings were then made at 30-second intervals (timed by stop watch) for $2\frac{1}{2}$ minutes. Then followed a similar injection of $\frac{1}{2}$ c.c. of a sterile solution of 1/10,000 adrenaline hydrochloride. Readings were made at 15-second intervals for 2 minutes, at 30-second intervals for a further 4 minutes, and thereafter at minute intervals until the blood-pressure had definitely returned to resting level. Normally after intravenous injection of

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adrenaline the increase in blood-pressure reaches its maximum within the first 1 - 2 minutes, and readings at intervals greater than 15 seconds during this period would increase the possibility of the highest level being missed. The effects of the adrenaline normally disappear before the end of the 8th minute. In those cases where the blood-pressure had not returned to resting level within 10 minutes following injection two final readings at minute intervals were recorded.

On the following day the patient was again put to bed at the same hour and the resting blood-pressure recorded as before. An intramuscular (upper arm) injection of $\frac{1}{2}$ c.c. Amechol (acetylcholine bromide) was then given and blood-pressure readings were made at $\frac{1}{2}$-minute intervals for six minutes and thereafter at minute intervals for a further 18 minutes. In many cases the resting blood-pressure differed slightly from that of the previous day, being a few mms. higher or lower than the first recording. In these cases, in view of the necessity of a single base line for graphic purposes, the second resting blood-pressure reading was taken as being the actual reading plus or minus 'x' ('x' being the difference between the actual reading and the resting blood pressure on the previous day), and all readings made following the Amechol injection were likewise calculated. A syringe containing Atropine sulphate gr. 1/60th was kept at hand to counteract any ill effects or abnormal reactions.

The test was again carried out on the patients following treatment. Each patient was tested on the 7th day

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following the date of termination of treatment. Funkenstein and his colleagues retested their patients on the day immediately following completion of treatment (all by electroshock,) but it was felt that the mild mental confusion which so commonly occurs during and after shock therapy might in some way modify the individual's responses to autonomic stimulation. Again no sedative was given within 24 hours of the test. The responses of each individual were charted in graphic form.

Assessment of Clinical change following treatment.

The degree of clinical change was assessed by the same three psychiatrists, again with the aid of the nursing staff. All patients were kept under close observation throughout the week following termination of treatment. Three grades were established, the patient's condition at assessment being judged 'not improved', 'improved', or 'recovered'.

Method of Estimation and Comparison of Responses.

It was considered that the use of curve shape or outline in comparing the responses was not altogether a logical method. As Fulton (26c) states, "The effects of sympathetic or parasympathetic excitation vary according to the physiological state of the tissue at the time of the experiment". While all these patients were 'stimulated' while the blood pressure was at resting level no measurement could be made of what Woodworth (35a) terms 'the preparatory set' of the individual - in these cases the state of activity of the sympathetic and parasympathetic divisions respectively at the moment of injection of the drugs. Differences

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in this state would result in differences in the maximum blood pressure readings. Further, to quote Fulton again (26d), "a state of reciprocal innervation exists between the action of the sympathetic and the parasympathetic, their effects tending to be antagonistic". Thus it is presumed that the greater the response of one division, and provided that the continuance of such a response is not only unnecessary but harmful to the welfare of the individual, the greater will be the effort of its opponent to counteract the response and enable the body as quickly as possible to resume its state of homeostasis. There are thus two factors to be considered, (a) intensity of response, and (b) duration of response, and these must be considered together. The requirement can be fulfilled by measuring the responses in terms of the area enclosed by each curve, and this has been the method used here. In these cases where the sympathetic curve descends below the base-line, the area enclosed below the line is subtracted from the total area above the line. When the parasympathetic curve ascends above the base level a similar adjustment is made. What was thought to be of great importance was the fact that the sympathetic area is to some extent an indirect measure of the parasympathetic 'pull', and vice-versa. It was therefore considered that a figure might be obtained which would express any preponderance of either division when compared with the so-called normal figure as calculated from the responses of the controls. To this end the term "Autonomic Index" was conceived and is the expression of

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$$\frac{\text{Area of sympathetic curve}}{\text{Area of parasympathetic curve}} \times 100.$$

It was on the basis of curve area and Autonomic Index that similarities were sought and comparisons made.

RESULTS.

As already stated 100 male and female patients suffering from the various types of mental illness were subjected to the test before and after treatment, the latter being one of the following methods - Electroplexy, Electronarcosis, Insulin Coma, Leucotomy, or Psychotherapy. One male patient suffering from a depressive reaction made a rapid spontaneous recovery without receiving any of these forms of therapy.

The types of illness were represented thus:-

Type of illness.	Female.	Male.	Total.
Schizophrenic states.	17	24	41
Manic states.	5	2	7
Depressive states.	8	12	20
Paranoid states.	2	5	7
Agitated melancholics.	4	-	4
Anxiety states.	4	10	14
Hysterical states.	2	1	3
Obsessional states.	2	2	4
Total:	44	56	100

The graphs indicate the individual vasomotor responses before and after treatment. The dotted curve represents the responses to the normal saline injection. The areas enclosed by the sympathetic (red) and parasympathetic (blue) curves were measured by means of a Planimeter and are expressed in hundredths of a square inch.

Table 1 shows the average figures of each group before treatment.

TABLE 1.

Group.	Sympathetic area.	Parasympathetic area.	Autonomic Index.
Schizophrenic states.	49.4	148.7	33.2
Manic states.	92.6	168.6	55.3
Depressive states.	23.5	46.3	50.8
Paranoid states.	63.3	155.6	40.7
Agitated melancholia.	55.8	78.8	70.5
Anxiety states.	79.6	96.0	82.9
Hysterical states.	62.7	118.0	53.1
Obsessional states.	63.5	90.3	70.3
Controls.	60.1 (48-69)	114.7 (98-135)	52.4 (48.2-56.6)

The figures in brackets underneath the average for the controls are the ranges within which the responses of all these ten members fell.

Observations on these results.

It will be noted that there are wide variations between the different groups. For example, in comparison with the controls the average autonomic index of the schizophrenic group is low, while that of the anxiety group is high. Less marked, but on the low side is the paranoid group, while the agitated melancholics and obsessionals show high figures.

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The manic, depressive and hysterical states, however, show average indices fairly close to the figure of the controls.

As the Autonomic Index (hereinafter referred to as A.I.) is the expression of $\frac{\text{Sympathetic area}}{\text{Parasympathetic area}} \times 100$ it follows that in those states in which the average A.I. is below normal there is a parasympathetic preponderance. This may be either the result of a subnormal sympathetic area or a hypernormal parasympathetic area. Similarly, in those states which show an average A.I. greater than normal, there is a sympathetic preponderance arising from either a subnormal parasympathetic area or a hypernormal sympathetic area. Referring again to Table 1, the degree of abnormality of both areas for each group may be roughly expressed thus:-

Group.	Sympathetic area.		Parasympathetic area.	
	Subnormal.	Hypernormal.	Subnormal.	Hypernormal.
Schiz.	+	0	0	++
Manic.	0	+++	0	+++
Dep.	+++	0	+++	0
Par.	0	0	0	+++
Agit.mel.	0	0	++	0
Anx.	0	++	+	0
Hyst.	0	0	0	0
Obs.	0	0	+	0

It will be seen that with the exception of the hysterics all groups show abnormalities of either sympathetic

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or parasympathetic areas, or of both. In the manic and depressive groups both autonomic divisions give abnormal responses - in the former the areas are markedly high, while in the latter the opposite is the case. Furthermore, if the members of the depressive group are divided into the three sub-groups according to the degree of severity of the presenting symptoms, it can be shown that there is a definite relationship between the clinical state and the autonomic responses, viz., that the more severe the depression the greater are the responses reduced. Table 11 illustrates this point:-

TABLE 11.

Depressive states subdivided according to severity of symptoms.	Average Sym. area.	Average Parasym. area.
Sub Group 1 (simple depression)	33.1	65.5
Sub Group 11 (acute depression)	20.0	39.4
Sub Group 111(depressive stupor)	10.5	20.2

It is feasible to suggest that a similar relationship holds for manic states, with increased instead of decreased responses, but as already stated it was impossible to obtain the necessary cooperation in patients of this group with other than mild manic symptoms.

It will also be noted that the responses of the hysterical states (although the numbers are too small for the purpose of validity) show little difference from those of the controls. This would appear to be in agreement with the

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generally accepted view that in this type of illness there is little genuine emotional upset.

Responses after treatment.

Table 111 shows for each group the mean areas of both components together with the mean A.I. The figures for the controls are again included for comparison.

TABLE 111.

Group	Sympathetic area.	Parasympathetic area.	Autonomic Index.
Schizophrenic states.	53.4	146.8	36.4
Manic states.	59.6	108.9	54.5
Depressive states.	55.9	108.2	51.7
Paranoid states.	69.5	155.6	44.7
Agitated melancholia.	49.0	84.8	57.8
Anxiety states.	67.5	111.6	60.5
Hysterical states.	64.3	124.0	51.9
Obsessional states.	58.0	99.3	58.4
Controls.	60.1 (48-69)	114.7 (98-135)	52.4 (48.2-56.6)

The Table shows that the average A.I. of each group, with the exception of the manic, depressive and hysterical states, which are little changed, have 'improved' insofar that they have to varying extents approached the figure for the controls. With regard to the manic and depressive states the significant changes occur in the areas of both divisions. In

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the former there is a marked reduction, while the latter shows a marked increase.

TABLE IV.

Average areas of the manic and depressive groups before and after treatment.

	Before Treatment.			After Treatment.		
	Sym.A.	Parasym.A.	A.I.	Sym.A.	Parasym.A.	A.I.
Manic.	92.6	168.6	55.3	59.6	108.9	54.5
Depressive.	23.5	46.3	50.8	55.9	108.2	51.7

Now these figures are averages for all the cases in each group, irrespective of the mental state following treatment. When the patients are grouped according to the degree of improvement this approach towards 'normality' becomes more significant, as is shown in the following Tables. The figures in brackets are the averages of the same group prior to treatment. -

TABLE V.

Patients considered Not Improved.

Group.	No. of Cases.	Sympathetic area.	Parasympathetic area.	Autonomic Index.
Schiz.	29.	51.2 (46.3)	151.8 (152.7)	33.7 (30.3)
Manic.	0	-	-	-
Dep.	1	21.0 (17.0)	37.0 (29.0)	56.8 (58.6)
Par.	5	70.4 (61.6)	162.2 (146.2)	43.4 (41.7)
Ag.mel.	1	58.0 (49.0)	93.0 (74.0)	62.4 (66.2)
Anx.	0	-	-	-
Hyst.	0	-	-	-
Obs.	3	61.3 (62.3)	98.7 (95.0)	62.1 (65.6)
Controls.		60.1	114.7	52.4

TABLE VI.

Patients considered Improved.

Group.	No. of Cases.	Sympathetic area.	Parasympathetic area.	Autonomic Index.
Schiz.	9	59.8 (45.7)	140.1 (133.3)	42.7 (34.3)
Manic.	2	62.5 (89.5)	115.0 (168.0)	54.3 (53.3)
Dep.	9	57.1 (26.3)	110.1 (52.7)	51.9 (49.9)
Par.	1	59.0 (45.0)	125.0 (136.0)	47.2 (33.1)
Ag.mel.	3	46.0 (58.0)	82.0 (80.3)	56.1 (72.2)
Anx.	10	66.6 (79.2)	106.8 (96.4)	61.9 (82.1)
Hyst.	1	56.0 (50.0)	121.0 (110.0)	46.3 (45.5)
Obs.	0	-	-	-
Controls.		60.1	114.7	52.4

TABLE VII.

Patients considered Recovered.

Group.	No. of Cases.	Sympathetic area.	Parasympathetic area.	Autonomic Index.
Schiz.	3	58.0 (57.0)	121.3 (157.3)	47.8 (35.6)
Manic.	5	58.4 (93.8)	106.4 (168.8)	54.9 (55.6)
Dep.	10	58.2 (21.7)	113.4 (42.2)	51.3 (51.4)
Par.	1	75.0 (90.0)	153.0 (221.0)	49.0 (40.7)
Ag.mel.	0	-	-	-
Anx.	4	69.8 (90.5)	123.0 (120.0)	56.8 (75.4)
Hyst.	2	68.5 (69.0)	125.5 (122.0)	54.6 (56.4)
Obs.	1	48.0 (67.0)	100.0 (76.0)	48.0 (88.2)
Controls.		60.1	114.7	52.4

It will be seen that the responses of those deemed 'Not Improved' show little change following treatment. Perusal of the individual graphs show in some an improved A.I., while in others, chiefly among the schizophrenic group, the figure has become more abnormal.

In the 'Improved' group changes do appear. There are significant rises in the indices of the schizophrenic group and of the one paranoid case, while those of both anxiety and agitated melancholic states have fallen. The manic and depressive groups show respectively decreased and increased areas of both divisions, the indices remaining little changed.

These changes are still more marked in those patients judged to be 'Recovered'. Indeed the average figures of all groups in this category fall within or very near to the normal limits. It must be admitted, of course, that in most of the groups the number of recoveries is small, only one having been recorded in each of the paranoid and obsessional groups, two in the hysterical group, and three in the schizophrenic group, but the results are in keeping with the apparent relationships between the autonomic responses and the clinical changes.

DISCUSSION.

(A) On the results.

Before the significance of the results can be accepted, however, it is necessary to be reassured on two points:- (a) the suitability of the material tested, which in our case means the accuracy of the diagnoses, and (b) the sufficiency of the material tested (i.e., the number of patients) to justify the conclusion. With regard to the diagnoses, an advantage was that the patients were carefully selected and not chosen at random. In addition to the presenting symptoms which, if suggestive of a 'mixed' type of illness, resulted in rejection, age, previous personality and mode of onset were considered important diagnostic factors. No patient in whom the diagnosis was doubtful was selected for the test. The advantage of this method of selection was also felt to apply to the question of numbers. The responses of a smaller number of classical representatives of a certain type of illness are more characteristic of that illness than those of a larger number of lesser similarity. The number of patients in the hysterical and obsessional groups, however, is too small to warrant any definite conclusions. These illnesses in pure form appear to be uncommon in the wards of a mental hospital - many find their way into the psychiatric wards of a general hospital. Nevertheless, those tested are included for the purpose of completion and any relevant observations.

With some degree of reassurance that these two conditions have been fulfilled, the results can now be reviewed in

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comparison with the findings of previous investigators and attempts made to supply answers to the questions which presented themselves at the outset. The groups will be discussed in turn.

(1) Schizophrenic Group.

The 41 patients in this group all showed abnormal responses, the constant feature being a parasympathetic preponderance. When each division of the autonomic system is considered separately, however, it will be seen that conclusions can be misleading. In this series no fewer than 16 of the patients gave a sympathetic response which was within normal limits, while 6 gave a hypernormal response. Thus 22 patients (almost 54%) failed to show a decreased sympathetic response. The areas of the remaining 19 fell below normal. Based on these figures then, the findings might well agree with the observations of those investigators who claimed to find no characteristic abnormality in the responses of schizophrenics to sympathetic stimulation. The wide variations in the shape of the sympathetic curve are such that agreement could also be reached with the conclusion of Funkenstein that these patients can show various patterns of response.

When the parasympathetic responses are considered the abnormalities of the group are perhaps more marked. Only 9 patients had areas within normal limits, 6 were subnormal, and 26 (almost 65%) showed areas greater than normal. Thus, while increased response to cholinergic drugs is not a constant

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feature in persons suffering from schizophrenia, it is a common finding. This is again more or less in agreement with the majority of previous observations made in this field. When the responses of both divisions are considered together, however, a much more assertive statement can be made on this schizophrenic/normal comparison. In every case in the present group a varying degree of parasympathetic preponderance (as measured by the A.I.) was found. Making use of the latter as a basis for comparison, the highest recorded index in the group is 46.7: 14 (34%) showed indices of 40 or over, while the remaining 27 (66%) had indices below that figure. It will be noted that the lowest index among the controls is 48.2:

It would appear, therefore, that the state of the autonomic system cannot be judged from the responses of either of the divisions when considered separately. The conclusion that a case of schizophrenia which gives a normal response to adrenaline shows no autonomic imbalance is misleading. A similar error can be made in a schizophrenic patient responding normally to parasympathetic stimulation. These points are illustrated in the following Table which shows the average indices of the 22 individuals who failed to show a decreased sympathetic response and of the 15 whose parasympathetic areas were within or below normal limits. It will be seen that in each group the A.I. is well below the normal level.

TABLE VIII.

Hypernormal Sympathetic area.	Normal Sympathetic area.	Subnormal Parasympathetic area.	Normal Parasympathetic area.	A.I.
6.	-	-	-	38.5
-	16	-	-	36.4
-	-	6	-	38.9
-	-	-	9	31.7

The conflicting results of the previous investigations on schizophrenia reviewed in the introduction appear to be due to this failure to consider the autonomic system as a whole.

2. Manic Group.

The feature of this group before treatment was the markedly increased responses of both autonomic divisions, with the maintenance of an A.I. within normal limits. Following treatment both areas were proportionately reduced to within normal limits, the A.I. remaining little changed. The fact that despite the abnormalities of these responses in manic and depressive states a fairly normal autonomic balance is maintained may in some way be associated with the more hopeful prognoses in these conditions compared with the other forms of mental illness. Baird (36) suggests that the feeling of well-being associated with mania is due to the fact that although there is a massive over-reaction of the entire autonomic system, both components function equally and thus homeostasis is preserved. Such a suggestion cannot, of course, explain the melancholy etc., associated with states of depression - the magnitude of the

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response must also play an important part in symptomatology.

3. Depressive Group.

As are the clinical signs and symptoms, so are the autonomic responses of this illness exactly opposite to those of mania. This can be illustrated in the case of patient No. 45, admitted in a manic state from which she recovered only to be readmitted three months later suffering from depression. The following Table shows the responses on both occasions.

TABLE IX.

	BEFORE TREATMENT.			AFTER TREATMENT.		
	S.A.	P.A.	A.I.	S.A.	P.A.	A.I.
Manic state. (Case No. 45.)	87.	172.	50.6	58.	120.	48.3
Depr. state. (Case No. 55.)	35.	68.	51.5	65.	130.	50

The figures obtained prior to the patient being discharged on the second occasion (i.e., after recovery from her depressive state) are approaching the upper normal limits and would suggest a swing towards a recurrence of the manic state. When seen at the Outpatient Clinic some four weeks after discharge she was definitely euphoric but sufficiently controlled to remain out of Hospital, It will be seen that this patient's A.I. shows little change on each of the four tests.

4. Agitated Melancholic states.

As will be seen from Table I, these cases show

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a marked sympathetic preponderance resulting from a subnormal parasympathetic response. The average sympathetic response is in the lower range of normal limits.

With reference to these last three groups Kanner stated that the manic and agitated melancholic states were sympathicotonic, while the depressives were vagotonic individuals. Here again the fallacy of basing the conclusions on the responses of one division is brought out; it is presumptuous to assume that a hypernormal sympathetic response is associated with a subnormal parasympathetic response, and vice-versa. In the agitated melancholic group the results appear to be in contradiction to Kanner's observation. Certainly the numbers are too small for the results to be conclusive: suffice to say that no individual figures influence to any extent the mean figures for the group and to reflect that Kanner's three groups of manic, agitated and stuporous melancholic patients totalled 9 in number.

5. Paranoid states.

This group shows the greatest parasympathetic response of all. Nevertheless, as the mean sympathetic area is in the upper-normal range the resulting A.I. is higher than in schizophrenia. Here, however, these findings cannot be considered conclusive, for among the 7 patients comprising the group 4 gave parasympathetic responses which were within normal limits while 2 gave markedly hypernormal responses, thus

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materially influencing the average figure for the group. Nevertheless, when the latter 2 members are omitted the mean A.I. becomes 39.7, which is little different from the figure for the total group, (40.7). The charts following treatment appear to show that improvement is associated with a decreased parasympathetic area.

6. Anxiety states.

It is generally accepted that the physical symptoms of anxiety are really those of fear and are produced by the excessive secretion of adrenaline. One might therefore assume that in these cases the sympathetic division predominates and the results in the present series indeed demonstrate that such an assumption is correct. Not only is the average sympathetic area greater than normal but the average parasympathetic area is slightly below normal. This results in a very high A.I., - the highest among all the groups. Here again any conclusions reached by the consideration of either division alone would be misleading. Six patients (43%) gave a normal response to adrenaline, while a similar number showed normal parasympathetic responses. In the former the parasympathetic area is hyponormal, while in the latter the sympathetic is hypernormal. Although no methodical assessment of the clinical state was made there appeared to be a direct relationship between the severity of the attack and the height of the A.I. Two patients (Nos. 83 and 86), both intensely apprehensive and just able to offer sufficient cooperation for the test to be carried out, had

/indices

indices of 160.1 and 144.3 respectively.

7. Hysterical states.

The three members comprising the group gave responses which were within normal range, but the indices were varied:- 60.3, 52.4, and 45.5 respectively. Thus the illness would appear to be somewhat hybrid in character - independent of either a sympathetic or parasympathetic preponderance. It is also noted that there appears to be little relationship between clinical change and autonomic response. Two of the patients improved and one recovered, yet in the three cases little difference is seen between the figures before and after treatment. As far as hysteria is concerned mental symptoms do not appear to show any definite relationship with autonomic abnormality. Jones (37) measuring the pulse responses of neurotic patients to stress in the form of standard physical work found no significant differences between hysterics and normal controls.

8. Obsessional states.

Again in this group it would be unwise to reach conclusions other than of a very tentative nature. It would appear, however, that the abnormality is one of decreased parasympathetic response resulting in a high A.I., a pattern similar to, but less marked than the agitated melancholic group. Little added information can be obtained from the responses following treatment. Two of the three 'Not Improved' cases show indices little changed, while the third gives what appears to be a much

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improved index. The fourth in the group (No. 98), judged to be 'Recovered', shows a change of index from 88.2 prior to treatment, to 48.0 following treatment. Incidentally this patient, while obviously displaying marked obsessional traits, was also tense and apprehensive. At first she was not considered to be an ideal case, but as she was to be treated by prefrontal leucotomy it was decided to include her in this group. The interruption of the cortico-thalamic (? cortico-hypothalamic) fibres may markedly alter the autonomic pattern, thus offering an explanation for the marked change in the A.I.. Reitman (38), and Rinkel (39), although their findings are somewhat at variance, both observed that the responses to autonomic stimulation after leucotomy are altered. The only other case in this series treated by prefrontal leucotomy, Case No. 3, showed following operation markedly decreased responses to both drugs, but without great alteration in the A.I. The relief from tension which our obsessional patient experienced after operation would at any rate suggest that the sympathetic division was no longer predominant.

Parasympathetic 'chill'.

A common feature among the patients tested by Funkenstein and his colleagues was the occurrence of what they termed a 'chill' following the injection of Mecholyl. This chill occurred at varying intervals after the injection, when the patient began to shiver and complained of feeling cold. These workers considered this sign to be of importance in relation to treatment and prognosis. In the present work only one patient, an anxiety

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state, gave such a response. Four minutes following the injection of Amechol he began to shiver and to experience discomfort in the form of dyspnoea and, as he stated, "felt shaky and weak". During this period his systolic blood-pressure fell rapidly to 60 mms. Hg., when he was given an intravenous injection of atrophine sulphate and the test discontinued. Twenty minutes following the atropine injection his blood-pressure had returned to normal resting level. He left hospital before his treatment was completed and could not therefore be included in the series.

It is difficult to explain the frequent occurrence of this 'chill' in one series of cases and its almost complete absence in another. Although different brands of drug were used the amount of acetyl-choline in each was relatively the same.

(B) On the possible psychophysiological factors involved.

From these results it is now possible to supply answers to the first two of the three questions which formed the basis of the present work.

(1) It can be stated that with the exception of the hysterical states (and bearing in mind the relatively few numbers in the agitated melancholic and obsessional groups), the various types of mental illnesses, measured by the vasomotor changes, show autonomic responses characteristic of each type, but only when both divisions of the autonomic system are considered together.

(2) A definite relationship exists between clinical

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changes and the changes in autonomic response. It would appear that the more severe the symptoms the greater are the abnormalities of the responses when compared with the controls.

These affirmative answers, therefore, give rise to question 3, viz., the possible psychophysiological factors.

If the recoveries are considered together, we see a group of 26 people, all apparently normal in thought and action, and all with autonomic responses which fall within normal limits. But it is also seen that the responses of some members of the group lie in the upper normal range and those of others in the lower normal range. Furthermore, it is found that the responses of each individual 'lean' towards the average figures associated with the type of illness from which he or she had previously suffered. For example, the indices of the recovered anxiety states are high, while those of the recovered schizophrenic and paranoid states are respectively low. As will be seen, the recovered obsessional proves an exception - comment has already been made on this case. Thus among this group some show a sympathetic preponderance, some a parasympathetic preponderance, others a subnormal response by both divisions, and so on, but all within normal limits. Now if we examine the charts of the controls we find similar variations of response. For example, one of the members (Case No.CIII) shows responses similar to those of the recovered schizophrenics, while Nos. C.II, and C.VIII, give a manic type of response. No. C.VI, shows a fairly definite sympathetic preponderance similar to that of a recovered anxiety

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state, while No. C.IX might be classed as depressive.

Reviewing the charts of all these 36 individuals then, one can postulate the existence of what might be termed 'autonomic types', and that each 'type' has some affinity to a particular form of mental disorder. It is immediately realised, of course, that the number of controls is very small and that when the recoveries are classed as 'normals' we are referring to individuals who have recently suffered from mental illness. Any conclusions therefore must be to some extent speculative. Nevertheless, as Partridge (28b) truly remarks - "The advancement of science has been due to the formulation of postulates which have later been corrected as the development of knowledge has proved them wrong". Moreover, the idea of individual differences appears to have been indirectly suggested by Wenger (40) who, measuring the autonomic responses in a group of 87 children, argues that the range and variability in autonomic scores is genetically determined. If we look upon mental illness as an abnormality of behaviour (the latter used in the broad sense of mental and physical activity) then our conception is further supported by Funkenstein's assertion that "a predisposition to act in a given way is dependent.....upon specific autonomic capabilities". In other words, there is an association between autonomic pattern and behaviour. How can such an association be explained?.

Physiological considerations.

The presence of abnormal emotional responses in /mental

mental disorder is too well recognised to warrant further comment. It is also universally agreed that emotion is of paramount importance in the genesis of mental disorders. Curran & Guttman (41), discussing the aetiology of mental illness, state that mental symptoms are always produced by emotional disturbance or by mental activity associated with emotional disturbance. As to emotion itself, Woodworth (35b) describes it as "a stirred-up state of feeling". Emotion as we know it is a subjective experience - it is experienced in consciousness. The latter has been likened by Freud to a sense organ through which we perceive the biological forces which motivate us (42). As Whitehorn (43) states - "life consists essentially in satisfying these forces (needs, urges, responses,) in the environment and behaviour is the manner in which the individual gains and maintains such a state of satisfaction". But many of the physiological determinants of behaviour are mainly unconscious and only enter awareness when the need becomes acute or when more complex patterns of behaviour are required; in other words, when the individual is subjected to stress. This awareness of the presence of stress, coupled with the necessary physiological adaptive reactions, produces a state of emotion. In the words of Masserman - "Emotions are subjective epiphenomena that accompany stressful adaptation". (44).

By what mechanism is this 'stirred-up' state produced?.

First of all the importance of the autonomic nervous system in the mediation of emotion shown by the work of Cannon (45),

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Bard (46), Gellhorn (47) and Massermann (19b), led Fulton to conclude that 'the autonomic nervous system is brought into play constantly..... with every phase of emotional behaviour". (26e). While the experiments of Cannon and Bard, employing respectively the methods of stimulation and ablation have clearly shown that the hypothalamus does integrate the mechanisms of the expression of emotion, Massermann proved that this structure was not the seat of either conation or affective experience - that direct stimulation produced 'pseudo-affective' reactions which neither modified spontaneous behaviour nor were directly influenced by external stimuli. As Fulton asserts - "the activities of the cerebral cortex play an integral part in the production of emotional states". (26f). Recently published work by Hill et al. (48) has perhaps thrown more light on the matter. Subjecting schizophrenics and controls to stress by means of induced hypoglycaemia, these workers made continuous observation on the cerebral cortex by means of the E.E.G., and on the autonomic activity by electrical recordings of the heart rate and skin resistance. In 41 out of 51 experiments the records showed that changes in the electrical activity of the cortex anticipated the sympathetic-adrenaline discharge, and the authors suggest that this is the normal homeostatic mechanism to stress.

It might therefore be assumed that in stress of any nature, whether arising within the body or from without, whether physical or mental, the presence of such stress is first registered in consciousness and as a result the autonomic system is

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further activated. Thus, the necessary physiological processes are brought into function in the interests of defence and successful adaptation. This awareness of danger to his welfare, together with the autonomic activity, produces in the individual that 'stirred-up' feeling which we call emotion.

As to the means by which the autonomic nervous system is activated we do not know. Hill and his colleagues believe that the functional depression of the cortex as the result of hypoglycaemia reduces the cortical restraint on the activity of the lower autonomic centres. But one cannot conceive that this is the mechanism in all forms of stress. It is hardly possible that in the mediation of fear and response to danger cortical activity is depressed. Moreover, not only has the presence in certain regions of the cortex of pressor and depressor centres for various autonomic functions (blood-pressure, sweating, respiration) been shown by the work of Hoff & Green (21b) and Pinkston et al.(49), but Bard and Mountcastle (50) have demonstrated that in the expression of anger facilitatory as well as inhibitory centres are located in the cortex. Thus one would expect that with changes in cortical physiology, such as are produced by hypoglycaemia, all these centres would be equally affected. It would appear rather that in stressful adaptation the resultant autonomic activity is dependent upon some form of reciprocity between facilitatory and inhibitory elements located in the cortex. It may well be that just as from the cognitive point of view final evaluation of an object or situation results not from the summation of the various sensory stimuli but

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as the interpreted 'whole' from the integration of these stimuli, so from the affective side a similar integration may take place. We know, for example, that feelings aroused by sounds are modified by visual recognition of the source of these sounds, the affective response to an object may depend upon olfactory or tactile stimuli, and so on. More recent anatomical and physiological studies at least suggest some functional relationship between sensory psychic areas and the orbito-frontal cortex and cingulate gyrus - regions which not only are known to be closely connected with autonomic function but which on stimulation or ablation produce in man well marked emotional changes. Ward (51) following removal of area 24 in monkeys and studying the anatomical connections by the Marchi method, states that a large tract of fibres projects from this gyrus to the medial surface of area 19, the so-called visual psychic area. Pribram, Lennox & Dunsmore, (52) by means of neuronographic studies on macaca monkeys, have shown that the tip of the temporal lobe, anterior insula, the posterior orbital surface of the frontal lobe, the anterior perforate space, and the sub and pre-callosal areas are interconnected. Fulton believes that area 13, the tip of the temporal lobe, the uncinate gyrus, and area 24 are all part of a single projection which is connected with the respiratory and vasomotor centres. These findings tend to suggest that there is an autonomic link-up of regions closely related to various sensory psychic areas. Thus a stimulus received in the appropriate area would be evaluated in the light of intensity, past experience etc., and invested

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with the necessary degree of affective tone. Modifications, with which the inhibitory and facilitatory cortical centres are concerned, are made according to the responses from the various sensory areas until, with ever-widening chains of association, the individual finally achieves a full affective evaluation of the stimulus and of his position in relation to it - like an engineer who, having knowledge of the weight of a structure, has carefully calculated the strength necessary to support it. By means of cortico-hypothalamic pathways, whether direct or via the thalamus, the hypothalamus is accordingly activated and the required intensity of autonomic response mediated. When this response is normal the emotional state appropriate to the situation is produced, and in the absence of any obstacle preventing its normal discharge, is successfully dissipated.

Psychological considerations.

By dealing with stressful situations in this way, the individual is thus enabled to meet the demands made upon him and so maintains a satisfactory adaptation to his environment. It follows that failure in adaptation results from a discrepancy between stress and response. With regard to the former it is appreciated that the severe stresses encountered by men in battle were responsible for the production of mental symptoms in the form of panic states and other forms of acute neuroses in individuals who otherwise would probably never have shown manifest emotional disturbances. Illness, injury, bereavement, loss of security etc., are other well-known causal factors in mental illness.

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But why do the majority of all who are exposed to similar stresses remain symptom free?. And, among those who show failure of adaptation, why does one individual develop an anxiety state, another an hysterical state, another become depressed, and so on?. It would appear that there are two factors to be considered here. First of all there is the capacity to withstand stress. In this respect Seyle (16b) has suggested that the ability of living organisms to adapt themselves to changes in their surroundings, their adaptability or 'adaptation energy' is a finite quality; its magnitude appears to depend on genetic factors. Rosenweig (53) assumes that individuals differ in respect to certain stress thresholds. He states that "within a specifiable range of stressfulness the responses of a given individual would be adequate. Below it they would be lacking in adequacy because insufficiently motivated to initiate appropriate behaviour. Above it their inadequacy would result from the disorganization of excessive stress". In other words, individuals vary in their capacity to withstand stress without resulting to inadequate or abnormal modes of response. The second factor concerns the type of abnormal behaviour which results when the individual fails in adaptation. While it is obviously impossible to discuss the psychodynamics of mental illness solely on the basis of autonomic pattern, some tentative suggestions, based on our findings, may be made briefly and in general terms. Firstly, it may be reasonable to compare the anxiety pattern with that of schizophrenia, the two types of illness which in opposite ways show

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the greatest degree of autonomic imbalance. In anxiety there is an exaggerated sympathetic response to stress. The emotional reaction is therefore of abnormal intensity - greater than is necessary for satisfactory adaptation to the stimulus. The individual is thus left with 'surplus' emotion which is converted into somatic symptoms such as palpitation, tremors, etc., symptoms which Stalker (54) refers to as the effects of 'exciting' emotions. The schizophrenic reaction type on the other hand, as a result of parasympathetic preponderance, may fail to react with sufficient response to the stressful situation. Likewise, he must resort to defence reactions to preserve the constancy of his internal environment. He therefore tends to withdraw from interpersonal contact and adopts an increasingly seclusive attitude, thus avoiding or minimising normal environmental stresses. Such maladaptation inevitably leads to further frustration, and the process is therefore progressive, culminating in complete divorce from reality. That schizophrenia is the outcome of progressive maladaptation of the individual to his environment is the view held by the Meyerian school.

With regard to the other types of illness certain features of the responses appear to be of some significance. For example, a low parasympathetic response is associated with depression (vide the depressive and agitated melancholic groups), while a high sympathetic response bears a close relationship to mental and physical overactivity as seen in the manic and anxiety groups. The fact that the sympathetic responses of the paranoid

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group are well within normal limits may partly explain the ability of these cases to maintain a better environmental relationship than the schizophrenics, although indeed many tend to be asocial and solitary. On the other hand several members of the schizophrenic group gave normal sympathetic responses yet were withdrawn and apathetic. Attempts to differentiate the two groups on the basis of autonomic pattern appear to present the same difficulties as do present day efforts to classify them on clinical grounds.

In the affective disorders it would appear that the manic individual reacts to stress by an increased response of both sympathetic and parasympathetic divisions, while in depression inhibition of both occurs. It might be said that in mania the individual, strongly fortified, goes forward to battle with stressful situations, while the depressive strips himself of his defences, withdraws and adopts a pacifist attitude. In the former the behavioural responses are exaggerated, in the latter they are diminished. This withdrawal of the depressive from his external environments differs from that of the schizophrenic in that in the latter the responses are of an abnormal qualitative character while in the former the abnormality is quantitative.

But what of the cyclothymic person whose illnesses alternate between manic and depressive states?. The figures already quoted in respect of our solitary representative of this type would suggest that in these cases the autonomic responses are labile, tending to swing between the hypernormal and subnormal levels, but with a continuous maintenance of autonomic balance.

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While the range of the responses remains within normal limits the individual is able to adjust himself to his environment and is recognised as the extravert who mixes well in the world but who is subject to mood swings ranging between elation and depression. When the elation becomes abnormal a state of mania will occur, while when the depression becomes pathological a depressive state ensues. But in the large majority of cyclothymic individuals the changes of mood never interfere with normal daily activities. It would therefore appear that in these cases which develop an illness of the manic depressive type the 'adaptation energy' is low. Seyle's belief in the genetic determination of the magnitude of this adaptability would thus account for the importance of hereditary predisposition as an aetiological factor in this illness. Whether manic or depressive symptoms develop would depend on the state of the autonomic nervous system at the time of onset of stress, (Gellhorn's first hypothesis in relation to the autonomic responses in schizophrenia might well apply here). If the responses were within the upper-normal range then the reaction would be of the manic type, while if in the lower range the reaction would be depressive in nature. In the production of manic-depressive psychoses the relative importance of the endogenous or reactive (exogenous) element is still a much debated point. Might not the answer lie again in the individual degree of stress tolerance?. An individual with a low threshold, and whose responses at the time of onset were near the upper or lower limits of normality, would succumb to stresses which on the surface would not be

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recognised as such, while another individual, with perhaps a higher stress threshold might well develop symptoms in the presence of marked psychological trauma, even when his responses were well within normal limits. Thus in fact all manic depressive illnesses could be classed as reactive in nature.

CONCLUSIONS.

When two forces are in opposition, the strength or power of either can only be measured by consideration of its opponent; failure to do so might well lead to false conclusions. This equally applies to the two divisions of the autonomic nervous systen, and it has already been suggested that the inconsistent results hitherto obtained in investigations on the dominance of either division have been due to failure to observe the above rule. By the conception of the A.I., a figure can be obtained which would appear to indicate any relative sympathetic or parasympathetic preponderance. The results of the present work prove that with the exception of hysteria (a condition in which other observers have found no physiological abnormalities), all the types of mental illness investigated show abnormal autonomic patterns. Furthermore, it has been demonstrated that there is a close association between autonomic pattern and behaviour in that patients with the same illness show similar patterns, different types of illness show different patterns, and that the nearer does behaviour approach 'normality' the more similar do all patterns become, irrespective of the illness. Yet when the responses fall within

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normal limits, as do those of the recoveries, the pattern of each individual is still that of his previous illness, although, of course, much modified. It would therefore seem that the individual is predisposed toward that type of illness. The patterns of the controls also show 'leanings' toward those characteristic of the various mental disorders, and it would be reasonable to expect that should these persons succumb to mental illness the form of illness would be that towards which their patterns incline.

In brief then, it is suggested that when an individual fails to react satisfactorily to stressful situations, either because the stress is of abnormal intensity or because his 'adaptation energy' is subnormal, the resultant behaviour of that individual will be influenced by his autonomic pattern. It is further suggested that this pattern is a specific or characteristic element in his constitutional make-up.

Whether these patterns themselves are in turn determined by anatomical, physiological or endocrinological factors is a question which must remain for future investigation. While the procedures adopted in carrying out the present work can in no sense be termed scientifically accurate, the results are such as to offer encouragement for further research along these lines. From the preventive aspect the importance of increased knowledge in this field requires no emphasis. As Wolf (55) truly remarks, - "In

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the study of a sick person the question of cause or precipitating factor may be less relevant than a consideration of the character and dimensions of the organism's protective reaction. Cure may not require a removal of or even a discovery of cause but merely the adoption of a less costly adjustment..... More pertinent things for future study besides mechanisms are factors which evoke and modify patterns and ways of making them unnecessary. This approach may eventually illuminate the causes".

SUMMARY.

1. The blood pressure responses to sympathetic and parasympathetic stimulation of 100 patients suffering from the commoner types of mental illness were recorded before and after treatment. The responses of 10 healthy male subjects were recorded for control purposes.

2. With the exception of hysteria, all the types of mental illness investigated showed abnormal autonomic patterns in terms of blood-pressure response but the individuals in each group showed a pattern which appeared to be characteristic of that group.

3. The possible reasons for the inconsistency in the observations of previous workers in this line of investigation were discussed.

4. Following treatment the tests revealed a relationship between clinical improvement and altered patterns of response in that the greater the improvement the nearer did the

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patterns approach 'normality' as judged by those of the controls.

5. The possible psychophysiological mechanisms involved in this relationship were discussed.

6. Suggestions were made on the influence of the autonomic pattern upon behaviour.

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A P P E N D I X.

Individual Graphs.

(a) Before treatment.

(b) After treatment.

Schizophrenic states.....	Nos. 1 - 41	inclusive.
Manic states.....	Nos. 42 - 48	"
Depressive states.....	Nos. 49 - 68	"
Paranoid states.....	Nos. 69 - 75	"
Agitated melancholics.....	Nos. 76 - 79	"
Anxiety states.....	Nos. 80 - 93	"
Hysterical states.....	Nos. 94 - 96	"
Obsessional states.....	Nos. 97 - 100	"
Controls.....	Nos. C.1. to C.X.	"

S. A. - Sympathetic area.

P. A. - Parasympathetic area.

A. I. - Autonomic Index.

CASE No.: 1 (a)

S.A. = 88
P.A. = 332

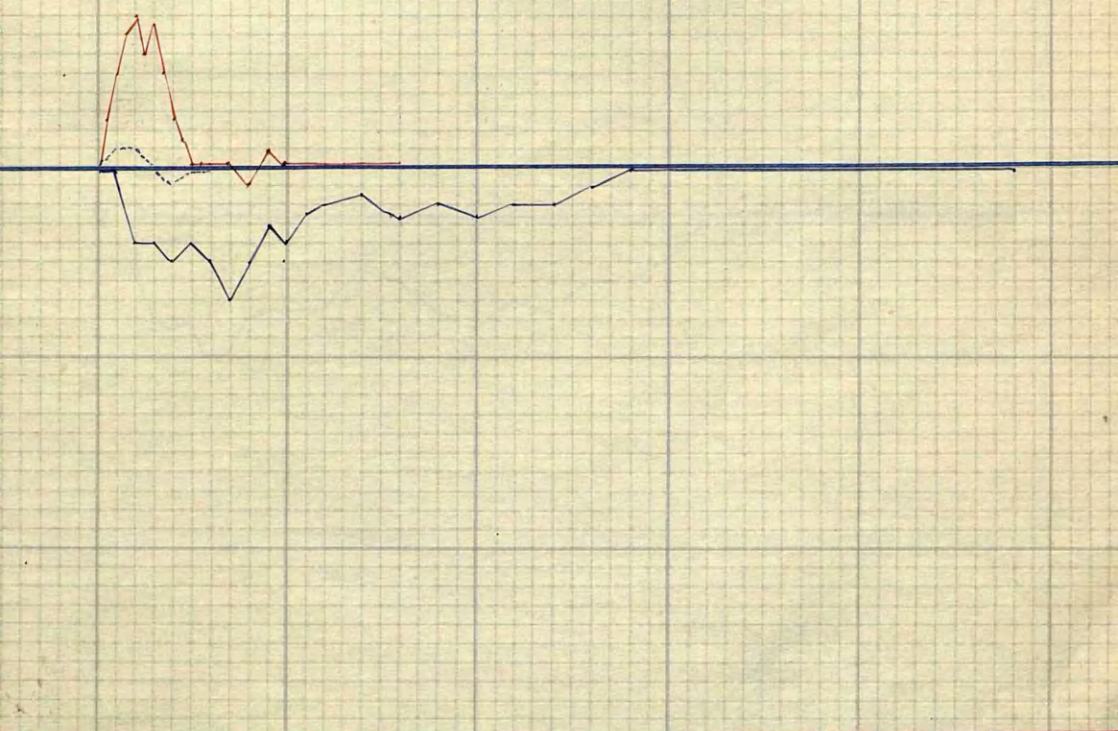
A.I. = 26.5

CASE No.: 2 (a)

S.A. = 23

P.A. = 74

A.I. = 31.1



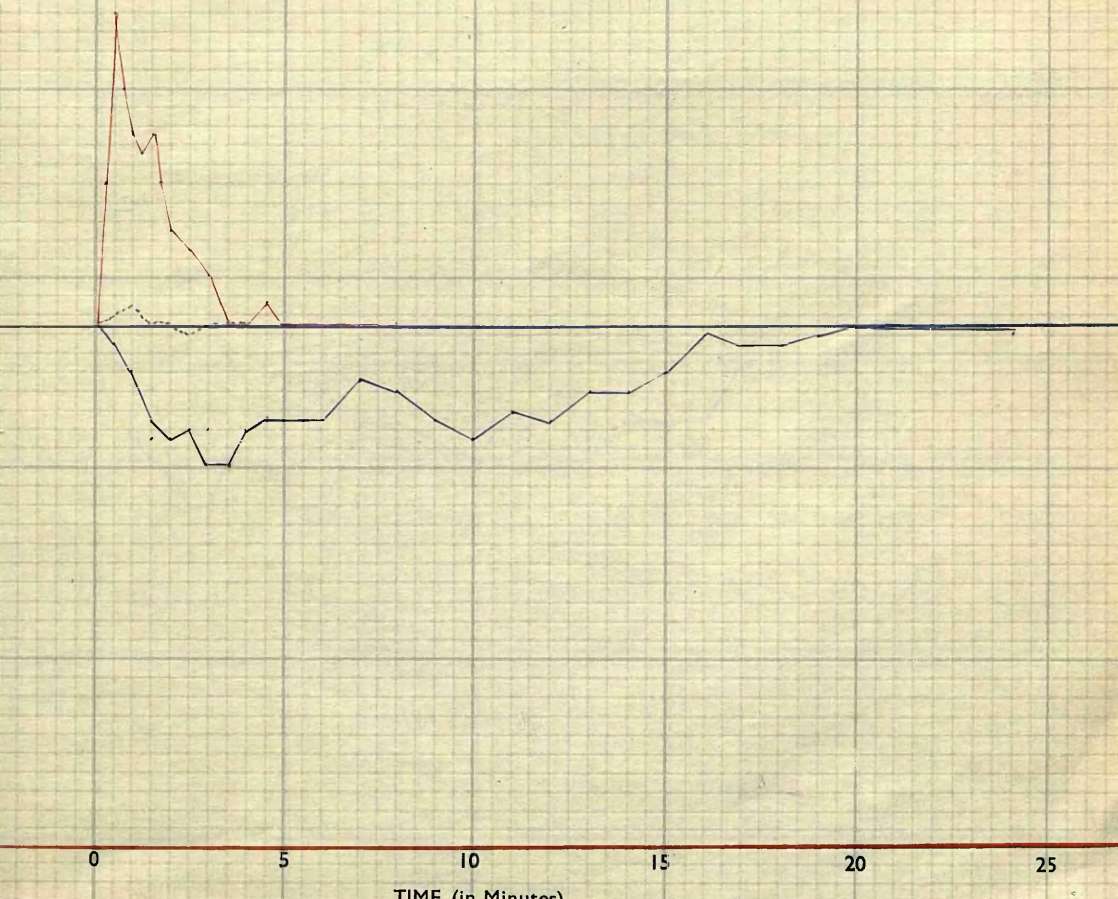
CASE No. : 2 (b)

S.A. = 46

P.A. = 140

A.I. = 32.9

NOT IMPROVED.

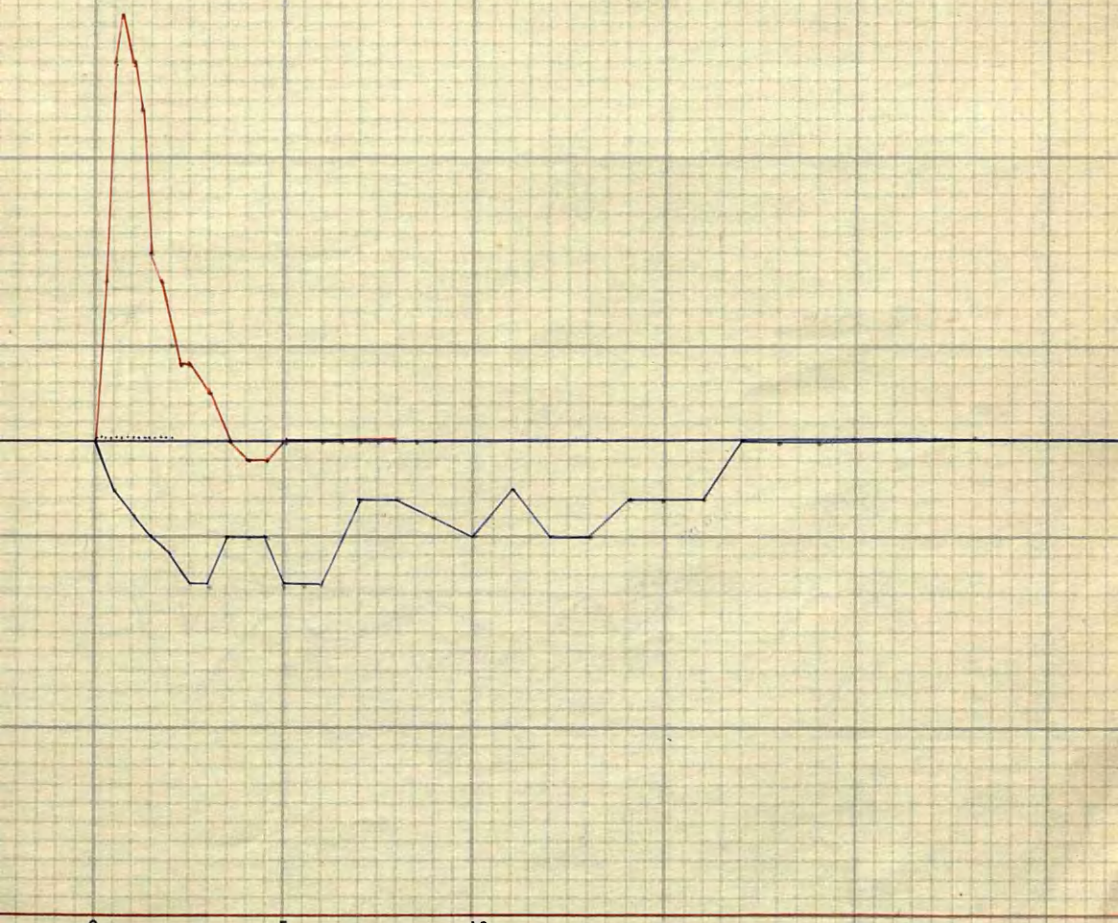


CASE No. : 3 (a)

S. A. = 60

P. A. = 148

A. I. = 40.5



0 5 10 15 20 25

TIME (in Minutes)

CASE No.: 3 (b)

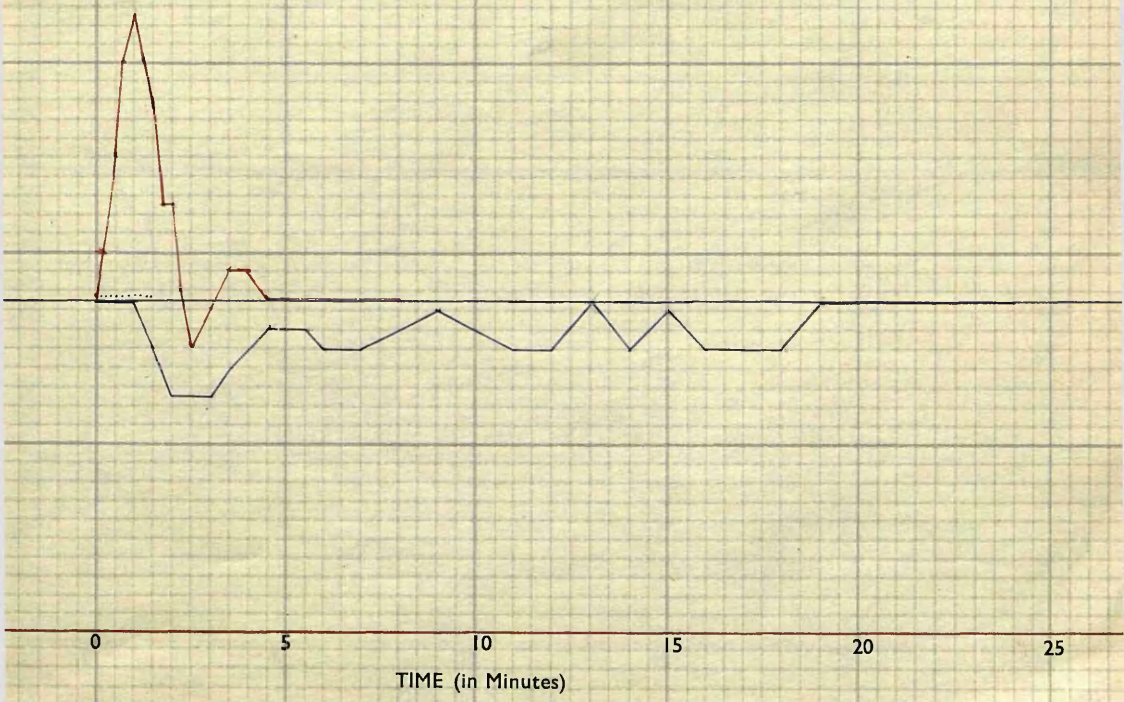
S.A. = 37

P.A. = 77

A.I. = 48.1

RECOVERED

(Prefrontal leucotomy.)



CASE No. : 4 (a)

C.A. = 73

P.A. = 180

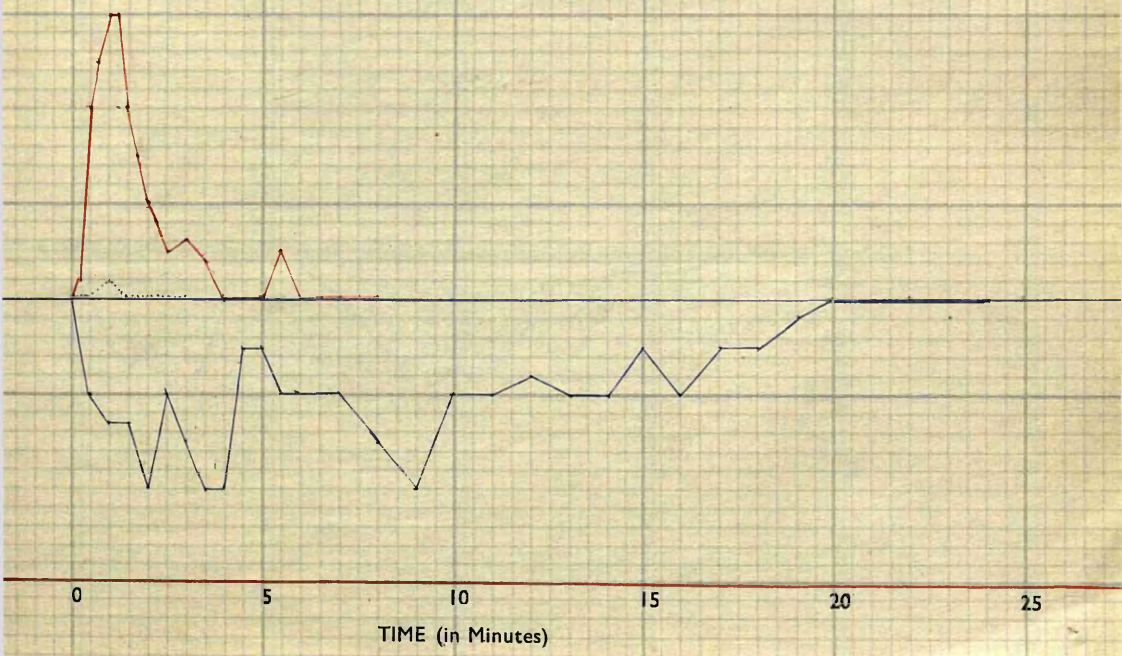
A.I. = 40.6

CASE No. : 5 (a)

S.A. = 48

P.A. = 197

A.I. = 24.4

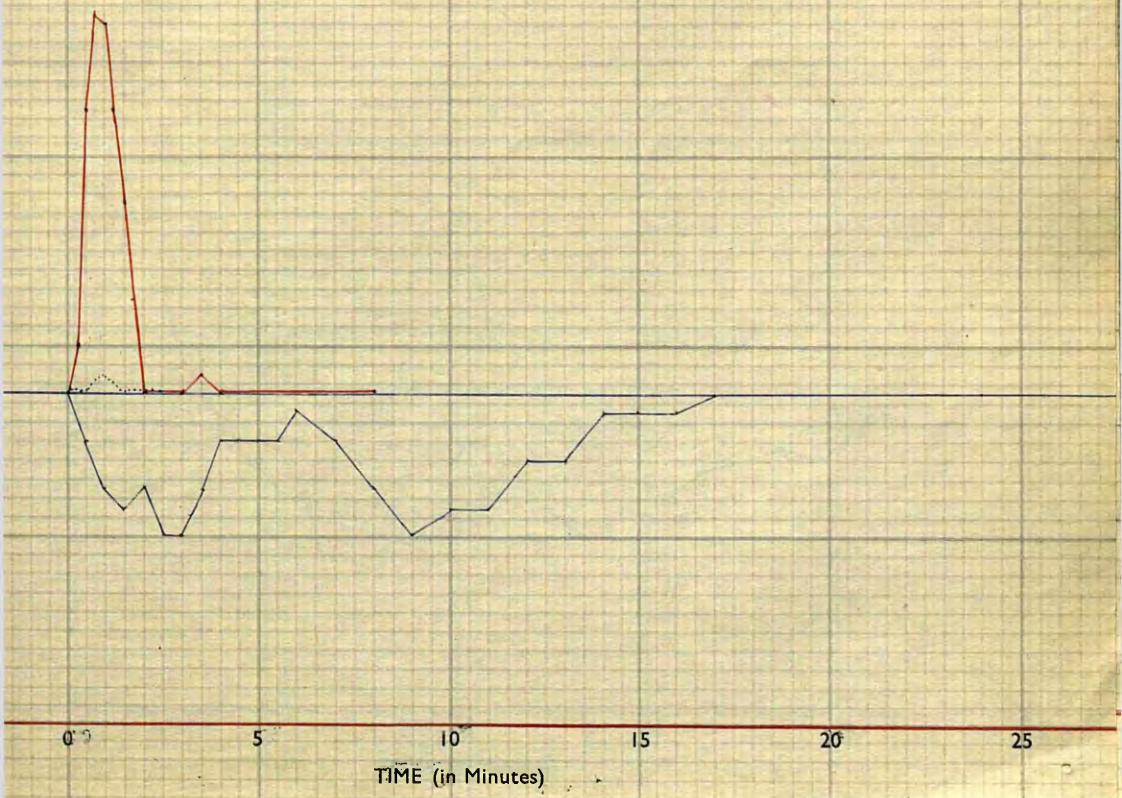


CASE No.: 5 (b)

S.A. = 41
P.A. = 127

A.I. = 32.2

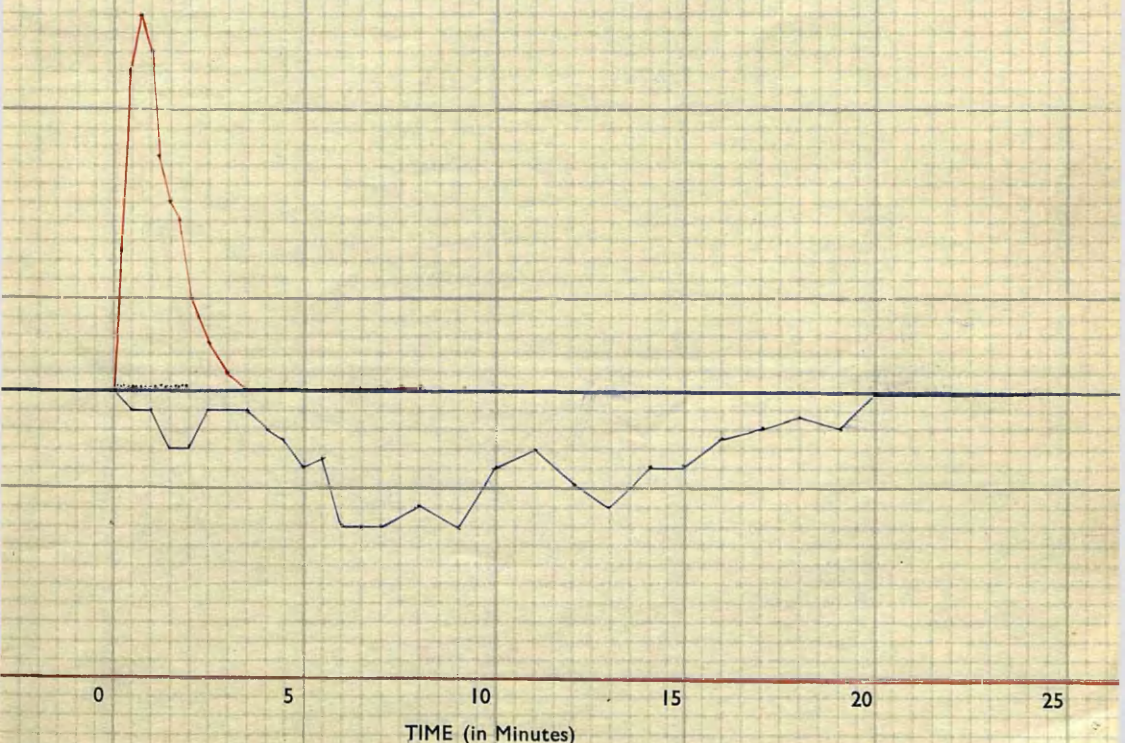
IMPROVED.



CASE No.: 6 (a)

S.A. = 55
P.A. = 149

A.I. = 37

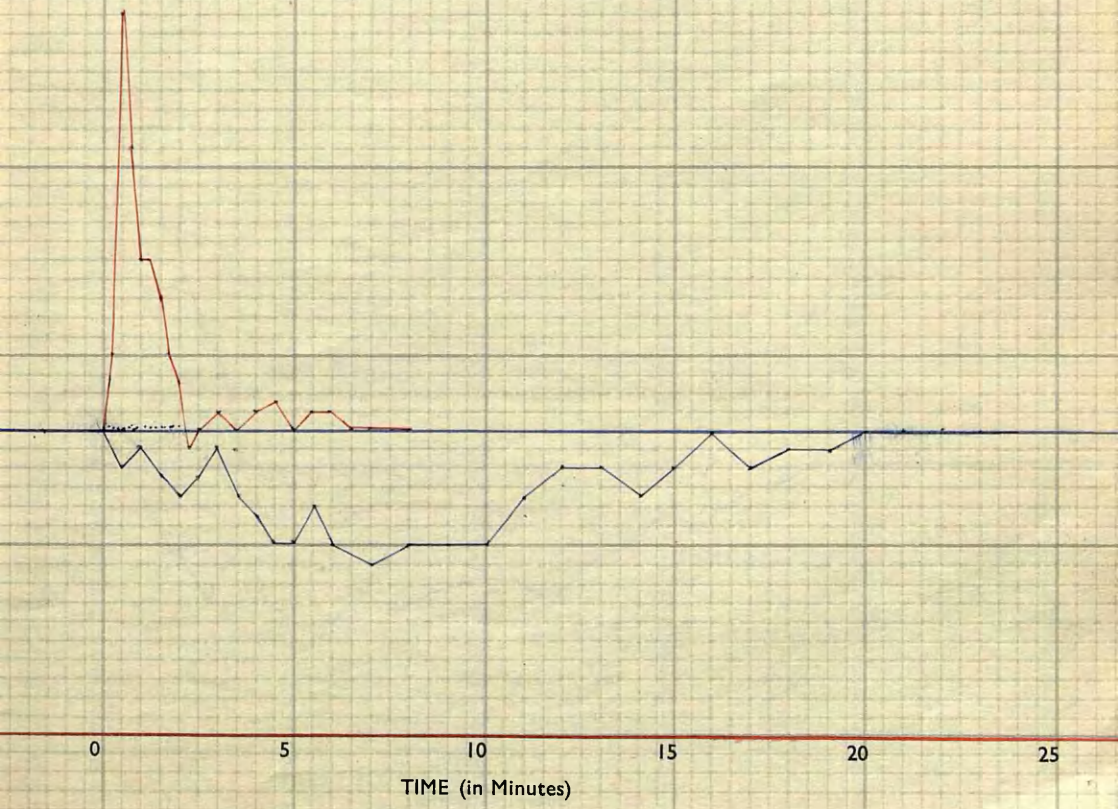


CASE No.: 6 (b)

S.A.= 41
P.A.= 127

A.I. 32.2

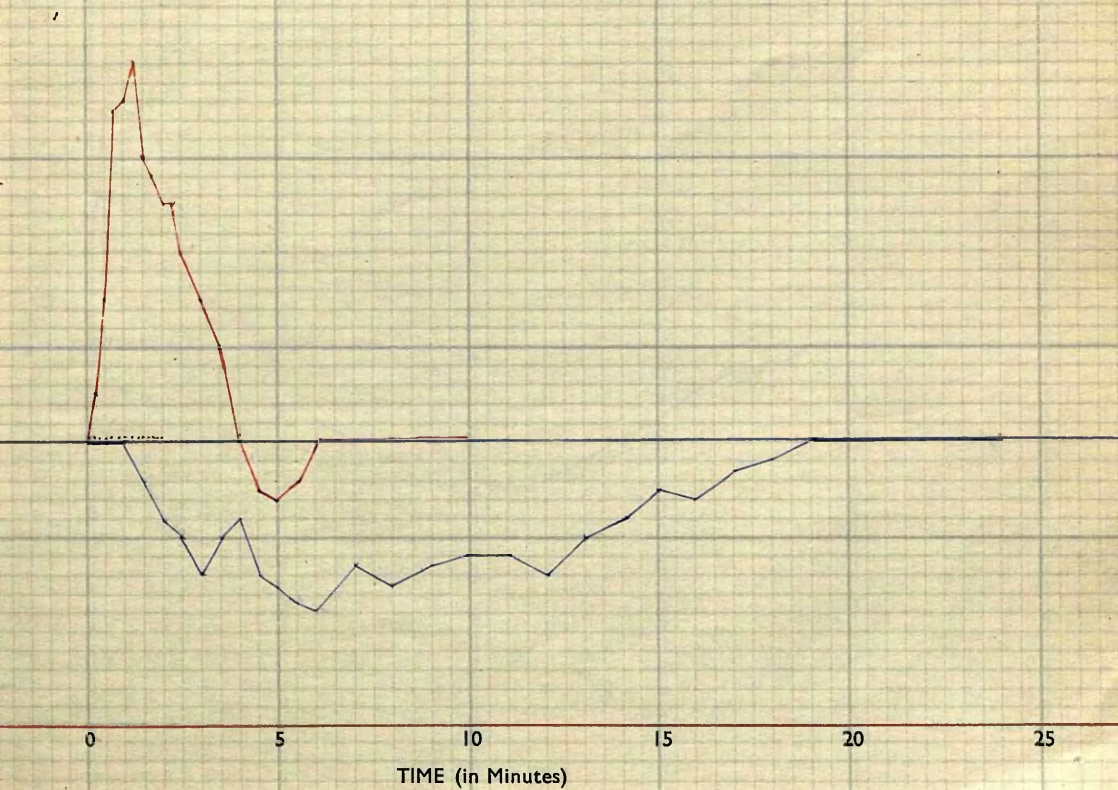
NOT IMPROVED.



CASE No. : 7 (a)

S.A. = 72
P.A. = 174

A.I. = 41.1



CASE No.: 7 (b)

S.A.= 74
P.A.=162

A.I.= 45.8

IMPROVED.

CASE No. : 8 (a)

S.A. = 57
P.A. = 143

A.I. = 40

0 5 10 15 20 25

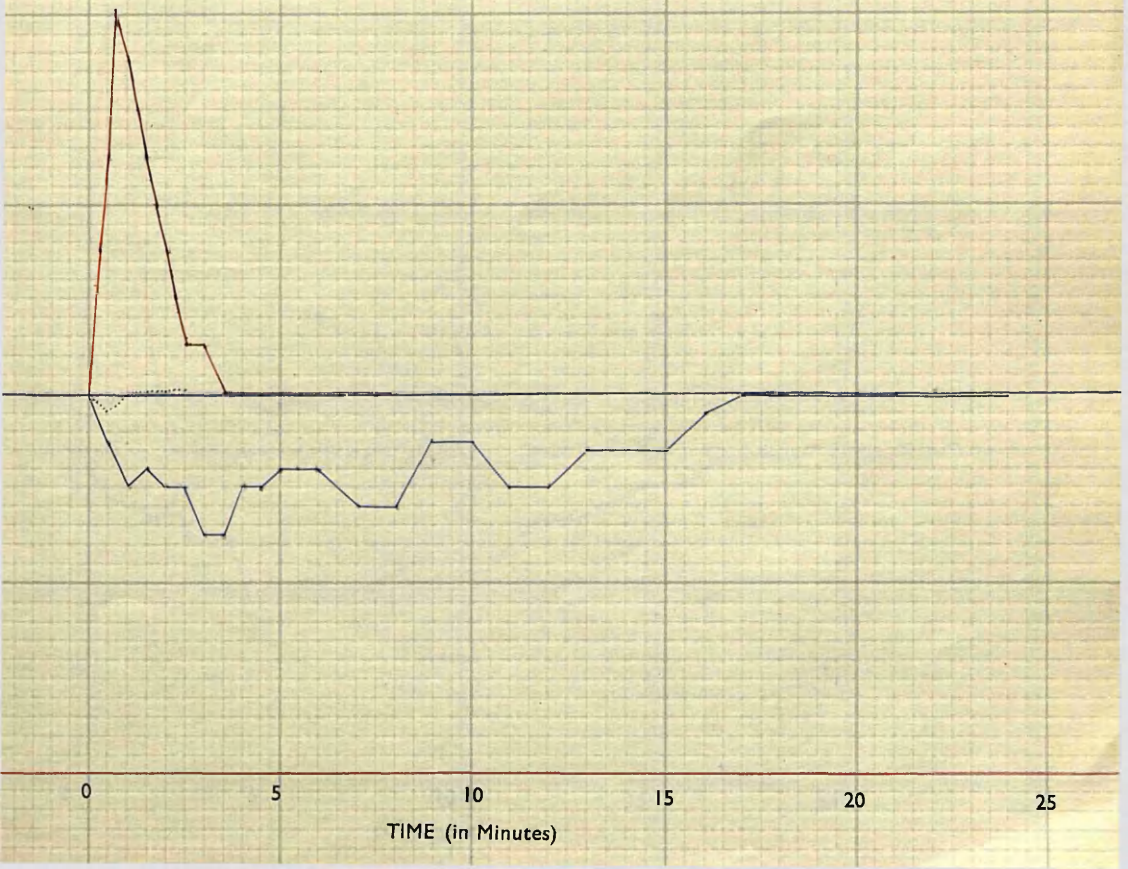
TIME (in Minutes)

CASE No. : 8 (b)

S.A. = 58
P.A. = 135

A.I. = 43

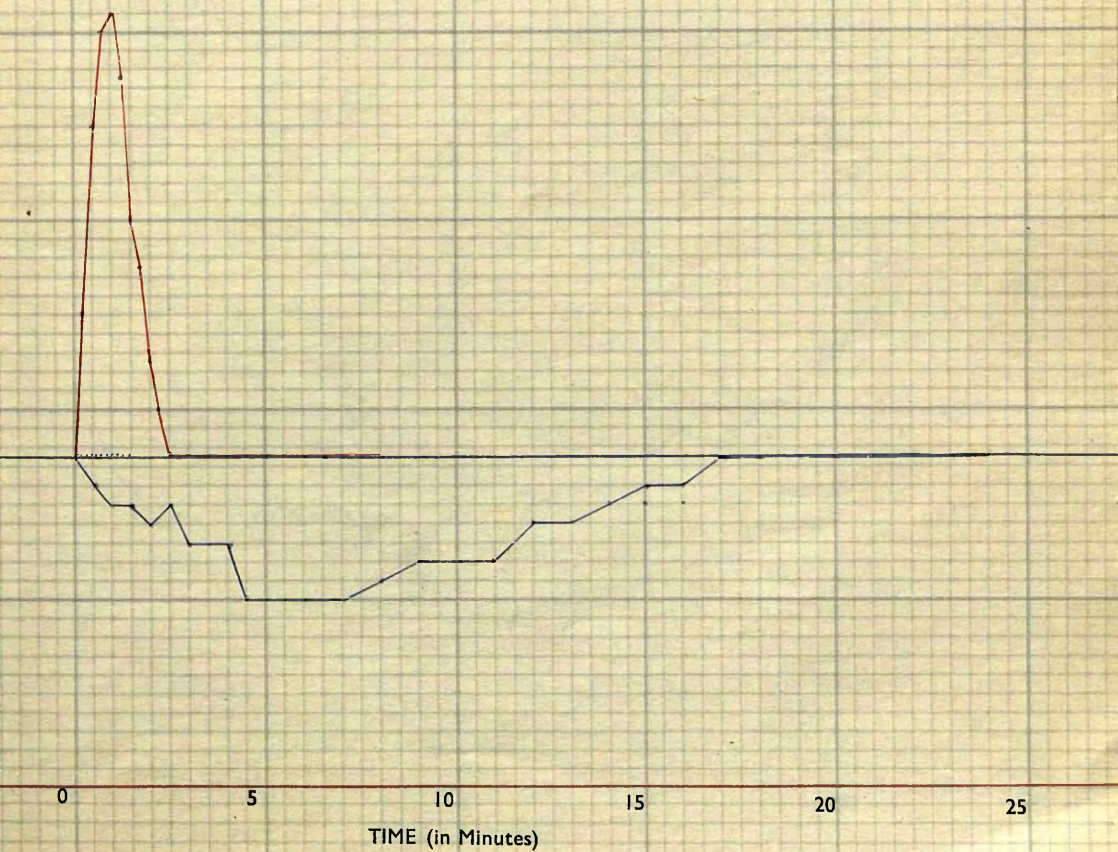
NOT IMPROVED.



CASE No. : 9 (a)

S.A. = 60
P.A. = 47

A.I. 40.8

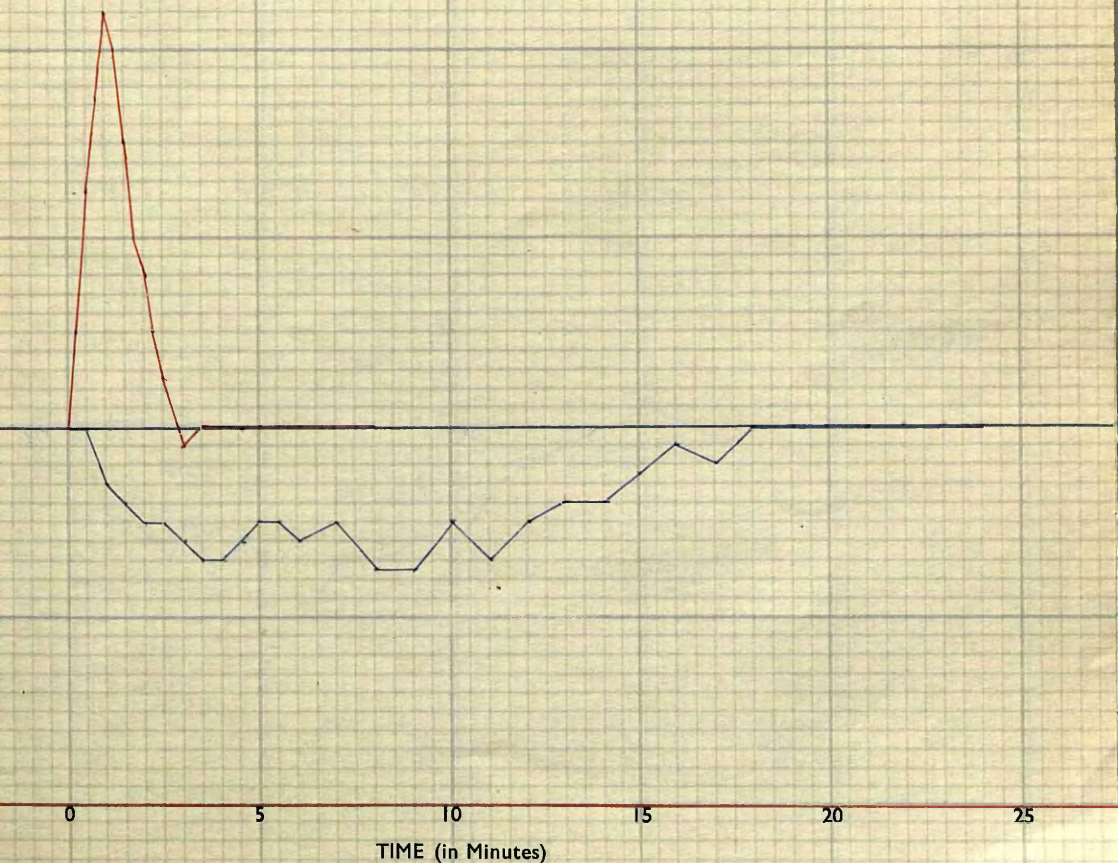


CASE No.: 9 (b)

S.A. = 58
P.A. = 162

A.I. = 35.8

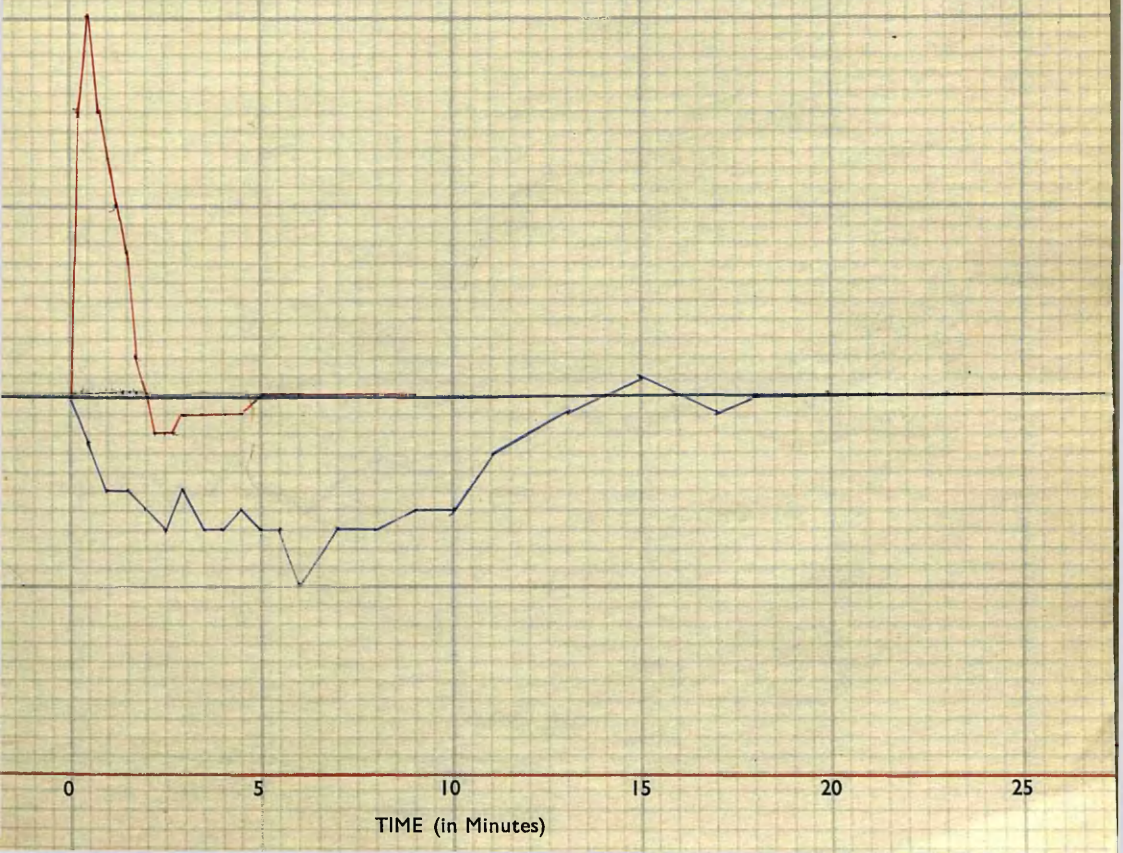
NOT IMPROVED.



CASE No. : 10 (a)

S.A. = 37
P.A. = 145

A.I. = 25.6

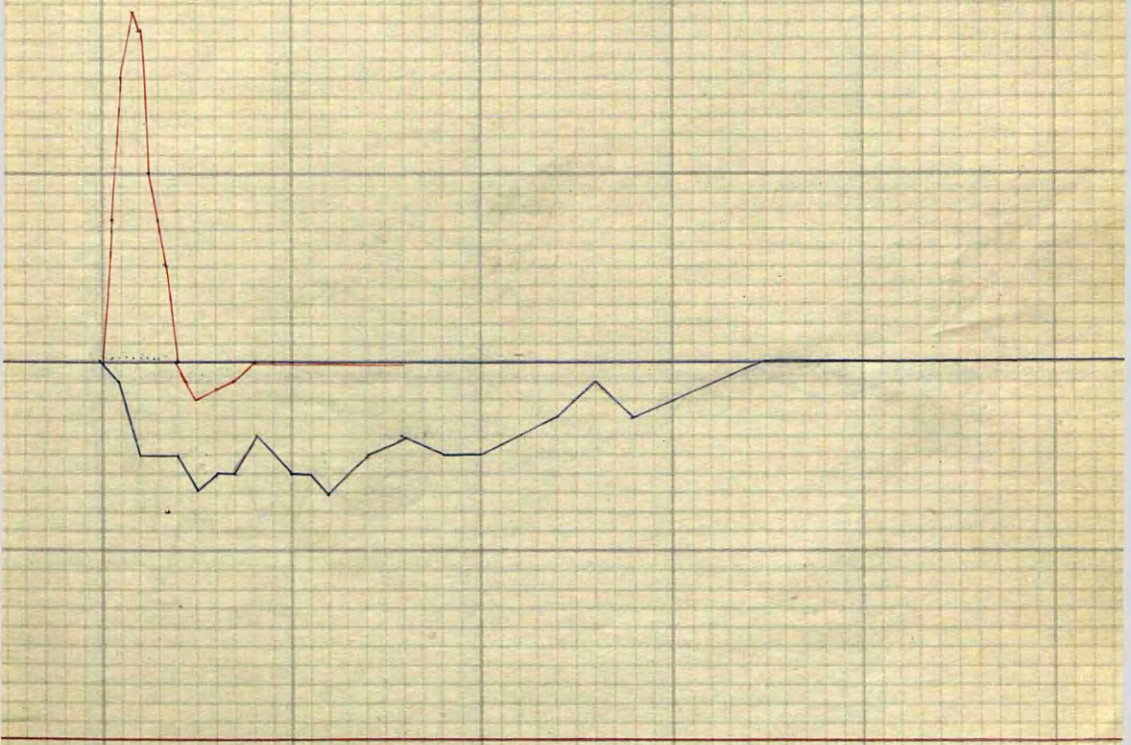


CASE No.: 10 (b)

S.A.= 37
P.A.= 135

P.A.= 27.4

NOT IMPROVED.



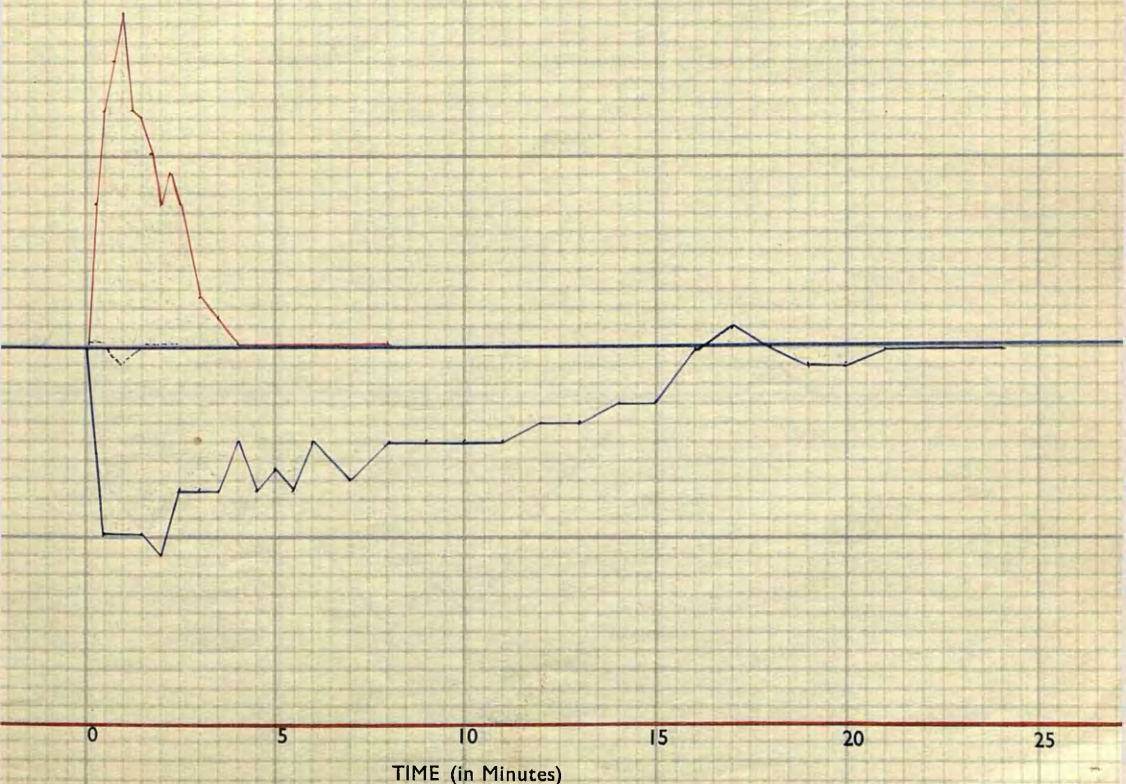
0 5 10 15 20 25

TIME (in Minutes)

CASE No.: 11 (a)

S.A. = 60
P.A. = 175

A.I. = 34.3

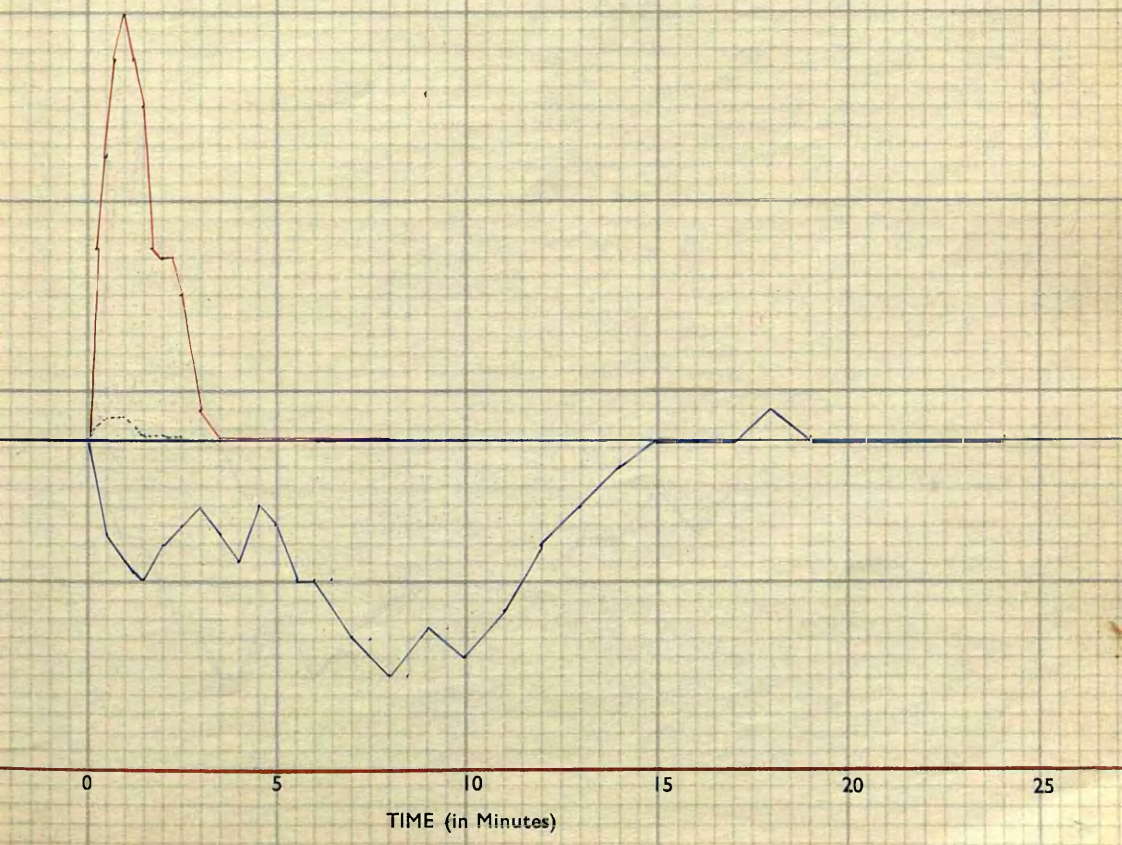


CASE No.: 11 (b)

S.A. = 71
P.A. = 190

A.I. = 37.4

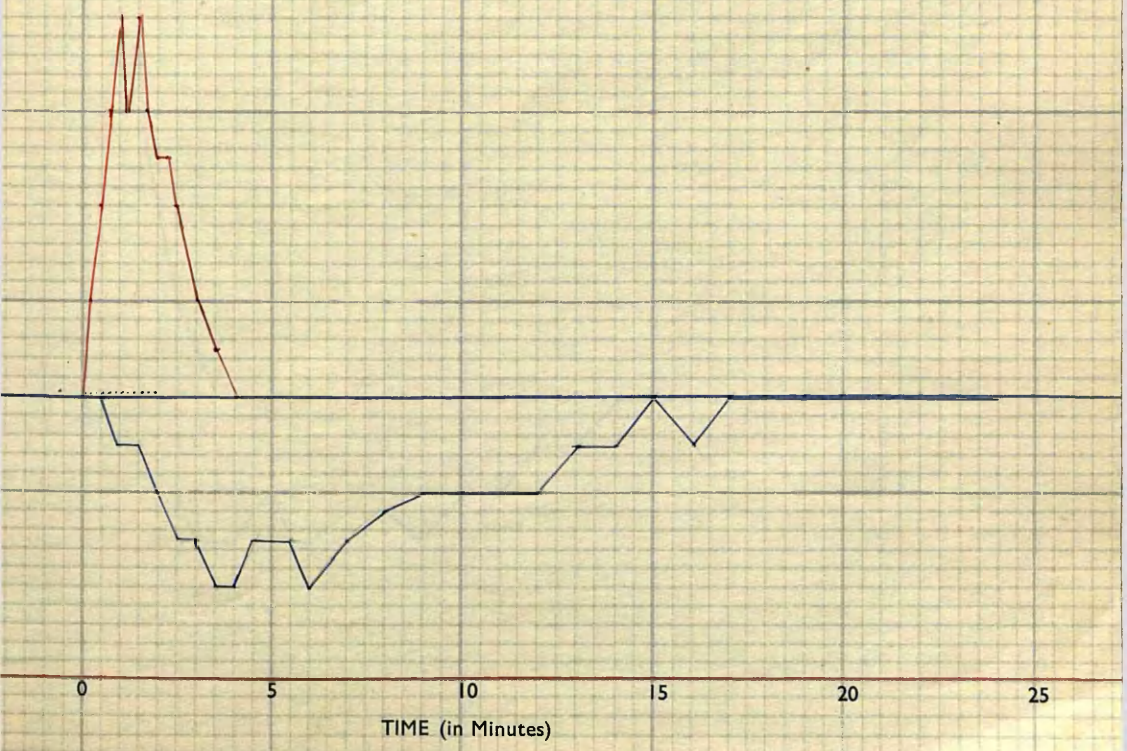
NOT IMPROVED.



CASE No. : 12 (a)

S.A. = 77
P.A. = 167

A.I. = 46.1

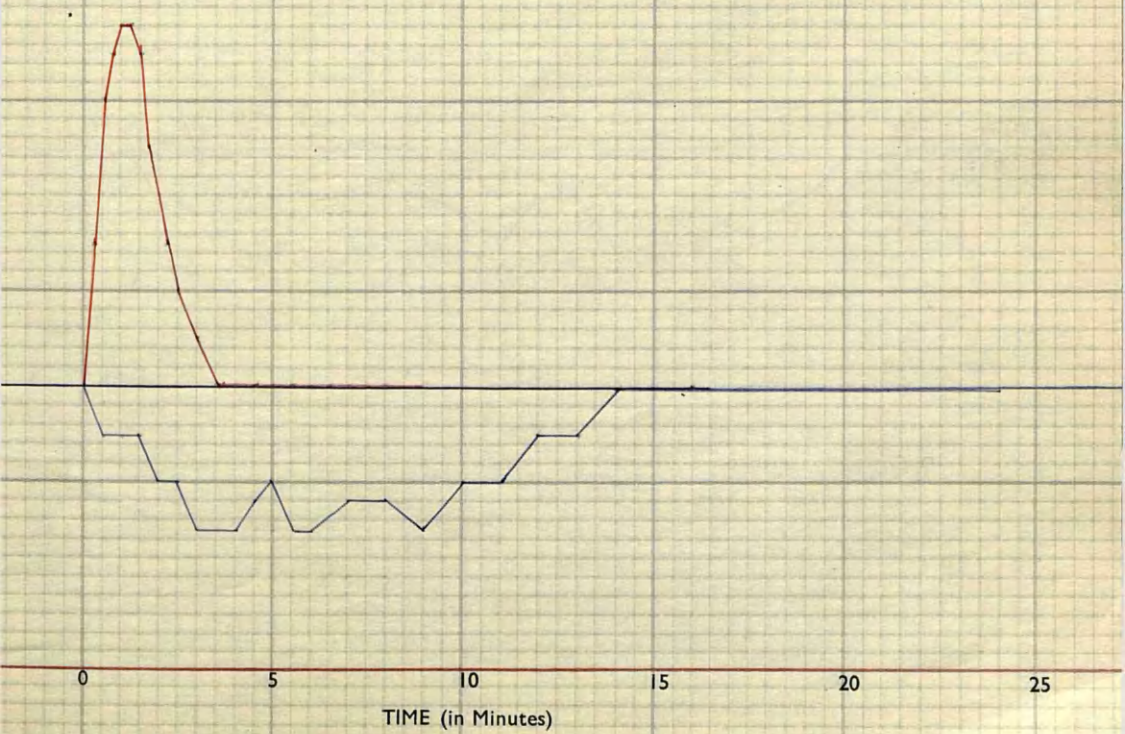


CASE No. : 12 (b)

S.A. = 68
P.A. = 138

A.I. 49.3

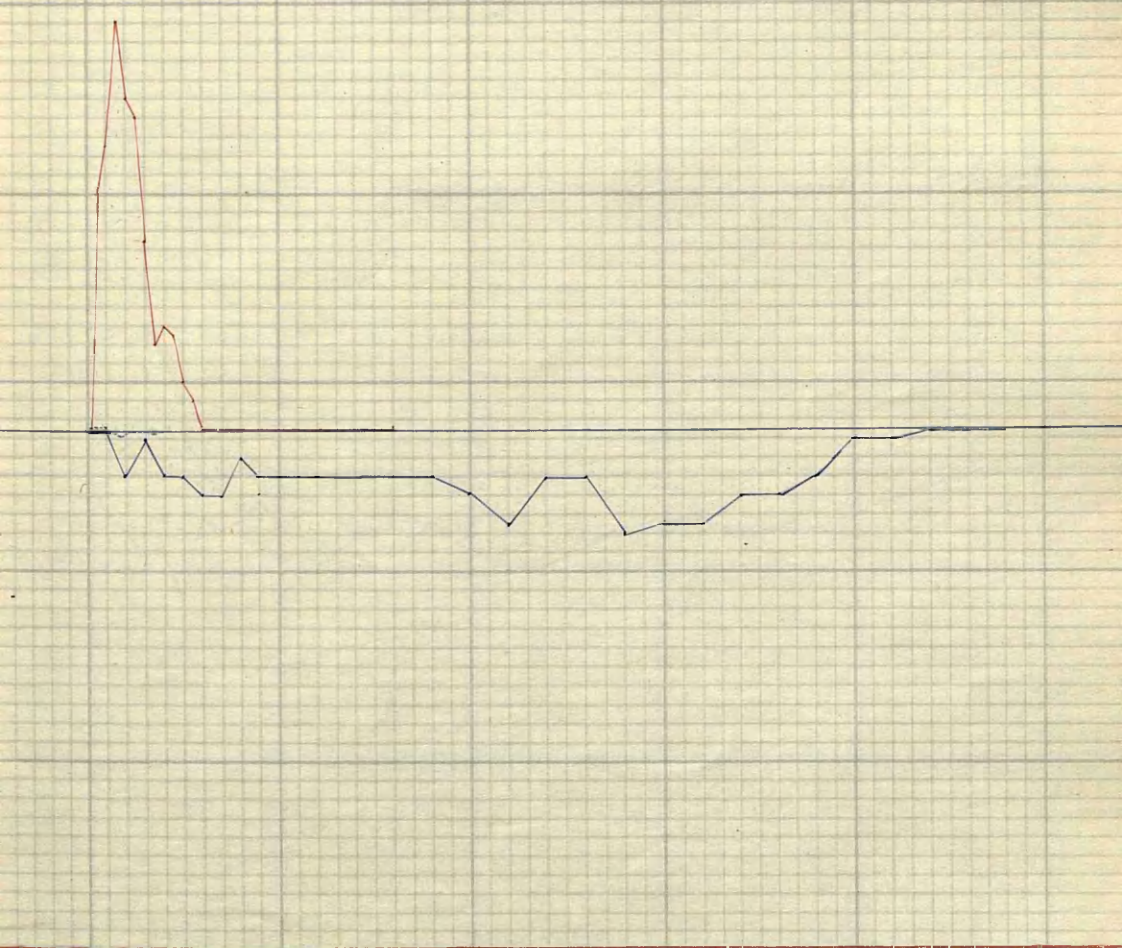
RECOVERED.



CASE No.: 13 (a)

S.A. = 54
P.A. = 123

A.I. = 43.9



CASE No.: 13 (b)

S.A. = 54
P.A. = 121

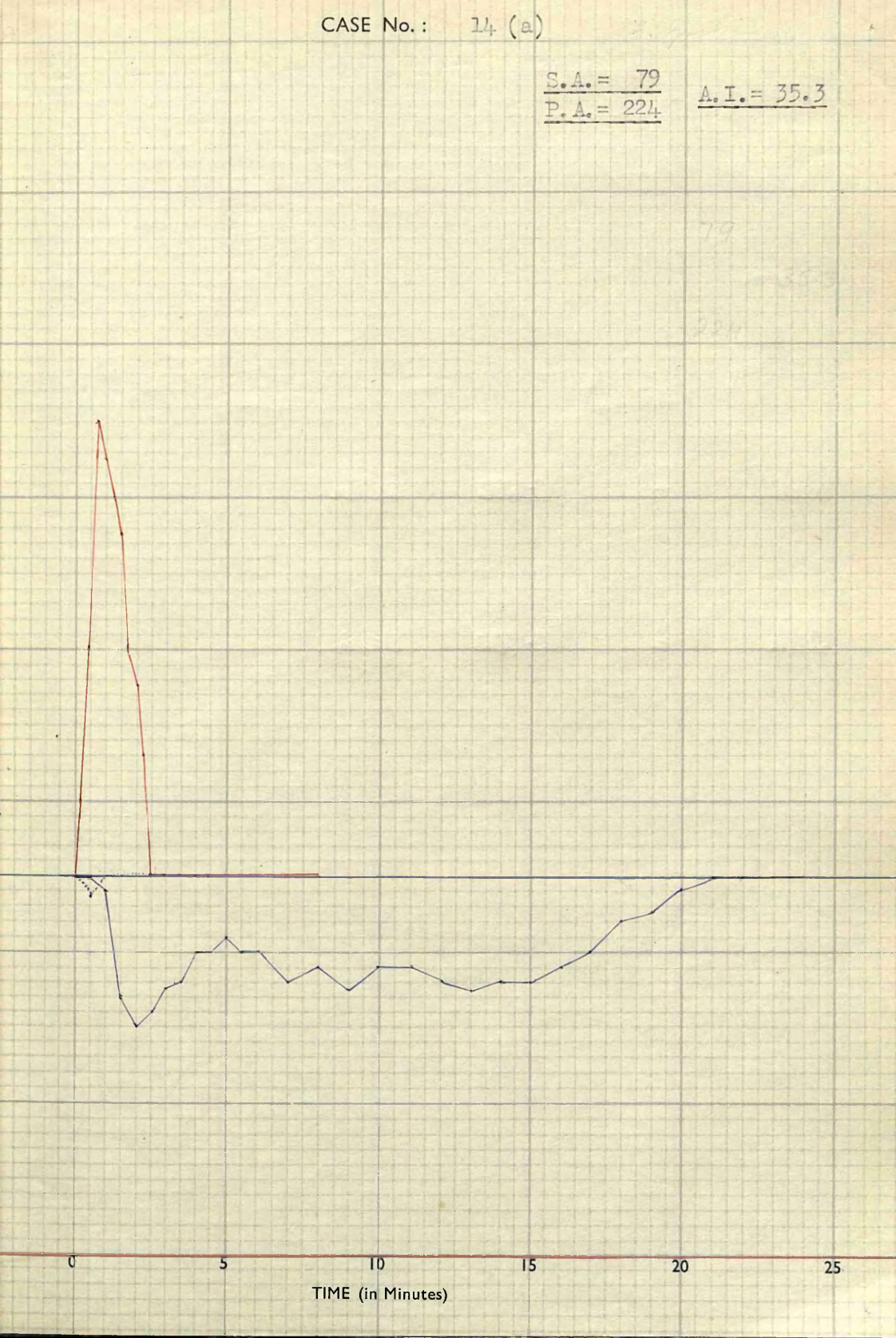
A.I. = 44.6

IMPROVED.

CASE No.: 14 (a)

S.A. = 79
P.A. = 224

A.I. = 35.3

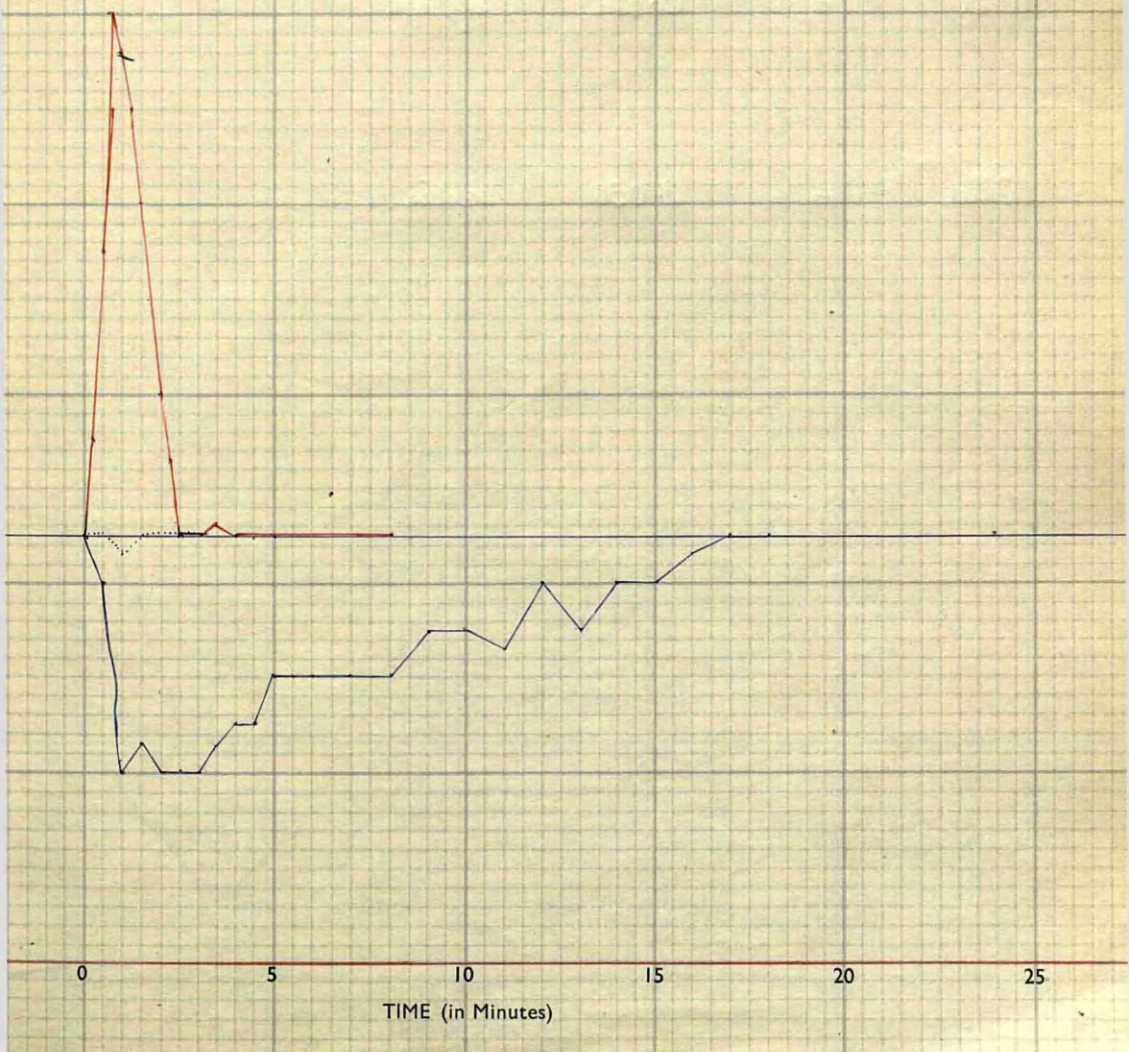


CASE No. : 14 (b)

S. A. = 68
P. A. = 210

A. I. = 32.4

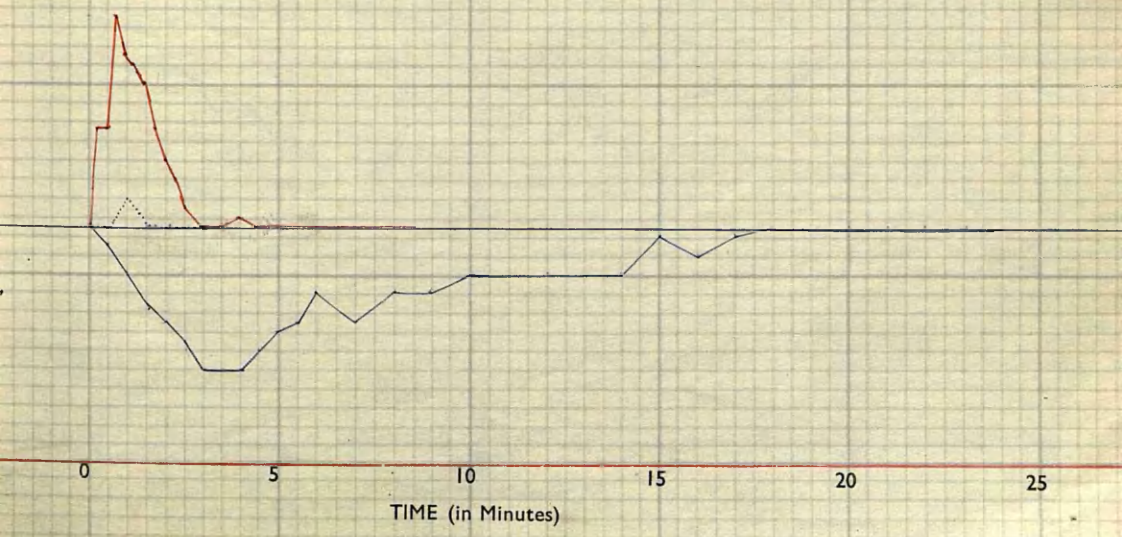
NOT IMPROVED.



CASE No.: 15 (a)

S.A. = 30
P.A. = 117

A.I. = 25.6

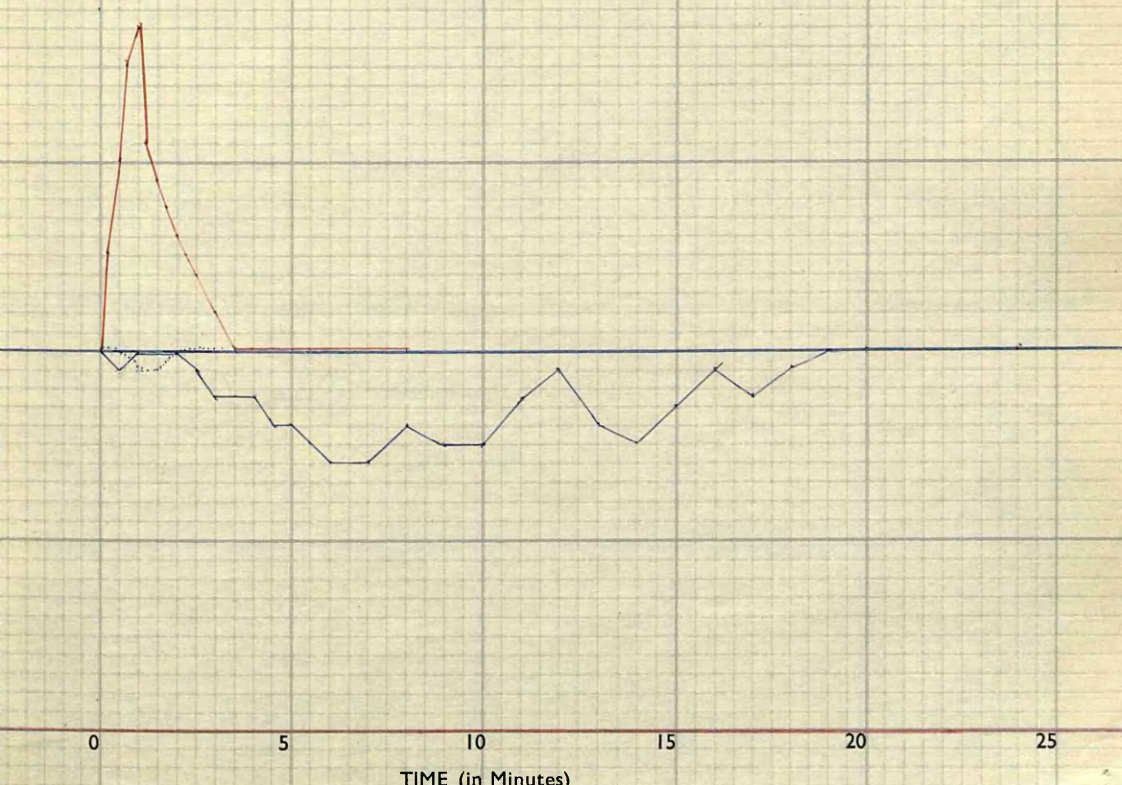


CASE No.: 15 (b)

S.A. = 48
P.A. = 112

A.I. = 42.9

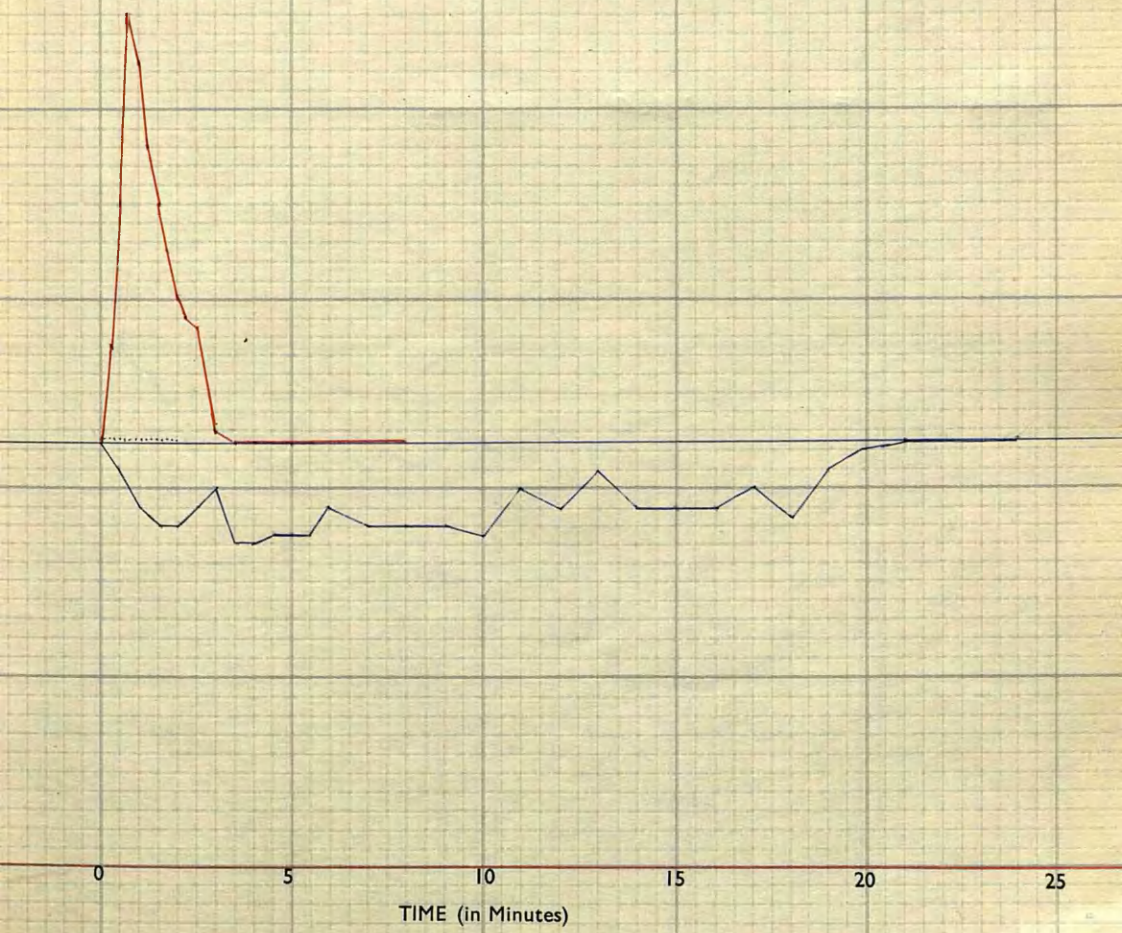
IMPROVED.



CASE No. : 16 (a)

S.A. = 68
P.A. = 163

A.I. = 41.7

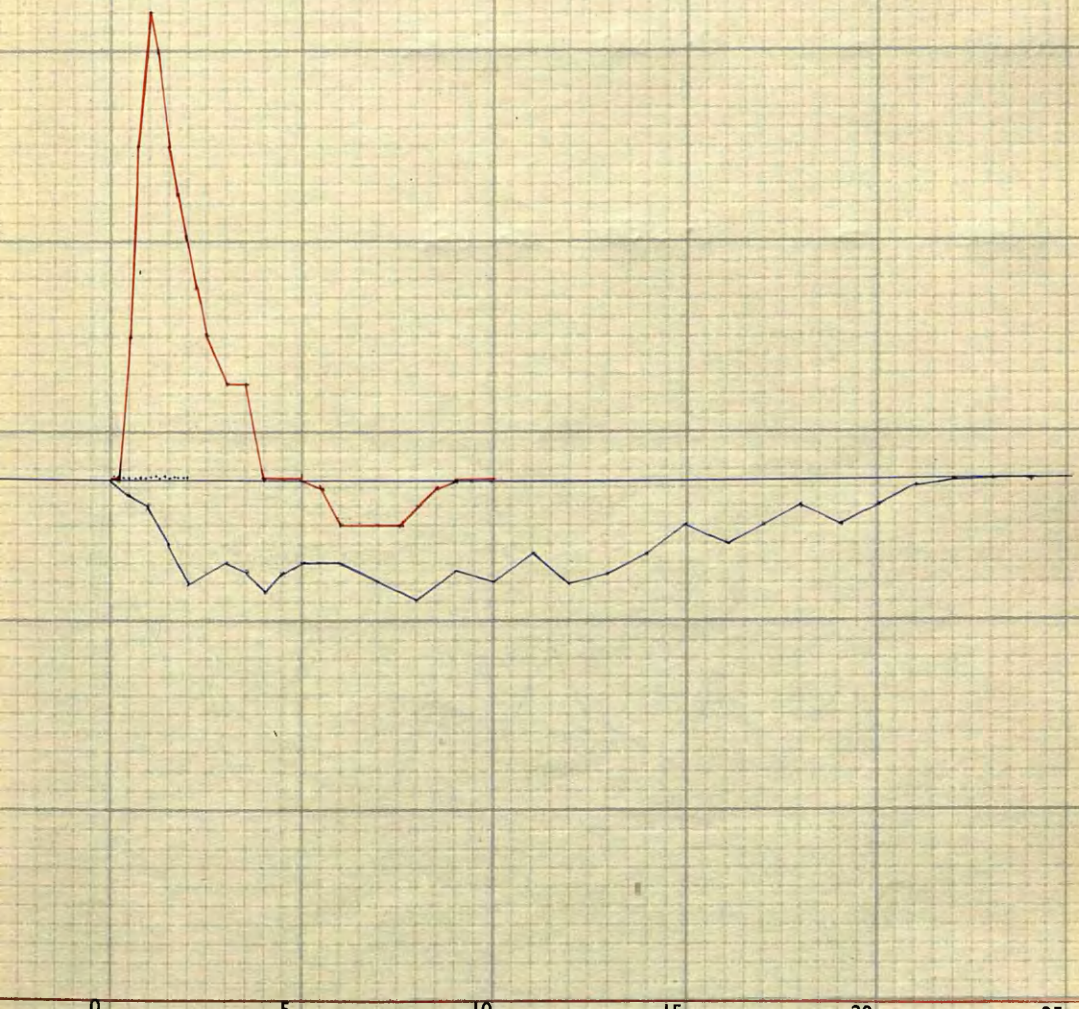


CASE No.: 16 (b)

S.A. = 60
P.A. = 142

A.I. = 42.3

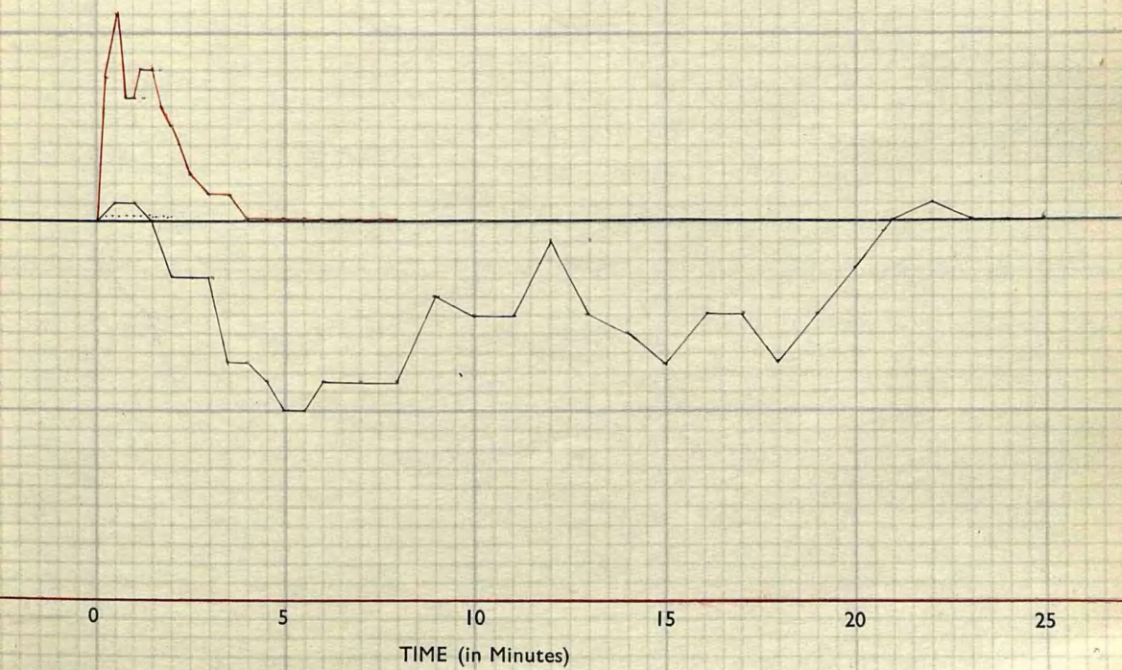
NOT IMPROVED.



CASE No.: 17 (a)

S.A. = 39
P.A. = 217

A.I. = 18

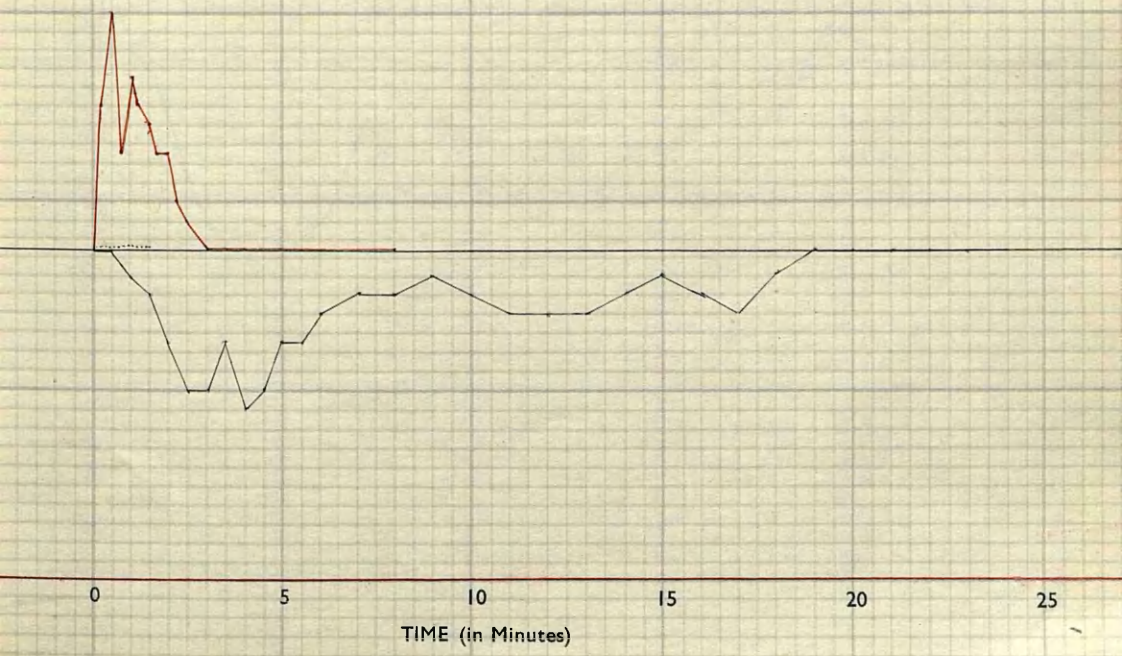


CASE No.: 17 (b)

S.A. = 30
P.A. = 120

A.I. = 25

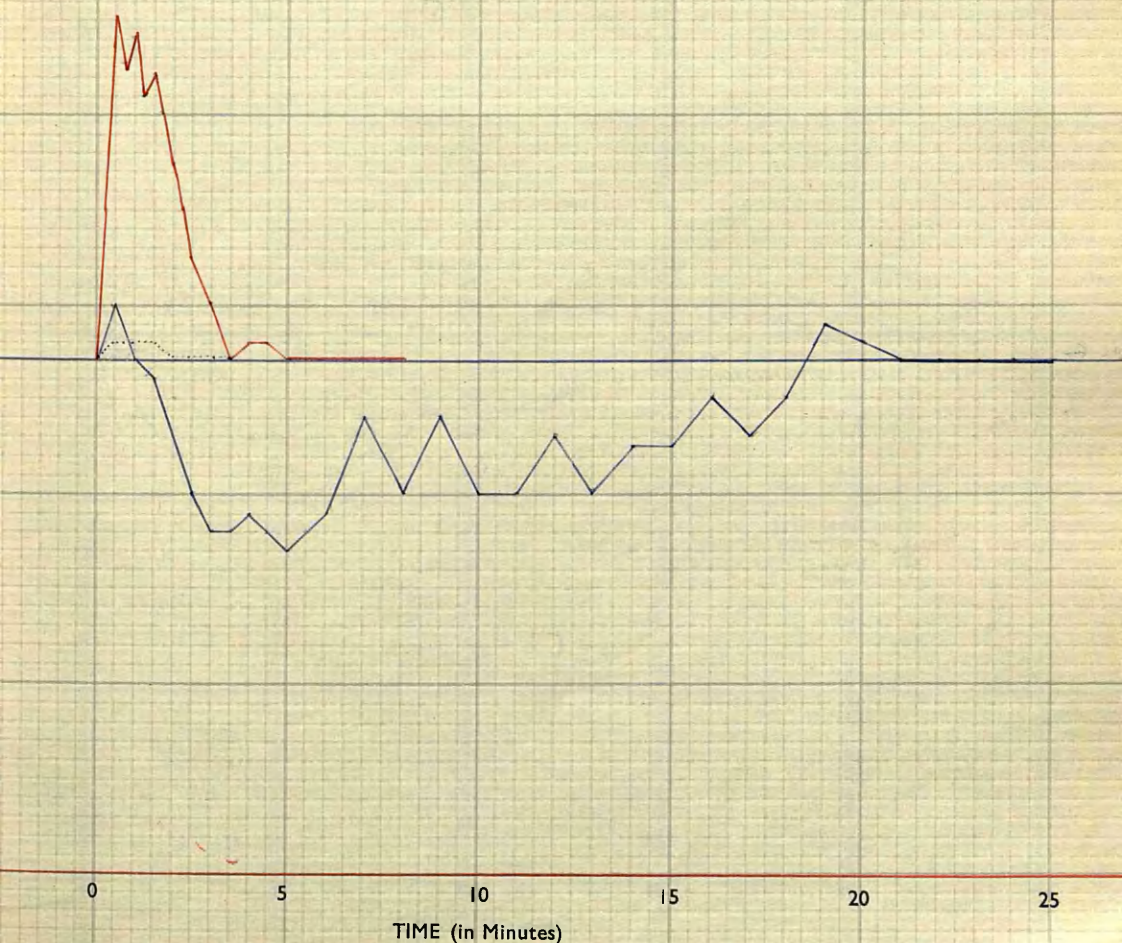
NOT IMPROVED.



CASE No.: 18 (a)

S.A. = 65
P.A. = 173

A.I. = 37.6

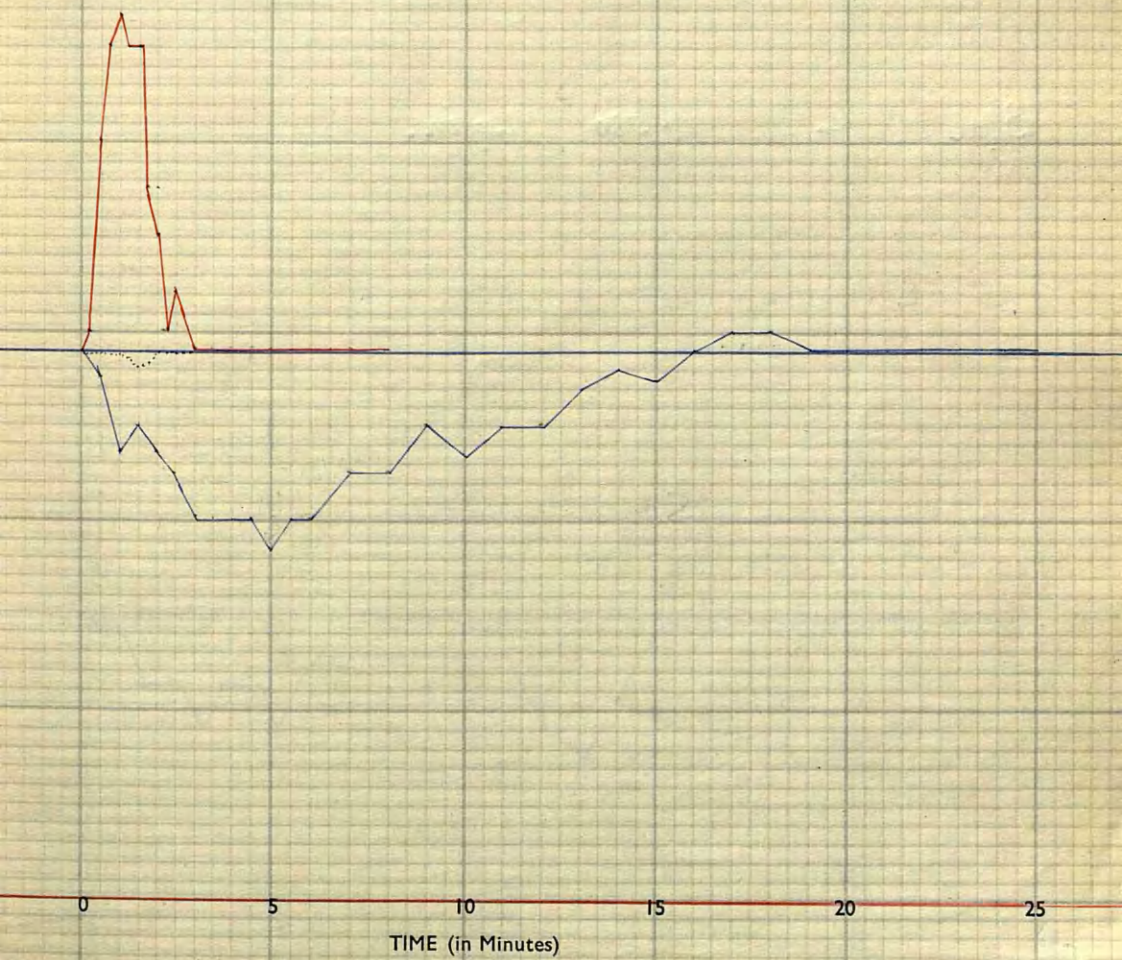


CASE No.: 18 (b)

S.A. = 49
P.A. = 152

A.I. = 32.2

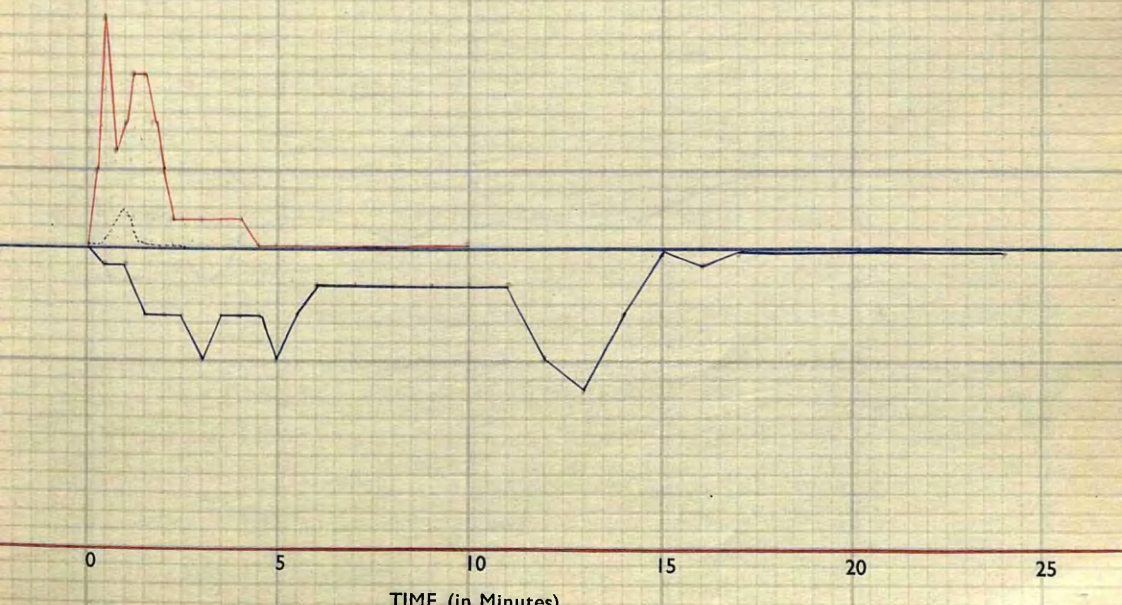
NOT IMPROVED.



CASE No. : 19 (a)

S.A. = 36
P.A. = 96

A.I. = 37.5

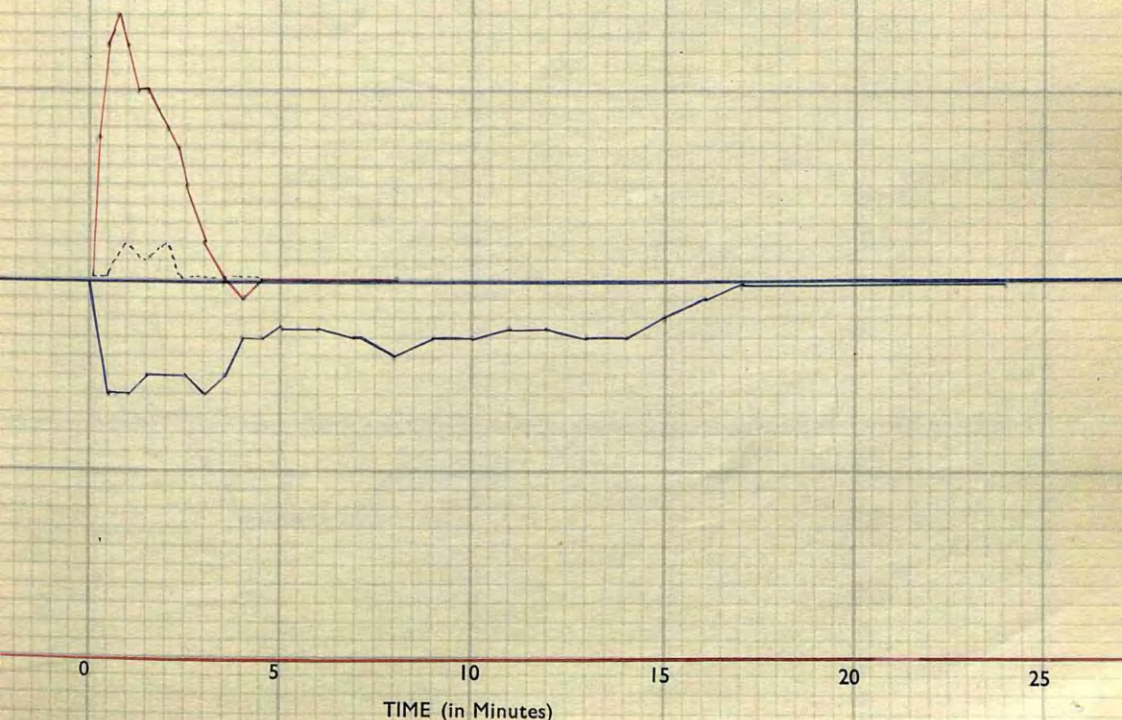


CASE No. : 19 (b)

S.A. = 47
P.A. = 105

A.I. = 44.8

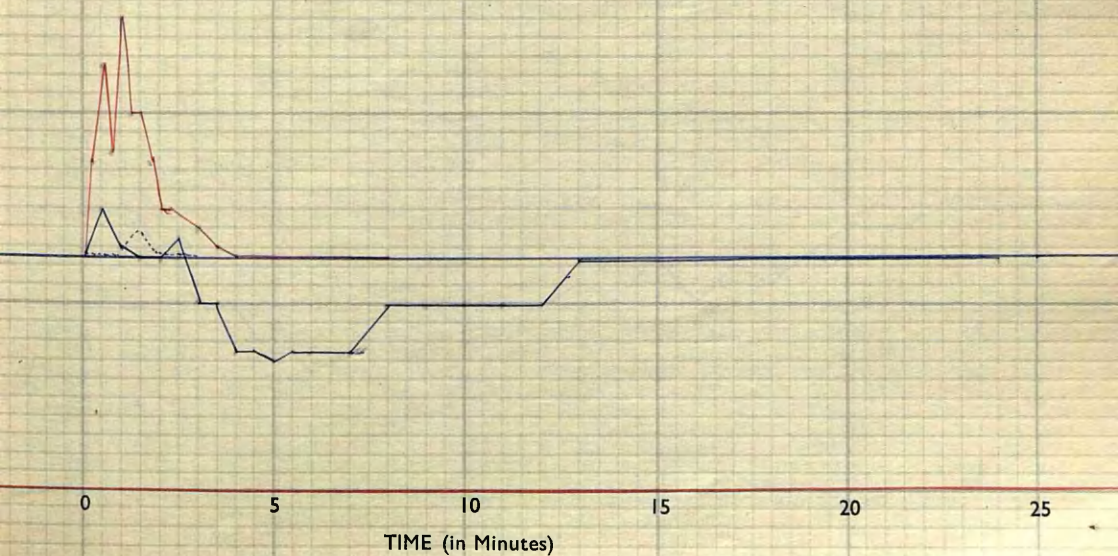
NOT IMPROVED.



CASE No. : 20 (a)

S.A. = 29
P.A = 69

A.I. = 42.0

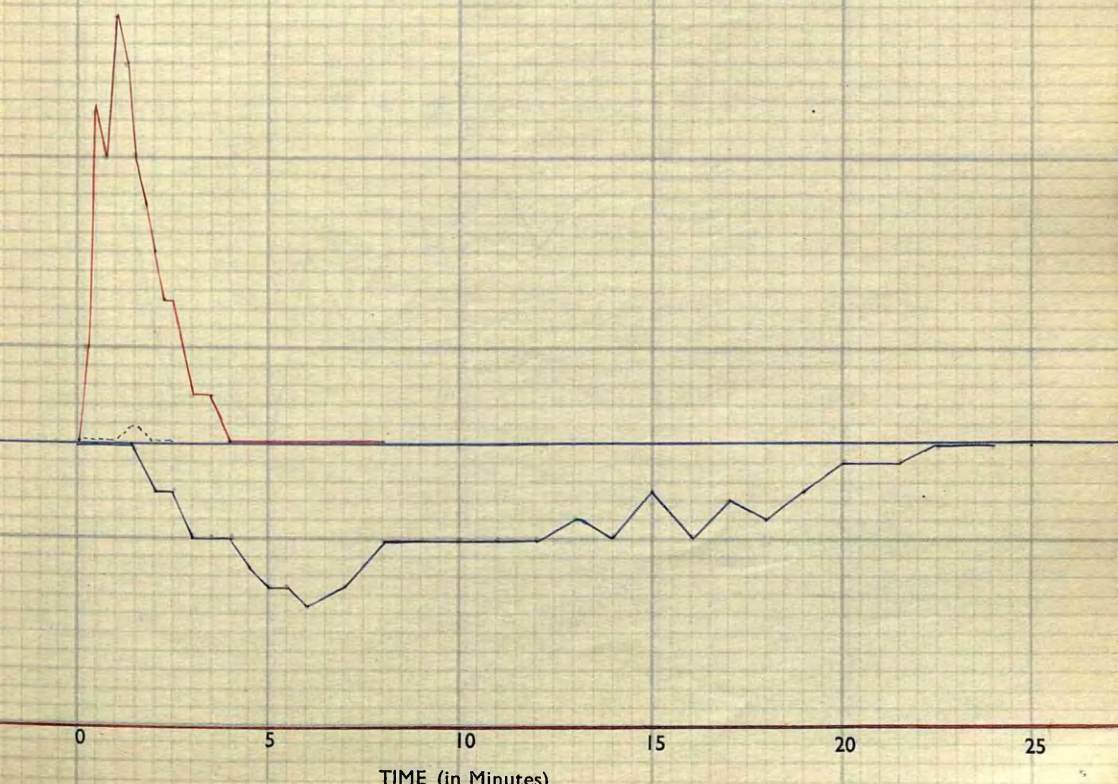


CASE No. : 20 (b)

S.A.= 71
P.A.= 170

A.I.= 41.8

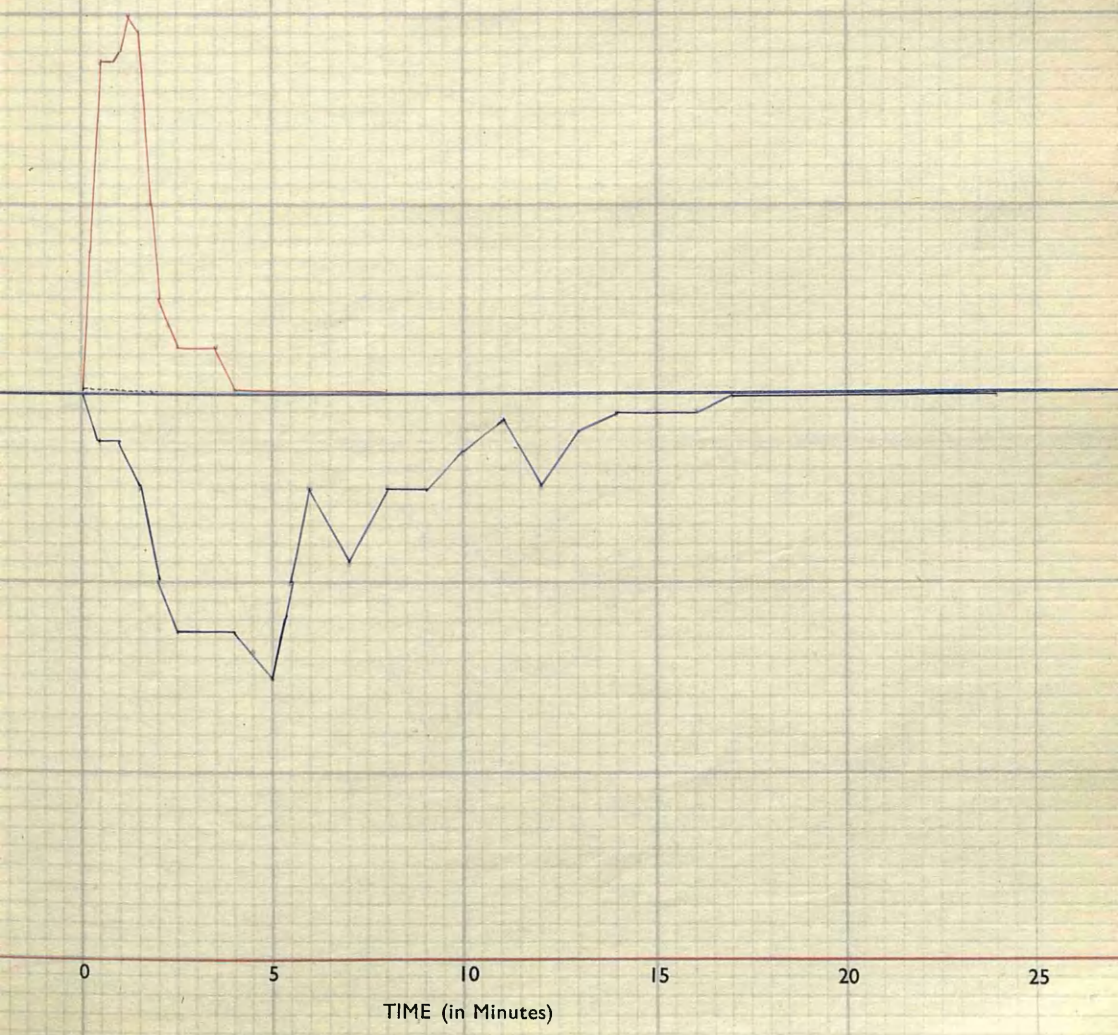
NOT IMPROVED.



CASE No. : 21 (a)

S.A. = 64
P.A. = 183

A.I. = 35

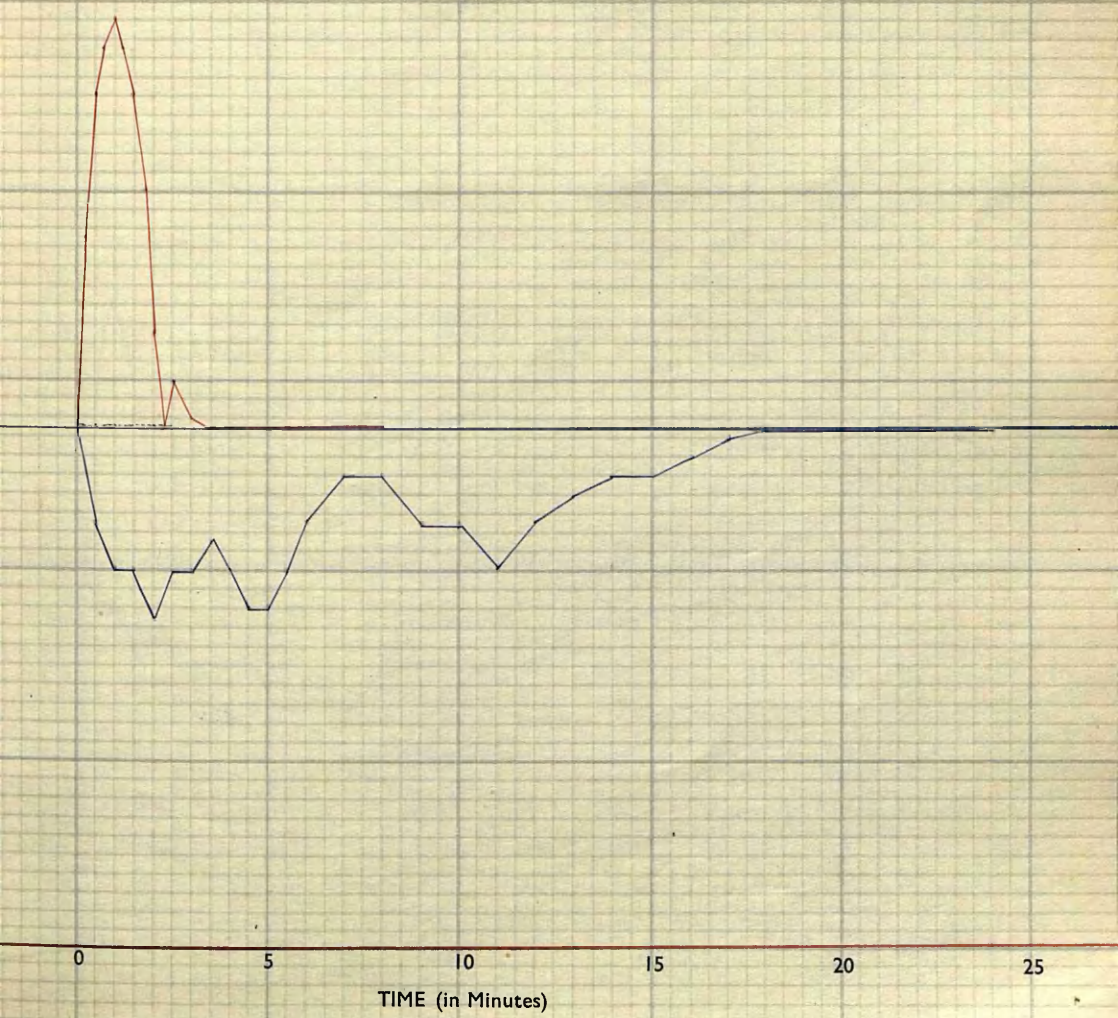


CASE No.: 21 (b)

S.A. = 64
P.A. = 168

A.I. = 38

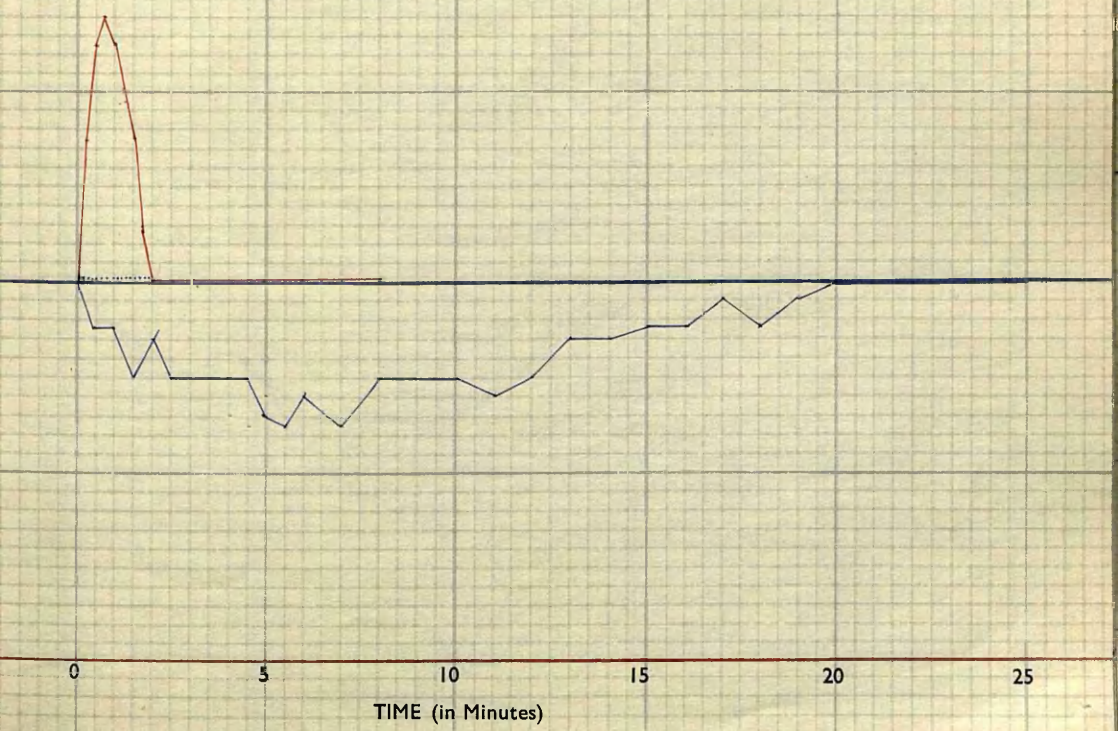
NOT IMPROVED.



CASE No. : 22 (a)

S.A. = 34
P.A. = 157

A.I. = 21.7

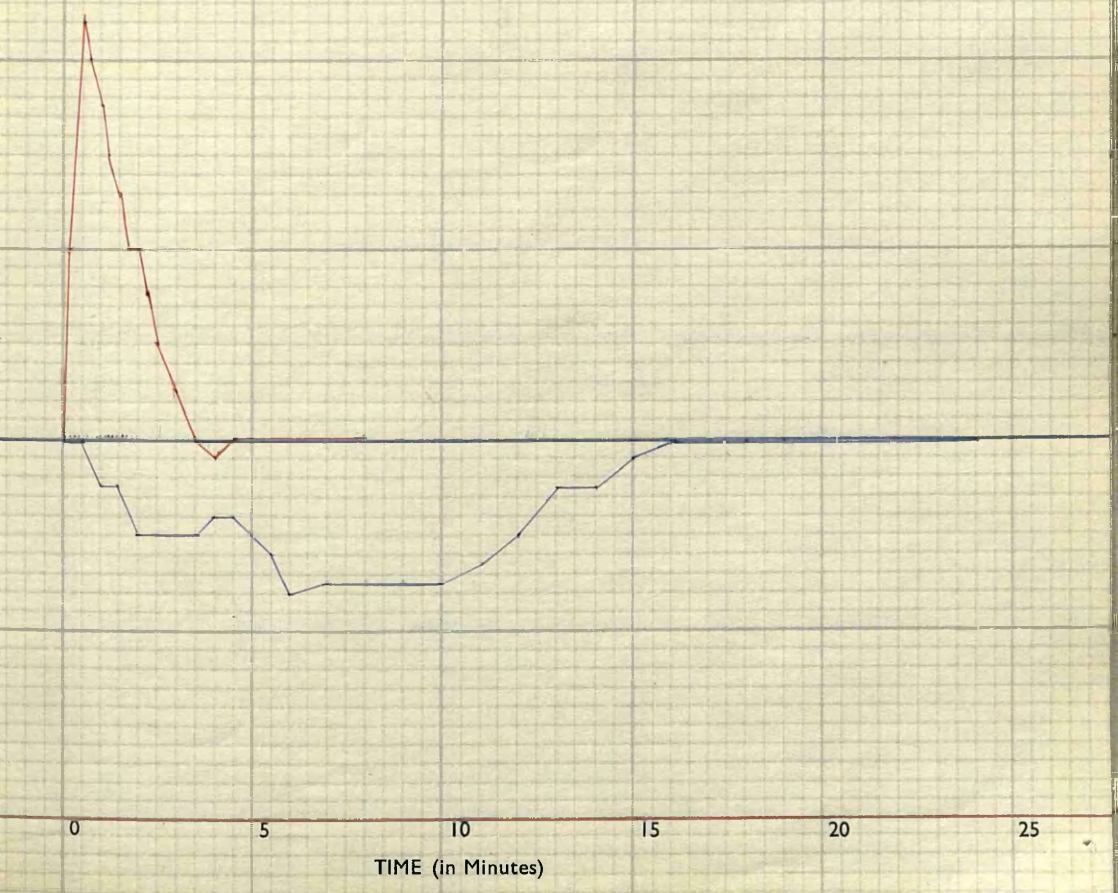


CASE No. : 22 (b)

S.A.= 69
P.A.= 149

A.I.= 46.3

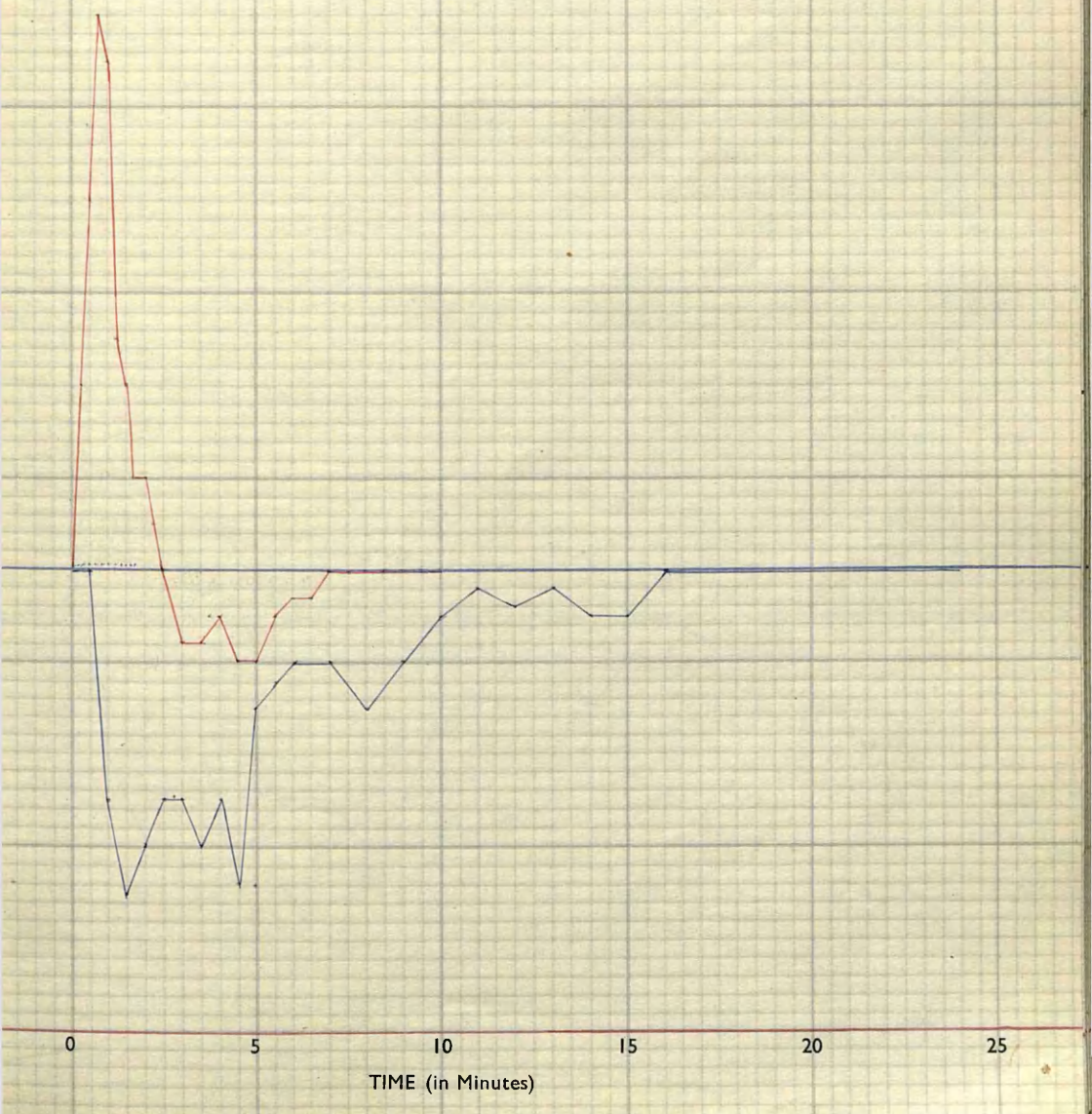
RECOVERED.



CASE No. : 23 (a)

S. A. = 34
P. A. = 191

A. I. = 17.8

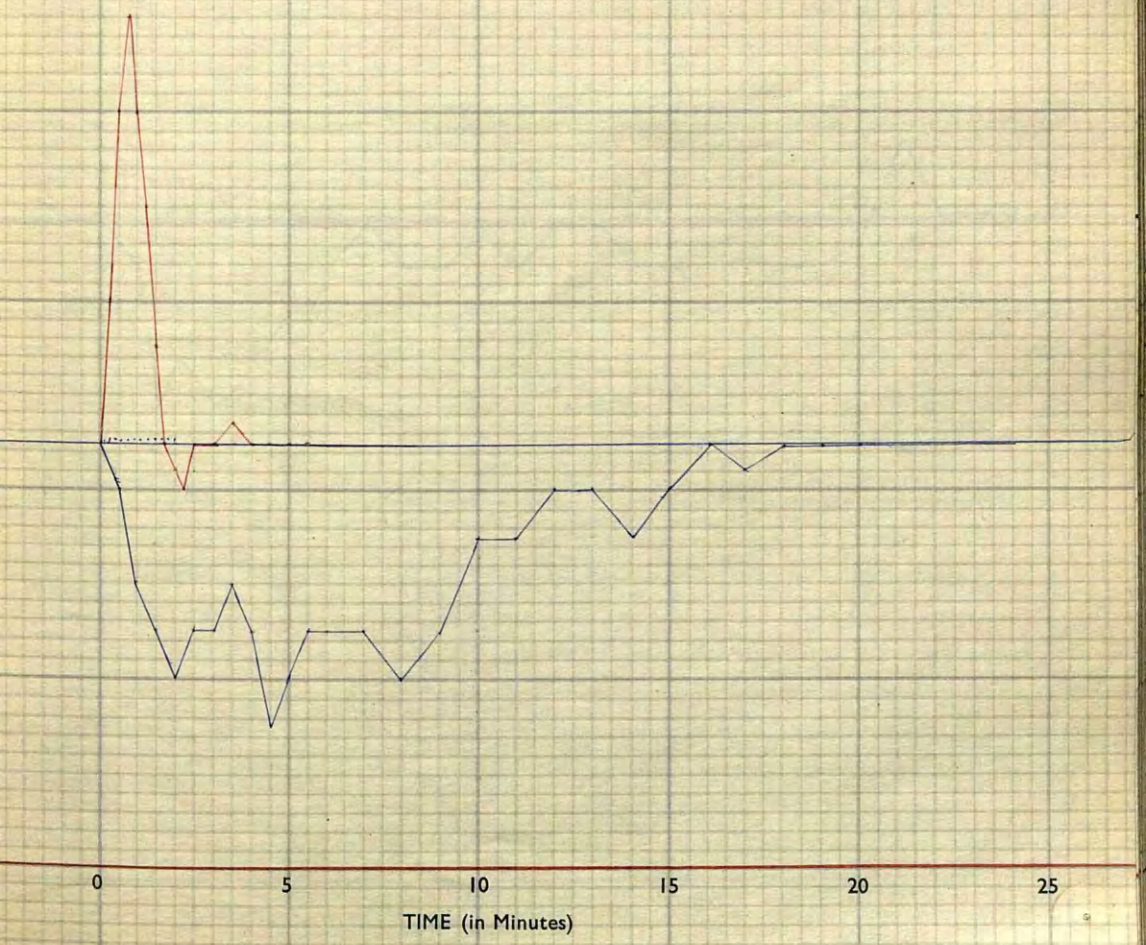


CASE No.: 23 (b)

S.A. = 37
P.A. = 235

A.I. = 15.7

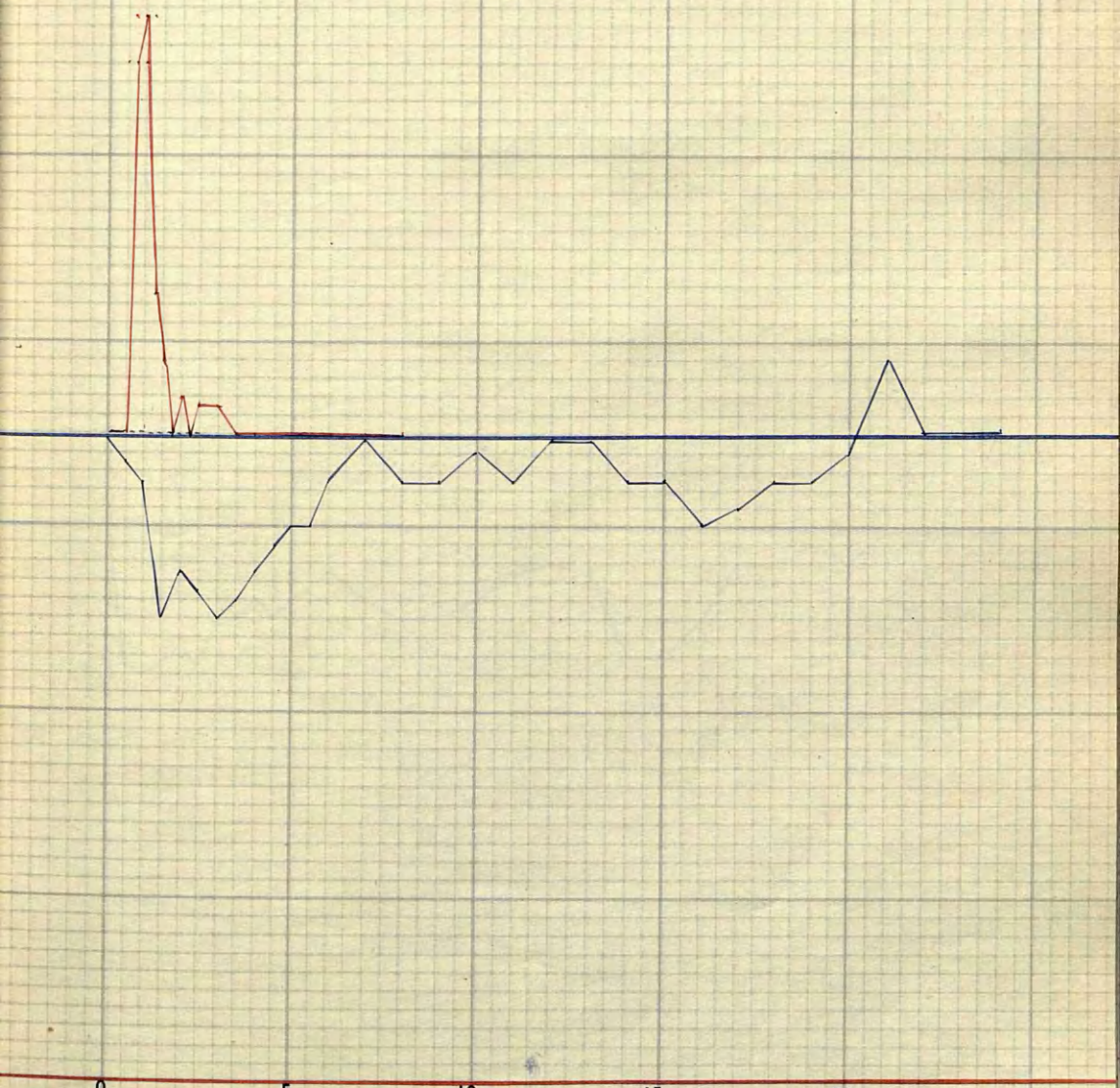
NOT IMPROVED.



CASE No. : 24 (a)

S.A. = 29
P.A. = 114

A.I. = 25.4

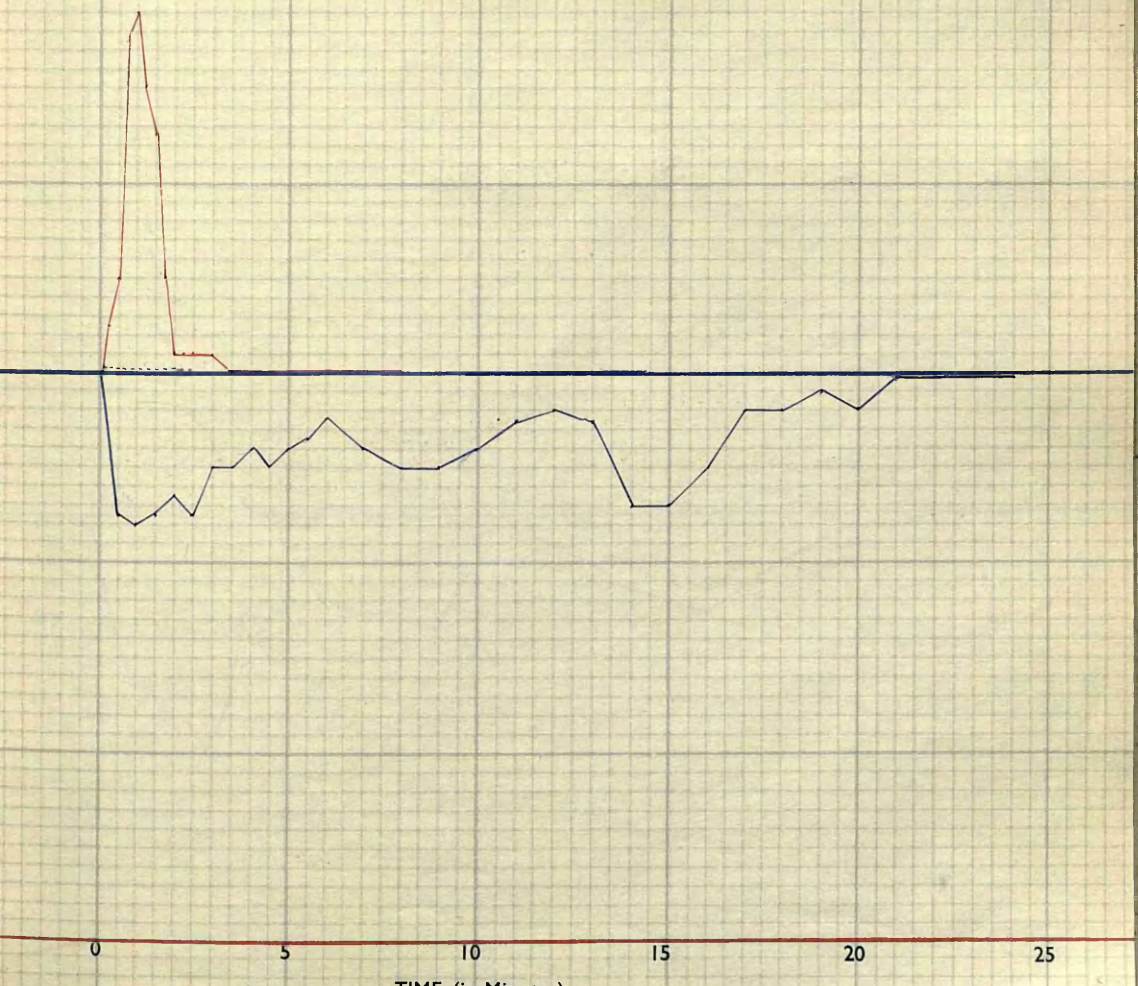


CASE No. : 24 (b)

S.A. = 37
P.A. = 168

A.I. = 22.6

NOT IMPROVED.



CASE No.: 25 (a)

S.A. = 76
P.A. = 183

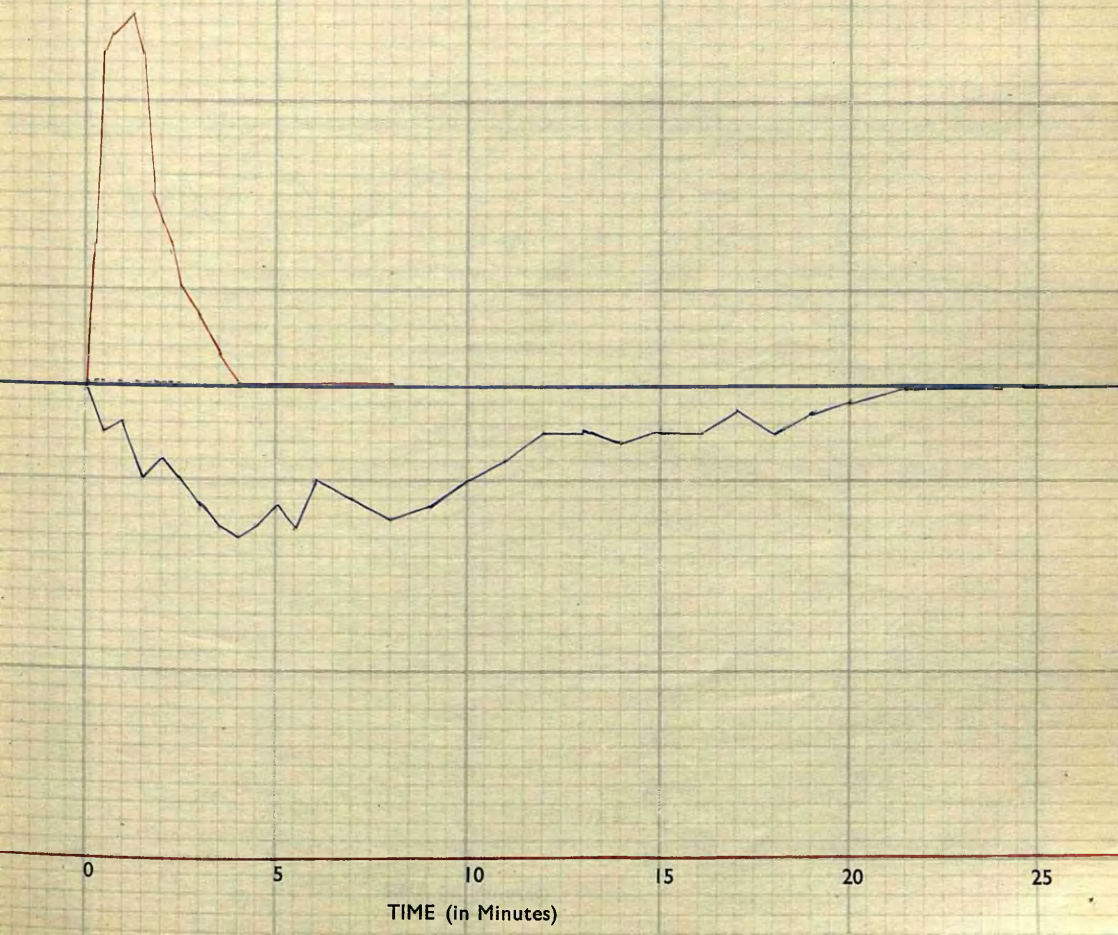
A.I. = 41.5

CASE No. : 25 (b)

S.A. = 70
P.A. = 160

A.I. = 44.4

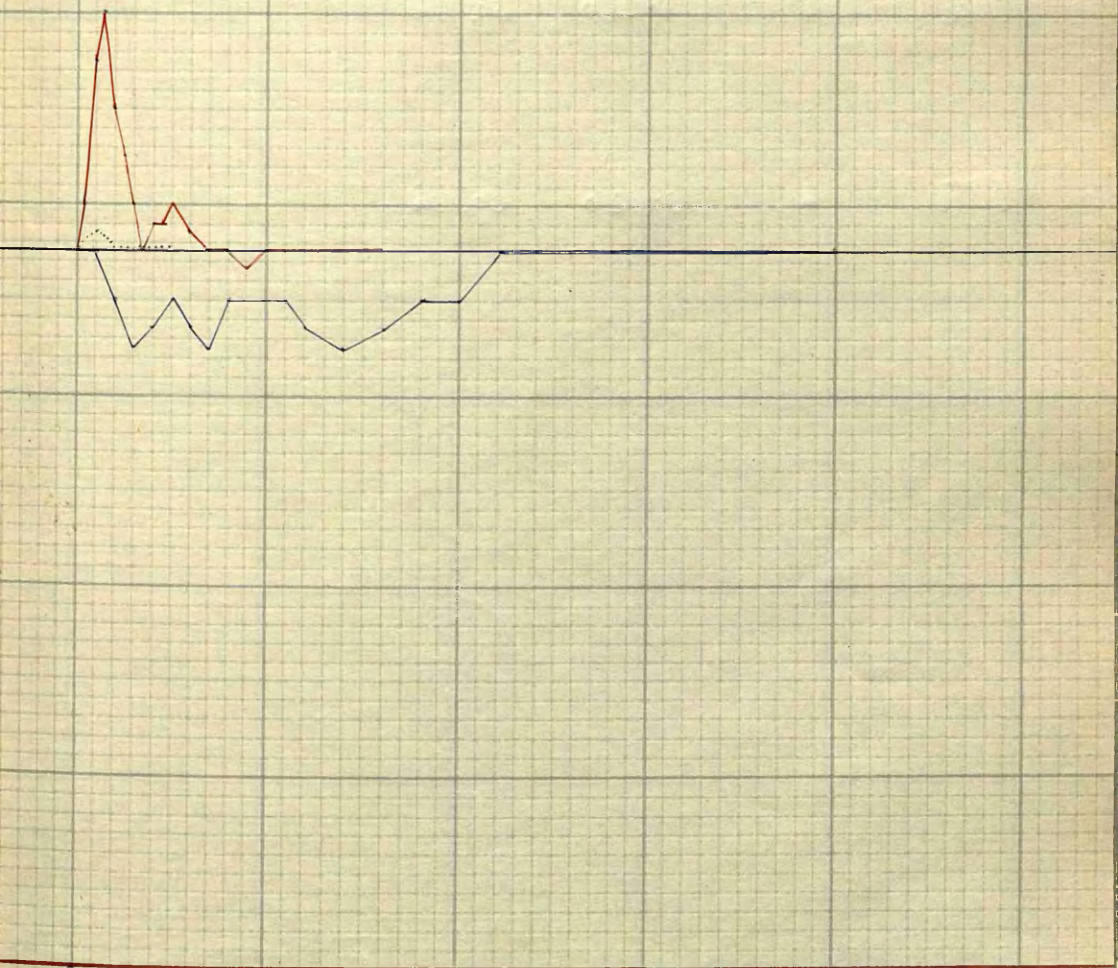
NOT IMPROVED.



CASE No.: 26 (a)

S.A. = 24
P.A. = 67

A.I. 35.8



CASE No. : 26 (b)

S.A. = 45
P.A. = 114

A.I. = 38.6

NOT IMPROVED.

CASE No.: 27 (a)

S.A.= 50
P.A.= 149

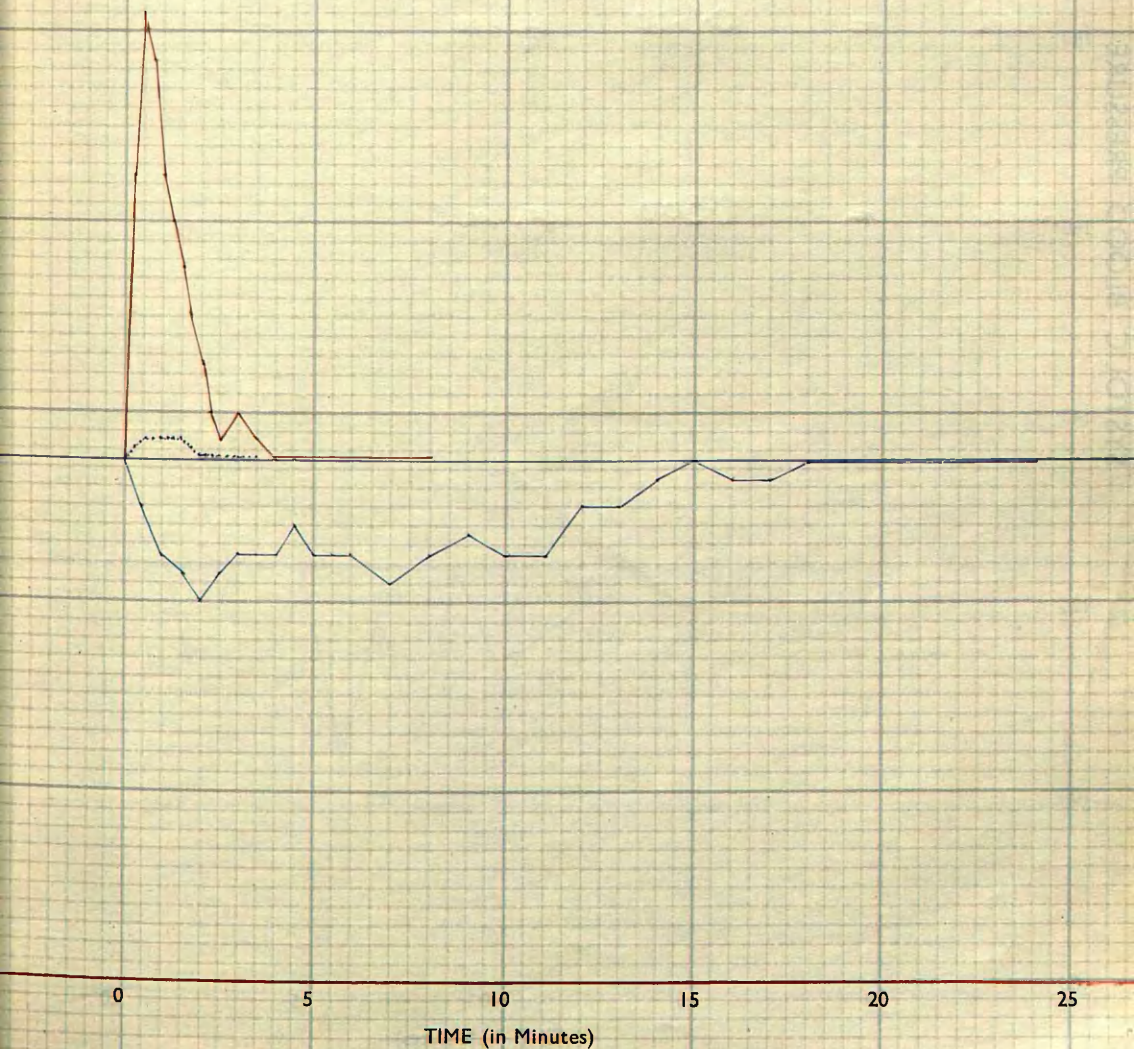
A.I.= 33.6

CASE No.: 27 (b)

S.A.= 59
P.A.= 126

A.I.= 48.4

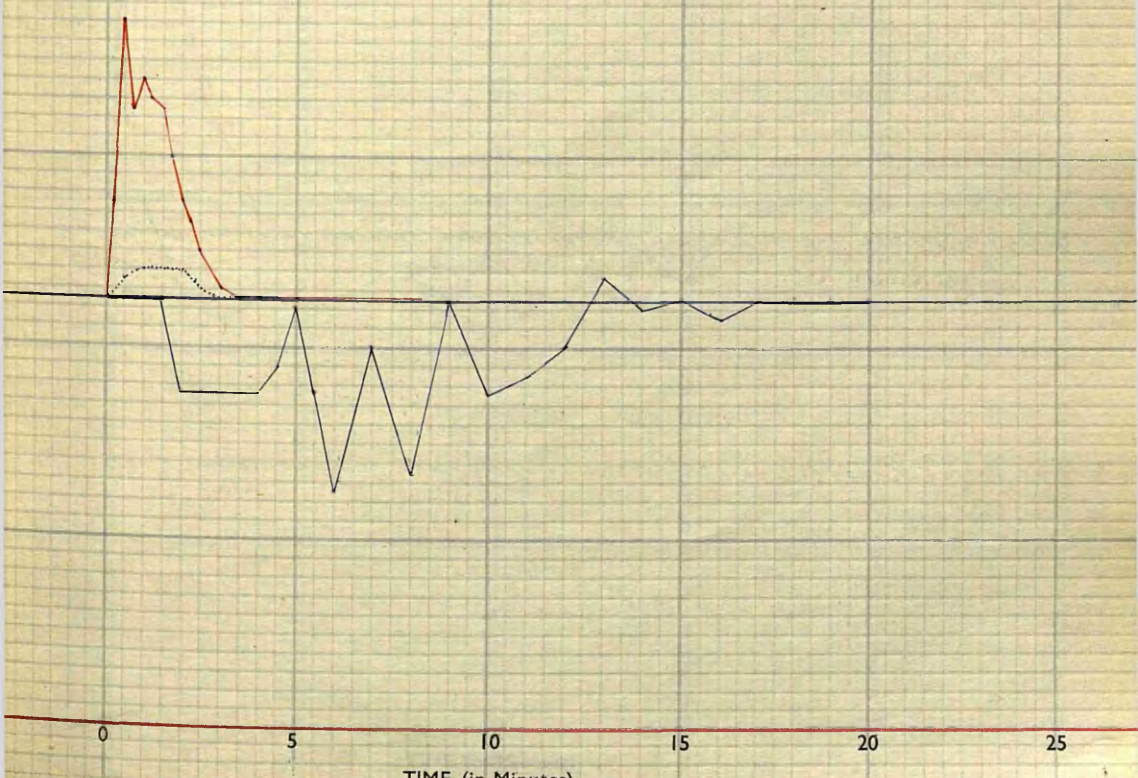
IMPROVED.



CASE No. : 28 (a)

S.A. = 43
P.A. = 92

A.I. = 46.7

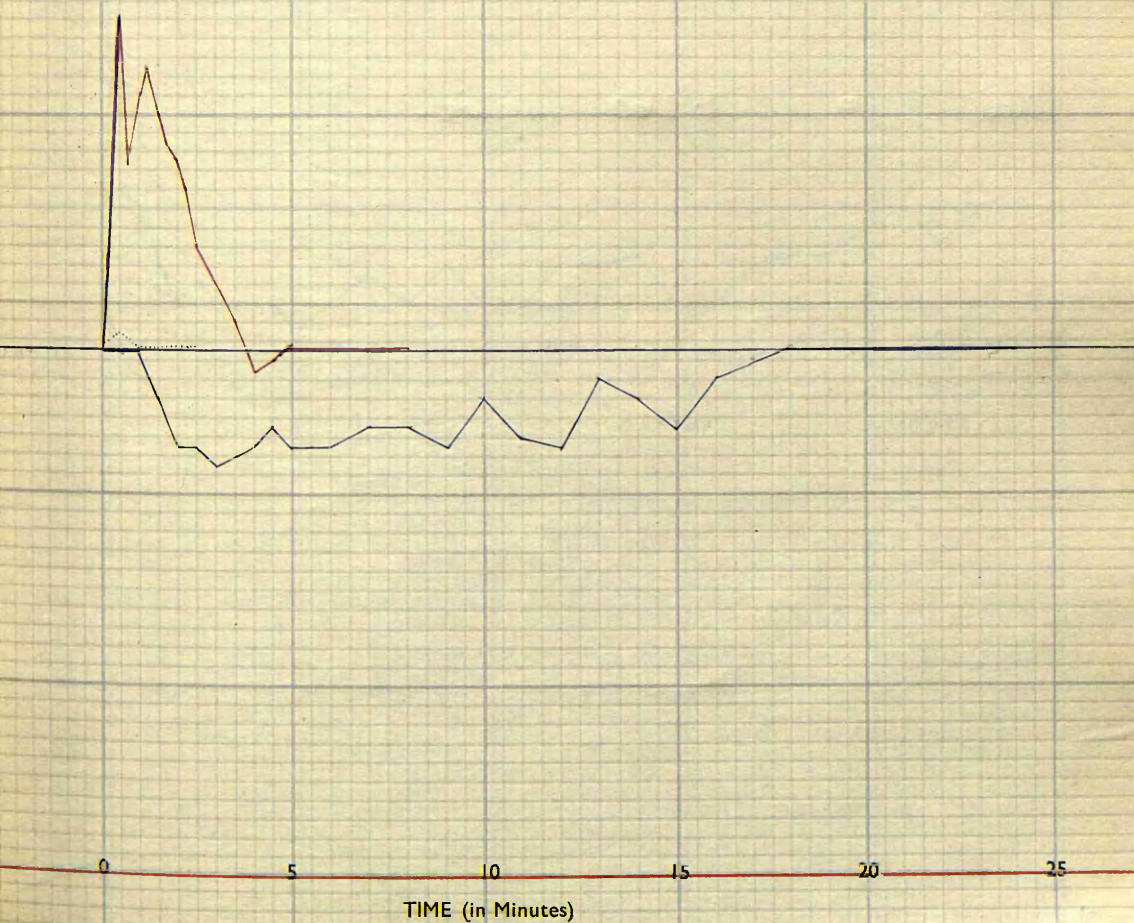


CASE No. : 28 (b)

S.A. = 58
P.A. = 119

A.I. = 48.6

NOT IMPROVED.



CASE No. : 29 (a).

S.A. = 66
P.A. = 150

A.I. = 44.4

0 5 10 15 20 25

TIME (in Minutes)

CASE No.: 29 (b)

S.A. = 56
P.A. = 128

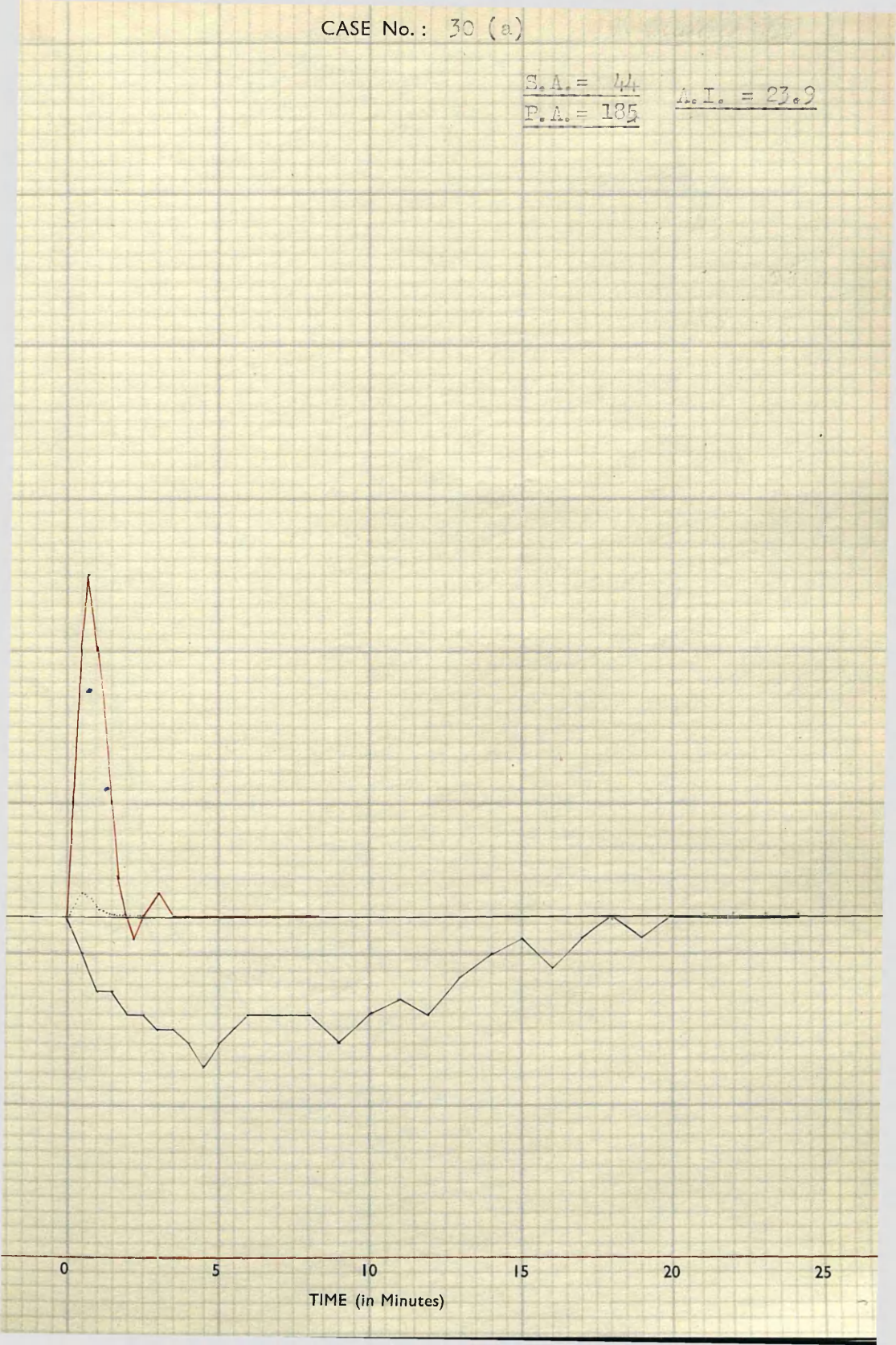
A.I. = 43.8

NOT IMPROVED.

CASE No.: 30 (a)

S.A. = 44
P.A. = 185

A.I. = 23.9

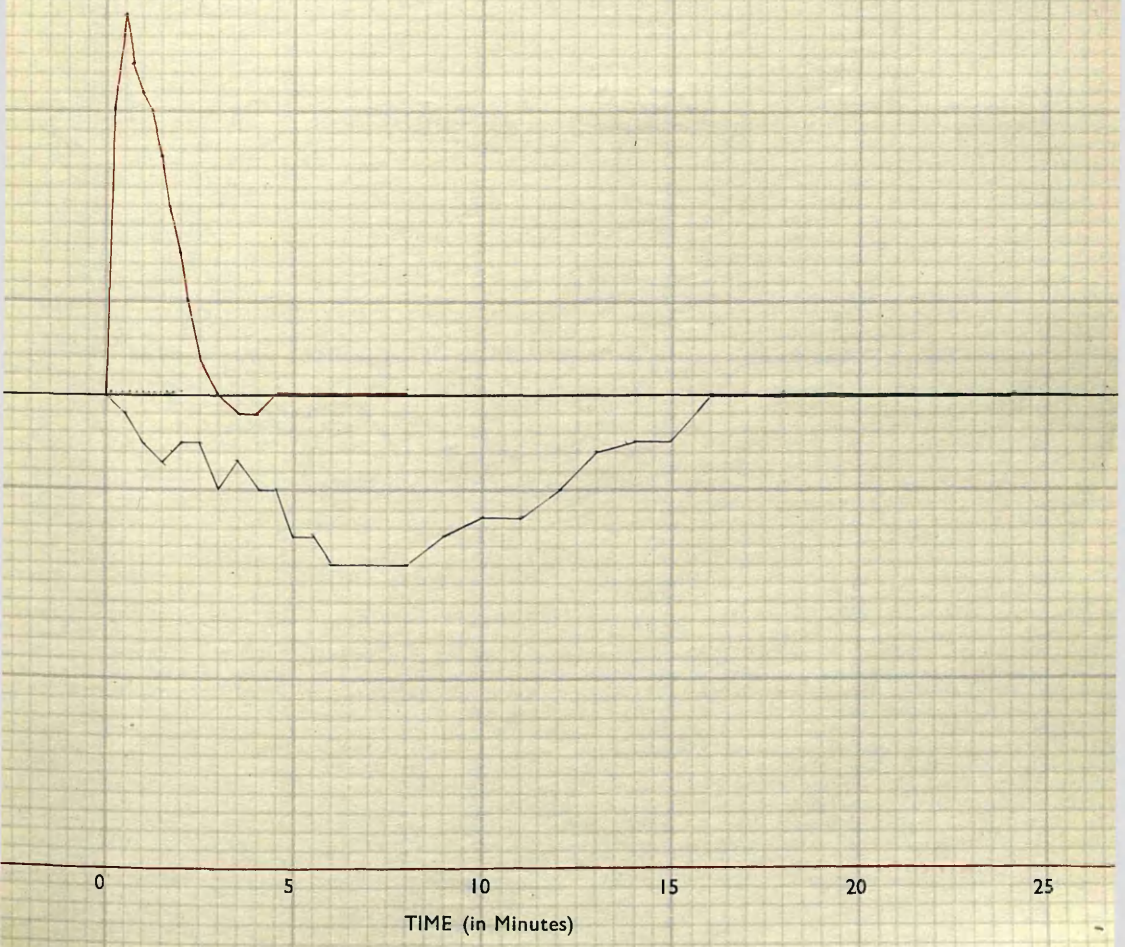


CASE No.: 30 (b)

S.A. = 62
P.A. = 159

A.I. = 39

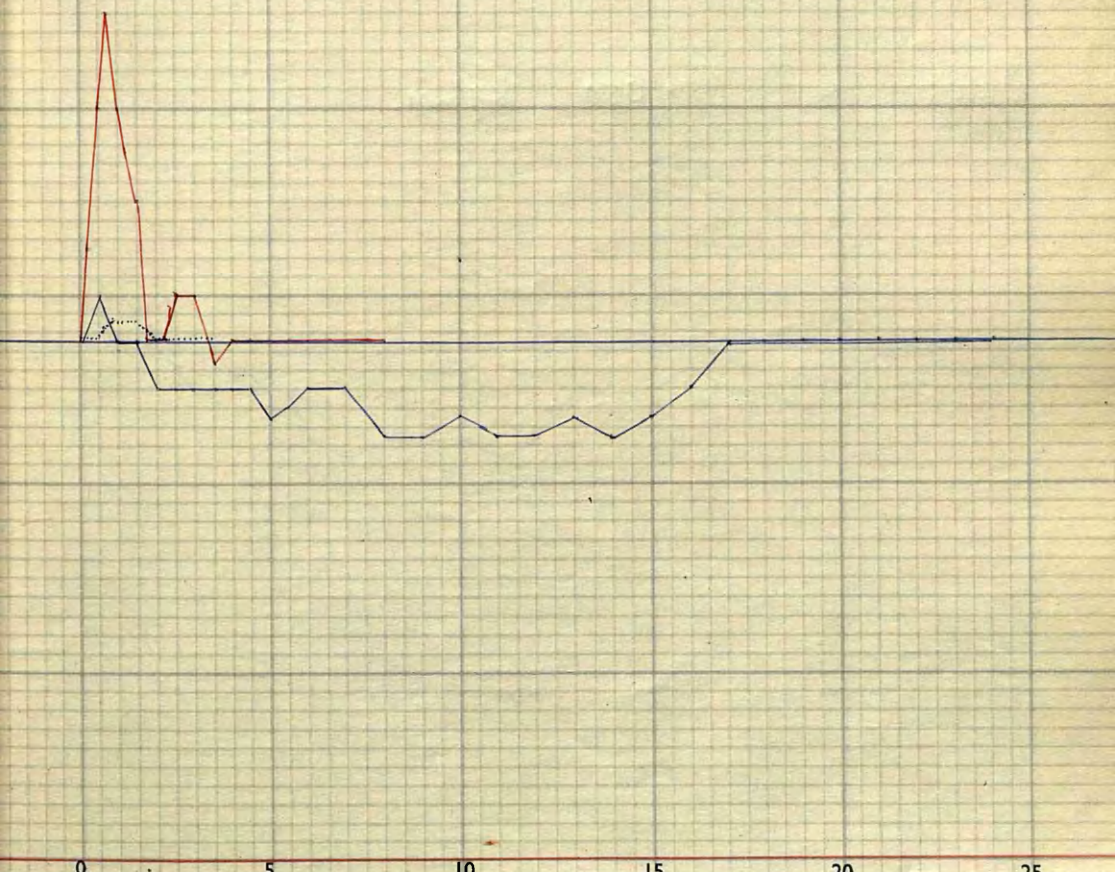
NOT IMPROVED.



CASE No.: 31 (a)

S.A. = 39
P.A. = 108

A.I. = 36.2

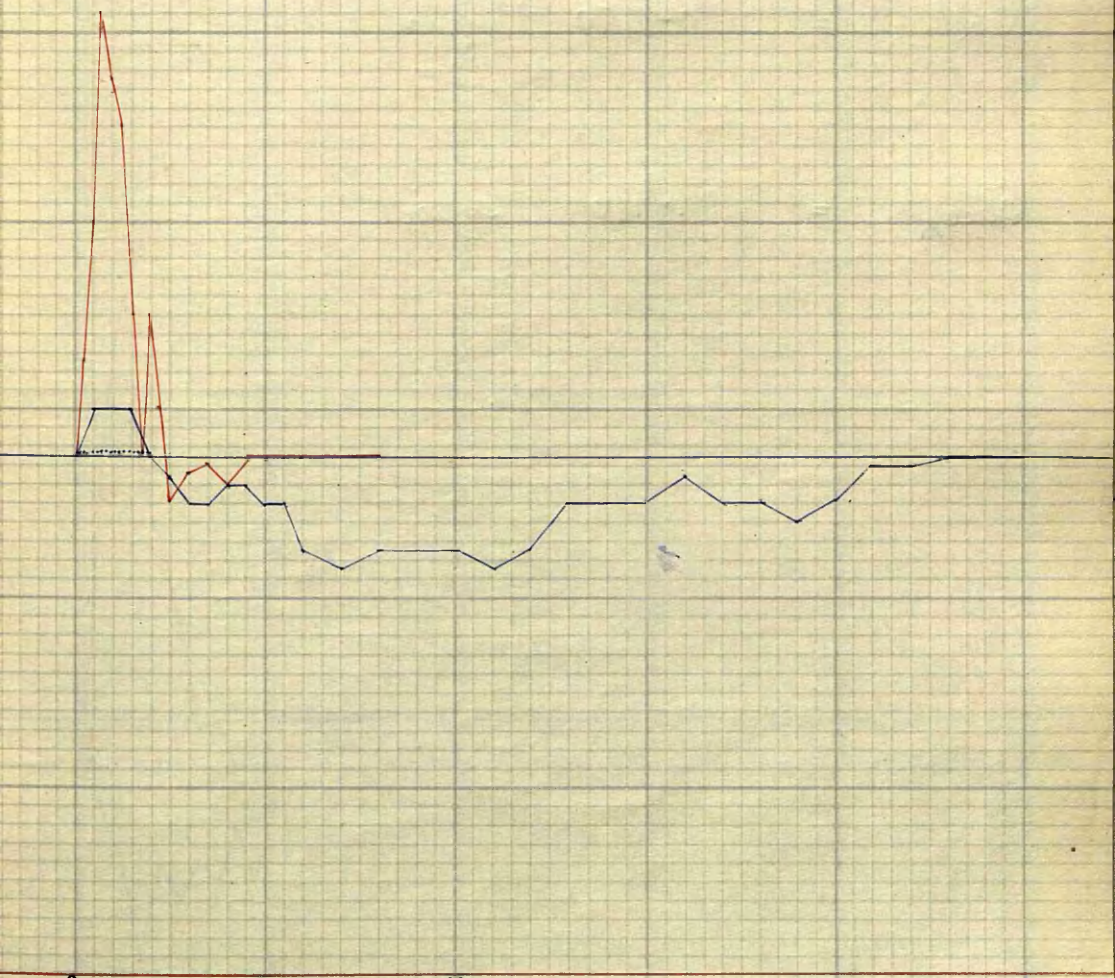


CASE No.: 31 (b)

S.A. = 42
P.A. = 117

A.I. = 35.9

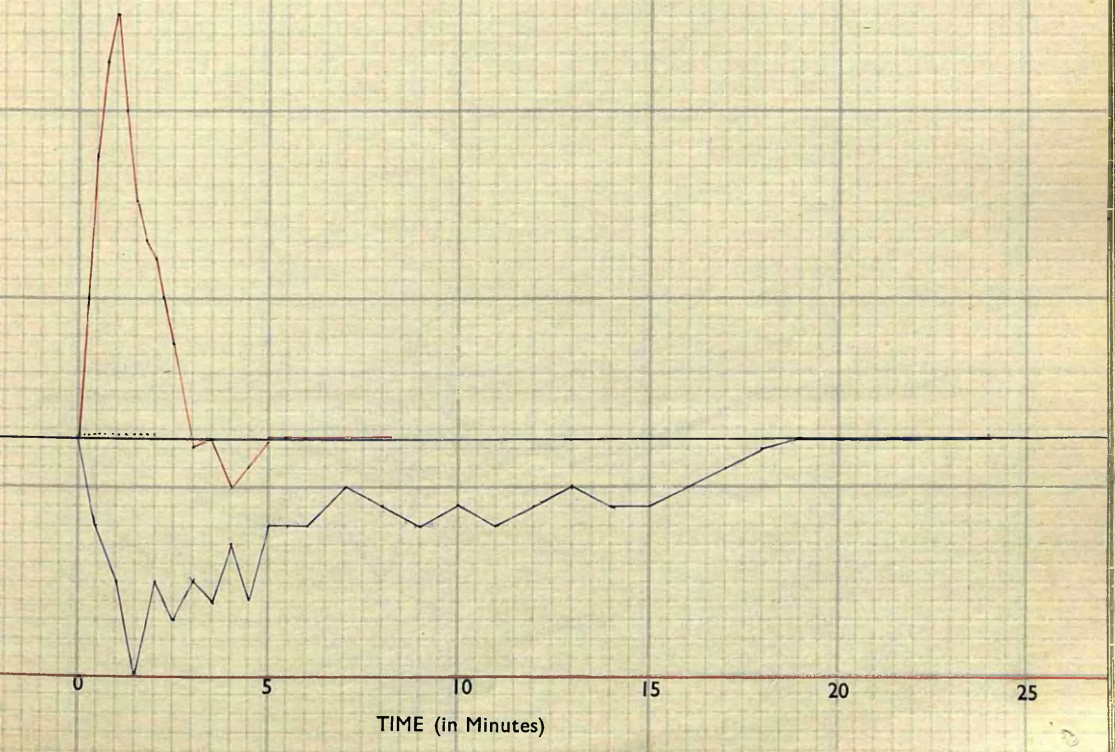
NOT IMPROVED.



CASE No.: 32 (a)

S.A. = 58
P.A. = 160

A.I. = 36.2

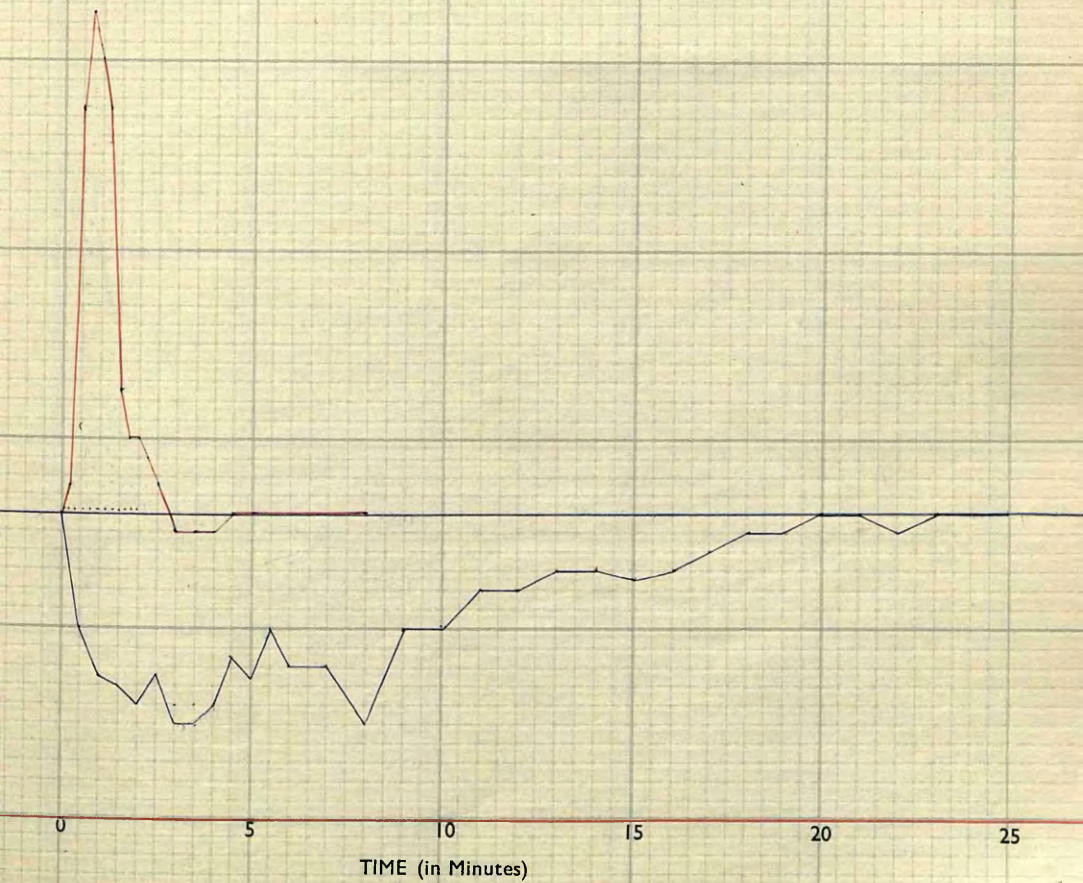


CASE No. : 32 (b)

S. A. = 54
P. A. = 219

A. I. = 24.7

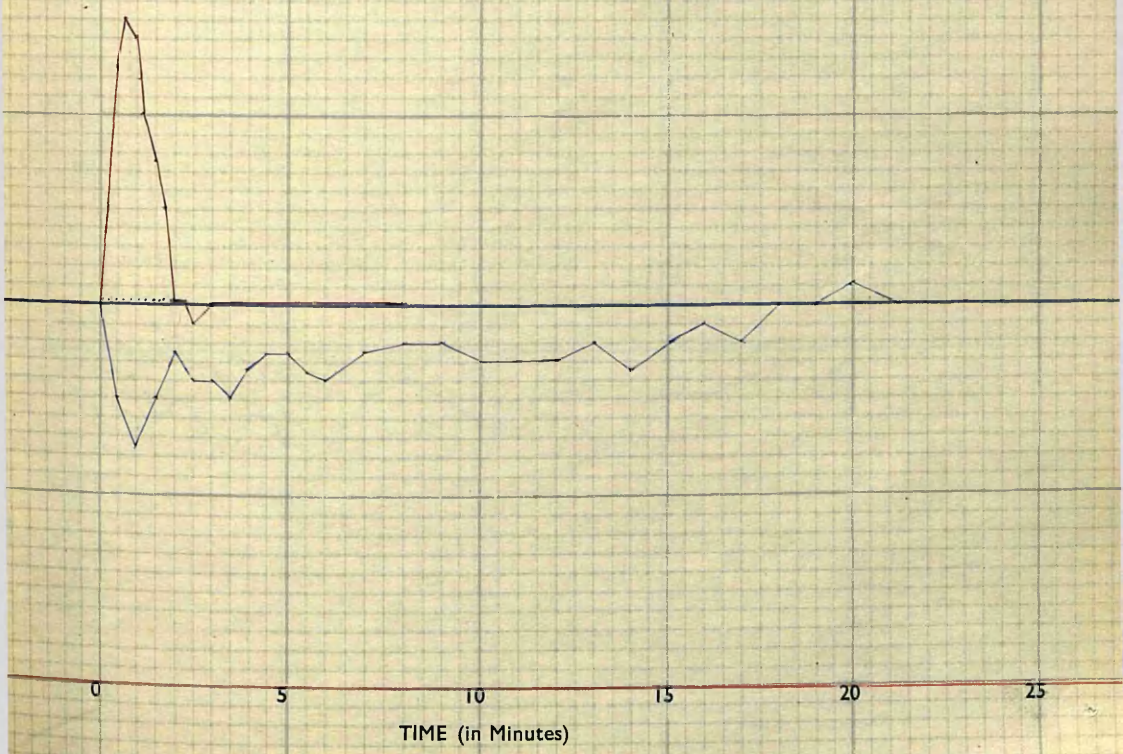
NOT IMPROVED.



CASE No.: 33 (a)

S. A. = 34
P. A. = 103

A. I. = 33

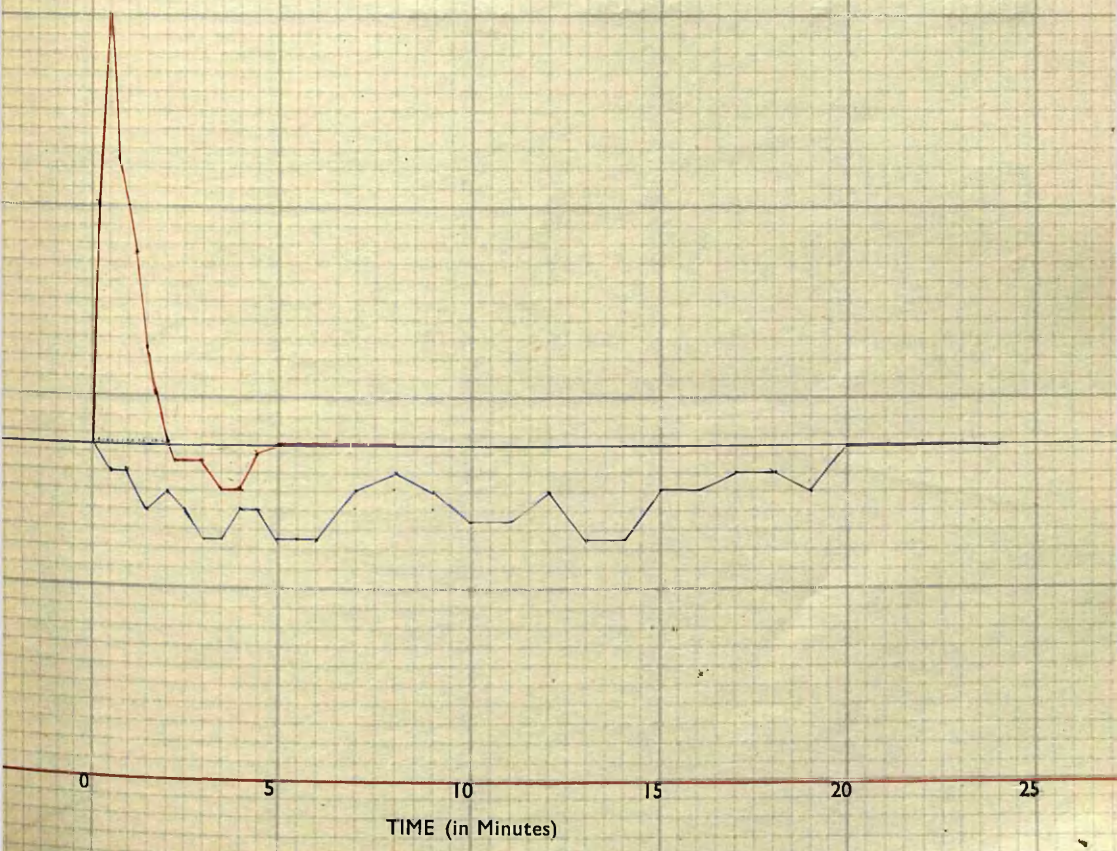


CASE No.: 33 (b)

S.A. = 35
P.A. = 123

A.I. = 28.5

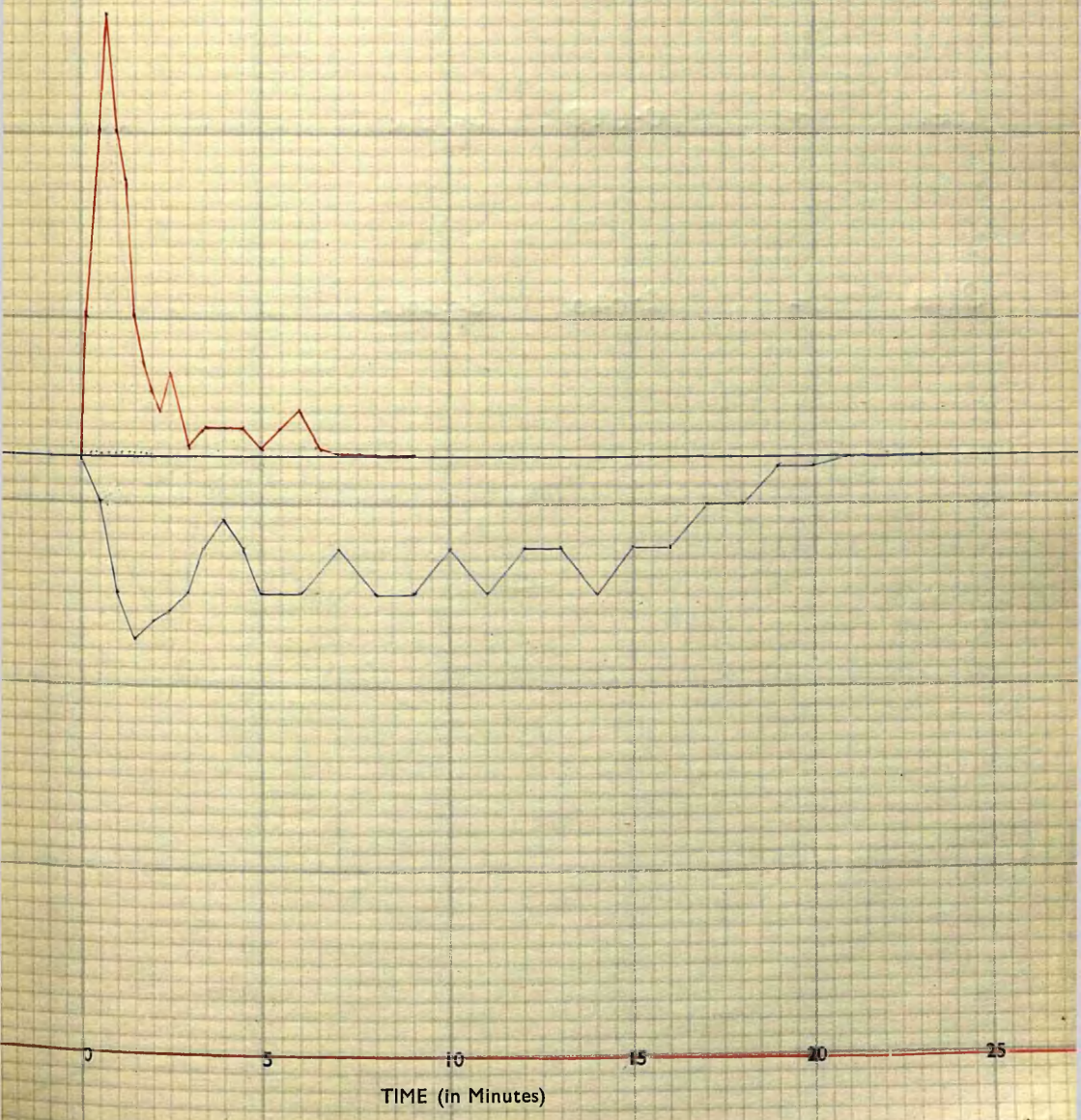
NOT IMPROVED.



CASE No. : 34 (a)

S.A. = 63
P.A. = 213

A.I. = 30

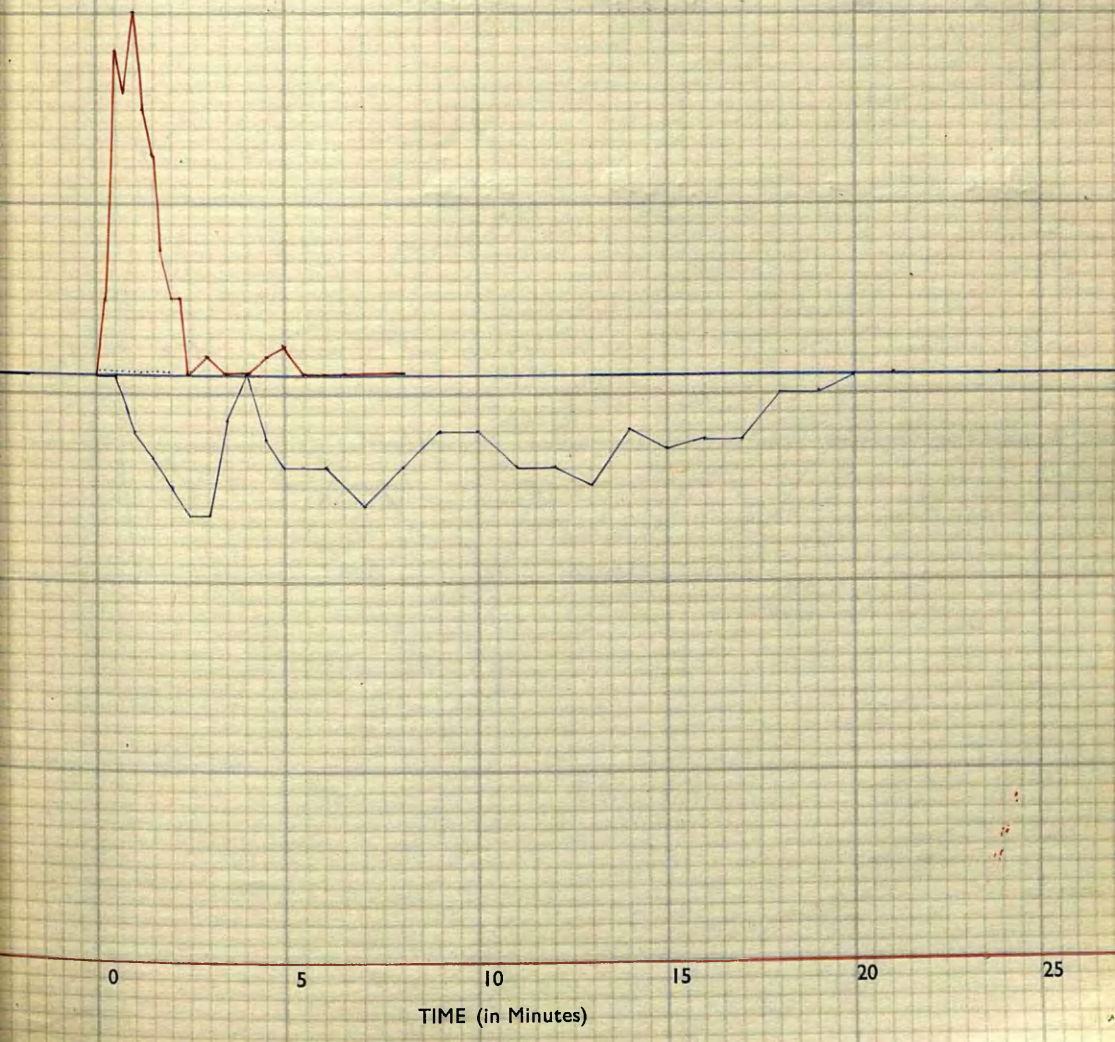


CASE No.: 34 (b)

S.A.= 47
P.A.= 149

A.I.= 31.5

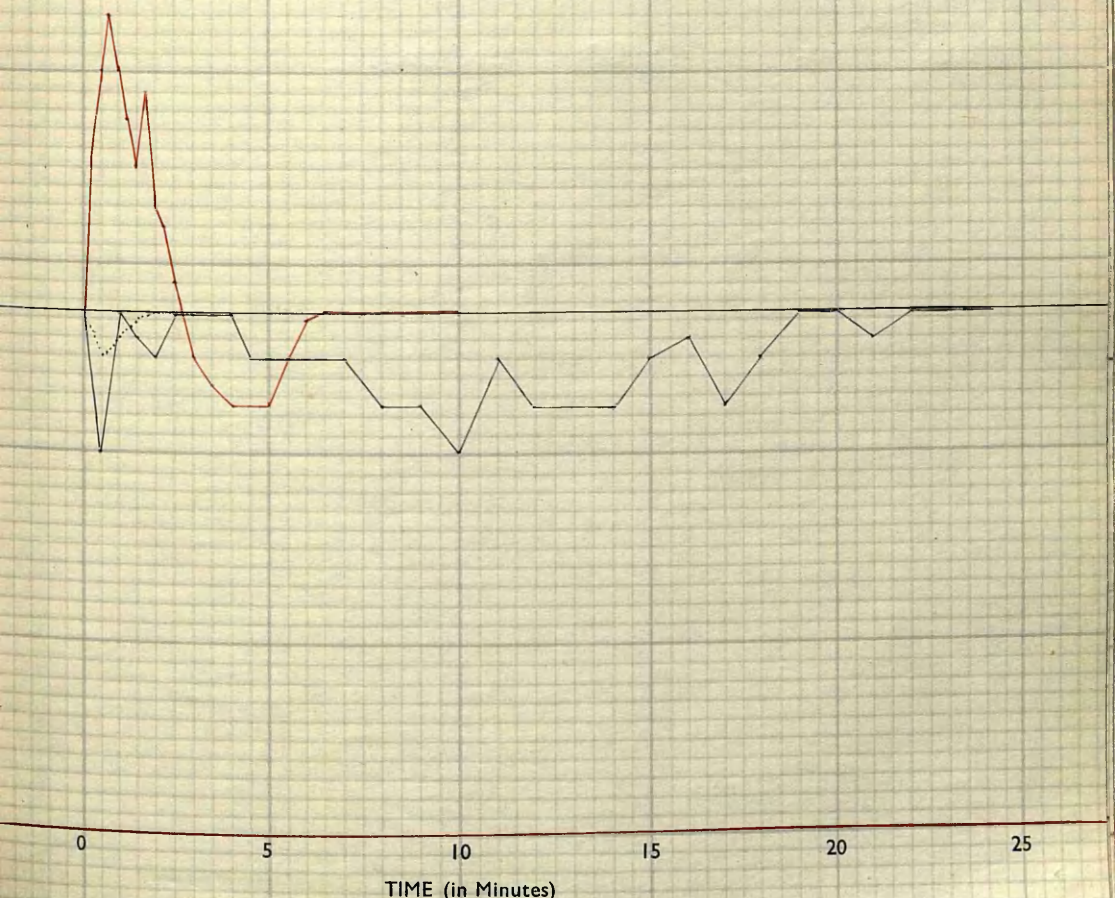
NOT IMPROVED.



CASE No. : 35 (a)

S.A. = 22
P.A. = 117

A.I. = 18.9

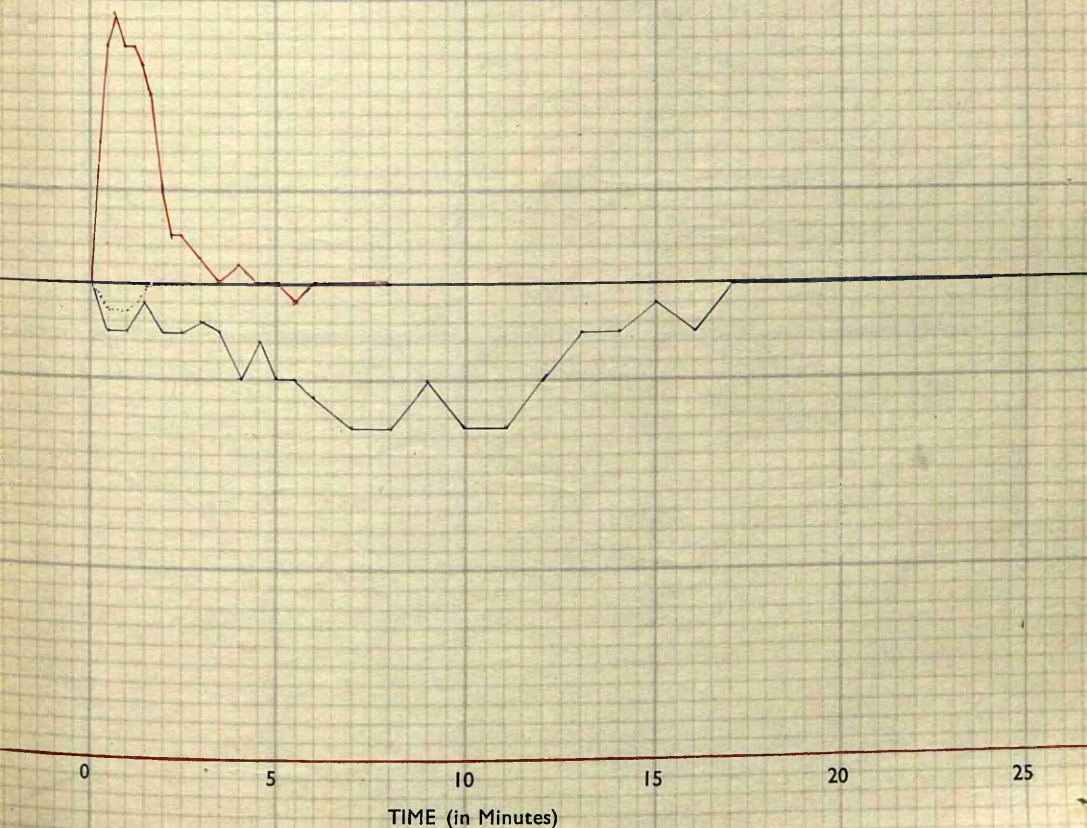


CASE No.: 35 (b)

S.A.= 45
P.A.= 136

A.I.= 33.1

NOT IMPROVED.

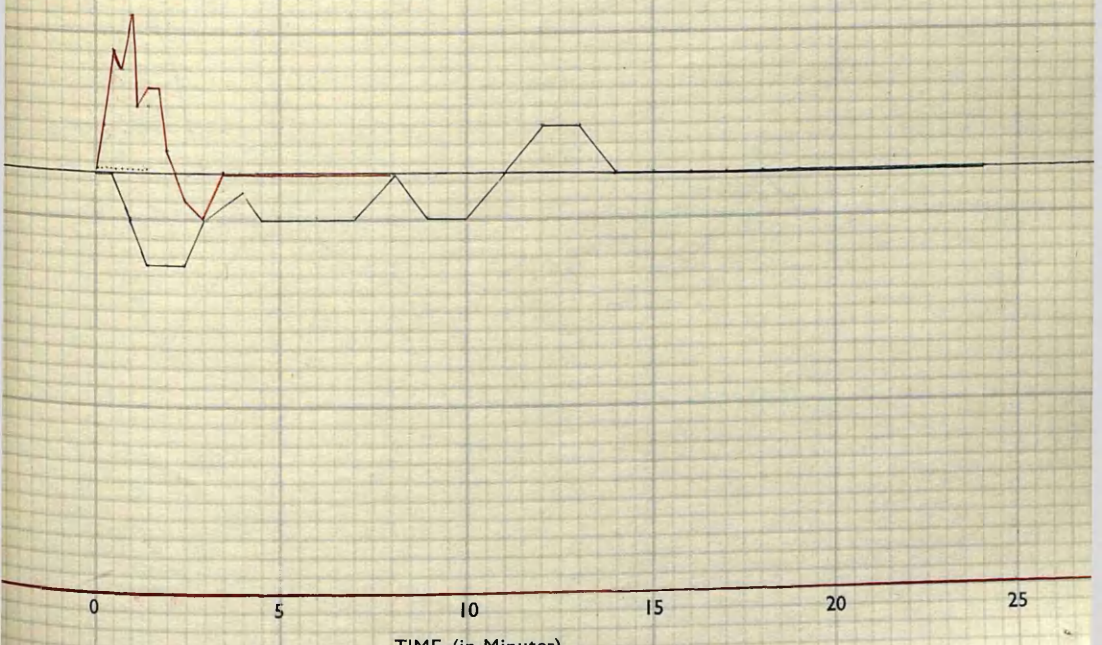


CASE No.: 36 (a)

S.A.= 14

P.A.= 35

A.I.= 40

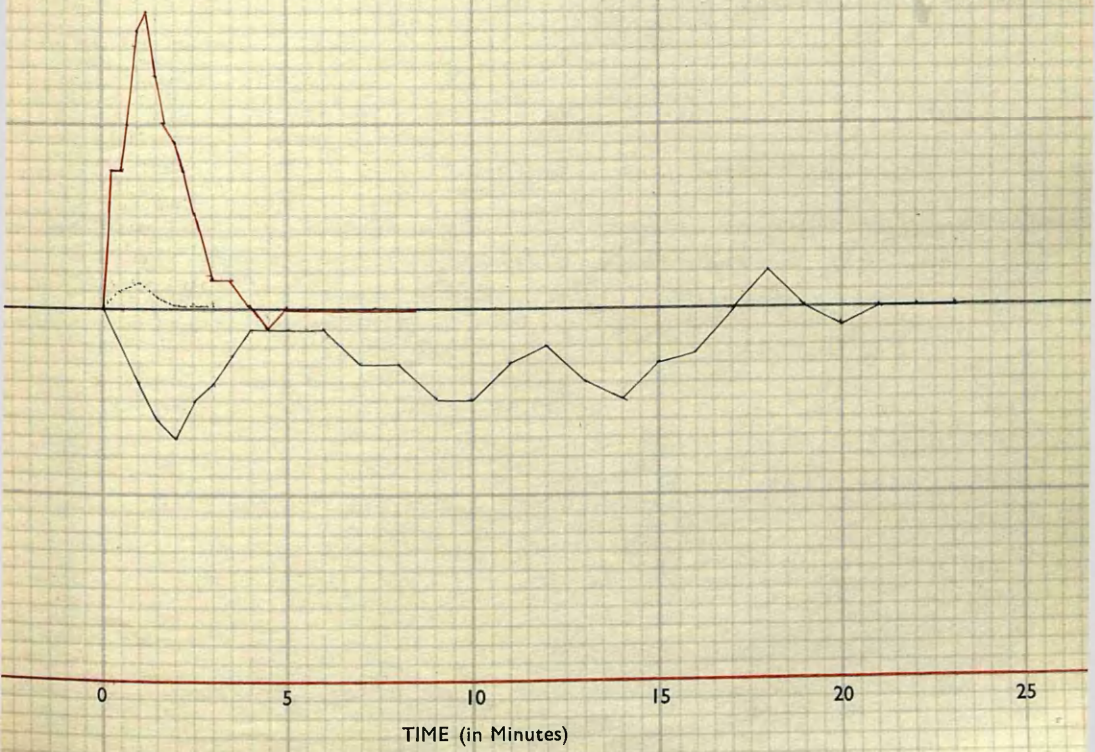


CASE No.: 36 (b)

S.A. = 52
P.A. = 107

A.I. = 48.6

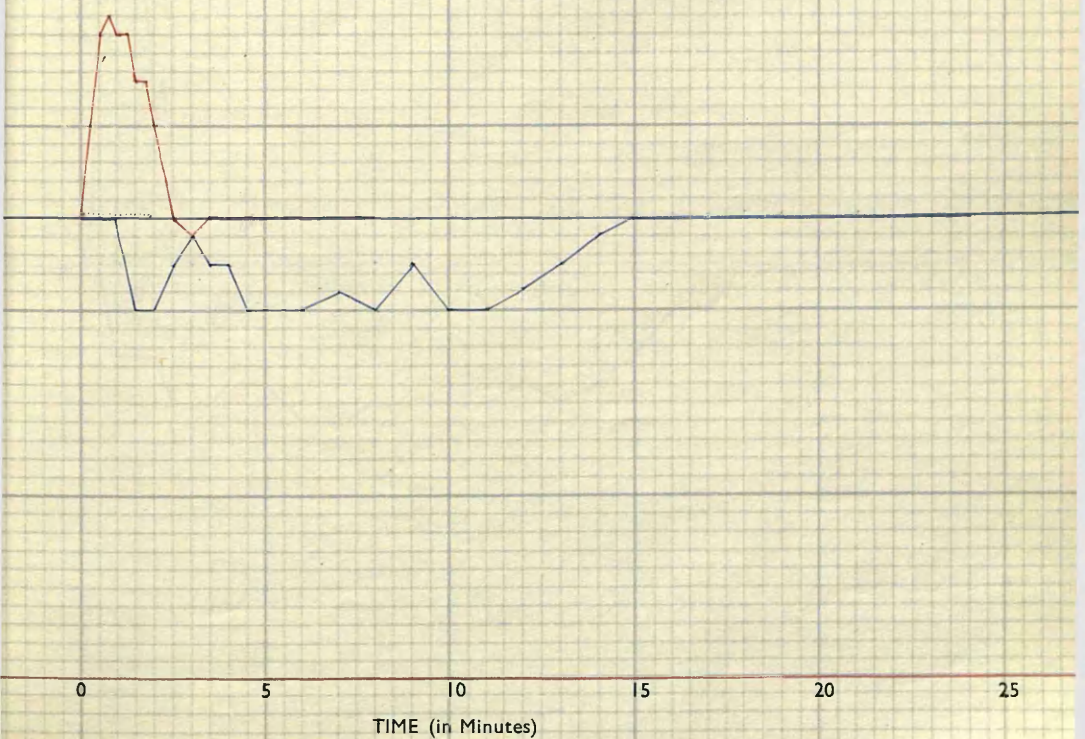
IMPROVED.



CASE No. : 37 (a)

S.A. = 35
P.A. = 100

A.I. = 35



CASE No.: 37 (b)

S.A.= 88
P.A.= 217

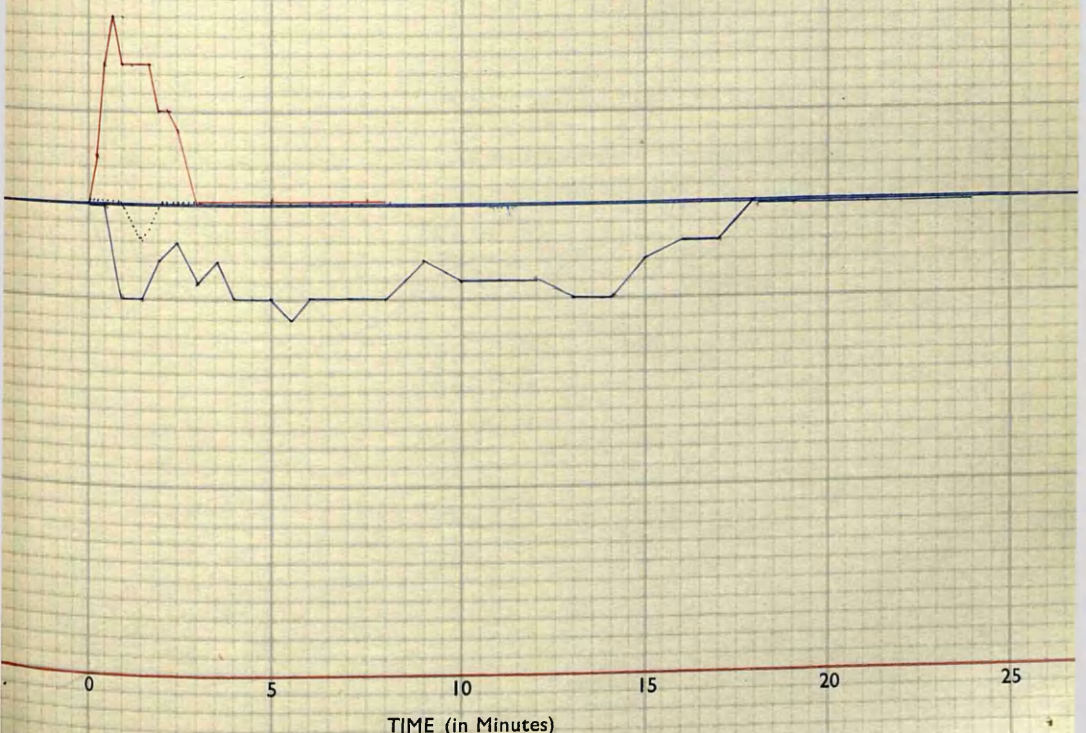
A.I.= 36.9

IMPROVED.

CASE No. : 38 (a)

S.A. = 33
P.A. = 133

A.I. = 25.7

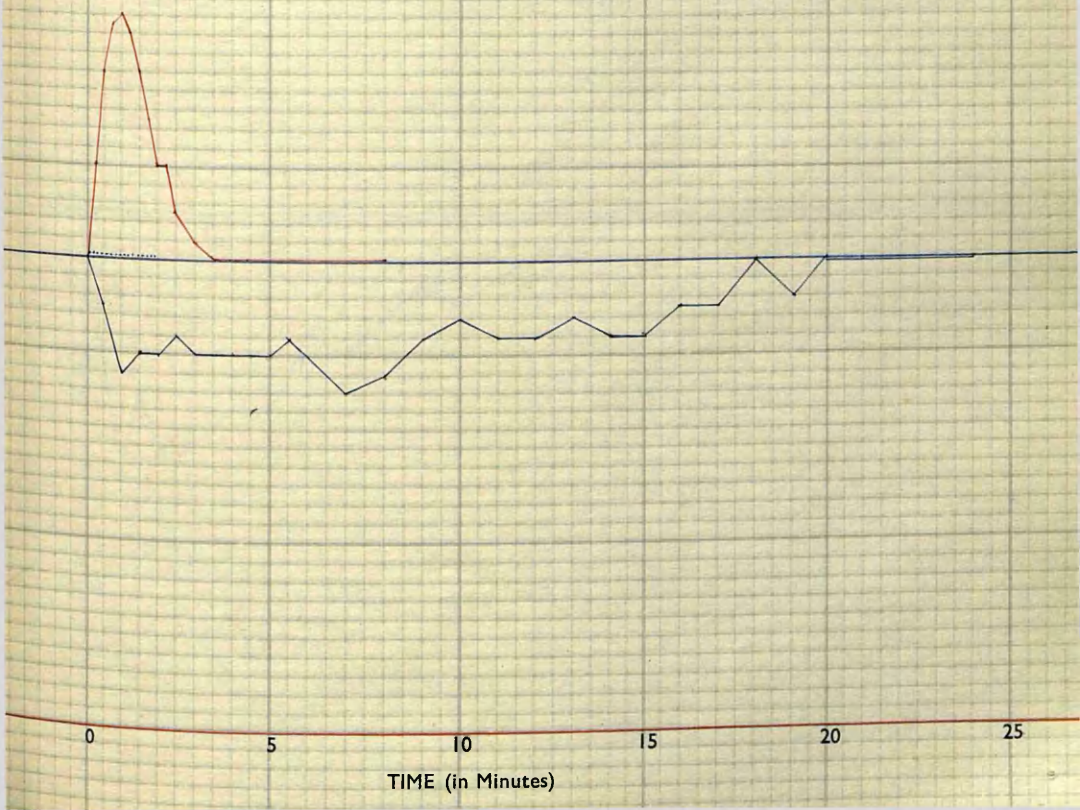


CASE No. : 38 (b)

S.A. = 42
P.A. = 150

A.I. = 28

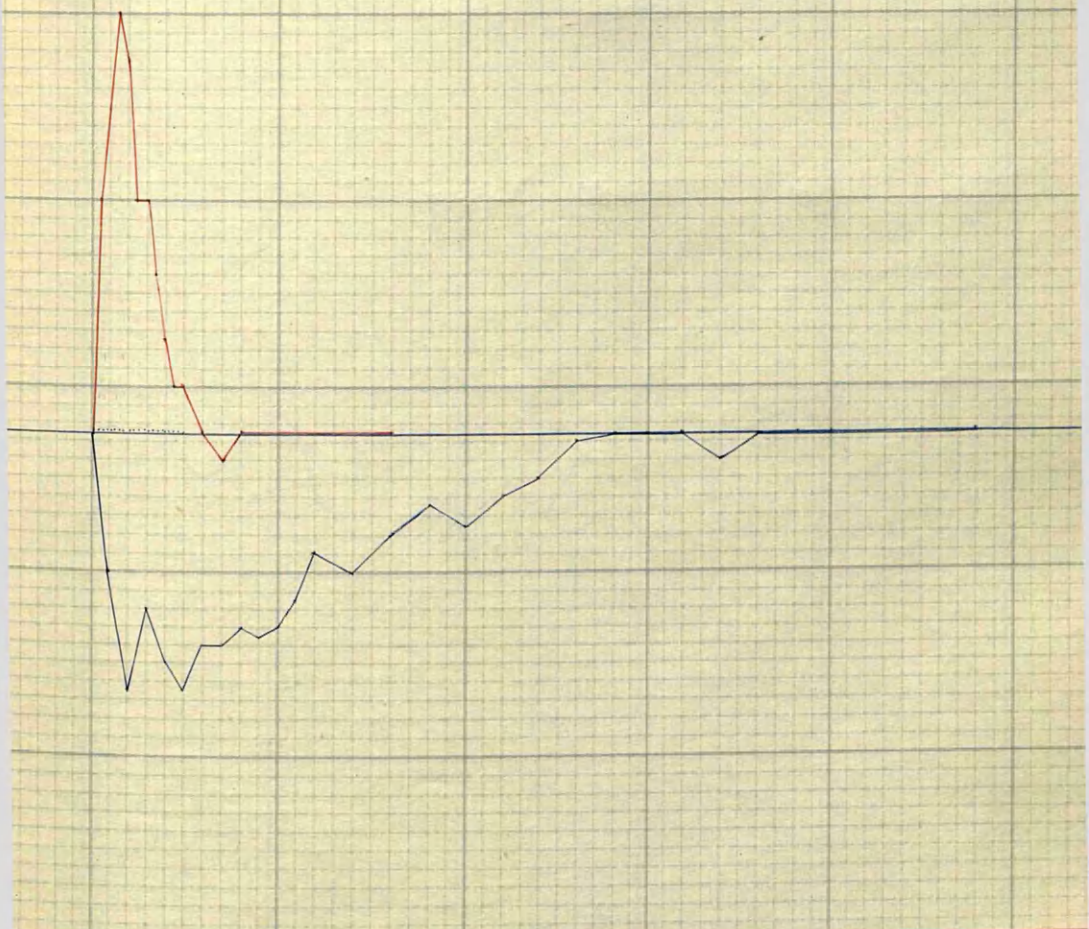
NOT IMPROVED.



CASE No. : 39 (a)

S.A.= 56
P.A.= 178

A.I.= 31.5

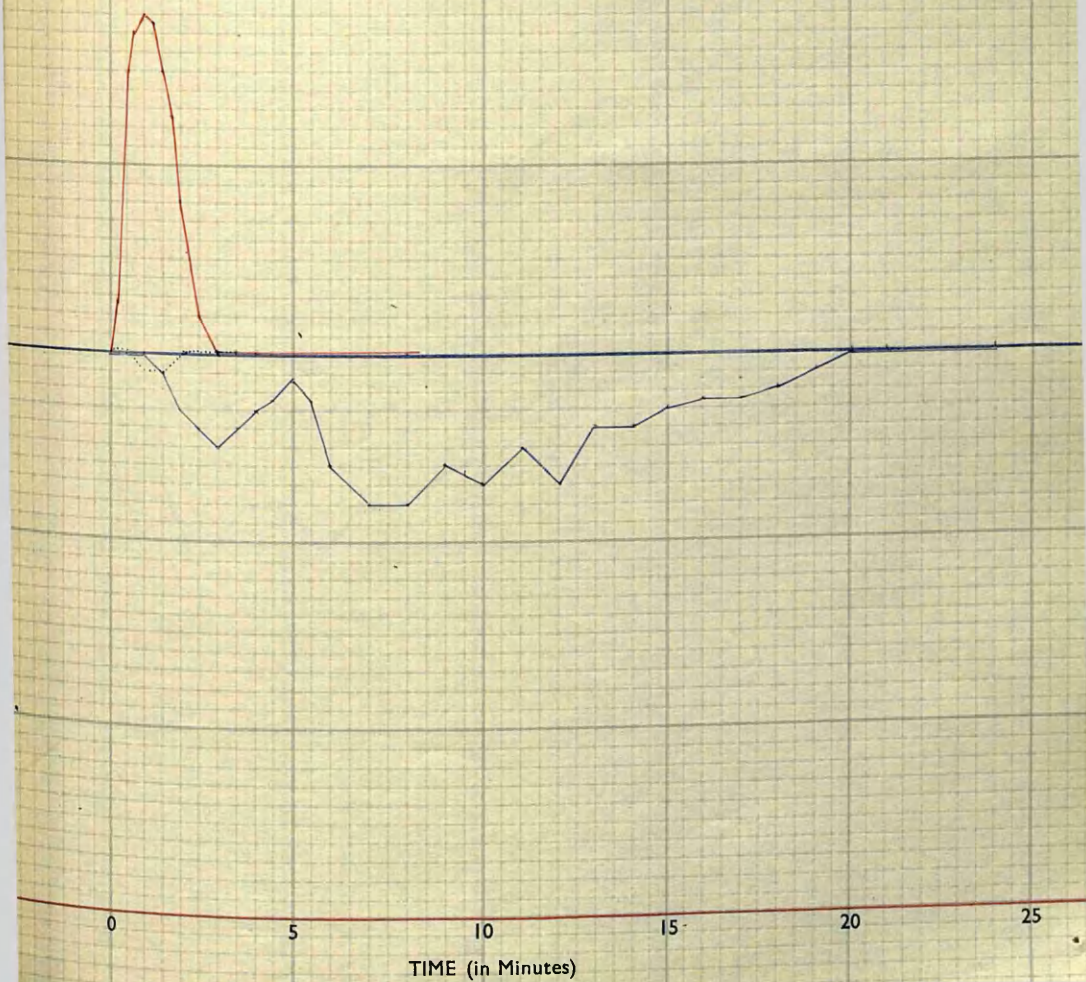


CASE No. : 39 (b)

S.A. = 56
P.A. = 156

A.I. = 35.9

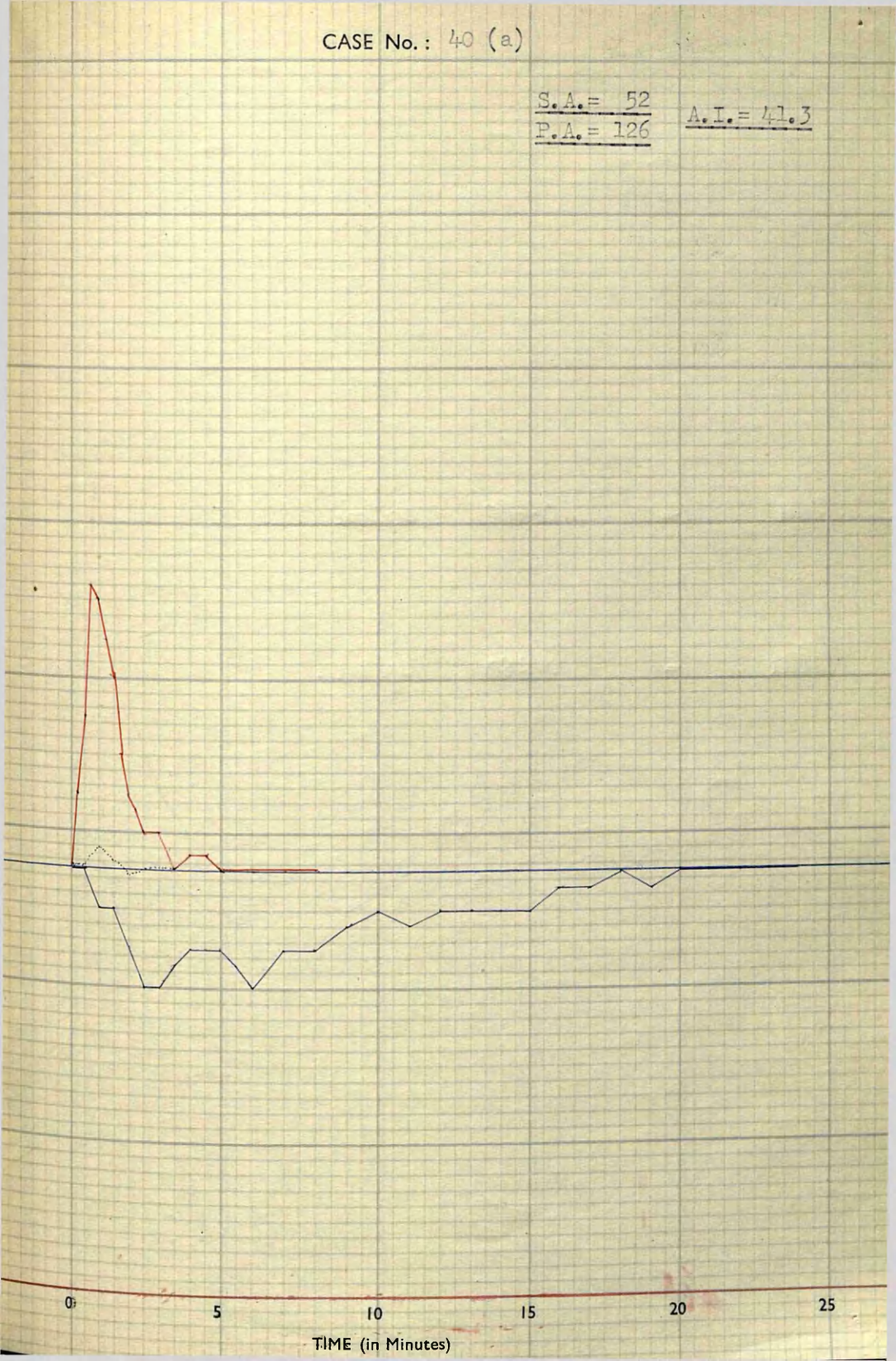
IMPROVED.



CASE No. : 40 (a)

S.A. = 52
P.A. = 126

A.I. = 41.3

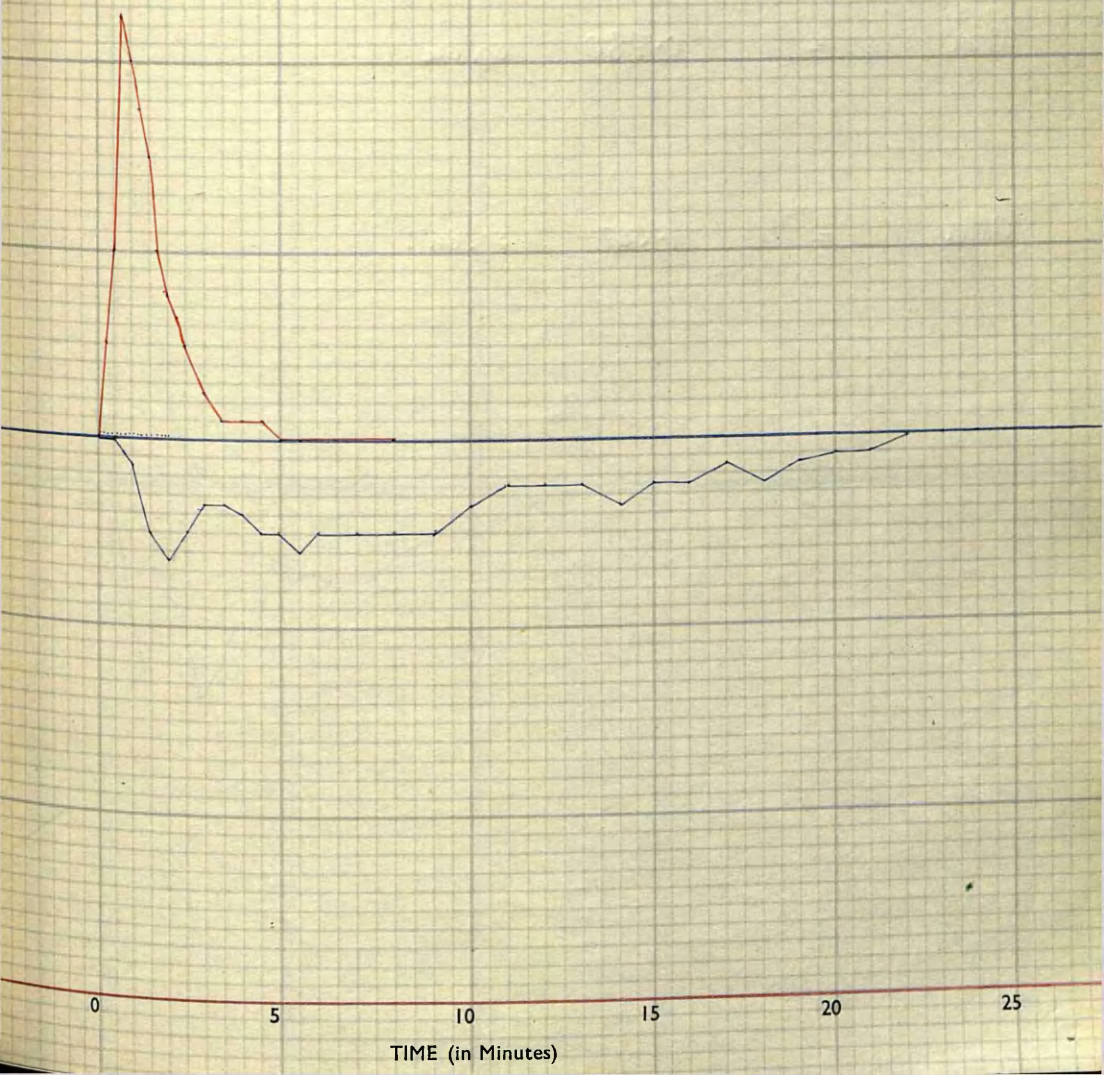


CASE No.: 40 (b)

S.A.= 66
P.A.= 135

A.I.= 48.9

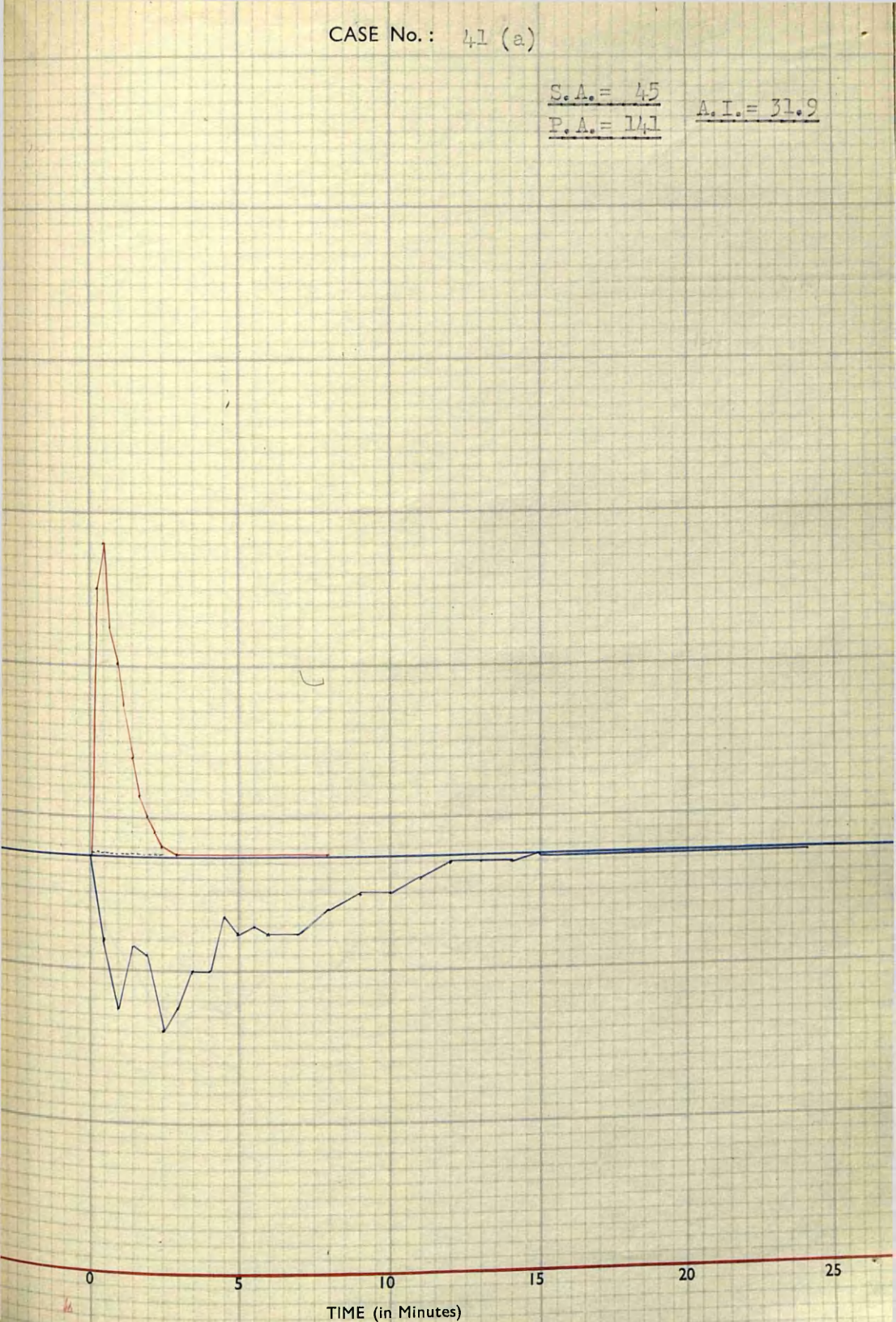
IMPROVED.



CASE No.: 41 (a)

S.A.= 45
P.A.= 141

A.I.= 31.9

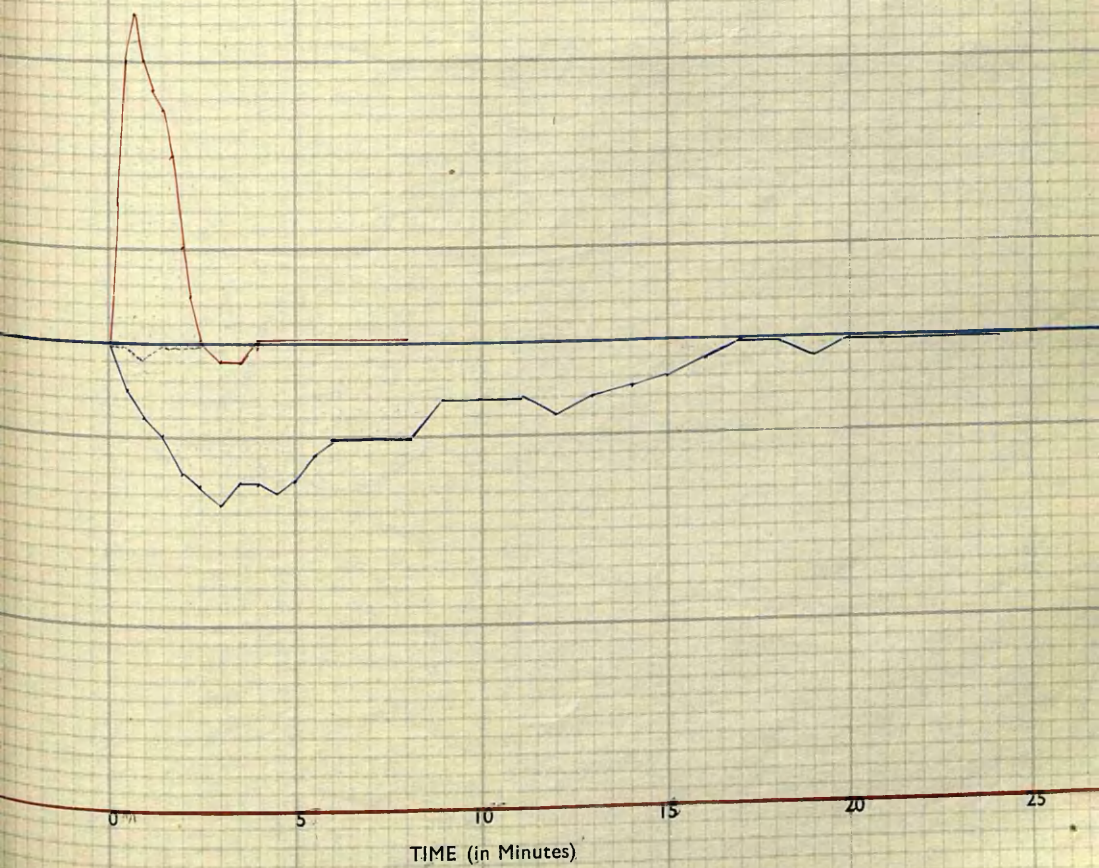


CASE No.: 41 (b)

S.A.= 42
P.A.= 116

A.I.= 36.2

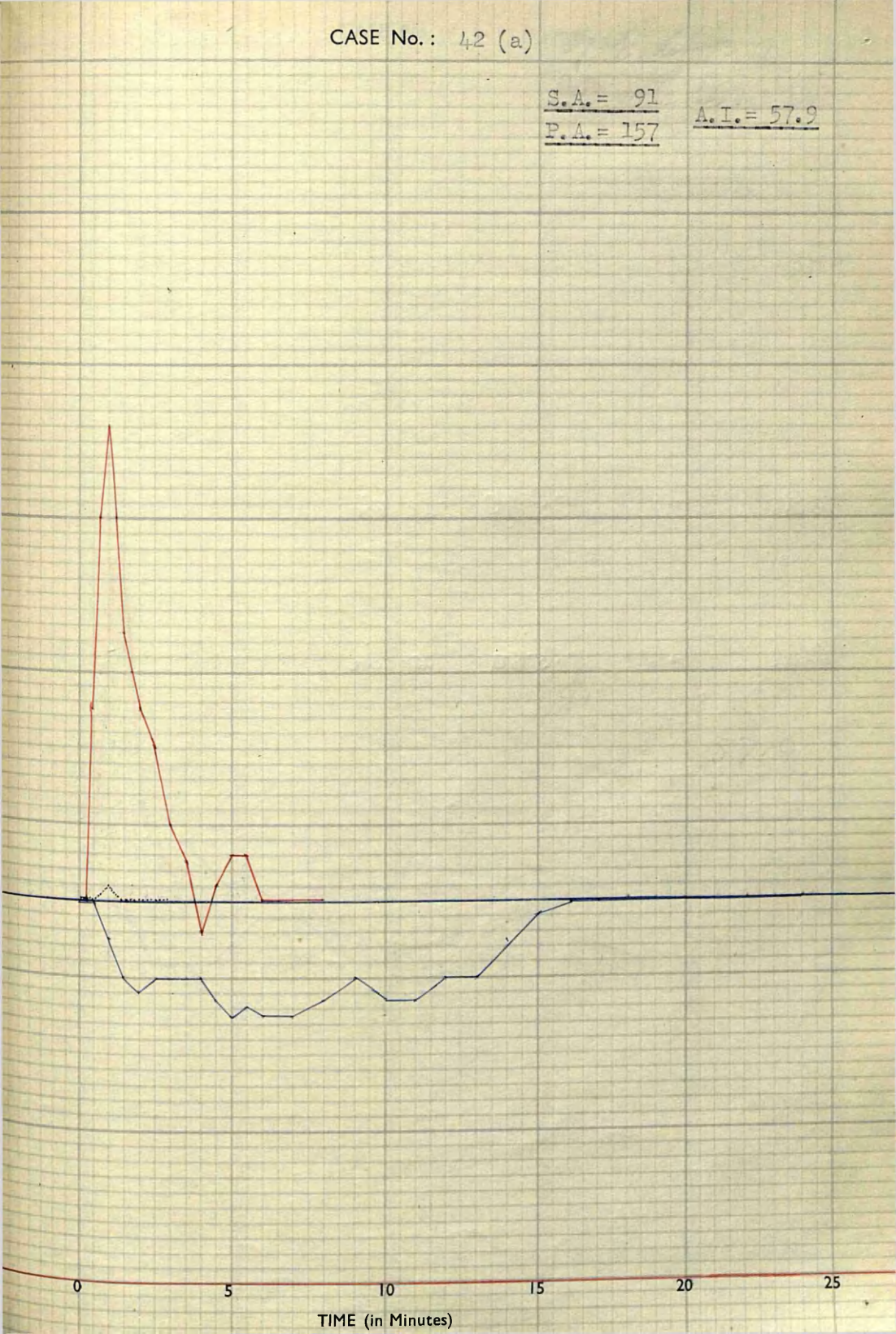
NOT IMPROVED.



CASE No. : 42 (a)

S.A. = 91
P.A. = 157

A.I. = 57.9

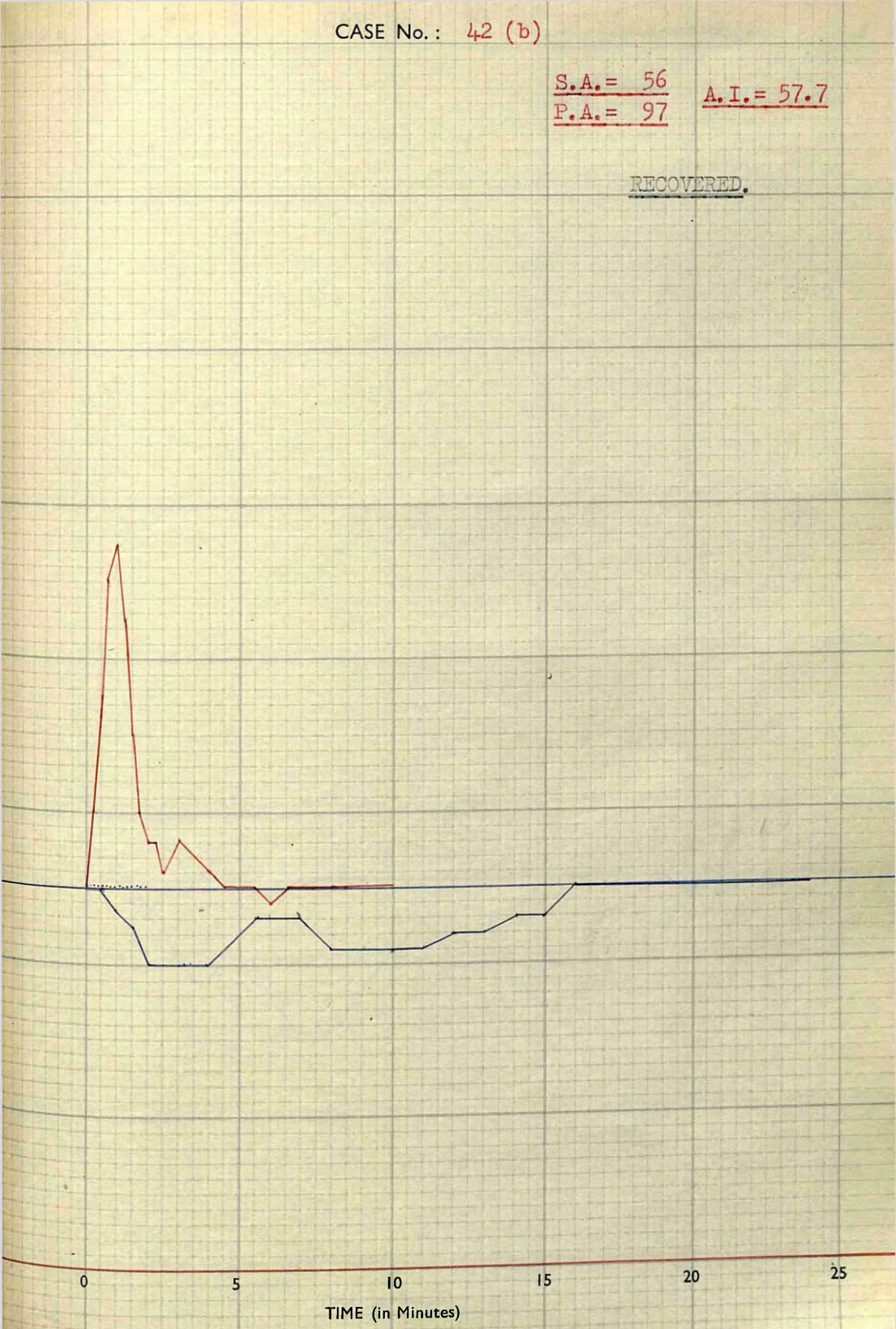


CASE No.: 42 (b)

S.A.= 56
P.A.= 97

A.I.= 57.7

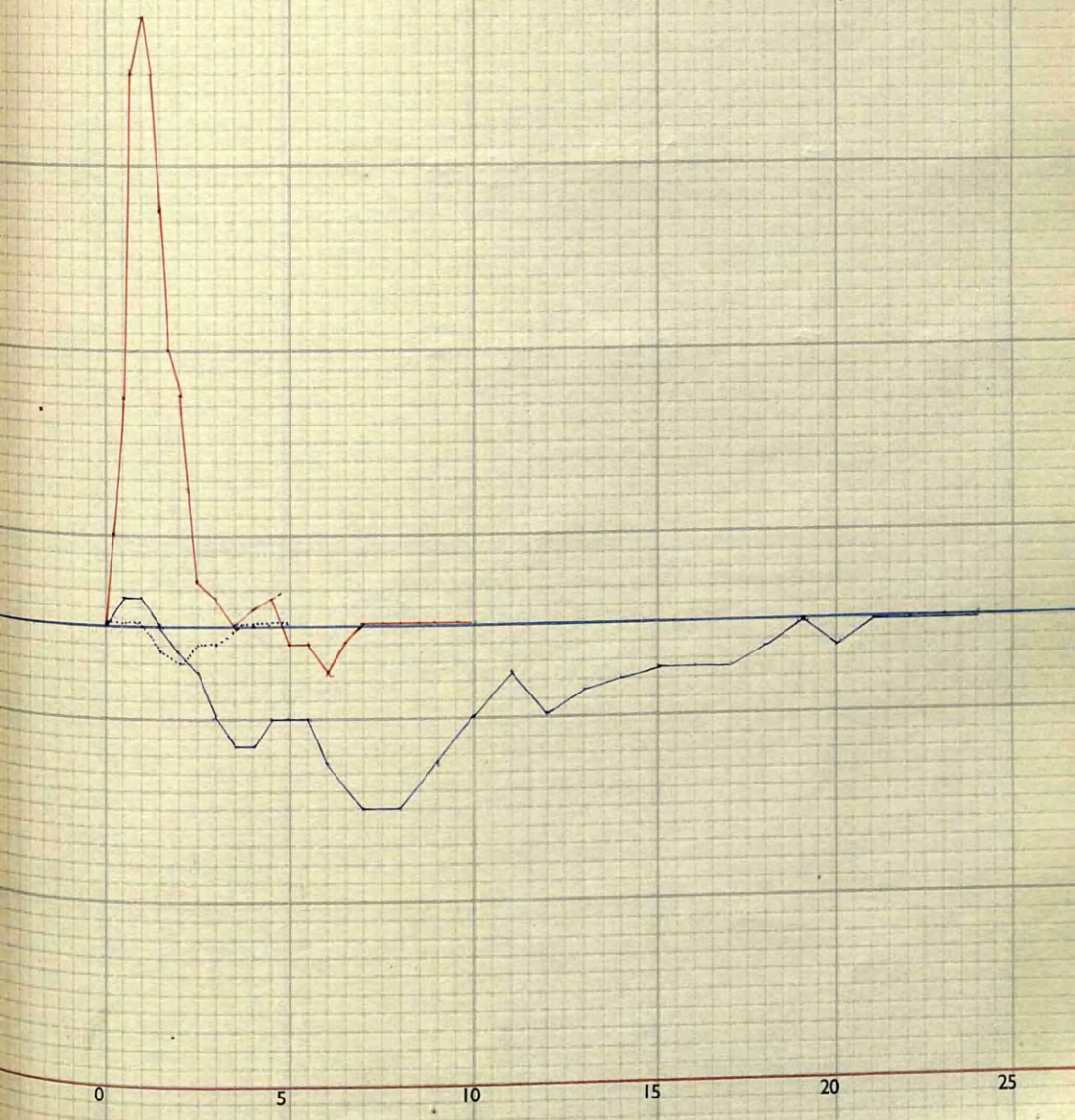
RECOVERED.



CASE No.: 43 (a)

S.A. = 83
P.A. = 161

A.I. = 51.6

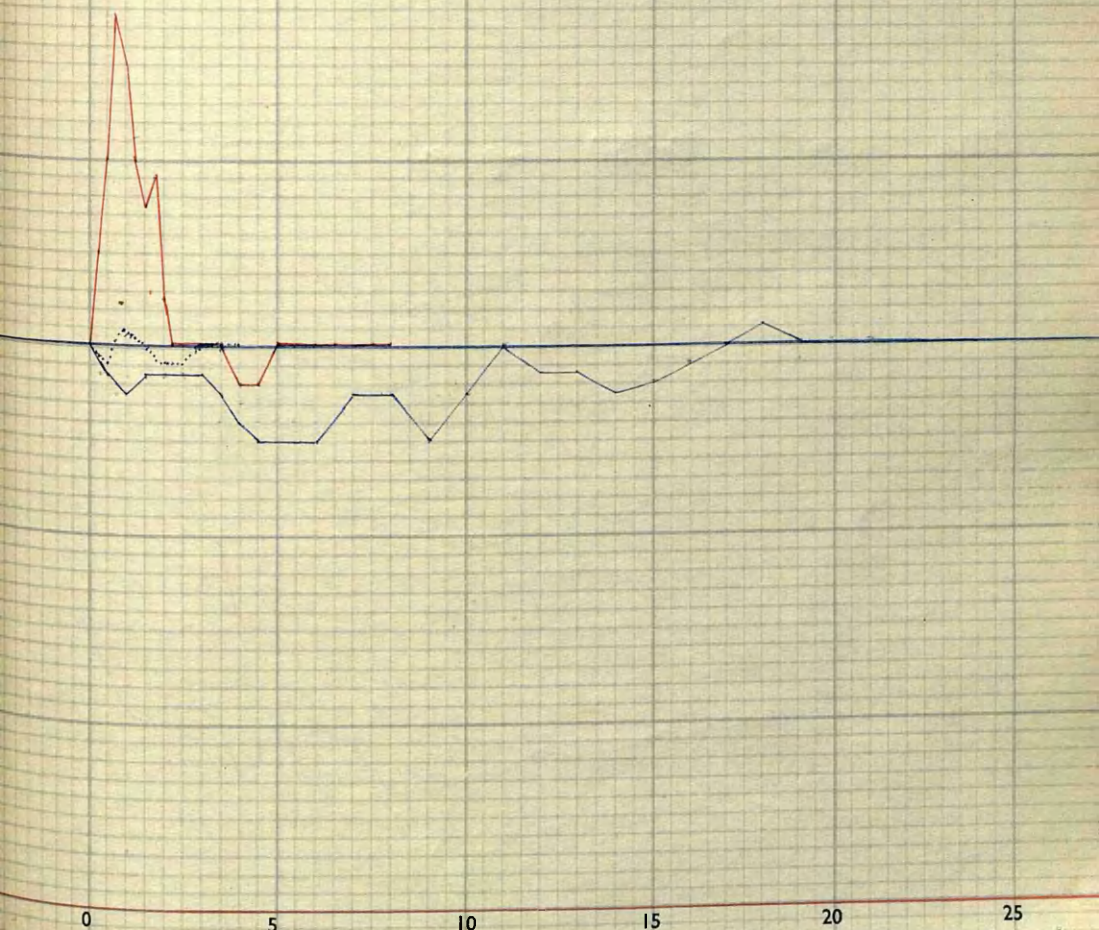


CASE No.: 43 (b)

S.A. = 37
P.A. = 75

A.I. = 49.3

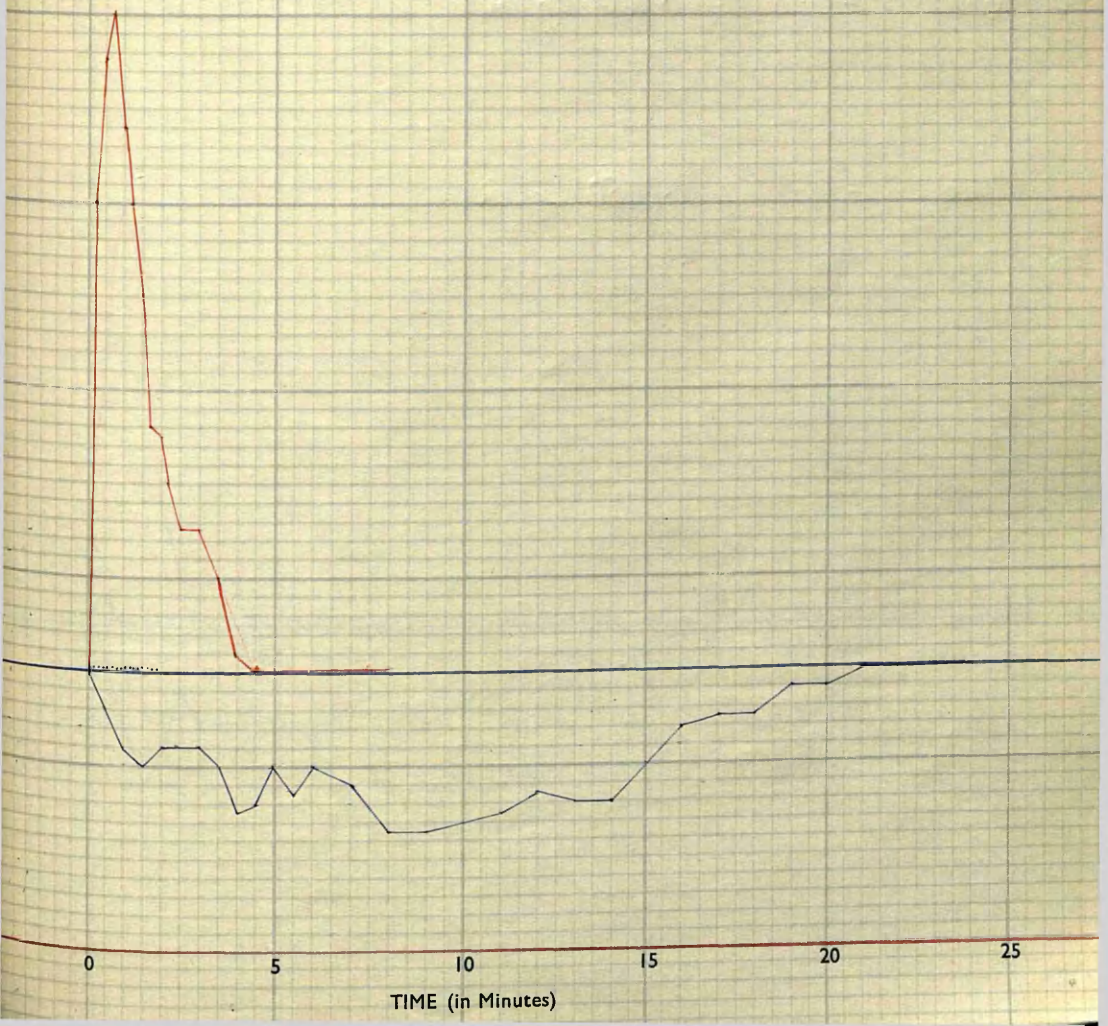
RECOVERED.



CASE No. : 44 (a)

S.A. = 116
P.A. = 208

A.I. = 55.8

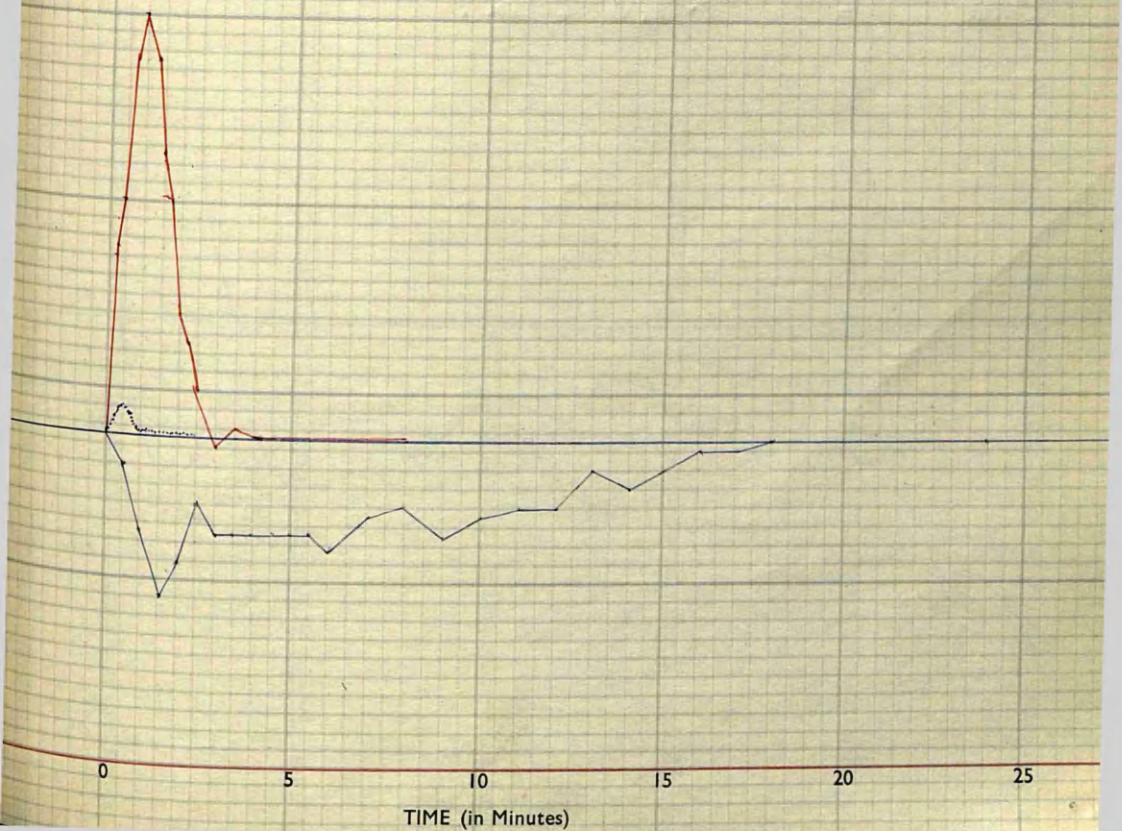


CASE No. : 44 (b)

S.A. = 66
P.A. = 121

A.I. = 54.5

RECOVERED.



CASE No. : 45 (a)

S.A. = 87
P.A. = 172

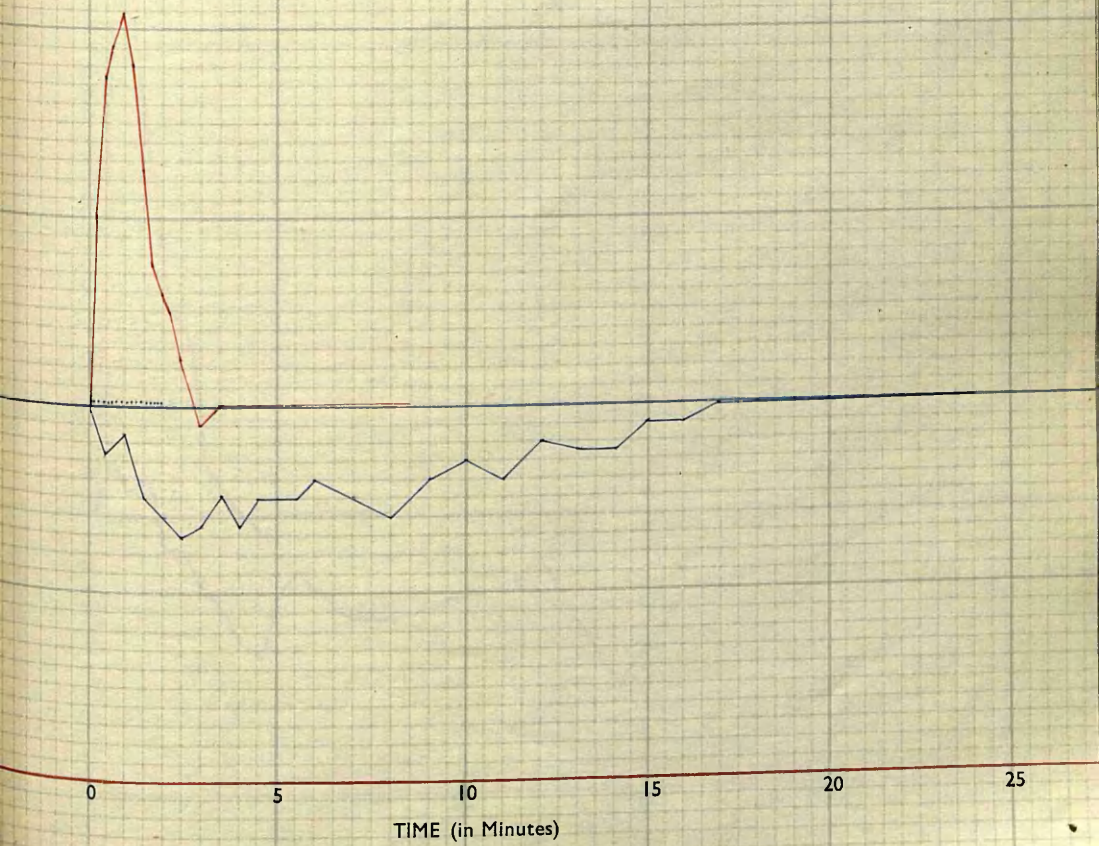
A.I. = 50.6

CASE No.: 45 (b)

S.A. = 58
P.A. = 120

A.I. = 48.3

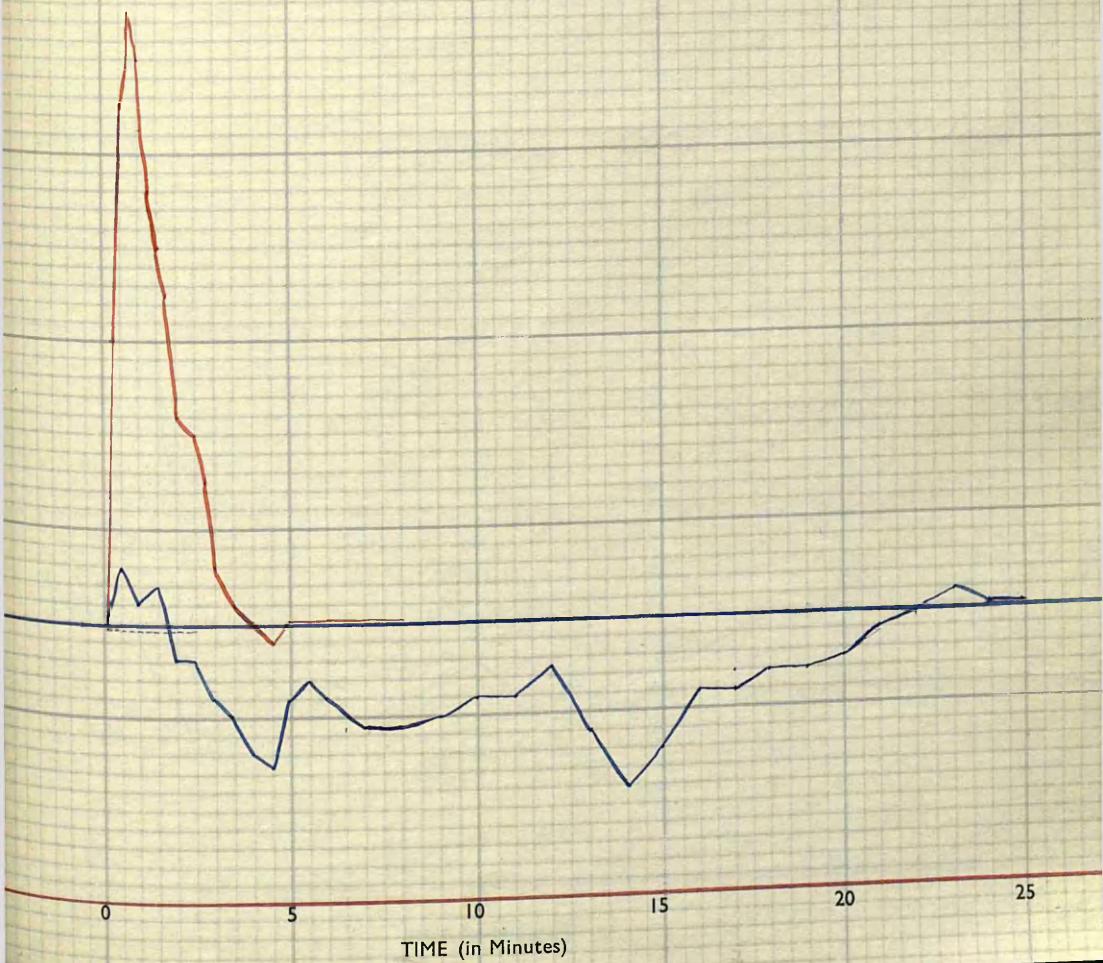
IMPROVED.



CASE No. : 46 (a)

S.A. = 92
P.A. = 164

A.I. = 56.1

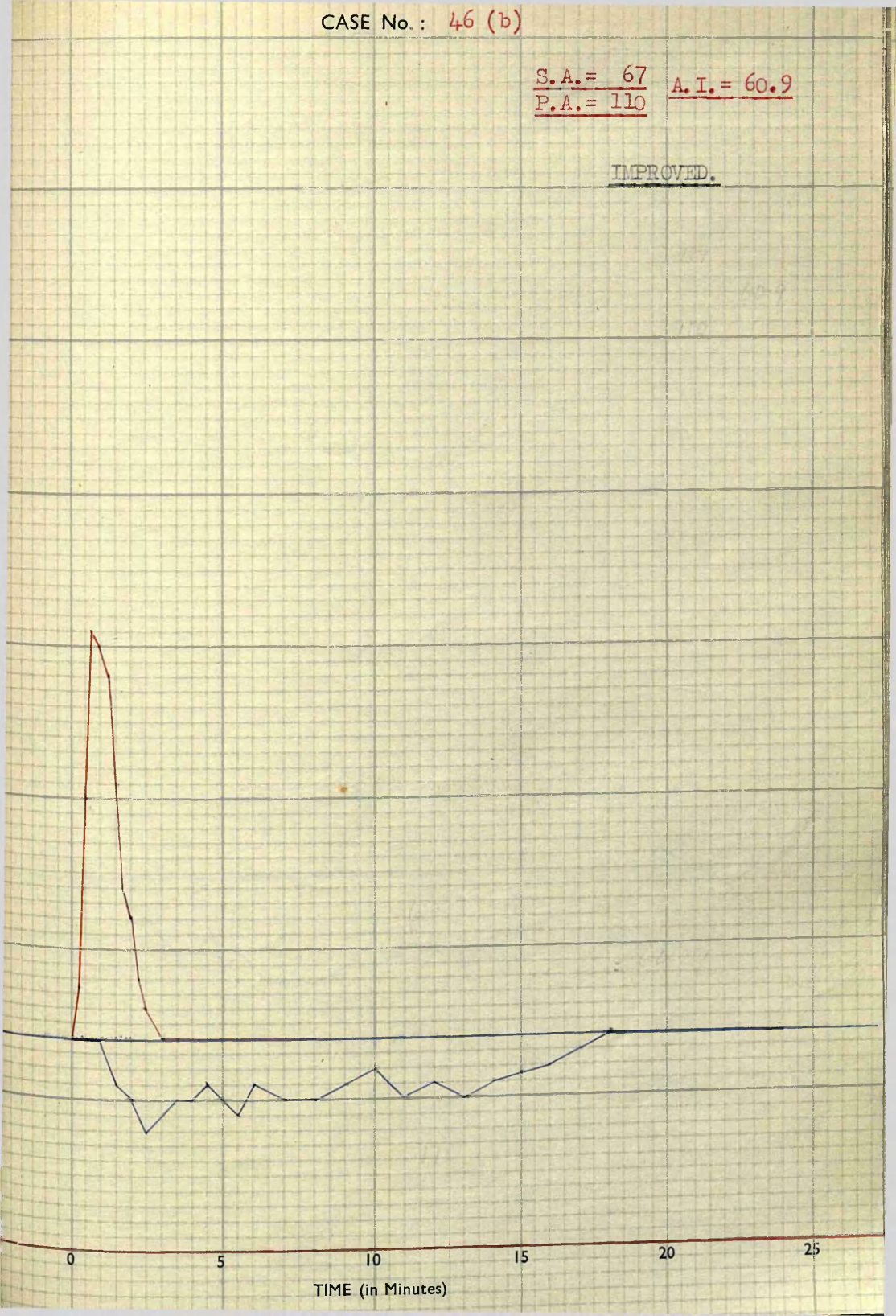


CASE No. : 46 (b)

S.A. = 67
P.A. = 110

A.I. = 60.9

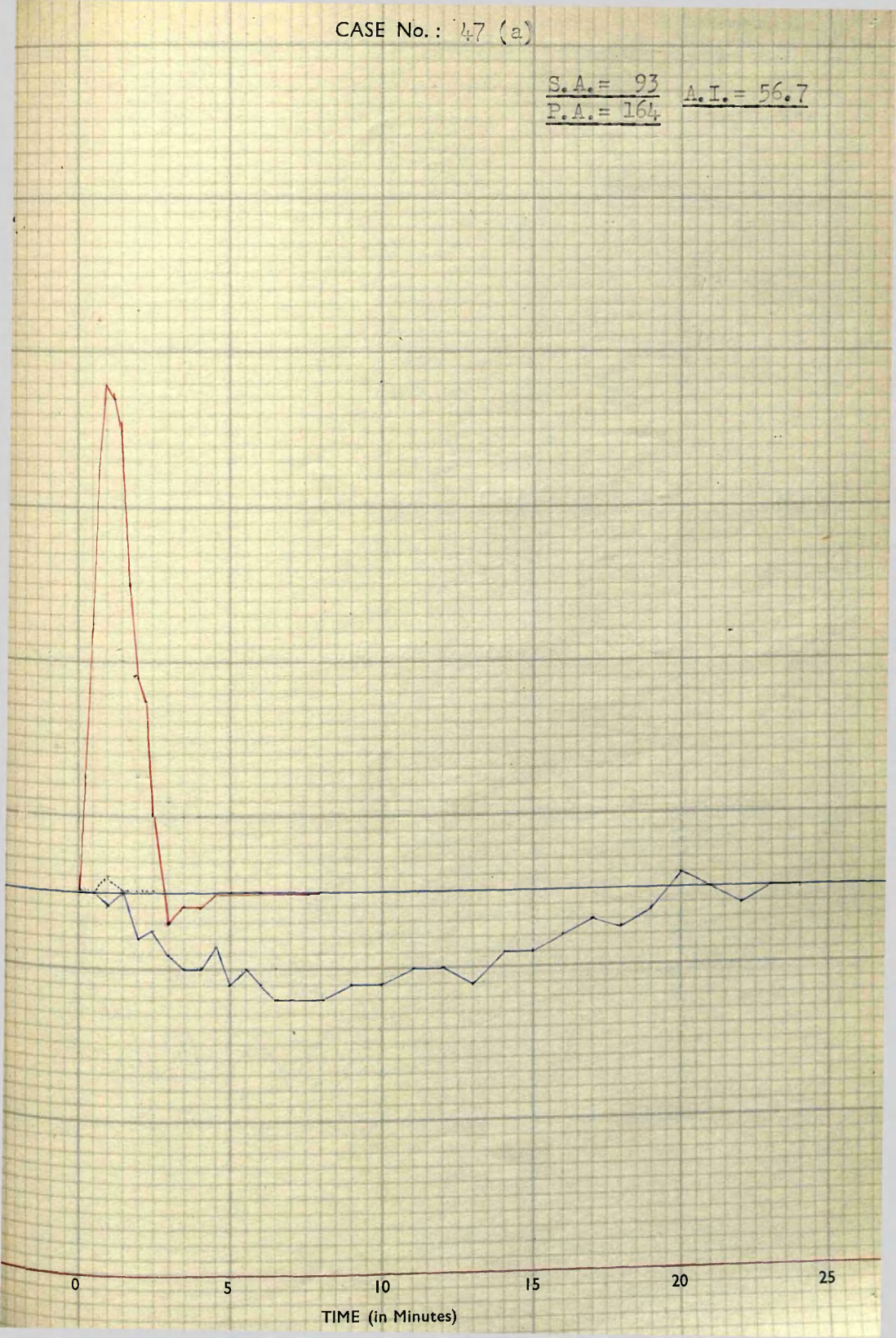
IMPROVED.



CASE No. : 47 (a)

S.A. = 93
P.A. = 164

A.I. = 56.7

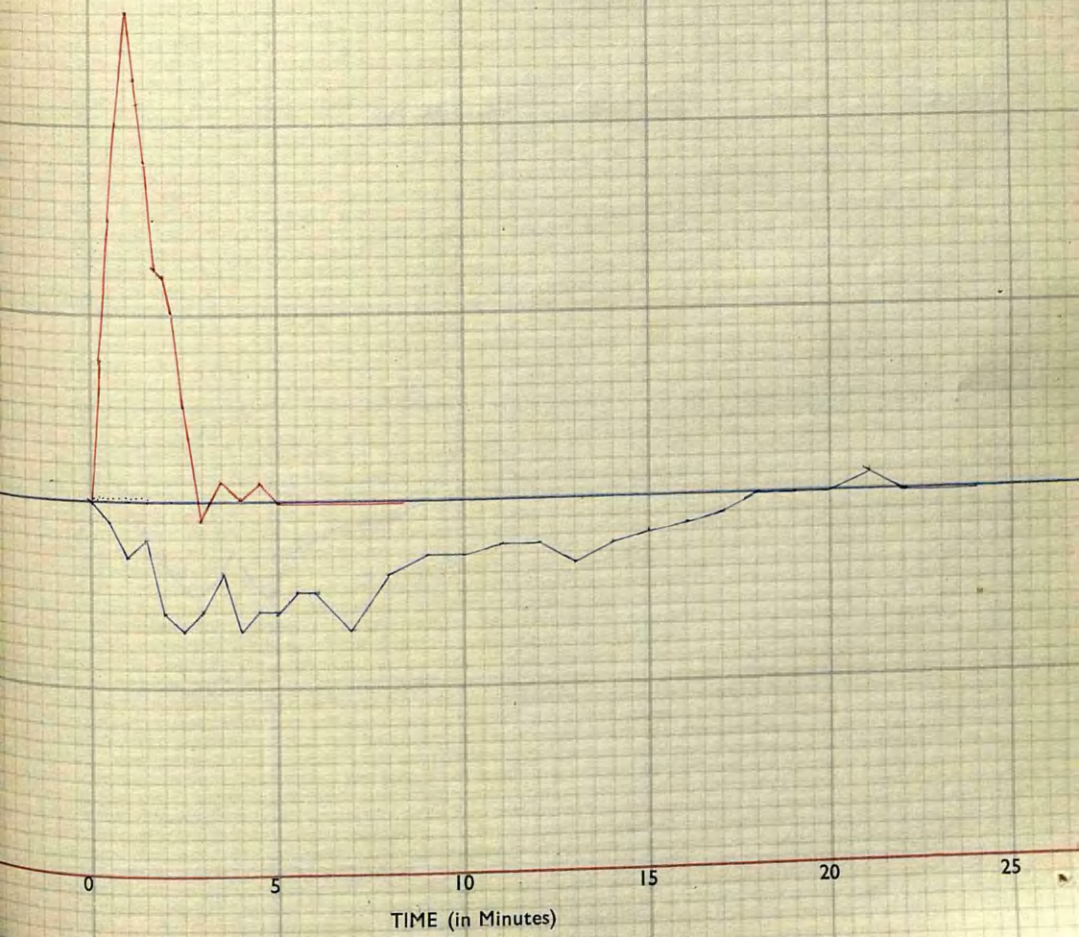


CASE No.: 47 (b)

S.A.= 73
P.A.= 127

A.I.= 57.5

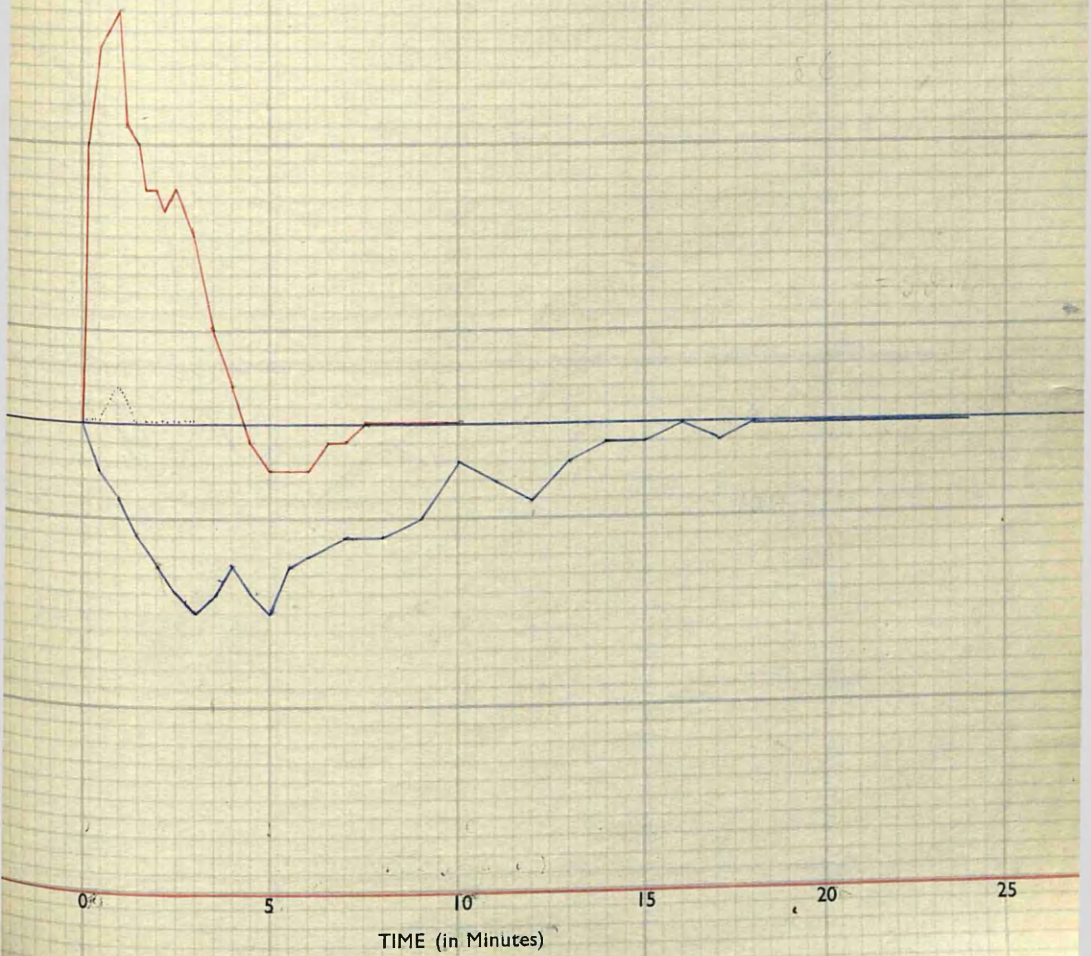
RECOVERED.



CASE No. : 48 (a)

S.A. = 86
P.A. = 154

A.I. = 58.4

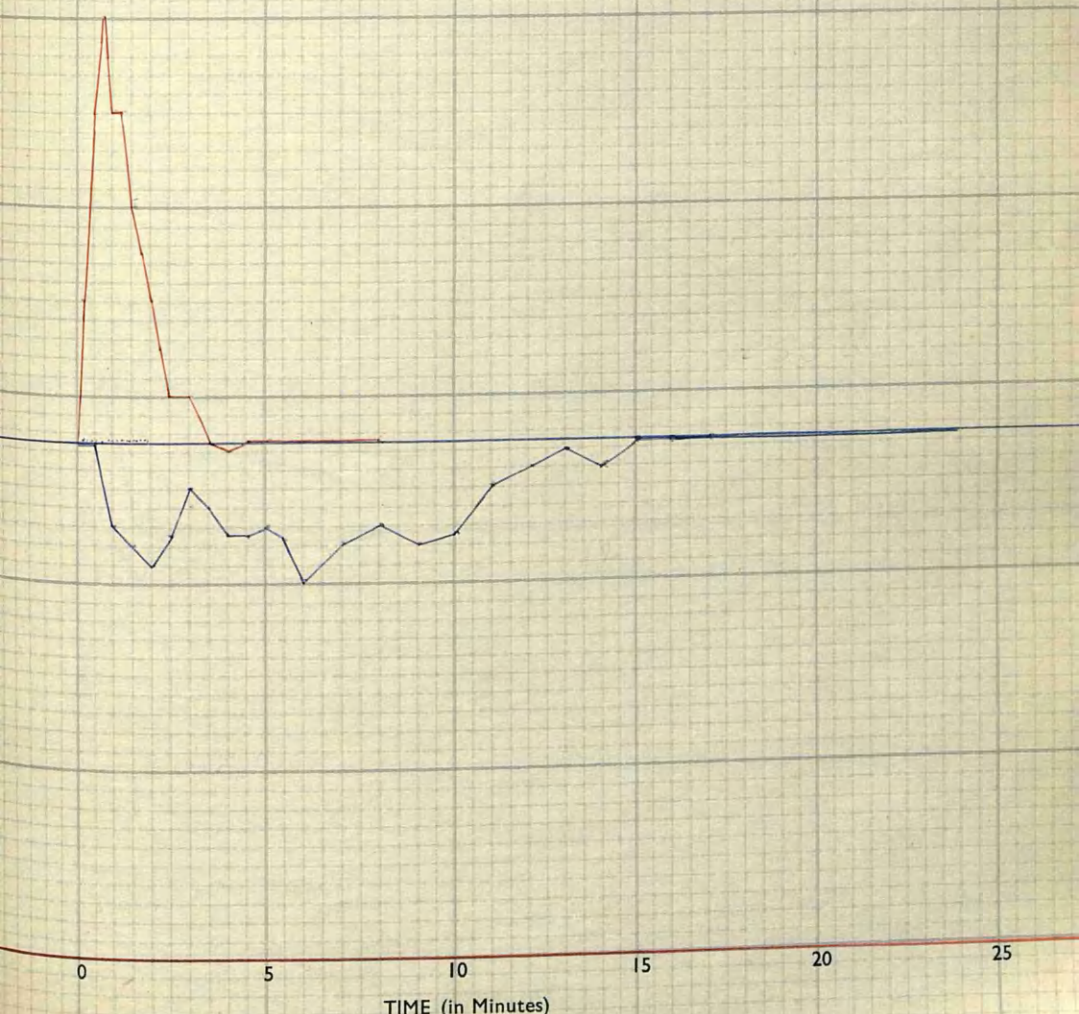


CASE No. : 48 (b)

S.A.= 60
P.A.= 112

A.I.= 53.6

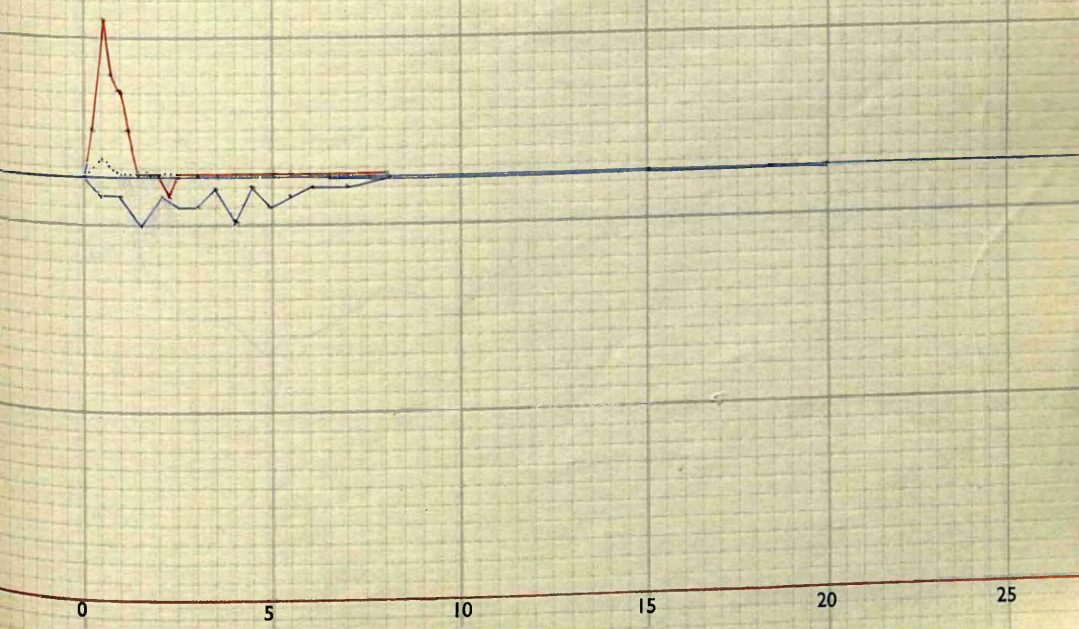
RECOVERED.



CASE No.: 49(a) Sub-group III

S.A. = 9
P.A. = 16

A.I. = 56.3

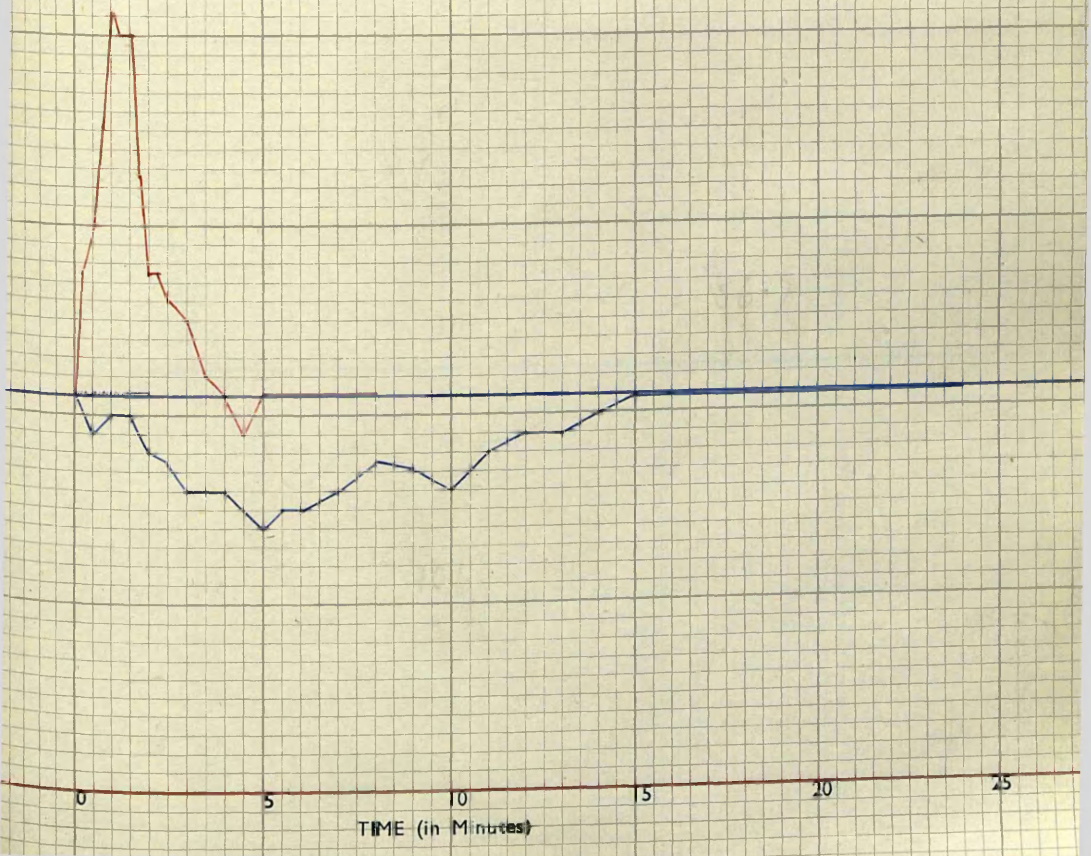


CASE. No.: 49 (b)

S.A.= 59
P.A.= 106

A.I.= 56.7

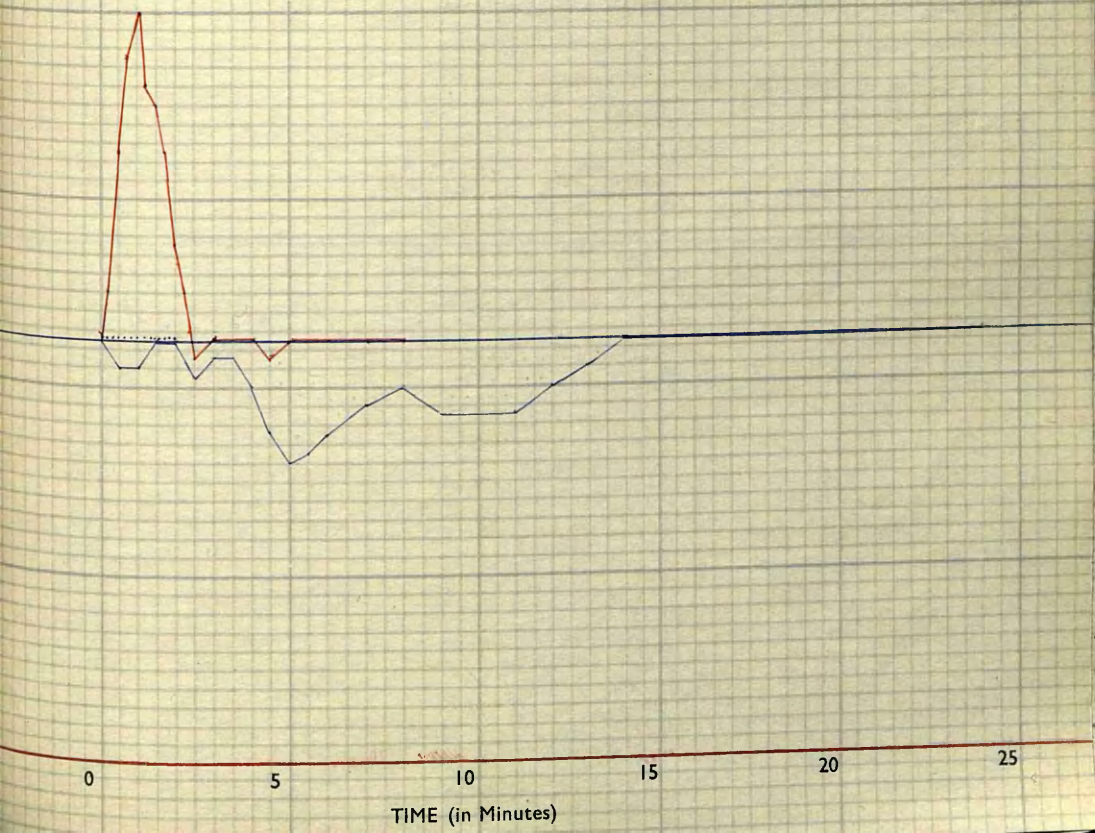
RECOVERED



CASE No.: 50 (a) Sub-group II.

S.A. = 43
P.A. = 77

A.I. = 55.9

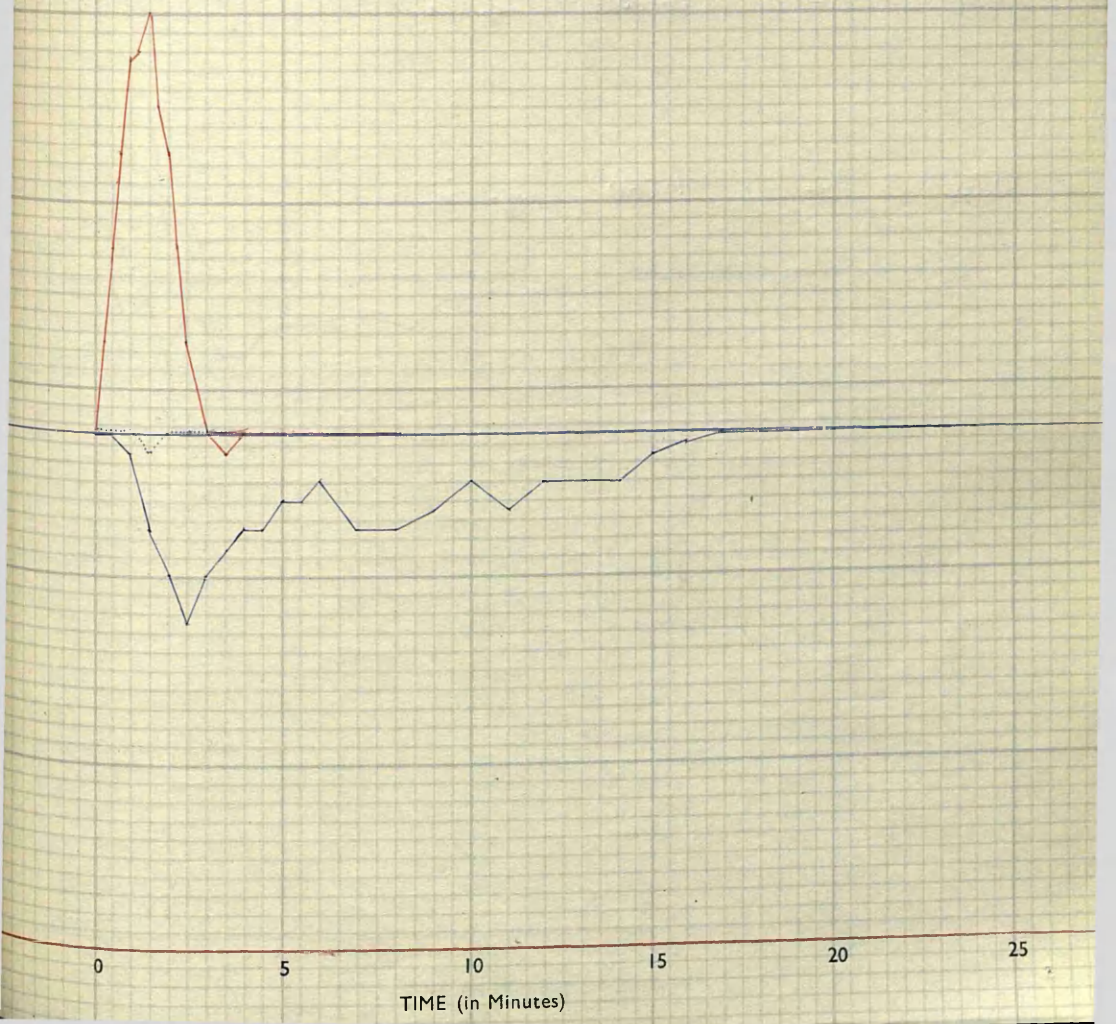


CASE No.: 50 (b)

S.A.= 66
P.A.= 116

A.I.= 56.9

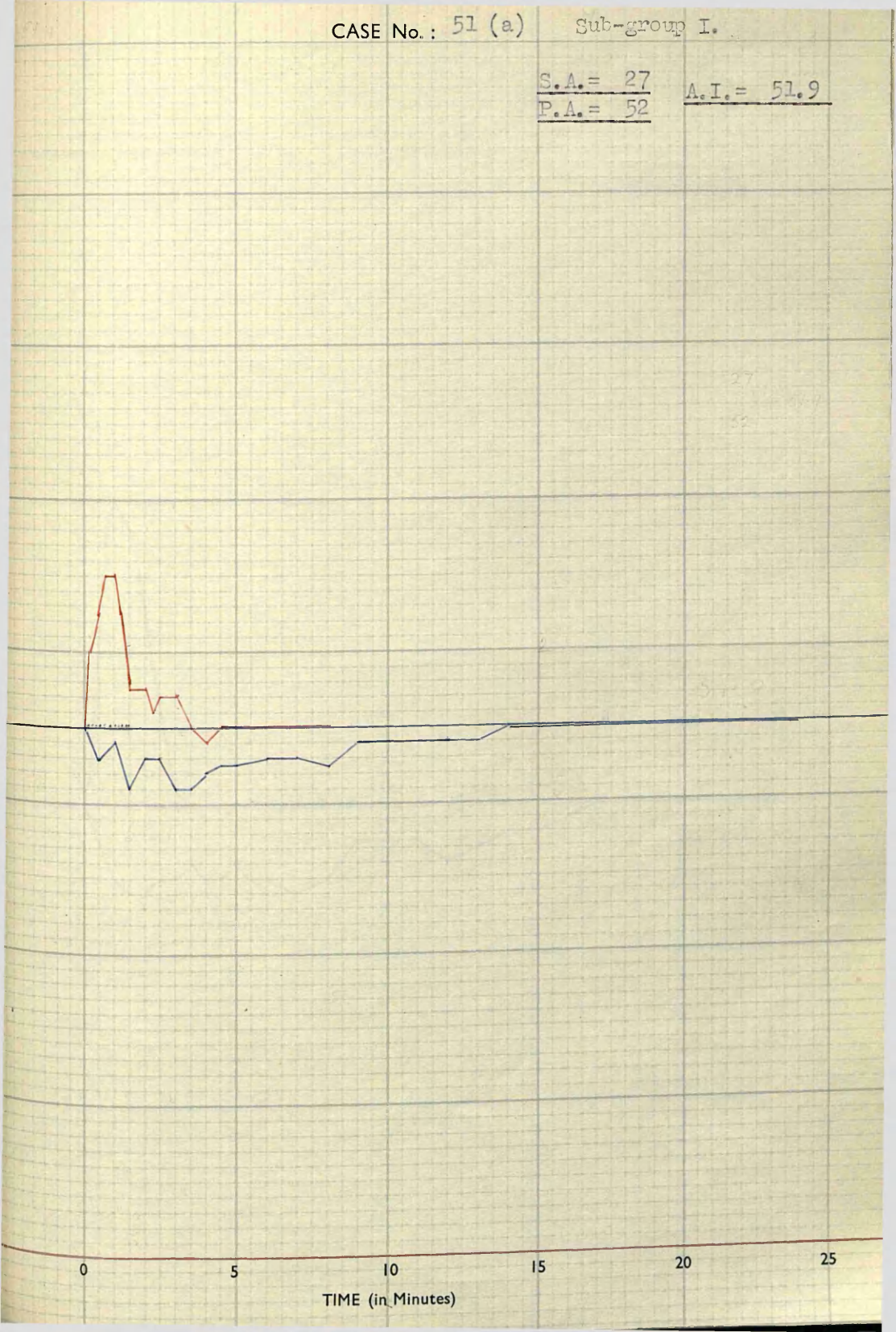
IMPROVED.



CASE No. : 51 (a) Sub-group I.

S.A.= 27
P.A.= 52

A.I.= 51.9

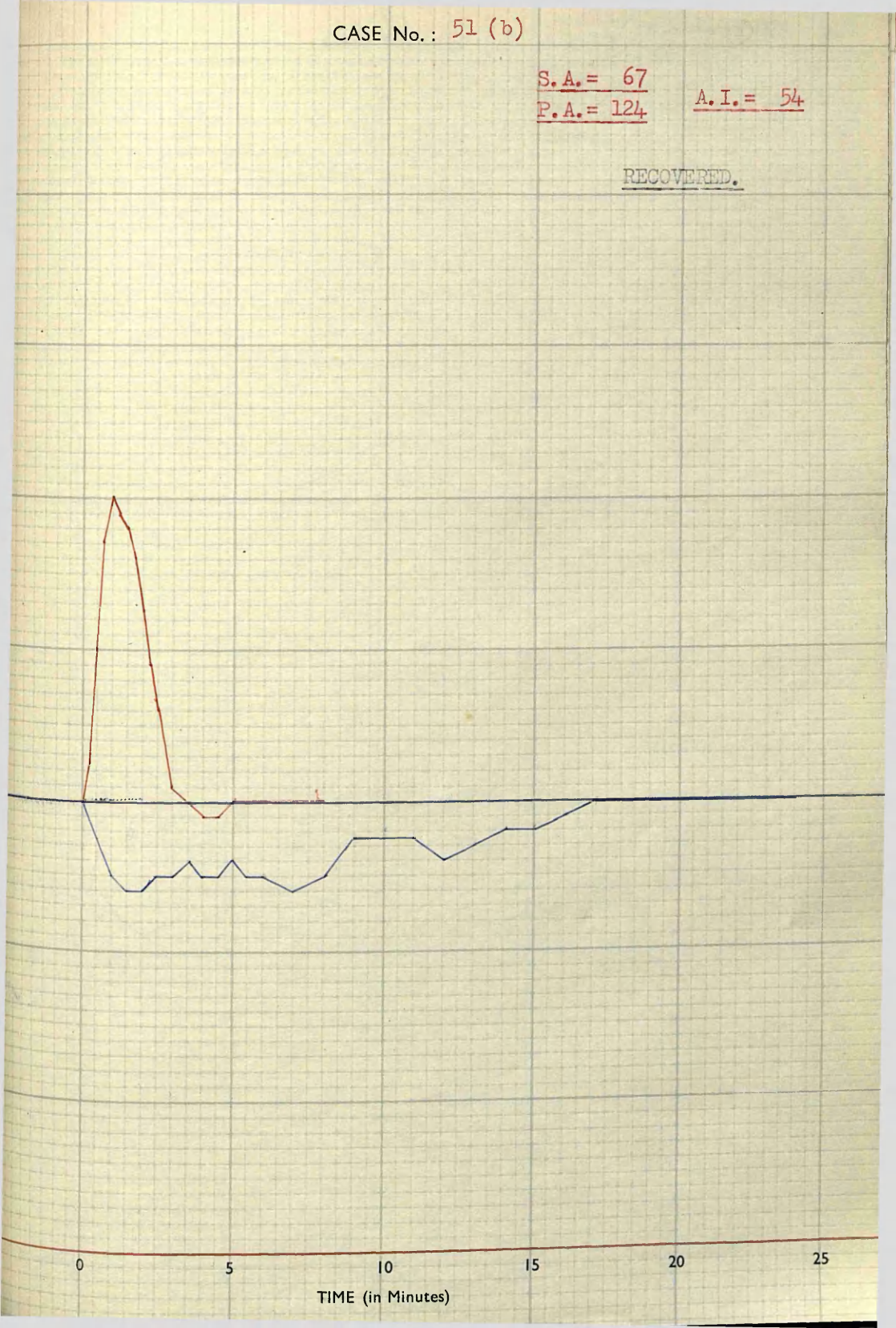


CASE No. : 51 (b)

S. A. = 67
P. A. = 124

A. I. = 54

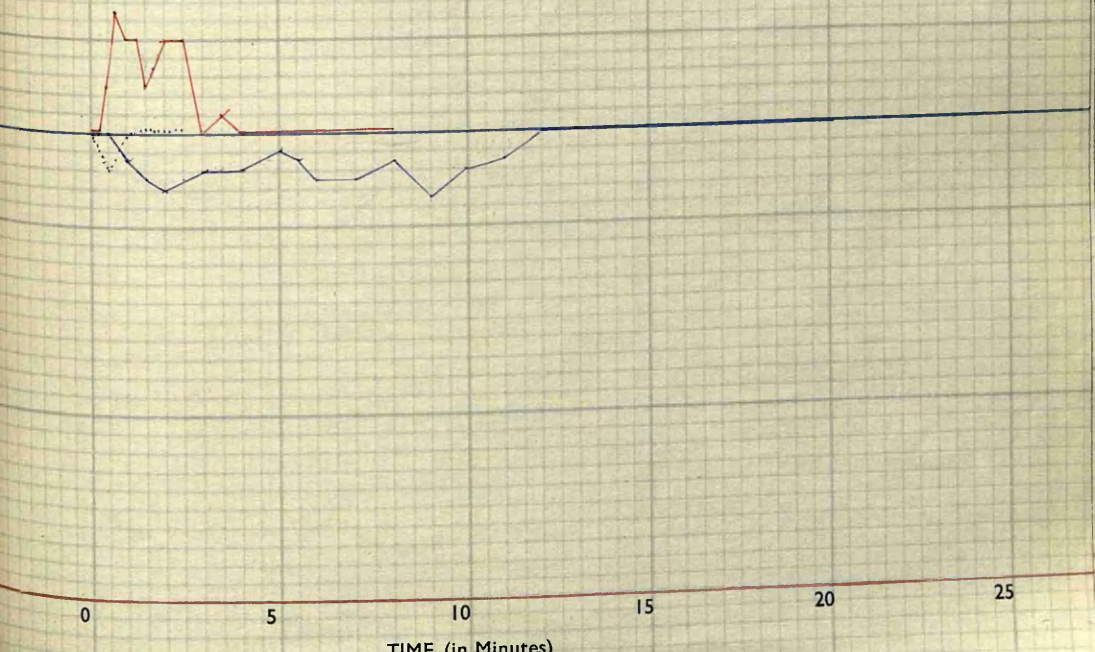
RECOVERED.



CASE No.: 52 (a) Sub-group II.

S.A. = 22
P.A. = 44

A.I. = 50

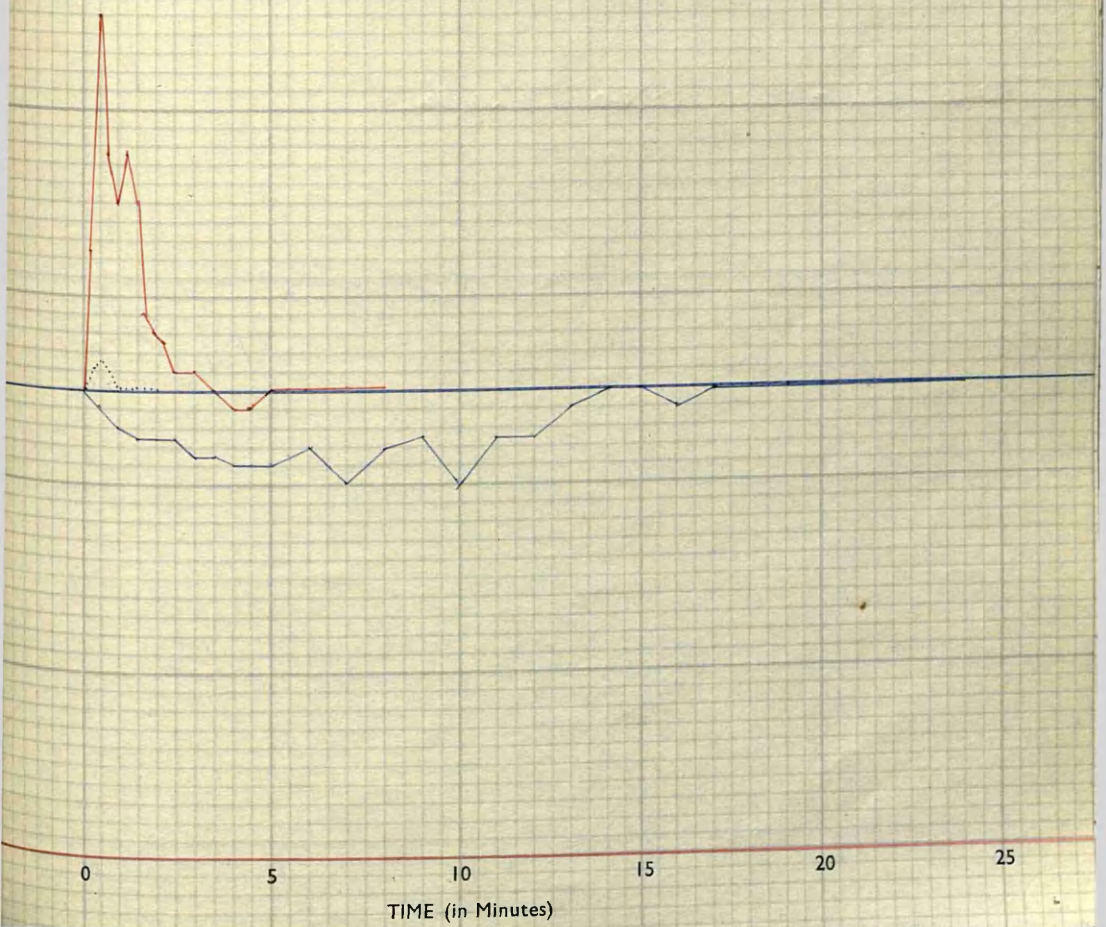


CASE No.: 52 (b)

S.A. = 39
P.A. = 81

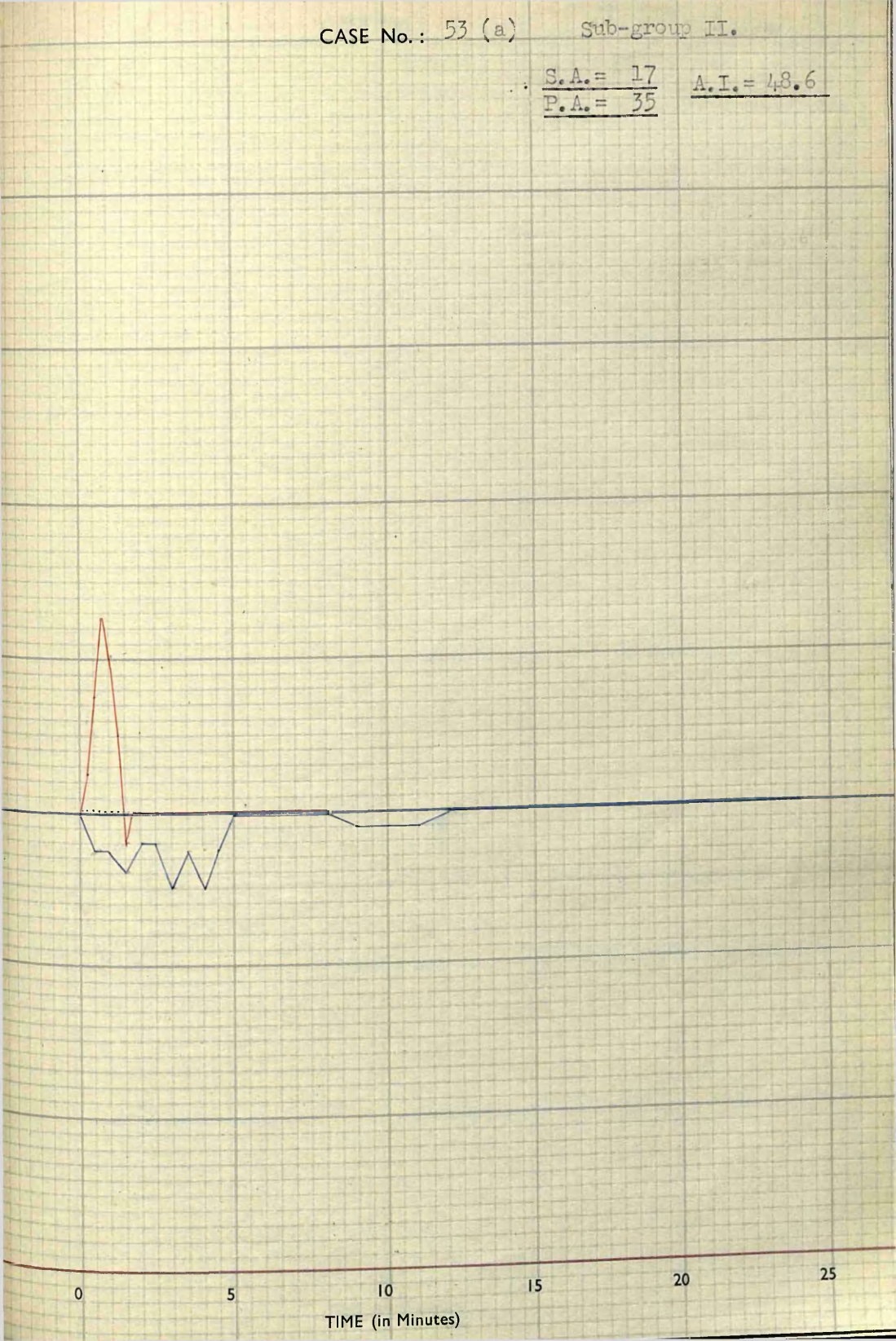
A.I. = 48.2

RECOVERED.



CASE No.: 53 (a) Sub-group II.

$\therefore \frac{S.A.= 17}{P.A.= 35}$ A.I. = 48.6



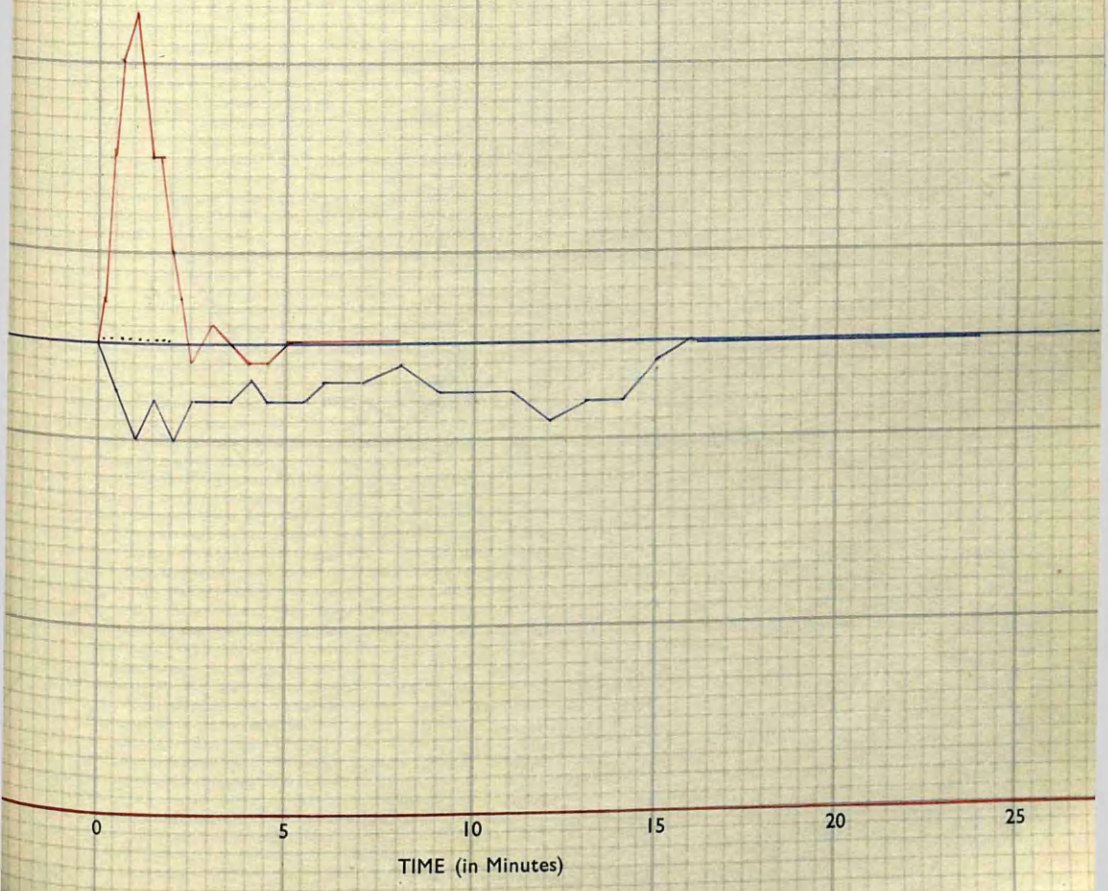
CASE No. : 53 (b)

S.A. = 41

P.A. = 84

A.I. = 49.5

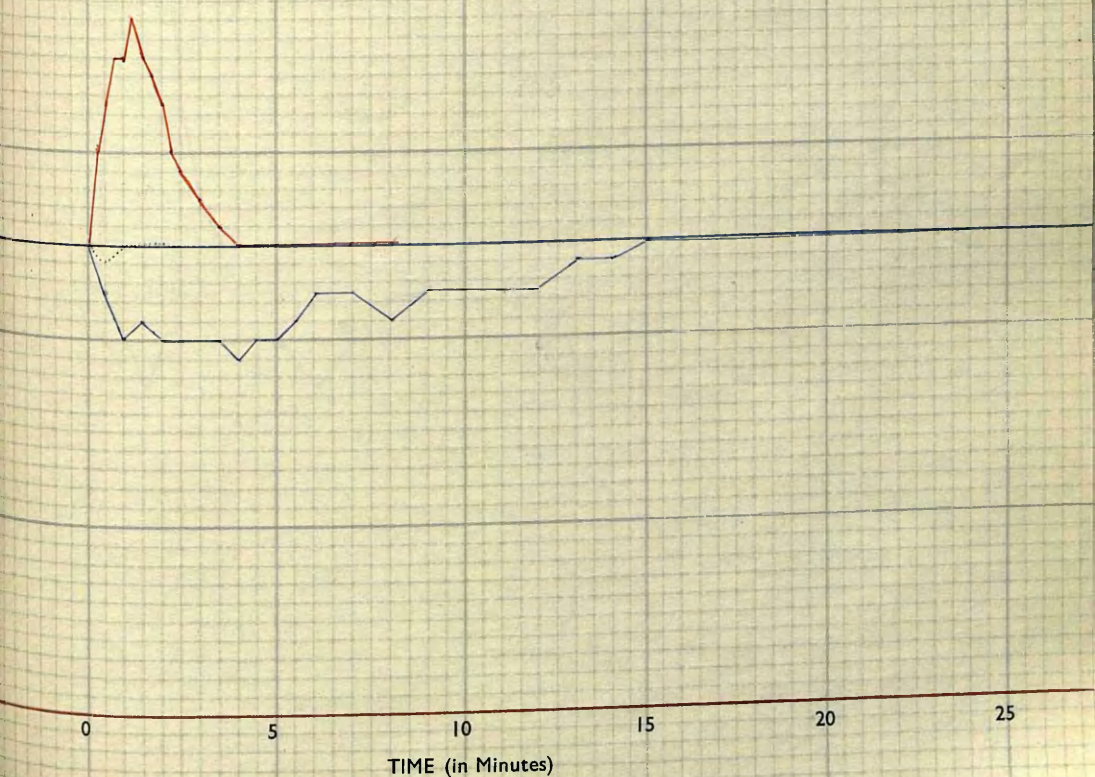
IMPROVED.



CASE No. : 54 (a) Sub-group I.

S.A. = 43
P.A. = 93

A.I. = 46.2

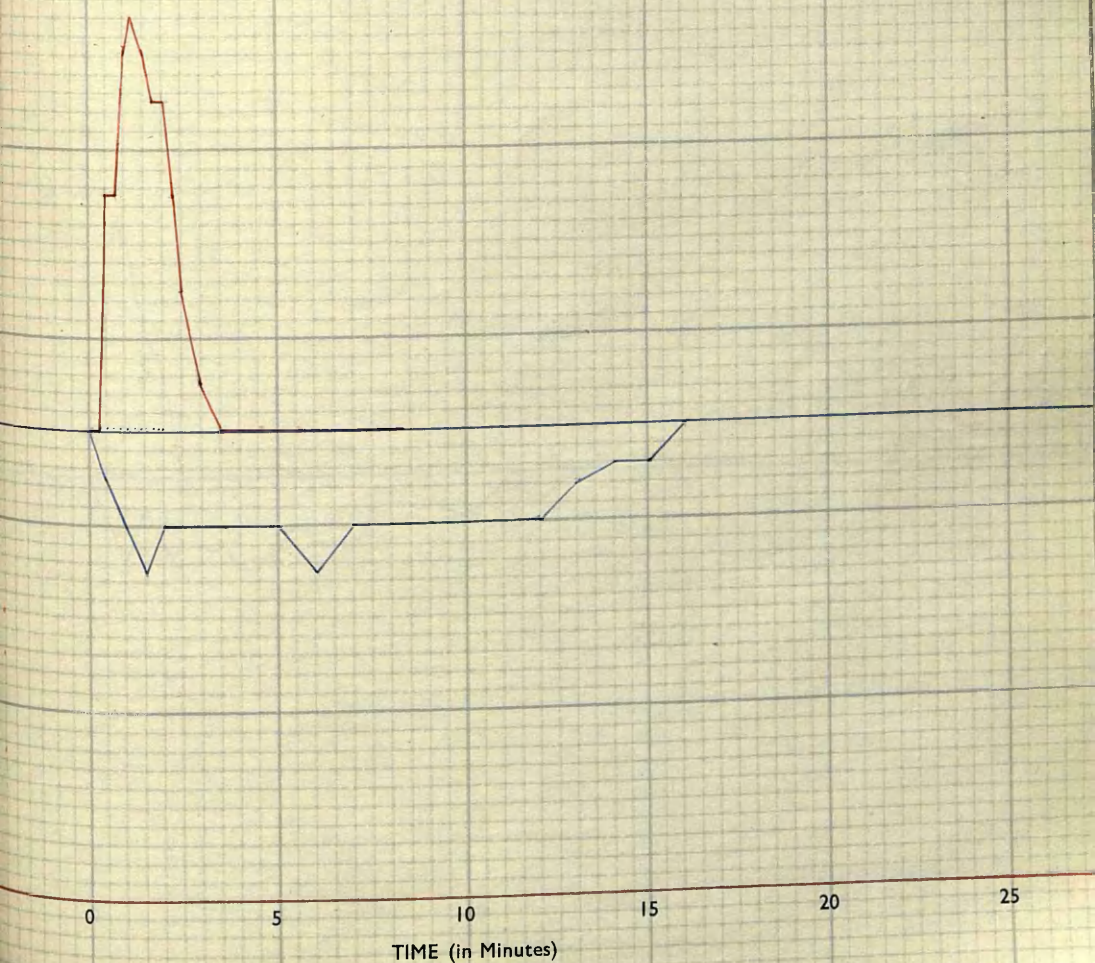


CASE No. : 54 (b)

S.A. = 70
P.A. = 142

A.I. = 49.9

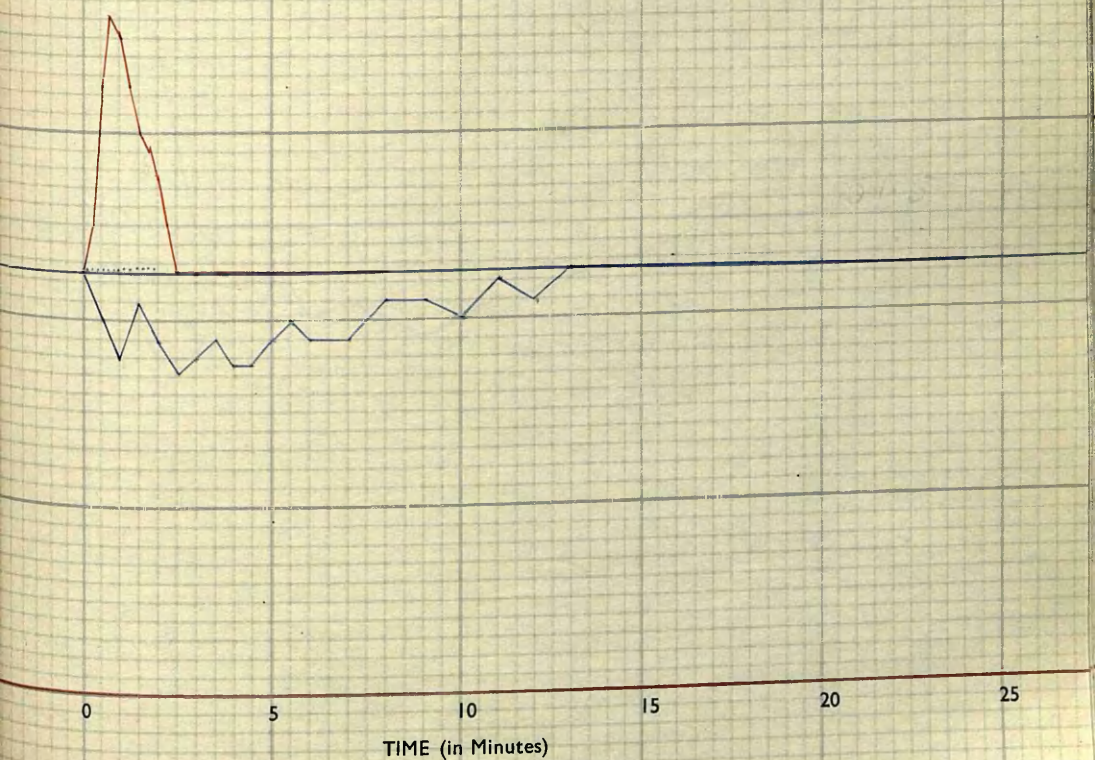
IMPROVED.



CASE No.: 55 (a) Sub-group I.

S.A. = 35
P.A. = 68

A.I. = 51.5

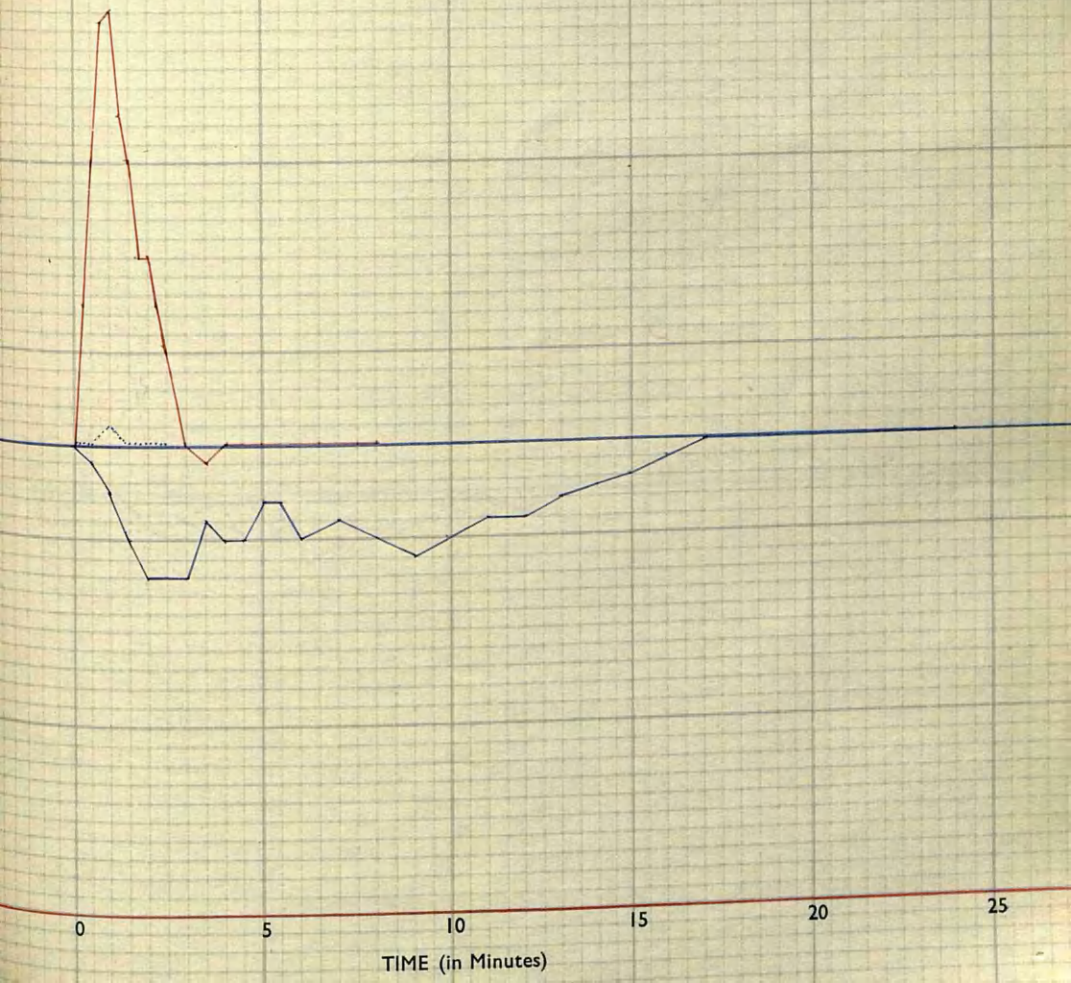


CASE No.: 55 (b)

S.A. = 65
P.A. = 130

A.I. = 50

RECOVERED.

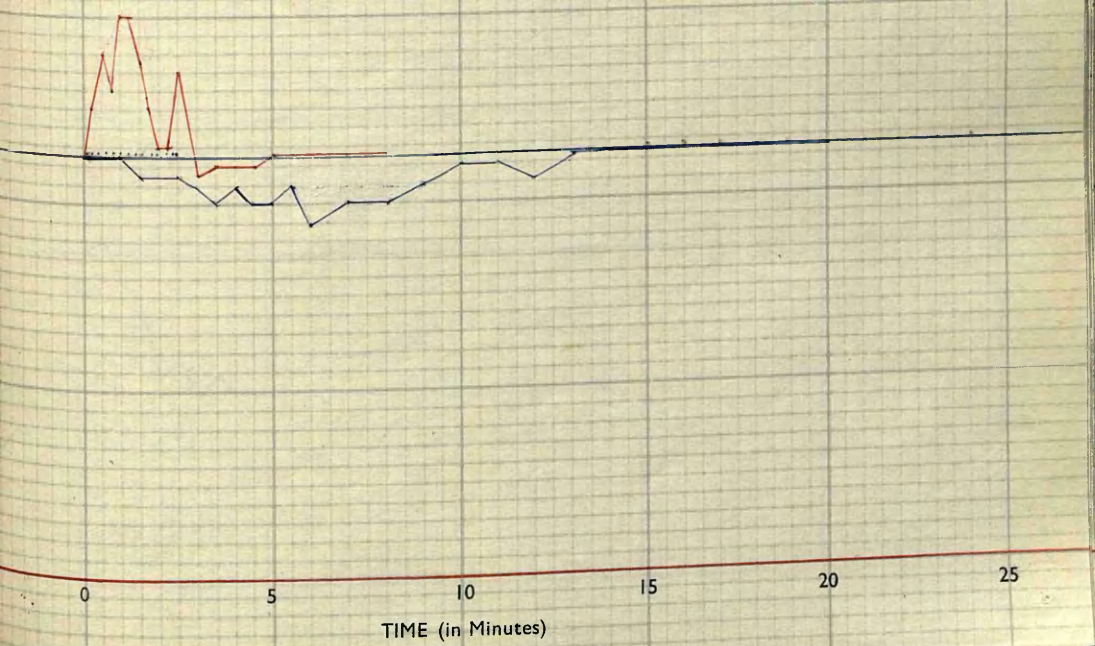


CASE No.: 56(a) Sub-group II.

S.A. = 19

P.A. = 41

A.I. = 46.3

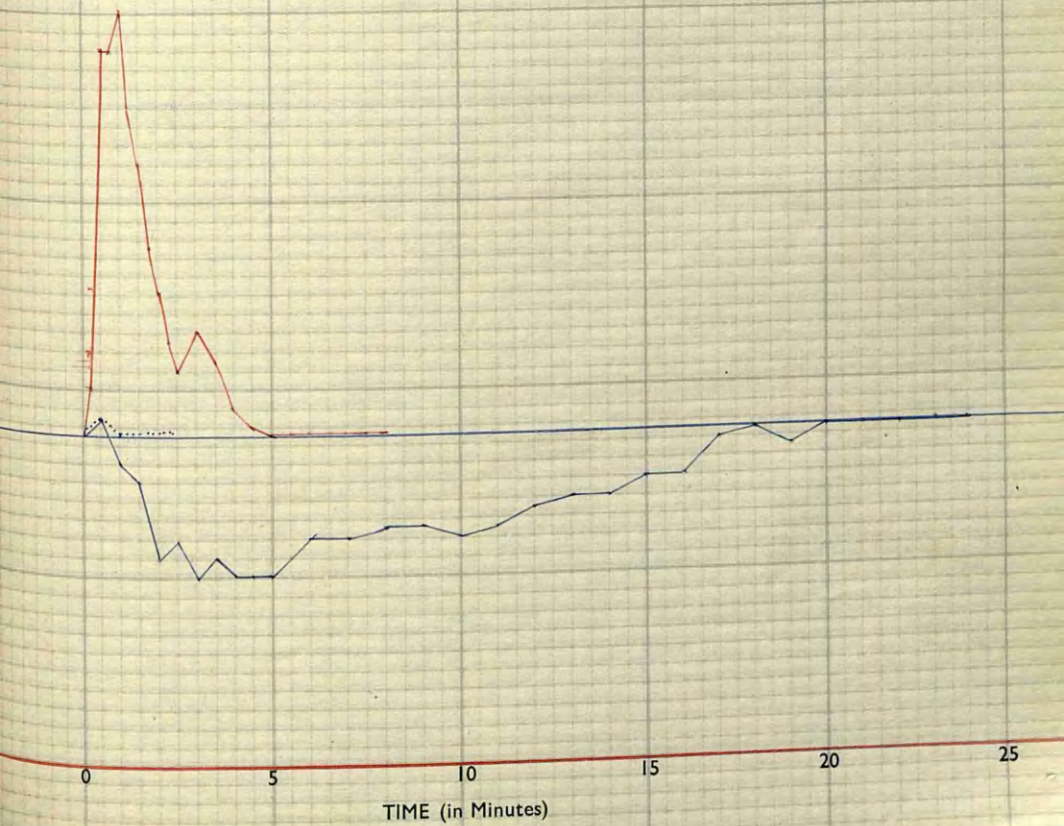


CASE No. : 56 (b)

S.A. = 71
P.A. = 153

A.I. = 46.4

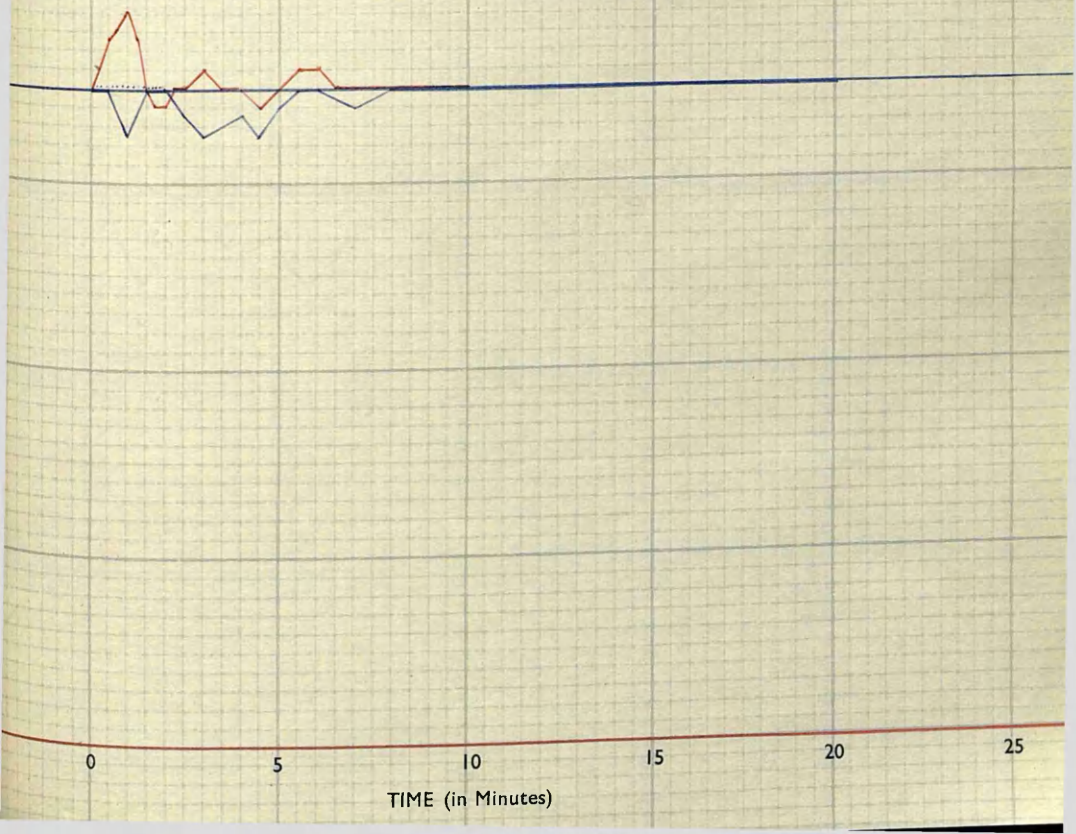
SPONTANEOUS RECOVERY.



CASE No.: 57 (a) Sub-group III.

S.A. = 7.5
P.A. = 15

A.I. = 50

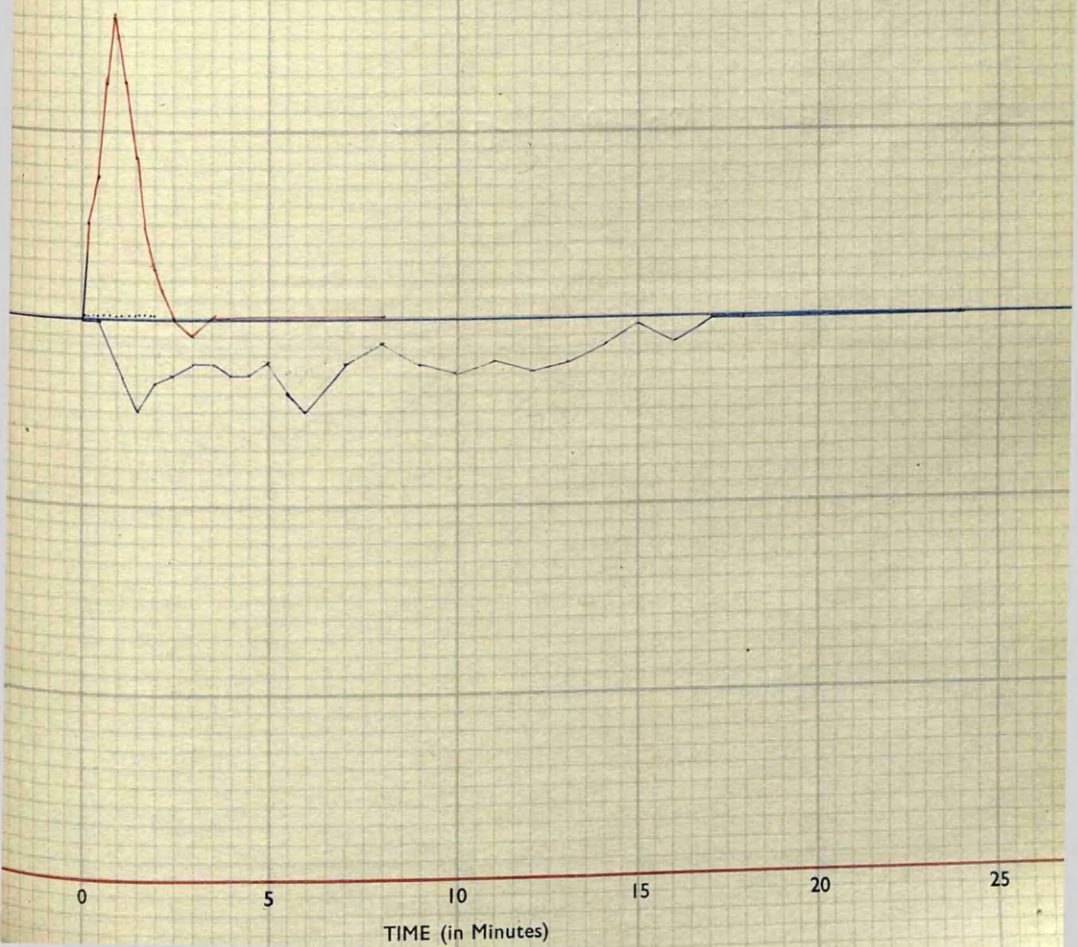


CASE No.: 57 (b)

S.A. = 36
P.A. = 78

A.I. = 46.2

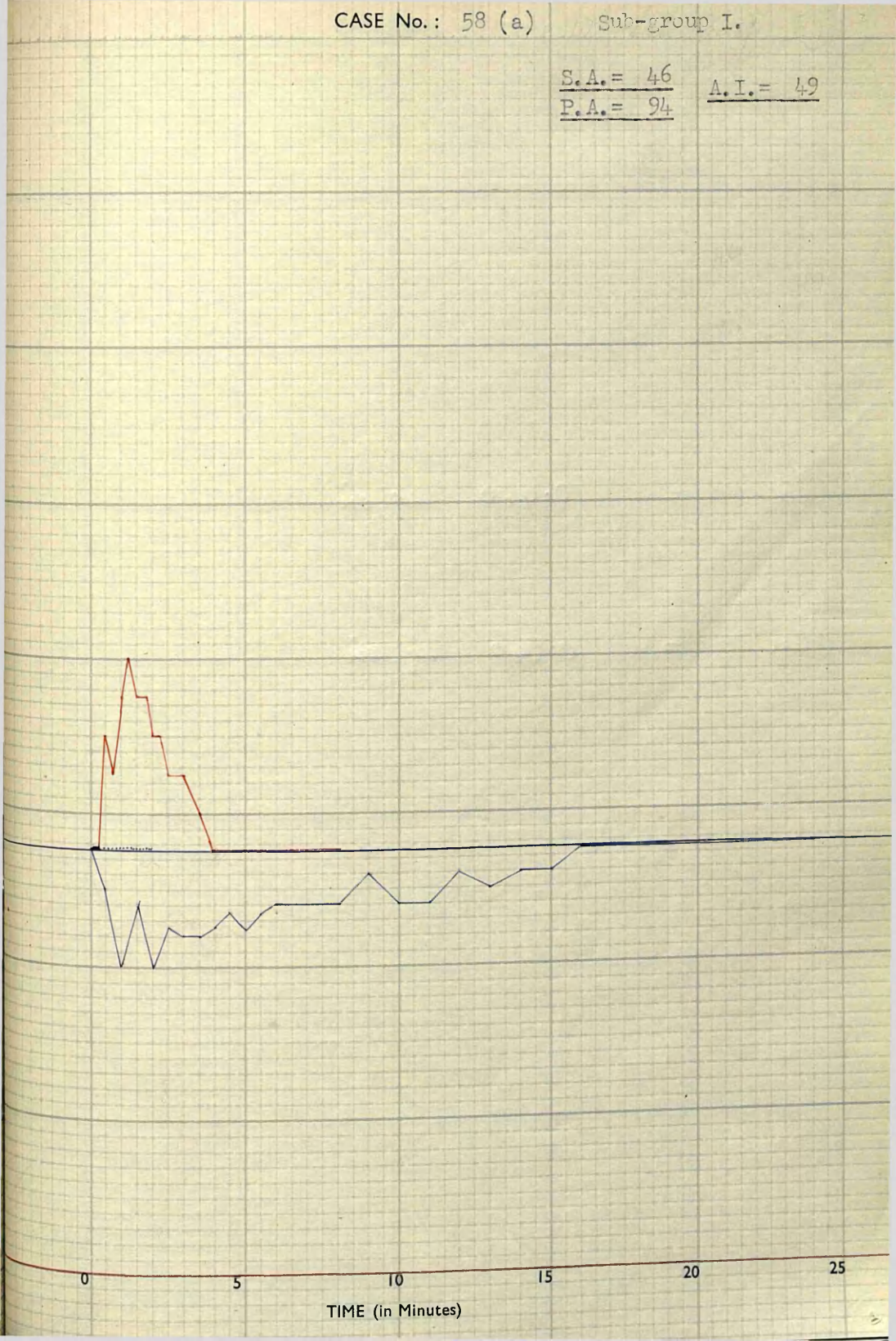
RECOVERED.



CASE No.: 58 (a) Sub-group I.

S.A.= 46
P.A.= 94

A.I.= 49

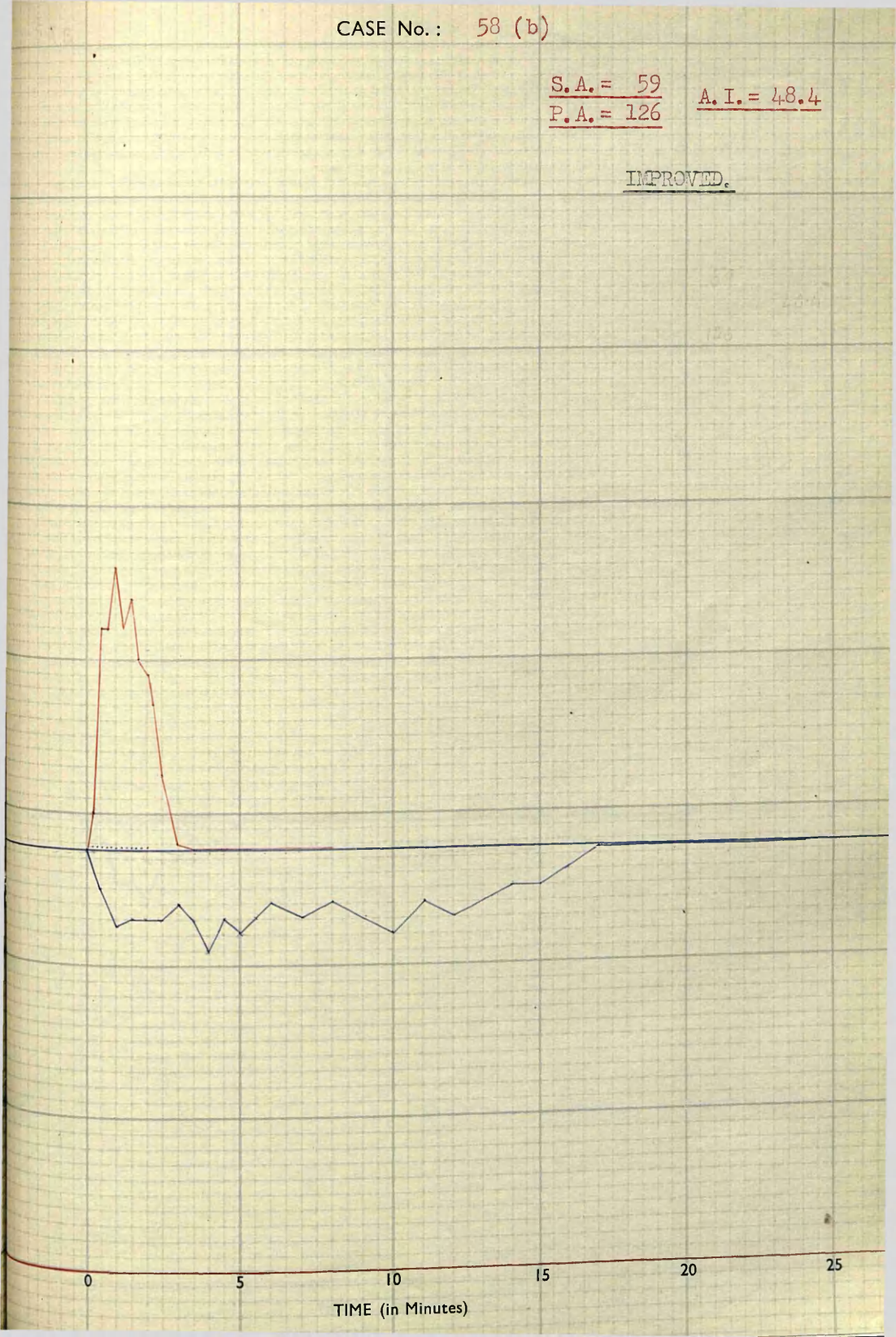


CASE No. : 58 (b)

S. A. = 59
P. A. = 126

A. I. = 48.4

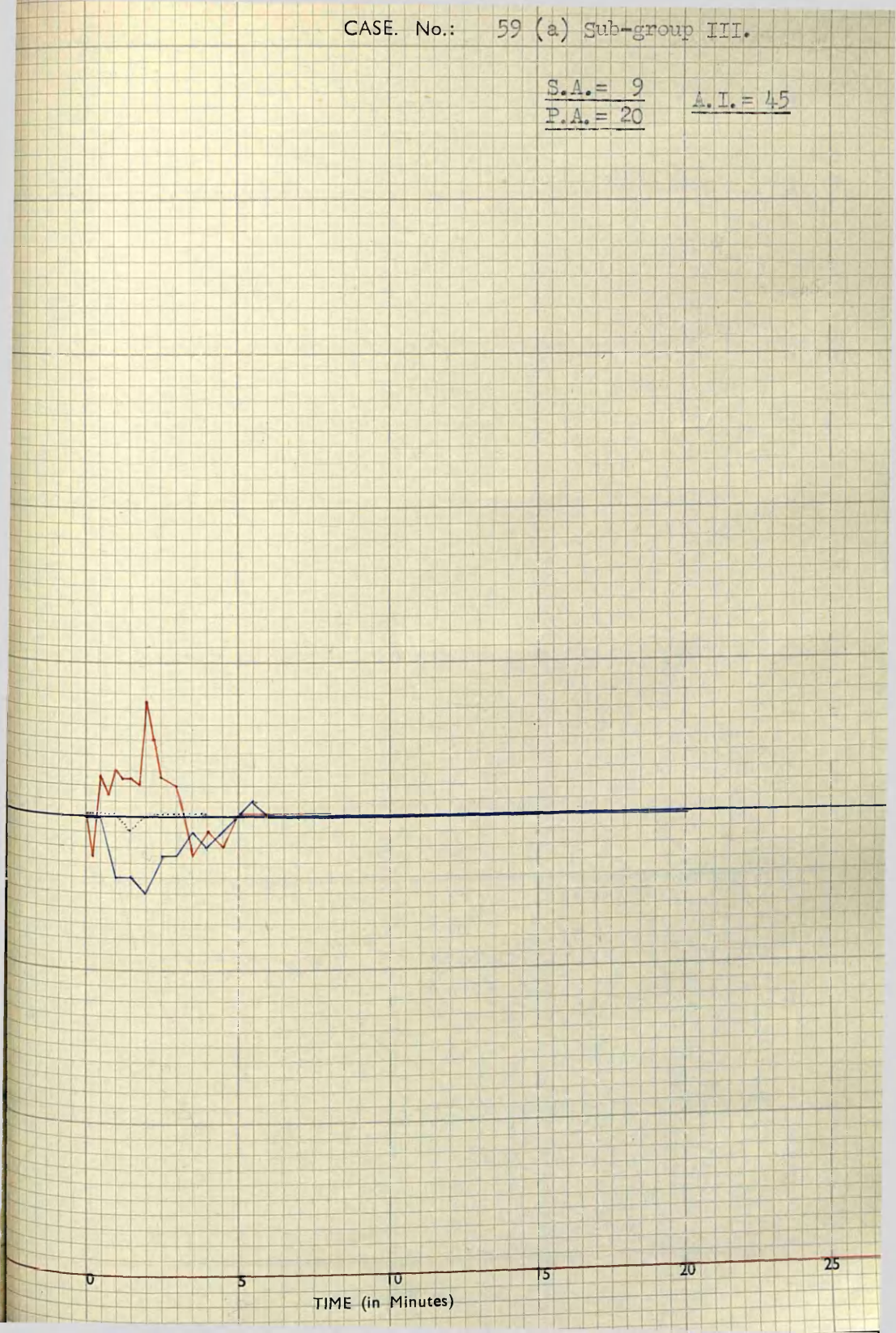
IMPROVED.



CASE. No.: 59 (a) Sub-group III.

S.A. = 9
P.A. = 20

A.I. = 45

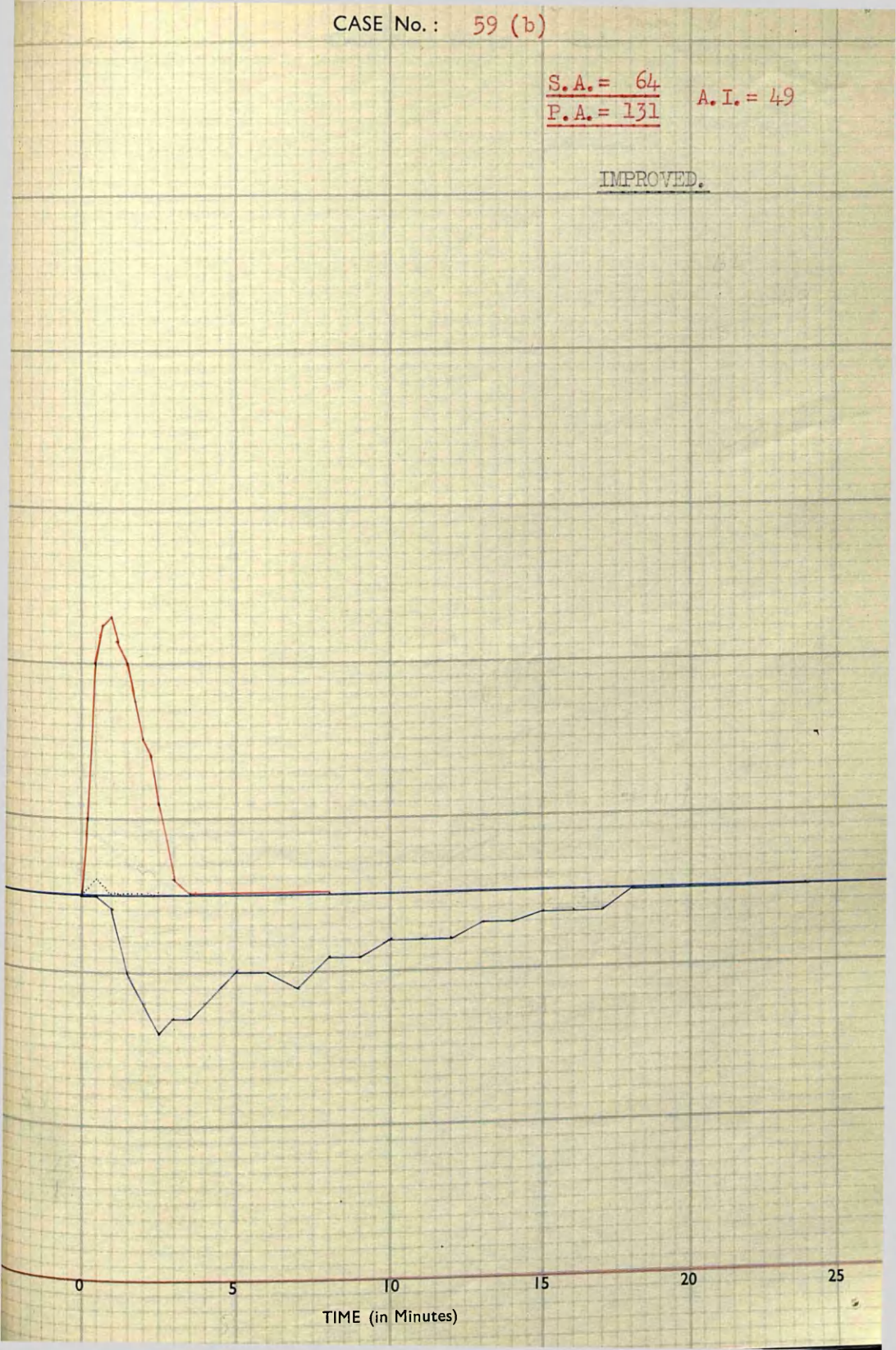


CASE No. : 59 (b)

S.A. = 64
P.A. = 131

A.I. = 49

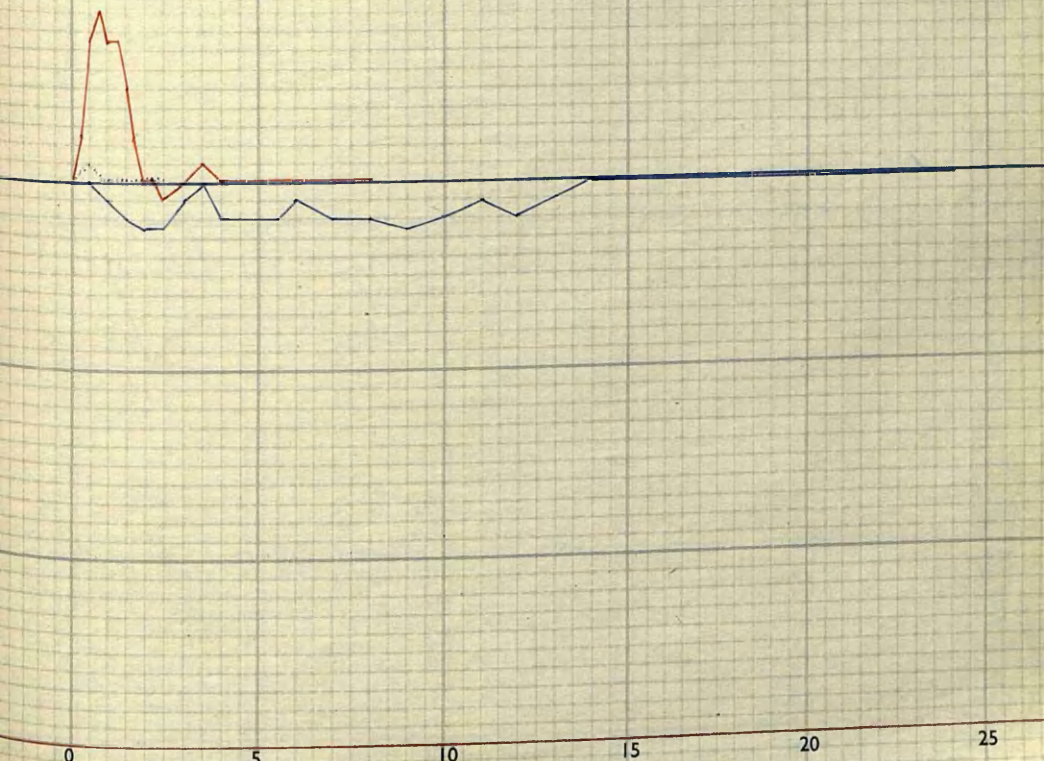
IMPROVED.



CASE No.: 60 (a) Sub-group II

S.A.= 21
P.A.= 42

A.I.= 50

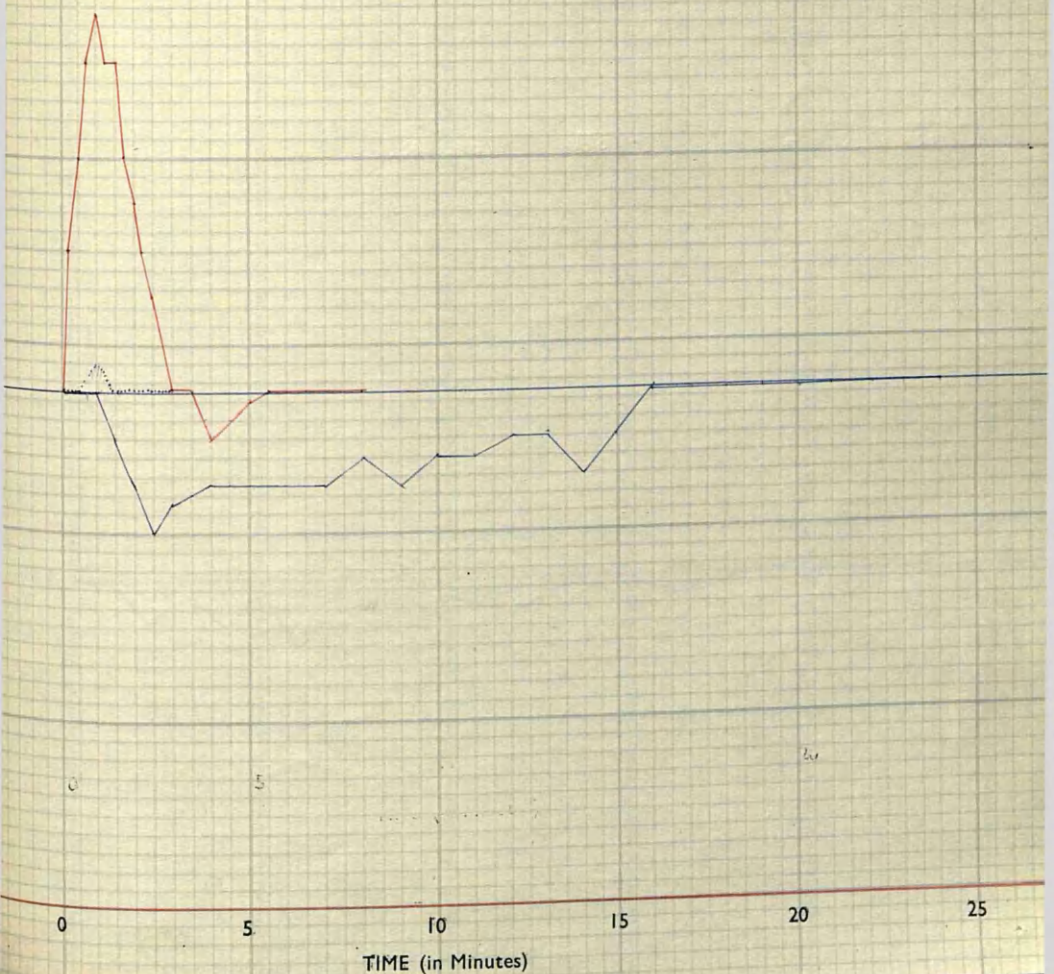


CASE No.: 60 (b)

S.A. = 62
P.A. = 118

A.I. = 53.6

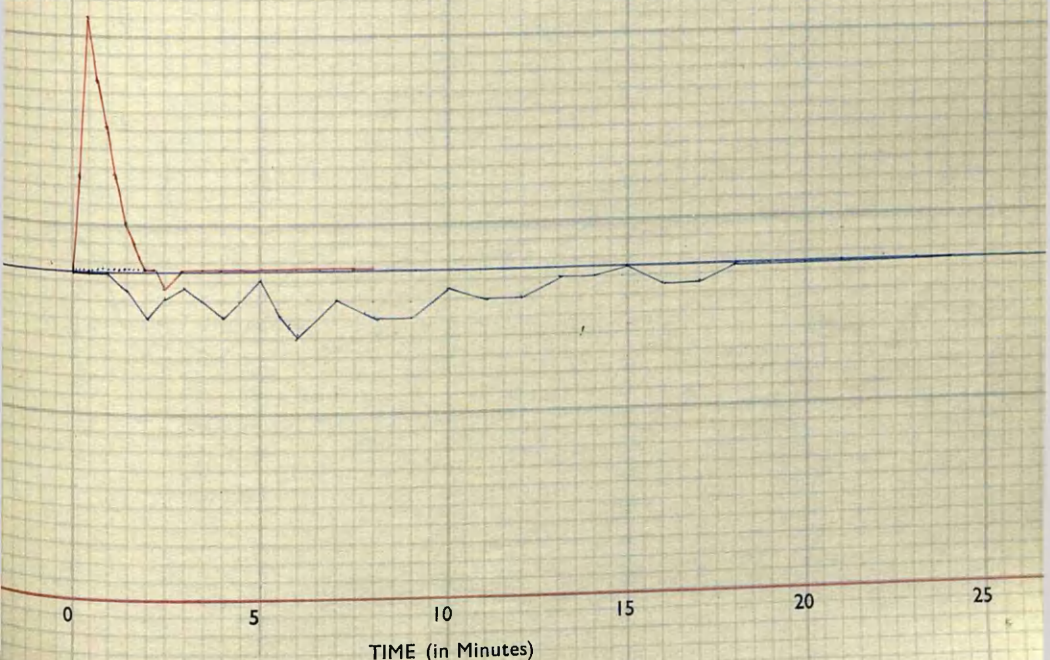
RECOVERED.



CASE No.: 61 (a) Sub-group II.

S.A. = 24
P.A. = 45

A.I. = 53.3

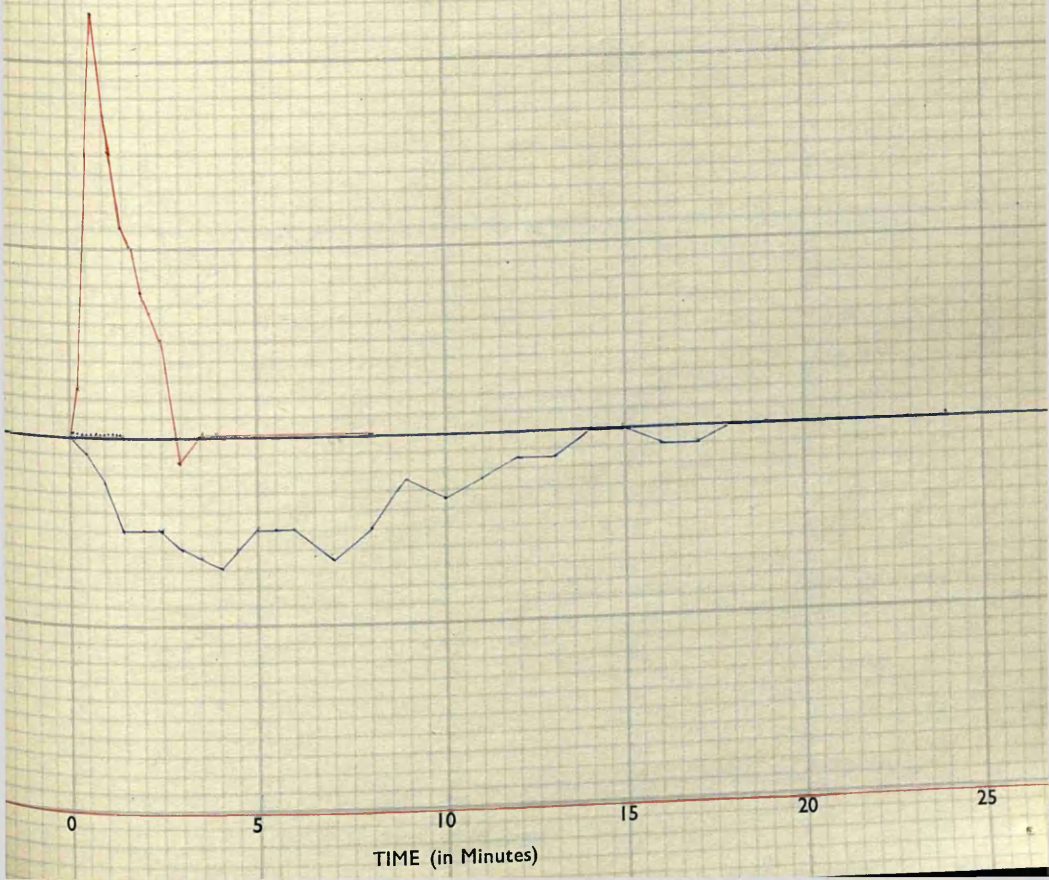


CASE No.: 61 (b)

S. A. = 56
P. A. = 100

A. I. = 56

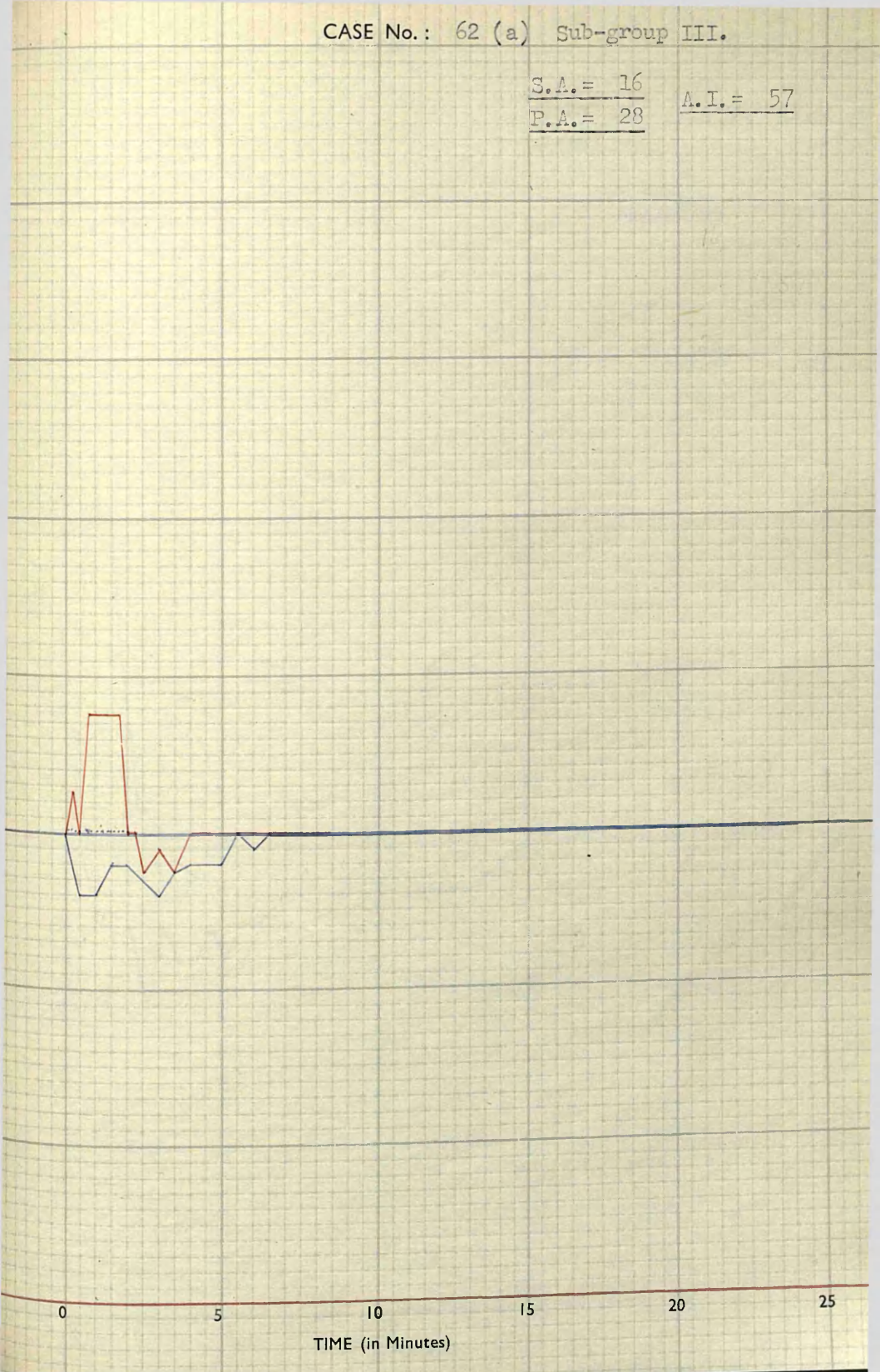
RECOVERED.



CASE No.: 62 (a) Sub-group III.

S.A.= 16
P.A.= 28

A.I.= 57

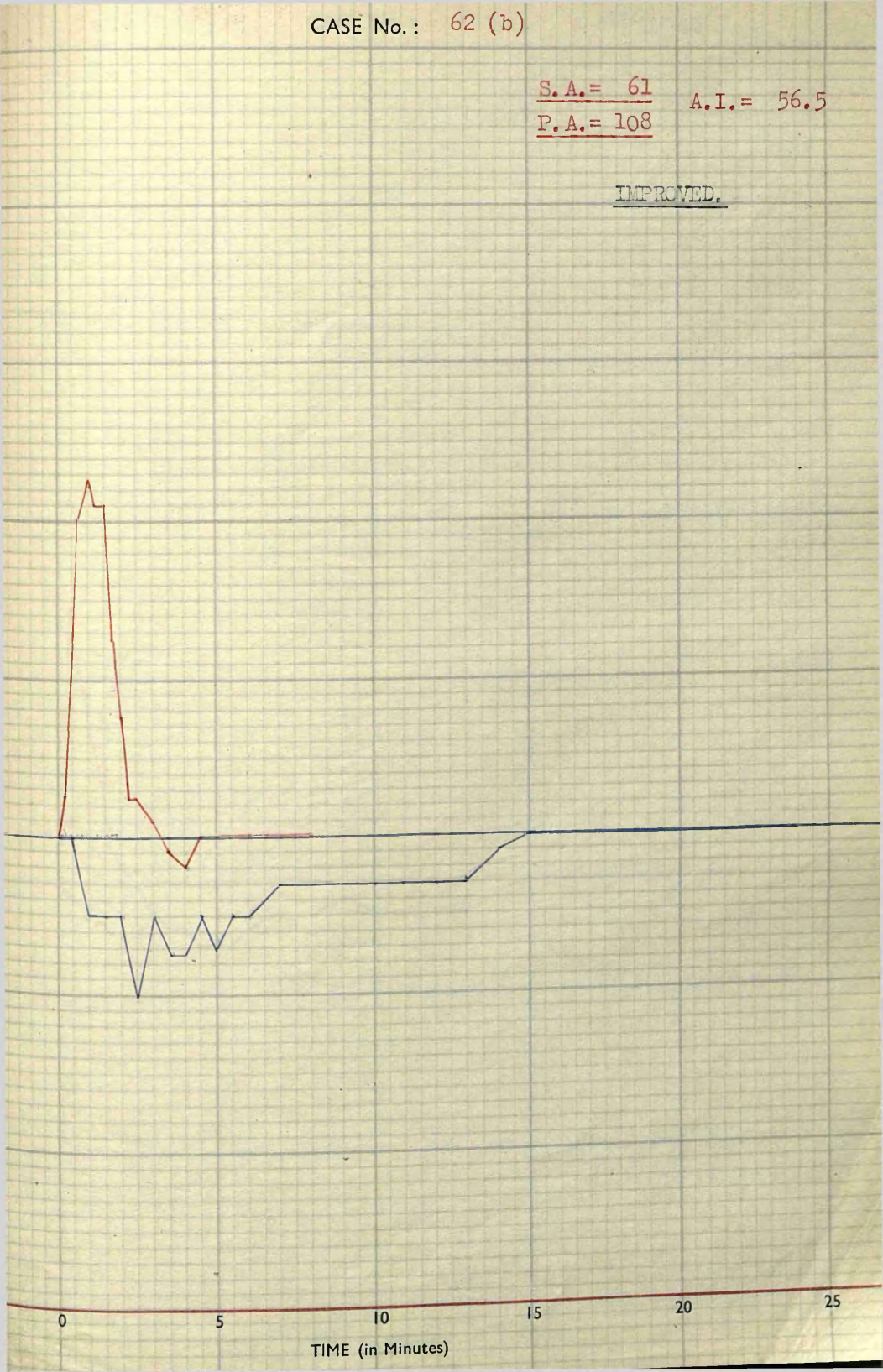


CASE No.: 62 (b)

S.A.= 61
P.A.= 108

A.I.= 56.5

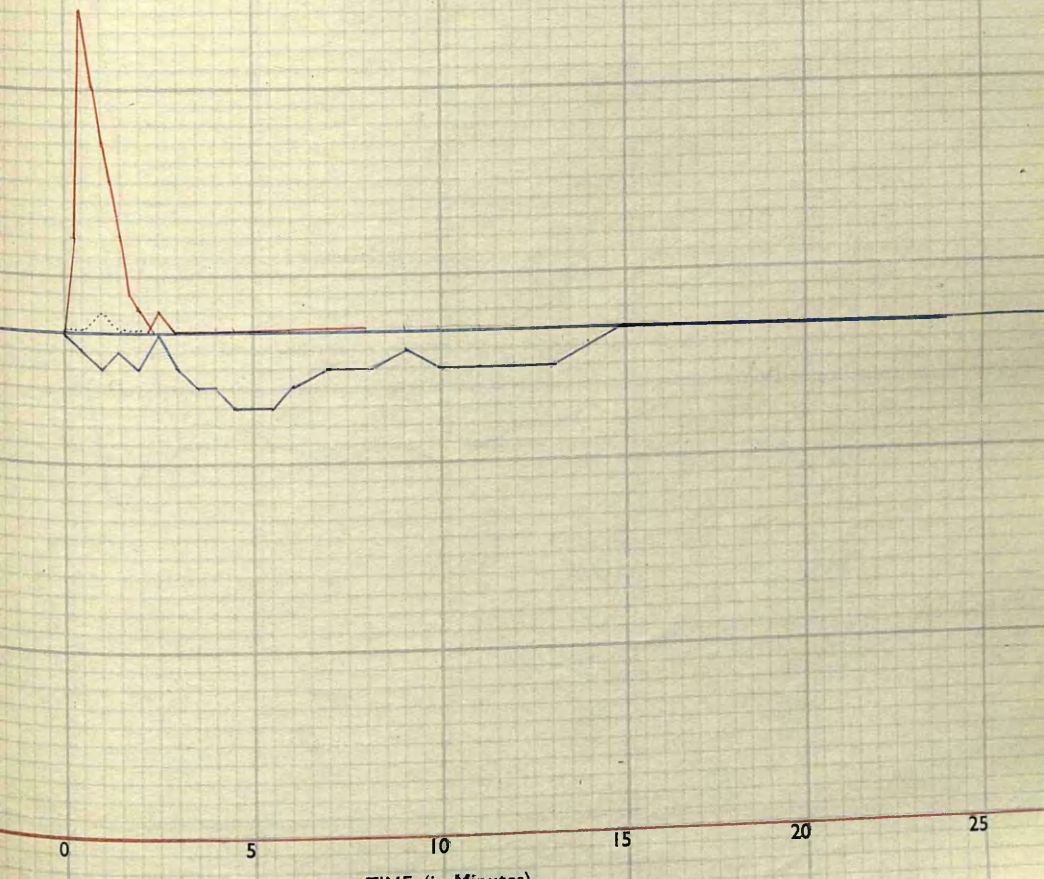
IMPROVED.



CASE No.: 63 (a) Sub-group I.

S.A.= 29
P.A.= 60

A.I.= 48.3

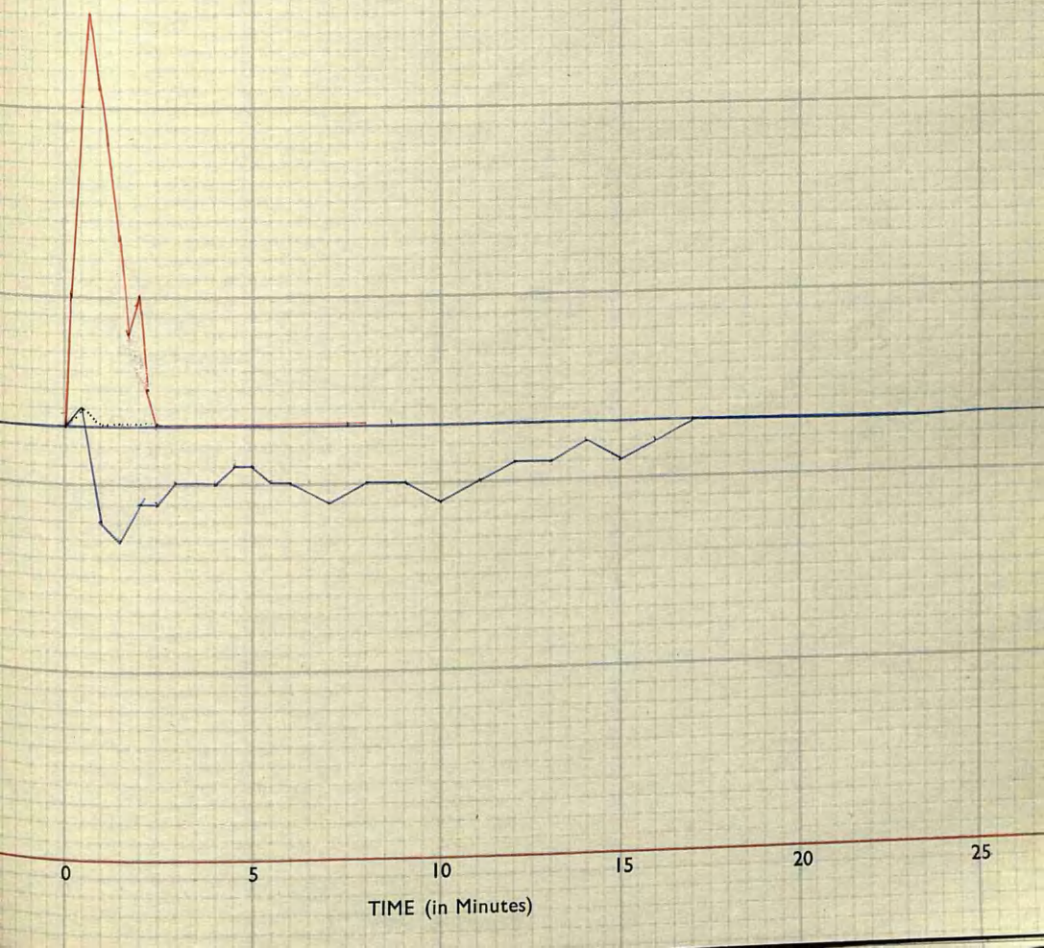


CASE No.: 63 (b)

S.A.= 48
P.A.= 90

A.I.= 53.3

IMPROVED.



CASE No.: 64 (a) Sub-group I.

S.A. = 26
P.A. = 52

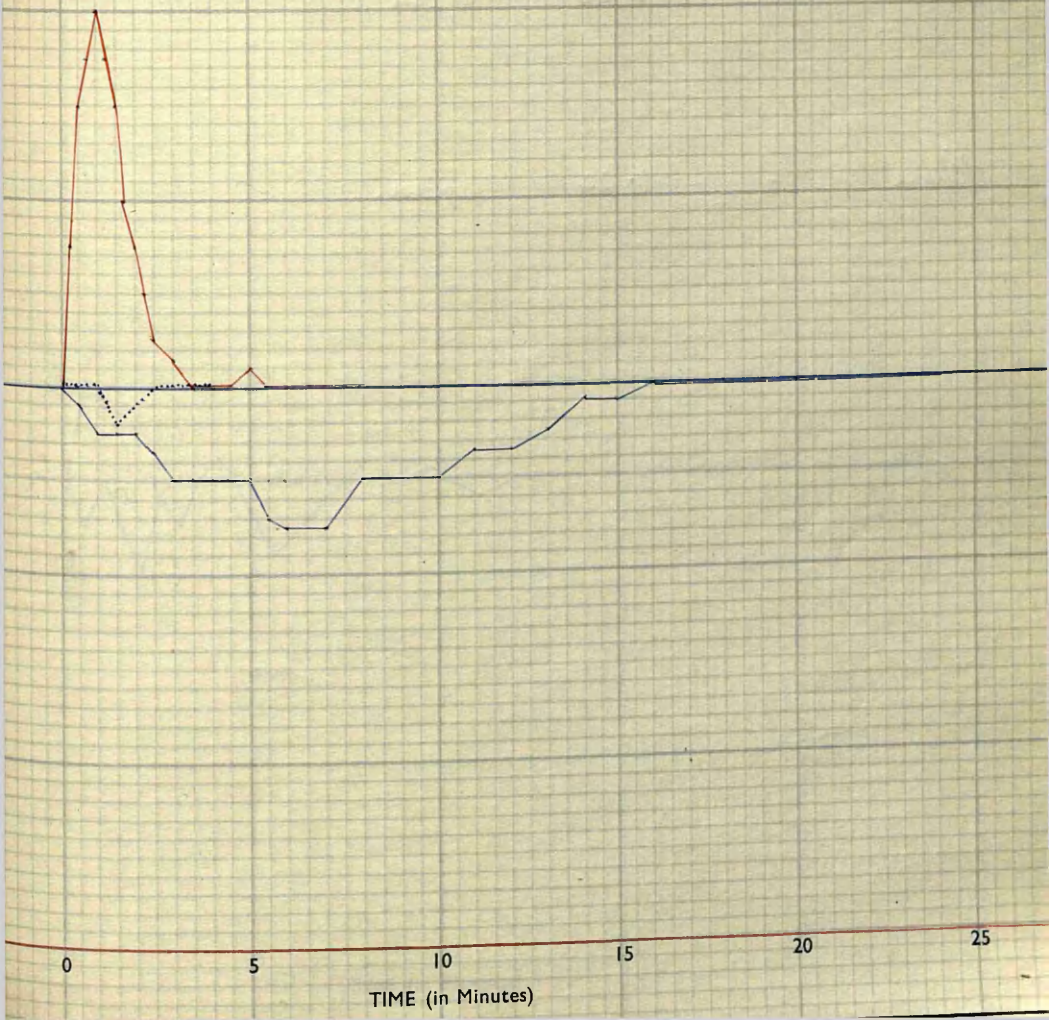
A.I. = 50

CASE No.: 64 (b)

S.A.= 60
P.A.= 120

A.I.= 50

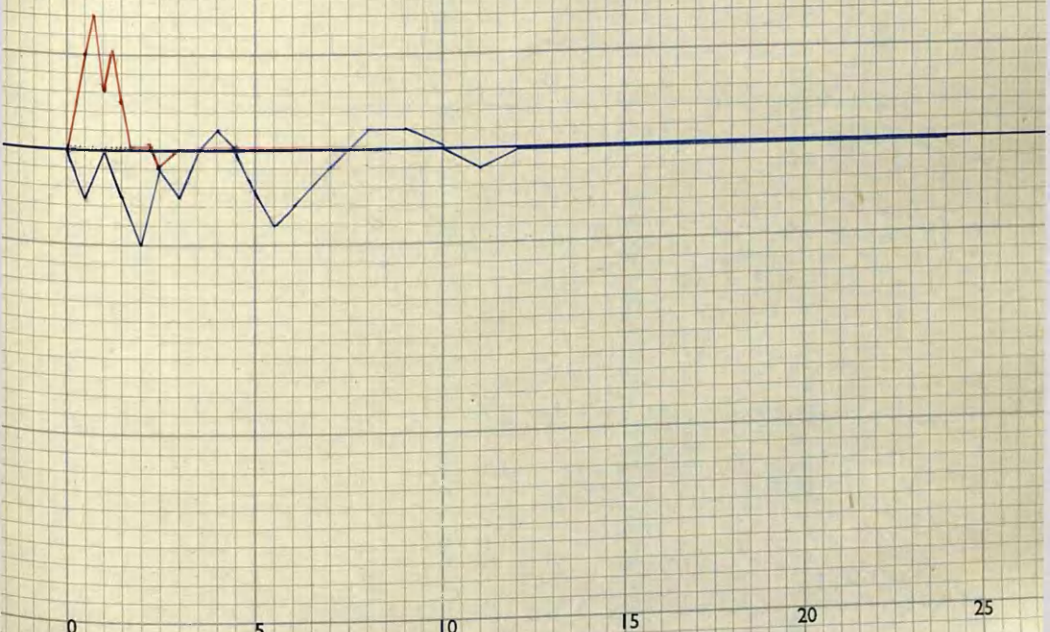
RECOVERED.



CASE. No.: 65 (a) Sub-group III.

S.A. = 11
P.A. = 22

A.I. = 50

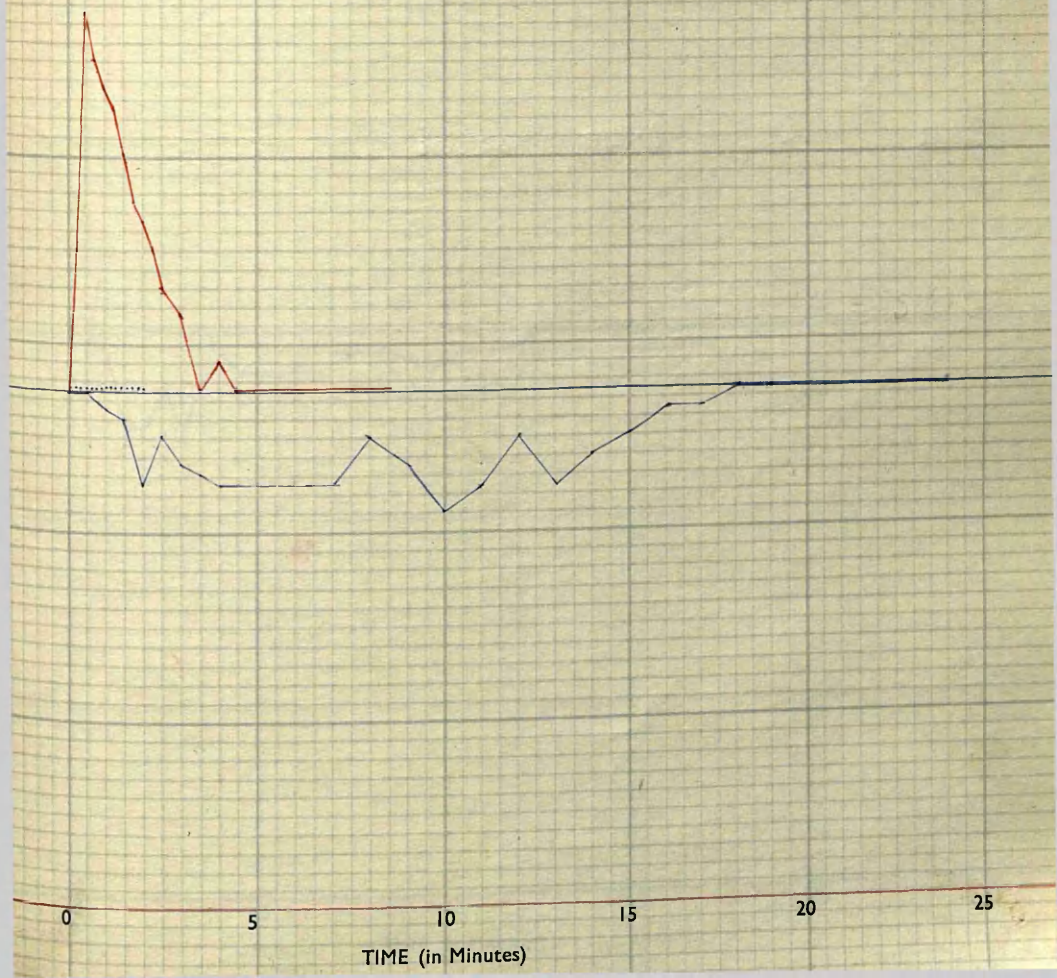


CASE No.: 65 (b)

S.A. = 67
P.A. = 121

A.I. = 54.5

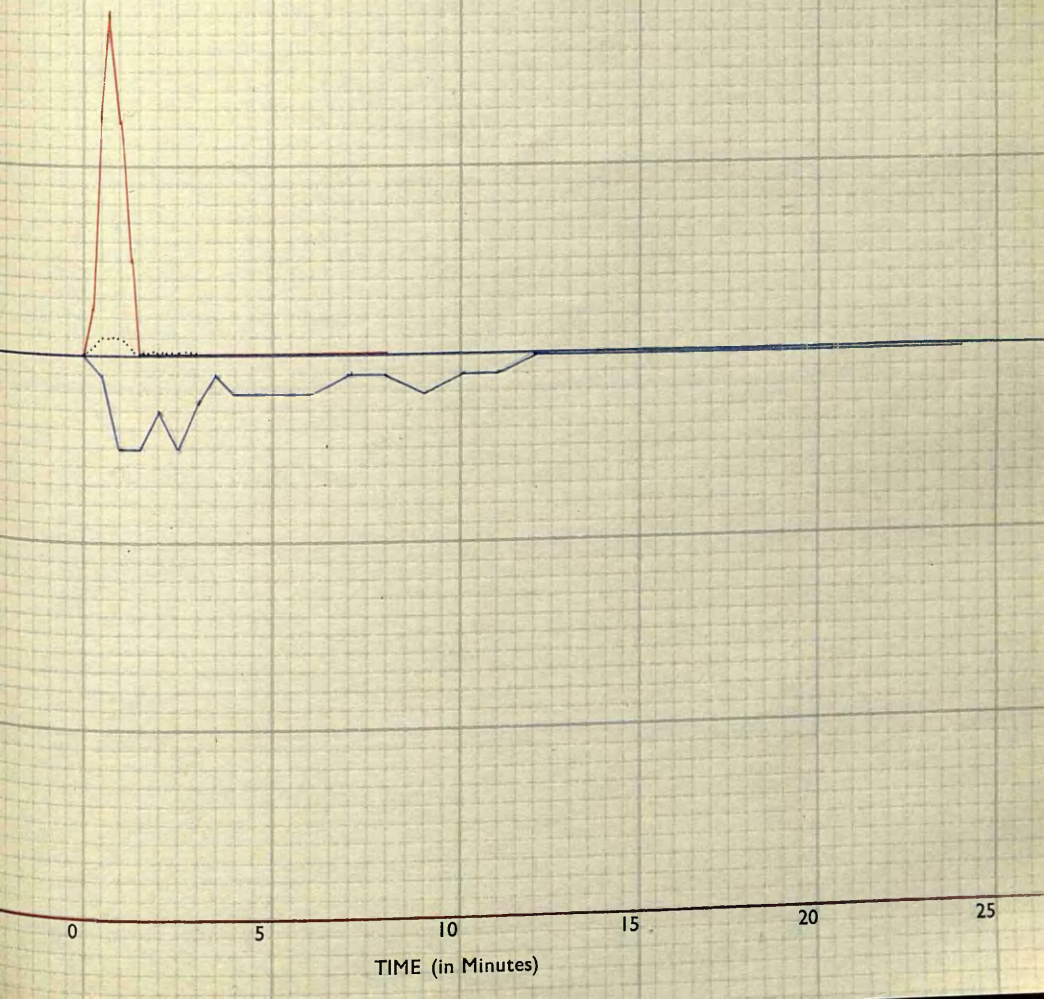
IMPROVED.



CASE No.: 66 (a) Sub-group I.

S.A.= 23
P.A.= 45

A.I.= 51.1

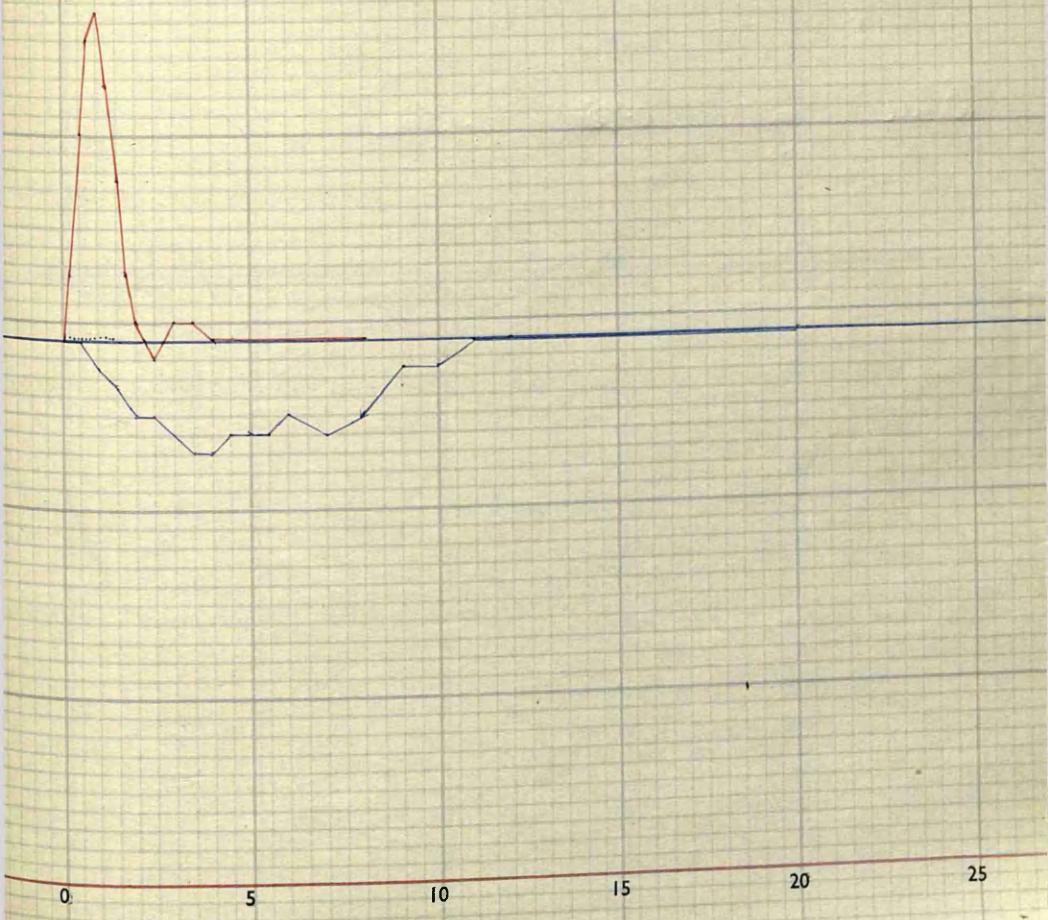


CASE No. : 66 (b)

S.A.= 38
P.A.= 74

A.I.= 51.4

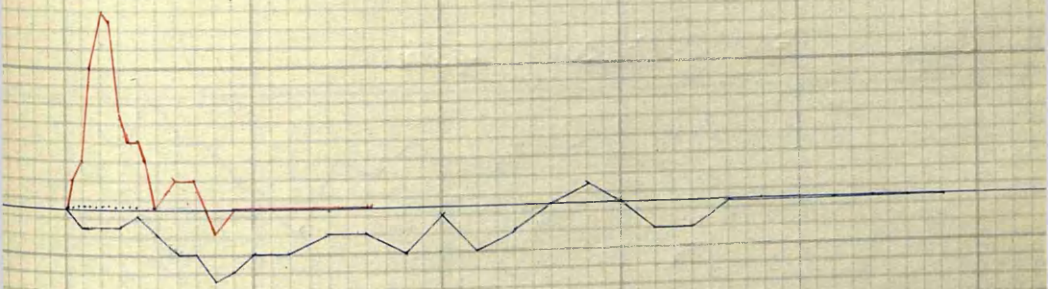
IMPROVED.

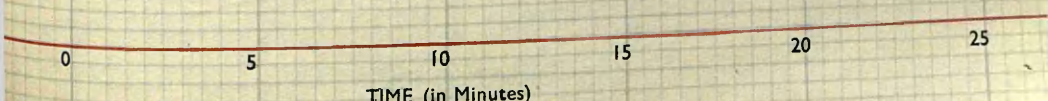


CASE No.: 67 (a) Sub-group I.

S.A. = 26
P.A. = 47

A.I. = 55.3





CASE No.: 68 (a) Sub-group II.

S.A.= 17
A.I.= 29

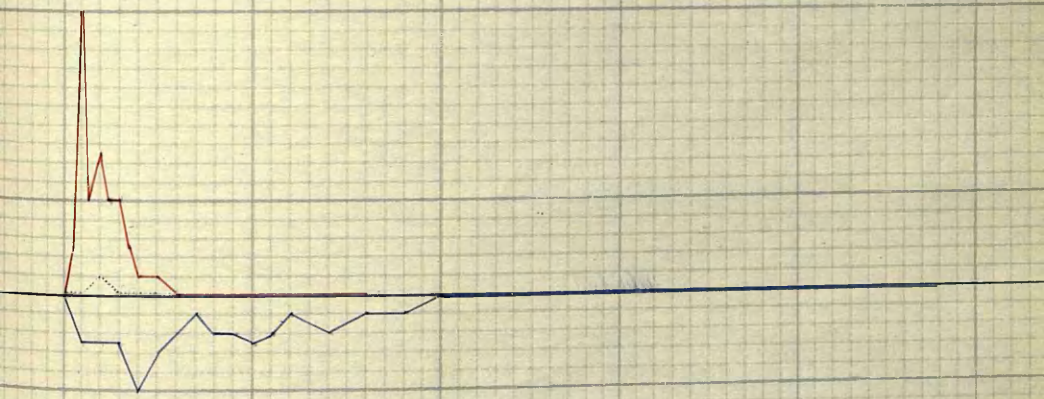
A.I.= 58.6

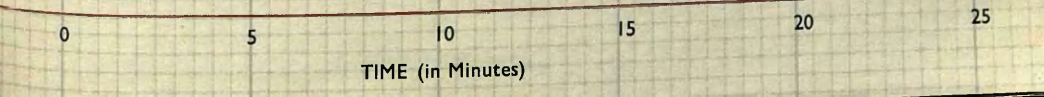
CASE No. : 68 (b)

S.A. = 21
P.A. = 37

A.I. = 56.8

NOT IMPROVED.

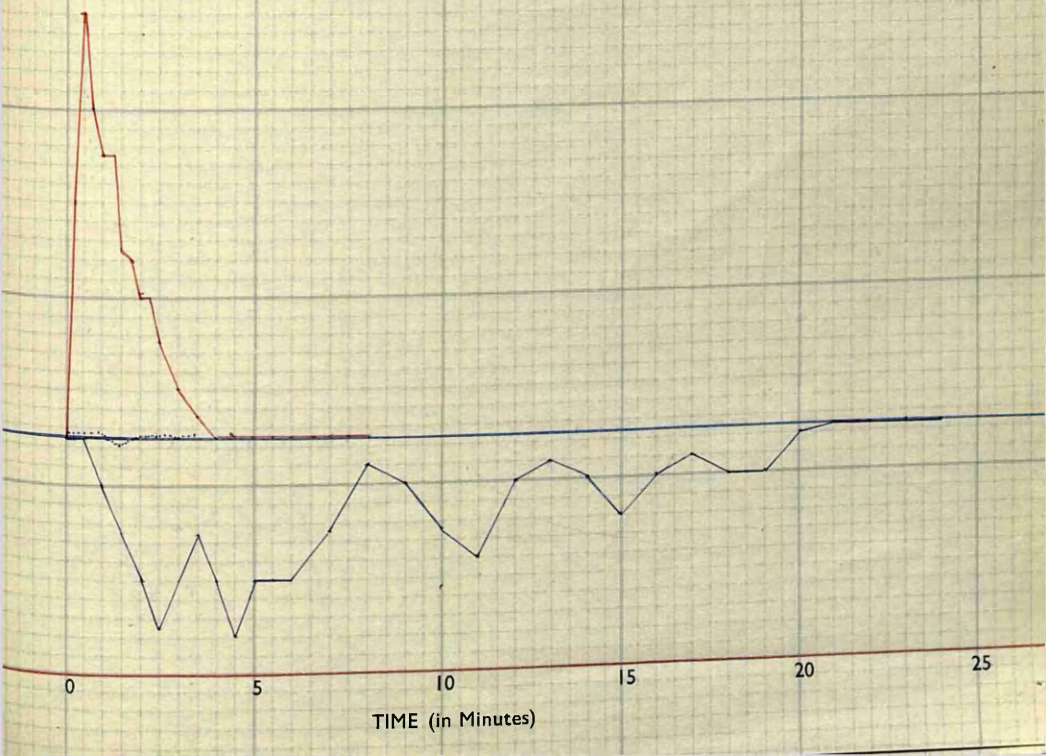




CASE No.: 69 (a)

S.A. = 68
P.A. = 167

A.I. = 40.7

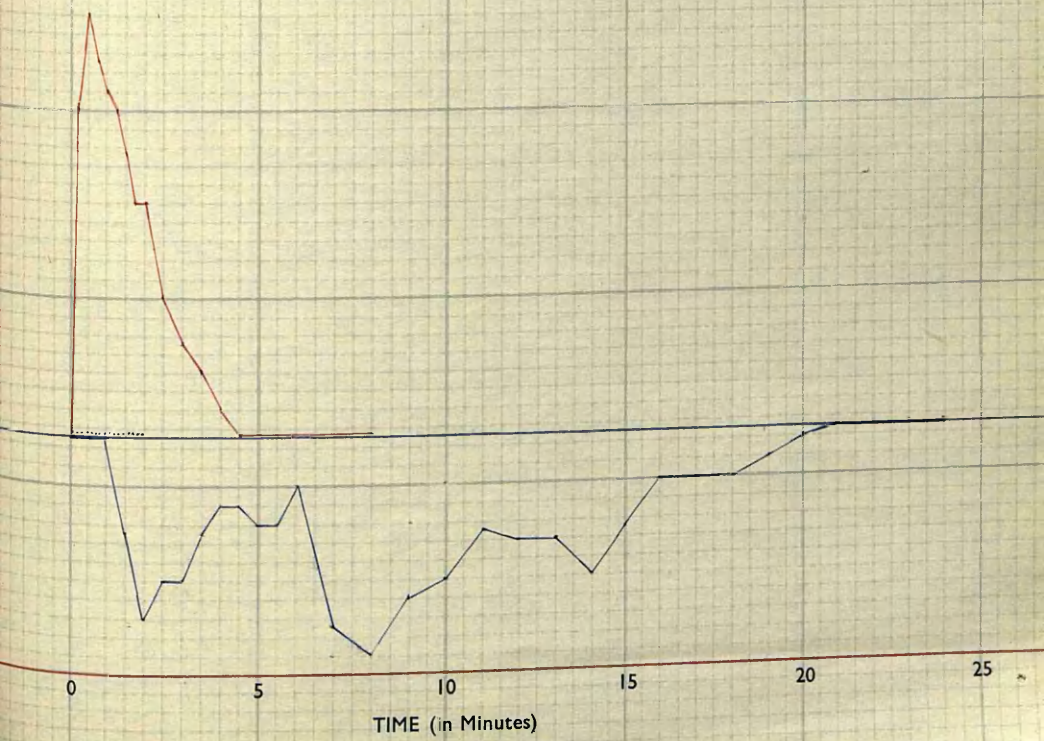


CASE No. : 69 (b)

S.A. = 89
P.A. = 216

A.I. = 41.2

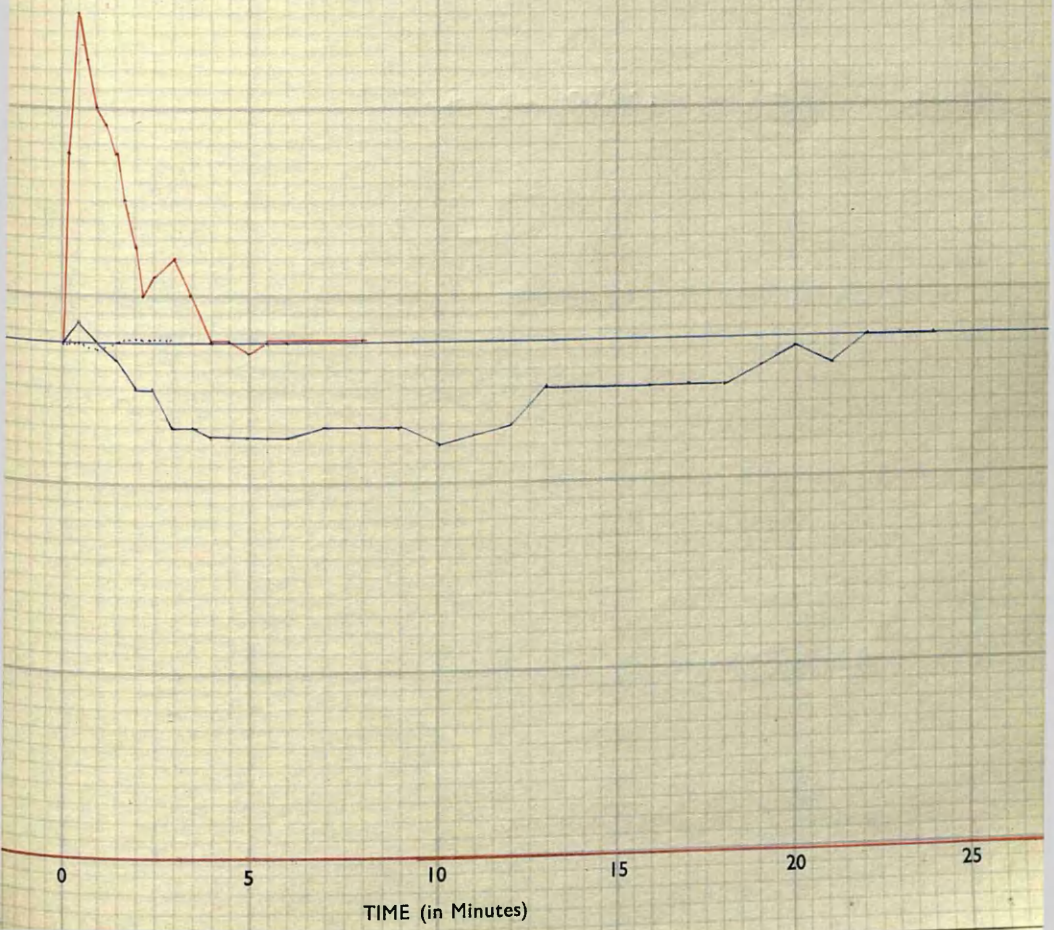
NOT IMPROVED.



CASE No.: 70 (a)

S.A. = 53
P.A. = 130

A.I. = 40.8

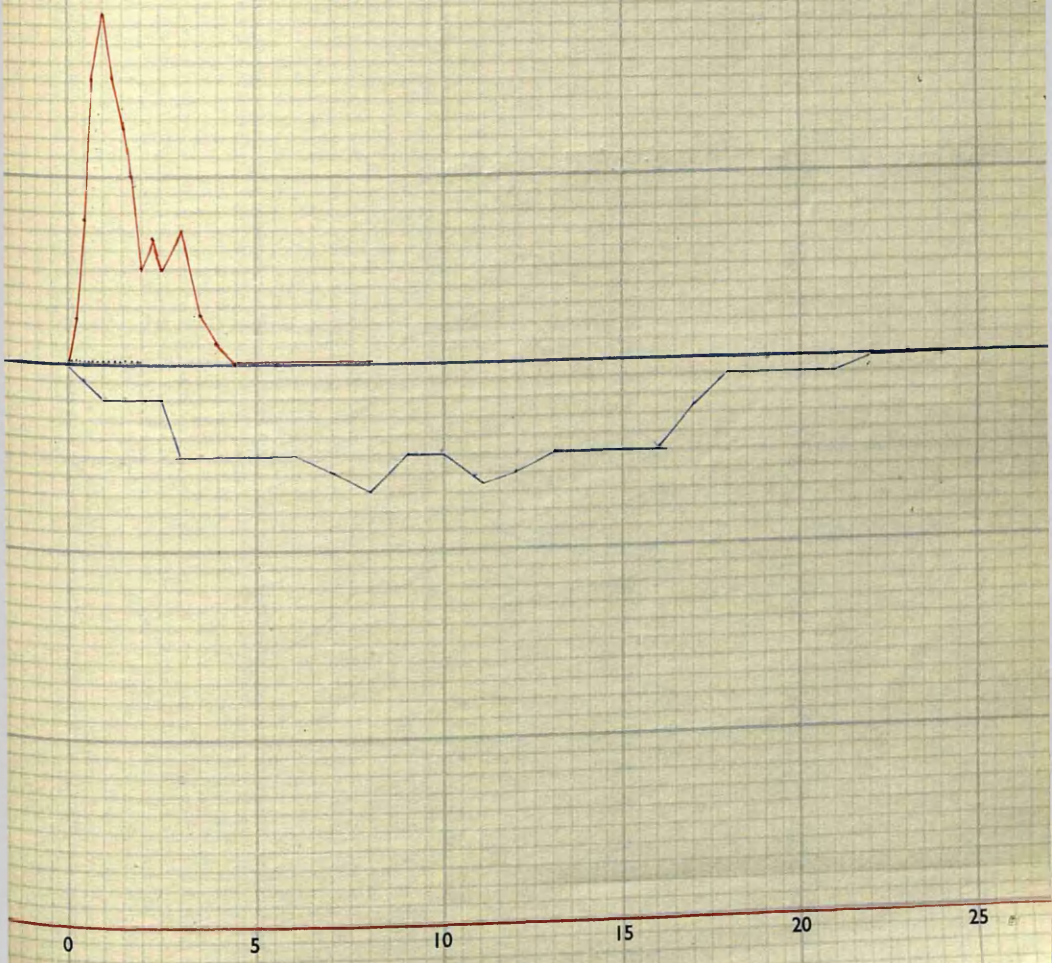


CASE No. : 70 (b)

S. A. = 62
P. A. = 155

A. I. = 40

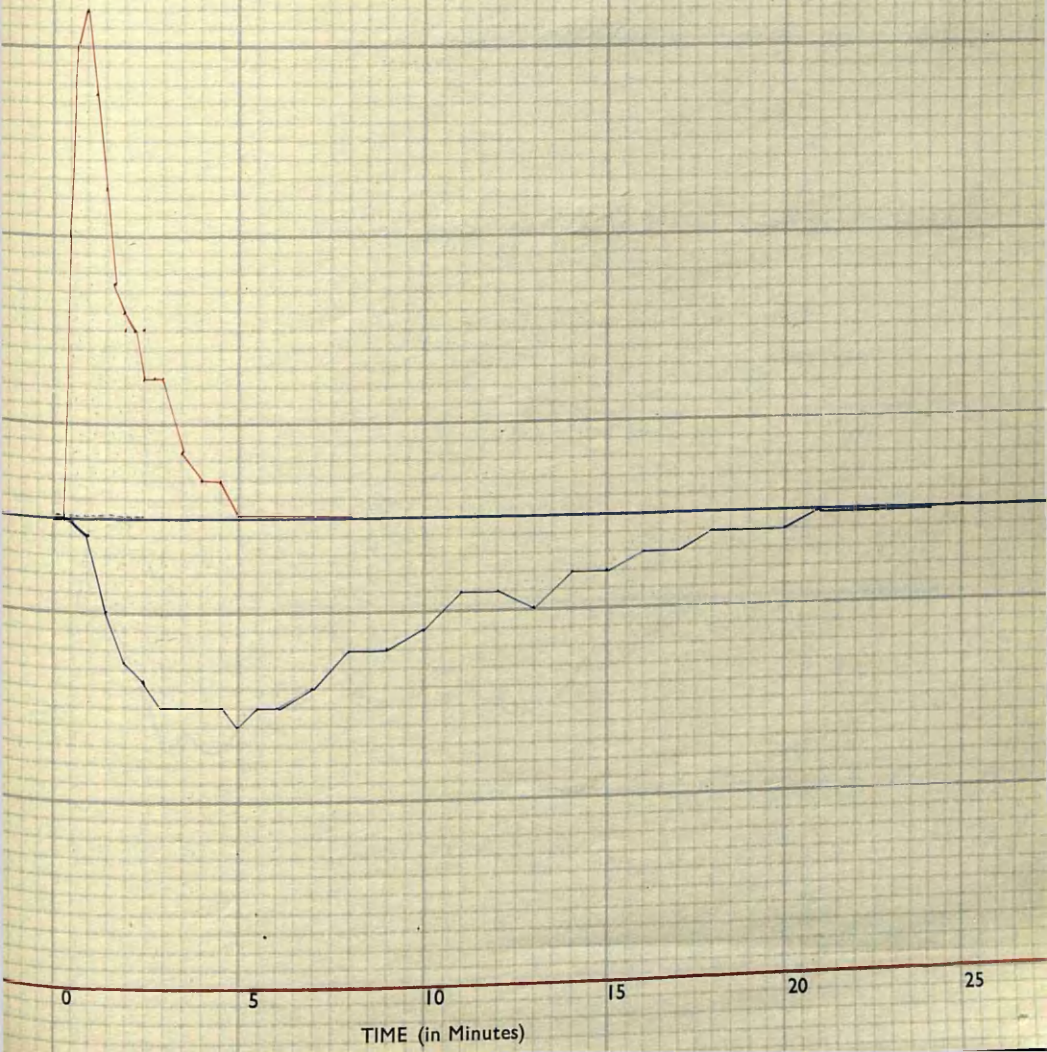
NOT IMPROVED



CASE No. : 71 (a)

S.A. = 89
P.A. = 202

A.I. = 44.1

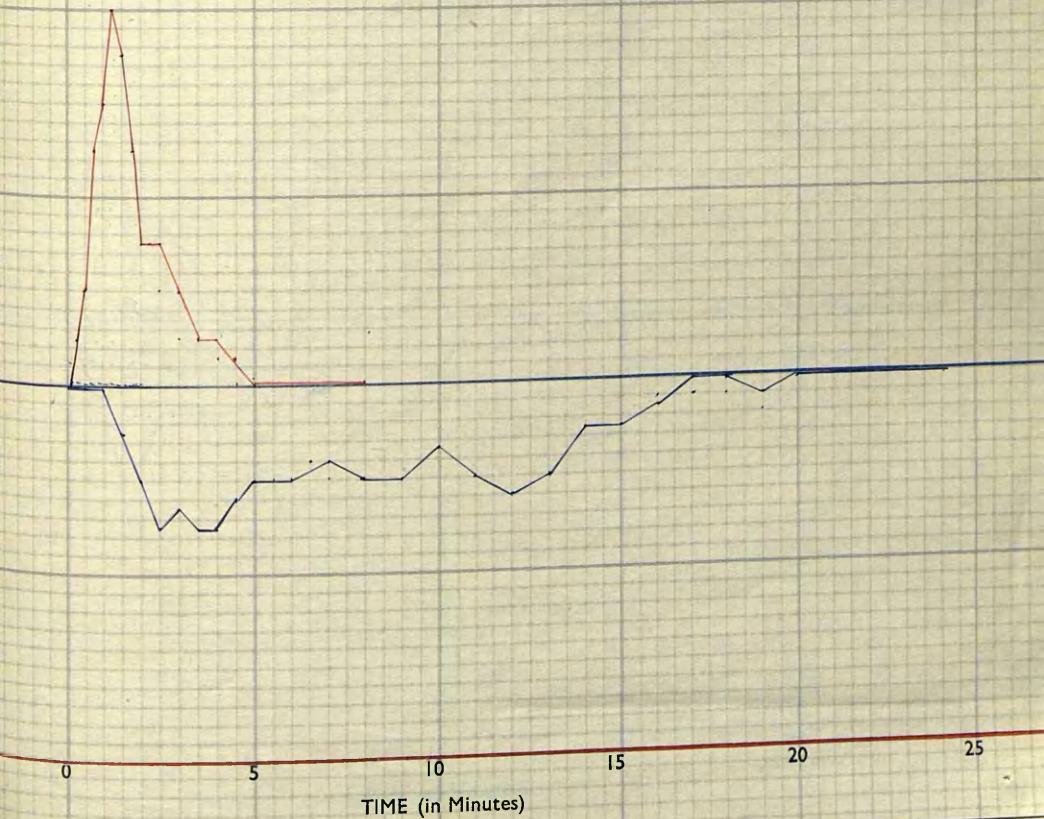


CASE No. : 71 (b)

S. A. = 64
P. A. = 140

A. I. = 45.7

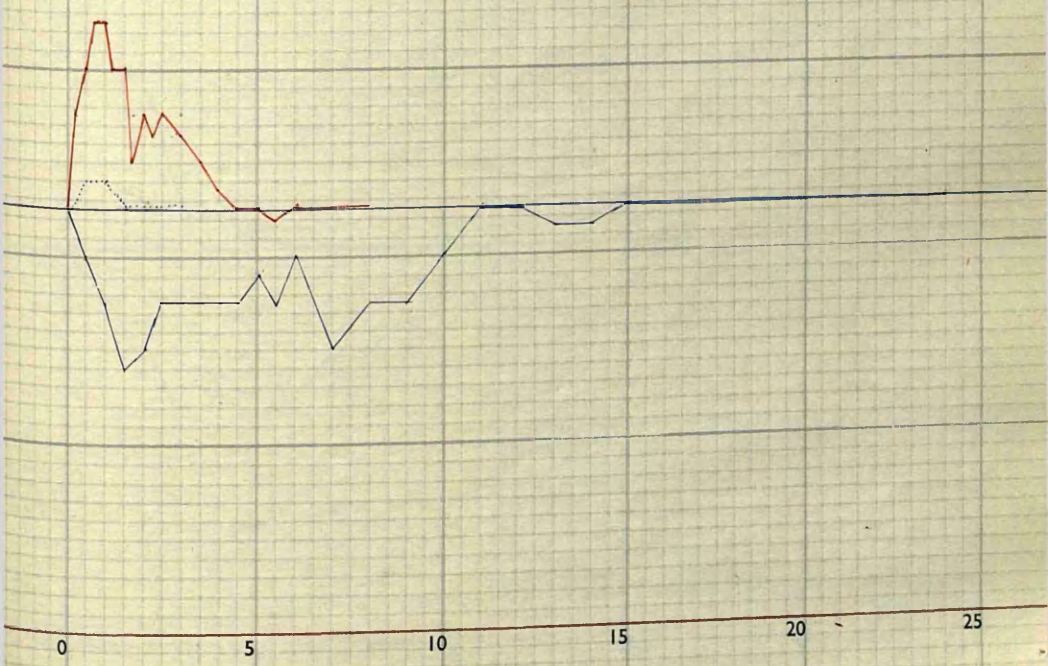
NOT IMPROVED.



CASE No. : 72 (a)

S.A. = 40
P.A. = 103

A.T. = 38.8

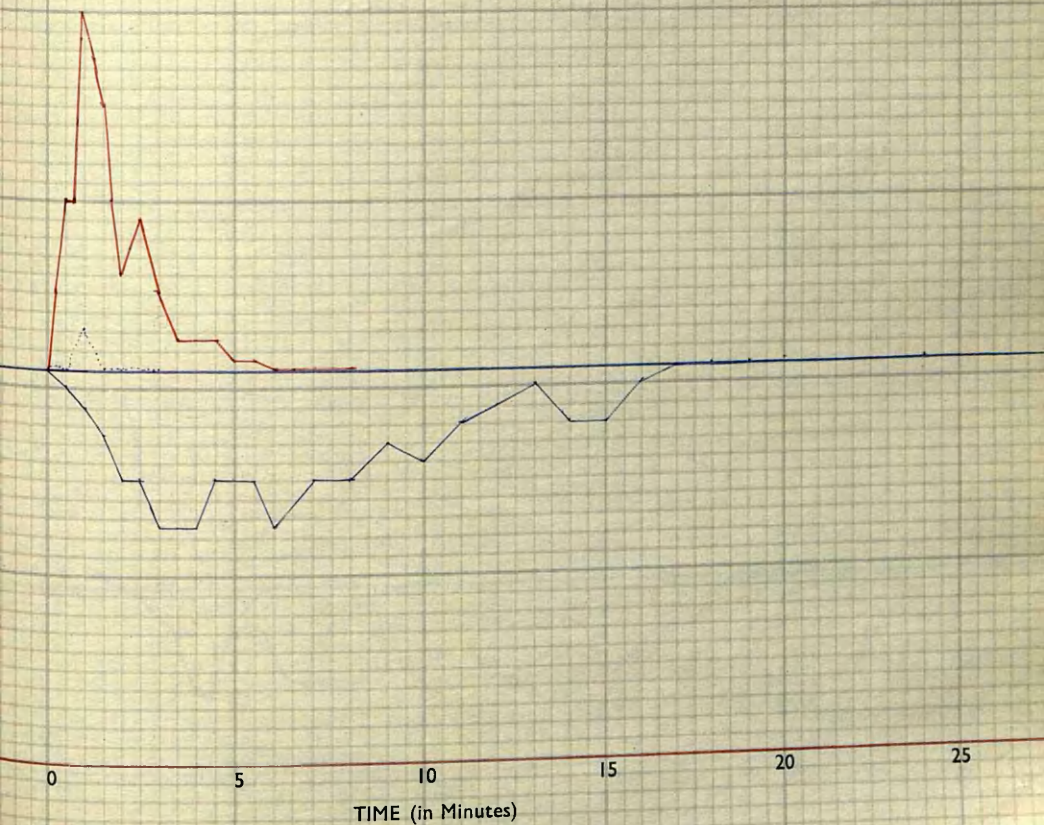


CASE No.: 72 (b)

S.A. = 61
P.A. = 140

A.I. = 42.3

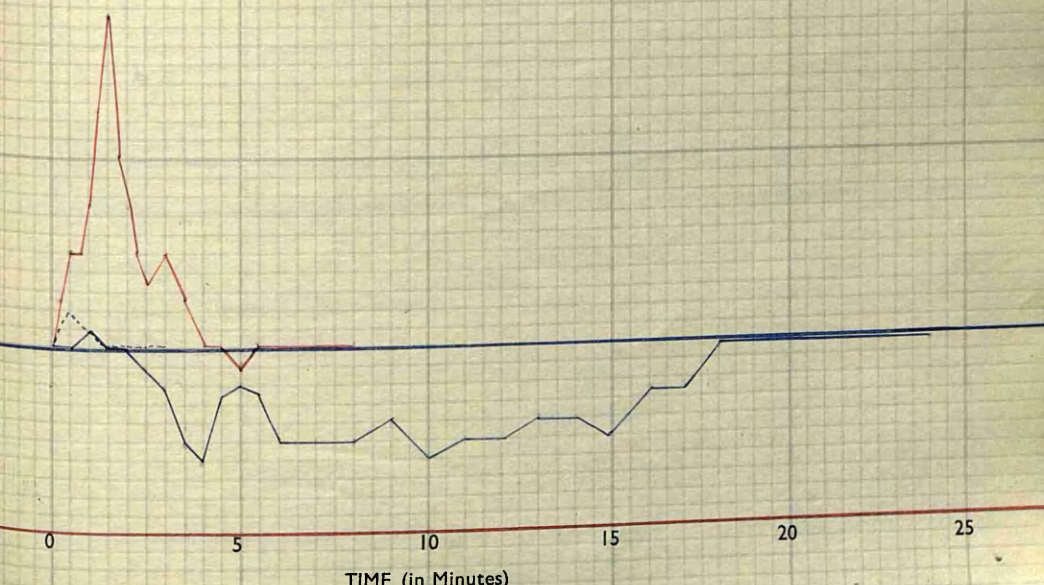
NOT IMPROVED.



CASE No.: 73 (a)

S.A. = 45
P.A. = 136

A.I. = 33.1

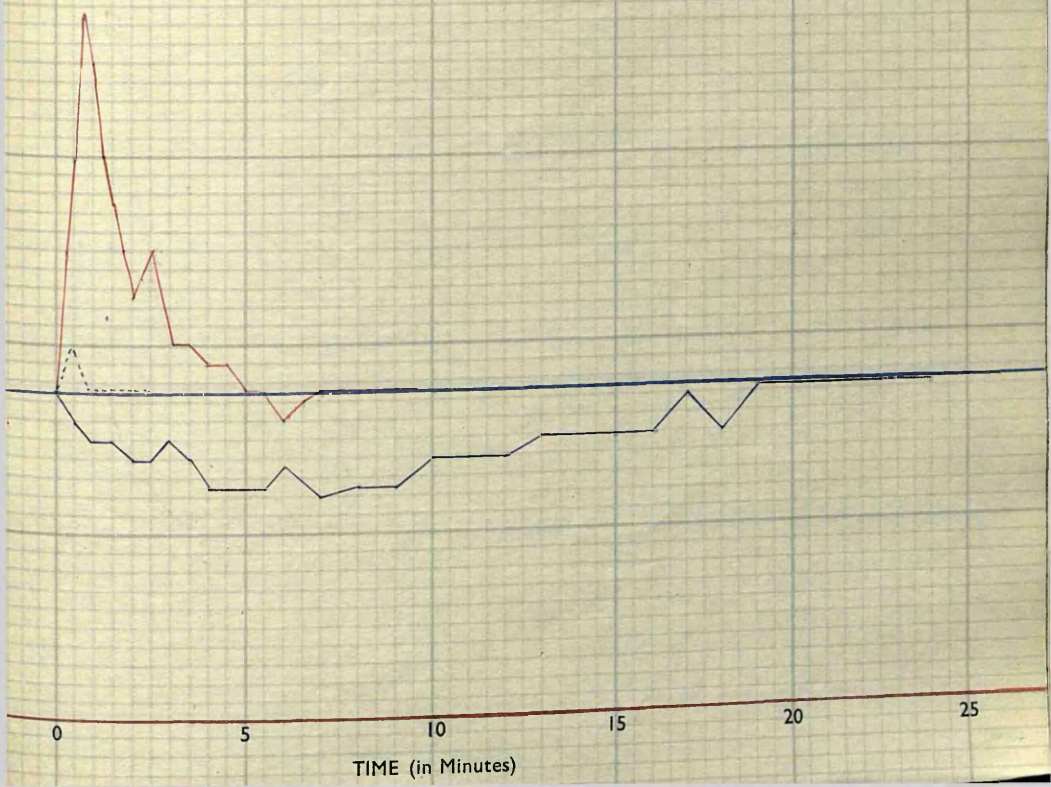


CASE No.: 73 (b)

S.A. = 59
P.A. = 125

A.I. = 47.2

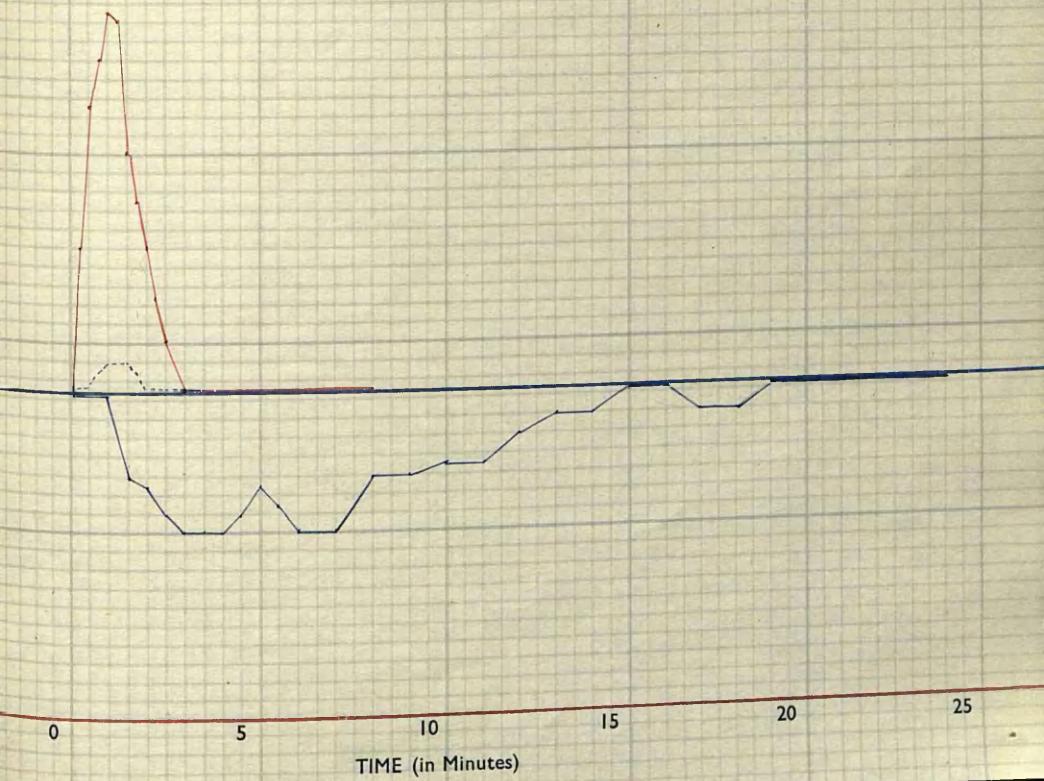
IMPROVED.



CASE No.: 74 (a)

B.A. = 58
P.A. = 129

A.I. = 45

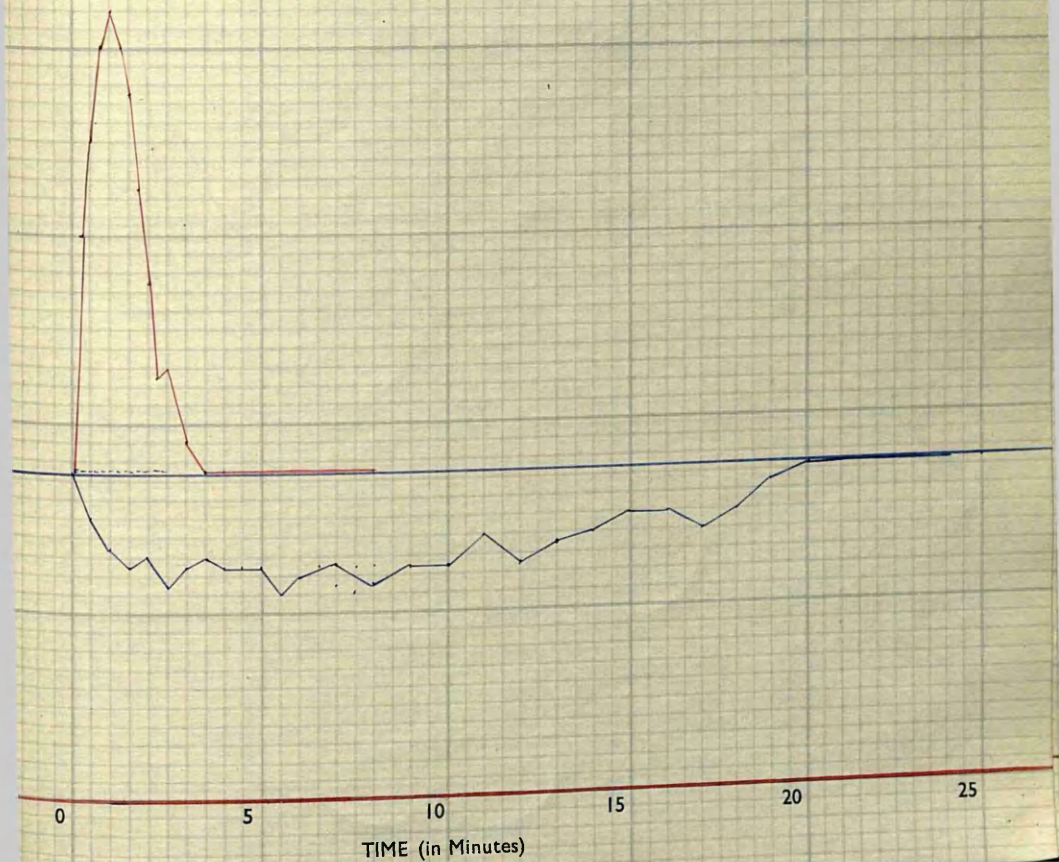


CASE No.: 74 (b)

S.A. = 76
P.A. = 160

A.I. = 47.5

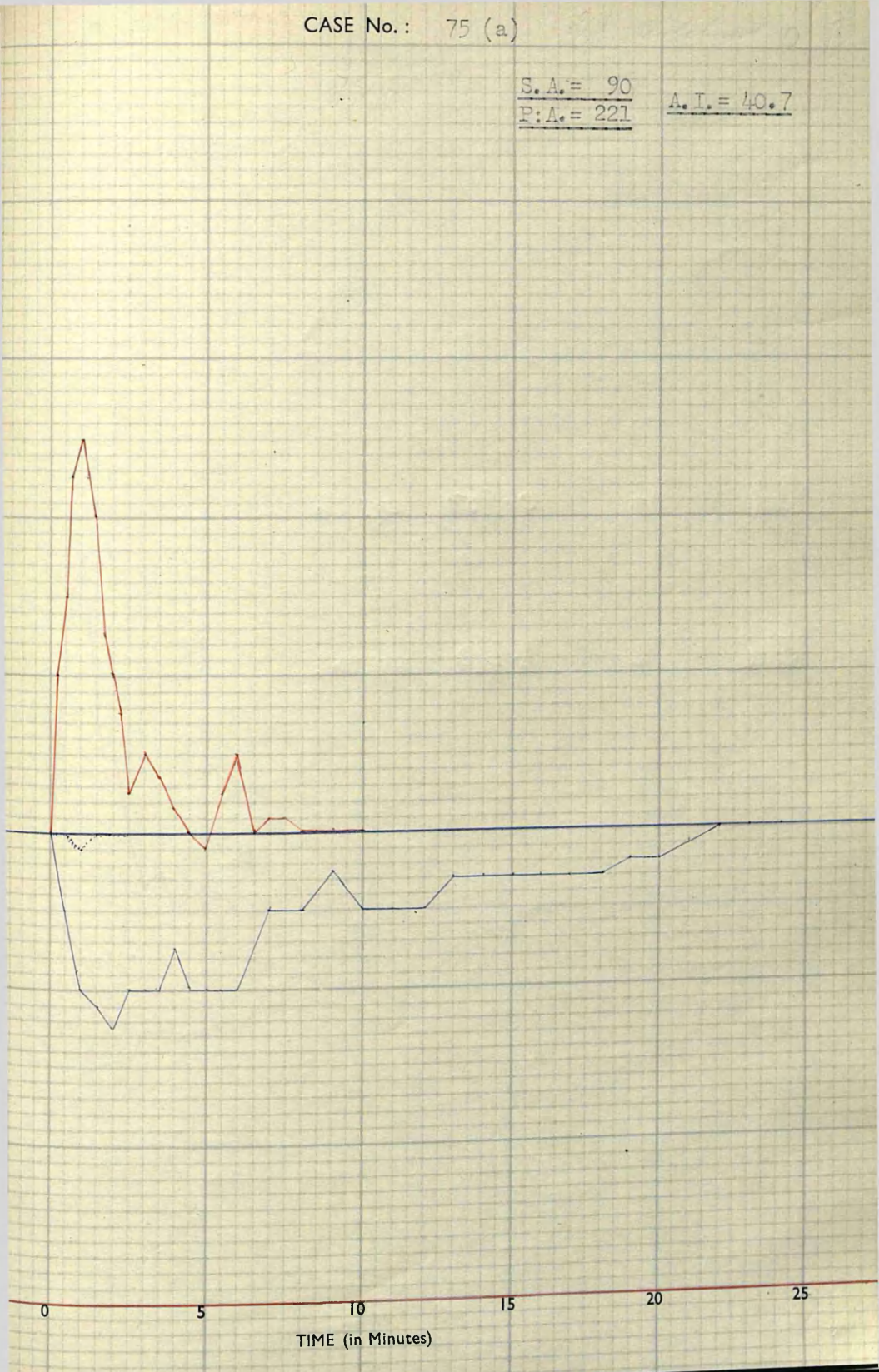
NOT IMPROVED.



CASE No.: 75 (a)

S.A.= 90
P.A.= 221

A.I.= 40.7

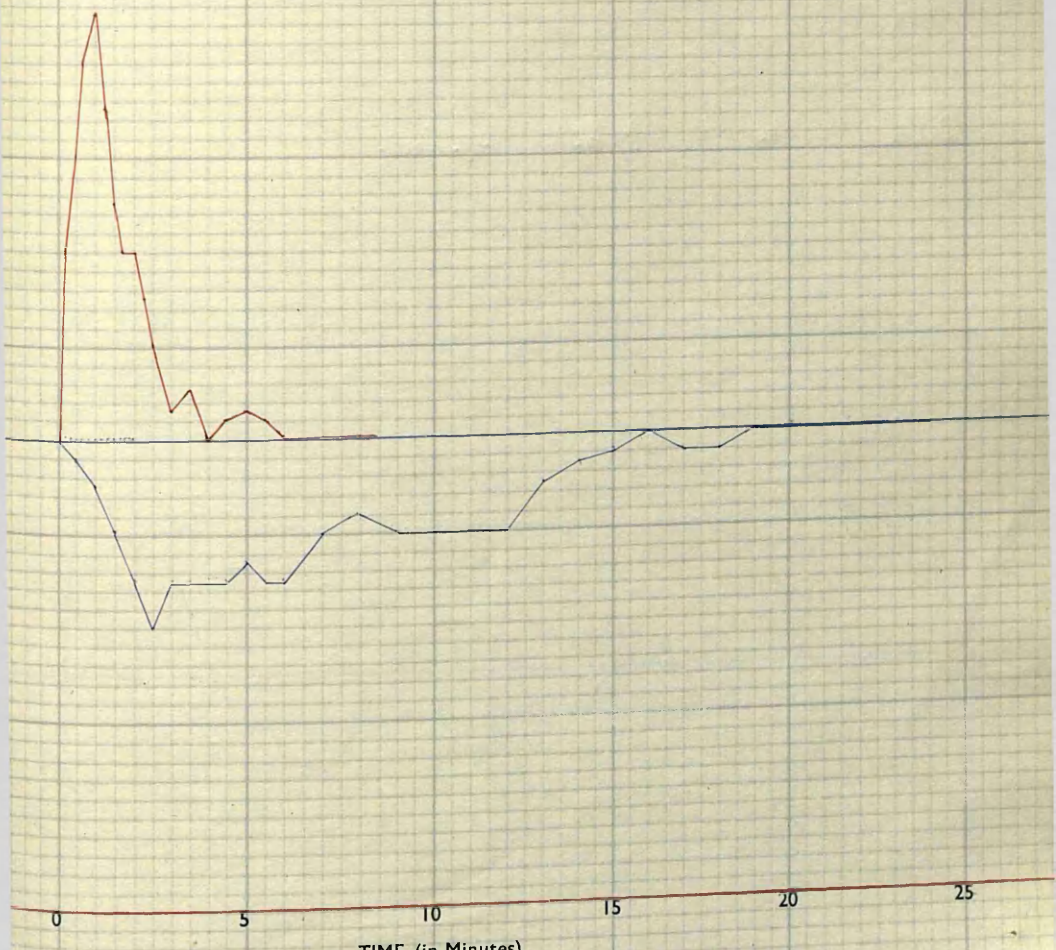


CASE No.: 75 (b)

S.A.= 75
P.A.= 153

A.I.= 49

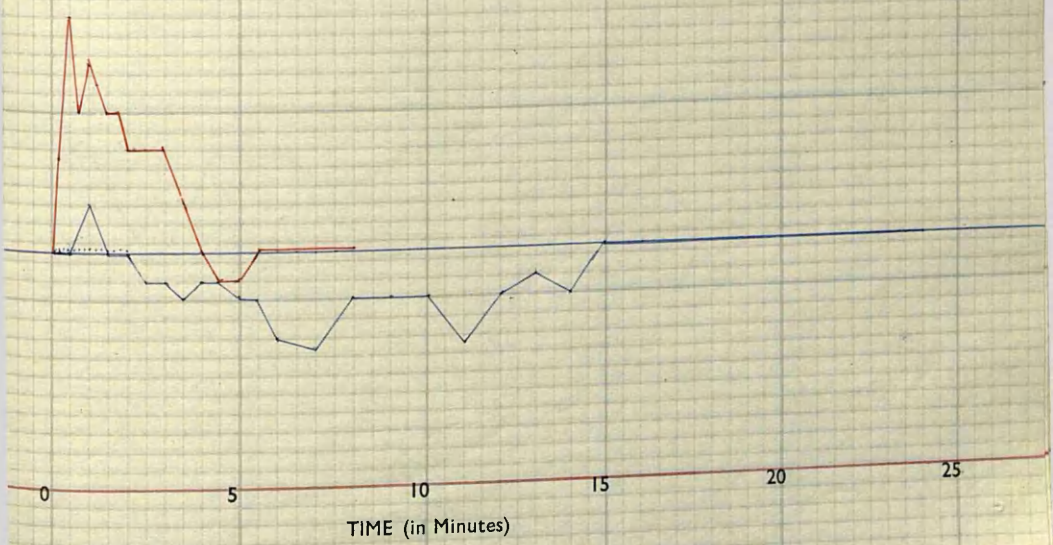
RECOVERED.



CASE No.: 76 (a)

S.A. = 44
P.A. = 64

A.I. = 68.4



CASE No.: 76 (b)

S.A.= 45
P.A.= 81

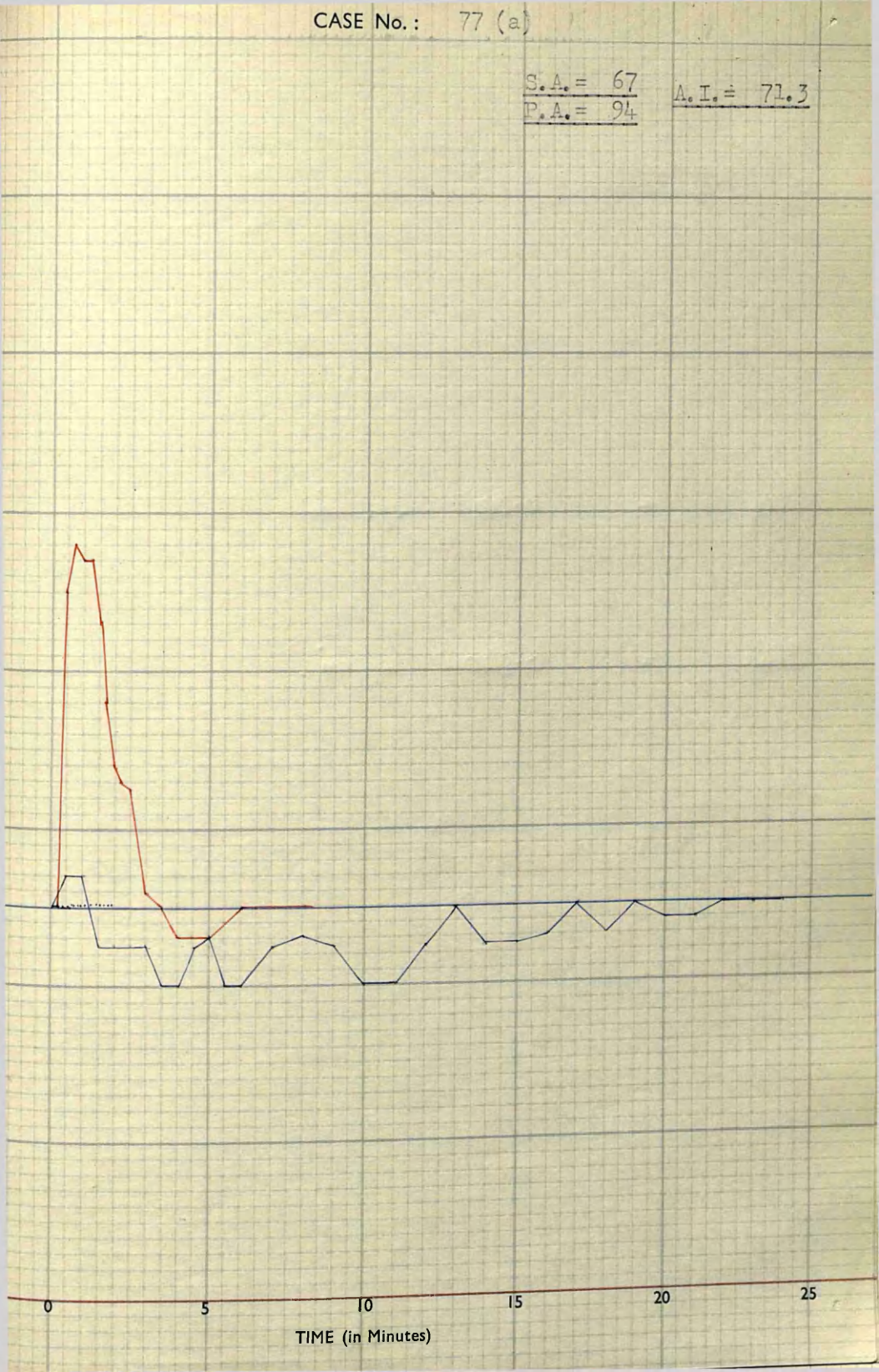
A.I.= 55.2

IMPROVED.

CASE No.: 77 (a)

S.A. = 67
P.A. = 94

A.I. = 71.3

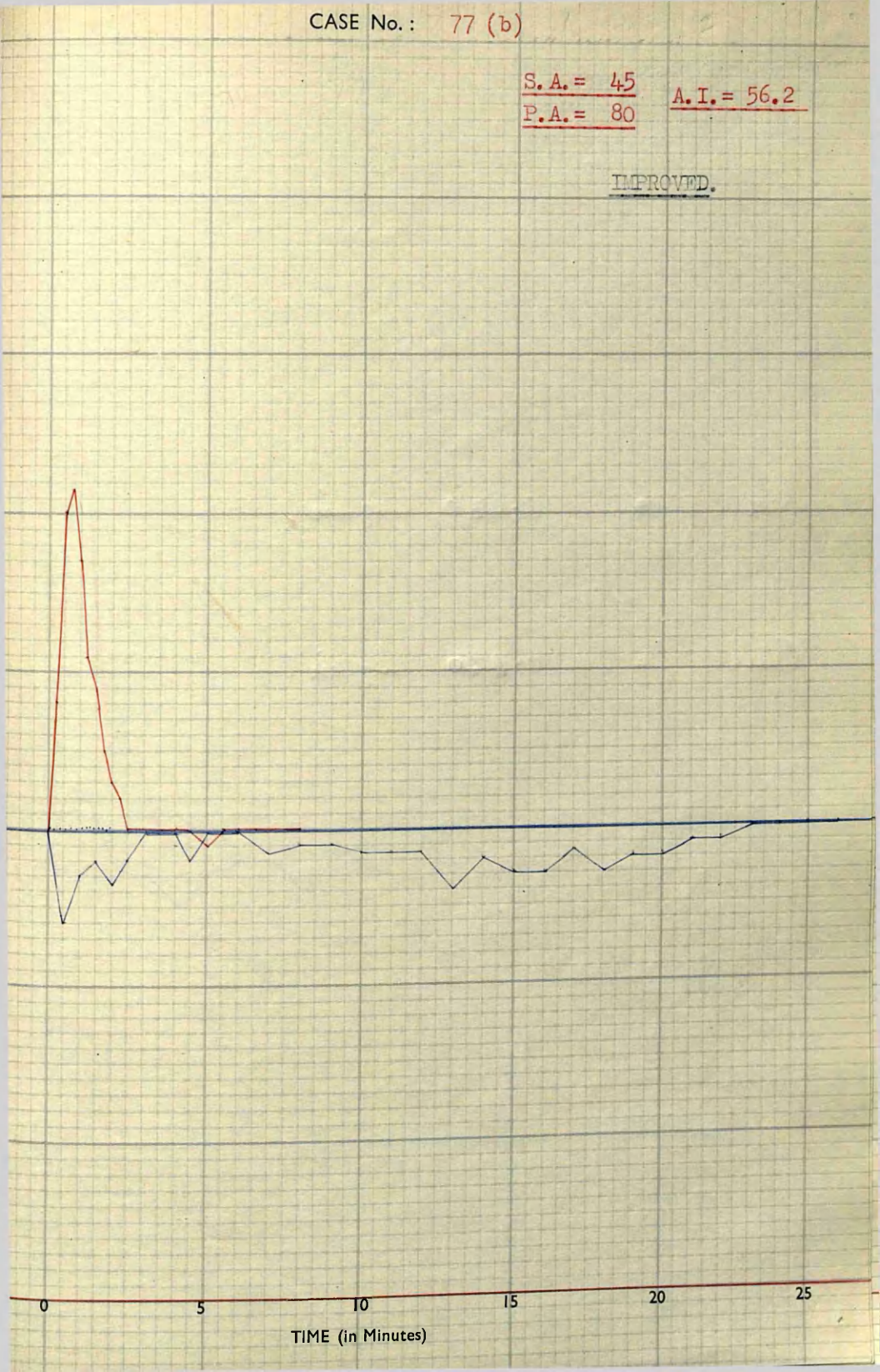


CASE No.: 77 (b)

S.A. = 45
P.A. = 80

A.I. = 56.2

IMPROVED.



CASE No. : 78 (a)

S.A. = 63
P.A. = 83

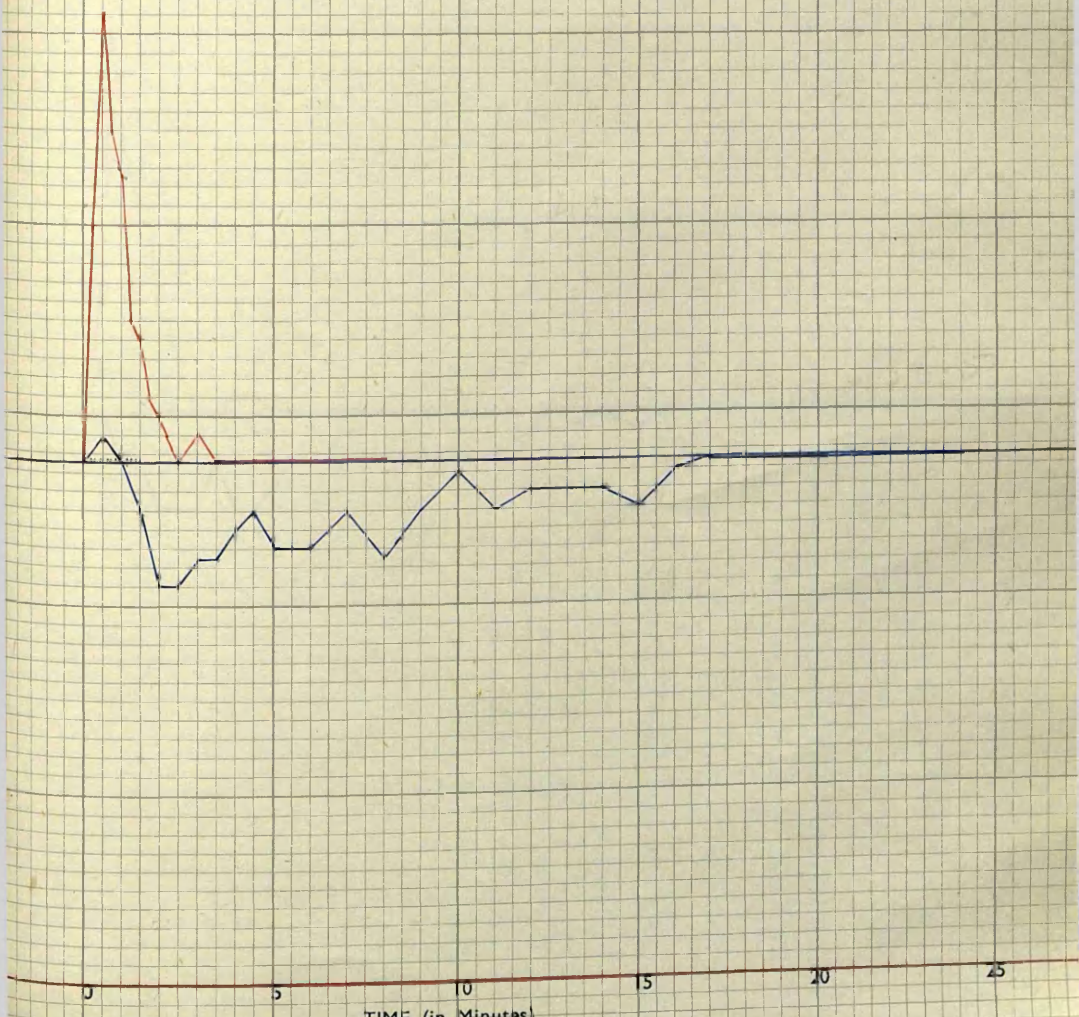
A.I. = 76

CASE. No.: 78 (b)

S.A.= 48
P.A.= 85

A.I.= 56

IMPROVED.

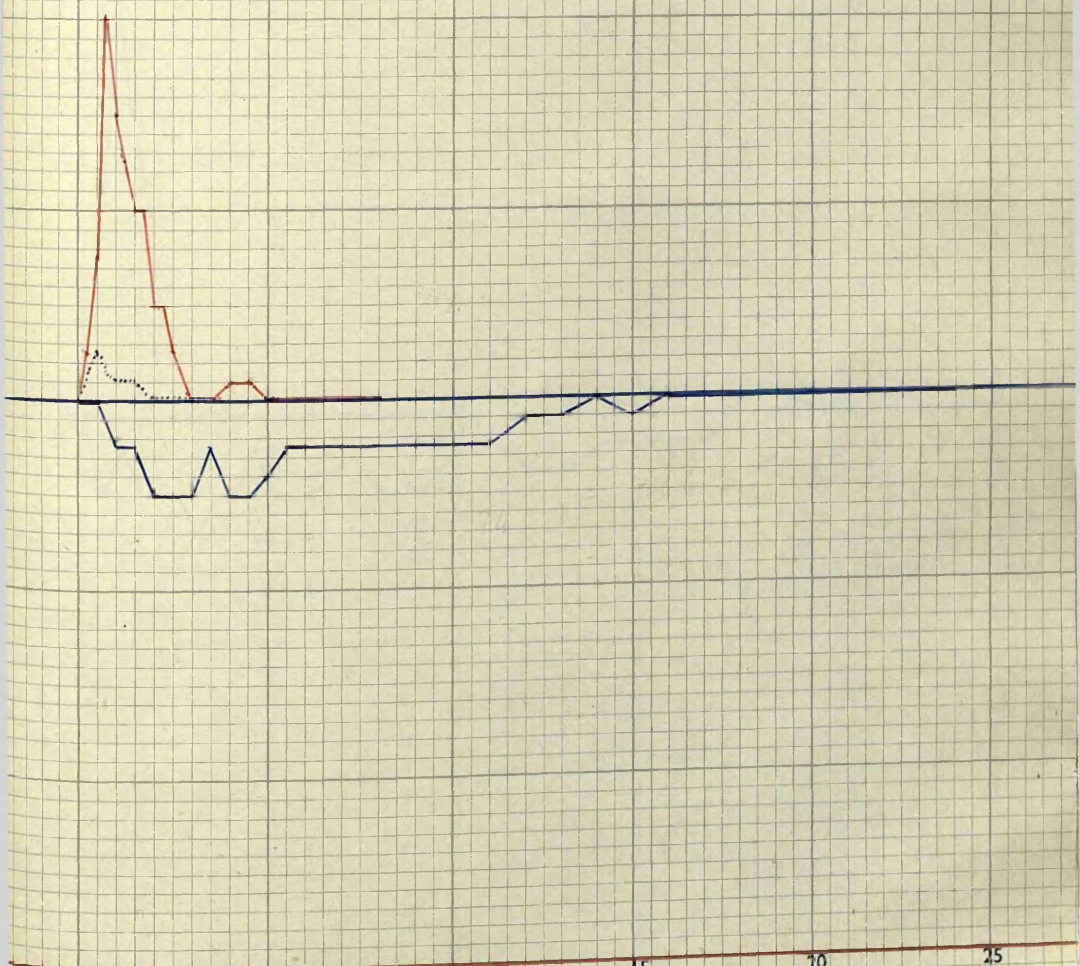


CASE. No.: 79 (a)

S.A. = 49

P.A. = 74

A.I. = 66.2



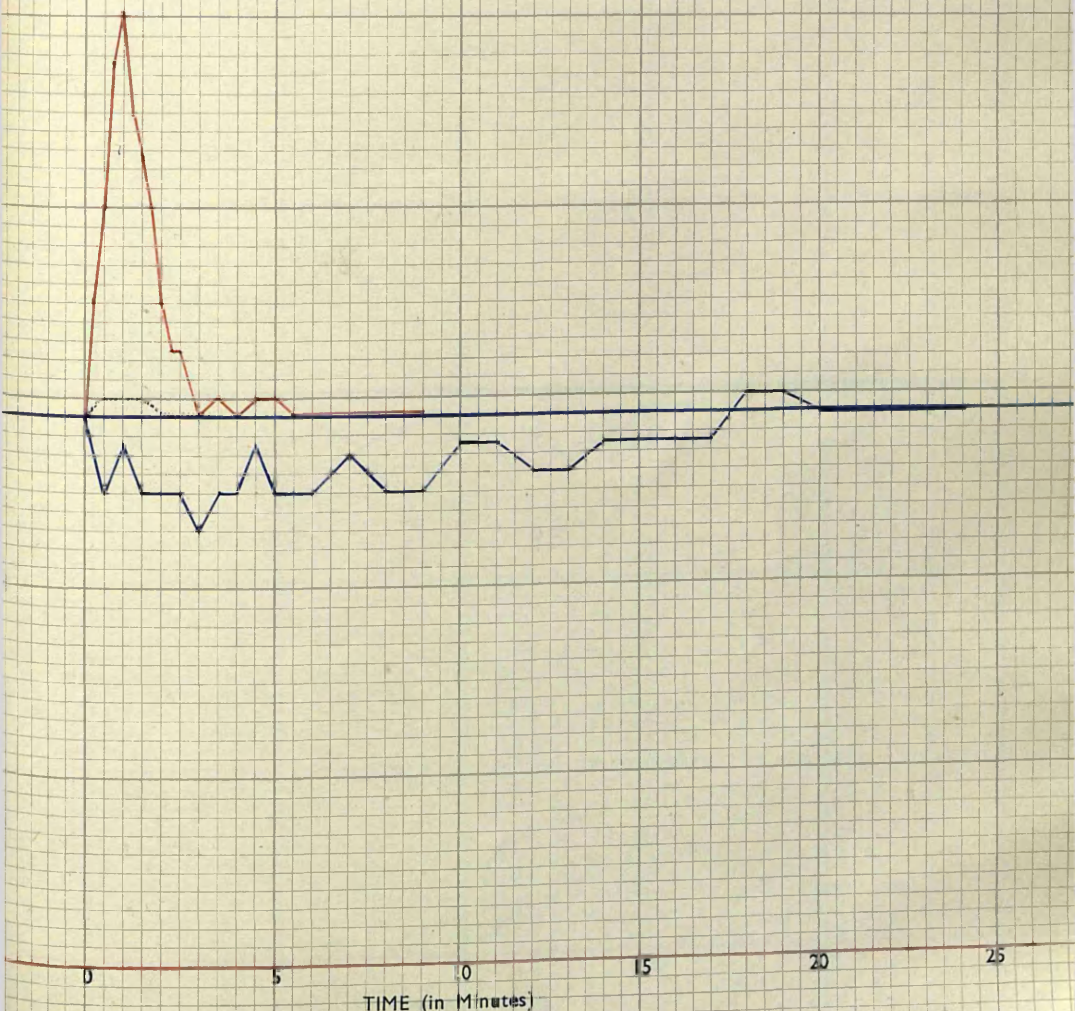
CASE. No.: 79 (b)

S. A. = 58

P. A. = 93

A. I. = 62.4

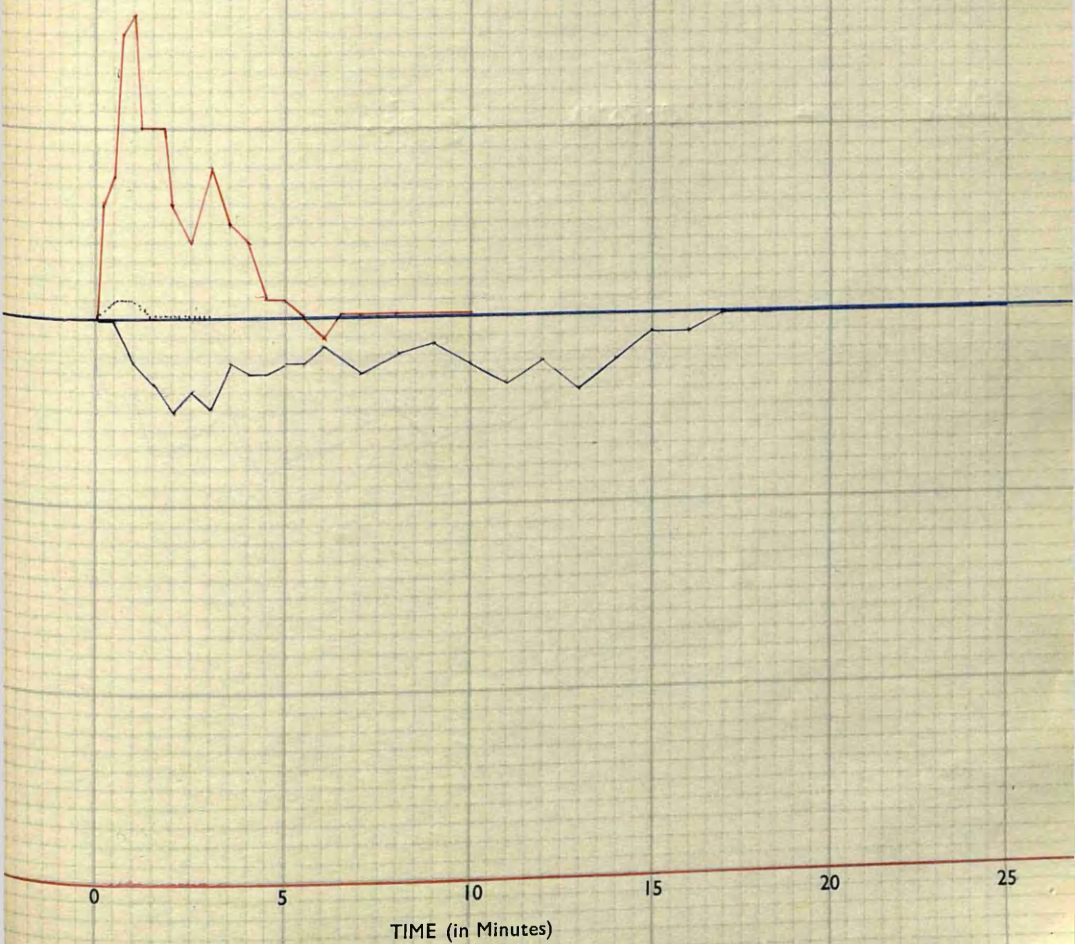
IMPROVED.



CASE No.: 80 (a)

S.A. = 64
P.A. = 83

A.I. = 77.1

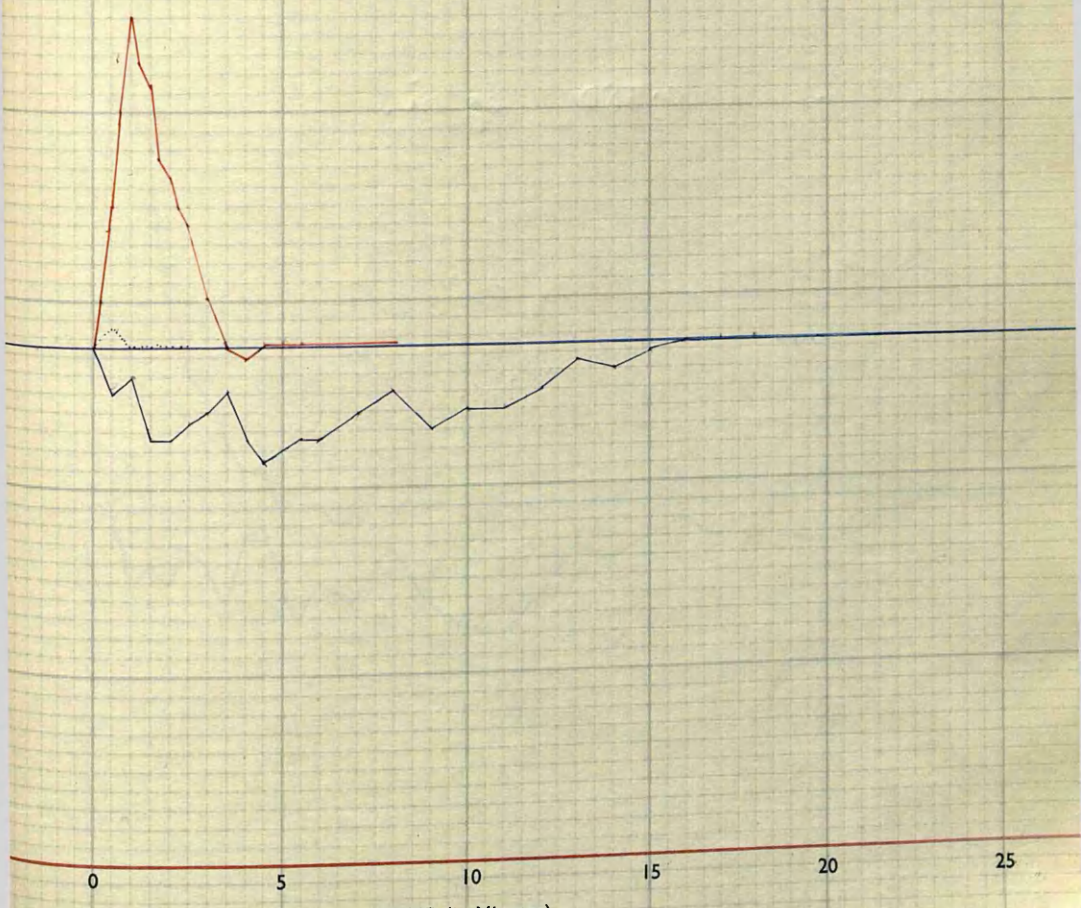


CASE No.: 80 (b)

S.A. = 56
P.A. = 98

A.I. = 57.1

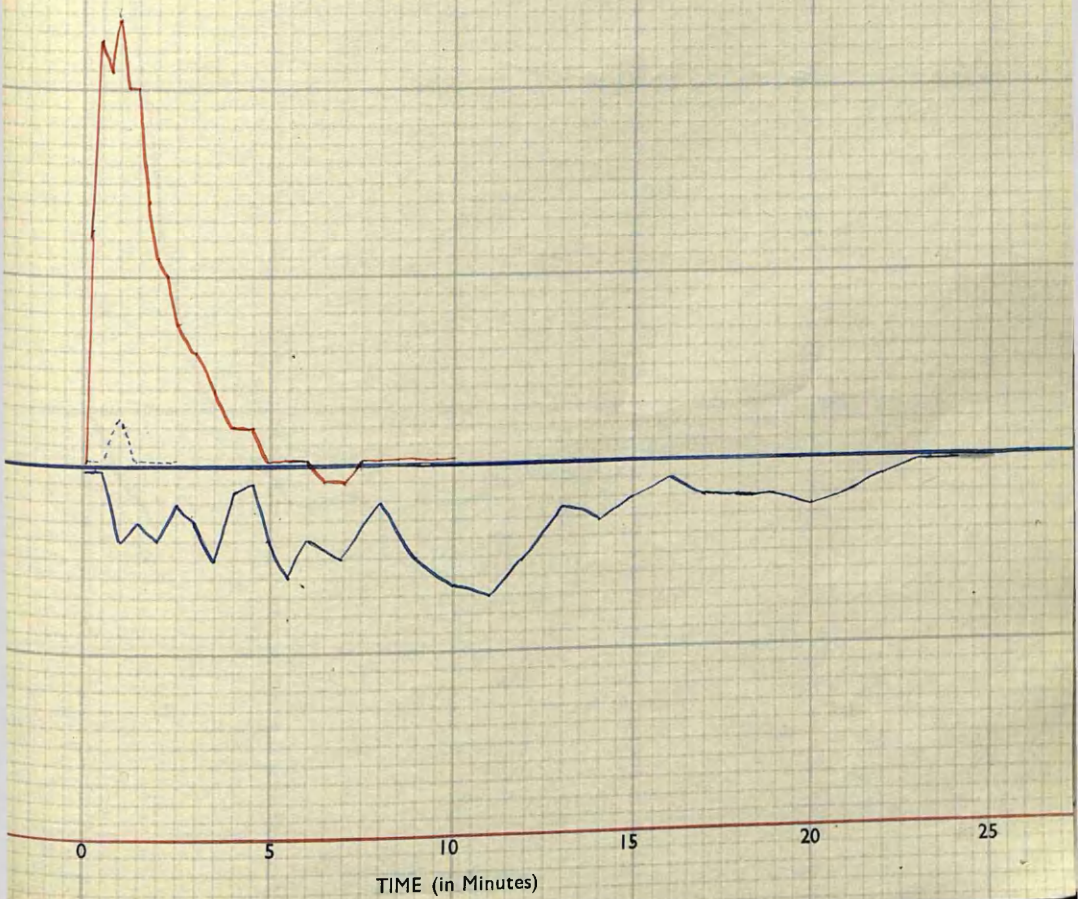
IMPROVED.



CASE No. : 81 (a)

S.A. = 91
P.A. = 140

A.I. = 65

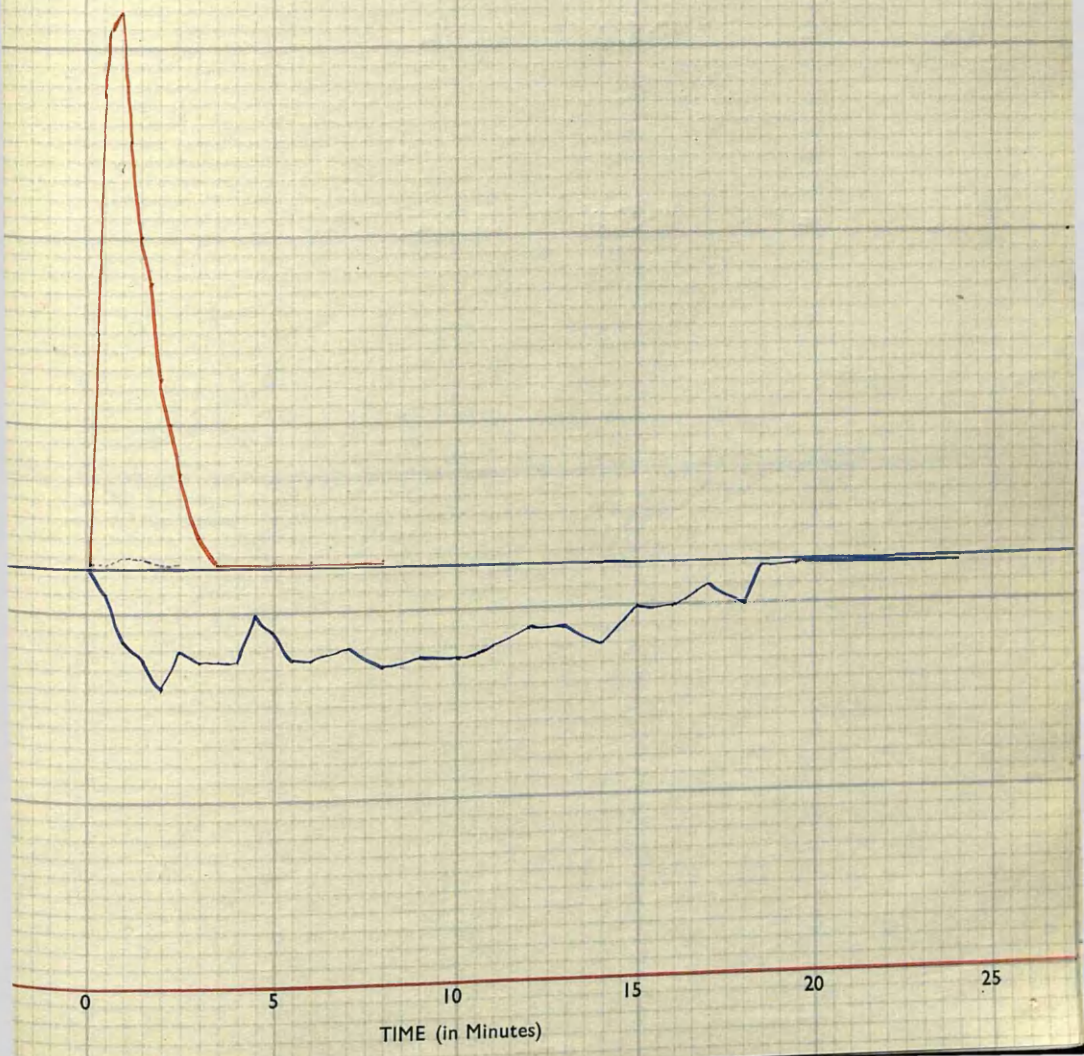


CASE No.: 81 (b)

S.A.= 81
P.A.= 137

A.I.= 59.1

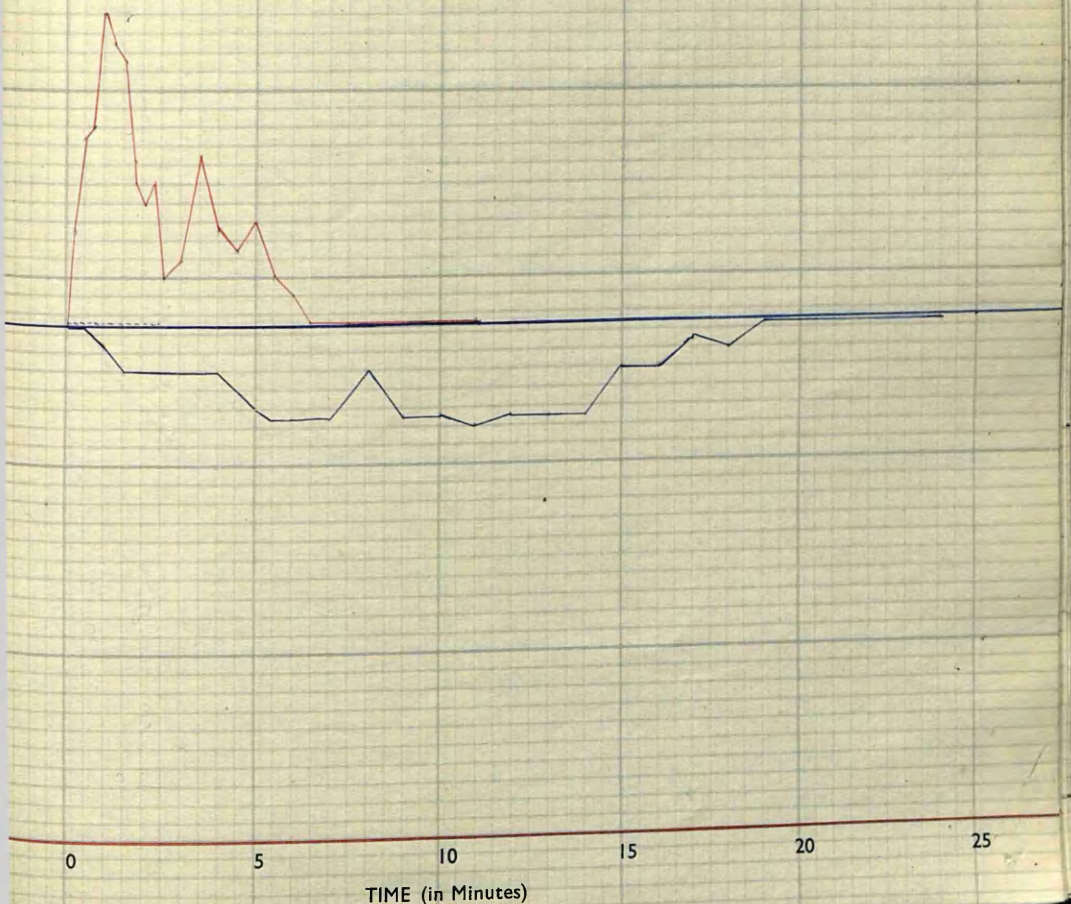
IMPROVED.



CASE No.: 82 (a)

S.A. = 77
P.A. = 123

A.I. = 62.6

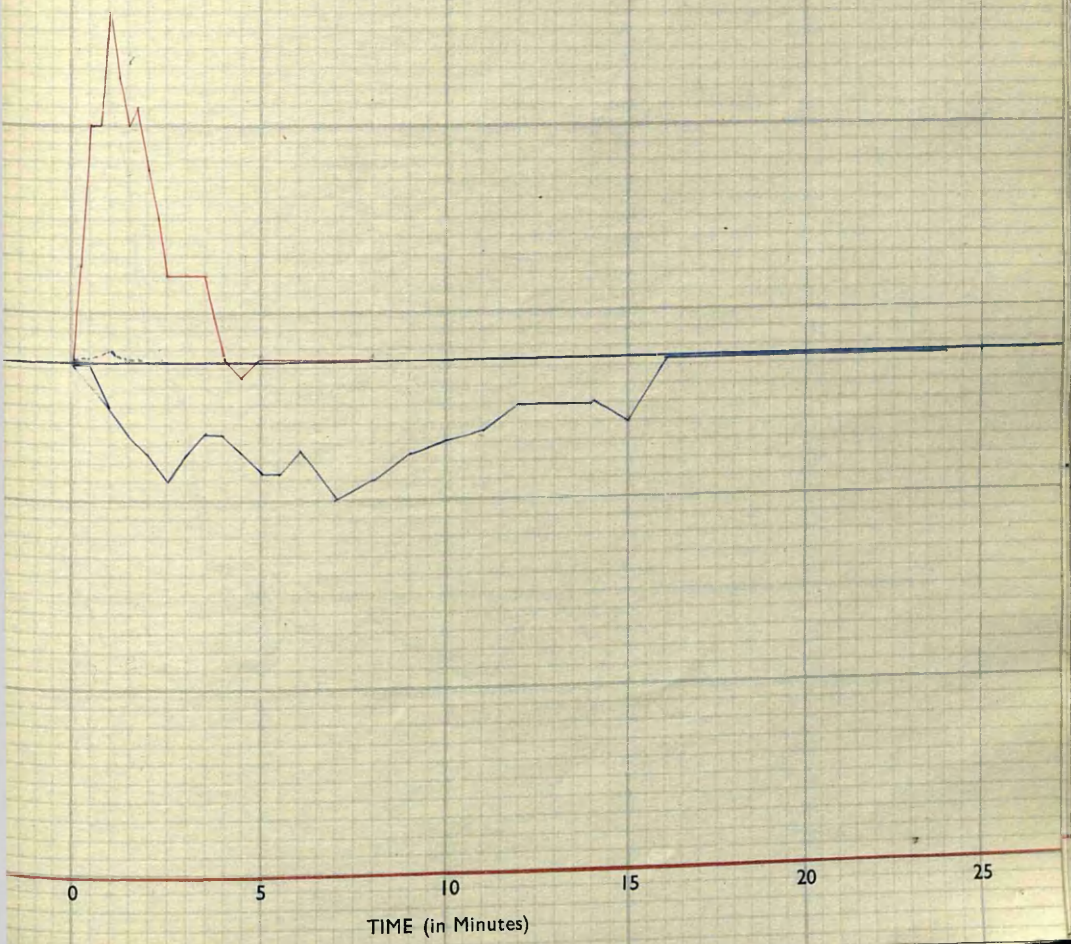


CASE No. : 82 (b)

S.A. = 64
P.A. = 117

A.I. = 54.8

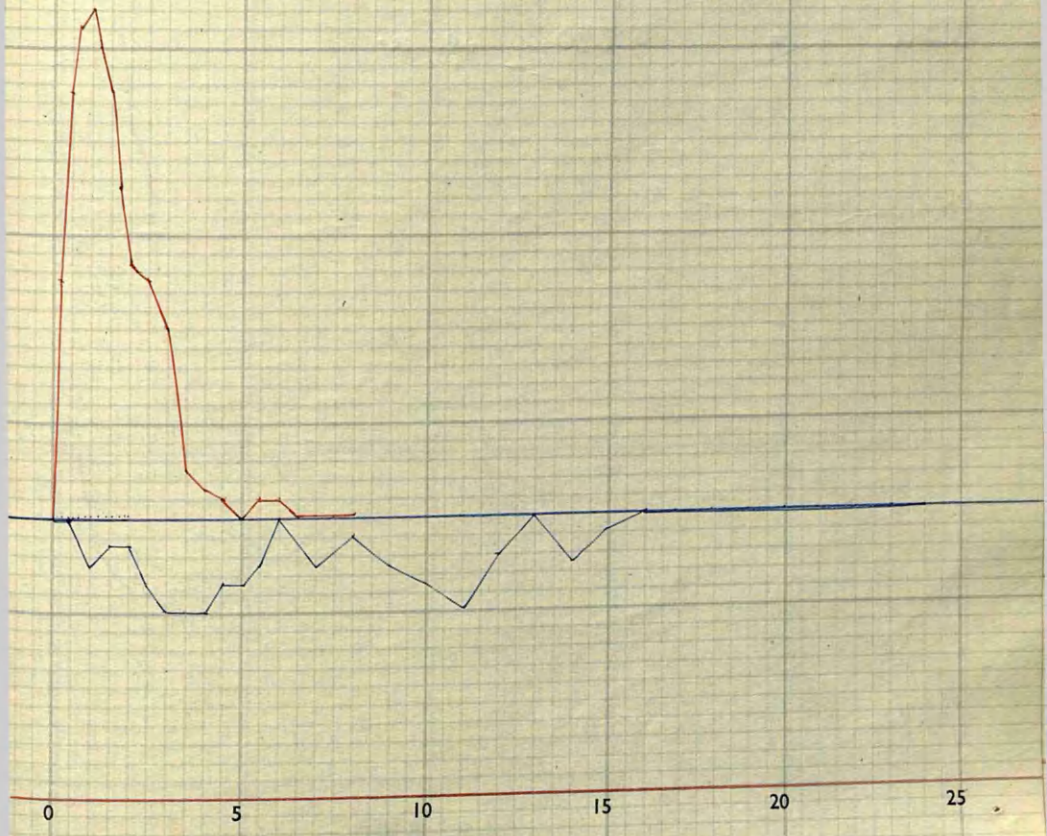
IMPROVED.



CASE No.: 83 (a)

S.A. = 119
P.A. = 74

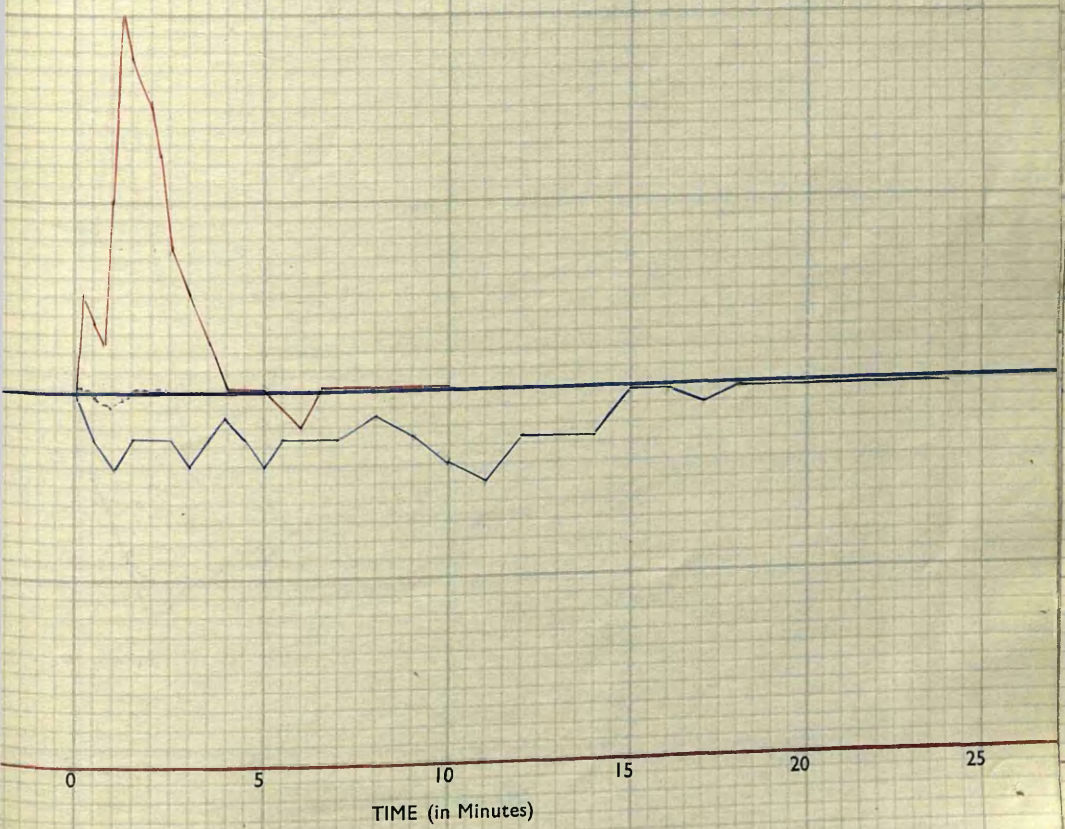
A.I. = 160.1



CASE No.: 84 (a)

S.A. = 60
P.A. = 80

A.I. = 75

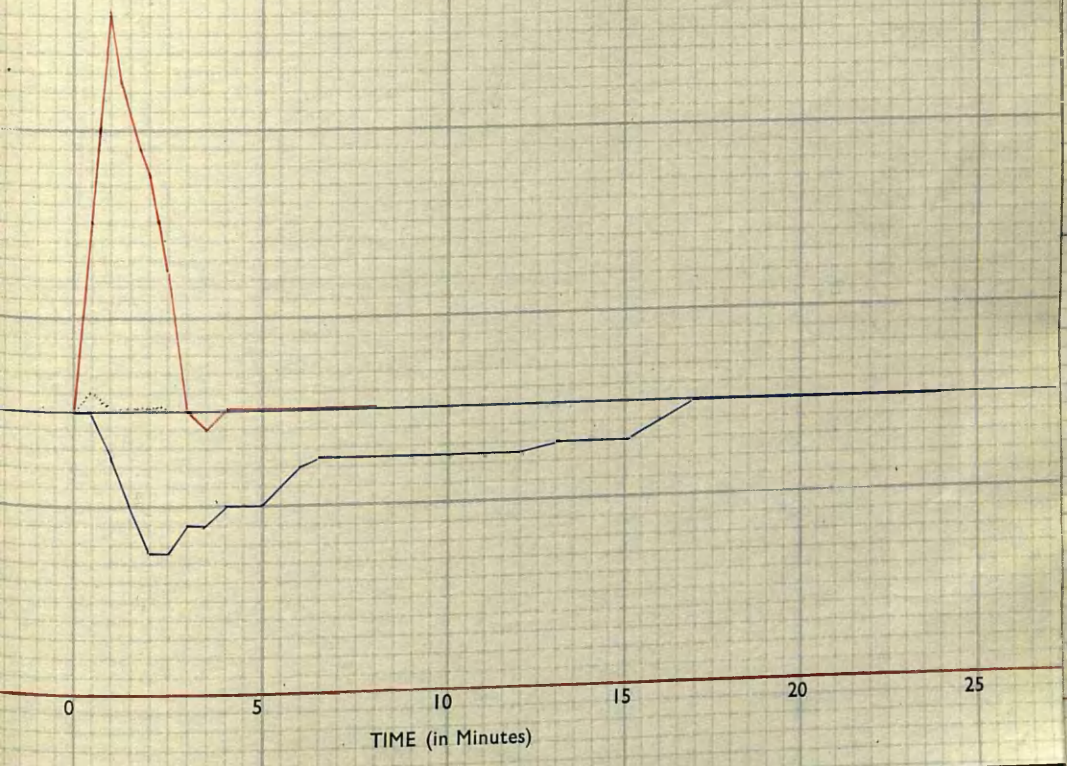


CASE No. : 84 (b)

S.A. = 65
P.A. = 103

A.I. = 63.2

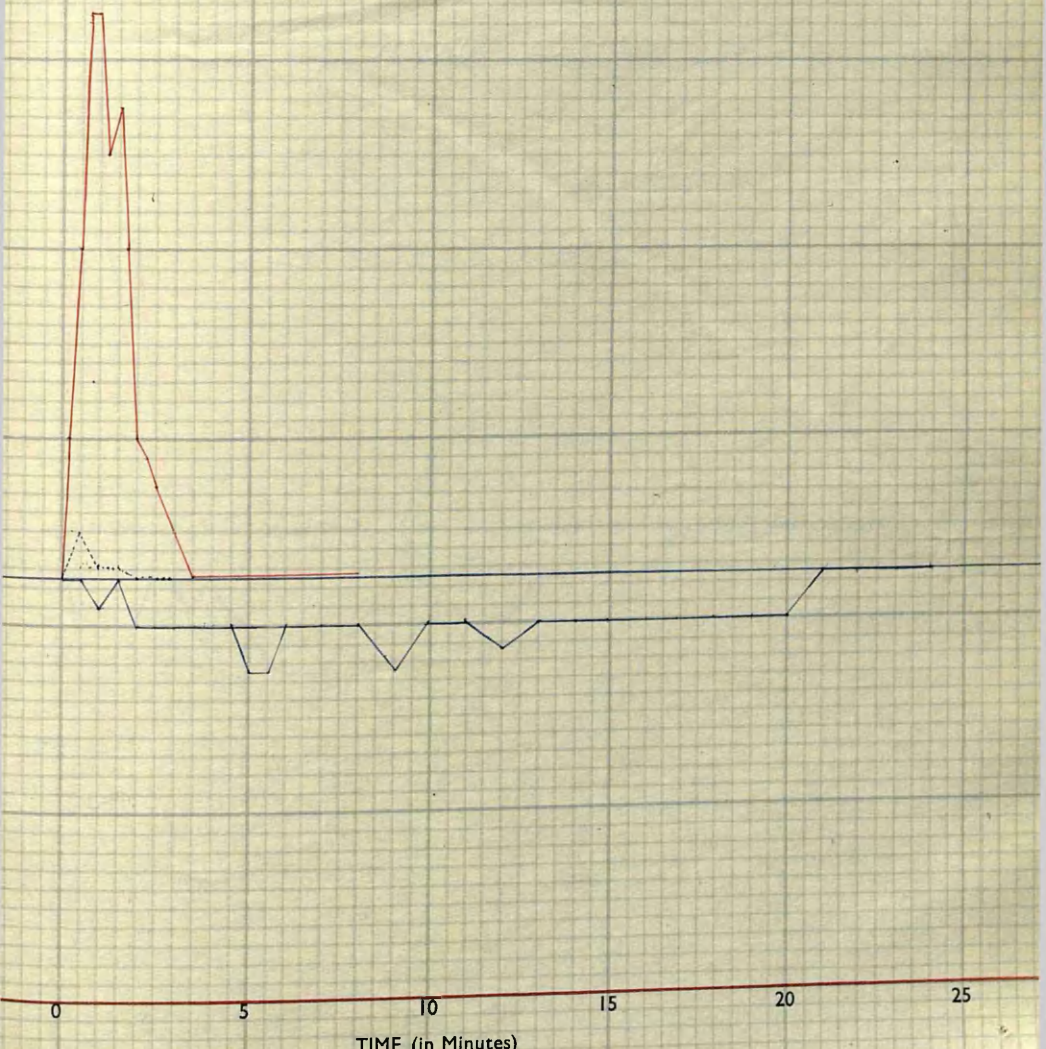
IMPROVED.



CASE No.: 85 (a)

S.A. = 82
P.A. = 108

A.I. = 75.9

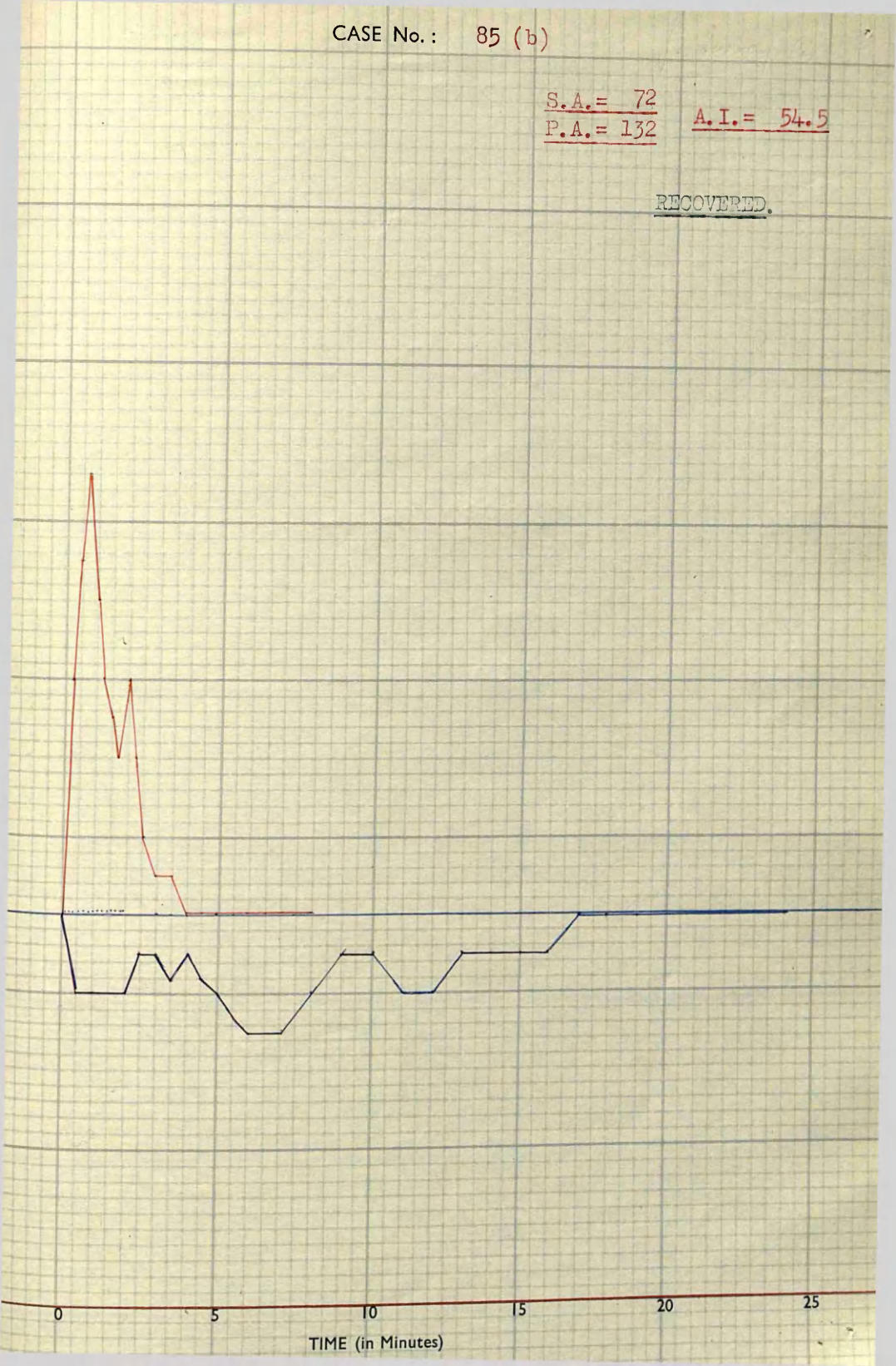


CASE No. : 85 (b)

S.A.= 72
P.A.= 132

A.I.= 54.5

RECOVERED.

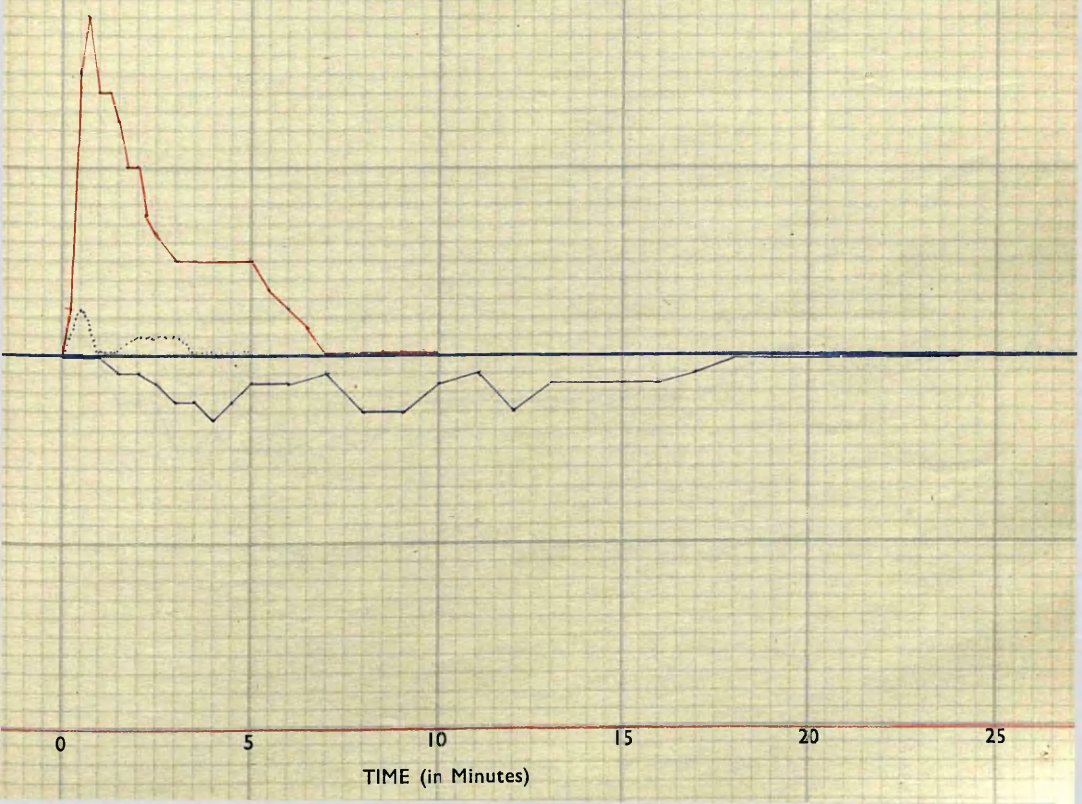


CASE No. : 86 (a)

S.A. = 88

D.A. = 61

A.I. = 44.3



CASE No.: 86 (b)

S.A.= 76
P.A.= 107

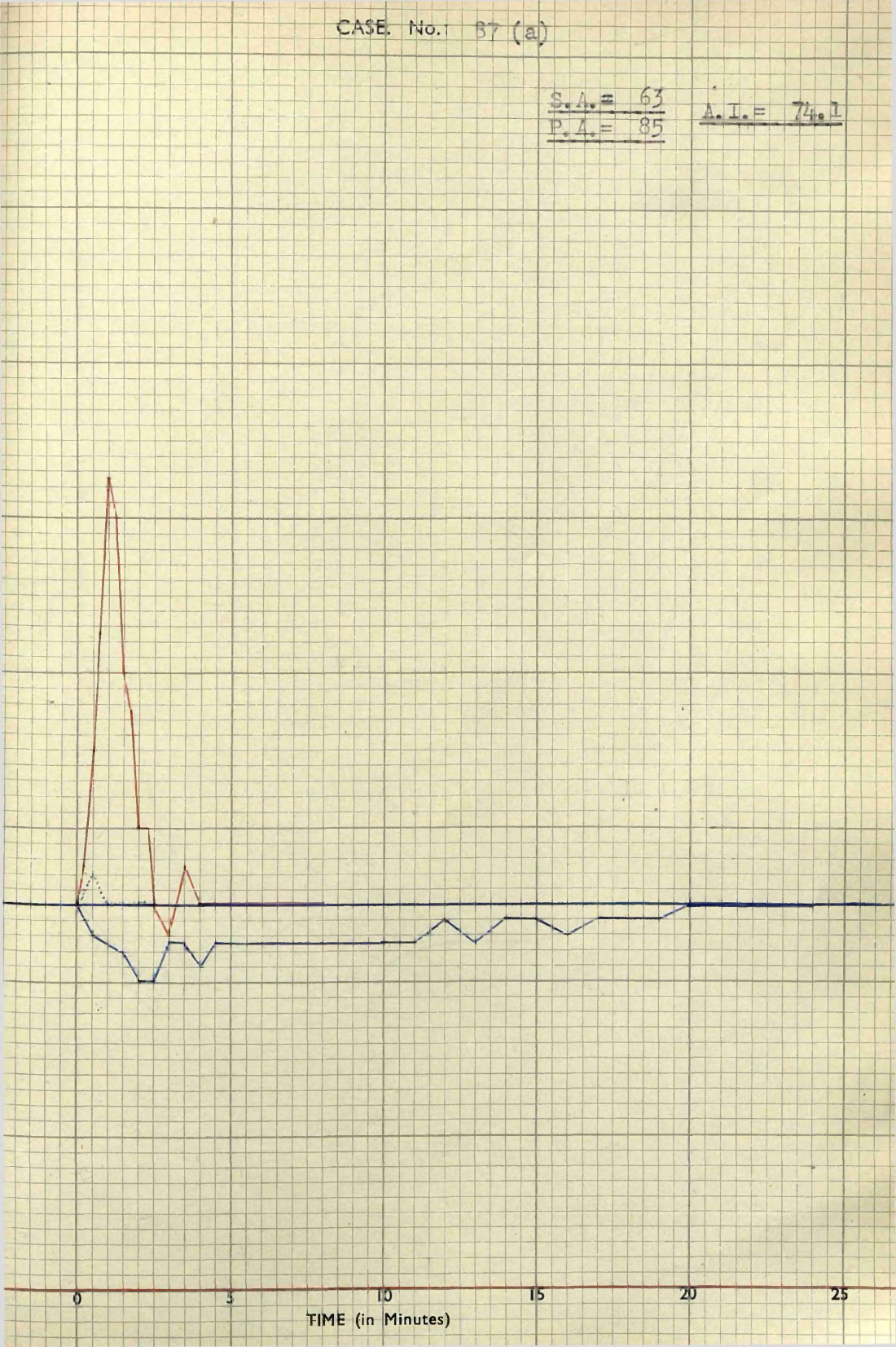
A.I.= 71

IMPROVED.

CASE. No.1 B7 (a)

S.A. = 63
P.A. = 85

A.I. = 74.1

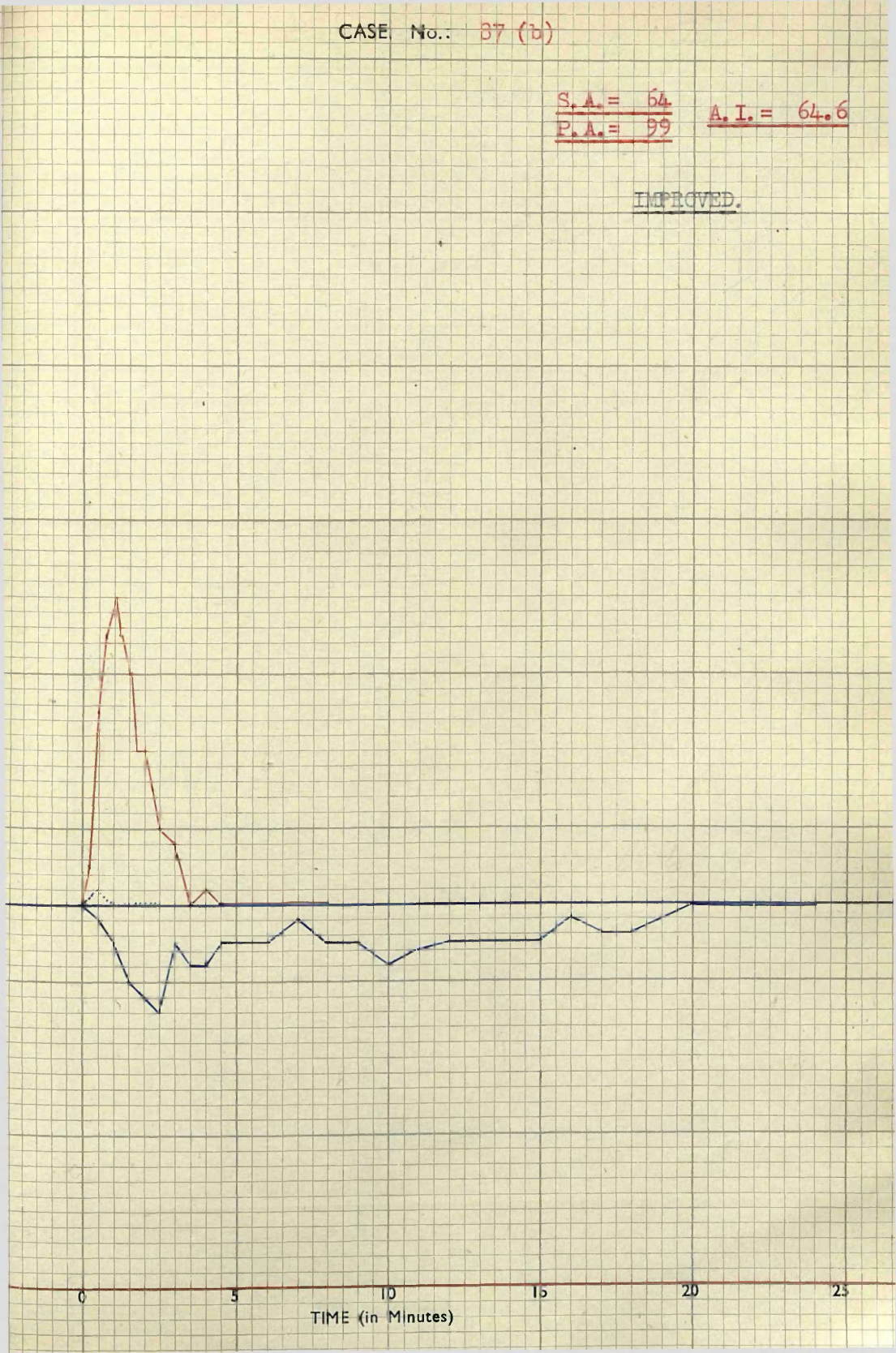


CASE No.: 87 (b)

S. A. = 64
P. A. = 99

A. I. = 64.6

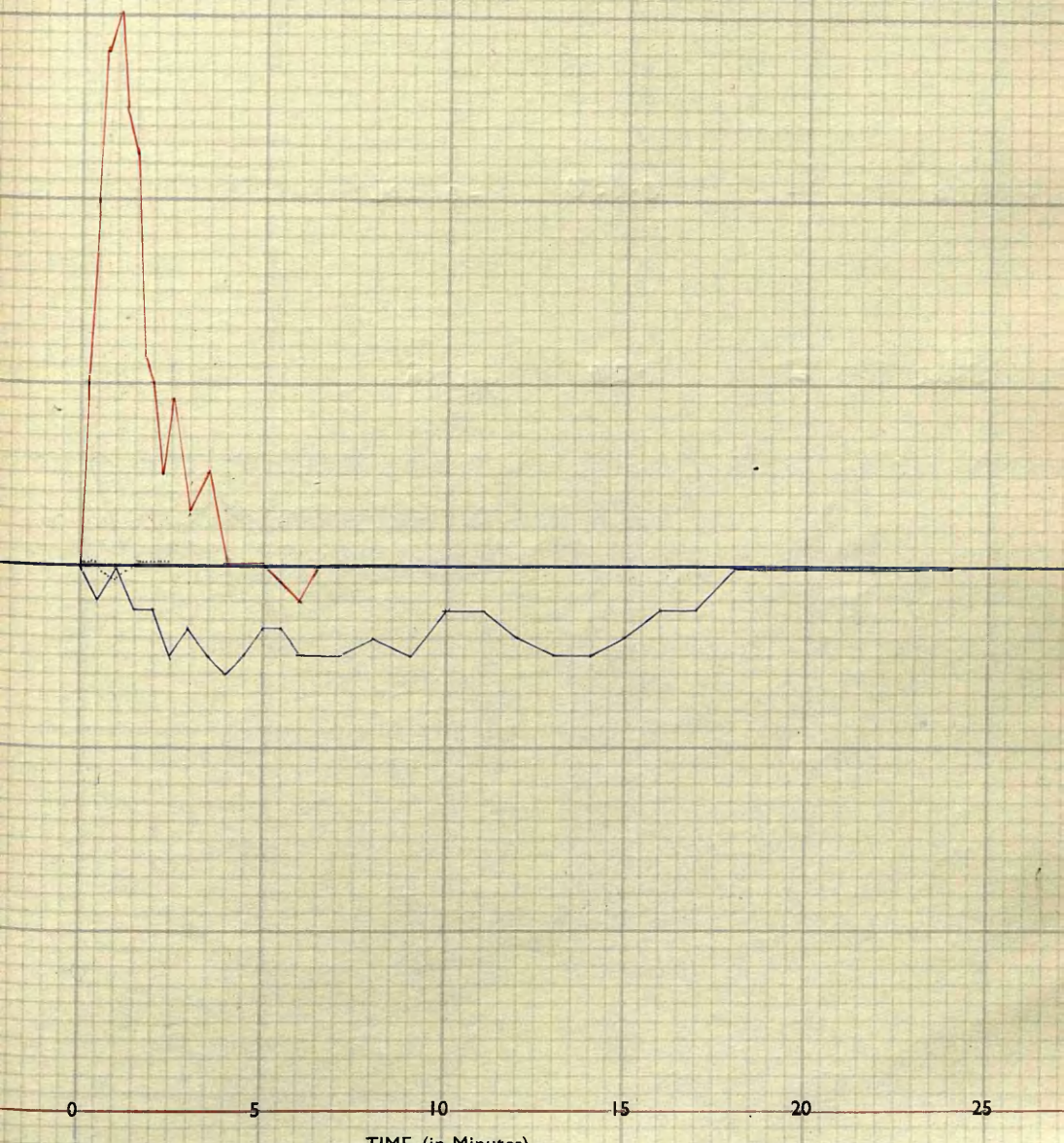
IMPROVED.



CASE No.: 88 (a)

S.A.= 90
P.A.= 131

A.I.= 68.7

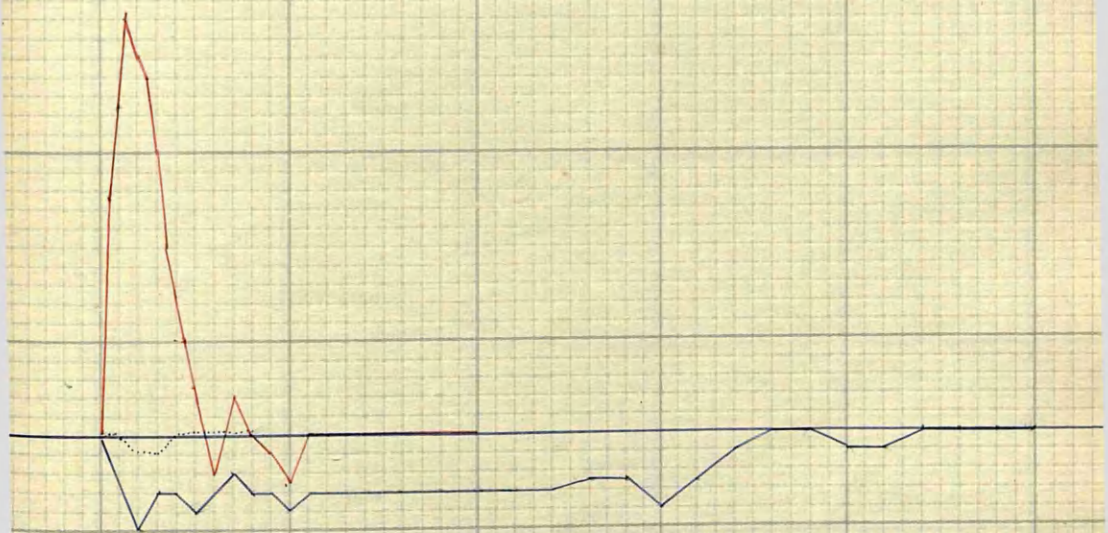


CASE No.: 88 (b)

S.A.= 63
P.A.= 105

A.I.= 60.1

IMPROVED.



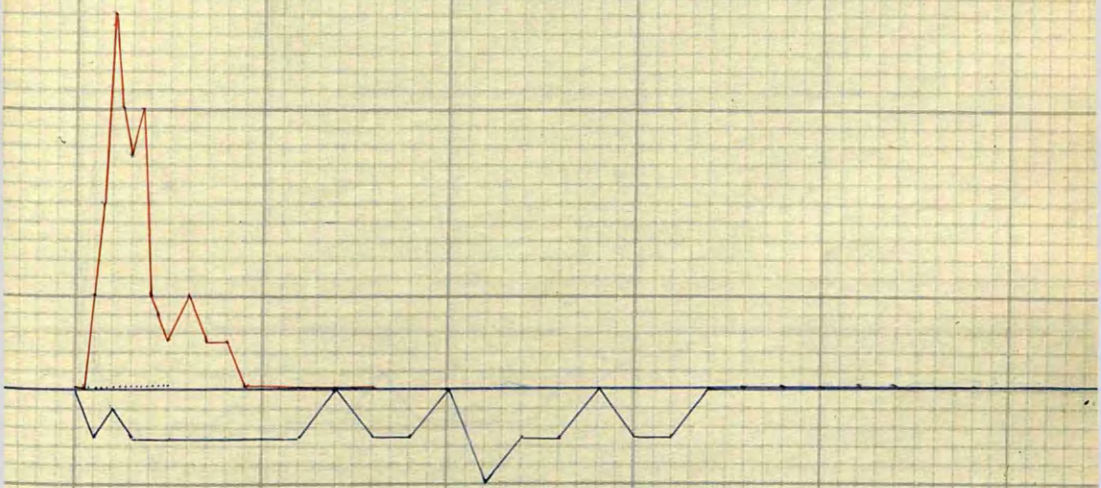
0 5 10 15 20 25

TIME (in Minutes)

CASE No.: 89 (a)

S.A.= 53
P.A.= 63

A.I.= 84.1



0 5 10 15 20 25

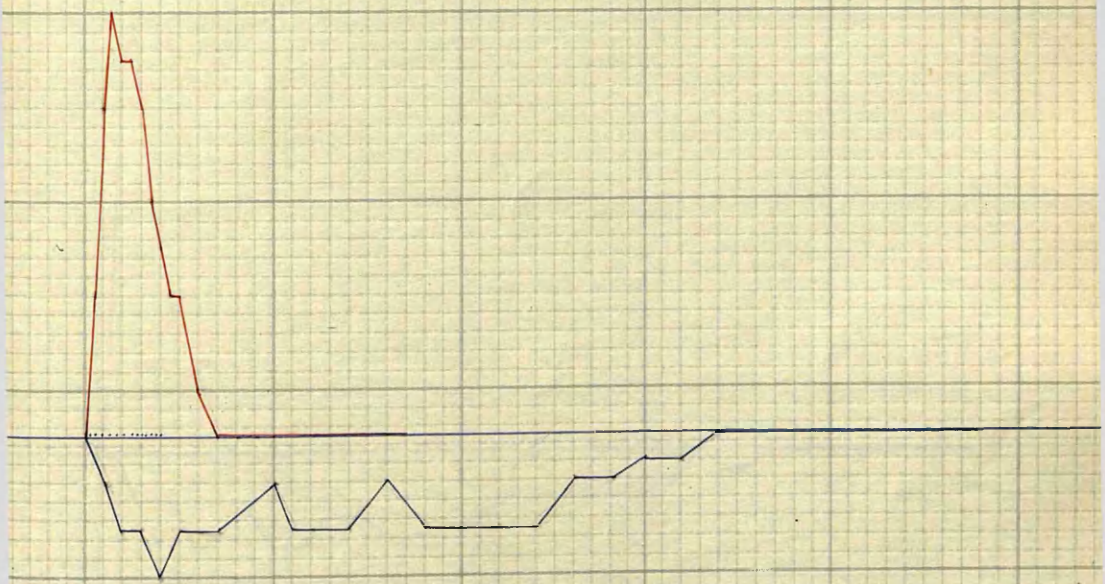
TIME (in Minutes)

CASE No.: 89 (b)

S.A.= 73
P.A.= 126

A.I.= 58

RECOVERED.



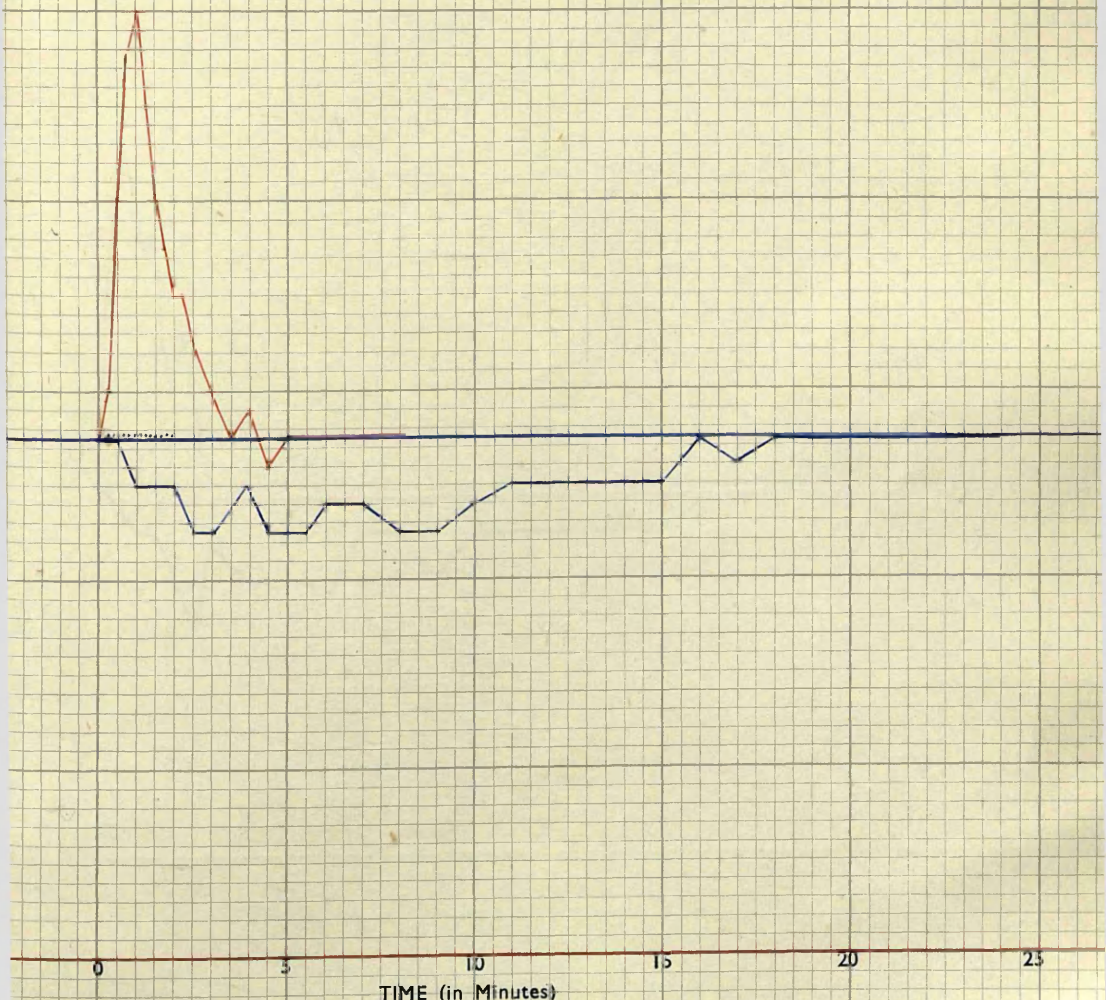
0 5 10 15 20 25

TIME (in Minutes)

CASE No.: 90 (a)

S.A. = 61
P.A. = 99

A.I. = 61.2

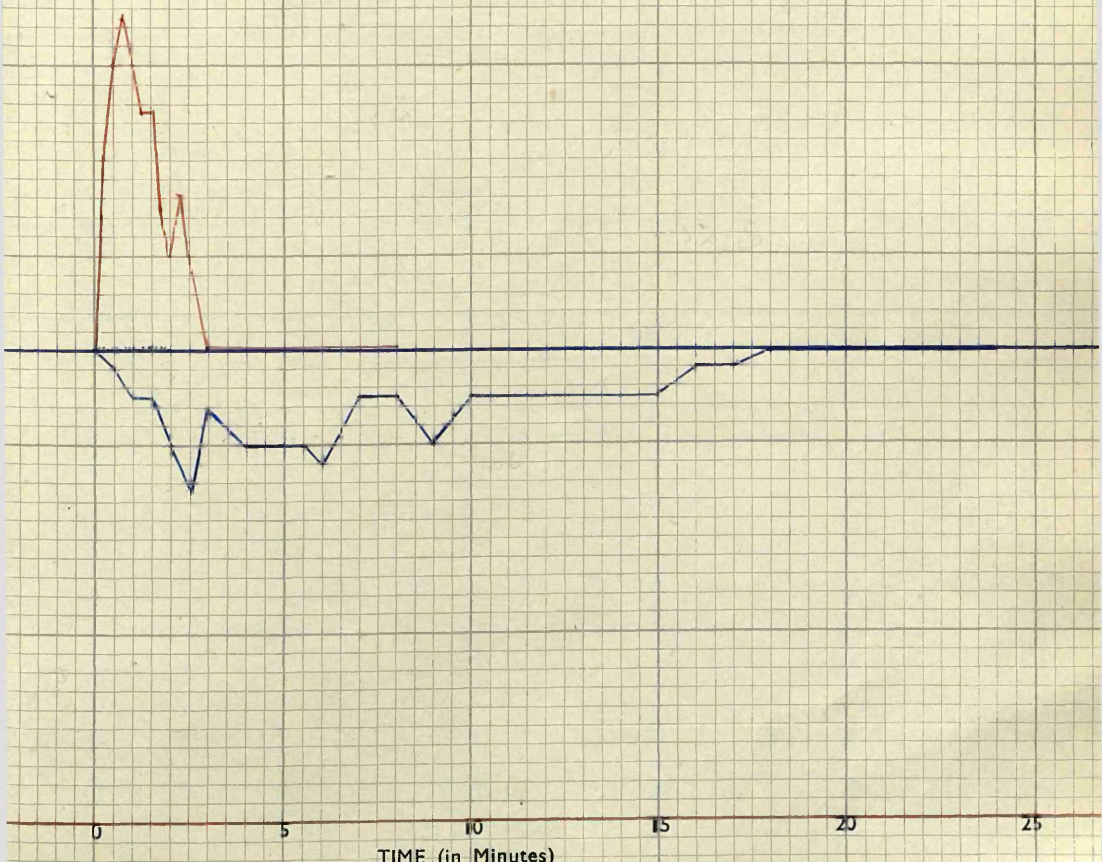


CASE. No.: ~~90~~ (b)

S. A. = 56
P. A. = 106

A. I. = 52.8

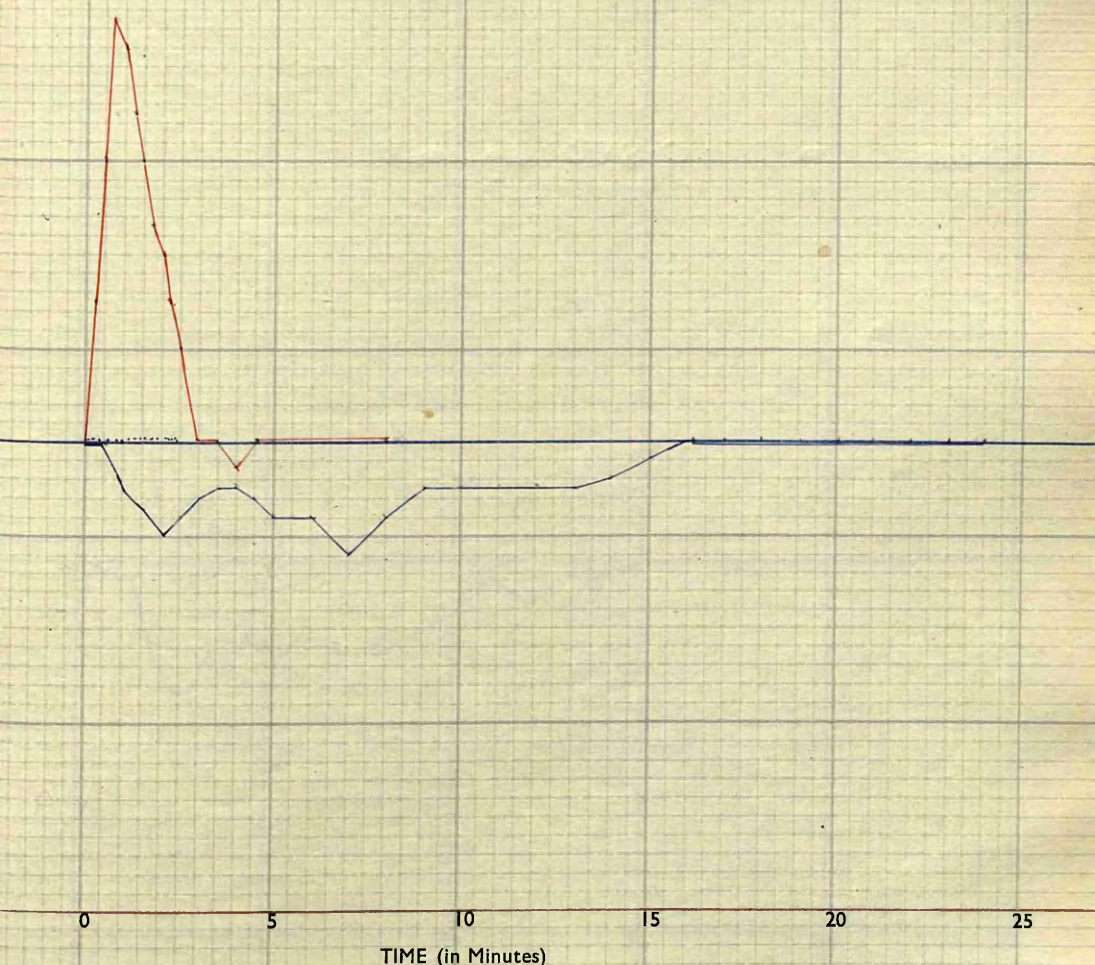
RECOVERED.



CASE No.: 91 (a)

S.A. = 65
P.A. = 90

A.I. = 72.2



CASE No.: 91 (b)

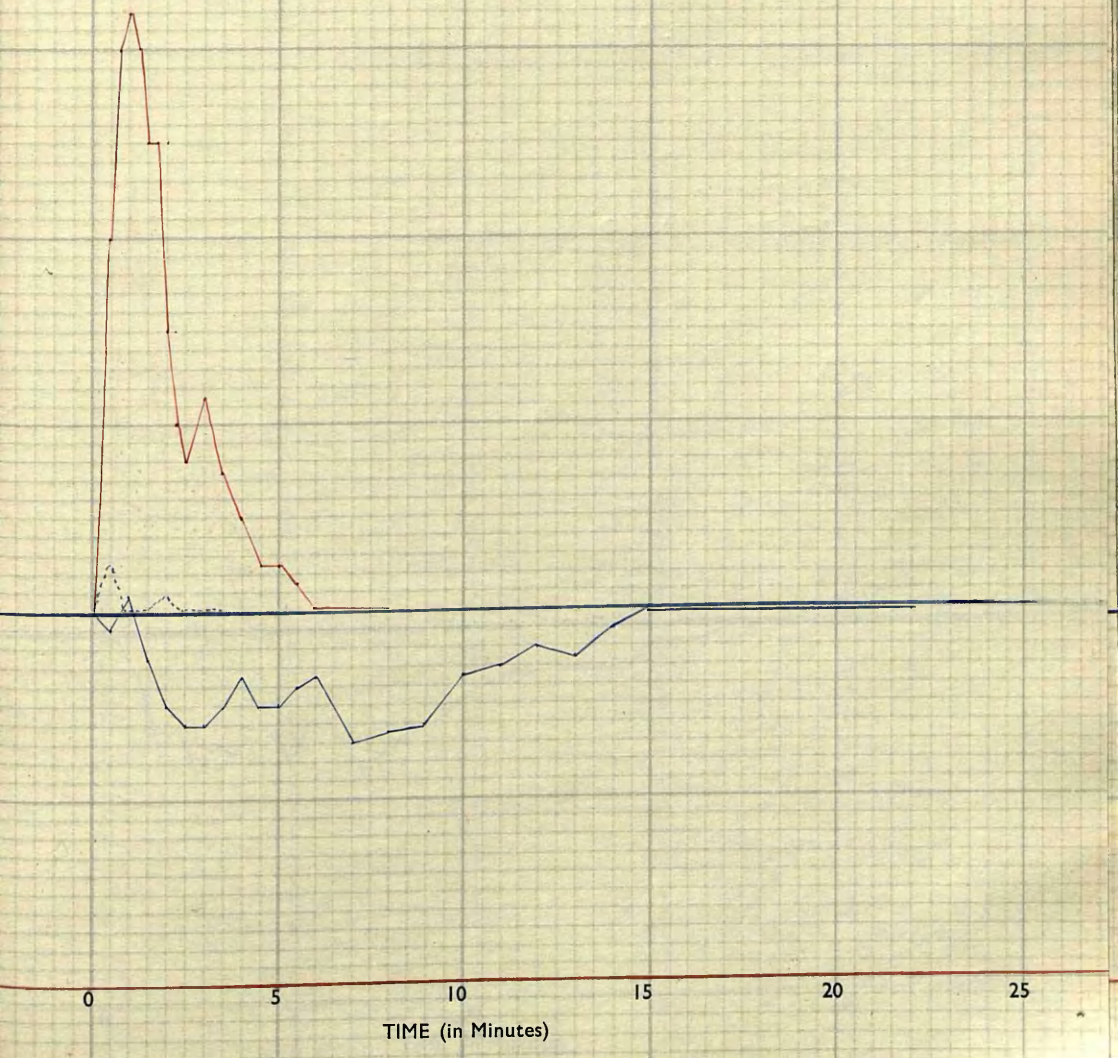
S.A.= 55
P.A.= 93

A.I.= 59.1

IMPROVED.

CASE No. : 92 (a)

S.A. = 126 / P.A. = 110 A.I. = 114.5

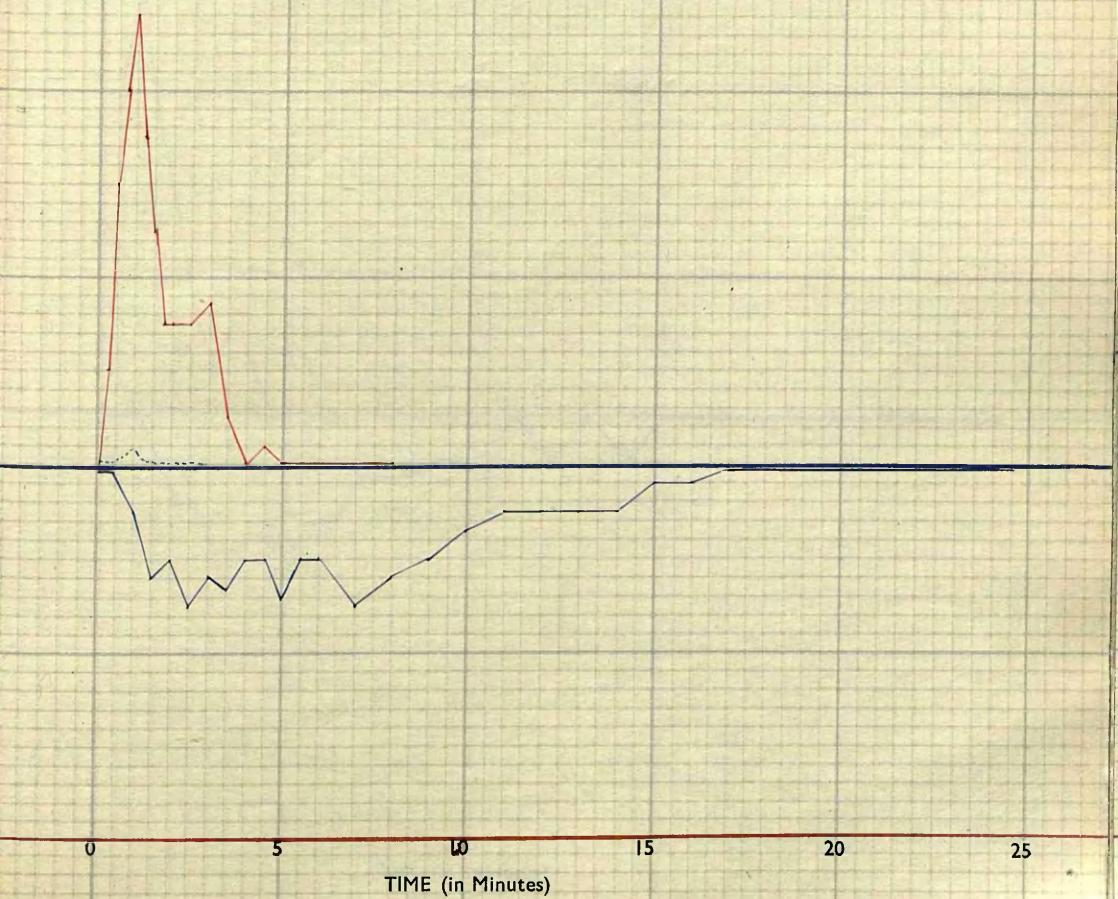


CASE No.: 92 (b)

S.A.= 78
P.A.= 130

A.I.= 60

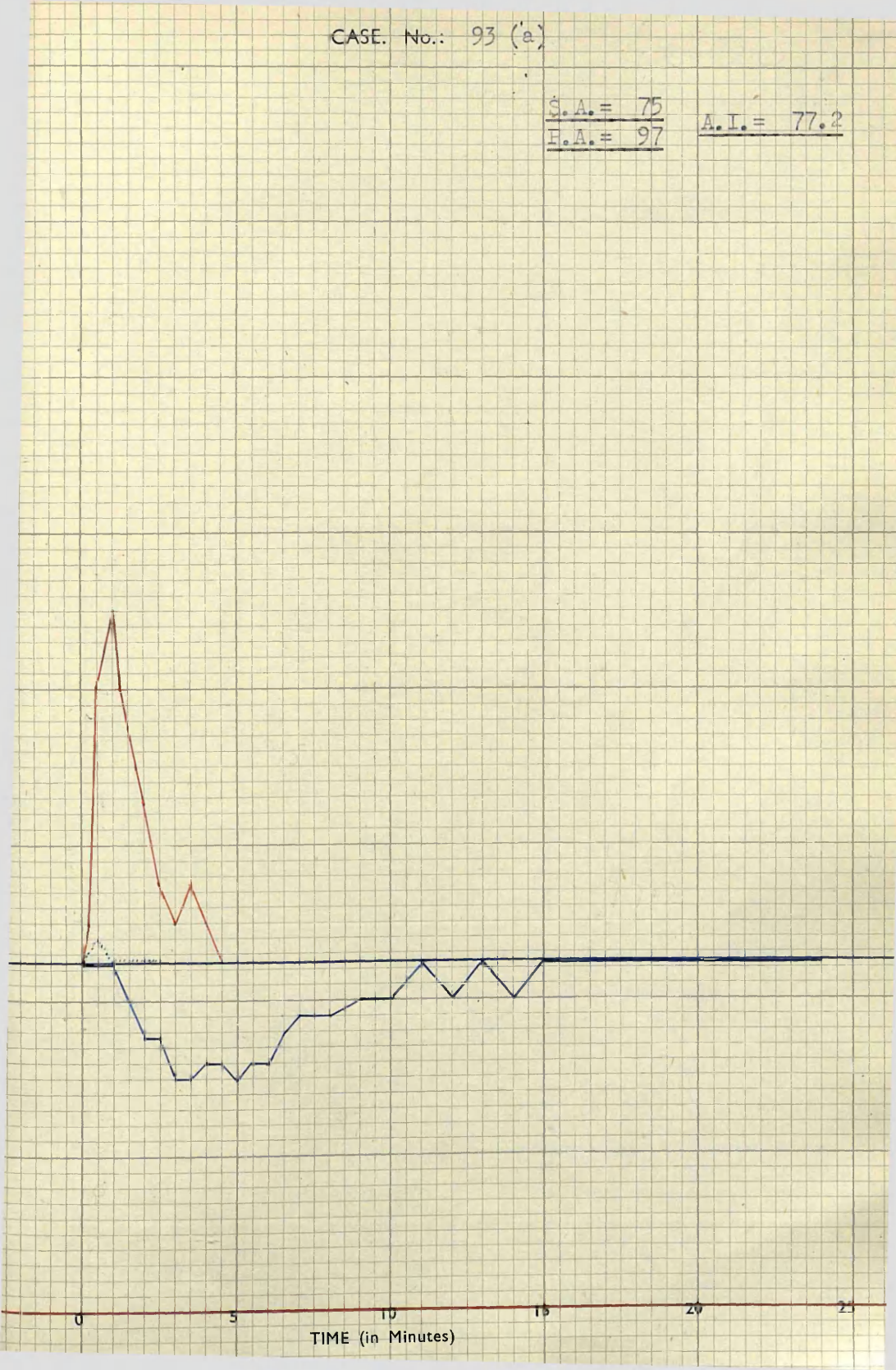
RECOVERED.



CASE. No.: 93 ('a')

S.A. = 75
F.A. = 97

A.I. = 77.2

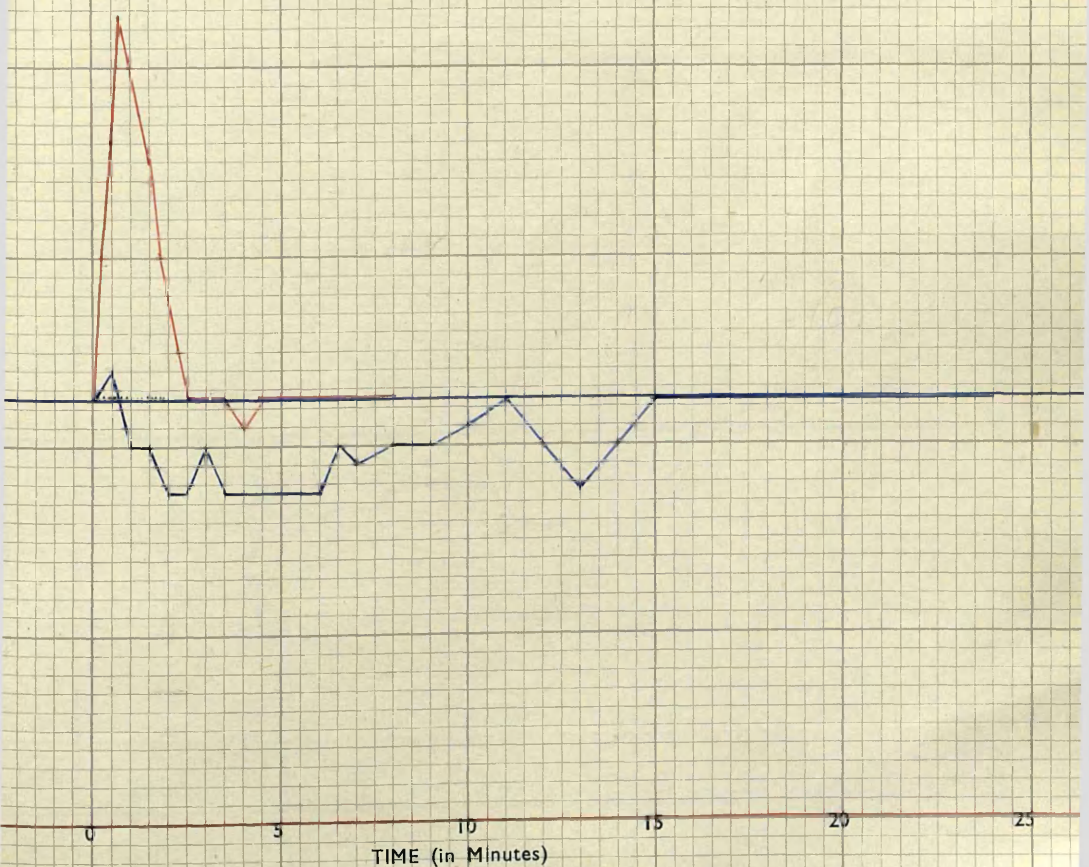


CASE. No.: 93 (b)

S.A.= 49
P.A.= 82

A.I.= 60

IMPROVED.



CASE No. : 94 (a)

S.A. = 68
P.A. = 128

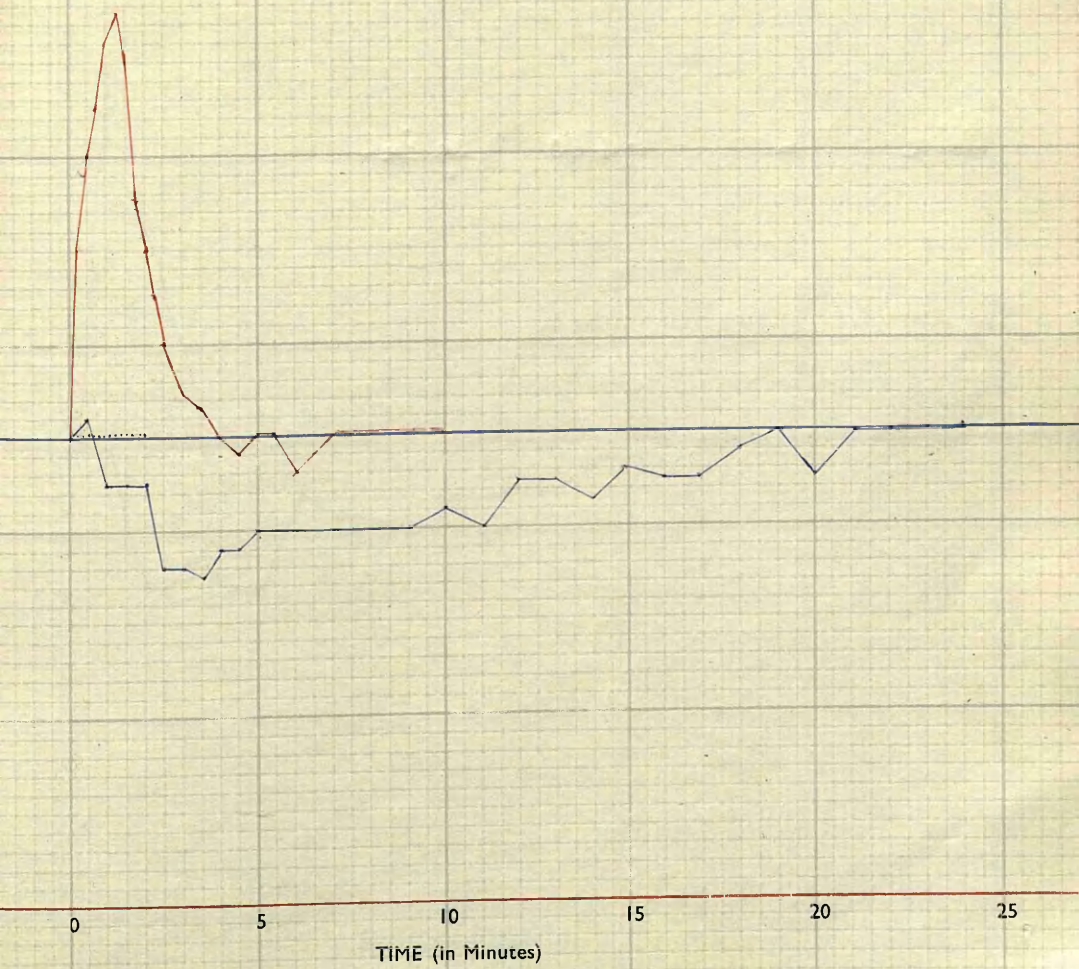
A.I. = 52.4

CASE No.: 94 (b)

S.A.= 72
P.A.= 143

A.I.= 50.4

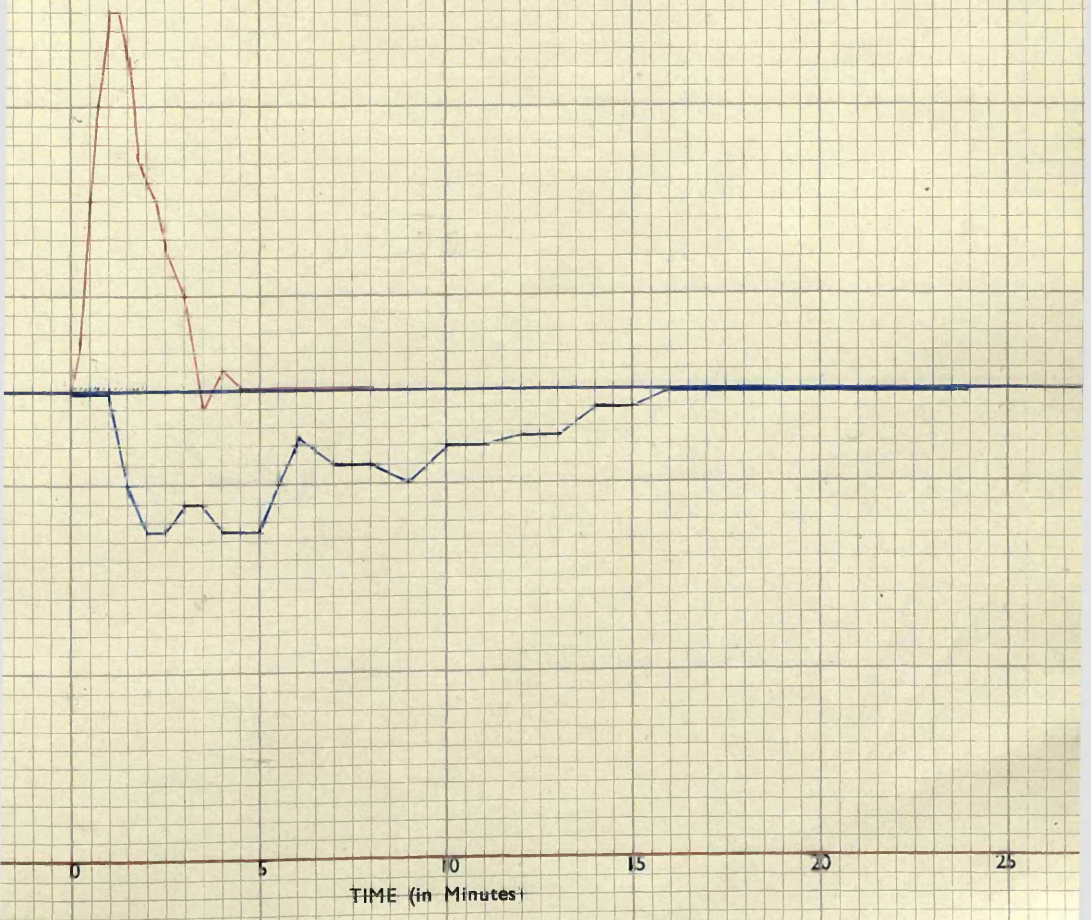
RECOVERED.



CASE. No.: 95 (a)

S.A. = 70
P.A. = 116

A.I. = 60.3

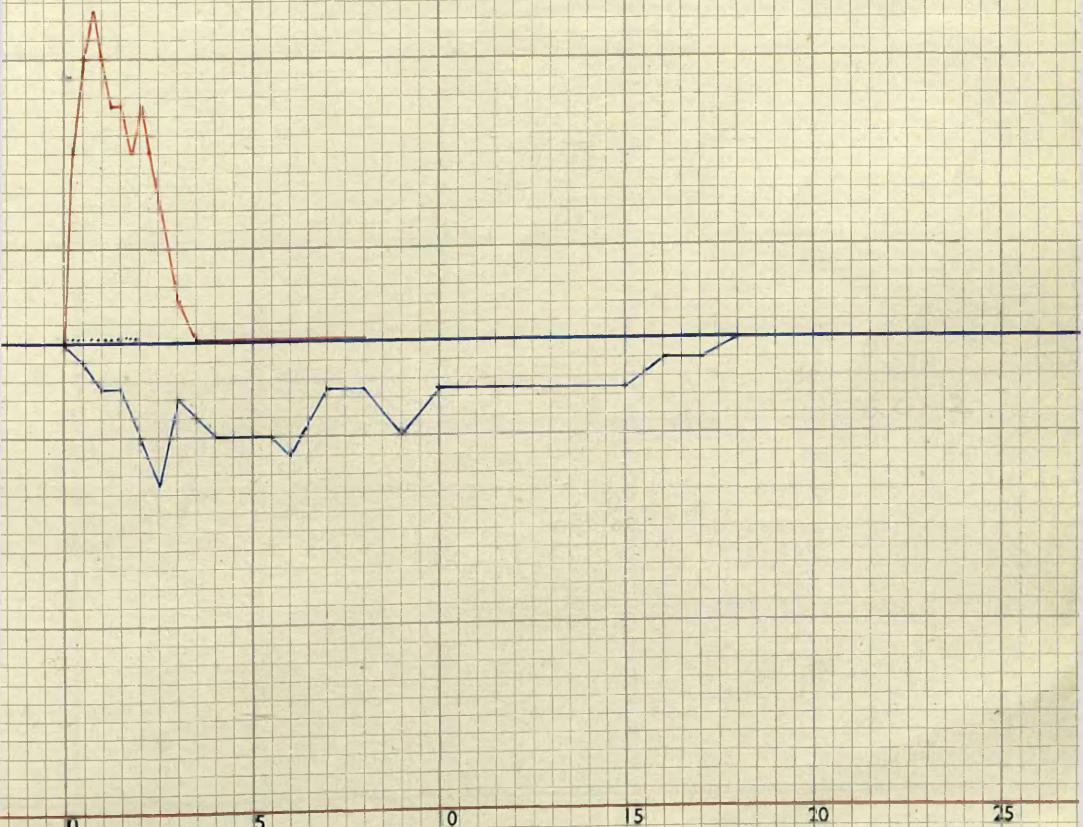


CASE. No.: 95 (b)

S.A. = 65
P.A. = 108

A.I. = 60.2

RECOVERED.



CASE No.: 96 (a)

S.A.= 50
P.A.= 110

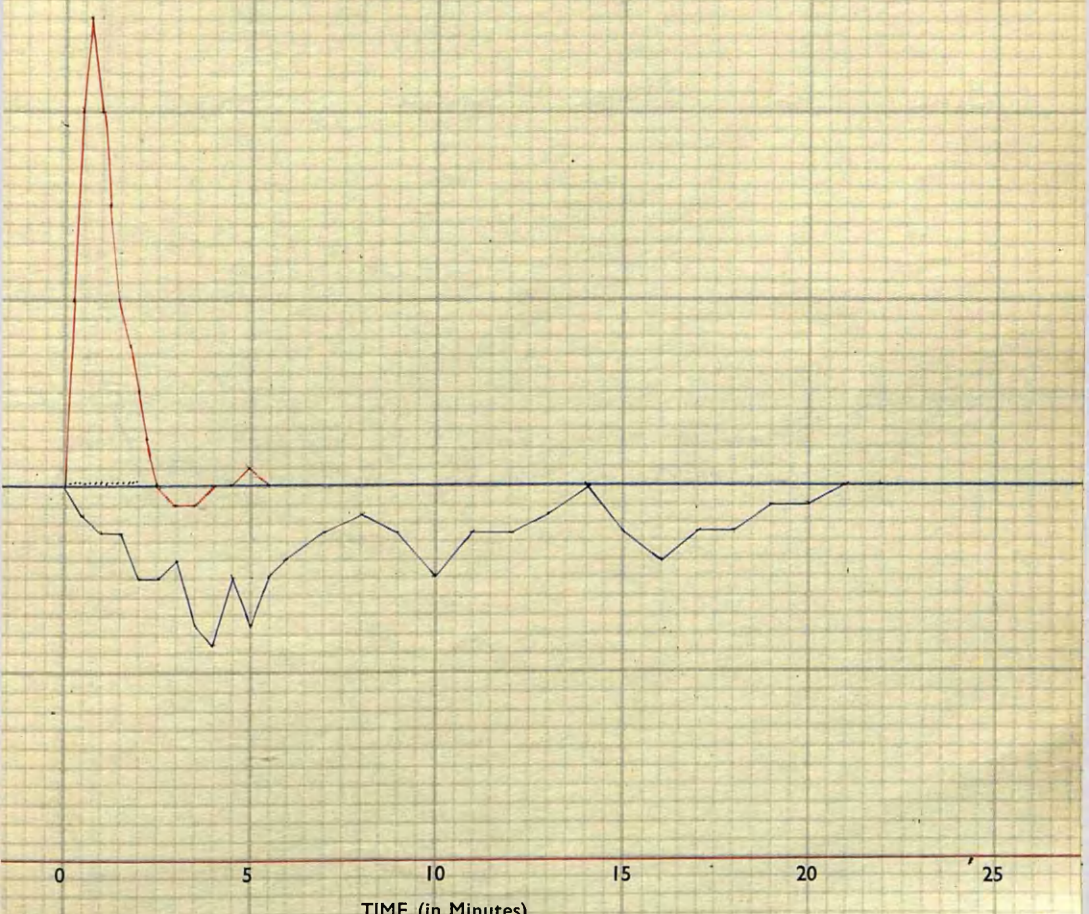
A.I.= 45.5

CASE No.: 96 (b)

S.A.= 56
P.A.= 121

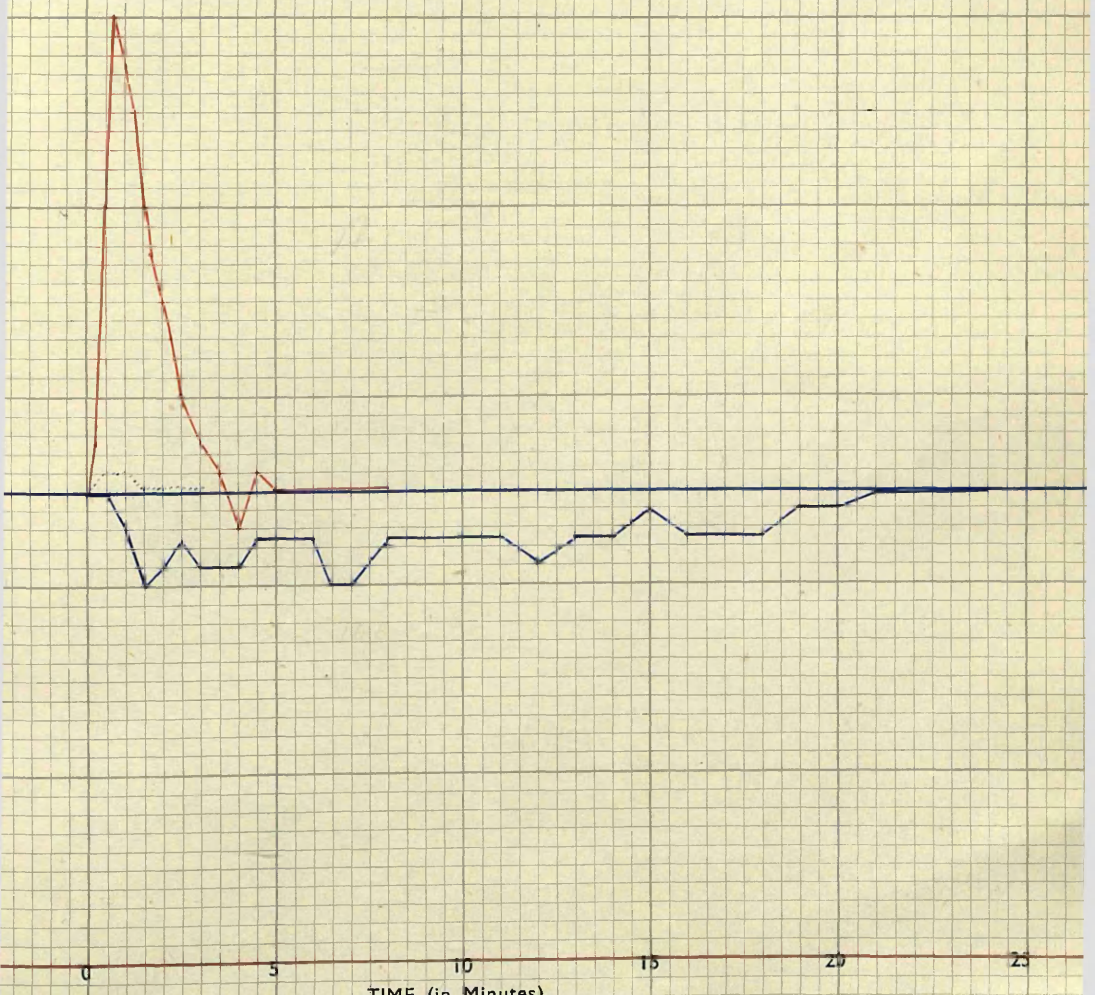
A.I.= 46.3

IMPROVED.



CASE. No.: 97 (a)

S.A. = 72 / P.A. = 100 A.I. = 66.7

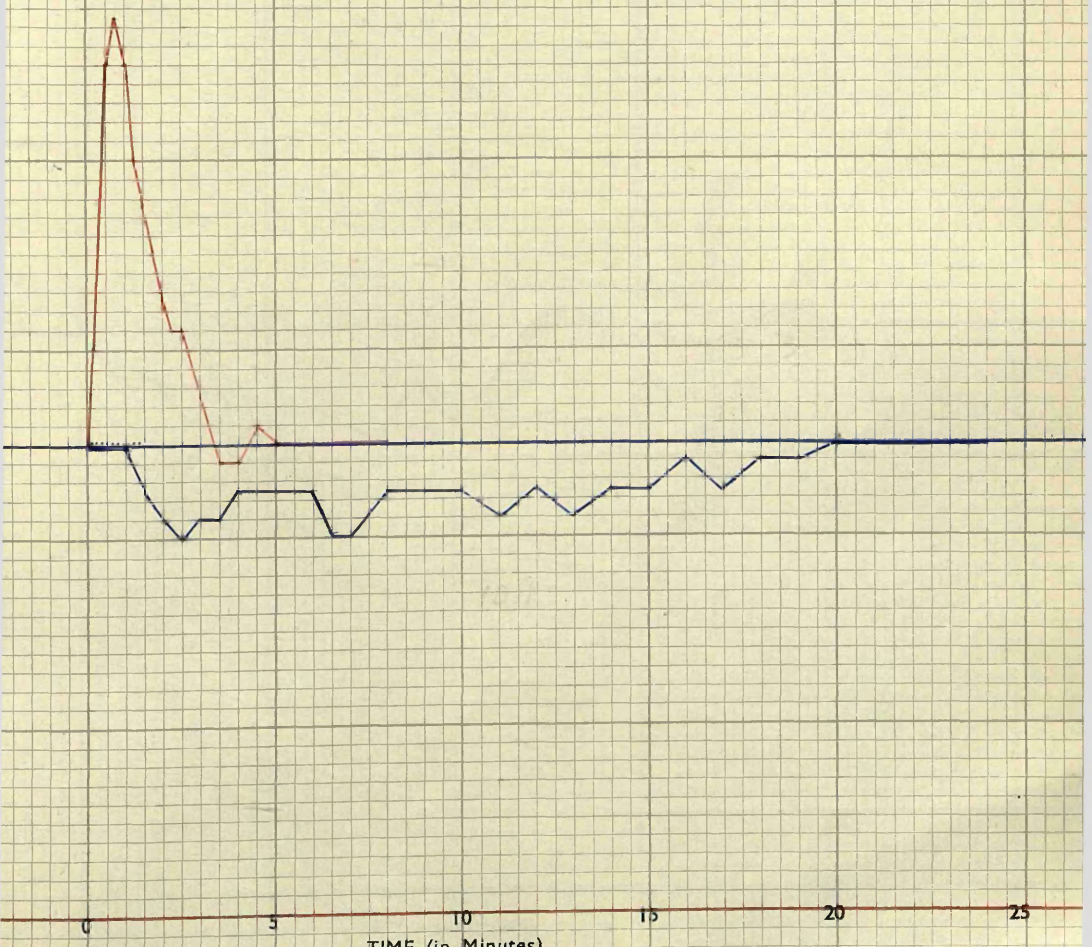


CASE. No.: 97 (b).

S.A.= 66
P.A.= 101

A.I.= 63.9

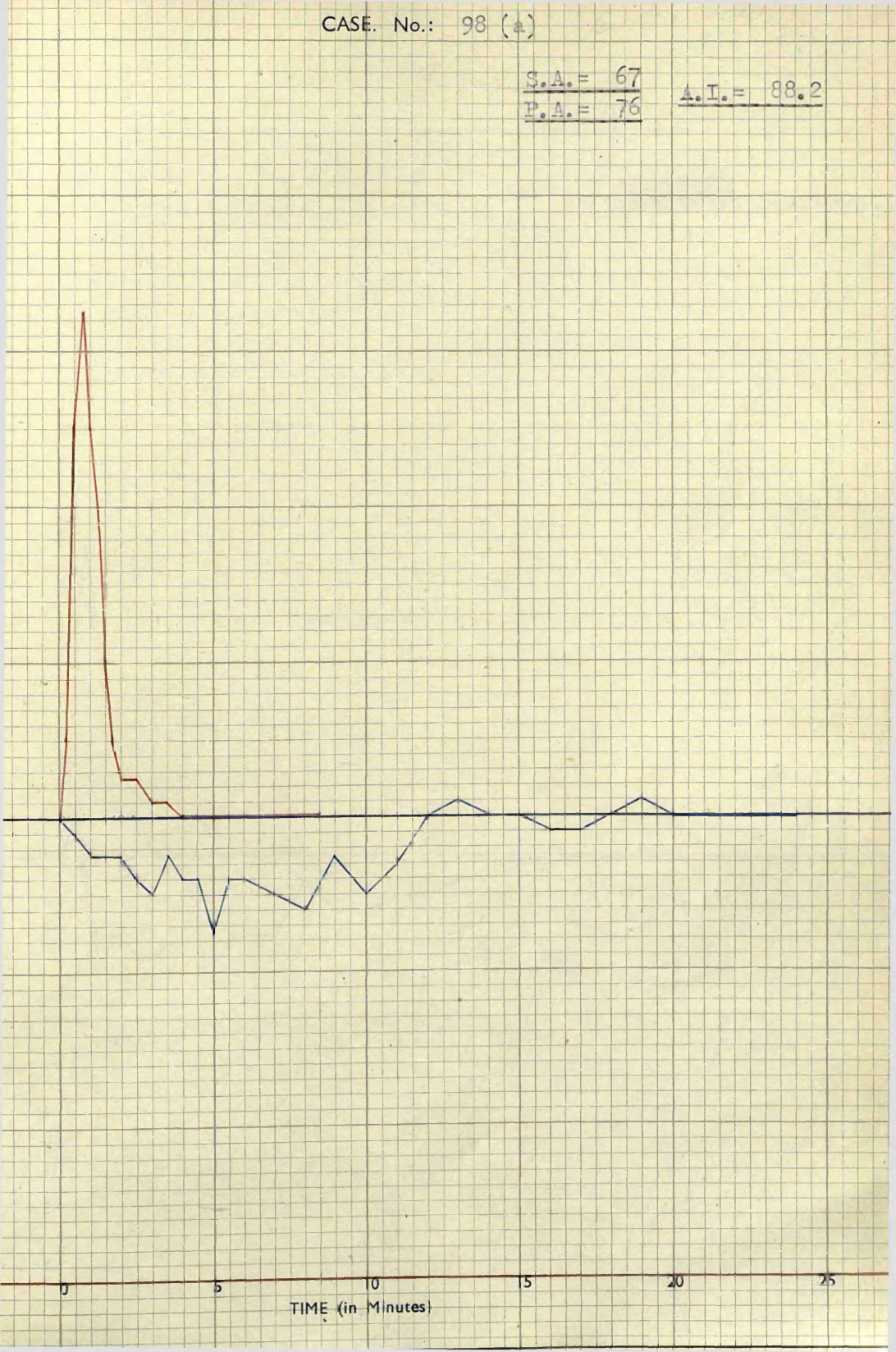
NOT IMPROVED.



CASE. No.: 98 (a)

S.A.= 67
P.A.= 76

A.I.= 88.2

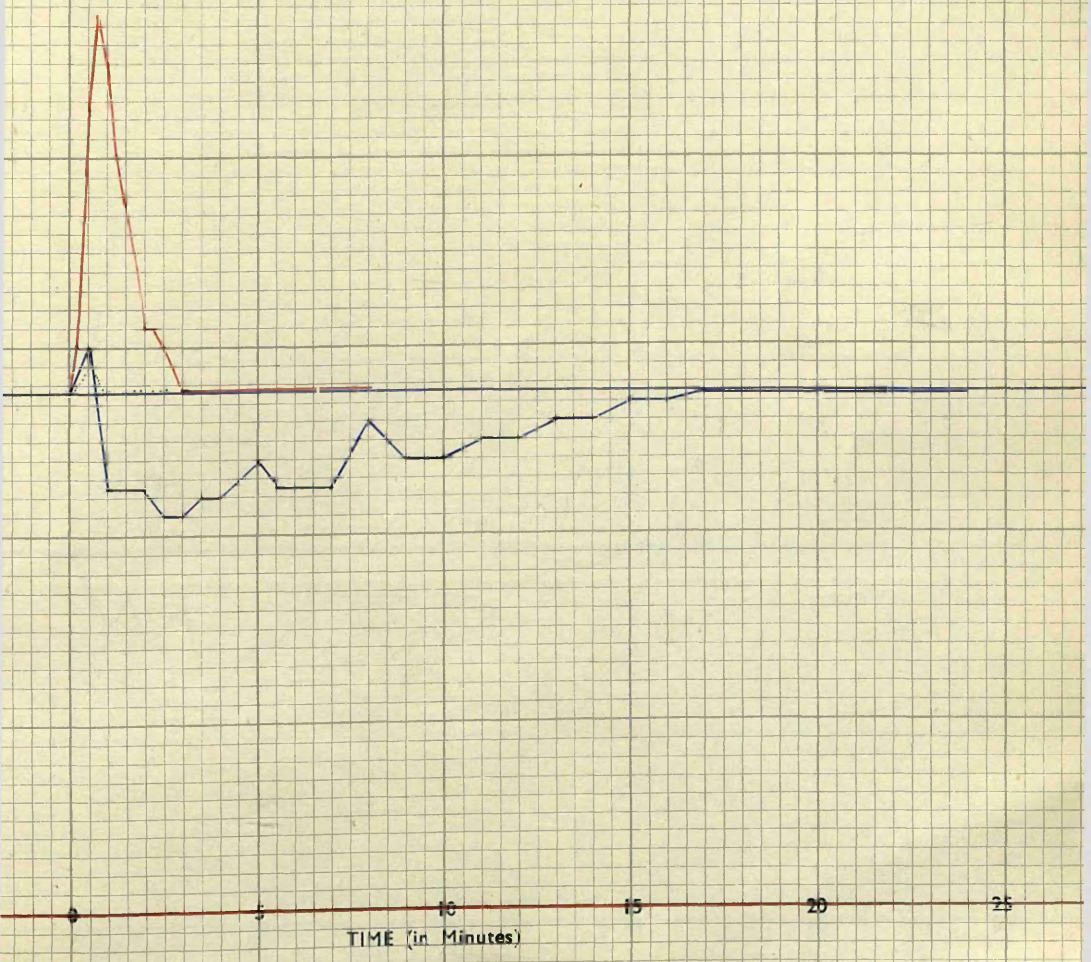


CASE. No.: 98 (b)

S.A. = 46
P.A. = 100

A.I. = 48

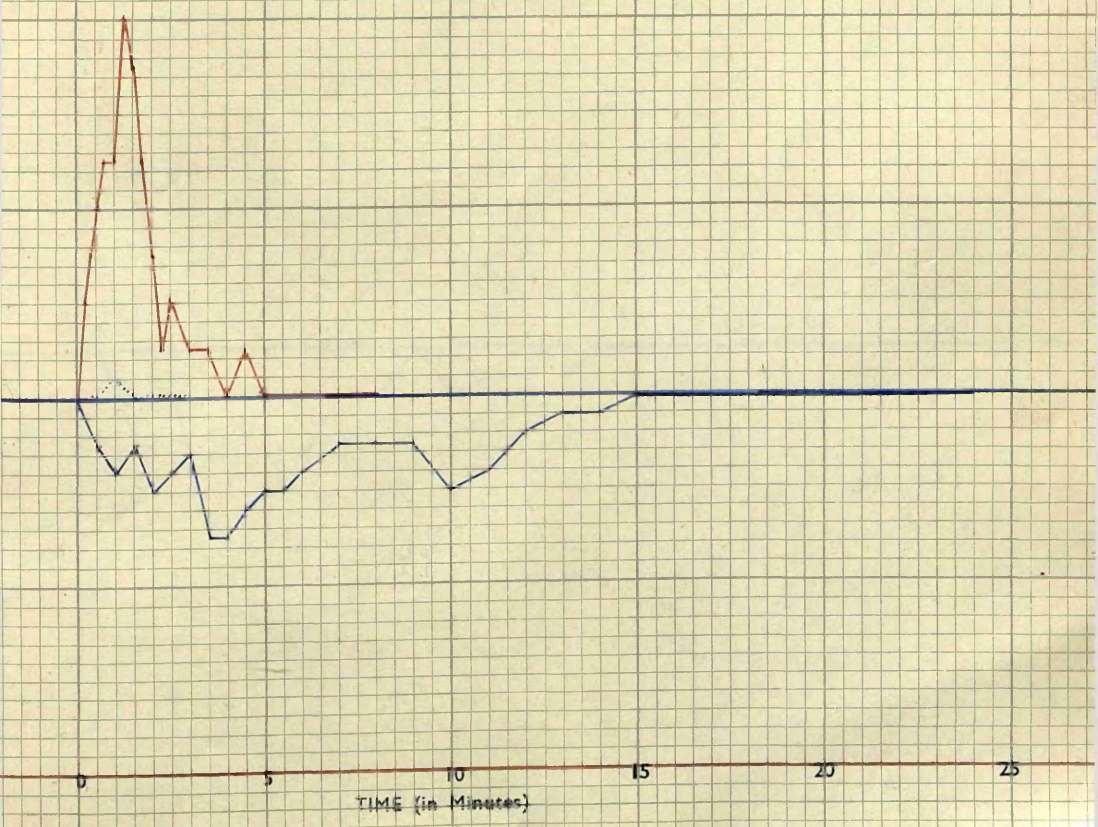
RECOVERED.
(pre-frontal leucotomy.)



CASE. No.: 99 (e)

S.A.= 64
P.A.= 99

A.I.= 64.6

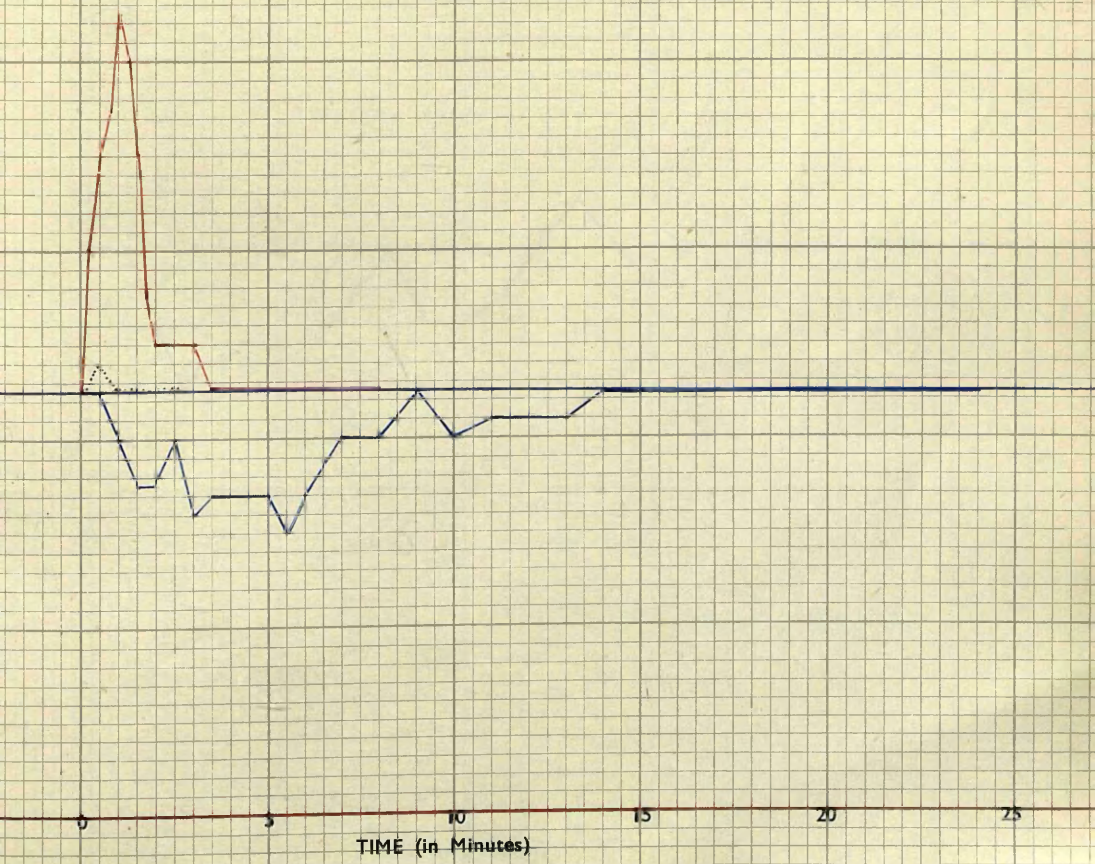


CASE. No.: 99 (b)

S.A. = 53
P.A. = 83

A.I. = 63.9

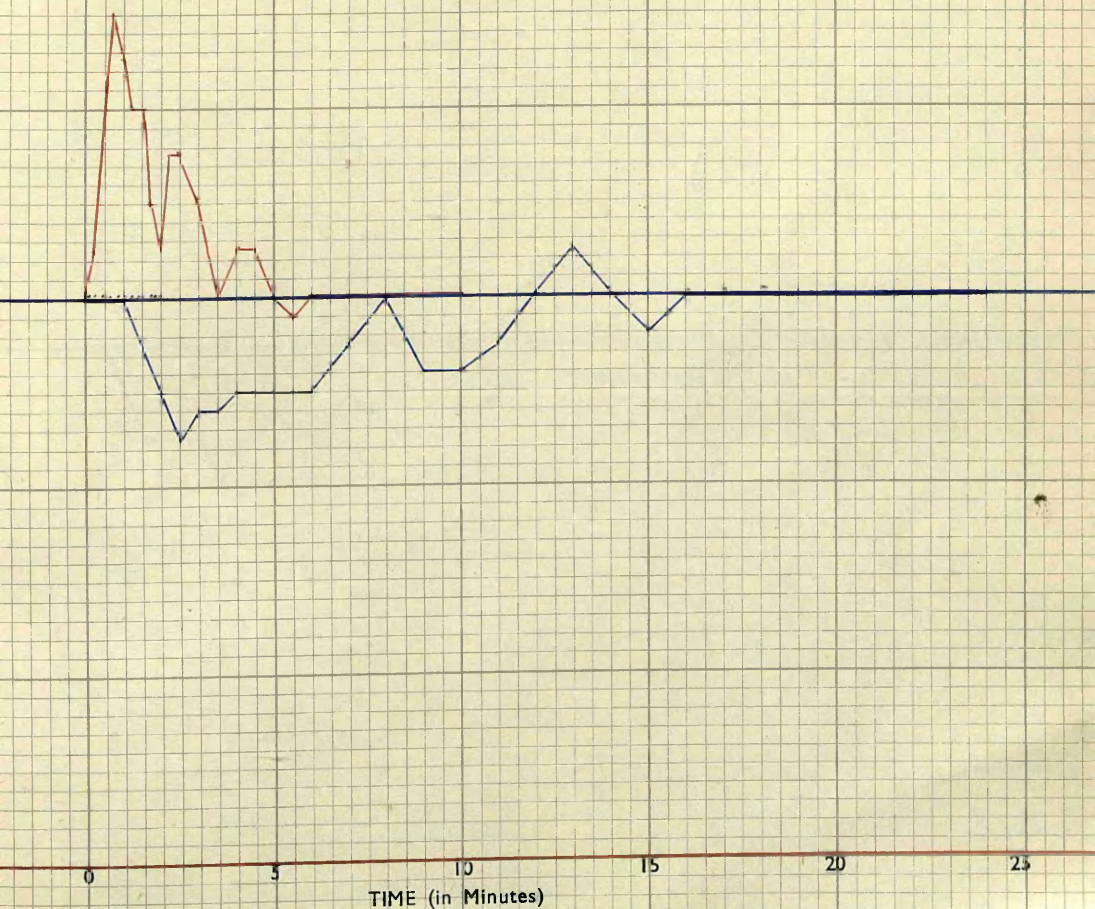
NOT IMPROVED.



CASE No.: 100 (A)

S.A. = 51
P.A. = 78

A.I. = 65.4

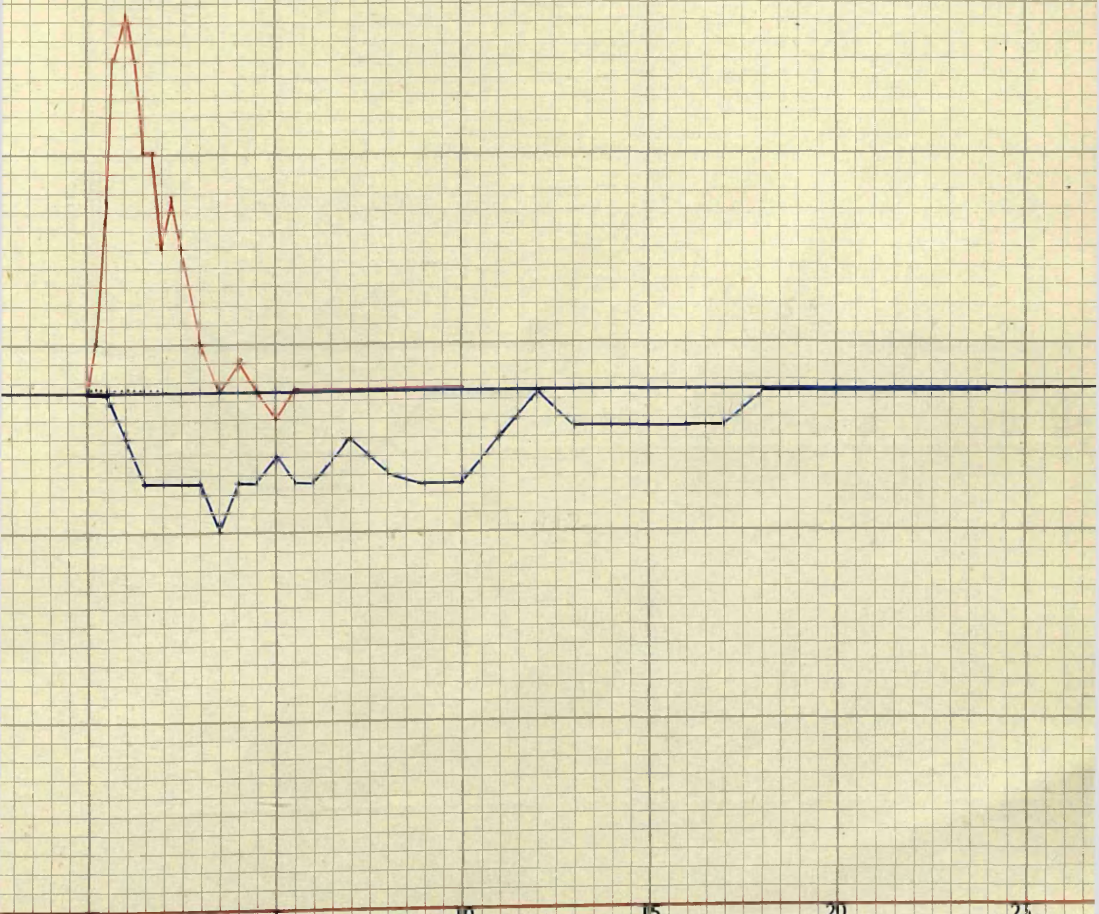


CASE. No.: 100 (b)

S.A.= 65
P.A.= 112

A.I.= 58

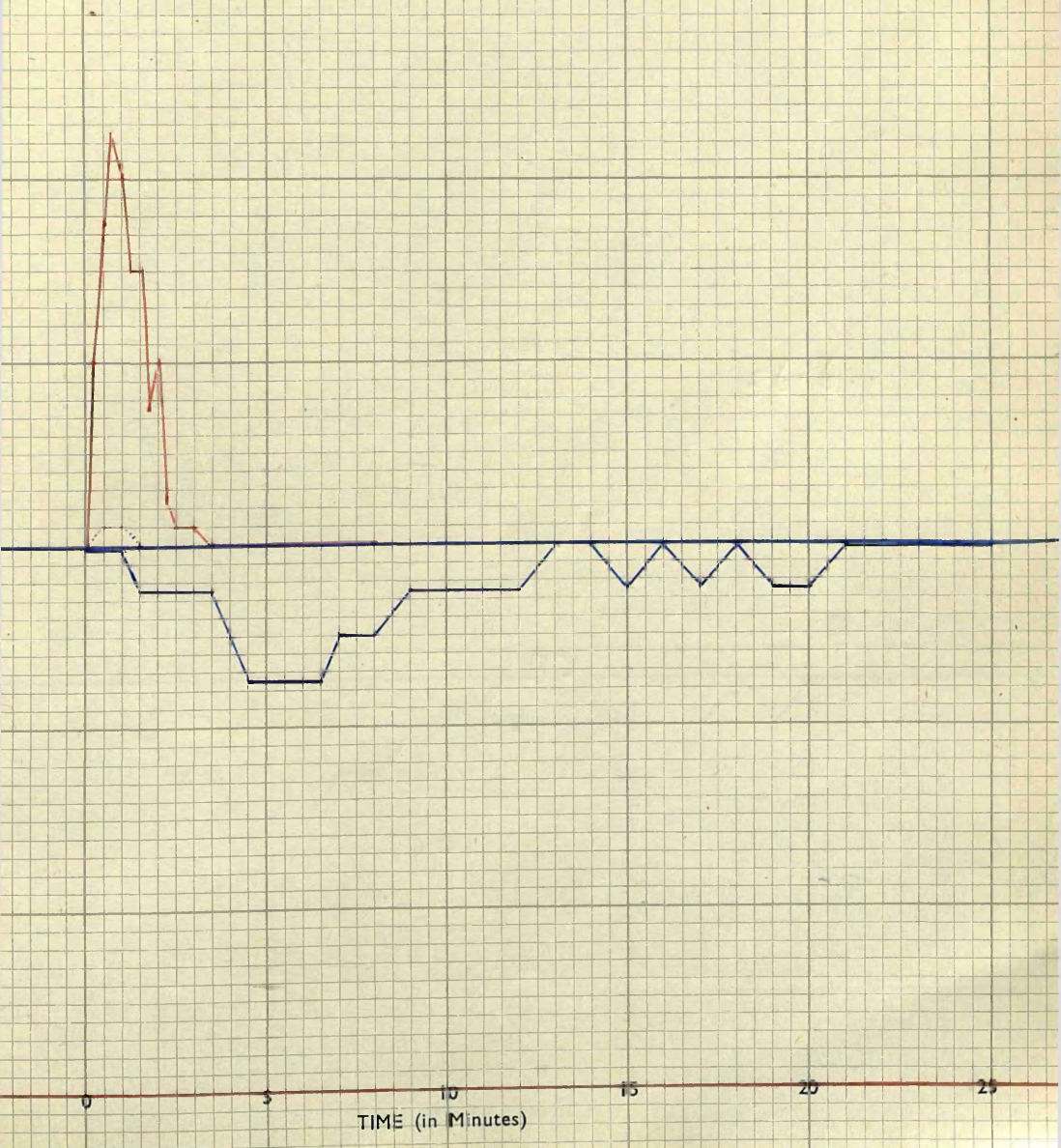
NOT IMPROVED.



CASE No.: C.1.

E.A. = 64
P.A. = 113

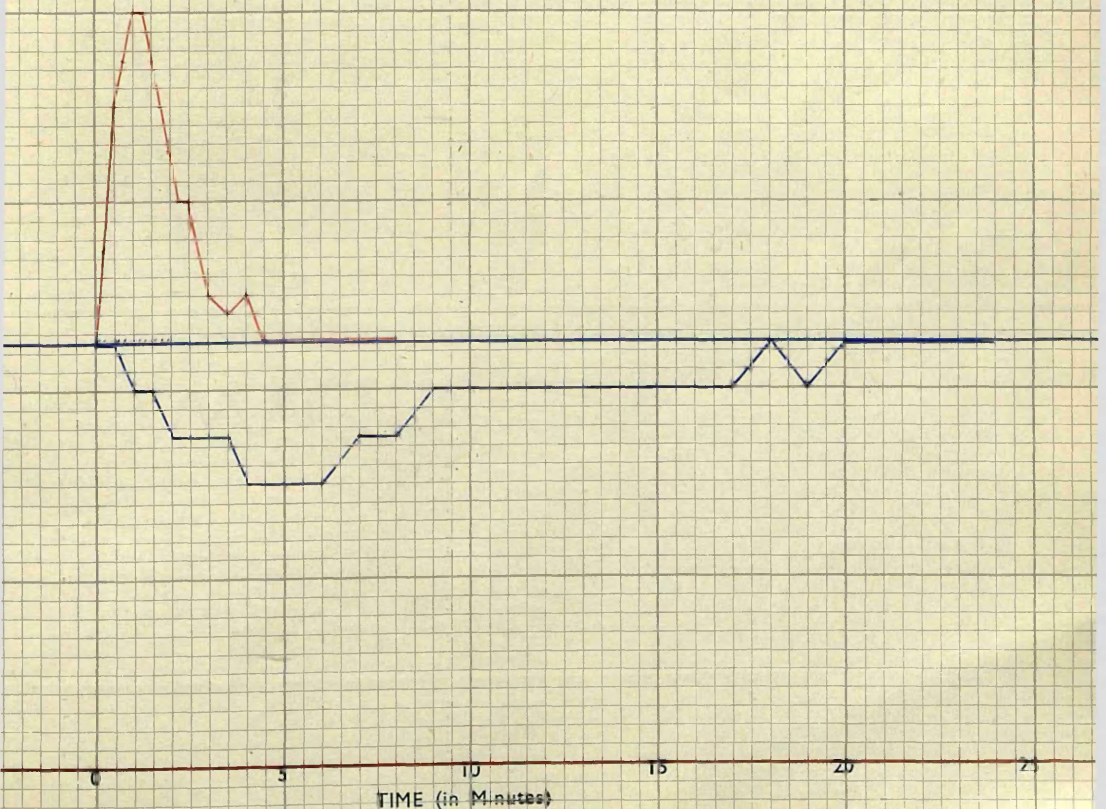
A.I. = 56.6



CASE. No.: C. II.

S. A. = 63
P. A. = 135

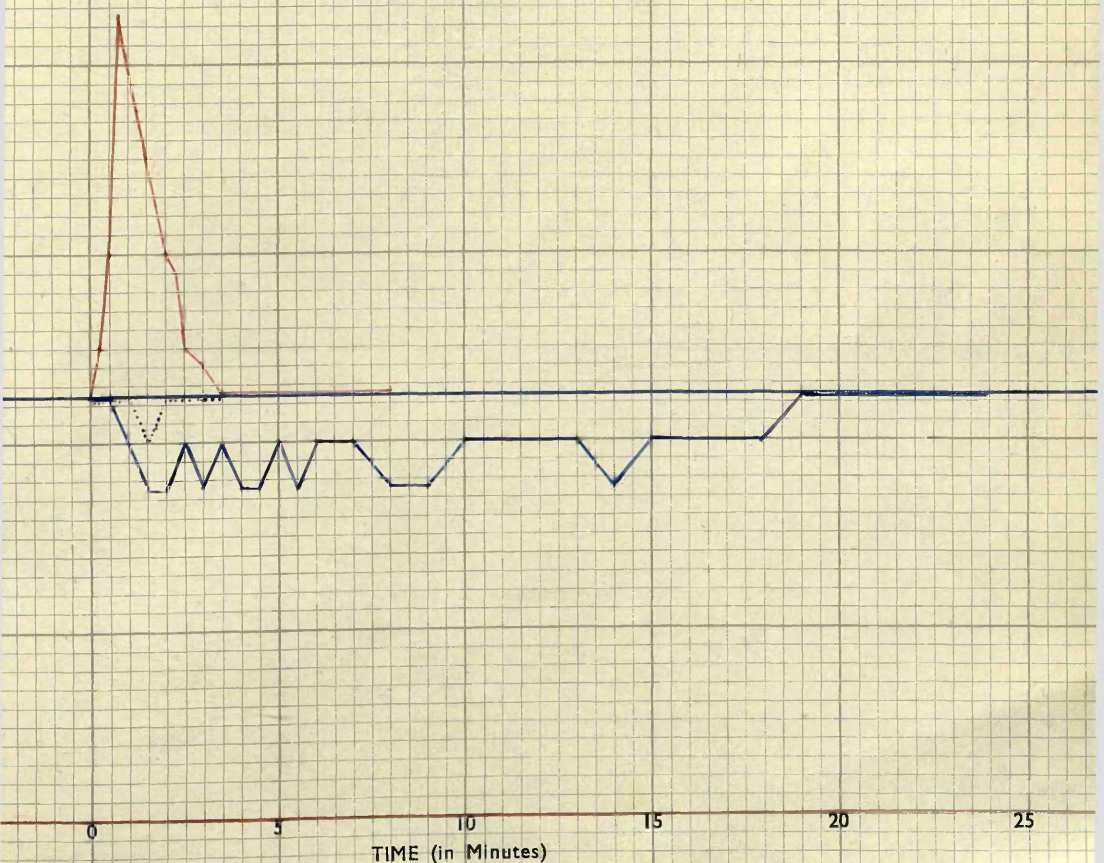
A. I. = 50.4



CASE. No.: C. III.

S.A. = 54
P.A. = 112

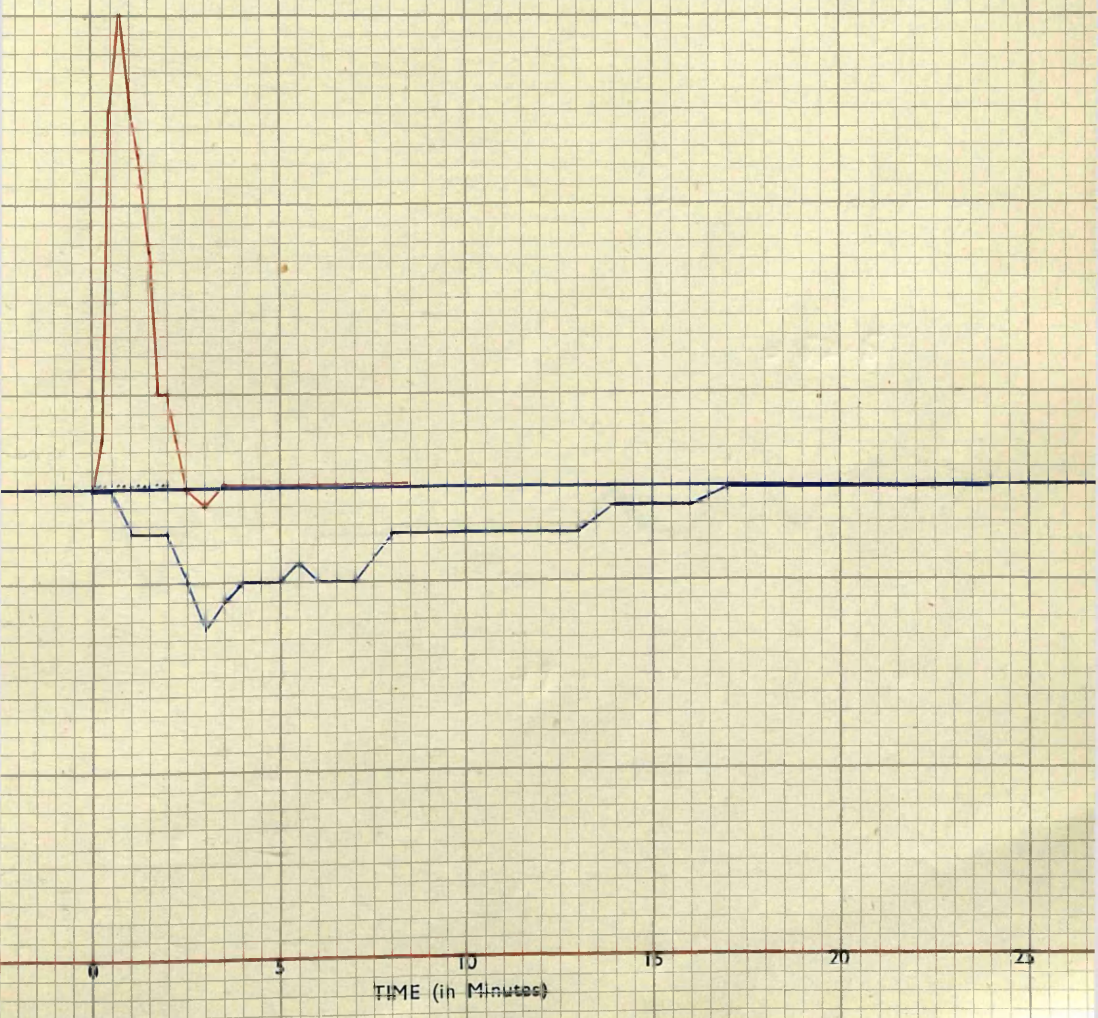
A.I. = 48.2



CASE No.: C.IV.

S.A. = 52
P.A. = 99

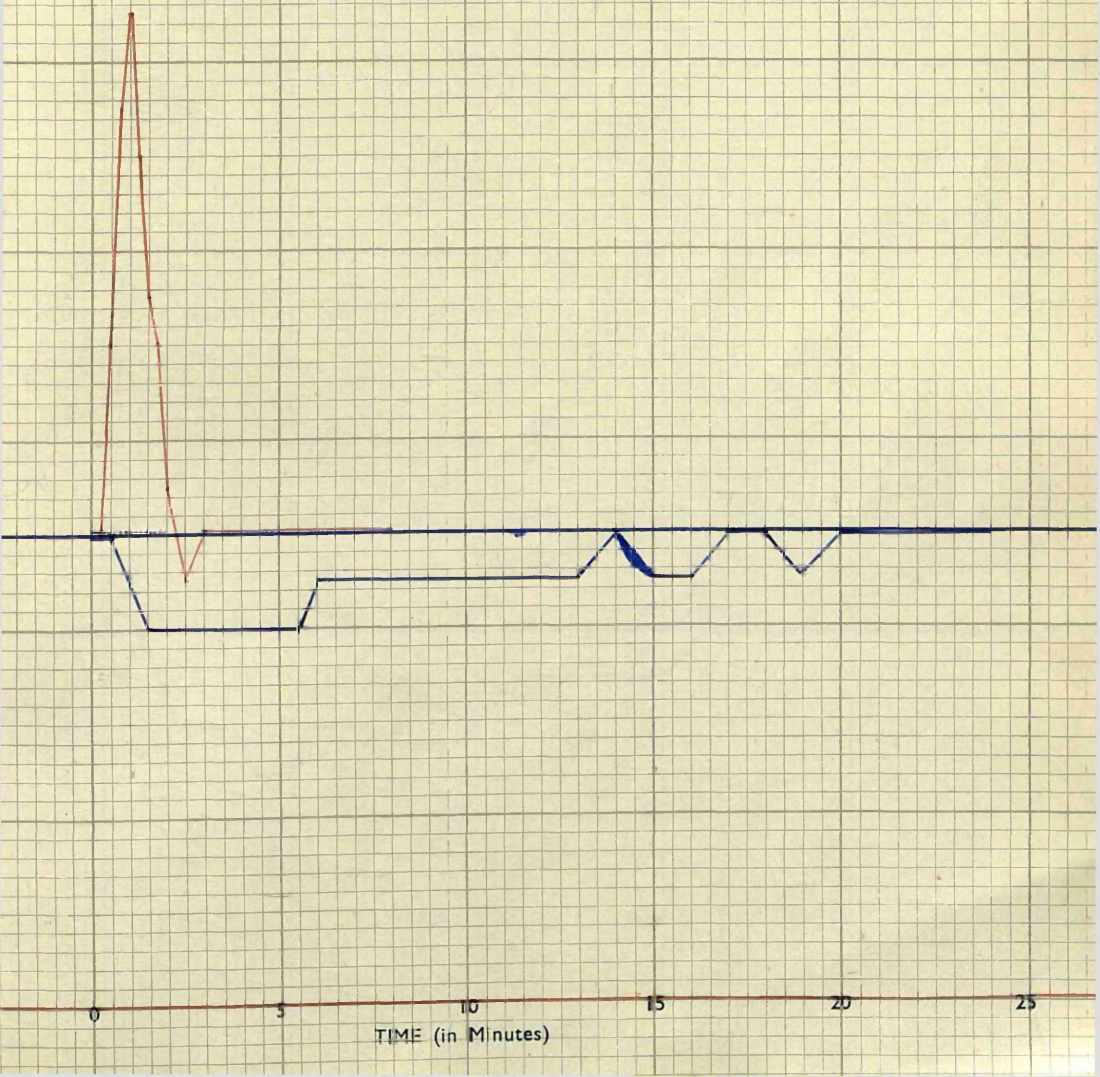
A.I. = 52.5



CASE. No.: D.T.

S.A. = 53
P.A. = 100

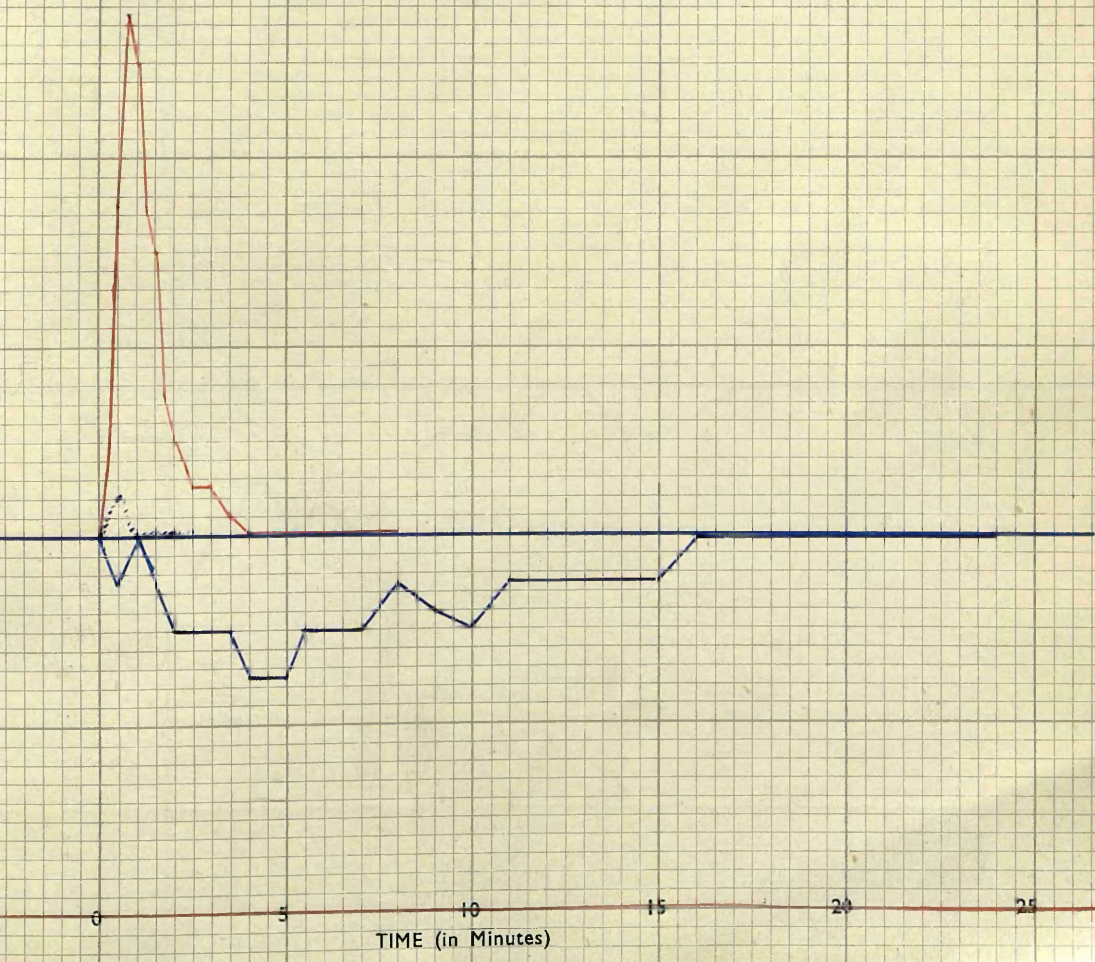
A.I. = 53



CASE No: C.VI.

S.A. = 69
P.A. = 118

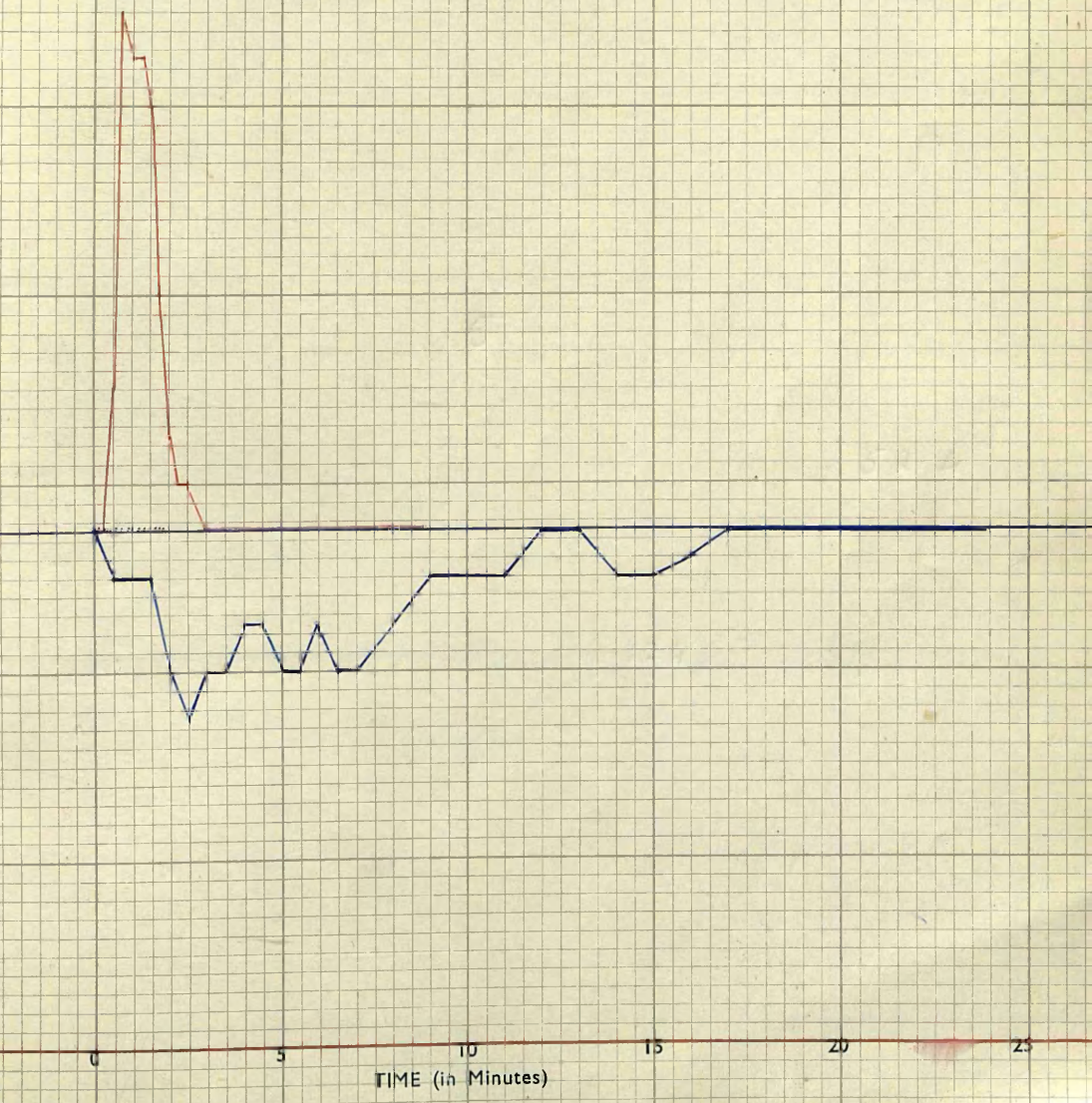
A.I. = 58.5



CASE. No.: C.VII.

S.A. = 65
P.A. = 124

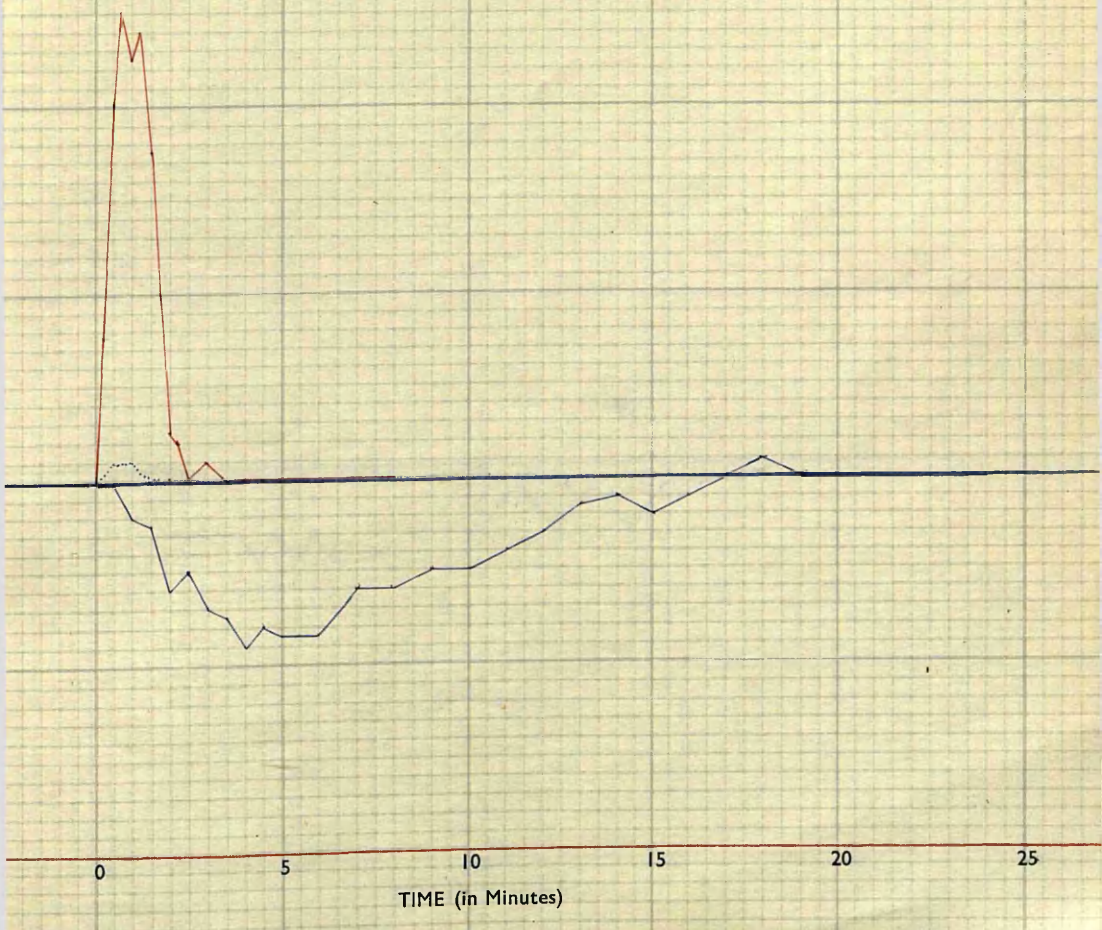
A.I. = 52.4



CASE No. : C.VIII.

S.A. = 67
P.A. = 136

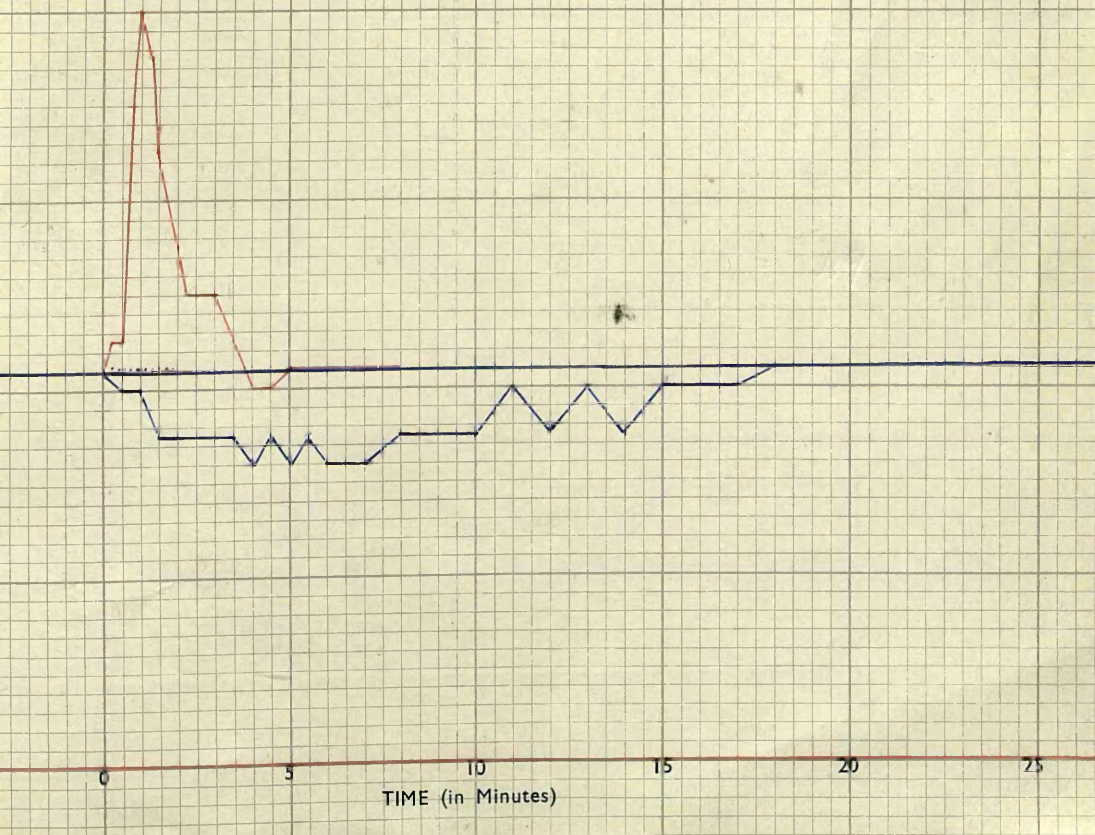
A.I. = 49.2



CASE, No.: C. IX.

S.A. = 48
P.A. = 98

A.I. = 49



CASE. No.: C.X.

S.A.= 62
P.A.= 171

A.I.= 55.9