

THE CHANGES IN THE PERIPHERAL LEUCOCYTE PICTURE  
IN THE STATE OF SHOCK ASSOCIATED WITH SEVERE  
BURNS AND SCALDS.

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T H E S I S

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PART ONE.

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PREFACE.



## PREFACE.

THE PROBLEM OF THE AETIOLOGY OF SHOCK ASSOCIATED WITH THERMAL TRAUMA HAS BEEN ATTACKED IN SO MANY WAYS THAT IT APPEARS UNNECESSARY TO OFFER ANY APOLOGY FOR PRESENTING THIS SUBJECT FROM THE HAEMATOLOGICAL VIEW-POINT. AT LEAST SUCH A COURSE CAN HARDLY PRODUCE MORE IRRELEVANT CONCLUSIONS THAN SOME OF THE MODERN CONTRIBUTIONS.

THIS THESIS WOULD BE INCOMPLETE IF I WERE NIGGARDLY IN EXPRESSING MY GRATITUDE TO THOSE WHO, BY THEIR ENCOURAGEMENT AND HELP, MADE THIS INVESTIGATION POSSIBLE FOR ME.

IN PARTICULAR I WOULD EXPRESS MY GRATITUDE TO:-  
PROFESSOR E.P. CATHCART, WHO WAS AT ALL TIMES A KINDLY AND ENCOURAGING SUPERVISOR;  
MR. A.M. CLARK, FOR PERMITTING ME TO EXAMINE THE PATIENTS UNDER HIS CARE;  
MR. FRED GAIRNS, FOR HIS VERY CONSIDERABLE HELP WITH THE PHOTOGRAPHIC REPRODUCTION OF MY OWN RATHER INFERIOR DIAGRAMS;  
AND LAST, BUT BY NO MEANS LEAST, SISTER LAURA STIRLING, FOR HER KINDNESS AND UNENDING PATIENCE.

CHAPTER ONE.

SHOCK.

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## CHAPTER ONE.

THE IMPORTANCE OF SHOCK IS BY NO MEANS CONFINED TO WAR TIME, ALTHOUGH THE PRESENT WAR, LIKE THE LAST, HAS STIMULATED INTEREST IN THIS SUBJECT. THIS IS NOT ENTIRELY DUE TO THE MANY AND SEVERE INJURIES AMONG THE FIGHTING SERVICES, BUT ALSO TO THE GREAT INCREASE IN INDUSTRIAL INJURIES WHICH RESULTS FROM BOTH EXPANDING PRODUCTION AND THE UTILIZING OF INEXPERIENCED LABOUR.

SHOCK IS RECOGNISED TO BE THE MAJOR CAUSE OF DEATH IN ALL TYPES OF INJURIES. THIS IS ESPECIALLY TRUE OF SHOCK IN BURNS, WHERE SEVENTY PER CENT OR MORE OF THE DEATHS FROM SEVERE THERMAL TRAUMA OCCUR WITHIN THE FIRST FORTY-EIGHT HOURS. (GIBSON).

IT IS WITH THE CURRENTLY ACCEPTED VIEWS ON THE AETIOLOGY OF SHOCK IN BURNS THAT THIS CHAPTER IS CONCERNED, BUT A BETTER APPRECIATION OF THE PRESENT POSITION CAN BE HAD IF THE MATTER IS DEALT WITH FROM AN HISTORICAL VIEW-POINT IN THE FIRST INSTANCE. THIS IS SPECIALLY SO BECAUSE RECENT ADVANCES IN THIS SUBJECT HAVE BEEN RAPID AND IN SOME RESPECTS REVOLUTIONARY, AND BECAUSE CONFLICTING OPINIONS STILL EXIST ON

*Of Burns.*

Even that stupor with which patients in this situation are sometimes attacked, is more readily removed by opium than any other remedy. As this symptom is probably induced by some degree of effusion upon the brain, and as we are to consider this as an effect of the irritation which always accompanies burns, we may readily conceive that opiates should prove particularly useful in removing it: And I have found in a variety of instances that they do so.

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AN EARLY REFERENCE TO SHOCK IN  
BURNS. IT WOULD APPEAR TO BE  
AN EARLY CONCEPT OF THE  
NERVOUS THEORY.  
(FROM "A SYSTEM OF SURGERY" BY  
BENJAMIN BELL. EDIN. 1801).

MANY POINTS. IT APPEARS TO THE WRITER TO BE OF GREAT IMPORTANCE TO REITERATE SIMONART'S CAUTION THAT THE PROBLEM OF SHOCK IN BURNS MAY BE QUITE SEPARATE FROM THAT OF SHOCK DUE TO OTHER FORMS OF TRAUMA. THE STUDY OF SHOCK IN BURNS HAS GAINED SO MUCH FROM THE STUDY OF TRAUMATIC SHOCK IN GENERAL, HOWEVER, THAT A SHORT ACCOUNT OF THE DEVELOPMENT OF OUR KNOWLEDGE OF SHOCK IN THIS LESS PARTICULAR SENSE MAY SERVE AS A REASONABLE POINT OF DEPARTURE.

DEFINITION: SINCE JAMES LATTA'S FIRST USE OF THE TERM IN 1795 THE DEFINITIONS WHICH HAVE BEEN FROM TIME TO TIME OFFERED FOR SHOCK HAVE, NATURALLY ENOUGH, BEEN DICTATED BY KNOWLEDGE OF THE PROCESS AND FASHION OF THE TIME. SOME IDEA OF THE HISTORICAL DEVELOPMENT MAY BE OBTAINED FROM THE FOLLOWING LIST, WHICH IS CERTAINLY NOT COMPLETE, BUT MAY CLAIM TO BE REPRESENTATIVE.

- 1826     TRAVERS     SHOCK IS A SPECIES OF FUNCTIONAL CONCUSSION, BY WHICH THE INFLUENCE OF THE BRAIN OVER THE ORGAN OF CIRCULATION IS DERANGED OR SUSPENDED.
- 1834     DELCASSE     AN ARREST OF INNERVATION WITHOUT WHICH ALL ORGANS PASS INTO INSENSIBILITY (THIS LATER BECAME MELTZER'S INHIBITION THEORY).

- 1872 GROSS A MANIFESTATION OF A RUDE UNHINGING OF THE MACHINERY OF LIFE.
- 1880 PIESHAUD LE CHOC EST UN ÉTAT GÉNÉRAL PLUS OU MOINS GRAVE CONSÉCUTIF AUX TRAUMATISMES, SPÉCIALEMENT AUX PLAIES PAR ARMES À FEU ET AUX GRANDS ÉCRASEMENT, CARACTÉRISÉ PAR L'AFFAIBLISSEMENT DES PULSATIONS DU COEUR, L'ABAISSEMENT DE LA TENSION, LA PALEUR DES TISSUS, UN CERTAIN DEGRÉ D'ANAESTHÉSIE JOINT À LA FAIBLESSE MUSCULAIRE, AVEC CONSERVATION DE L'INTELLIGENCE.
- 1882 MANSELL-  
MOULLIN A SUDDEN CHECK TO THE CIRCULATION BROUGHT ABOUT THROUGH THE AGENCY OF THE NERVOUS SYSTEM.
- 1892 ROGER LE CHOC EST UN ÉTAT MORBIDE QUI PEUT SE PRODUIRE À LA SUITE DE FORTES EXCITATIONS DU SYSTÈME NERVEUX ET QUI SE CARACTÉRISE PAR UN ENSEMBLE D'ACTES INHIBITOIRES DONT UN SEUL, L'ARRÊT DES ÉCHANGES ENTRE LE SANG ET LES TISSUS, SEMBLE CONSTANT ET INDISPENSABLE.
- 1905 LOCKHART-  
MUMMERY SURGICAL SHOCK IS A CONDITION PRODUCED BY EXHAUSTION OF THE VASOMOTOR CENTERS, AND THE RESULTING GREAT FALL IN BLOOD PRESSURE.

- 1910 LOCKHART-MUMMERY A CONDITION OF LOWERED BLOOD PRESSURE RESULTING FROM EXHAUSTION OF THE VASOMOTOR CENTERS.
- 1912 GRAY & PARSONS THE REACTION OF THE CENTRAL NERVOUS SYSTEM TO EXAGGERATED OR ABNORMAL AFFERENT IMPULSES.
- 1915 MORRISON & HOOKER A LOW ARTERIAL BLOOD PRESSURE OF SUCH DURATION THAT RECOVERY IS IMPOSSIBLE.
- 1917 BROWN EXHAUSTION OF THE FOOD MATERIAL - THE NISSL GRANULES - STORED IN THE NERVE CELLS, MORE PARTICULARLY THOSE OF THE VASOMOTOR CENTERS.
- 1918 QUENU TOXÉMIE TRAUMATIQUE DÉPRESSIVE.
- 1919 & CANNON EXEMIA.  
1923
- 1926 MEEK A DECREASE IN THE EFFECTIVE CIRCULATORY VOLUME.
- 1936 SCHUBERTH A PERIPHERAL CIRCULATORY INSUFFICIENCY.
- 1937 DAVIS AN ANOXAEMIA WHICH IS THE RESULTANT OF SUCH FACTORS AS - OLEGEMIA, LOWERED BLOOD PRESSURE, DIMINISHED FLOW OF BLOOD, AND PERIPHERAL VASO-CONSTRICTION.
- 1937 TOMB THE COLLAPSE OF THE CIRCULATION FROM OVER-STIMULATION OF THE SYMPATHETIC NERVOUS SYSTEM.
- 1938 GRISWALD A DEFICIENCY IN CIRCULATING BLOOD VOLUME.



DIMINISHED VOLUME FLOW, LOWERED VENOUS PRESSURE, DECREASED OXYGEN CONSUMPTION, ARTERIOLAR VASOCONSTRICTION, ACAPNIA, AND SECONDARY BLOOD PRESSURE FALL; AND PERPETUATED BY A SUMMATION OF THESE FACTORS AND POSSIBLY HYPERPOTASSEMIA, ANOXIA, ACTION OF TISSUE METABOLITES, AND DEFICIENCY OF ADRENAL CORTICAL HORMONE.

CLASSIFICATION: EVEN AT THE PRESENT TIME EFFORTS TO CLASSIFY SHOCK ARE RATHER UNSUCCESSFUL, BUT THE FOLLOWING THREE GROUPS ARE INDICATIVE OF PRESENT OPINION.

(1) DETERMINATION BY ORIGIN, THUS:- TRAUMATIC SHOCK, OPERATIVE SHOCK, OBSTETRICAL SHOCK, MEDICAL SHOCK, BURN SHOCK ETC. THIS IS A PURELY DESCRIPTIVE CLASSIFICATION, AND EVEN IF THESE TYPES OF SHOCK ARE LATER FOUND TO HAVE DISTINCT AETIOLOGIES, SUCH A CLASSIFICATION IS, IN THE LIGHT OF OUR PRESENT KNOWLEDGE, UNJUSTIFIABLE.

(2) DIVISION INTO PRIMARY AND SECONDARY SHOCK. HARKINS DEMONSTRATED IN 1935 THAT THE CHANGES WHICH END IN SECONDARY SHOCK START AT THE POINT WHERE THE PRECIPITATING FACTOR (FOR EXAMPLE, INJURY) OCCURS. THUS, PRIMARY SHOCK MUST BE EITHER A PSEUDO SHOCK STATE, UNASSOCIATED WITH TRUE SHOCK, OR AN UNRECOGNISABLE STAGE IN THE DEVELOPMENT OF TRUE SHOCK. IN THE FORMER INSTANCE THE CONDITION IS PRIMARY, BUT IS NOT SHOCK; AND IN THE LATTER, IT IS SHOCK

BUT IS NOT PRIMARY. THUS THE CLASSIFICATION IS ERONEOUS. IT MUST BE CLEAR, HOWEVER, FROM THIS CLASSIFICATION AND THE COMMENTS UPON IT THAT THE TERM "PRIMARY SHOCK" IS A BAD ONE, AND ITS USE SHOULD BE DISCONTINUED.

(3) BLALOCK'S CLASSIFICATION. THIS HAS PROBABLY MOST TO RECOMMEND IT; IT IS AS FOLLOWS:

A. HAEMATOGENIC TYPE (OLIGEMIC TYPE).

THE MAIN FACTOR IS OLIGEMIA AND THE FALL IN BLOOD PRESSURE IS SECONDARY.

B. NEUROGENIC TYPE.

THIS IS PROBABLY SYNONYMOUS WITH THE COLLAPSE STAGE WHICH IS USUALLY CALLED PRIMARY SHOCK. THE FALL IN BLOOD PRESSURE IS PRIMARY, AND IF THIS BE LONG CONTINUED, MAY OBVIOUSLY RESULT IN OLIGEMIA.

C. VASOGENIC TYPE.

HISTAMINE SHOCK IS TYPICAL OF THIS CLASS. THE PRIMARY FEATURE IS FAILURE OF THE VESSEL ENDOTHELIUM TO PREVENT LOSS OF FLUID FROM THE BLOOD VESSELS INTO THE TISSUES, AND TO MAINTAIN THE BLOOD PRESSURE AT A NORMAN LEVEL.

FROM WHAT HAS BEEN WRITTEN SO FAR, IT WILL BE SEEN THAT OPINION ON THE CAUSE OF SHOCK HAS DEVELOPED THROUGH NERVOUS TOXIC AND ADRENAL HYPOTHESES TO THE PRESENTLY ACCEPTED PHYSICAL THEORY, THIS LAST STANDING UNCHALLENGED AT THE PRESENT TIME, AT LEAST IN SO FAR AS TRAUMATIC SHOCK IS CONCERNED. NOW ALTHOUGH BURNS ARE BUT ONE

FORM OF TRAUMA, (THERMAL) SHOCK IN RELATION TO THIS TYPE OF INJURY HAS LONG BEEN REGARDED AS A SEPARATE PROBLEM. THIS HAS BEEN PARTICULARLY NOTICEABLE SINCE SIMONART'S PAPER IN 1930. THUS FOUR DISTINCT AND SEPARATE THEORIES ARE TO-DAY OFFERED IN EXPLANATION OF BURN SHOCK.

THESE ARE:- TOXIC THEORY  
 PHYSICAL THEORY  
 ADRENAL AND NERVOUS THEORY  
 BACTERIAL THEORY.

IT IS NOW PROPOSED TO DEAL WITH THESE IN TURN, AND TO INDICATE THE PRINCIPAL EVIDENCE FOR AND AGAINST EACH. NO CLAIM IS MADE THAT THE REFERENCES GIVEN ARE EXHAUSTIVE, AS THE TASK OF RECORDING, LET ALONE REVIEWING, THE ENTIRE LITERATURE ON THIS SUBJECT WOULD BE A HERCULEAN ONE, AND AT ANY RATE FAR BEYOND THE SCOPE OF THE PRESENT CHAPTER.

THE BACTERIAL THEORY. ALDRICH AROUSED INTEREST IN THIS THEORY IN 1933. HE HAD FOUND THAT, FOR THE FIRST TWELVE HOURS, BURNS WERE STERILE, BUT THEREAFTER ALL SEVERE BURNS BECAME INFECTED, AND IN ONE HUNDRED PER CENT OF THEM HAEMOLYTIC STREPTOCOCCI COULD BE GROWN FROM REPEATED CULTURES. HE STATED THAT THE CONCENTRATION OF THESE ORGANISMS INCREASED WITH THE TOXICITY OF THE PATIENT, UNTIL WITHIN FORTY-EIGHT TO FIFTY-SIX HOURS PURE CULTURES OF STREPTOCOCCI COULD BE GROWN, THESE ORGANISMS HAVING

OUTSTRIPPED ALL OTHERS. HE ALSO SUGGESTED GENTIAN VIOLET APPLICATIONS TO COMBAT THE BACTERIAL ACTION. CLARK AND CRUICKSHANK (1935) SHOWED THAT INFECTION OF BURNS WAS EXTREMELY COMMON, EVEN WITH TANNIC ACID TREATMENT. ACCORDING TO THESE AUTHORS THE HAEMOLYTIC STREPTOCOCCUS WAS THE MOST FREQUENTLY ENCOUNTERED ORGANISM. THEY CLAIMED THAT THIS WAS THE CAUSE OF THE FEVER AND TOXAEMIA IN THE FIRST FOUR TO FIVE DAYS AFTER BURNING, AND SUGGESTED THAT "DETTOL" COMBINED WITH THE TANNIC ACID AND ANTI-STREPTOCOCCAL SERUM SHOULD BE ADMINISTERED AS A COUNTER MEASURE. CRUICKSHANK (1935) CARRIED OUT DETAILED BACTERIOLOGICAL STUDIES IN BURNS AND CAME TO THE CONCLUSION THAT THE HIGH INCIDENCE OF INFECTION WITH HAEMOLYTIC STREPTOCOCCI WAS THE RESULT OF THE AGGREGATION OF PATIENTS IN WARDS.

MARSH (1935) WITHOUT TROUBLING TO DEMONSTRATE WHETHER BURNS WERE INFECTED BY STAPHYLOCOCCI ADVISED, "EVERY CASE OF SEVERE BURNING SHOULD RECEIVE, INTRA-VENOUSLY, AT THE EARLIEST POSSIBLE MOMENT, AN INJECTION OF STAPHYLOCOCCUS ANTITOXIN AMOUNTING, FOR AN ADULT OF NORMAL SIZE, TO AT LEAST FIVE THOUSAND UNITS." HE FURTHER SUGGESTED THAT PEOPLE WHO WERE, BY NATURE OF THEIR EMPLOYMENT, CONSTANTLY EXPOSED TO THE RISK OF SEVERE BURNS, MIGHT BE TREATED PROPHYLACTICALLY BY STAPHYLOCOCCAL TOXOID INJECTIONS. SUCH A CONTRIBUTION AS THIS LAST NEITHER ADDED TO NOR DETRACTED FROM THE

WORTH OF THE THEORY, BUT IT IS RECORDED TO ILLUSTRATE THAT THE BACTERIAL HYPOTHESIS HAS GAINED SOME POPULARITY AND HAS ARDENT, IF RATHER BLIND, ADHERENTS.

HARKINS (1936) REPORTED THAT OVER A LARGE SERIES OF BURNS WHICH HE HAD INVESTIGATED THE ONLY FATAL CASES WITHIN THE FIRST THREE WEEKS OF ILLNESS RESULTED FROM SEPSIS. THE FIRST WAS A MALE, AGED FORTY-FOUR YEARS, WHO HAD RECEIVED SECOND DEGREE BURNS OF THE LEFT LEG, FACE, THORAX, AND ARMS, AND THIRD DEGREE BURNS OF HANDS AND FOREARMS, DURING A PETROL EXPLOSION. ON THE SEVENTH DAY THE PATIENT DEVELOPED A PYARTHROSIS AND A TEMPERATURE OF 106<sup>0</sup>F. HE DIED, AND THE RESPONSIBLE ORGANISM WAS FOUND TO BE HAEMOLYTIC STREPTOCOCCUS. THE SECOND CASE WAS A CHILD AGED FOUR YEARS, WHO DIED ELEVEN DAYS AFTER A SECOND AND THIRD DEGREE SCALD OF THE ARMS, LEGS, THIGHS, AND TRUNK. THE PATIENT DEVELOPED THROMBOSIS OF THE VEINS OF THE RIGHT ARM, QUINZY, AND A TEMPERATURE OF 104<sup>0</sup>F. AT AUTOPSY A CURLING'S ULCER WAS FOUND. AFTER REPORTING THE TWO CASES IN DETAIL HARKINS COMMENTS, "THESE CASES DEMONSTRATE THAT NOT ONLY MANY OF THE TOXIC MANIFESTATIONS PRESENT AFTER THE FIRST FEW DAYS BUT ALSO SOME OF THE COMPLICATIONS OF BURNS MAY BE EXPLAINED ON THE BASIS OF A SEPTICAEMIA, ALTHOUGH THIS IS NOT CONCLUSIVELY PROVED." HIS CONCLUDING REMARK IS, HOWEVER, MORE IMPORTANT, AND MUST MEET WITH GENERAL APPROVAL, "DEATH FROM TRUE SECONDARY SHOCK AFTER A BURN OCCURS

WITHIN FORTY-EIGHT HOURS, WHICH IS EARLIER THAN INFECTION BECOMES ACTIVE."

THE ADRENAL AND NERVOUS THEORY. THESE TWO ARE HERE TAKEN TOGETHER FOR, ALTHOUGH SEVERAL SEPARATE THEORIES ARE ATTACHED TO THE SUPRARENALS, NO PURELY NERVOUS THEORY HAS BEEN PUT FORWARD FOR THE ORIGIN OF SHOCK IN BURNS. IT WILL BE NOTED THAT THIS IS CONTRARY TO THE STATE OF AFFAIRS IN TRAUMATIC SHOCK IN GENERAL.

THE MEDULLA AND CORTEX OF THE SUPRARENALS HAVE FROM TIME TO TIME BEEN IMPLICATED BOTH SEPARATELY AND TOGETHER. THE EARLIEST RECORD APPEARS TO BE THAT OF BARDEEN (1898). THIS AUTHOR REVIEWED AND CONTRIBUTED TO KNOWLEDGE OF THE PATHOLOGY OF FATAL BURNS BY AN INVESTIGATION INTO FIVE CASES. HE REPORTED THAT THE ADRENALS SHOWED NO PATHOLOGICAL CHANGES. WEISKOTTEN (1917 AND 1919) DISCOVERED ADRENAL CHANGES IN TEN CASES OF FATAL SUPERFICIAL BURNS. THESE FINDINGS WERE CONFIRMED LATER BY MANY WORKERS, E.G. BERKOW, INOUE, LATTES, SALVIOLI, HARTMAN, ROSE, SCHMIDT, AND OLDBRYCHT. RIEHL (1928) WAS OF OPINION THAT, IN SPITE OF THE REPORTED ADRENAL CHANGES, DEFICIENCY OF ADRENALIN PLAYED NO PART IN THE PRODUCTION OF SHOCK. SAITO (1932) EXPRESSED OPPOSITE OPINIONS. HE BELIEVED THAT DEFICIENCY OF ADRENALIN WAS THE MAIN FACTOR AND REPORTED THAT HE HAD PROLONGED THE LIVES OF EXPERIMENTALLY BURNED ANIMALS ( BY TWENTY-SEVEN TO SIXTY-FOUR HOURS OVER

CONTROLS) BY THE INTRAPERITONEAL ADMINISTRATION OF ADRENALINE. BROOKS AND BLALOCK (1934) SHOWED THAT SIMILAR CHANGES IN THE ADRENALS FOLLOWED HAEMORRHAGE AND TRAUMA TO MUSCLE; THUS THEY WERE NOT PECULIAR TO BURNS. FREEMAN (1935), AND FREEMAN, SHAW, AND SNYDER (1936), FROM ALL THESE AND THEIR OWN OBSERVATIONS, PROPOSED A THEORY OF SHOCK WHICH IS IN ESSENCE AS FOLLOWS:-

AN OVERSECRETION OF ADRENALINE TAKES PLACE IN ORDER TO MAINTAIN THE BLOOD PRESSURE AT OR NEAR NORMAL, DESPITE A REDUCED BLOOD VOLUME. IF NOW THE BLOOD VOLUME STILL DECREASES (AND THIS IT TENDS TO DO BECAUSE OF TRANSUDATION THROUGH AN INCOMPETENT CAPILLARY WALL AIDED BY INCREASED ARTERIOLATTONUS) THE ADRENALINE OUTPUT OF THE SUPRARENALS CAN MAINTAIN THE BLOOD PRESSURE AT A NORMAL LEVEL ONLY SO LONG AND THEN IT MUST COLLAPSE.

MANY OTHER WORKERS HAVE INDICATED THE ADRENAL CORTEX AS BEING THE SITE OF INJURY WITH RESULTANT HYPO-FUNCTION AND DEATH. SWINGLE, PFIFFNER, BOTT, VARS, AND PARKINS (1933) AND SWINGLE, DONAHUE, AND PARKINS (1935) SHOWED THAT BILATERAL ADRENALECTOMY CAUSED SHOCK AND DEATH, AND FURTHER THAT SUCH SHOCK IS IN MANY WAYS QUITE SIMILAR TO TRAUMATIC AND SURGICAL SHOCK. SWINGLE, PFIFFNER, BOTT, VARS, AND PARKINS (1933) WERE

SO IMPRESSED BY THE SIMILARITY OF THE TWO CONDITIONS THAT THEY DREW UP A TABLE COMPOSED OF THIRTY-TWO DIFFERENT FACTORS, AND SHOWED THAT IN ONLY TWO RESPECTS DID A DIFFERENCE EXIST (VIDE TABLE 1).

THE SAME AUTHORS ALSO SHOWED THAT THE VARIOUS PHYSIOLOGICAL AND BIOCHEMICAL CHANGES WHICH ACCOMPANIED POST-ADRENALECTOMY SHOCK COULD BE RELIEVED BY THE ADMINISTRATION OF SUFFICIENT DOSES OF ADRENAL CORTICAL EXTRACT.

WILSON, ROWLEY, AND GRAY (1936) APPLIED THESE OBSERVATIONS TO THE TREATMENT OF THREE CASES OF BURN SHOCK, AND REPORTED RECOVERY IN TWO OF THE CASES WHICH THEY BELIEVED WOULD OTHERWISE HAVE DIED. THE WORK IMPLICATING THE ADRENAL CORTEX WAS BITTERLY ATTACKED BY FREEMAN (1933) AND BRITTON AND SILVETTE (1933).

THROUGHOUT THIS LAST SECTION MENTION HAS FREQUENTLY BEEN MADE OF "PATHOLOGICAL CHANGES IN THE ADRENALS." THE READER MAY RIGHTLY FEEL THAT THE EXPRESSION IS VAGUE AND INADEQUATE. SCRUTINY OF THE CITATIONS THEMSELVES, HOWEVER, DOES LITTLE TO CLEAR UP THE MATTER. THE FOLLOWING CHANGES ARE THOSE MOST FREQUENTLY NOTED AND LEAST VAGUELY DESCRIBED.

1. LOSS OF CHROMAFFIN AFFINITY.
2. HAEMORRHAGE (DISSEMINATED AND MASSIVE).
3. FOCAL NECROSIS.
4. DISAPPEARANCE OF LIPOID BODIES.

TABLE I.

CONDITIONS EXISTING IN ADRENAL INSUFFICIENCY (ANIMALS)  
AND TRAUMATIC SHOCK (MAN).

(FROM SWINGLE, PFIFFNER, VARS, BOTT, AND PARKINS (1933)).

1.	BLOOD VOLUME	DECREASED
2.	BLOOD PRESSURE	DECREASED
3.	HEMOGLOBIN	INCREASED
4.	HEMATOCRIT	INCREASED
5.	RED CELL COUNT	INCREASED
6.	VENOUR PRESSURE	DECREASED
7.	RATE BLOOD FLOW	DECREASED
8.	BLOOD VISCOSITY	INCREASED
9.	HEMOCONCENTRATION	INCREASED
10.	CARDIAC OUTPUT	DECREASED
11.	VENOUR RETURN TO RIGHT HEART	DECREASED
12.	HEART RATE	INCREASED
13.	HEART CONDITION	NORMAL APPARENTLY
14.	WEAK, FAST PULSE	PRESENT
15.	VASOCONSTRICTION	PRESENT
16.	ABILITY TO DILUTE	LACKING
17.	BLOOD NONPROTEIN NITROGEN AND UREA	INCREASED
18.	ALKALI RESERVE	DECREASED
19.	BASAL METABOLISM	DECREASED
20.	BLOOD SUGAR	DECREASED IN ADRENAL INSUFFICIENCY NORMAL OR SLIGHTLY ABOVE IN TRAUMATIC SHOCK
21.	BODY TEMPERATURE	DECREASED
22.	USE VASOCONSTRICTOR DRUGS	INEFFECTIVE
23.	EFFECT FORCING FLUIDS	BENEFICIAL
24.	VASOMOTOR CENTER	NORMAL APPARENTLY
25.	SENSITIVITY TO PAINFUL STIMULI	DECREASED
26.	SENSITIVITY TO COLD	INCREASED
27.	SENSITIVITY TO ANAESTHETICS	INCREASED
28.	SENSITIVITY TO HISTAMINE	INCREASED IN ADRENAL INSUFFICIENCY, ACTION UNKNOWN IN SHOCK
29.	SENSITIVITY TO INFECTIONS AND TOXINS	INCREASED
30.	URINE VOLUME	DECREASED
31.	SENSITIVITY TO HAEMORRHAGE	INCREASED
32.	SENSITIVITY TO TRAUMA AND OPERATIONS	INCREASED

THE PHYSICAL THEORY. ALTHOUGH SHORT SUGGESTED IN 1913

THAT SHOCK WAS DUE TO OLIGEMIA INDUCED BY:-

(A) LOCAL FLUID LOSS INTO THE DAMAGED TISSUES,

(B) FLUID LOSS FROM THE CAPILLARIES ALL OVER

THE BODY AS A RESULT OF GENERAL REFLEX VASOCONSTRICTION,

IT WAS LEFT TO UNDERHILL ET AL. (1923-1930) TO DRAW

ATTENTION TO THE VERY GREAT LOCAL LOSS OF FLUID IN

SEVERE BURNS. UNDERHILL AND HIS COLLEAGUES CONDUCTED

A SERIES OF EXPERIMENTS AND AFTER EXPERIMENTALLY

BURNING ANIMALS, SHOWED THAT THE OEDEMA WAS MAXIMAL

AT THE SITE OF THE BURN IN TWENTY-FOUR HOURS, AND

WAS SLOWLY REABSORBED OVER A PERIOD OF FIVE OR SIX

DAYS. THEIR ANALYSIS OF THE FLUID SHOWED IT TO BE

SIMILAR TO PLASMA. THESE WORKERS ALSO MEASURED THE

AMOUNT OF OEDEMA FLUID BY SQUEEZING IT OUT OF THE

ANASARCOUS TISSUES, AND FOUND IT, IN SOME CASES,

TO BE EQUAL TO SEVENTY PER CENT OF THE TOTAL BLOOD

VOLUME. IT IS HARDLY NECESSARY TO POINT OUT THAT

THIS OEDEMA FLUID IS NOT SIMPLY A WATERY TRANSUDATE

BUT REPRESENTS WHAT HARKINS CALLS "WHITE HAEMORRHAGE."

THIS AUTHOR COMMENTS, "A PERSON MAY EXCRETE THREE

LITRES OF URINE PER DAY, BUT CANNOT STAND THE LOSS

OF THAT AMOUNT OF BLOOD IN THE SAME TIME." THE

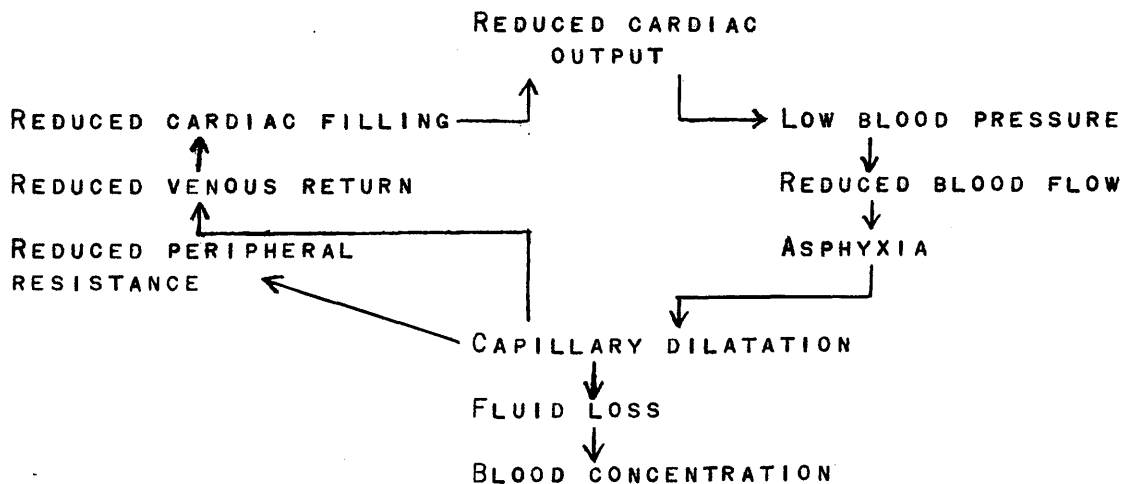
INFERENCE IS SO OBVIOUS THAT NO ELABORATION IS

REQUIRED.

BLALOCK (1931) ESTIMATED THE QUANTITY OF FLUID

LOST IN SUCH CASES BY BURNING ONE SIDE OF AN ANIMAL, BISECTING IT, AND WEIGHING THE TWO SIDES. USING DOGS AS EXPERIMENTAL ANIMALS, HE FOUND THE FLUID AVERAGED 3.34 PER CENT OF THE ANIMALS' BODY WEIGHT. BEARD AND BLALOCK (1931) SHOWED THAT THE OEDEMA FLUID IN THESE EXPERIMENTS WAS VERY SIMILAR TO PLASMA. BLALOCK (1931) ALSO FOUND THAT IN PLASMAPHERESIS EXPERIMENTS THE ANIMALS DIED IF PLASMA TO THE QUANTITY OF 3.5 PER CENT OF THEIR BODY WEIGHT WAS REMOVED. THUS HE CONCLUDED THAT IN THESE BURNS THE ANIMALS' DEATHS COULD BE ACCOUNTED FOR BY FLUID LOSS ALONE, WITHOUT INTRODUCING BACTERIAL, ADRENAL, OR TOXIC THEORIES.

JOHNSON AND BLALOCK (1931) DEMONSTRATED THAT AFTER BURNS THE OUTPUT OF THE HEART WAS GREATLY REDUCED. IT IS FITTING, AT THIS POINT, TO RECORD MCDOWALL'S VIEWS, ALTHOUGH IT REQUIRES JUMPING TO 1940 FOR THE MOMENT. IN HIS REVIEW OF THE LITERATURE OF SHOCK MCDOWALL ILLUSTRATES WHAT HE CALLS "THE DEATH CYCLE" AS FOLLOWS:-



HARKINS (1934 - 1938) IN A SERIES OF PAPERS CONFIRMED BLALOCK'S FINDINGS AND CONTRIBUTED FURTHER INFORMATION. BY REPEATING BISECTION EXPERIMENTS, AND USING A TIPPING APPARATUS COUPLED TO A KYMOGRAPH, HE SUCCEEDED IN PRODUCING TIME CURVES OF THE FLUID COLLECTION IN THE BURNED AREAS. HE SHOWED THAT THE WEIGHT SHIFT BEGAN AT THE TIME OF THE BURN, AND CONTINUED IN THE FORM OF A DECELERATING CURVE, UNTIL DEATH. HE CONTINUES, "AFTER MOST OF THE FLUID HAD ACCUMULATED, THE FALL IN BLOOD PRESSURE SET IN, AND CONTINUED RAPIDLY UNTIL DEATH OCCURRED IN A STATE OF SECONDARY SHOCK." HE ALSO POINTED OUT THAT WITH THE COLLECTION OF FLUID THE HAEMOGLOBIN AND HAEMATOCRIT READINGS OF THE ANIMALS' BLOOD ROSE, AND THAT THE BLEEDING VOLUME OF THE BURNED ANIMALS WAS MARKEDLY REDUCED. HARKINS AND HARMON (1937) COLLECTED AND COMPARED DATA ON PLASMA LOSS IN TEN DIFFERENT CONDITIONS. THEIR CONCLUSIONS WERE AS FOLLOWS:-

(1) "PLASMA-LIKE FLUID IS LOST FROM THE BLOOD STREAM IN A VARIETY OF CONDITIONS. THESE INCLUDE BURNS, FREEZING, BILE PERITONITIS, TISSUE AUTOLYSIS IN VIVO, ACUTE PANCREATITIS, PNEUMONIA AND PULMONARY OEDEMA, INTESTINAL MANIPULATION, PORTAL AND MESENTERIC OBSTRUCTION, EXTERNALLY STRANGULATED COLOSTOMY LOOPS, AND RELEASE OF A CONSTRICTOR OF AN EXTREMITY.

(2) THE TYPES OF TRAUMA WHICH PRODUCE THESE CONDITIONS CAN BE ROUGHLY DIVIDED INTO (A) THERMAL TRAUMA, (B) CHEMICAL AND BACTERIAL TRAUMA, (C) MILD CONTINUED MECHANICAL TRAUMA, (D) CAPILLARY INJURY DUE TO INADEQUATE CIRCULATION.

(3) THE AMOUNT OF PLASMA-LIKE FLUID LOST IN THESE CONDITIONS APPROACHES THAT WHICH, WHEN REMOVED EXPERIMENTALLY IN PLASMAPHERESIS EXPERIMENTS, WILL PRODUCE DEATH. EVEN IN CASES WHERE THE AMOUNT OF FLUID LOST IS NOT SUFFICIENT TO CAUSE DEATH, IT IS OFTEN OF SUFFICIENT IMPORTANCE TO BE RECOGNISED."

THE MORE IMPORTANT AND INTERESTING OF THE FIGURES UPON WHICH THESE CONCLUSIONS ARE BASED, ARE REPRODUCED IN TABULAR FORM AS BELOW (VIDE TABLES 2,3,& 4).

TABLE 2.CONDITIONS IN WHICH OLIGEMIC SHOCK MAY OCCUR.

1. HAEMORRHAGE - TO OUTSIDE, INTO TISSUES, INTO BODY CAVITIES.
  2. MECHANICAL TRAUMA - OPERATIVE, ACCIDENTAL, TRAUMA TO INTESTINES.
  3. THERMAL TRAUMA - BURNS, FREEZING, PERITONEAL COOLING.
  4. ASPHYXIAL TRAUMA - MESENTERIC VASCULAR OCCLUSION, INTESTINAL STRANGULATION, TOURNIQUET, HEAT STROKE.
  5. ACTINIC TRAUMA - RADIATION BURNS, SUNBURN.
  6. CHEMICAL TRAUMA - BILE PERITONITIS, PERFORATED PEPTIC ULCER, ACUTE PANCREATITIS, WAR GAS POISONING.
  7. TRAUMA DUE TO SPECIFIC OR NON-SPECIFIC POISONS - MERCURIC CHLORIDE, ARSENICALS, GOLD CHLORIDE, SNAKE VENOM.
  8. SPECIAL CAPILLARY POISONS - TISSUE AUTOLYSIS, HISTAMINE, ANAPHYLAXIS, PEPTONE.
  9. MEDICAL CONDITIONS - DIABETIC COMA, ECLAMPSIA.
  10. INFECTIONS - CHOLERA, PNEUMONIA (ESPECIALLY INFLUENZAL AND STREPTOCOCCAL), GAS GANGRENE, DIPHTHERIA, PERITONITIS.
  11. HYPERVENTILATION.
  12. SPINAL ANAESTHESIA.
-

TABLE 3.

FLUID	SUGAR	NACL. MG PER 100 C.C.	NONPROTEIN NITROGEN	PROTEIN GM PER 100 C.C.
1. BURNS	134	686	66	7.6
2. FREEZING	67	697	50	3.6
3. BILE PERITONITIS	60	516	32	4.3
4. TISSUE AUTOLYSIS IN VIVO	83	565	71	7.6
5. ACUTE PANCREA- TITIS	No DATA	No DATA	No DATA	No DATA
6. PNEUMONIA AND PULMONARY OEDEMA	No DATA	631	No DATA	No DATA
7. INTESTINAL MANIPULATION	221	616	61	6.2
8. MESENTERIC OBSTRUCTIONS	215	577	36	3.0
9. EXTERNALLY STRANG- ULATED COLOSTOMY LOOPS	137	689	21	4.5
10. RELEASE OF A CONSTRUCTOR OF AN EXTREMITY	No DATA	619	47	4.4
AVERAGE	131	622	48	5.2

## CONTROL VALUES FOR BLOOD PLASMA:-

SUGAR, 104; NACL, 676; NONPROTEIN NITROGEN, 54 MG. PER 100 C.C.  
PROTEIN, 4.2 GM. PER 100 C.C.

TABLE 4.

BLEEDING VOLUME IN VARIOUS CONDITIONS IN WHICH PLASMA  
HAEMORRHAGE OCCURS. HARKINS AND HARMON (1937).

CONDITION	BLEEDING VOLUME PER CENT BODY WEIGHT.
1. BURNS	1.6
2. FREEZING	2.0
3. BILE PERITONITIS	1.8
4. TISSUE AUTOLYSIS IN VIVO	2.2
5. ACUTE PANCREATITIS	NO DATA
6. PNEUMONIA AND PULMONARY OEDEMA	NO DATA
7. INTESTINAL MANIPULATION	1.4
8. MESENTERIC OBSTRUCTION	NO DATA
9. EXTERNALLY STRANGULATED COLOSTOMY LOOPS	NO DATA
10. RELEASE OF A CONSTRICTOR OF AN EXTREMITY	NO DATA
AVERAGE	1.8

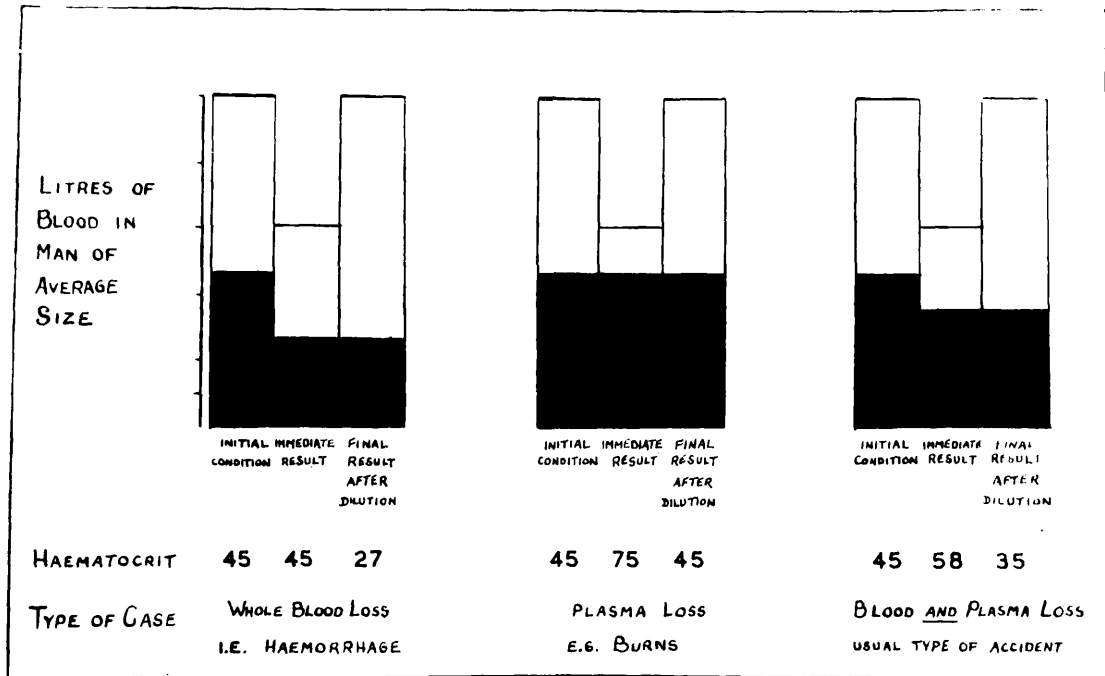
LAMBRET, DREISSENS, AND CORNILOT (1937) CONDUCTED A SERIES OF EXPERIMENTS, WITH COMPARABLE RESULTS, AND THEY, LIKE MANY OTHERS, BASE THEIR TREATMENT ON THE PRINCIPAL OF REPLACING THE PLASMA LOST TO THE CIRCULATION .



MOST OF THIS WORK IS OBVIOUSLY EXPERIMENTAL, BUT Mc IVOR (1933) SHOWED THAT THE BLISTER FLUID FROM BURNED HUMAN BEINGS WAS SIMILAR TO PLASMA, AND THAT THE HAEMOGLOBIN READING OF THE BLOOD FROM THESE PATIENTS WAS CONSIDERABLY INCREASED. WEINER, ROWLETTE, AND ELMAN (1936) POINTED OUT THAT LOSS OF FLUID BY PLASMA TRANSUDATION (E.G. BURNS) DECREASED, WHEREAS LOSS OF FLUID BY VOMITING ETC. INCREASED, THE BLOOD PROTEINS.

HAEMOCONCENTRATION. IT HAS BEEN ALREADY POINTED OUT THAT HAEMOCONCENTRATION IS AN ACCOMPANIMENT OF SHOCK IN GENERAL, AND IS NOT PECULIAR TO SHOCK ASSOCIATED WITH BURNS; NEVERTHELESS IT IS SO REGULARLY FOUND IN THIS LATTER CONDITION THAT IT HAS BEEN USED BY SOME WORKERS AS AN INDEX OF THE DEGREE OF SHOCK. FOR THIS REASON, AND IN SPITE OF THE FACT THAT IT FORMS AN ESSENTIAL PART OF THE PHYSICAL THEORY, IT DESERVES A LITTLE SECTION TO ITSELF.

EARLY INVESTIGATORS TO REPORT INCREASED BLOOD CONCENTRATION INCLUDED BARADUC (1862), TAPPEINER (1881), HOCK (1893), AND LOCKE (1905). THE LAST REPORTED A RED BLOOD CORPUSCLE COUNT OF OVER NINE MILLIONS PER CUBIC

FIGURE 1.



 = PLASMA  
 = CELLS

TO ILLUSTRATE THE FALLACY OF USING HAEMOCONCENTRATION  
 AS AN INDEX TO TREATMENT OF SHOCK ASSOCIATED WITH  
 VARIOUS CONDITIONS.

MILLIMETER IN FOUR OF TEN CASES ADMITTED TO THE MASSACHUSETTS HOSPITAL. PFEIFFER (1905) ALSO REPORTED HAEMOCONCENTRATION. UNDERHILL, CARRINGTON, KAPSINOW, AND PACK (1923) REPORTED ON TWENTY-ONE PATIENTS BURNED IN A THEATRE FIRE, AND RECORDED HAEMOGLOBIN CONCENTRATIONS OF ONE HUNDRED AND SEVENTEEN TO TWO HUNDRED AND NINE PER CENT OF NORMAL.

McIVOR (1933), SHIMADA (1934), DOUGLAS (1934), WEINER, ROWLETTE, AND ELMAN (1936), LAMBRET, DREISSENS AND CORNILOT (1937), LAMBRET AND DREISSENS (1937), ALSO REPORTED INSTANCES OF HAEMOCONCENTRATION IN SEVERELY BURNED PATIENTS. SIMONART (1928), BLALOCK ET AL. (1931), AND HARKINS (1934 AND 1936), DREW ATTENTION TO THE OCCURRENCE OF SIMILAR HAEMOCONCENTRATION IN EXPERIMENTALLY BURNED ANIMALS. IN ADDITION TO ITS USE AS A METER FOR SHOCK, HAEMOCONCENTRATION HAS BEEN USED BY SOME AS THE GUIDE TO TREATMENT BY FLUID REPLACEMENT. FIG. 1. SHOULD BE CONSULTED AS IT INDICATES THE FALLACY OF SUCH A PROCEDURE. (ILLUSTRATION).

THE TOXIC THEORY. FROM THE EARLIEST DAYS OF INTEREST IN SHOCK ASSOCIATED WITH BURNS, THE TOXIC THEORY HAS BEEN ONE OF THE FOREMOST EXPLANATIONS FOR ITS CAUSE. UPWARDS OF ONE HUNDRED POISONS HAVE BEEN NAMED FROM TIME TO TIME - MANY OF THEM QUITE EMPIRICALLY. INDEED THE NUMBER OF SUBSTANCES INDICTED IS THE MAIN ARGUMENT AGAINST THE ACCEPTANCE OF THIS THEORY.

AS LONG AGO AS 1868 WETHEIM EXPRESSED THE VIEW THAT DEATH IN BURNS WAS DUE TO A CIRCULATING POISON. PONFICK (1876) STATED SIMILAR VIEWS, BUT NEITHER OF THESE AUTHORS SPECULATED ON THE NATURE OF THE POISONOUS SUBSTANCE. IN 1880, HOWEVER, LESSER CLAIMED THAT RED BLOOD CORPUSCLES, IN PASSING THROUGH THE BURNED AREA, WERE ALTERED IN SUCH A WAY AS TO MAKE THEM FOREIGN TO THE ORGANISM; THIS HE CALLED FUNCTIONAL ANAEMIA. CATTIANO (1882) PUT FORWARD THE THEORY THAT AMMONIUM FORMATE IN THE SWEAT LIBERATED HYDROCYANIC ACID, WHICH WAS ABSORBED FROM THE BURNED AREA AND THEN PRODUCED ITS POISONOUS EFFECTS. PARASCANDOLO (1904) MADE A STUDY OF EXPERIMENTALLY BURNED RABBITS AND CONCLUDED THAT DEATH WAS DUE TO THE ACTION OF A CIRCULATING POISON ON THE LIVER AND KIDNEYS WHICH, HE CLAIMED, WERE THE SEAT OF FATTY DEGENERATION. HE FURTHER REPORTED THAT THE BLOOD FROM THESE ANIMALS PROVED TOXIC WHEN INJECTED INTO OTHER HEALTHY RABBITS. PFEIFFER (1905) WROTE AN EXTENSIVE MONOGRAPH ON EXPERIMENTS PERFORMED ON GUINEA PIGS AND RABBITS. HE REPORTED THAT DEATH WITHIN THE FIRST SIX HOURS WAS DUE TO "SHOCK," WHILE SUBSEQUENTLY IT WAS CAUSED BY THE DECOMPOSITION PRODUCTS OF BURNED PROTEIN WHICH HE CLAIMED HE HAD ISOLATED.

ROBERTSON AND BOYD (1923) PUBLISHED A PAPER WHICH STARTED WIDE POLEMICS. THEY HAD PRODUCED EXPERIMENTAL BURNS IN SKIN, SUBCUTANEOUS TISSUE, AND MUSCLE, AND

REPORTED FINDING A BURN TOXIN WHICH WAS PRESENT IN WHOLE BLOOD AND CELLS, BUT NOT IN THE SERUM. THEY CLAIMED, THEREFORE THAT THE TOXIN WAS ADSORBED ON THE CELLS. THEY FOUND THAT ALCOHOLIC EXTRACTS OF BURNED SKIN PRODUCED TOXIC SYMPTOMS WHEN ADMINISTERED TO HEALTHY ANIMALS BY INTRAPERITONEAL OR INTRAVENOUS INJECTION. NOT ONLY DID THE SYMPTOMS PRODUCED CLOSELY RESEMBLE THE CONDITION OF BURNED ANIMALS, BUT "THE AUTOPSY FINDINGS IN THE FATAL CASES WERE IDENTICAL WITH THOSE SEEN IN BURNED ANIMALS."

THESE SYMPTOMS DID NOT FOLLOW THE ADMINISTRATION OF EXTRACTS OF NORMAL SKIN, OR OF SKIN WHICH HAD BEEN BURNED AFTER ITS REMOVAL FROM THE DONOR ANIMAL. THE SUMMARY TO THEIR PAPER WAS AS FOLLOWS:-

1. " DEATH FROM BURNING OCCURRING WITHIN THE FIRST TWENTY-FOUR HOURS IS PRACTICALLY ALWAYS DUE TO PRIMARY SHOCK. LATER THAN THIS IT IS DUE TO TOXIC SHOCK.
2. THERE IS A TOXIN PRODUCED IN BURNED TISSUE, IN LARGER QUANTITIES IN SKIN BURNS, WHICH CIRCULATES IN THE BLOOD, EITHER IN, OR ADSORBED ON, THE RED BLOOD CORPUSCLES, AND WHICH CAUSES THE SYMPTOMS SEEN IN BAD SUPERFICIAL BURNS, AND IN SOME CASES DEATH.
3. EXTRACTS OF BURNED SKIN ARE TOXIC. EXTRACTS OF SKIN BURNED POST MORTEM ARE INNOCUOUS.
4. THERE IS INCREASED PROTEIN CATABOLISM IN BURNS AS EVIDENCED BY THE INCREASE IN THE NON-PROTEIN NITROGEN AND

UREA NITROGEN OF THE BLOOD.

5. THE CONTENTS OF BURN BLISTERS ARE NOT TOXIC.

6. WHOLE CITRATED BLOOD FROM BURNED CASES IS TOXIC.

THE BLOOD SERUM IS NOT TOXIC. SOLUTIONS OF THE CORPUSCLES ARE MORE TOXIC THAN IS WHOLE BLOOD.

7. THE TOXIC SUBSTANCE CONSISTS OF TWO PORTIONS, ONE OF WHICH IS THERMOSTABLE, DIFFUSIBLE, AND NEUROTOXIC; THE OTHER IS THERMOLABILE, COLLOIDAL, AND NECROTOXIC. CHEMICALLY THE TOXIN CONSISTS OF PRIMARY AND SECONDARY PROTEOSES.

8. NO EVIDENCE OF THE PRODUCTION OF ANTIBODIES AGAINST THE BURN TOXIN COULD BE FOUND."

FROM THESE FINDINGS THEY ARGUED THAT THE PROPER TREATMENT OF BURNS WAS REPLACEMENT TRANSFUSION, AND CONCLUDED:- "FROM A PURELY CLINICAL POINT OF VIEW THERE SEEMS TO BE NO DOUBT THAT THE BURNED TISSUES ARE RESPONSIBLE FOR THE PRODUCTION OF SOME TOXIN WHICH IS TAKEN UP BY THE BLOOD STREAM."

RAVDIN AND FERGUSON (1925) AND DAVIDSON (1925 AND 1927) SUPPORTED THE TOXIC THEORY, AND THE LAST'S INTRODUCTION OF TANNIC ACID THERAPY WAS BASED ON THIS CONCEPT. UNDERHILL, KAPSINOW, AND FISK (1930) SHOWED THAT THE ABSORPTION, FROM BURNED AREAS, OF SUCH SUBSTANCES AS STRYCHNINE AND PHENOLSULPHONEPHTHALEIN WAS GREATLY DELAYED. THIS THEY BELIEVED TO BE EVIDENCE OF UNIDIRECTIONAL INCREASED CAPELLARY PERMEABILITY. SIMONART (1930)

REPEATED MANY OF THE EARLIER EXPERIMENTS AND REPORTED THAT HE COULD FIND NO EVIDENCE OF TOXIC ACTION.

HARRISON AND BLALOCK (1932) ALSO REPEATED A NUMBER OF THE EXPERIMENTS WHICH HAD BEEN SAID TO FAVOUR THE TOXIC THEORY. THEIR FINDINGS, HOWEVER, WERE AGAINST THE ACCEPTANCE OF SUCH A HYPOTHESIS; THUS -

1. THE TRANSPLANTATION OF SKIN FROM BURNED TO NORMAL ANIMALS HAD NO EFFECT ON THE RECIPIENTS.
2. THE EFFECT OF DEBRIDEMENT ON THE SURVIVAL OF BURNED DOGS WAS DELETERIOUS ( AN AVERAGE OF  $7\frac{1}{2}$  AGAINST  $17\frac{1}{2}$  HOURS).
3. THE TRANSFUSION OF BLOOD FROM BURNED INTO NORMAL ANIMALS WAS WITHOUT EFFECT.

INOUE (1933) REPORTED HIS POST-MORTEM FINDINGS IN THREE CASES OF BURNS. HE WAS OF OPINION THAT THE CHANGES IN THE ADRENALS, VIZ: DISAPPEARANCE OF LIPOID BODIES, LOSS OF CHROMAFFIN AFFINITY, HAEMORRHAGE, AND FOCAL NECROSIS WERE THE SAME AS THOSE PRODUCED BY POISONING WITH PICROTOXIN, STRYCHNINE, AND BARIUM CHLORIDE. HE CITED PFEIFFER (1905) AS HAVING ATTRIBUTED THOSE CHANGES IN THE SUPRARENALS TO THE LOW BLOOD PRESSURE WHICH HAD RESULTED FROM THE STATE OF SHOCK. HE QUOTED KOLISKO, NAKATA, AND NIEMEYER AS STATING THAT A TOXIN PRODUCED THE ADRENAL CHANGES AND THAT ADRENAL INSUFFICIENCY KILLED THE ANIMAL. HE FURTHER QUOTED TAKEUCHI AS CLAIMING THAT THE SUPRARENAL CHANGES WERE SIMPLY PART OF THE GENERAL PATHOLOGY, BUT NOT THE CAUSE OF DEATH.

INOUE SUPPORTED TAKEUCHI'S VIEWS, BUT BELIEVED THAT THE ADRENAL CHANGES WERE A MAJOR FACTOR IN CAUSING DEATH. FENDER (1933) REVIEWED MUCH OF THE EARLY WORK IN SUPPORT OF THE TOXIC THEORY. HE SHOWED THAT MANY OF THE EXPERIMENTS WERE OPEN TO QUESTION MAINLY ON THE GROUNDS THAT THEY WERE BADLY CONTROLLED. THE VIEW THAT HIS WORK DISPROVED THE TOXIC THEORY IS SHARED BY MANY, ALTHOUGH FENDER'S OWN CONCLUSIONS ARE MUCH MORE CONSERVATIVE. "THE THEORY OF CAUSATION OF DEATH BY A TOXIN CANNOT BE SAID TO REST UPON ADEQUATE EXPERIMENTAL WORK AT PRESENT."

MIURA (1934) PERFUSED THE HIND LIMBS OF BURNED RABBITS AND FOUND A SUBSTANCE WHICH WAS TOXIC WHEN INJECTED INTO HEALTHY ANIMALS.

NAGAMITU (1933 AND 1935) SHOWED THAT, IF THE BURNED LIMBS OF AN EXPERIMENTAL ANIMAL WERE PERFUSED BY SERUM OR SALINE AND THIS FLUID THEN TESTED ON CAT BLOOD PRESSURE OR GUINEA PIG UTERUS, IT CONTAINED A HISTAMINE-LIKE DEPRESSOR SUBSTANCE. HE ALSO FOUND THAT THIS DEPRESSOR ACTION COULD NOT BE ABOLISHED BY HISTAMINASE. SHIMADA (1934) BELIEVED THAT THE TOXIN WAS HISTOTOXIN WHICH COULD BE DISTINGUISHED FROM HISTAMINE BY ITS ACTION ON TOAD KIDNEY. HARKINS, WILSON, AND STEWART (1935) PRESENTED RESULTS WHICH THEY CLAIMED WERE AGAINST A TOXIC THEORY. THEY PRODUCED EXPERIMENTAL SKIN BURNS IN RABBITS AND USING

TRICHLORACETIC ACID PREPARED PROTEIN-FREE EXTRACTS OF THIS AND NORMAL SKIN. THE EXTRACT OF NORMAL SKIN CONTAINED A DEPRESSOR SUBSTANCE WHICH WAS NOT ACETYLCHOLINE, ADENOSINE, HISTAMINE, OR THE "P SUBSTANCE" OF EULER AND GADDUM (1931). THAT FROM BURNED SKIN WAS SHOWN TO CONTAIN AN IDENTICAL SUBSTANCE FOR PERIODS UP TO FORTY-EIGHT HOURS AFTER BURNING. THIS LATTER EXTRACT, HOWEVER, DID NOT HAVE A MORE DEPRESSING, AND FREQUENTLY HAD A LESS DEPRESSING, EFFECT. IT IS DIFFICULT TO UNDERSTAND WHY THIS SHOULD HAVE BEEN CONSIDERED, EVEN BY THE AUTHORS THEMSELVES, EVIDENCE AGAINST A TOXIC THEORY, AS ALL THAT CAN BE SAID IS THAT THESE WORKERS FAILED TO FIND ANY UNUSUALLY TOXIC SUBSTANCE IN PROTEIN-FREE EXTRACT OF BURNED SKIN, PREPARED BY TRICHLORACETIC ACID. IT FURTHER APPEARS TO THE PRESENT WRITER THAT THE DIMINISHED TOXICITY OF THE BURNED SKIN EXTRACTS IS EXPLAINED BY THE DILUTION WHICH MUST HAVE OCCURRED DUE TO OEDEMA FLUID. ISHIZAWA (1935) PRESENTED A PAPER WHICH, LIKE THE PRESENT ONE, DIRECTED ATTENTION TO THE BLOOD CORPUSCLES. HE CLAIMED, FROM EXPERIMENTAL WORK DONE ON RABBITS, THAT HAEMOLYSIS OF ERYTHROCYTES AT THE SITE OF A BURN GAVE RISE TO A TOXIC SUBSTANCE WHICH WAS THE CAUSE OF EARLY DEATH IN BURNED ANIMALS. AFTER BURNING AN ANIMAL HE WITHDREW SPECIMENS OF BLOOD EVERY FIFTEEN MINUTES AND ESTIMATED THE DEGREE OF HAEMOCONCENTRATION AND THE AMOUNT OF HAEMOGLOBIN IN THE

PLASMA. HE APPEARS TO HAVE DRAWN HIS CONCLUSIONS RATHER CARELESSLY BECAUSE:-

1. HAEMOGLOBIN WAS FOUND IN THE PLASMA ONLY IN THE FIRST SAMPLE, EXCEPT IN THE CASES OF FOUR ANIMALS WHERE IT WAS PRESENT UP TO ONE HOUR AFTER BURNING.
2. ALL FOUR OF THESE ANIMALS RECOVERED, WHILE THE REMAINDER DIED WITHIN SIXTY HOURS OF BURNING.
3. THE BLOOD SHOWED INCREASING CONCENTRATION LONG AFTER HAEMOGLOBIN HAD DISAPPEARED FROM THE PLASMA.

MASON, PAXTON, AND SHOEMAKER (1936) CARRIED OUT EXPERIMENTS VERY SIMILAR TO THOSE OF UNDERHILL, KAPSINOW, AND FISK (1930) WHICH HAVE ALREADY BEEN REPORTED. THEY (MASON, PAXTON, AND SHOEMAKER) INJECTED A SOLUTION OF SODIUM IODIDE INTO THE SUBCUTANEOUS TISSUE OF A BURNED AREA SIX HOURS AFTER BURNING AND SHOWED THAT THE SAME AMOUNT OF SODIUM IODIDE WAS EXCRETED IN THE URINE OF THESE AND CONTROL ANIMALS. THEY THEMSELVES HASTENED TO POINT OUT THAT THE ONLY ESSENTIAL DIFFERENCE BETWEEN THEIR OWN AND UNDERHILL'S EXPERIMENTS WAS THE USE OF A SUBSTANCE OF LOW MOLECULAR WEIGHT, VIZ. SODIUM IODIDE, COMPARED WITH THE LATTER'S STRYCHNINE AND PHENOL-SULPHONEPHTHALEIN. BARSOUN AND GADDUM (1936) REPORTED THE RESULTS OF THEIR RESEARCHES INTO THE CONCENTRATION OF HISTAMINE IN THE BLOOD FOLLOWING BURNS. THEY SHOWED THAT THIS ROSE STEADILY, REACHING A MAXIMUM ON THE FIFTH OR SEVENTH DAY AFTER THE BURN, AND OFFERED AS AN

EXPLANATION PROGRESSIVE INTERFERENCE WITH THE HISTAMINE EXCRETING ORGANS, E.G. THE KIDNEYS. THEY POINTED OUT THAT THE PEAK WAS REACHED AFTER THE TIME OF "SECONDARY" SHOCK, BUT THE REASON FOR THEIR ATTRIBUTING THIS TO THE FACT THAT THE PATIENTS WERE EGYPTIANS IS TOO SUBTLE FOR THE PRESENT WRITER. IN THEIR CONCLUSIONS, HOWEVER, THEY STATED :- "THE RELATION OF THIS RISE IN BLOOD HISTAMINE TO SECONDARY SHOCK IS UNCERTAIN. THERE IS NO CLEAR EVIDENCE OF ANY CORRELATION BETWEEN THE BLOOD HISTAMINE AND THE CLINICAL CONDITION OF THE PATIENT."

WILSON, JEFFRY, ROXBURGH, AND STEWART (1937) PREPARED EXTRACTS OF BURNED SKIN WHICH WERE NOT PROTEIN-FREE, AND THESE, THEY SHOWED, DID POSSESS TOXIC ACTION QUITE DISTINCT FROM THE ACTION OF THE PROTEIN-FREE EXTRACTS OF HARKINS, WILSON, AND STEWART (1935). THEY ALSO DEMONSTRATED THAT THE OEDEMA FLUID OBTAINED FROM A BURNED AREA ACQUIRED TOXIC PROPERTIES; THUS FORTY-EIGHT HOURS AFTER THE BURN IT WAS LETHAL TO HEALTHY ANIMALS. THEY BELIEVED THAT THIS ACQUISITION OF TOXICITY WAS INDEPENDENT OF BACTERIAL ACTION, AND THAT IT WAS PROBABLY RELATED TO AUTOLYSIS OF THE BURNED TISSUE. IT WAS CLAIMED THAT THE TOXIN WAS COMBINED WITH THE GLOBULIN FRACTION OF THE PROTEINS PRESENT AND THAT IT PRODUCED NECROSIS OF THE LIVER CELLS TOGETHER WITH A DISTURBANCE OF THE CENTRAL NERVOUS AND CIRCULATORY SYSTEMS. THESE AUTHORS WERE OF THE OPINION THAT IT WAS UNNECESSARY TO

CONSIDER AS IMPORTANT SUCH FACTORS AS HAEMOCONCENTRATION, EARLY INFECTION, AND CHANGES IN THE BLOOD CHEMISTRY.

THE SUBJECT OF BURNS WAS VERY FULLY DISCUSSED AT A SESSION OF THE FRENCH SURGICAL CONGRESS IN 1937. ALL THOSE PRESENT APPEAR TO HAVE FAVOURED THE TOXIC THEORY; THUS,

DUVAL:- BELIEVED AUTOLYSING TISSUE ACTED AS A TOXIN AND THAT, AT LEAST IN EXPERIMENTAL ANIMALS, REPEATED BURNS RESULTED IN A STATE OF SENSITIZATION WHICH CONFERRED A DEGREE OF IMMUNITY TO BURNS.

MOURGE-MOLINES:- ACCEPTED THE TOXIC THEORY AND ADVOCATED THE USE OF SILVER NITRATE AND TANNIC ACID IN THE TREATMENT OF BURNS.

MCCLURE (DETROIT):- AGREED CONCERNING THE USE OF TANNIC ACID.

RIEHL (VIENNA):- SUPPORTED THE TOXIC THEORY AND ADVISED BLOOD TRANSFUSION AND TANNIC ACID.

WILSON (EDINBURGH):- SAID THAT BURNS COULD BEST BE TREATED WITH TANNIC ACID, GENTIAN VIOLET, AND ACRI-FLAVINE, TOGETHER WITH ADRENAL EXTRACTS. (THE REPORT DOES NOT MAKE CLEAR WHETHER ADRENALINE, CORTICAL EXTRACT, OR BOTH WERE ADVOCATED. FROM WILSON'S OTHER PAPERS, HOWEVER, IT SEEMS PROBABLE THAT CORTICAL EXTRACT WOULD BE THE ONE SUGGESTED).

SEEMEN (MUNICH):- PRAISED THE RESULTS OBTAINED BY ELECTROCOAGULATION.

DONATI (MILAN) :- SAID THAT THE PRIMARY OBJECT OF TREATMENT IN BURNS SHOULD BE TO "PREVENT DEHYDRATION AND INTOXICATION."

ROSENTHAL (1937) :- FORGED THE NEWEST LINK IN THE CHAIN OF EVIDENCE IN FAVOUR OF A TOXIC THEORY. HE SHOWED THAT A SUBSTANCE COULD BE OBTAINED FROM THE BLOOD OF BURNED SHOATS, GUINEA PIGS, AND HUMAN BEINGS WHICH PRODUCED CONTRACTION OF THE VIRGIN GUINEA PIG UTERUS. HE SHOWED THAT SOON AFTER THE BURN THIS SUBSTANCE WAS ADSORBED ON THE RED BLOOD CORPUSCLES BUT LATER WAS FREE IN THE SERUM. HE FURTHER DEMONSTRATED THAT THIS SUBSTANCE DIFFERED FROM HISTAMINE IN A VARIETY OF WAYS. IN THE HEALING STAGE OF THE BURN THE SERUM OF THE PATIENT, EITHER GUINEA PIG OR HUMAN, HAD A NEUTRALISING EFFECT ON HISTAMINE AND BURN TOXIN AS TESTED ON THE VIRGIN GUINEA PIG UTERUS. THE FOLLOWING LIST, WHILE INCOMPLETE, GIVES SOME IMPRESSION OF THE GREAT VARIETY OF SUBSTANCES WHICH HAVE BEEN NAMED BY VARIOUS INVESTIGATORS AS BEING THE "TOXIN" RESPONSIBLE FOR BURN SHOCK.

<u>TOXIN</u>	<u>AUTHOR</u>
1. ABRIN AND RICIN-LIKE TOXIN	STENGEL & FOX
2. AMMONIA	EDENBUIZEN
3. AMMONIA OR UREA	EDENBUIZEN
4. ANAPHYLAXIS	TUDER
5. CHOLINE-LIKE SUBSTANCE	KOHLRAUSCH
6. DIAMINO ACIDS	EDIN AND HERIMAN

7.	FIBRIN FERMENT	FOA
8.	HAEMOLYSINS AND HAEMAGGLUTININS	VON DIETEMICHS
9.	HYDROCYANIC ACID	CATIANO
10.	INORGANIC INTRACELLULAR MATERIAL	TURCK
11.	METHYL GUANIDINE	HEYDE
12.	PEPTONE	OLDBRYCHT
13.	POTASSIUM SALTS	SCHJERNING
14.	PRIMARY AND SECONDARY PROTEOSES	ROBERTSON & BOYD
15.	PTOMAIN	LUSTGARTEN & PARASCANDOLO
16.	PYRIDINE BASE	REISS
17.	TOXALBUMIN	DORRANCE & BRANSFIELD
18.	UNSPECIFIED PROTEIN CLEAVAGE PRODUCTS	PFEIFFER, FRANKEL, SPIEGLER, BRANCATI, NISHIMURA
19.	UNSPECIFIED TOXIN	BOYER, GUINARD, McCRAE, BARDEEN, PACK, DAVIDSON

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THE FOREGOING ACCOUNT OF THE FOUR THEORIES OF THE AETIOLOGY OF BURN SHOCK IS LITTLE MORE THAN A CATALOGUE, AND BRIEF COMMENT HAS BEEN MADE ON THE LITERATURE MENTIONED ONLY WHERE IT WAS SPECIALLY NECESSARY. SOME FURTHER ANALYSIS OF THESE THEORIES IS REQUIRED, HOWEVER, IN ORDER TO INDICATE THE OBJECT OF THE THIRD AND FOURTH CHAPTERS.

THE BACTERIAL THEORY MAY BE DISMISSED AS BEING, AT THE LEAST IMPROBABLE. WHILE IT MUST BE ADMITTED THAT BACTERIAL INFECTION MAY PLAY A MAJOR ROLE IN CAUSING DEATH IN THE LATER STAGES OF SEVERE BURNS, IT IS ADMITTED BY A GREAT MAJORITY THAT IT CANNOT ACCOUNT FOR DEATHS OCCURRING IN THE FIRST FORTY-EIGHT HOURS AFTER BURNING. PUT IN ANOTHER WAY, IT IS OBVIOUS THAT A FACTOR CAUSING DEATH AT ONE STAGE OF AN ILLNESS NEED NOT BE THE LETHAL ENTITY ALL THROUGH.

THE ADRENAL AND NERVOUS THEORY IS SLOWLY TENDING TO BE INCLUDED IN THE PHYSICAL THEORY, ALTHOUGH SOME WORKERS STILL SUPPORT ITS PRIMACY. IT APPEARS THAT THE EVIDENCE IN FAVOUR OF THIS THEORY IS ALMOST ENTIRELY BASED ON POST-MORTEM FINDINGS AND, IN THE WRITER'S OPINION, IT IS OPEN TO ONE MAJOR CRITICISM, VIZ. THE PATHOLOGY OF THE ORGANS EXAMINED MAY HAVE BEEN CAUSED BY ONE OR BOTH OF TWO FACTORS,

- A. THE BURNS THEMSELVES
- B. THE TREATMENT USED

THIS SECOND FACTOR MAY NOT BE OF PRIME IMPORTANCE, BUT IS SURELY WORTHY OF CONSIDERATION. RECENT PAPERS (E.G. WELLS, HUMPHREYS & COLE) HAVE ACCUSED TANNIC ACID, WHICH IS COMMONLY USED IN THE TREATMENT OF BURNS, OF PRODUCING PATHOLOGICAL CHANGES IN THE LIVER AND OTHER ORGANS, BUT ITS EFFECT ON THE ADRENALS IS NOT DISCUSSED. IT IS NOT CLEAR, THEREFORE, SO FAR AS

HUMAN BEINGS ARE CONCERNED, WHETHER THE ALLEGED CHANGES IN THE ADRENALS ARE THE RESULT OF THE BURN OR THE TREATMENT OR PERHAPS BOTH.

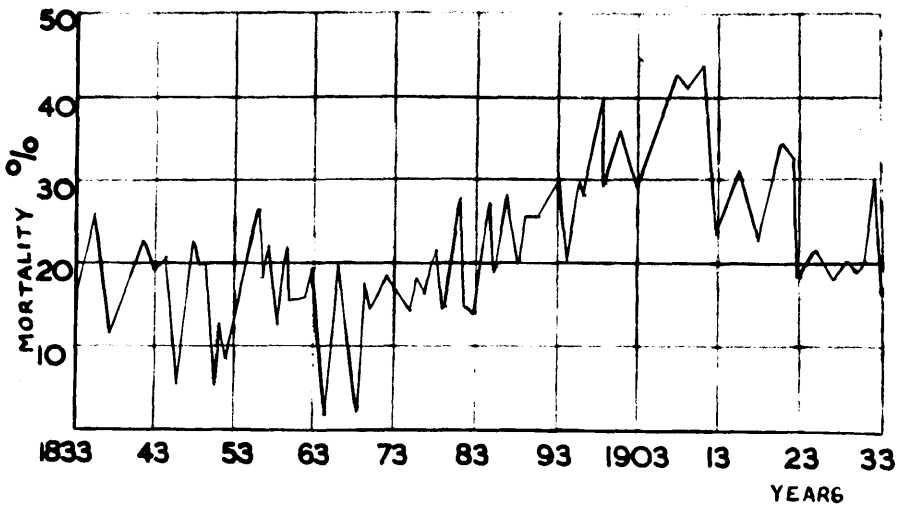
THE PHYSICAL THEORY IS, AS HAS BEEN SAID, THE DOMINANT ONE AT PRESENT. SO FAR AS CAN BE SEEN FROM THE LITERATURE, IT EMBRACES SUCH FACTORS AS LOCAL FLUID LOSS, (BLOOD AND/OR PLASMA), DECREASED CARDIAC OUTPUT, DIMINISHED VOLUME FLOW, ARTERIOLAR VASOCONSTRICTION, CAPILLARY CONGESTION AND STASIS, PROGRESSIVE HAEMOCONCENTRATION ETC. WITH ALL THESE CHANGES GOING ON THE DIFFICULTY OF DECIDING WHICH ARE INITIATING AND WHICH ARE PERPETUATING OR ACCOMPANYING FACTORS, BECOMES IMMENSE. AGAIN THE BULK OF THE EVIDENCE FOR THE PHYSICAL THEORY HAS BEEN OBTAINED FROM OBSERVATIONS ON EXPERIMENTAL TRAUMA AND INJURIES OTHER THAN BURNS. THE VIEW, ALREADY EXPRESSED, THAT THESE MAY BE ENTIRELY DIFFERENT ENTITIES MUST THEREFORE BE GIVEN CAREFUL CONSIDERATION. FURTHER, THE TREATMENT OF SHOCK ACCORDING TO THE PROGRAMME OF THE PHYSICAL SCHOOL - I.E. BLOOD OR PLASMA TRANSFUSION SUPPLEMENTED BY INTRAVENOUS SALINE AND THE ADMINISTRATION OF ADRENAL CORTICAL EXTRACT - HAS MET WITH SCANT SUCCESS WHEN APPLIED TO BURNS.

THE TOXIC THEORY HAS RECEIVED RELATIVELY LITTLE ATTENTION OF LATE, APPARENTLY BECAUSE MOST WORKERS HAVE BEEN DIRECTING THEIR EFFORTS TOWARDS LINKING UP

BURN SHOCK WITH THE PHYSICAL THEORY OF TRAUMATIC SHOCK IN GENERAL. IT MUST BE ADMITTED THAT, APART FROM EXPERIMENTAL WORK ALTOGETHER, THERE IS A VERY CONSIDERABLE AMOUNT OF EVIDENCE IN FAVOUR OF THE TOXIC THEORY. THUS AS EVIDENCE OF INTOXICATION WE HAVE NOT ONLY CLINICAL MANIFESTATIONS, SUCH AS HAEMOGLOBINURIA, ALBUMINURIA, VOMITING, BLOODY DIARRHOEA ETC., BUT MANY REPORTED POST-MORTEM FINDINGS HAVE BEEN NOTABLY SIMILAR TO THOSE DUE TO INTOXICATION WITH BACTERIAL PRODUCTS. HERE AGAIN, HOWEVER, IT IS DIFFICULT TO SAY TO WHAT EXTENT THESE CHANGES HAVE BEEN DUE TO THE THERAPEUTIC MEASURES USED AND OFTEN MENTIONED IN SUMMARY FASHION OR NEGLECTED ENTIRELY BY REPORTERS. IT IS NOT INTENDED TO DISCUSS THE LEGALITY OF THE TERM "TOXIC" AS APPLIED TO THIS THEORY, BUT A FEW REMARKS ARE NECESSARY TO MAKE THE POSITION CLEAR.

WHILE TOXINS ARE REGARDED AS THOSE SOLUBLE POISONOUS SUBSTANCES PRODUCED BY SYNTHETIC PROCESSES BY BACTERIA, POISONS OF A SIMILAR NATURE PRODUCED BY ANIMALS (ZOOTOXINS) AND PLANTS (PHYTOTOXINS) ARE USUALLY INCLUDED. IT IS NOT CLEAR WHETHER TOXINS THUS DEFINED ARE PROTEINS, ALTHOUGH IT IS CONSIDERED POSSIBLE THAT THEY CONSIST OF A PROTEIN MOLECULE TO WHICH IS ATTACHED A TOXIC RADICAL AND WHICH MAY OR MAY NOT BE AN INTEGRAL PART OF THE PROTEIN MOLECULE. IT HAS BEEN SUGGESTED THAT THE SPECIFICITY OF THESE TOXINS IS DUE

FIGURE 2.



REPRODUCTION OF CHART FROM DUNBAR'S REVIEW WHICH  
IS REFERRED TO ON THE OPPOSITE PAGE.

TO THE PROTEIN AND NOT THE TOXIC RADICAL. IT IS TO BE REMEMBERED THAT THESE COMMENTS ARE APPLICABLE ONLY TO THE TRUE TOXINS AND NOT TO THE LESS SPECIFIC ENDOTOXINS, THE NON-SPECIFIC BACTERIAL PROTEINS, OR THE PTOMAINES. IF, THEN, THE WORD "TOXIC" IS TECHNICALLY INCORRECT WHEN USED IN RELATION TO BURN SHOCK, IT HAS BEEN SANCTIONED BY WIDE AND LONG CONTINUED USE, AND IN ADDITION IT IS LESS UNWIELDY, IF LESS ACCURATE, THAN THE TERM "NOXIOUS SUBSTANCE."

IT HAS BEEN ALREADY NOTED THAT THE GREATEST CRITICISM OF THE TOXIC THEORY CONCERNS THE LACK OF UNIFORMITY OF OPINION AS TO THE NATURE AND NAME OF THE TOXIC SUBSTANCE. THIS MERE LACK OF CONFORMITY IS, HOWEVER, NO EVIDENCE OR ARGUMENT AGAINST THE EXISTENCE OF SUCH A SUBSTANCE. A FURTHER OBJECTION RAISED IS THE FAILURE OF THERAPEUTIC MEASURES BASED ON THIS CONCEPT TO DIMINISH APPRECIABLY THE INCIDENCE OR GRAVITY OF SHOCK. THESE MEASURES ARE THE VARIOUS MODIFICATIONS OF THE ORIGINAL TANNIC ACID THERAPY. DUNBAR, IN HIS REVIEW OF BURNS AND THEIR TREATMENT, PRESENTED A GRAPH (FIG.2) SHOWING THE PERCENTAGE MORTALITY AMONG BURNED PATIENTS ADMITTED TO THE GLASGOW ROYAL INFIRMARY BETWEEN THE YEARS 1833 AND 1933, AND COMMENTED:-

"I THINK THE MOST OUTSTANDING FACT SHOWN BY THE GRAPH IS THE DIFFERENCE BETWEEN THE PRE-ANTISEPTIC AND ANTISEPTIC ERAS. IF A LINE IS DRAWN AT TWENTY PER CENT

IT WILL AT ONCE BE SEEN THAT ONLY ON SIX OCCASIONS WAS THE RATE ABOVE TWENTY PER CENT PRE-ANTISEPTIC AND NEVER ABOVE TWENTY-FOUR PER CENT, AND SINCE THEN IT HAS ONLY BEEN UNDER IT ON TWENTY-ONE OCCASIONS.

THIS IS TRUE IN SPITE OF THE FACT THAT IN THE PRE-ANTISEPTIC ERA ONLY THE WORST BURNS WOULD COME TO THE HOSPITAL, THE STATE OF THE HOSPITALS BEING WELL KNOWN TO THE PUBLIC, WHO ALSO KNEW THAT A BURN OF SLIGHT OR MODERATE SEVERITY HAD A BETTER CHANCE OF RECOVERY AT HOME."

HE CONCLUDED HIS PAPER THUS:-

"EVEN WITH THOSE (ANTISEPTIC) METHODS AND EMPLOYING TANNIC ACID FOR THE TREATMENT OF SUPERFICIAL BURNS OUR DEATH RATE IS STILL TOO HIGH (13.8%) AND STILL DOES NOT COMPARE FAVOURABLY WITH THE PRE-ANTISEPTIC PERIOD, ESPECIALLY WHEN WE REMEMBER THE DIFFICULTIES THE PRE-LISTER SURGEONS HAD TO CONTEND WITH, AND THAT MANY OF THEIR PATIENTS DIED OF TETANUS AND ERYSIPELAS."

IT MUST BE REMEMBERED, HOWEVER, THAT THE TANNIC ACID TREATMENT AND ITS VARIANTS WERE BASED NOT ONLY ON THE TOXIC THEORY BUT ALSO ON THE ASSUMPTION THAT THE TOXIC SUBSTANCE WAS EITHER OF A PROTEIN NATURE ITSELF, OR WAS CAPABLE OF BEING PRECIPITATED TOGETHER WITH THE PROTEIN. IT IS NOT TO BE INFERRED THAT THIS CRITICISM IS INTENDED AS A CONDEMNATION OF THE USE OF TANNIC ACID FOR, IN SPITE OF ITS SEVERAL

DISADVANTAGES, SUCH AS SCARRING AND CONTRACTURE FORMATION - WHICH HAVE BEEN RECENTLY MUCH PUBLICISED - IT REMAINS A USEFUL, DURABLE, EASILY APPLICABLE, AND RELATIVELY COMFORTABLE DRESSING FOR BURNS.

THIS CHAPTER WILL HAVE FULFILLED ITS PURPOSE, IF IT HAS MADE THE FOLLOWING POINTS CLEAR:-

1. THAT IN SPITE OF THE GREAT AMOUNT OF WORK WHICH HAS BEEN DONE IN AN EFFORT TO SOLVE THE PROBLEM OF THE CAUSE OF BURN SHOCK, THERE IS, EVEN NOW, NO UNANIMITY.
2. THAT ALL FORMS OF TREATMENT FAIL TO PREVENT BURN SHOCK, AND DO VERY LITTLE TO RESTORE THE PATIENT ONCE IT HAS DEVELOPED.
3. THAT BURN SHOCK MAY BE REGARDED AS AN IRREVERSIBLE PROCESS.

CHAPTER TWO.

THE NEUTROPHIL GRANULOCYTE.

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## CHAPTER TWO.

HAEMATOLOGISTS HAVE BUT SLOWLY LEARNED THAT THE LEUCOCYTES PLAY AN IMPORTANT PART IN THE PHYSIOLOGY AND PATHOLOGY OF THE HUMAN ORGANISM. THE CREDIT FOR THEIR DISCOVERY IS GIVEN TO HEWSON (1773), ALTHOUGH IT IS PROBABLE THAT SWAMMERDAM (1658) AND LEEUWENHOCK (1673), WHO WERE THE FIRST MICROSCOPISTS TO DESCRIBE THE RED BLOOD CORPUSCLES, SAW AND IGNORED THE LARGER BUT LESS NUMEROUS LEUCOCYTES. KIRCHER, TOO, IN HIS SCUTINIUM PESTIS (1658) REFERRED TO WORMS AND PUTRID MATTER SEEN IN MICROSCOPIC PREPARATIONS OF THE BLOOD OF PATIENTS WITH PLAGUE; THESE WERE ALMOST CERTAINLY LEUCOCYTES AND ROULEUX OF ERYTHROCYTES. IT WAS NOT UNNATURAL THAT LITTLE IMPORTANCE SHOULD HAVE BEEN ATTACHED BY SUBSEQUENT OBSERVERS TO BODIES WHICH WERE PRESENT IN SUCH RELATIVELY SMALL NUMBERS IN NORMAL BLOOD.

VIRCHOW'S DISCOVERY OF LEUKAEMIA AND HIS OBSERVATIONS ON, AND DEFINITION OF, LEUCOCYTOSIS (1845) WERE THE FIRST STEPS TOWARDS THE RECOGNITION OF THE IMPORTANCE OF THE WHITE BLOOD CELLS IN PATHOLOGY. IT WAS, HOWEVER, ONLY AFTER CONHEIM'S DISCOVERY, THAT

SUPPURATION WAS DUE TO MIGRATION OF WHITE BLOOD CELLS THAT INTEREST IN THE LEUCOCYTES WAS FINALLY AWAKENED. CONHEIM'S OBSERVATIONS HAD DRAWN ATTENTION TO THE FACT THAT LARGE QUANTITIES OF PUS COULD BE FORMED AND LOST NOT ONLY WITHOUT IMPOVERISHMENT OF THE BLOOD IN RESPECT OF LEUCOCYTES BUT ACTUALLY IN ASSOCIATION WITH A RISE IN THE NUMBER OF CIRCULATING CELLS. IN THE LIGHT OF THIS OBSERVATION, IT WAS SEEN THAT NOT WITHSTANDING THE SMALL NUMBER OF LEUCOCYTES IN NORMAL BLOOD (RELATIVE TO THE ERYTHROCYTES), THE LEUCOCYTOPOIETIC TISSUE MUST HAVE AN ENORMOUS PRODUCTION POTENTIAL.

THE NEXT FEW YEARS SAW RAPID PROGRESS, ALMOST ALL OF IT FROM THE LABOURS OF EHRLICH. HE FIRST CLASSIFIED LEUCOCYTES ACCORDING TO THE PRESENCE OR ABSENCE OF INTRA-CELLULAR GRANULES, THEN, APPLYING HIS NEWLY-DISCOVERED TRI-ACID STAIN, HE DIVIDED THE GRANULOCYTES INTO NEUTROPHILS, EOSINOPHILS, AND BASOPHILS, AND FINALLY DEMONSTRATED THAT LEUCOCYTOPOIESIS WAS A FUNCTION OF BONE MARROW. EVEN THEN, HOWEVER, THE PIONEER CHARACTER OF HIS WORK WAS NOT REALISED, AND LITTLE PROGRESS WAS MADE SINCE CLINICIANS CONTENTED THEMSELVES WITH AN ENUMERATION OF THE WHITE BLOOD CELLS AND THE CALCULATION OF THE RATIO OF THESE TO THE ERYTHROCYTES. IT WAS BELIEVED AT THIS TIME THAT CONCLUSIONS AS TO DIAGNOSIS AND PROGNOSIS COULD BE DRAWN FROM THE DEGREE OF LEUCOCYTOSIS, AND THIS WAS

REPUTED TO BE SPECIALLY TRUE OF PNEUMONIA, IN WHICH LEUCOCYTOSIS HAD LONGEST AND MOST EXTENSIVELY BEEN STUDIED. GRADUALLY IT WAS RECOGNISED THAT THE MERE NUMBER OF LEUCOCYTES WAS OF LITTLE CONSEQUENCE, SINCE THIS WAS A RESULT OF BOTH SUPPLY AND DEMAND, THAT IS, IT DEPENDED UPON TWO QUANTITIES:-

(A) THE VIRULENCE OF THE INFECTION, AND

(B) THE RESISTANCE OR REACTION OF THE PATIENT.

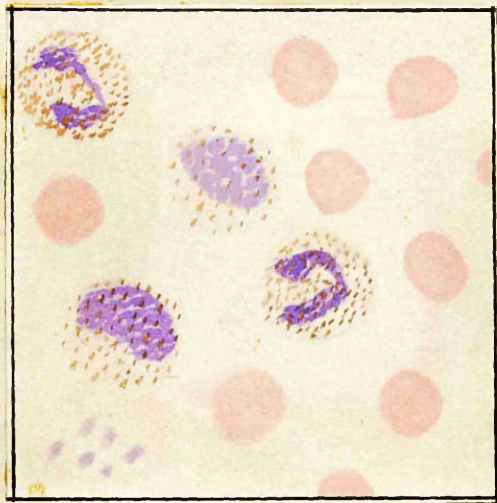
BOTH OF THESE QUANTITIES WERE UNKNOWN, AND THEREFORE THE EQUATION SO CONSTRUCTED WAS INCAPABLE OF SOLUTION.

IN AN EFFORT TO OBTAIN THESE DIFFICULTIES, ATTENTION WAS DIRECTED TO QUALITATIVE CHANGES IN THE CIRCULATING LEUCOCYTES, DURING THE PROGRESS OF INFECTIONS. THESE QUALITATIVE ALTERATIONS ARE OF TWO TYPES, (A) NUCLEAR, (B) CYTOPLASMIC. THE TECHNICAL ADVANCES IN THE STUDY OF THE LEUCOCYTES DEPENDENT ON NUCLEAR CHARACTERS WERE AS FOLLOWS:-

1. SCHINDLER'S STUDIES. BESIDES FULLY DEVELOPED LEUCOCYTES, SCHINDLER FOUND THEIR UNDEVELOPED PROGENITORS ( I.E. THE MYELOCYTES ) IN THE BLOOD DURING LEUCOCYTOSIS. HE RIGHTLY CONSIDERED THAT THE NUMBER OF UNDEVELOPED CELLS PRESENTED A CRITERION FOR JUDGING THE DEMANDS MADE UPON THE BONE MARROW, SINCE MANIFESTLY ONLY AN INTENSE TOXIC IRRITATION OF THIS COULD MAKE SUCH DEMANDS

AS TO CAUSE THE PRESENCE OF THESE YOUNG CELLS IN THE BLOOD. HE EXPRESSED HIS RESULTS WITH REGARD TO THE FINDING OF THE MYELOCYTES IN THE BLOOD IN INFECTIOUS DISEASE BY THE FOLLOWING PROPOSITIONS:-

1. "THE MOST VARIED CAUSES (IN PARTICULAR, THOSE OF AN INFECTIOUS NATURE) WHICH EXCITE LEUCOCYTOSIS ARE, IN SO FAR AS THEY ARE PERMANENT, THOSE WHICH GIVE RISE TO A MIGRATION INTO THE BLOOD OF LARGE MONONUCLEAR CELLS, WITH NEUTROPHIL GRANULES (MYELOCYTES) THAT NORMALLY NEVER LEAVE THE BONE MARROW. THUS WE FIND MYELOCYTES IN PNEUMONIA, SCARLET FEVER, DIPHTHERIA, ERYSIPELAS, MENINGITIS, POLYARTHRITIS, SEPTIC CONDITIONS ETC. THEIR MERE OCCURRENCE IS NOT ALWAYS OF THE SAME SIGNIFICANCE. IF THEY OCCUR MERELY AS AN ACCOMPANIMENT OF LEUCOCYTOSIS AT THE HEIGHT OF THE SAME AND DISAPPEAR WITH ITS RECESSION, WE CAN INFER NOTHING FURTHER THAN AN INSIGNIFICANT EXPRESSION OF THE ABILITY OF THE BONE MARROW TO SUPPLY CELLS HASTILY, FOLLOWING THE EXHAUSTION OF THE EXISTING RESERVES OF DEVELOPED LEUCOCYTES. (IT SHOULD HERE BE NOTED THAT THIS LAST STATEMENT WOULD NOW BE ACCEPTED WITH SOME RESERVATIONS, AS THE CELLS WHICH SCHINDLER REGARDS AS INDICATIVE OF A NORMAL REACTION TO GREAT DEMANDS WOULD REQUIRE TO BE, AT MOST, YOUNG METAMYELOCYTES, TRUE MYELOCYTES OCCURRING ONLY



PERIPHERAL BLOOD FROM A CASE OF  
LEUKAEMIC MYELOSIS. THE CELLS  
PRESENT ARE MYELOCYTE, YOUNG  
METAMYELOCYTE, PRE-SEGMENTATION  
METAMYELOCYTE AND POLYMORPH.

IN VERY SMALL NUMBERS. WITH THE TRI-ACID STAIN WHICH HE USED, HOWEVER, IT IS LIKELY THAT MANY OF HIS "MYELOCYTES" HAD IN FACT SLIGHTLY INDENTED NUCLEI - AUTHOR). IF, HOWEVER, MYELOCYTES OCCUR AT A TIME WHEN THE LEUCOCYTOSIS HAS PARTIALLY OR QUITE RECEDED, THEY BEAR WITNESS TO A FUNCTIONAL EXHAUSTION OF THE BONE MARROW THE DEGREE OF WHICH IS INDICATED BY THEIR NUMERIC RELATIONS TO THE DEVELOPED CELLS. WHEN THE DECREASE IN LEUCOCYTOSIS IS, TOGETHER WITH THE FALLING TEMPERATURE AND THE GENERAL SYMPTOMS OF IMPROVEMENT, A SIGN OF THE VICTORY OF THE ORGANISM OVER THE INFECTION, THIS TRANSITORY EXHAUSTION IS OF NO MOMENT AND IS SOON RELIEVED. IT IS, HOWEVER, OF GRAVEST SIGNIFICANCE IF IT SUPERVENES AT A TIME WHEN THE INFECTION IS STILL FULLY VIRULENT AND WHEN THE ORGANISM IS IN GREATEST NEED OF THE SUPPLY OF PROTECTIVE CELLS. HEREIN LIE THE GROUNDS FOR THE PROGNOSTIC AND, SO TO SPEAK, PRACTICAL VALUE OF THE MYELOCYTES AS A MEASURE OF THE NORMAL POWER OF THE MARROW TO RESPOND TO STIMULATION. GREAT NUMBERS DURING A FALLING LEUCOCYTOSIS AND AN UNCONQUERED INFECTION ARE A BAD SIGN, (DIPHThERIA AND PNEUMONIA).

2. IN THE CASES CITED THE CAUSE OF THE DEFECTIVE LEUCOCYTE PRODUCTION LIES IN THE EXHAUSTIVE PARALYSIS WHICH RESULTS FROM EXCESSIVE DEMANDS ( NATURALLY, THE

MARROW REACTS AT FIRST BECAUSE OF ITS INHERENT PROPERTIES, WHETHER OR NOT IT BECOMES INSUFFICIENT LATER). THUS, IN TYPHOID AND IN MALARIA, THE CAUSE OF THE LEUCOPENIA IS A DIRECT ARREST OF THE FUNCTION OF THE LEUCOCYTE-FORMING TISSUE THROUGH THE SPECIFIC INFLUENCE OF THE TOXINS DUE TO THE DISEASE - AN ARREST WHICH IN ONE CASE (TYPHOID) IS PERMANENT, IN THE OTHER (MALARIA) IS ONLY TEMPORARY. HERE AGAIN, WE CONCEIVE THE MYELOCYTES TO BE THE EVIDENCE OF AN ABNORMAL REACTION OF THE BONE MARROW TO STIMULATION."

WHEN ONE CONSIDERS THAT THIS WAS WRITTEN IN 1904 AND THAT THE OBSERVATIONS WERE MADE WITH POOR STAINING FACILITIES, THE BRILLIANCE OF SCHINDLER'S CONCEPTION OF MARROW FUNCTION AND HIS INTERPRETATION OF PERIPHERAL BLOOD FINDINGS IS TRULY AMAZING. WITH THE EXCEPTION OF HIS VIEWS ON THE CAUSE OF LEUCOPENIA IN TYPHOID FEVER ( NOW KNOWN TO BE DUE TO A PHENOMENON OF DISTRIBUTION AND NOT TO MARROW INSUFFICIENCY) HIS THEORIES ARE, EVEN TO-DAY, SEEN TO BE COMPLETELY ACCURATE. IT IS ALMOST UNBELIEVABLE THAT HIS WORK AND HIS NAME ALIKE HAVE BEEN FORGOTTEN, WHILE ARNETH AND SCHILLING, WHOSE FOOTSTEPS HE DIRECTED AND WHOSE CONTRIBUTIONS ARE HARDLY GREATER, ARE STILL WELL-KNOWN NAMES.

2. ARNETH'S NEUTROPHIL BLOOD PICTURE. ARNETH, FROM HIS STUDY OF THE BLOOD BOTH IN HEALTH AND IN DISEASE,



PLATE I.

TO ILLUSTRATE THE FIVE PRIMARY DIVISIONS IN ARNETH'S  
CLASSIFICATION OF THE NEUTROPHIL GRANULOCYTES.

WAS LEAD TO DIVIDE THE POLYMORPHONUCLEAR NEUTROPHIL LEUCOCYTES INTO FIVE CLASSES DEPENDING UPON THE NUMBER OF NUCLEAR LOBES. (PLATE I.) HE CLAIMED THAT HIS DIVISIONS WERE CONSTANT IN HEALTH, BUT THAT GREAT VARIATION WAS SEEN IN DISEASE, ESPECIALLY IN INFECTIOUS CONDITIONS.

#### CLASS 1.

- (A) M. CELLS. THESE WERE MONONUCLEAR CELLS, IDENTICAL WITH EHRLICH'S MYELOCYTES.
- (B) W. CELLS. THESE WERE ALSO MONONUCLEAR CELLS, BUT THE NUCLEUS EXHIBITED SLIGHT INDENTATION WHICH, HOWEVER, DID NOT EXTEND BEYOND THE MIDDLE OF THE NUCLEUS.
- (C) T. CELLS. THESE TOO WERE MONONUCLEAR CELLS, BUT THEY EXHIBITED DEEPER INDENTATION WHICH, HOWEVER, FELL SHORT OF ACTUAL LOBULATION.

ACCORDING TO ARNETH, THIS CLASS IS PRESENT IN NORMAL BLOOD TO THE EXTENT OF FIVE PER CENT OF THE TOTAL NEUTROPHILS, THE MAJORITY OF THESE BEING OF THE "T" TYPE.

#### CLASS 2.

THIS CLASS EMBRACED ALL CELLS WITH TWO DISTINCT NUCLEAR FRAGMENTS AND HAS THREE SUB-DIVISIONS:-

- (A) 2K IN THESE THE TWO FRAGMENTS WERE ROUND BODIES.

(B) 2S HERE THE FRAGMENTS WERE S-SHAPED OR  
ROD-SHAPED ELEMENTS.

(c) 1K 1S.

THIS CLASS REPRESENTS THIRTY-FIVE PER CENT OF THE  
TOTAL NEUTROPHILS, AND OF THIS TOTAL THE 2S TYPE ACCOUNTS  
FOR TWENTY-FIVE PER CENT.

CLASS 3. THIS HAD THREE NUCLEAR DIVISIONS AND FOUR  
SUB-DIVISIONS:-

(A) 3K

(B) 3S

(c) 2K 1S

(D) 1K 2S

THIS CLASS ACCOUNTS FOR FORTY-ONE PER CENT OF  
THE TOTAL NEUTROPHILS, AND OF THESE THE 2K 1S AND  
2S 1K EACH REPRESENTS SIXTEEN PER CENT.

CLASS 4. THIS WAS COMPOSED OF FOUR NUCLEAR DIVISIONS  
AND FIVE SUB-DIVISIONS:-

(A) 4K

(B) 4S

(c) 2K 2S

(D) 3K 1S

(E) 3S 1K

THIS CLASS ACCOUNTED FOR SEVENTEEN PER CENT OF  
THE TOTAL NEUTROPHILS, THE 4K, 3K 1S AND 2K 2S BEING  
LARGELY IN EXCESS OF THE OTHER FORMS.

CLASS 5. COMPOSED OF FIVE OR MORE NUCLEAR DIVISIONS WITH SIMILAR SUB-DIVISIONS. THIS GROUP ACCOUNTED FOR TWO PER CENT OF THE TOTAL NEUTROPHILS.

A NORMAL BLOOD PICTURE ACCORDING TO ARNETH, MIGHT BE AS FOLLOWS:-

<u>1 NUCLEUS</u>	<u>2 NUCLEI</u>	<u>3 NUCLEI</u>	<u>4 NUCLEI</u>	<u>5 OR MORE NUCLEI</u>
<u>M.W.T.</u>				
5	35	41	17	2

HERE THE ABSOLUTE NUMBERS REPRESENT THE PERCENTAGES ALSO, SINCE ARNETH ALWAYS CONSTRUCTED HIS TABLES FROM A COUNT OF 100 CELLS.

IN PATHOLOGICAL CONDITIONS, HOWEVER, THIS RELATION HE FOUND TO BE STRIKINGLY ALTERED, SO THAT THE NUMBER OF CELLS TO THE LEFT OF THE ABOVE TABLE WAS INCREASED AT THE EXPENSE OF THOSE TO THE RIGHT. ARNETH TERMED THIS A "SHIFTING OF THE NEUTROPHIL BLOOD PICTURE TOWARDS THE LEFT," AND SINCE HE REGARDED POLYNUCLEARS AS OLDER AND MATURED DESCENDANTS OF THE MONONUCLEARS, HE ASSUMED THAT THIS SHIFTING WAS BROUGHT ABOUT BY THE RETIREMENT OF THE DEVELOPED CELLS IN FAVOUR OF THE IMMATURE ONES, AND THUS IT HAD THE SAME SIGNIFICANCE AS THE APPEARANCE OF SCHINDLER'S MYELOCYTES. THE FOLLOWING BLOOD PICTURE OBTAINED BY ARNETH IN A CASE OF PNEUMONIA IS AN EXAMPLE OF SUCH A SHIFTING:-

<u>1 NUCLEUS</u>	<u>2 NUCLEI</u>	<u>3 NUCLEI</u>	<u>4 NUCLEI</u>	<u>5 OR MORE NUCLEI</u>
<u>M.W.T.</u>				
21	54	22	2	1

ARNETH SHOWED THAT THESE QUALITATIVE CHANGES WERE QUITE INDEPENDENT OF THE ABSOLUTE NUMBER OF THE LEUCOCYTES, AND THEREFORE HE UNDERTOOK TO MAKE THE FOLLOWING CLASSIFICATION OF THE PATHOLOGICAL VARIATIONS IN THE NEUTROPHIL BLOOD PICTURE, TAKING INTO CONSIDERATION BOTH THE QUALITATIVE AND THE QUANTITATIVE CHANGES. HE USED THE TERM ISOCYTOSIS TO INDICATE A NORMAL PERCENTAGE OF THE SEVERAL VARIETIES OF NEUTROPHILS, AND THE TERM ANISOCYTOSIS TO INDICATE A QUALITATIVE CHANGE IN THE NORMAL RELATIONS.

1. HYPERLEUCOCYTOSIS OR HYPERCYTOSIS, AN INCREASE OF THE NEUTROPHIL LEUCOCYTES.
  - (A) ISOHYPERCYTOSIS - AN INCREASE WITHOUT QUALITATIVE CHANGES.
  - (B) ANISOHYPERCYTOSIS - AN INCREASE WITH QUALITATIVE CHANGES.
2. NORMOLEUCOCYTOSIS OR NORMOCYTOSIS - A NORMAL LEUCOCYTE COUNT.
  - (A) ISONORMOCYTOSIS - THE SAME WITHOUT QUALITATIVE CHANGES.
  - (B) ANISONORMOCYTOSIS - THE SAME WITH QUALITATIVE CHANGES.
3. HYPOLEUCOCYTOSIS OR HYPOCYTOSIS - A DECREASE IN THE LEUCOCYTE COUNT.
  - (A) ISOHYPOCYTOSIS - THE SAME WITHOUT QUALITATIVE CHANGES.



PLATE 2.

TO ILLUSTRATE THE FOUR TYPES OF CELL IN SCHILLING'S  
NUCLEAR COUNT.

(B) ANISOHYPOCYTOSIS - THE SAME WITH  
QUALITATIVE CHANGES.

ARNETH'S CLASSIFICATION WAS ATTACKED FROM MANY  
QUARTERS, MAINLY ON THE GROUND THAT THERE WAS NO  
EVIDENCE THAT DECREASE IN THE NUMBER OF NUCLEAR LOBES  
WAS A MARK OF IMMATUREITY. HIS THEORY'S CLOSE ACCORD  
WITH SCHINDLER'S STUDIES, HOWEVER, WAS REGARDED AS  
BEING STRONGLY IN FAVOUR OF HIS VIEWS, PARTICULARLY  
WHEN THE CERTAINTY OF THE MYELOCYTES BEING IMMATURE  
POLYMORPHS WAS CONSIDERED.

ARNETH'S METHOD ENTAILS EXACTING AND TEDIOUS  
WORK AND IN ITS ORIGINAL FORM WAS NEVER EXTENSIVELY  
PRACTISED, SINCE IT WAS RIGHTLY FELT THAT THE VALUE  
OF ITS RESULTS WAS HARDLY COMMENSURATE WITH THE  
LABOUR AND TIME INVOLVED IN OBTAINING THEM.

SCHILLING'S HAEMOGRAM.

SCHILLING DEvised A METHOD OF CLASSIFYING LEUCO-  
CYTES AND INTERPRETING THEIR NUMBERS IN THE CIRCULATING  
BLOOD, WHICH HE AND HIS MANY FOLLOWERS CLAIMED TO BE  
SIMPLER AND MORE INFORMATIVE THAN WAS ARNETH'S. (PLATE 2.)  
SCHILLING CORRELATES ALL THE ORDINARY DATA OF TOTAL  
AND DIFFERENTIAL COUNTS WITH HIS OWN NUCLEAR COUNT  
AND CONSIDERS THE RESULTS IN THE FORM OF WHAT HE CALLS  
A "HAEMOGRAM." THE NEUTROPHIL GRANULOCYTES HE DIVIDES  
INTO FOUR CLASSES, THUS:-

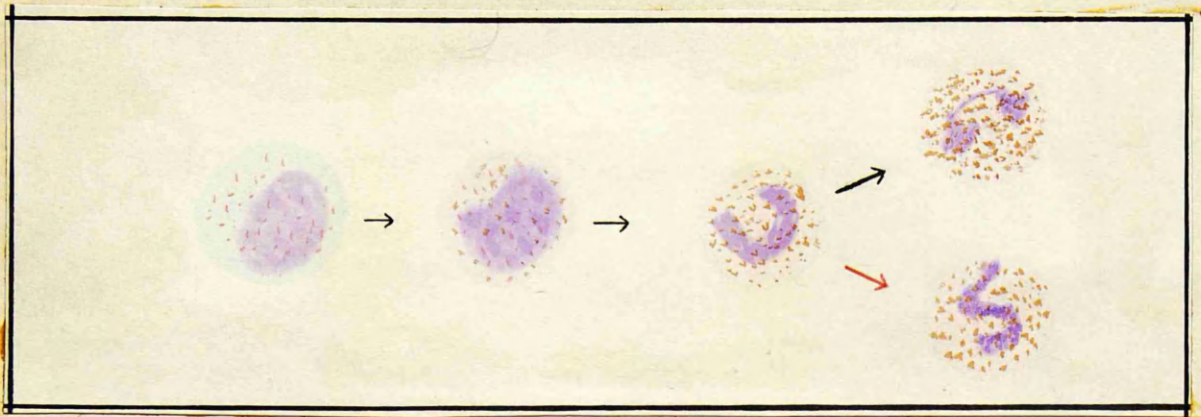


PLATE 3.

TO ILLUSTRATE THE FORMATION OF STAB-NUCLEAR CELLS.

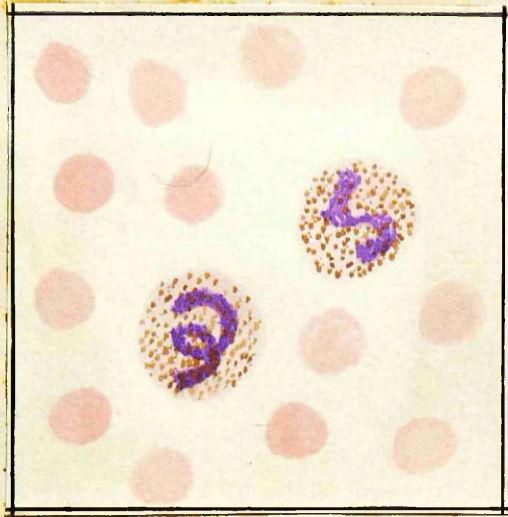
THE BLACK ARROWS SHOW THE NORMAL PROCESS OF

MATURATION, THE RED THE ABNORMAL.

(1) MYELOCYTES (M) - MOST OF THESE CELLS - AS SEEN FROM SCHILLING'S OWN DESCRIPTIONS - ARE YOUNG METAMYELOCYTES EXHIBITING VARYING DEGREES OF NUCLEAR INDENTATION.

(2) JUVENILE POLYMORPHONUCLEARS (J) - THESE CELLS WOULD NOW BE CLASSED AS LATE METAMYELOCYTES - THE "BAND-FORMS" OF SOME AUTHORS - AND POSSESS A SAUSAGE-SHAPED NUCLEUS SHOWING LITTLE CHROMATIN CONDENSATION AND NO NUCLEAR PYKNOSIS.

(3) STAB CELLS (ST) - ACCORDING TO SCHILLING, THE NORMAL PROCESS OF MATURATION OF THE MYELOCYTE IS THROUGH METAMYELOCYTE AND BAND-FORM STAGES TO THE POLYMORPHONUCLEAR, BUT IF THE MARROW WORKS UNDER THE BURDEN OF A TOXIC STATE OR OTHER DELETERIOUS PROCESS THE JUVENILE NUCLEUS DOES NOT SEGMENT BUT TAKES ON THE STAB FORM. (PLATE 3). THIS IS A NARROW RIBBON-LIKE PYKNOTIC NUCLEUS WITH THE STAINING CHARACTERS OF THE MATURE SEGMENTED NUCLEUS. THE NUCLEUS IS BEST COMPARED TO A PIECE OF LEAD PIPE WHICH MAY BE BENT INTO MANY BIZARRE SHAPES, E.G. KNOTTED ROPE AND CORKSCREW. THE CELL CONTAINING SUCH A NUCLEUS IS OF NORMAL SIZE, AND REPRESENTS THE END POINT OF MATURATION, NO SUBSEQUENT SEGMENTATION TAKING PLACE. THE PRACTICE OF MANY AUTHORS OF TRANSLATING THE GERMAN "STAB" INTO THE ENGLISH EQUIVALENT "STAFF" WILL BE SEEN TO BE INSUFFICIENT,



TO ILLUSTRATE THE CHARACTERS  
OF THE STAB-FORM NUCLEUS.  
NOTE THE ADULT CHROMATIN  
AND CORK-SCREW AND "S"  
SHAPED FORMS.

AS IT DOES NOT CONVEY SCHILLING'S MEANING, VIZ.

"FLEXIBLE AND MALLEABLE ROD." (ILLUSTRATION).

(4) POLYMORPHONUCLEARS (S) - THESE CELLS HAVE TWO OR MORE NUCLEAR LOBES AND ARE CALLED BY SCHILLING "SEGMENTED POLYMORPHS."

IT WILL BE SEEN THAT IN SCHILLING'S CLASSIFICATION, EMPHASIS IS LAID ON THE PRE-SEGMENTED FORMS OF NUCLEUS, WHILE THE SEGMENTED FORMS ARE ALL CLASSED TOGETHER, IRRESPECTIVE OF THE EXTENT OF NUCLEAR LOBULATION. IN THIS RESPECT SCHILLING'S WORK DIFFERS GREATLY FROM ARNETH'S AND IS MORE CLOSELY ALLIED TO SCHINDLER'S STUDIES. APART FROM THIS, HOWEVER, HIS METHOD OF INTERPRETING A HAEMOGRAM IS ENTIRELY DIFFERENT FROM ARNETH'S. SCHILLING BELIEVES THAT AN INFECTION MAY EVOKE TWO DIFFERENT REACTIONS ON THE PART OF THE BONE MARROW:-

(1) REGENERATIVE. IN THIS MANY NEW LEUCOCYTES ARE FORMED AND THE WHITE CELL COUNT RISES STEADILY, LARGE NUMBERS OF JUVENILE POLYMORPHS ENTERING THE BLOOD STREAM, AS DO A FEW MYELOCYTES.

(2) DEGENERATIVE. THIS REACTION HE HOLDS TO BE TYPICAL OF SEVERE TOXEMIC STATES, E.G. TYPHOID FEVER AND PROTOZOAL DISEASES SUCH AS MALARIA AND KALA AZAR. IN THESE A LEUCOPENIA IS USUAL, AND IS DUE, SCHILLING BELIEVES, TO DEPRESSION OF THE MARROW BY TOXINS. THIS SAME TOXIC ACTION, HE ALLEGES, CAUSES

FAILURE OF MATURATION OF THOSE JUVENILE CELLS WHICH ARE RELEASED FROM THE MARROW, AND WITH THEIR ASSUMPTION OF STAB NUCLEI THEY REPRESENT THE END POINT OF THIS ABNORMAL MATURATION. ( VIDE DIAGRAMS AT END OF CHAPTER ).

APART FROM THESE CHANGES THUS DESCRIBED SCHILLING ATTACHED GREAT IMPORTANCE TO THE EOSINOPHIL POLYMORPHS. REDUCTION OR DISAPPEARANCE OF THESE CELLS AT THE ONSET OF AN INFECTION IS USUAL, BUT THEIR COMPLETE FAILURE TO REAPPEAR, ESPECIALLY AS JUDGED BY EXAMINATION OF THE BLOOD, BY THE "THICK DROP" METHOD HE REGARDS AS AN OMINOUS SIGN. THE CONSTITUENTS OF SCHILLING'S NORMAL HAEMOGRAM ARE AS FOLLOWS:-

TOTAL COUNT	PERCENTAGES							
	BASO.	EOSIN.	M.	J.	ST.	S.	L.	M.
5000 TO 8000	0-1	2-4	0	0-1	3-5	51- 67	21- 35	4-8

PONS AND KRUMBHAAR, WHILE THEY EXPRESSED THEIR BELIEF THAT ARNETH'S FORMULA REPRESENTED A TRUE INDICATION OF THE AGE OF THE GRANULOCYTES REGARDED IT, AS DID MANY OTHERS AS IMPRACTICABLE FOR ROUTINE CLINICAL PURPOSES. THEY CLAIMED THAT ALL ESSENTIAL PURPOSES WERE SERVED BY SUBDIVIDING THE NEUTROPHILS INTO:-

1. MYELOCYTES. (PONS' AND KRUMBHAAR'S "METAMYELOCYTES - VERY YOUNG - WITH ROUND OR SLIGHTLY INDENTED NUCLEI.")
2. NON-SEGMENTED FORMS WHERE THE NUCLEAR LOBES ARE

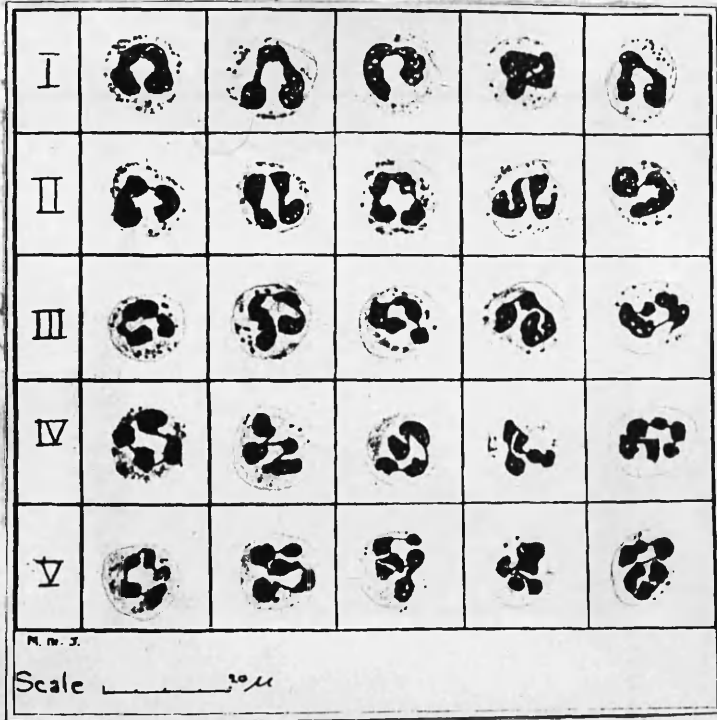
CONNECTED BY BROAD BANDS OF CHROMATIN.

3. SEGMENTED FORMS WHERE TWO OR MORE MASSES OF NUCLEAR MATERIAL ARE JOINED BY NARROW FILAMENTS. THEIR FORMULA WAS THUS A MODIFICATION OF ARNETH'S BUT THEY FOCUSSED ATTENTION ON THE PRE-SEGMENTATION FORMS OF THE NEUTROPHILS, AS HAD SCHILLING.

COOKE AND PONDER EVOLVED A CLASSIFICATION OF THE NEUTROPHIL GRANULOCYTES WHICH THEY CLAIMED WAS SIMPLER THAN THAT OF ARNETH, ON WHOSE WORK IT WAS BASED. THEY GROUPED THE NEUTROPHILS ACCORDING TO THE NUMBER OF NUCLEAR LOBES, AND IN THIS WAY, ARRIVED AT A CLASSIFICATION EXACTLY THE SAME AS ARNETH'S PRIMARY GROUPING. THEY DID NOT FURTHER SUB-DIVIDE THESE FIVE DIVISIONS, HOWEVER, REGARDING THIS PROCEDURE AS VALUELESS. THEY STATED THAT THE PRIME DIFFICULTY LAY IN DETERMINING WHETHER OR NOT THE NUCLEUS HAD DIVIDED; THAT THE POLYMORPHONUCLEAR NUCLEUS NEVER DIVIDES COMPLETELY; THAT THERE IS ALWAYS A FINE FILAMENT OF CHROMATIN CONNECTING EVEN THE MOST DISCRETE LOBES. THEREFORE, AS THE BASIS FOR DIFFERENTIATING THE FIVE CLASSES, COOKE'S AND PONDER'S CRITERION IS AS FOLLOWS:- "IF THERE IS ANY BAND OF NUCLEAR MATERIAL EXCEPT THIS CHROMATIN FILAMENT, CONNECTING THE DIFFERENT PARTS OF THE NUCLEUS, THAT NUCLEUS CANNOT, FOR THE PURPOSES OF THE COUNT, BE SAID TO BE DIVIDED."

IT MUST BE APPARENT, THEREFORE, THAT, APART FROM

FIGURE 3.



TO DEMONSTRATE THE FIVE CLASSES  
 IN THE POLYNUCLEAR COUNT OF COOKE  
 AND PONDER. IF THERE BE ANY BAND  
 OF NUCLEAR MATERIAL OTHER THAN A  
 CHROMATIN FILAMENT UNITING THE  
 NUCLEAR MASSES, THOSE PARTS MUST  
 NOT BE CONSIDERED AS SEPARATE  
 SEGMENTS.

(FROM "THE POLYNUCLEAR COUNT" -  
 COOKE & PONDER, LONDON, 1927).

ESTABLISHING A DEFINITE CRITERION FOR DECIDING THE NUMBER OF NUCLEAR LOBES IN ANY GIVEN CELL, THEIR WORK CONTAINED NOTHING NEW SINCE IT WAS MERELY A SIMPLIFIED FORM OF AN OLD FORMULA. (FIG. 3 Cf. PLATE 1.)

PINEY SUGGESTED THAT SCHILLING'S CLASSES 1 AND 2 (MYELOCYTES AND YOUNG FORMS (J)) SHOULD BE DISREGARDED, AS THEY APPEARED, SO HE STATED, SO SELDOM AND IN SUCH SMALL NUMBERS IN INFECTIONS AS TO BE OF NO CLINICAL SIGNIFICANCE. IT IS DIFFICULT TO RECONCILE THIS WITH SCHINDLER'S OBSERVATIONS WHICH HAVE ALREADY BEEN REFERRED TO.

FARLEY, ST. CLAIR, AND REISINGER PREPARED A CLASSIFICATION WHICH WAS BASED ON THE WORK OF ARNETH, SCHILLING, PINEY, PONS, KRUMBHAAR, COOKE AND PONDER. TO USE THEIR OWN WORDS THEY ATTEMPTED, "TO POPULARIZE A VALUABLE METHOD, BY FURTHER SIMPLIFICATION, THUS MAKING IT AVAILABLE FOR THOSE LACKING SPECIAL TRAINING IN BLOOD EXAMINATIONS." THEY COMPLAINED THAT ARNETH'S AND COOKE'S AND PONDER'S CLASSIFICATIONS WERE TOO COMPLICATED, WHILE SCHILLING'S LACKED THE CLEAR-CUT DIFFERENTIATION OF CELL NUCLEI WHICH WAS POSSIBLE BY THE FORMER METHODS. THEY THEREFORE SUGGESTED THAT COOKE'S AND PONDER'S FIVE CLASSES SHOULD BE REGROUPED TO FORM TWO LARGER DIVISIONS; THUS THEIR CLASS 1 WAS LEFT UNALTERED AS GROUP 1, AND THEIR CLASSES 2,3,4 AND 5 TAKEN TOGETHER AS GROUP 2. FOLLOWING COOKE'S AND PONDER'S CRITERION, THEY CALLED

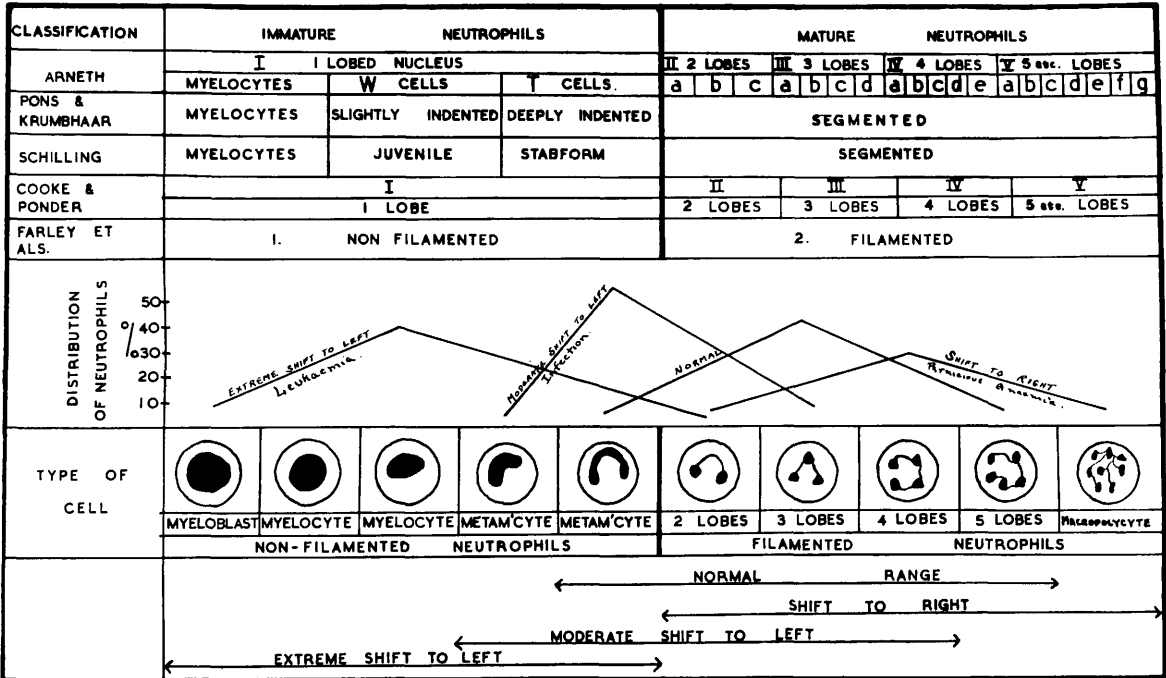


CHART I.

TO SHOW HOW THE VARIOUS CLASSIFICATIONS OF THE NEUTROPHIL GRANULOCYTES, JUST DESCRIBED, MAY BE CORRELATED.

THESE NON-FILAMENT NEUTROPHILS AND FILAMENT NEUTROPHILS RESPECTIVELY. THIS IS VERY SIMILAR TO THE CLASSIFICATION OF PONS AND KRUMBHAAR, EXCEPT THAT THE LATTERS' INFREQUENT GROUP OF METAMYELOCYTES IS IN FARLEY'S CLASSIFICATION INCLUDED IN THE NON-FILAMENT FORM.

MANY OTHER CLASSIFICATIONS OF THE NEUTROPHILS HAVE BEEN FROM TIME TO TIME INTRODUCED, BUT THOSE DESCRIBED ABOVE ARE THE MOST IMPORTANT, AND ARE AT THE SAME TIME REPRESENTATIVE OF ANY WHICH HAVE BEEN OMITTED. (VIDE CHART I.)

IN ADDITION TO THESE FORMULAE, HOWEVER, A NUMBER OF "MEANS," "RATIOS" AND "INDICES" HAVE BEEN INVENTED, BUT IT IS EXTREMELY DOUBTFUL IF ANY OF THESE ARE OF PRACTICAL VALUE. AS AN ILLUSTRATION COOKE'S "WEIGHTED MEAN" MAY BE TAKEN. IN THIS THE PERCENTAGE OF CELLS IN EACH CLASS OF THE COOKE-PONDER FORMULA IS MULTIPLIED BY THE NUMBER OF THE CLASS; THE RESULTS ARE ADDED TOGETHER AND DIVIDED BY 100. THE NORMAL FIGURE IS ABOUT 2.30:- HIGHER NUMBERS INDICATE A SHIFT TO THE RIGHT, AND LOWER ONES A SHIFT TO THE LEFT.

NEUTROPHILIA IS NOT AN OCCURRENCE WHICH IS CONFINED TO INFECTIONS, BUT IS FREQUENTLY ASSOCIATED WITH MANY OTHER PROCESSES BOTH PATHOLOGICAL AND PHYSIOLOGICAL, THUS:-

- I. PHYSIOLOGICAL.
  - A. IN THE NEW-BORN.
  - B. AFTER STRENUOUS EXERCISE.

- C. AFTER CONTINUED OR REPEATED VOMITING.
- D. AFTER CONVULSIONS.
- E. DURING LABOUR.
- F. AFTER PAROXYSMAL TACHYCARDIA.

OF THIS GROUP, C, D AND E ARE PROBABLY VARIANTS  
OF EXAMPLE B.

2. PATHOLOGICAL.

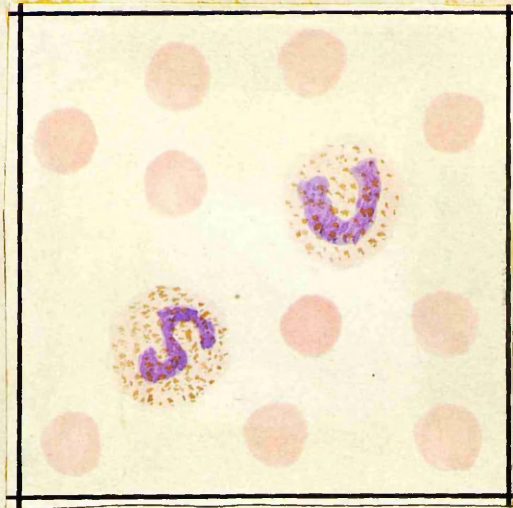
- A. INTOXICATIONS. THESE MAY BE ASSOCIATED WITH:-
  - (1) METABOLIC DISORDERS, E.G. URAEMIA,  
DIABETIC ACIDOSIS, ECLAMPSIA, AND GOUT.
  - (2) POISONING BY VARIOUS CHEMICALS AND DRUGS,  
E.G. LEAD, MERCURY, DIGITALIS, INSECT  
VENOMS, AND FOREIGN PROTEINS (USUALLY  
AFTER A PRELIMINARY NEUTROPENIA).
- B. FOLLOWING ACUTE HAEMORRHAGE.
- C. AFTER OPERATIONS (PROBABLY THE RESULT  
OF TRAUMA TO TISSUES).
- D. ASSOCIATED WITH MALIGNANT NEOPLASMS,  
PARTICULARLY THOSE AFFECTING THE GASTRO-  
INTESTINAL SYSTEM, THE LIVER, AND THE  
BONE MARROW.
- E. IN NON-INFLAMMATORY AUTOLYTIC CONDITIONS  
SUCH AS CORONARY THROMBOSIS.
- F. FOLLOWING SUDDEN HAEMOLYSIS OF RED  
CORPUSCLES.

## G. IN LEUKAEMIC MYELOSIS AND ERYTHRAEMIA.

WITH THE EXCEPTION OF THE NEUTROPHILIA OF THE NEW-BORN, PHYSIOLOGICAL LEUCOCYTOSIS IS A PHENOMENON OF RE-DISTRIBUTION AND IS NOT ASSOCIATED WITH THE APPEARANCE OF IMMATURE GRANULOCYTES.

PATHOLOGICAL NEUTROPHILIA, ON THE OTHER HAND, APPEARS TO BE THE RESULT OF INCREASED MARROW ACTIVITY, AND IS CHARACTERISED BY THE APPEARANCE OF PRE-SEGMENTATION FORMS OF THE NEUTROPHILS IN THE PERIPHERAL BLOOD.

THE AIM OF ALL THE CLASSIFICATIONS OF THE NEUTROPHIL GRANULOCYTES NOW DESCRIBED IS TO GAIN INFORMATION, BY EXAMINATION OF THE PERIPHERAL BLOOD, REGARDING THE CONDITION OF THE MARROW WITH SPECIAL REFERENCE TO THE DEGREE AND NATURE OF ITS ACTIVITY AS A LEUCYTOPOIETIC ORGAN. WITH THE EXCEPTION OF ARNETH, COOKE, AND PONDER, ALL CONTRIBUTORS TO THIS SUBJECT HAVE LAID EMPHASIS ON THE PRE-SEGMENTATION FORMS OF THE NEUTROPHILS. SCHILLING'S METHOD IS MOST WIDELY USED, AND THIS IS JUSTIFIED NOT ONLY BY ITS SIMPLICITY AND RAPIDITY OF EXECUTION, BUT ALSO BECAUSE IT DIRECTS ATTENTION TO THE IMPORTANT STAB NUCLEARS, AND THUS AFFORDS MORE INFORMATION THAN DOES ANY OTHER FORMULA. THE SCHILLING HAEMOGRAM HAS BEEN APPLIED AS A DIAGNOSTIC AND PROGNOSTIC AID TO ALL KINDS OF INFECTION BY MANY WORKERS, WHOSE RESULTS LEAVE NO DOUBT AS TO ITS VALUE. IT HAS BEEN SHOWN THAT THE STAB COUNT IS PROPORTIONAL TO THE

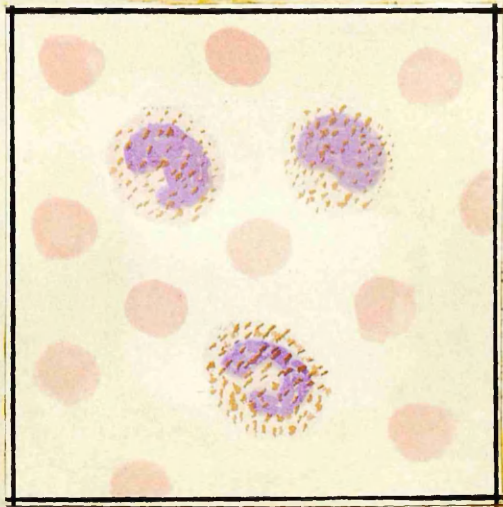


METAMYELOCYTE AND STAB-NUCLEAR  
NEUTROPHIL. THE LATTER HAS  
ADULT AND PYKNOTIC NUCLEAR  
CHROMATIN.

SEVERITY OF THE INFECTION, AND THAT IF JUVENILE CELLS OUTNUMBER THE STAB CELLS, THE PROGNOSIS IS GRAVE, (WILSON AND COOPER 1934, AND CROCKER AND VALENTINE 1936). THIS LAST STATEMENT APPEARS AT FIRST TO BE INCOMPATIBLE WITH WHAT HAS ALREADY BEEN WRITTEN OF SCHILLING'S WORK, BUT WHILE THE UTILITY OF HIS FORMULA CANNOT BE DOUBTED, HIS VIEWS ON LEUCOCYTOSIS AND LEUCOPENIA ARE NOT ACCEPTABLE WITHOUT MODIFICATION.

THE WRITER IS CONVINCED THAT AN INFECTION CAN PRODUCE A HIGH STAB CELL COUNT WITHOUT DEPRESSING THE MARROW TO THE EXTENT OF CAUSING A LEUCOPENIA, AND WITH HIS OPINION MANY HAEMATOLOGISTS ARE IN AGREEMENT. THIS POINT IS IMPORTANT, SINCE IT MAKES THE USE OF THE TERM "DEGENERATIVE" INACCURATE AS APPLIED TO THE MARROW REACTION WHICH RESULTS IN STAB CELL FORMATION.

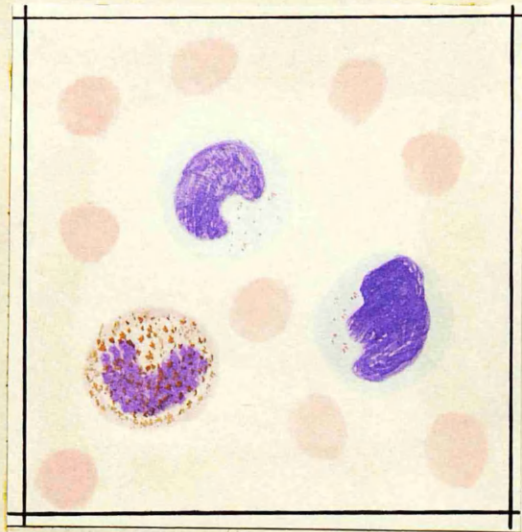
IF AN INFECTION IS LOCALISED, AND OF ONLY MODERATE SEVERITY, THE RESULT WILL BE A LEUCOCYTOSIS WHICH IS BROUGHT ABOUT FIRSTLY BY THE EFFUSION INTO THE BLOOD STREAM OF THOSE FORMED POLYMORPHS ALREADY IN THE MARROW AND READY FOR DISCHARGE WHEN REQUIRED, AND SECONDLY BY INCREASED ACTIVITY OF THE MARROW ALONG STRICTLY NORMAL LINES. AS THE GRAVITY OF THE INFECTION INCREASES, HOWEVER, SO DO THE DEMAND MADE UPON THE MARROW, AND THUS IMMATURE CELLS MAY APPEAR IN THE BLOOD, IN VARYING NUMBERS. THE NUMBER OF IMMATURE GRANULOCYTES WHICH ARE PRESENT DEPENDS,



METAMYELOCYTES SHOWING DIFFERENT  
DEGREES OF INDENTATION OF THE  
NUCLEUS.

NOT ONLY UPON THE VIRULENCE OF THE INFECTION, BUT ALSO UPON THE CAPACITY OF THE MARROW TO RESPOND TO THE DEMANDS MADE UPON IT, SINCE IMMATURE CELLS ARE RELEASED ONLY IN THE ABSENCE OF MATURE ELEMENTS. IT WILL THUS BE SEEN THAT A HIGH JUVENILE OR BAND CELL COUNT IS INDICATIVE OF EITHER A VIRULENT INFECTION, OR A RELATIVELY INCOMPETENT MARROW. AN OVERWHELMING INFECTION MAY ACT IN ONE OF TWO WAYS. IT MAY PRODUCE RAPID EXHAUSTION OF THE BONE MARROW, AND A BLOOD PICTURE CHARACTERISED BY A RAPIDLY DIMINISHING GRANULOCYTE COUNT AND RAPIDLY INCREASING IMMATURITY OF THE NEUTROPHILS PRESENT, OR IT MAY FROM THE FIRST SO DEPRESS MARROW FUNCTION THAT A LEUCOPENIA, WITHOUT THE RELEASE OF EVEN IMMATURE CELLS, IS PRESENT FROM THE OUTSET. IN MOST INFECTIONS, HOWEVER, IRRESPECTIVE OF THEIR SEVERITY, THERE IS EVIDENCE OF INTERFERENCE WITH, THOUGH NOT NECESSARILY DEPRESSION OF, MARROW FUNCTION. THIS EVIDENCE IS IN THE FORM OF THE APPEARANCE OF STAB CELLS IN VARYING NUMBERS. THE MODE OF FORMATION OF STAB-NUCLEAR CELLS HAS ALREADY BEEN DESCRIBED AND IT IS ON THEIR SIGNIFICANCE RATHER THAN THEIR NATURE THAT THE AUTHOR WISHES TO DILATE.

UNLIKE SCHILLING, MANY OF HIS ADHERENTS FREQUENTLY USE THE TERMS "BAND CELL" AND "STAB CELL" AS THOUGH THEY WERE SYNONYMS. THE WRITER BELIEVES THAT THIS IS AN INACCURATE AND DANGEROUS PRACTICE, SINCE STAB CELLS DO NOT REPRESENT JUVENILE CELLS POURED OUT BY



MONOCYTES AND METAMYELOCYTE.

THESE CELLS ARE SOMETIMES  
CONFUSED BY INEXPERIENCED  
OBSERVERS.

A MARROW WHICH IS STRETCHED NEARLY TO THE LIMIT OF ITS LEUCOCYTOPOIETIC CAPACITY. RATHER THEY INDICATE A COMPETENT MARROW WHICH IS SO BURDENED BY A TOXIC SUBSTANCE THAT, ALTHOUGH ITS PRODUCTION SCALE REMAINS UNALTERED, ITS PRODUCTS ARE SO INFLUENCED AS TO BE INCAPABLE OF MATURATION ALONG THE NORMAL PATH. (VIDE PLATE 3.) STAB CELLS THEREFORE REPRESENT YOUNG POLY-MORPHONUCLEARS AND NOT PRE-SEGMENTATION FORMS. THE ANATOMICAL AND PHYSIOLOGICAL CHARACTERS OF THE CELLS THEMSELVES IN FAVOUR OF THIS VIEW, ARE :- THEIR POSSESSION OF PYKNOTIC NUCLEAR CHROMATIN AND WELL DEVELOPED GRANULES; THE ABSENCE OF MITOCHONDRIA AND PRESENCE OF INTER-GRANULAR RED-STAINING AREAS IN SUPRAVITALLY STAINED SPECIMENS; THE PRESENCE OF PSEUDO-PODIUM FORMATION; STREAMING OF THE GRANULES; AND SOME CELLULAR MOVEMENT.

THE NUMBER OF STAB CELLS OCCURRING IN ANY GIVEN CASE DEPENDS THEREFORE, NOT ONLY UPON THE VIRULENCE OF THE INFECTION AND THE REACTIVE POWER OF THE MARROW, BUT ALSO UPON THE DEGREE TO WHICH THIS SPECIFIC INTERFERENCE WITH GRANULOCYTE MATURATION IS PRESENT. MASSIVE INTERFERENCE OF THIS NATURE, HOWEVER, MAY PRODUCE DEPRESSION OF LEUCOCYTOPOIESIS IN PRECISELY THE SAME WAY AS ALREADY DESCRIBED.

REGARDING THE NATURE OF THOSE SUBSTANCES CAPABLE OF CAUSING STAB CELL FORMATION LITTLE IS KNOWN EXCEPT

THAT POISONOUS SUBSTANCES (SUCH AS AMIDOPYRIN) AND POISONS PRODUCED BY ABNORMAL METABOLISM (E.G. THAT OF URAEMIA) HAVE THIS CAPACITY, ALTHOUGH TO A LESSER DEGREE, AS WELL AS BACTERIAL PRODUCTS.

WITH FEW EXCEPTIONS ALL THE STUDIES RECORDED IN THE LITERATURE ON LEUCOCYTE CHANGES IN INFECTION DEAL WITH NUCLEAR CHANGES AS RECORDED BY THE AFORE-MENTIONED AUTHORS. MUCH LESS ATTENTION HAS BEEN DIRECTED, BY CONTRAST TO THE CYTOPLASMIC ALTERATIONS IN THE NEUTROPHILS DURING THE PROGRESS OF DISEASE.

SINCE THE DISCOVERY BY MOMMSEN AND FREYFELD OF A TECHNIQUE WHICH EASILY AND CLEARLY DEMONSTRATED THESE TOXIC OR DEGENERATIVE CYTOPLASMIC CHANGES IN THE NEUTROPHILS, MORE HAS BEEN WRITTEN OF THESE IMPORTANT PHENOMENA. THE TECHNICAL ADVANCES IN THE STUDY OF THE LEUCOCYTES WHICH WERE DEPENDENT UPON CYTOPLASMIC CHARACTERS WILL NOW BE DEALT WITH IN SOME DETAIL.

CESARIS-DEMEL IN 1908 USING SUPRA-VITAL STAINS, OBSERVED AND DESCRIBED WHAT HE BELIEVED TO BE DEGENERATIVE CHANGES IN THE LEUCOCYTES, NAMELY VACUOLATION AND EXCESSIVE GRANULATION. HE WAS OF OPINION THAT THE VACUOLATION WAS DUE TO LOSS OF FAT FROM THE CYTOPLASM OF CELLS "ABOUT TO DIE" AND THAT THE PROCESS WAS ONE OF AUTOPHAGOCYTOSIS. SCHLEIP ALSO RECORDED INCREASED GRANULATION IN NEUTROPHILS DURING SEPTIC LEUCOCYTOSIS. WE ARE INDEBTED TO TURK, HOWEVER, FOR

THE FIRST COMPLETE DESCRIPTION (1912) OF THE CYTOPLASMIC CHANGES IN THE GRANULAR LEUCOCYTES IN A VARIETY OF DISEASES, ESPECIALLY SEVERE INFECTIONS. MOMMSEN, USING A SPECIAL GIEMSA STAIN TOGETHER WITH A BUFFERED DILUTING SOLUTION OF PH 5.4 RE-ENUMERATED THE CHANGES DESCRIBED BY CESARIS-DEMEL; BUT HIS PAPER IS SPECIALLY IMPORTANT BECAUSE OF THE FACTS THAT THE STAINING TECHNIQUE THEREIN DESCRIBED WAS THE PARENT OF THOSE NOW IN GENERAL USE FOR THIS PURPOSE, AND SECONDLY THAT IT WAS THERE SUGGESTED FOR THE FIRST TIME THAT THE DEGREE OF EXCESSIVE GRANULATION MIGHT BE A MEASURE OF THE INTENSITY OF THE INFECTION. BARTA SHOWED THAT BY THIS MEANS IT WAS POSSIBLE TO DIFFERENTIATE BETWEEN LOCALISED AND GENERALISED INFECTION. NAEGELI WAS PARTICULARLY IMPRESSED BY THESE SO-CALLED TOXIC GRANULATIONS, AND BELIEVED THAT THEIR SIGNIFICANCE AS A DIAGNOSTIC AND PROGNOSTIC AID COULD HARDLY BE OVER-ESTIMATED. IN THIS CONNECTION IT IS INTERESTING TO NOTE THAT IN 1923, WHICH WAS TWO YEARS PREVIOUS TO MINOT AND MURPHY'S CLASSICAL WORK ON PERNICIOUS ANAEMIA, NAEGELI COMMENTED ON THE ABSENCE OF TOXIC GRANULES WITHIN THE NEUTROPHILS IN THIS DISEASE, THUS:- "THIS FINDING ALONE IS SUFFICIENT TO CONVINC ME THAT THE CAUSE OF PERNICIOUS ANAEMIA IS NOT INFECTION." FOR PRECISELY SIMILAR REASONS HE CLAIMED THAT LEUKAEMIA WAS NOT AN INFECTION. HIS ARGUMENT THAT THE PRESENCE OF THESE DEGENERATIVE

GRANULES IN CASES OF A-GRANULOCYTOSIS IS EVIDENCE OF AN INFECTIOUS ORIGIN, IS HOWEVER, OBVIOUSLY FAULTY, SINCE THE PAUCITY OF NEUTROPHILS MAY RESULT IN SEPSIS (E.G. ANGINA) AND THIS THEN LEADS TO TOXIC GRANULATION. SPAETH, USING MOMMSEN'S STAINING TECHNIQUE, INVESTIGATED VARIOUS INFECTIONS AND DEDUCED FROM HIS OBSERVATIONS THAT THE TOXIC GRANULATION WAS INDICATIVE OF THE VIRULENCE OF THE INFECTING ORGANISM. IN ADDITION HE DEMONSTRATED THAT PATHOLOGICAL GRANULATION DID NOT ALWAYS RUN PARALLEL TO THE CHANGES IN THE ARNETH AND SCHILLING FORMULAE. VARGA DESCRIBED TWO TYPES OF PATHOLOGICAL GRANULATION:- (A) COARSE GRANULES WHICH HE BELIEVED WERE PRESENT WHEN THE INFECTION WAS AT ITS HEIGHT, AND (B) FINE GRANULES WHICH HE ALLEGED WERE CHARACTERISTIC OF A CONVALESCENT STAGE. GLOOR ALSO DESCRIBED FINE AND COARSE GRANULES. THE FORMER HE CALLED "A" GRANULES, THE LATTER "B" GRANULES. HE INTERPRETED THEIR APPEARANCE IN ANOTHER WAY, HOWEVER, REGARDING THE COARSER GRANULES AS INDICATING A MORE VIRULENT PROCESS OF INFECTION, AND CLAIMING THAT THEY WERE OF SIMILAR NATURE TO THE BASOPHILIC AGGREGATIONS CALLED DOHLE BODIES WHICH OCCUR IN GRAVE CASES OF SCARLET FEVER. MUCH MORE SIGNIFICANT WAS HIS DEMONSTRATION OF THE FACT THAT THE DEGREE OF ABSORPTION WAS MORE IMPORTANT, WITH REGARD TO THE PRODUCTION OF PATHOLOGICAL GRANULATION, THAN THE LOCAL SEVERITY OF A SEPTIC PROCESS.

HE THUS SHOWED THAT THE LARGER THE ABSORBING SURFACE,  
THE GREATER WAS THE ABNORMAL GRANULATION.

MENDELL, MERANZE AND MERANZE HAVE INVESTIGATED  
THE CYTOPLASMIC CHANGES IN A VERY LARGE NUMBER OF  
DISEASES, AND HAVE CONCLUDED THAT IN SEVERE INFECTIONS  
THE DEGENERATIVE INDEX IS OF GREATER SIGNIFICANCE THAN  
NUCLEAR CHANGES AS OBSERVED IN (SAY) THE SCHILLING  
HAEMOGRAM. (THE DEGENERATIVE INDEX HERE REFERRED TO  
IS A DEVICE OF KUGEL'S AND ROSENTHAL'S FOR THE  
REPRESENTATION OF THE EXTENT OF NEUTROPHIL TOXICITY, THUS:-

D.I. =  $\frac{\text{NUMBER OF DEGENERATED NEUTROPHILS}}{\text{TOTAL NUMBER OF NEUTROPHILS COUNTED}}$  AND IS USUALLY

EXPRESSED AS A PERCENTAGE.) MENDELL, MERANZE AND MERANZE  
MADE NO SWEEPING CLAIMS FOR THE UTILITY OF THEIR PROCED-  
URE, AND DREW ATTENTION TO THE FACT THAT THE GREATEST  
CYTOPLASMIC AND NUCLEAR CHANGES IN NEUTROPHIL POLY-  
MORPHS BOTH OCCURRED IN ADVANCED STAGES OF INFECTION.  
THEY FOUND THAT "NON-PURULENT INFECTIOUS STATES, SUCH  
AS RHEUMATIC FEVER, ARTHRITIS, AND TUBERCULOSIS,"- DO  
NOT SHOW HIGH DEGENERATIVE INDICES, WHILE THE SCHILLING  
HAEMOGRAM IS VERY INFORMATIVE. THE CONCLUSIONS TO THEIR  
EXCELLENT PAPER, CONTAINED THE FOLLOWING POINTS:-

"4. THIS SERIES SHOWED THAT AT THE HEIGHT OF THE  
ILLNESS THE DEGENERATIVE INDEX MORE ACCURATELY REFLECTED  
THE EXISTING CLINICAL STATE AND THE SUBSEQUENT COURSE.

5. DEGENERATIVE CYTOPLASMIC CHANGES APPEARED EARLIER,  
AND PERSISTED LONGER, THAN DID THE CORRESPONDING NUCLEAR

CHANGES DURING THE CRITICAL STAGES OF THE ILLNESSES STUDIED.

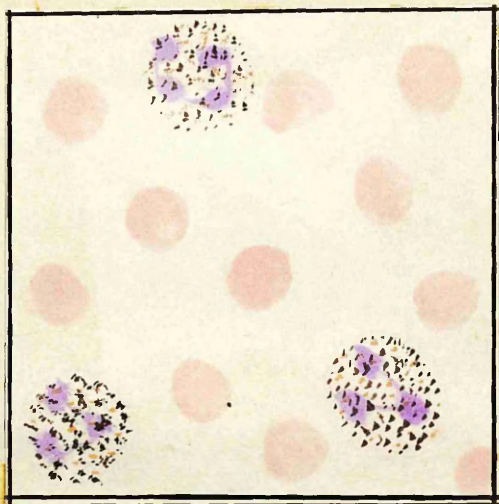
6. IT IS IMPORTANT TO NOTE HOW VALUABLE BOTH TESTS PROVED TO BE, AND THAT, THOUGH THE DEGENERATIVE INDEX PROVED TO BE SUPERIOR IN THE MAJORITY OF CASES, THE SCHILLING INDEX AGAIN SHOWED ITSELF TO BE A VERY VALUABLE PROCEDURE.

7. FROM THIS STUDY IT IS AGAIN EVIDENT THAT NO HAEMOGRAM IN SEVERE INFECTION IS COMPLETE WITHOUT A DETERMINATION OF THE DEGENERATIVE INDEX."

IT IS NOW RECOGNISED THAT DEGENERATIVE CHANGES IN THE PERIPHERAL NEUTROPHILS CONSIST OF :-

- A. VACUOLATION OF THE CYTOPLASM.
- B. ALTERATION OF THE STAINING OF THE CYTOPLASM.
- C. ABNORMAL GRANULATION.

THE ACTUAL PICTURE PRESENTED DEPENDS TO A CONSIDERABLE EXTENT UPON THE STAINING TECHNIQUE USED. THE PRESENT WRITER EMPLOYS HIS OWN MODIFICATION OF KUGEL'S AND ROSENTHAL'S TECHNIQUE, PANCHROM BEING SUBSTITUTED FOR THEIR GIEMSA SOLUTION, AND USES A BUFFER SOLUTION OF PH 6.2. (VIDE CHAPTER 3.) WITH THIS PROCEDURE DEGENERATIVE VACUOLES ARE SEEN MAINLY AT THE PERIPHERY OF THE CYTOPLASM, AND, WHEN PRESENT, GIVE TO THE CELL A MOTH-EATEN APPEARANCE. THE CYTOPLASM OF THESE CELLS STAINS A BLUE OR BLUISH-GREY COLOUR INSTEAD OF THE NORMAL PINK. THE DEGENERATIVE GRANULES MAY BE EITHER



DEGENERATIVE (TOXIC) GRANULES IN  
NEUTROPHIL POLYMORPHS. (FROM A  
CASE OF LOBAR PNEUMONIA).

FINE OR COARSE, STAIN A NAVY BLUE OR BLACK COLOUR, AND ARE IRREGULARLY DISTRIBUTED THROUGHOUT THE CYTOPLASM. THEY ARE FREQUENTLY CONGLOMERATED ROUND THE PERIPHERY OF THE CELL, AND ARE AT ALL TIMES DISTINCT FROM THE FINE, REGULARLY DISTRIBUTED NEUTROPHIL GRANULES OF A NORMAL POLYMORPH. (PLATE 4.)

REGARDING THE NATURE OF THE GRANULES THERE HAS BEEN MUCH SPECULATION ALTHOUGH LITTLE EXPLANATION. THUS SCHILLING BELIEVES THEM TO BE DEGENERATIVE CHANGES OCCURRING IMMEDIATELY BEFORE DEATH OF THE CELL; NAEGELI BELIEVES THAT THEY CONSTITUTE A TOXIC EFFECT ON THE CYTOPLASM; BARTA REGARDS THEM AS PHAGOCYTOSED PARTICLES; HIRSCHFELD AND MOLDOVSKY ARE OF OPINION THAT THEY REPRESENT A REACTIVE CHANGE ON THE PART OF THE LEUCOCYTES.

ACCORDING TO CURRENT LITERATURE, MOST HAEMATOLOGISTS ARE AGREED THAT THESE TOXIC GRANULATIONS, WHATEVER THEIR NATURE AND CAUSE, ARE PRODUCED DURING RIPENING OF THE NEUTROPHILS WHILE STILL IN THE MARROW. NAEGELI, HOWEVER, IS CONVINCED THAT THIS IS NOT SO, THAT THESE GRANULES ARE PRESENT ONLY IN PERIPHERAL NEUTROPHILS, AND RESULT, SO HE CLAIMS, FROM DAMAGE TO THE GRANULOCYTE EITHER AT THE FOCUS OF INFECTION OR BY TOXINS IN THE BLOOD STREAM. WITH THIS LATTER VIEW THE WRITER IS IN FULL AGREEMENT. A SERIES OF SYNCHRONOUSLY PREPARED BLOOD AND BONE MARROW FILMS HAS RECENTLY BEEN MADE FROM PATIENTS

SUFFERING FROM VARIOUS DISEASES ASSOCIATED WITH HIGH DEGENERATIVE INDICES. THE RESULTS SHOW THAT:-

1. TOXIC GRANULES ARE NEVER PRESENT IN MYELOCYTES OR EARLY METAMYELOCYTES IN THE MARROW.
2. THE DEGENERATIVE INDEX OF MARROW POLYMORPHS IS CONSISTENTLY LOWER THAN THAT OF PERIPHERAL POLYMORPHS.
3. THE PERCENTAGE OF MARROW POLYMORPHS WHICH SHOWS TOXIC GRANULATIONS IS SUCH AS TO BE EXPLICABLE ON THE BASIS OF CONTAMINATION OF THE MARROW SPECIMEN, OBTAINED BY STERNAL PUNCTURE, BY CIRCULATING BLOOD.

IT IS DIFFICULT TO BELIEVE THAT EVEN NOW, WHEN THE SIGNIFICANCE AND USEFULNESS OF THESE CYTOPLASMIC CHANGES ARE FULLY RECOGNISED IN AMERICA AND GERMANY, BRITISH HAEMATOLOGISTS STILL CLING TO THOSE FORMULAE WHICH ARE CONSTRUCTED FROM OBSERVATIONS ON THE NUCLEAR CHARACTERS ALONE.

THE PRESENT POSITION OF OUR KNOWLEDGE OF LEUCOCYTOSIS AND THE ASSOCIATED CHANGES IN THE CHARACTERS OF THE NEUTROPHILS HAVE NOW BEEN INDICATED.

THAT THE MYELOID TISSUE AND ITS CIRCULATING PRODUCTS ARE EASILY ALTERABLE EVEN BY WHAT APPEAR TO BE RELATIVELY TRIFLING STIMULI (E.G. CLIMATE, DIGESTION ETC.) REQUIRES NO FURTHER PROOF, AND THE FACT IS SO WELL KNOWN THAT EVEN ENUMERATION OF THE EVIDENCE IS UNNECESSARY.

IF A TOXIC OR SUPPOSEDLY TOXIC PROCESS IS AT

WORK IN THE BODY, EXAMINATION OF THE CIRCULATING LEUCOCYTES, BOTH QUANTITATIVELY AND QUALITATIVELY, WOULD APPEAR TO BE A USEFUL AND POSSIBLY INFORMATIVE ADDITION TO OTHER METHODS OF INVESTIGATION, E.G. CLINICAL, BIOCHEMICAL, AND IMMUNOLOGICAL STUDIES.

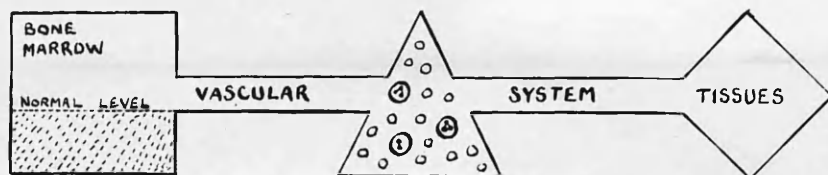
IN SPITE OF THE ONCE POPULAR TOXIC THEORY OF BURN SHOCK, APPARENTLY NO DETAILED INVESTIGATIONS OF THIS KIND HAVE BEEN CARRIED OUT. INDEED, APART FROM THE OCCASIONAL RECORD OF ABNORMALLY HIGH LEUCOCYTE COUNTS (AS HIGH AS 80,000) OCCURRING IN BURNS, OBSERVERS APPEAR TO HAVE ENTIRELY IGNORED THIS PROMISING LINE OF INVESTIGATION.

DIAGRAMS

TO ILLUSTRATE SOME OF THE MECHANISMS DISCUSSED  
IN CHAPTER TWO.

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DIAGRAM I.



BONE MARROW  
varies in its:

1. Capacity to respond.
2. State of activity.
3. Degree of maturation of myeloid cells.
4. Injury from toxæmia.

LEUCOCYTES en  
route to tissues

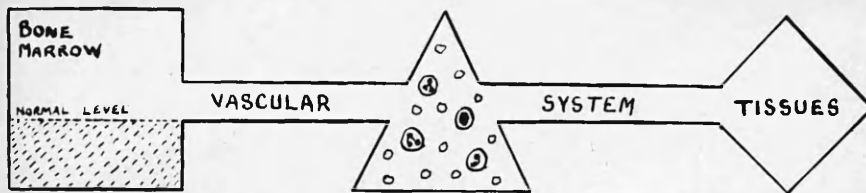
1. Always reflect need of tissue & capacity of marrow to respond.
2. May reflect condition of marrow if cells are freely released.
3. May reflect need of tissues if marrow can freely respond.

TISSUES vary  
in:

1. Need to combat injury.
2. Speed of withdrawal of granulocytes from blood.
3. Degree of injury.

TO ILLUSTRATE THE MECHANISMS OF GRANULOCYTES.

DIAGRAM 2.



BONE MARROW

Normal

BLOOD

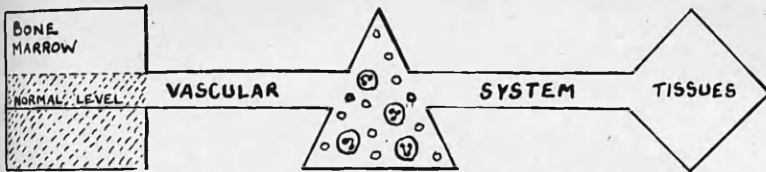
W.B.C. 16,000  
Cells normal.  
Increase in  
number due to  
redistribution.

TISSUES

Normal or  
moderate local  
granulocytosis.

TO ILLUSTRATE PHYSIOLOGICAL LEUCOCYTOSIS E.G. DUE TO  
EFFORT, DIGESTION, PAIN, ETC.

DIAGRAM 3.



BONE MARROW

Increased activity with delivery of more normal cells.

BLOOD

W.B.C. 20,000  
Filamented 80%  
'Toxic' Nil.  
'Stab' Nil.

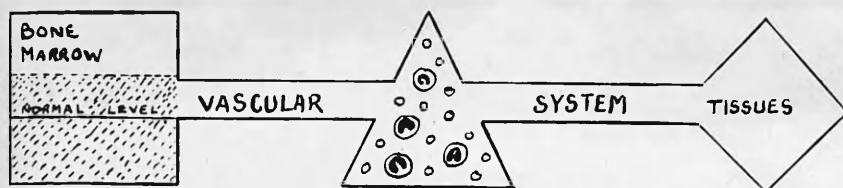
TISSUES

Granulocytosis due to increased need of tissues for defence cells.  
Reaction to injury good.

TO ILLUSTRATE GRANULOCYTE REACTION TO INJURY,

NO INFECTION BEING PRESENT.

DIAGRAM 4.



BONE MARROW

Overactive because of unusually great need for cells or because it works with difficulty.

BLOOD

W.B.C. 20,000  
Filamented 20%  
Immature 60%  
'Toxic' Nil.  
'Stab' Nil.

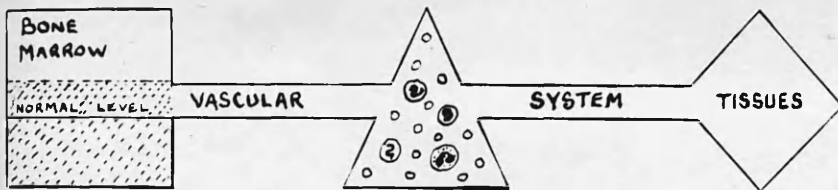
TISSUES

Have great need for granulocytes. Cells are either delivered very rapidly or are produced with great difficulty by marrow thus leaving before fully matured.

TO ILLUSTRATE THE RESULTS OF MORE URGENT NEED OF  
TISSUES FOR GRANULOCYTES OR INADEQUACY OF MARROW.

(VIDE DIAGRAM 3).

DIAGRAM 5.



BONE MARROW

Overactive but injured by toxin. Cells released show evidence of this.

BLOOD

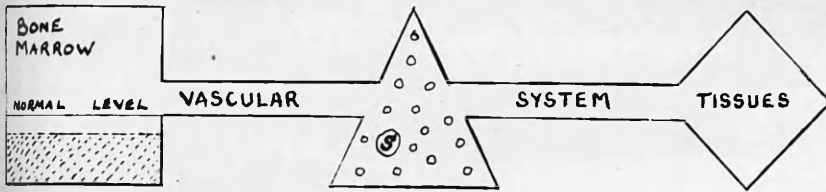
W.B.C. 20,000  
 Filamented 50%  
 Immature 40%  
 'Toxic' & 'Stab' cells abundant.

TISSUES

Increased need for cells as defence against same toxin as damages marrow. Reaction to injury poor.

TO ILLUSTRATE THE GRANULOCYTOSIS ASSOCIATED WITH  
 A TOXAEMIA.

DIAGRAM 6.



BONE MARROW

Depressed by  
toxin. Cells  
immature and  
toxic.

BLOOD

W.B.C. 3,000  
Filamented 50%  
Immature 40%  
'Toxic' & 'Stab'  
cells abundant.

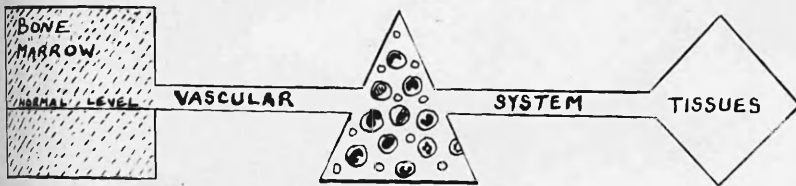
TISSUES

Increased need  
for cells as  
defence against  
same toxin as  
damages marrow.  
Reaction to injury  
very poor.

TO ILLUSTRATE THE EFFECT OF OVERWHELMING TOXAEMIA.

(VIDE DIAGRAM 5).

DIAGRAM 7.



BONE MARROW

Hyperplastic.  
Filled with  
immature cells  
of all types.  
Erythron  
crowded out by  
leucoc.

BLOOD

W.B.C. 200,000  
Filamented 50%  
Myelocytes 40%  
Myeloblasts 8%

TISSUES

Engorged with  
unnecessary cells.  
Spleen etc., may  
take on myelo-  
poietic properties  
due to metaplasia.  
If mature cells are  
few defence is poor.

TO ILLUSTRATE THE CONDITION OF MARROW, BLOOD  
AND TISSUES IN LEUKAEMIC MYELOSIS.

**CHAPTER THREE.**

**PERSONAL CONTRIBUTION TO THE SOLUTION OF THE  
PROBLEM OF THE AETIOLOGY OF BURN SHOCK.**

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## CHAPTER THREE.

IT HAS ALREADY BEEN STATED THAT NO EXAMINATIONS OF THE LEUCOCYTE CHANGES ASSOCIATED WITH SHOCK IN BURNS APPEAR TO HAVE BEEN CARRIED OUT. THE PURPOSE OF THIS CHAPTER AND THE NEXT IS TO RECORD THE RESULTS OF AN INVESTIGATION INTO THE CHANGES IN THE PERIPHERAL LEUCOCYTES IN BURN SHOCK, AND TO INDICATE THE POSSIBLE SIGNIFICANCE OF THESE FINDINGS WITH REGARD TO THE VEXED QUESTION OF THE SHOCK'S AETIOLOGY.

BEFORE PROCEEDING TO DEAL WITH THIS MATTER, HOWEVER, IT IS NECESSARY TO MENTION BRIEFLY THE CLINICAL MANIFESTATIONS OF THIS STATE OF SHOCK AS IT OCCURS IN BURNED PATIENTS. SHOCK IN BURNS DIFFERS FROM SHOCK ASSOCIATED WITH OTHER FORMS OF TRAUMA IN RESPECT OF ITS SIGNS AND SYMPTOMATOLOGY, AND THESE MAY CONVENIENTLY BE DIVIDED INTO FOUR STAGES.

I. INITIALLY, THAT IS AT THE TIME OF INJURY, THE PATIENTS APPARENTLY SUFFER FROM WHAT HAS BEEN CALLED "PRIMARY" SHOCK, THAT IS A STATE WHICH IS CHARACTERIZED BY UNCOMPLICATED FALL IN THE BLOOD PRESSURE AND WHICH IS APPARENTLY OF NEUROGENIC OR PSYCHOGENIC ORIGIN, PROBABLY RESULTING FROM SUCH FACTORS AS PAIN AND FRIGHT. THIS STAGE IS VERY TRANSIENT AND APPEARS TO BE OF LITTLE

IMPORTANCE, IN ALL BUT A FEW CASES HAVING PASSED OFF BY THE TIME OF THE PATIENT'S ADMISSION TO THE INFIRMARY.

2. THIS STAGE IS THAT IN WHICH PRACTICALLY ALL CASES ARE ADMITTED TO THE WARDS ONE TO TWO HOURS AFTER INJURY. IT IS CHARACTERIZED BY A FEELING OF WELL-BEING, WHICH IS OCCASIONALLY SO MARKED AS TO MERIT THE TERM EUPHORIA. THE PATIENTS ARE FREQUENTLY TALKATIVE, AND THE FEW WHO DO COMPLAIN OF PAIN ARE EASILY AND COMPLETELY RELIEVED BY MODERATE DOSES OF MORPHINE SULPHATE - GRAIN  $1/6$  TO  $1/4$ . THE BLOOD PRESSURE IS REMARKABLY NORMAL IN MOST CASES, WHILE THE PULSE VOLUME AND RATE ARE ONLY EXCEPTIONALLY GREATLY ALTERED. THIRST IS FREQUENTLY COMPLAINED OF AT THIS STAGE, AND WATER OR GLUCOSE-SALINE WHEN GIVEN BY MOUTH IS WELL RETAINED.

3. USUALLY WITHIN FOUR TO TEN HOURS, BUT RARELY DELAYED FOR SOME TWENTY-FOUR HOURS, THE THIRST BECOMES INTENSIFIED; BUT FLUIDS GIVEN BY MOUTH ARE NOW IMMEDIATELY VOMITED. DISORIENTATION BECOMES EVIDENT, AND THE PATIENT'S SPEECH IS INDISTINCT AND RAMBLING. IN THIS PHASE THE PATIENTS ARE FREQUENTLY RESTLESS AND REQUIRE A FURTHER DOSE OF MORPHINE SULPHATE. AT THIS TIME, HOWEVER, MODERATE DOSES APPEAR TO BE ALMOST USELESS, AND FREQUENTLY GRAIN  $1/2$  HAS TO BE EMPLOYED.

4. THE FOURTH AND LAST STAGE IS ONE OF DEEPENING COMA, WHICH, IN THE AUTHOR'S EXPERIENCE, INVARIABLY ENDS FATALLY. IT HAS BEEN THE WRITER'S EXPERIENCE THAT,

IF STAGE 2 IS PRESENT ON ADMISSION, STAGE 3 ALMOST INVARIABLY FOLLOWS, BUT TRANSITION TO STAGE 4 OCCURS ONLY IN THOSE CASES WHICH END FATALLY. IN SO FAR AS CHILDREN ARE CONCERNED, STAGE 2 DOES NOT OCCUR AS DESCRIBED, AS INFANTS USUALLY CRY CONTINUOUSLY, WHILE OLDER CHILDREN INVARIABLY COMPLAIN OF CONSIDERABLE PAIN. SHIVERING TOO, IS FREQUENTLY SEEN IN THESE YOUNG PATIENTS. STAGES 3 AND 4, HOWEVER, OCCUR PRECISELY AS DESCRIBED FOR ADULTS.

SUCH THEN IS THE MELANCHOLY RECORD OF THIS IRREVERSIBLE PROCESS. IT APPEARS THAT A BURNED PATIENT IS, FROM THE MOMENT OF THE ACCIDENT, COMMITTED BY THE EXTENT AND DEGREE OF HIS OR HER INJURIES TO RECOVERY OR DEATH. EVEN THOSE CASES WHICH DIE, COULD, WITH PRESENT DAY ADVANCES IN SKIN GRAFTING, ANTISEPTICS, ASEPTIC TECHNIQUE, AND CHEMOTHERAPY, BE ALMOST GUARANTEED TO HEAL, BUT FOR THEIR SUCCUMBING TO BURN SHOCK.

THE CASES TO BE RECORDED WERE CHOSEN, NOT BECAUSE OF THEIR SEVERITY, NOT BECAUSE OF THEIR EXTENT, AND NOT BECAUSE OF THEIR ULTIMATE TERMINATION, BUT SIMPLY BECAUSE IN ALL OF THEM SHOCK DEVELOPED.

THE PERIPHERAL LEUCOCYTES OF ONE HUNDRED AND FIFTY CASES ADMITTED TO THE BURN WARDS OF THE GLASGOW ROYAL INFIRMARY WERE INVESTIGATED AT TWO-HOURLY INTERVALS FROM THE TIME OF THEIR ADMISSION UNTIL FORTY-EIGHT HOURS AFTERWARDS, OR UNTIL THE DEATH OF THE PATIENT.

THE TECHNIQUE OF THE BLOOD EXAMINATIONS WAS AS FOLLOWS:-

1. THE BLOOD FOR EXAMINATION WAS OBTAINED IN THE CASE OF ADULT PATIENTS BY PUNCTURE OF THE PULP OF THE THUMB BY A HAGEDORN NEEDLE, WHILE IN THE CASE OF CHILDREN THE PUNCTURE WAS MADE IN THE HEEL. THE AUTHOR IS CONVINCED THAT THE BEST METHOD OF OBTAINING SPECIMENS FOR HAEMATOLOGICAL INVESTIGATIONS IS BY VENI-PUNCTURE; BUT SINCE THIS WAS SO FREQUENTLY IMPOSSIBLE, OWING TO THE DISTRIBUTION OF MANY OF THE BURNS AND SCALDS, IT WAS DECIDED THAT SAMPLES OF CAPILLARY BLOOD, WHILE PROBABLY LESS ACCURATE, WOULD AT LEAST BE MORE STANDARD, AS THIS METHOD WAS APPLICABLE TO ALL CASES.

2. THE TOTAL LEUCOCYTE COUNT WAS MADE BY MEANS OF A THOMA-ZEISS COUNTING CHAMBER AND A GROUND GLASS COVER SLIP. THE DILUTING FLUID USED WAS A TWO PER CENT AQUEOUS SOLUTION OF ACETIC ACID COLOURED BY METHYLENE BLUE.

3. SYNCHRONOUSLY WITH EACH LEUCOCYTE COUNT, A BLOOD FILM WAS PREPARED ON A GLASS SLIDE.

4. EACH SLIDE THEN HAD THE FILM REMOVED FOR A DISTANCE OF ONE INCH FROM ONE END, AND ON THIS STRIP A SMALL FILM OF NORMAL BLOOD WAS SPREAD.

5. THE BLOOD FILMS SO PREPARED WERE THEN STAINED AS FOLLOWS:-

A. EACH FILM WAS COVERED BY STOCK FILTERED SOLUTION OF MAY-GRUNWALD STAIN, AND THIS

- WAS ALLOWED TO ACT FOR THREE MINUTES.
- B. THE STAIN WAS THEN DILUTED WITH AN EQUAL QUANTITY OF BUFFER SOLUTION (PH 6.2), AND THE SOLUTION WAS THOROUGHLY MIXED BY BLOWING THROUGH A FINE GLASS PIPETTE. THIS DILUTED STAIN WAS ALLOWED TO ACT FOR ONE MINUTE.
- C. THE STAIN WAS THEN Poured, BUT NOT WASHED, OFF.
- D. THE FILM WAS NEXT COVERED BY PANCHROM SOLUTION, PREPARED BY ADDING ONE HUNDRED DROPS OF PANCHROM SOLUTION TO ONE HUNDRED CUBIC CENTIMETRES OF DISTILLED WATER, AND THIS STAIN WAS ALLOWED TO ACT FOR EIGHTEEN MINUTES.
- E. AT THE END OF THIS TIME THE STAIN WAS WASHED OFF WITH BUFFER SOLUTION, AND THE FILM WAS THEN THOROUGHLY RINSED IN RUNNING TAP WATER.
- F. THE SMALL FILM OF NORMAL BLOOD WAS NOW EXAMINED UNDER A HIGH POWER OF THE MICROSCOPE AND THE STAINING OF THE WHITE CELLS NOTED. THIS PROCEDURE PROVED TO BE OF VERY GREAT VALUE, SINCE THE FILM OF PATIENT'S BLOOD COULD BE CONSIDERED SUITABLE FOR EXAMINATION ONLY IF THE CONTROL FILM WAS SATISFACTORILY STAINED.
- WITH THE TECHNIQUE DESCRIBED, HOWEVER, THE STAINING REACTIONS OF THE WHITE CELLS WERE REMARKABLY CONSTANT, AND DEGENERATIVE GRANULES, WHEN PRESENT, WERE EASILY RECOGNISED BY THEIR

DEEP NAVY-BLUE COLOUR.

6. EACH FILM WAS EXAMINED UNDER AN OIL-IMMERSION LENS, AND FROM A DIFFERENTIAL COUNT OF TWO HUNDRED CELLS A HAEMOGRAM WAS CONSTRUCTED.

7. THE VARIATIONS IN THE PERIPHERAL LEUCOCYTE PICTURE WERE THEN REPRESENTED GRAPHICALLY BY PIECING TOGETHER THE SERIAL BLOOD FINDINGS.

FOR THE VERY NECESSARY PURPOSES OF COMPARISON AND CONTROL THE CASES WERE CLASSIFIED AS:-

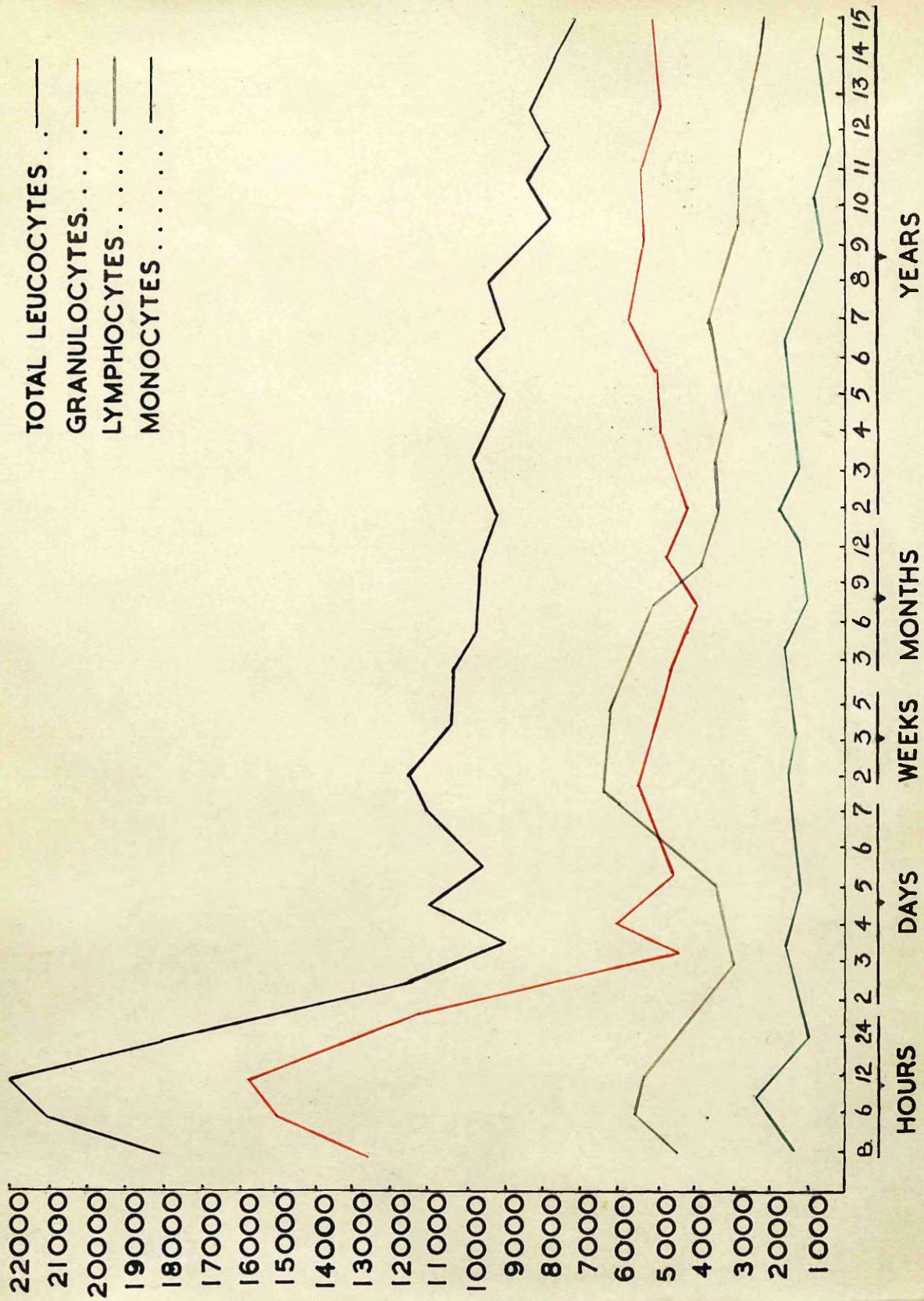
(1) THOSE TREATED BY TANNIC ACID OR SOME OTHER COAGULANT METHOD, AND -

(2) THOSE TREATED BY THE APPLICATION OF ONE PER CENT OF EMULSION OF SULPHANILAMIDE IN COD LIVER OIL.

SUCH A DIVISION IS NECESSARY IN ORDER THAT ANY LEUCOCYTE CHANGES FOUND MIGHT NOT BE ATTRIBUTED TO THE TREATMENT EMPLOYED - A CRITICISM THAT HAS ALREADY BEEN DIRECTED BY THE AUTHOR AGAINST A NUMBER OF INVESTIGATIONS IN THIS FIELD; AND SECONDLY BECAUSE OF THE VERY DIFFERENT MOTIVES FOR THESE TWO FORMS OF THERAPY. THE COAGULANT TREATMENT HAS ALREADY BEEN SHOWN TO BE BASED ON THE TOXIC CONCEPTION OF BURN SHOCK, WHILE THE CHEMOTHERAPEUTIC MEASURES ARE OBVIOUSLY FOUNDED ON THE BACTERIAL VIEW-POINT.

EACH OF THESE PRIMARY DIVISIONS IS SUB-DIVIDED ACCORDING TO THE AGE OF THE PATIENTS, THUS:-

- A. CHILDREN - UP TO FIFTEEN YEARS OF AGE, AND
- B. ADULTS - OVER FIFTEEN YEARS OF AGE.



TO ILLUSTRATE THE PERIPHERAL LEUCOCYTE PICTURE AT VARIOUS AGES. (AFTER KATO).

THESE SUB-GROUPS ARE MADE NECESSARY BY TWO FACTORS. FIRSTLY, INFANTS AND YOUNG CHILDREN ARE KNOWN TO DEVELOP SHOCK EVEN WITH RELATIVELY MINOR BURNS AND SCALDS AND TO SUCCUMB TO IT READILY. FURTHER IT IS RECOGNISED THAT THE YOUNGER THE CHILD, THE WORSE IS THE PROGNOSIS. SECONDLY, THE LEUCOCYTOPOIETIC TISSUE OF A CHILD IS NOT ONLY MORE QUANTITATIVELY ACTIVE THAN THE ADULT'S, BUT APPEARS TO BE, AT LEAST AS JUDGED BY ITS REACTION TO THE STIMULUS OF SEPSIS, MORE LABILE ALSO. (KATO ET AL.) IF THE FIRST POINT ALONE IS CONSIDERED, IT MAY BE JUSTIFIABLY ARGUED THAT THE SUB-GROUP "A" IS INADEQUATE, SINCE IT INCLUDES INFANTS AND CHILDREN BOTH YOUNG AND OLD. NEVERTHELESS, AS HAS ALREADY BEEN INDICATED, THE PRESENT INVESTIGATION IS CONCERNED WITH THE LEUCOCYTE CHANGES RATHER THAN THE DEGREE OF SHOCK OR ITS RESULT, AND THEREFORE THE ONLY REACTION OF THE PATIENT WHICH IS OF IMPORTANCE IS THE LEUCOCYTIC ONE. ACCORDING TO THE INVESTIGATIONS OF KATO ET AL., THE PERIPHERAL-LEUCOCYTE PICTURE OF THE CHILD FROM BIRTH TO ABOUT TWELVE YEARS VARIES CONSIDERABLY FROM TIME TO TIME, BUT BY THE FIFTEENTH YEAR IT HAS SETTLED DOWN TO THE AVERAGE NORMAL ADULT LEVEL. THIS OBSERVATION, THEN, HAS BEEN THE WRITER'S GUIDE IN HIS SUB-DIVISION OF THE CASES. IT APPEARED TEMPTING TO SEPARATE THE MALE FROM THE FEMALE PATIENTS, BECAUSE OF THE LATTERS' ALLEGED SPECIAL SUSCEPTIBILITY TO SHOCK, BUT FOR PRECISELY

SIMILAR REASONS THIS PLAN WAS REJECTED. IN ORDER THAT THE CLASSIFICATION PROPOSED AND ADOPTED MIGHT EMBRACE ALL THE CASES, HOWEVER, A THIRD SMALL GROUP HAD TO BE ADDED, THUS:-

(3) THOSE CASES ( ALL ADULTS, AS IT HAPPENED) WHICH RECEIVED NO TREATMENT FOR THEIR INJURIES BECAUSE OF THEIR EXTENT AND SEVERITY AND THE OBVIOUS FACT THAT DEATH COULD NOT BE DELAYED FOR MORE THAN A FEW HOURS.

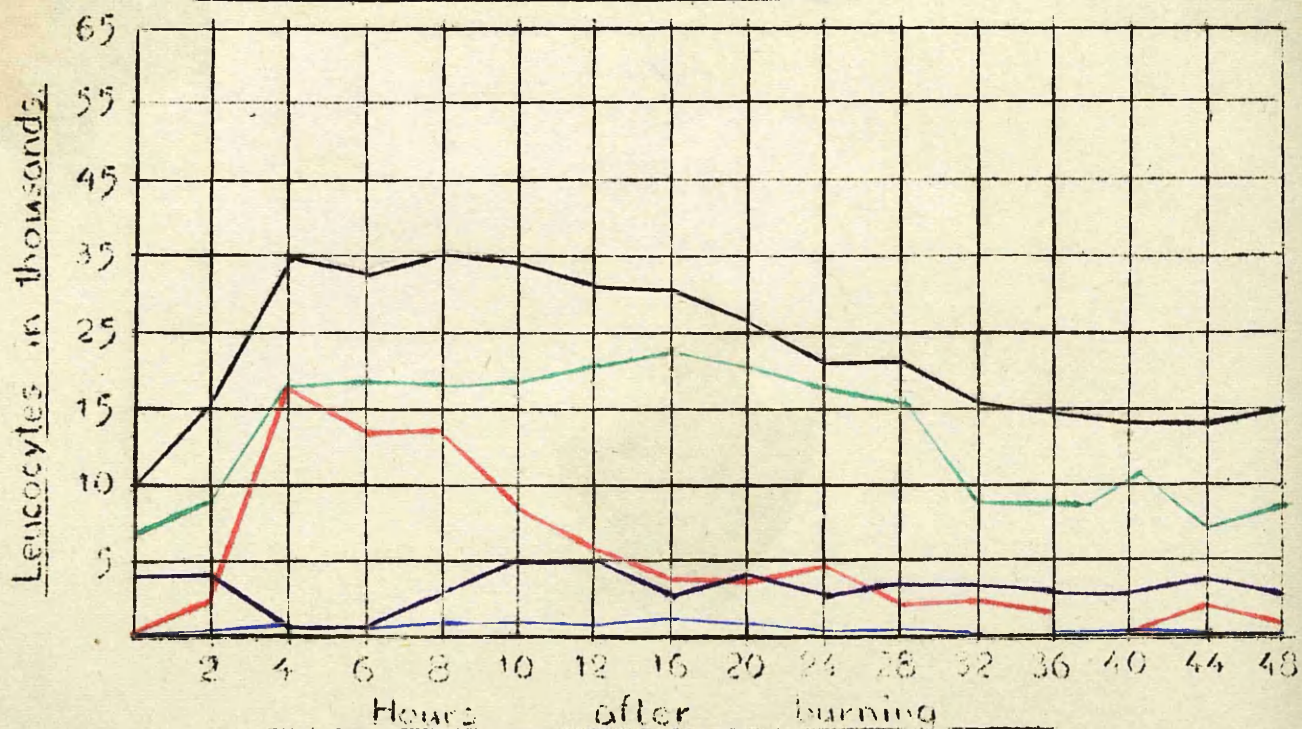
### ILLUSTRATIVE CASES.

#### GROUP I.

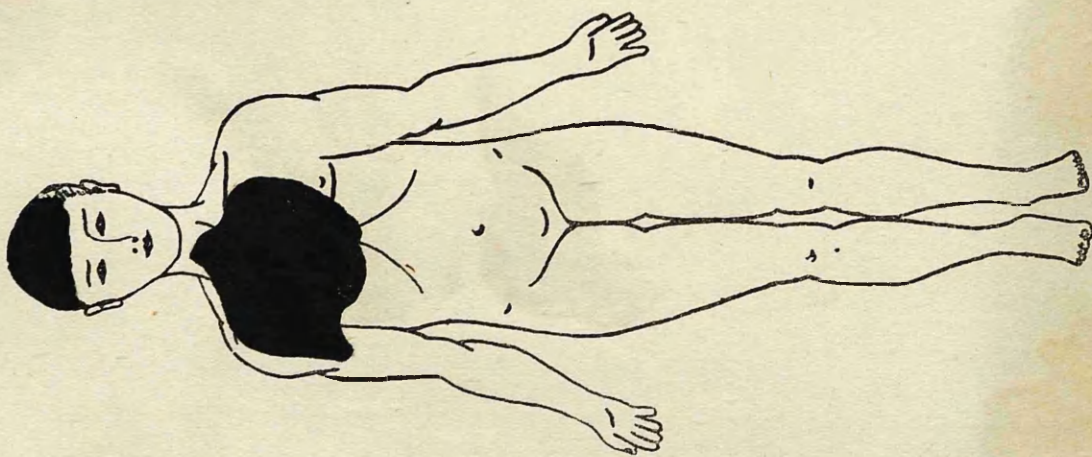
##### SUB-GROUP A.

(1) CASE NO. 4. THE PATIENT WAS A FEMALE INFANT AGED TEN MONTHS, WHO WAS ADMITTED TO THE WARDS WITHIN ONE HOUR OF SUSTAINING A SCALD OF THE HEAD AND THORAX. THE CHILD HAD UPSET A CUP OF HOT TEA, WHICH HAD SPILLED OVER HER. ON ADMISSION SHE WAS QUIET AND THEREFORE DID NOT APPEAR TO BE SUFFERING PAIN. HER TEMPERATURE WAS 99.8F. THE PULSE WAS VERY RAPID, BUT WAS REGULAR AND OF FAIR VOLUME. THE RESPIRATIONS WERE NOT DISTURBED. IN SPITE OF THE PATIENT'S CALMNESS, MIN. 5 NEPENTHE WERE ADMINISTERED IN MILK, BEFORE THE CHILD WAS BATHED, AND THE INJURED AREAS WERE CLEANED. ALL THE BLISTERS WERE SNIPPED AND STRIPPED. A COAGULUM WAS APPLIED BY REPEATEDLY SWABBING OVER THE SCALDED

# HAEMATOLOGICAL FINDINGS



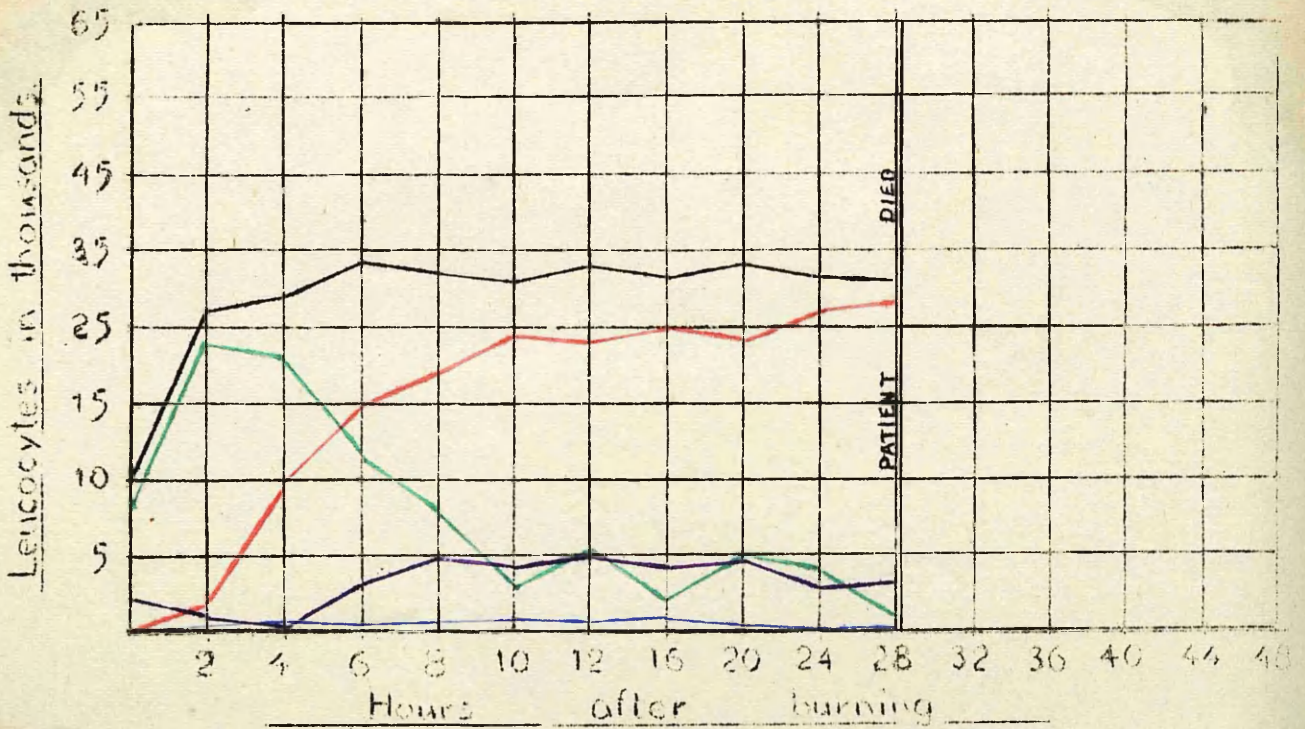
Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



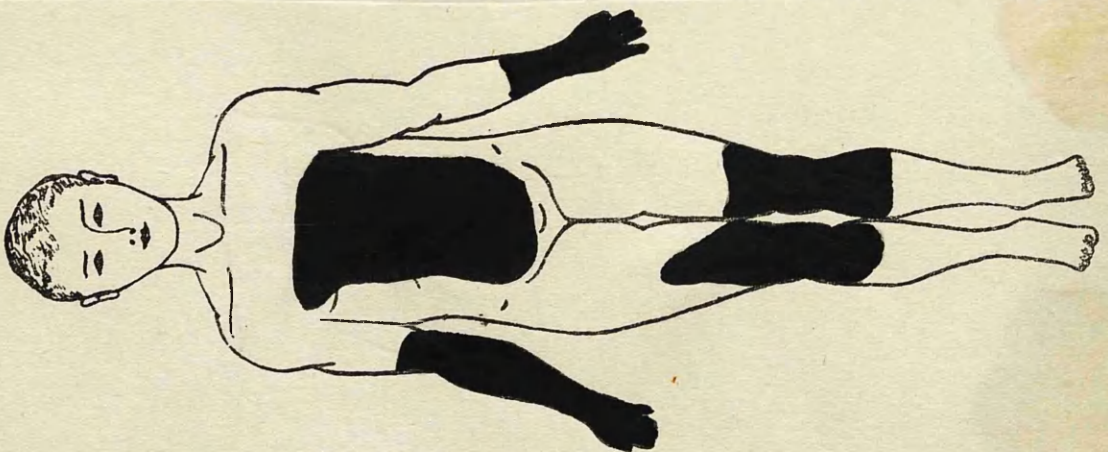
AREAS WITH A MIXTURE OF GENTIAN VIOLET ONE PER CENT AND BRILLIANT GREEN ONE PER CENT, AND FINISHING WITH SEVERAL APPLICATIONS OF TEN PER CENT AQUEOUS SOLUTION OF SILVER NITRATE. THE APPLICATION OF THESE SUBSTANCES OCCASIONED NO PAIN, AND IN THIS RESPECT THEY HAD AN ADVANTAGE OVER TANNIC ACID WHICH MADE THEM PARTICULARLY USEFUL FOR THE TREATMENT OF YOUNG CHILDREN. THE PATIENT DRANK WELL, AND FLUID IN THE FORM OF GLUCOSE-SALINE WAS ADMINISTERED FREELY. AT THE END OF FOUR HOURS, HOWEVER, THE CHILD BEGAN TO RETURN THE FLUIDS. SHE WAS RESTLESS, AND HER PULSE WAS MARKEDLY WEAKER. THUS SHE REMAINED FOR SOME SIX HOURS, AT THE END OF WHICH TIME SOME IMPROVEMENT IN THE AMPLITUDE OF THE PULSE WAS NOTICED AND SMALL QUANTITIES OF FLUID WERE AGAIN RETAINED. THE PATIENT WAS NOW REMOVED FROM THE SHOCK ROOM (TEMPERATURE 75<sup>0</sup>F) IN WHICH SHE HAD BEEN TREATED SO FAR, AND PUT INTO THE WARDS. THE VARIATIONS IN THE PERIPHERAL LEUCOCYTE PICTURE ARE SHOWN IN THE ACCOMPANYING CHART.

- (ii) CASE No. 17. A BOY OF TEN YEARS WAS ADMITTED ONE HOUR AND A HALF AFTER FALLING, WHILE AT PLAY, ON HOT SLAG WHICH HAD JUST BEEN TIPPED OUT OF A TRUCK ON TO A BING. HE HAD SUSTAINED SEVERE AND EXTENSIVE BURNS OF THE CHEST, ABDOMEN, UPPER AND LOWER LIMBS.

# HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_

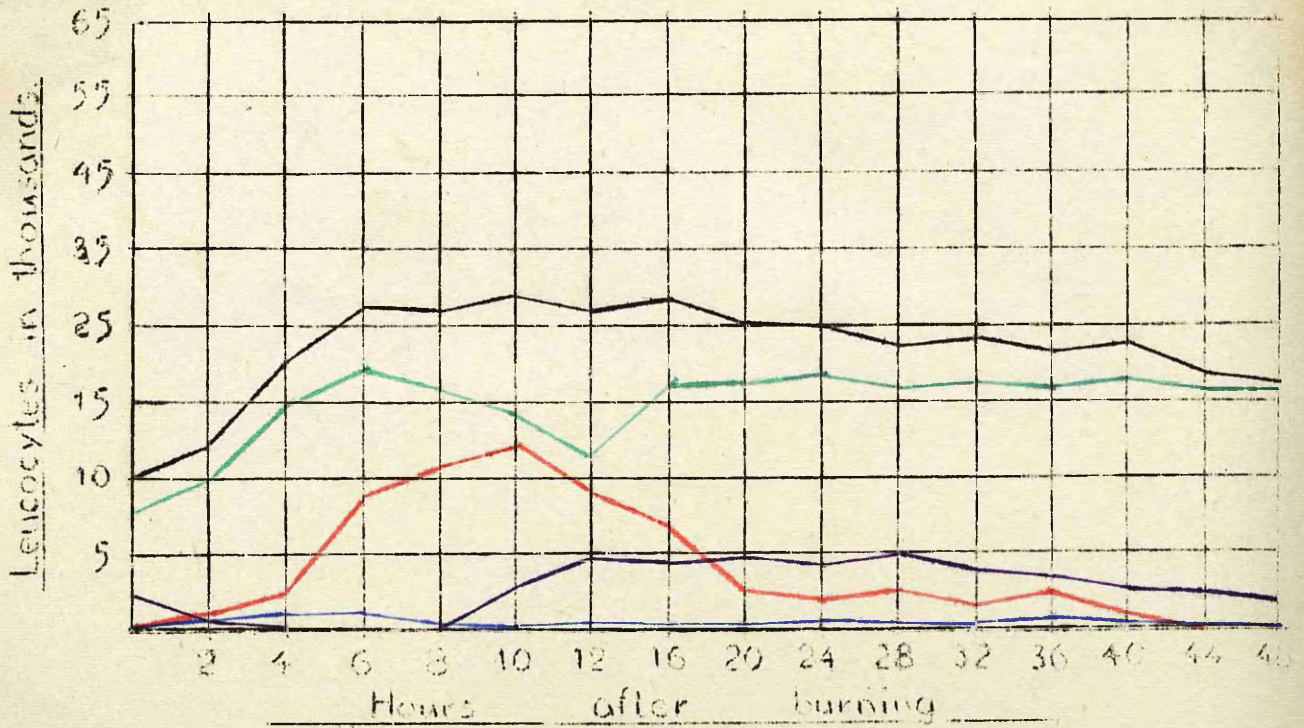


THE DISTRIBUTION OF THE BURNS IS SHOWN IN THE ACCOMPANYING DIAGRAM. ON ADMISSION THE PATIENT CRIED CONTINUOUSLY AND APPEARED TO BE IN GREAT PAIN. HIS TEMPERATURE WAS 100<sup>0</sup>F AND THE PULSE RATE 130 PER MINUTE. MINS.15 NEPENTHE WERE ADMINISTERED BEFORE THE CHILD WAS BATHED. ALL BLISTERS WERE SNIPPED AND STRIPPED AND TISSUE DEBRIS REMOVED WHERE POSSIBLE BY FORCEPS AND SCISSORS. A COAGULUM WAS THEN APPLIED, WITH GENTIAN VIOLET ONE PER CENT, BRILLIANT GREEN ONE PER CENT, AND SILVER NITRATE TEN PER CENT. THE PATIENT DRANK THIRSTILY AND FLUIDS WERE GIVEN FREELY, BUT TWO HOURS AFTER ADMISSION VOMITING COMMENCED. HE BECAME EXTREMELY RESTLESS, AND IT WAS NECESSARY TO REPEAT THE NEPENTHE. SIX HOURS LATER HE BECAME COMATOSE. THE PULSE RATE WAS NOW 100 PER MINUTE, BUT THE VOLUME POOR. FLUIDS WERE ADMINISTERED PER RECTUM, BUT THESE WERE NOT RETAINED. THE CHILD DIED THIRTY HOURS AFTER ADMISSION, WITHOUT REGAINING CONSCIOUSNESS. THE VARIATIONS WHICH OCCURRED IN THE PERIPHERAL LEUCOCYTE PICTURE ARE SHOWN IN THE CHART.

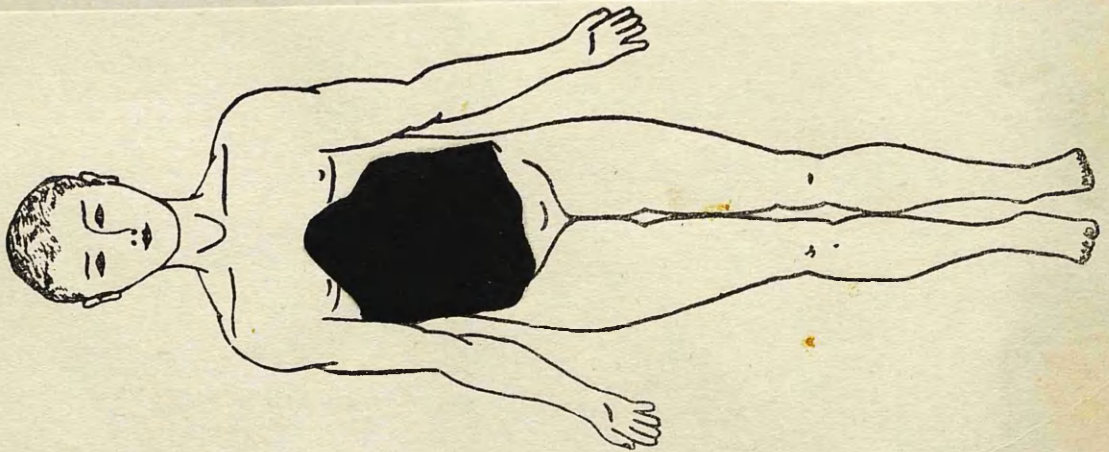
SUB-GROUP B.

- (1) CASE No. 25. A FEMALE AGED FORTY YEARS WAS ADMITTED THIRTY MINUTES AFTER INJURY. SHE HAD OVERTURNED A PAN OF HOT FAT, AND RECEIVED SCALDS

# HAEMATOLOGICAL FINDINGS



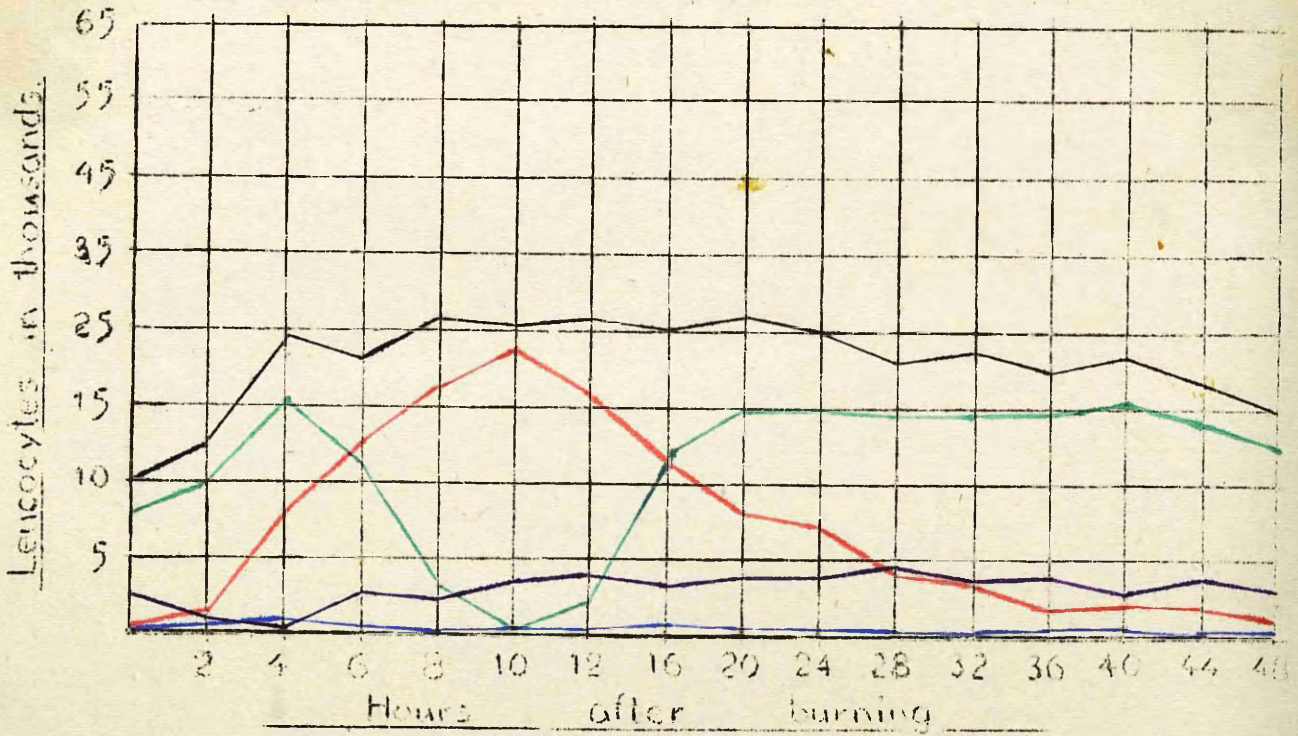
Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_  
 & Monocytes \_\_\_\_\_



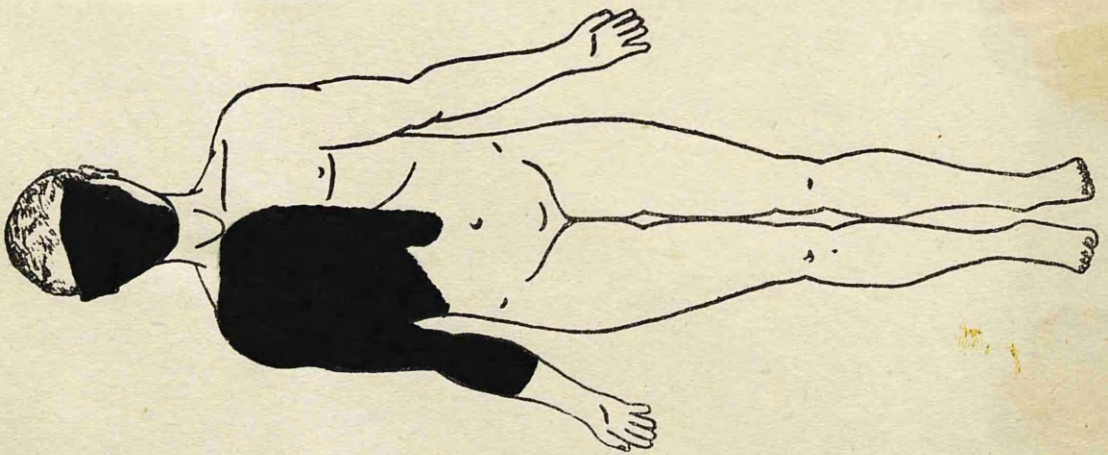
OF THE CHEST AND ABDOMEN, DISTRIBUTED AS IN THE ACCOMPANYING DIAGRAM. ON ADMISSION SHE COMPLAINED OF SOME PAIN, AND MORPHINE SULPHATE GRAIN 1/4 WAS ADMINISTERED BY HYPODERMIC INJECTION. THE PATIENT WAS THEN BATHED AND THE BLISTERS CUT AWAY. A COAGULUM WAS APPLIED WITH DIFFICULTY, BECAUSE OF THE PROFUSE EXUDATION OF SEROUS FLUID FROM THE DENUDED AREA. TANNIC ACID TWO AND A HALF PER CENT WAS SPRAYED ON, AND EACH APPLICATION DRIED WITH A HAIR-DRYER BEFORE THE NEXT WAS APPLIED. THE PATIENT DRANK THIRSTILY, AND GLUCOSE-SALINE WAS FREELY ADMINISTERED. SIX HOURS AFTER ADMISSION SHE BECAME RESTLESS AND AGAIN COMPLAINED OF PAIN, NECESSITATING A FURTHER DOSE OF MORPHINE SULPHATE. ALL ORALLY ADMINISTERED FLUIDS WERE NOW IMMEDIATELY RETURNED, BUT THE PATIENT DID NOT LOSE CONSCIOUSNESS. EIGHT HOURS LATER SHE WAS MUCH MORE COMFORTABLE, AND THE VOMITING HAD CEASED. THE VARIATIONS IN THE LEUCOCYTE PICTURE OVER THE FIRST FORTY-EIGHT HOURS ARE SHOWN IN THE CHART.

(II) CASE No. 47. A MALE AGED FORTY-TWO YEARS WAS ADMITTED ONE HOUR AFTER SUSTAINING SEVERE BURNS OF THE RIGHT ARM AND CHEST. THE PATIENT WAS EMPLOYED IN AN ENGINEERING FACTORY AND HAD BEEN TESTING AN ELECTRIC MOTOR, IN A GAS-FILLED TANK. THE MOTOR PROVED FAULTY AND AN EXPLOSION RESULTED

# HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_  
 Monocytes \_\_\_\_\_



BEFORE THE PATIENT HAD GONE BEHIND THE SAFETY-SCREEN. HIS DUNGAREES WERE SET ALIGHT ABOUT HIS CHEST AND RIGHT ARM, AND THE FLAMES WERE EXTINGUISHED WITH GREAT DIFFICULTY BECAUSE OF THE OIL-SOAKED NATURE OF THE FABRIC. ON ADMISSION HE FELT WELL, AND WAS EXTREMELY TALKATIVE. THERE WAS NO COMPLAINT OF PAIN, TEMPERATURE 98<sup>0</sup>F, PULSE 96 PER MINUTE, REGULAR AND OF GOOD VOLUME. IN ANTICIPATION OF THE PAIN OCCASIONED BY BATHING, MORPHINE SULPHATE GRAIN 1/4 WAS GIVEN SUBCUTANEOUSLY. ALL THE BLISTERS AND TISSUE DEBRIS WERE REMOVED WITH FORCEPS AND SWABS. A COAGULUM WAS APPLIED TO THE INJURED AREAS BY THE REPEATED USE OF THE TANNIC ACID SPRAY, EACH APPLICATION BEING DRIED BEFORE THE NEXT WAS SUPERIMPOSED. FOR SOME SIX HOURS AFTER ADMISSION THE PATIENT WAS FAIRLY COMFORTABLE, AND DRANK WELL. VOMITING COMMENCED AT SEVEN HOURS, HE BECAME RESTLESS AND REQUIRED MORPHINE. THE PATIENT DID NOT LOSE CONSCIOUSNESS, AND TWENTY-FOUR HOURS AFTER ADMISSION WAS FIT TO BE REMOVED INTO THE WARD. THE CHANGES OCCURRING IN THE PERIPHERAL LEUCOCYTES DURING THE FIRST FORTY-EIGHT HOURS ARE SHOWN IN THE CHART.



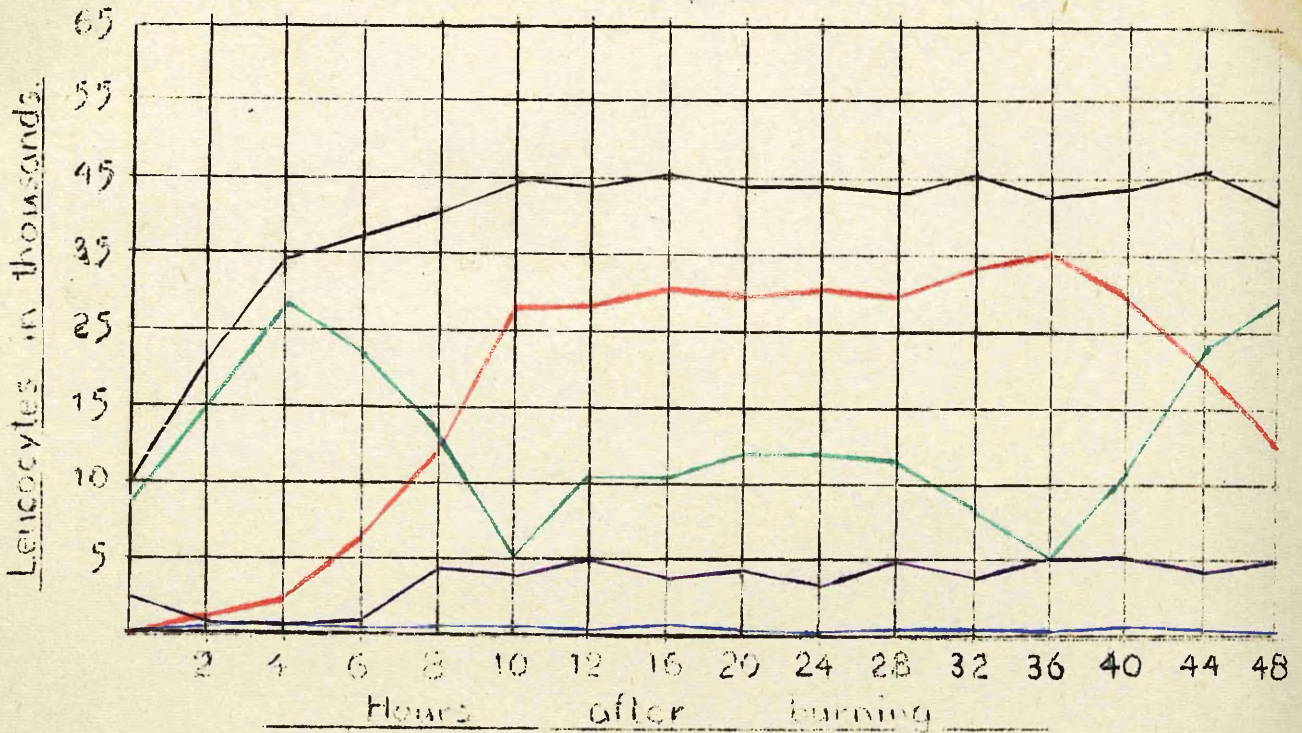
GROUP 2.

## SUB-GROUP A.

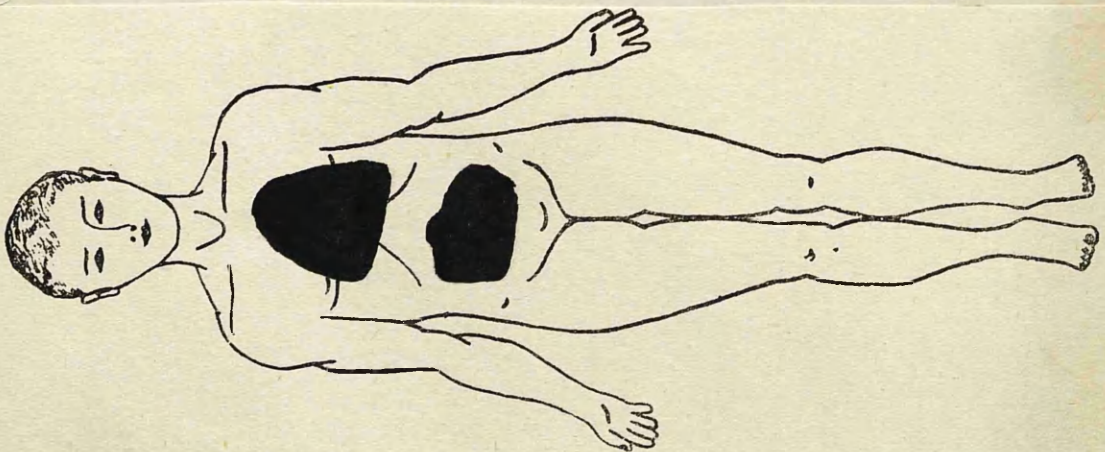
(I) CASE No. 83. A FEMALE CHILD THREE YEARS OF AGE, WAS ADMITTED ABOUT FORTY-FIVE MINUTES AFTER BEING SCALDED OVER THE LOWER LIMBS. THE TODDLER HAD PULLED A TEA-POT FULL OF TEA OFF THE KITCHEN RANGE, AND THE CONTENTS HAD SPILLED OVER HER LOWER LIMBS. AFTER ADMISSION SHE CRIED CONTINUOUSLY, SHIVERING THE WHILE. HER TEMPERATURE WAS 100°F, HER PULSE RAPID AND WEAK. NEPENTHE MINS.10 WAS ADMINISTERED IN MILK, AND THEN THE CHILD WAS BATHED AND HAD THE SCALDED AREAS CLEANED UP BY REMOVAL OF ALL EPITHELIAL DEBRIS. DRESSINGS OF ONE PER CENT SULPHANILAMIDE IN COD LIVER OIL WERE APPLIED. THE PATIENT DRANK WELL, UNTIL FOUR HOURS AFTER ADMISSION, WHEN VOMITING COMMENCED. THE CHILD THEN BECAME EXTREMELY RESTLESS, AND NEPENTHE MINS.15 HAD TO BE GIVEN RECTALLY IN A LITTLE NORMAL SALINE. SUBSEQUENTLY SHE QUIETENED DOWN, THE PULSE VOLUME IMPROVED, AND AFTER TWENTY-FOUR HOURS SHE WAS FIT TO BE MOVED INTO THE WARDS. THE VARIATIONS IN THE LEUCOCYTE PICTURE DURING THE FIRST FORTY-EIGHT HOURS ARE SHOWN IN THE CHART.

(II) CASE No. 92. A MALE INFANT OF EIGHT MONTHS WAS ADMITTED THIRTY MINUTES AFTER BEING SCALDED ABOUT THE CHEST AND ABDOMEN. THE MOTHER HAD BEEN NURSING

## HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes & Monocytes ———  
 Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———

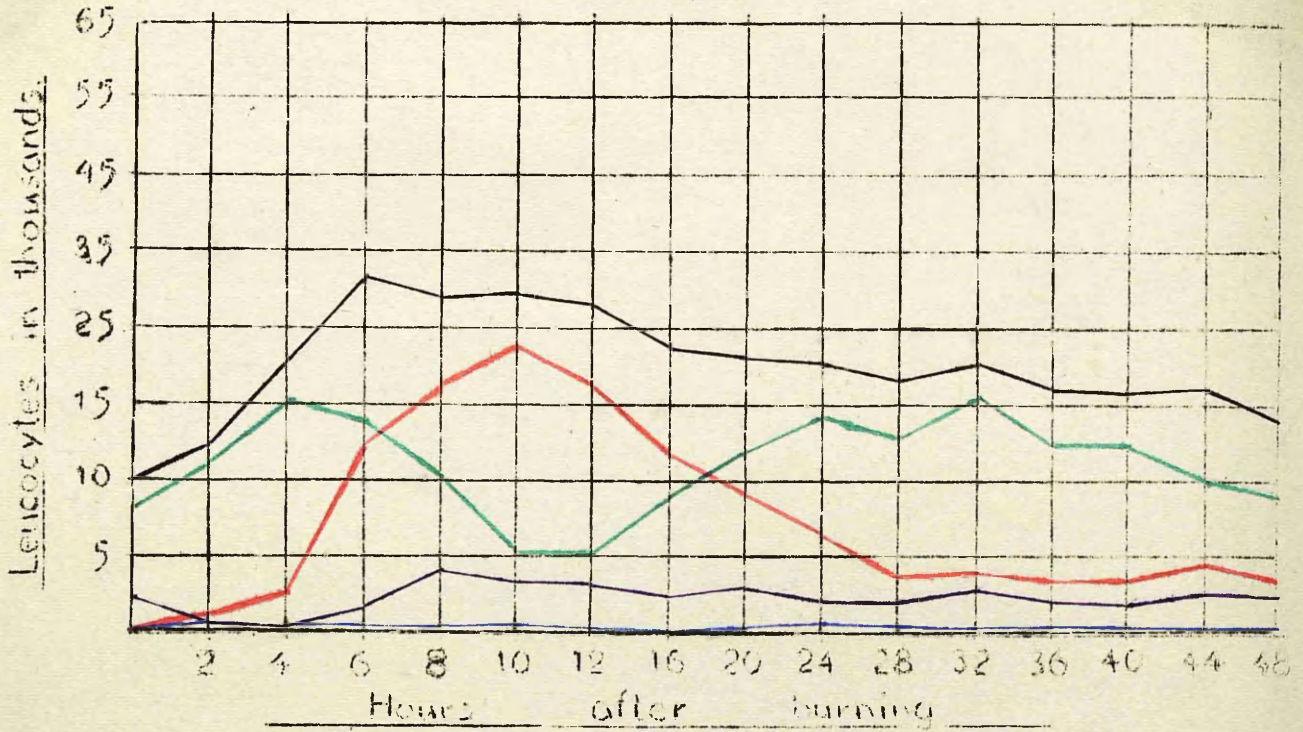


THE INFANT, WHILE SHE HERSELF WAS DRINKING TEA, AND HAD INADVERTANTLY SPILLED IT OVER THE CHILD. AFTER ADMISSION THE PATIENT CRIED CONTINUOUSLY AND APPEARED TO BE IN PAIN. HIS TEMPERATURE WAS 101<sup>0</sup>F, AND THE PULSE VERY RAPID AND WEAK. NEPENTHE MINS.5 WAS ADMINISTERED IN MILK, THE CHILD WAS BATHED, AND THE SCALDED AREAS WERE CLEARED OF DEBRIS. DRESSINGS OF ONE PER CENT SULPHANILAMIDE IN COD LIVER OIL WERE APPLIED. THE INFANT DRANK WELL UNTIL FOUR HOURS AFTER ADMISSION, WHEN VOMITING COMMENCED. RECTAL SALINES WERE ADMINISTERED, BUT THESE WERE NOT RETAINED. THREE HOURS LATER THE PATIENT WENT INTO A RESTLESS COMA, HIS PULSE BECAME EXTREMELY WEAK, AND AT TIMES THE HEART WAS MARKEDLY IRREGULAR. FORTY-EIGHT HOURS AFTER ADMISSION HIS CONDITION WAS LITTLE CHANGED, EXCEPT THAT FLUIDS ADMINISTERED IN SMALL QUANTITIES PER RECTUM WERE NOW WELL RETAINED, AND THE PULSE THOUGH WEAK, WAS REGULAR IN RHYTHM. THE VARIATIONS IN THE PERIPHERAL LEUCOCYTE PICTURE ARE SHOWN IN THE CHART.

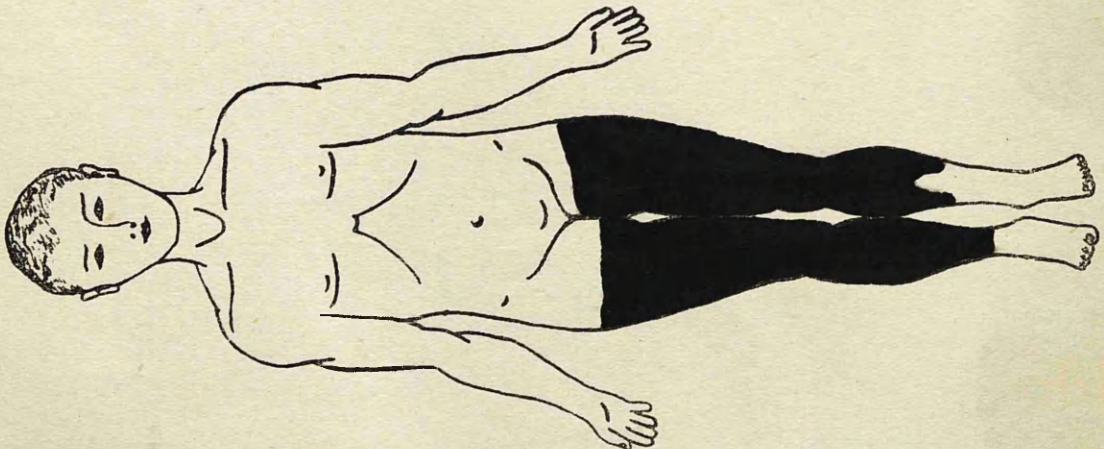
SUB-GROUP B.

- (1) CASE NO. 118. A YOUNG ADULT MALE AGED EIGHTEEN YEARS, WAS ADMITTED ONE AND A HALF HOURS AFTER BEING BURNED ABOUT THE LOWER LIMBS. APPARENTLY THE PATIENT HAD SEATED HIMSELF WITH HIS LEGS OVER

## HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes }  
 ( & Monocytes )



A SMALL FURNACE FLUE, IN ORDER TO WARM THEM. HIS DUNGAREES CAUGHT FIRE. WHEN ADMITTED, HE WAS SUFFERING NO PAIN, BUT WAS TALKATIVE AND COMPLAINED OF THIRST. HIS TEMPERATURE WAS 98.8<sup>0</sup>F, AND THE PULSE 94 PER MINUTE. MORPHINE GRAIN 1/4 WAS GIVEN SUBCUTANEOUSLY AND THE PATIENT BATHED. THE BURNED AREAS WERE THEN CLEARED OF CLOTHING AND TISSUE DEBRIS, WITH FORCEPS AND SWABS. A DRESSING OF SULPHANILAMIDE CREAM WAS APPLIED. SIX HOURS LATER THE PATIENT COMPLAINED OF PAIN AND THE MORPHINE WAS REPEATED. HE BECAME RESTLESS AND THE PULSE RATE ROSE TO 120 PER MINUTE, BUT HE DID NOT LOSE CONSCIOUSNESS. AT THE END OF TWENTY-FOUR HOURS HE WAS SUFFICIENTLY IMPROVED TO MAKE HIS TRANSFER TO THE WARD POSSIBLE. THE VARIATIONS IN THE PERIPHERAL LEUCOCYTE PICTURE ARE SHOWN IN THE CHART.

- (11) CASE NO. 134. A FEMALE AGED SIXTY YEARS, WAS ADMITTED ONE HOUR AFTER SUSTAINING SEVERE BURNS OF THE RIGHT UPPER LIMB AND BACK. WHILE SHE WAS PREPARING FOR BED, BEFORE AN ELECTRIC RADIATOR, HER NIGHTDRESS HAD CAUGHT FIRE. ON ADMISSION SHE COMPLAINED OF PAIN, AND A FEELING OF COLDNESS. HER TEMPERATURE WAS 99<sup>0</sup>F, THE PULSE RATE 96. MORPHINE GRAIN 1/4 WAS ADMINISTERED SUBCUTANEOUSLY, THE PATIENT WAS BATHED, AND THE BURNED AREAS

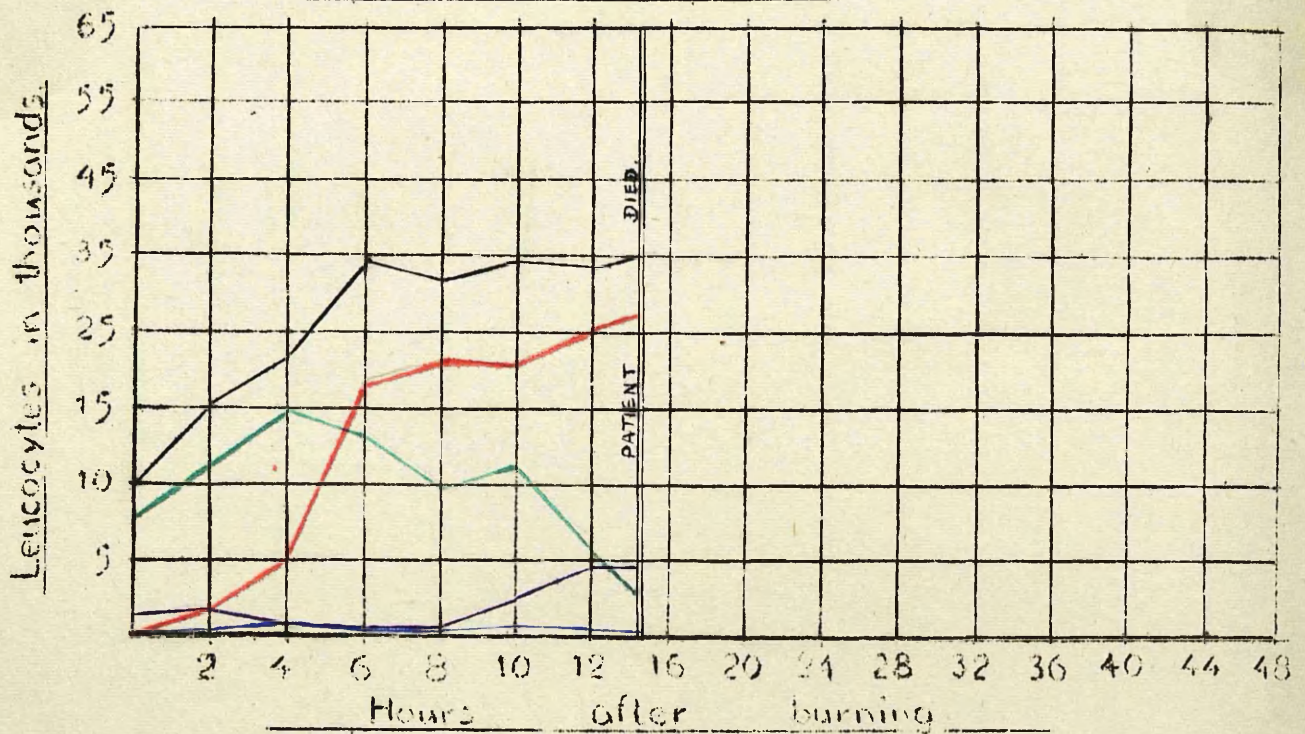


WERE CLEANED UP. A DRESSING OF SULPHANILAMIDE CREAM WAS APPLIED. THE PATIENT WAS THIRSTY, AND FLUIDS WERE WELL RETAINED FOR THE FIRST FEW HOURS, AFTER WHICH THEY WERE PROMPTLY VOMITED. FOUR HOURS AFTER ADMISSION THE PATIENT BECAME EXTREMELY RESTLESS, AND WITHIN AN HOUR WAS COMATOSE. SHE DIED TWELVE HOURS AFTER ADMISSION. THE VARIATIONS IN THE PERIPHERAL LEUCOCYTES ARE SHOWN IN THE CHART.

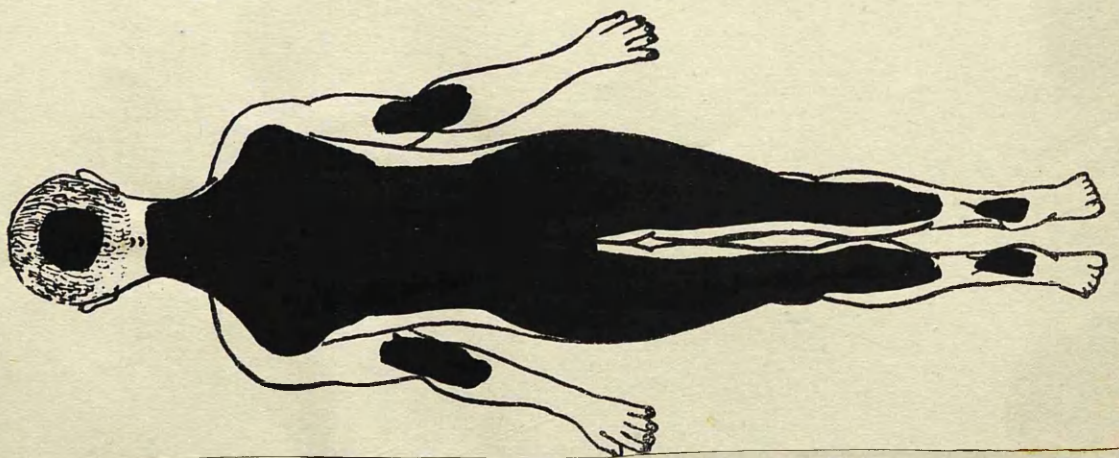
GROUP 3.

- (1) CASE NO. 146. THE PATIENT WAS A MALE AGED THIRTY-EIGHT YEARS, WHO WAS ADMITTED THREE-QUARTERS OF AN HOUR AFTER SUSTAINING EXTENSIVE BURNS OF THE UPPER AND LOWER LIMBS, BACK, NECK, AND HEAD. THE PATIENT WAS A STEEL WORKER, WHO HAD BEEN STANDING AT THE END OF A ROLLING-MILL, WHEN A RED-HOT INGOT OVERSHOT AND HIT HIM LOW DOWN ON THE LEGS, CAUSING HIM TO FALL BACK ON TOP OF IT. ON ADMISSION, HE WAS EXTREMELY TALKATIVE AND HAD NO PAIN. THE BURNS WERE EXTREMELY DEEP, AS WELL AS BEING EXTENSIVE, AND CONSEQUENTLY IT WAS DECIDED THAT TREATMENT WOULD BE USELESS. HE WAS THEREFORE PUT TO BED IN THE SHOCK ROOM AND MORPHINE GRAIN 1/4 GIVEN BY HYPODERMIC INJECTION. HIS TEMPERATURE AT THIS TIME WAS 100.2<sup>0</sup>F, THE PULSE RATE 100 PER MINUTE. TWO HOURS AFTER ADMISSION HE BECAME EXTREMELY

# HAEMATOLOGICAL FINDINGS



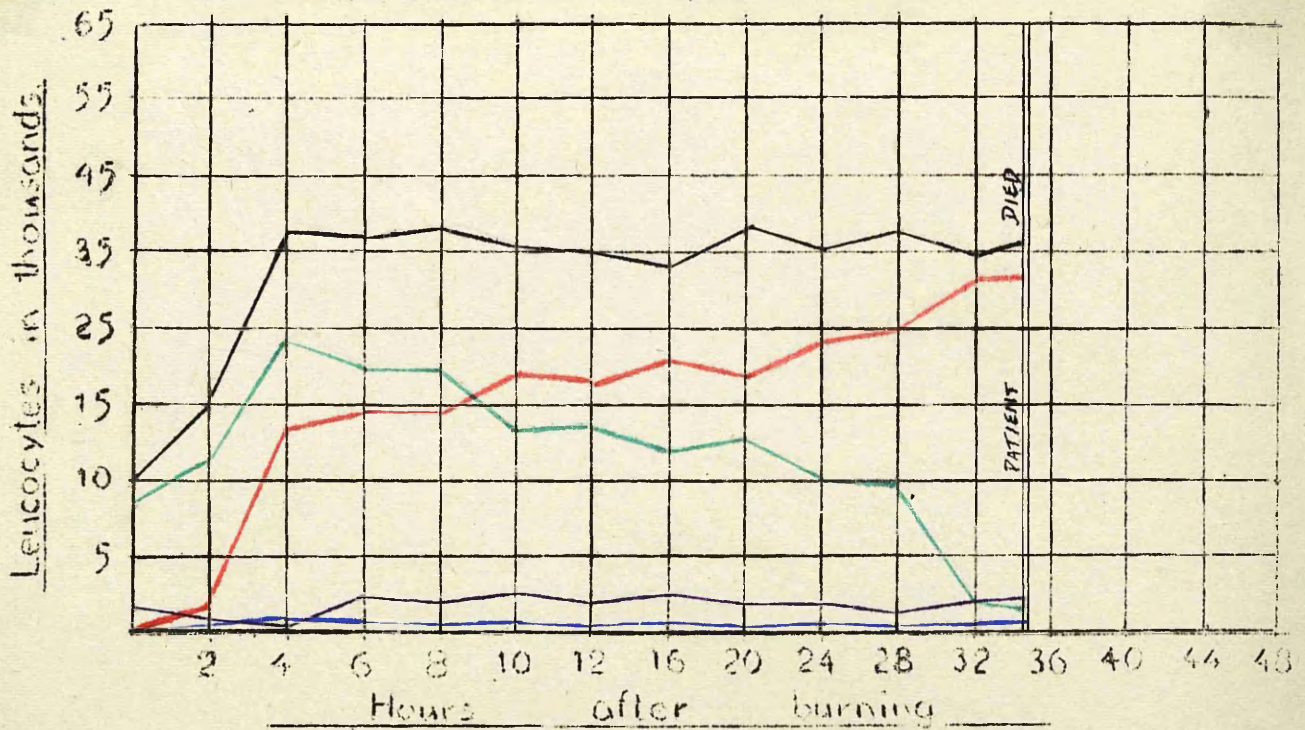
Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
 & Monocytes } ———  
 Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



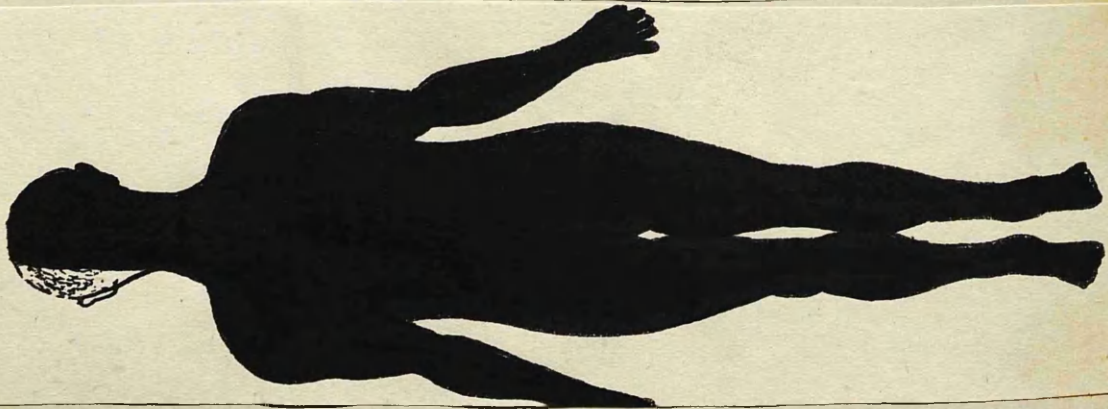
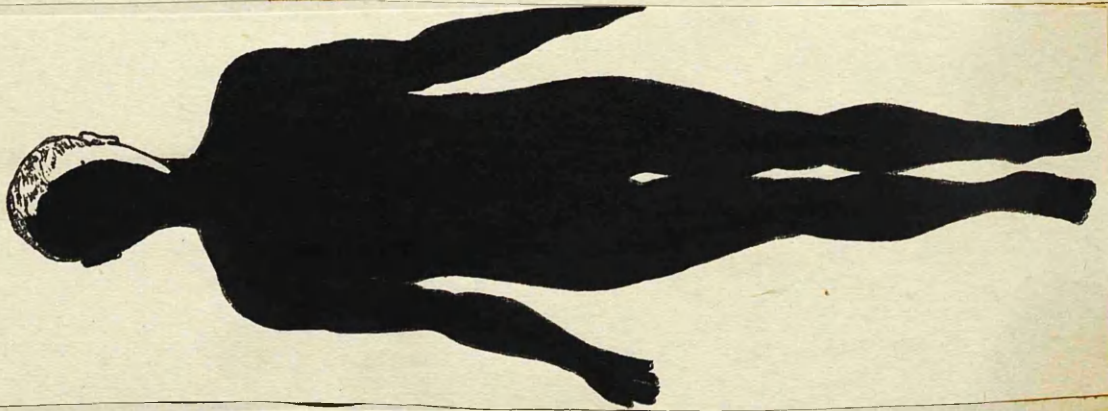
RESTLESS, AND FLUIDS GIVEN ORALLY, WHICH HAD PREVIOUSLY BEEN WELL RETAINED, WERE NOW IMMEDIATELY VOMITED. THE MORPHINE WAS REPEATED. SUBSEQUENTLY HE QUIETENED DOWN, BUT WENT INTO COMA SIX HOURS AFTER ADMISSION, AND DIED NINE HOURS LATER. THE CHANGES IN THE PERIPHERAL LEUCOCYTE PICTURE ARE SHOWN IN THE CHART.

- (11) CASE No. 147. A YOUNG ADULT MALE EIGHTEEN YEARS OF AGE, WAS ADMITTED THIRTY MINUTES AFTER RECEIVING SEVERE GENERALISED BURNS. HE HAD BEEN FLYING A TOY KITE WHICH WAS MOORED BY THIN COPPER WIRE. THE KITE FLEW INTO OVERHEAD HIGH-TENSION CABLES, AND THE YOUTH SUSTAINED GENERALISED ELECTRICAL BURNS OF THE HANDS, UPPER LIMBS, CHEST, ABDOMEN, LOWER LIMBS, AND FEET. THE THORAX AND ABDOMEN WERE PITTED ALL OVER AS THOUGH BY GUNSHOT, AND FROM THE FOOT OF EACH PIT A TINY BLOB OF COPPER COULD BE EXTRACTED. APPARENTLY THEN, THE COPPER WIRE HAD FUSED, AND IN A MOLTEN CONDITION HAD BEEN DRIVEN INTO HIS BODY. ON ADMISSION HE WAS EXTREMELY DROWSY, BUT CERTAINLY NOT UNCONSCIOUS, AND COMPLAINED FROM TIME TO TIME OF THIRST. HIS TEMPERATURE WAS  $105^{\circ}\text{F}$ , THE PULSE RATE 120 PER MINUTE, FEEBLE BUT REGULAR. FLUIDS WERE ADMINISTERED ORALLY, AND THESE WERE RETAINED FOR THE FIRST HOUR, AFTER WHICH THE BOY BEGAN TO VOMIT.

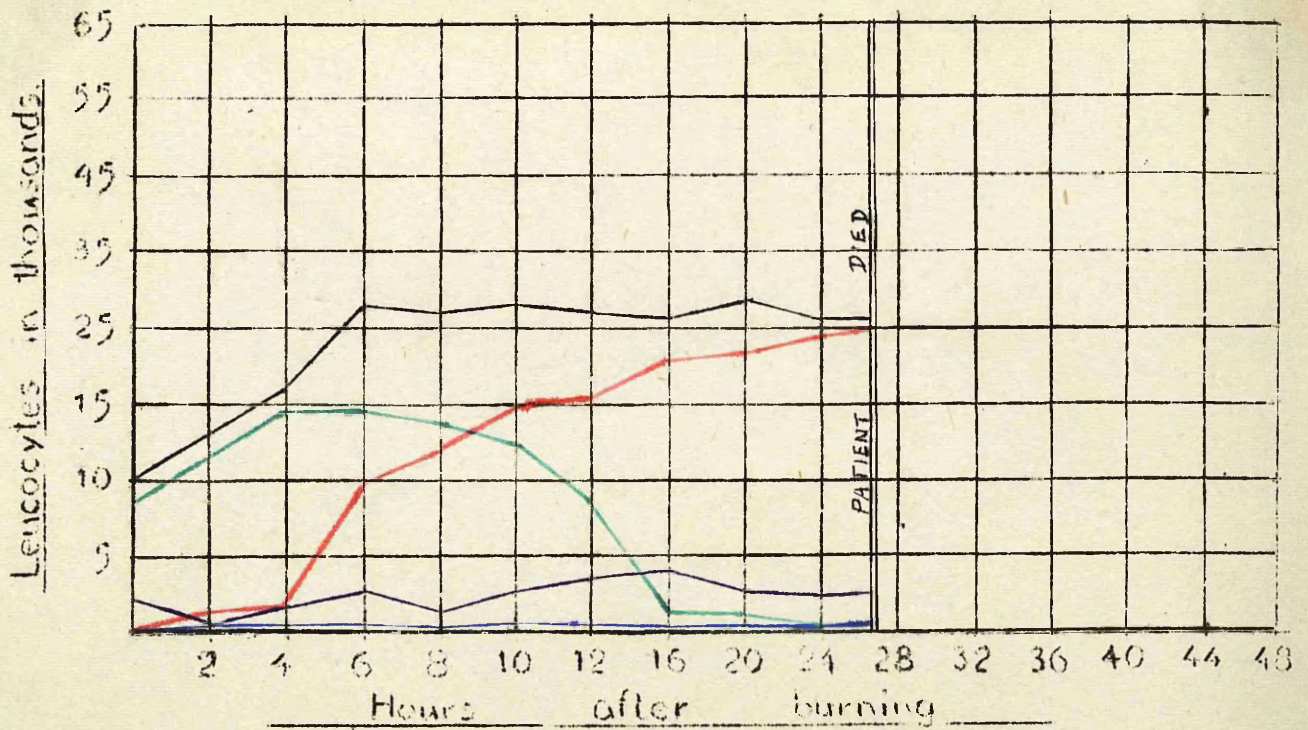
# HAEMATOLOGICAL FINDINGS



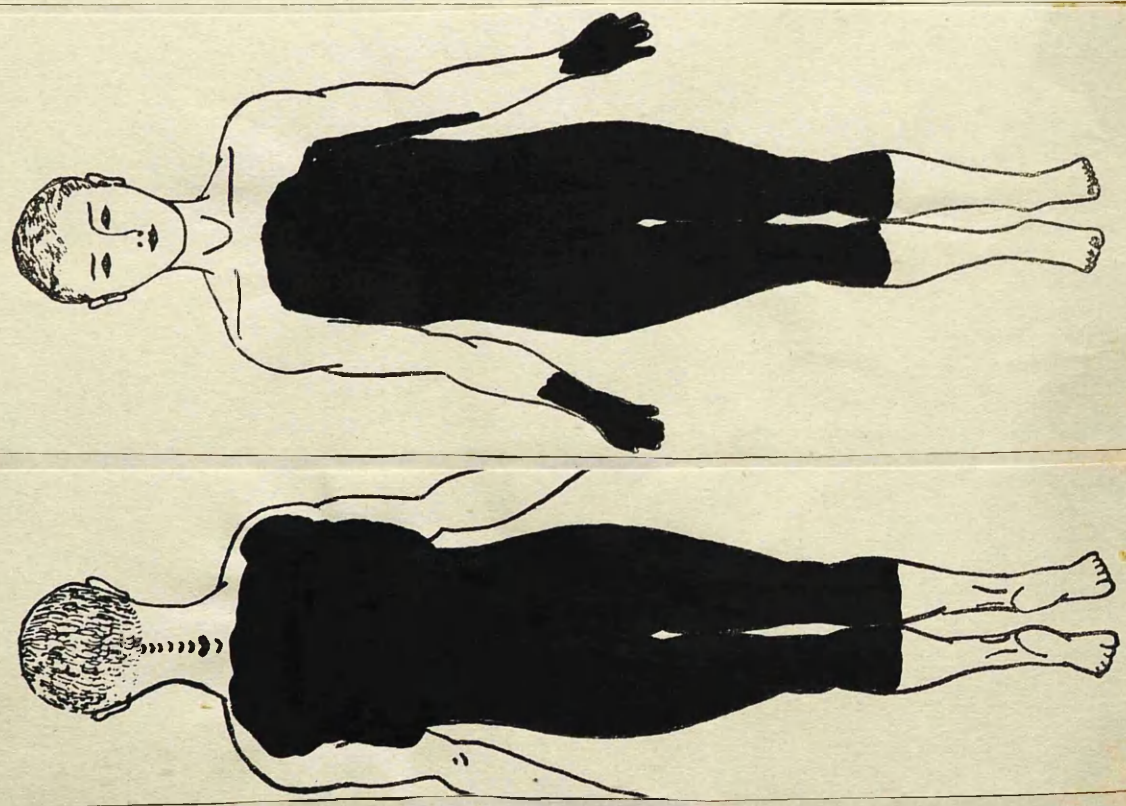
Total Leucocytes ————— Metamyelocytes ————— Lymphocytes }  
 & Monocytes }  
 Polymorphs ————— Stab Nuclears ————— Toxic Granulocytes —————



# HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
 Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ——— }  
 & Monocytes }



AT THE END OF THREE HOURS HE WAS QUITE COMATOSE, AND DIED THIRTY HOURS LATER. THE CHANGES IN THE LEUCOCYTE PICTURE ARE SHOWN IN THE CHART.

(III) CASE No. 150. A FEMALE OF SEVENTY-SIX YEARS WAS ADMITTED THREE HOURS AFTER SUSTAINING SEVERE BURNS OF THE CHEST, BACK, AND UPPER LIMBS. HER NIGHT-DRESS HAD CAUGHT FIRE. ON ADMISSION SHE DID NOT COMPLAIN OF PAIN, BUT WAS EXTREMELY TALKATIVE AND DISORIENTATED. HER TEMPERATURE WAS  $97.8^{\circ}\text{F}$ , THE PULSE RATE 110 PER MINUTE, ITS VOLUME POOR. IN VIEW OF THE PATIENT'S AGE AND THE EXTENT AND SEVERITY OF HER INJURIES, NO ATTEMPT AT TREATMENT OF ANY KIND WAS MADE. FOR THE FIRST HOUR ORAL FLUIDS WERE RETAINED, BUT SHE BECAME RESTLESS TWO AND A HALF HOURS AFTER ADMISSION, AND SO REMAINED UNTIL COMA SUPERVENED ONE HOUR LATER. THE PATIENT DIED TWENTY-FOUR HOURS AFTER ADMISSION. THE CHANGES IN THE LEUCOCYTE PICTURE ARE SHOWN IN THE CHART.

IT BECOMES CLEAR, AFTER SCRUTINY OF ALL THE CASES, THAT THE LEUCOCYTE CHANGES WERE INDEPENDENT OF THE FORM OF TREATMENT, AND THAT THESE VARIATIONS FOLLOW A DEFINITE PATTERN THUS:-

### I. ADULT PATIENTS.

A. TOTAL LEUCOCYTES. THE NUMBER OF CIRCULATING LEUCOCYTES INCREASES STEADILY, UNTIL BETWEEN EIGHT AND

FOURTEEN HOURS AFTER INJURY THE MAXIMUM FIGURE IS REACHED. THIS FIGURE IS SEEN TO VARY CONSIDERABLY FROM PATIENT TO PATIENT, AND DOES NOT APPEAR TO BE RELATED TO THE EXTENT OF THE INJURY OR THE SEVERITY OF THE SHOCK. IT DOES SEEM, HOWEVER, TO BE RELATED, IN SOME MEASURE, TO THE AGE OF THE PATIENT; ALL THE PATIENTS OVER SIXTY YEARS OF AGE REACTED WITH CONSIDERABLY LESS VIGOUR IN THIS RESPECT THAN THE YOUNGER SUBJECTS. THE MAXIMUM COUNT BEING REACHED, THIS LEVEL IS MAINTAINED FOR THE DURATION OF THE STAGE OF SEVEREST SHOCK. THIS IS, IN TURN, FOLLOWED BY A PERIOD OF STEADY FALL IN THE COUNT, A FALL WHICH CONFORMS FAIRLY CLOSELY TO THE CLINICAL IMPROVEMENT IN THE PATIENT'S CONDITION. CLOSER EXAMINATION CAUSES ONE FURTHER POINT TO EMERGE:- THE HEIGHT OF THE LEUCOCYTOSIS IS REACHED BEFORE THE SHOCK IS MOST SEVERE; AND THUS, ALTHOUGH AN INCREASE IN THE NUMBER OF CIRCULATING LEUCOCYTES PROBABLY INDICATES THAT THE SHOCK MECHANISM IS IN ITS ASCENDANT PHASE, THIS LATTER PROCESS MAY, AND VERY FREQUENTLY DOES, CONTINUE AFTER THE LEUCOCYTES HAVE CEASED TO ACT AS A METER FOR THE GRAVITY OF THE SHOCK. THE TOTAL LEUCOCYTE COUNT MAY THEREFORE BE REGARDED IN THE SAME WAY AS A SPEEDOMETER, WHICH INDICATES SPEEDS UP TO ONLY THIRTY MILES PER HOUR.

B. STAB-NUCLEAR NEUTROPHILS. THE NUMBER OF STAB-NUCLEAR NEUTROPHILS IN THE PERIPHERAL CIRCULATION INCREASES, AT FIRST MORE GRADUALLY THAN THE TOTAL LEUCOCYTES, AND THEN VERY STEEPLY, UNTIL APPROXIMATELY THE TIME AT WHICH THE TOTAL LEUCOCYTES REACH THEIR PEAK. THE UPWARD TREND OF THE STAB CELL COUNT THEN CONTINUES MORE SLOWLY TO A POINT WITHIN THE TIME BOUNDARIES OF THE TOTAL LEUCOCYTE PLATEAU. UNLIKE THE TOTAL LEUCOCYTE GRAPH, HOWEVER, THERE IS NO PLATEAU FORMATION BY THE STAB CELLS. THE SUBSEQUENT CHANGES APPARENTLY DEPEND UPON WHETHER THE PATIENT DIES OR LIVES. IN THE FORMER INSTANCE, DEATH TAKES PLACE WHEN THE STAB CELL COUNT IS AT ITS HEIGHT, IN THE LATTER EVENT, THE NUMBER OF THESE CELLS DECREASES STEADILY. THE POSSIBLE SIGNIFICANCE OF THESE FACTS WILL BE DISCUSSED IN DETAIL LATER. IF THIS DESCRIPTION CONVEYS THE IMPRESSION THAT THERE IS SOMETHING AKIN TO A CRISIS IN THE PATIENT'S CONDITION, SUCH IS NOT INTENDED, AS RECOVERY FROM THE STATE OF SHOCK IS ALMOST INVARIABLY SLOW AND GRADUAL. THAT THERE IS, ON THE OTHER HAND, A DEFINITE STAB-NUCLEAR CRISIS, THE AUTHOR IS CONVINCED.

C. NEUTROPHIL POLYMORPHS. DURING THE FIRST HOUR OR TWO FOLLOWING INJURY, THE PERIPHERAL NEUTROPHIL POLYMORPHS INCREASE IN NUMBER; BUT AS THE STAB CELL GRAPH RISES, THE NEUTROPHIL POLYMORPH GRAPH FALLS. THIS IS EASILY UNDERSTOOD, SINCE BOTH TYPES OF CELL HAVE THE SAME

ANCESTORS, AND THEREFORE, IF THE PRODUCTION OF ONE TYPE IS BEING INCREASED, THE OUTPUT OF THE OTHER MUST RELATIVELY FALL. THE NEUTROPHIL POLYMORPH PEAK IS REACHED BETWEEN THREE AND SIX HOURS AFTER INJURY, THAT IS TO SAY, BEFORE THE PRODUCTION OF STAB CELLS HAS REALLY BECOME SERIOUS, AND AT THE TIME WHEN THE LYMPHOPENIA (TO BE DESCRIBED) HAS REACHED ITS MAXIMUM DEPTH. THE FILAMENTED NEUTROPHIL GRAPH IS UNDERSTANDABLY AT ITS GREATEST RELATIVE DEPRESSION WHEN THE STAB CELL GRAPH IS AT ITS HEIGHT. SUBSEQUENTLY, IT RISES AT ROUGHLY THE SAME SPEED AS THE STAB CELL GRAPH FALLS. THUS THE DIFFERENCE BETWEEN THE TOTAL LEUCOCYTE AND THE STAB-CELL COUNT IS ROUGHLY ACCOUNTED FOR BY NEUTROPHIL POLYMORPHS. IT IS CONVENIENT TO EMPHASIZE AT THIS POINT THAT MOVEMENTS IN THE GRAPHS OF THE VARIOUS TYPES OF CELLS ARE HERE BEING COMPARED, SO THAT A FALL IN ANY GRAPH DOES NOT NECESSARILY INDICATE THAT THE NUMBER OF THOSE CELLS PRESENT IS BELOW THE NORMAL LEVEL. IN OTHER WORDS, IT IS THE ABSOLUTE AND NOT THE PERCENTAGE FIGURES THAT ARE IMPORTANT. FOR THIS REASON THE GRAPHS ARE CONSTRUCTED FROM ABSOLUTE FIGURES. NEVERTHELESS A CERTAIN LICENSE MUST BE GRANTED FOR PURPOSES OF DESCRIPTION, IF SUCH TERMS AS "RELATIVE NEUTROPENIA" AND "ABSOLUTE NEUTROPHILIA" ARE TO BE AVOIDED.

D. METAMYELOCYTES AND MYELOCYTES. MYELOCYTES WERE SEEN IN ONLY TWO CASES (NO. 31 AND NO. 136) AND THESE ARE REPORTED SEPARATELY ELSEWHERE. METAMYELOCYTES WERE FOUND OCCASIONALLY, BUT ONLY IN ASSOCIATION WITH VERY HIGH TOTAL WHITE CELL COUNTS, AND THEN THEY APPEARED IN THAT PHASE WHEN THE STAB CELL COUNT WAS FALLING, AND THE NEUTROPHIL POLYMORPH COUNT RISING. WITH THE EXCEPTION OF THE TWO CASES MENTIONED, THEIR NUMBERS WERE NEVER GREATER THAN COULD REASONABLY BE EXPECTED FROM THE MAGNITUDE OF THE ASSOCIATED NEUTROPHILIA.

E. EOSINOPHILS. EOSINOPHILS WERE CONSTANTLY PRESENT IN NORMAL OR SLIGHTLY GREATER THAN NORMAL ABSOLUTE NUMBERS, THROUGHOUT THE OBSERVED FORTY-EIGHT HOURS. THE SIGNIFICANCE OF THIS FINDING WILL BE LATER DISCUSSED.

F. LYMPHOCYTES. LYMPHOCYTES AT FIRST RAPIDLY DECREASED THEIR ABSOLUTE NUMBER IN THE CIRCULATION, THE MAXIMUM LYMPHOPENIA BEING REACHED BETWEEN THE THIRD AND FIFTH HOURS AFTER INJURY. THEREAFTER THE NUMBER OF THESE CELLS SLOWLY INCREASED TO A NORMAL OR HIGHER LEVEL, THIS APPARENTLY BEING DETERMINED BY THE MAGNITUDE OF THE TOTAL WHITE CELL COUNT. CASE NO. 91 PROVED EXCEPTIONAL AND IS LATER DESCRIBED.

G. MONOCYTES. THESE CELLS MAINTAINED VERY NORMAL NUMBERS IN THE PERIPHERAL BLOOD THROUGHOUT THE PERIOD

OF THE LEUCOCYTOSIS. THEIR NUMBERS APPEARED TO BE UNAFFECTED BY BOTH THE MAGNITUDE AND THE NATURE OF THE LEUCOCYTE RESPONSE.

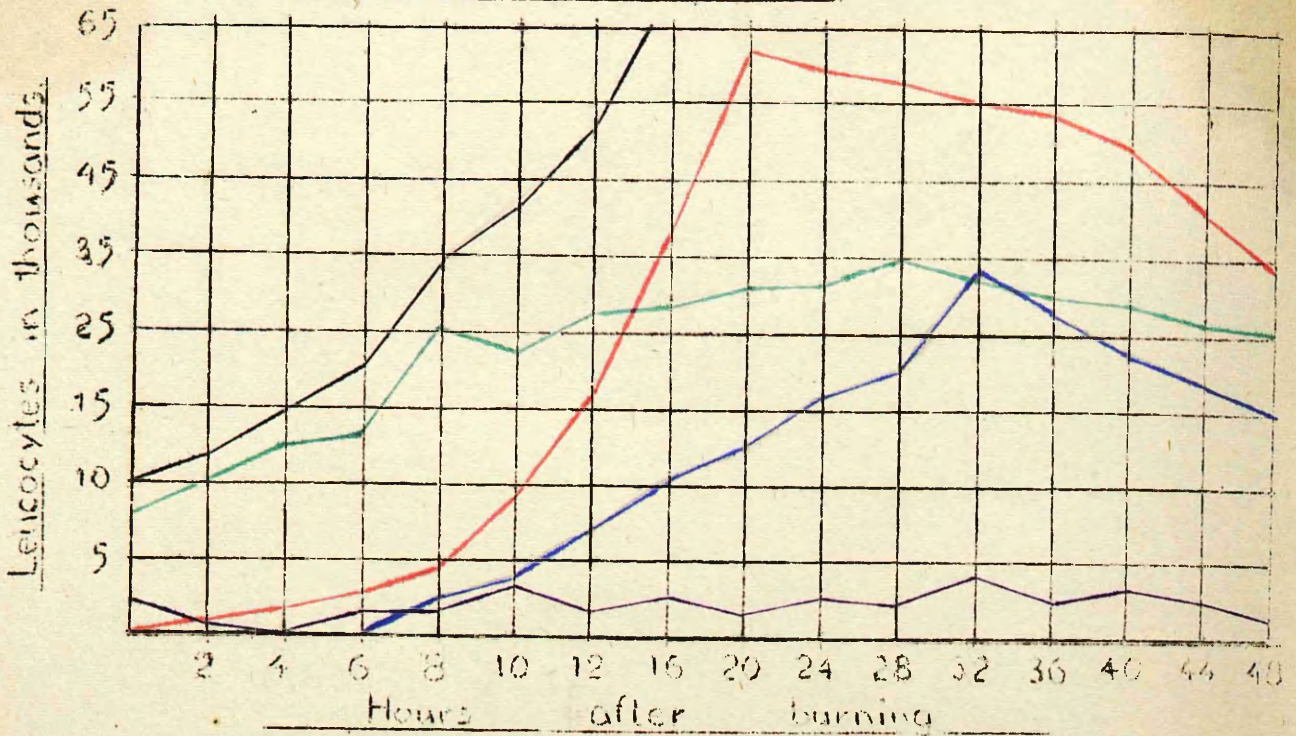
H. DEGENERATIVE POLYMORPHS. (I.E. POLYMORPHS SHOWING DEGENERATIVE CYTOPLASMIC CHANGES.) SUCH CELLS WERE NEVER ENCOUNTERED IN SIGNIFICANT NUMBERS AT ANY STAGE OF THE INVESTIGATIONS. VARIOUS AUTHORS HAVE FOUND UP TO FIVE PER CENT OF NORMAL NEUTROPHIL POLYMORPHS SHOWING SUCH CHANGES. IF THE NORMAL AVERAGE NEUTROPHIL COUNT BE TAKEN AS 6000, THIS WOULD REPRESENT THREE HUNDRED DEGENERATIVE CELLS PER CUBIC MILLIMETRE. THE GREATEST NUMBER OF SUCH CELLS FOUND IN ANY OF THE 150 CASES REPORTED, WAS TWO HUNDRED PER CUBIC MILLIMETRE. THE POSSIBLE SIGNIFICANCE OF THEIR ABSENCE IS LATER DISCUSSED.

## 2. CHILD PATIENTS.

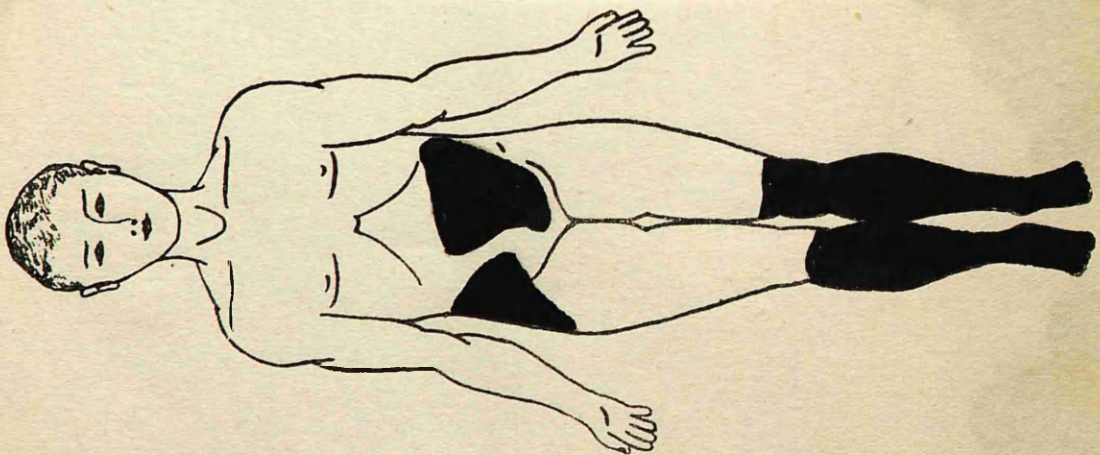
WHILE THE PATH FOLLOWED BY THE GRANULOCYTES AND MONOCYTES IN THE CASE OF CHILD PATIENTS IS SIMILAR TO THAT IN ADULTS, THE LYMPHOCYTES SHOW GREATER QUANTITATIVE CHANGES THAN IN ADULTS. AFTER THE PRELIMINARY LYMPHOPENIA, WHICH OCCURS AS IN ADULTS, THERE IS A STEADY RISE IN THE NUMBER OF LYMPHOCYTES IN THE CIRCULATION TO A FIGURE CONSIDERABLY ABOVE THE AVERAGE NORMAL. THE DEGREE OF LYMPHOCYTOSIS APPEARS TO VARY INVERSELY WITH THE AGE OF THE CHILD. UNDER THE AGE OF SEVEN YEARS, ABSOLUTE LYMPHOCYTOSIS WAS THE

# HAEMATOLOGICAL FINDINGS

X 120,000



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_

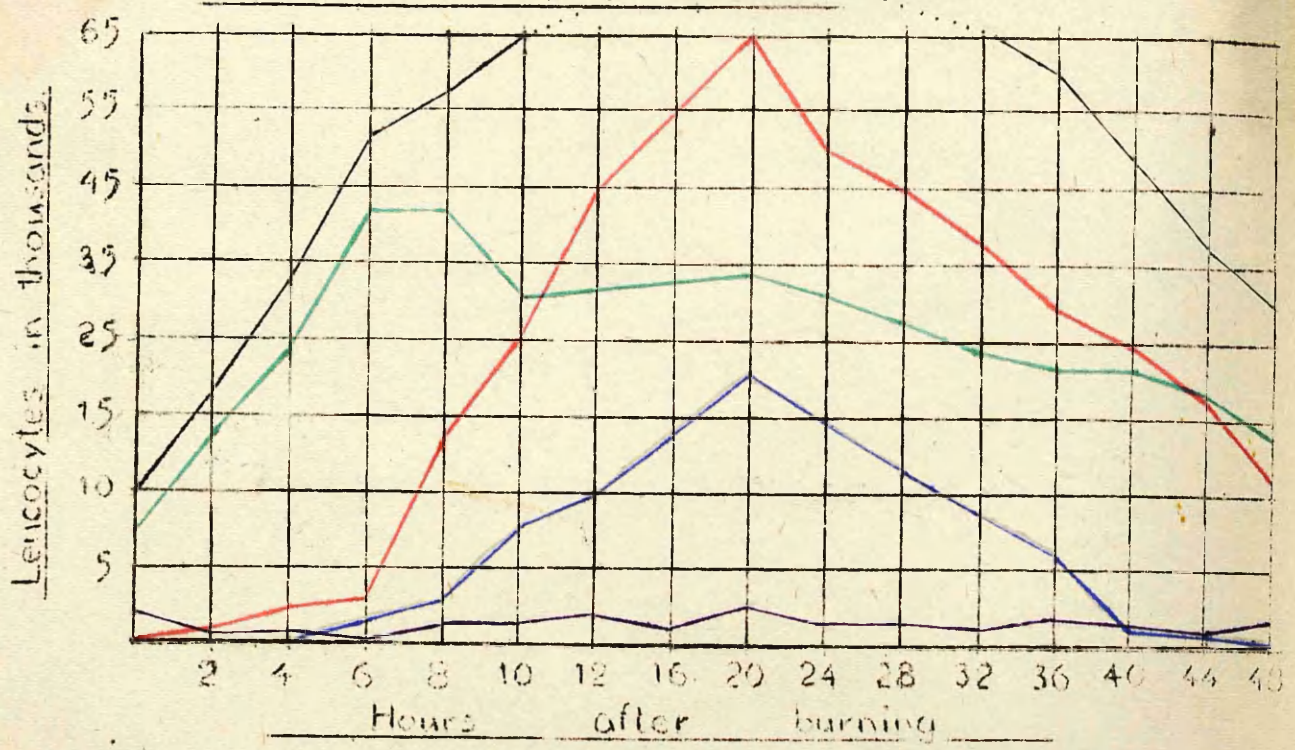


RULE; BETWEEN SEVEN AND FIFTEEN YEARS IT WAS EXCEPTIONAL; WHILE OVER THE AGE OF FIFTEEN YEARS IT WAS NEVER FOUND IN THE SERIES OF CASES REPORTED. IN CONSEQUENCE OF THIS VARIATION, THE LEUCOCYTE CHARTS OF CHILD PATIENTS DO NOT VARY IN FORM FROM THOSE OF ADULTS, THE DIFFERENCES EXISTING IN THE PERCENTAGE FIGURES ALONE.

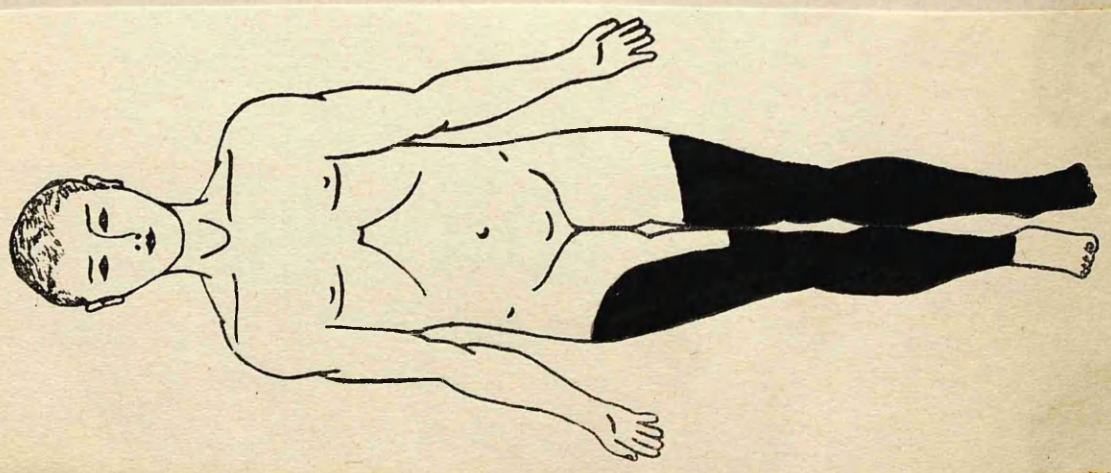
CERTAIN EXCEPTIONS TO THIS PERIPHERAL LEUCOCYTE FORMULA WERE ENCOUNTERED, AND ALTHOUGH THEY WERE FEW (THREE) IN NUMBER, THEY MERIT DESCRIPTION, IF ONLY BECAUSE OF THEIR INTEREST AS CURIOS. IN NONE OF THESE CASES WERE THE INJURIES OF UNUSUAL SEVERITY, BUT THE ASSOCIATED LEUCOCYTE CHANGES WERE REMARKABLE.

(1) CASE No. 31. A FEMALE AGED SIXTEEN YEARS SUSTAINED A SEVERE SCALD TO THE ABDOMEN, BUTTOCKS, AND LOWER LIMBS, BY SLIPPING INTO A VAT OF HOT STARCH. THE INJURIES WERE TREATED BY THE APPLICATION OF A TANNIC ACID COAGULUM. THE LEUCOCYTE PICTURE FOLLOWED THE USUAL PATTERN FOR THE FIRST SIX HOURS, AFTER WHICH IT BECAME PROGRESSIVELY MORE LEUKAEMOID IN CHARACTER. THE TOTAL NUMBER OF STAB-NUCLEAR NEUTROPHILS REMAINED HIGH, BUT METAMYELOCYTES STEADILY INCREASED THEIR NUMBERS, AND EVEN MYELOCYTES MADE THEIR APPEARANCE. AT THIRTY-TWO HOURS THE TOTAL LEUCOCYTE COUNT WAS 120,000 PER CUBIC MILLIMETRE, MADE UP AS FOLLOWS:-  
 NEUTROPHIL POLYMORPHS - 25% (30,000); STAB-NUCLEARS-  
 45% (54,000); METAMYELOCYTES AND MYELOCYTES - 27%(32,400);

# HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_

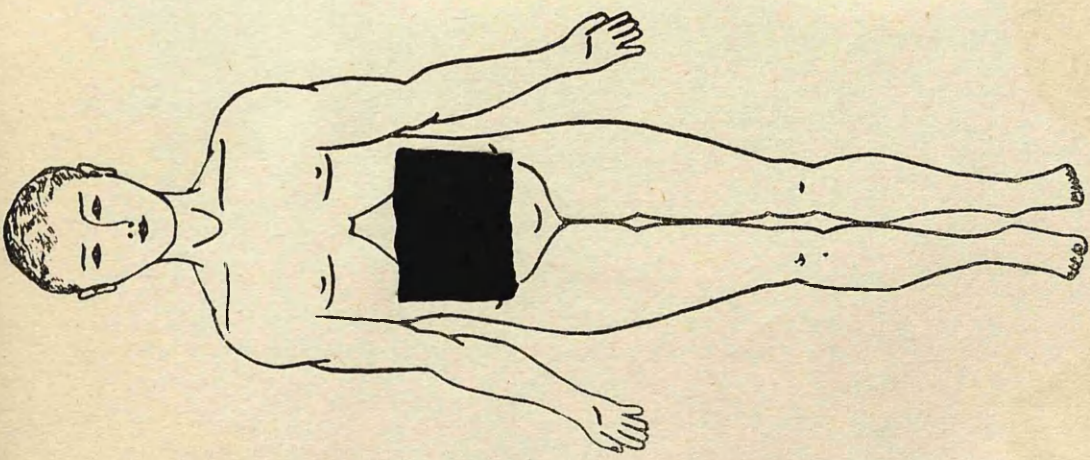
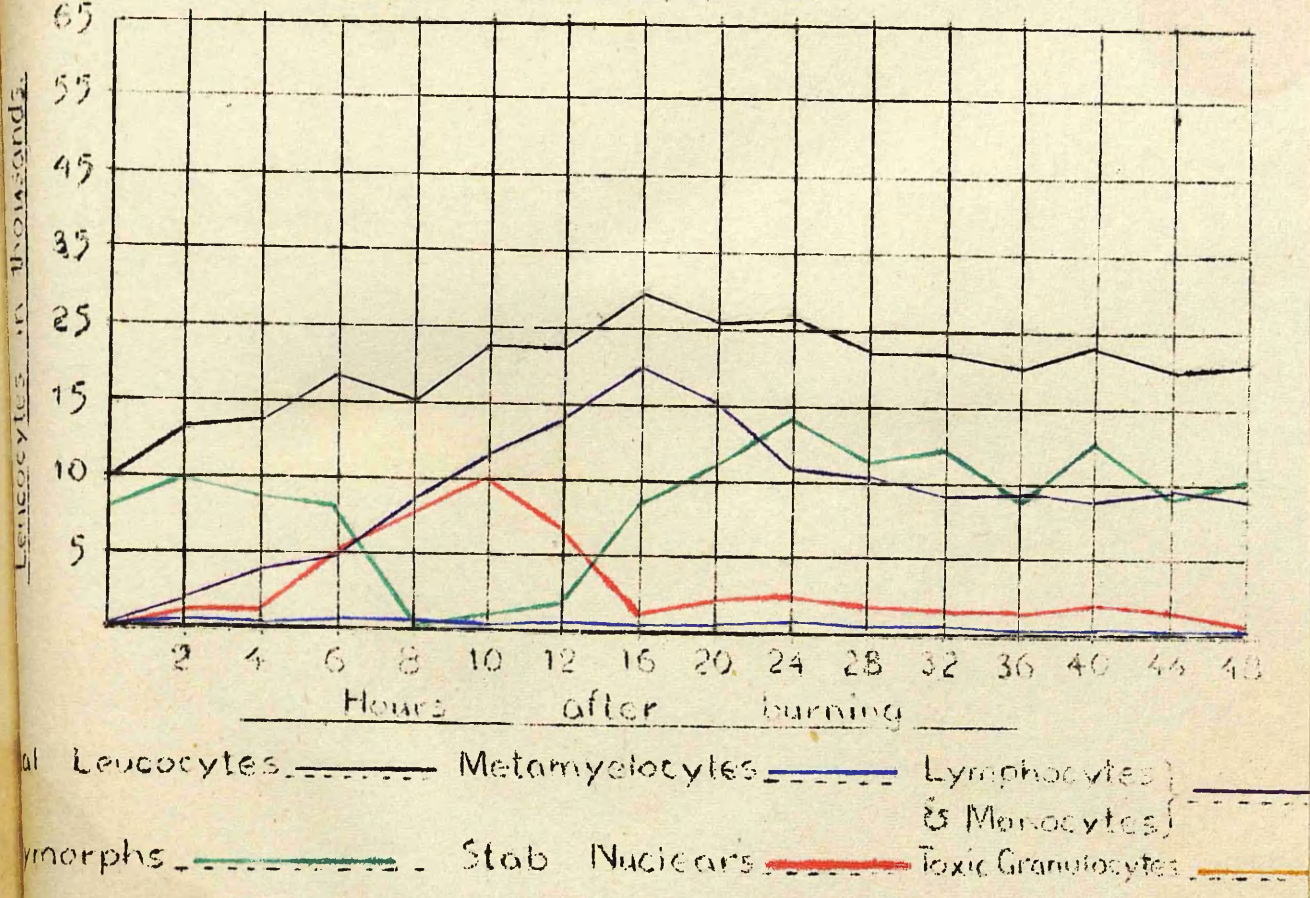


MONOCYTES-1% (1200); LYMPHOCYTES-2% (2400). THIS LEUKAEMOID PERIPHERAL BLOOD PICTURE PERSISTED UP TO FORTY-EIGHT HOURS AFTER ADMISSION AND THEN GRADUALLY SETTLED DOWN. THE PATIENT MADE A NORMAL RECOVERY.

(II) CASE No. 136. A MALE THIRTY-THREE YEARS OF AGE WAS ADMITTED SUFFERING FROM SEVERE BURNS OF THE LOWER LIMBS, DUE TO MOLTEN METAL, AND HIS DUNGAREES CATCHING FIRE. HIS INJURIES WERE DRESSED WITH SULPHANILAMIDE CREAM. AFTER ADMISSION THE LEUCOCYTE COUNT ROSE STEADILY, UNTIL AT TWENTY HOURS IT WAS ONE HUNDRED AND THIRTY THOUSAND PER CUBIC MILLIMETRE, CONSTITUTED AS FOLLOWS:- NEUTROPHIL POLYMORPHS-26% (33,800); STAB-NUCLEARS-50% (65,000); METAMYELOCYTES AND MYELOCYTES-22% (28,600); MONOCYTES-1/2% (650); LYMPHOCYTES-1 1/2% (1950). IMMEDIATELY THEREAFTER THE COUNTS BEGAN TO FALL, AND FORTY-EIGHT HOURS AFTER ADMISSION HAD REACHED AVERAGE FIGURES AND THE BLOOD PICTURE HAD LOST ITS LEUKAEMOID CHARACTERS, ALL THE MYELOCYTES AND MANY OF THE METAMYELOCYTES HAVING DISAPPEARED.

(III) CASE No. 91. A MALE CHILD EIGHTEEN MONTHS OLD, WAS ADMITTED WITH A SCALD OF THE ABDOMEN-THE RESULT OF A BOILING-WATER FOMENTATION. THE CHILD WAS DEALT WITH IN THE USUAL WAY, AND THE INJURIES WERE DRESSED WITH SULPHANILAMIDE CREAM. THE LEUCOCYTE COUNT NEVER ROSE ABOVE 30,000 PER CUBIC MILLIMETRE, BUT FOR THE

# HAEMATOLOGICAL FINDINGS



FIRST TWENTY-FOUR HOURS THERE WAS A STEADY INCREASE IN THE NUMBER OF LYMPHOCYTES UNTIL THE TOTAL COUNT WAS 26,000 MADE UP OF:- LYMPHOCYTES-80% (20,800); STAB-NUCLEARS-15% (3,900); NEUTROPHIL POLYMORPHS-4% (1040); MONOCYTES-1% (260). AT FORTY-EIGHT HOURS THE TOTAL COUNT WAS 18,000, OF WHICH ONLY 50% WERE LYMPHOCYTES. TWO DAYS LATER, LYMPHOCYTES ACCOUNTED FOR 20% OF A TOTAL OF 17,000.

SINCE THE VAST MAJORITY OF PATIENTS HAD SEDATIVES OF THE MORPHINE GROUP ADMINISTERED TO THEM, IT SEEMED ADVISABLE, EVEN IF NOT ABSOLUTELY NECESSARY, TO ELIMINATE THESE AS THE CAUSE OF, OR AS A CONTRIBUTING FACTOR, TO THE PRODUCTION OF THE ABNORMAL PERIPHERAL BLOOD PICTURE. TEN PATIENTS WERE THEREFORE SELECTED, WHO WERE SUFFERING FROM VARIOUS DISEASES, KNOWN ( AT LEAST IN THE CASES CHOSEN) NOT TO HAVE GIVEN RISE TO A GROSSLY ABNORMAL BLOOD PICTURE, AND THE EFFECT ON THE PERIPHERAL LEUCOCYTE PICTURE OF THE ADMINISTRATION OF MORPHINE STUDIED.

DISEASE.	SEDATIVE.	LEUCOCYTE COUNT OVER 12 HOURS.	REMARKS.
CARDIAC FAILURE	MORPHINE GRAIN-1/4	15,000-18,000	NO CHANGE IN BLOOD PICTURE.
NEOPLASM OF LUNG	MORPHINE GRAIN - 1/4 x 2	8,000-9,000	8% STAB-NUCLEARS, OTHERWISE NO CHANGE.
NEOPLASM OF LUNG	MORPHINE GRAIN-1/4	10,000	NO CHANGE IN BLOOD PICTURE.
CEREBRAL NEOPLASM	MORPHINE GRAIN - 1/4 x 2	12,000	5% STAB-NUCLEARS, OTHERWISE NO CHANGE.
CARDIAC FAILURE	MORPHINE GRAIN-1/4	11,000-16,000	2% STAB-NUCLEARS, OTHERWISE NO CHANGE.
PLEURISY	NEPENTHE MINS. 15	10,000-12,000	NO CHANGE IN BLOOD PICTURE.
CEREBRAL ARTERIO- SCLEROSIS	MORPHINE GRAIN - 1/4 x 2	7,000-9,000	5% STAB-NUCLEARS, OTHERWISE NO CHANGE.
HAEMATEMESIS	MORPHINE GRAIN-1/4	12,000-15,000	A FEW METAMYELO- CYTES PRESENT.
HAEMOPTYSIS	MORPHINE GRAIN-1/4	13,000-14,000	A FEW METAMYELO- CYTES PRESENT.
LYMPHADENOMA	NEPENTHE MINS. 15 x 2	12,000	NO CHANGE.

FROM THIS SERIES IT IS SEEN THAT THE ADMINISTRATION OF EITHER MORPHINE OR NEPENTHE IS NOT FOLLOWED BY A RISE IN THE NUMBER OF PERIPHERAL STAB-NUCLEAR NEUTROPHILS ABOVE THE NORMAL 6% TO 8%.

SINCE PAIN AND EMOTIONAL UPSET WERE ALSO FREQUENTLY, IF NOT INVARIABLY, EXPERIENCED BY THE PATIENTS STUDIED,

THESE STIMULI TOO MUST BE ELIMINATED AS CAUSES OF THE PERIPHERAL LEUCOCYTE CHANGES.

#### PAIN LEUCOCYTOSIS.

IT HAS RECENTLY BEEN RECOGNISED THAT PAIN CAN EVOKE A PERIPHERAL LEUCOCYTOSIS EVEN IN THE ABSENCE OF INFLAMMATION. (E.G. TRIGEMINAL NEURALGIA, ANGINA PECTORIS, NON-INFLAMMATORY TOOTHACHE ETC.) THERE IS AMPLE EVIDENCE, HOWEVER, THAT A LEUCOCYTOSIS CAUSED IN SUCH A WAY IS THE RESULT OF REDISTRIBUTION OF THE LEUCOCYTES AND IS NOT ASSOCIATED WITH QUALITATIVE CHANGES IN THE NEUTROPHILS OR ALTERATION IN THE DIFFERENTIAL COUNT. (WINTROBE ET AL.)

#### EMOTIONAL LEUCYTOSIS.

MILHORAT, SMALL, AND DIETHELM HAVE RECENTLY OBSERVED THAT LARGE NUMBERS OF PSYCHOPATHIC PATIENTS EXHIBIT LEUCOCYTOSIS. THIS DOES NOT APPEAR TO BE LIMITED TO ANY PARTICULAR MENTAL DISEASE, BUT IS CLEARLY RELATED TO THE EMOTIONAL STATES OF THE PATIENTS. THE BEHAVIOURS WHICH THESE WORKERS OBSERVED TO BE MOST OFTEN ASSOCIATED WITH LEUCOCYTOSIS WERE "PANIC REACTION, DEPRESSION WITH AGITATION, EXCITEMENT WITH OVER-ACTIVITY AND ANXIETY, AND EXCITEMENT WITH OVER-ACTIVITY AND ELATION." THEY RECORDED EXAMPLES OF EACH OF THESE TYPES AND SHOWED THAT LEUCOCYTOSIS UP TO 21,000 WHITE BLOOD CELLS PER CUBIC MILLIMETRE, COULD OCCUR IN THESE PHYSICALLY HEALTHY PSYCHOPATHS. THEY EMPHASISED THE FACT THAT

THE DIFFERENTIAL COUNT IS UNALTERED, EVEN AT THE HEIGHT OF THE LEUCOCYTOSIS. BLYTH AND WHITTKOWER HAVE BOTH CONFIRMED THESE OBSERVATIONS AND DEMONSTRATED FURTHER THAT THERE IS NO ALTERATION IN THE "ARNETH" (REALLY COOKE-PONDER - AUTHOR) FORMULA IN THESE CASES.

**CHAPTER FOUR.**

**INTERPRETATION OF THE RESULTS ARRIVED AT IN  
THE PRECEDING CHAPTER.**

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## CHAPTER FOUR.

IF ANY ATTEMPT IS TO BE MADE TO RELATE THE LEUCOCYTE CHANGES JUST DESCRIBED, TO THE STATE OF BURN SHOCK, LIBERTY MUST BE TAKEN TO INFER THE STATE OF THE MARROW FROM AN EXAMINATION OF THE PERIPHERAL LEUCOCYTE PICTURE. SUCH A PROCEDURE IS NOT, HOWEVER, ENTIRELY SPECULATIVE, SINCE THERE IS GOOD REASON TO BELIEVE THAT, IF THE NUCLEAR AND CYTOPLASMIC FORMULAE BE CONSIDERED TOGETHER WITH THE INFORMATION OBTAINED BY THE ORDINARY DIFFERENTIAL HAEMOGRAM, THE CONCLUSIONS REACHED ARE REASONABLY ACCURATE. SUCH, AT LEAST, IS TRUE OF UNDERSTOOD SEPTIC AND TOXIC PROCESSES. OBVIOUSLY THE MOST SATISFACTORY ATTACK ON THE PROBLEM COULD HAVE BEEN MADE BY OBTAINING SPECIMENS OF BONE MARROW AT INTERVALS DURING THE PROGRESS OF THE STATE OF SHOCK - AND THIS WAS EVIDENT TO THE WRITER FROM THE START OF THE INVESTIGATION. ALTHOUGH CIRCUMSTANCES MADE IT IMPOSSIBLE FOR THIS PROCEDURE TO BE CARRIED OUT, ITS IMPORTANCE IS OBVIOUS, AND THE POSITIVE CONFIRMATION OF SOME OF THE FOLLOWING DEDUCTIONS WHICH THESE EXAMINATIONS WOULD HAVE AFFORDED STILL REQUIRES TO BE SOUGHT. CONSEQUENTLY, THE ARGUMENT WHICH FOLLOWS IS BASED UPON THE EXAMINATION

OF THE PERIPHERAL BLOOD ALONE.

THE TOTAL LEUCOCYTE COUNT. THE TOTAL LEUCOCYTE COUNT PER SE MUST BE REGARDED AS OF MINO SIGNIFICANCE, SINCE THE LEUCOCYTOSIS PRODUCED BY THERMAL TRAUMA MAY BE DEPENDENT UPON ONE OR MORE OF THREE FACTORS, VIZ:-

1. HAEMOCONCENTRATION.
2. PERIPHERAL DISTRIBUTION OF THE LEUCOCYTES.
3. INCREASED MARROW ACTIVITY.

HAEMOCONCENTRATION. IT SEEMED AT FIRST THAT IT WOULD BE NECESSARY TO CORRECT EACH OF THE OBSERVED COUNTS FOR THE DEGREE OF HAEMOCONCENTRATION PRESENT WHEN IT WAS MADE, BUT SUCH A CALCULATION WAS LATER BELIEVED TO BE OF LITTLE VALUE. UNLIKE THE ERYTHROCYTES, WHICH ARE NON-MOTILE AND CONSEQUENTLY INCREASED OR DECREASED IN NUMBERS PROPORTIONATELY WITH THE DEGREE OF CONCEN- TRATION OR DILUTION OF THE BLOOD, THE LEUCOCYTES ARE KNOWN TO BE CAPABLE OF MOVEMENT, AND INDEPENDENT REACTIONS, SO THAT THEY MAY DISTRIBUTE THEMSELVES IN THE BODY ACTIVELY, AND REMAIN UNINFLUENCED BY HAEMOCONCENTRATION. HOLDING THESE VIEWS, THE WRITER CONSULTED DAVIS ON THIS SUBJECT, AND THIS AUTHORITY EXPRESSED COMPLETE AGREEMENT.

PERIPHERAL DISTRIBUTION OF THE LEUCOCYTES. THE MAGNITUDE OF THE LEUCOCYTOSIS PRESENT IN MOST CASES WAS AGAINST ITS EXPLANATION BY PERIPHERAL DISTRIBUTION OF THE LEUCOCYTES. NEVERTHELESS THIS POSSIBILITY HAD STILL TO BE CONSIDERED

AS A FACTOR IN THE PRODUCTION OF THE INCREASED NUMBER OF CIRCULATING CELLS. THE MATTER CANNOT FURTHER BE DISCUSSED HERE AS OBVIOUSLY ONLY THE NATURE OF THE LEUCOCYTOSIS ( VIDE INFRA ) CAN DECIDE THE EXTENT TO WHICH SUCH A MECHANISM IS AT WORK.

INCREASED MARROW ACTIVITY. LIKE THE DISTRIBUTION QUESTION THE EXISTENCE OF MARROW HYPERACTIVITY AS A CAUSE OF THE LEUCOCYTOSIS CANNOT BE CONFIRMED OR ELIMINATED UNTIL THE NATURE OF THE LEUCOCYTOSIS IS EXAMINED.

STAB CELLS. THE STEADY INCREASE IN THE NUMBER OF CIRCULATING STAB-NUCLEAR NEUTROPHILS IS UNQUESTIONABLE EVIDENCE OF BOTH INCREASED AND DISORDERED MARROW ACTIVITY. THAT THE STAB-NUCLEARS ARE BEING PRODUCED AT ALL IS EVIDENCE OF MARROW ACTIVITY; THAT THEY ARE BEING PRODUCED IN LARGE NUMBERS IS INDICATIVE OF HYPERACTIVITY. THIS FACT IS CLEARLY INDEPENDENT OF HAEMOCONCENTRATION, SINCE STAB CELLS HAVE FIRST TO BE MANUFACTURED AND THEN FREED FROM THE MARROW, BEFORE THEY CAN BE CONCENTRATED. THAT STAB-NUCLEARS ARE DEVELOPED METAMYELOCYTES HAS ALREADY BEEN INDICATED, AS HAS THE FACT THAT THEY REPRESENT THE END POINT OF MATURATION WHEN THE MARROW IS WORKING UNDER THE BURDEN OF A TOXIC PROCESS. IT HAS FURTHER BEEN SHOWN THAT THE STAB CELLS APPEAR IN THE BLOOD AT THE TIME OF, OR VERY SHORTLY AFTER, THE INJURY, AND THAT THEIR

INCREASE IN THE BLOOD STREAM IS PROGRESSIVE UNTIL A TIME WHICH IS COINCIDENT WITH THE DEEPEST PHASE OF BURN SHOCK. IT IS TEMPTING TO ASSUME, THEREFORE, THAT THE PRODUCTION OF STAB-NUCLEAR NEUTROPHILS BY THE MARROW, AND THE STATE OF SHOCK, ARE CAUSED BY THE SAME AGENT. WHETHER OR NOT THIS BE TRUE, THE FOLLOWING FACTS ARE CERTAIN:-

1. COINCIDENT WITH, OR AT MOST FOLLOWING WITHIN AN HOUR OR TWO OF THE THERMAL TRAUMA, THE GRANULOCYTOPOIETIC TISSUE HAS ITS FUNCTION DERANGED, AND COMMENCES TO PRODUCE ABNORMAL ELEMENTS.

2. THIS DYSLEUCOCYTOPOIESIS CONTINUES UNTIL THE STAGE OF SHOCK HAS PASSED.

3. THE INCREASE OF THE ABNORMAL CELLS IN THE BLOOD PROGRESSES STEADILY AS DOES THE SHOCK PROCESS.

4. THE MAXIMUM STAB CELL COUNT IS REACHED DURING THE STAGE OF GRAVEST SHOCK.

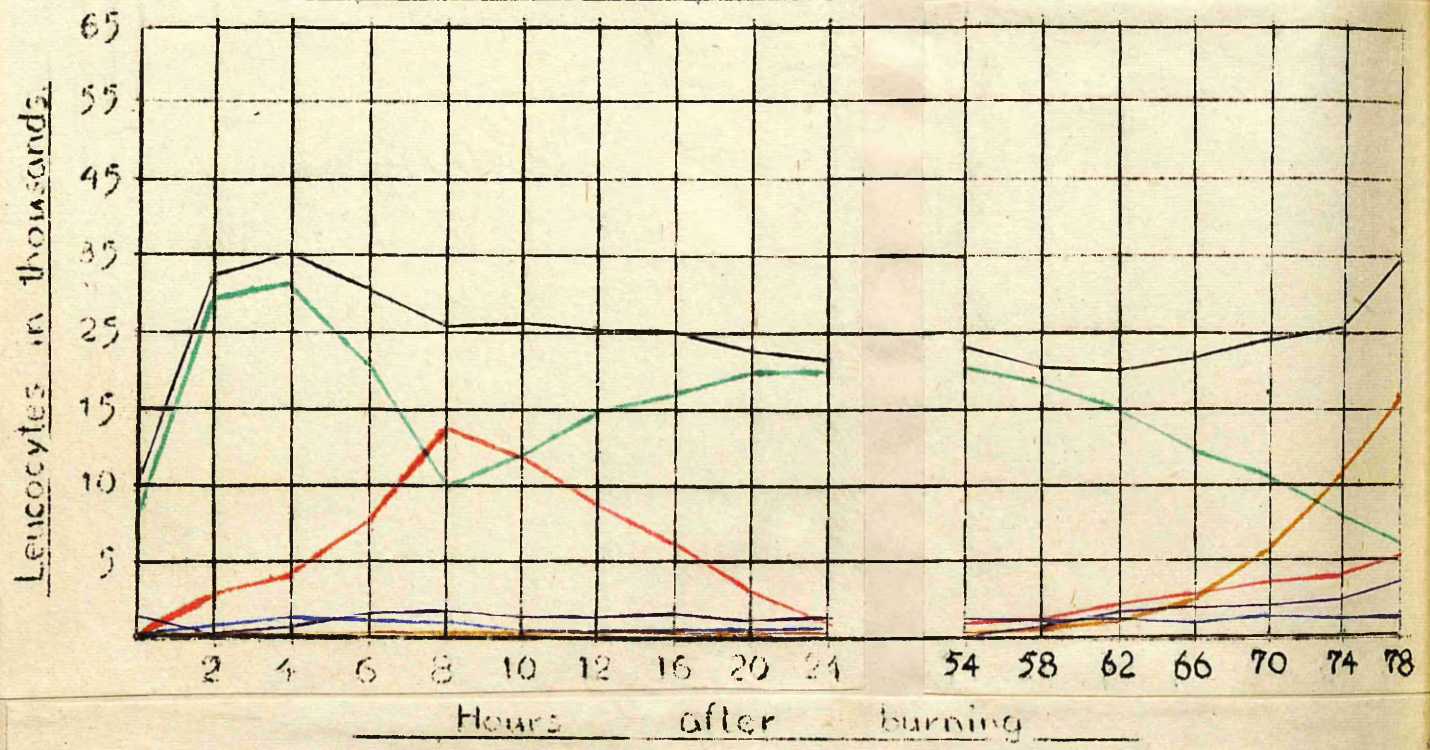
5. WITH THE DISAPPEARANCE OF THE CLINICAL MANIFESTATIONS OF SHOCK, THE NUMBER OF STAB CELLS IN THE CIRCULATION DECREASES.

IN A NUMBER OF CASES ( E.G. NUMBERS 5, 49, AND 70) THE STAB CELL COUNT DID NOT FALL SO MARKEDLY, EVEN AFTER OBVIOUS CLINICAL IMPROVEMENT IN THE PATIENT'S CONDITION. IN THESE CASES, HOWEVER, SUPPURATION WAS SEEN TO HAVE DEVELOPED, AND THE SEPSIS WAS RESPONSIBLE FOR THE MAINTAINED STAB-NUCLEAR COUNT. IT MAY SEEM RIDICULOUS

TO ARGUE THAT SUCH A CHANGE-OVER IN THE CAUSE OF THE STAB CELL PRODUCTION OCCURS, BUT REFERENCE TO THE DEGENERATIVE CYTOPLASMIC CHANGES ( Q.V. ) SUBSTANTIATES THIS CLAIM.

CYTOPLASMIC DEGENERATIVE CHANGES. NEUTROPHILS SHOWING TOXIC GRANULATION AND DEGENERATIVE VACUOLATION WERE NOT FOUND IN SIGNIFICANT NUMBERS. THAT SUCH CHANGES RESULT FROM A TOXIC ACTION ( BACTERIAL ) ON THE NEUTROPHILS HAS ALREADY BEEN DEMONSTRATED. ( CHAPTER 2. ) FURTHER, THE AUTHOR HAS ENDEAVOURED TO SHOW THAT THESE CHANGES TAKE PLACE IN THE PERIPHERY ( PROBABLY AT THE SITE OF SEPSIS ). EVEN IF THE PERIPHERAL ORIGIN OF THE CHANGES BE DENIED, HOWEVER, THEIR SIGNIFICANCE REMAINS THE SAME, VIZ., THEY CONSTITUTE EVIDENCE OF SEPSIS PLUS ABSORPTION OF BACTERIAL TOXINS. THIS WILL BE REMEMBERED FROM WHAT HAS BEEN WRITTEN OF MENDELL'S WORK IN CHAPTER 2. HE CONTENDS THAT THE LEUCOCYTE-FORMING TISSUE, WHILE RESPONDING TO THE STIMULI OF INFECTION, MAY HAVE ITS FUNCTION UPSET IN SUCH A WAY AS TO RESULT IN THE FORMATION OF STAB-NUCLEAR NEUTROPHILS, AND/OR DEGENERATIVE CYTOPLASMIC CHANGES. HE REGARDS THESE TWO REACTIONS AS BEING INDEPENDENT OF EACH OTHER, SOMETIMES ONE, SOMETIMES THE OTHER, AFFORDING MOST INFORMATION REGARDING THE SEVERITY OF THE INFECTION. THE AUTHOR BELIEVES THAT THIS VIEW IS NEARLY, BUT NOT QUITE, CORRECT. HE REGARDS THE

## HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_

TO ILLUSTRATE THE CHANGE IN THE PERIPHERAL LEUCOCYTE  
 PICTURE DUE FIRST, TO BURN SHOCK, AND SUBSEQUENTLY,  
 TO INFECTION OF THE BURNED AREA.

STAB CELL FORMATION AS BEING A RESULT OF DIRECT TOXIC ACTION ON THE MARROW, WHILE THE CYTOPLASMIC CHANGES ARE INDICATIVE OF DAMAGE TO THE NEUTROPHILS SUSTAINED WHILE IN CIRCULATION. THIS VIEW IS CONVENIENT, NOT MERELY BECAUSE OF THE PRESENT PROBLEM, BUT BECAUSE IT EXPLAINS THE VARYING RELATIONSHIP WHICH THE STAB CELLS BEAR TO THE DEGENERATIVE POLYMORPH FORMS IN DIFFERENT INFECTIONS AND EVEN IN THE SAME INFECTION AT DIFFERENT TIMES. THEIR ABSENCE, THEN, IN BURN SHOCK IS A STRONG ARGUMENT AGAINST ITS BEING CAUSED BY INFECTION, AND FURTHER INEVITABLY LEADS ONE TO SEEK A CAUSE OTHER THAN BACTERIAL TOXAEMIA FOR THE HIGH STAB-NUCLEAR CELL COUNT WHICH OBTAINS IN THESE CASES. (VIDE FIGS. 4 & 5.)

LYMPHOCYTES. THE PRELIMINARY LYMPHOPENIA IS INTERESTING, ALTHOUGH INEXPLICABLE. IT DOES NOT APPEAR TO BE PECULIAR TO THERMAL TRAUMA, SINCE IT HAS BEEN OBSERVED BY A NUMBER OF INVESTIGATORS ( E.G. STEVENSON ) IN PATIENTS SUFFERING FROM TRAUMA TO MUSCLE, AND IN MULTIPLE FRACTURES. IT HAS BEEN RECOGNISED ALSO TO OCCUR IN RATS AFTER VARIOUS TYPES OF TRAUMA, INCLUDING BURNS (CRUICKSHANKS), AND FURTHER TO OCCUR AT APPROXIMATELY THE SAME TIME AFTER INJURY AS THE AUTHOR OBSERVED IT TO DO IN BURNED HUMAN PATIENTS. IN THE SAME WAY, THE GREATER LYMPHOCYTOSIS FOUND IN BURNED CHILDREN CAN BE ASSOCIATED WITH THE MASSIVE LYMPHOCYTOSIS OBSERVED IN SOME CASES OF WHOOPING COUGH, STREPTOCOCCAL AND

PNEUMOCOCCAL INFECTION. THESE FACTS DO NOT EXPLAIN THE LYMPHOCYTOSIS, HOWEVER, AND GIVE NO INDICATION OF ITS SIGNIFICANCE. THERE IS ABUNDANT EVIDENCE THAT THE LYMPHOID TISSUE OF YOUNG CHILDREN IS MUCH MORE ACTIVE AND MORE LABILE THAN IN THE CASE OF ADULTS, (KATO ET AL.) AND THAT A STIMULUS WHICH WOULD RESULT IN A NEUTROPHILIA IN THE LATTER MAY EVOKE A LYMPHOCYTOSIS IN THE FORMER. IT IS UNNECESSARY THEREFORE, TO ASSUME THAT THE STIMULUS IS DIFFERENT IN ADULTS AND CHILDREN, BUT MERELY THAT THE RESPONSE IS PARTLY DETERMINED BY THE DIFFERENT ACTIVITY OF THE LYMPHOID TISSUE AT DIFFERENT AGES.

EOSINOPHILS. THE CONSTANT PRESENCE OF THESE CELLS DURING THE PROGRESS OF BURN SHOCK, IS STRONG EVIDENCE AGAINST ITS BEING DUE TO AN INFECTION OR EVEN THAT THERE IS A CO-EXISTENT INFECTION. THESE CELLS ALMOST INVARIABLY DISAPPEAR DURING THE ACUTE STAGE OF A SEPTIC PROCESS, AND THEIR RETURN TO THE PERIPHERAL BLOOD IS REGARDED AS AN EARLY SIGN OF CONVALESCENCE.

MONOCYTES. WHILE THE PHYSIOLOGY OF THE MONOCYTE IS NOT UNDERSTOOD, OBSERVATIONS OF ITS REACTIONS TO SEPTIC PROCESSES HAVE CAUSED IT TO BE REGARDED IN THE SAME LIGHT AS THE EOSINOPHIL POLYMORPH. ITS PRESENCE THROUGHOUT THE STATE OF SHOCK IS, THEREFORE, EVIDENCE AGAINST AN INFECTION.

IT MAY NOW BE STATED THAT THE EVIDENCE AGAINST AN ACUTE INFECTION IS AS FOLLOWS:-

1. ABSENCE OF DEGENERATIVE CYTOPLASMIC CHANGES.
2. PRESENCE OF EOSINOPHILS.
3. PRESENCE OF MONOCYTES.

THE EVIDENCE AGAINST THE THEORY THAT THE LEUCOCYTOSIS IS THE RESULT OF A PERIPHERAL DISTRIBUTION OF THE BODY'S LEUCOCYTES IS SIMPLY - THE NATURE OF THE LEUCOCYTOSIS WITH ITS HIGH PROPORTION OF STAB-NUCLEAR CELLS. THE SAME EVIDENCE IS QUITE AGAINST THE ARGUMENT THAT THE LEUCOCYTOSIS IS THE RESULT OF HAEMOCONCENTRATION. IN FAVOUR OF THE EXISTENCE OF A CIRCULATING TOXIN, THESE POINTS MAY BE OFFERED:-

1. EVIDENCE OF DYSLEUCOCYTOPOIESIS (THE PRODUCTION OF LARGE NUMBERS OF STAB-NUCLEAR NEUTROPHILS).

2. THE CLOSE ASSOCIATION BETWEEN THE NUMBER OF CIRCULATING STAB CELLS AND THE PROGRESS OF THE STATE OF BURN SHOCK.

THE RESULTS OF THESE SERIAL BLOOD EXAMINATIONS IN ONE HUNDRED AND FIFTY BURNED PATIENTS ARE INTERESTING, NOT ONLY BECAUSE THEY AFFORD THE ONLY AVAILABLE INFORMATION REGARDING THE CHANGES IN THE PERIPHERAL LEUCOCYTES DURING THE STATE OF SHOCK, BUT ALSO FOR THE FOLLOWING REASONS:-

1. THEY INDICATE THE RAPIDITY WITH WHICH MYELOPOIETIC TISSUE CAN RESPOND TO STIMULI OF ONE TYPE AT LEAST.

2. THEY ILLUSTRATE THE DIFFERENCES BETWEEN SUCH A

RESPONSE AND THAT DUE TO LOCAL OR GENERALISED SEPSIS,  
AND THUS -

3. THEY CONSTITUTE NEW EVIDENCE AGAINST THE  
BACTERIAL THEORY OF ORIGIN OF BURN SHOCK.

4. SUCH OBSERVATIONS MAY OFFER A REASONABLY  
ACCURATE METER FOR THE DEGREE OF SHOCK PRESENT IN ANY  
CASE.

5. THEY OFFER NEW PRESUMPTIVE EVIDENCE, THAT THIS  
FORM OF SHOCK IS PRESENT, IN SOME DEGREE, THIRTY MINUTES  
AFTER INJURY, AND THAT THE SAME MECHANISM MAY BE AT  
WORK FROM THE VERY MOMENT AT WHICH THE INJURY OCCURS.

6. THEY DEMONSTRATE THAT, WHETHER OR NOT THEY  
BE CAUSATIVE, FACTORS OTHER THAN LOSS OF FLUID AND  
HAEMOCONCENTRATION PLAY A PART IN THE MECHANISM OF  
BURN SHOCK.

7. THEY CONSTITUTE, IN THE AUTHOR'S OPINION,  
NEW EVIDENCE IN FAVOUR OF THE TOXIC THEORY OF THE  
AETIOLOGY OF SHOCK, ASSOCIATED WITH THERMAL TRAUMA.

8. THEY SHOW THAT THE MARROW MAY BE SO INFLUENCED  
AS TO PRODUCE STAB CELLS IN LARGE NUMBERS WITHOUT ITS  
PRODUCTIVE CAPACITY BEING DEPRESSED.

**BIBLIOGRAPHY.**

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## CHAPTER ONE.

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**PART TWO.**

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Age of patient **14 years.**

Case No. **1**

Sex of patient **Female.**

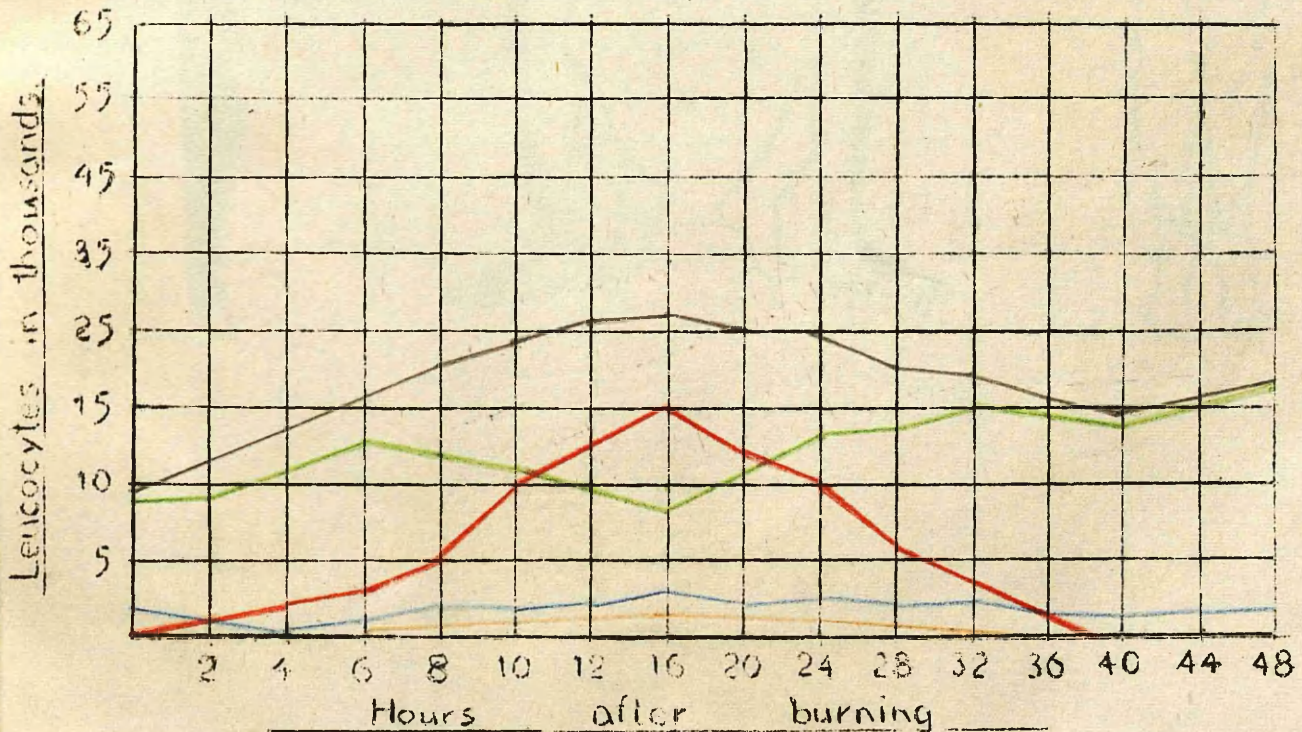
Nature of injuries **Burns of legs.**

**Distribution as shown on chart overleaf.**

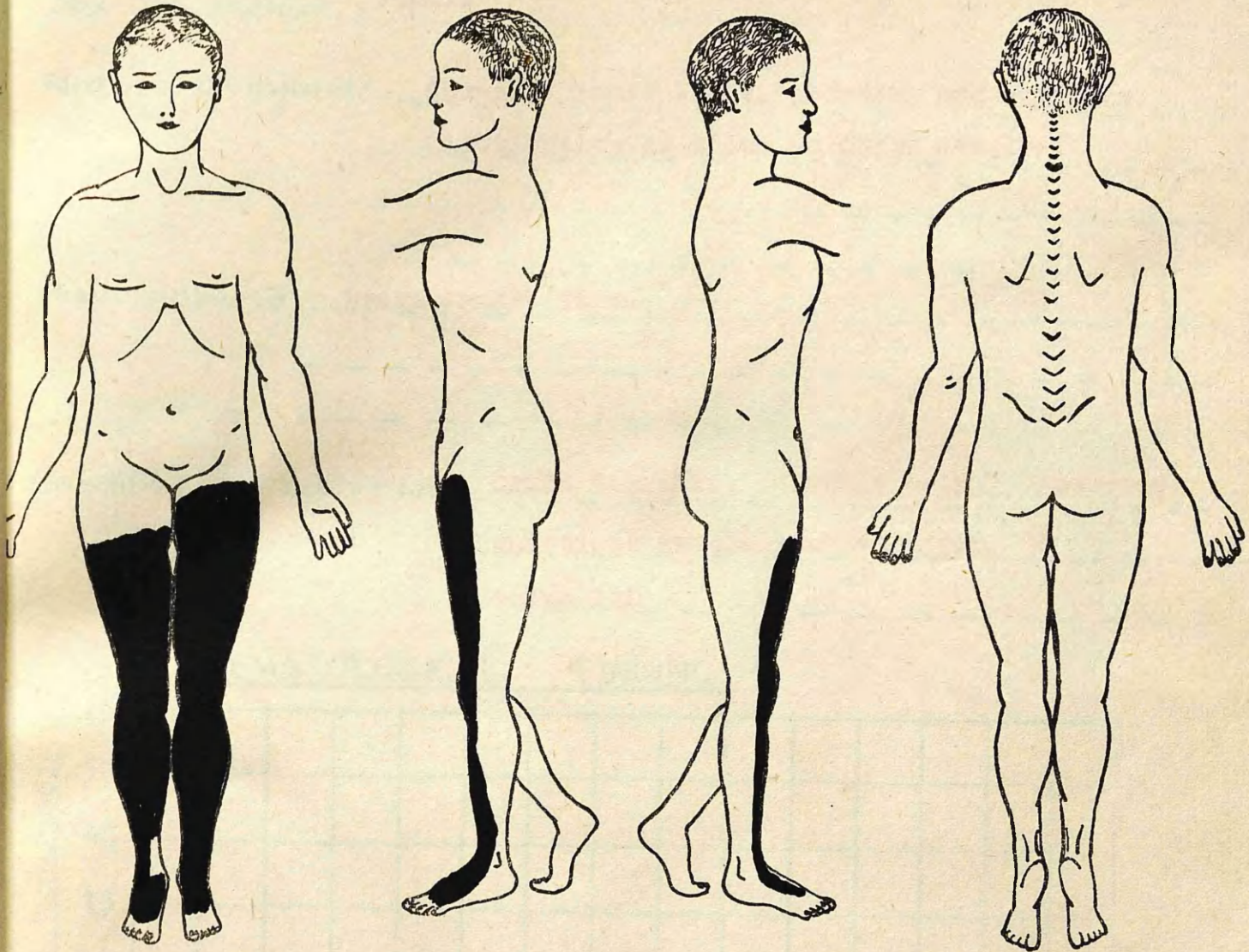
How sustained **Hot wax spilled out of vat at which patient was working.**

Condition on admission **No pain. Talkative. Temp. 98.4 Pulse 96**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes } \_\_\_\_\_  
 & Monocytes }



Case No. 1

TREATMENT

Tannic Acid.

Age of patient **8 years**

Case No. **2**

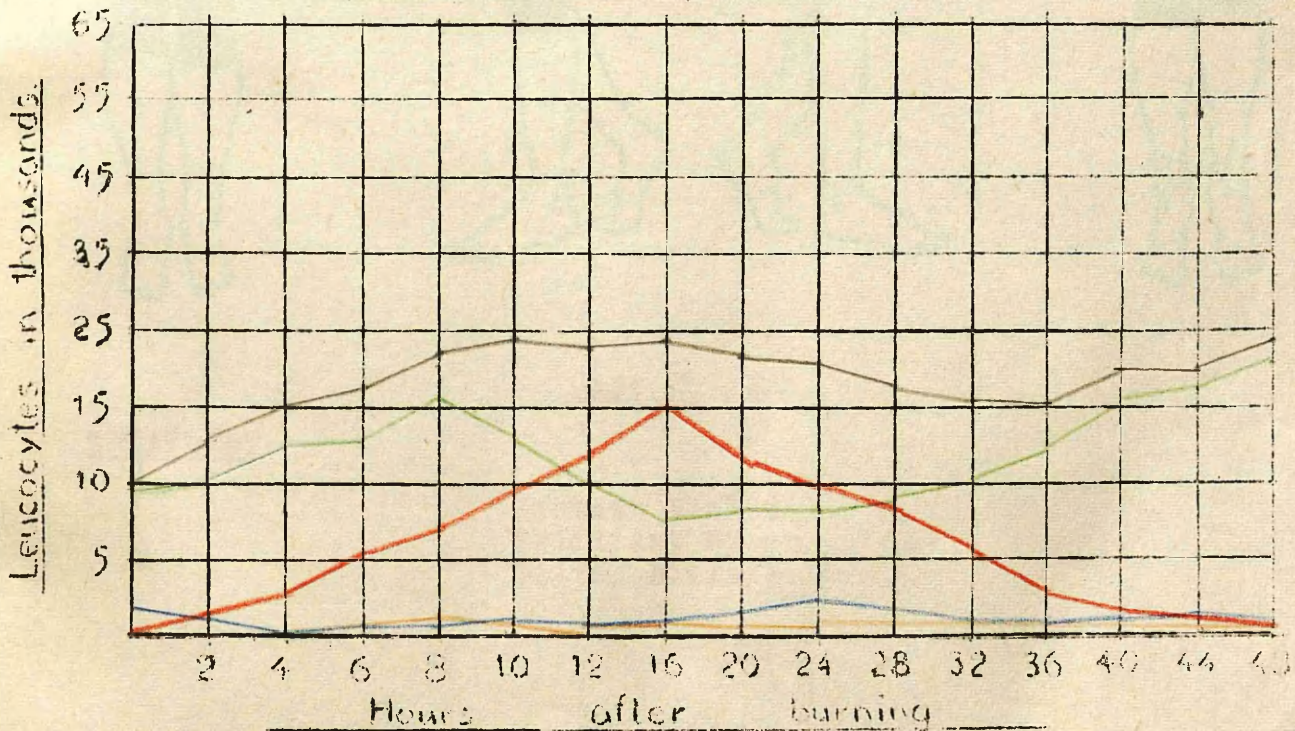
Sex of patient **Female**

Nature of injuries **Burns of lower limbs, abdomen, and buttocks.**  
**Distribution as shown on chart overleaf.**

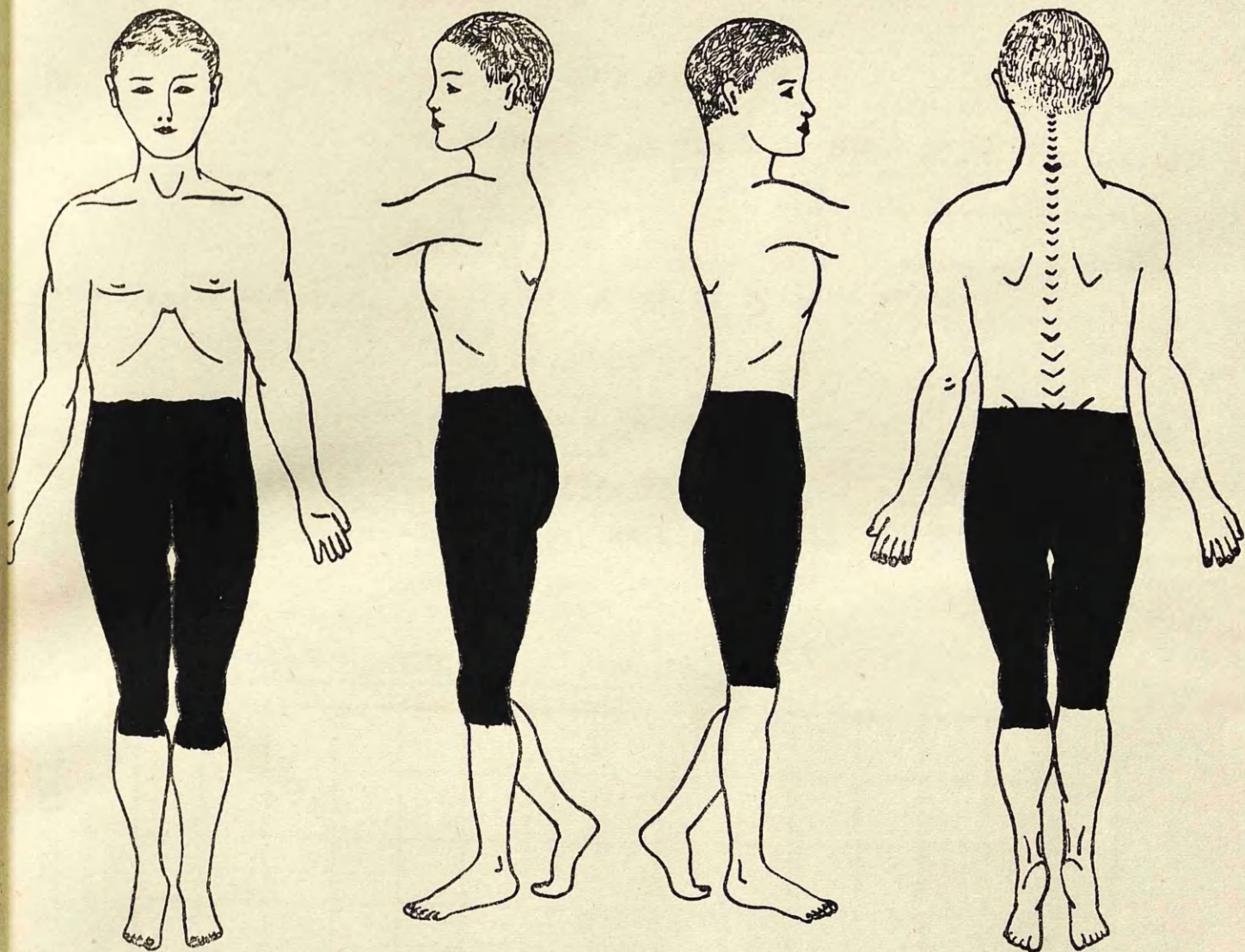
How sustained **Dress caught fire.**

Condition on admission **Cried fitfully. Little pain. Answered questions intelligently. Temp. 98**  
**Pulse 120**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 2

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate

Age of patient 6 years

Case No. 3

Sex of patient Female.

Nature of injuries Scald of neck, and chest.

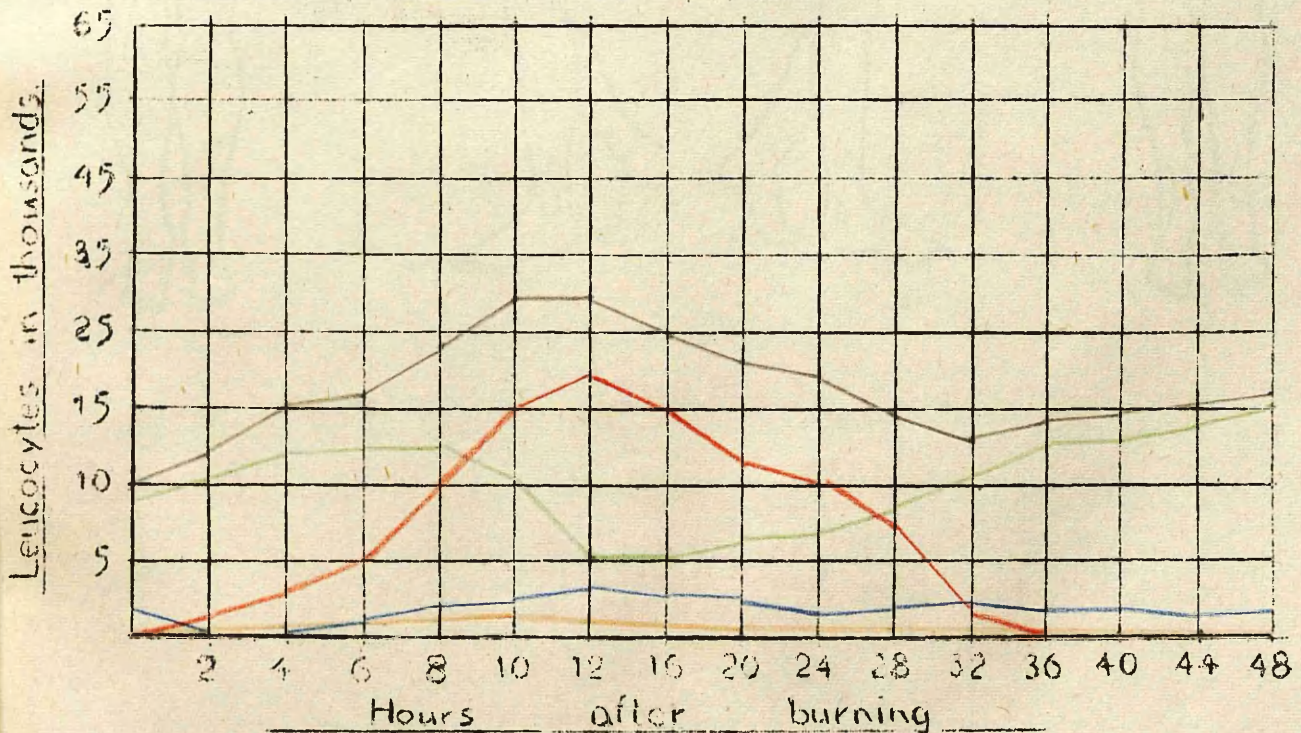
Distribution as shown on chart overleaf.

How sustained Overtured a pan of boiling water.

Condition on admission Painful, cried fitfully. Temp. 97.4

Pulse, weak and rapid.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_

Age of patient **10 months.**

Case No. **4**

Sex of patient **Female.**

Nature of injuries **Scald of head and chest.**

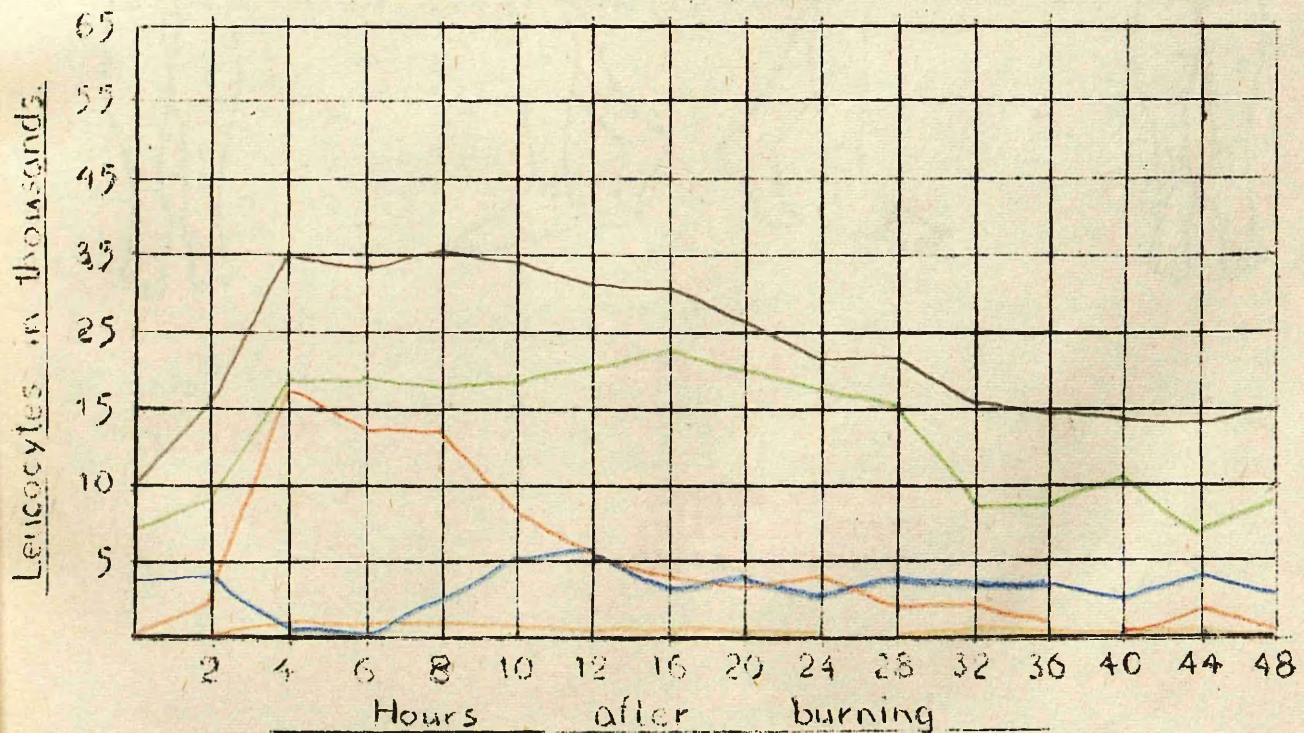
**distribution as shown on chart overleaf.**

How sustained **Overturned cup of hot tea.**

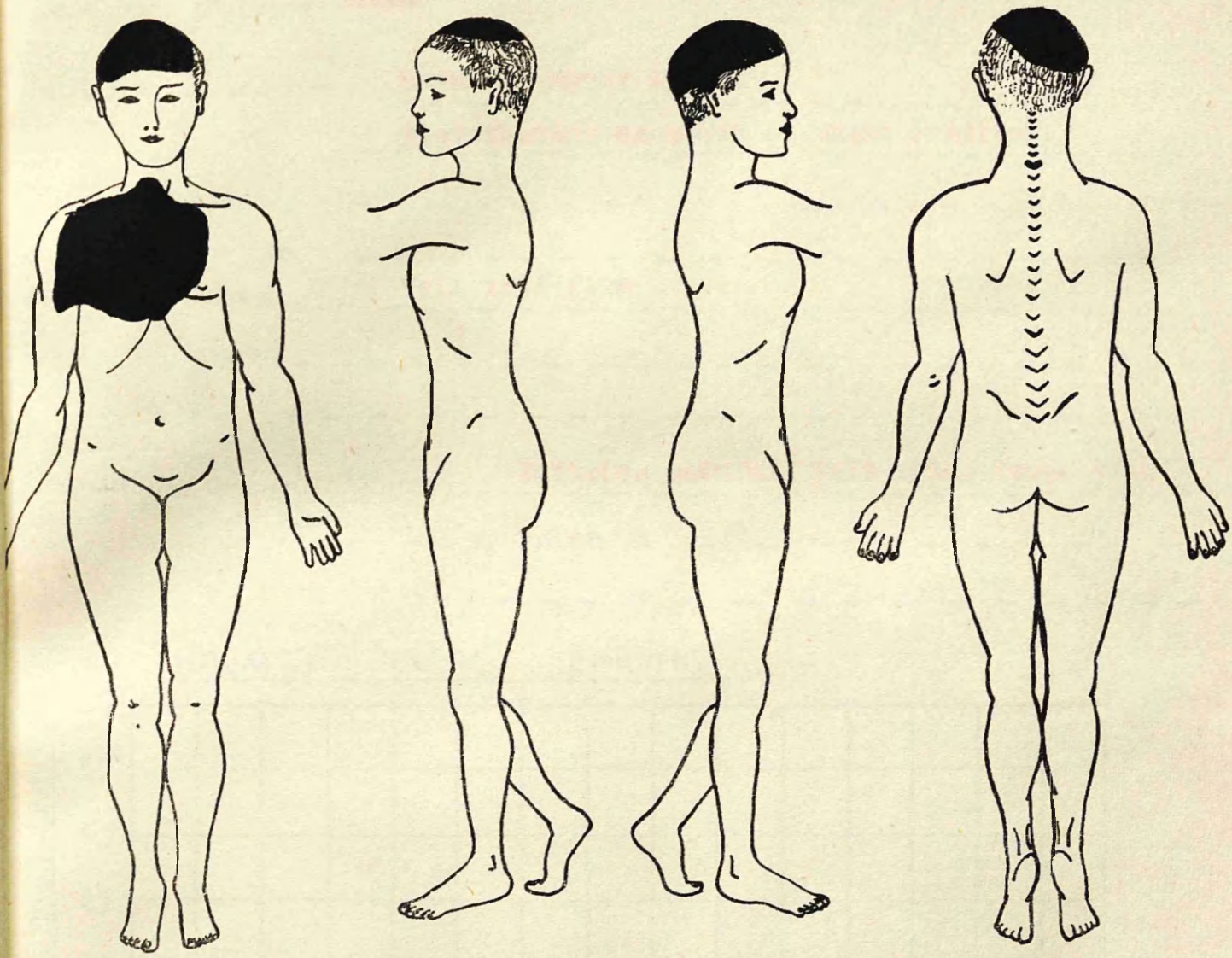
Condition on admission **Apparently no pain. Patient quiet.**

**Temp. 99.8 Pulse very rapid.**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ..... Metamyelocytes ..... Lymphocytes }  
& Monocytes }  
Polymorphs ..... Stab Nuclears ..... Toxic Granulocytes .....



Case No.4

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate

Age of patient **12 years.**

Case No. **5**

Sex of patient **Male**

Nature of injuries **Burns of upper limbs.**

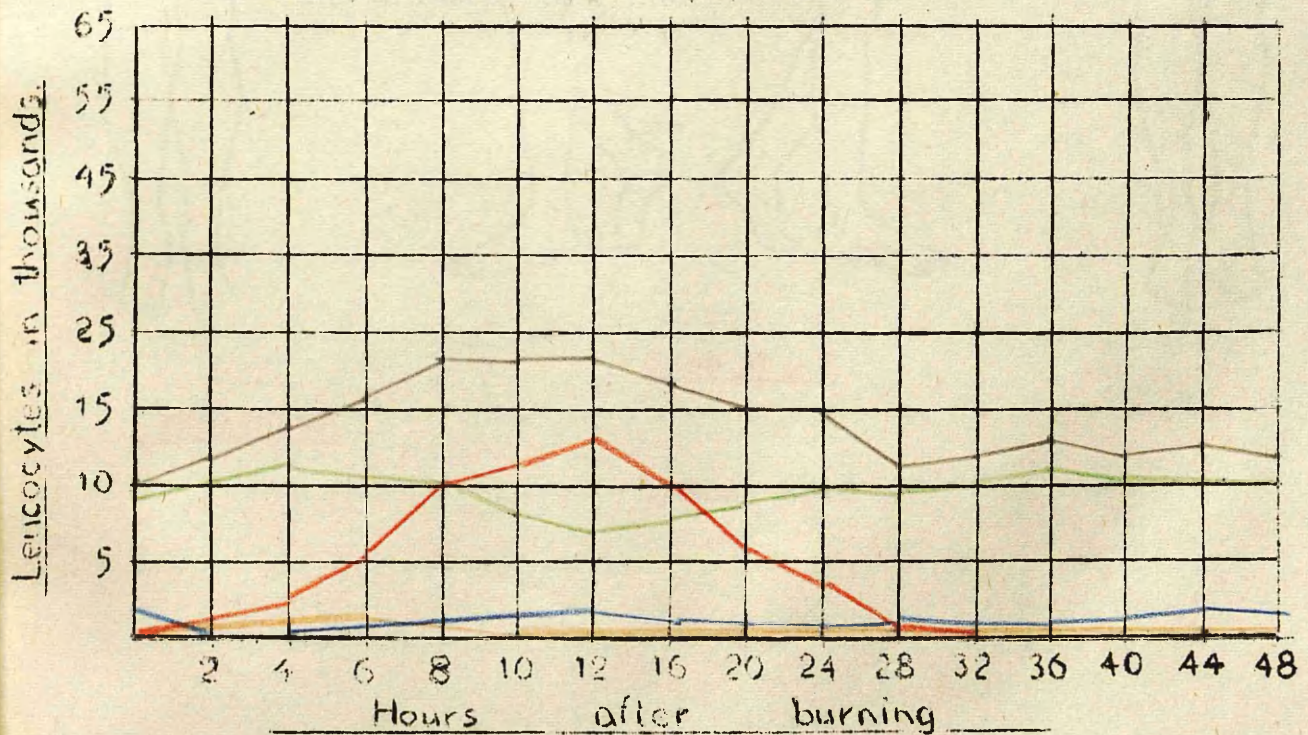
**Distribution as shown on chart overleaf.**

How sustained **Fell into fire**

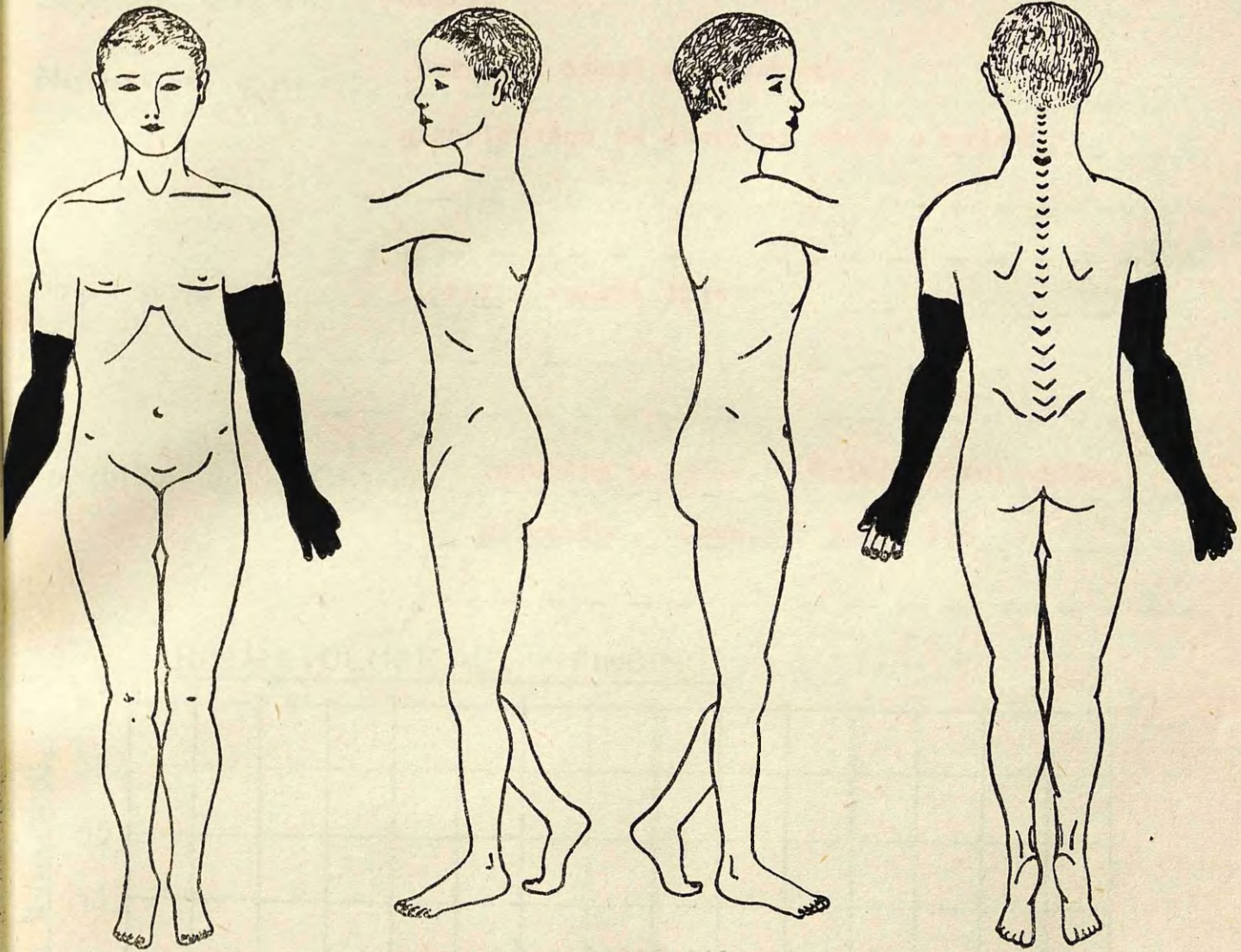
Condition on admission **Injuries painful. Felt cold. Temp. 97.8**

**Pulse 98**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes } \_\_\_\_\_  
 & Monocytes }



Case No. 5

TREATMENT

Tannic Acid

Age of patient... **11 years**

Case No. 6

Sex of patient... **Female.**

Nature of injuries... **Burns of chest and abdomen.**

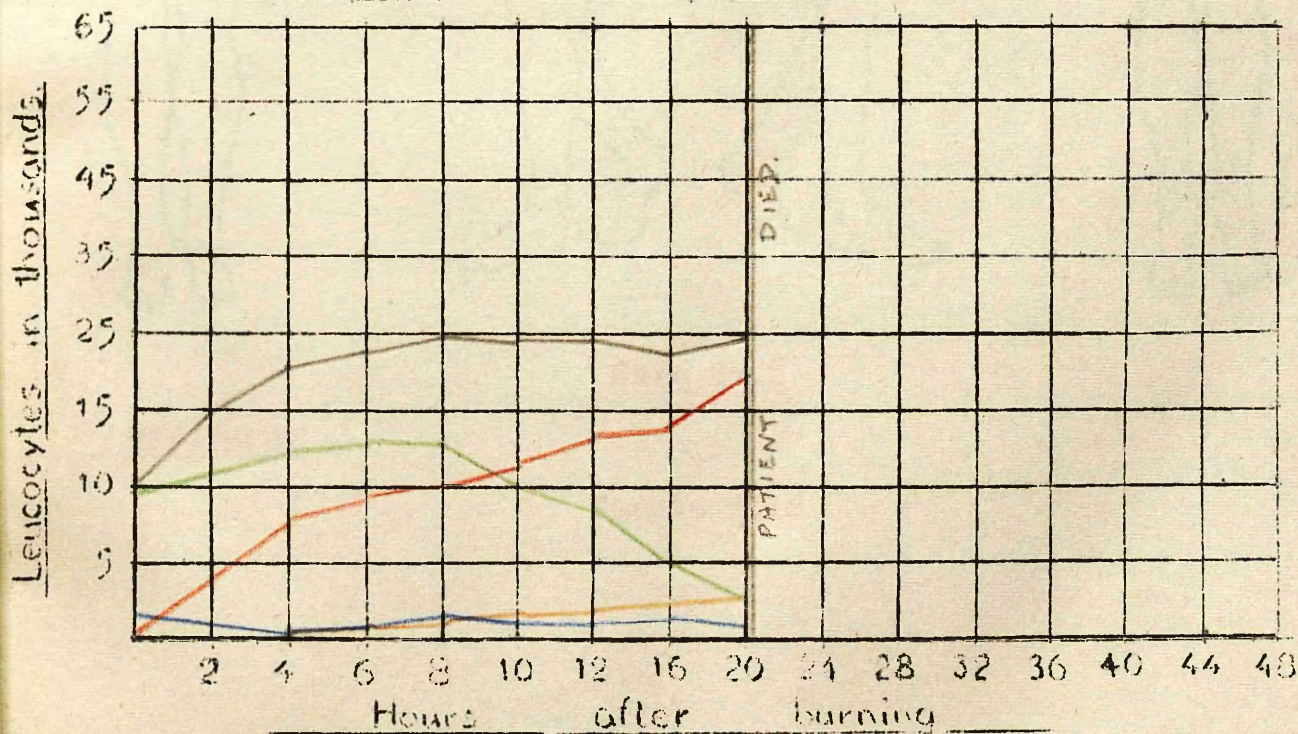
distribution as shown on chart overleaf.

How sustained... **Clothing caught fire.**

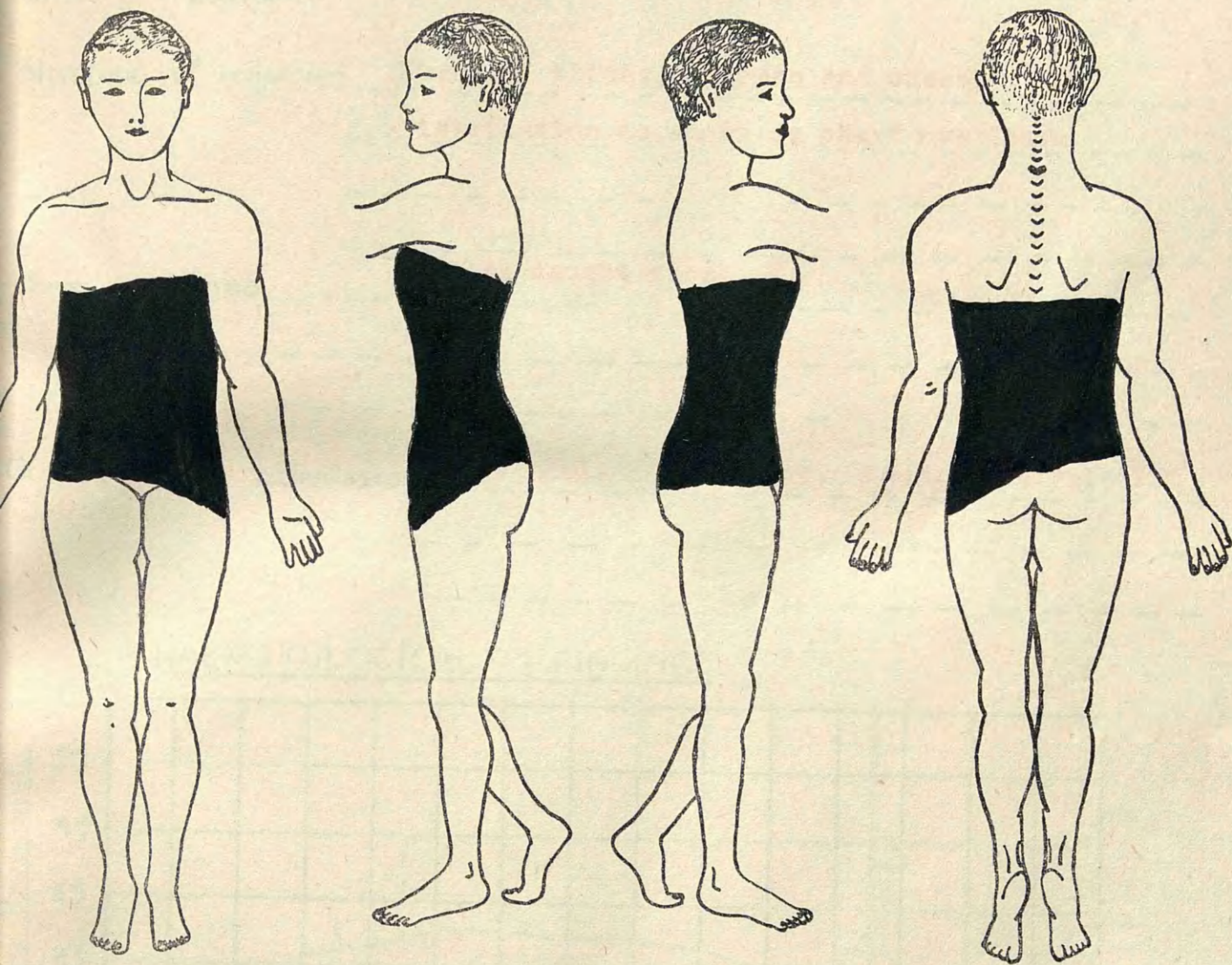
Condition on admission... **Injuries painful. Cried occasionally.**

Shivering. Temp. 98 Pulse 126

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes } ———  
& Monocytes } ———  
Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No.6

TREATMENT

Tannic Acid

Age of patient 12 years.

Case No. 7

Sex of patient Male

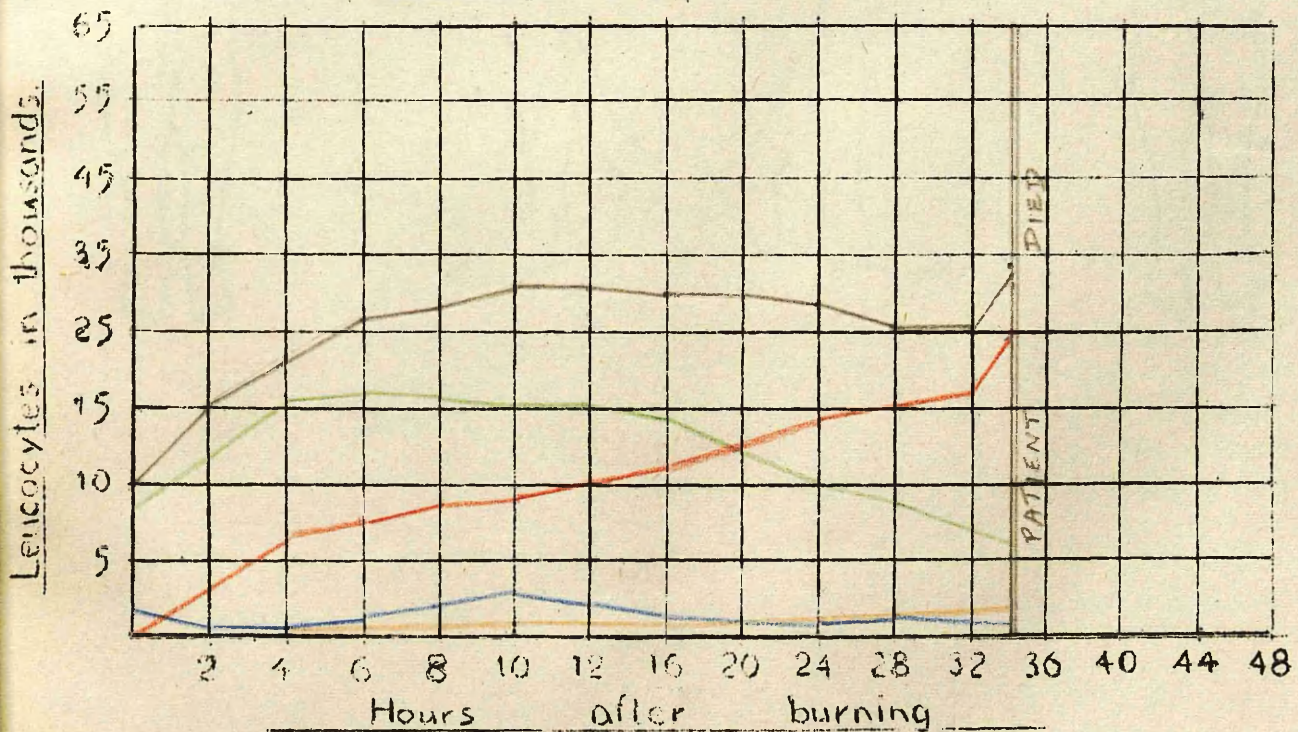
Nature of injuries Burns of thighs, abdomen and chest.

Distribution as shown on chart overleaf.

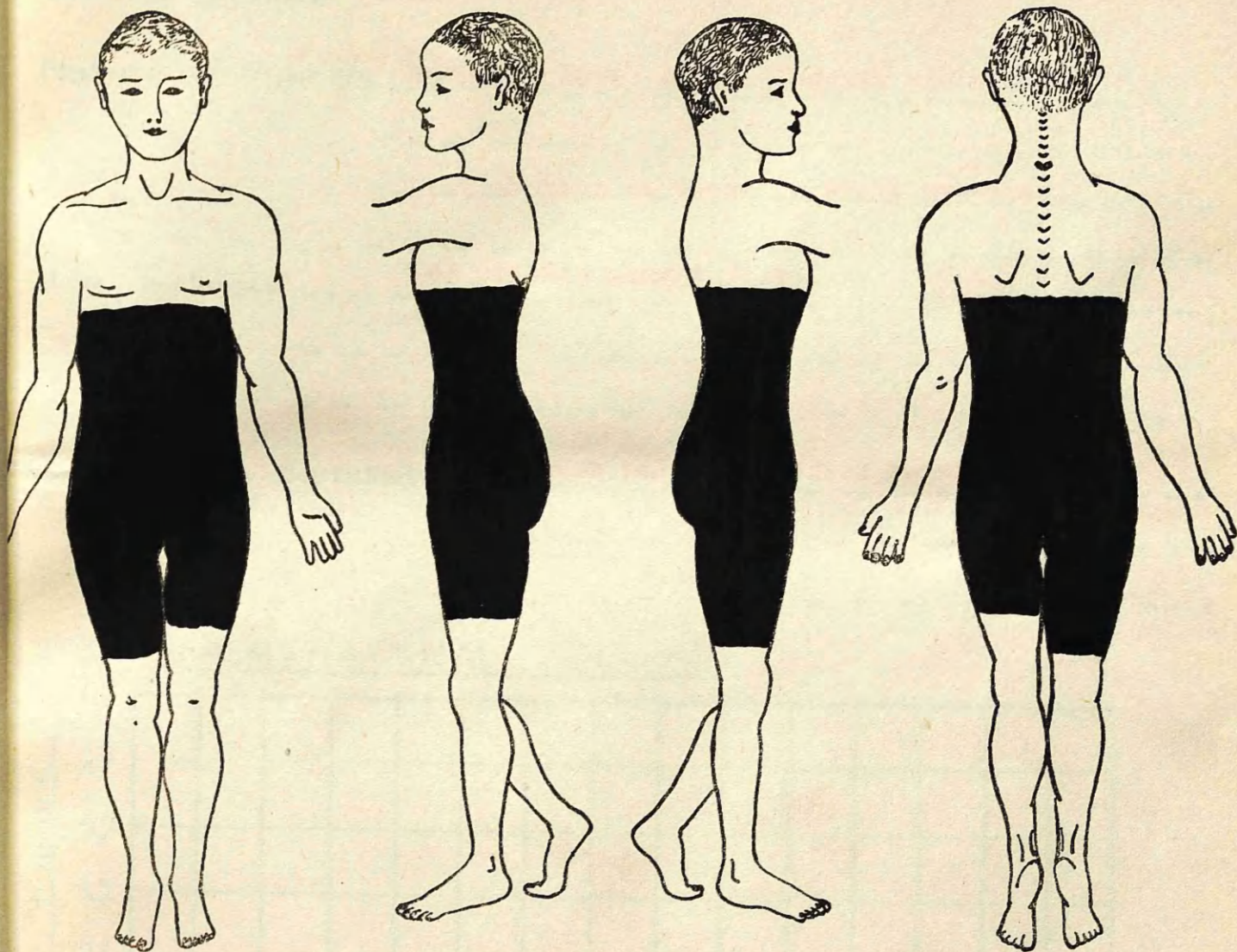
How sustained Clothes caught fire.

Condition on admission Painful. Shivering. Temp. 97.2 Pulse 110

HAEMATOLOGICAL FINDINGS



Total Leucocytes          Metamyelocytes          Lymphocytes }           
 & Monocytes }           
 Polymorphs          Stab Nuclears          Toxic Granulocytes



Case No.7

TREATMENT

Tannic Acid

Age of patient 11 years

Case No. 8

Sex of patient Female

Nature of injuries Burns of lower limbs, abdomen and chest.

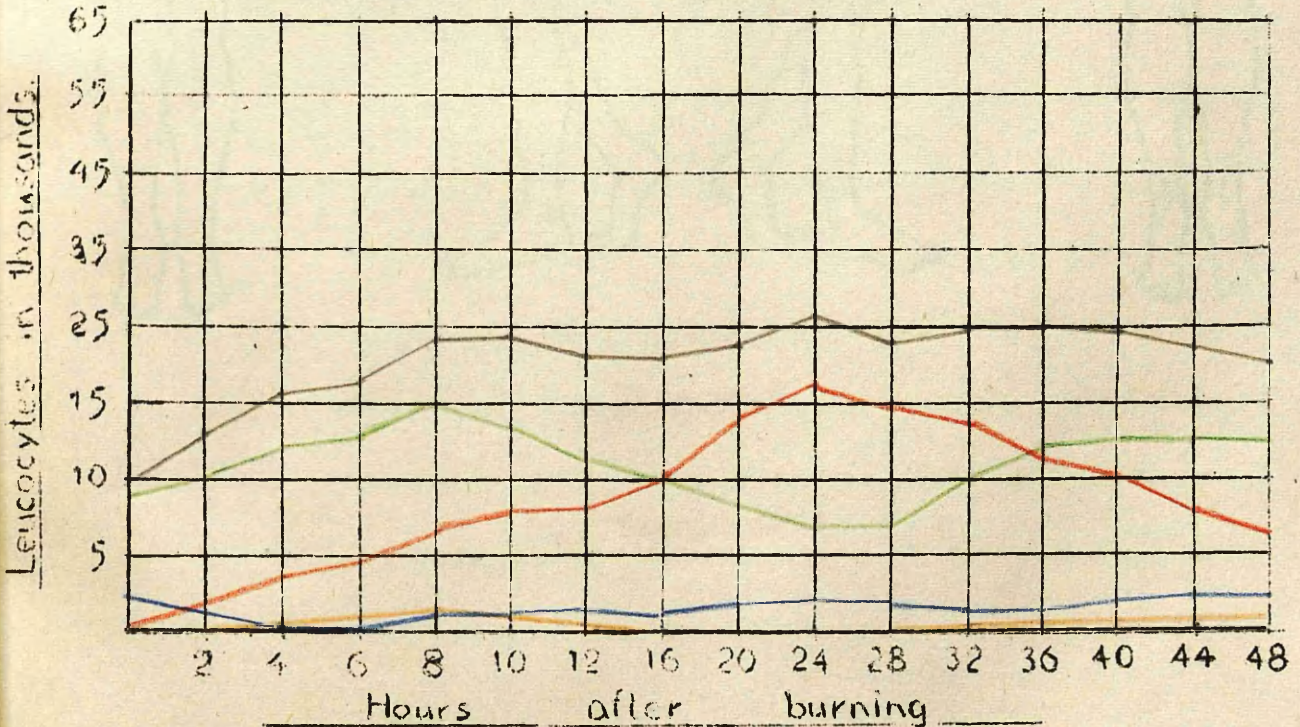
Distribution as shown on chart overleaf.

How sustained Bed clothes caught fire.

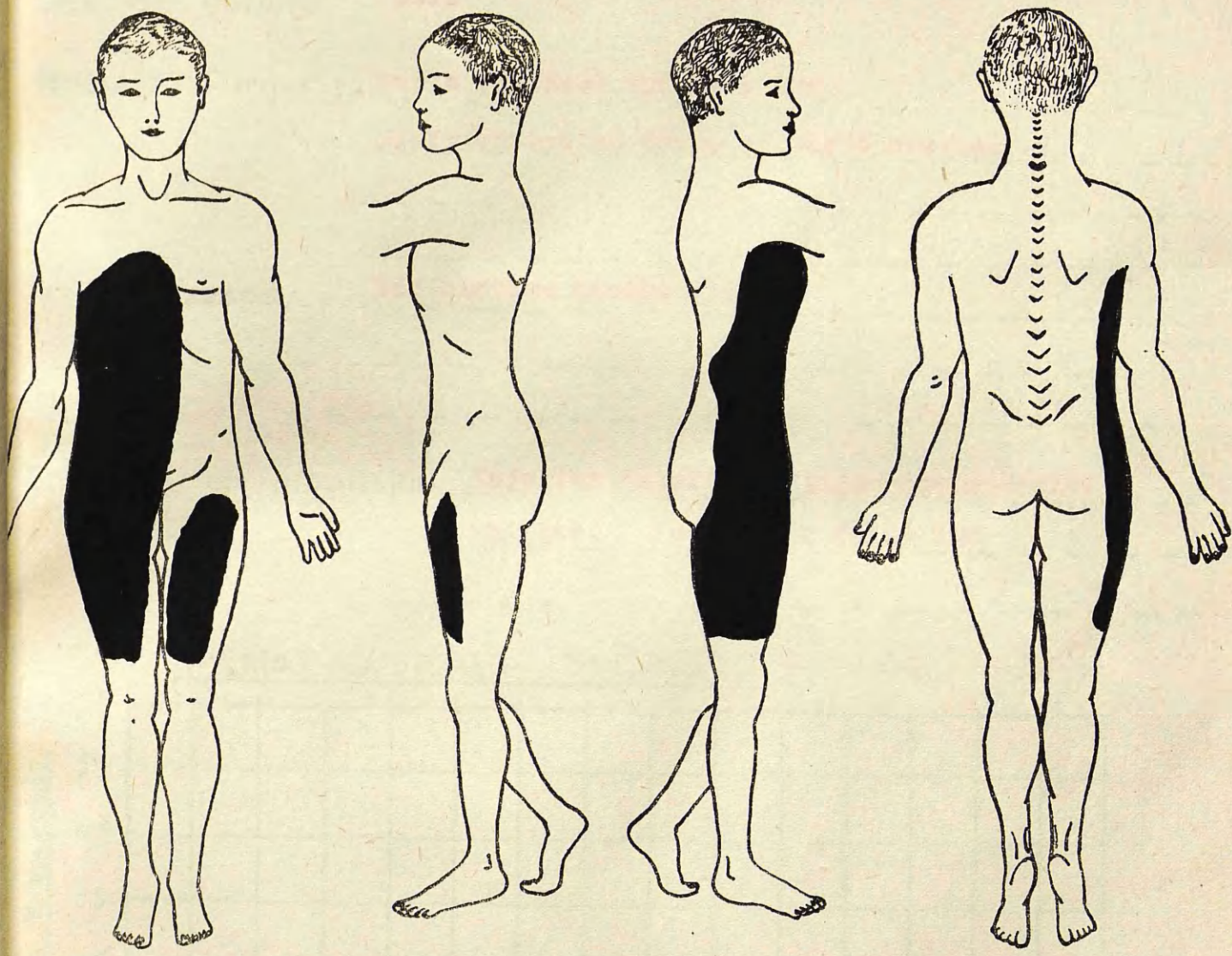
Condition on admission Injuries painful. Cried continuously.

Temp. 98.8 Pulse 110

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Myrmorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No.8

TREATMENT

Tannic Acid

Age of patient **6 years**

Case No. **9**

Sex of patient **Male**

Nature of injuries **Burns of chest and left arm.**

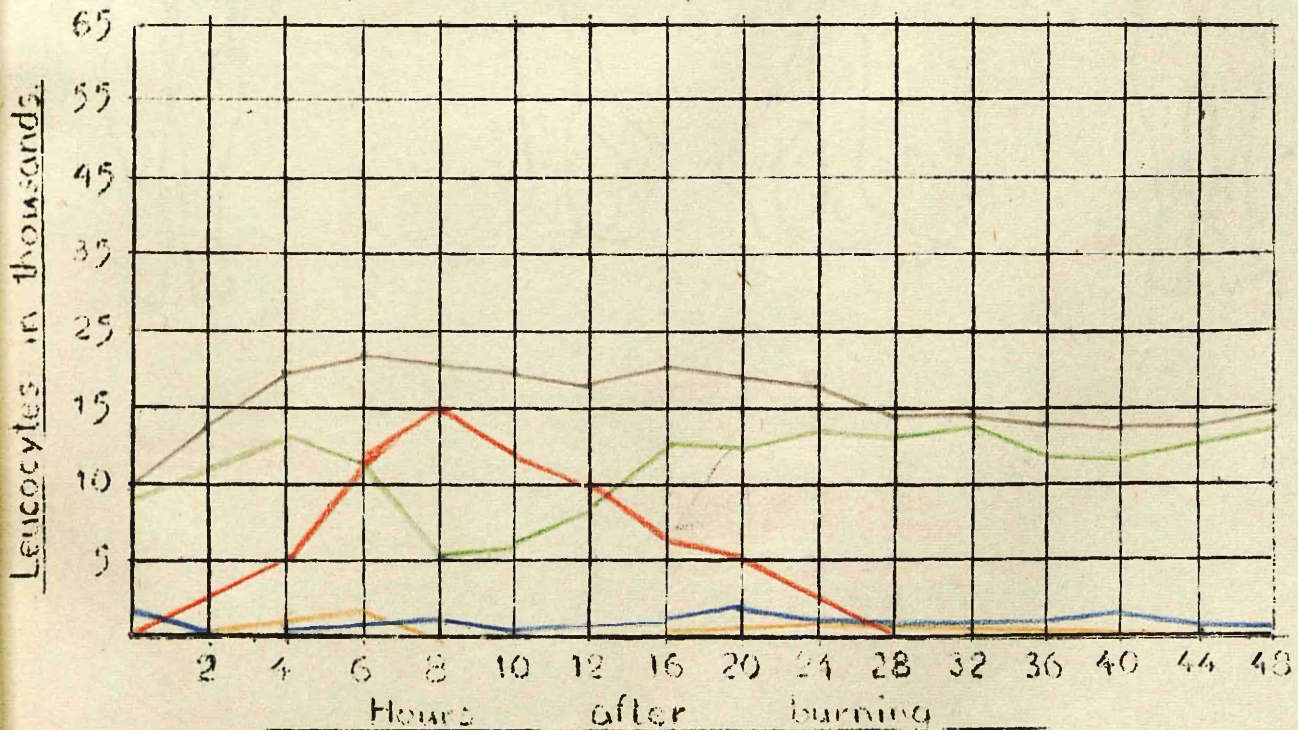
**Distribution as shown on chart overleaf.**

How sustained **Bed clothes caught fire.**

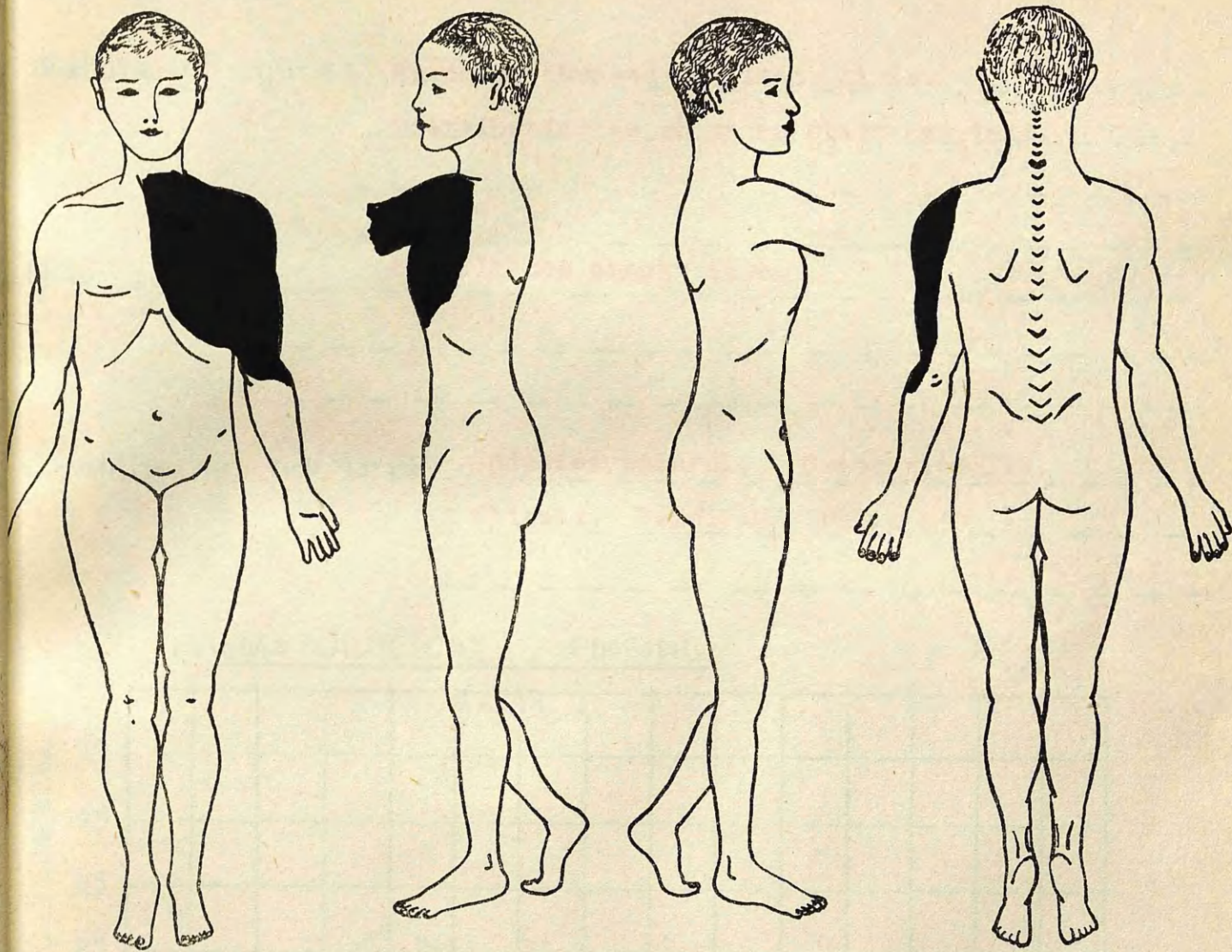
Condition on admission **Injuries painful. Cried continuously.**

**Thirsty. Temp. 97.1 Pulse 120**

### HAEMATOLOGICAL FINDINGS



tal Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
Eosinophils } \_\_\_\_\_  
Lymphocytes \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_

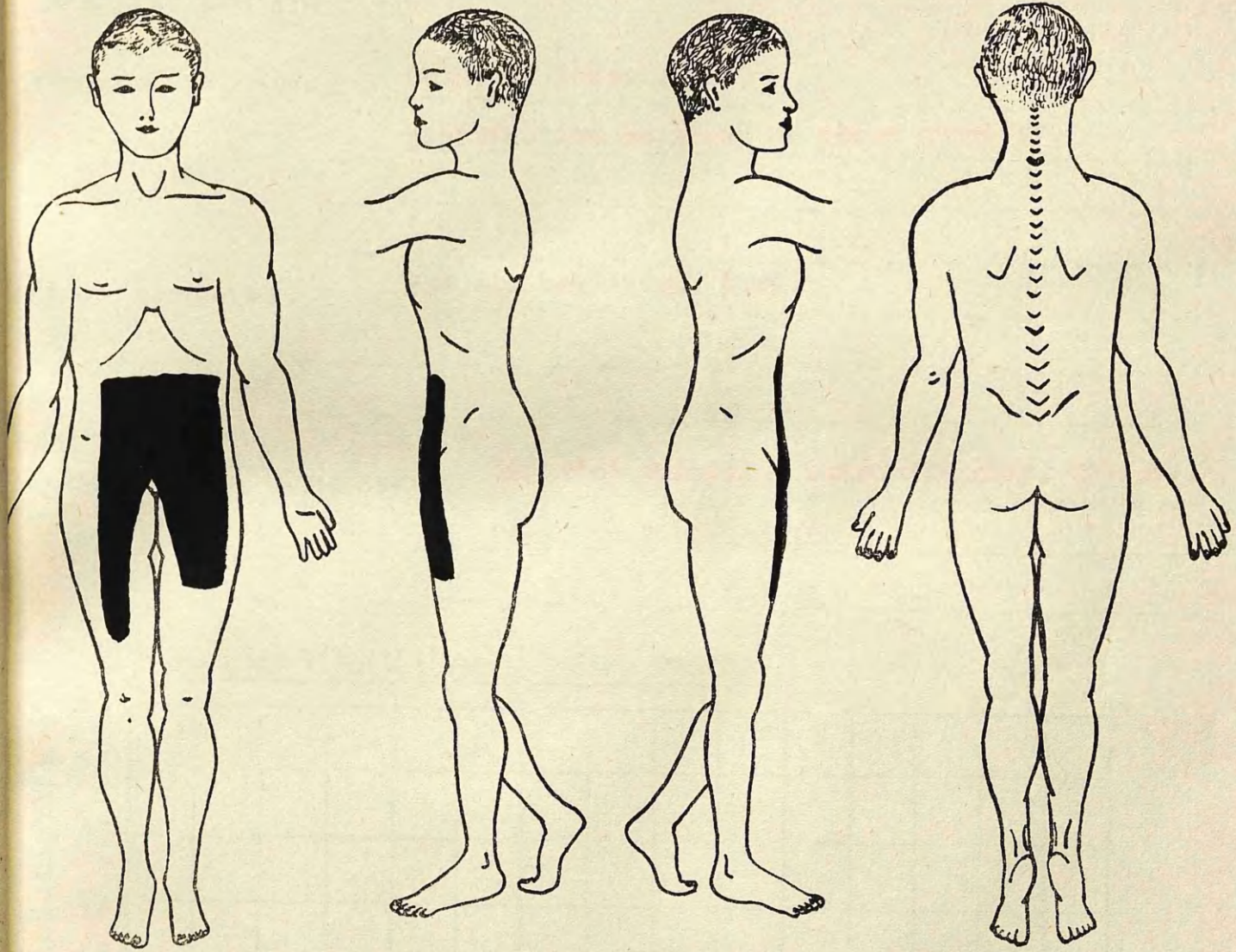


Case No.9

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate





Case No. 10

TREATMENT

Tannic Acid

Age of patient 7 years.

Case No. 11

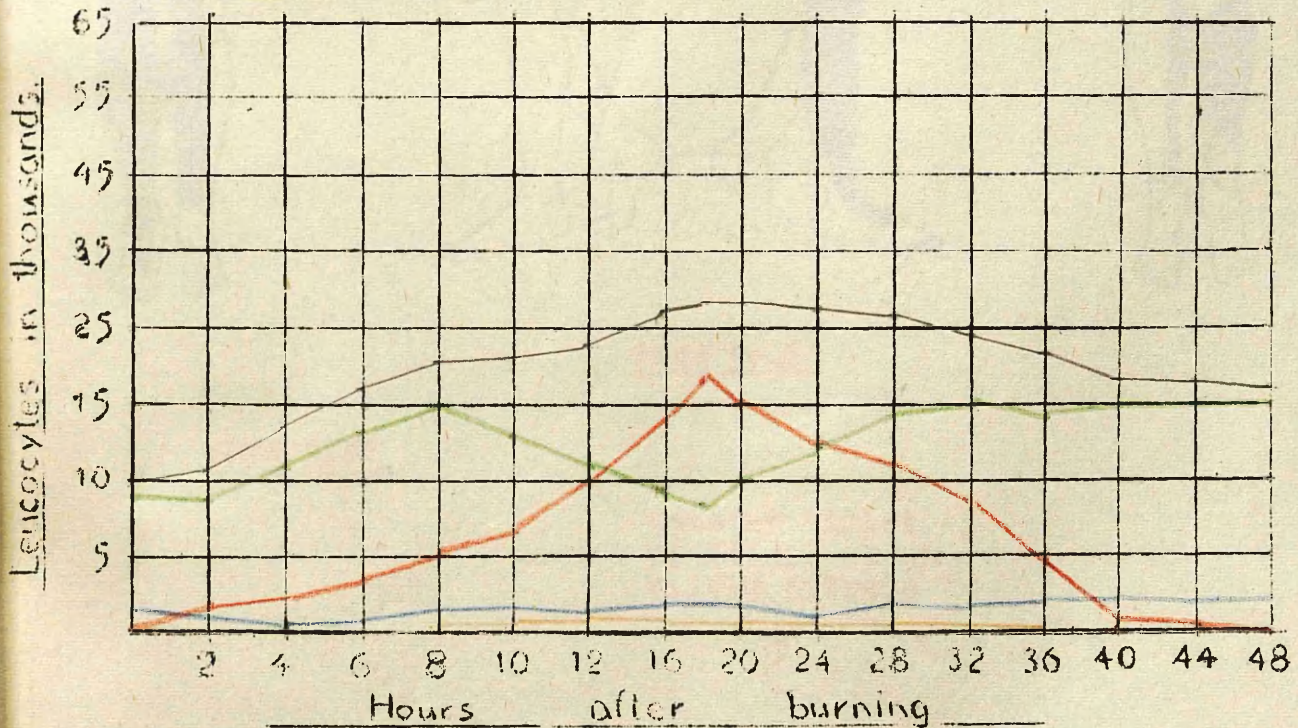
Sex of patient Male.

Nature of injuries Burns of lower limbs.  
distribution as shown on chart overleaf.

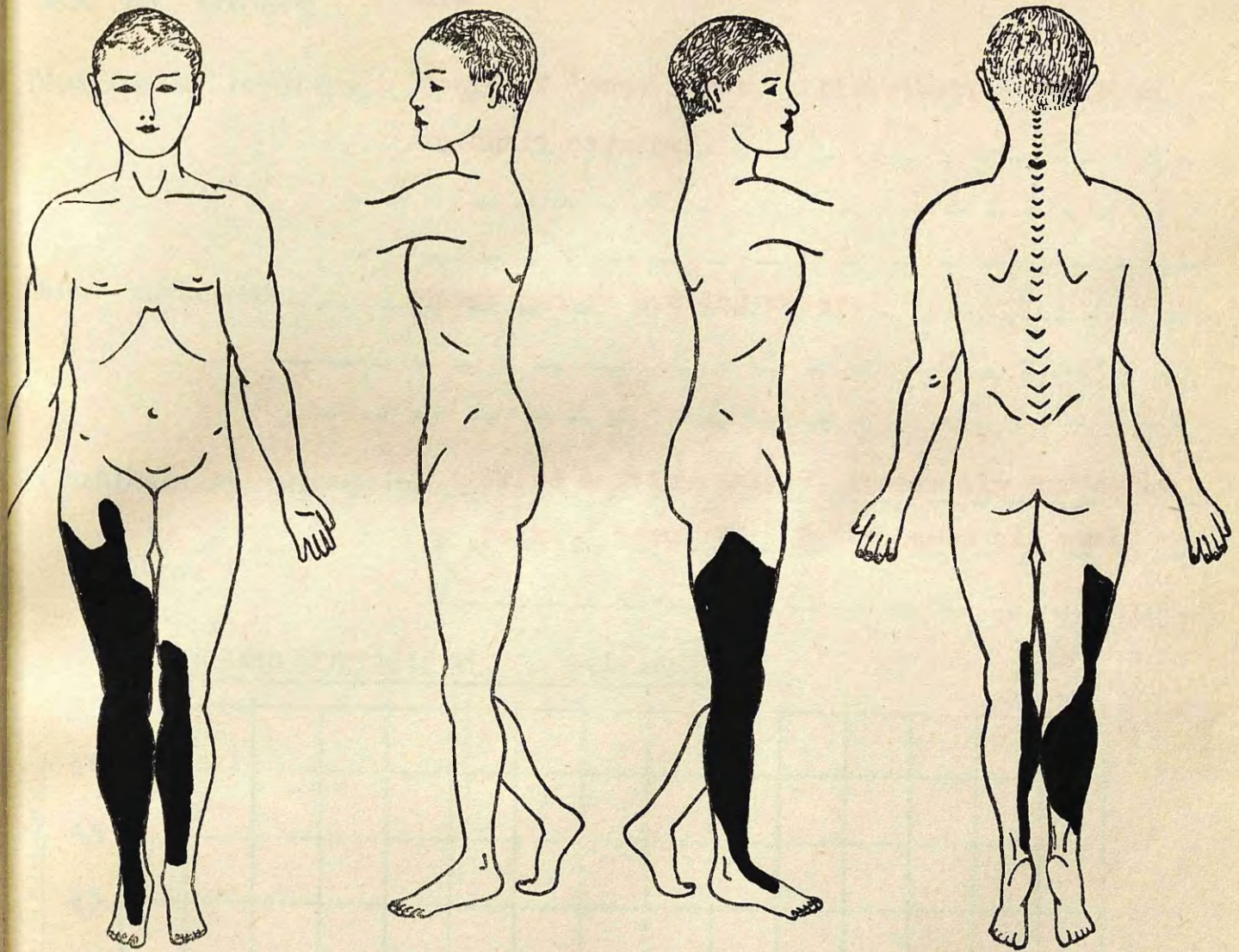
How sustained Bed clothes caught fire.

Condition on admission Injuries painful. Cried fitfully. Thirsty.  
Temp. 99.2 Pulse 100

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
( & Monocytes ) \_\_\_\_\_  
Lymphocytes \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No.11

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate

Age of patient... **7 years**...

Case No **12**...

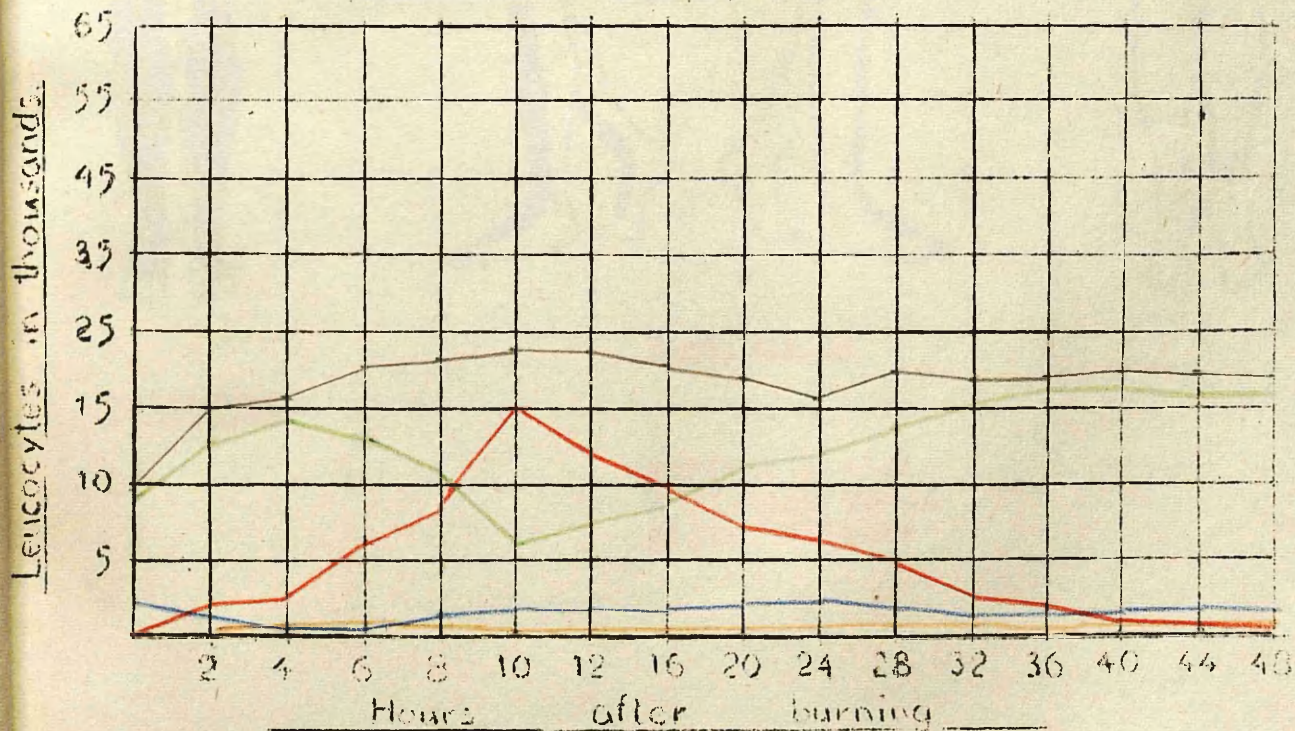
Sex of patient... **Female**...

Nature of injuries... **Scald of lower limbs. Distribution as shown on chart overleaf.**

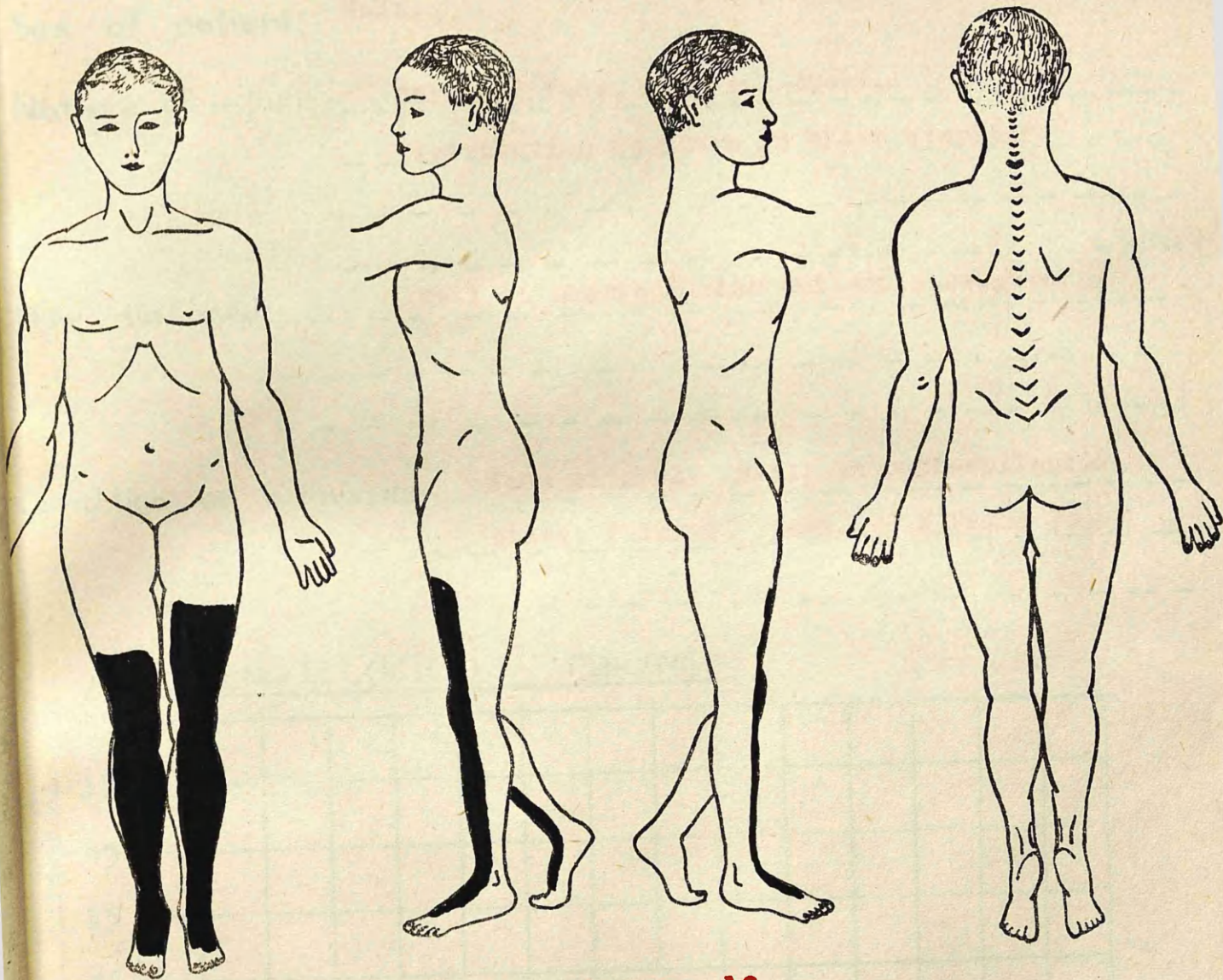
How sustained... **Upset pan of boiling water.**

Condition on admission... **Cried continuously. Apparently suffering pain. Temp. 98 Pulse rapid and weak.**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 Monocytes }  
 Lymphophs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 12

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate

Age of patient 15 years.

Case No. 13

Sex of patient Male.

Nature of injuries Burns of face, neck and chest.

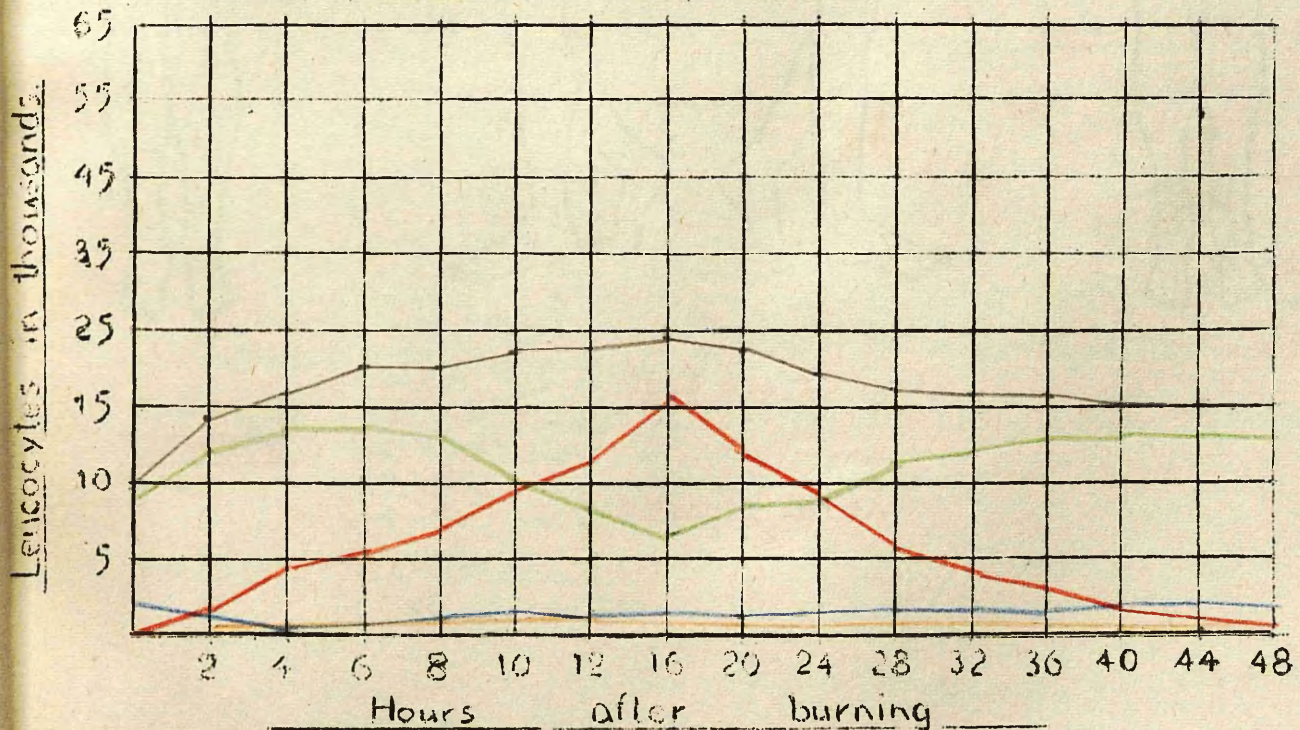
Distribution as shown on chart overleaf.

How sustained Fell on hearth during epileptic seizure.

Condition on admission Face painful. Still in post-epileptic

state. Thirsty. Temp. 98.8 Pulse 78

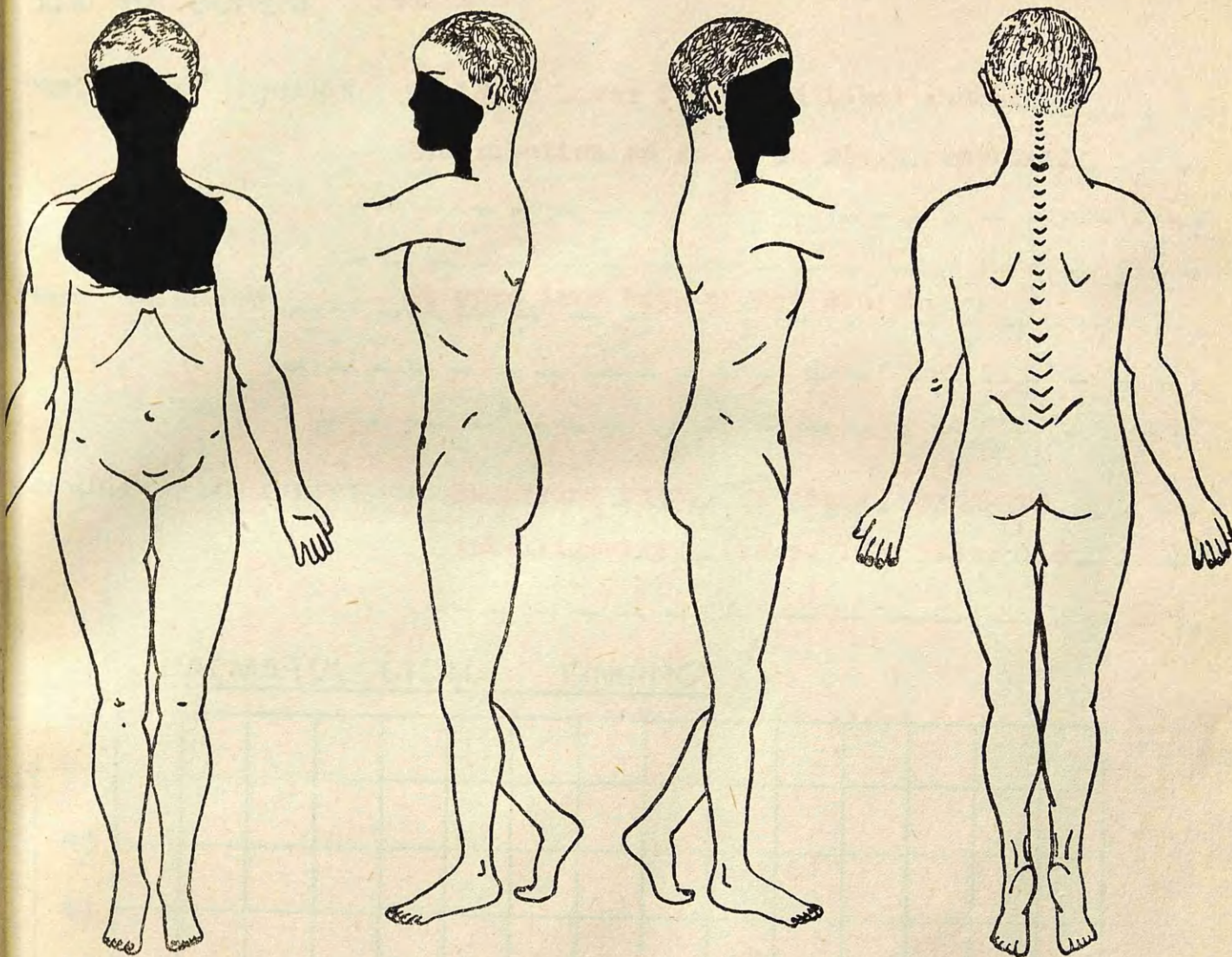
### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_

& Monocytes } \_\_\_\_\_

Lymphomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 13

TREATMENT

Tannic Acid

Age of patient... **14 years**

Case No. **14**

Sex of patient... **Female**

Nature of injuries... **Scald of lower limbs and lower abdomen.**

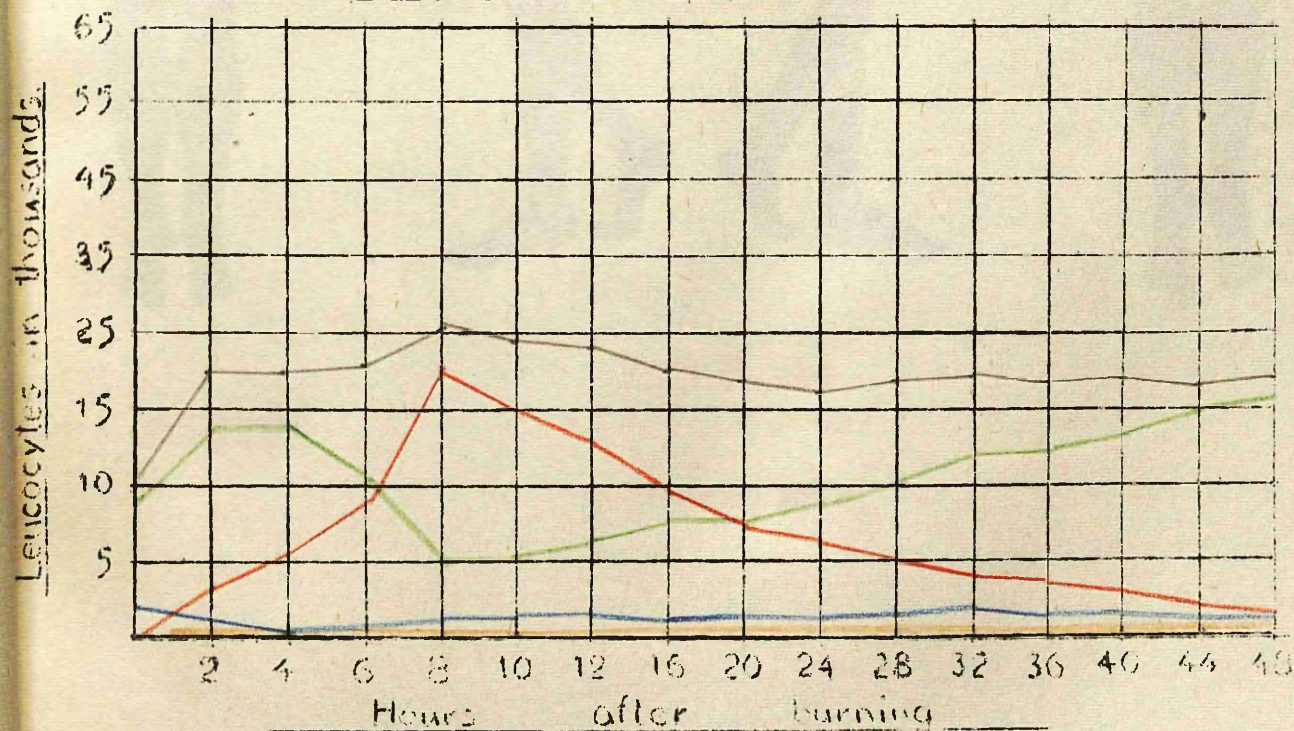
--- **Distribution as shown on chart overleaf.** ---

How sustained... **Slipped into bath of hot starch.**

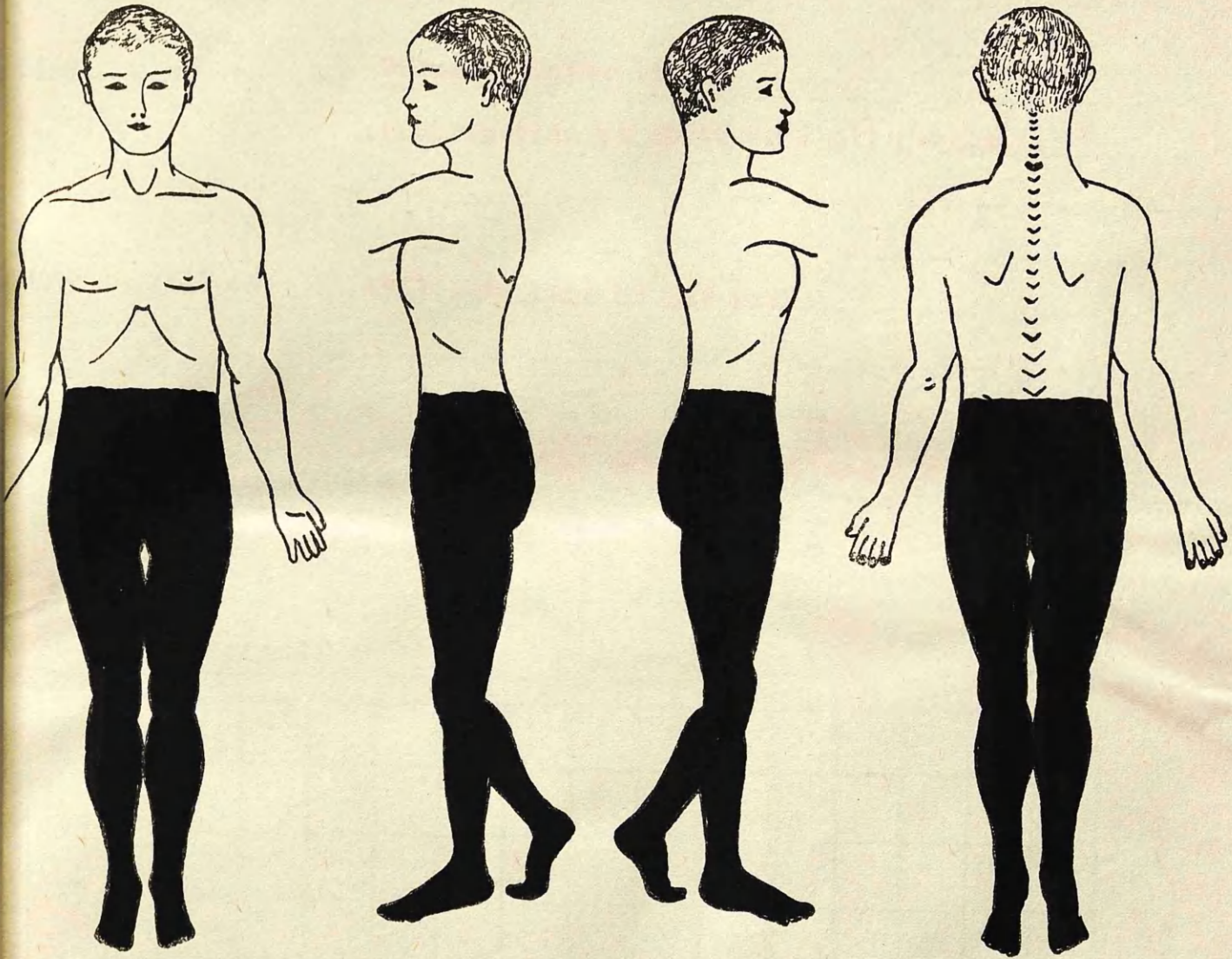
Condition on admission... **Suppering pain. Answered questions**

--- **intelligently. Temp. 100 Pulse 116** ---

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
Monocytes }  
Lymphomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 14

TREATMENT

Tannic Acid

Age of patient 6 years

Case No. 15

Sex of patient Male

Nature of injuries Burns of lower limbs.

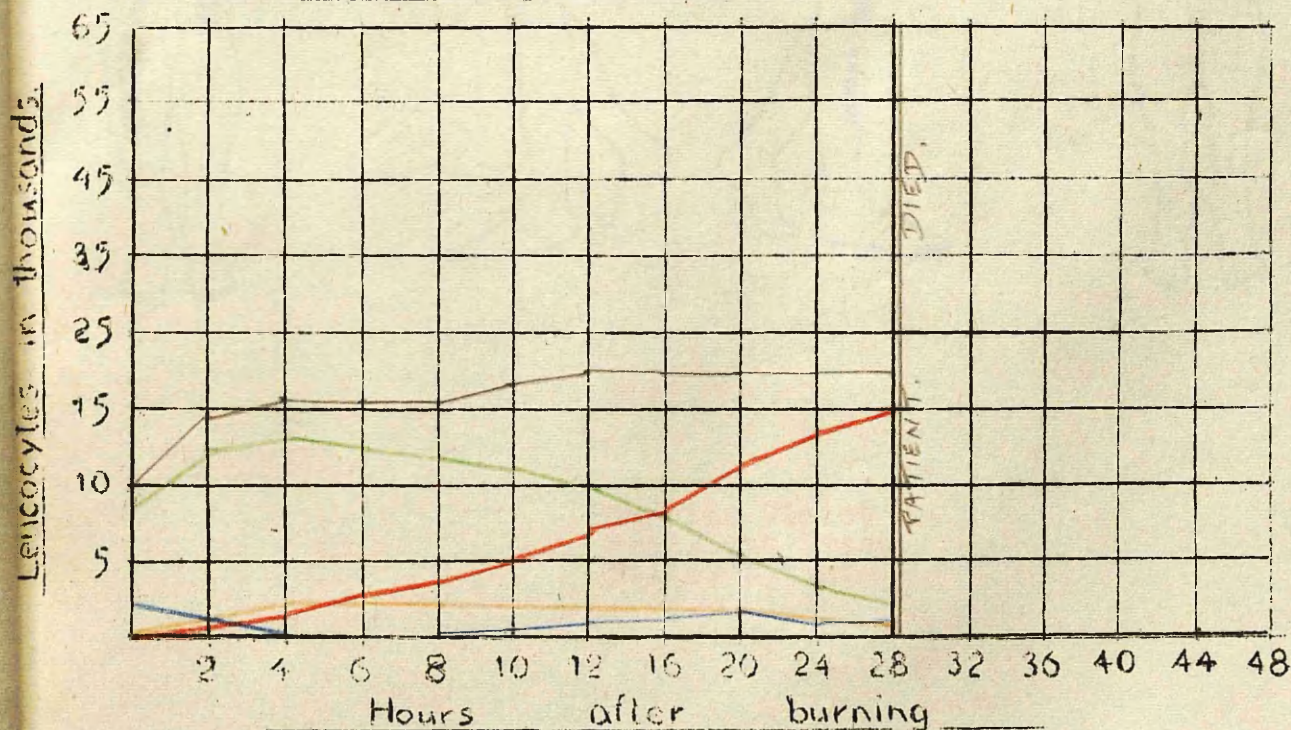
Distribution as shown on chart overleaf.

How sustained Fell into bath of hot water.

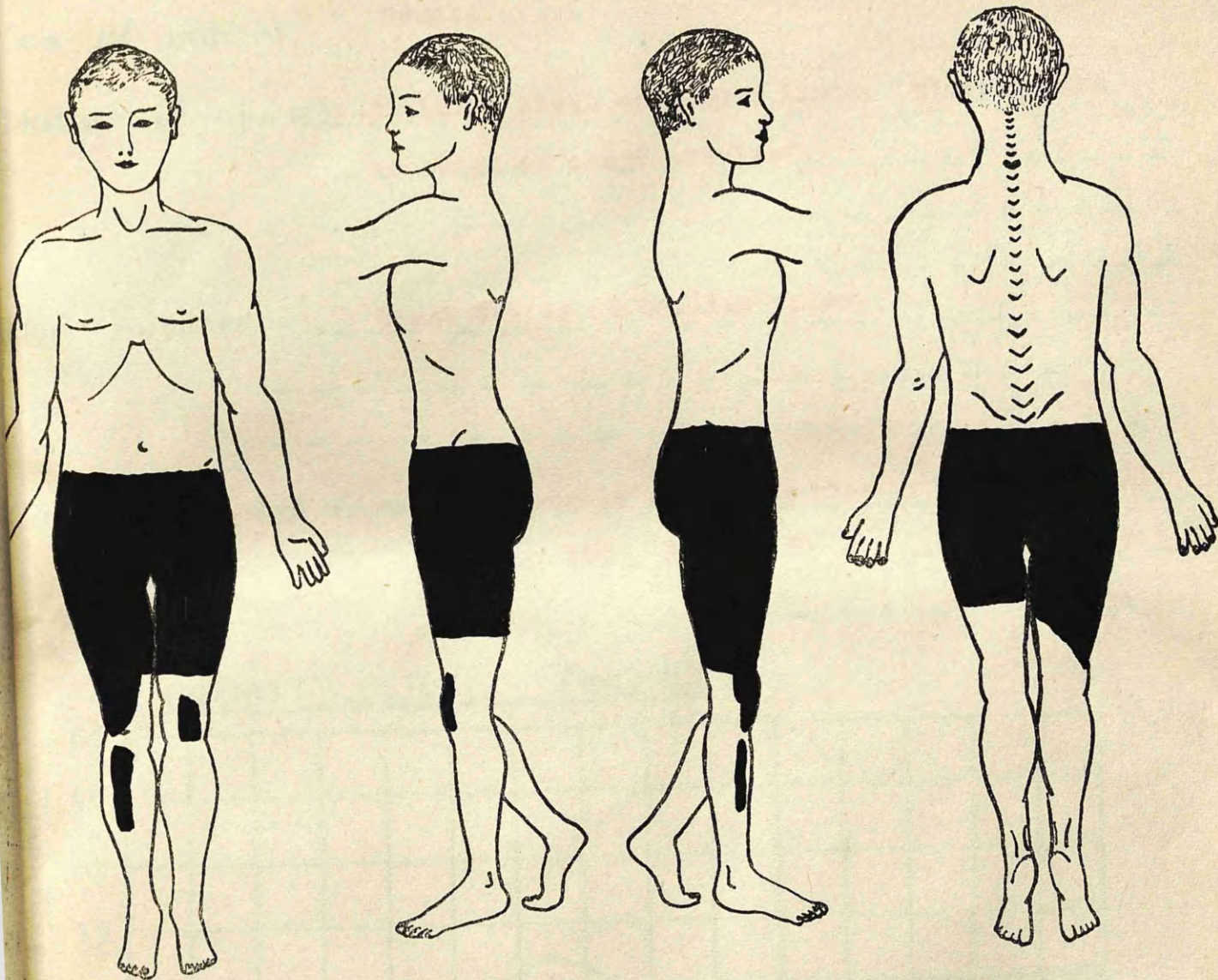
Condition on admission Injuries painful. Cried fitfully.

Temp. 98.8 pulse 106

### HAEMATOLOGICAL FINDINGS



at Leucocytes ..... Metamyelocytes ..... Lymphocytes }  
ymorphs ..... Stab Nuclears ..... Toxic Granulocytes }  
& Monocytes }



Case No. 15

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate

Age of patient **11 years**

Case No **16**

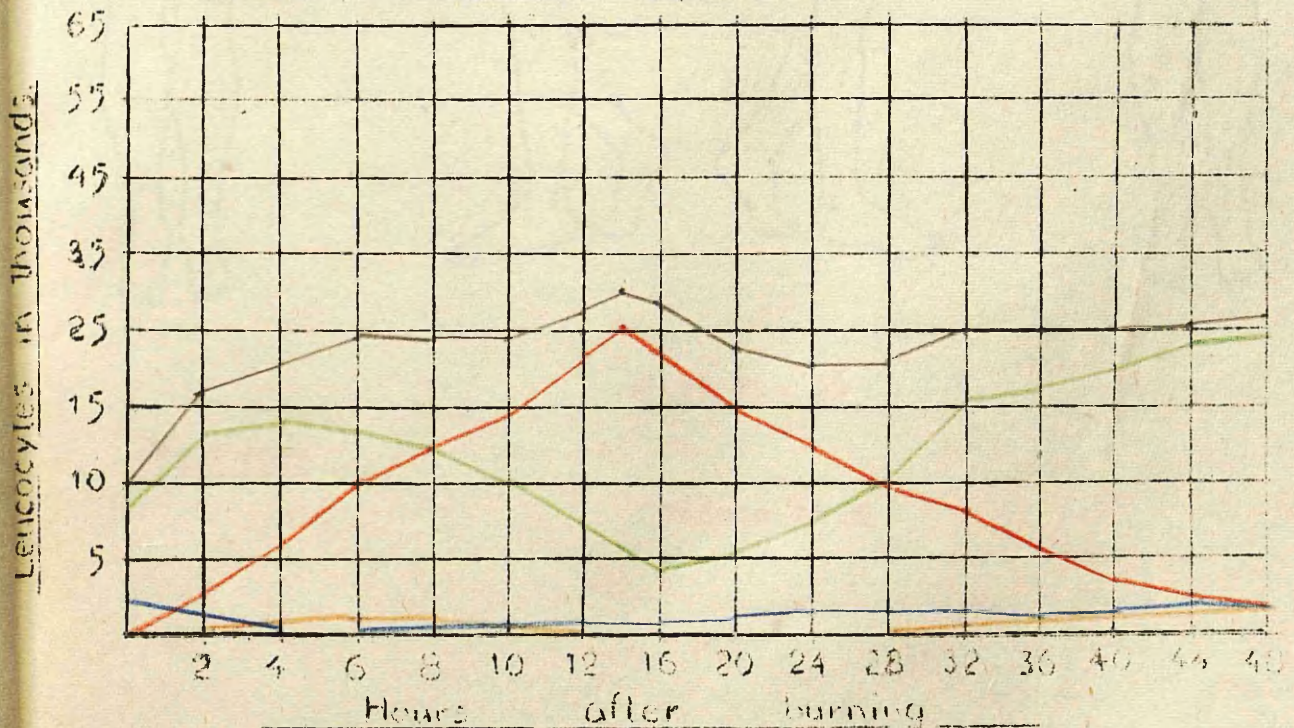
Sex of patient **Female**

Nature of injuries **Scald of chest and upper limbs. Distribution as shown on chart overleaf.**

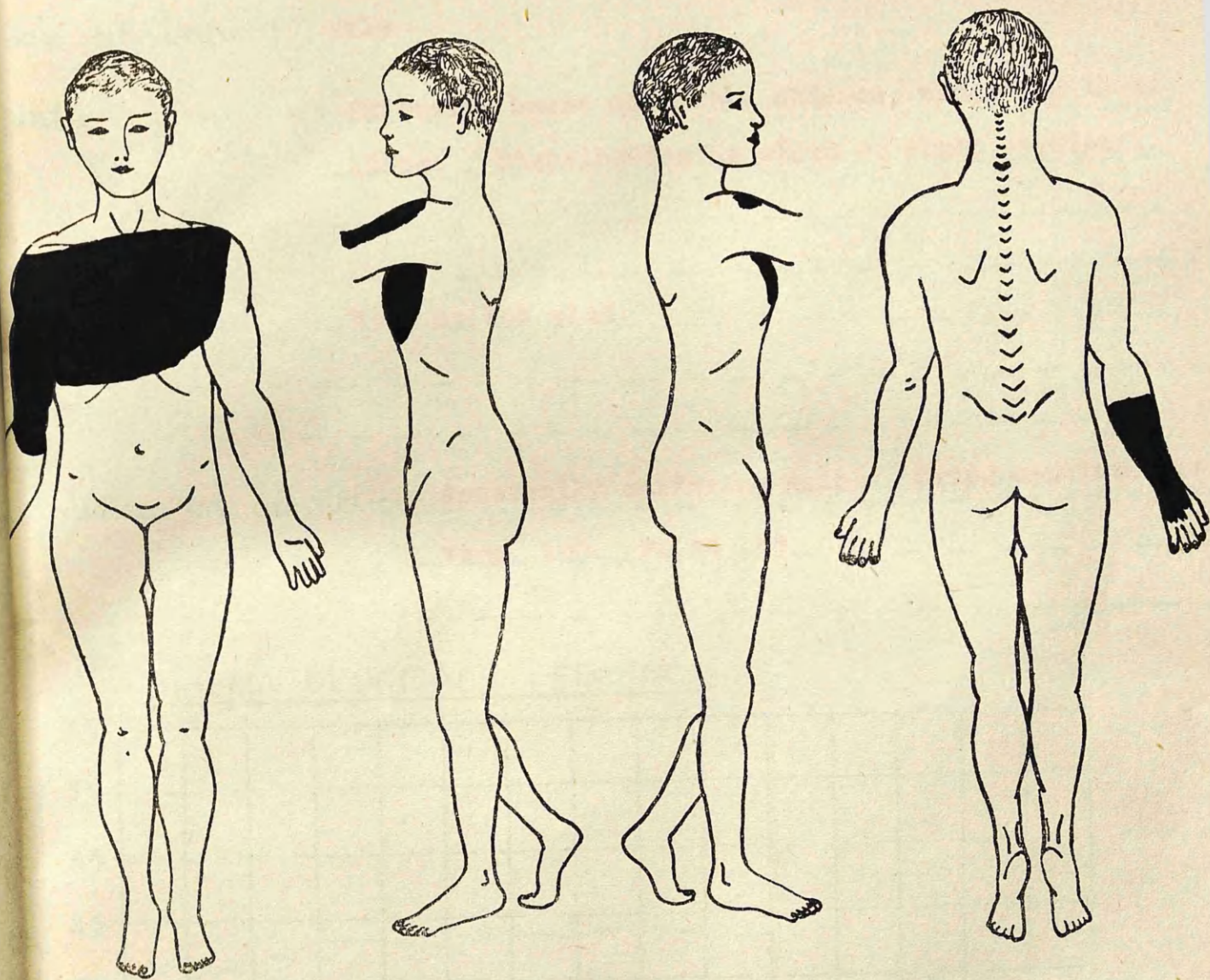
How sustained **Upset kettle of boiling water.**

Condition on admission **Apparently suffering pain. Cried fitfully. Temp. 100 Pulse 120**

HAEMATOLOGICAL FINDINGS



al Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 ymorphs \_\_\_\_\_ Eosinophils } \_\_\_\_\_  
 Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 16

TREATMENT

Tannic Acid

Age of patient 10 years

Case No 17

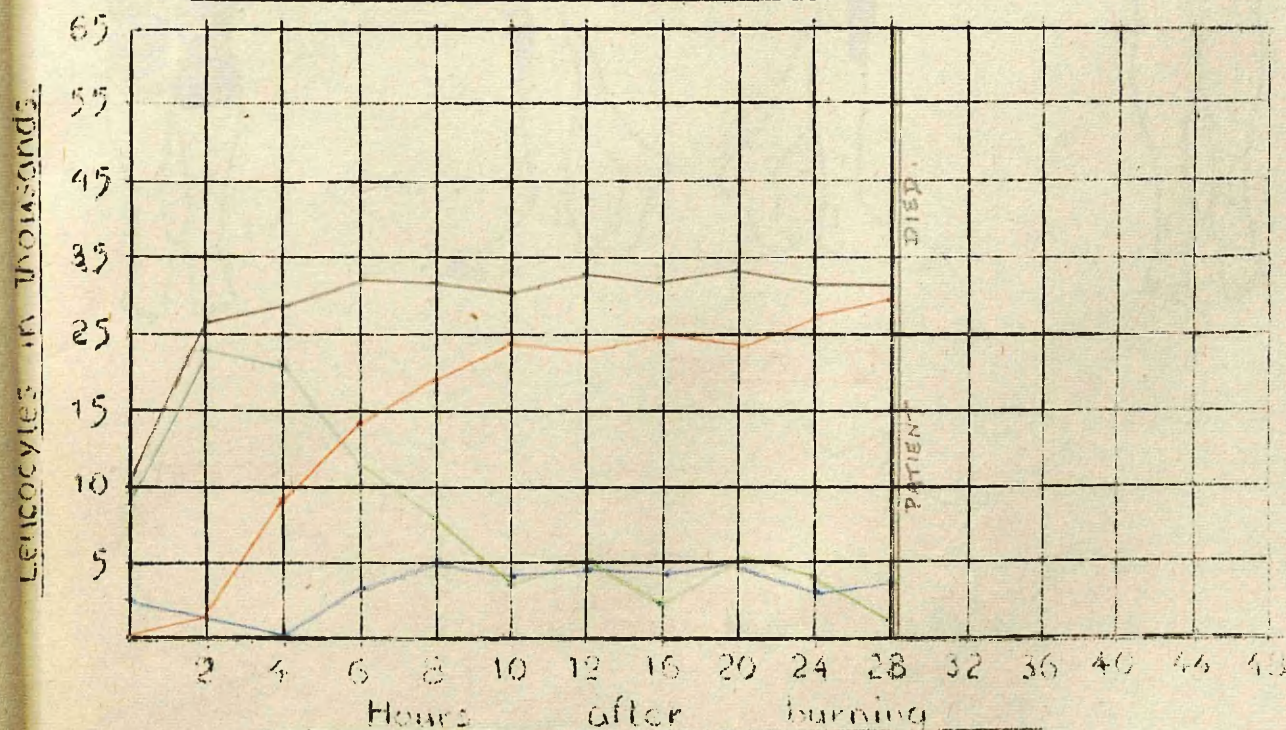
Sex of patient Male

Nature of injuries Extensive burns of chest, abdomen, upper and lower limbs. Distribution as shown on chart overleaf.

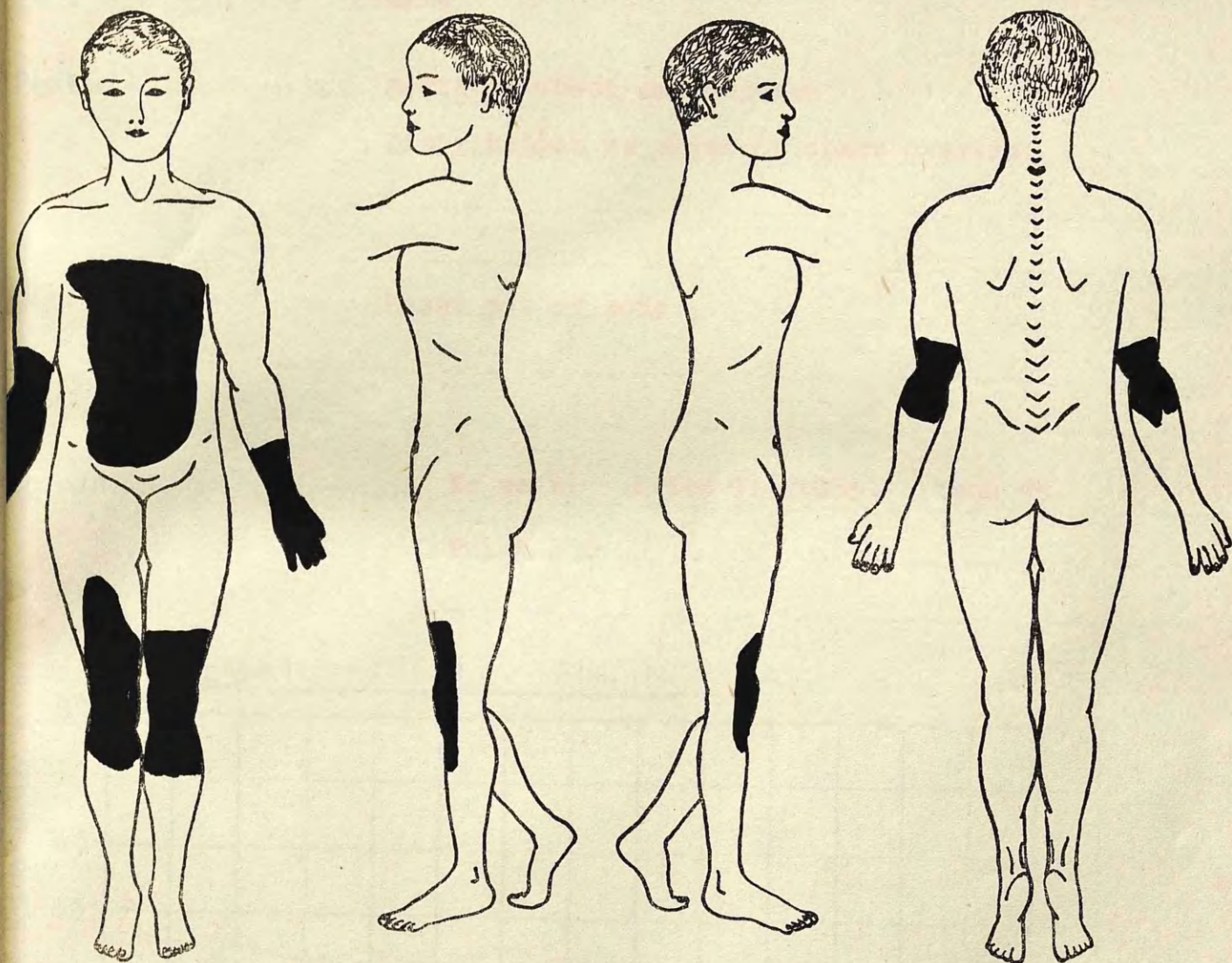
How sustained Fell on hot slag.

Condition on admission Apparently suffering pain. Cried continuously.  
Temp. 100. Pulse 130

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes \_\_\_\_\_  
Myeloblasts \_\_\_\_\_ Monocytes \_\_\_\_\_  
Myelomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 17

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate

Age of patient 9 years

Case No 18

Sex of patient Female

Nature of injuries Scald of chest and abdomen

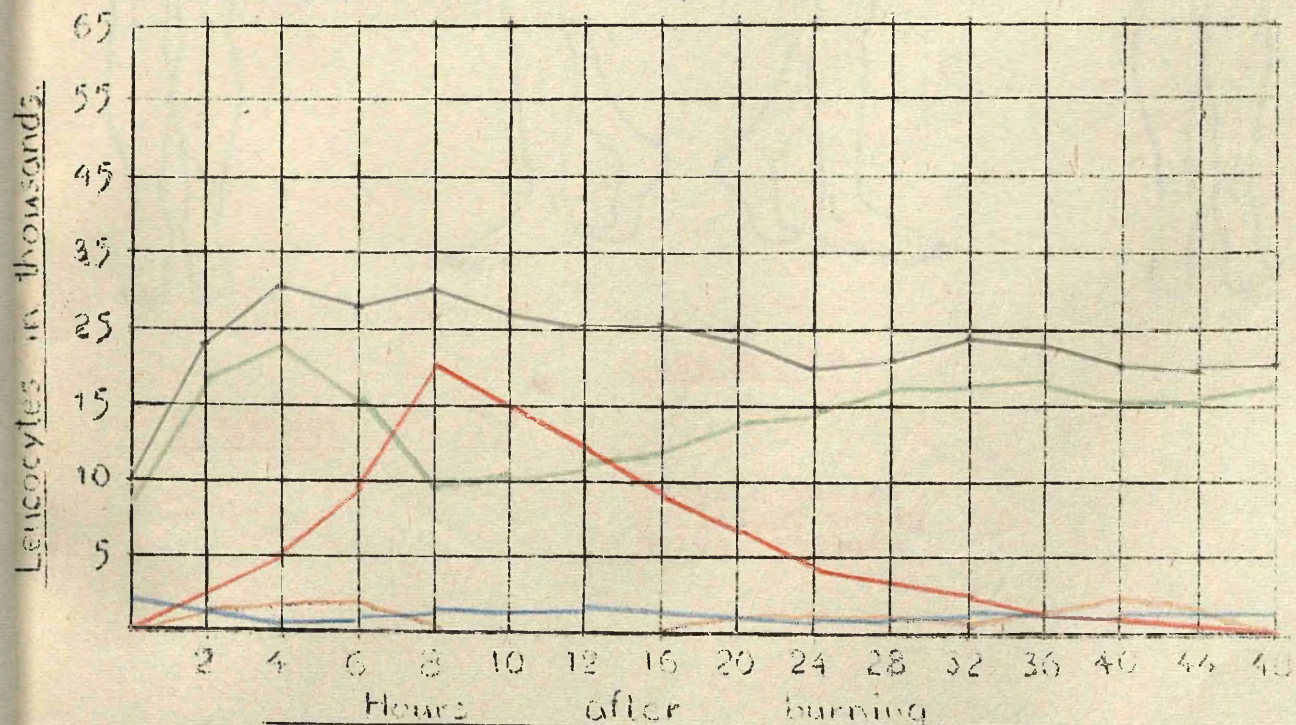
Distribution as shown on chart overleaf

How sustained Upset pot of soup.

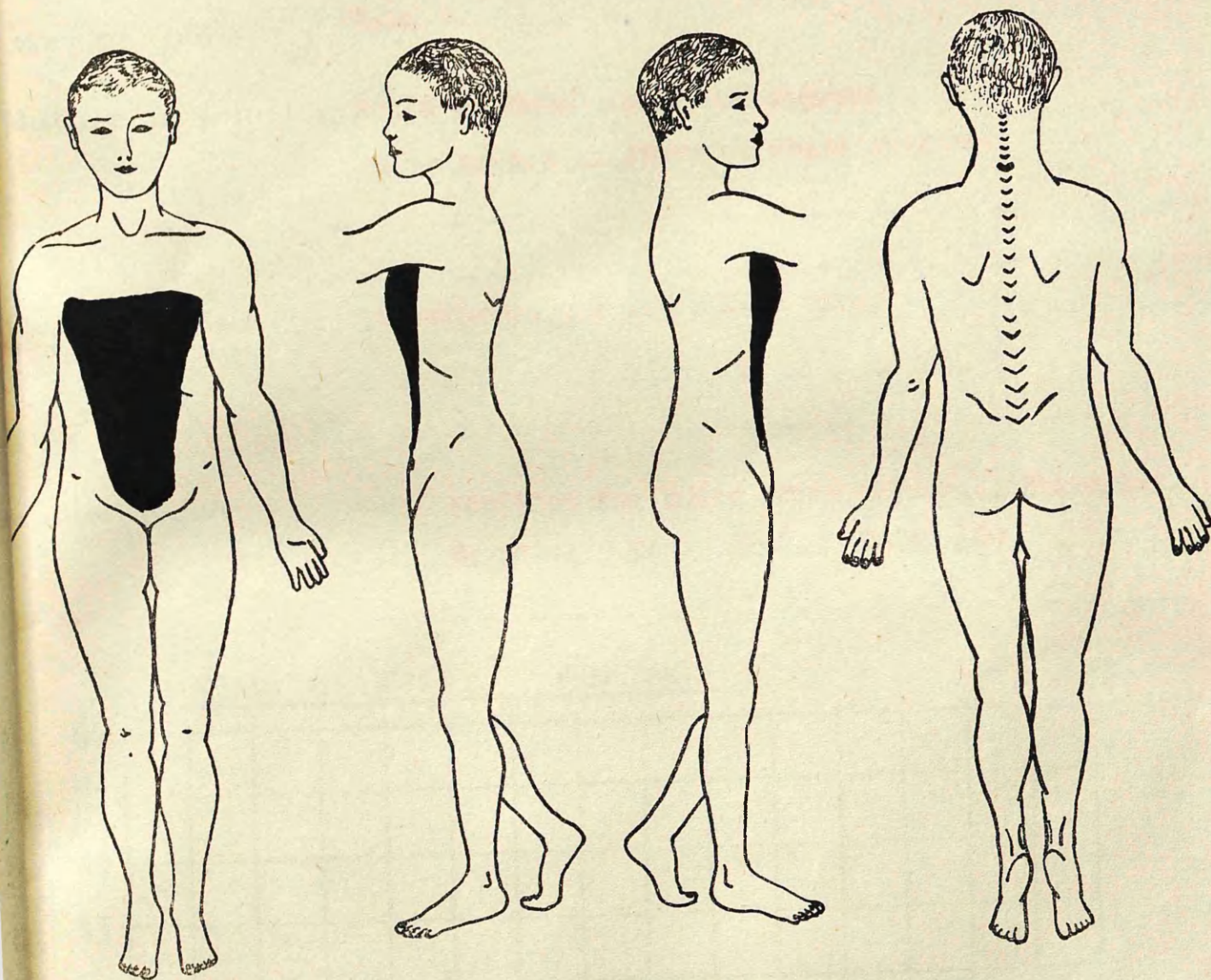
Condition on admission No pain. Cried fitfully. Temp 99.

Pulse 130

HAEMATOLOGICAL FINDINGS



Total Leucocytes          Metamyelocytes          Lymphocytes & Monocytes           
 Myeloblasts          Stab Nuclears          Toxic Granulocytes



Case No. 18

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate

Age of patient **11 years**

Case No **19**

Sex of patient **Male**

Nature of injuries **Scald of face, chest and abdomen**

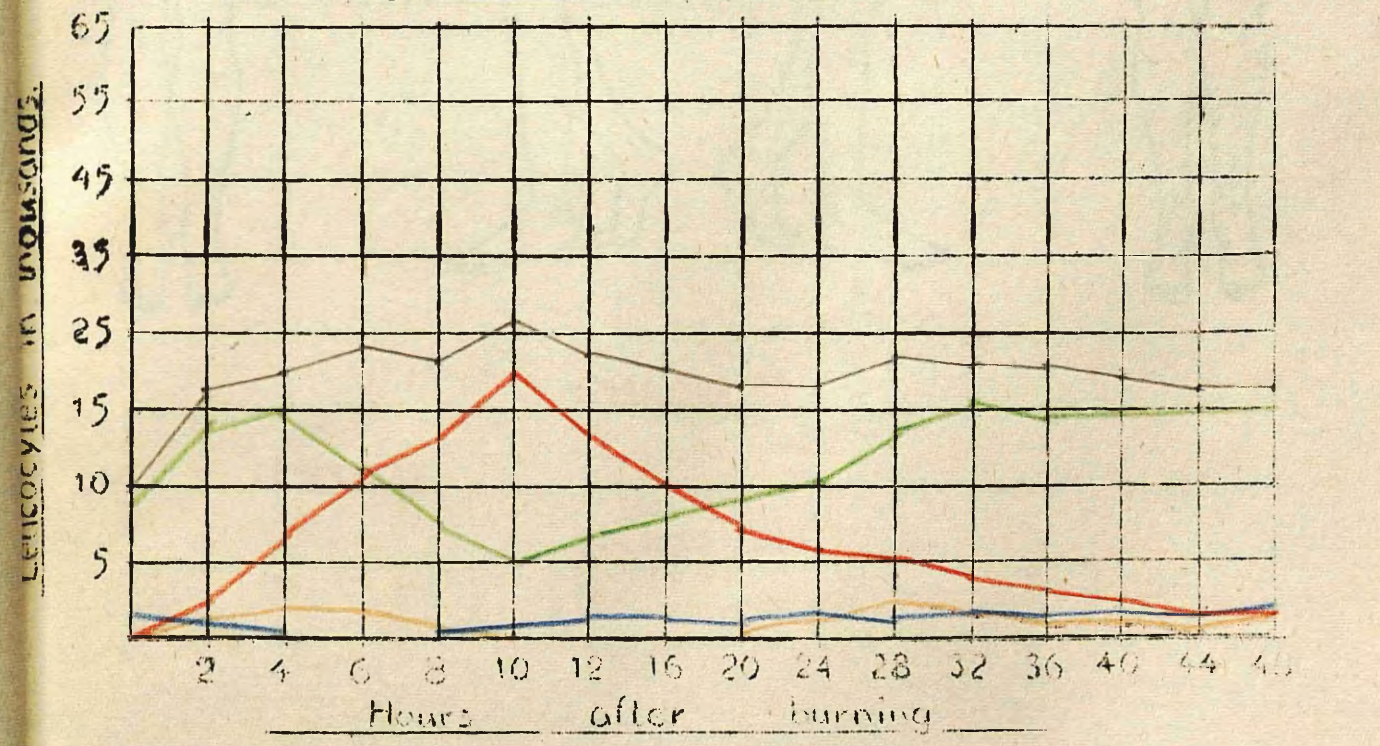
**Distribution as shown on chart overleaf**

How sustained **Overturnd pot of boiling water**

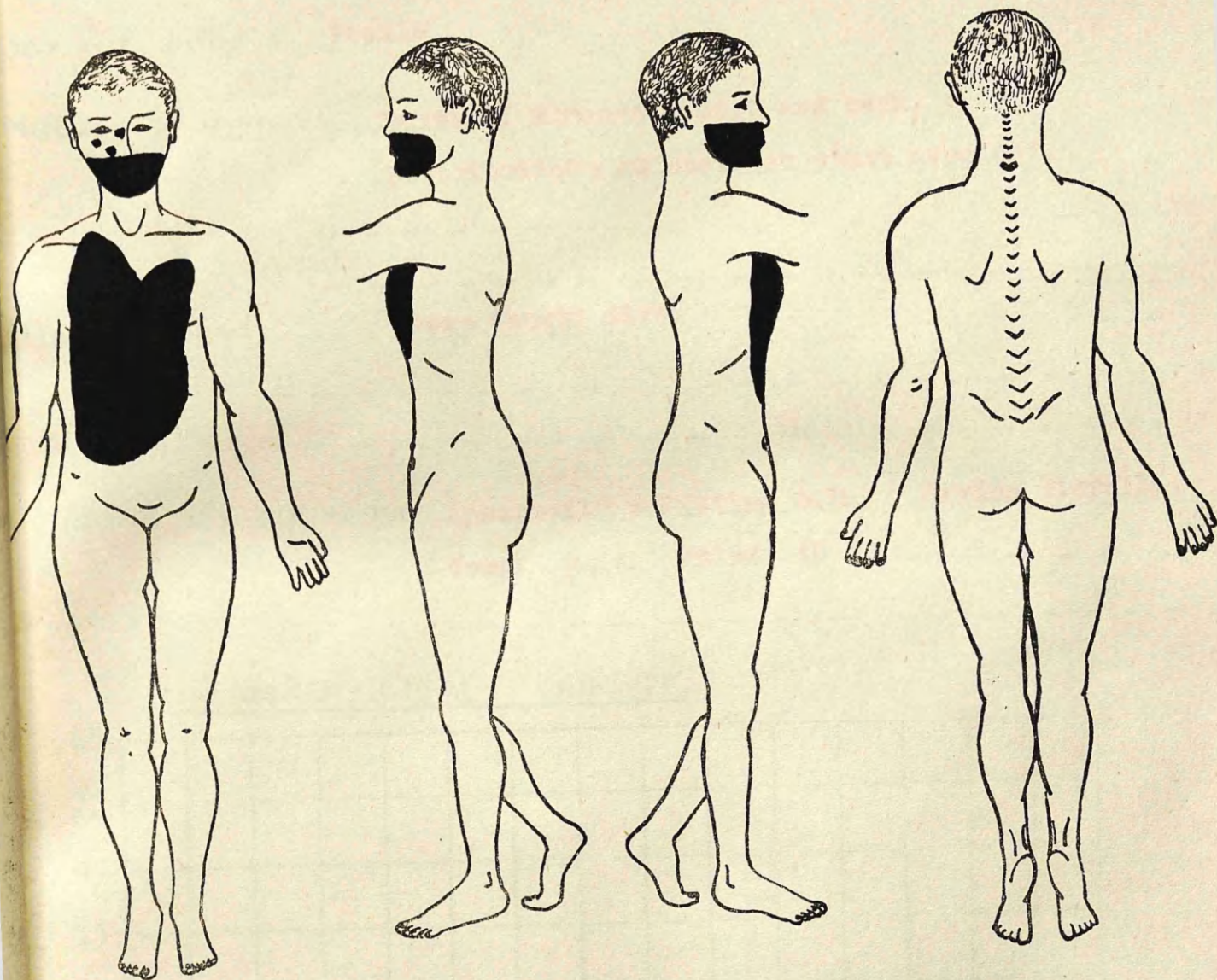
Condition on admission **Admitted two hours after injury. Shivering.**

**No pain. Temp. 97.6. Pulse 120**

### HAEMATOLOGICAL FINDINGS



al Leucocytes ----- Metamyelocytes ----- Lymphocytes } -----  
 ymorphs ----- Stab Nuclears ----- Toxic Granulocytes -----  
 (S Monocytes)



Case No. 19

TREATMENT

Tannic Acid

Age of patient 11 years

Case No. --20--

Sex of patient Female

Nature of injuries Burns of abdomen, chest and back.

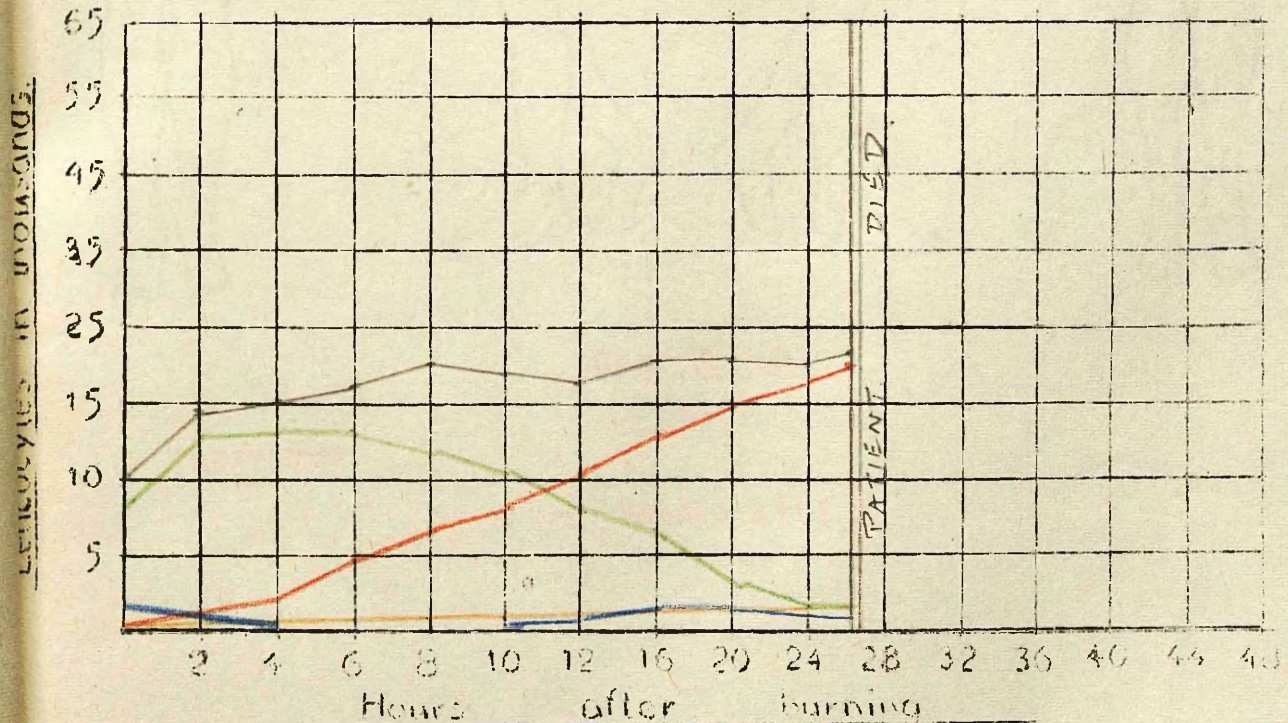
Distribution as shown on chart overleaf.

How sustained Dress caught fire.

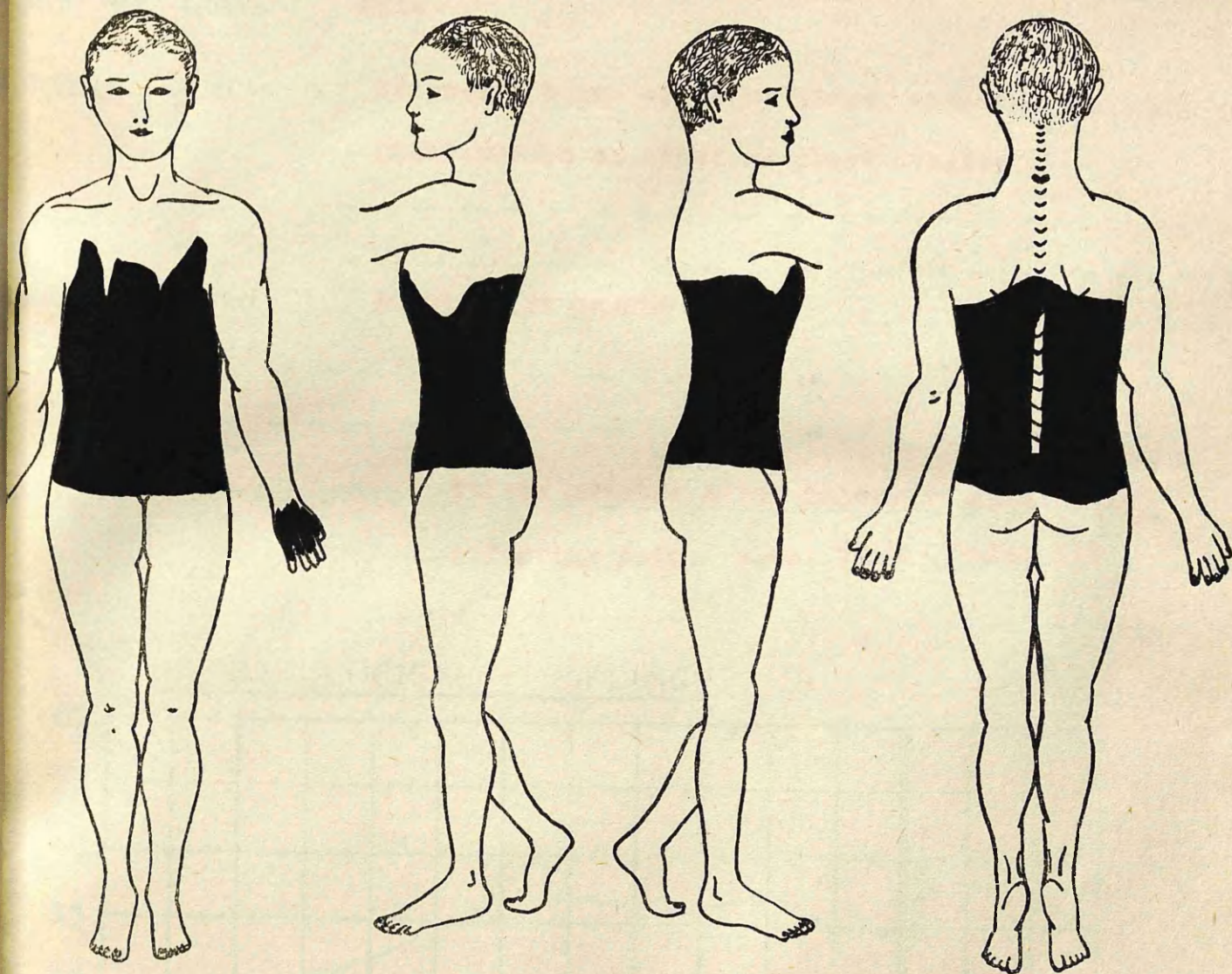
Condition on admission Apparently suffering pain. Crying fitfully.

Temp. 99.6 Pulse 140

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Eosinophils \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 20

TREATMENT

Tannic Acid

Age of patient... **9 years**

Case No. **21**

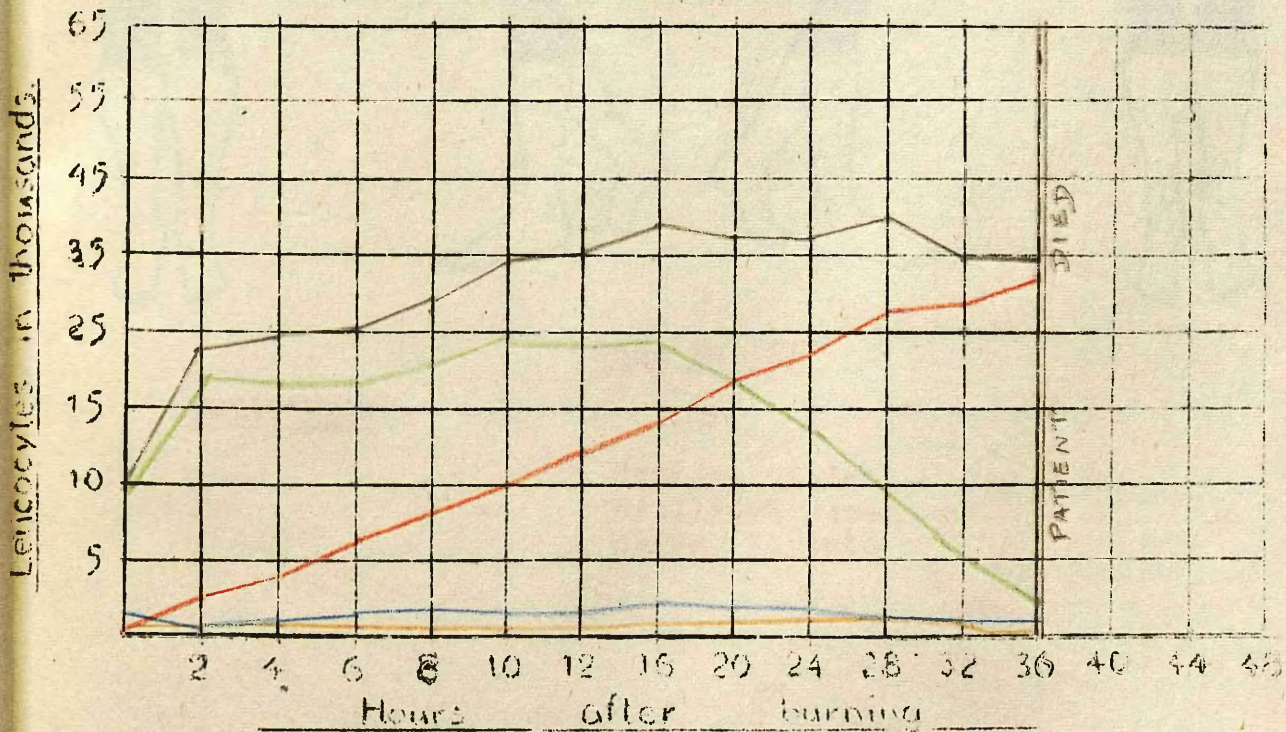
Sex of patient... **Male**

Nature of injuries... **Extensive burns of lower limbs, abdomen, and back**  
**- Distribution as shown on chart overleaf.**

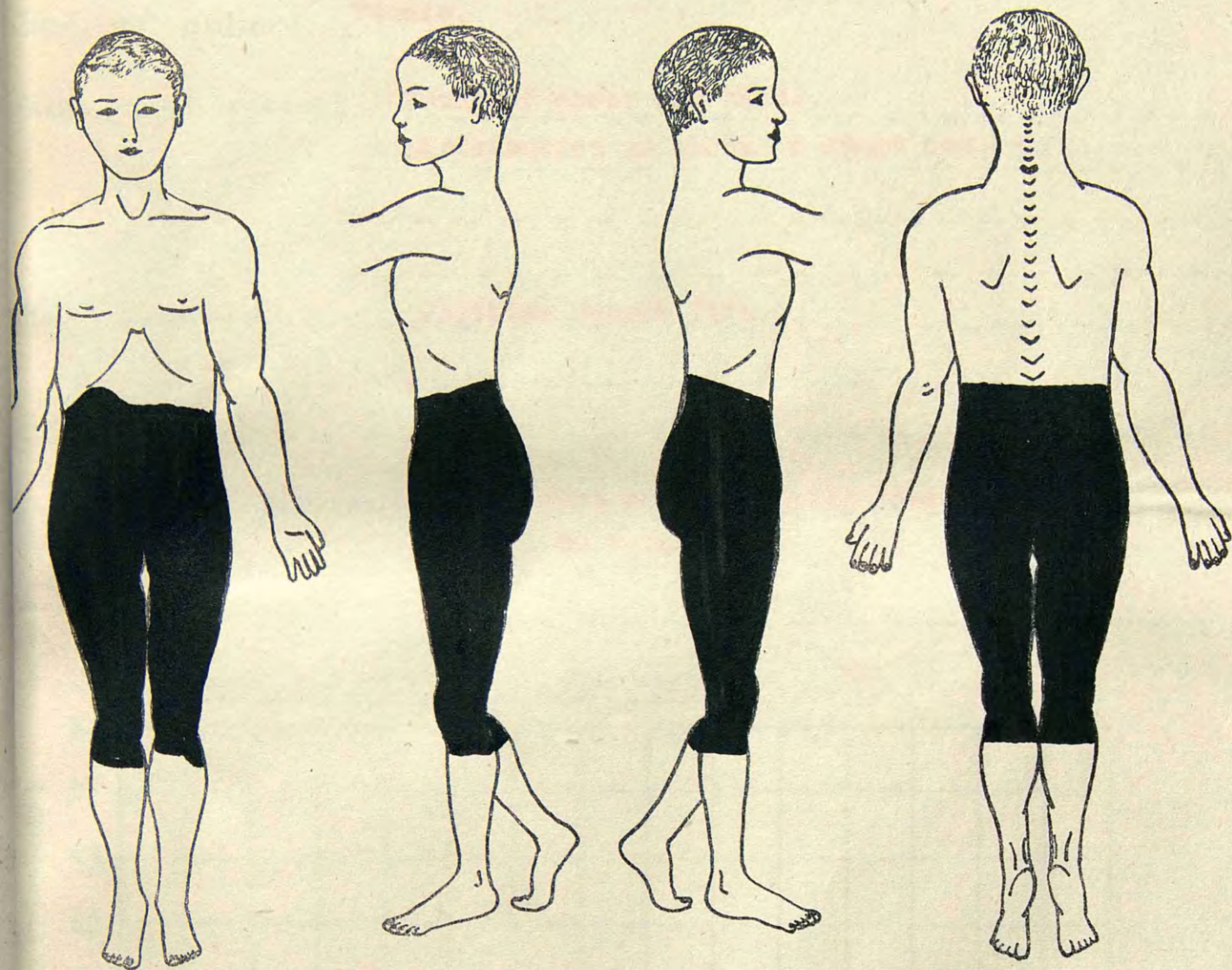
How sustained... **Night shirt caught fire**

Condition on admission... **Thirty minutes after injury. Apparently**  
**- suffering pain. Temp. 98.0 Pulse 110**

### HAEMATOLOGICAL FINDINGS



at Leucocytes... Metamyelocytes... Lymphocytes }  
Myeloblasts... Stab Nuclears... Toxic Granulocytes }  
& Monocytes }



Case No. 21

TREATMENT

Gentian Violet  
Brilliant Green  
Silver Nitrate

Age of patient 9 years.

Case No. 22

Sex of patient Female.

Nature of injuries Burns of chest and hands.

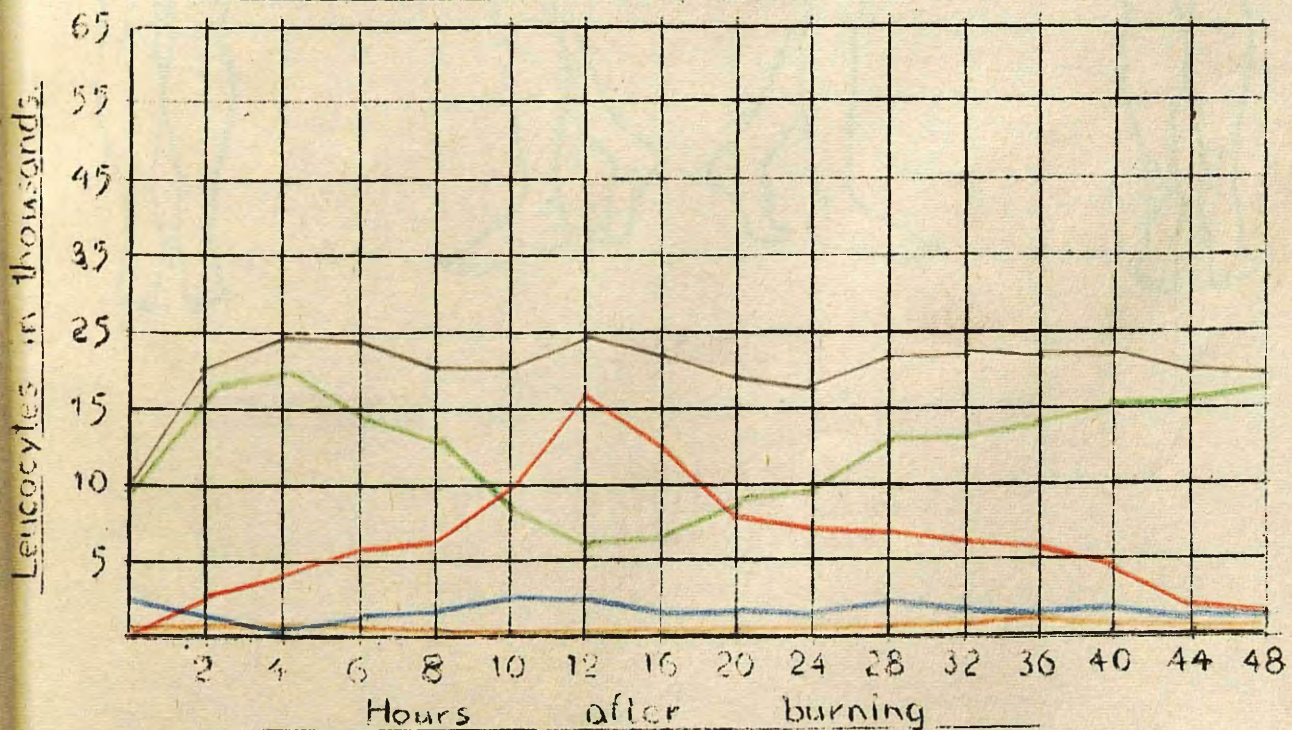
Distribution as shown on chart overleaf.

How sustained Clothing caught fire.

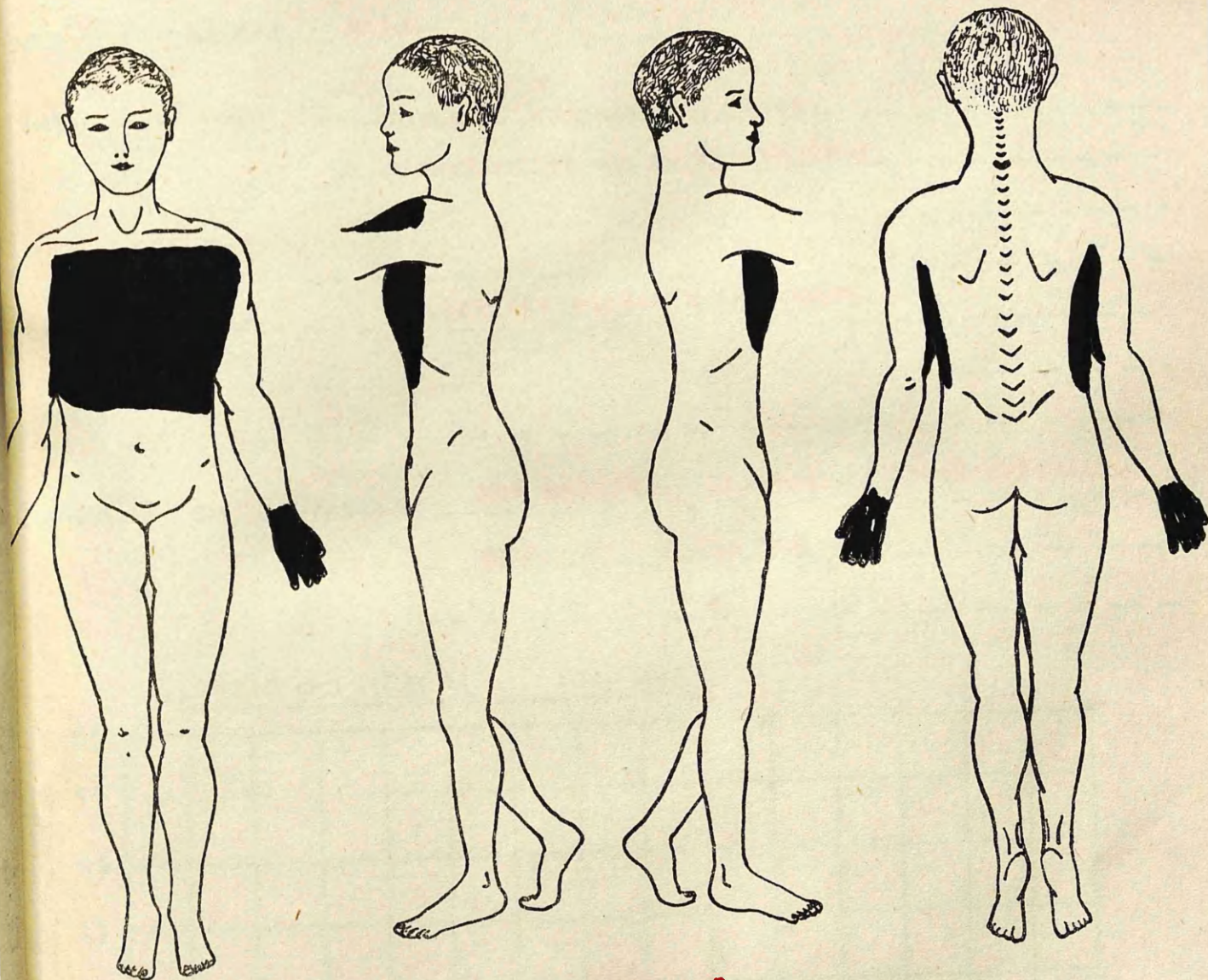
Condition on admission Injuries painful. Cried continuously.

Temp. 99 Pulse 120

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Myelomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 22

TREATMENT

Gentian violet  
Brilliant Green  
Silver Nitrate

Age of patient **12 years.**

Case No. **23**

Sex of patient **Male.**

Nature of injuries **Burns of abdomen and chest.**

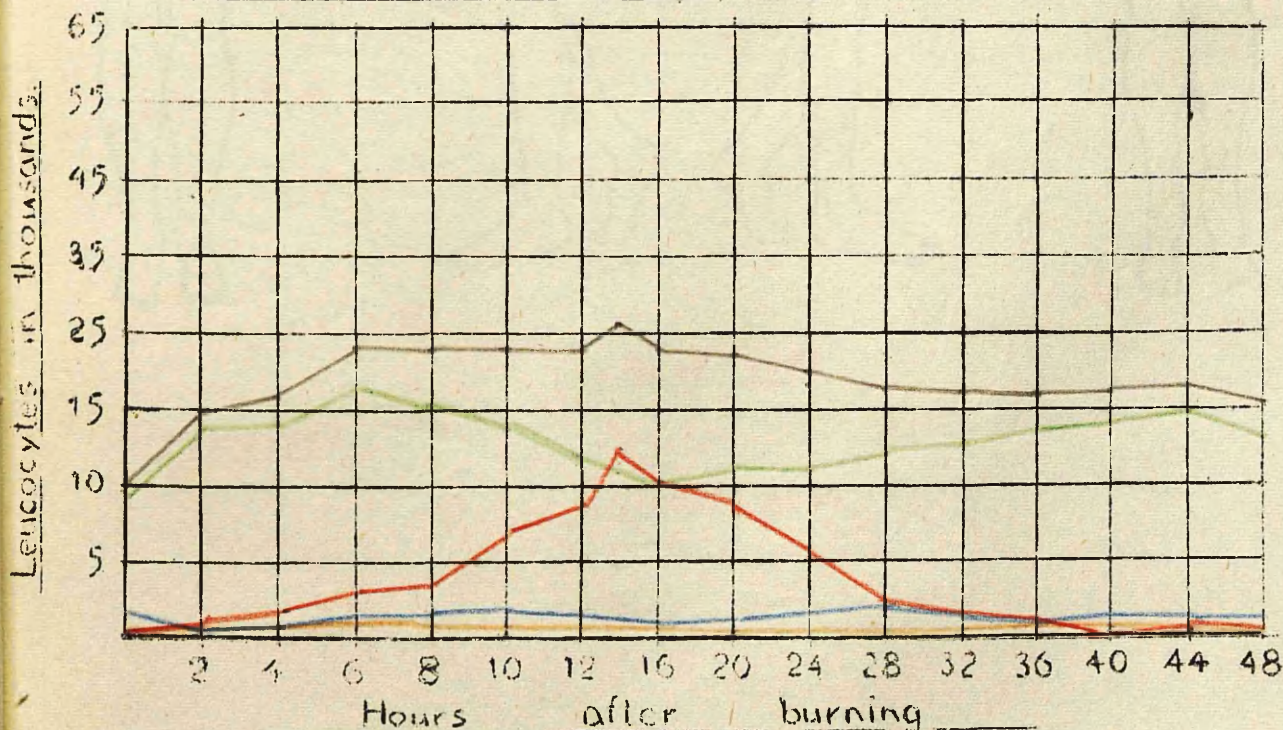
**Distribution as shown overleaf.**

How sustained **Fireworks exploded in pocket.**

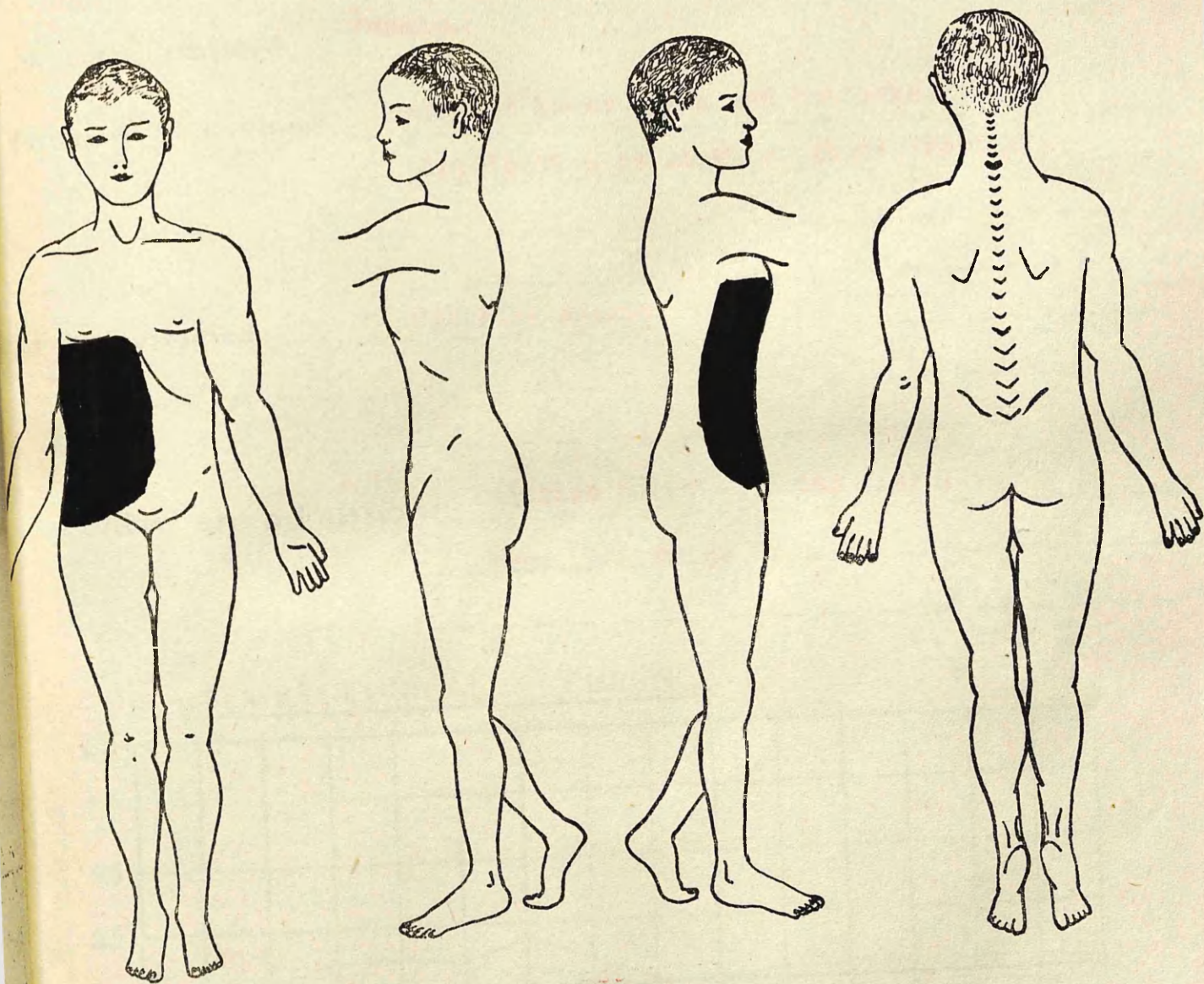
Condition on admission **Not painful. Shivering. Cried fitfully.**

**Temp. 97.7 Pulse 108**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Myeloblasts \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 23

TREATMENT

Tannic Acid

Age of patient... **12 years.**

Case No. **--24--**

Sex of patient... **Female.**

Nature of injuries... **Burns of lower limbs and buttocks.**

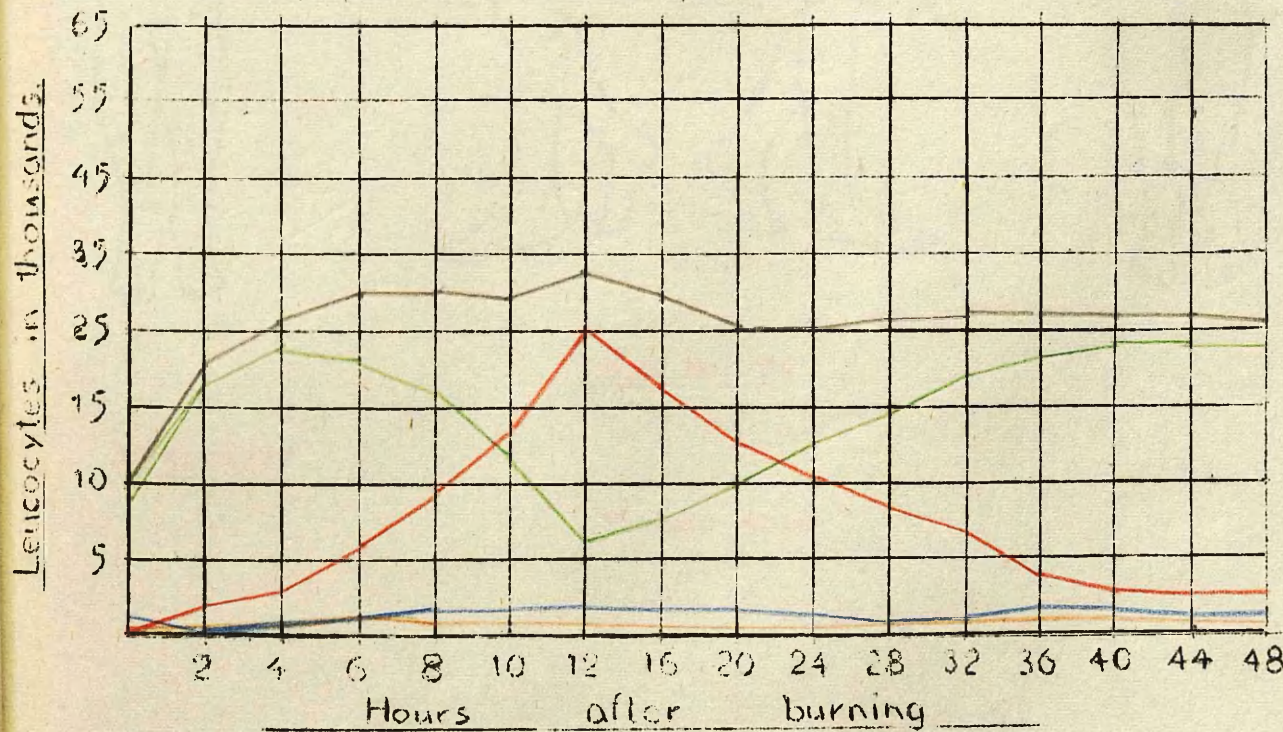
... **distribution as shown on chart overleaf.**

How sustained... **Clothing caught fire.**

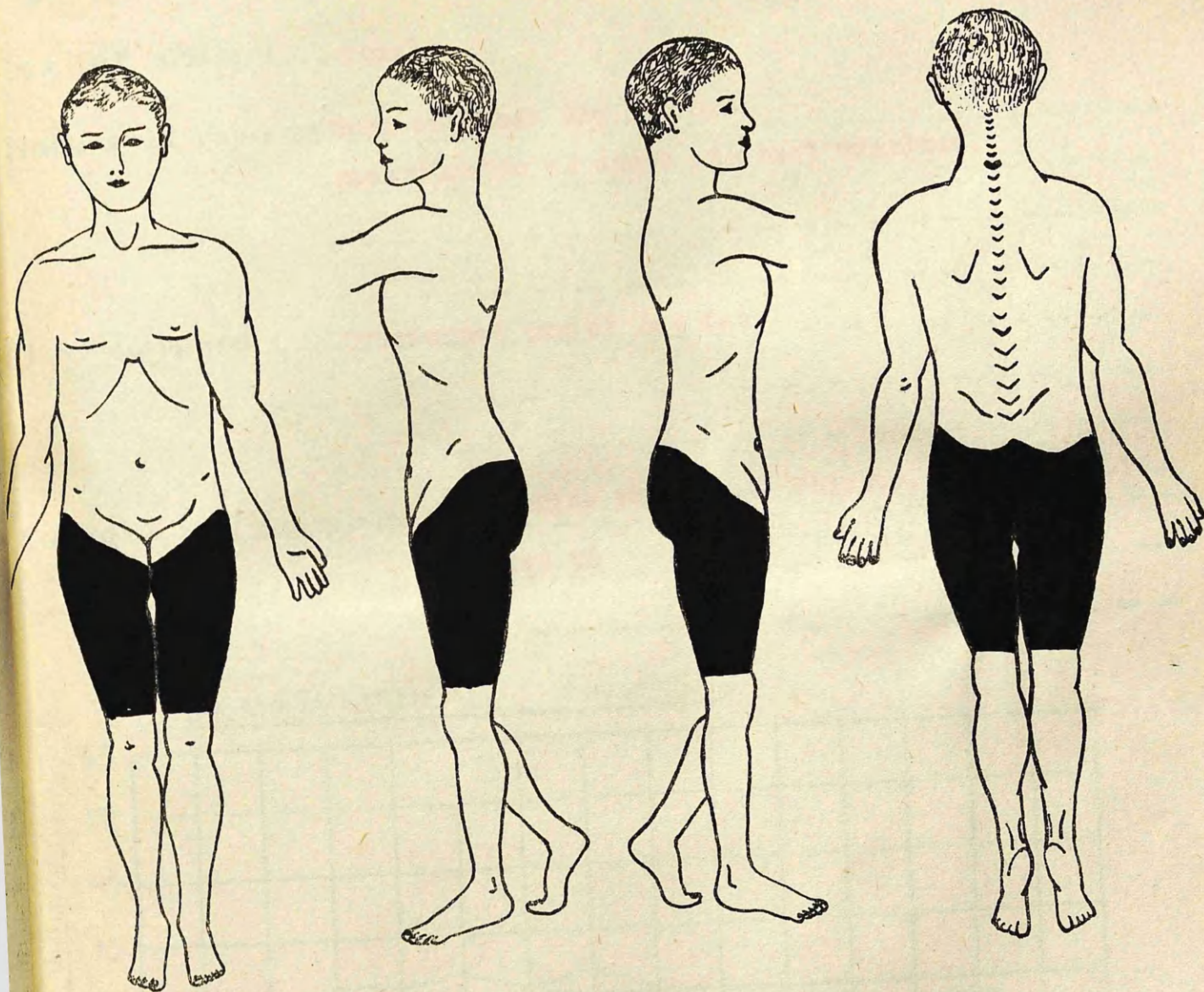
Condition on admission... **Injuries painful. Cried fitfully.**

... **Temp. 100 Pulse 110**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 24

TREATMENT

Tannic Acid

Age of patient **40 years.**

Case No **25**

Sex of patient **Female**

Nature of injuries **Burn of chest and abdomen.**

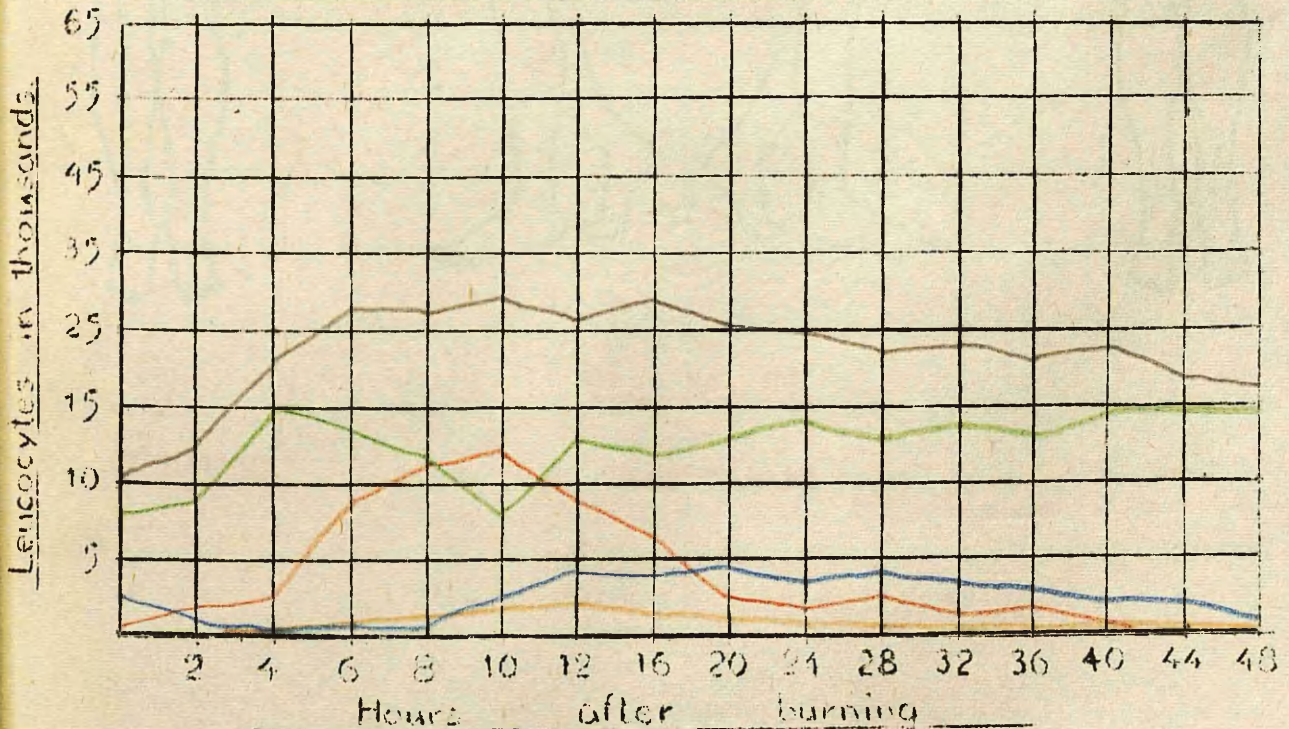
**distribution as shown on chart overleaf.**

How sustained **Overtured pan of hot fat.**

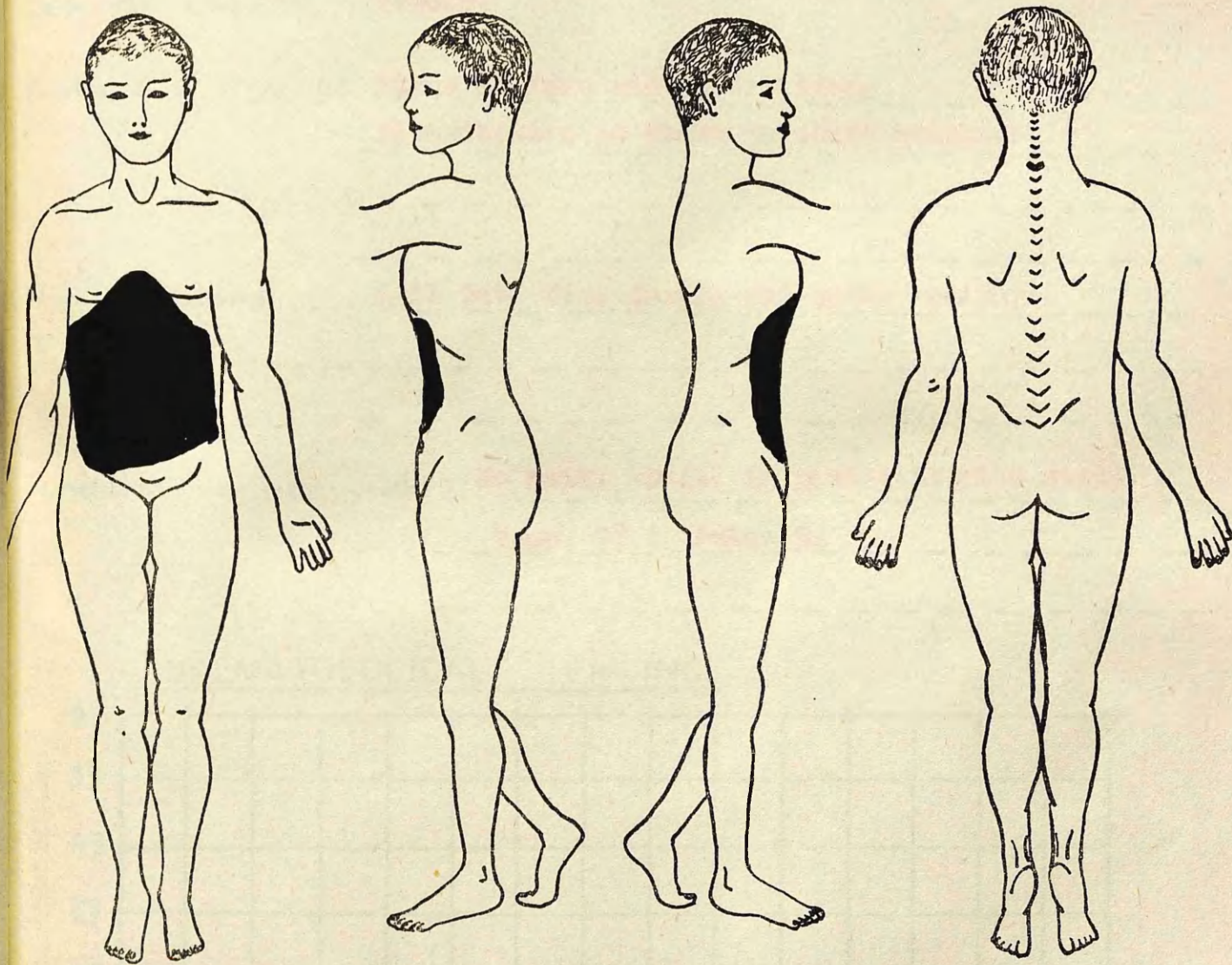
Condition on admission **Injuries painful. Thirsty. Temp. 99.3**

**Pulse 98**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes }  
Lymphocytes & Monocytes }



Case No. 25

TREATMENT

Tannic Acid

Age of patient 19 years.

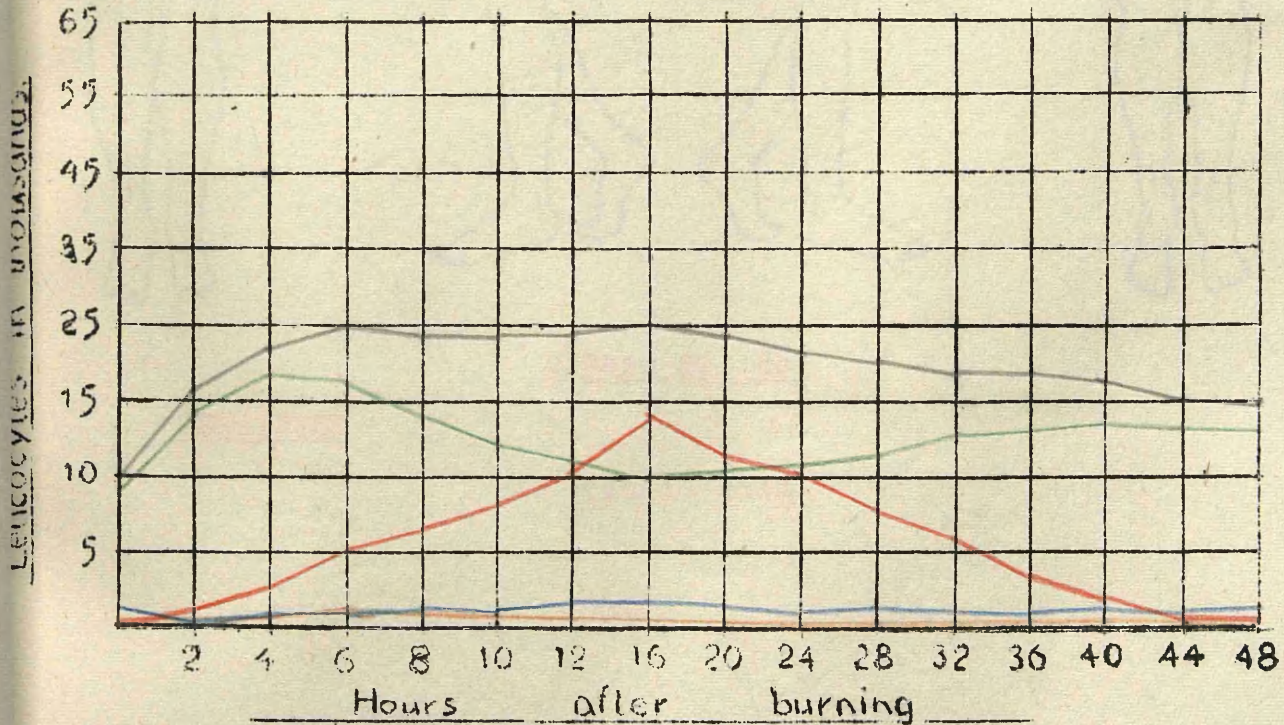
Sex of patient Female.

Nature of injuries Burns of face and upper limbs.  
Distribution as shown on chart overleaf.

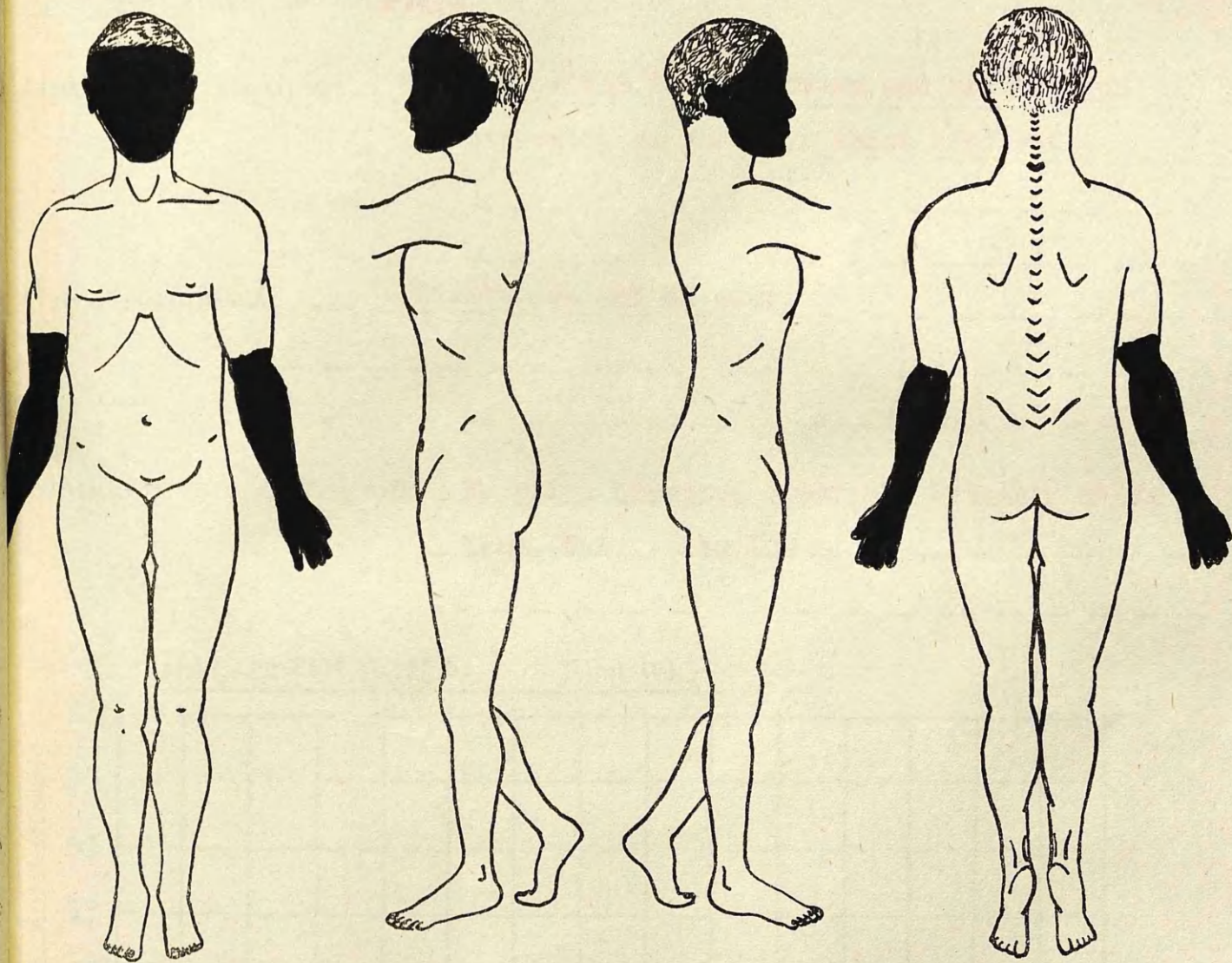
How sustained Fell into fire during epileptic seizure.

Condition on admission No pain. Still in post-epileptic state.  
Temp. 98.4 Pulse 94

HAEMATOLOGICAL FINDINGS



Total Leucocytes          Metamyelocytes          Lymphocytes }           
 & Monocytes }           
 Myelocytes          Stab Nuclears          Toxic Granulocytes



Case No. 26

TREATMENT

Tannic Acid

Age of patient **39 years.**

Case No. **27**

Sex of patient **Female.**

Nature of injuries **Scale of right hand, abdomen and right thigh.**

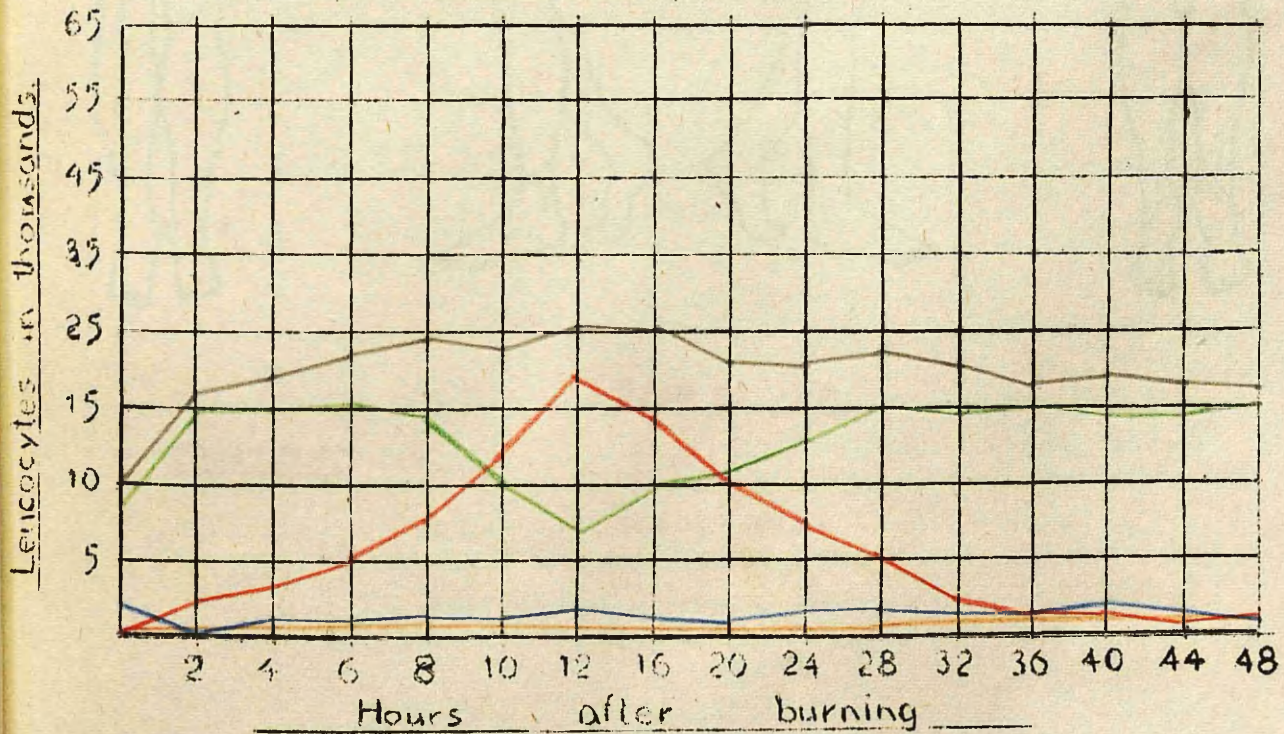
**Distribution as shown on chart overleaf.**

How sustained **Overturnd pot of soup.**

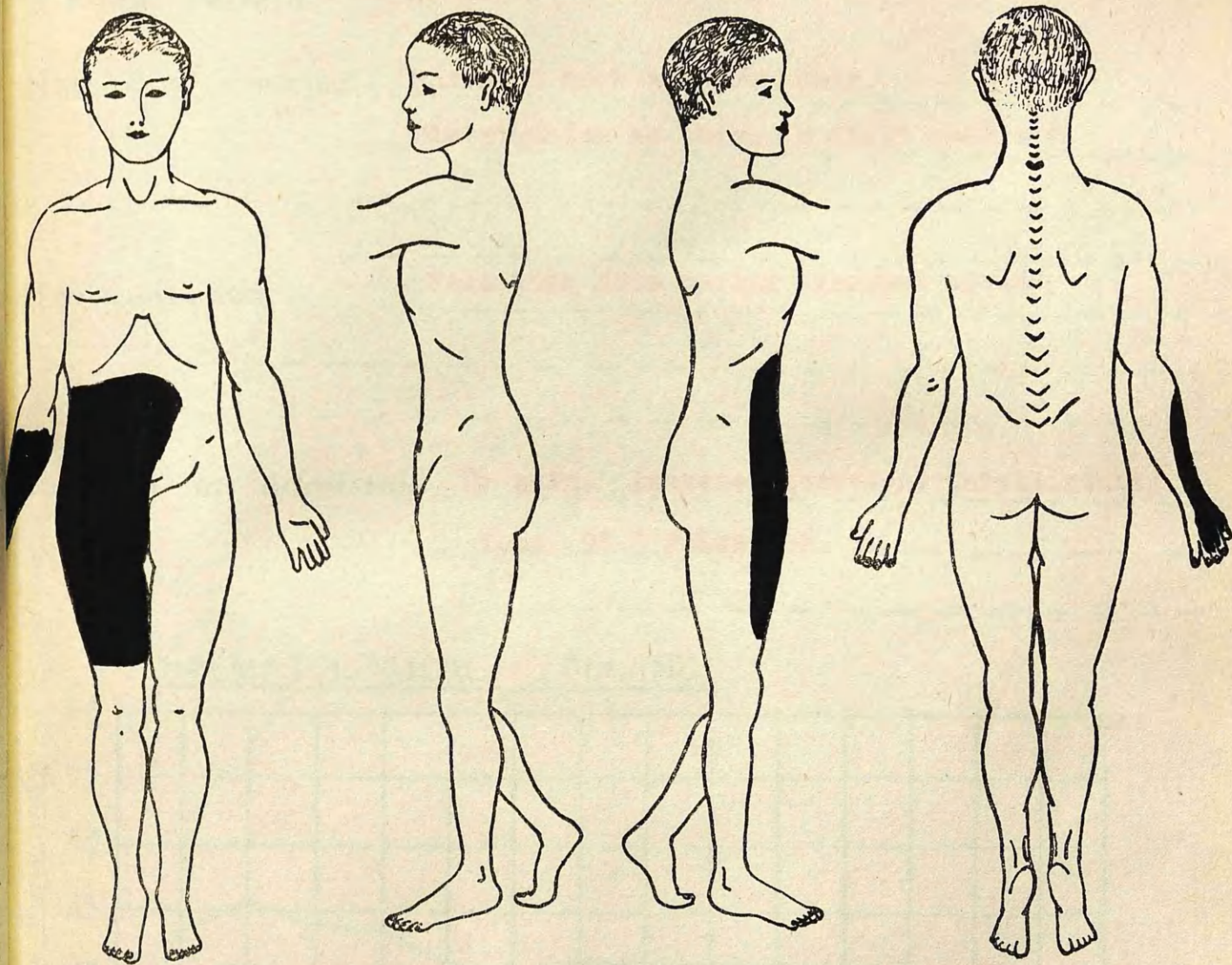
Condition on admission **No pain. Answered questions intelligently.**

**Temp. 98.4 Pulse 100**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Lymphorhphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 27

TREATMENT

Tannic Acid

Age of patient **21 years.**

Case No. **28**

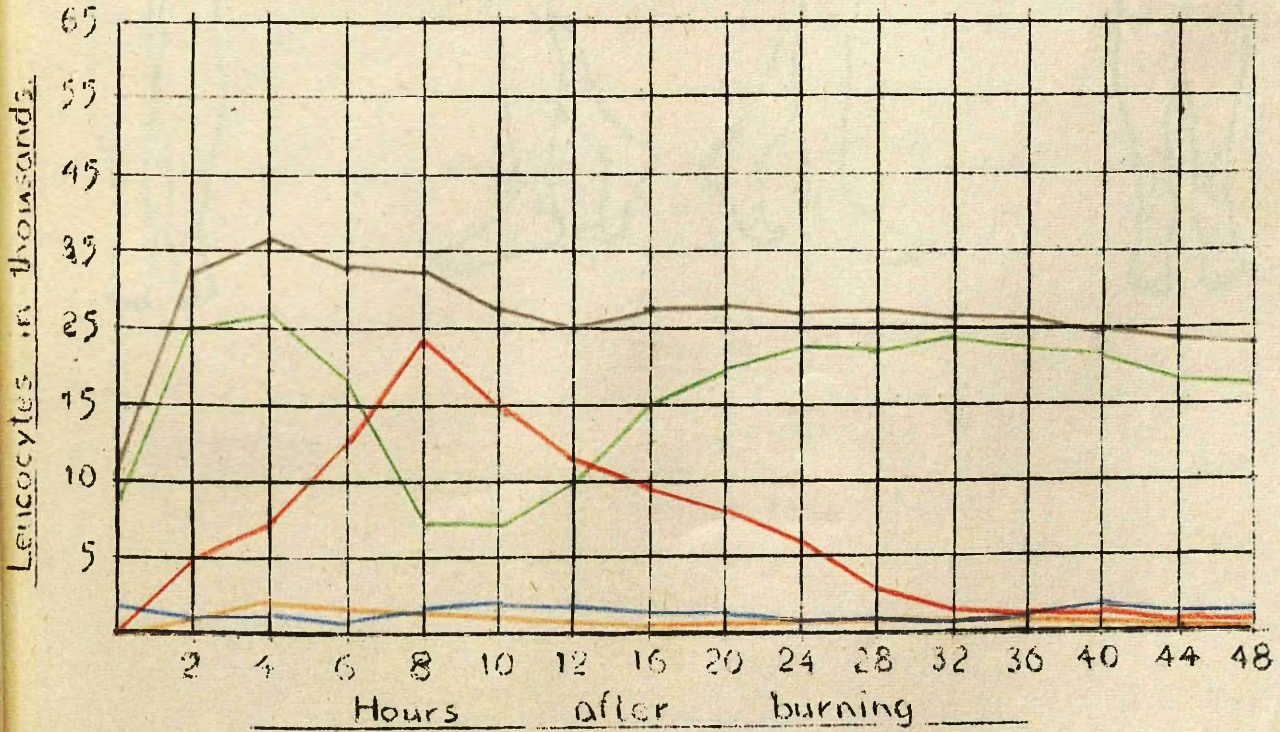
Sex of patient **Female.**

Nature of injuries **Burns of neck and shoulders.**  
**Distribution as shown on chart overleaf.**

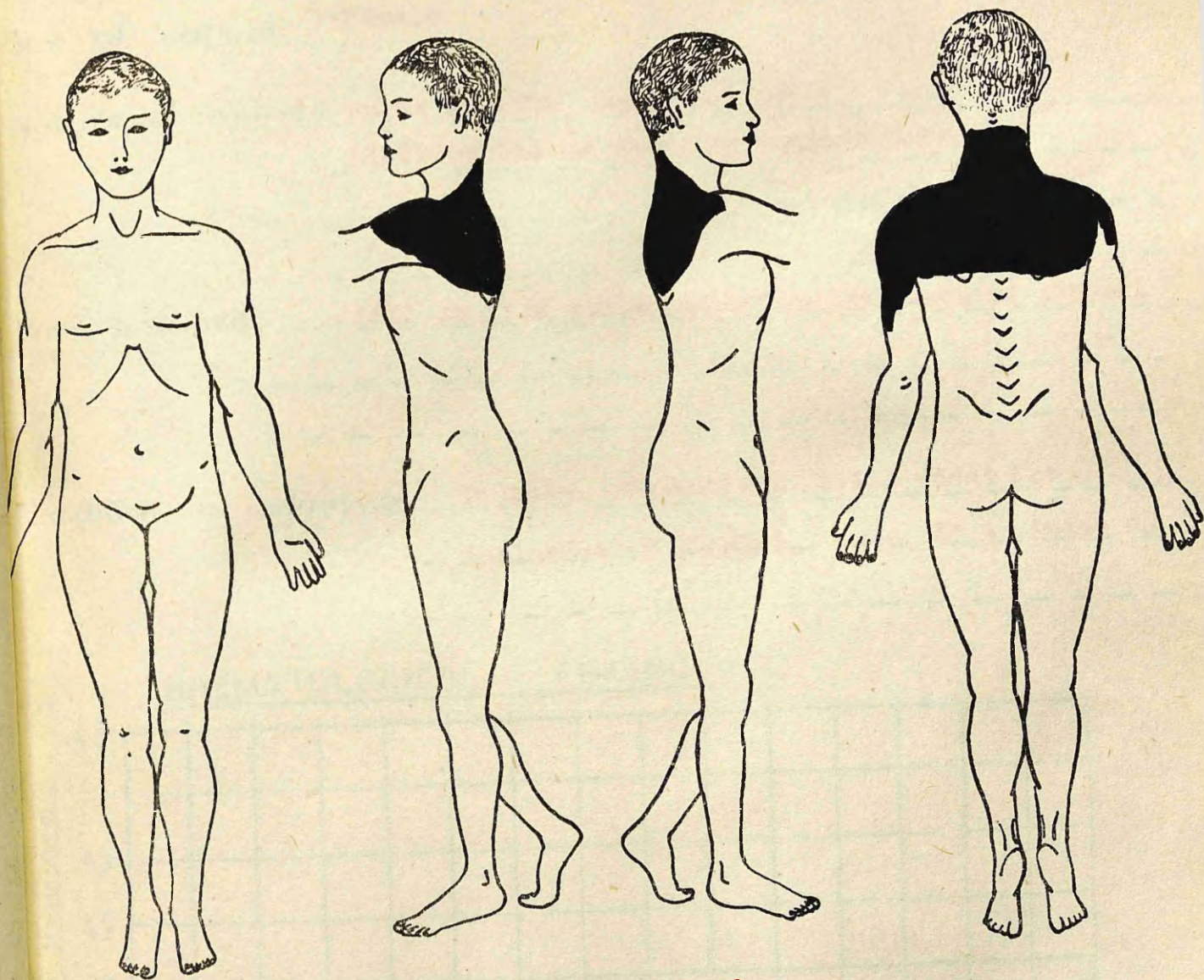
How sustained **Fell into fire during syncopal attack.**

Condition on admission **No pain. Answered questions intelligently.**  
**Temp. 98.3 Pulse 106**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Myeloblasts \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 28

TREATMENT

Tannic Acid

Age of patient 38 Years.

Case No. 29

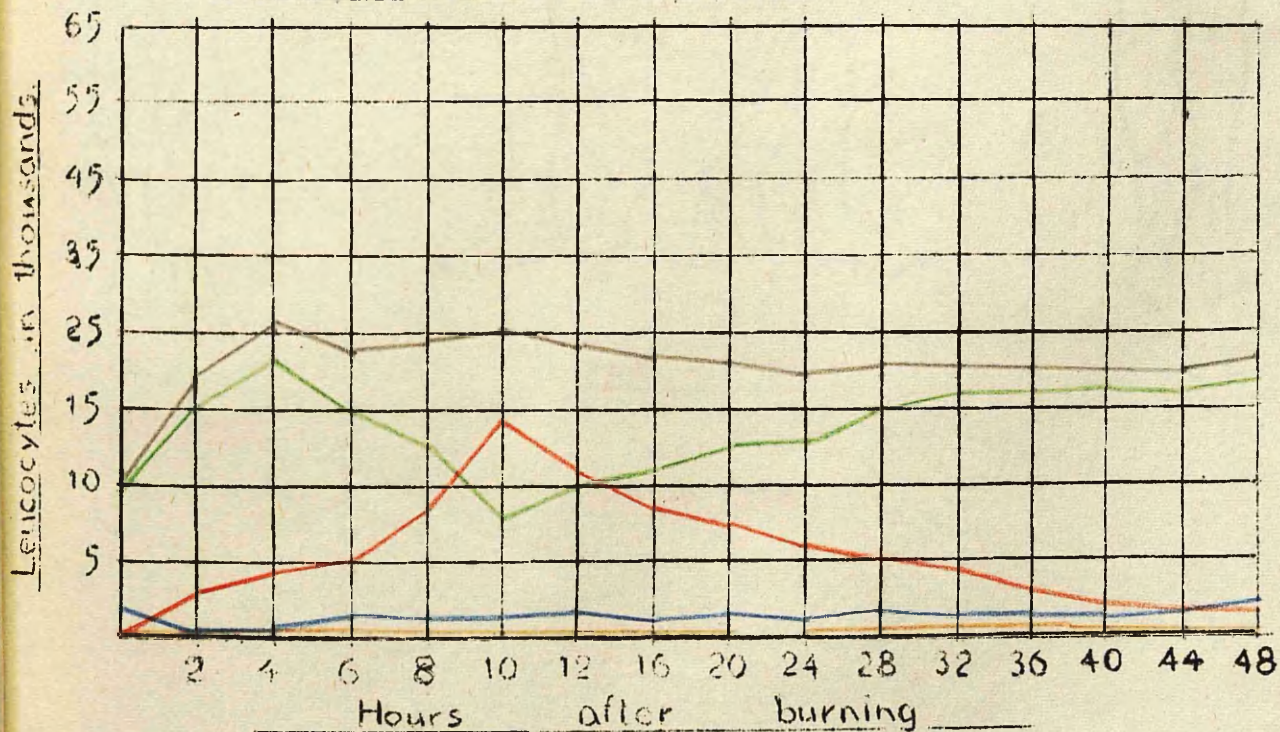
Sex of patient Female.

Nature of injuries Burns of arms, hands and chest.  
Distribution as shown on chart overleaf.

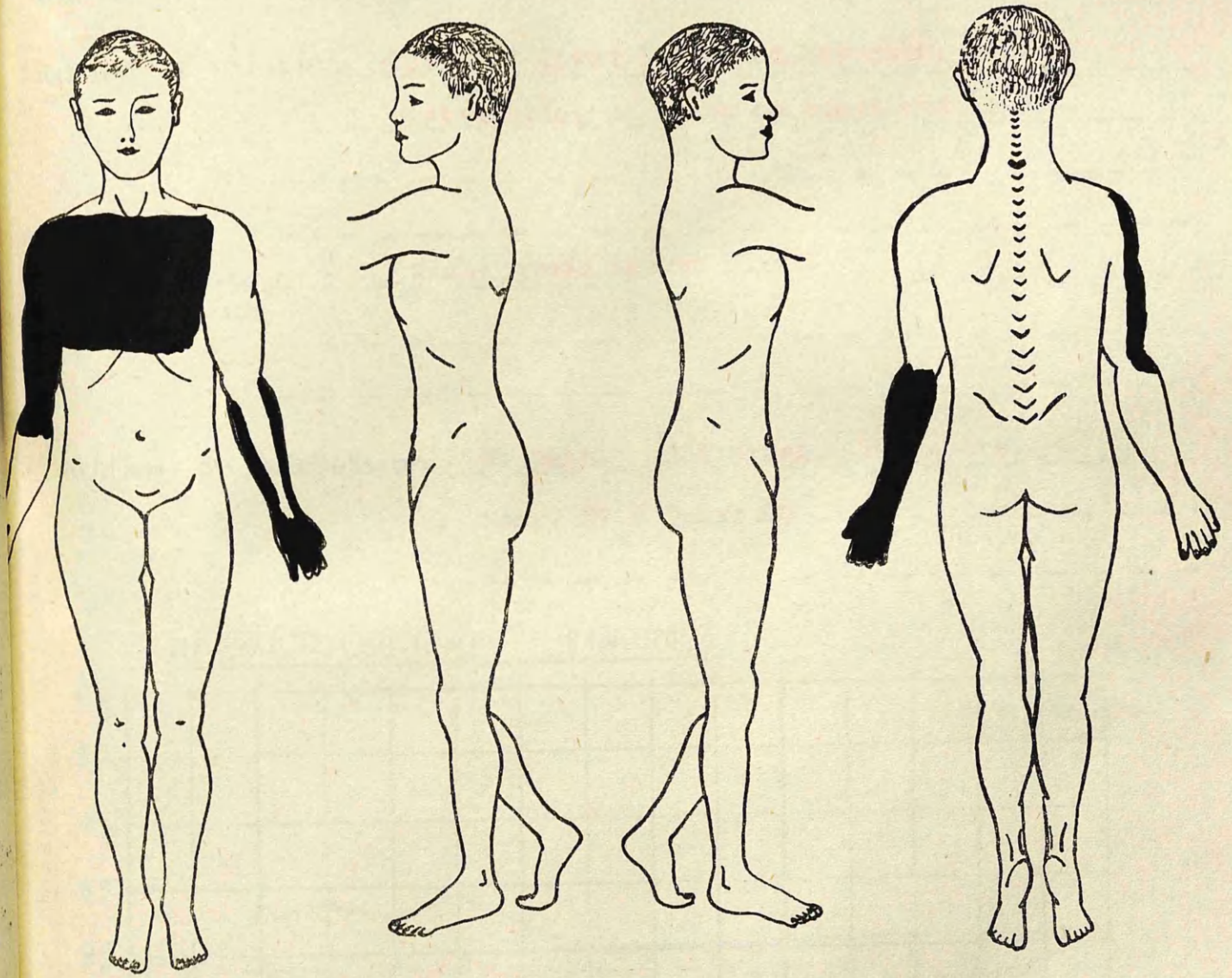
How sustained Fell in fire while under the influence of alcohol

Condition on admission No pain. Talkative. Still under the  
influence of alcohol. Temp. 97.5 Pulse 96

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes } \_\_\_\_\_  
Lymphorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 29

TREATMENT

Tannic Acid

Age of patient 17 years

Case No. 30

Sex of patient Female

Nature of injuries Burns of lower limbs and buttocks.

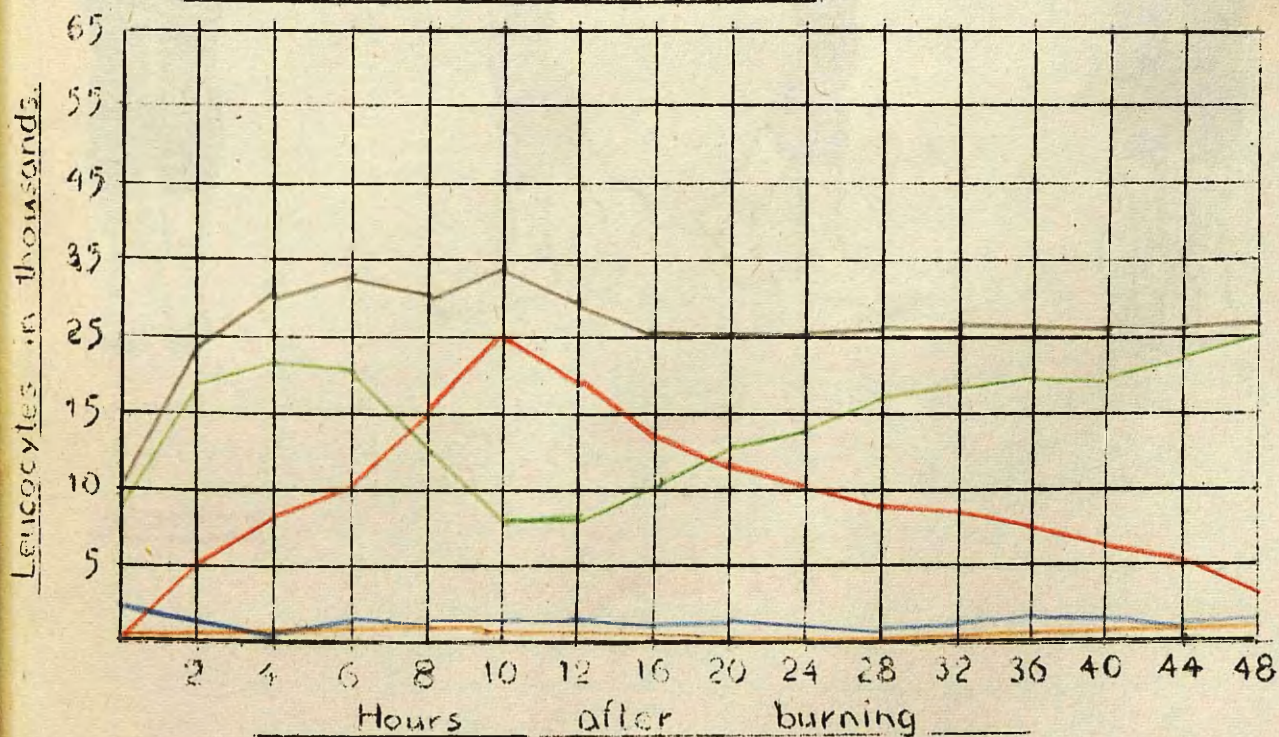
distribution as shown on chart overleaf.

How sustained Night dress caught fire.

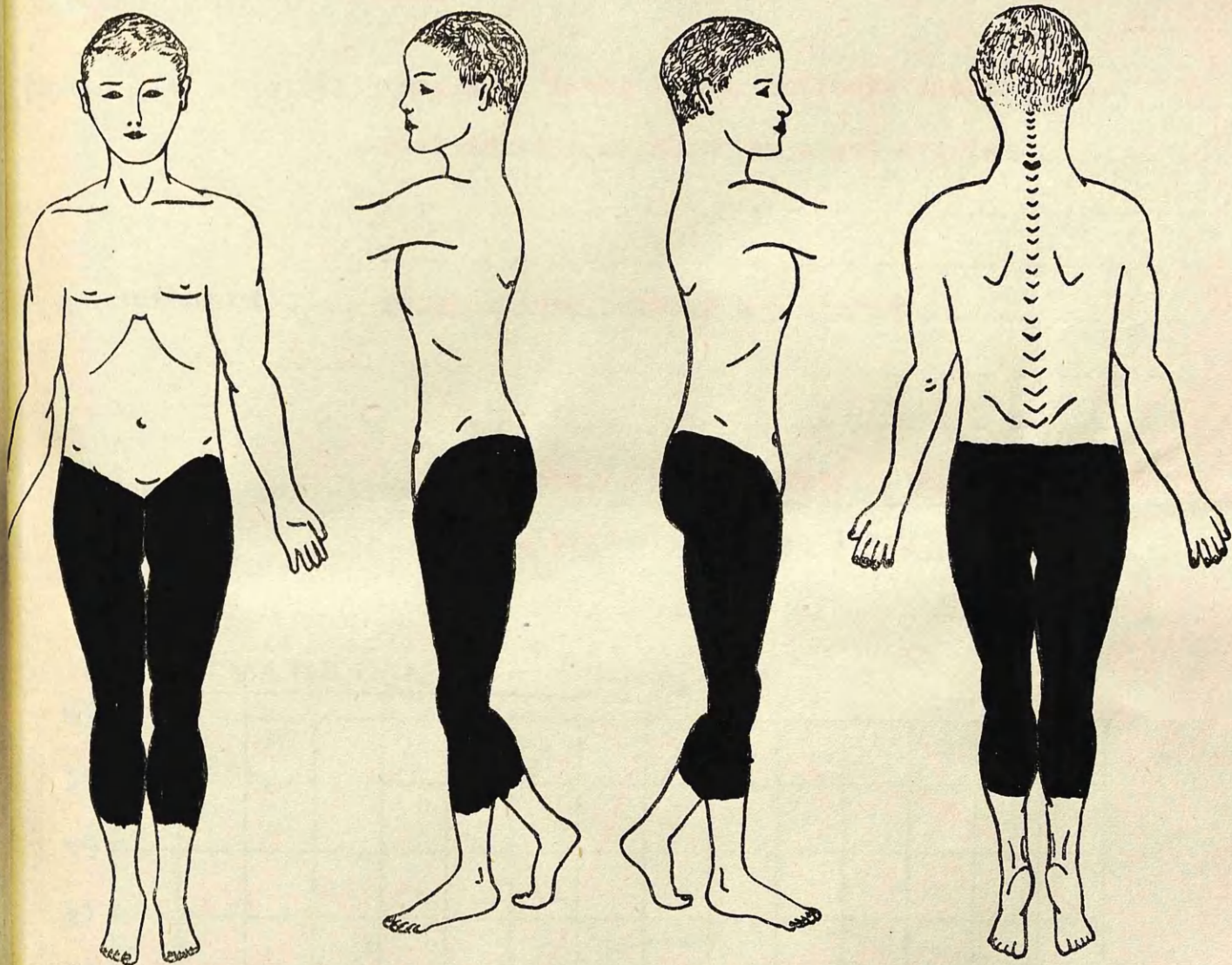
Condition on admission No pain. Shivering. Talkative.

Temp. 97.6 Pulse 90

### HAEMATOLOGICAL FINDINGS



Total Leucocytes          Metamyelocytes          Lymphocytes }           
& Monocytes }           
Polymorphs          Stab Nuclears          Toxic Granulocytes



Case No. 30

TREATMENT

Tannic Acid

Age of patient **16 years**

Case No. **31**

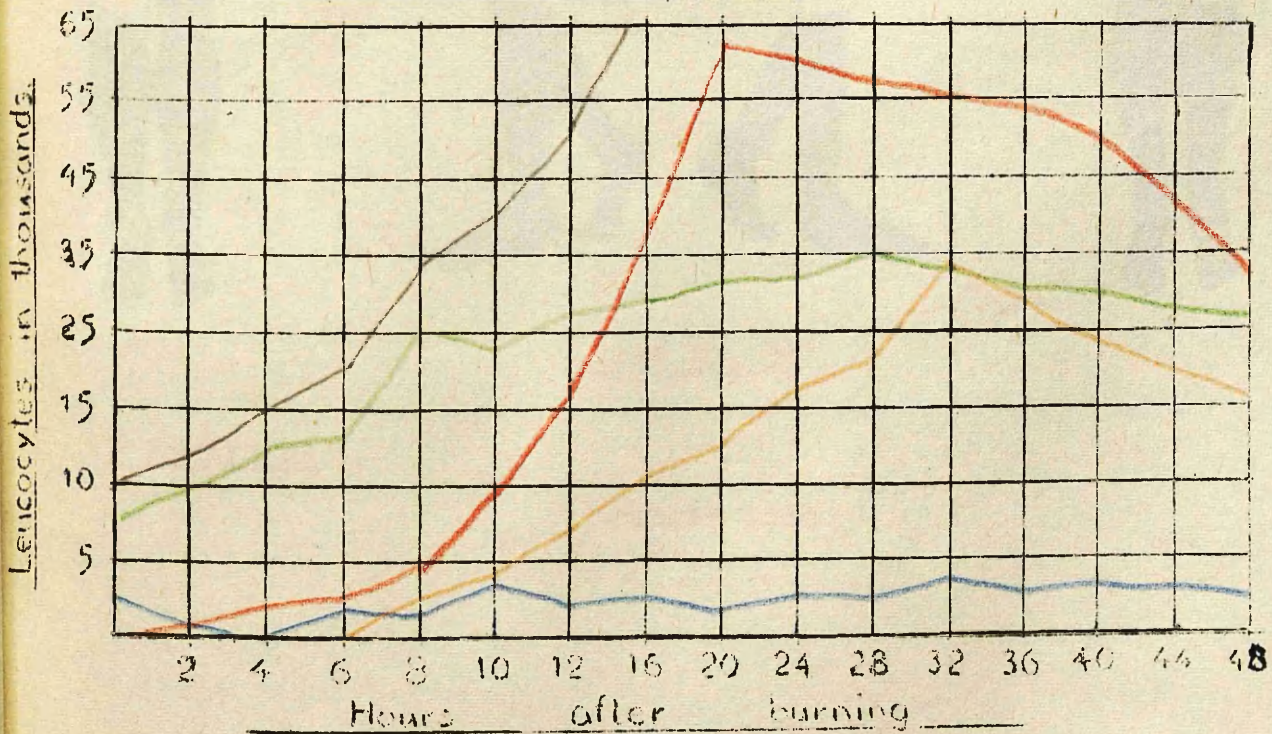
Sex of patient **Female**

Nature of injuries **Scald of lower limbs, buttocks and abdomen.**  
**Distribution as shown on chart overleaf.**

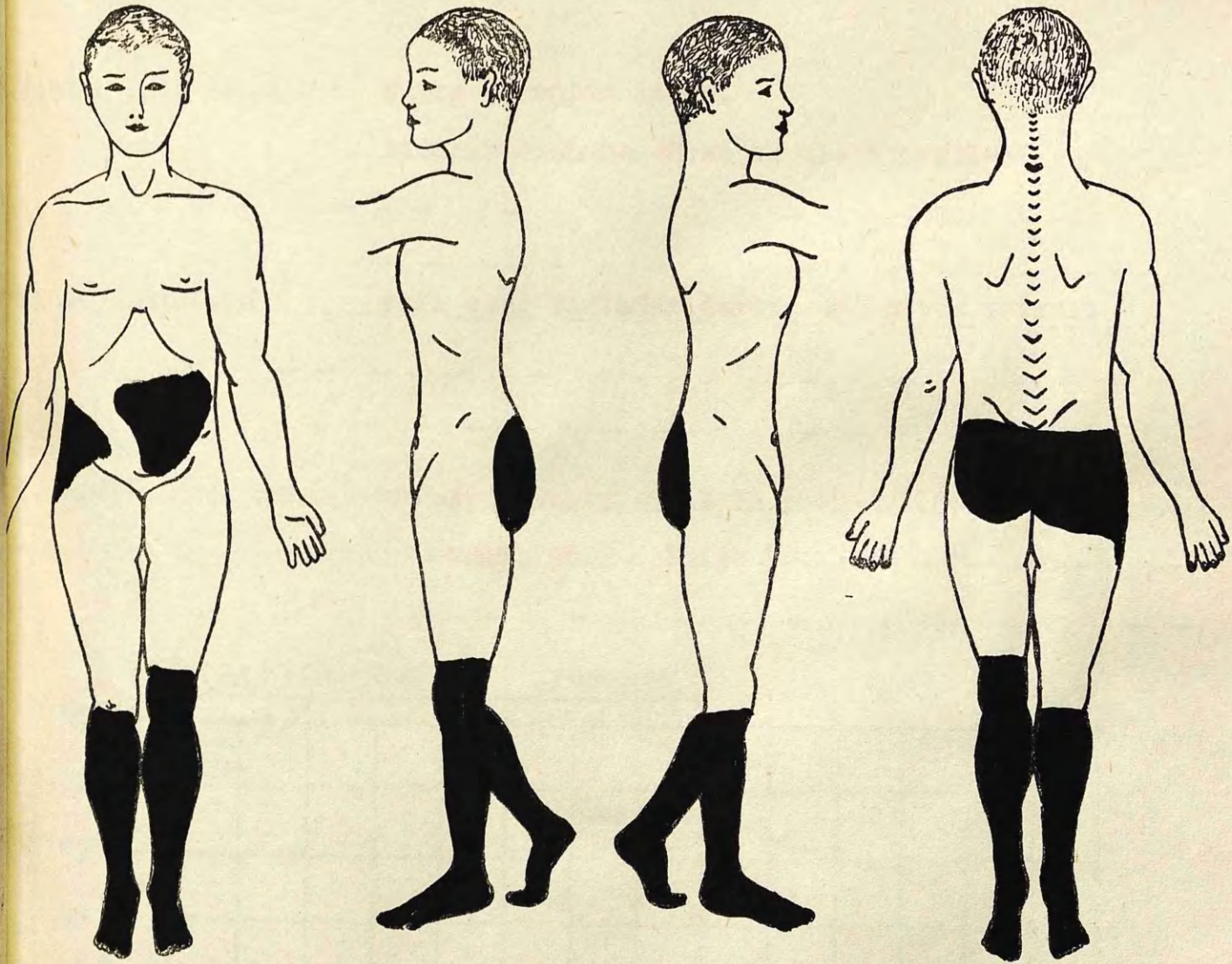
How sustained **Slipped into bath of hot starch.**

Condition on admission **No pain. Very thirsty. Answered questions intelligently. Temp. 100.2 Pulse 98**

**HAEMATOLOGICAL FINDINGS**



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Myeloblasts \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 31

TREATMENT

Tannic Acid

Age of patient 27 years

Case No. 32

Sex of patient Female

Nature of injuries Burns of upper limbs.

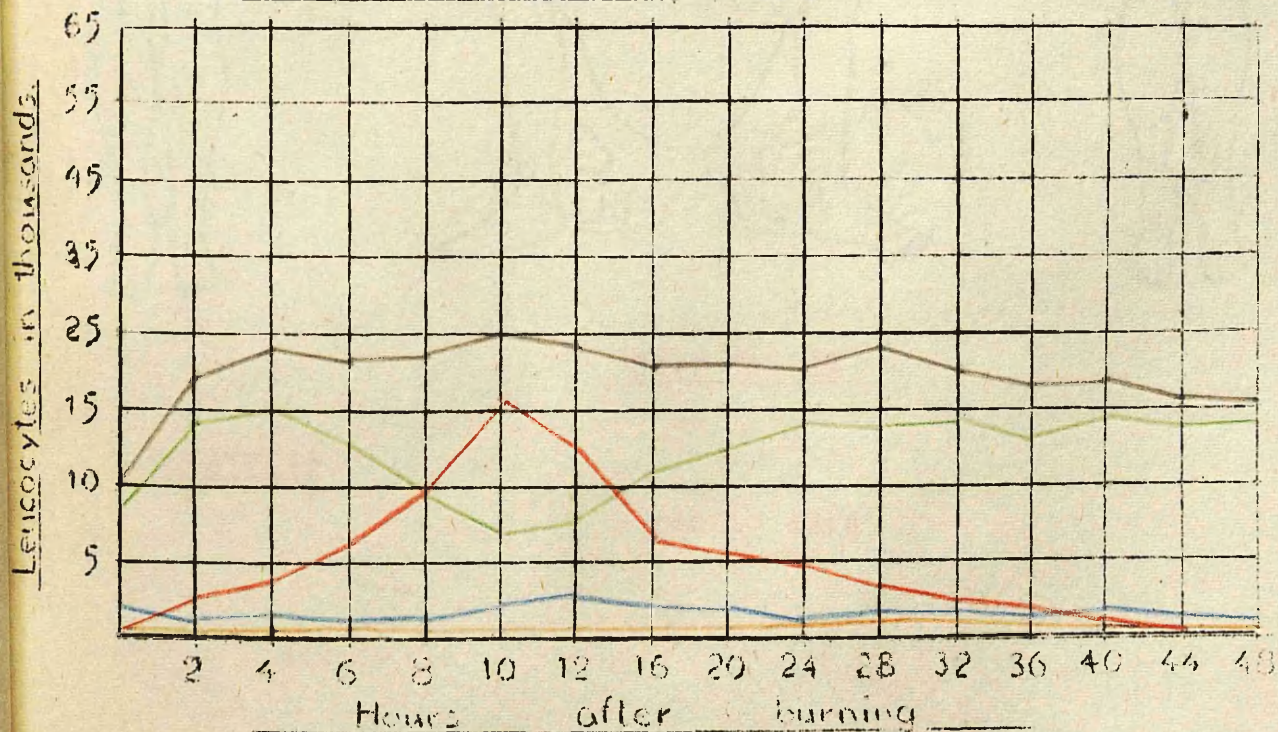
- Distribution as shown on chart overleaf.

How sustained Fell over radiator during epileptic seizure

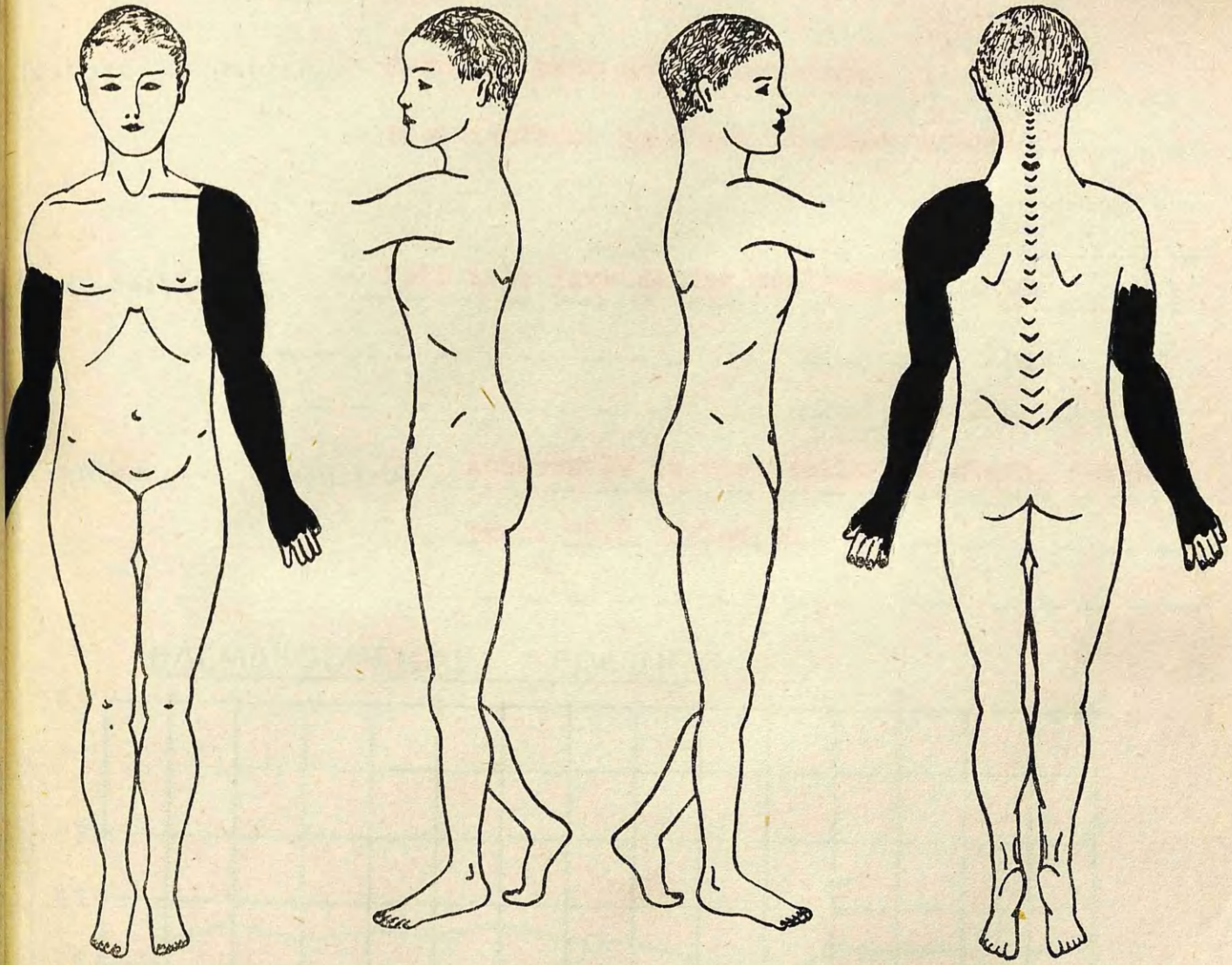
Condition on admission Apparently still in post-epileptic state.

- Temp 98.2 - Pulse 90.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ----- Metamyelocytes ----- Lymphocytes } -----  
& Monocytes } -----  
Lymphorhys ----- Stab Nuclears ----- Toxic Granulocytes -----



Case No. 32

TREATMENT

Tannic Acid

Age of patient **16 years.**

Case No. **33**

Sex of patient **Female.**

Nature of injuries **Burns of back and upper limbs.**

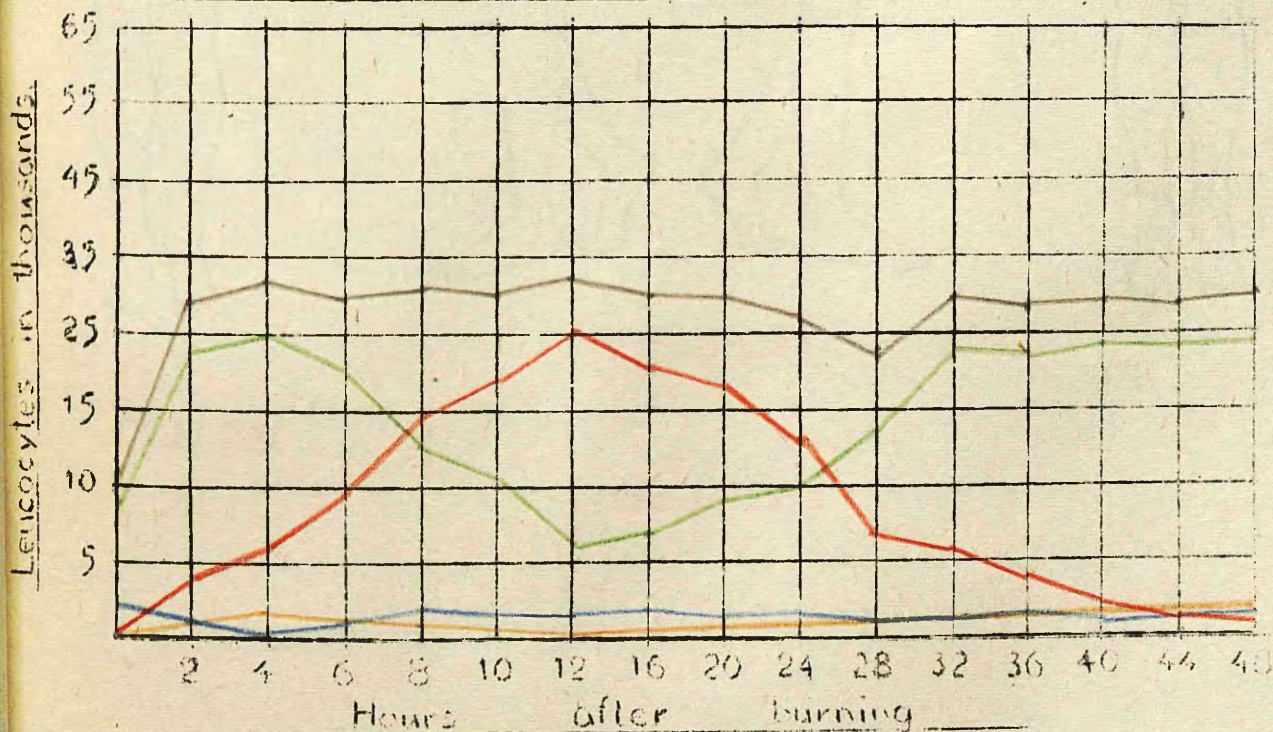
**Distributions as shown on chart overleaf.**

How sustained **Fell into fire during epileptic seizure.**

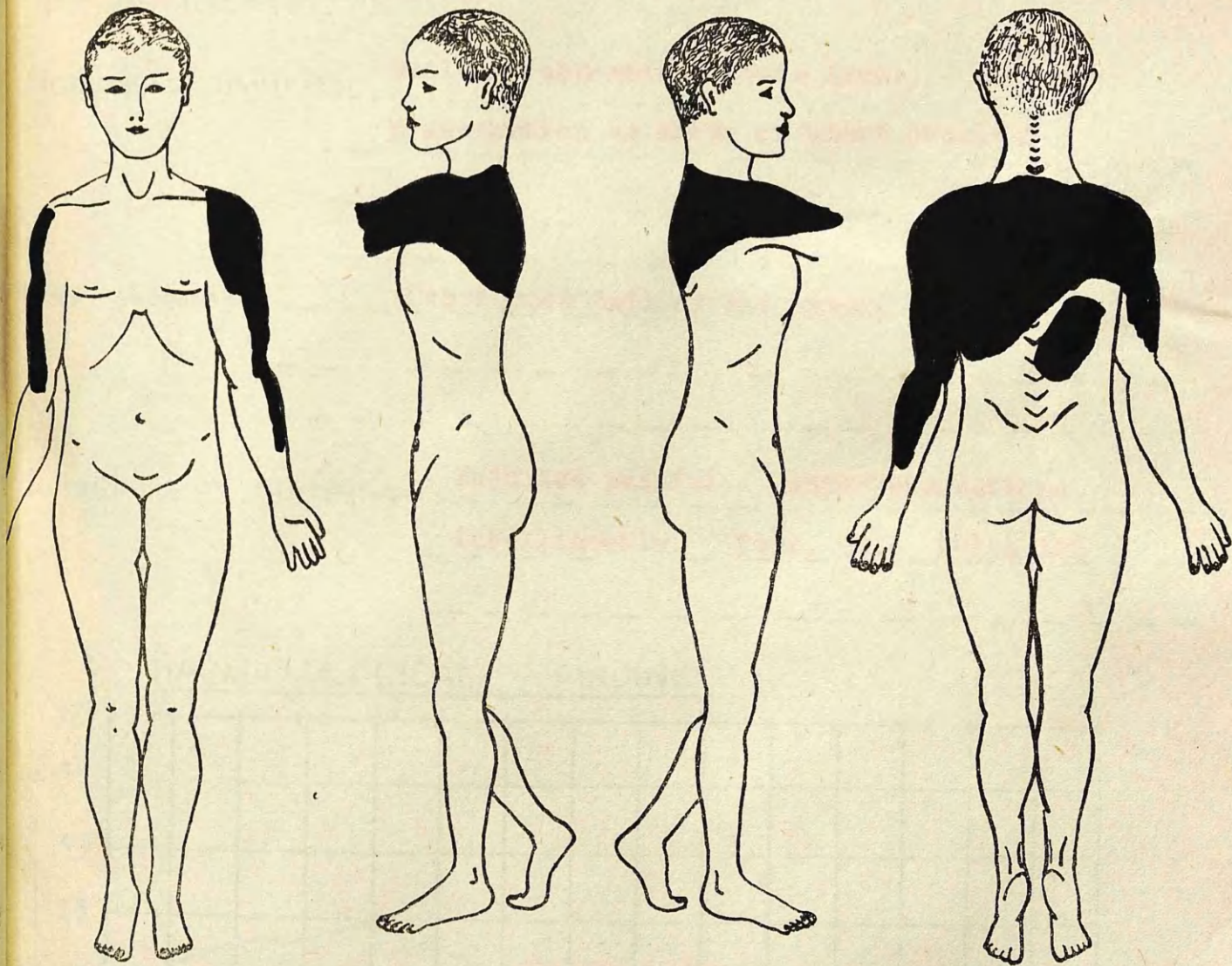
Condition on admission **Apparently in post-epileptic state. Thirsty.**

**Temp. 98.8 Pulse 90**

### HAEMATOLOGICAL FINDINGS



tal Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
Monocytes } \_\_\_\_\_  
Lymphorpha \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 33

TREATMENT

Tannic Acid

Age of patient **32 years**

Case No. **34**

Sex of patient **Female.**

Nature of injuries **Scald of abdomen and lower limbs.**

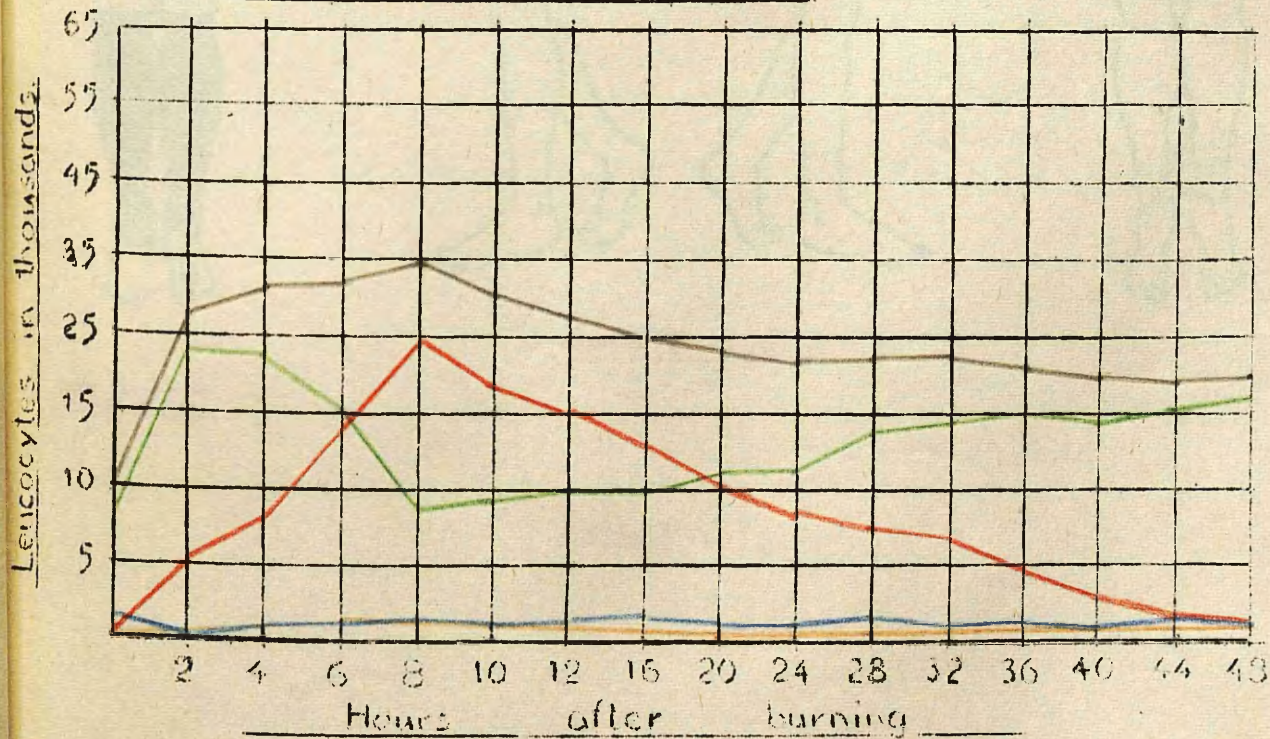
**Distribution as shown on chart overleaf.**

How sustained **Overtured pail of hot water.**

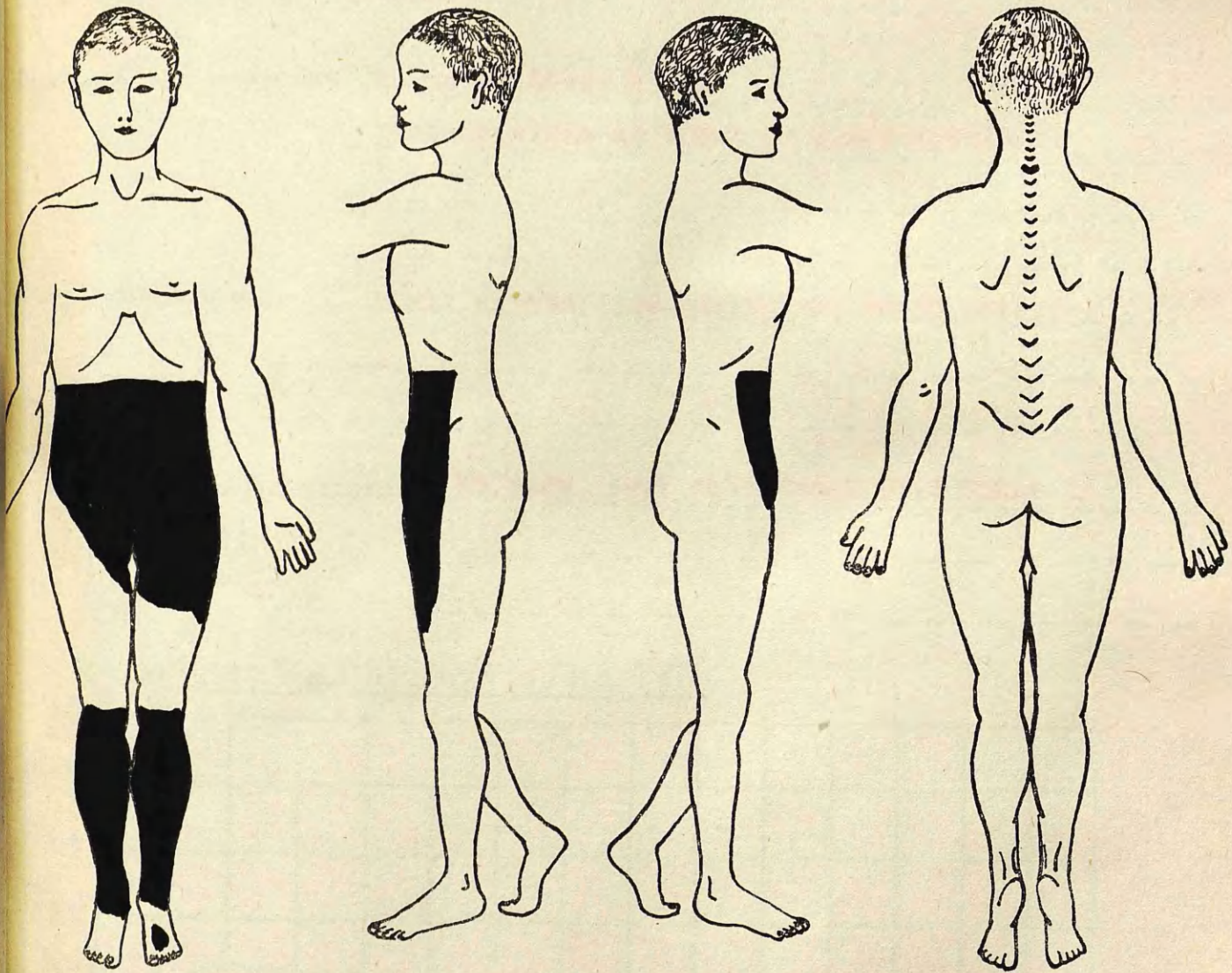
Condition on admission **Injuries painful. Answered questions**

**intelligently. Temp. 99.4 pulse 106**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes } \_\_\_\_\_  
Lymphorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 34

TREATMENT

Tannic Acid.

Age of patient **22 years.**

Case No. **35**

Sex of patient **Female.**

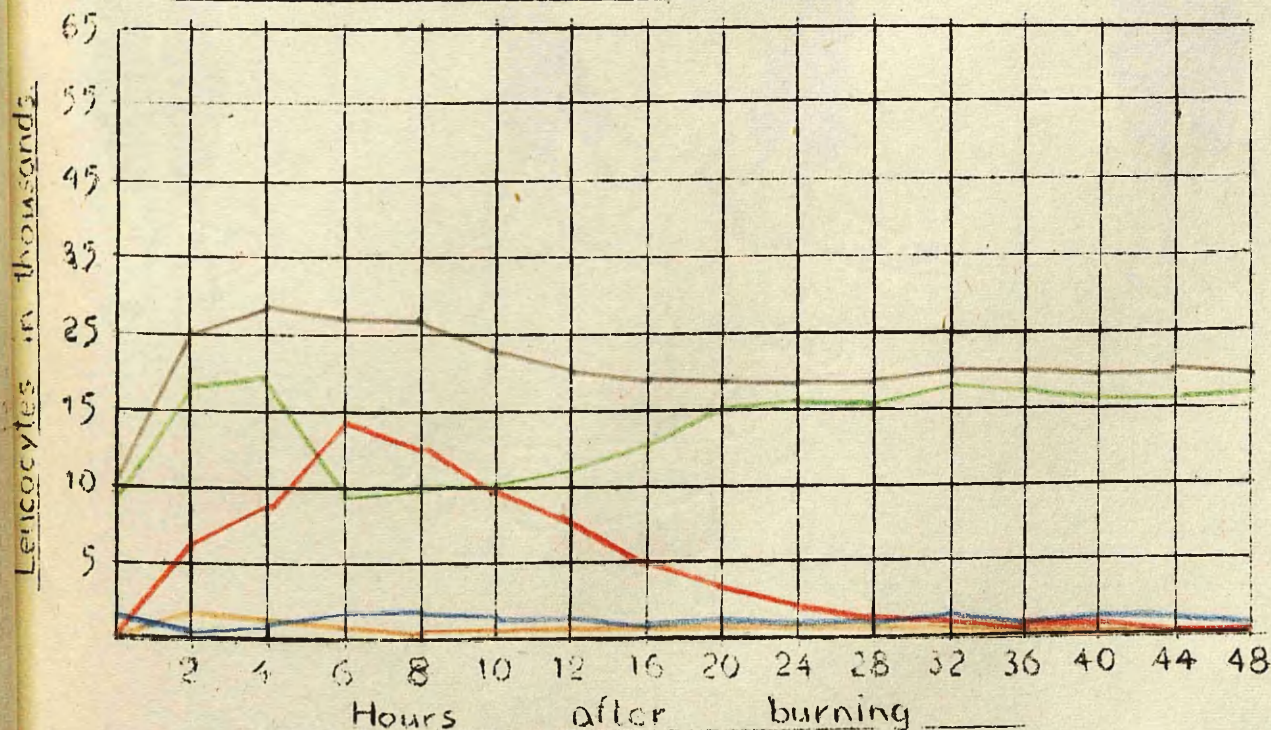
Nature of injuries **Burns of lower limbs.**

**Distributions as shown on chart overleaf.**

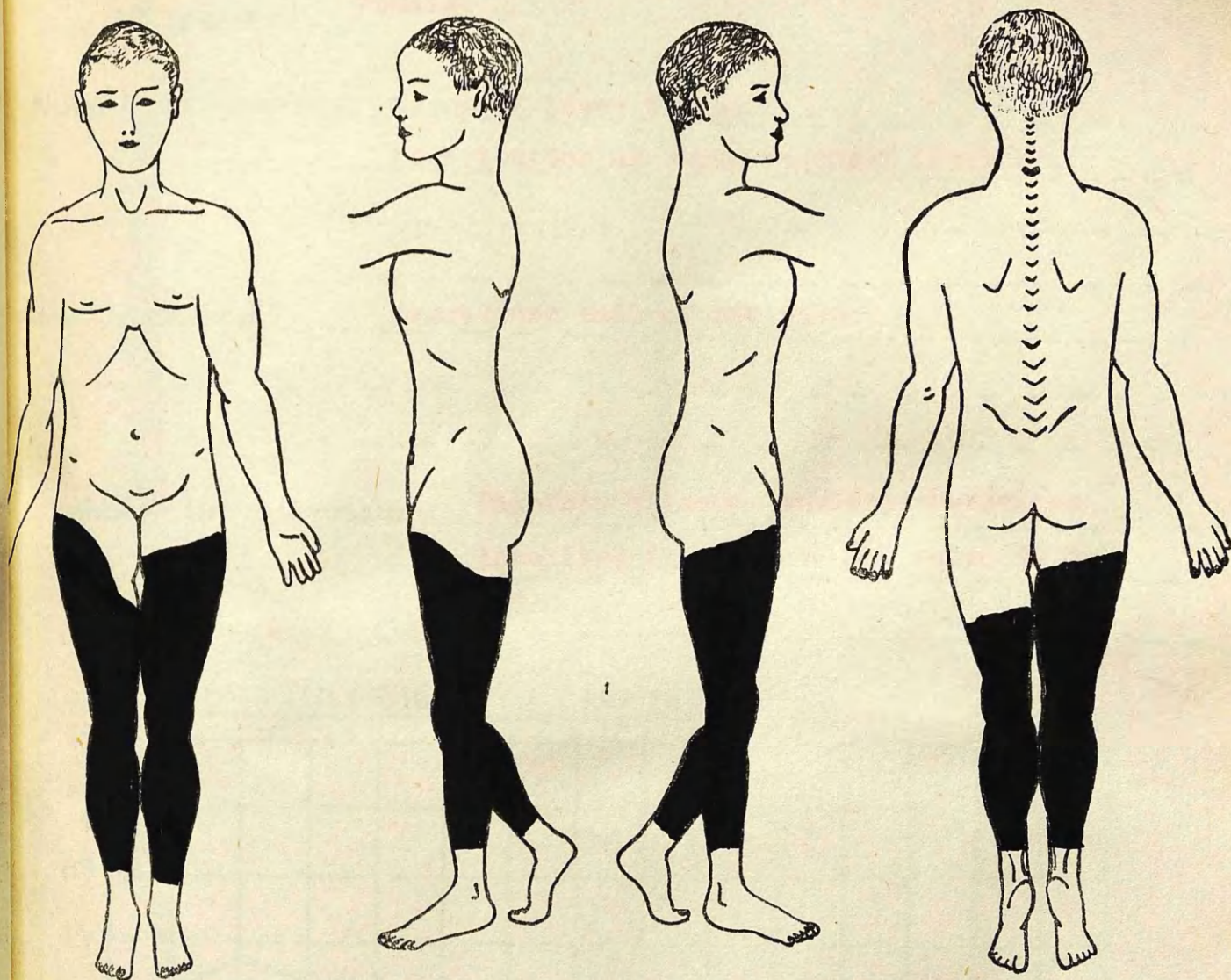
How sustained **Fell across fire during epileptic seizure.**

Condition on admission **No pain. Felt cold Temp. 97.4 Pulse 96**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Myelocytes & Monocytes }  
Lymphocytes & Stab Nuclears }  
Metamyelocytes \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 35

TREATMENT

Tannic Acid

Age of patient **48 years**

Case No. **36**

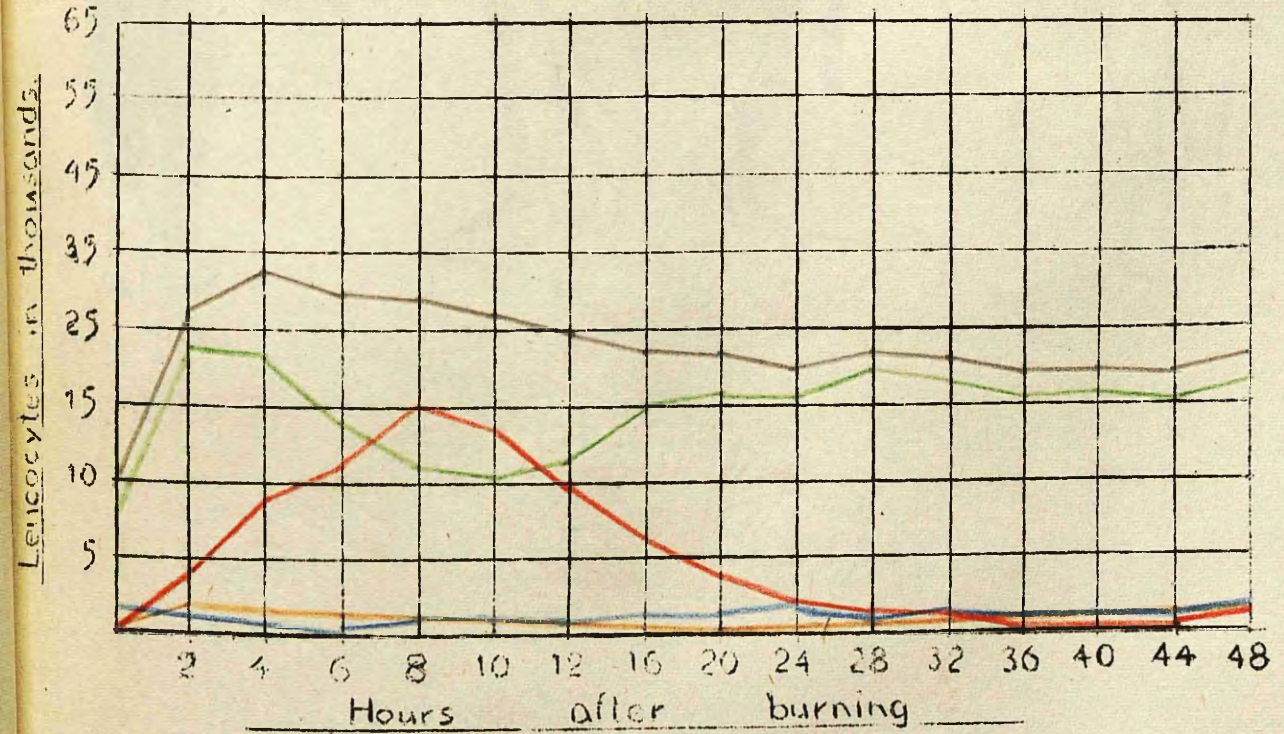
Sex of patient **Female.**

Nature of injuries **Burns of lower limbs.**  
**Distribution as shown on chart overleaf.**

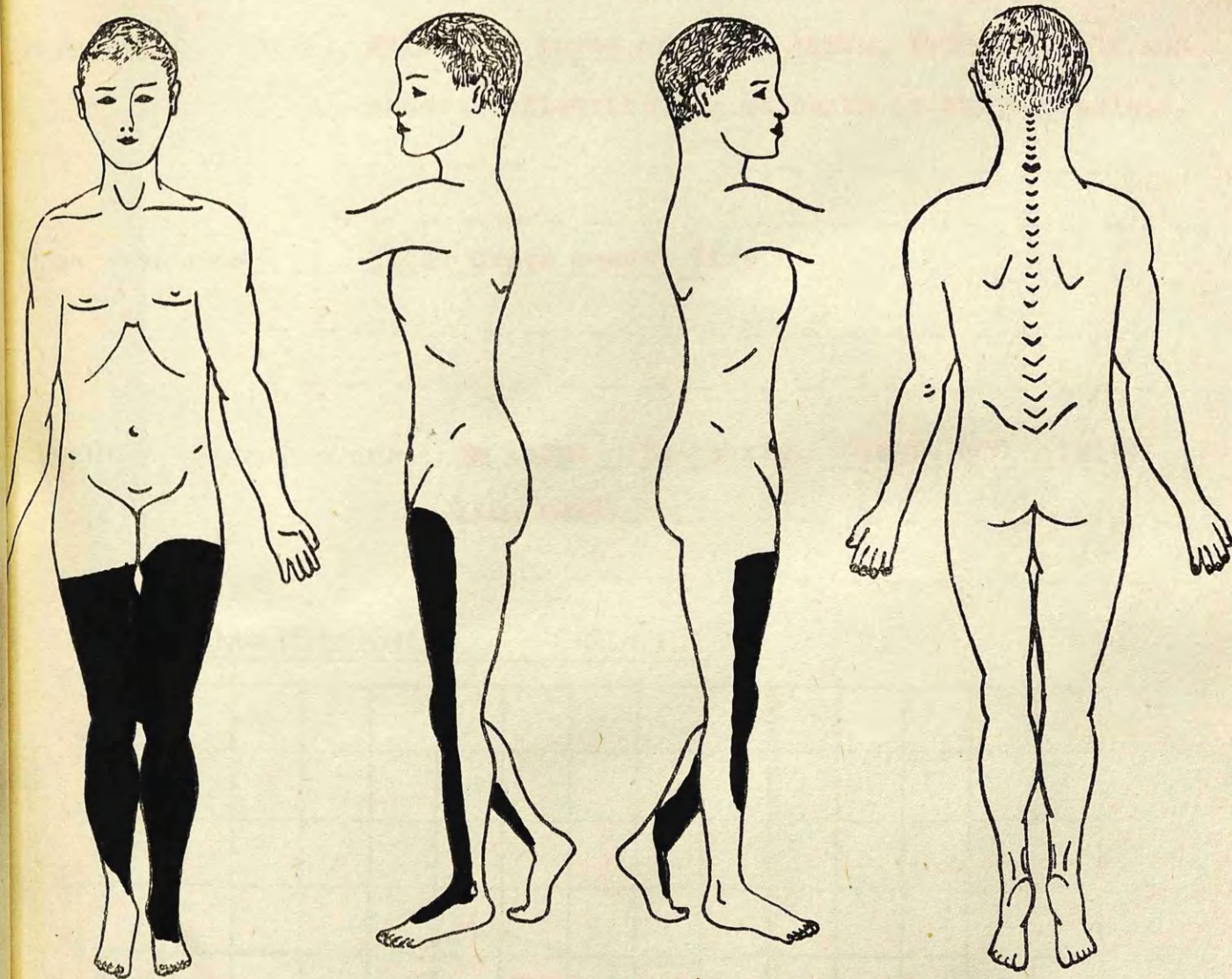
How sustained **Overturnd pail of hot water.**

Condition on admission **Painful. Thirsty. Answered Questions**  
**Intelligently. Temp. 96 Pulse 99.8**

HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
 & Monocytes }  
 Myeloblasts ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 36

TREATMENT

Tannic Acid

Age of patient **70 years**

Case No. **37**

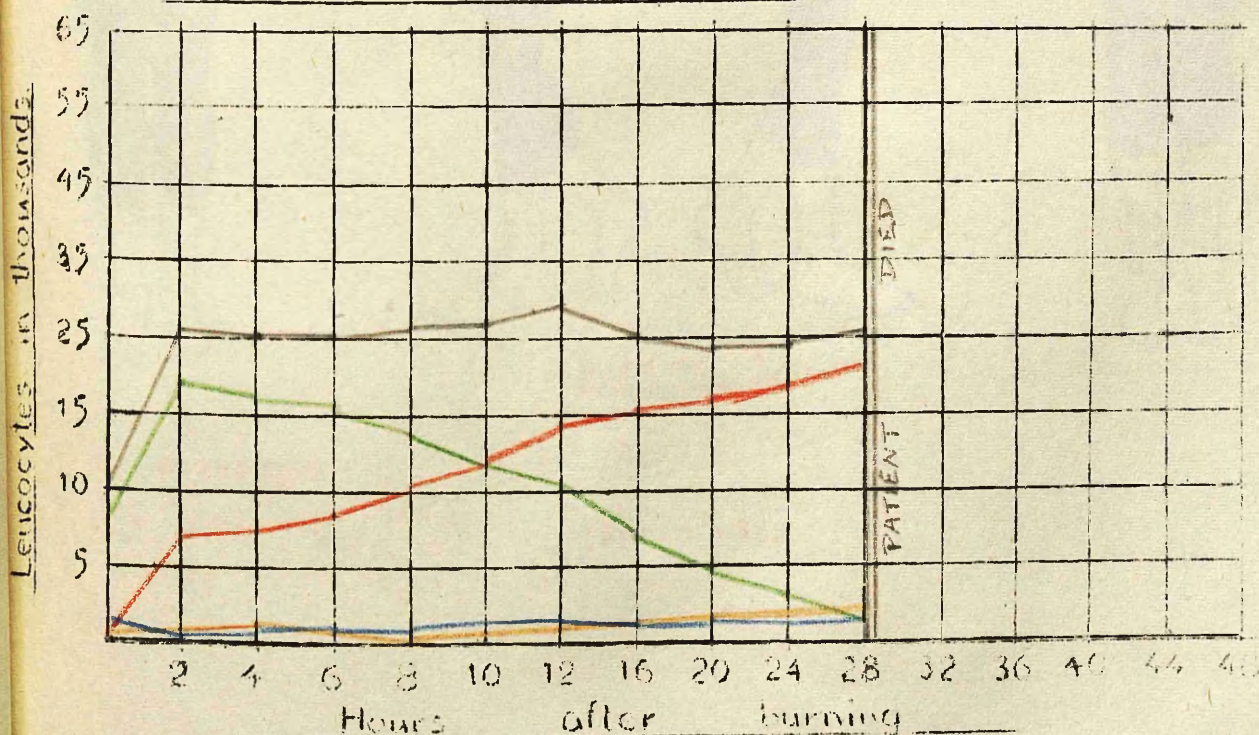
Sex of patient **Female**

Nature of injuries **Extensive burns of lower limbs, abdomen, back and chest. Distribution as shown on chart overleaf.**

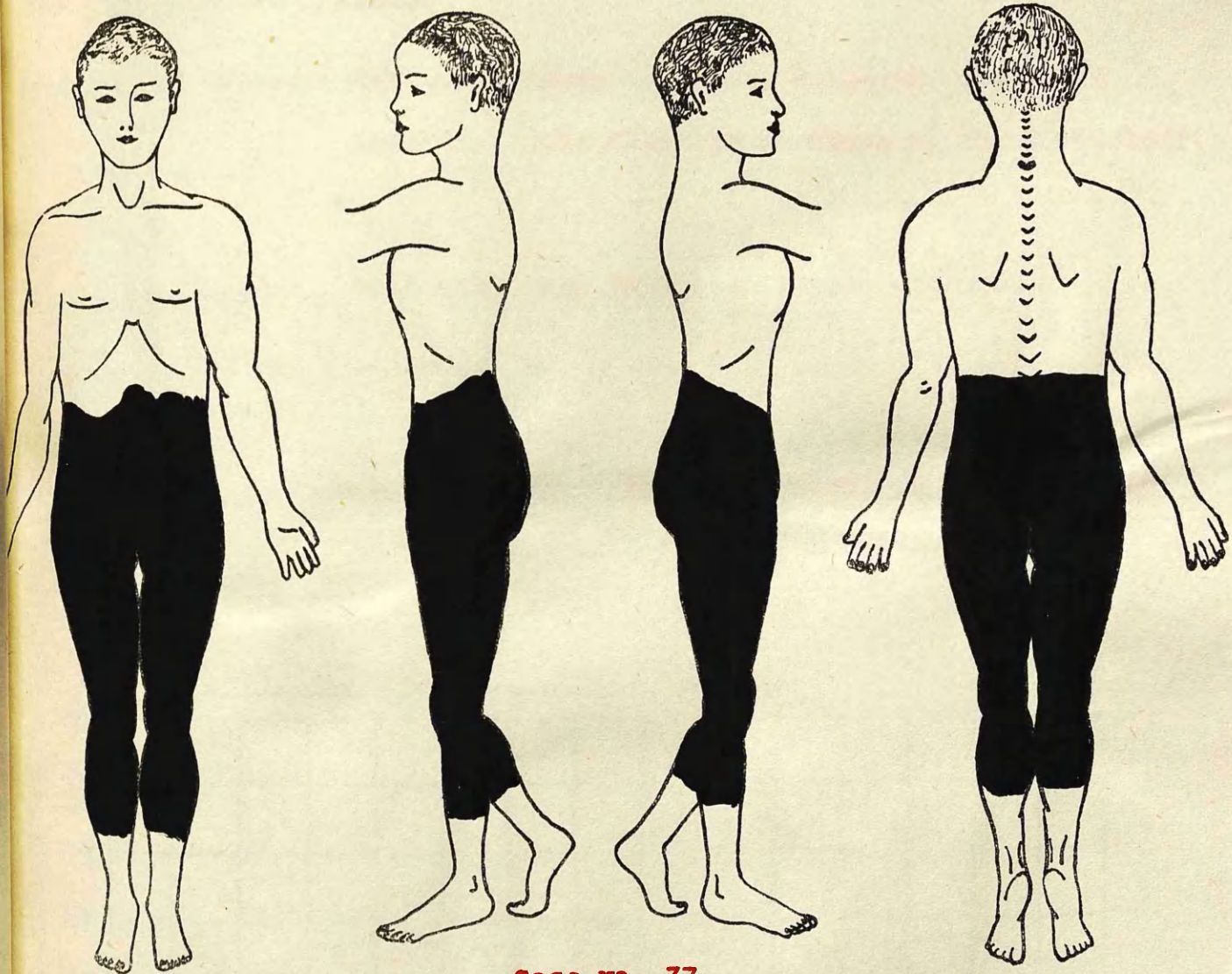
How sustained **Night dress caught fire.**

Condition on admission **No pain. Talkative. Temp. 100 Pulse 110, weak.**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes \_\_\_\_\_  
( & Monocytes )  
Monorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 37

TREATMENT

Tannic Acid

Age of patient. **40 years**

Case No. **38**

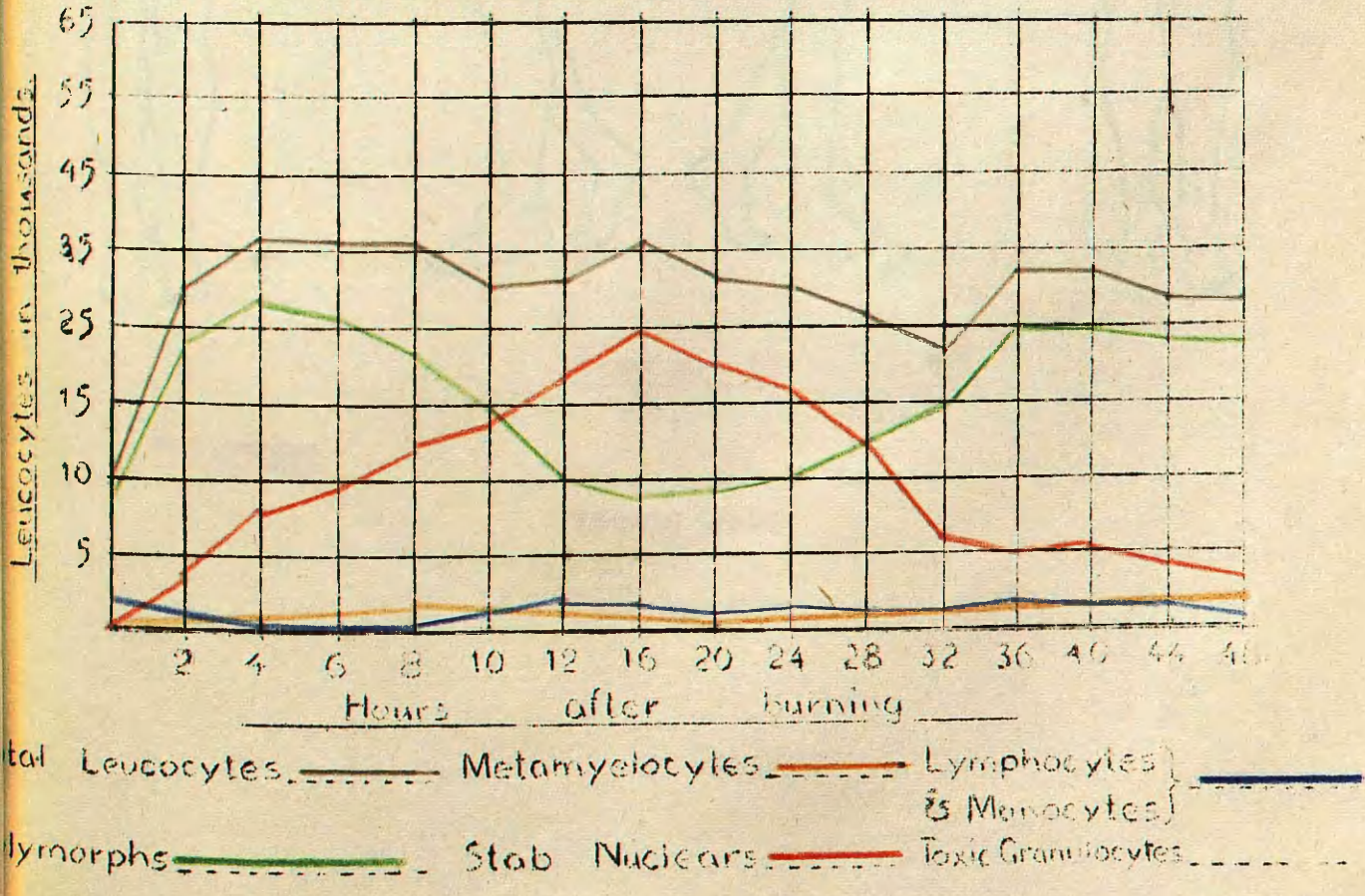
Sex of patient. **Female**

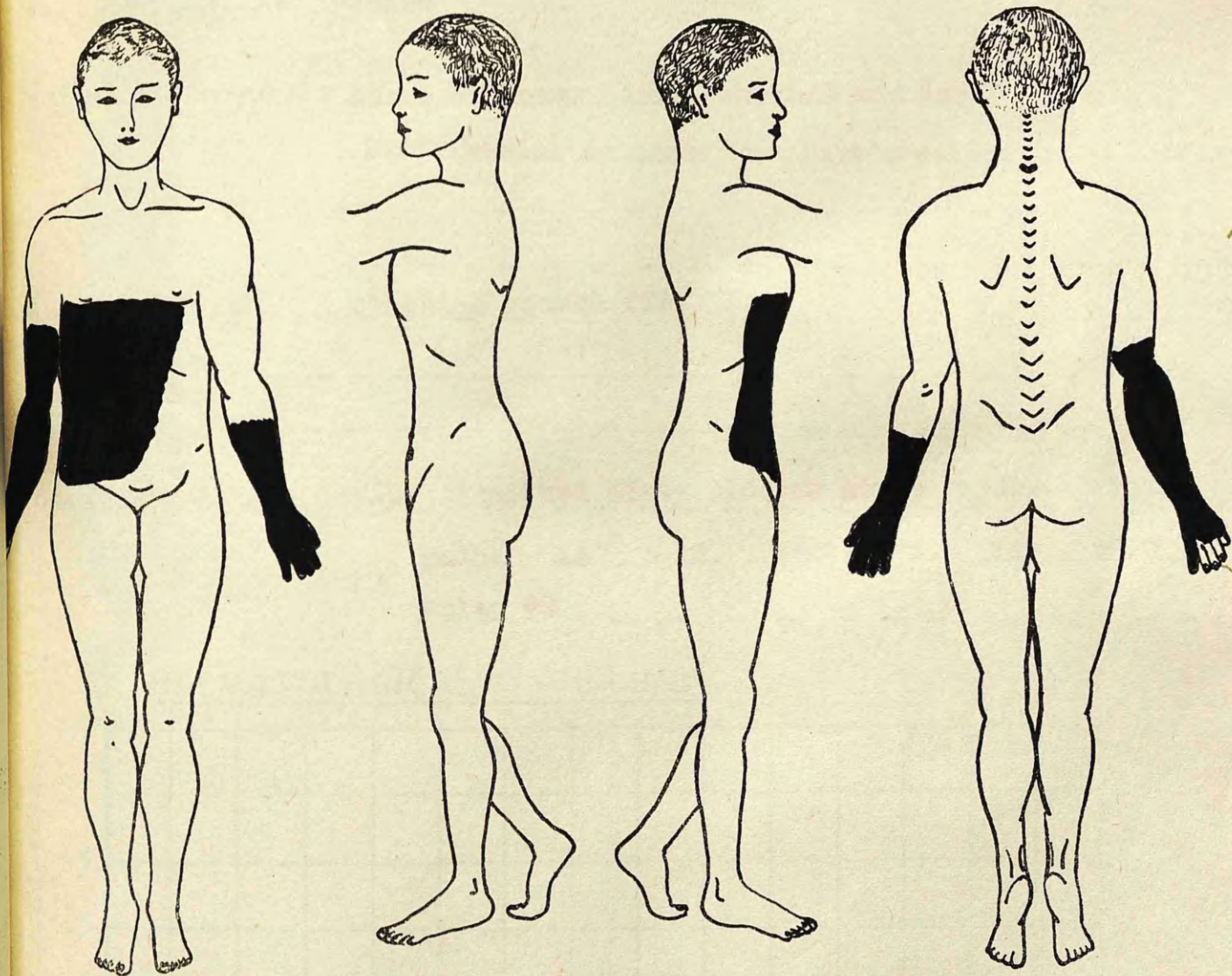
Nature of injuries. **Extensive burns of hands, forearms, chest and abdomen. Distribution as shown on chart overleaf.**

How sustained. **Fell into fire during epileptic seizure.**

Condition on admission. **No pain. Answered questions intelligently. Temp. 99 Pulse 130**

### HAEMATOLOGICAL FINDINGS





Case No. 38

TREATMENT

Tannic Acid

Age of patient **36 years**

Case No **99**

Sex of patient **Female**

Nature of injuries **Burns of lower limbs, abdomen and back**

**Distribution as shown on chart overleaf**

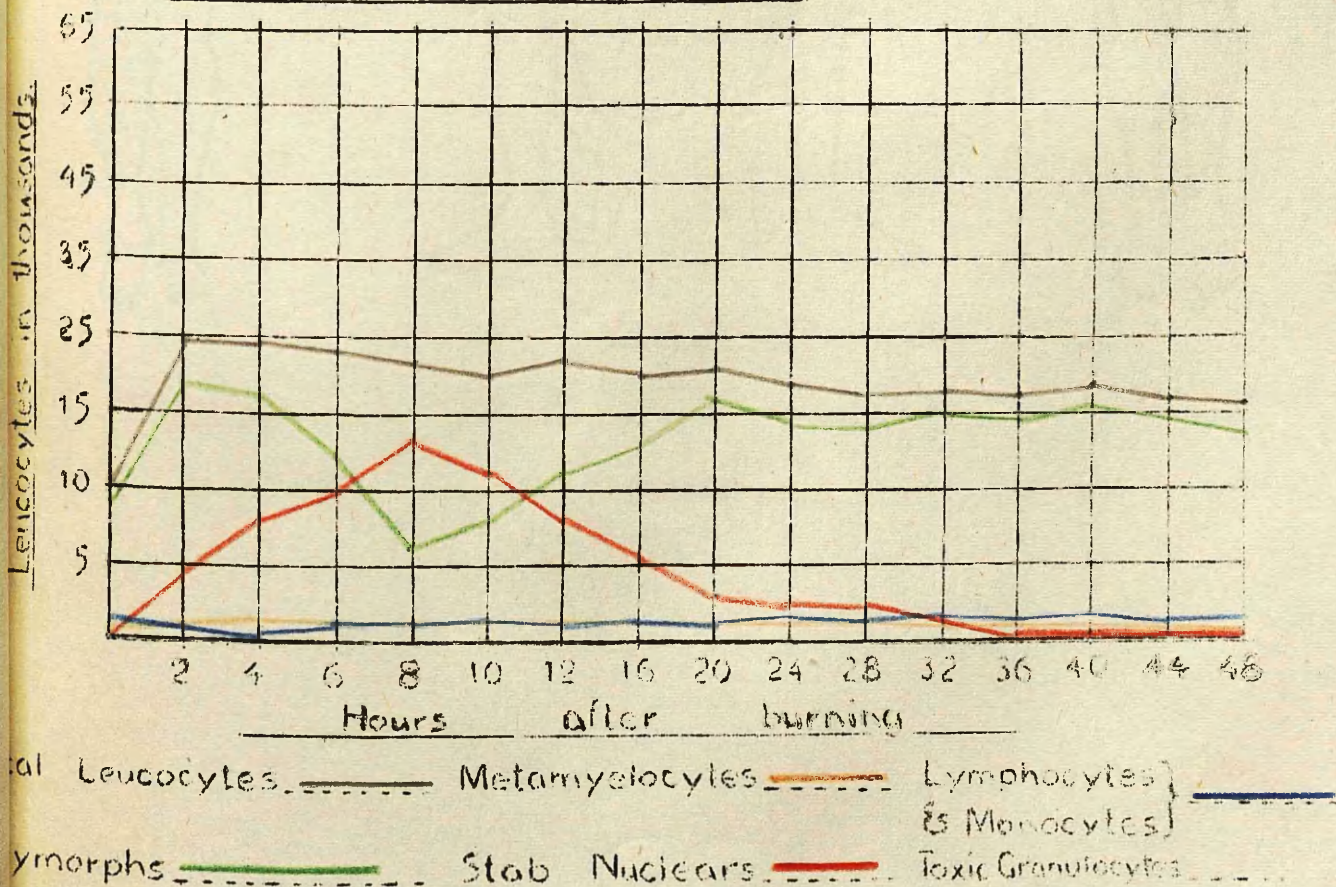
How sustained **Clothing caught fire.**

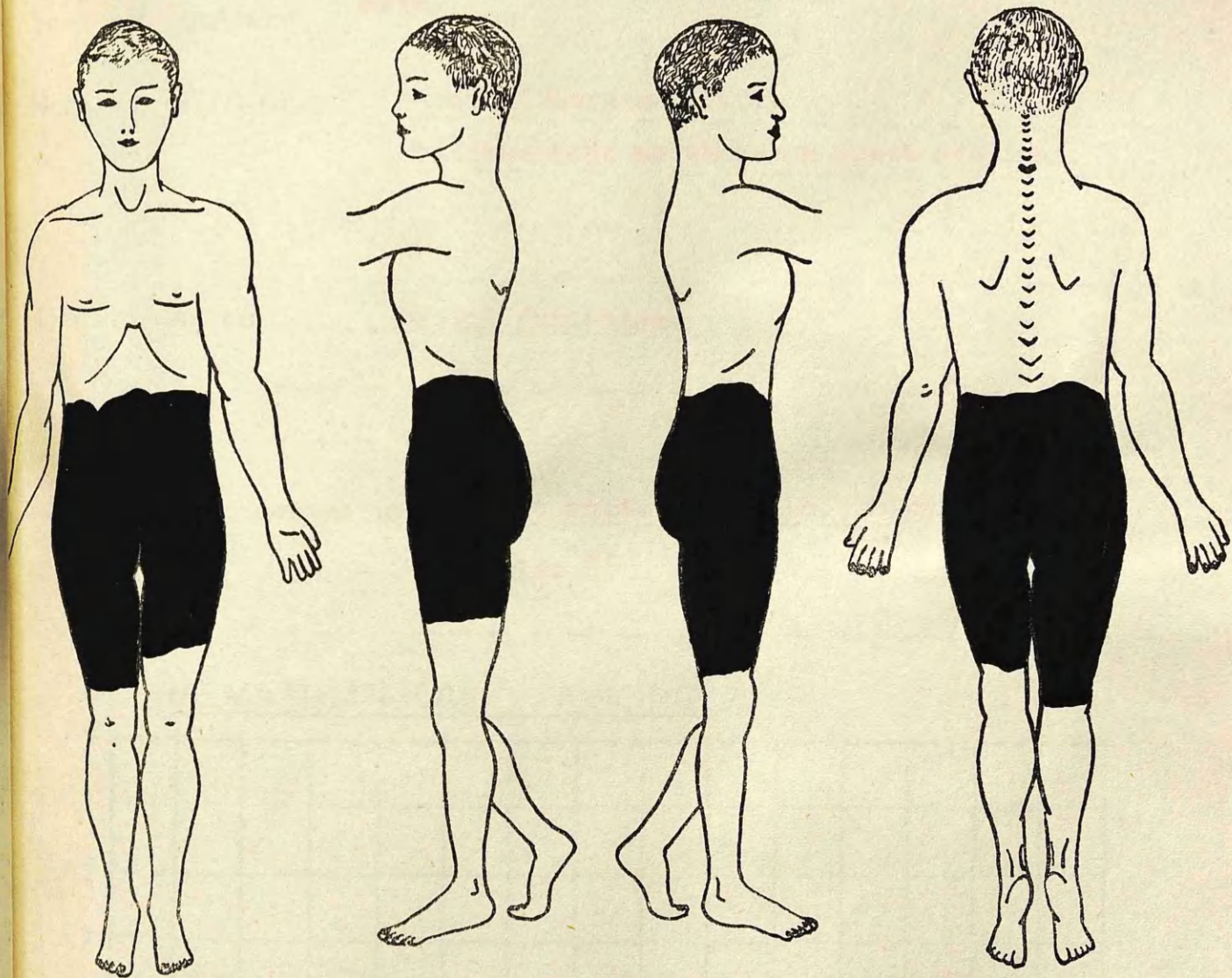
Condition on admission **Admitted forty minutes after injury. No**

**pain. Felt cold. Talkative. Temp. 99.0**

**Pulse 90**

HAEMATOLOGICAL FINDINGS





Case No. 39

TREATMENT

Tannic Acid

Age of patient 36 years.

Case No. 40

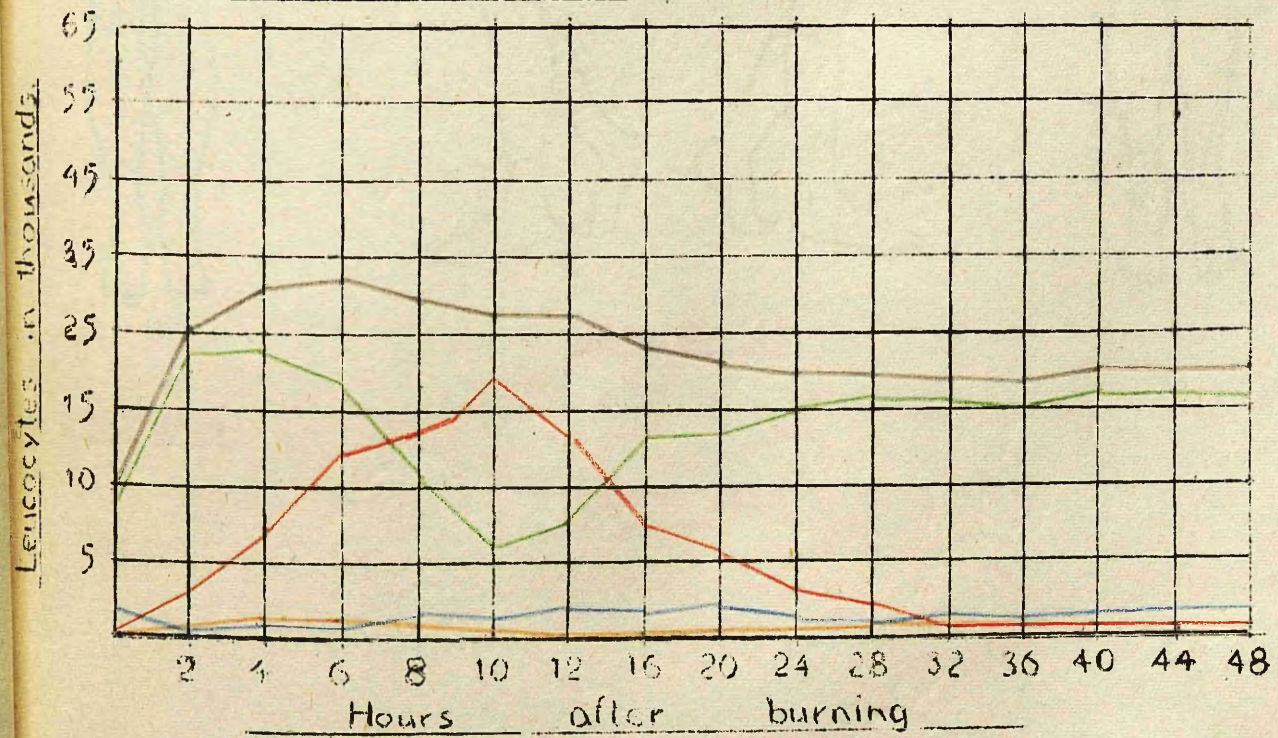
Sex of patient Male.

Nature of injuries Burns of arms and face.  
Distributions as shown on chart overleaf.

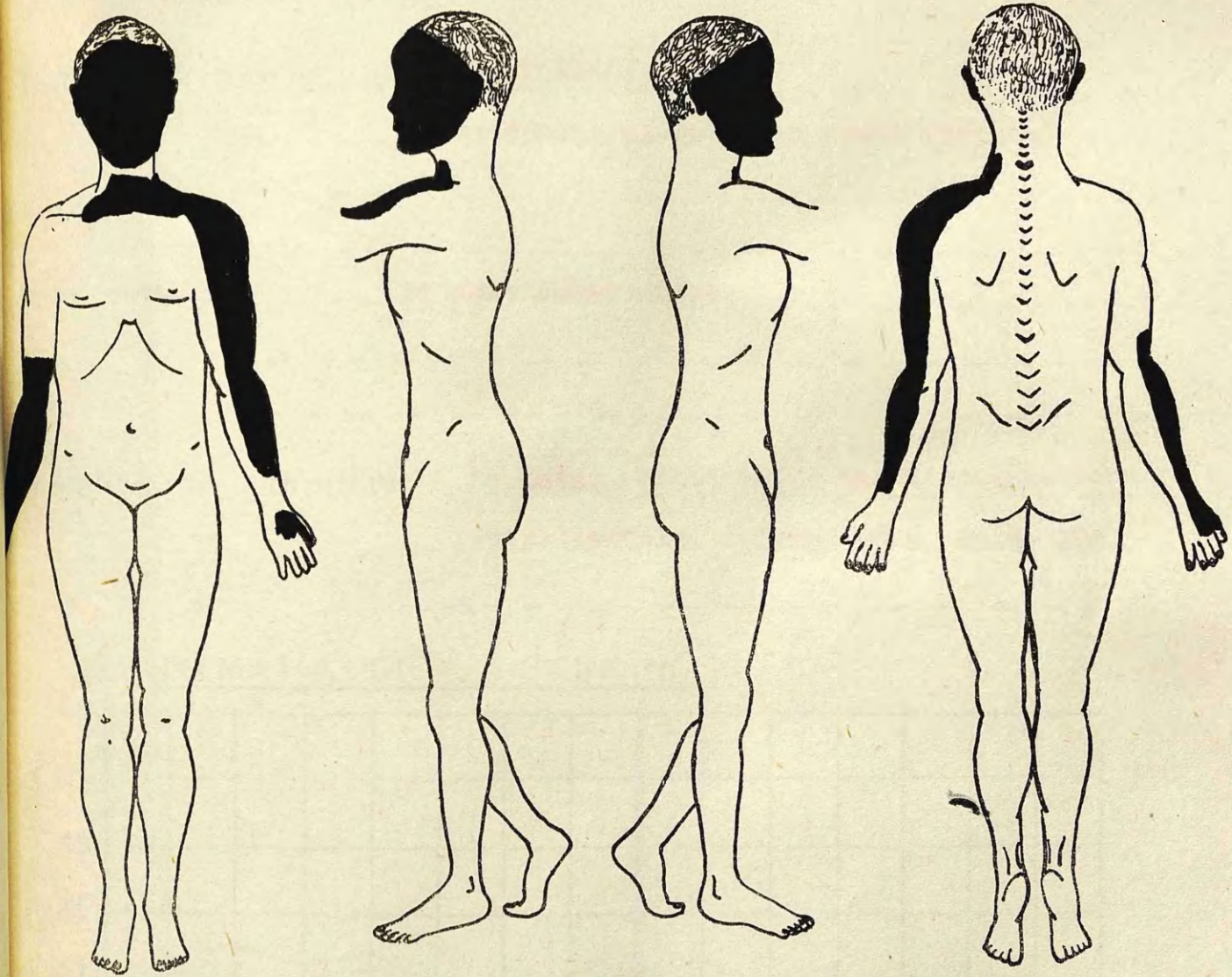
How sustained Petrol Explosion.

Condition on admission Felt cold. No pain. Temp. 97.4  
Pulse 86

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 Lymphomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_



Case No. 40

TREATMENT

Tannic Acid

Age of patient . 66 years .

Case No. 41

Sex of patient . Male

Nature of injuries . Burns of lower limbs.

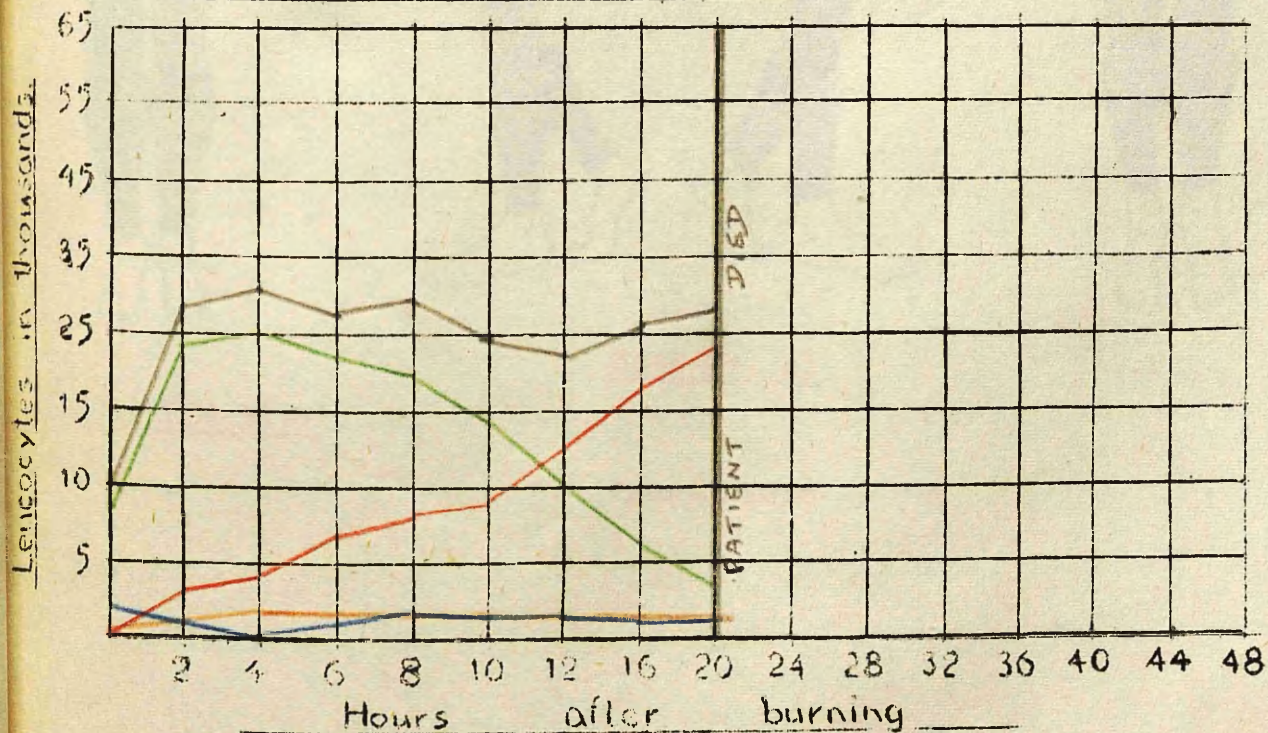
Distribution as shown on chart overleaf.

How sustained . Pyriamas caught fire.

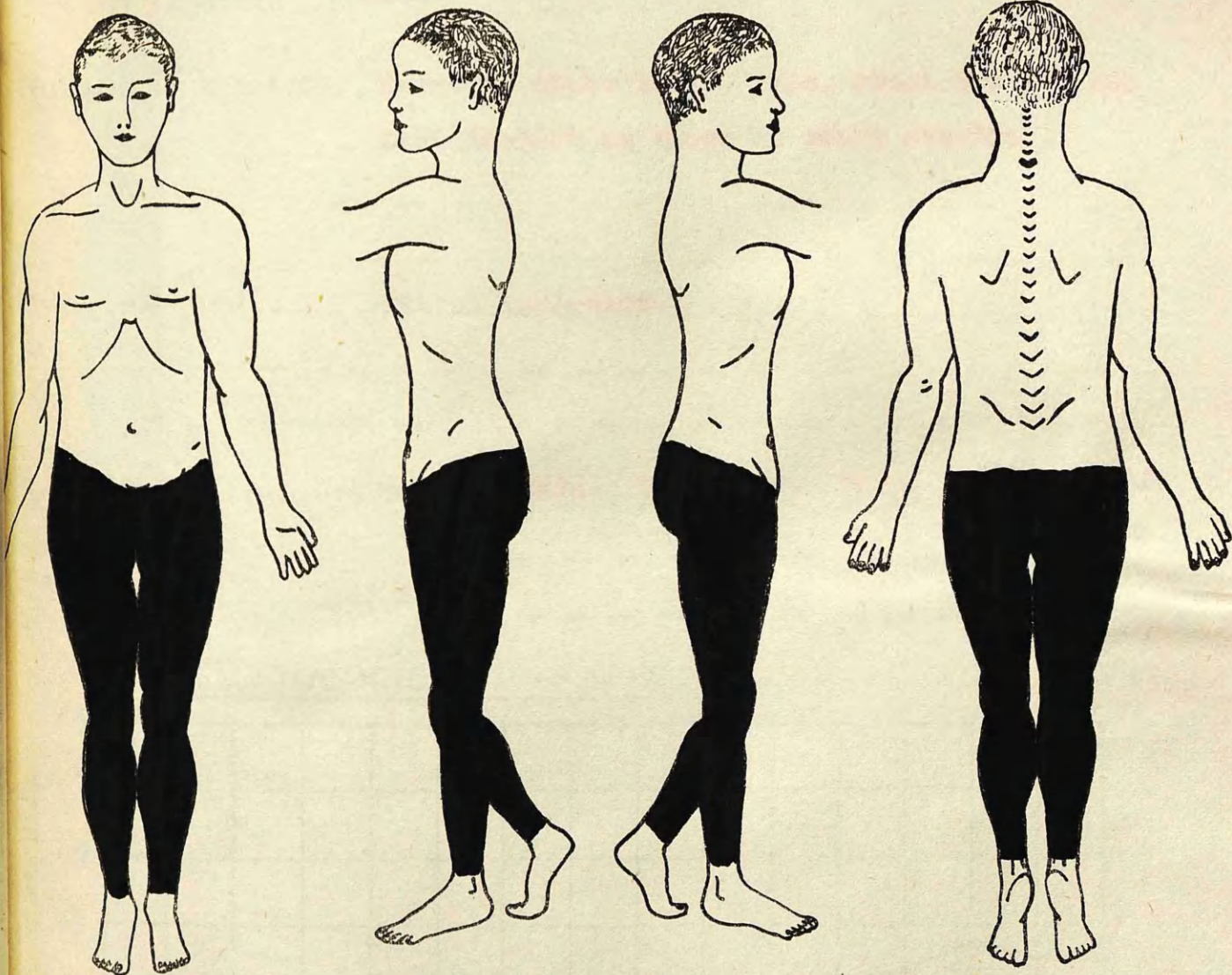
Condition on admission . No pain. Thirsty. Answered questions

intelligently. Temp. 98.6 Pulse 104

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Lymphorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 41

TREATMENT

Tannic Acid

Age of patient... **19 years**

Case No. 42

Sex of patient... **Male**

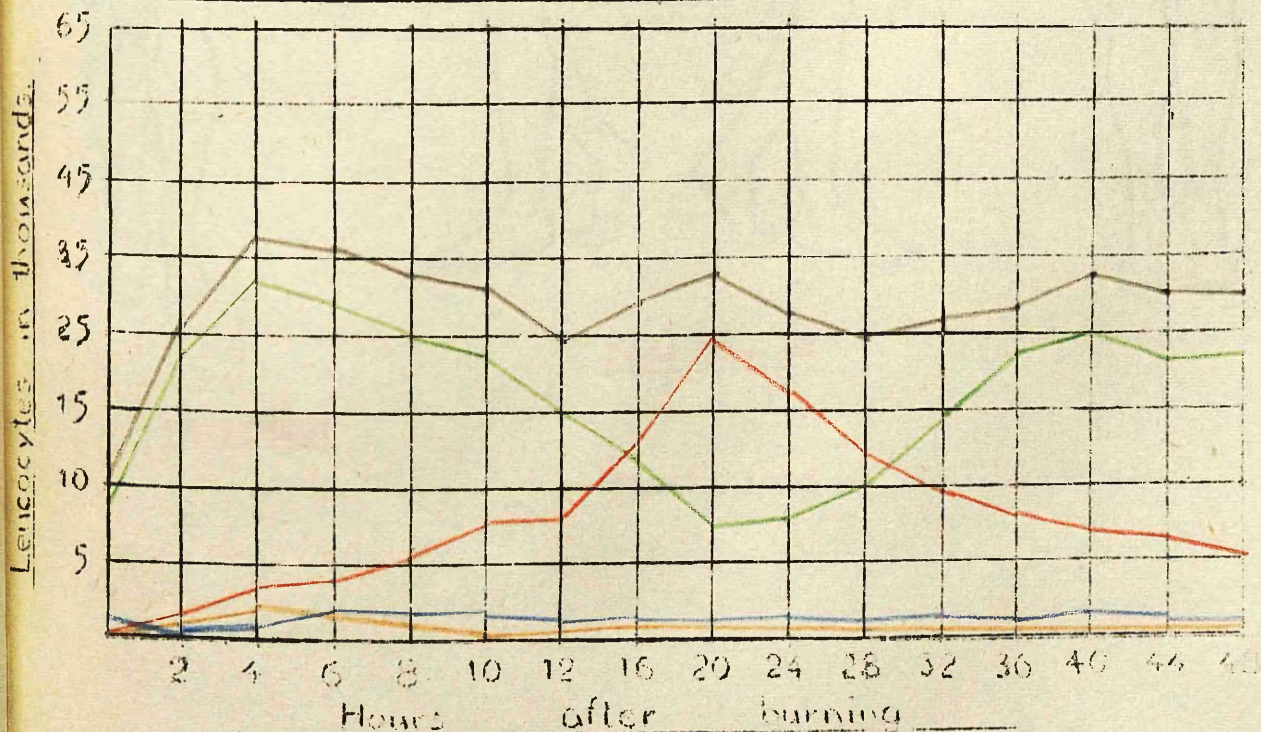
Nature of injuries... **Burns of upper limbs, face, chest and abdomen**

**Distribution as shown on chart overleaf.**

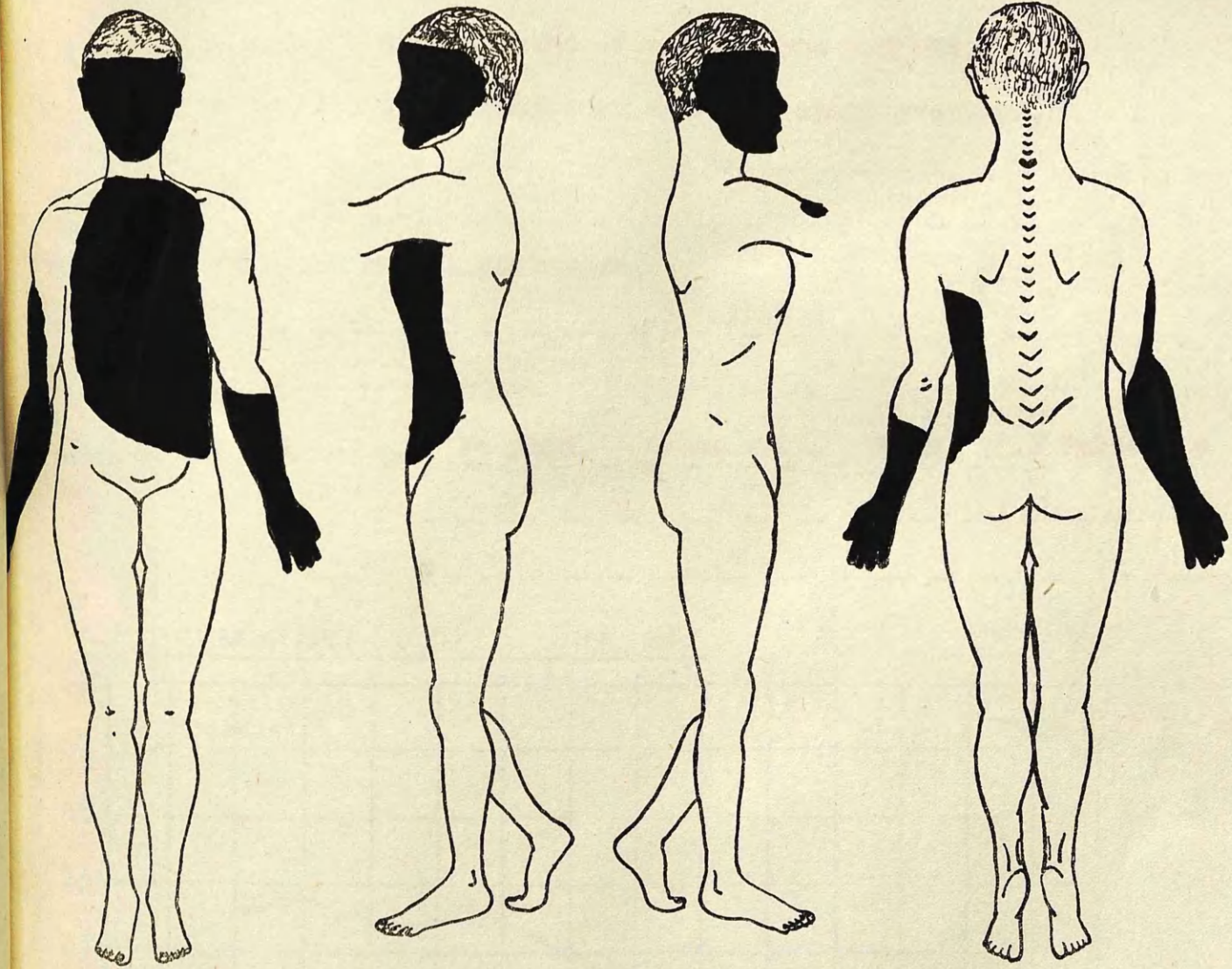
How sustained... **Petrol explosion.**

Condition on admission... **No pain. Talkative. Temp. 100 Pulse 120**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
( & Monocytes )  
Lymphomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 42

TREATMENT

Tannic Acid

Age of patient **36 years**

Case No. **43**

Sex of patient **Male**

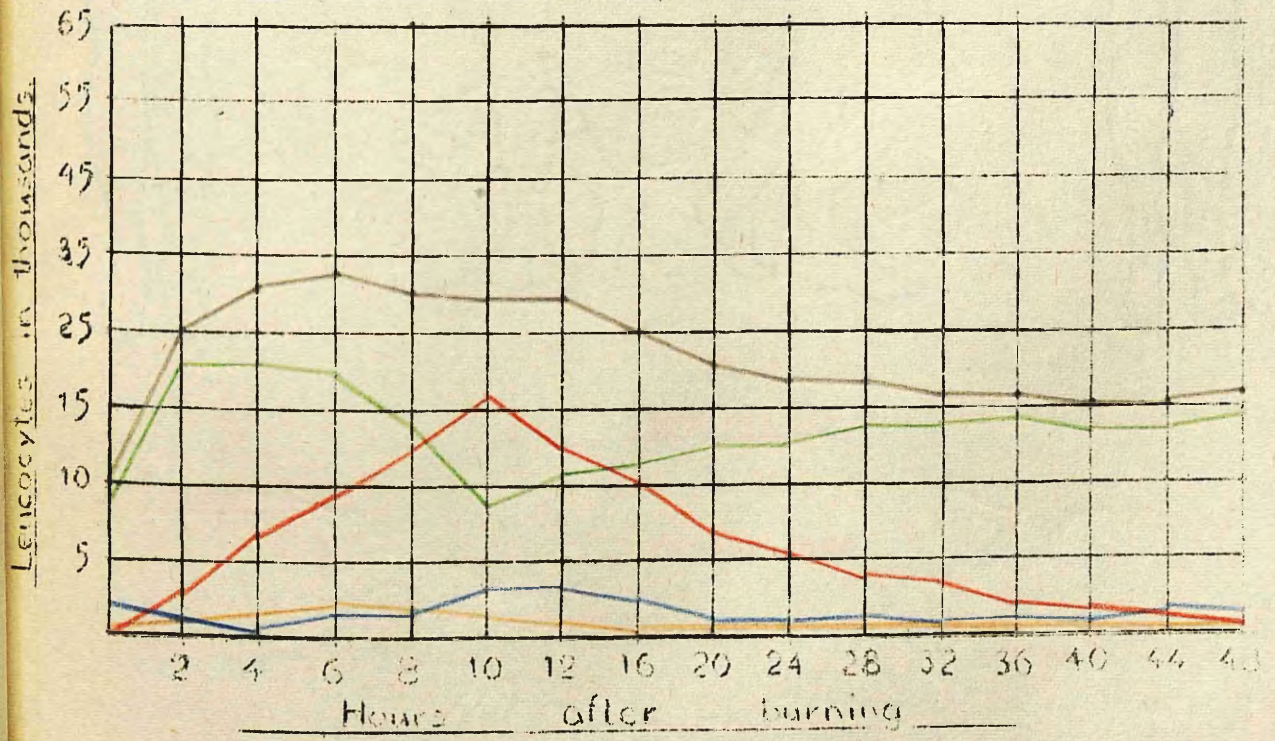
Nature of injuries **Severe burns of upper limbs and chest.**

**- Distribution as shown on chart overleaf.**

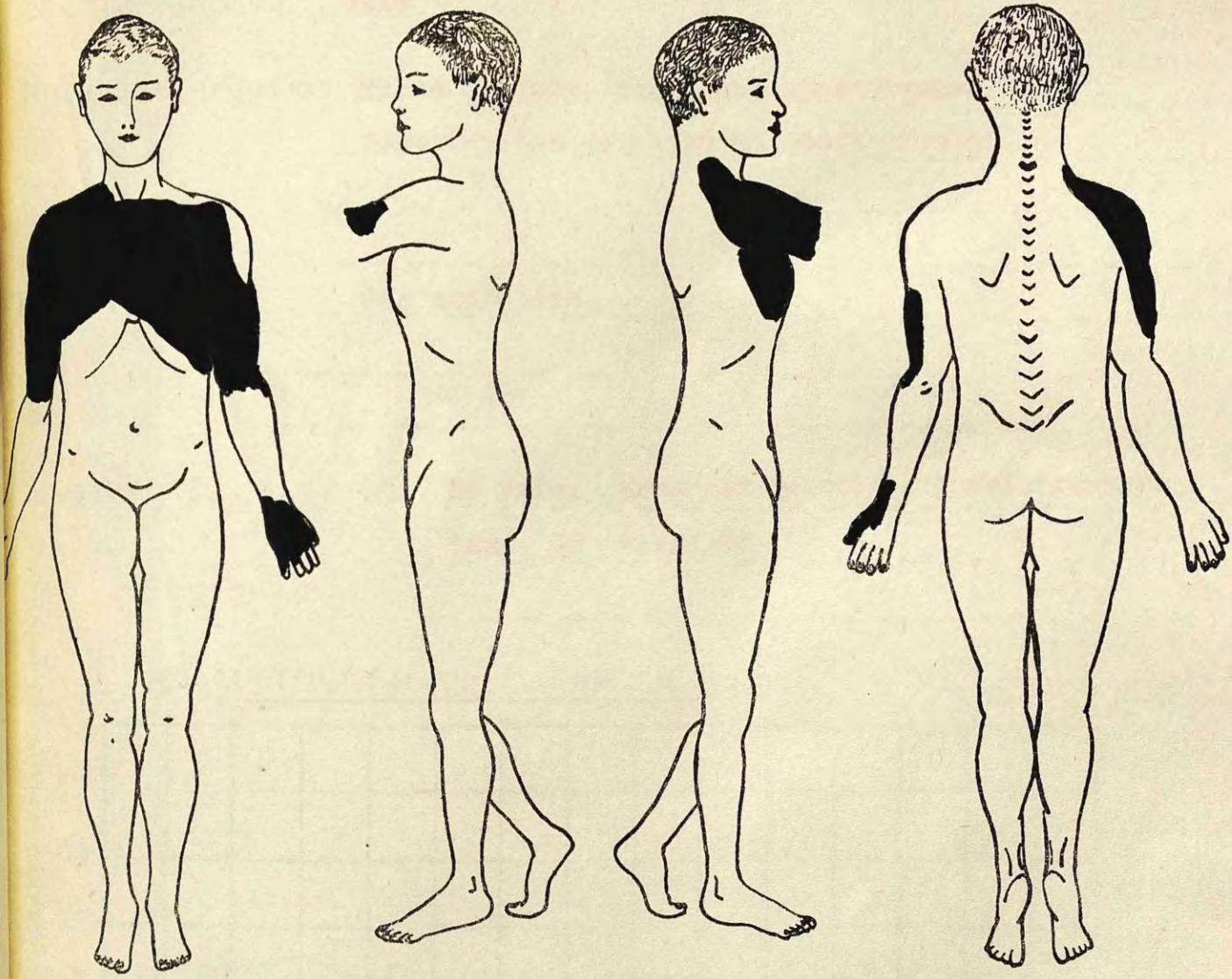
How sustained **Petrol explosion.**

Condition on admission **No pain. Feels well. Temp. 98.6 Pulse 100**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
Myelocytes \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ & Monocytes }  
Lymphorphs \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 43

TREATMENT

Tannic Acid

Age of patient... **50 years**...

Case No. **44**...

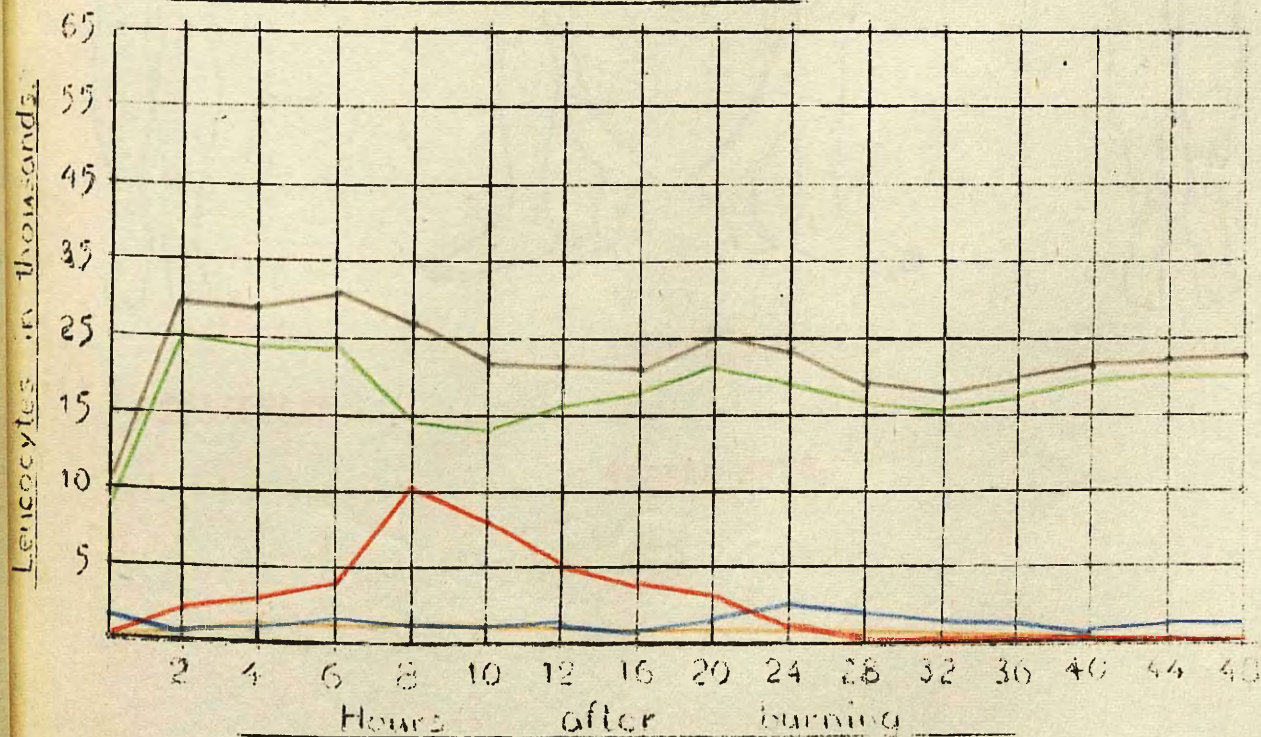
Sex of patient... **Male**...

Nature of injuries... **Burns of face, chest and upper limbs.**  
**distribution as shown on chart overlaf.**

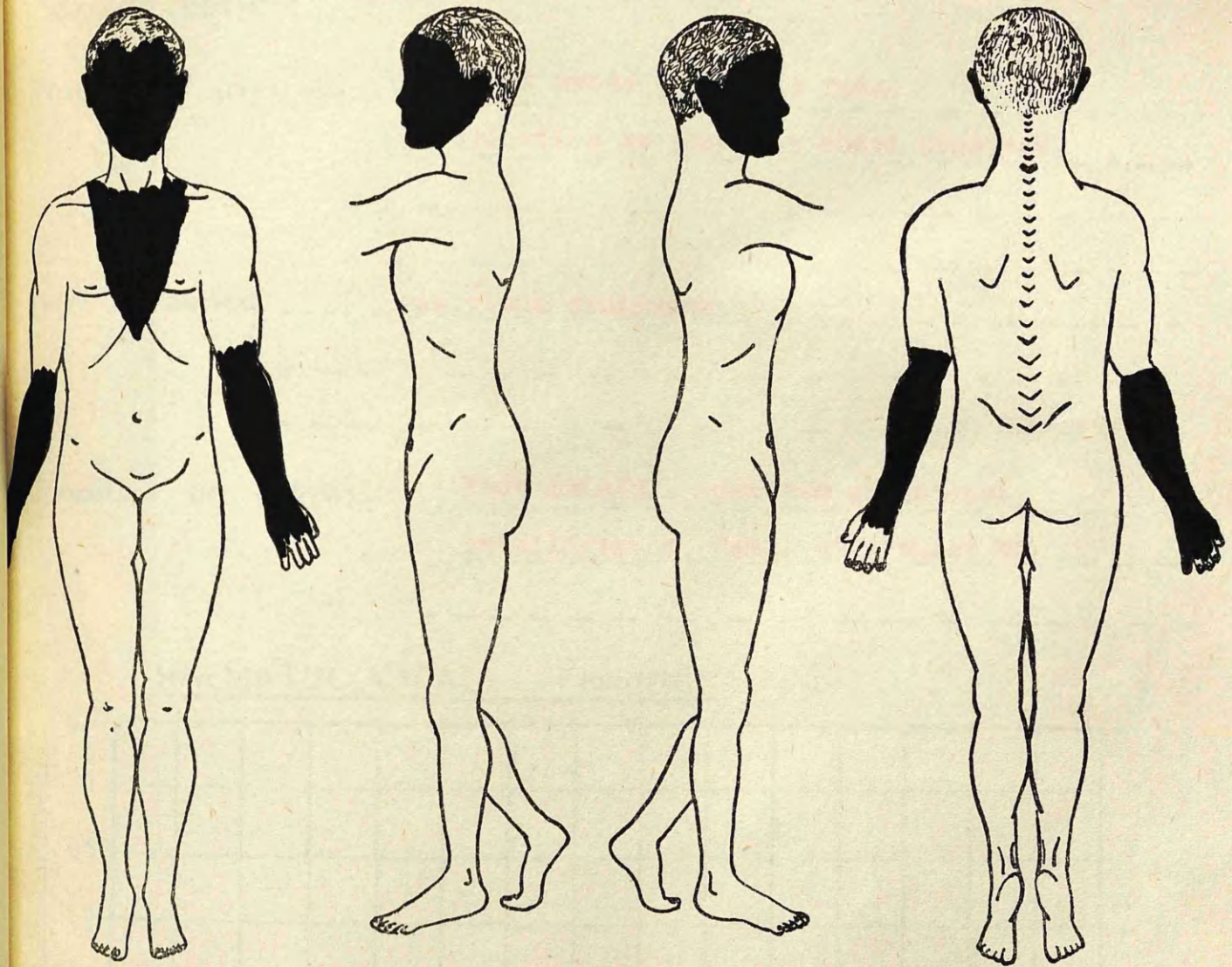
How sustained... **Gas explosion.**

Condition on admission... **No pain. Answered questions intelligently.**  
**Temp. 99 Pulse 90**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Myelomorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 44

TREATMENT

Tannic Acid.

Age of patient **16 years.**

Case No. **15**

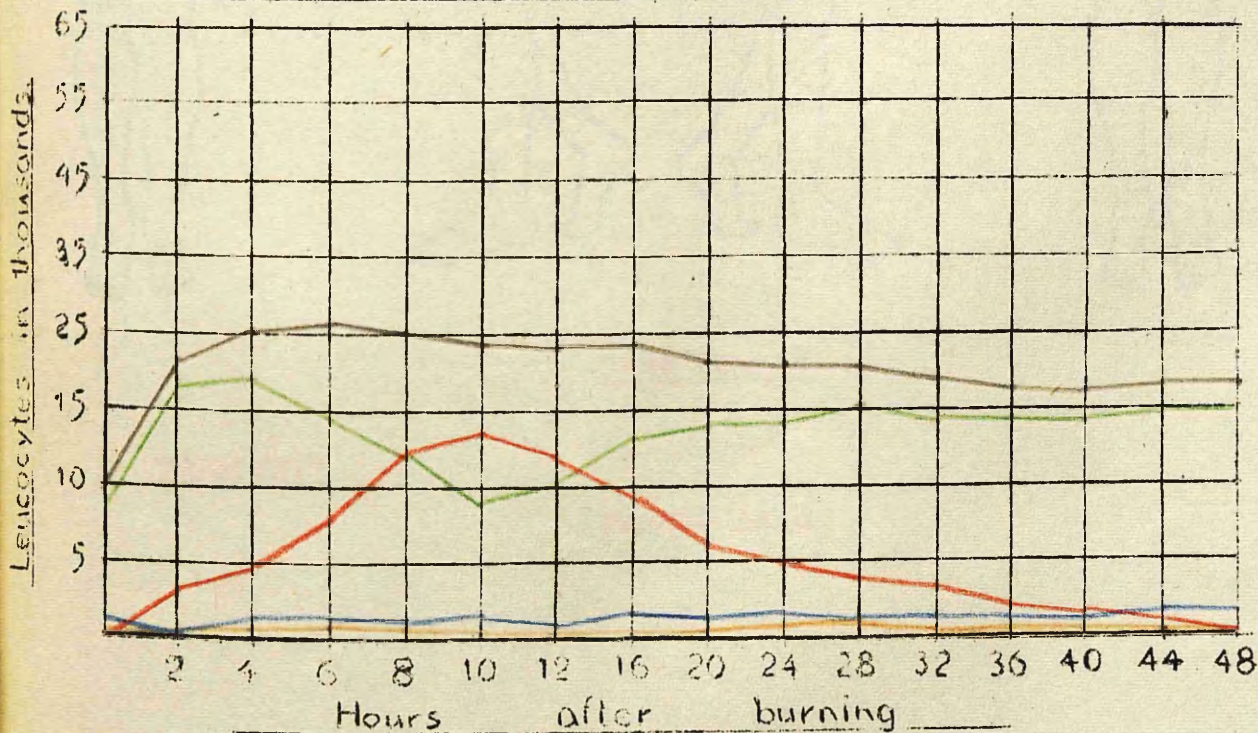
Sex of patient **Male.**

Nature of injuries **Burns of upper limbs and face.**  
**distribution as shown on chart overleaf.**

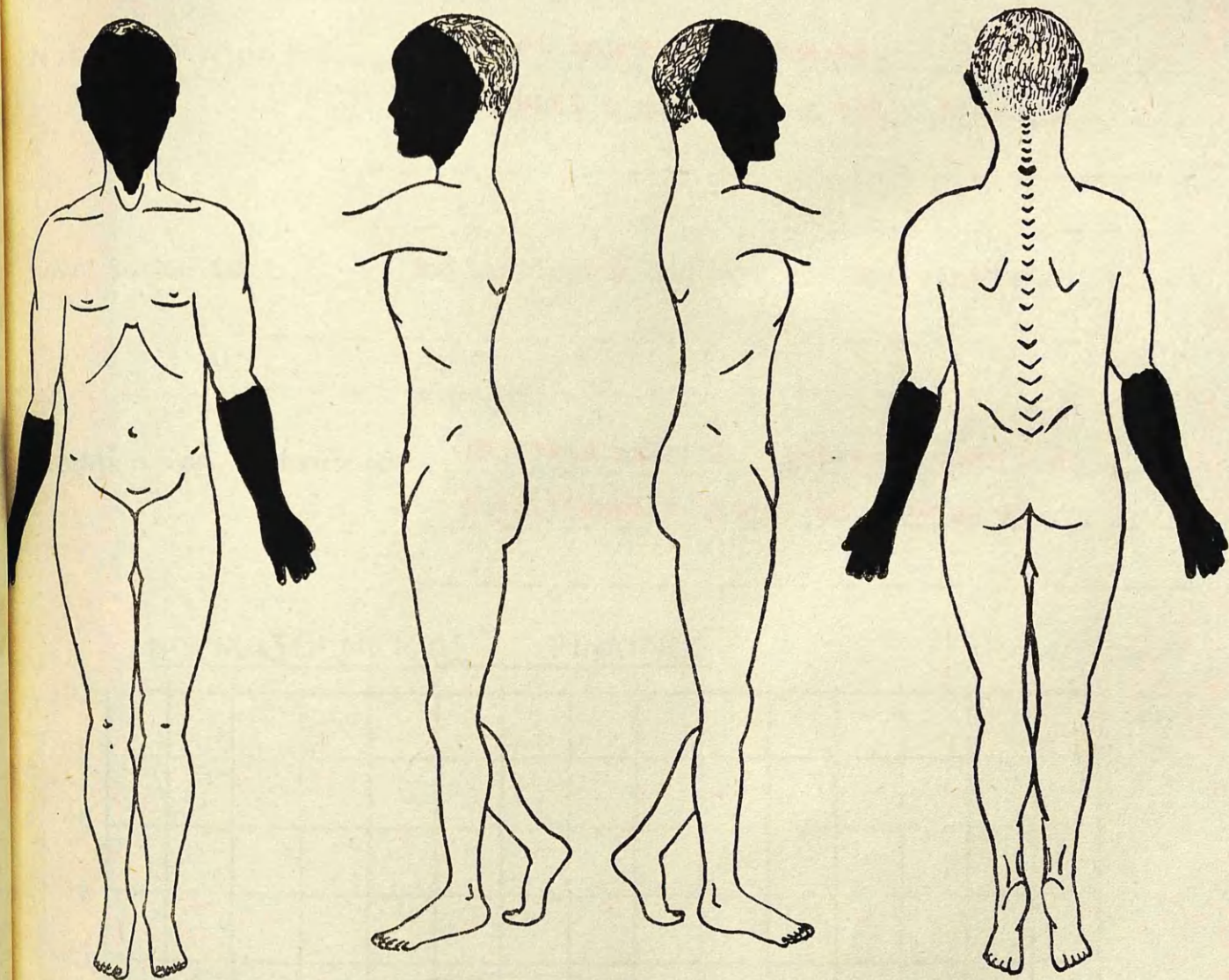
How sustained **Acetylene explosion.**

Condition on admission **Face painful. Answered questions**  
**intelligently. Temp. 99.3 pulse 90**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 45

TREATMENT

Tannic Acid

Age of patient **33 years.**

Case No. **46**

Sex of patient **Male.**

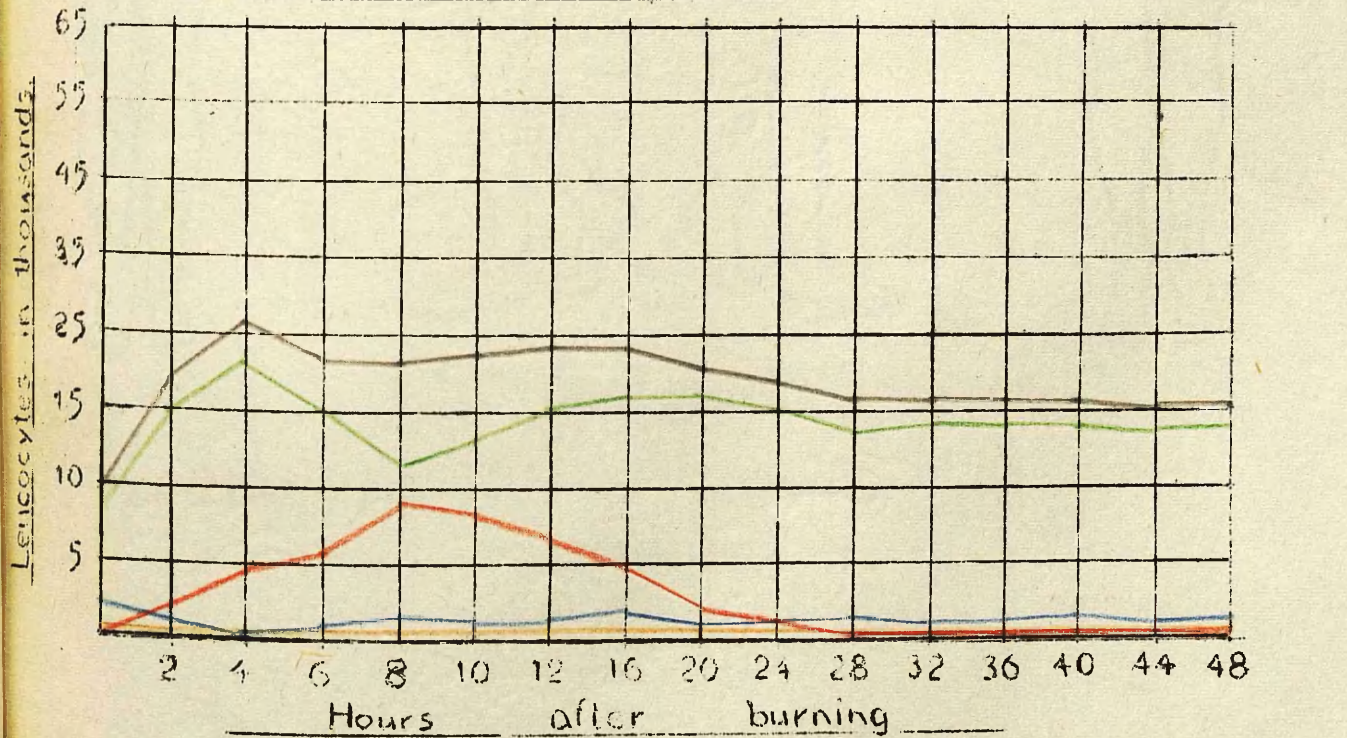
Nature of injuries **Burns of hands and forearms.**

**Distribution as shown on chart overleaf.**

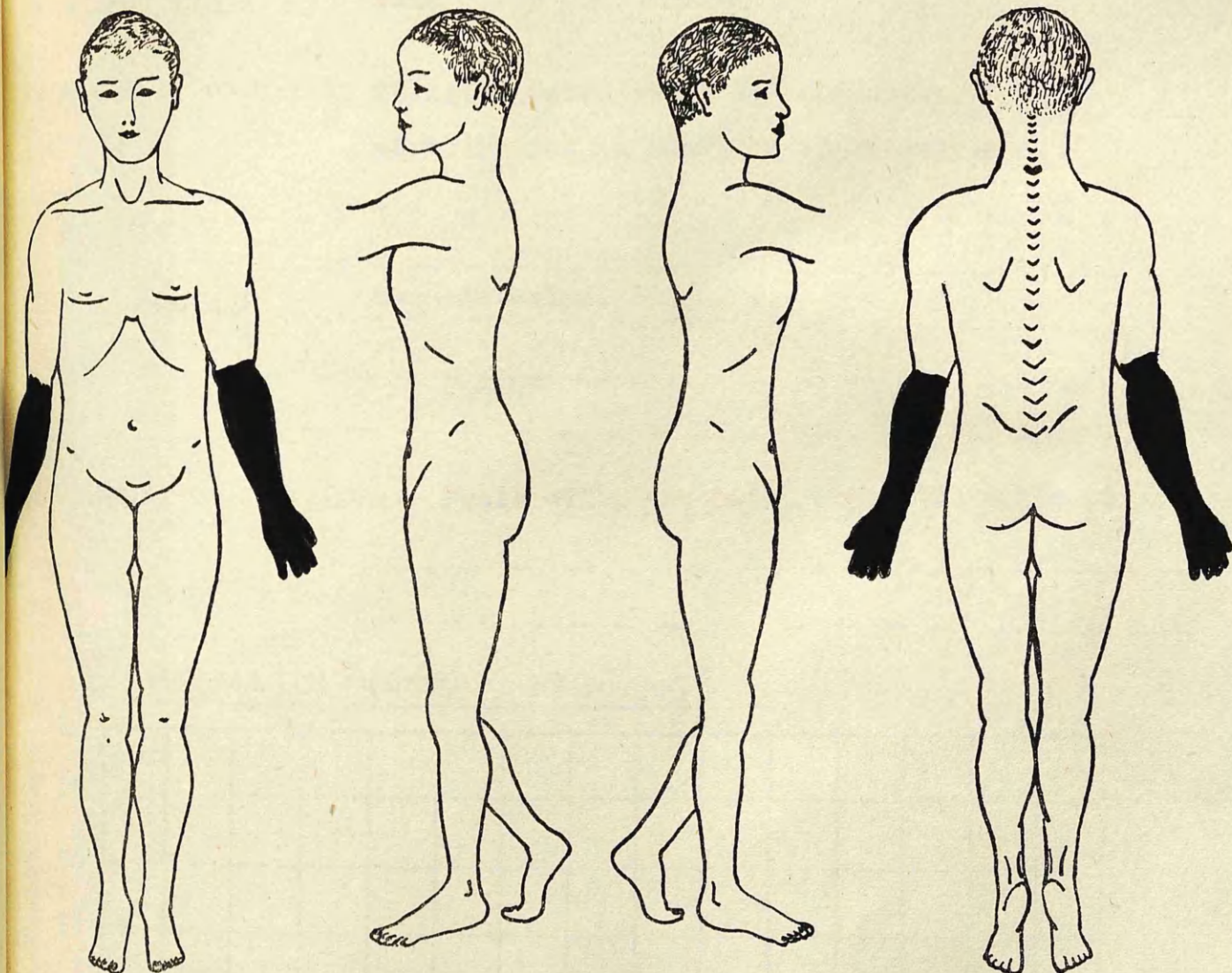
How sustained **Extinguishing child's burning clothes.**

Condition on admission **Injuries painful. Answered questions intelligently. Temp. 98.4 pulse 82**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Lymphomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 46

TREATMENT

Tannic Acid

Age of patient **42 years.**

Case No. **47**

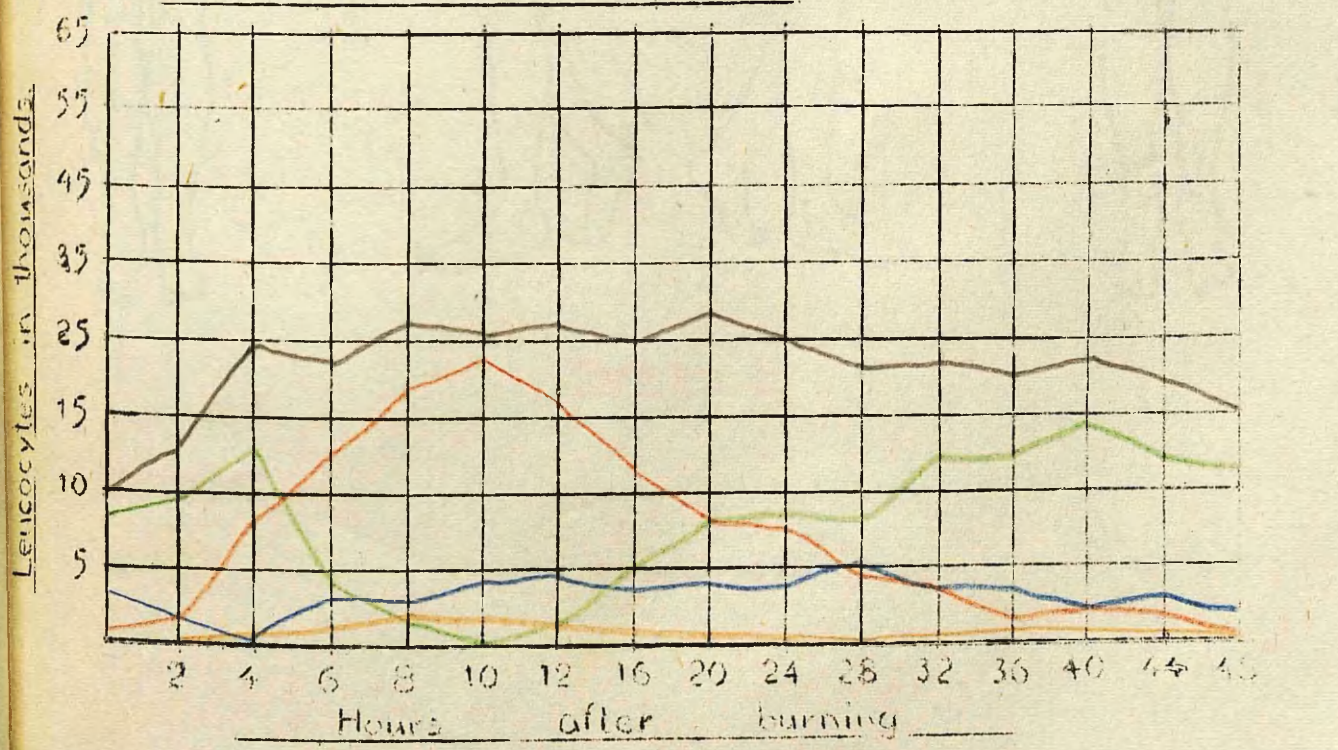
Sex of patient **Male**

Nature of injuries **Burns of face, right arm and chest.**  
**— distribution as shown on chart overleaf.**

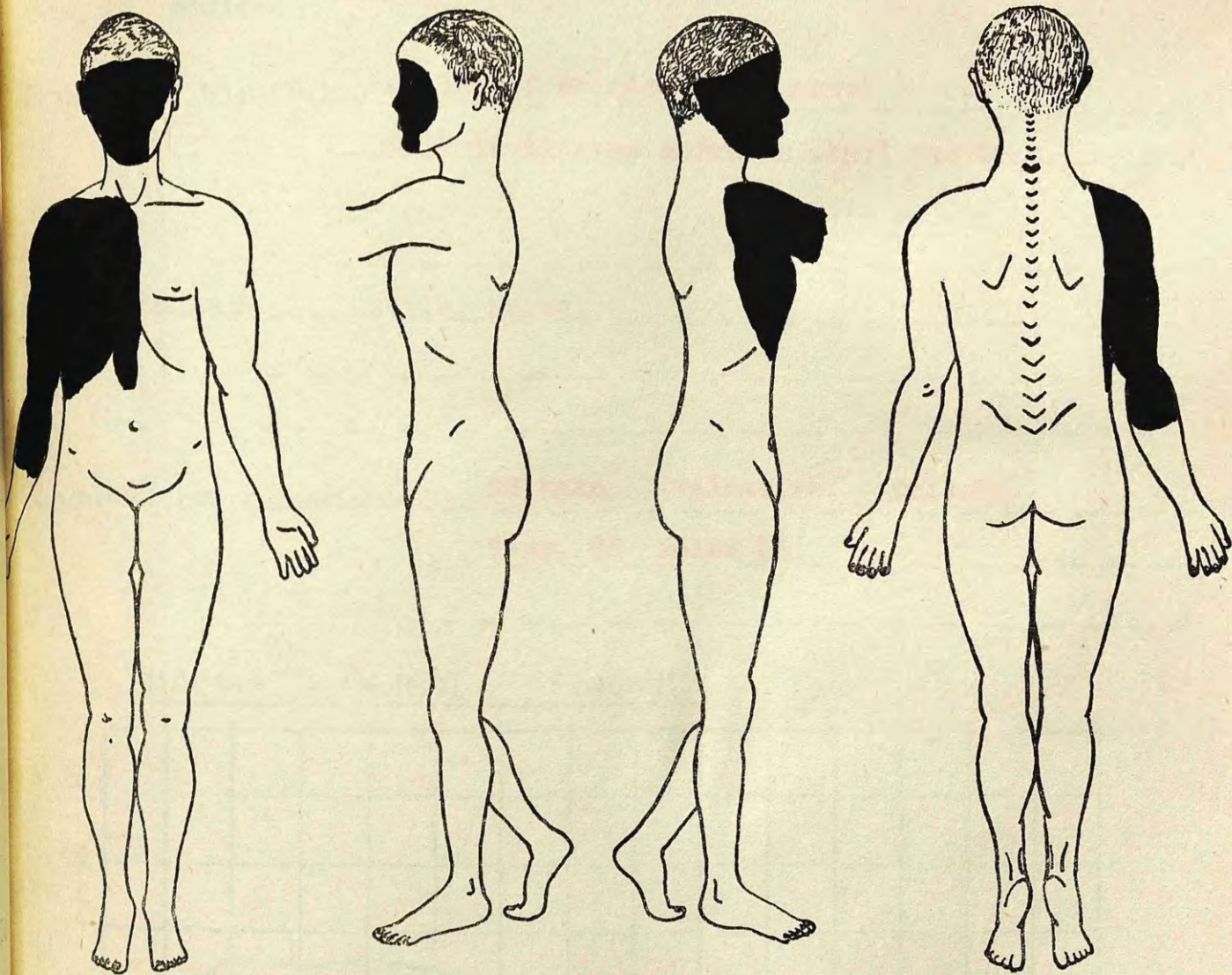
How sustained **Gas explosion.**

Condition on admission **Feels well. No pain. Temp. 98 Pulse 96**

HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes & Monocytes ———  
 Lymphorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 47

TREATMENT

Tannic Acid

Age of patient 44 years.

Case No. 48

Sex of patient Male.

Nature of injuries Scalds of shoulders and chest.

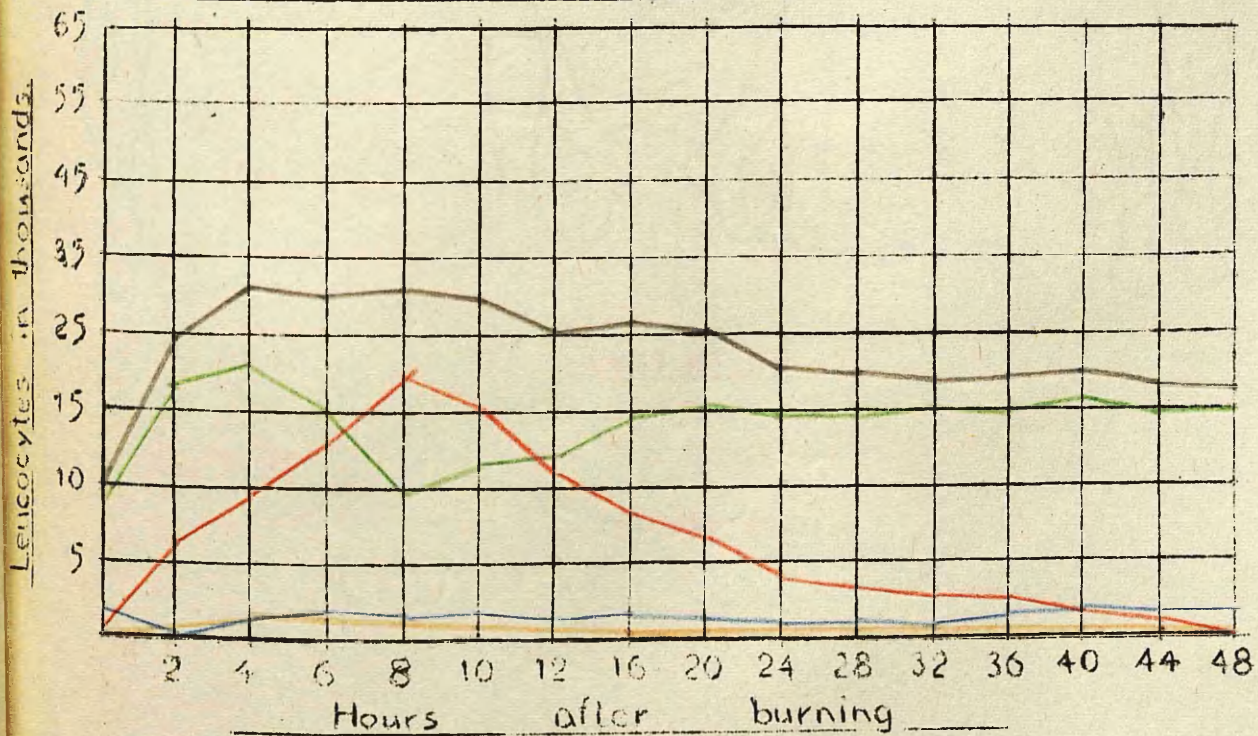
distribution as shown on chart overleaf.

How sustained Boiler burst.

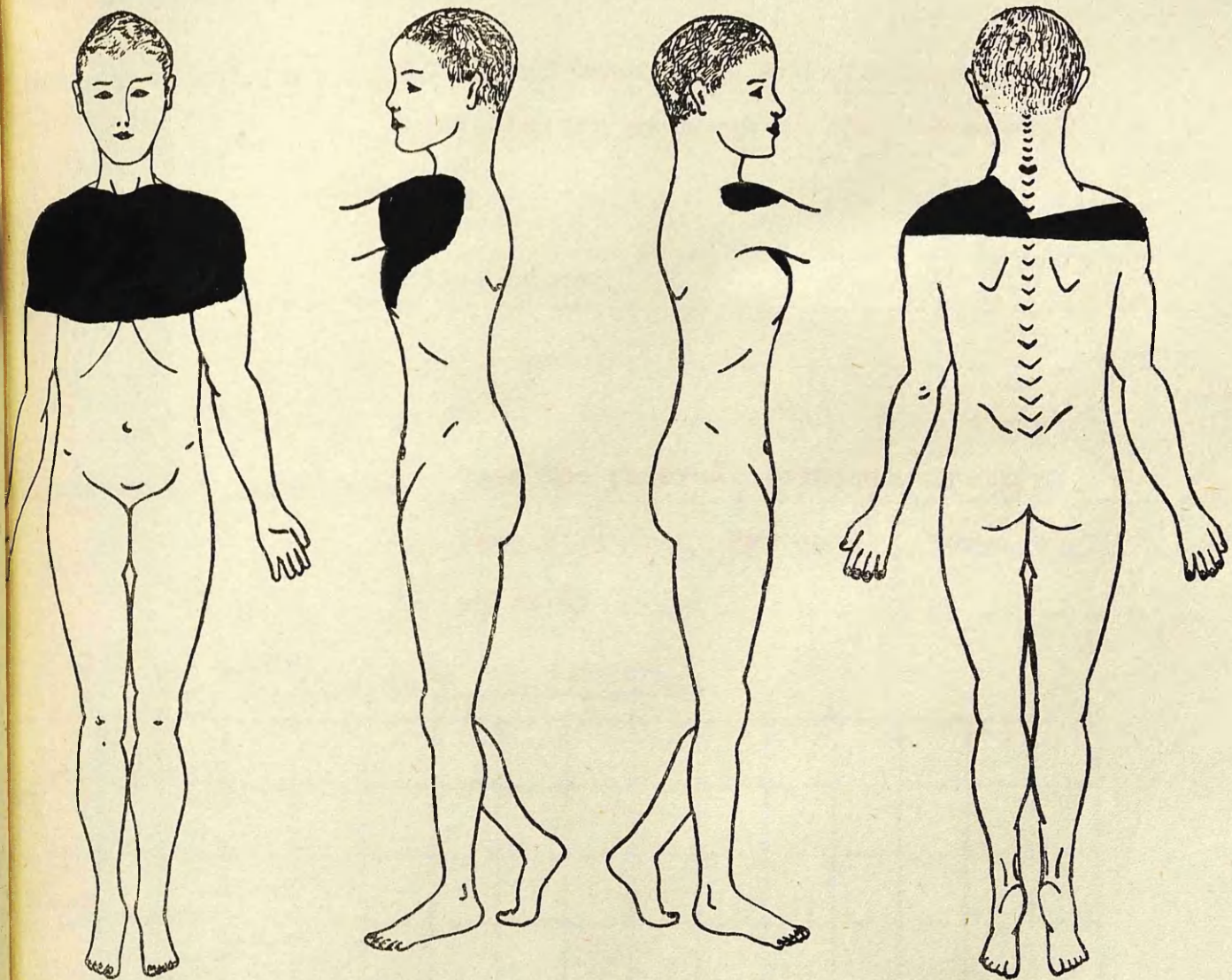
Condition on admission No pain. Talkative. Thirsty.

Temp. 98 Pulse 84

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Myelocytes \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_

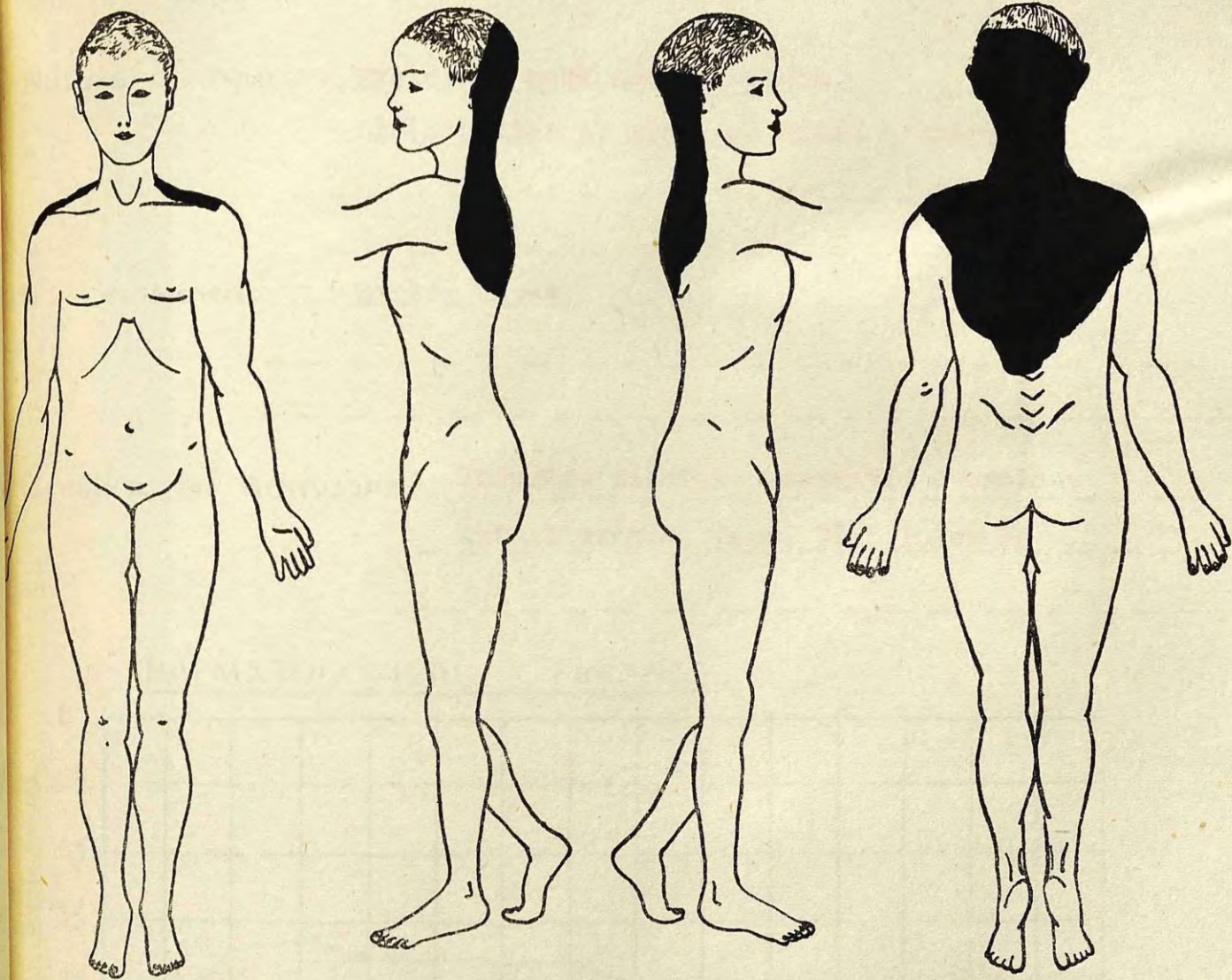


Case No. 48

TREATMENT

Tannic Acid





Case No. 49

TREATMENT

Tannic Acid

Age of patient 37 years.

Case No. 50

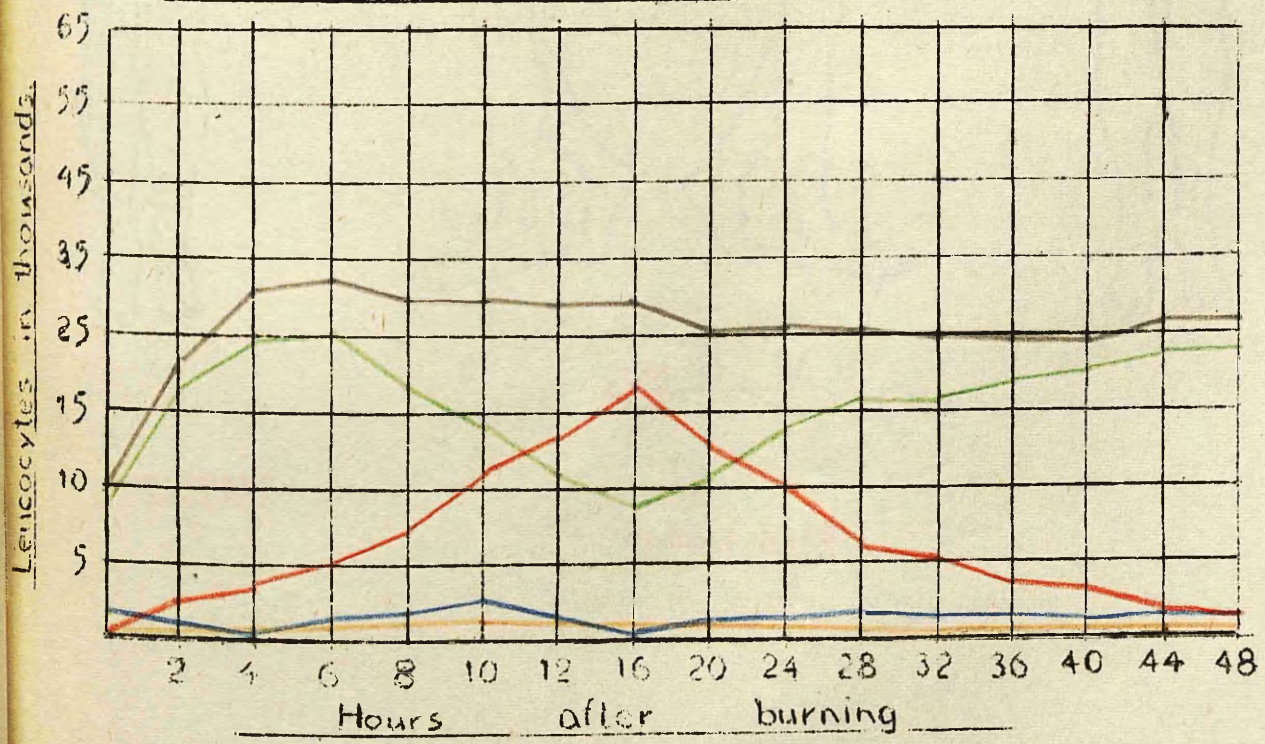
Sex of patient Male.

Nature of injuries Scalds of back and shoulders.  
Distribution as shown on chart overleaf.

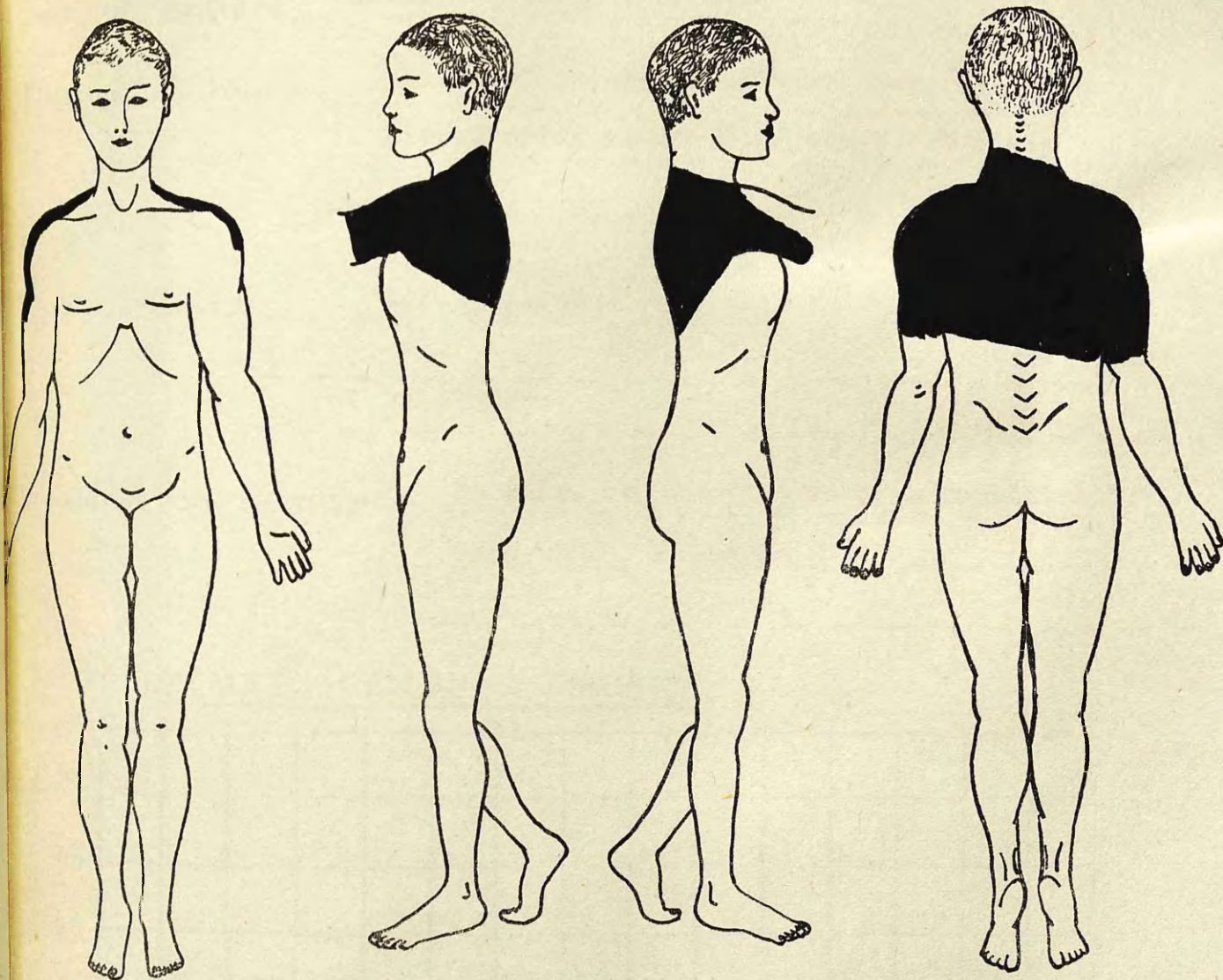
How sustained Boiler burst.

Condition on admission Injuries painful. Answered questions  
intelligently. Temp. 98.6 Pulse 80

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Lymphorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 50

TREATMENT

Tannic Acid

Age of patient 50 years.

Case No. 51

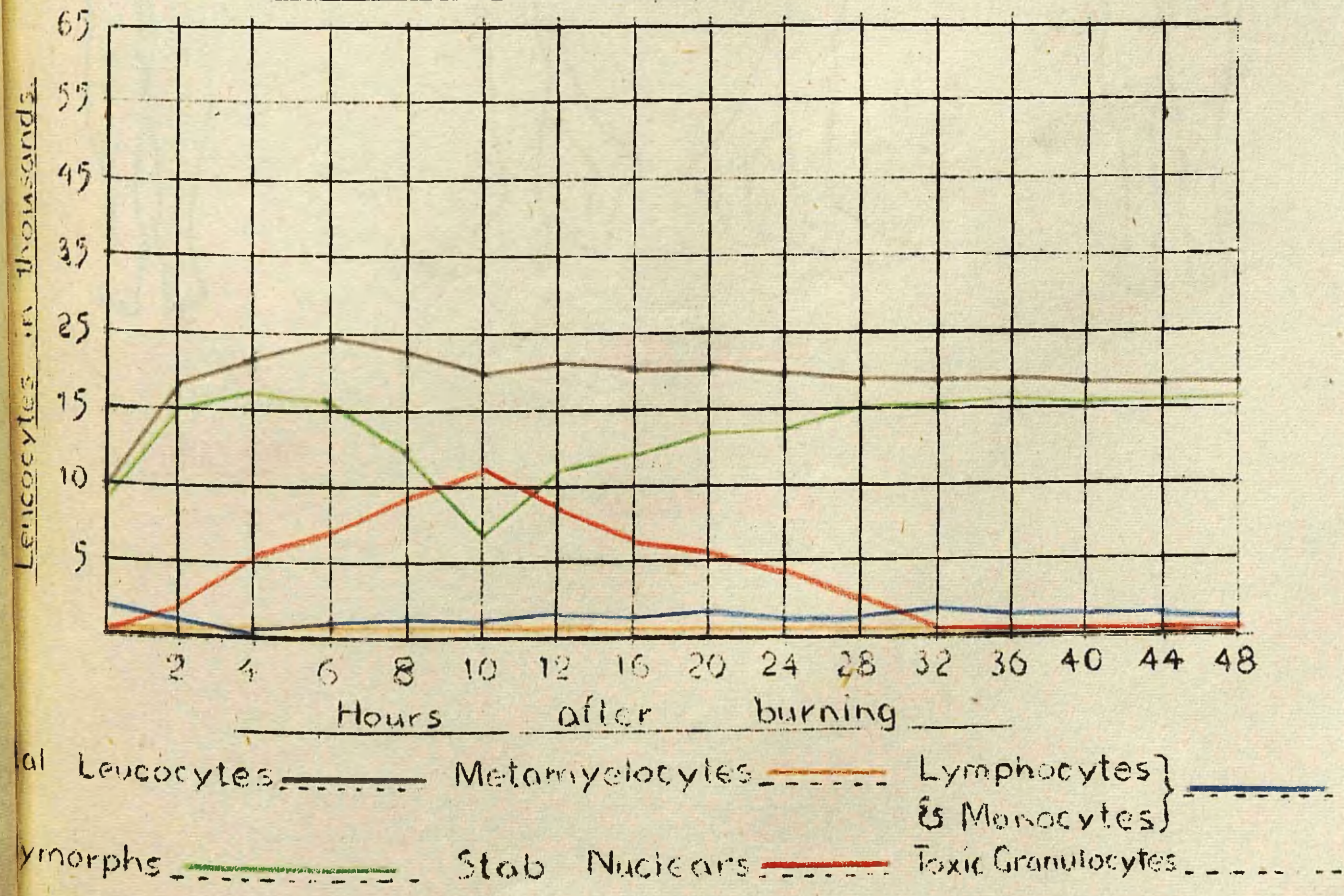
Sex of patient Male.

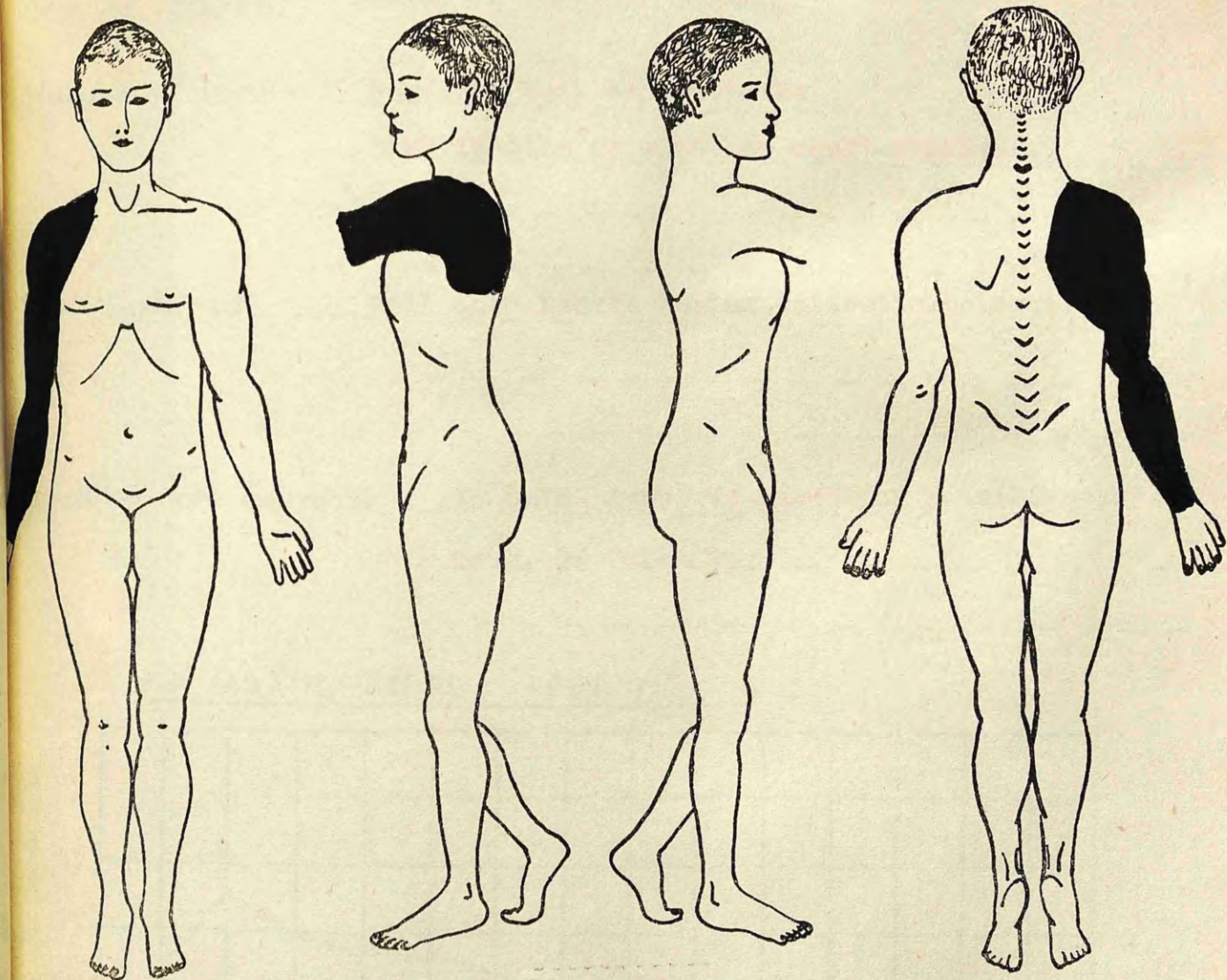
Nature of injuries Scalds of shoulder and right arm.  
Distribution as shown on chart overleaf.

How sustained Boiler burst.

Condition on admission No pain. Answered questions intelligently.  
Temp. 98.4 Pulse 92

### HAEMATOLOGICAL FINDINGS



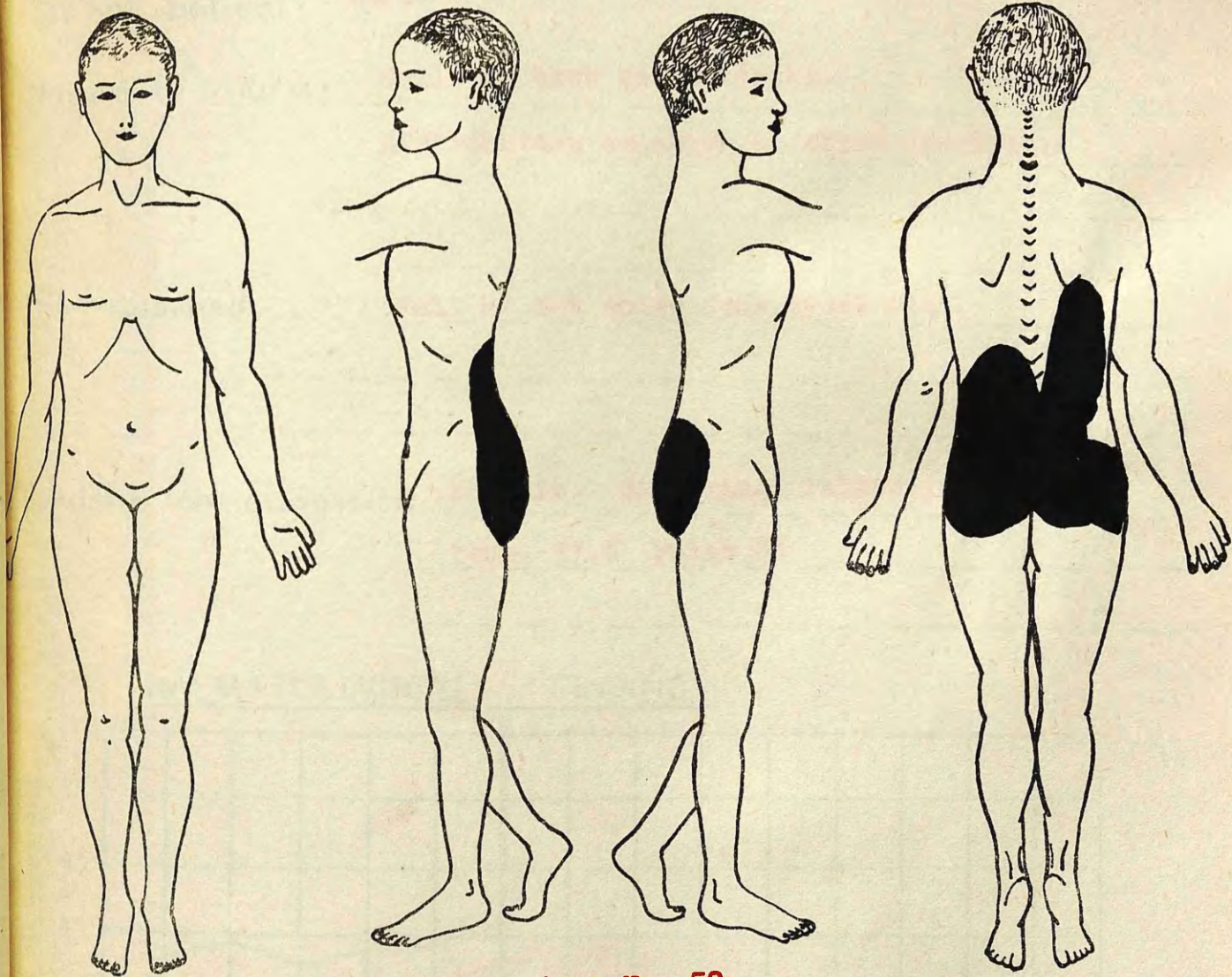


Case No. 51

TREATMENT

Tannic Acid





Case No. 52

TREATMENT

Tannic Acid

Age of patient **38 years.**

Case No. 53

Sex of patient **Male.**

Nature of injuries **Scald of back and buttocks.**

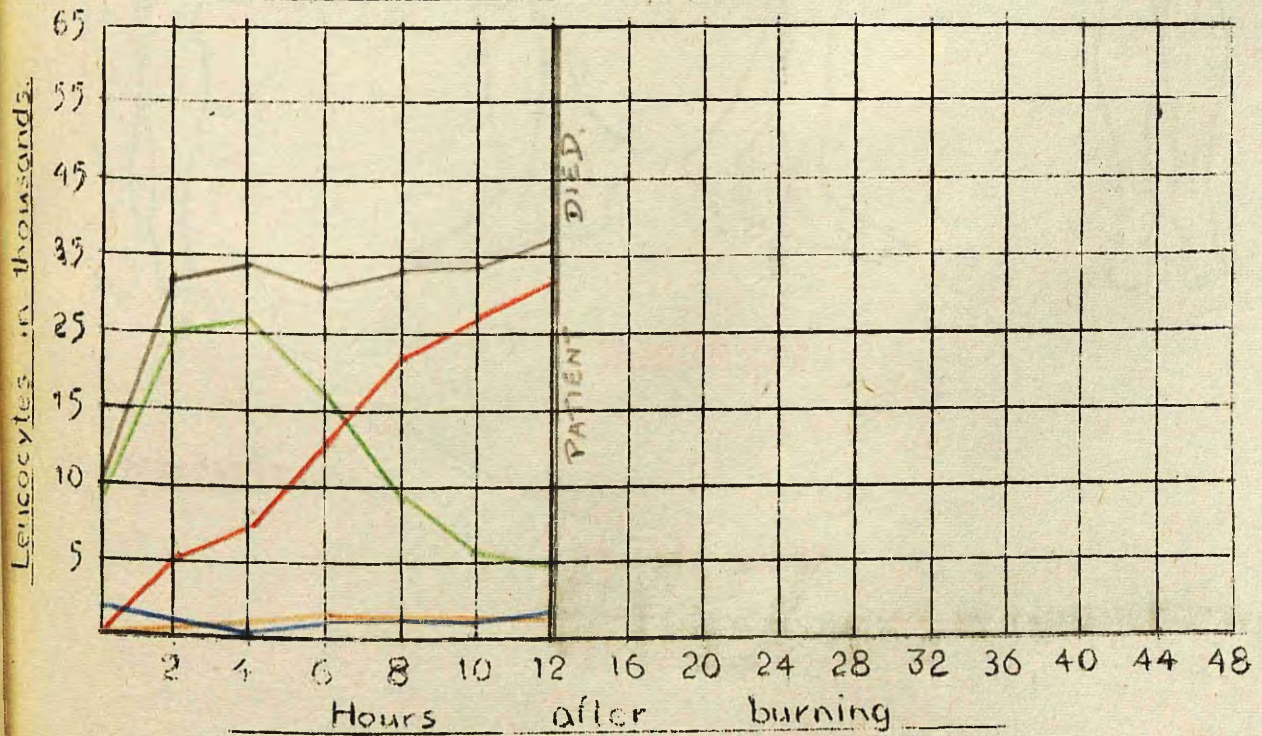
distribution as shown on chart overleaf.

How sustained **Fall of hot scale from steel mill.**

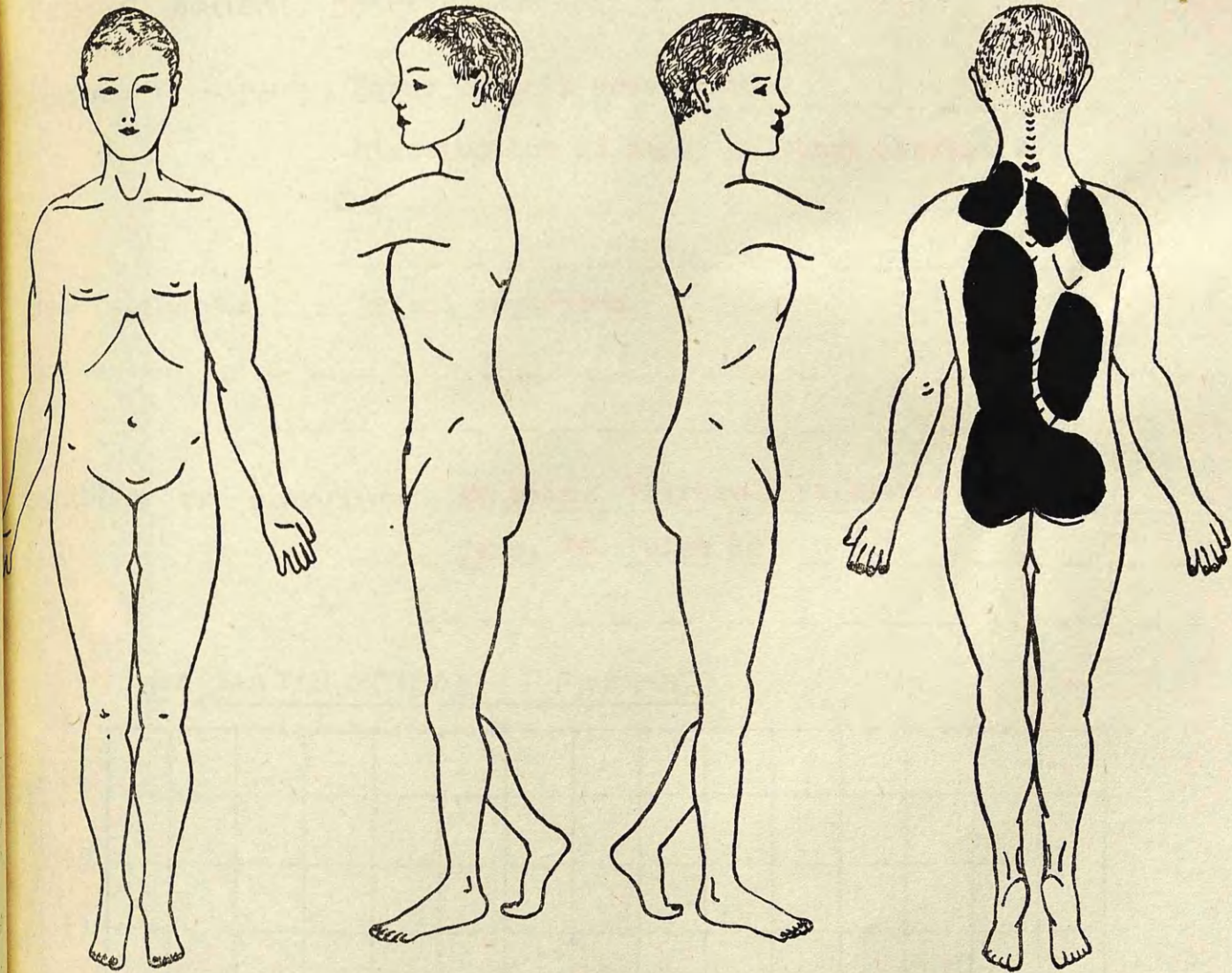
Condition on admission **No pain. Shivering. Talkative.**

Temp. 97.6 Pulse 88

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Myelomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 53

TREATMENT

Tannic Acid

Age of patient **17 years**

Case No. **54**

Sex of patient **Male**

Nature of injuries **Burns of both upper limbs.**

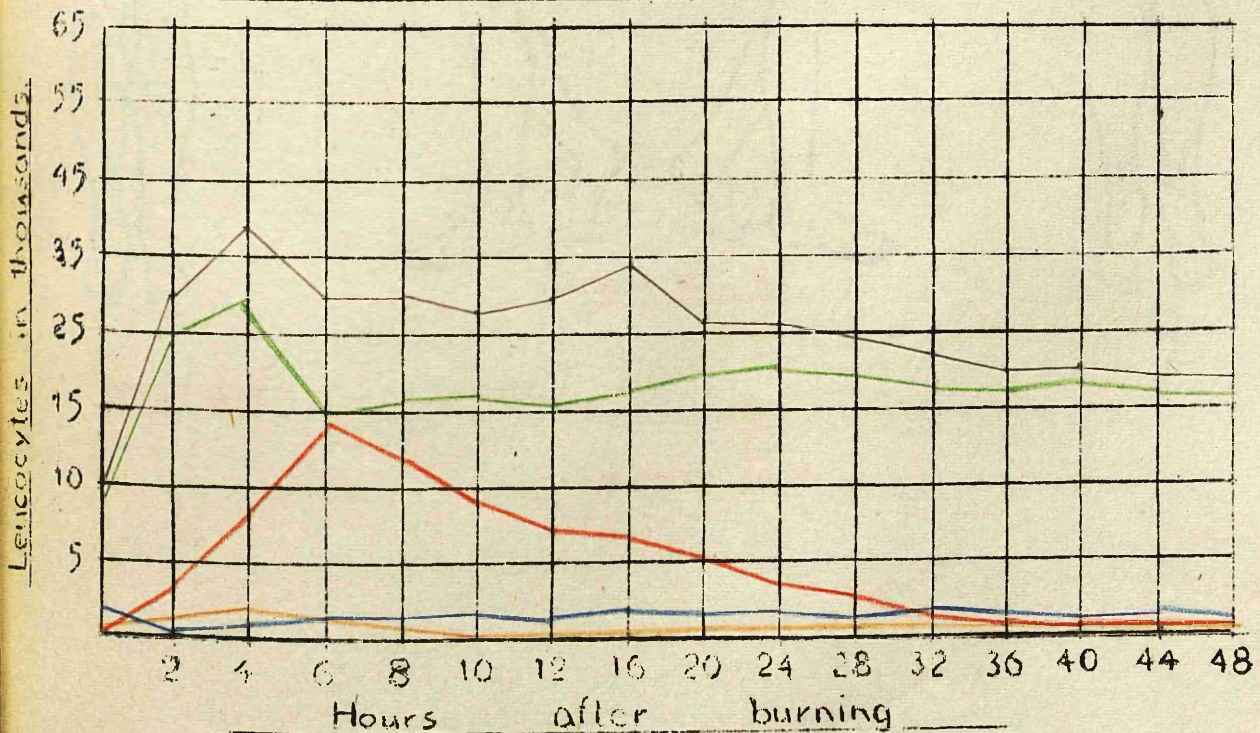
**Distribution as shown on chart overleaf.**

How sustained **Petrol explosion.**

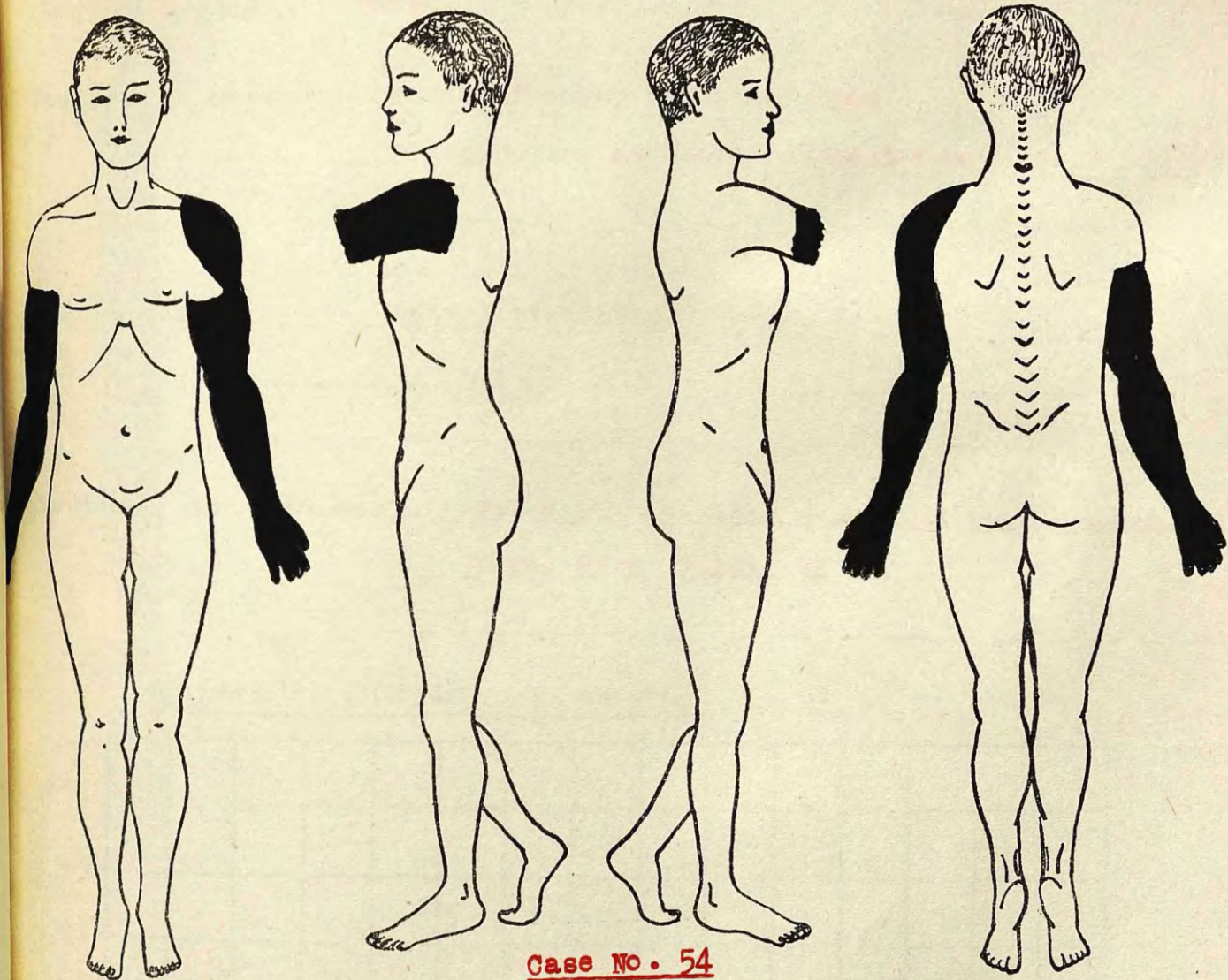
Condition on admission **No pain. Thirsty. Talkative.**

**Temp. 99 Pulse 80**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Lymphorhphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 54

TREATMENT

Tannic Acid

Age of patient **61 years.**

Case No. 55.

Sex of patient **Male.**

Nature of injuries **Burns of upper limbs and face.**

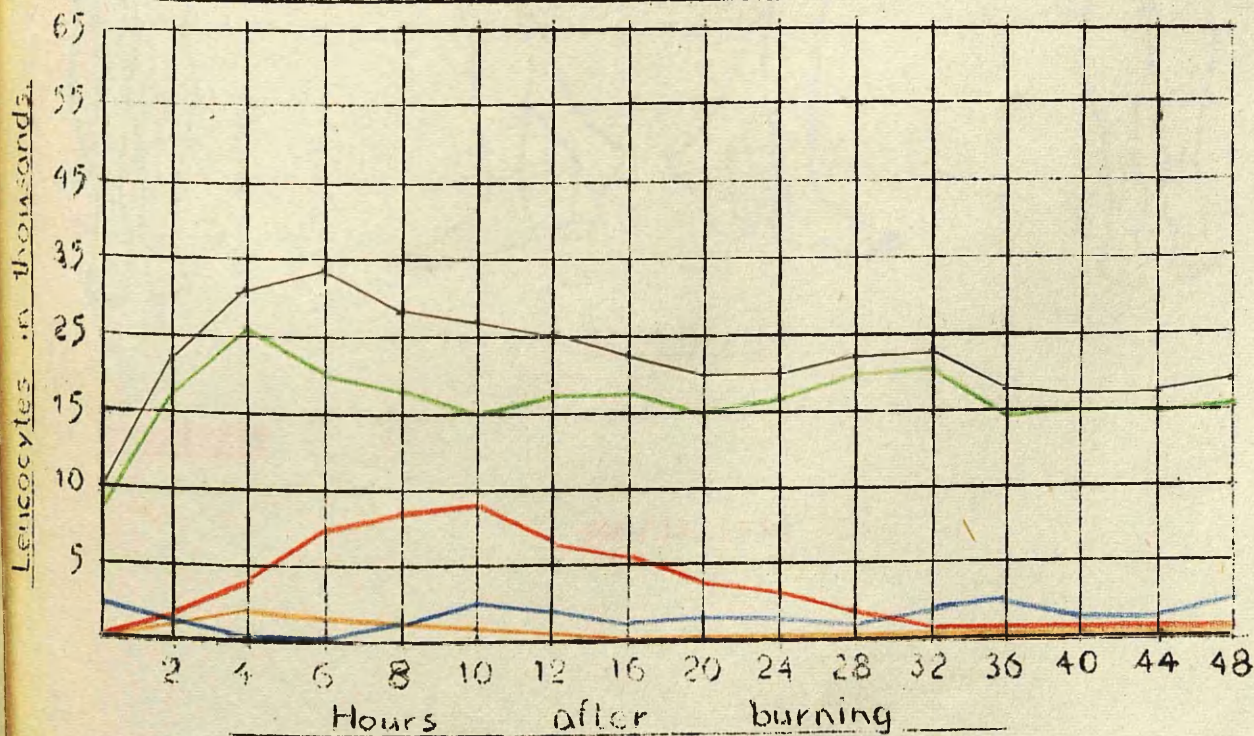
Distribution as shown on chart overleaf.

How sustained **Petrol explosion.**

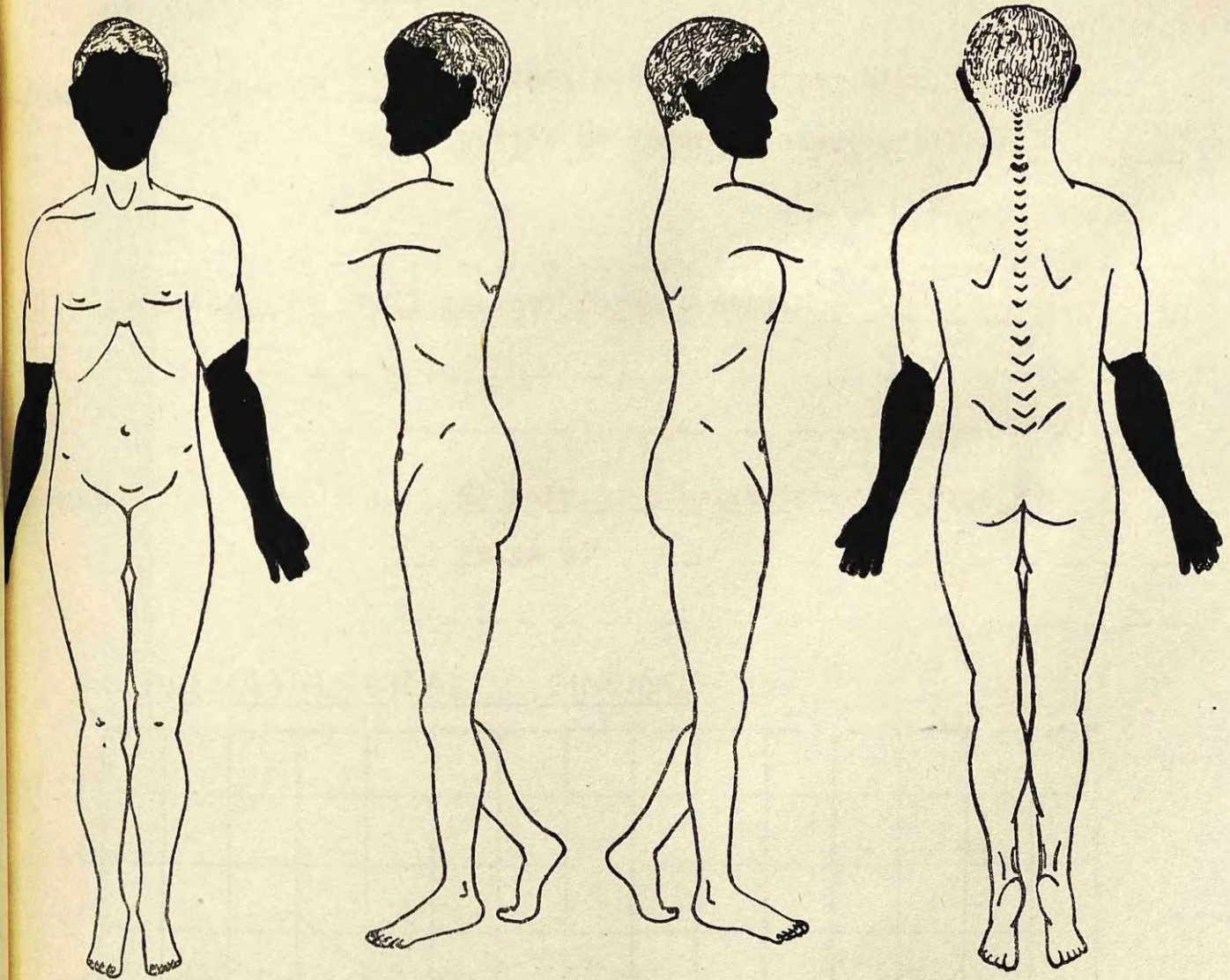
Condition on admission **No pain. Answered questions intelligently.**

Temp. 99.2 Pulse 94

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Lymphorhys \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 55

TREATMENT

Tannic Acid

Age of patient **60 years.**

Case No. **56**

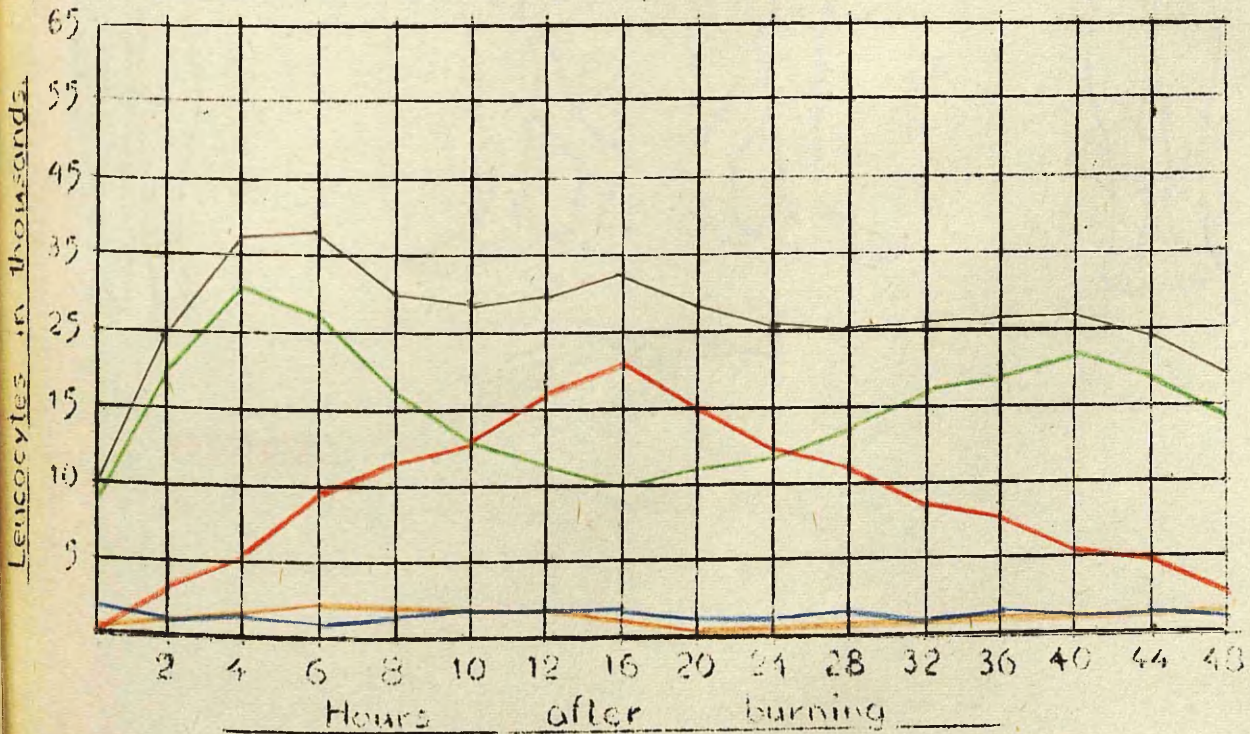
Sex of patient **Male.**

Nature of injuries **Burns of back and right upper limb.**  
**Distribution as shown on chart overleaf.**

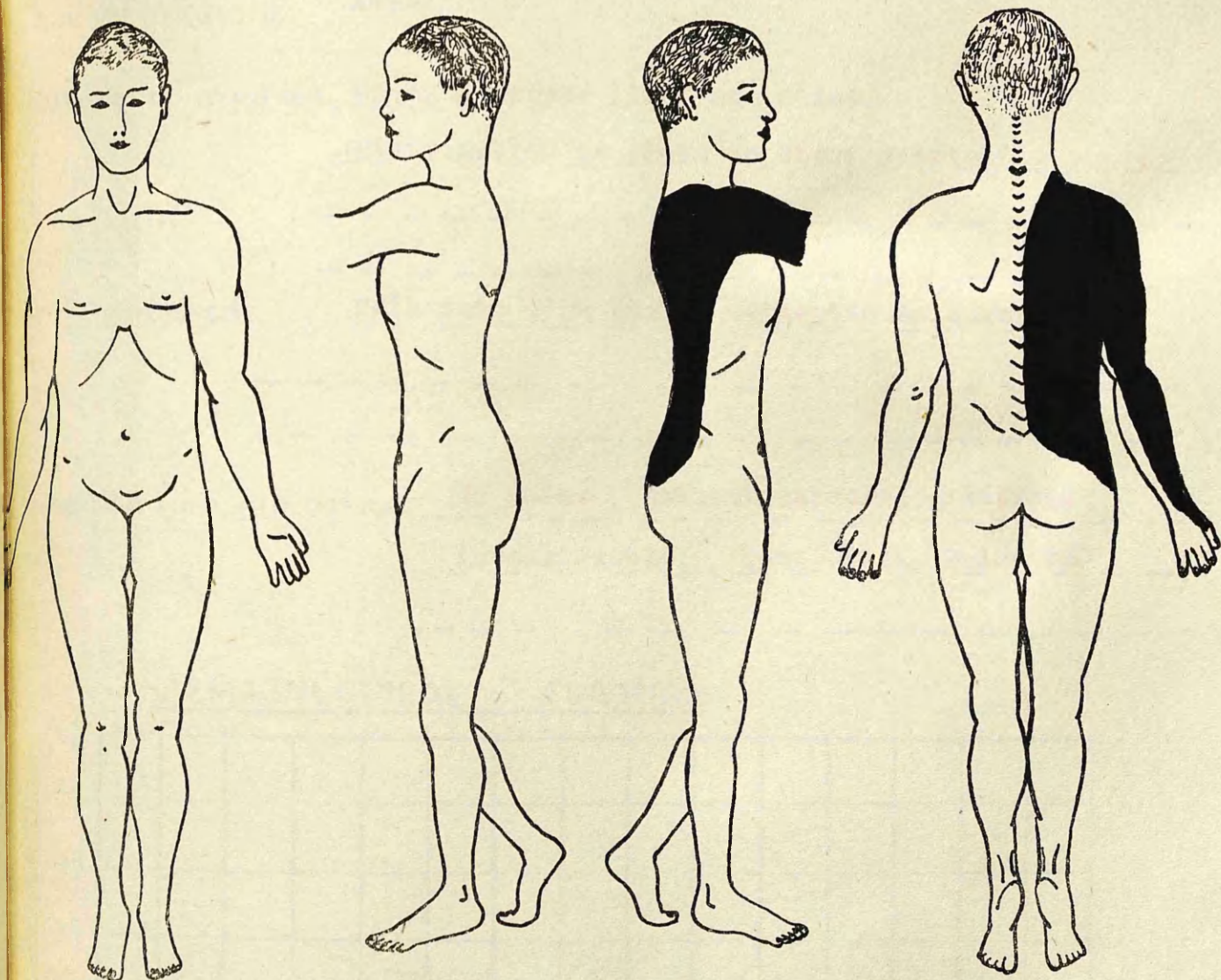
How sustained **Fell against furnace door.**

Condition on admission **No pain. Disorientated. Temp. 99.5**  
**Pulse 90**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Lymphorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 56

TREATMENT

Tannic Acid

Age of patient... **15 years.**

Case No. **-57-**

Sex of patient... **Male.**

Nature of injuries... **Burns of upper limbs and chest.**

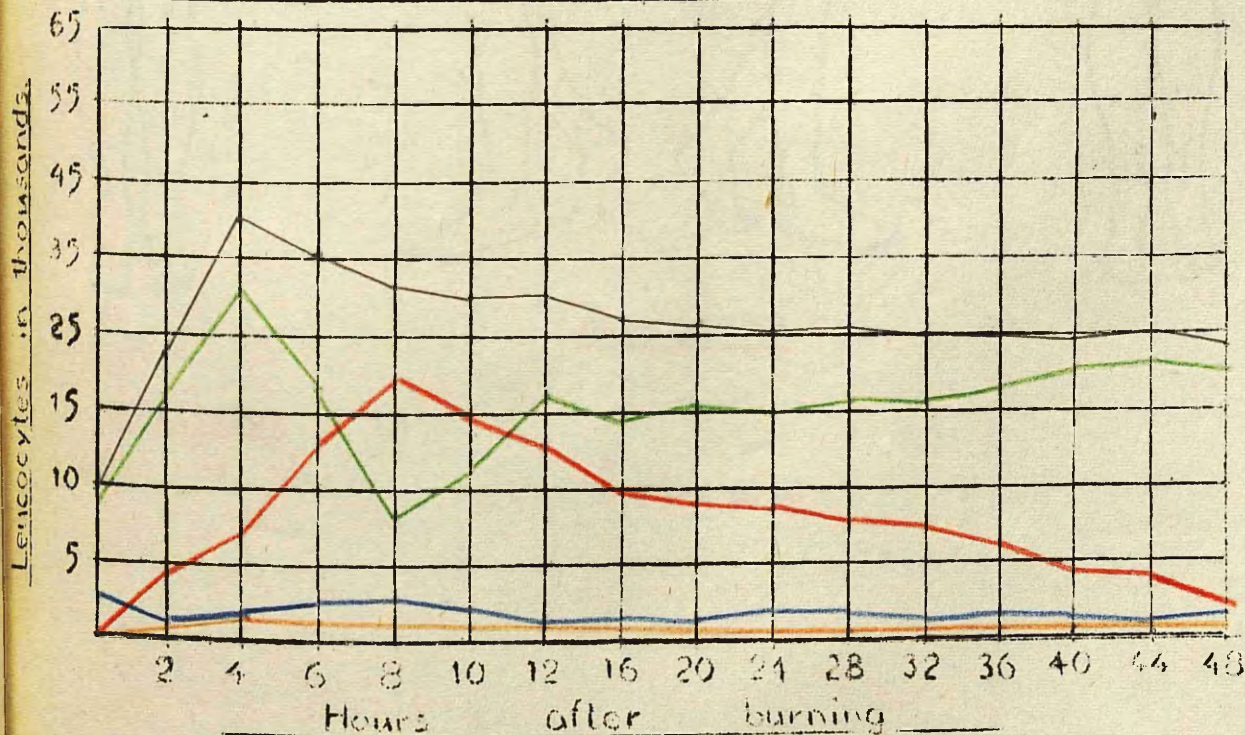
**Distribution as shown on chart overleaf.**

How sustained... **Fell into fire during epileptic seizure.**

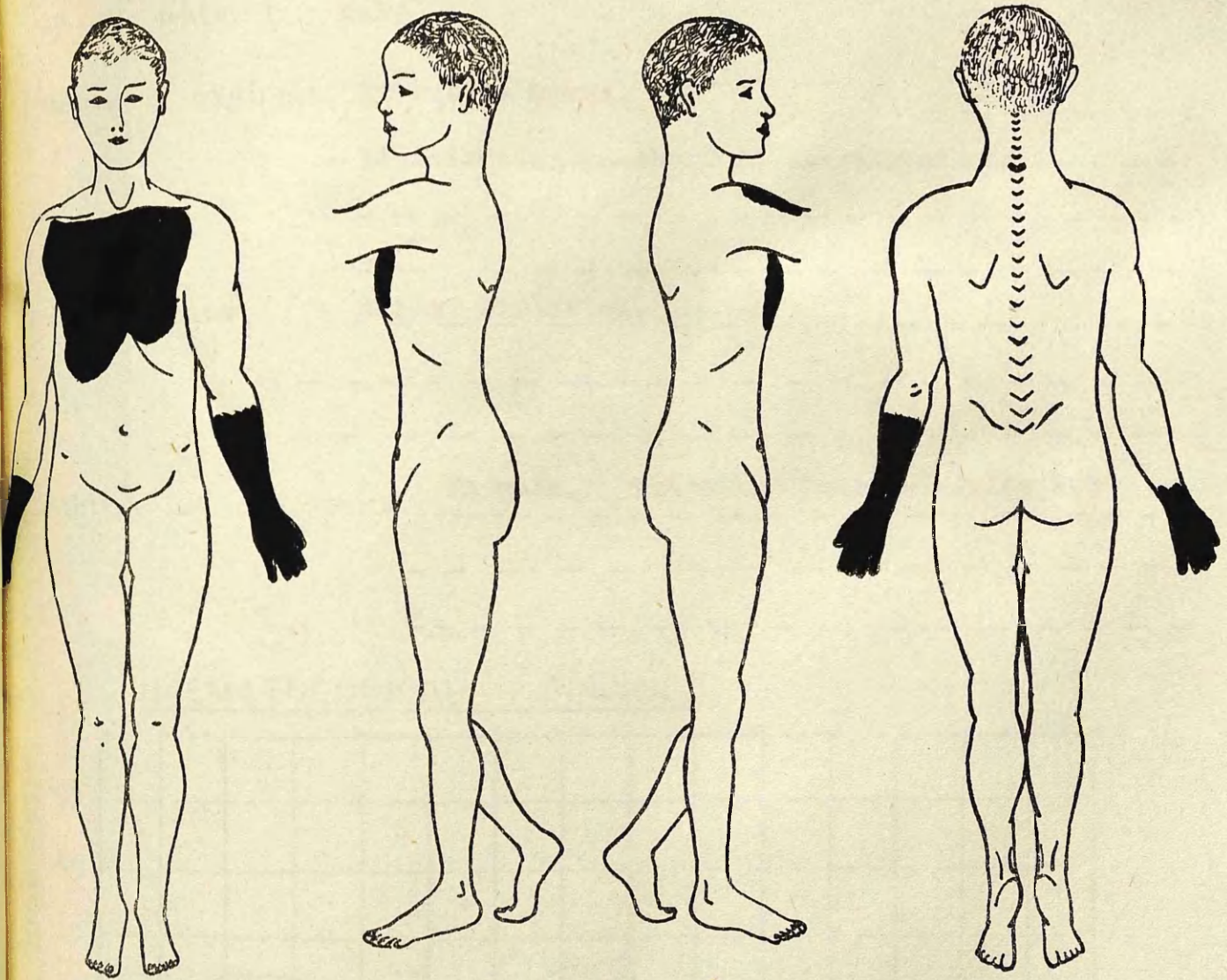
Condition on admission... **No pain. Patient answered questions**

**intelligently. Temp. 98.4 Pulse 86**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Toxiforms \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 57

TREATMENT

Tannic Acid

Age of patient **50 years.**

Case No. **58**

Sex of patient **Male**

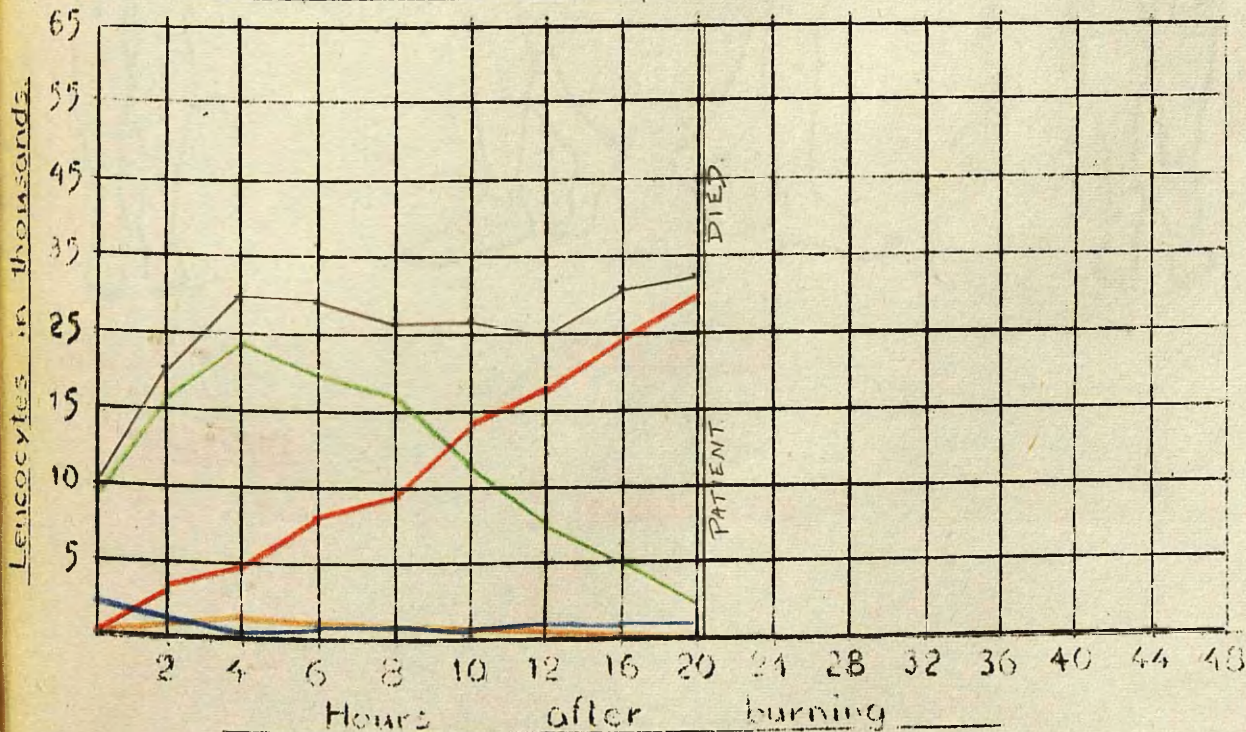
Nature of injuries **Extensive Burns.**

~~Distribution as shown on chart overleaf.~~

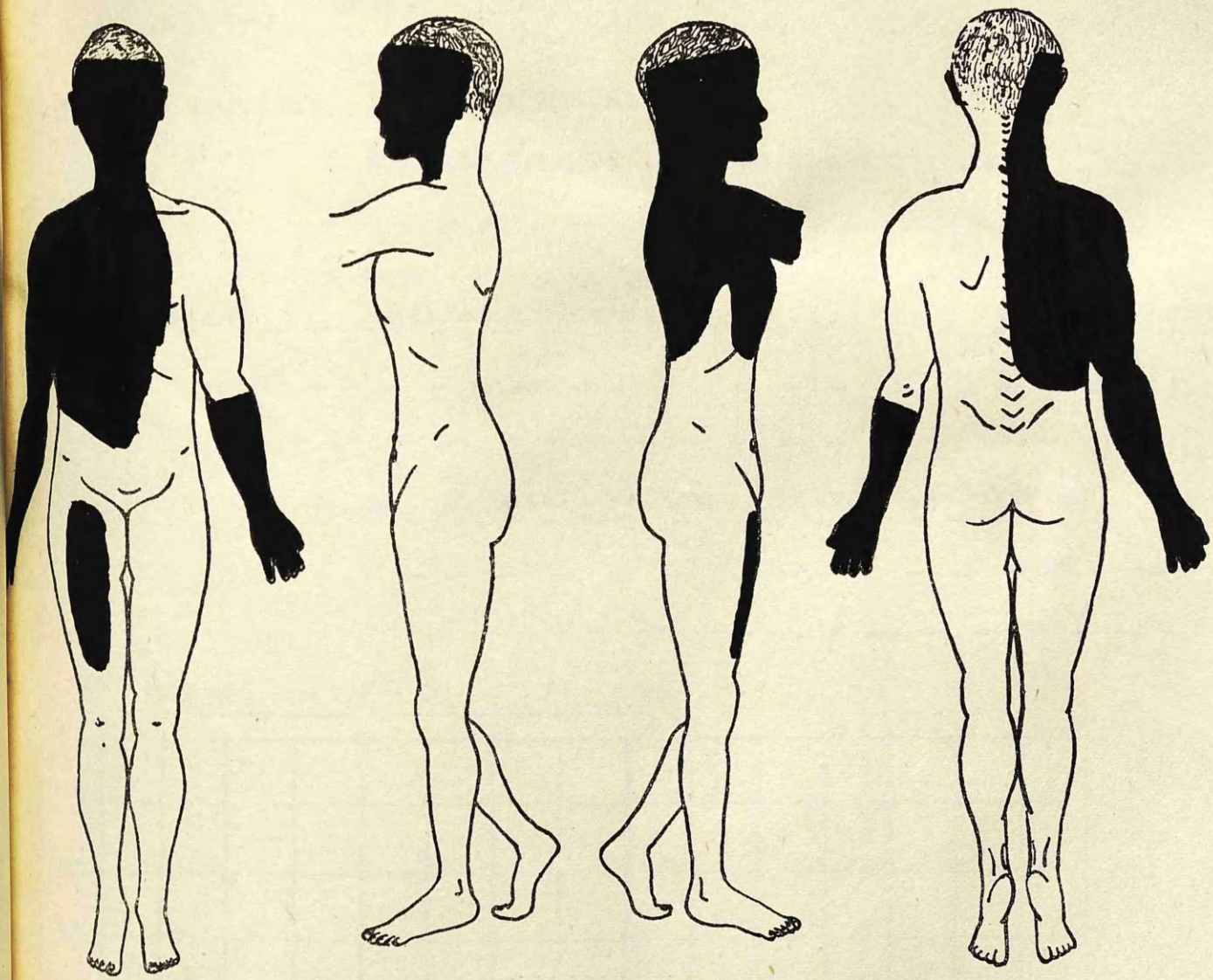
How sustained **Boiler explosion.**

Condition on admission **No pain. Thirsty. Temp. 99 Pulse 100**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Lymphorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 58

TREATMENT

Tannic Acid

Age of patient **36 years.**

Case No. **59**

Sex of patient **Male.**

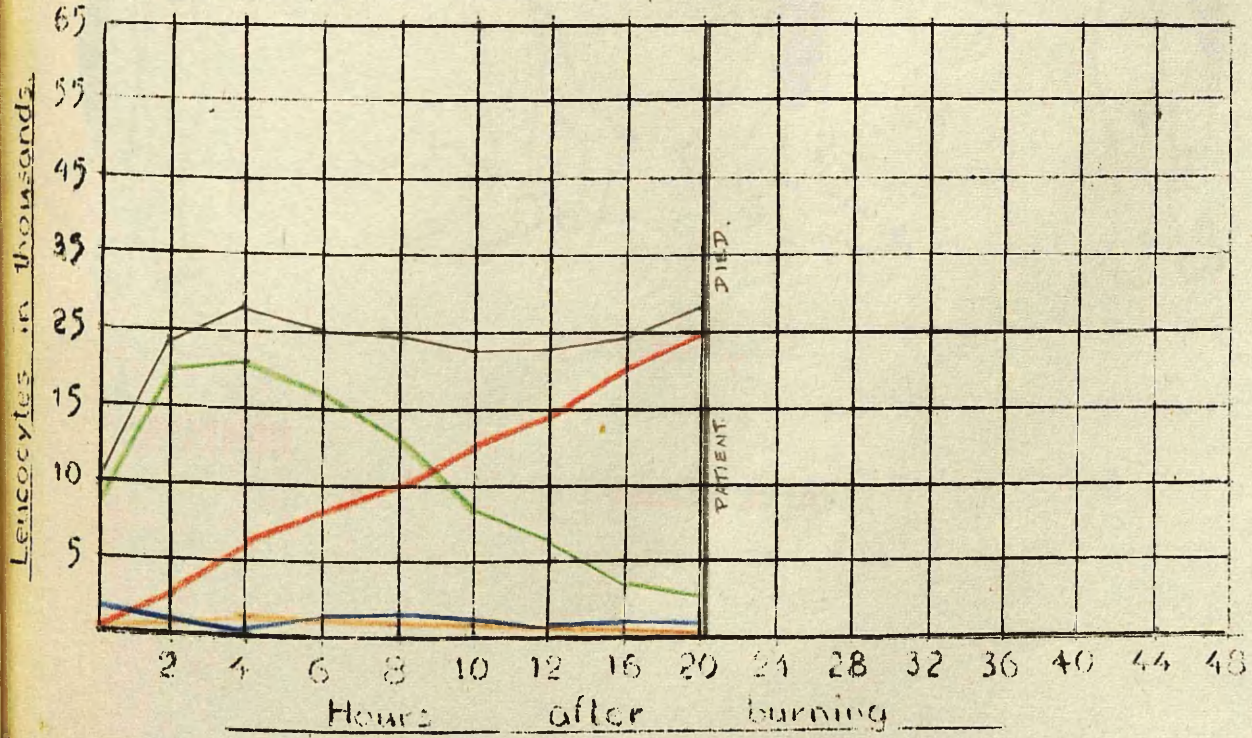
Nature of injuries **Extensive scalds.**

**Distribution as shown on chart overleaf.**

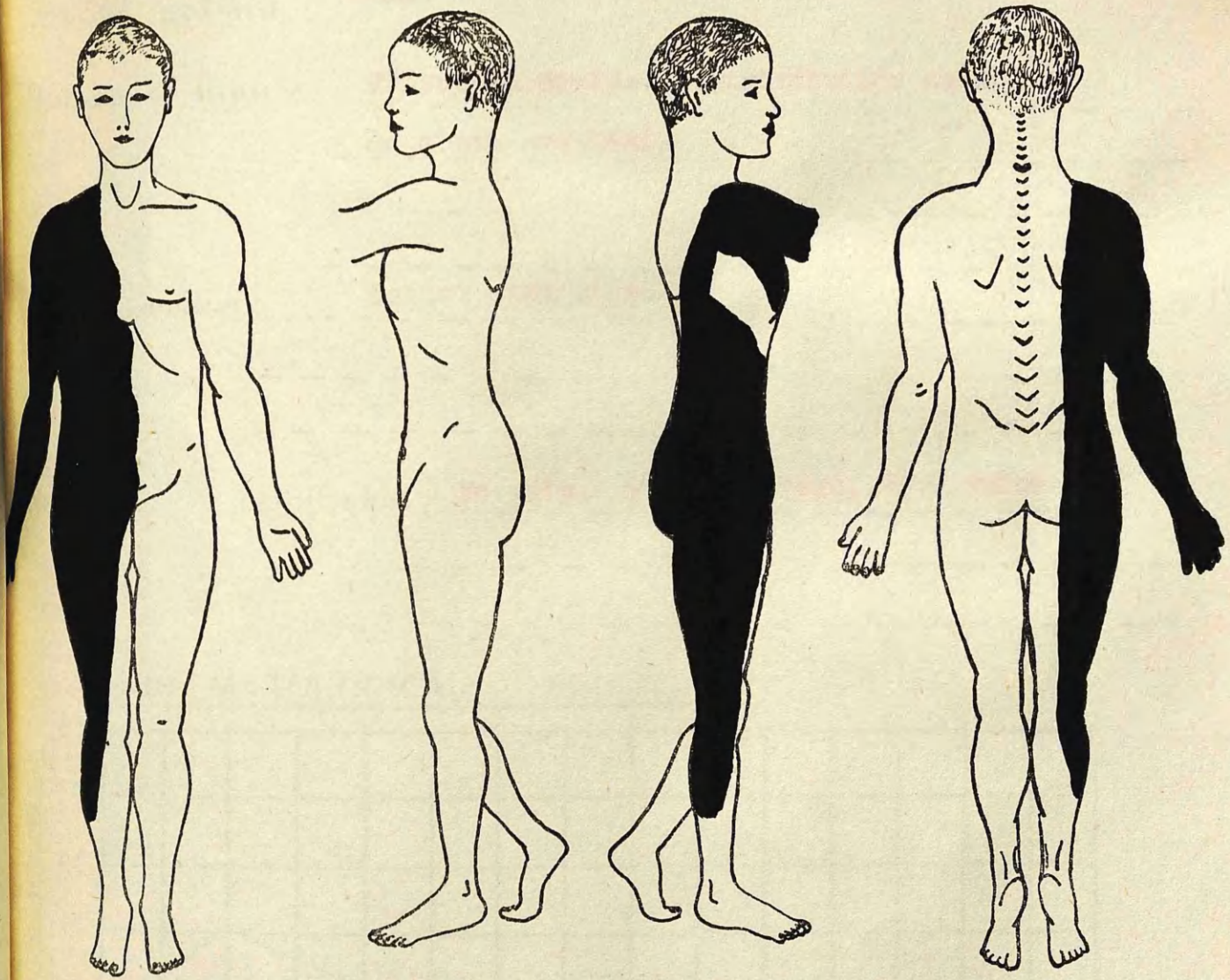
How sustained **Boiler explosion.**

Condition on admission **No pain. Thirsty. Temp. 88.4 Pulse 92**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 Lymphocytes } \_\_\_\_\_  
 Monocytes } \_\_\_\_\_  
 Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 59

TREATMENT

Tannic Acid

Age of patient... **20 years.**

Case No. **60**

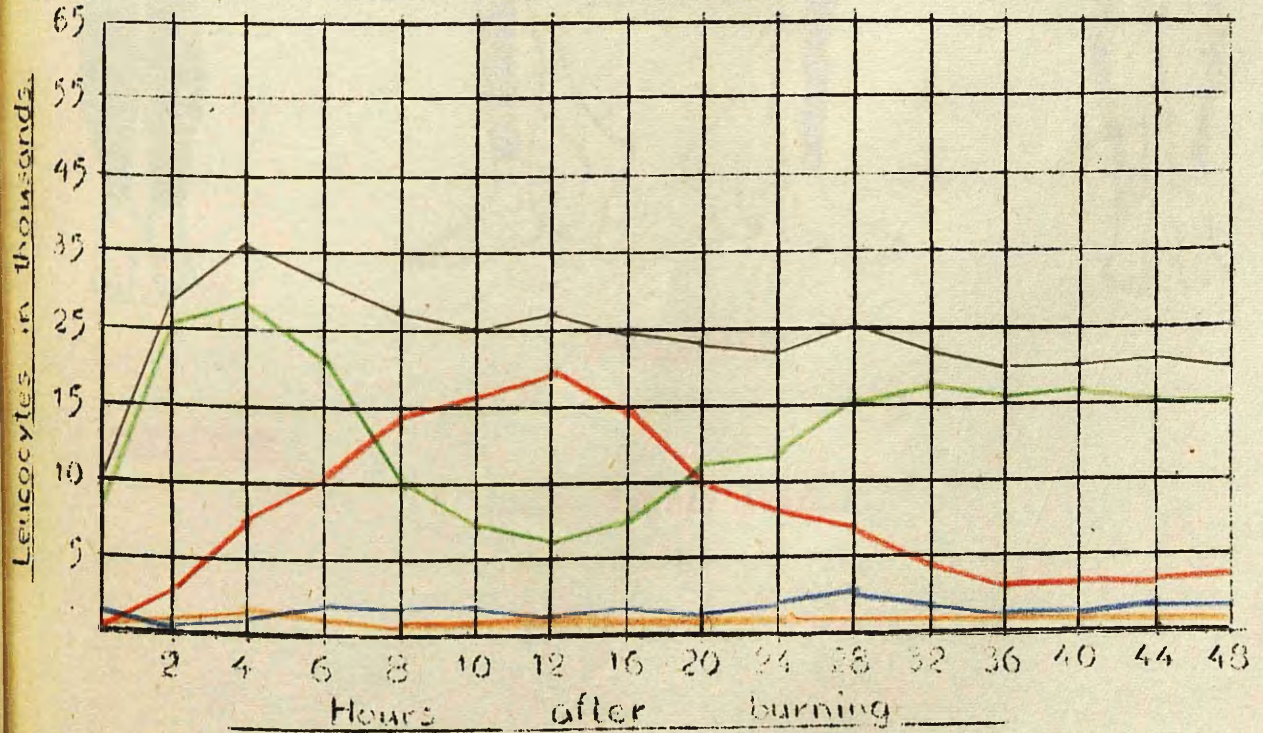
Sex of patient... **Male.**

Nature of injuries... **Extensive Scalds. Distribution as shown on chart overleaf.**

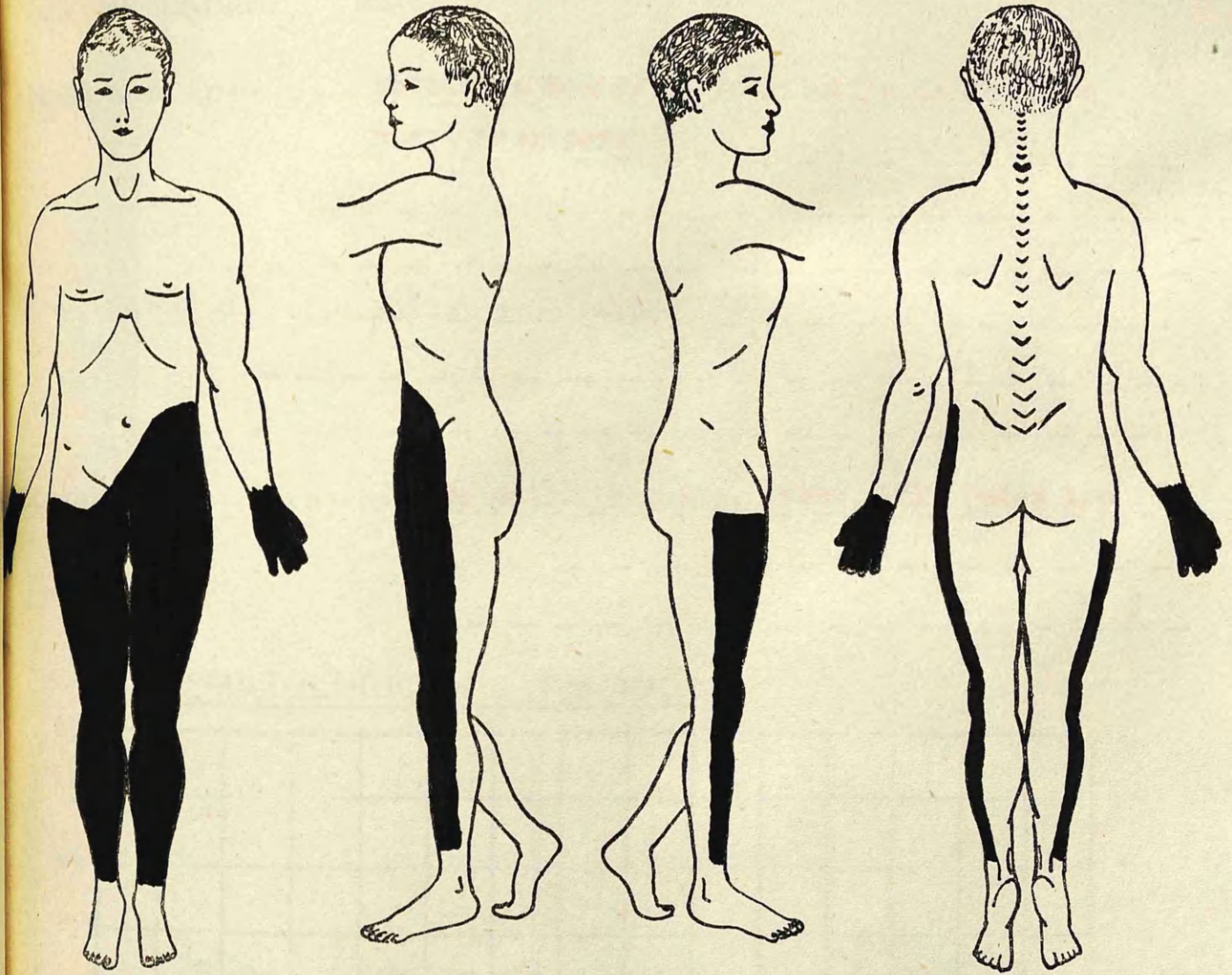
How sustained... **Boiler explosion.**

Condition on admission... **No pain. Thirsty. Temp. 98.8 Pulse 86**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes } \_\_\_\_\_  
 Lymphomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No.60

TREATMENT

Tannic Acid

Age of patient 16 years.

Case No. 61

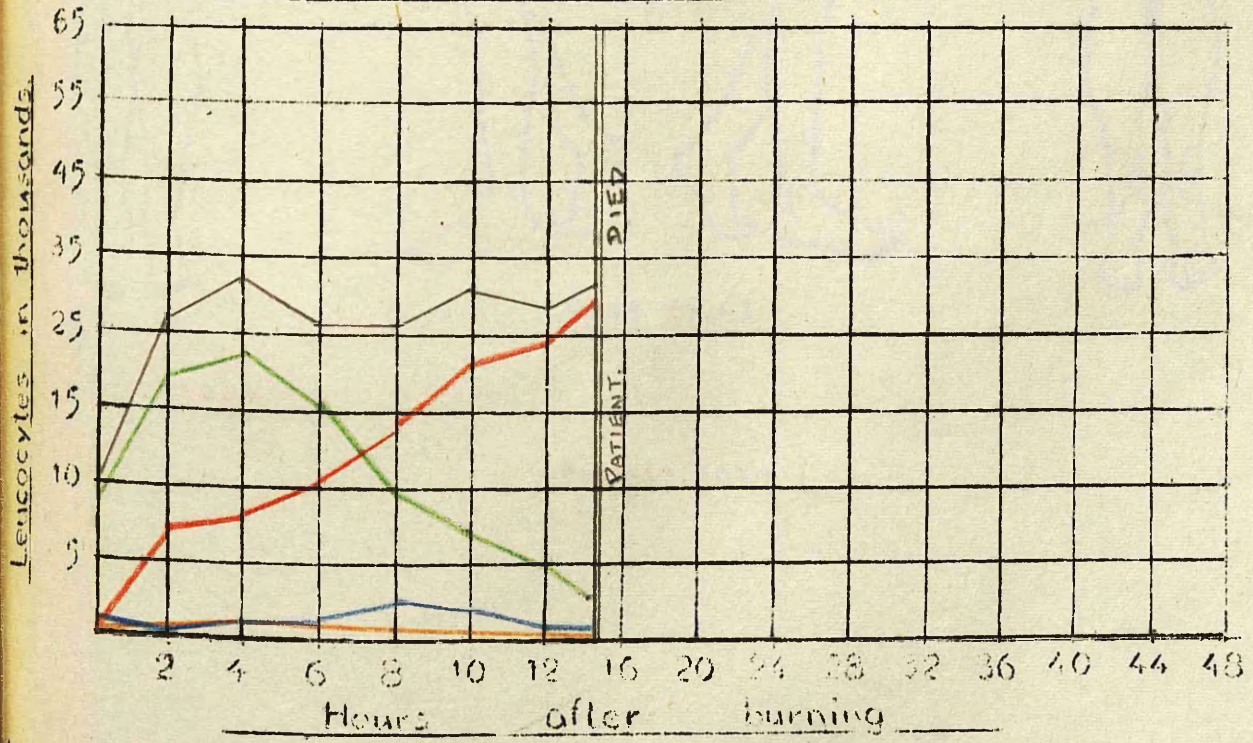
Sex of patient Male.

Nature of injuries Extensive Scalds. Distribution as shown on chart overleaf.

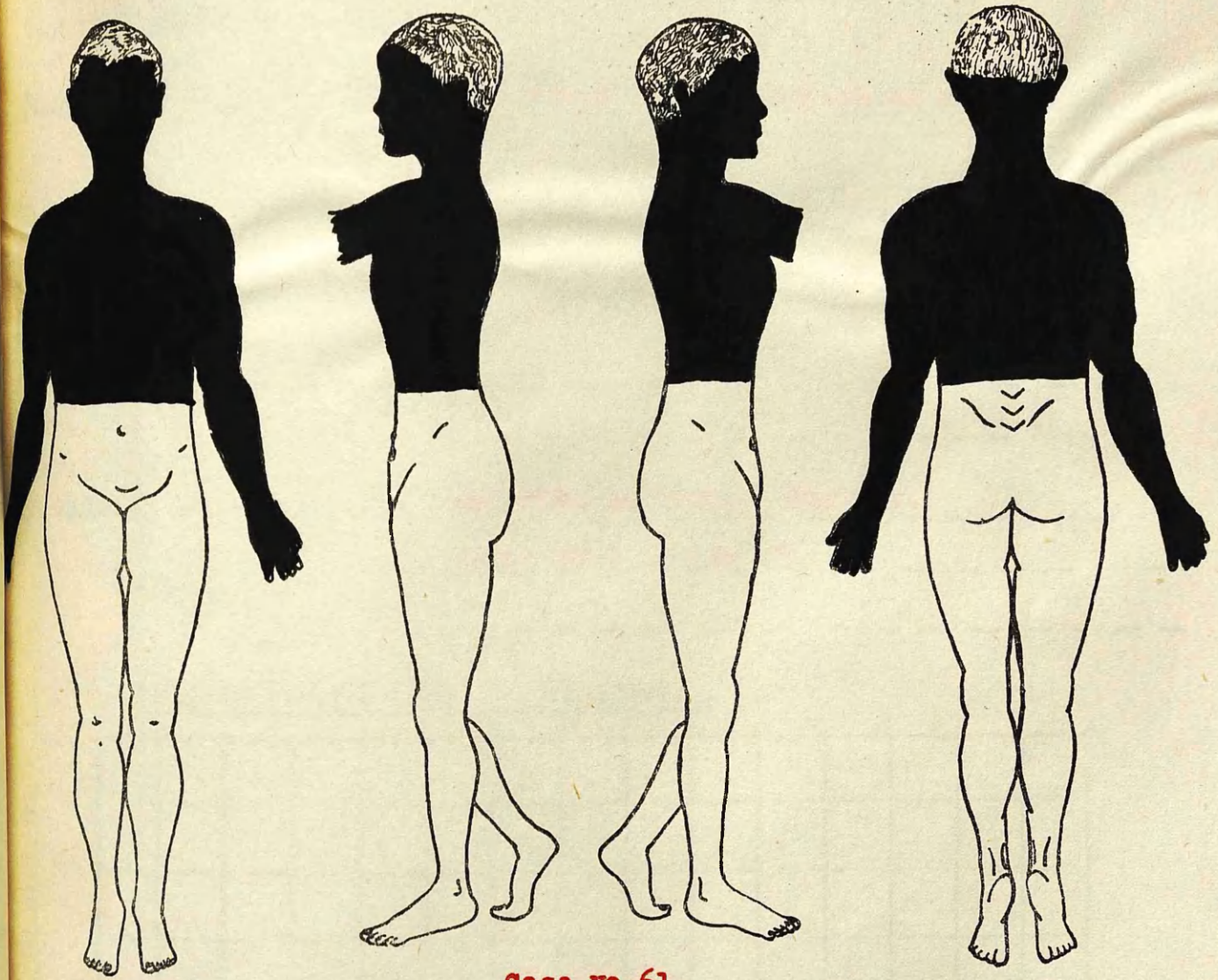
How sustained Boiler explosion.

Condition on admission No pain. Thirsty. Temp. 101 Pulse 120

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Lymphorhphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No.61

TREATMENT

Tannic Acid

Age of patient ... **33 years.**

Case No. **62**...

Sex of patient ... **Male.**

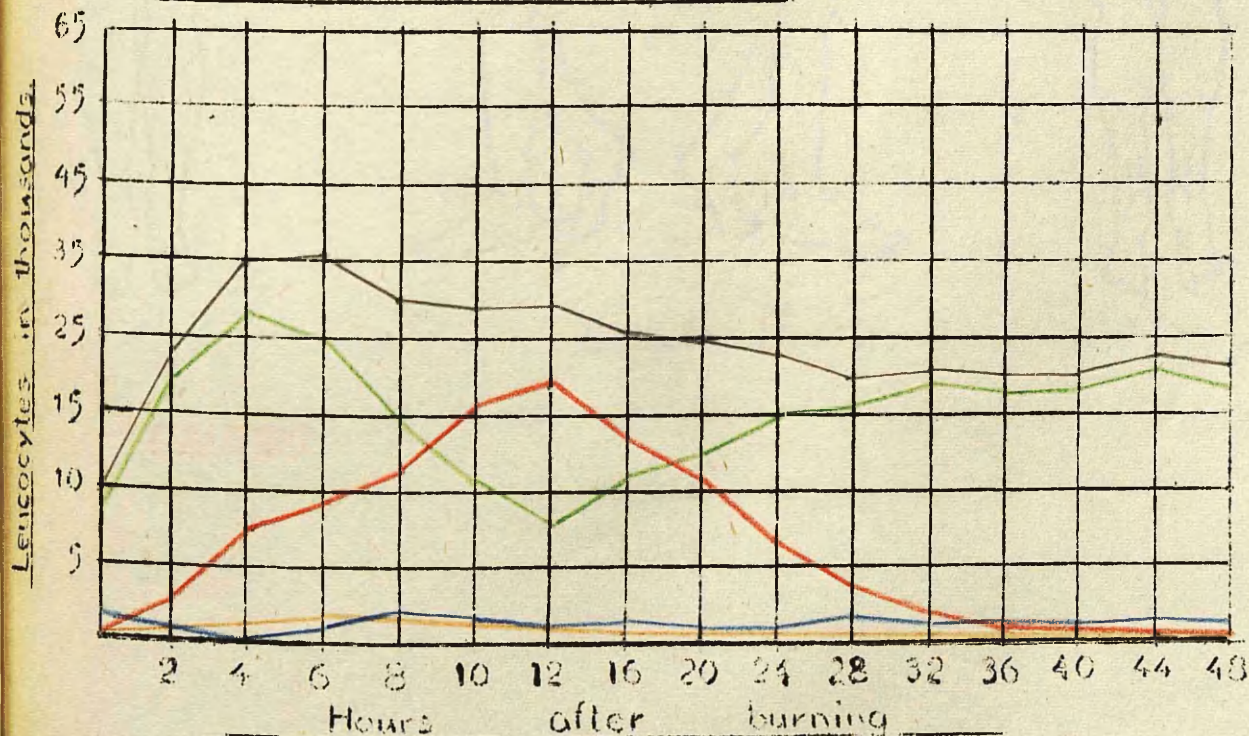
Nature of injuries: **Extensive Scalds. Distribution as shown on**  
**- chart overleaf.**

How sustained: **Boiler explosion.**

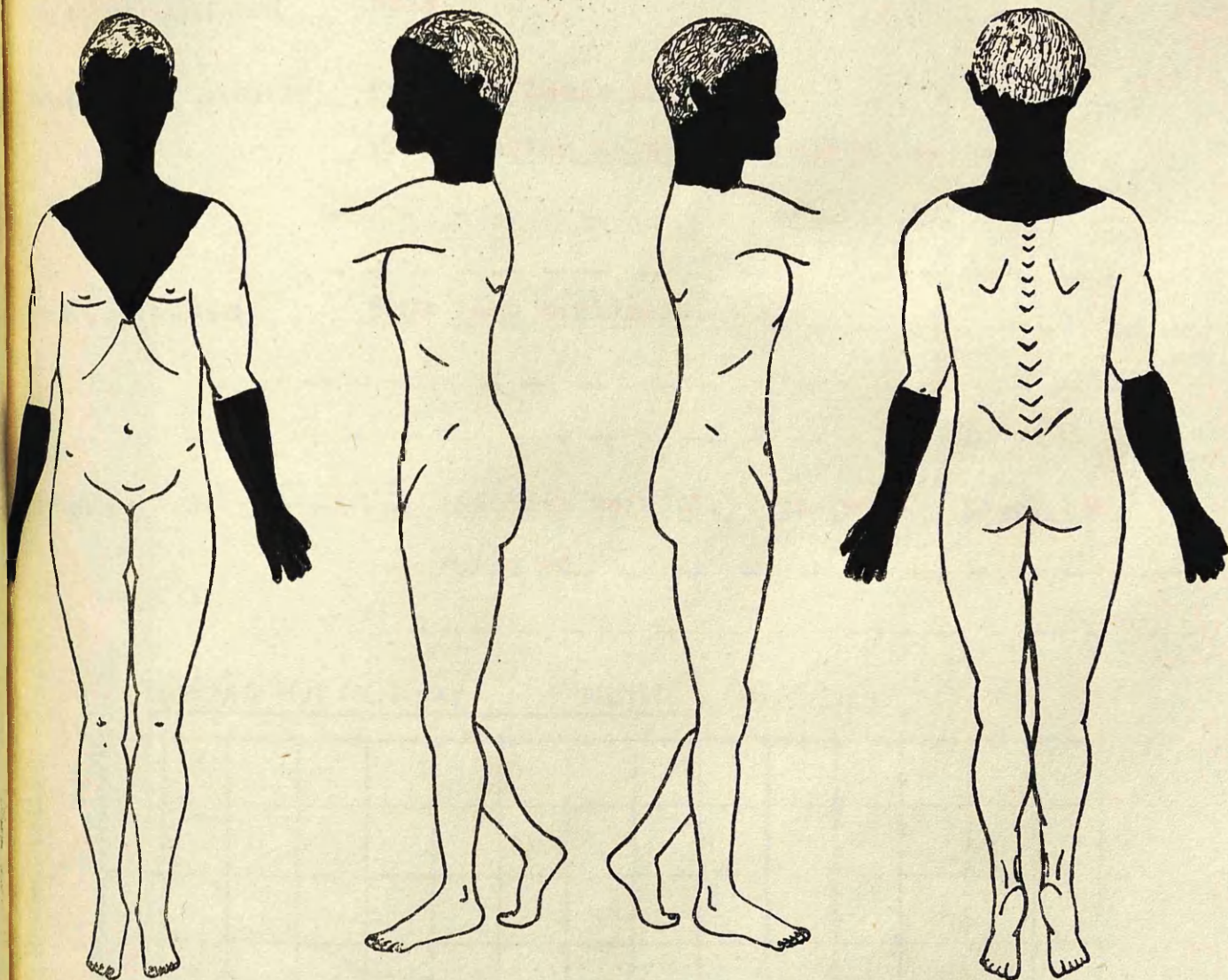
Condition on admission: **Injuries painful. Thirsty.**

**Temp. 99.1 pulse 83.**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
Monocytes } \_\_\_\_\_  
Lymphorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 62

TREATMENT

Tannic Acid

Age of patient 29 years

Case No. 63

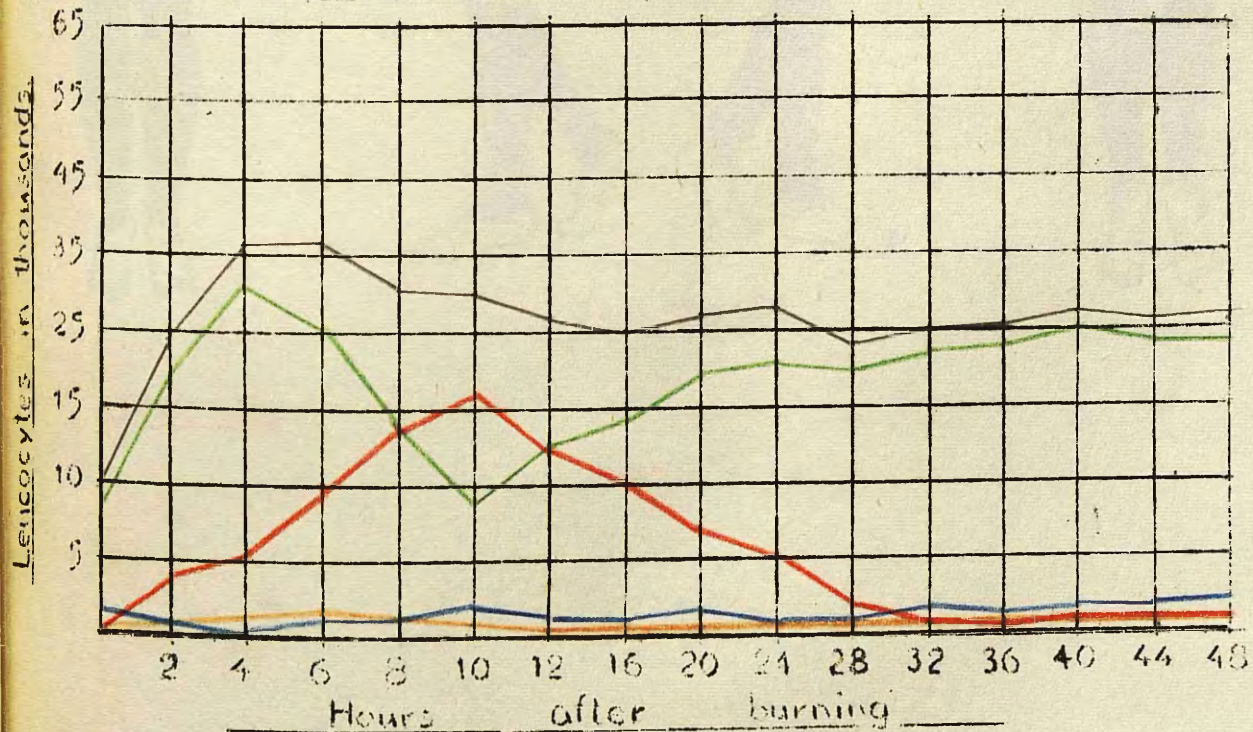
Sex of patient Male.

Nature of injuries Burns of lower limbs.  
distribution as shown on chart overleaf.

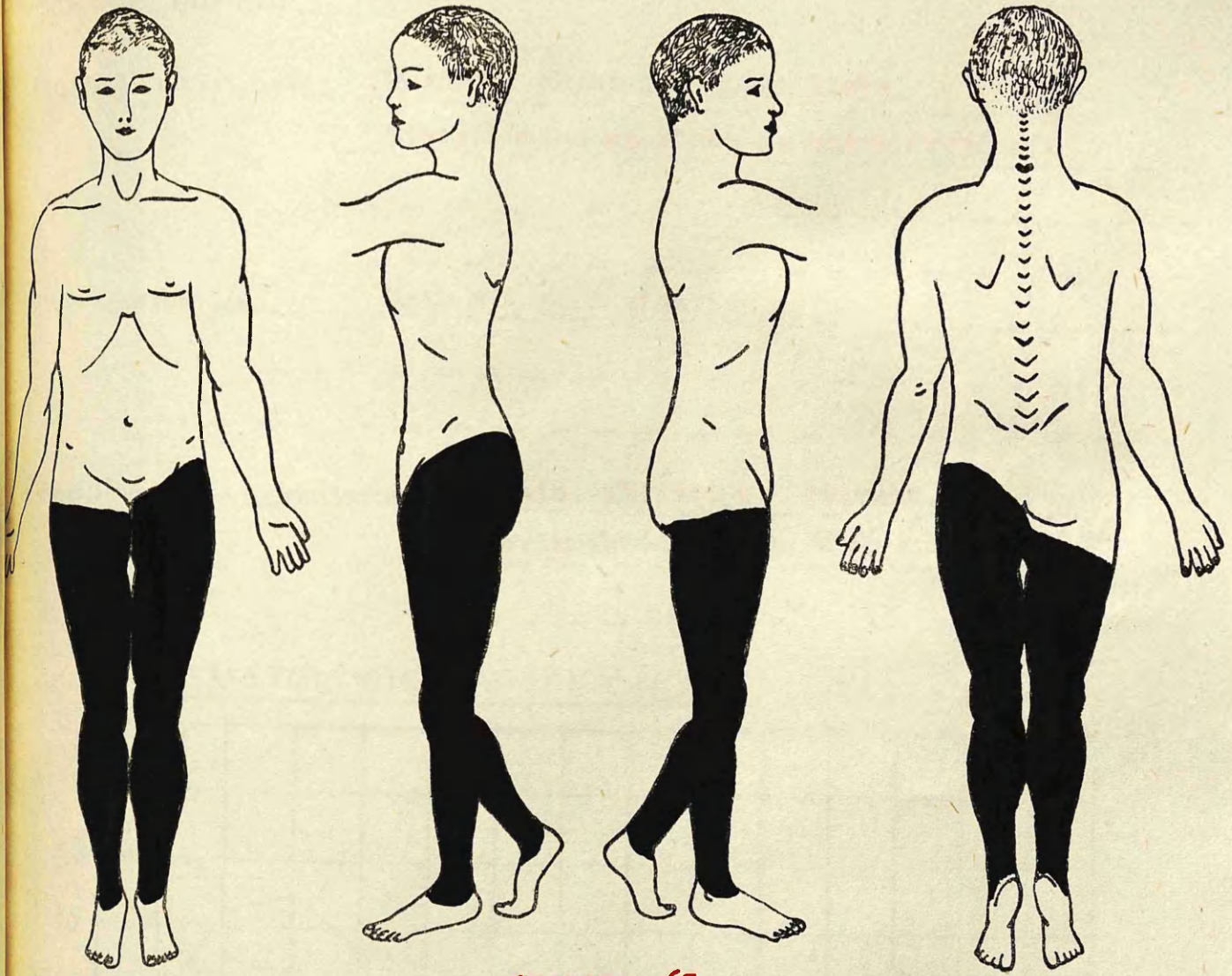
How sustained Blow lamp explosion.

Condition on admission Injuries painful. Thirsty. Temp. 101  
Pulse 94

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 63

TREATMENT

Tannic Acid

Age of patient **16 years** .....

Case No. -64-

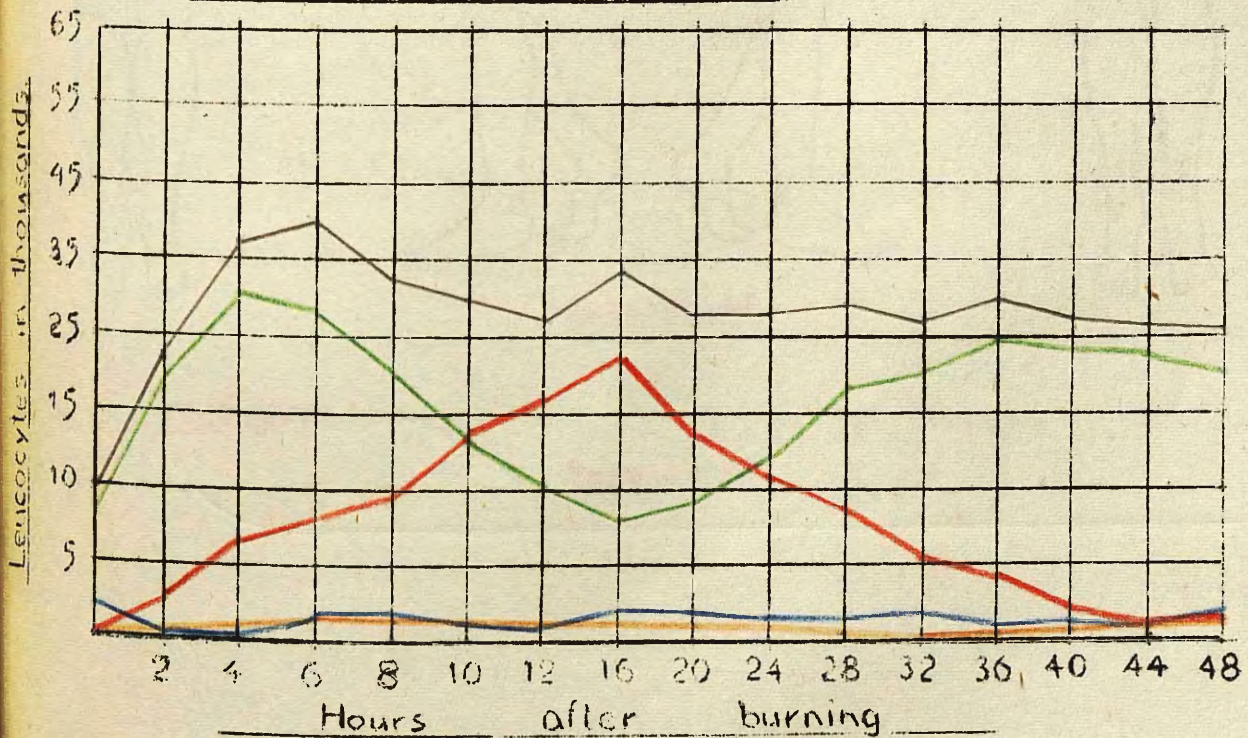
Sex of patient **Male** .....

Nature of injuries **Burns of chest and upper limbs.**  
**Distribution as shown on chart overleaf.**

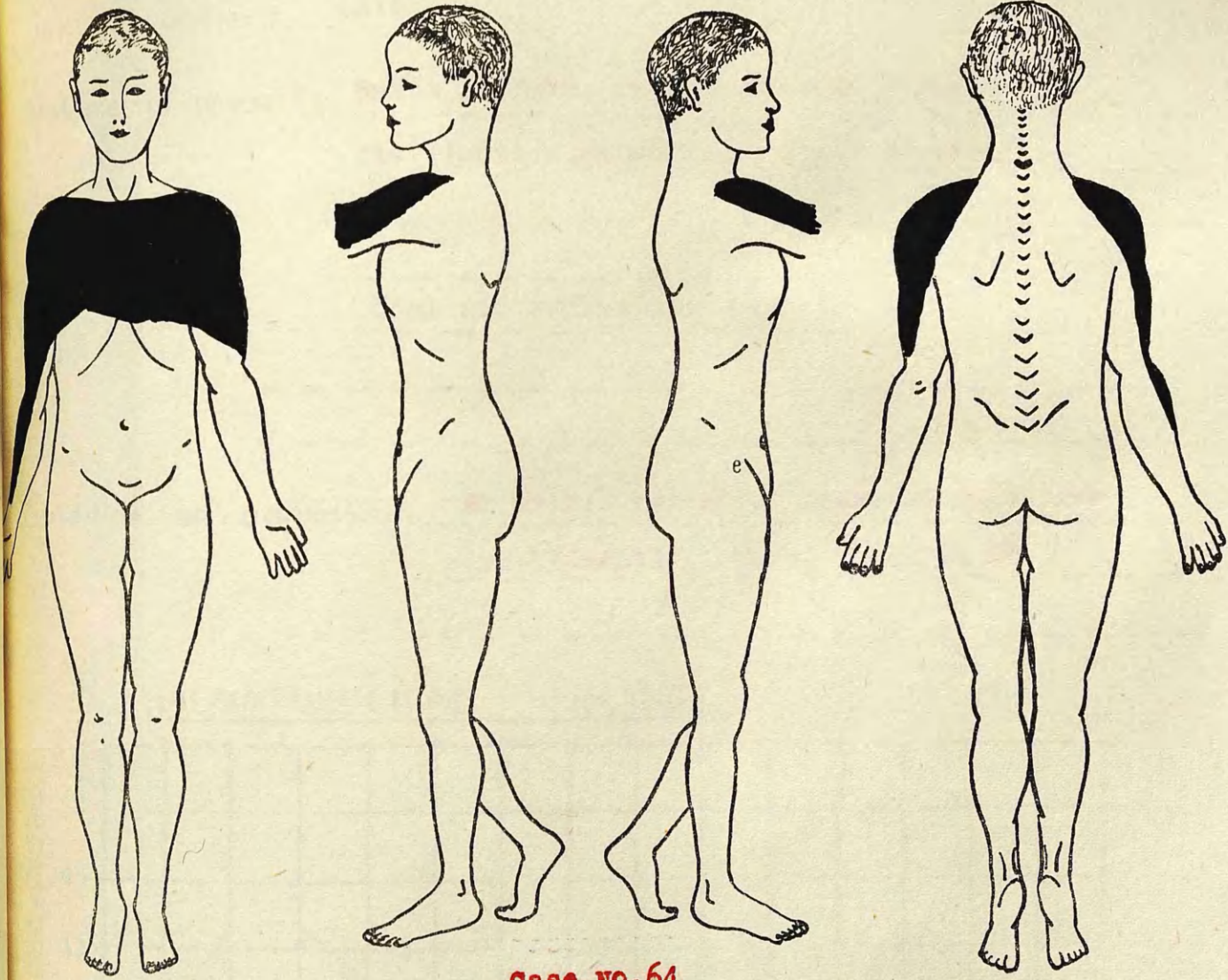
How sustained **Coal pit explosion.**

Condition on admission **No pain. Shivering. Thirsty.**  
**Disorientated. Temp. 97.6 Pulse 100**

HAEMATOLOGICAL FINDINGS



Total Leucocytes ..... Metamyelocytes ..... Lymphocytes }  
 & Monocytes }  
 Lymphorphs ..... Stab Nuclears ..... Toxic Granulocytes .....



Case No. 64

TRETTMENT

Tannic Acid

Age of patient 27 years.

Case No. 65.

Sex of patient Male.

Nature of injuries Burns of face, chest and upper limbs.

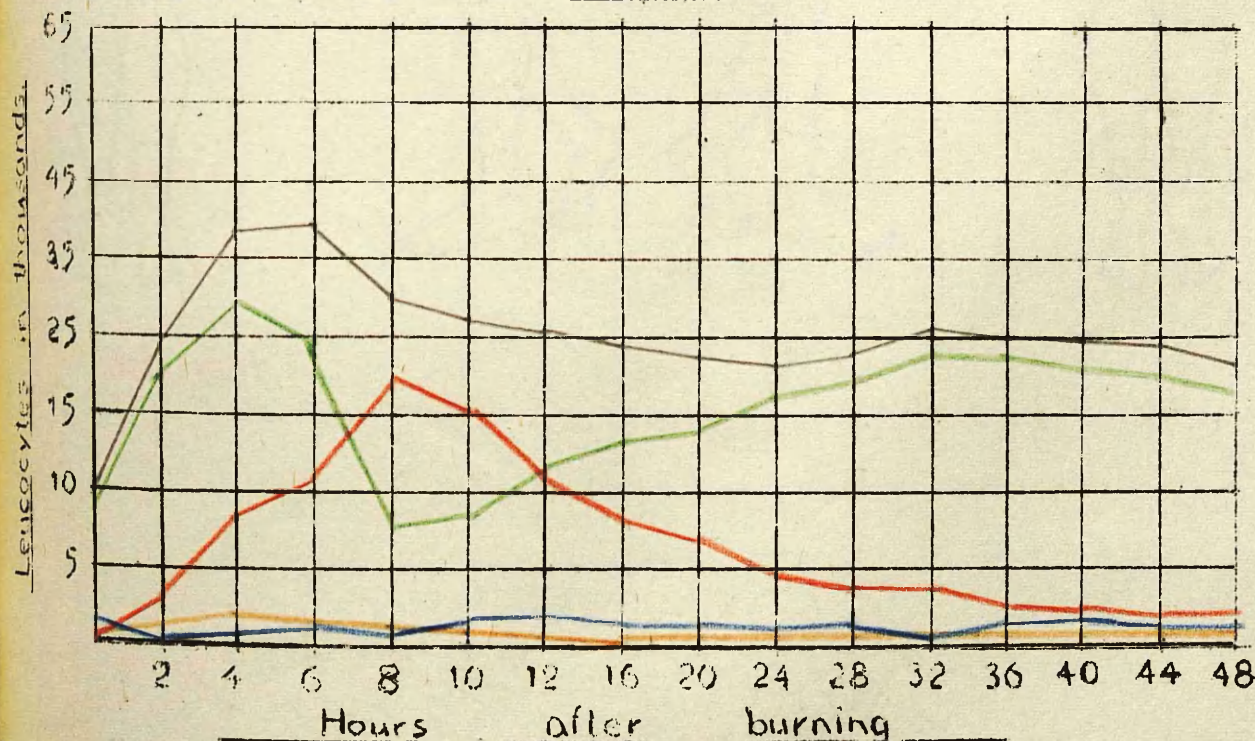
Distribution as shown on chart overleaf.

How sustained Coal pit explosion.

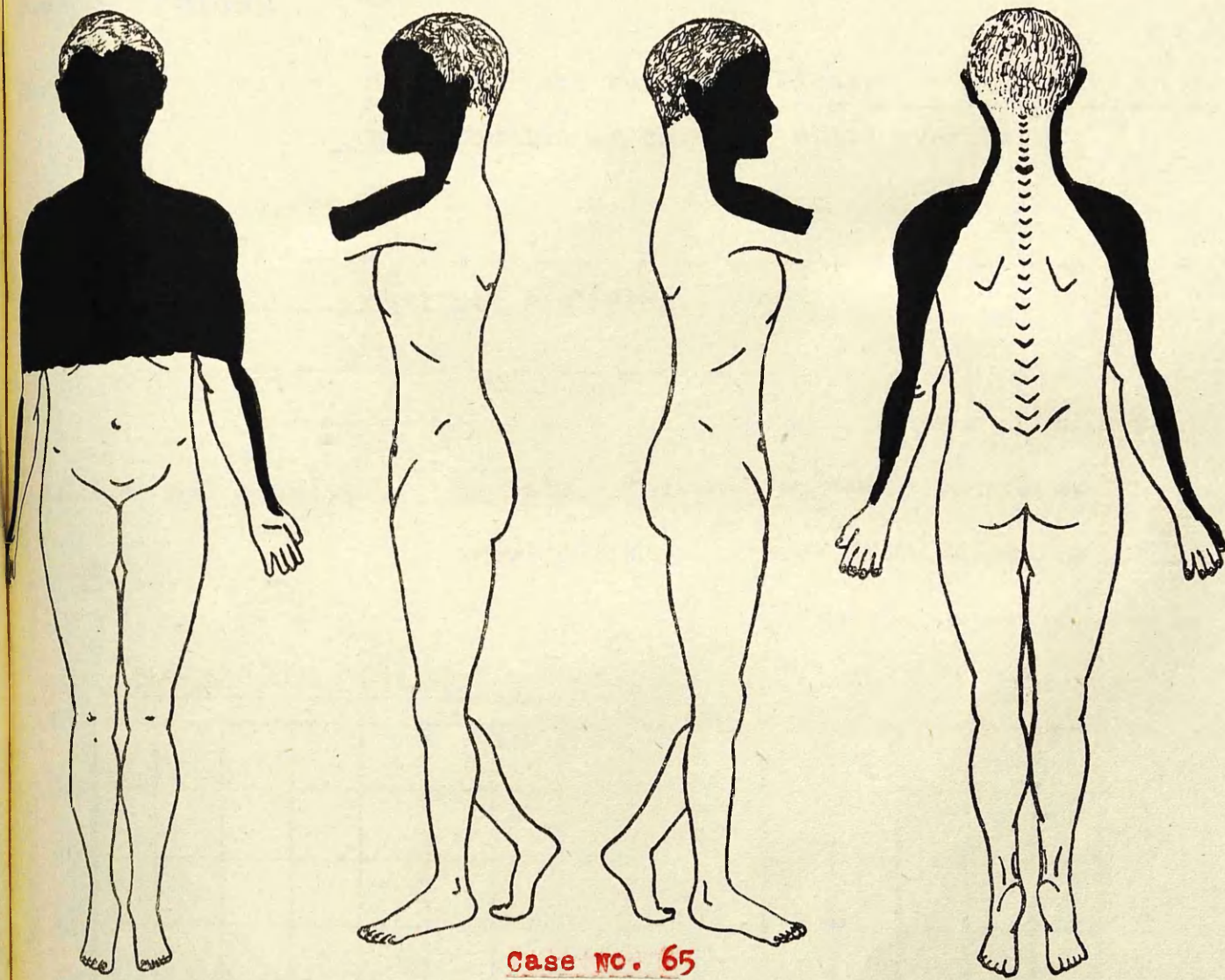
Condition on admission No pain. Thirsty. Answered questions

intelligently. Temp. 99 Pulse 98

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case no. 65

TREATMENT

Tannic Acid

Age of patient **22 years.**

Case No. **66**

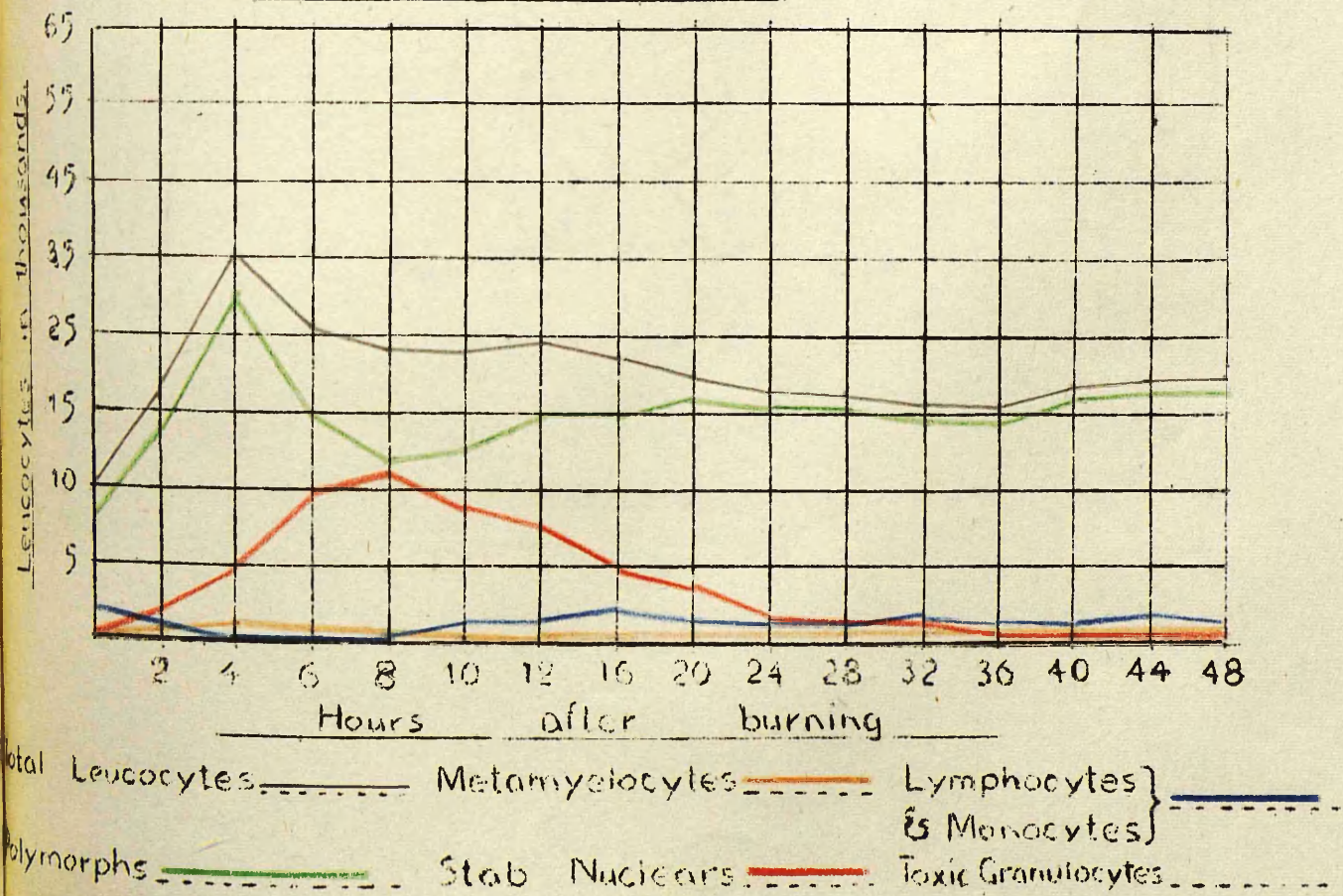
Sex of patient **Male.**

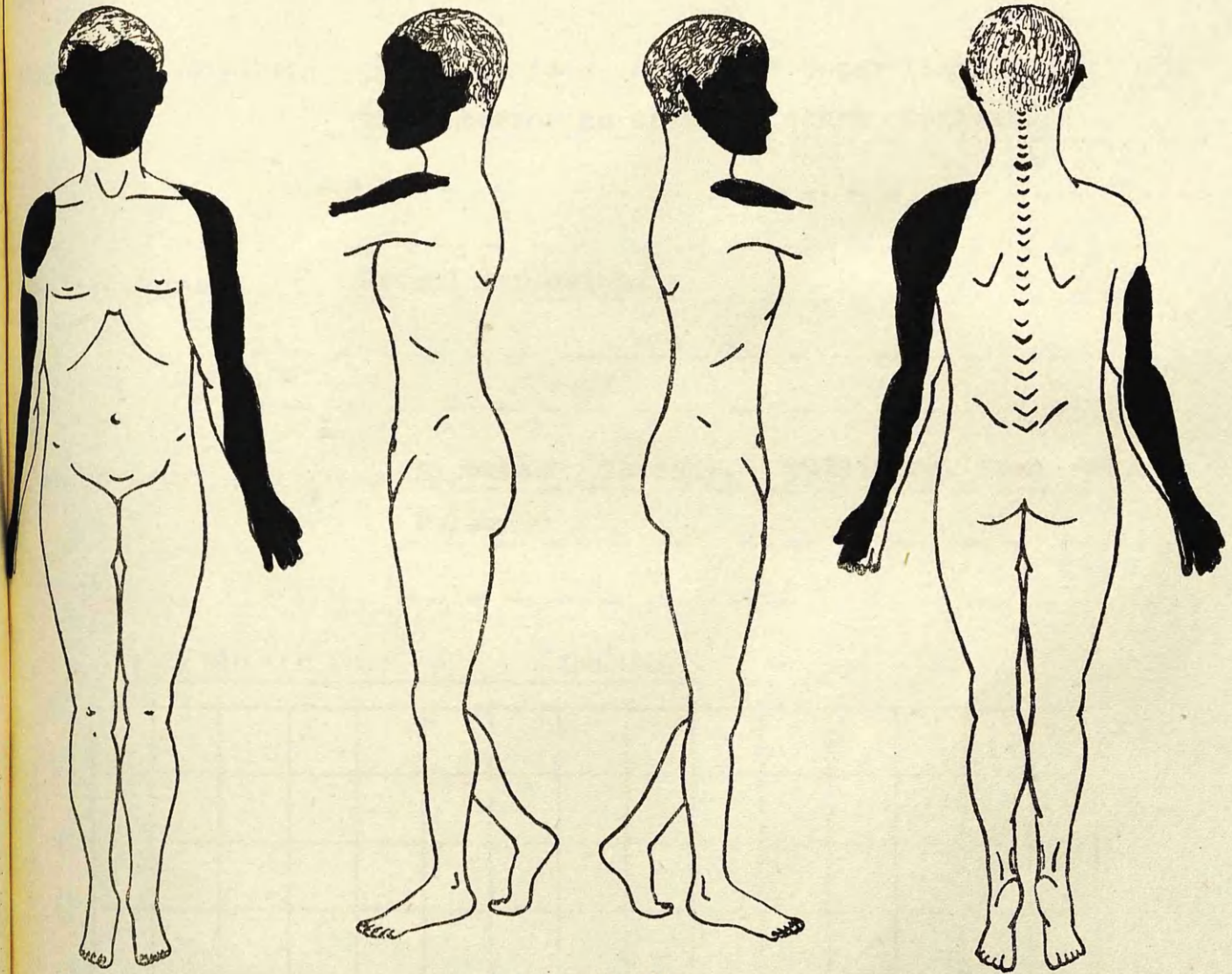
Nature of injuries **Burns of face and upper limbs.**  
**Distribution as shown on chart overleaf.**

How sustained **Coal pit explosion.**

Condition on admission **No pain. Thirsty. Answered questions**  
**intelligently. Temp. 99.4 Pulse 100**

HAEMATOLOGICAL FINDINGS





Case No. 66

TREATMENT

Tannic Acid

Age of patient **24 years**

Case No **67**

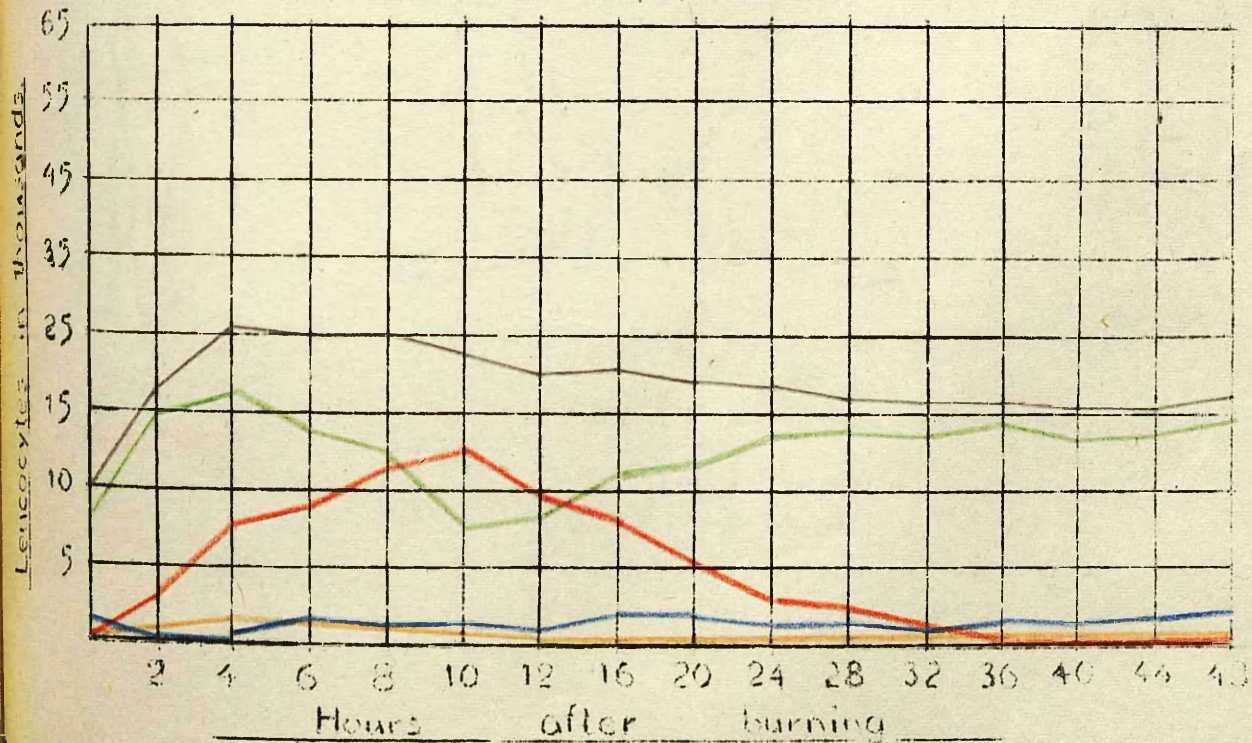
Sex of patient **Male**

Nature of injuries **Burns of face, chest and upper limbs.**  
**Distribution as shown on chart overleaf.**

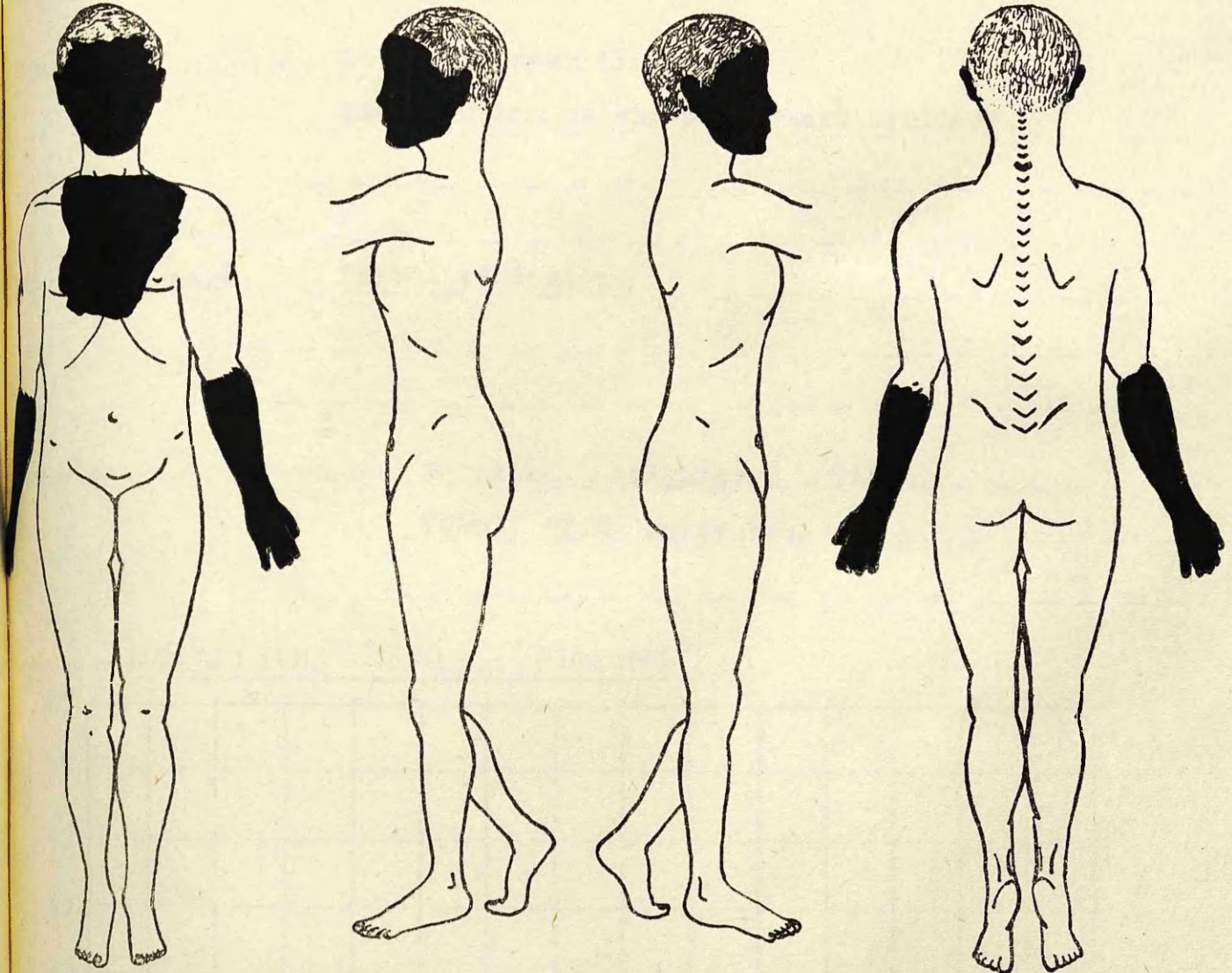
How sustained **Petrol explosion.**

Condition on admission **No pain. Thirsty. Talkative. Temp. 98.4**  
**Pulse 90**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
E Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 67

TREATMENT

Tannic Acid

Age of patient 20 years

Case No. 68

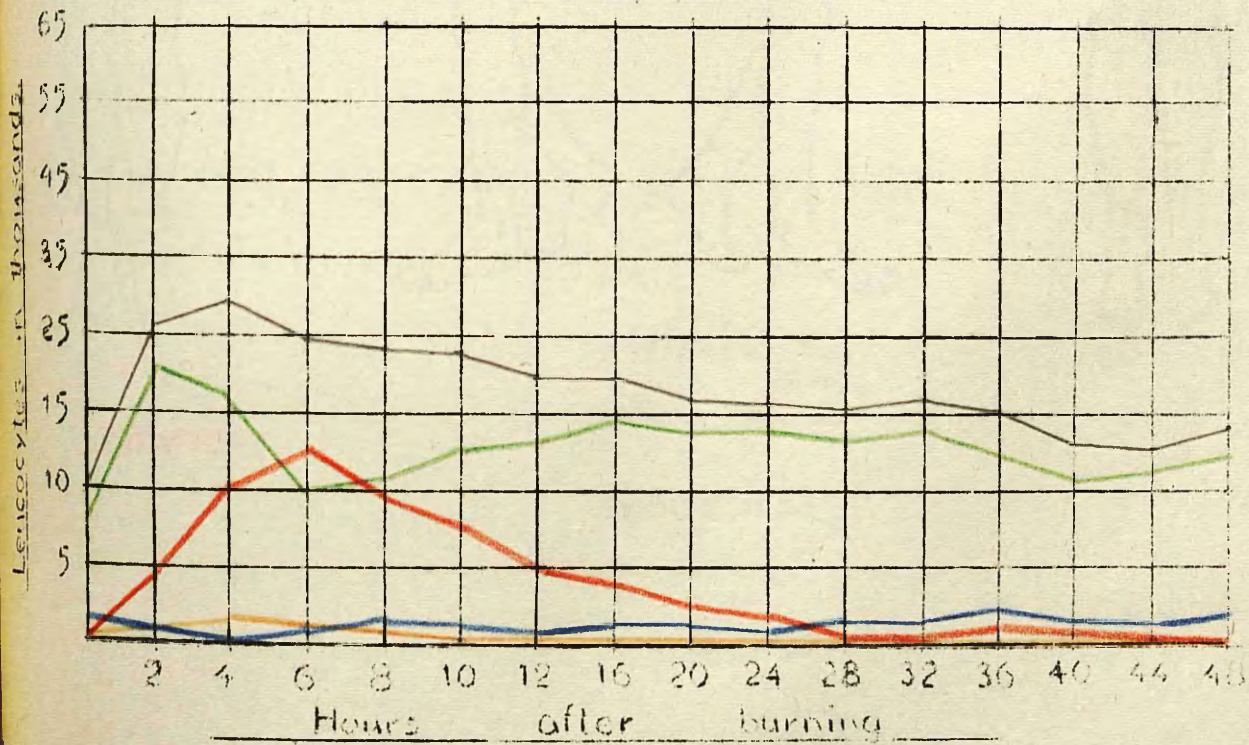
Sex of patient Male

Nature of injuries Burns of upper limbs.  
Distribution as shown on chart overleaf.

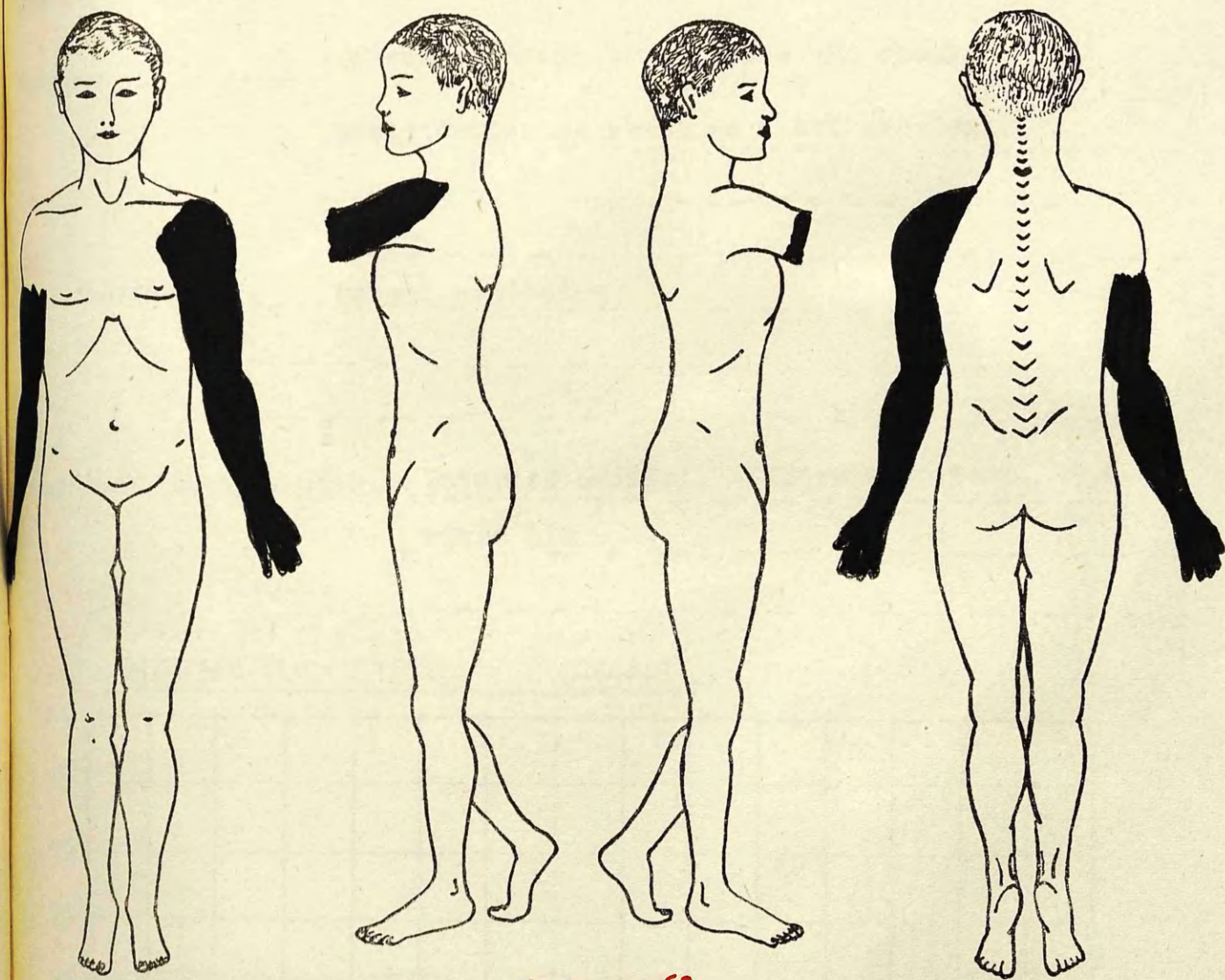
How sustained Petrol explosion.

Condition on admission No pain. Talkative. Thirsty.  
Temp. 98.8 Pulse 94.

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 68

TREATMENT

Tannic Acid

Age of patient **17 years**

Case No. **69**

Sex of patient **Male**

Nature of injuries **Burns of upper limbs, face and chest.**

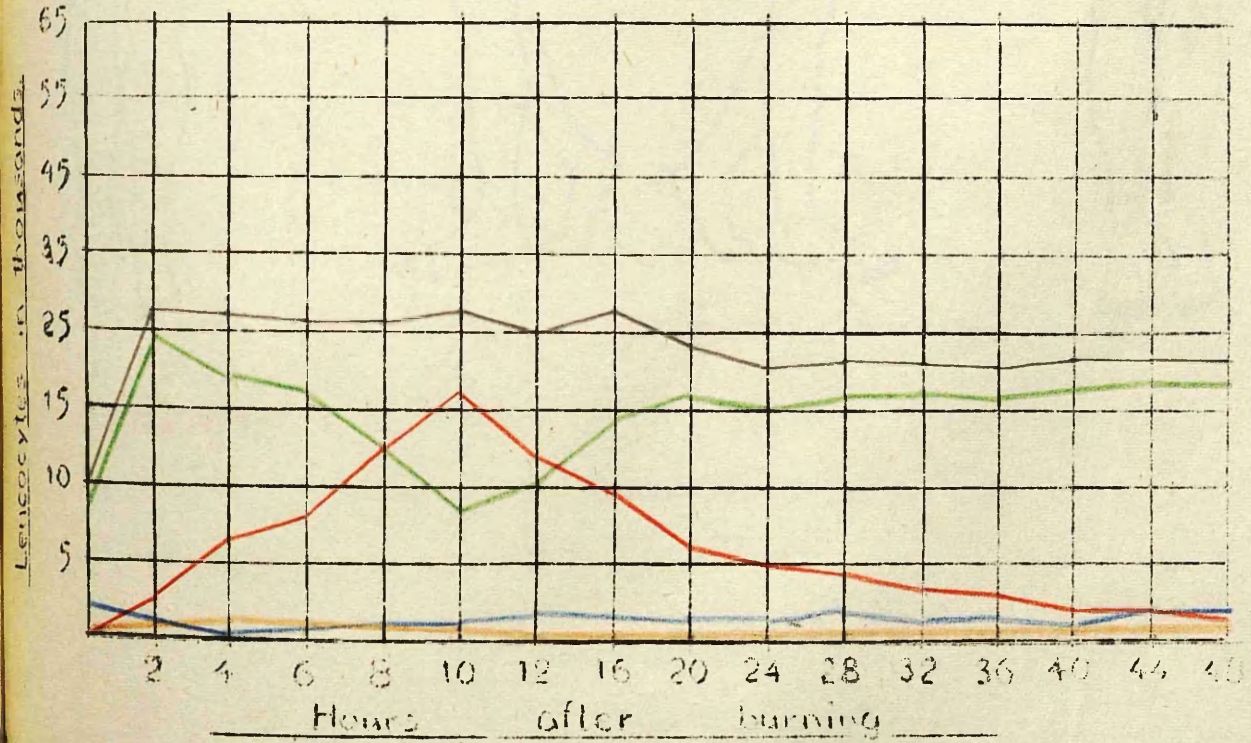
**Distribution as shown on chart overleaf.**

How sustained **Petrol explosion.**

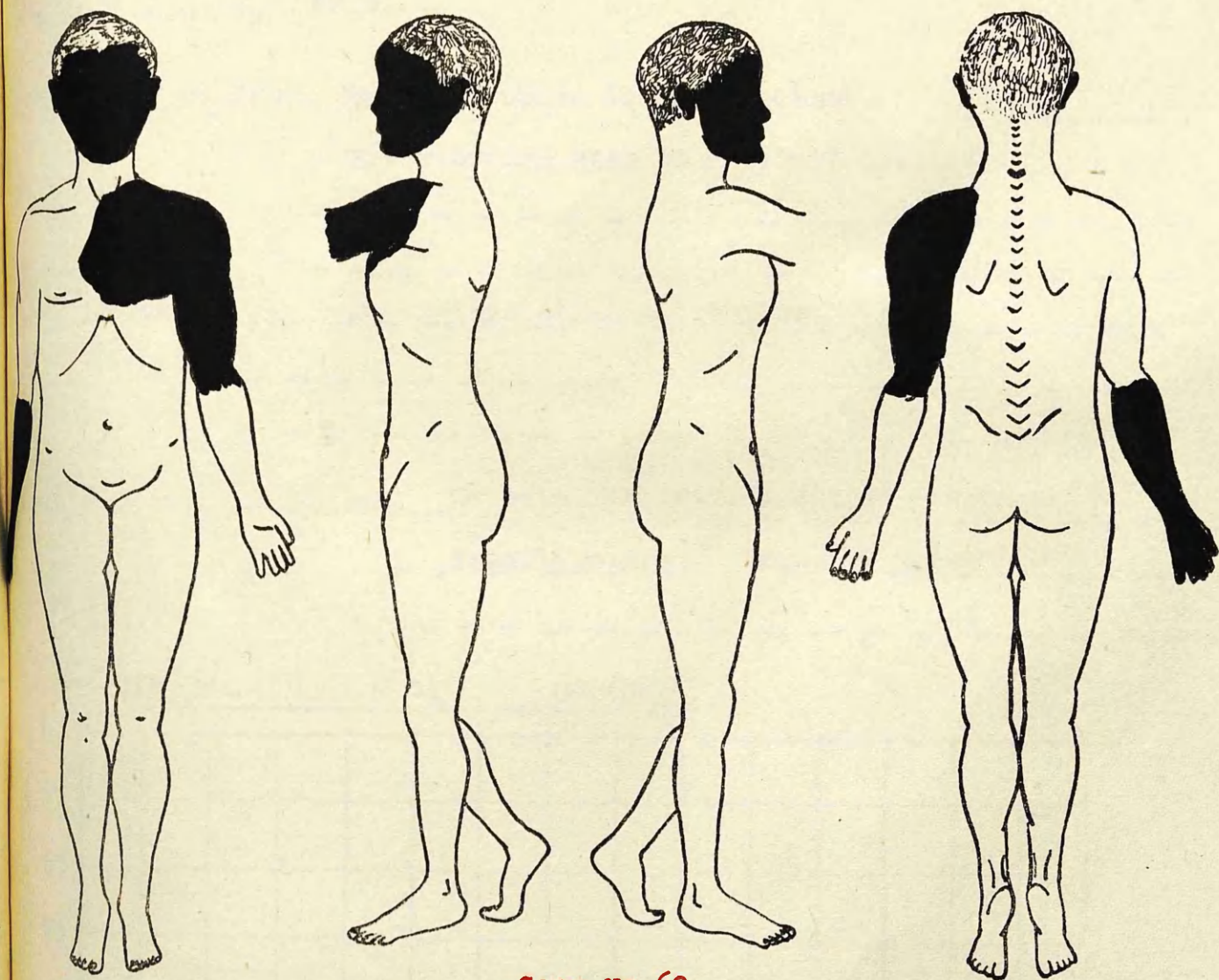
Condition on admission **Injuries painful. Thirsty. Temp. 99.6**

**Pulse 112**

HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes }  
& Monocytes }



Case No.69

TREATMENT

Tannic Acid

Age of patient **21 years**

Case No. **70**

Sex of patient **Male.**

Nature of injuries **Burns of upper limbs and chest.**

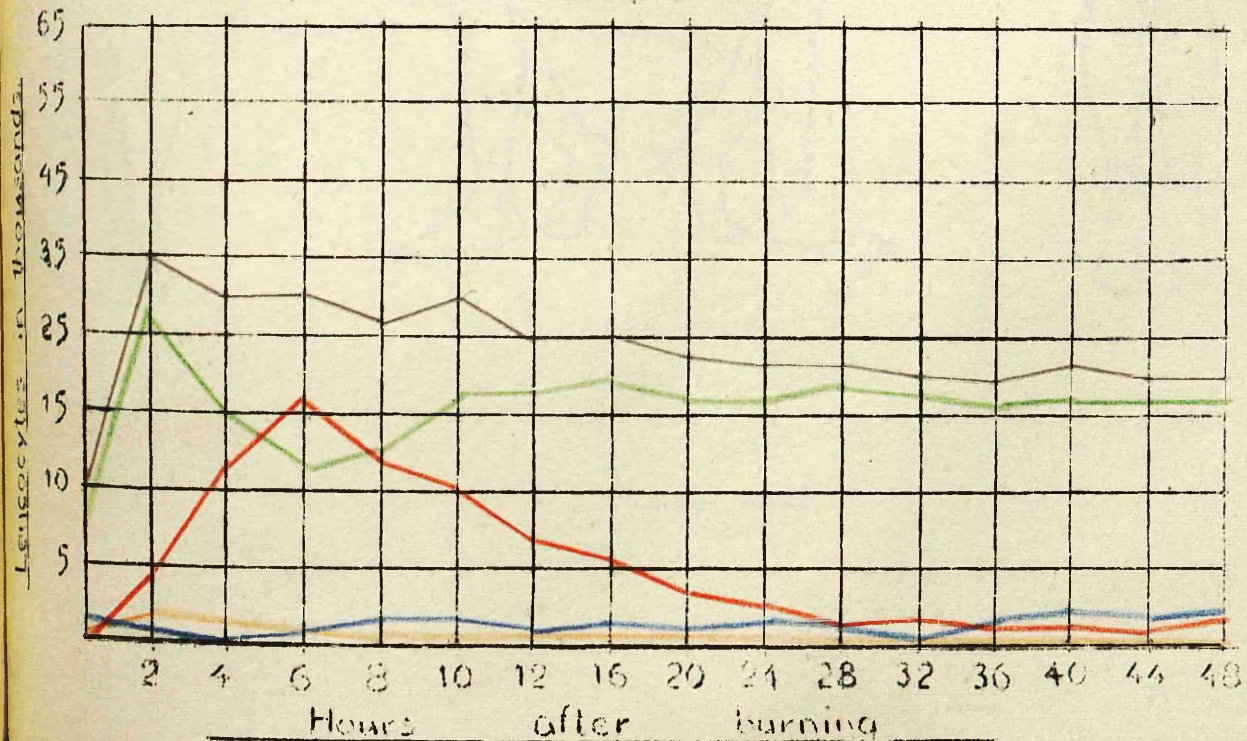
**- Distribution as shown on chart overleaf.**

How sustained **In extinguishing paint fire.**

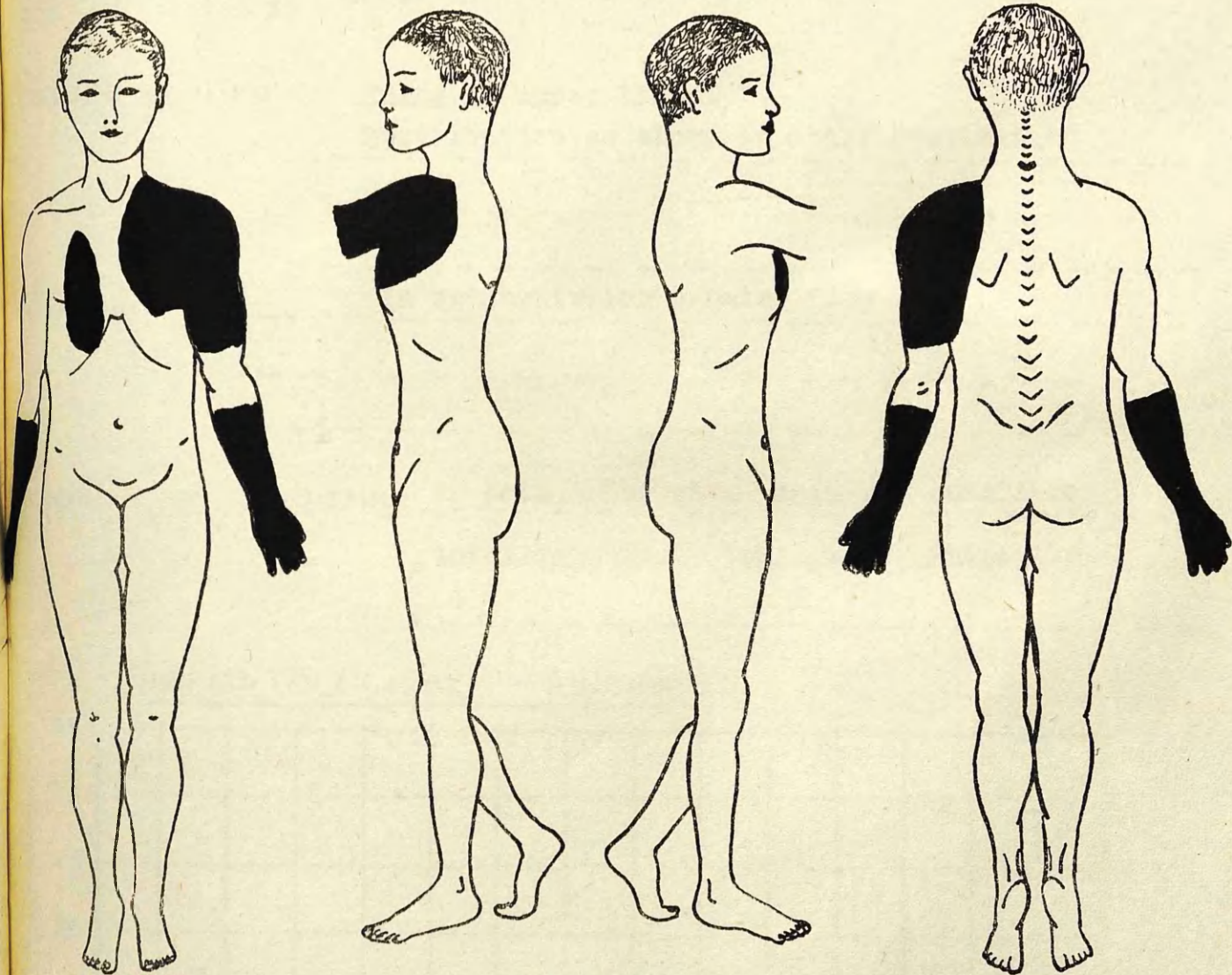
Condition on admission **No pain. Thirsty. Answered questions**

**intelligently. Temp. 99 Pulse 100**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 70

TREATMENT

Tannic Acid

Age of patient 30 years

Case No. -71---

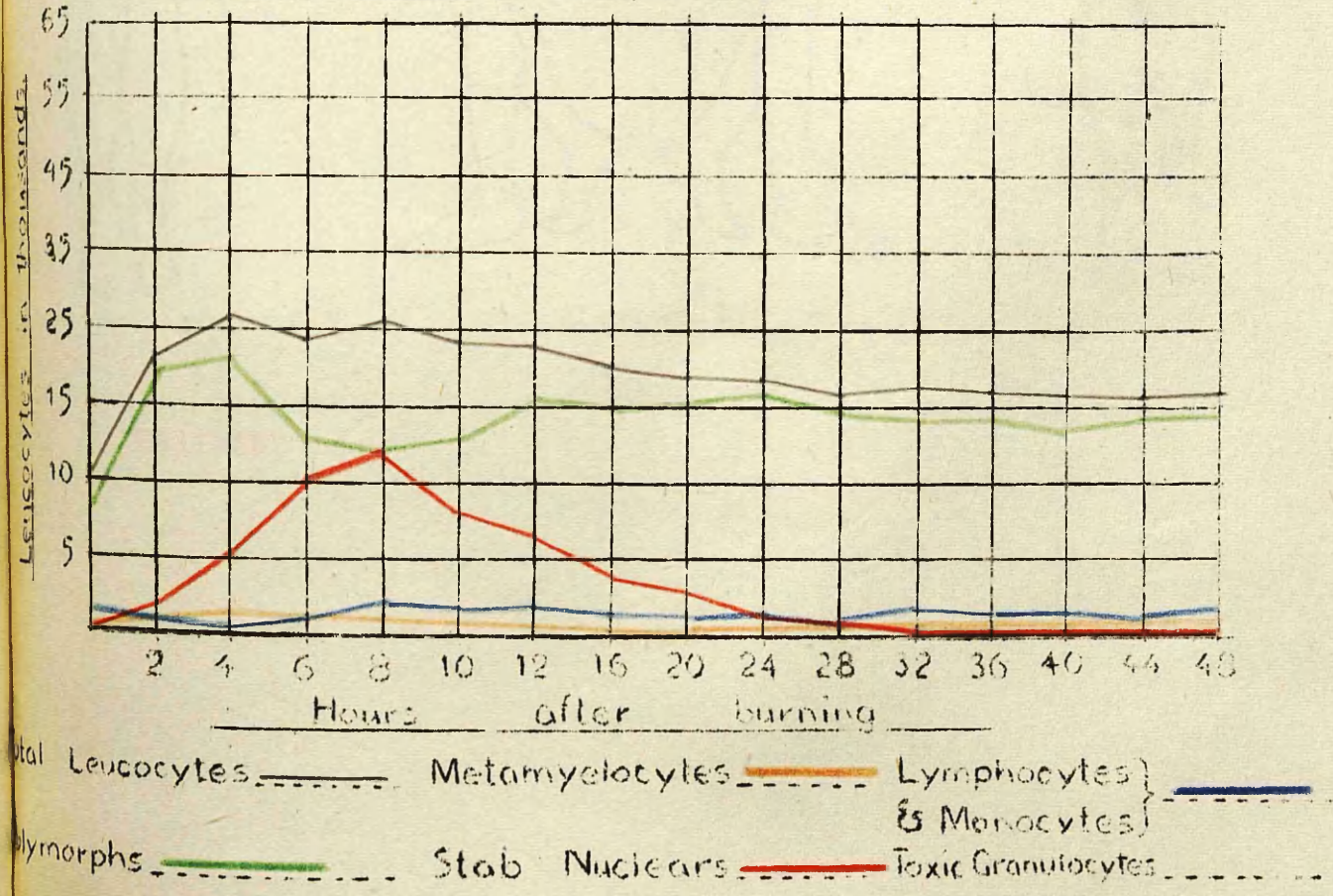
Sex of patient Male.

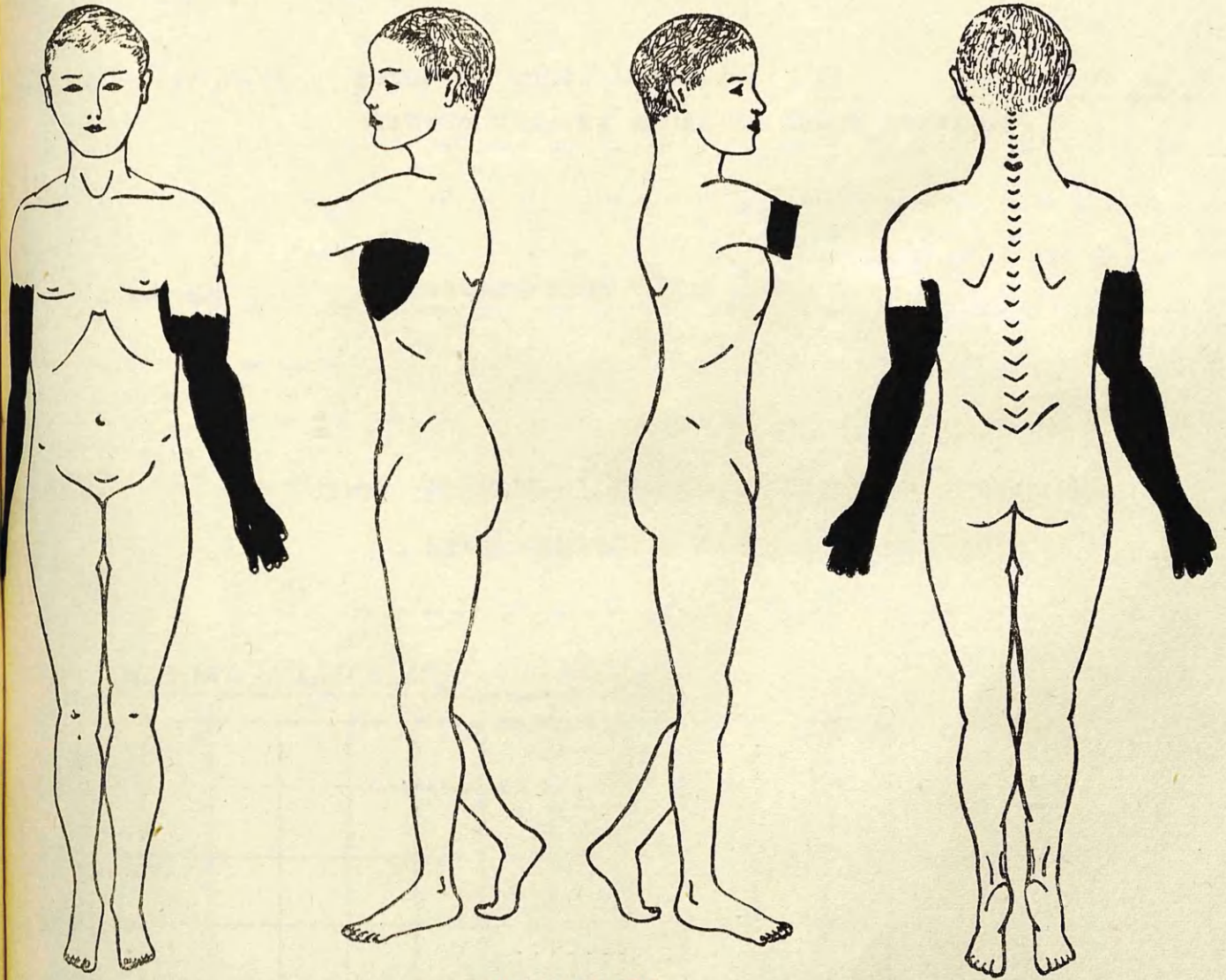
Nature of injuries Burns of upper limbs.  
Distribution as shown on chart overleaf.

How sustained In extinguishing a paint fire.

Condition on admission No pain. Thirsty. Answered questions  
intelligently. Temp. 98.8 Pulse 110

### HAEMATOLOGICAL FINDINGS





Case No.71

TREATMENT

Tannic Acid

Age of patient 33 years

Case No. 72

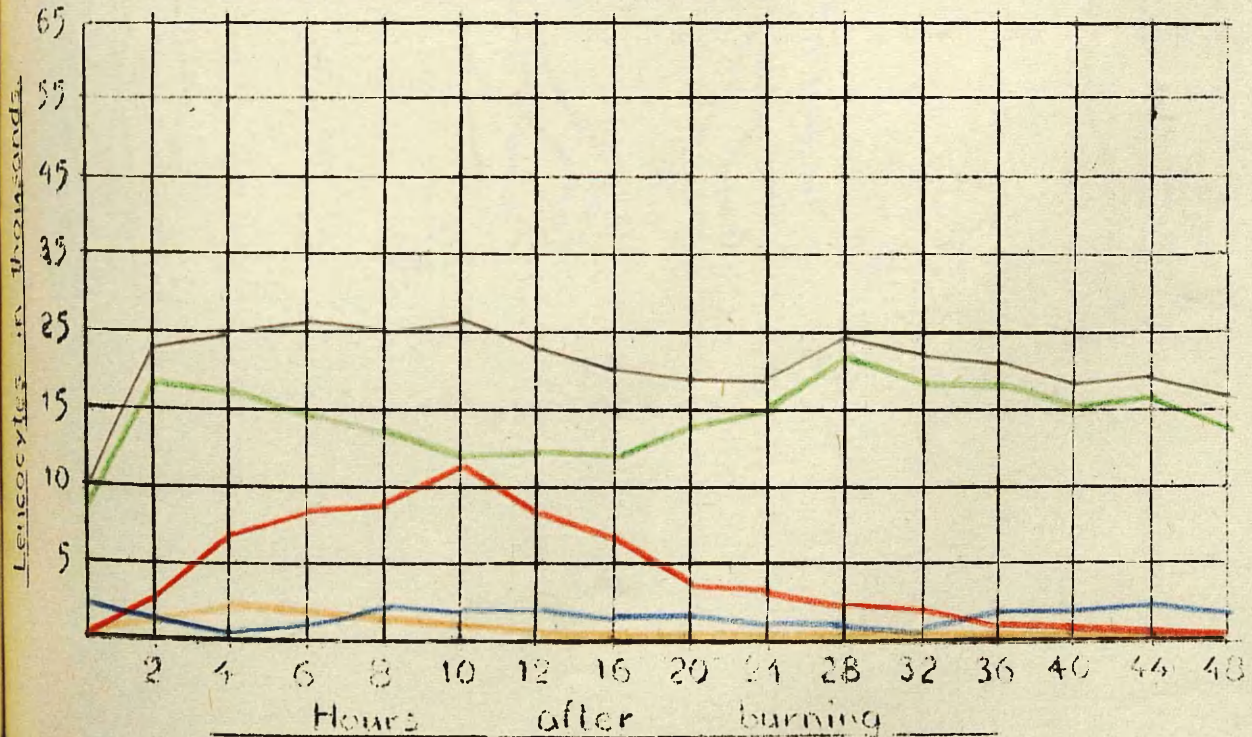
Sex of patient Male.

Nature of injuries Burns of upper limbs.  
distribution as shown on chart overleaf.

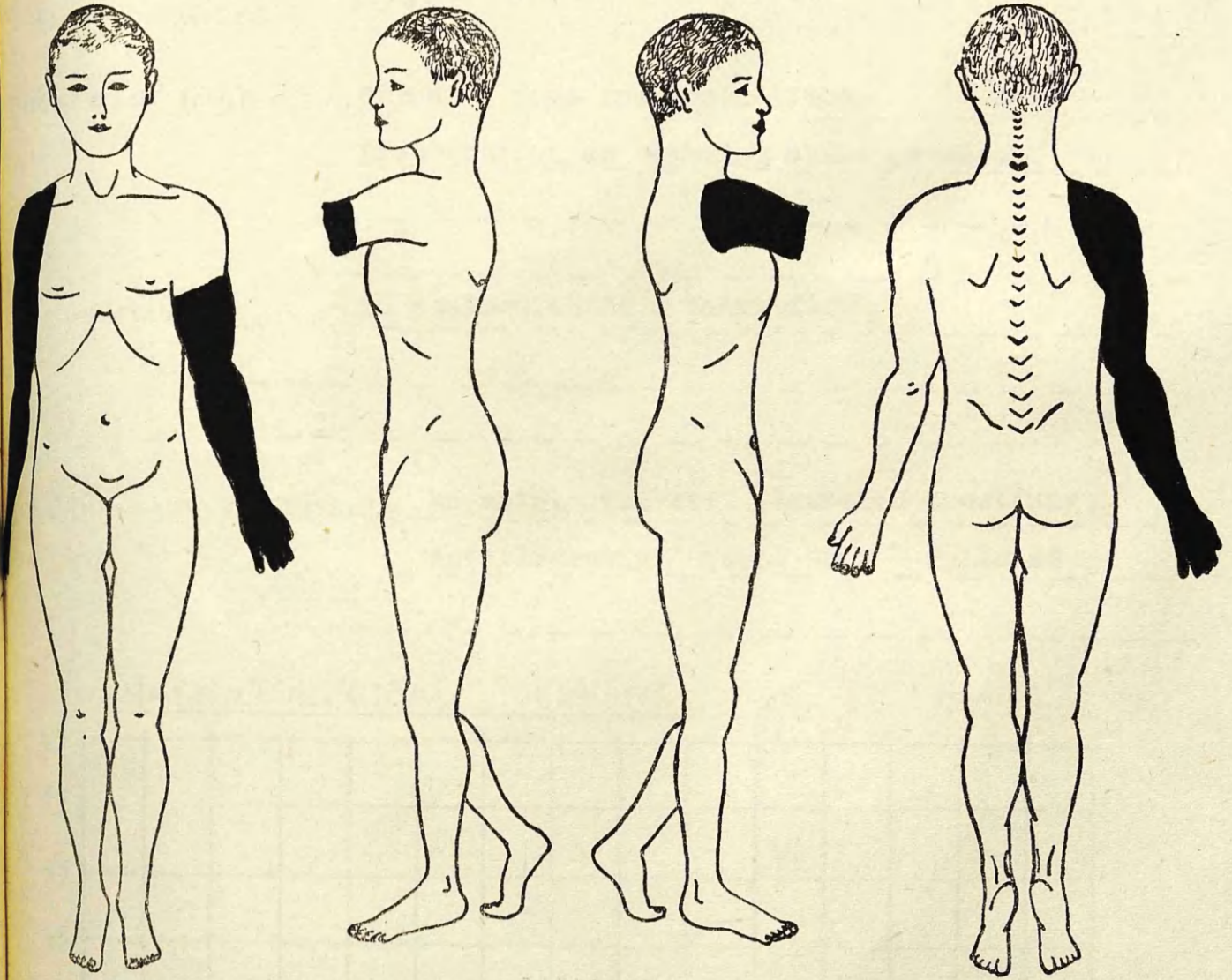
How sustained In extinguishing paint fire.

Condition on admission No pain. Thirsty. Answered questions  
intelligently. Temp. 98 Pulse 90.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 72

TREATMENT

Tannic Acid

Age of patient 32 years.

Case No. 73

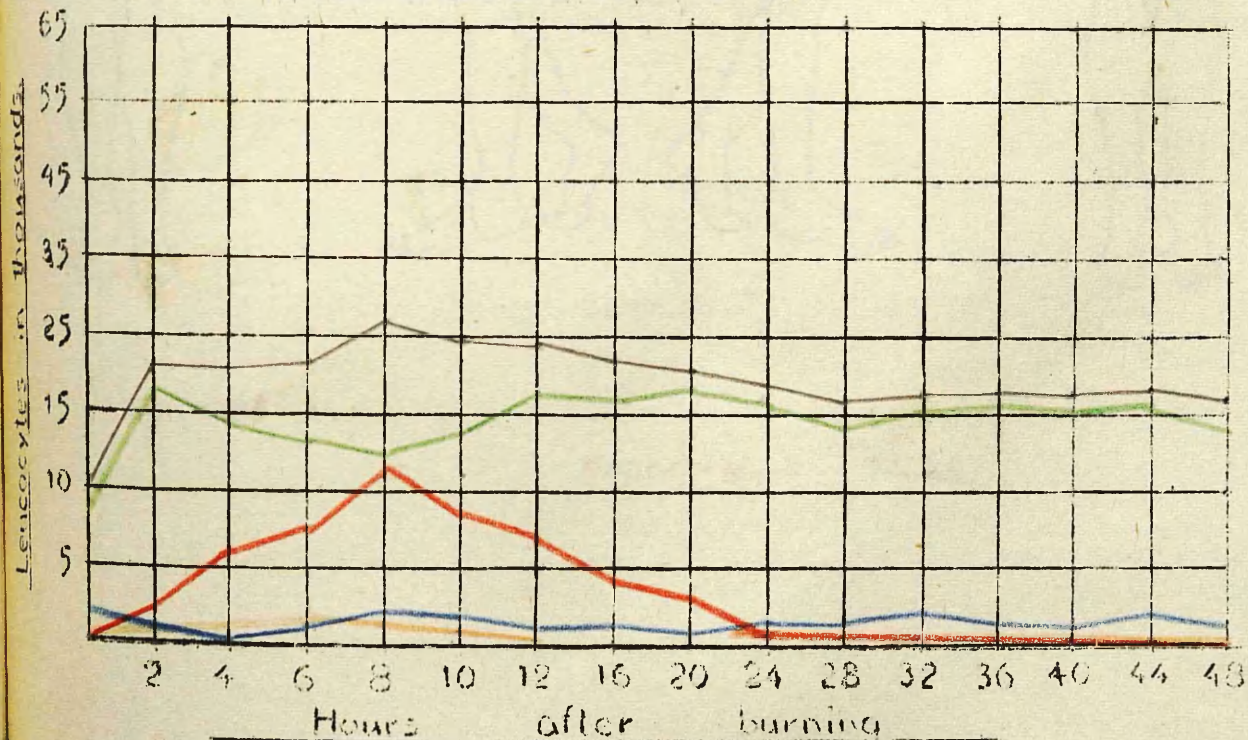
Sex of patient Male.

Nature of injuries Burns of face and upper limbs.  
Distribution as shown on chart overleaf.

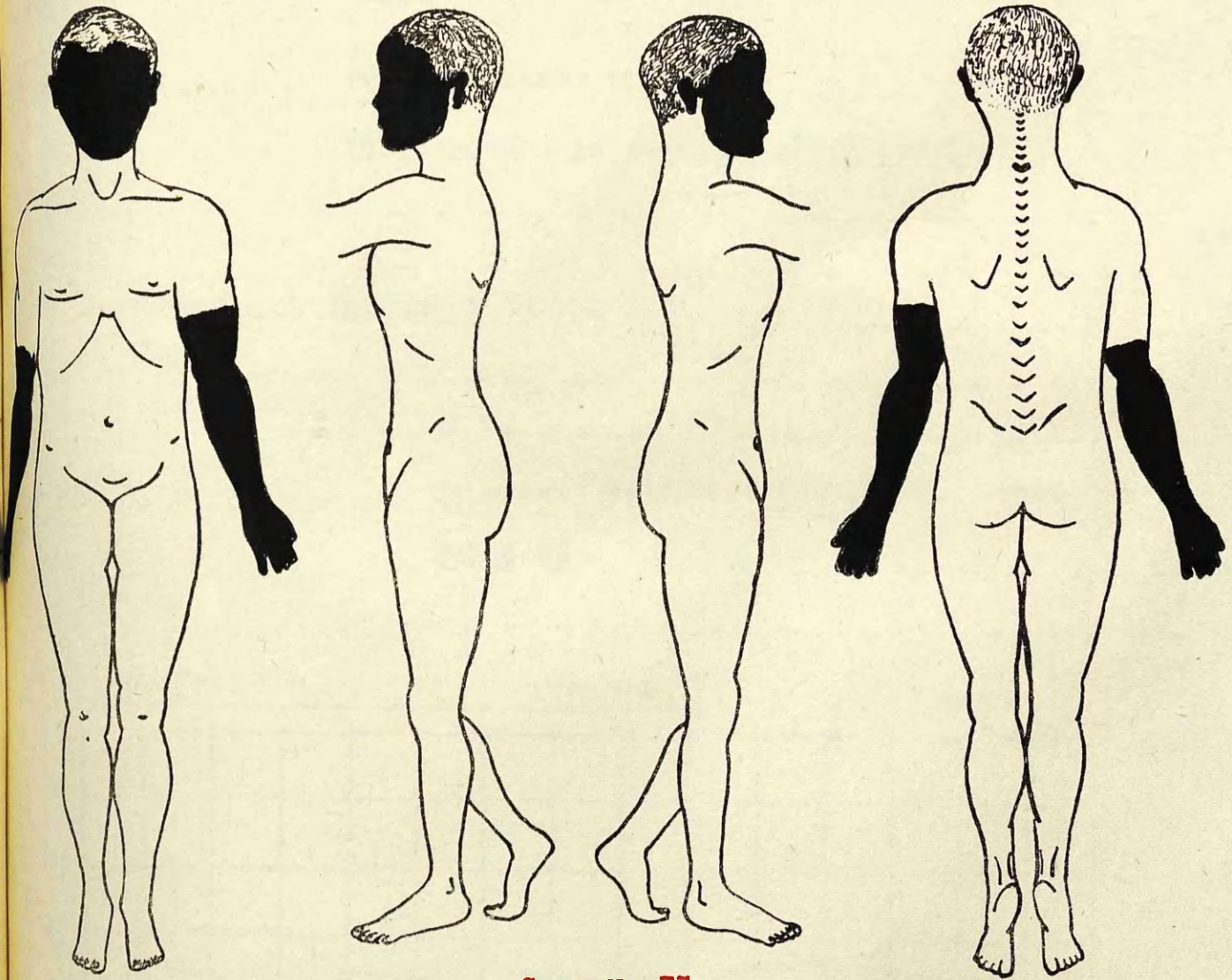
How sustained In extinguishing a paint fire.

Condition on admission No pain. Thirsty. Answered questions  
intelligently. Temp. 98.2 Pulse 88

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No.73

TREATMENT

Tannic Acid

Age of patient 49 years.

Case No. 74

Sex of patient Male.

Nature of injuries Burns of lower limbs.

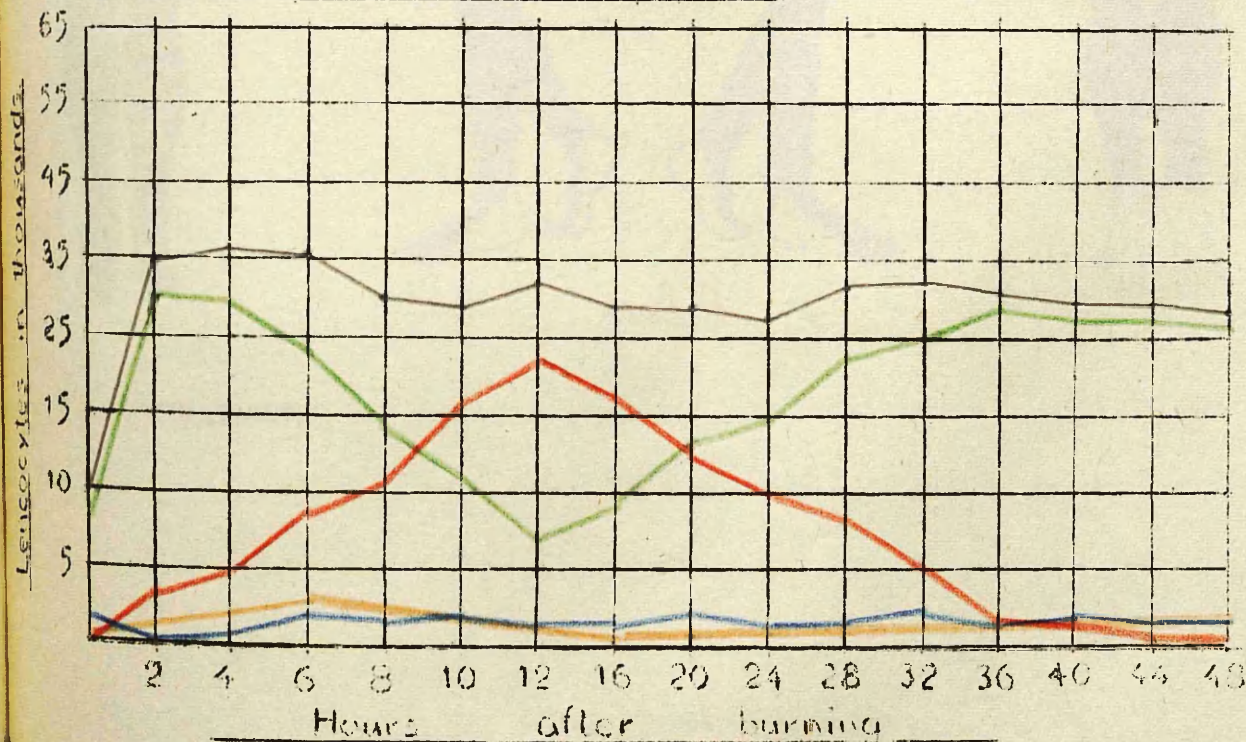
Distribution as shown on chart overleaf.

How sustained Dungarees caught fire.

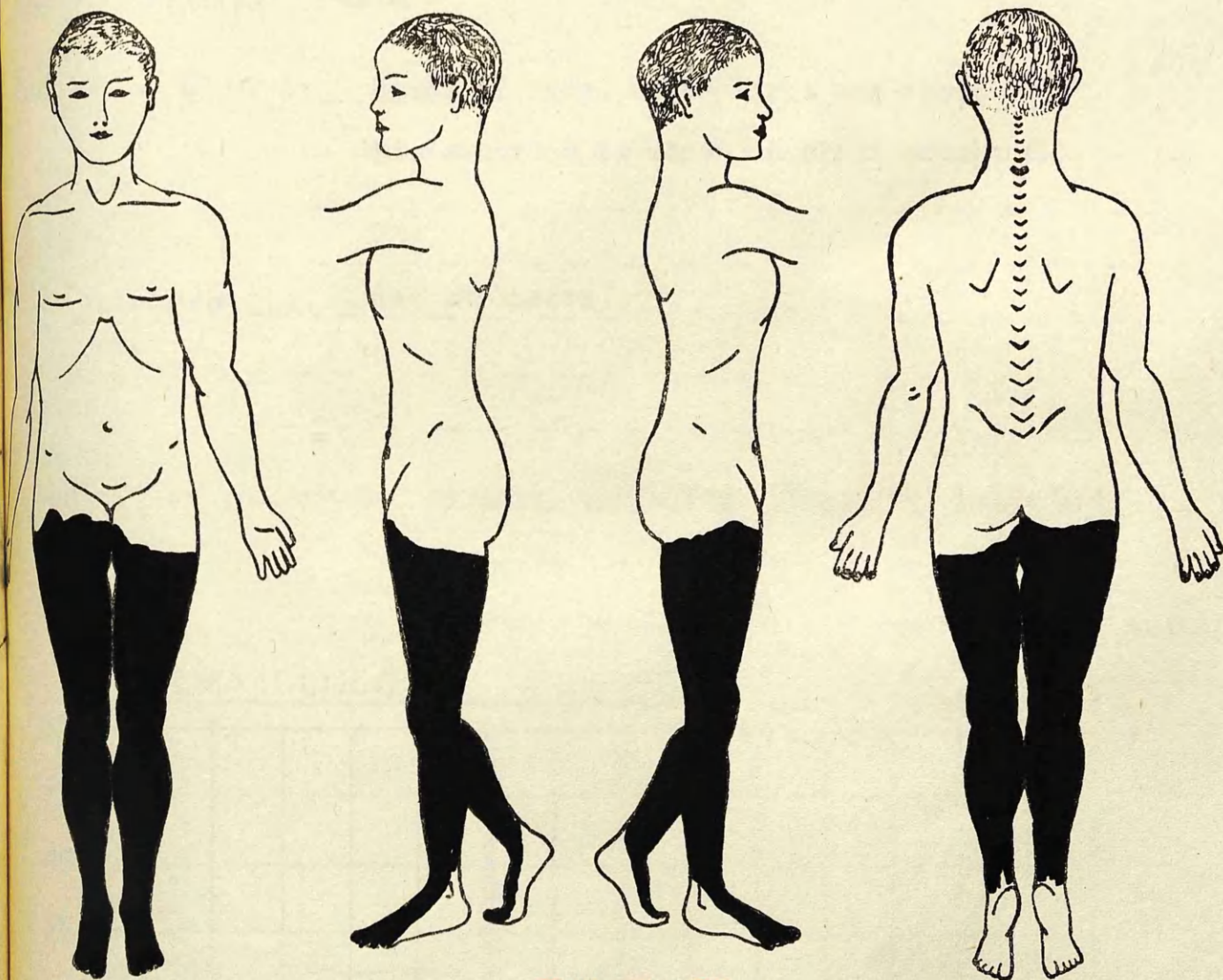
Condition on admission No pain. Thirsty. Talkative. Temp. 98

Pulse 86

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
( & Monocytes ) \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 74

TREATMENT

Tannic Acid

Age of patient **27 years**

Case No **75**

Sex of patient **Male**

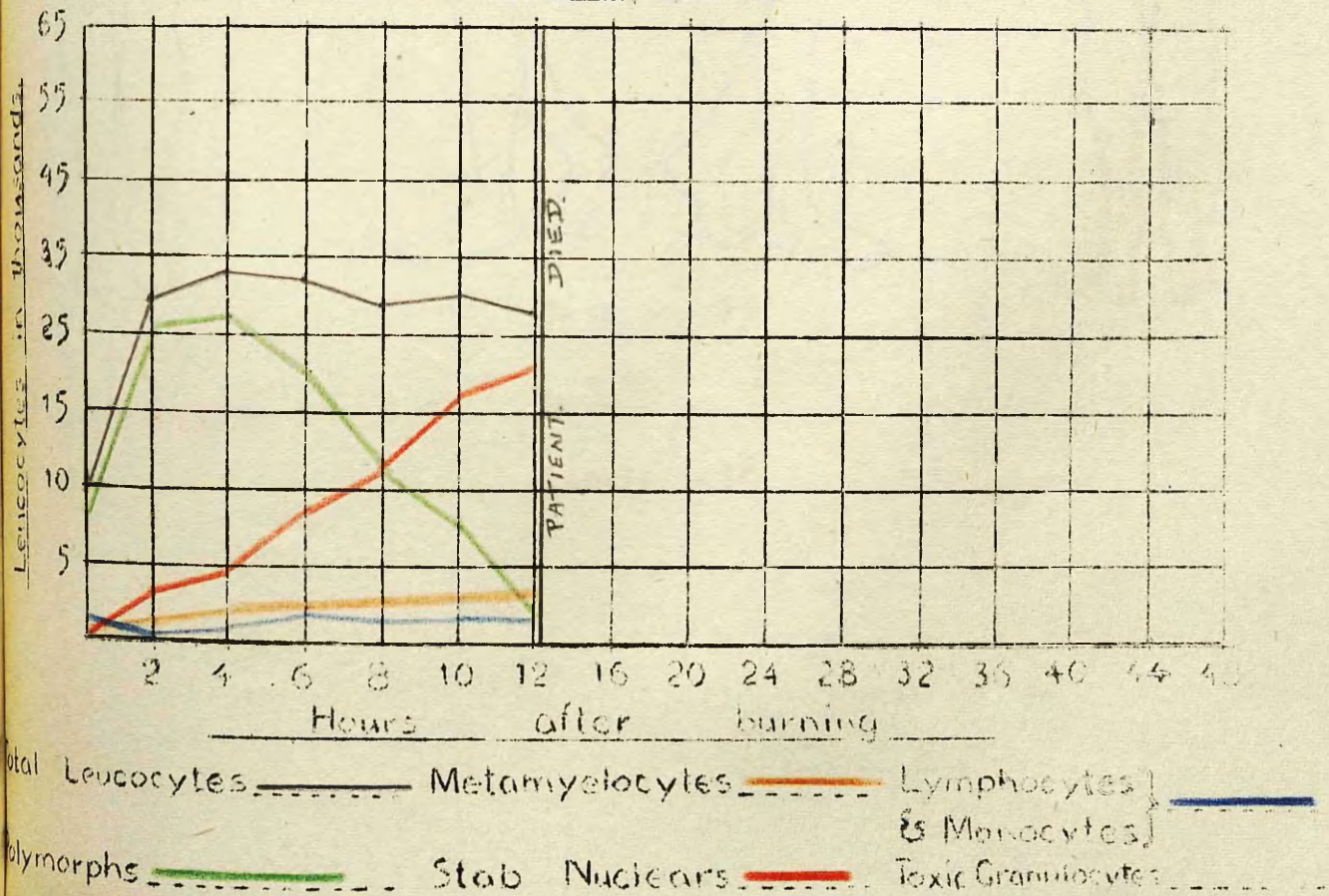
Nature of injuries **Burns of face, upper limbs and chest.**

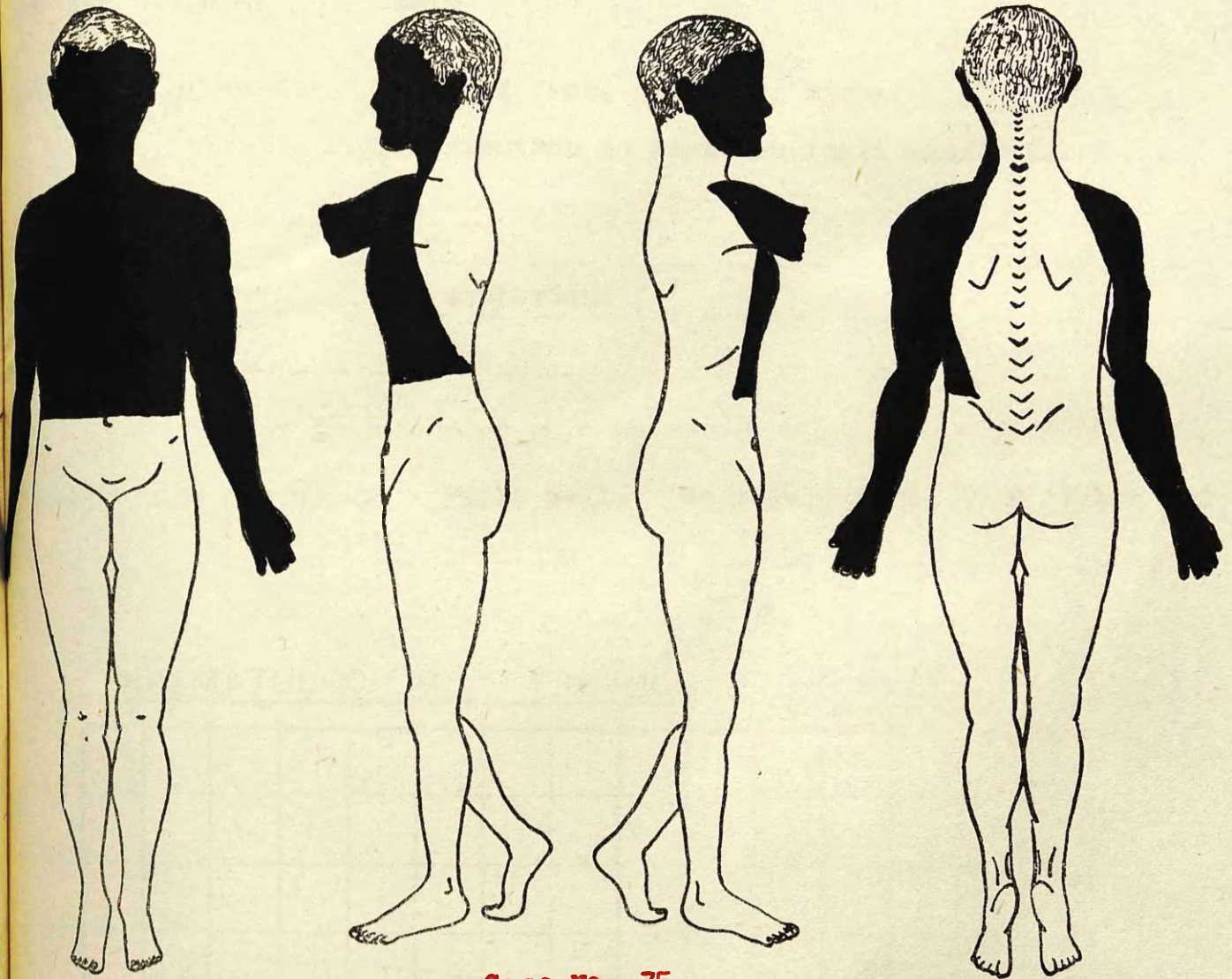
**-- Distribution as shown on chart overleaf.**

How sustained **Gas explosion.**

Condition on admission **No pain, talkative. Temp. 99 Pulse 106**

### HAEMATOLOGICAL FINDINGS





Case No. 75

TREATMENT

Tannic Acid

Age of patient **30 years**

Case No **76**

Sex of patient **Male**

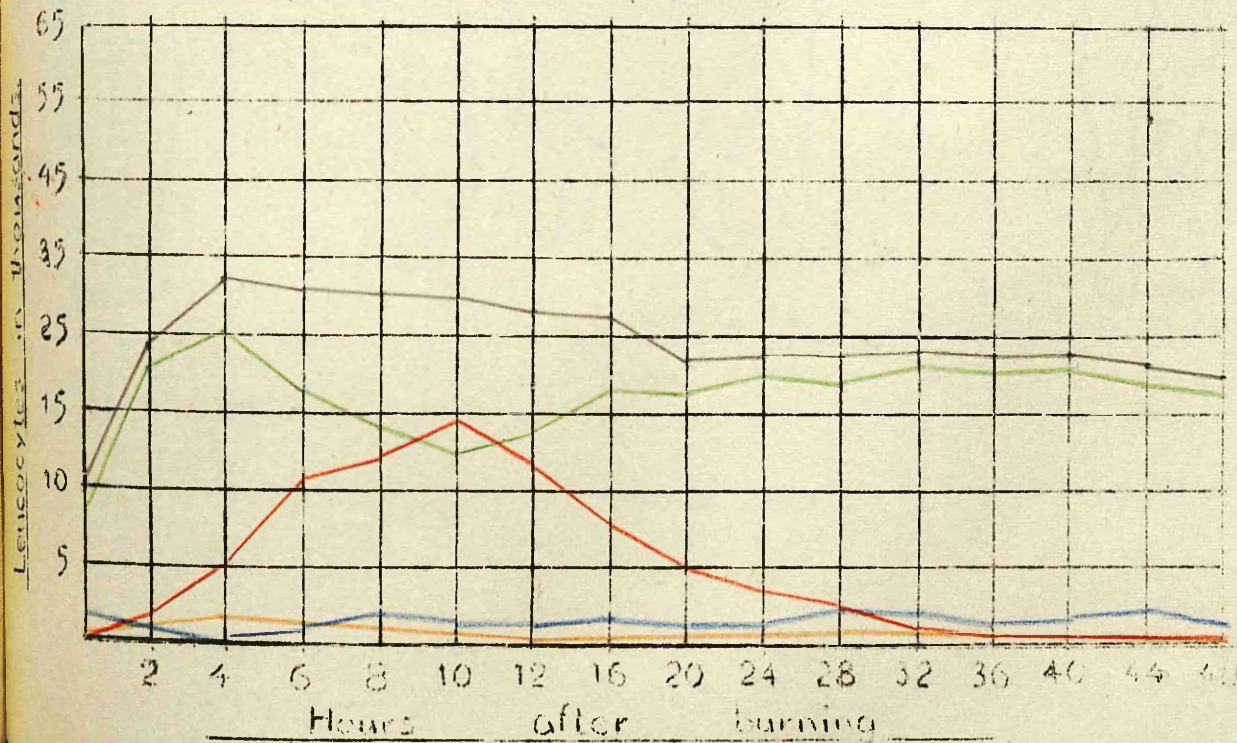
Nature of injuries **Burns of face, and upper limbs.**

**--- Distribution as shown on chart overleaf. ---**

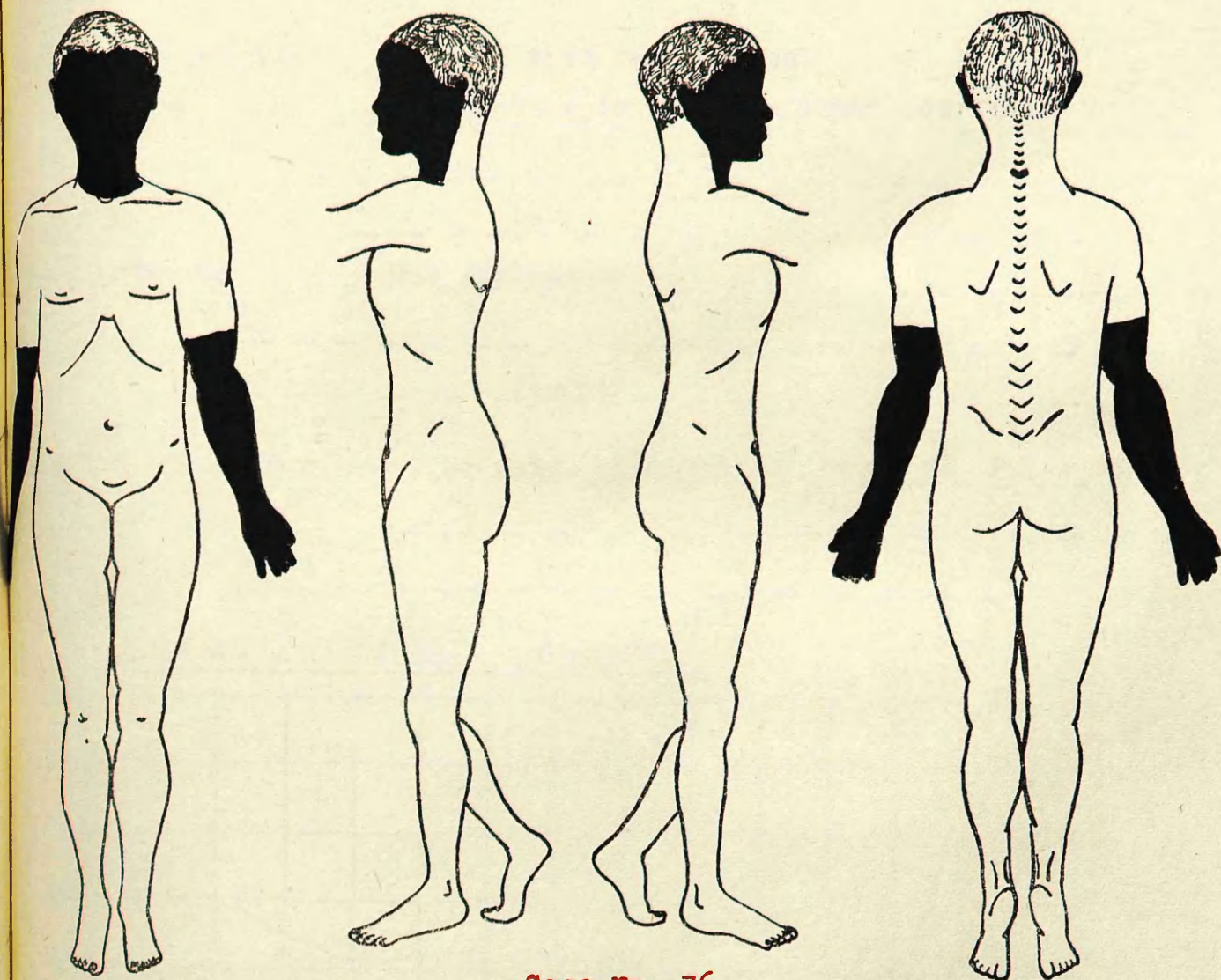
How sustained **Gas explosion.**

Condition on admission **Feels well. No pain. Temp. 99.4 Pulse 100**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes }  
 & Monocytes }



Case No. 76

TREATMENT

Tannic Acid

Age of patient **18 years**

Case No. **77**

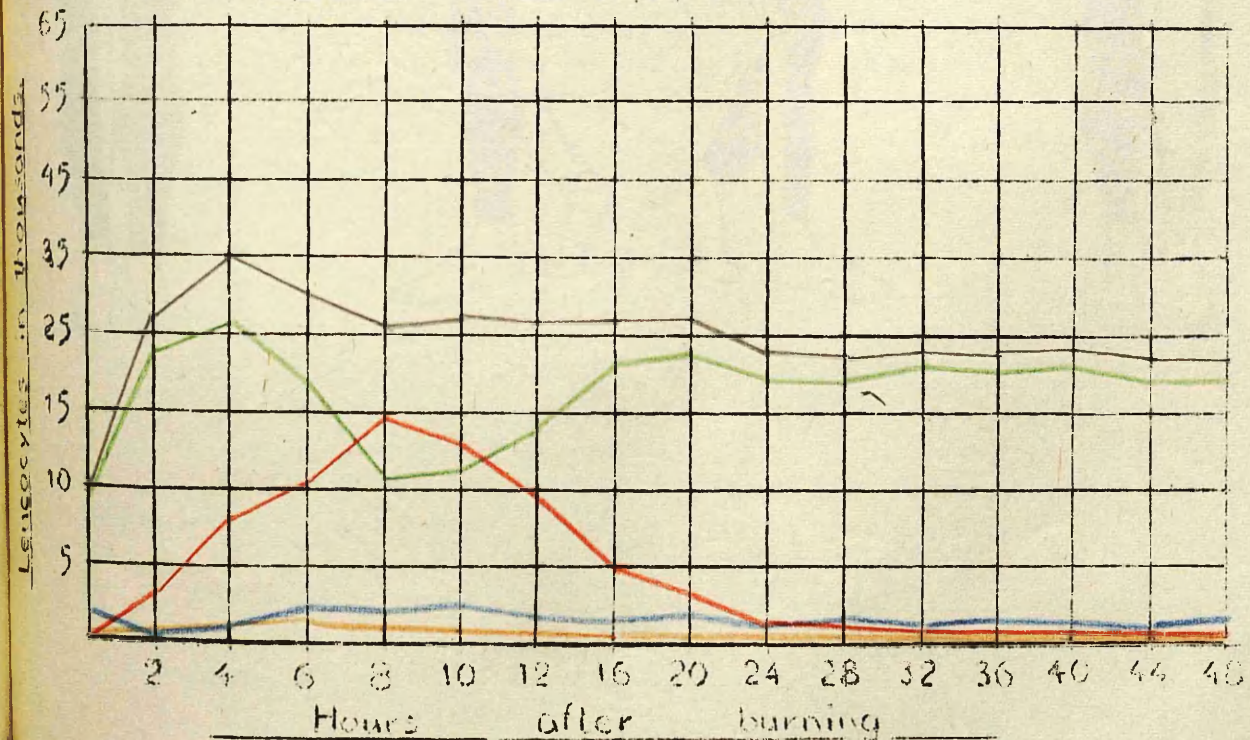
Sex of patient **Male**

Nature of injuries **Burns of both lower limbs.**  
**Distribution as shown on chart overleaf.**

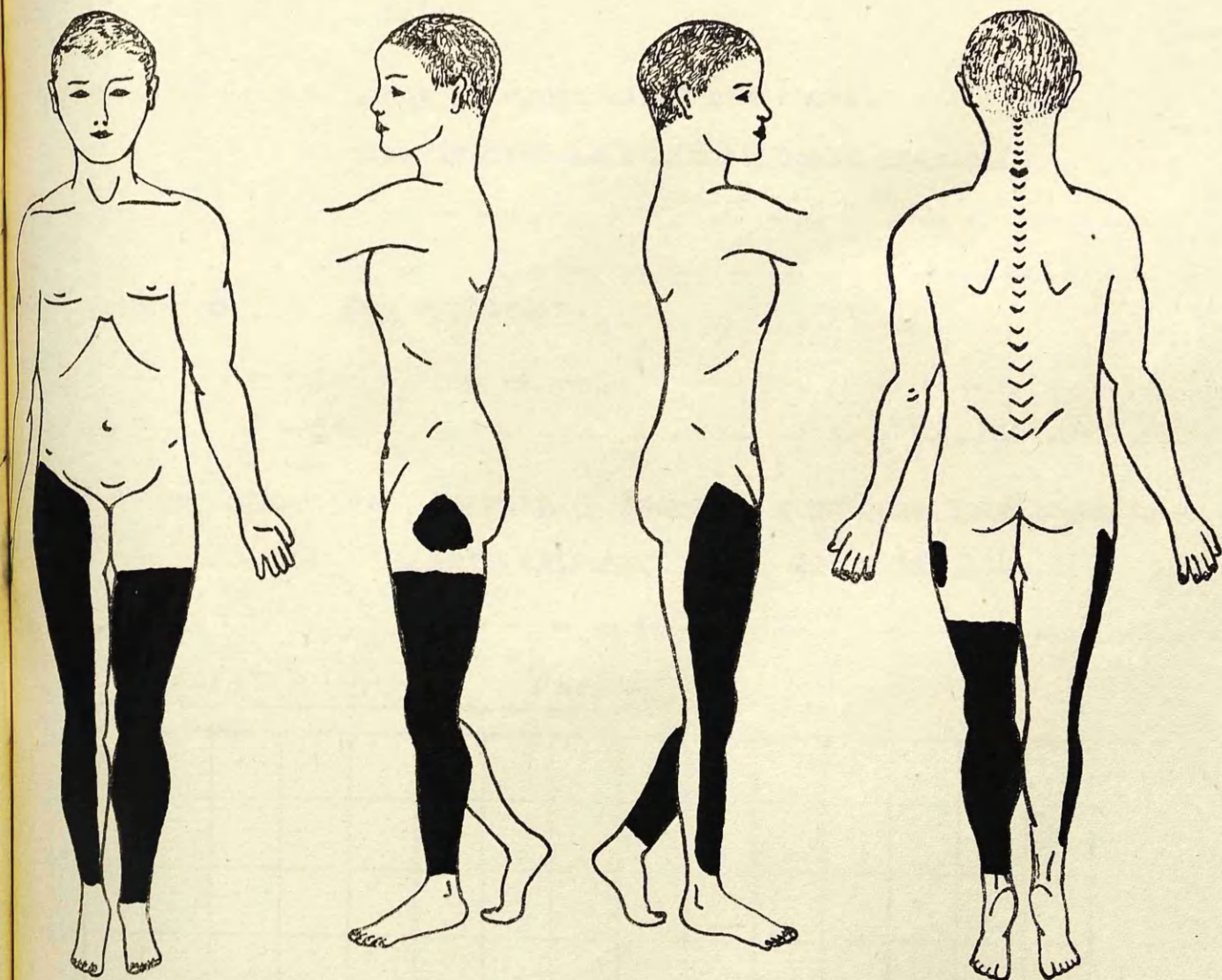
How sustained **Gas explosion.**

Condition on admission **No pain. Talkative. Temp. 98 Pulse 96**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No.77

TREATMENT

Tannic Acid

Age of patient **56 years**

Case No. **78**

Sex of patient **Male**

Nature of injuries **Burns of upper limbs and chest.**

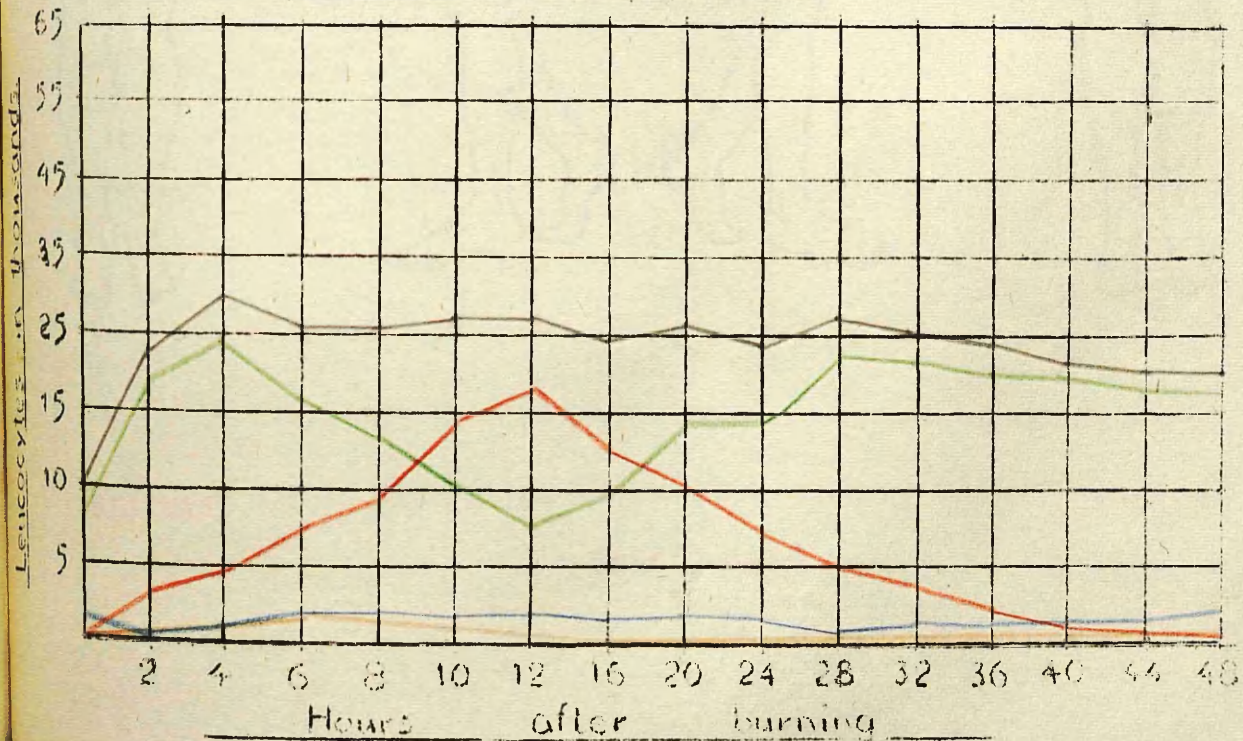
**- distribution as shown on chart overleaf.**

How sustained **Gas explosion.**

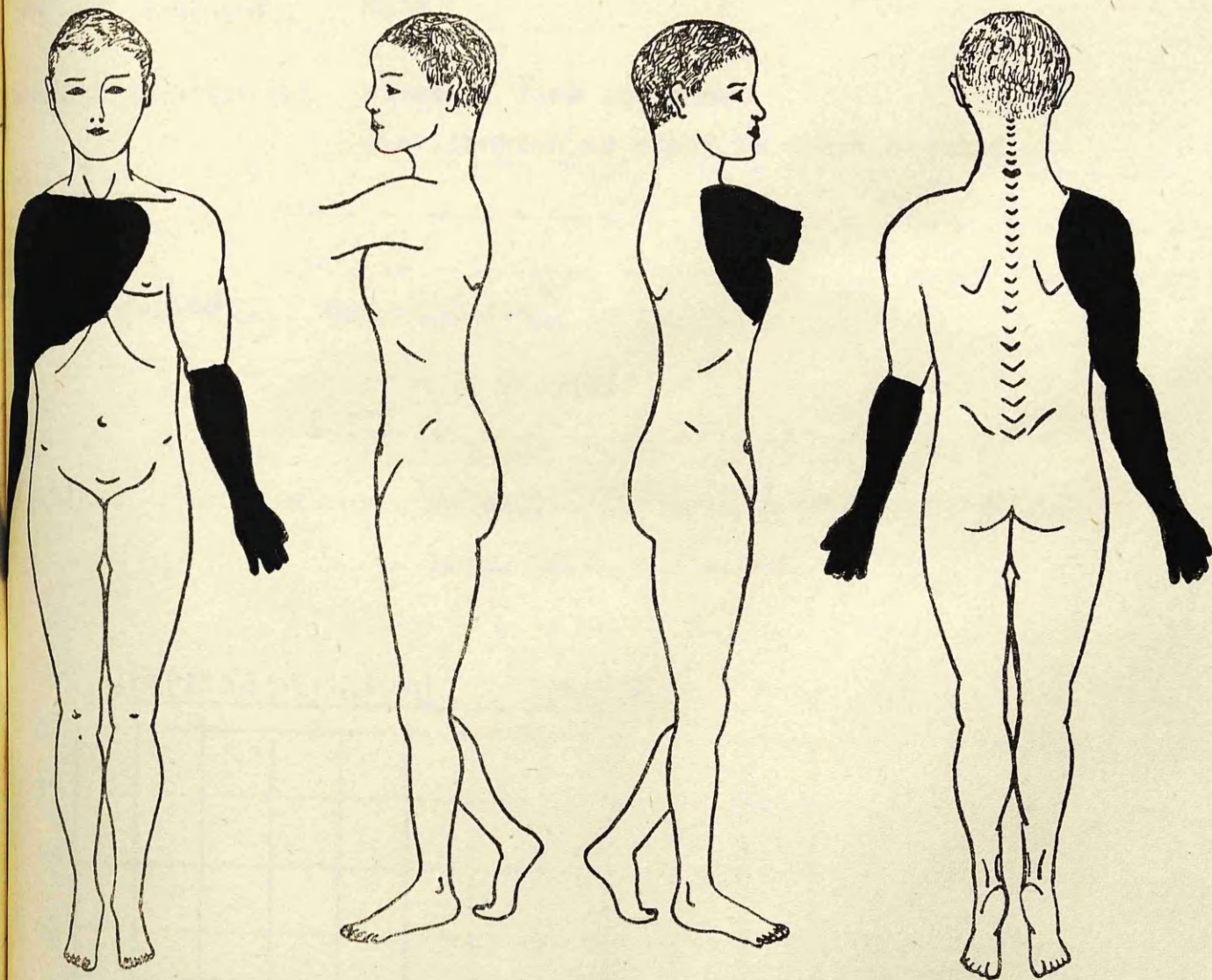
Condition on admission **No pain. Answered questions intelligently**

**- Very thirsty. Temp. 99 Pulse 100**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No.78

TREATMENT

Tannic Acid

Age of patient **22 years**

Case No **79**

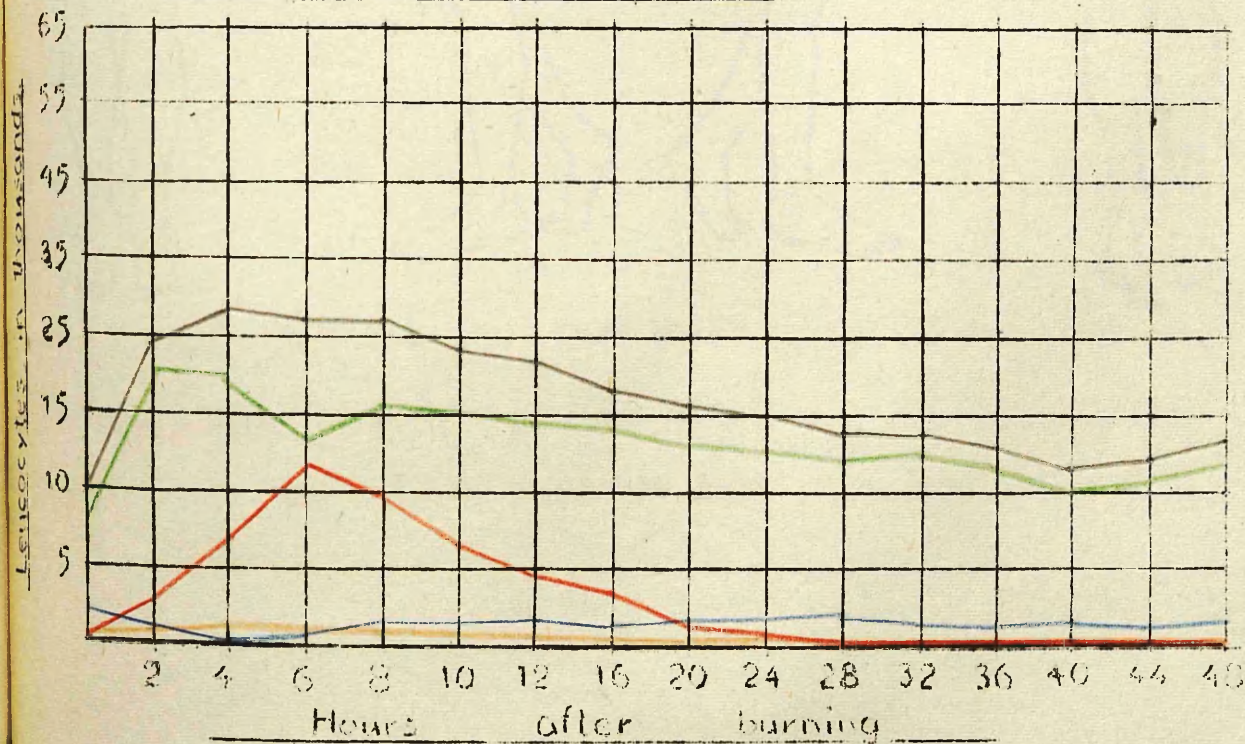
Sex of patient **Male**

Nature of injuries **Burns of face and chest**  
**distribution as shown on chart overlaf**

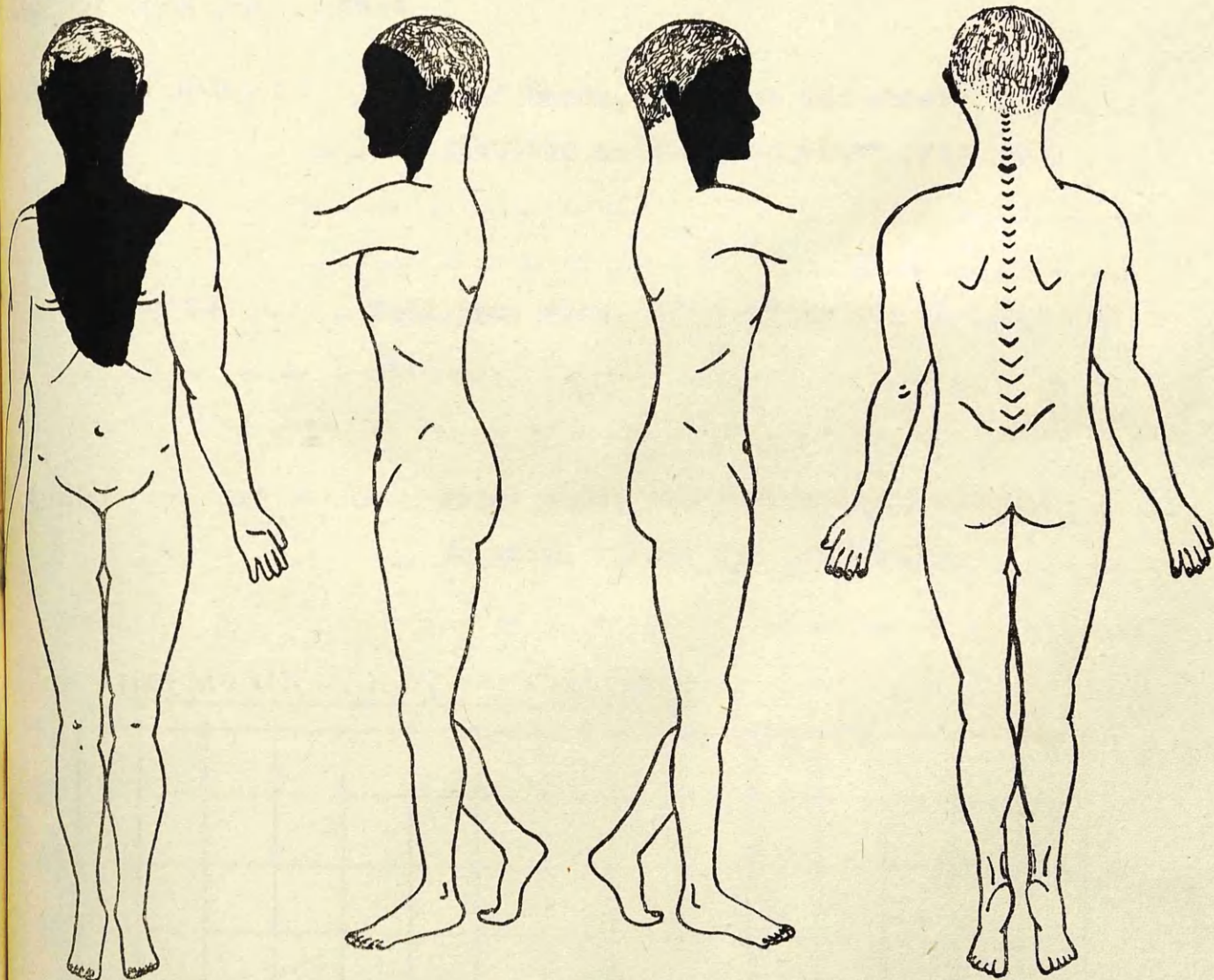
How sustained **Gas explosion.**

Condition on admission **No pain. Answered questions intelligently.**  
**Temp. 99.8 Pulse 100**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Myeloblasts \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No.79

TREATMENT

Tannic Acid

Age of patient **65 years**

Case No. **80**

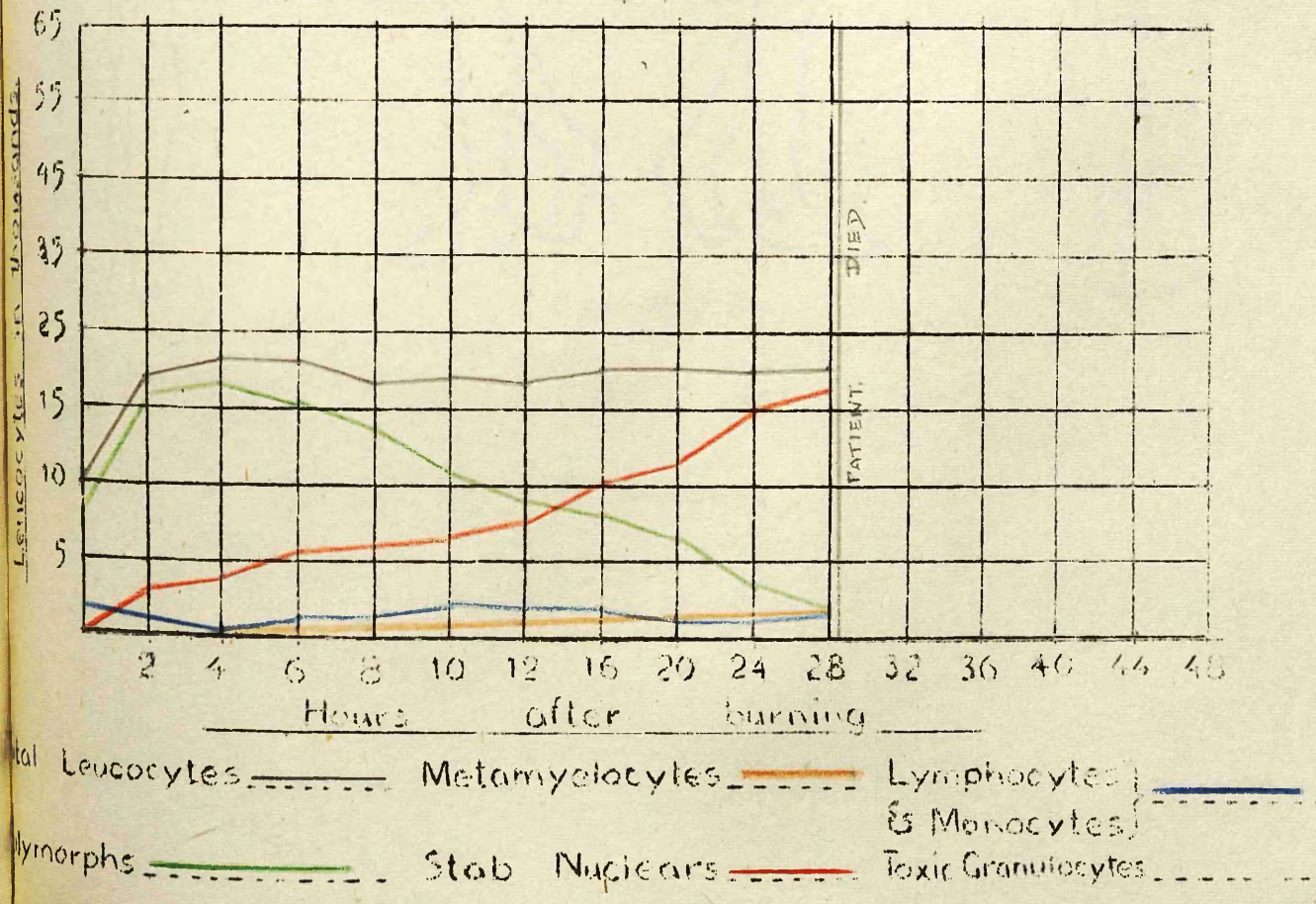
Sex of patient **Male**

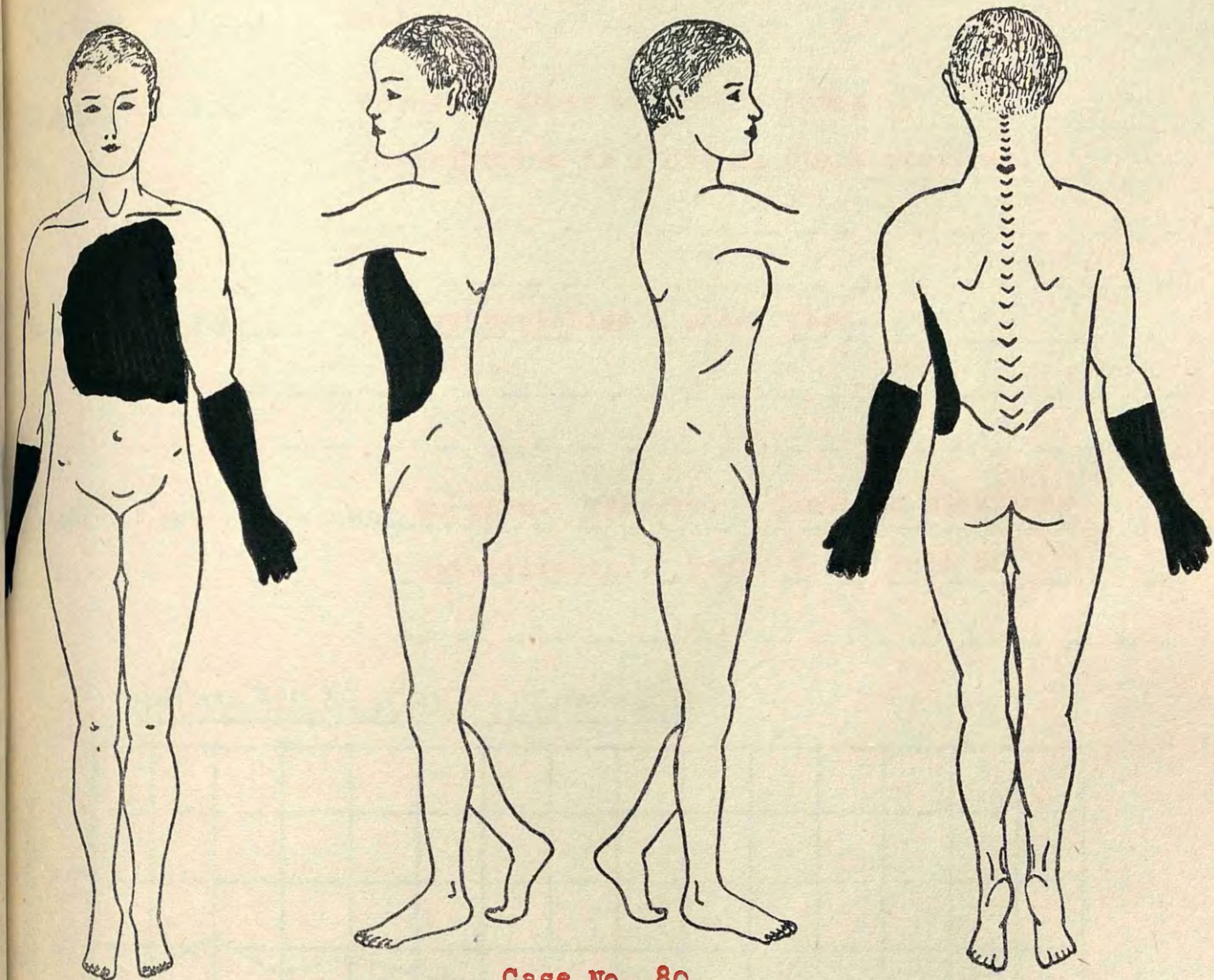
Nature of injuries **Burns of hands, forearms and chest.**  
**Distribution as shown on chart overleaf.**

How sustained **Fell into fire, while under the influence of alcohol.**

Condition on admission **Still under the influence of alcohol**  
**No pain. Temp. 99 Pulse 104**

HAEMATOLOGICAL FINDINGS





Case No. 80

TREATMENT

Tannic Acid

Age of patient **24 years**

Case No. **81**

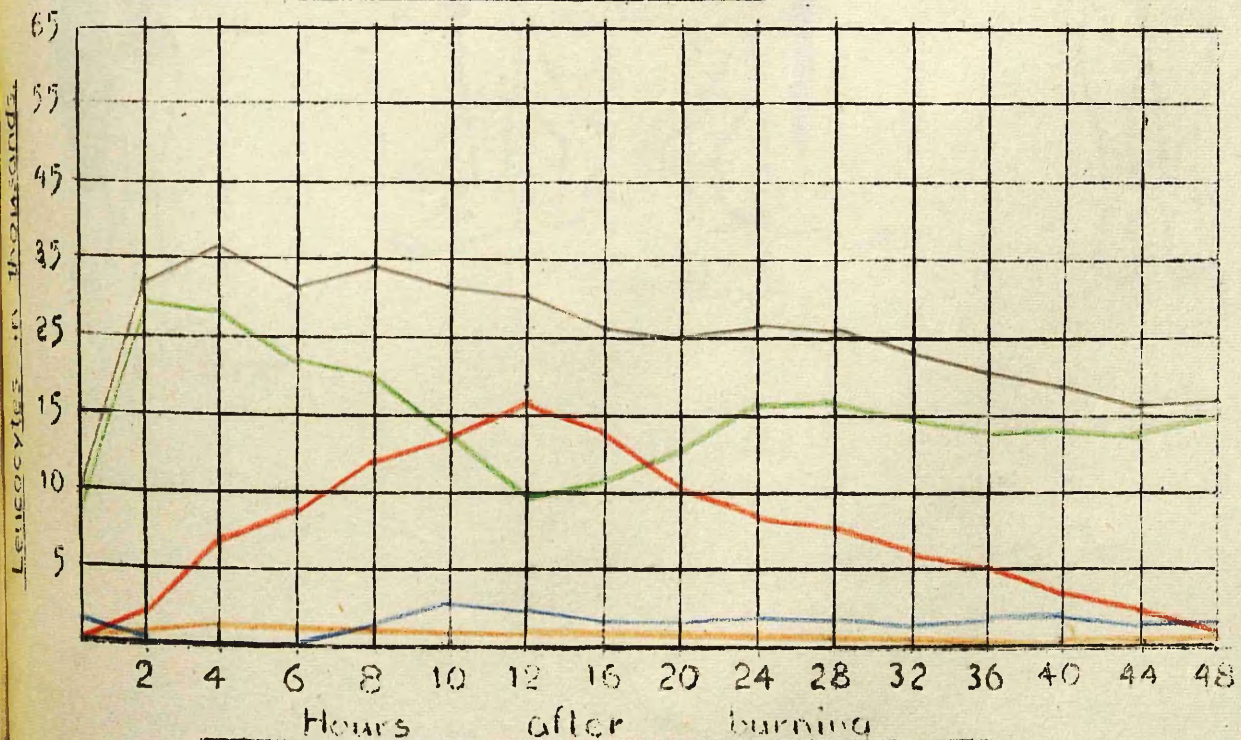
Sex of patient **Male.**

Nature of injuries **Burns of upper and lower limbs**  
**distribution as shown on chart overleaf.**

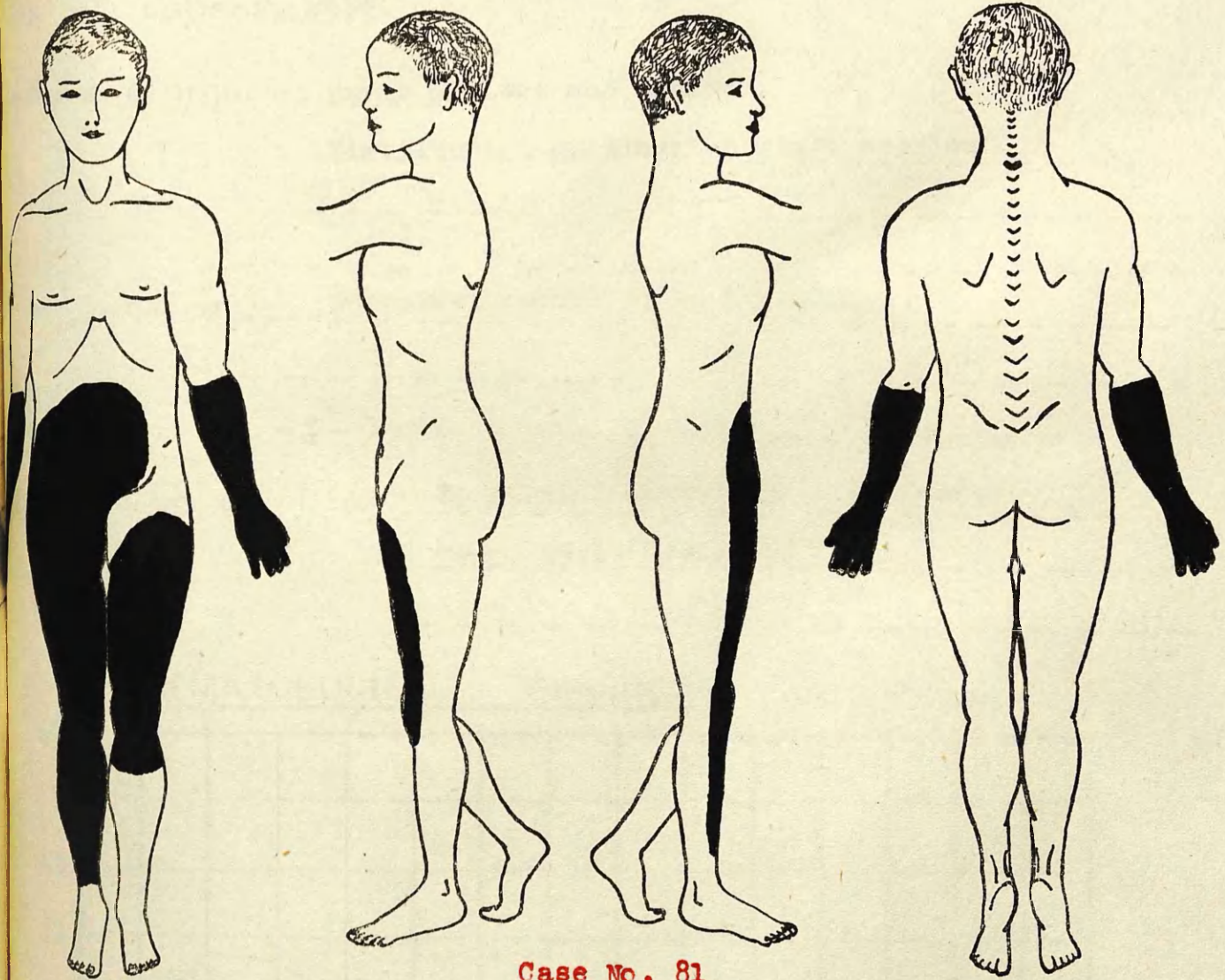
How sustained **In extinguishing a paint fire.**

Condition on admission **No pain. Thirsty. Answered questions**  
**intelligently. Temp. 97.9 Pule 80**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 81

TREATMENT

Tannic Acid

Age of patient 17 years

Case No. 82

Sex of patient Male

Nature of injuries Burns of legs and abdomen.

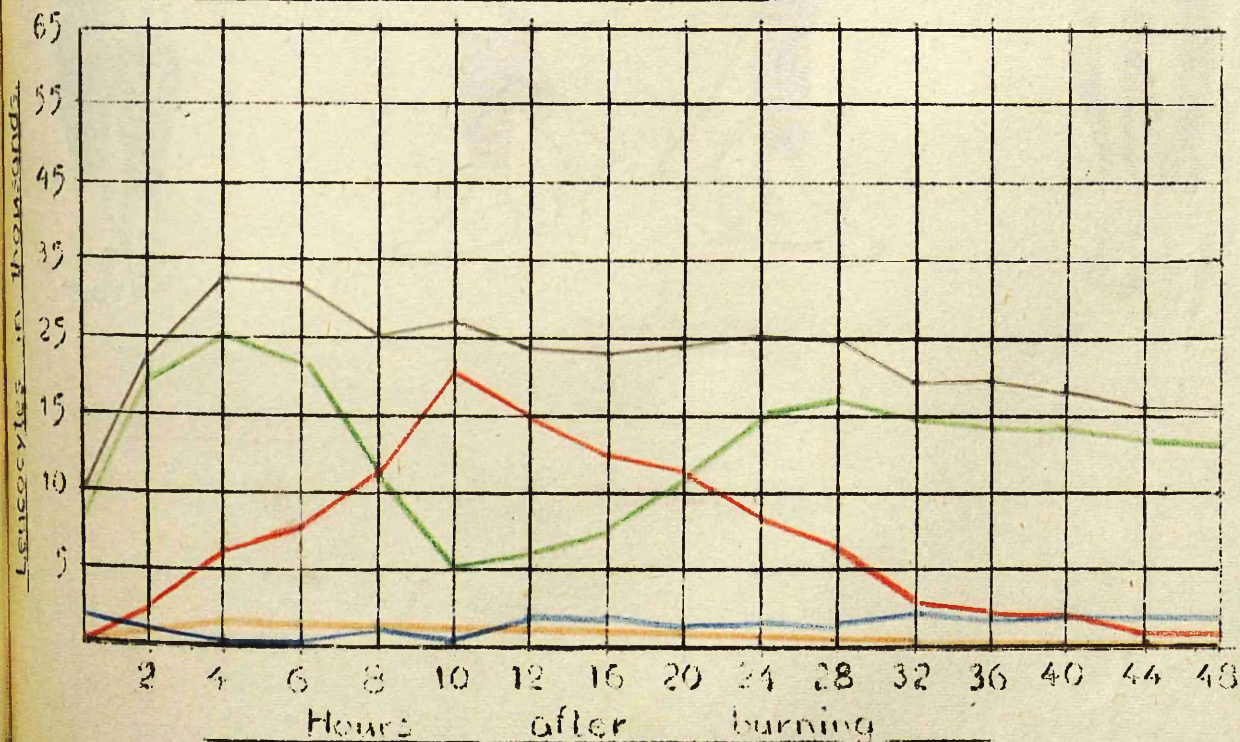
Distribution as shown on chart overleaf.

How sustained Dungarees caught fire.

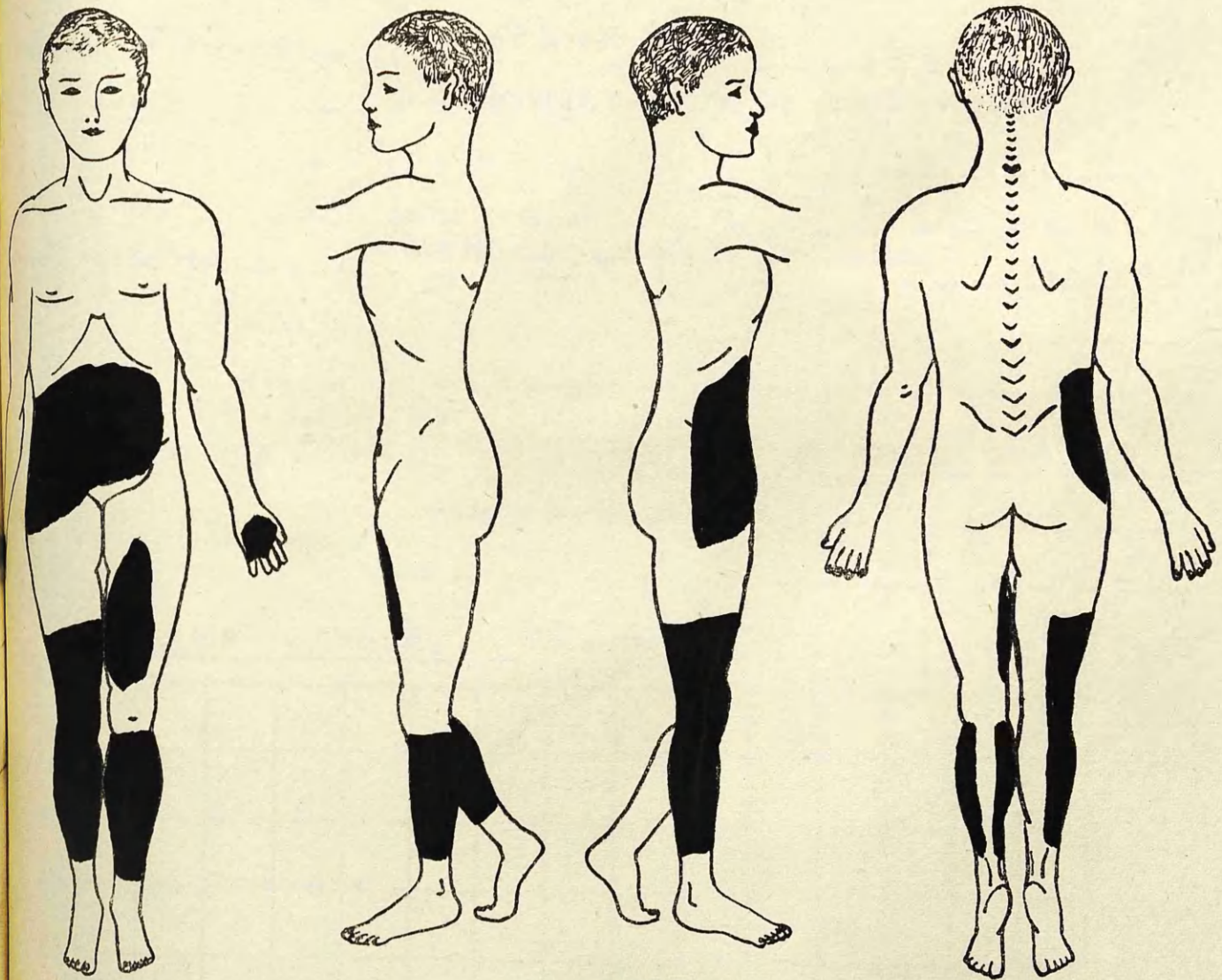
Condition on admission No pain. Shivering. Thirsty.

Temp. 99.1 Pulse 98

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No 82

TREATMENT

Tannic Acid

Age of patient **3 years.**

Case No. **83**

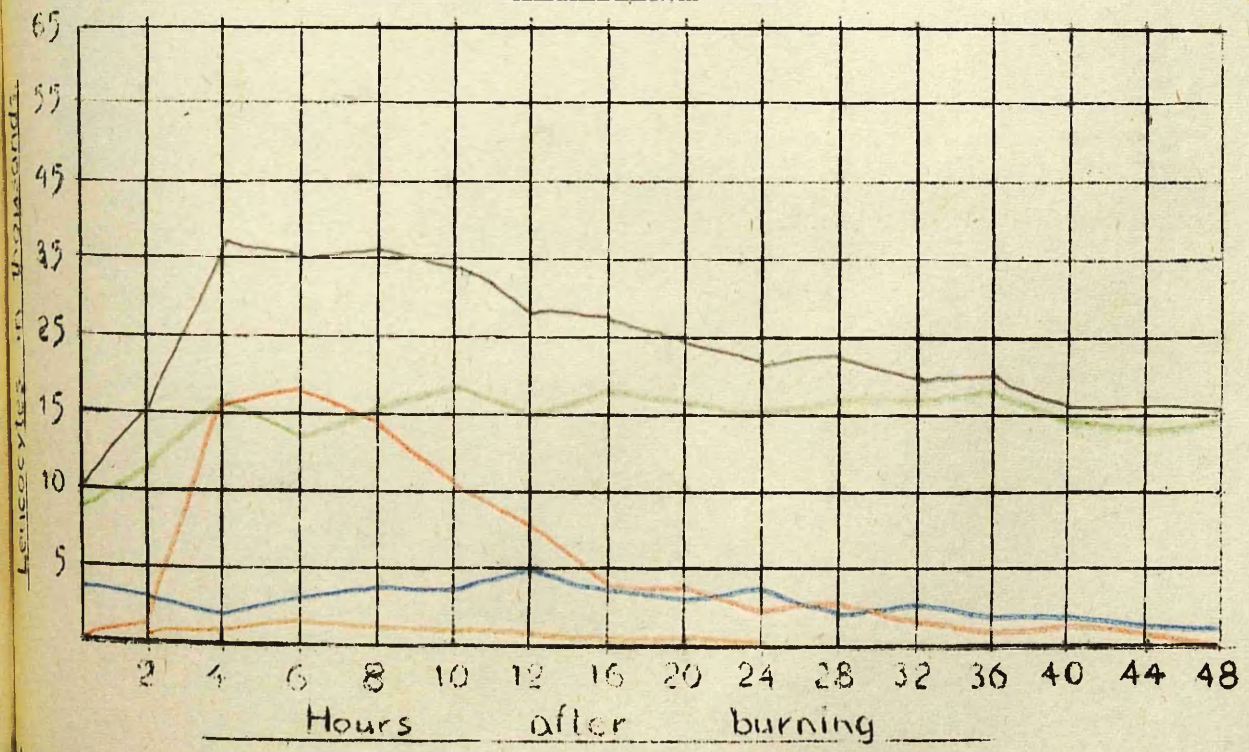
Sex of patient **Female**

Nature of injuries **Scald of lower limbs.**  
**Distribution as shown on chart overleaf.**

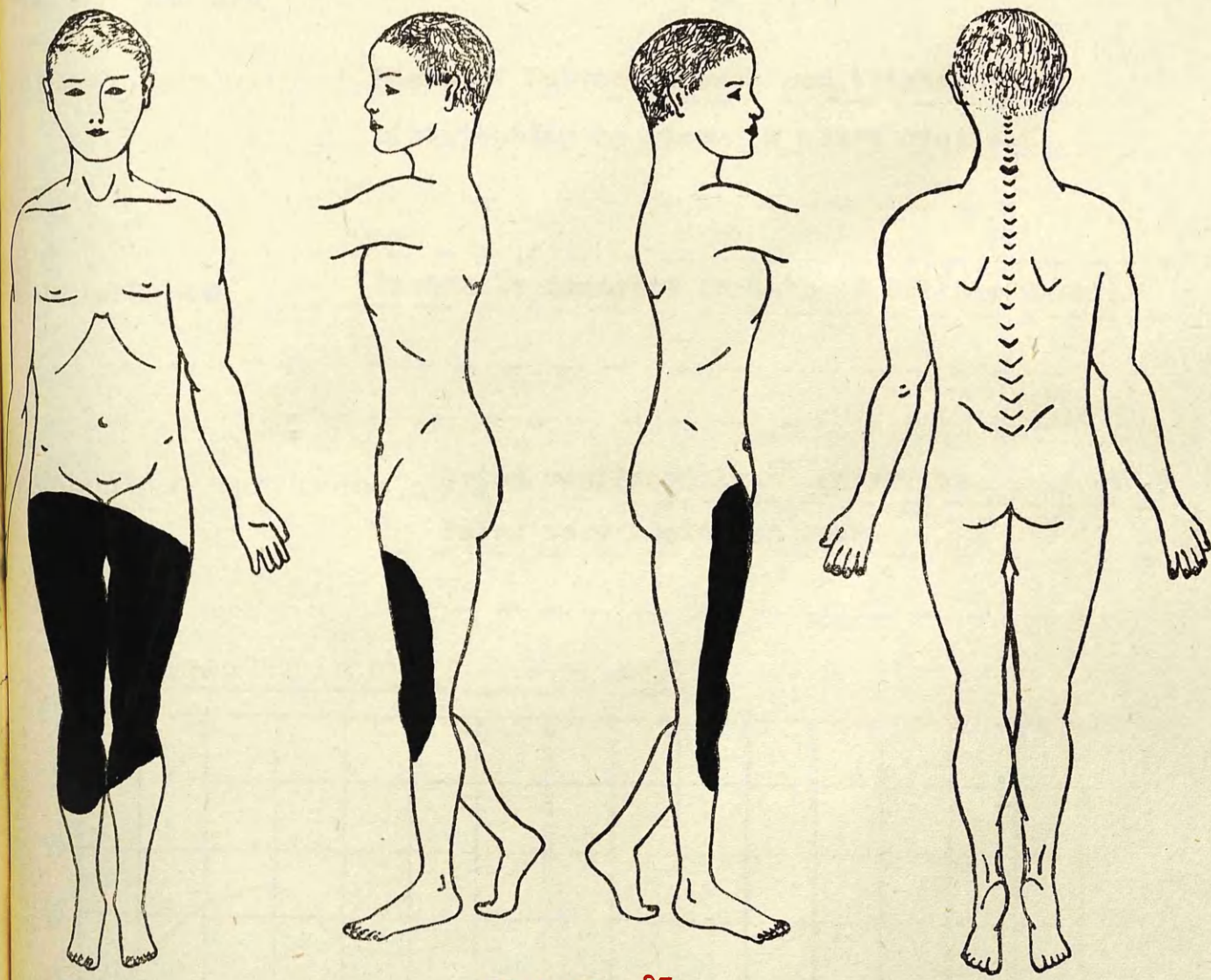
How sustained **Overtaken teapot of hot water.**

Condition on admission **Cried continuously. Shivering. Temp. 100**  
**Pulse rapid and weak.**

HAEMATOLOGICAL FINDINGS



Total Leucocytes ----- Metamyelocytes ----- Lymphocytes } -----  
 & Monocytes } -----  
 Polymorphs ----- Stab Nuclears ----- Toxic Granulocytes -----



Case No. 83

**TREATMENT**

**1% Sulphanilamide in Cod Liver Oil Emulsion.**

Age of patient **20 months.**

Case No. **84**

Sex of patient **Male.**

Nature of injuries **Scale of buttocks, back and thighs.**

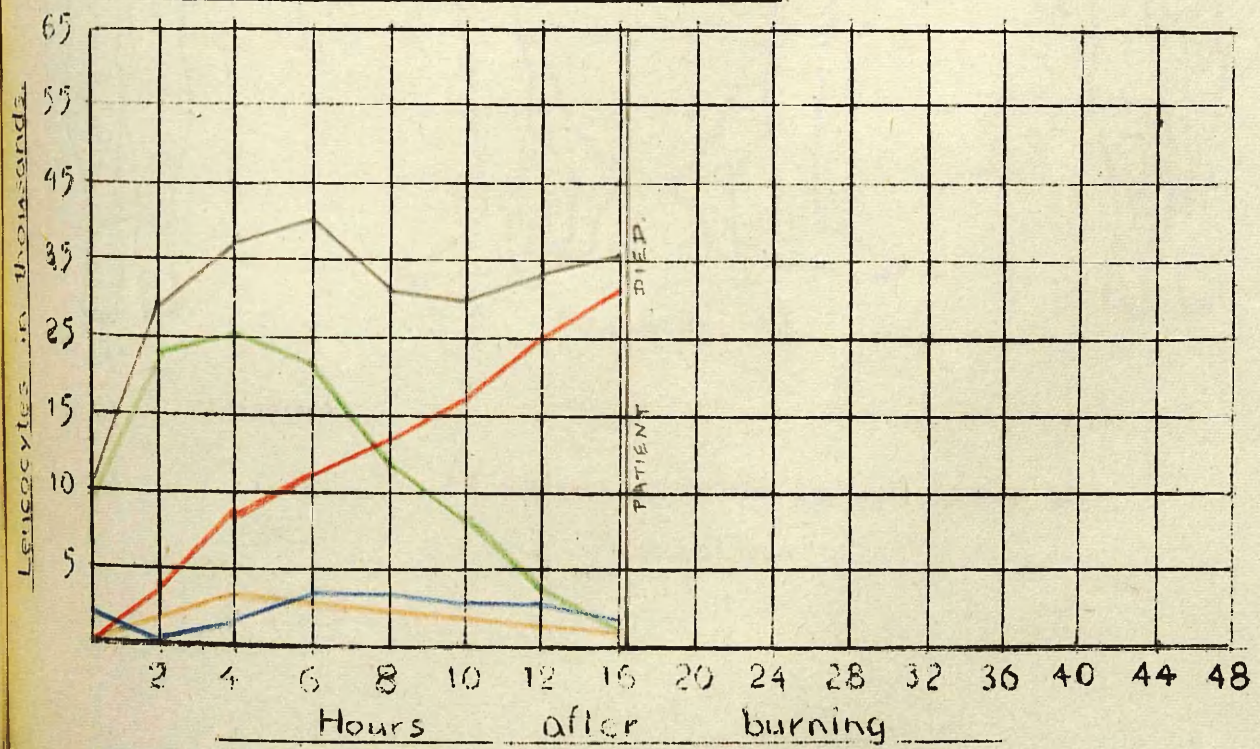
**Distribution as shown on chart overleaf.**

How sustained **Partially immersed in bath of boiling water.**

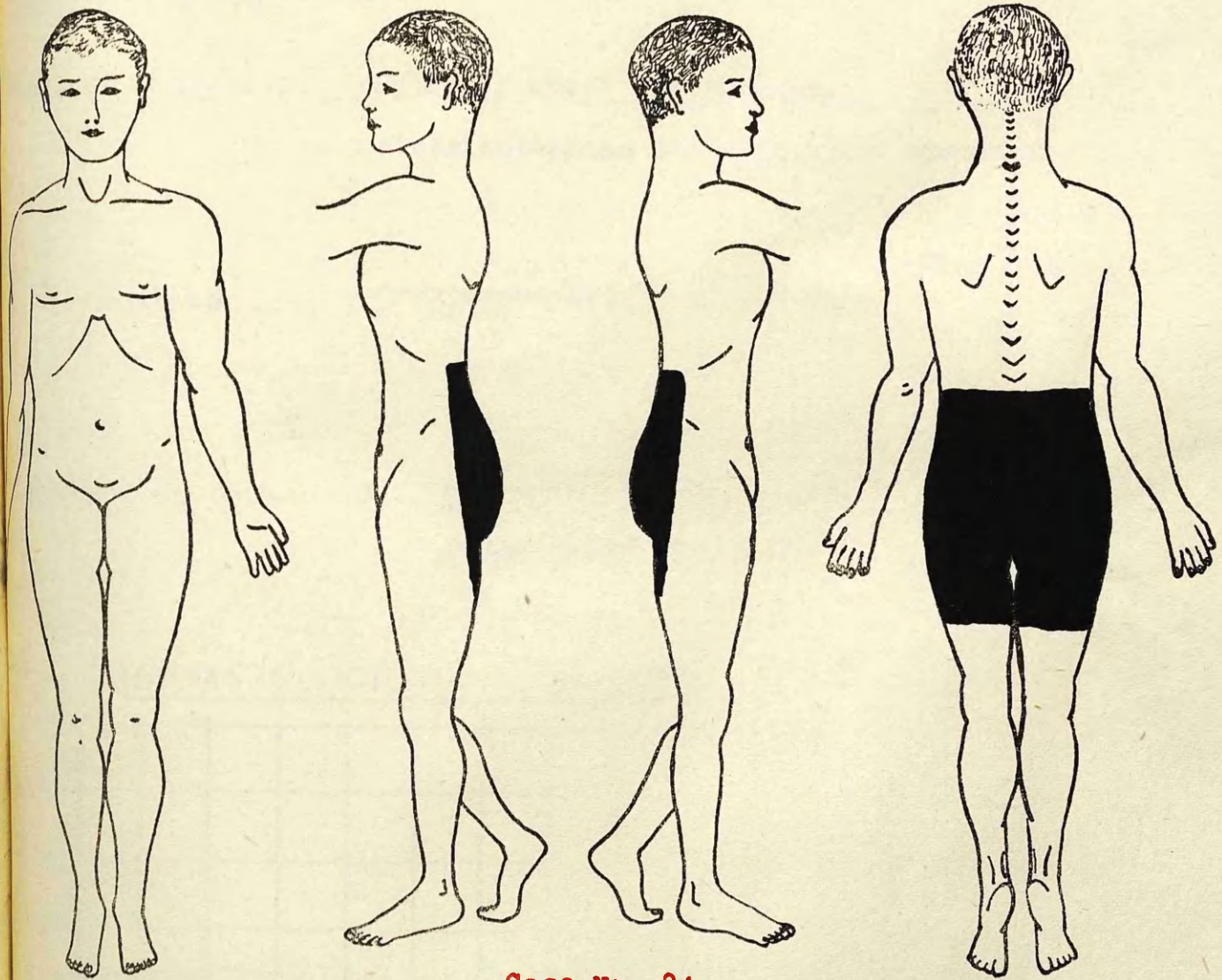
Condition on admission **Cried continuously. Shivering. Temp. 98.3**

**Pulse very rapid and weak.**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_



Case No. 84

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 4 years.

Case No. 85

Sex of patient Male.

Nature of injuries Scald of chest and abdomen.

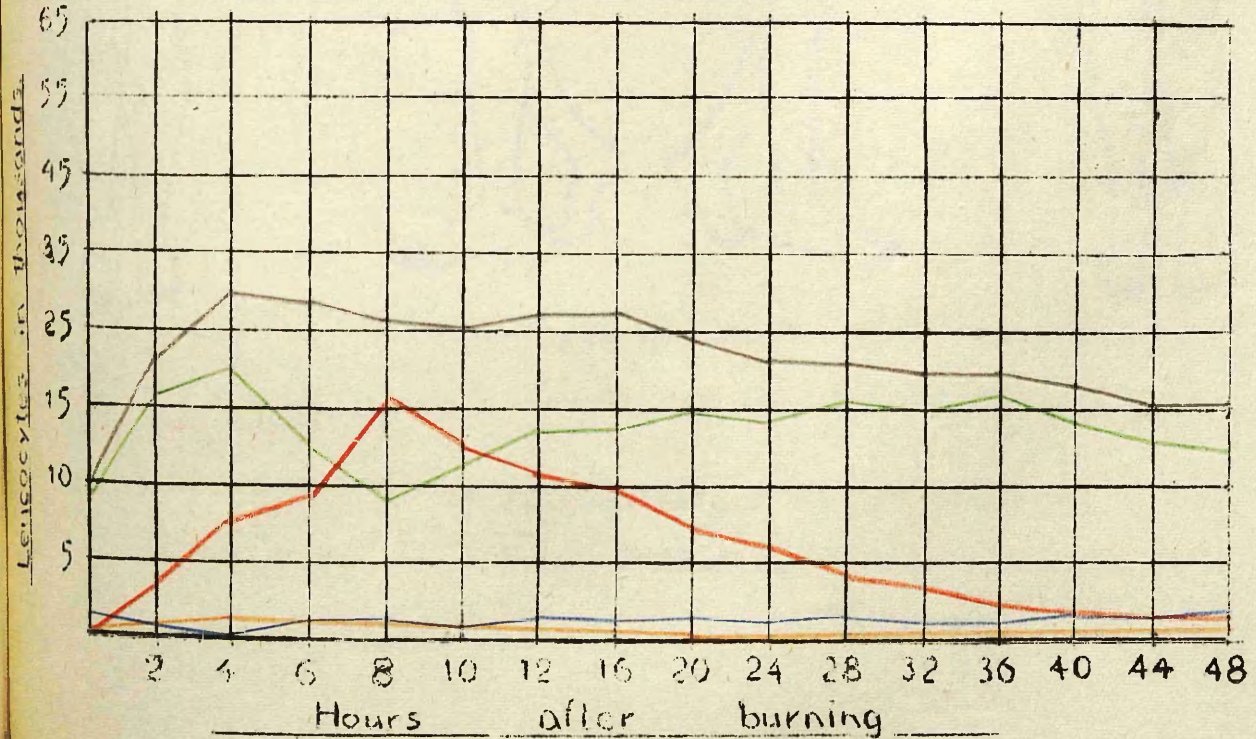
— distribution as shown on chart overleaf. —

How sustained Overturned kettle of hot water.

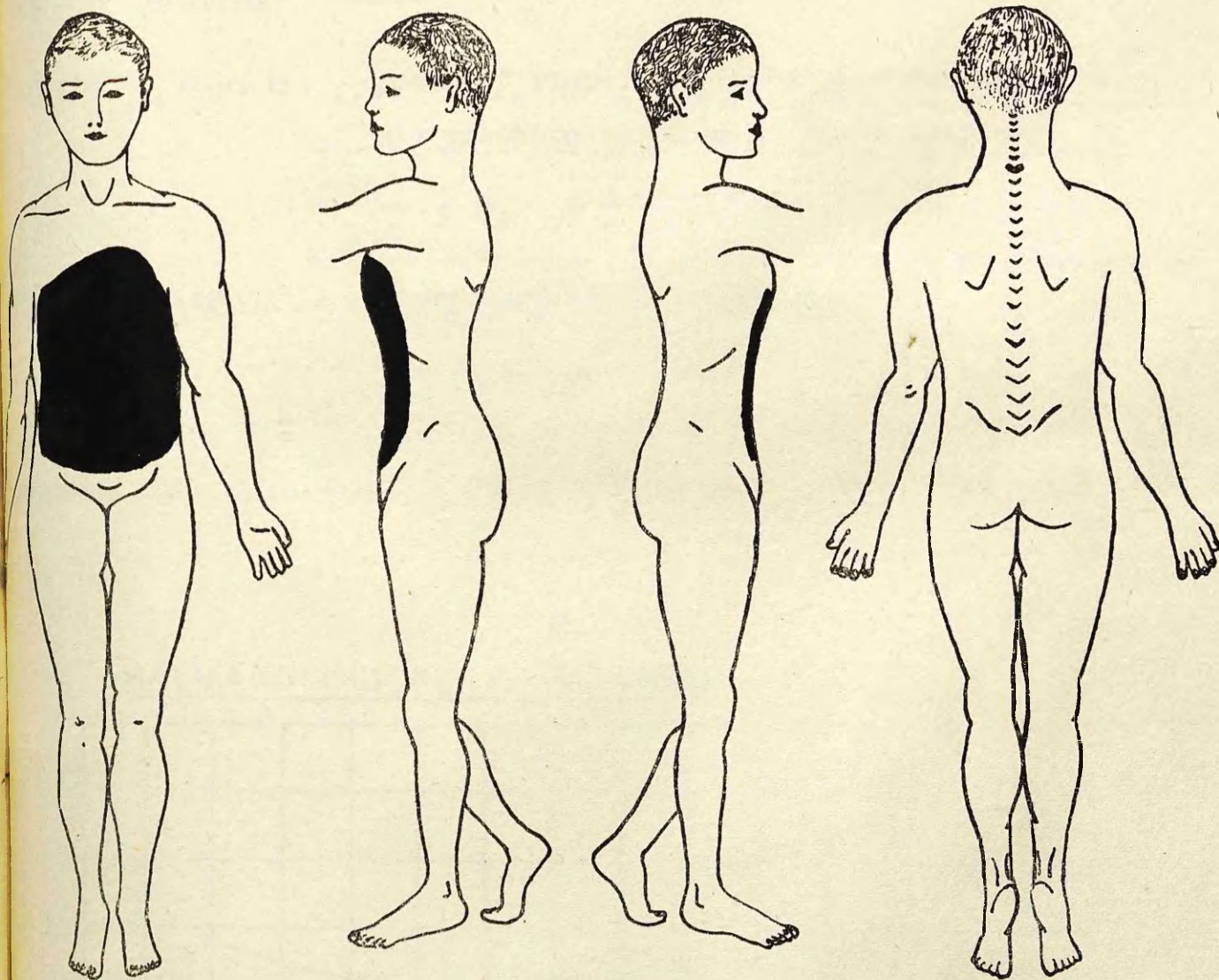
Condition on admission Cried continuously. Shivering. Temp. 98.2

— Pulse rapid and weak. —

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 85

**TREATMENT**

**1% Sulphanilamide in Cod Liver Oil  
Emulsion.**

Age of patient 5 years.

Case No. 86

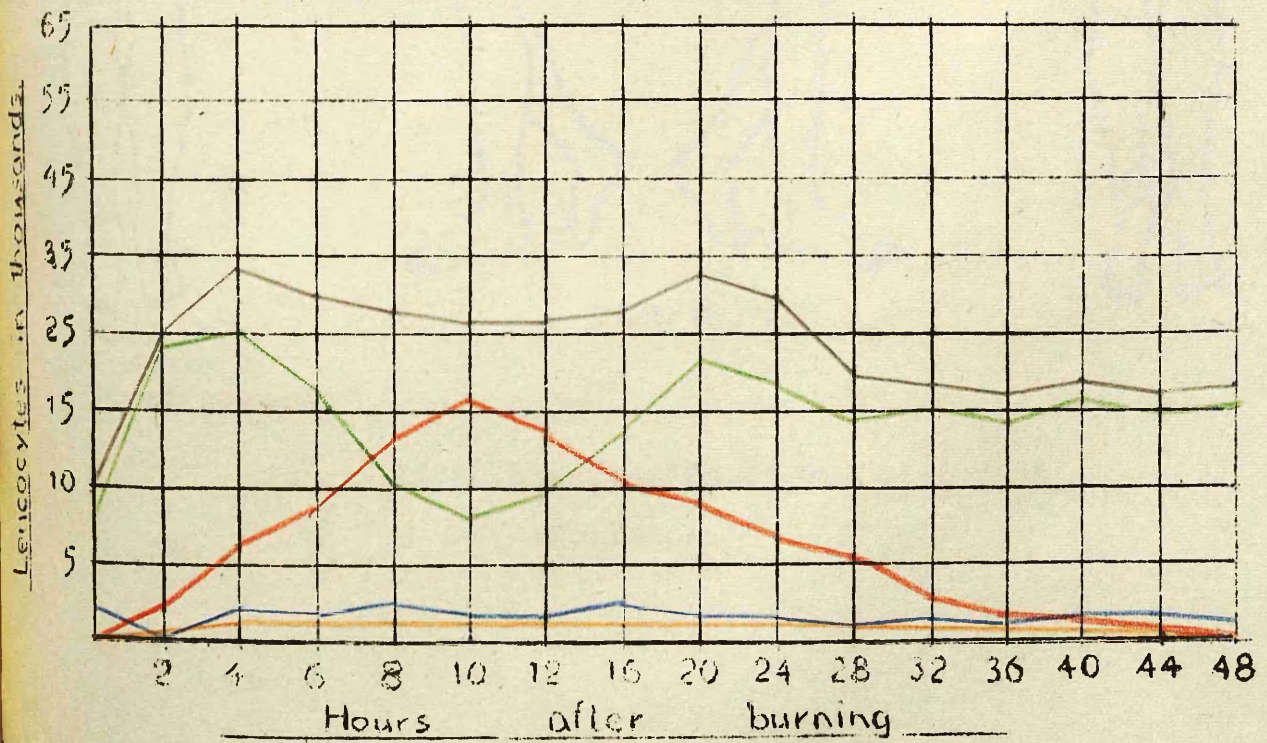
Sex of patient Male.

Nature of injuries Scald of right arm, right shoulder and back.  
distribution as shown on chart overleaf.

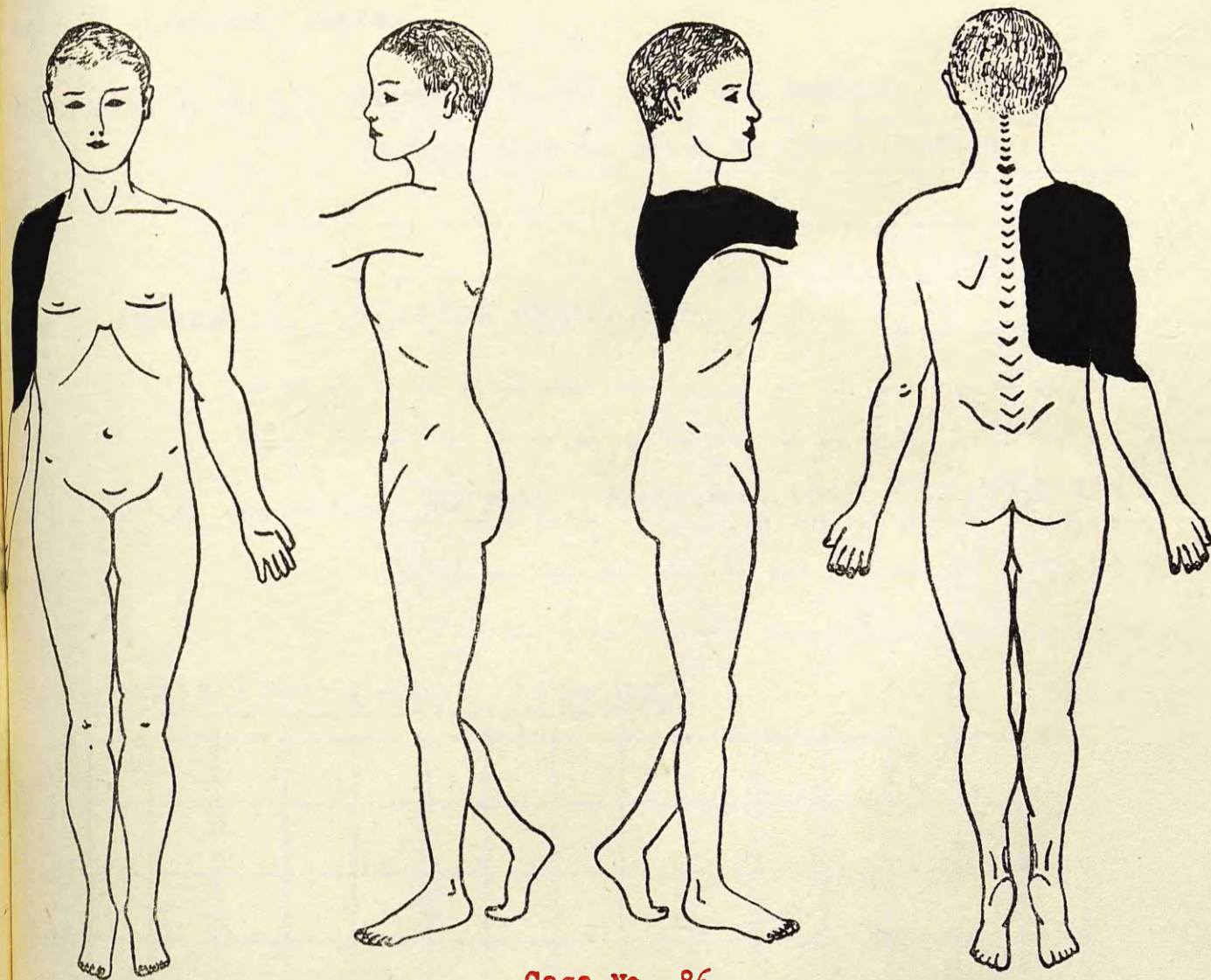
How sustained Overtumed pot of soup

Condition on admission Cried continuously. Temp. 98.8. Pulse 140

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 86

**TREATMENT**

**1% Sulphanilamide in Cod Liver Oil  
Emulsion.**

Age of patient **4 years.**

Case No. **87**

Sex of patient **Male.**

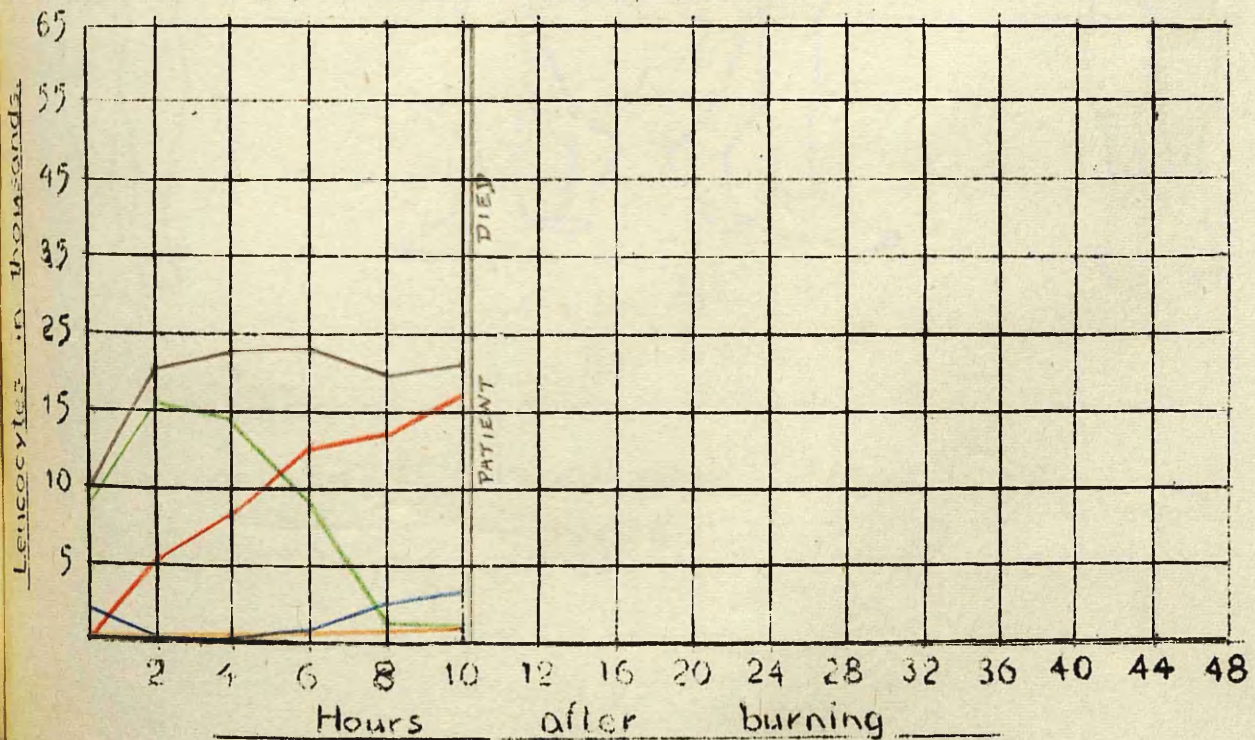
Nature of injuries **Burns of lower limbs and abdomen.**

**Distribution as shown on chart overleaf.**

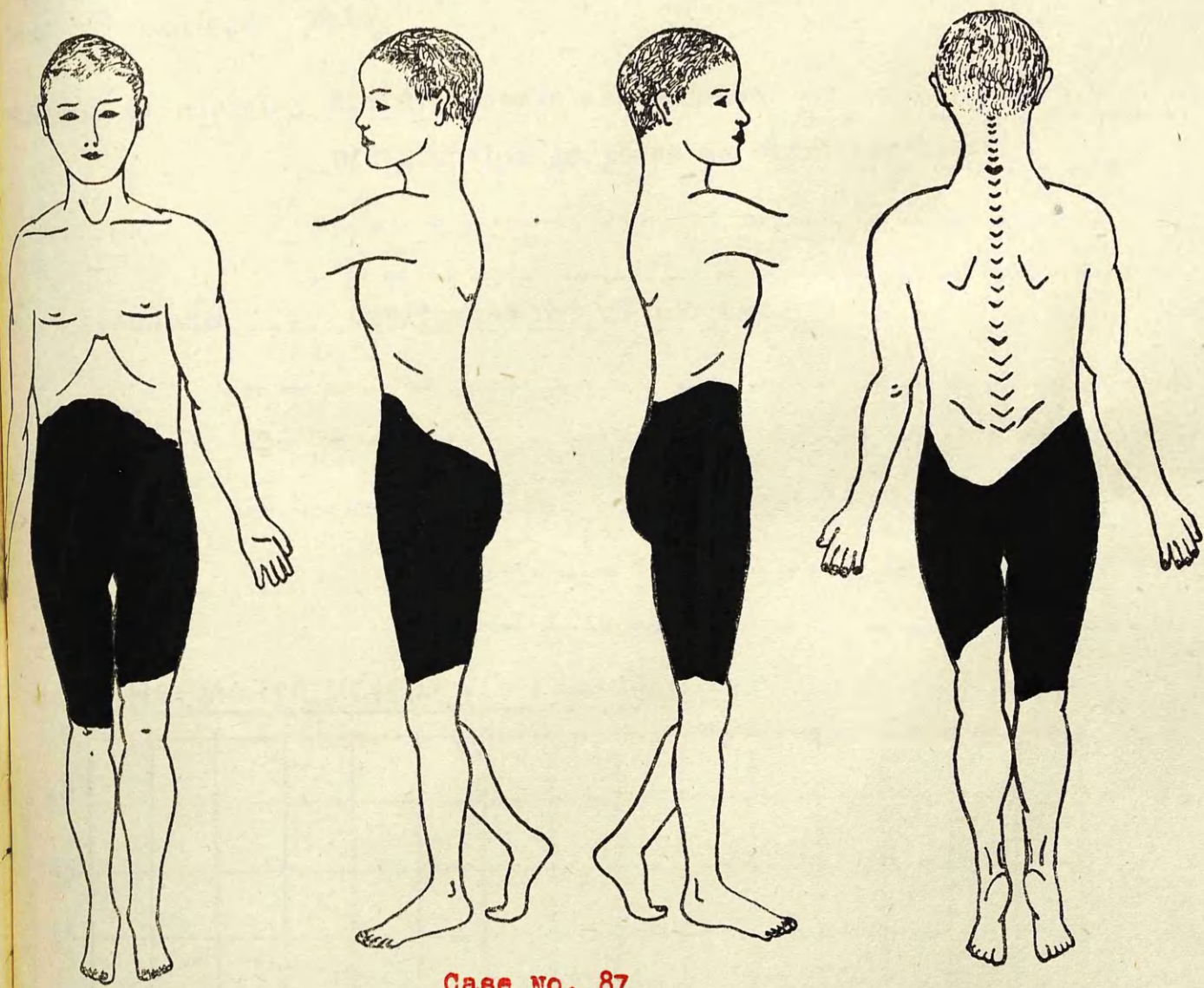
How sustained **Clothing caught fire.**

Condition on admission **No pain. Shivering. Temp. 98.2 pulse 120 weak**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 87

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion

Age of patient 7 years.

Case No 88

Sex of patient Male.

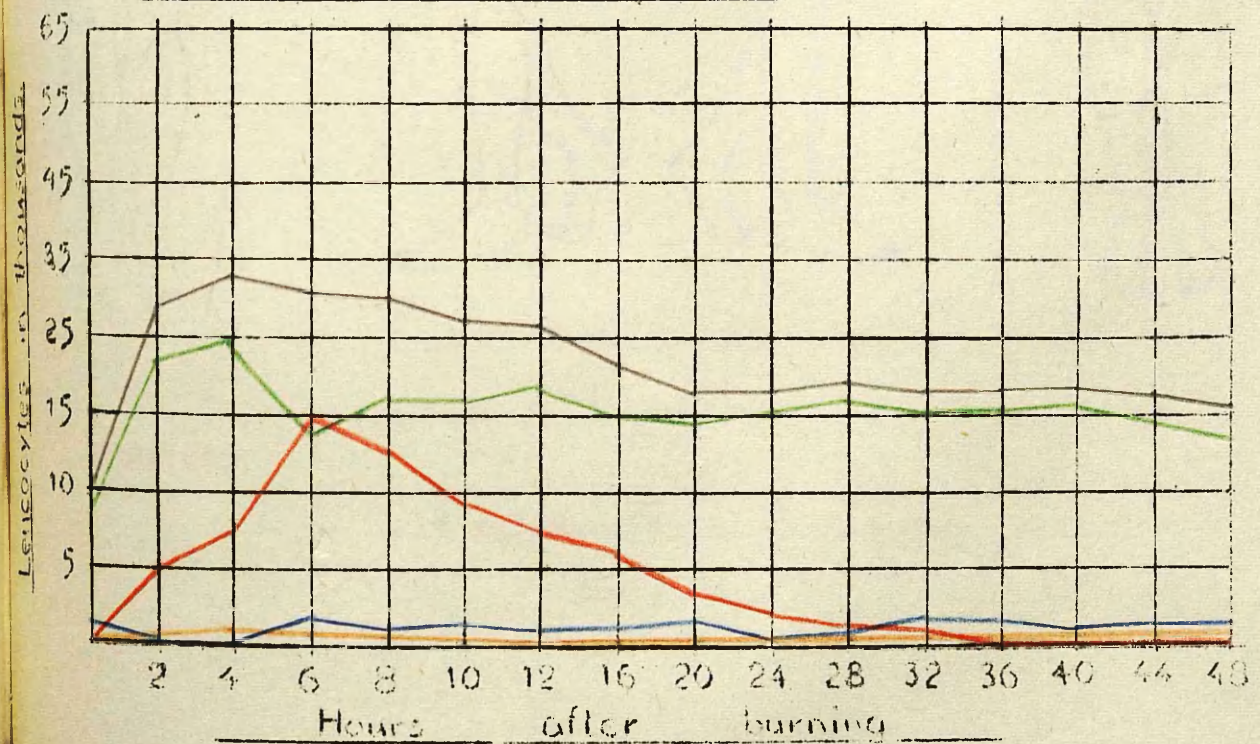
Nature of injuries Scald of chest and abdomen.

Distribution as shown on chart overleaf.

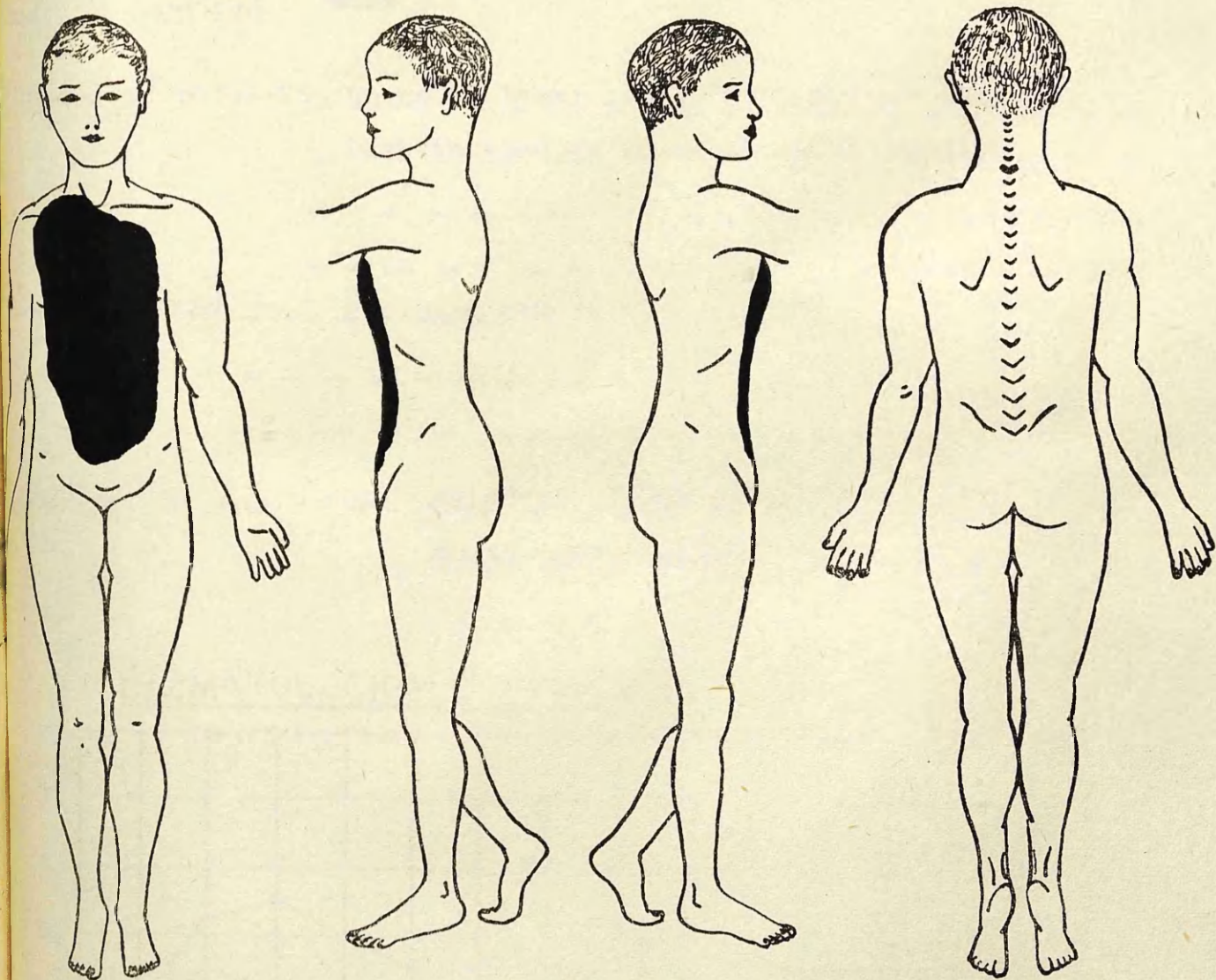
How sustained Overturnd pot of hot tea.

Condition on admission No pain. Shivering. Temp. 100 Pulse 130

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 88

**TREATMENT**

**1% Sulphanilamide in Cod Liver Oil  
Emulsion.**

Age of patient 5 years

Case No. 89

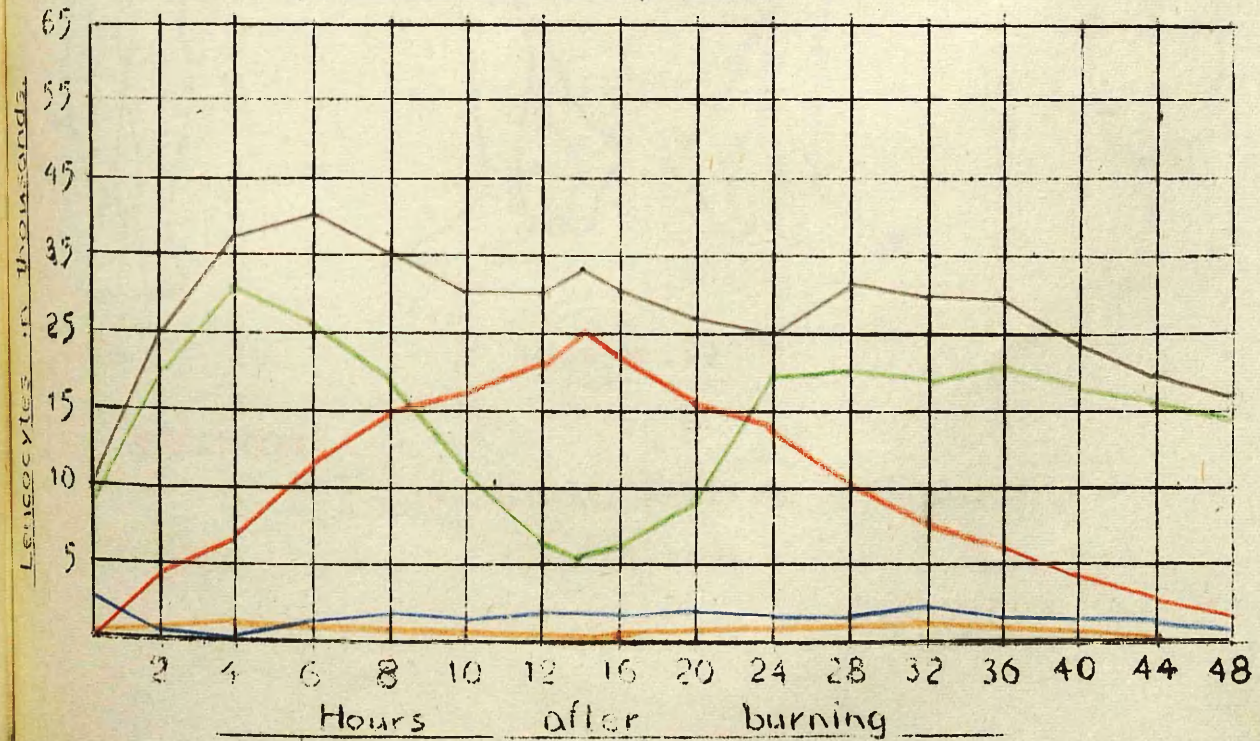
Sex of patient Male

Nature of injuries Burns of lower limbs, buttocks and abdomen.  
Distribution as shown on chart overleaf.

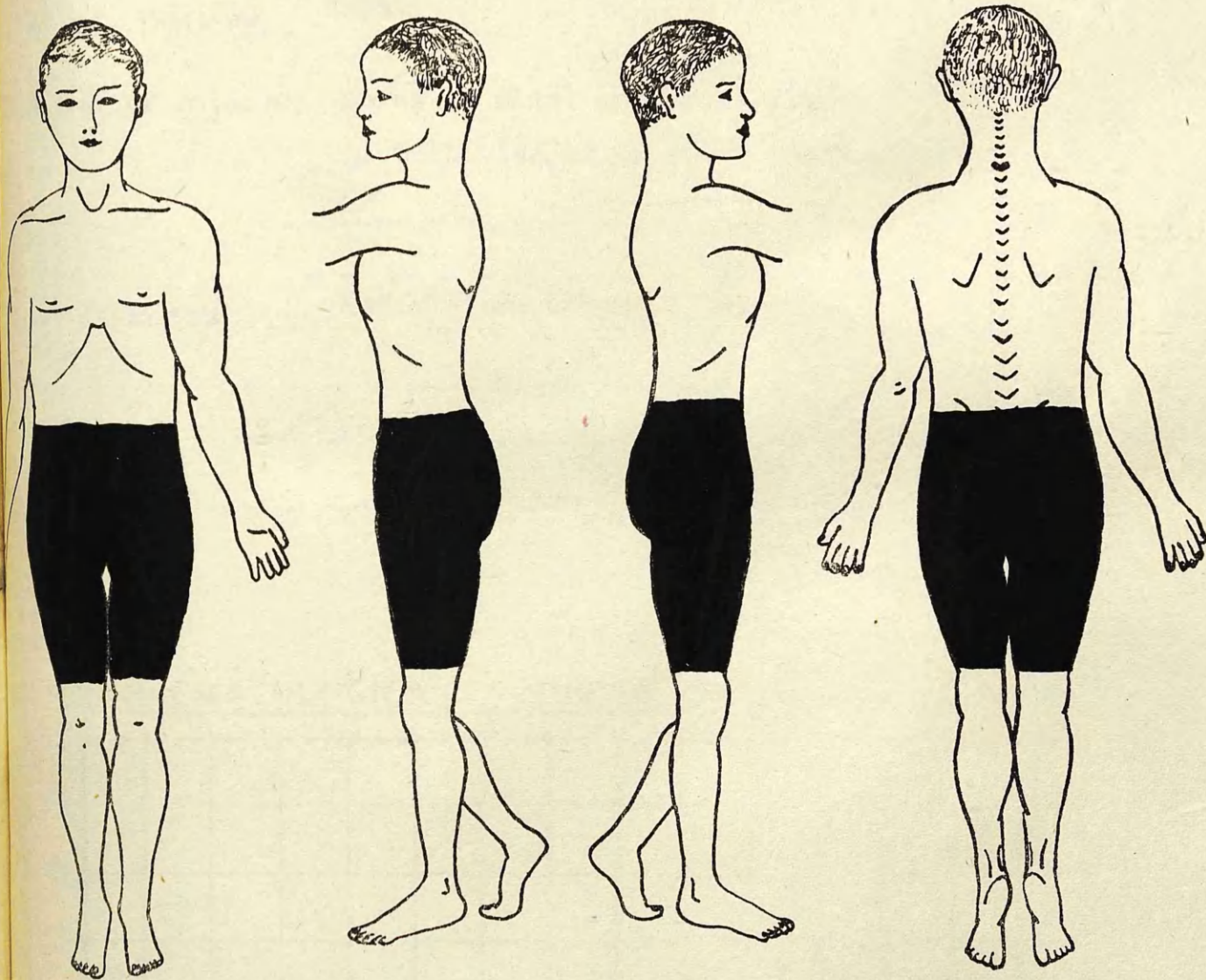
How sustained Clothing caught fire.

Condition on admission Painful. Cried continuously. Temp. 99.2  
Pulse rapid and weak.

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 89

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **5 years**

Case No. **90**

Sex of patient **Male.**

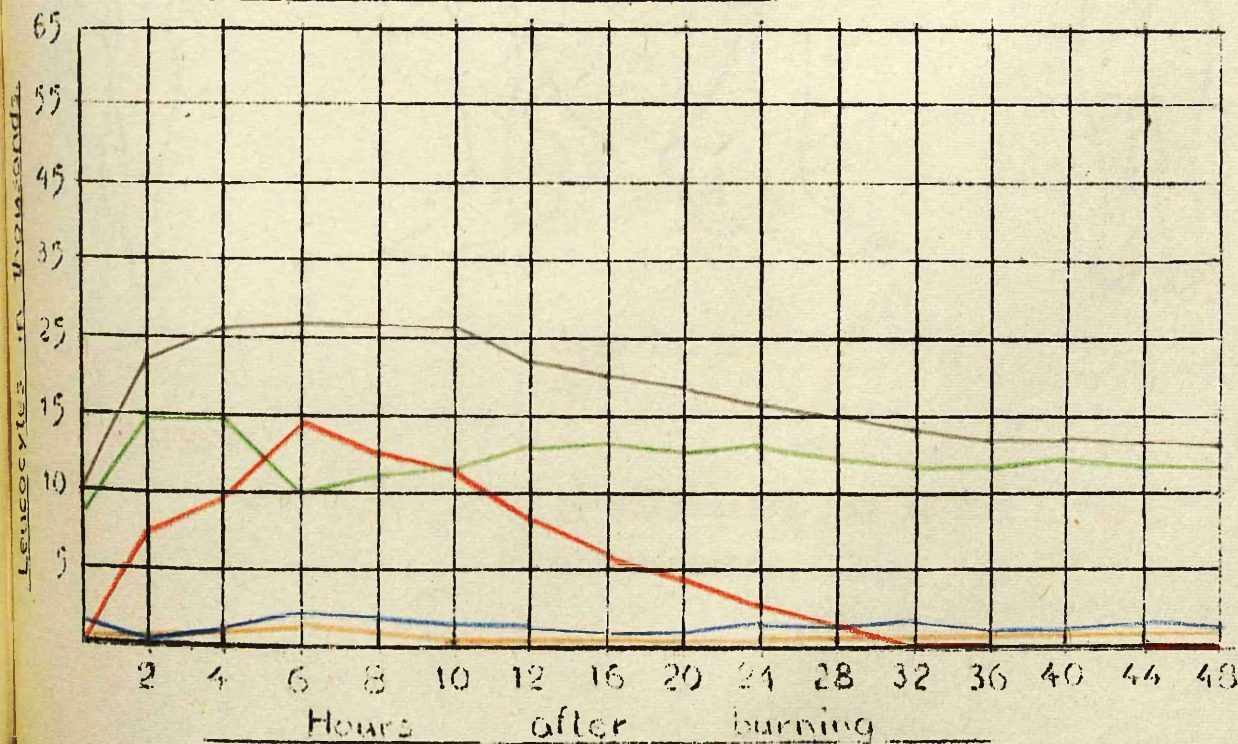
Nature of injuries **Burns of chest and upper limbs.**

**Distribution as shown on chart overleaf.**

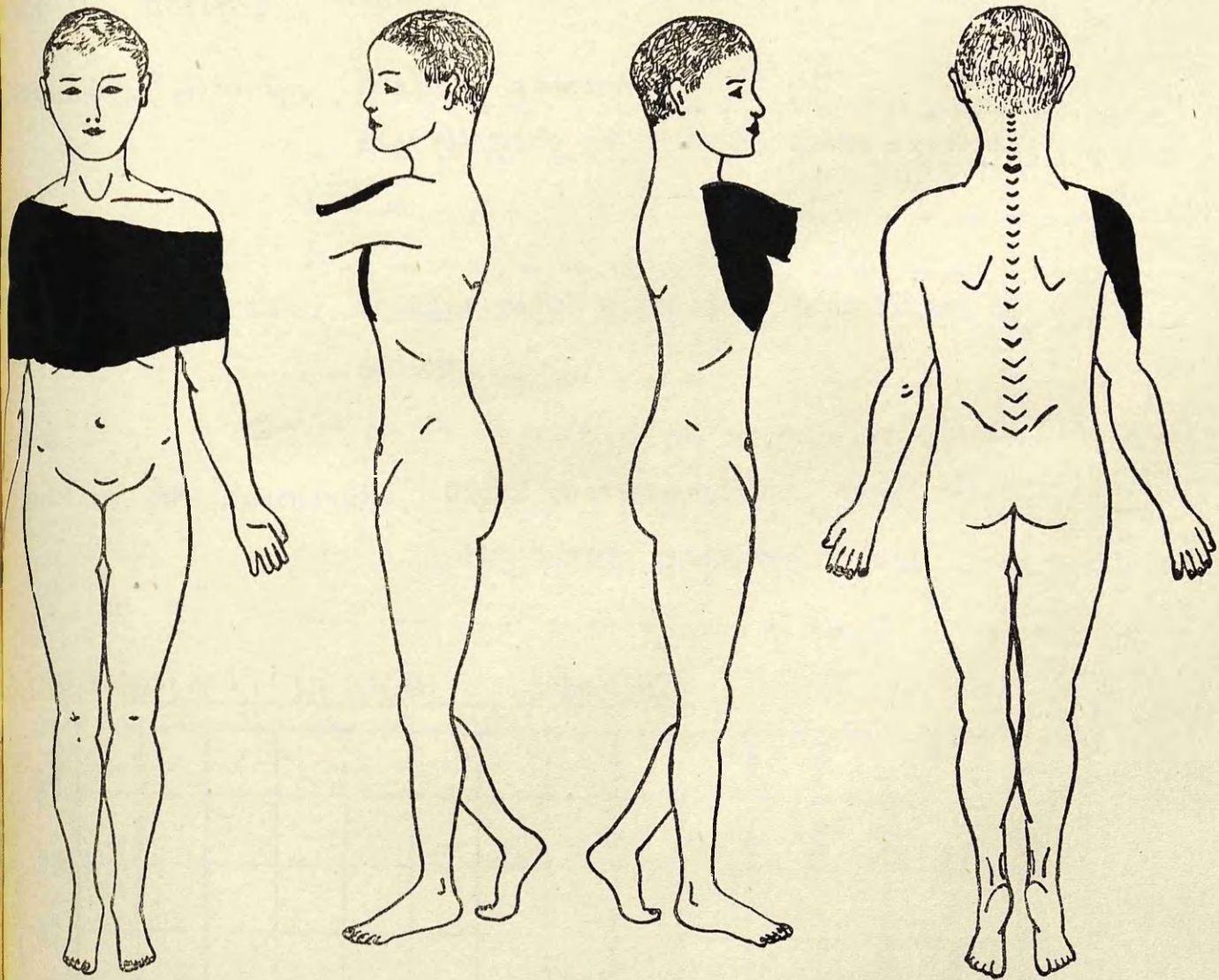
How sustained **Bed clothes caught fire.**

Condition on admission **No pain. Shivering. Temp. 97.8 Pulse 120**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 90

**TREATMENT**

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient **18 months.**

Case No. **91**

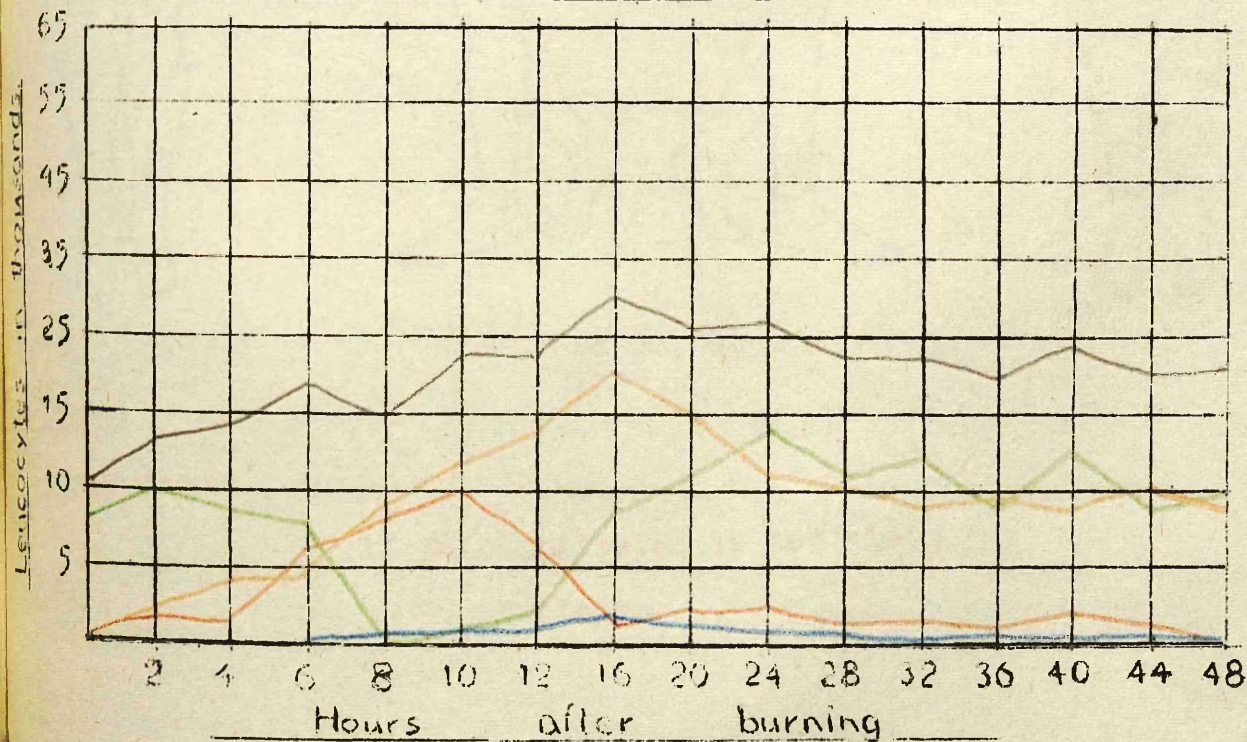
Sex of patient **Male.**

Nature of injuries **Scald of abdomen.**  
**Distribution as shown on chart overleaf.**

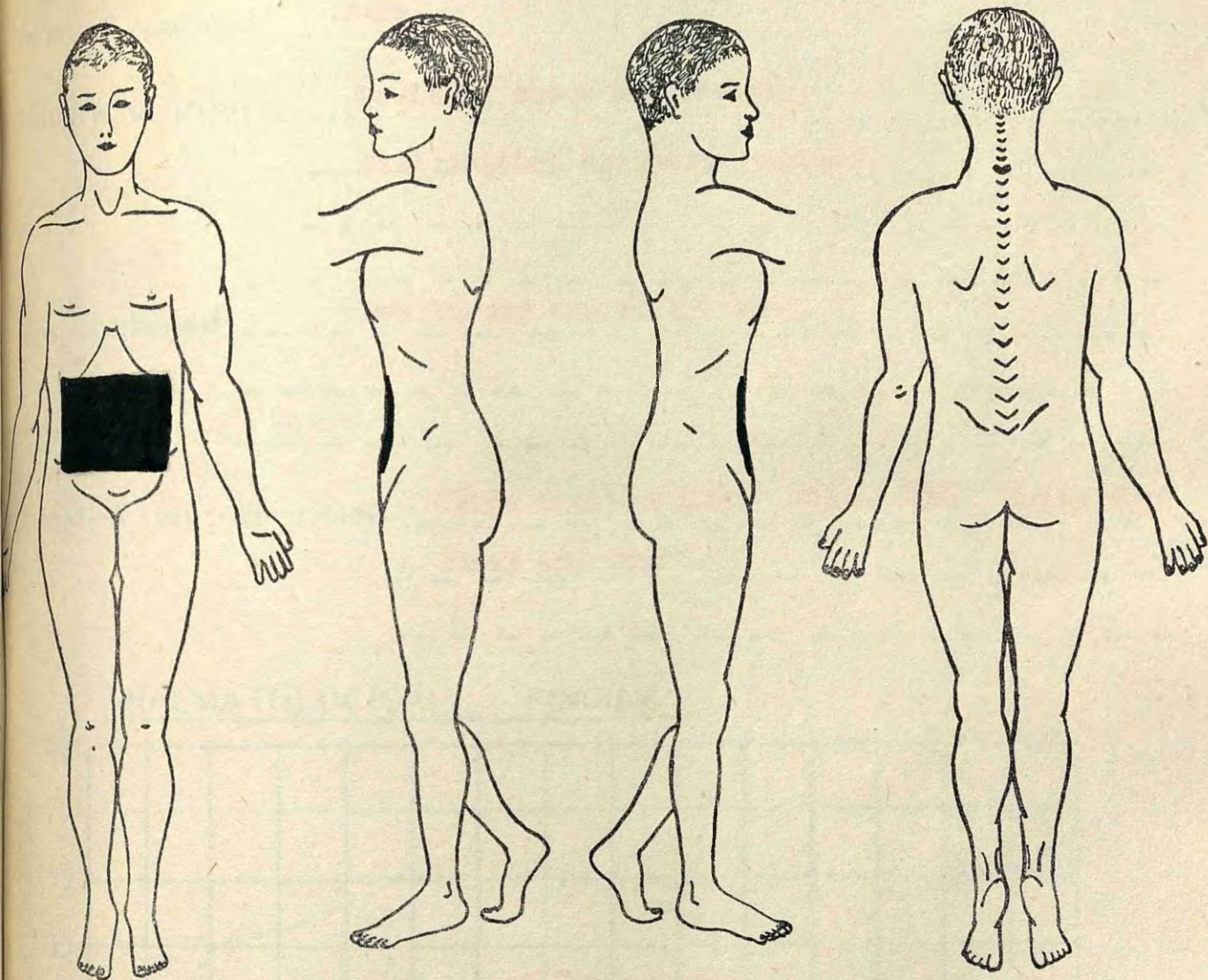
How sustained **Boiling water applied as fomentation by parent.**

Condition on admission **Cried continuously. Temp. 99.3**  
**Pulse very rapid and weak.**

HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 91

**TREATMENT**

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient... 8 months.

Case No. -92---

Sex of patient... Male.

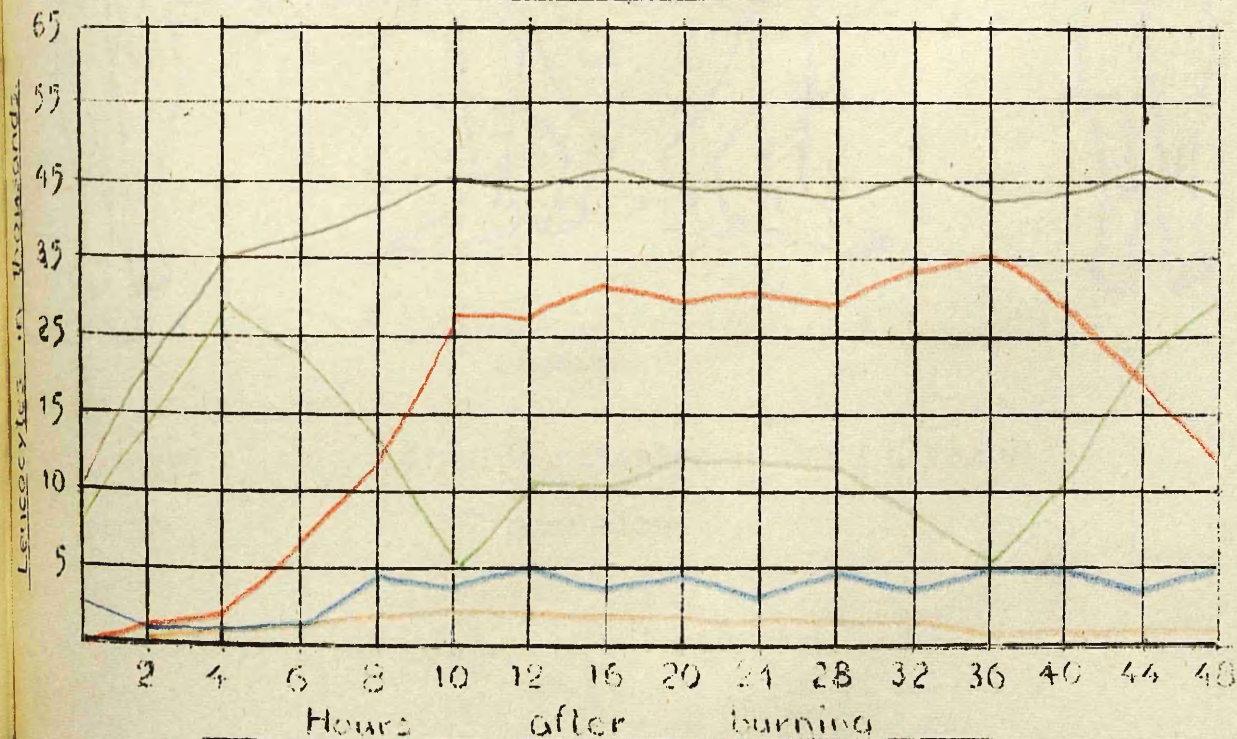
Nature of injuries... Scald of chest and abdomen.

--- Distribution as shown overleaf. ---

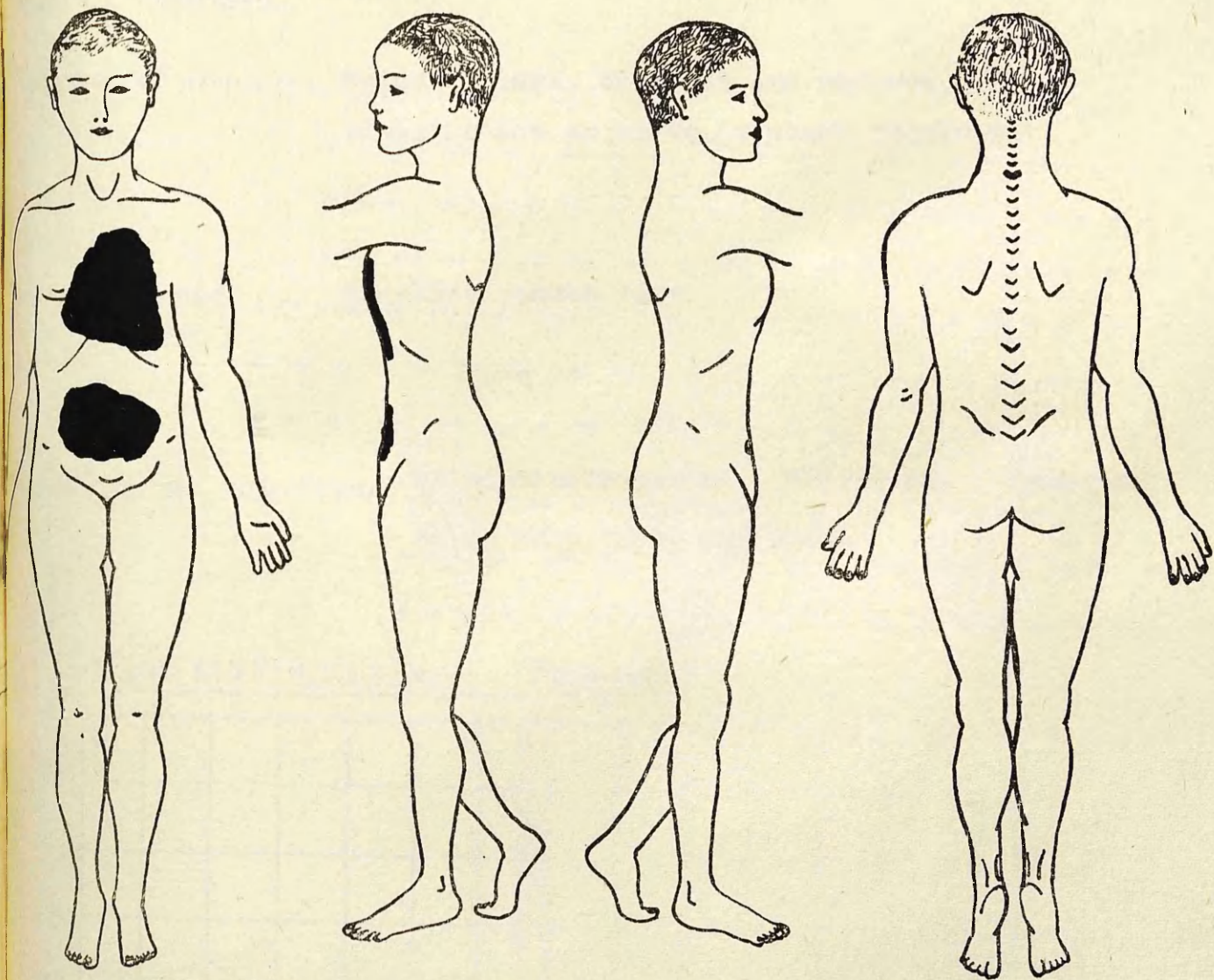
How sustained... Overturned cup of hot tea.

Condition on admission... Cried continuously. Temp. 101 Pulse very rapid and weak.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
 Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes }  
 & Monocytes }



Case No.92

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **2 years**

Case No. **93**

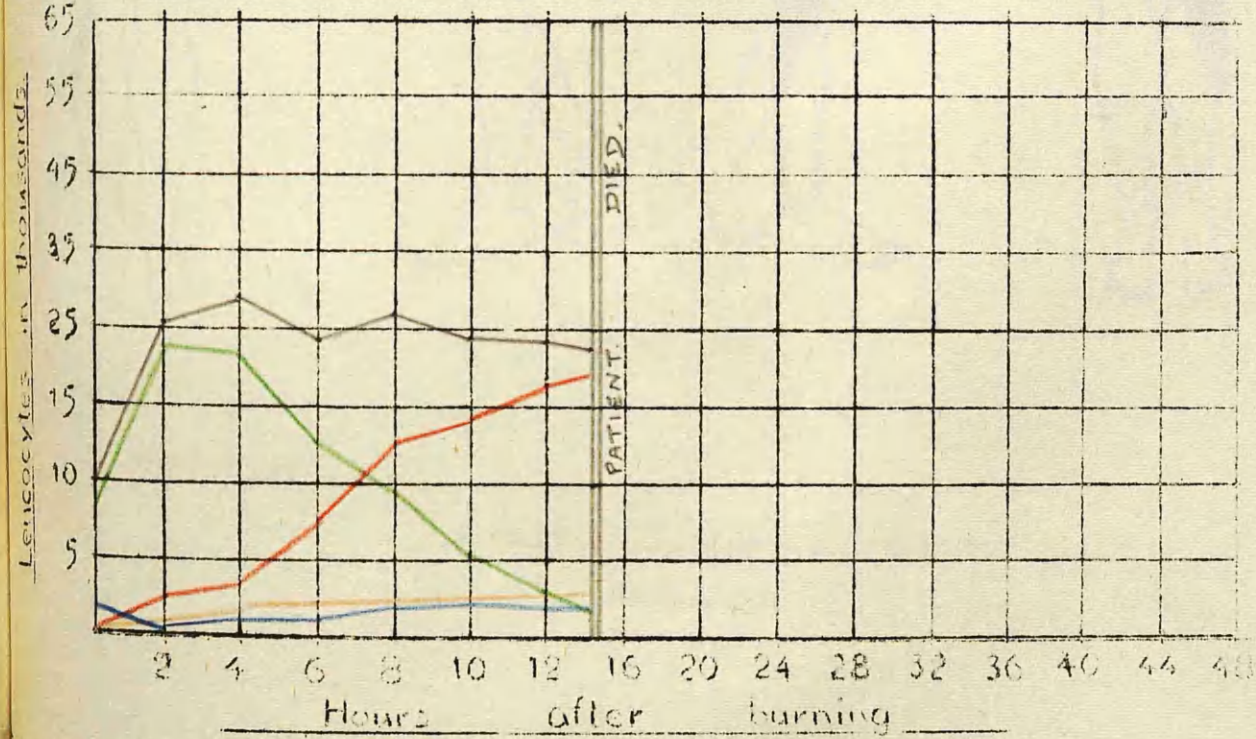
Sex of patient **Male**

Nature of injuries **Burns of legs, buttocks and abdomen.**  
**Distribution as shown on chart overleaf.**

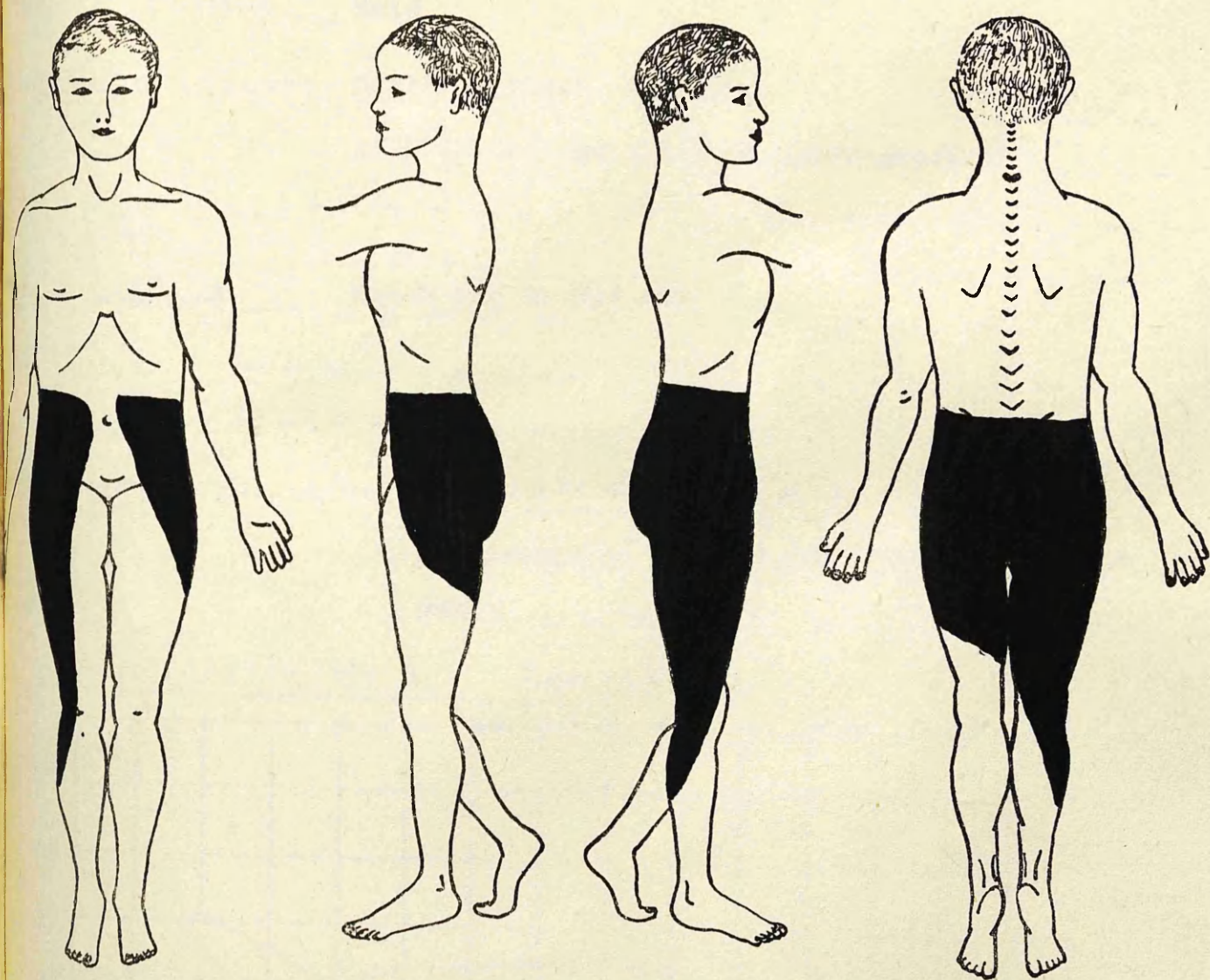
How sustained **Clothing caught fire.**

Condition on admission **Cried continuously. Shivering. Temp. 100**  
**Pulse very rapid and weak**

**HAEMATOLOGICAL FINDINGS**



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 93

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **2 years**

Case No **94**

Sex of patient **Male**

Nature of injuries **Scald of chest, and arms.**

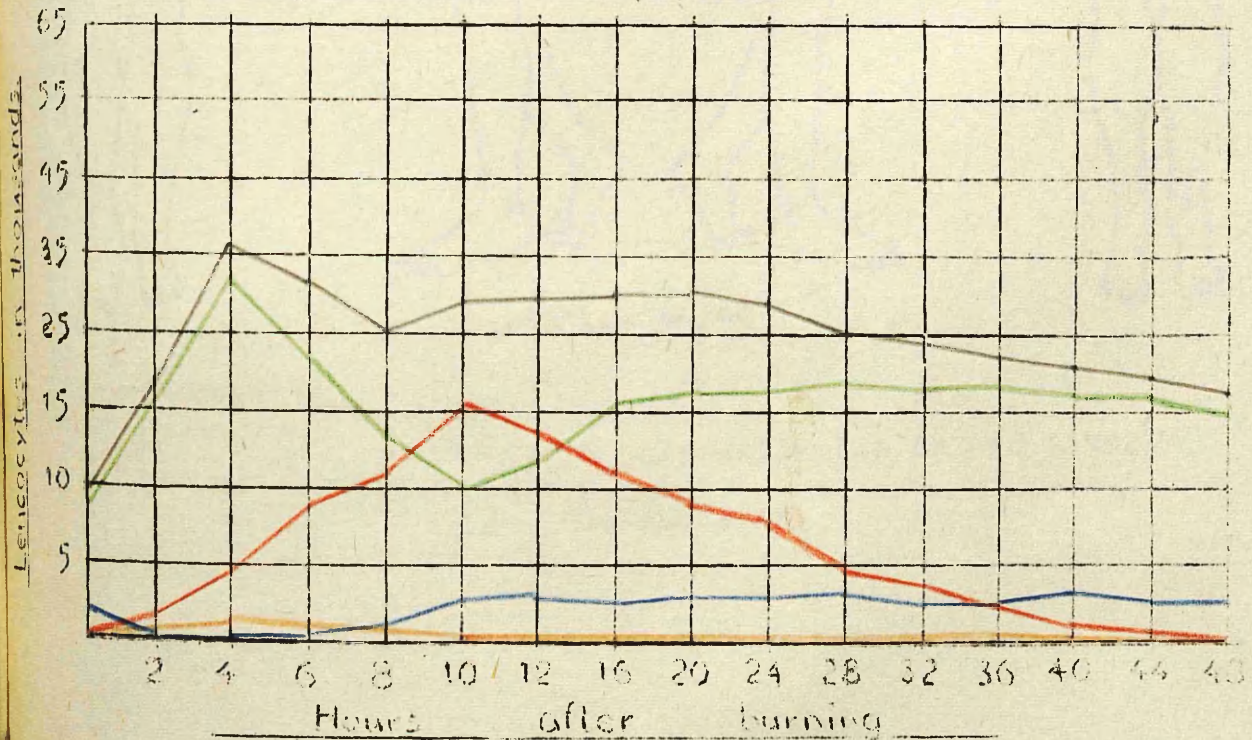
**- Distribution as shown on chart overleaf**

How sustained **Upset cup to hot tea.**

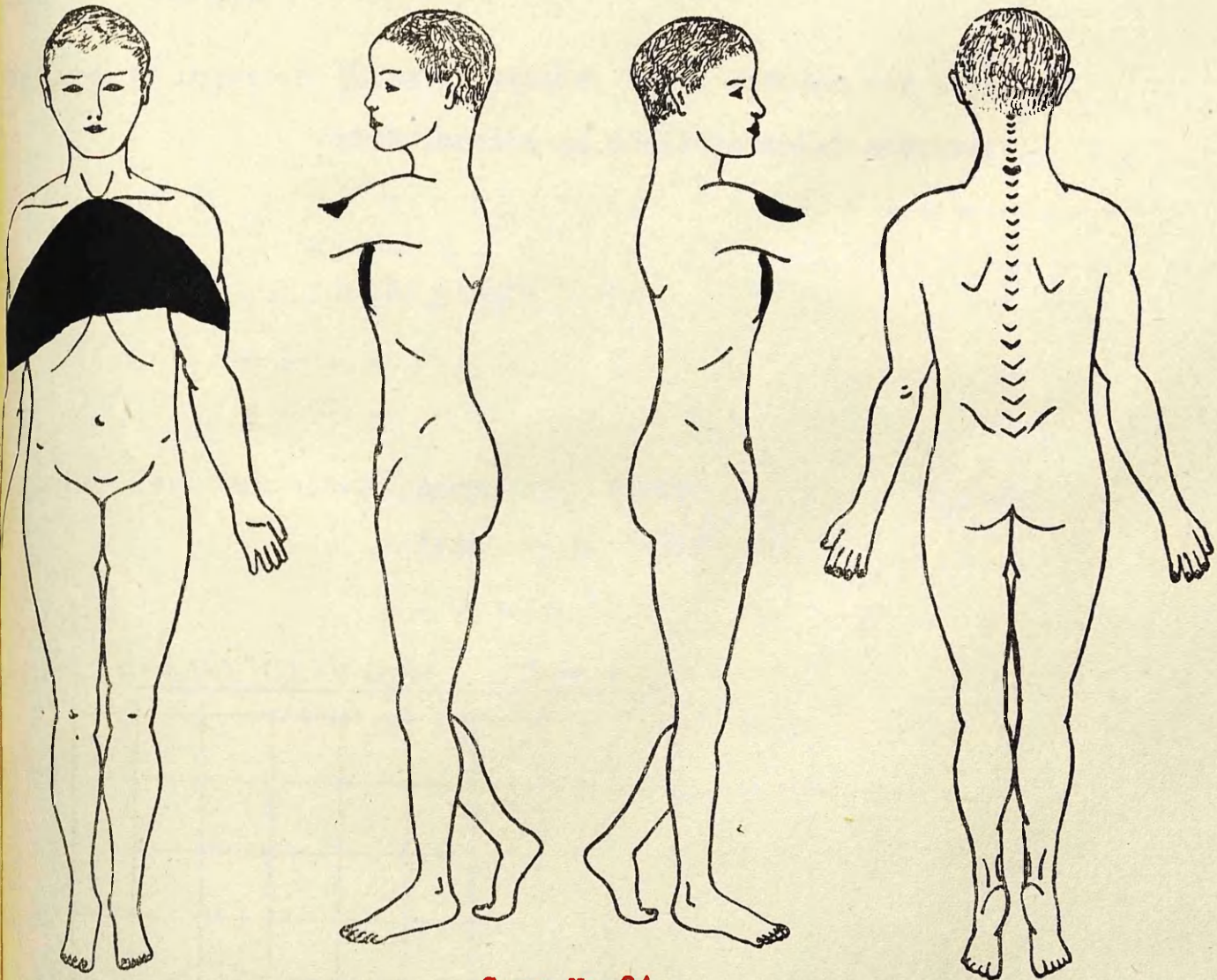
Condition on admission **Apparently suffering pain. Cried**

**- continuously. Temp. 100 Pulse rapid and weak.**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 94

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient **15 years**

Case No **95**

Sex of patient **Female**

Nature of injuries **Burns of thighs, lower abdomen and buttocks.**

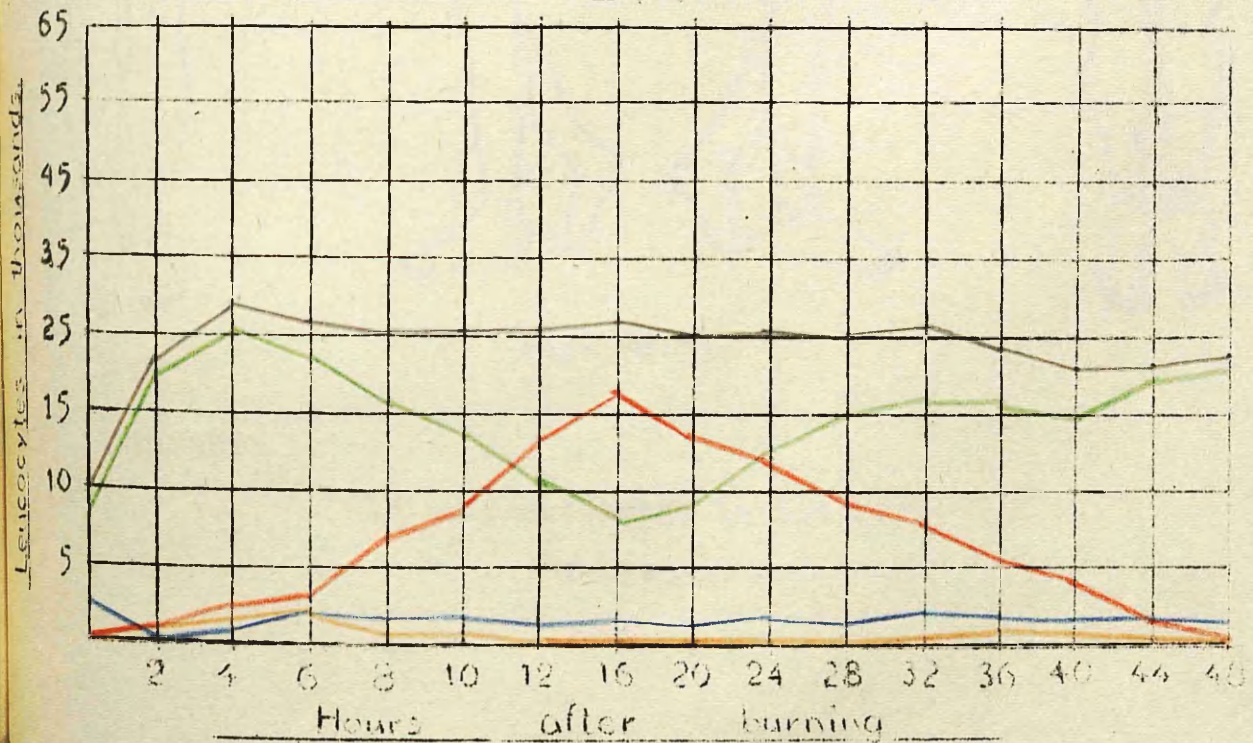
**-Distribution as shown on chart overleaf.**

How sustained **Dress caught fire.**

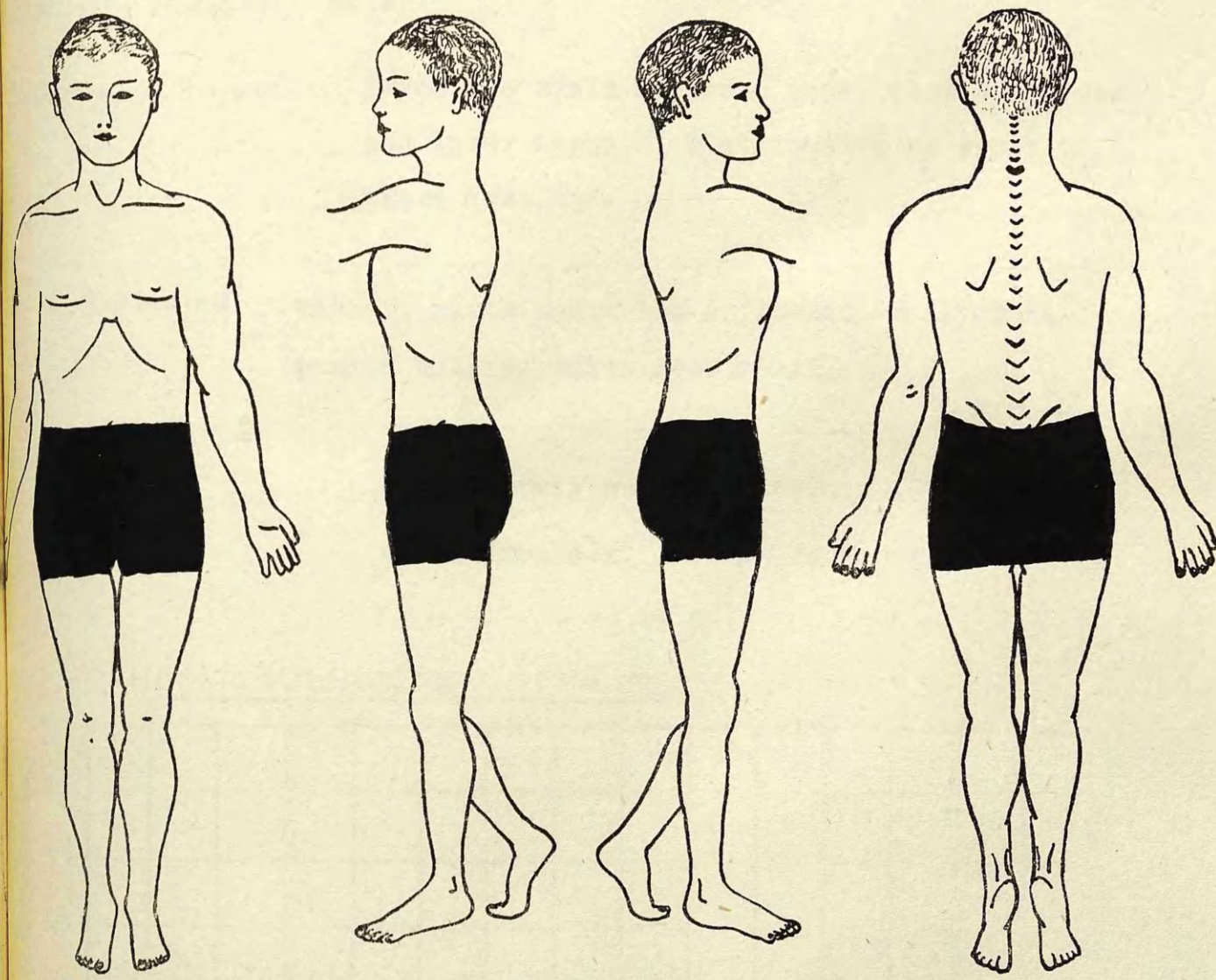
Condition on admission **Apparently suffering pain. Crying.**

**Temp. 97.2 Pulse 120**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 95

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient... **2 years**...

Case No. 96

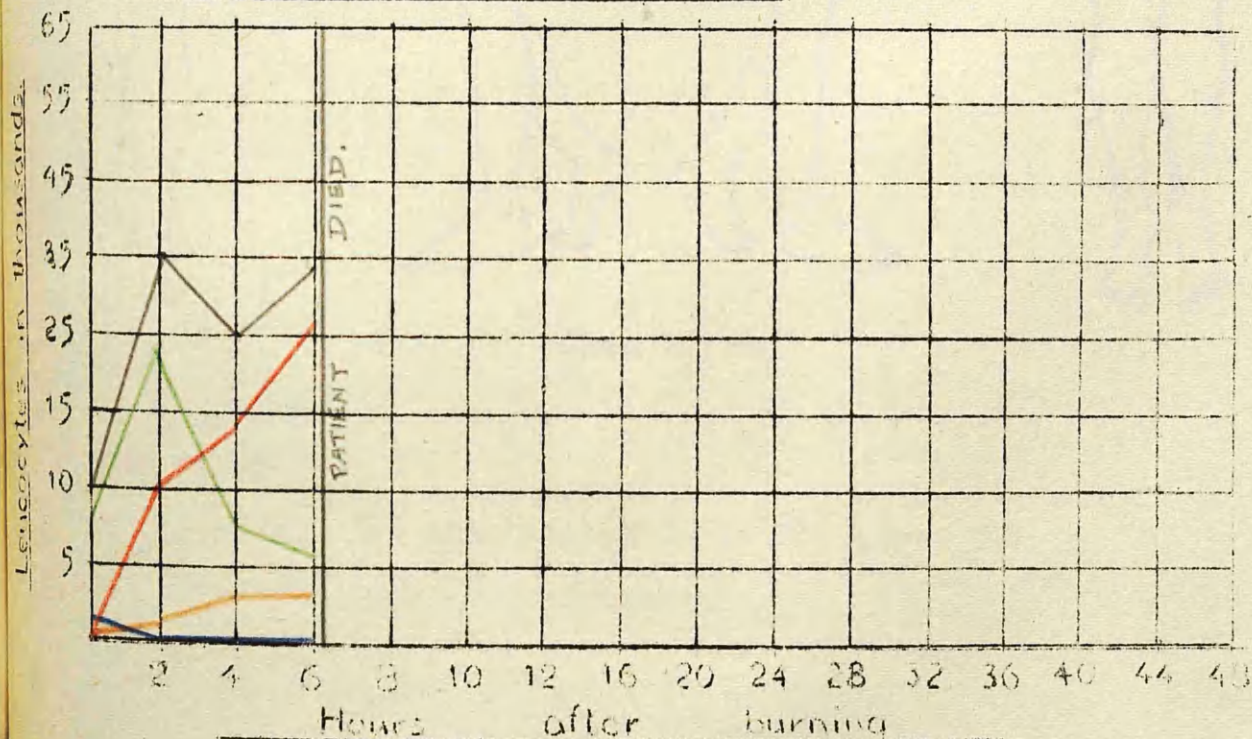
Sex of patient... **Male**...

Nature of injuries... **Extensive scald of face, neck, chest, abdomen and lower limbs. Distribution as shown on chart overleaf.**

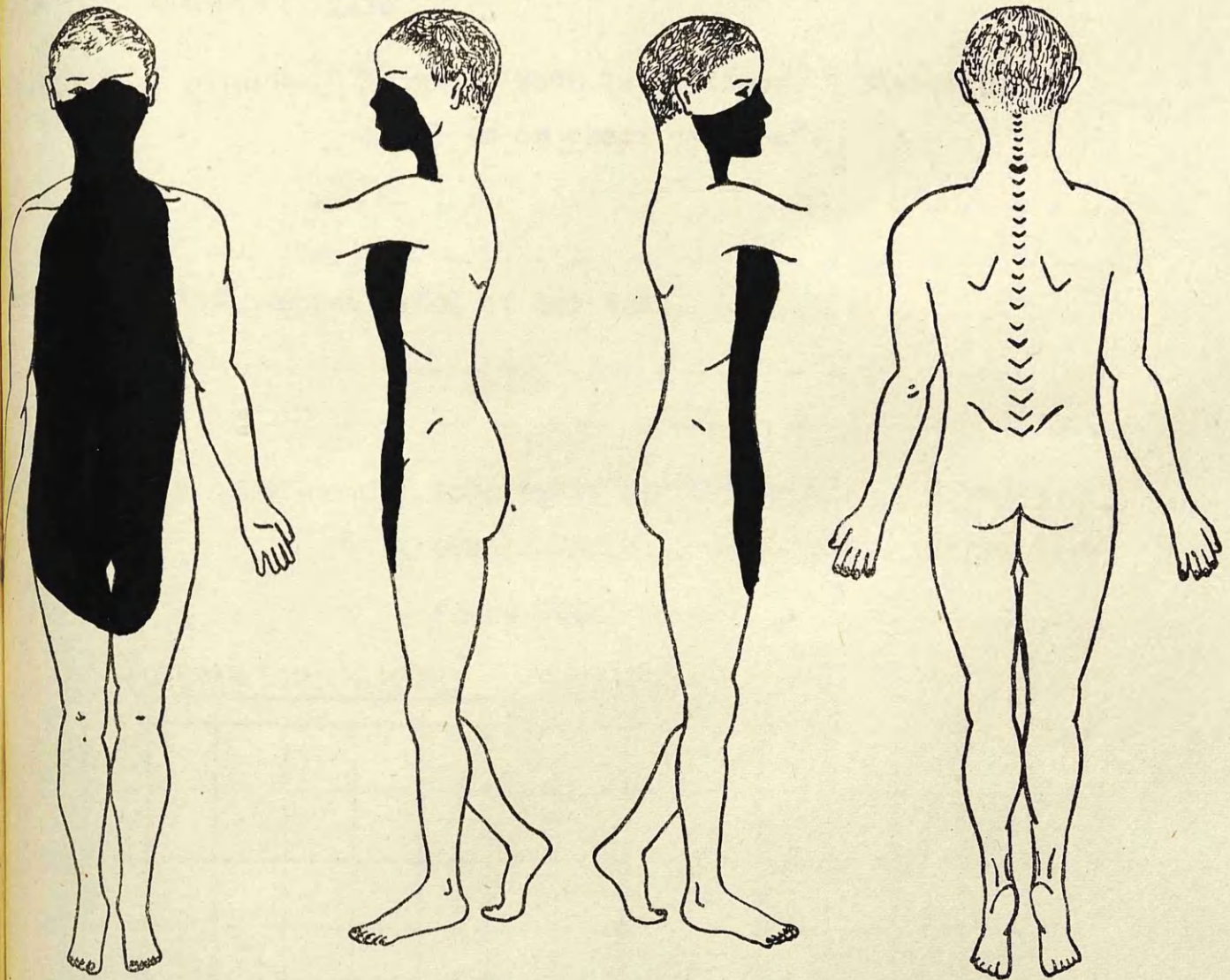
How sustained... **Father, while under the influence of alcohol, poured boiling water over child.**

Condition on admission... **Apparently suffering pain. Cried continuously. Pulse very rapid and weak.**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
 Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes }  
 & Monocytes }



Case No. 96

**TREATMENT**

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **5 years**

Case No. **97**

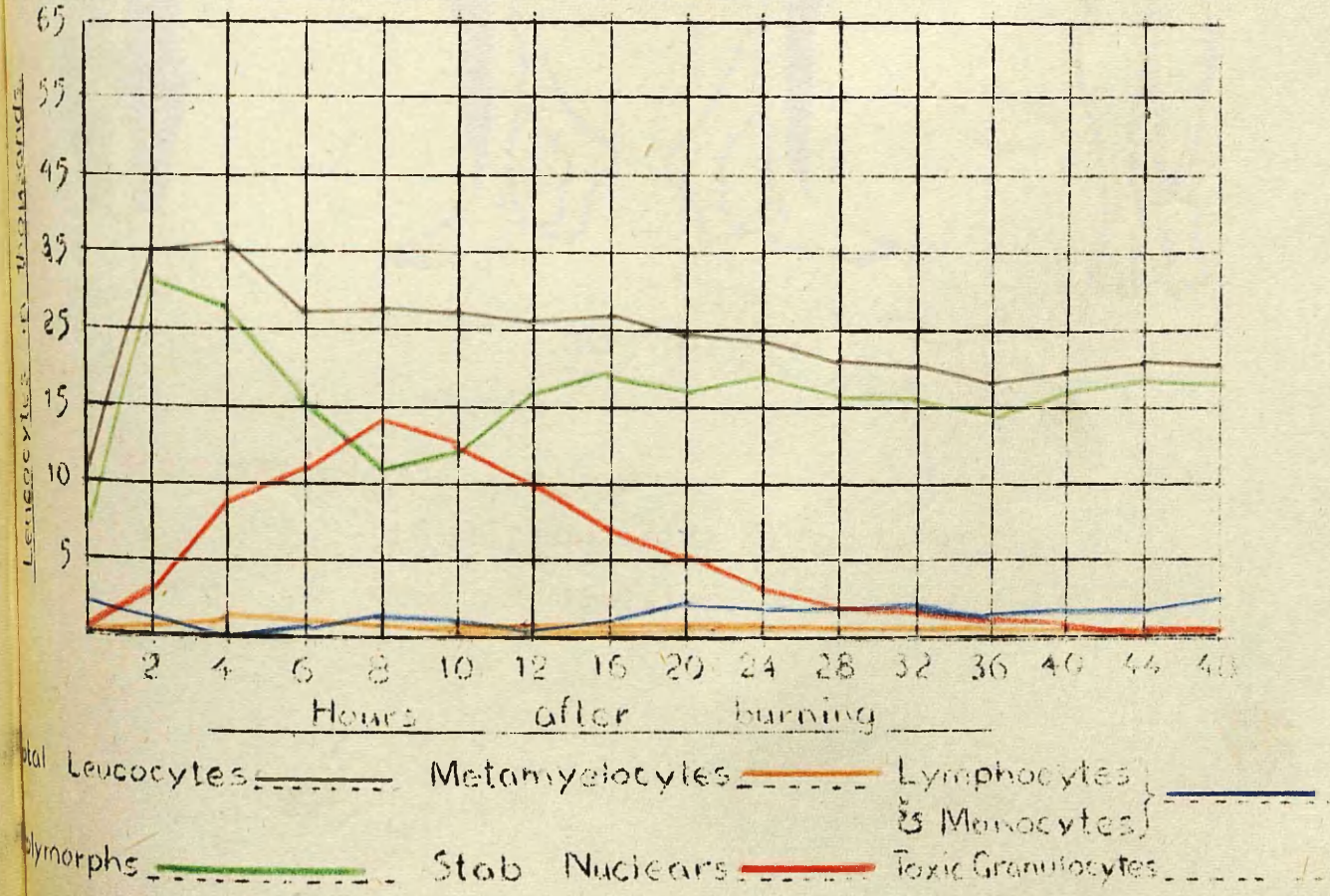
Sex of patient **Male**

Nature of injuries **Burns of both lower limbs. Distribution as shown on chart overleaf.**

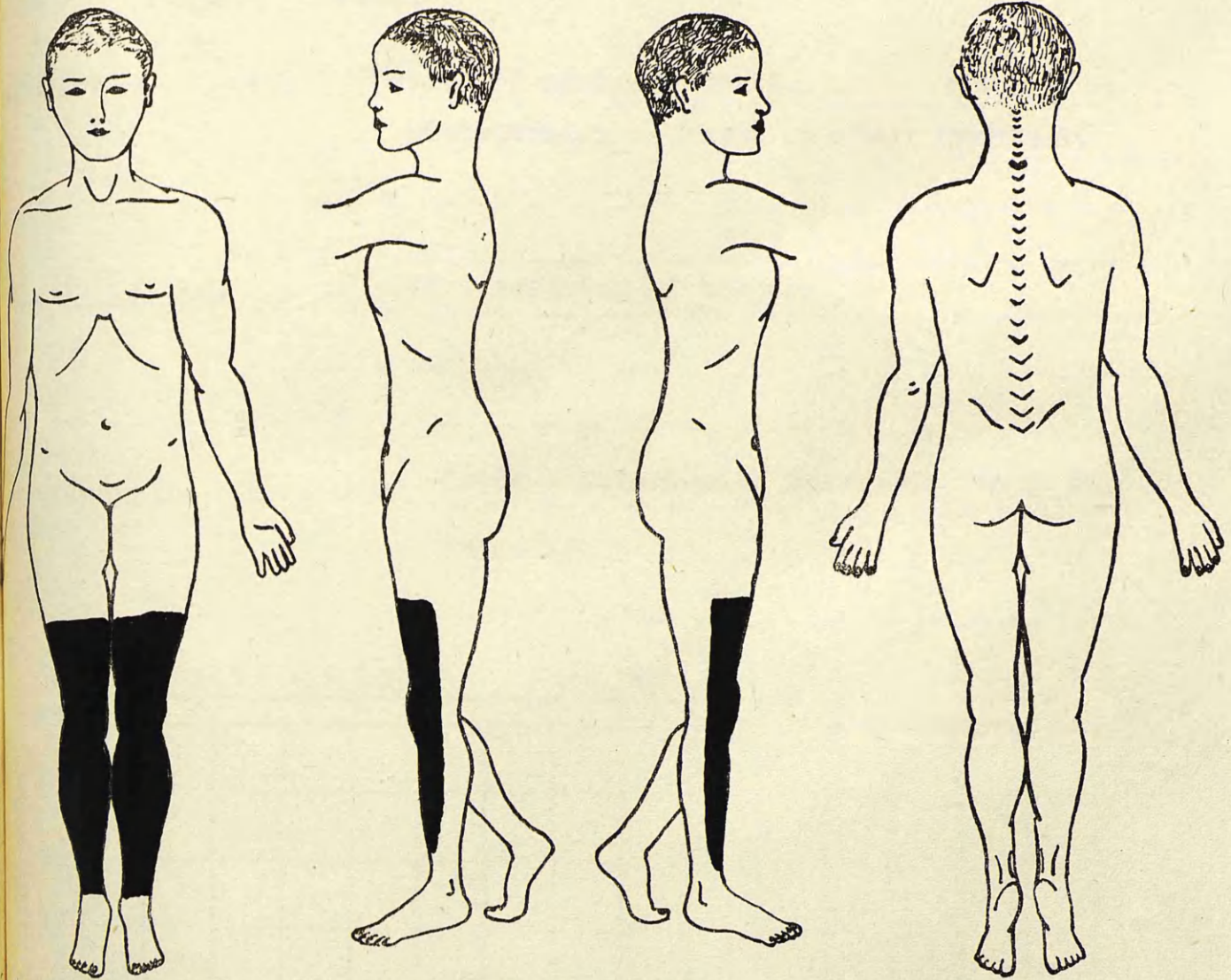
How sustained **Upset ladle of hot tar.**

Condition on admission **Apparently suffering pain. Cried continuously. Shivering. Temp. 97.6. Pulse 130**

HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
 & Monocytes }  
 Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 97

**TREATMENT**

**1% Sulphanilamide in Cod Liver Oil  
Emulsion.**

Age of patient **5 years.**

Case No. **98**

Sex of patient **Female**

Nature of injuries **Scald of neck and chest.**

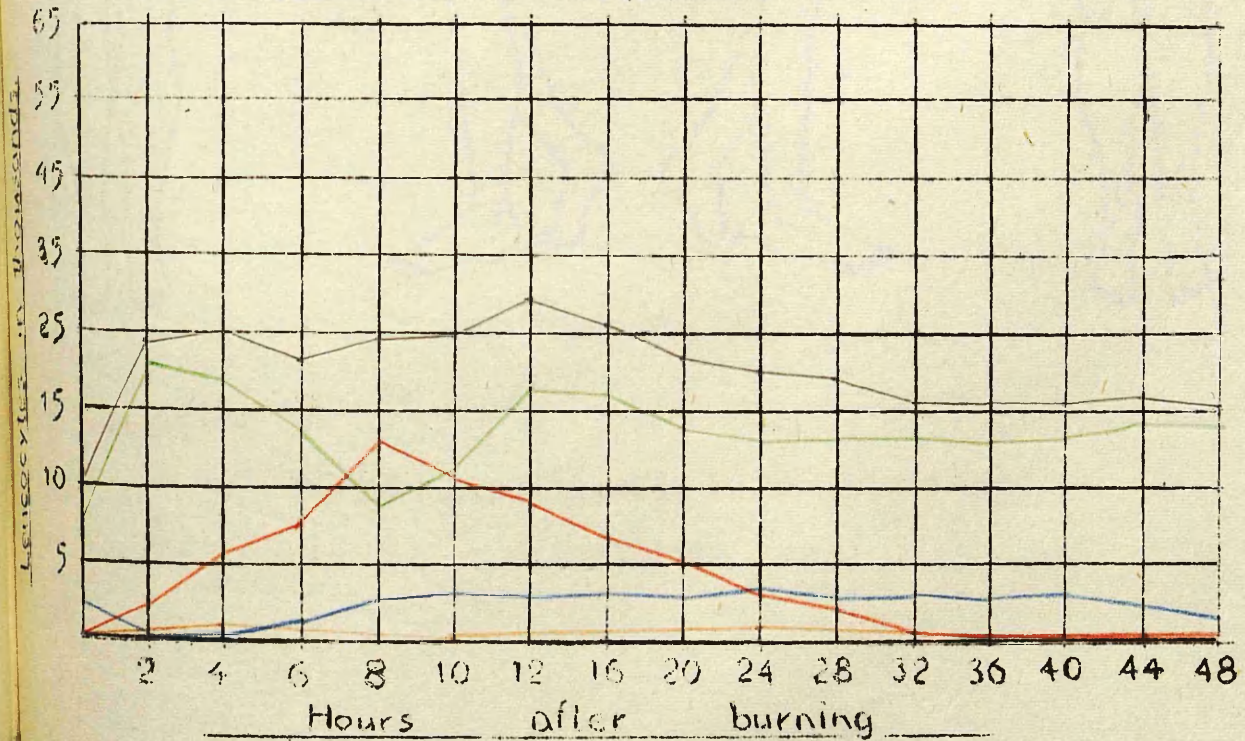
**Distribution as shown on chart overleaf.**

How sustained **Overturnd cup of hot tea.**

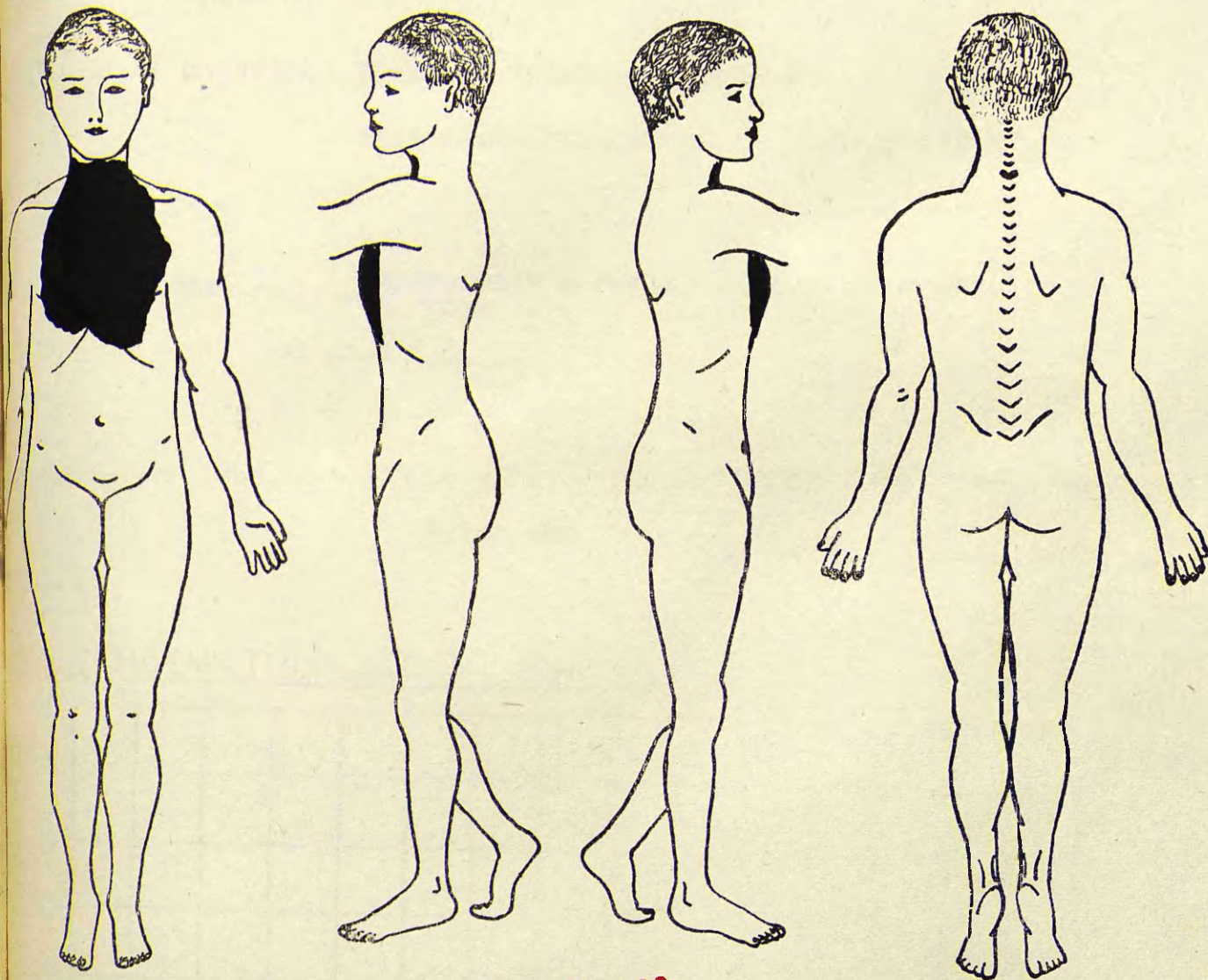
Condition on admission **Cried continuously. Shivering. Temp. 98.4**

**Pulse 110**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Myelomorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 98

**TREATMENT**

**1% Sulphanilamide in Cod Liver Oil  
Emulsion.**

Age of patient 15 years

Case No. 99

Sex of patient Female

Nature of injuries scald of thighs and abdomen.

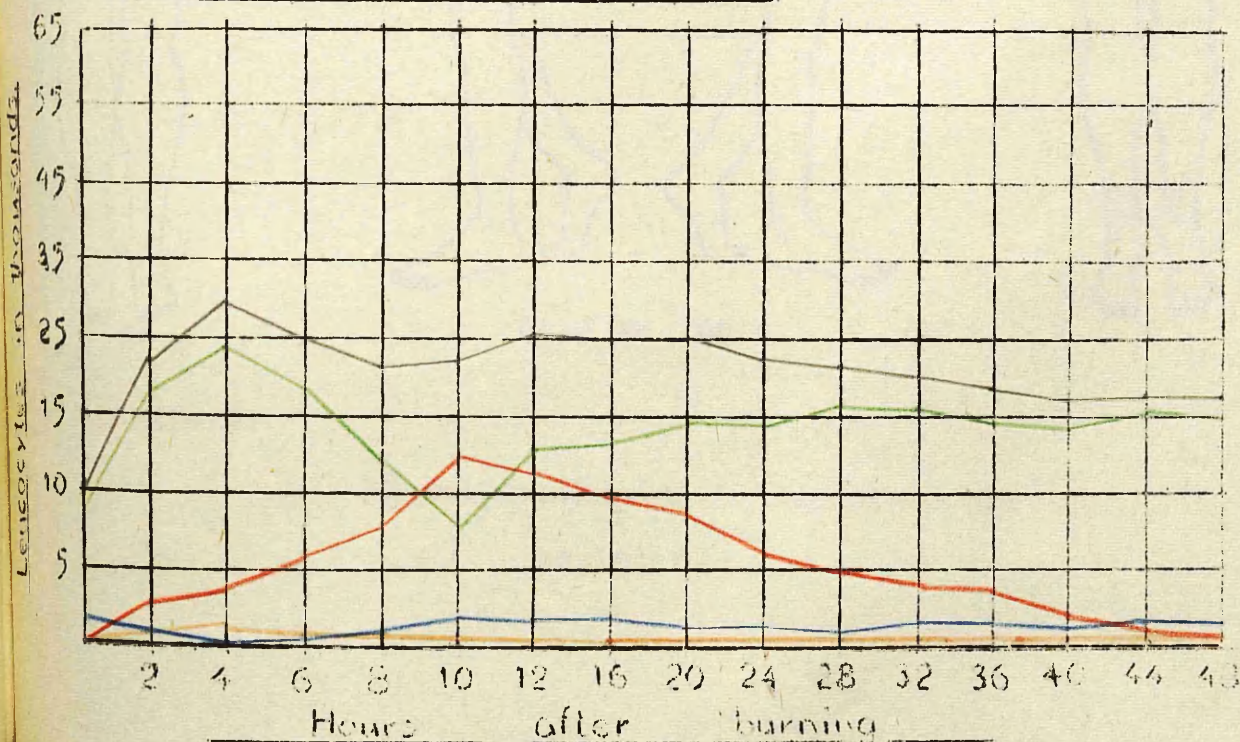
- Distribution as shown on chart overleaf.

How sustained Overturning a kettle of boiling water.

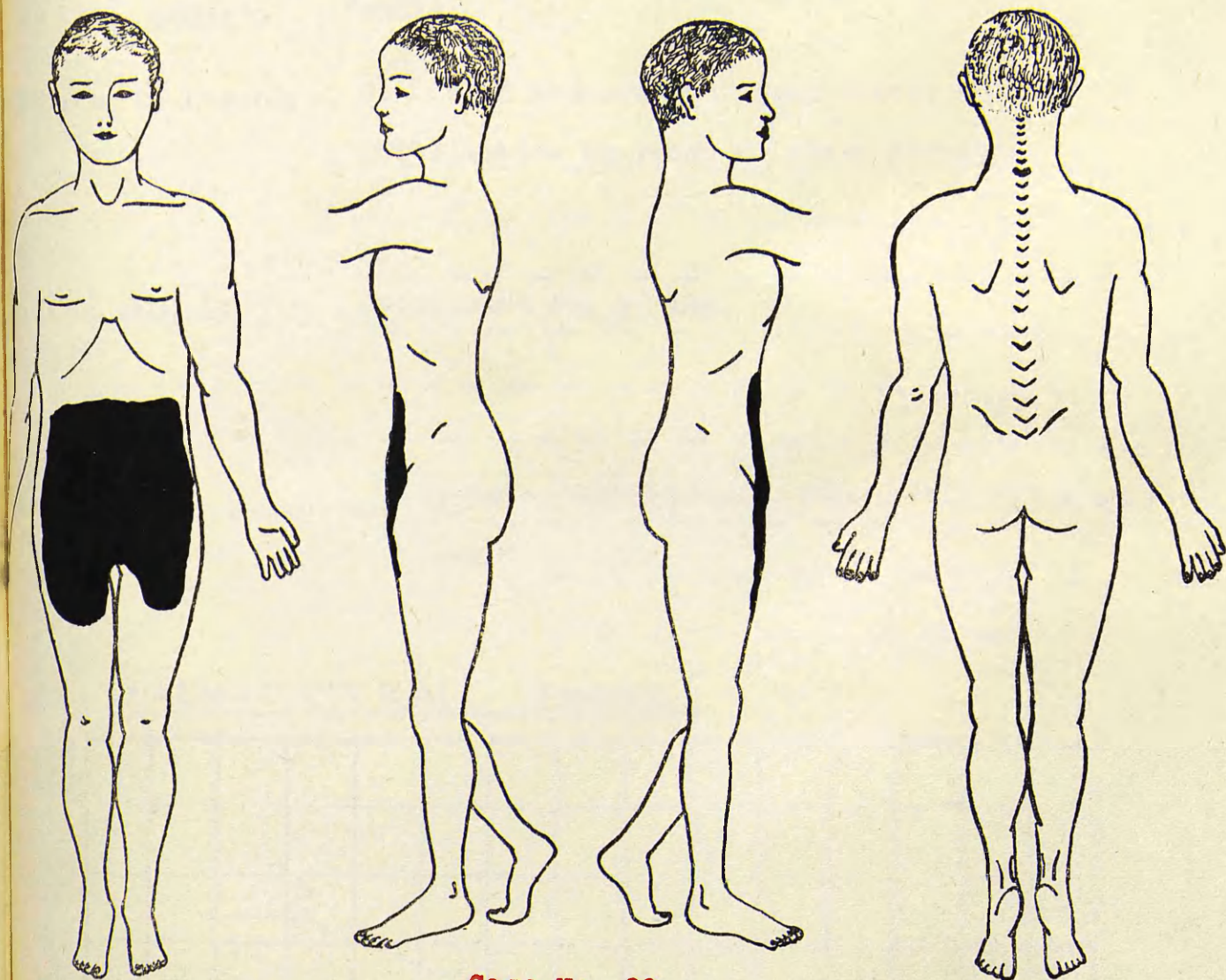
Condition on admission No pain. Cried occasionally. Temp. 99

Pulse 100

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 99

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 1 year

Case No. 100

Sex of patient Female

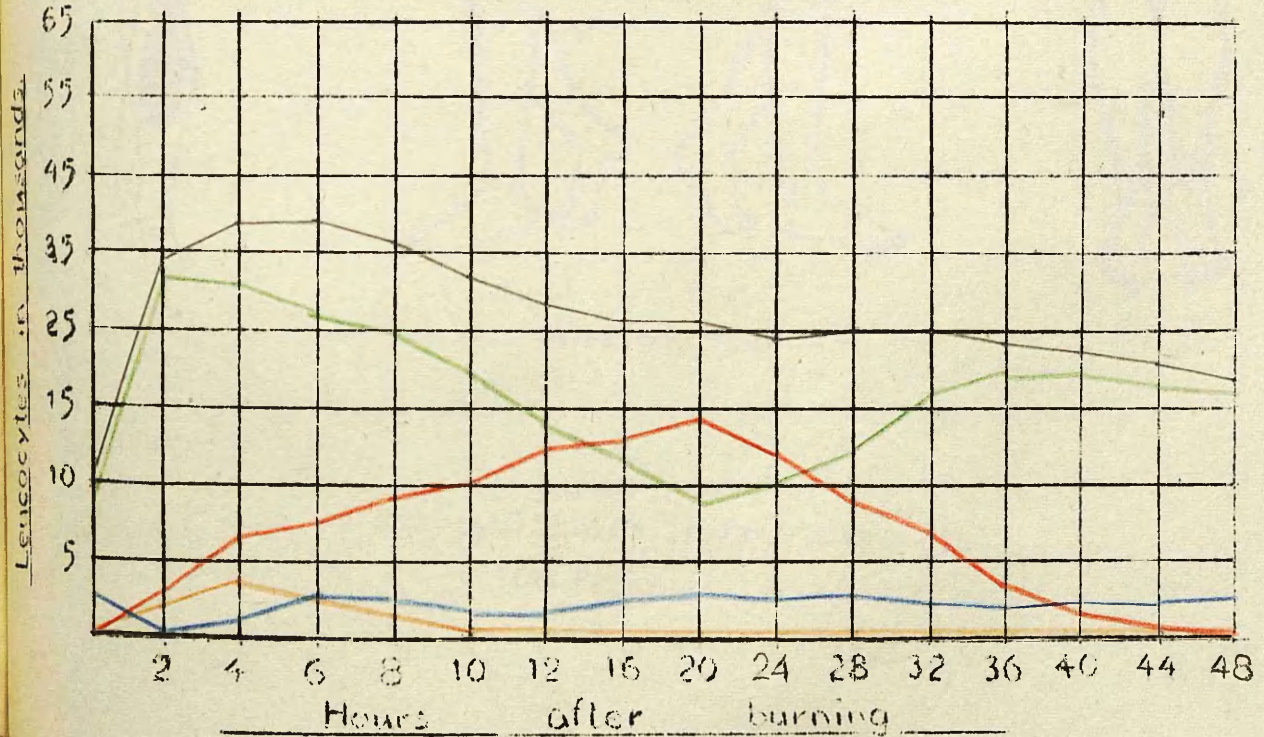
Nature of injuries Scalds of abdomen and lower limbs.

Distribution as shown on chart overleaf.

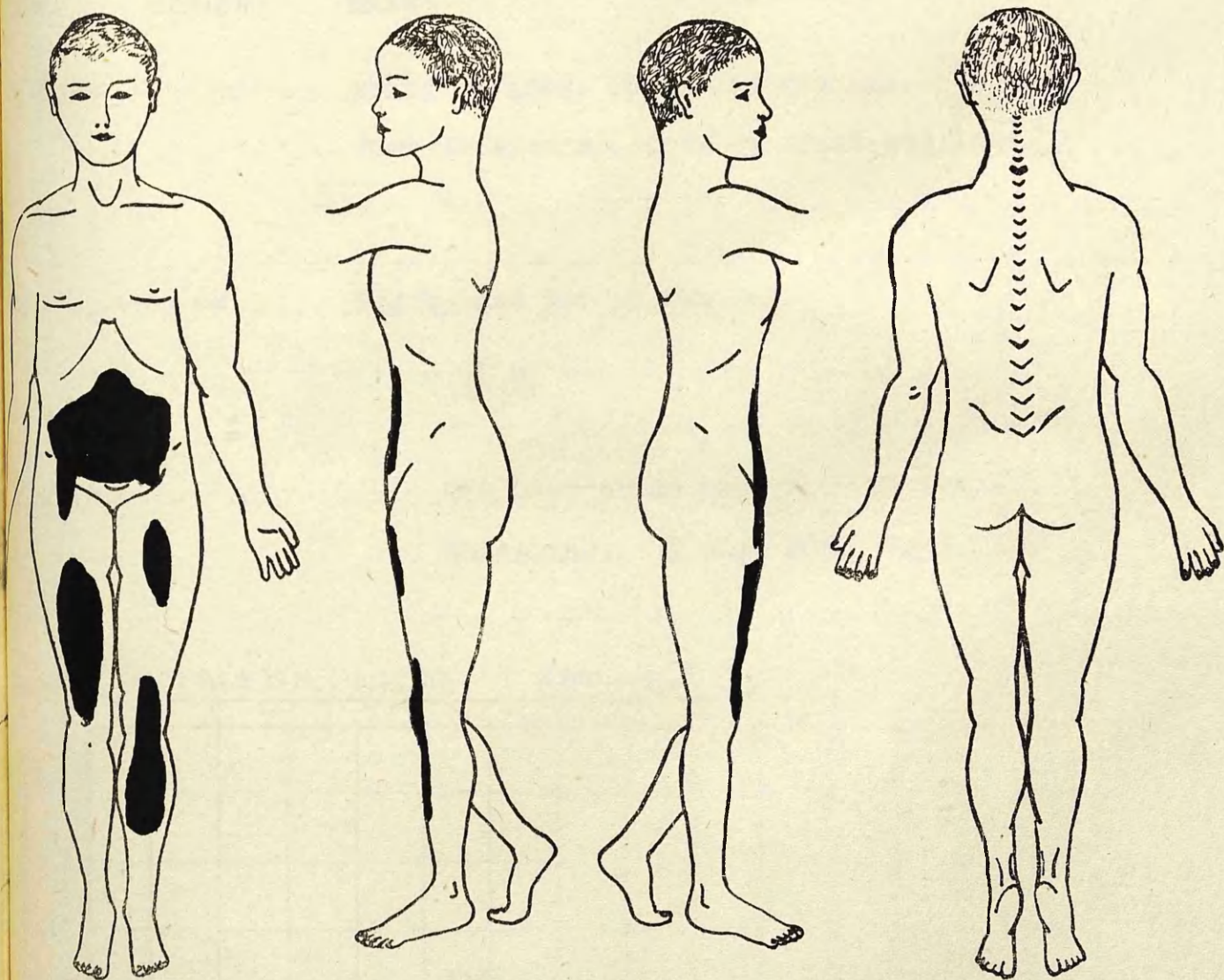
How sustained Overturnded cup of tea.

Condition on admission Cried continuously. Temp. 99.6 Pulse very rapid and weak.

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes }  
 & Monocytes }



Case No. 100

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **5 years**

Case No **101**

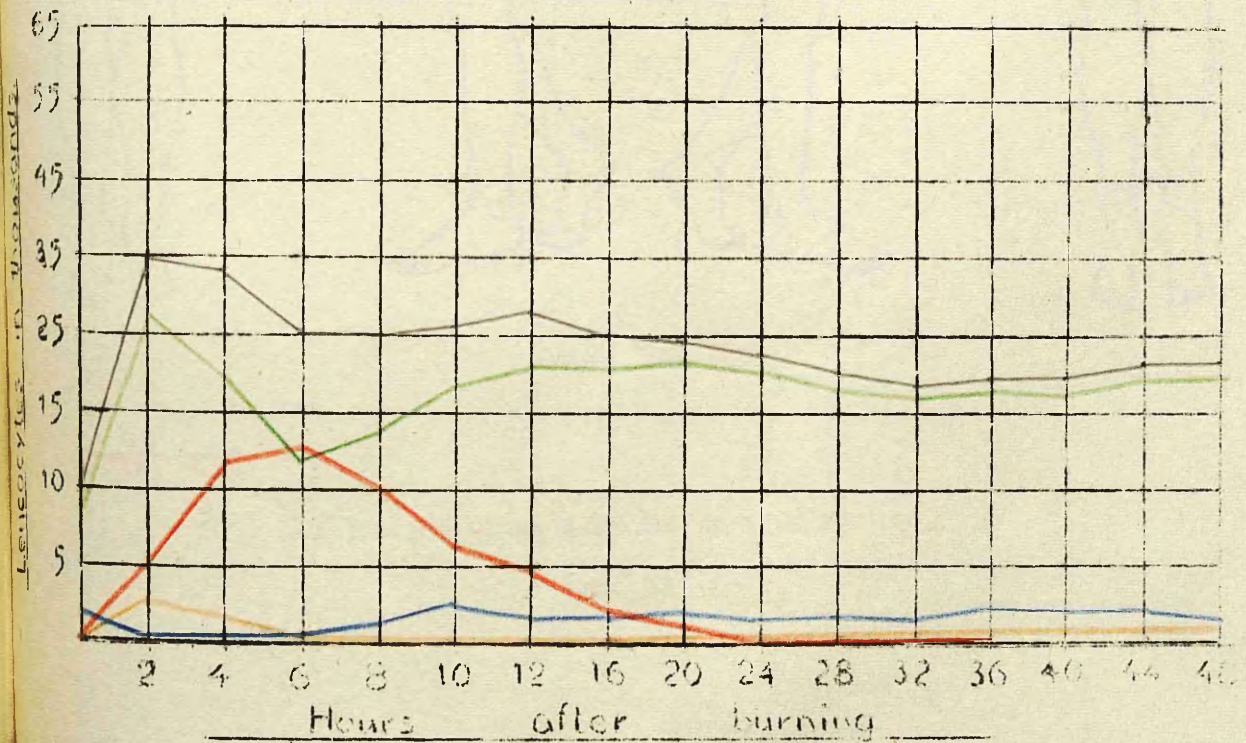
Sex of patient **Male**

Nature of injuries **Scald of arms, chest and abdomen.**  
**Distribution as shown on chart overleaf.**

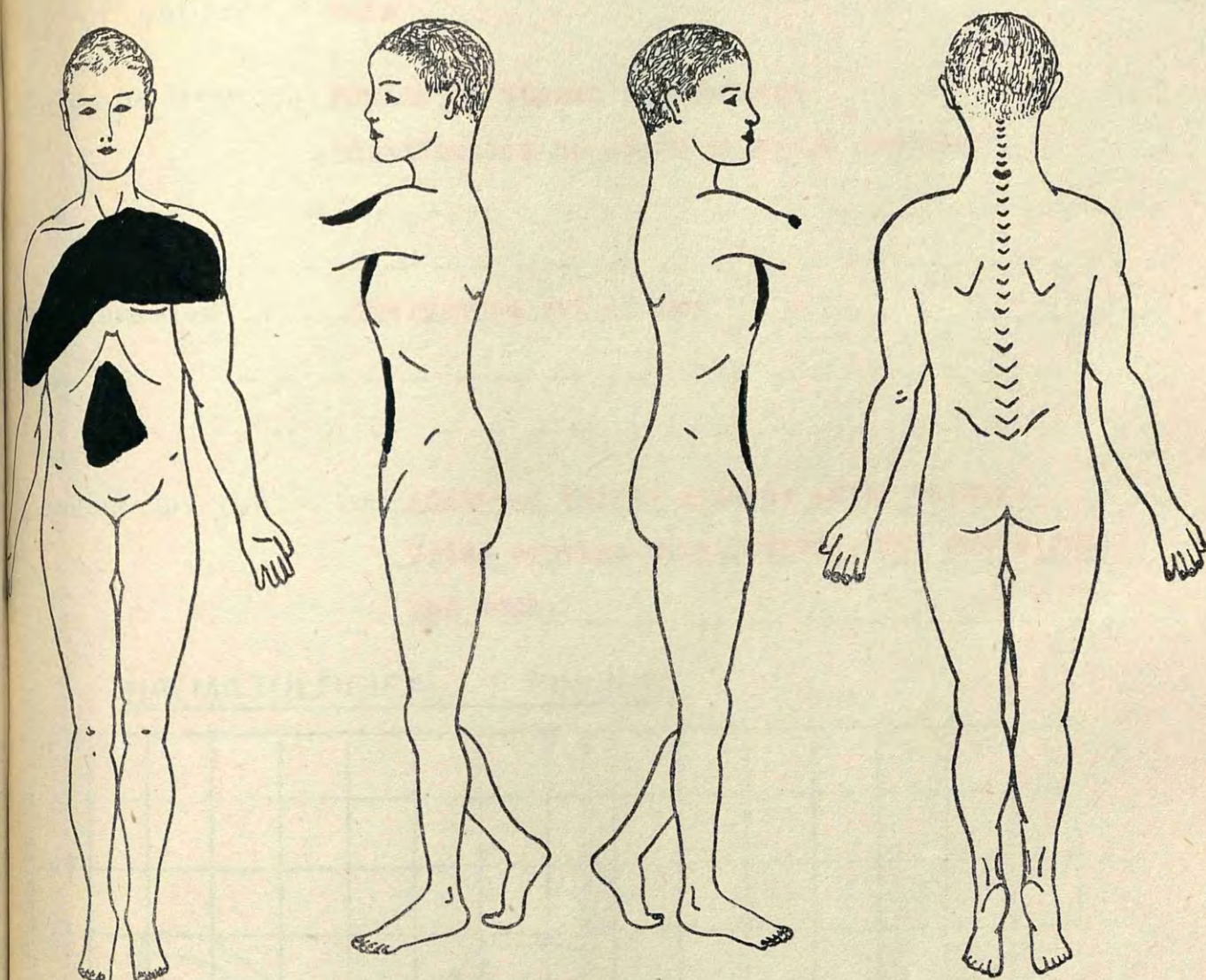
How sustained **Overturnd pot of tea.**

Condition on admission **One hour after injury. No pain.**  
**Shivering. Pulse 150 Temp. 100**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes \_\_\_\_\_  
 Eosinophils \_\_\_\_\_  
 Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_  
 Lymphophils \_\_\_\_\_



Case No. 101

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 1 year

Case No 102

Sex of patient Male

Nature of injuries Scalds of thorax and abdomen

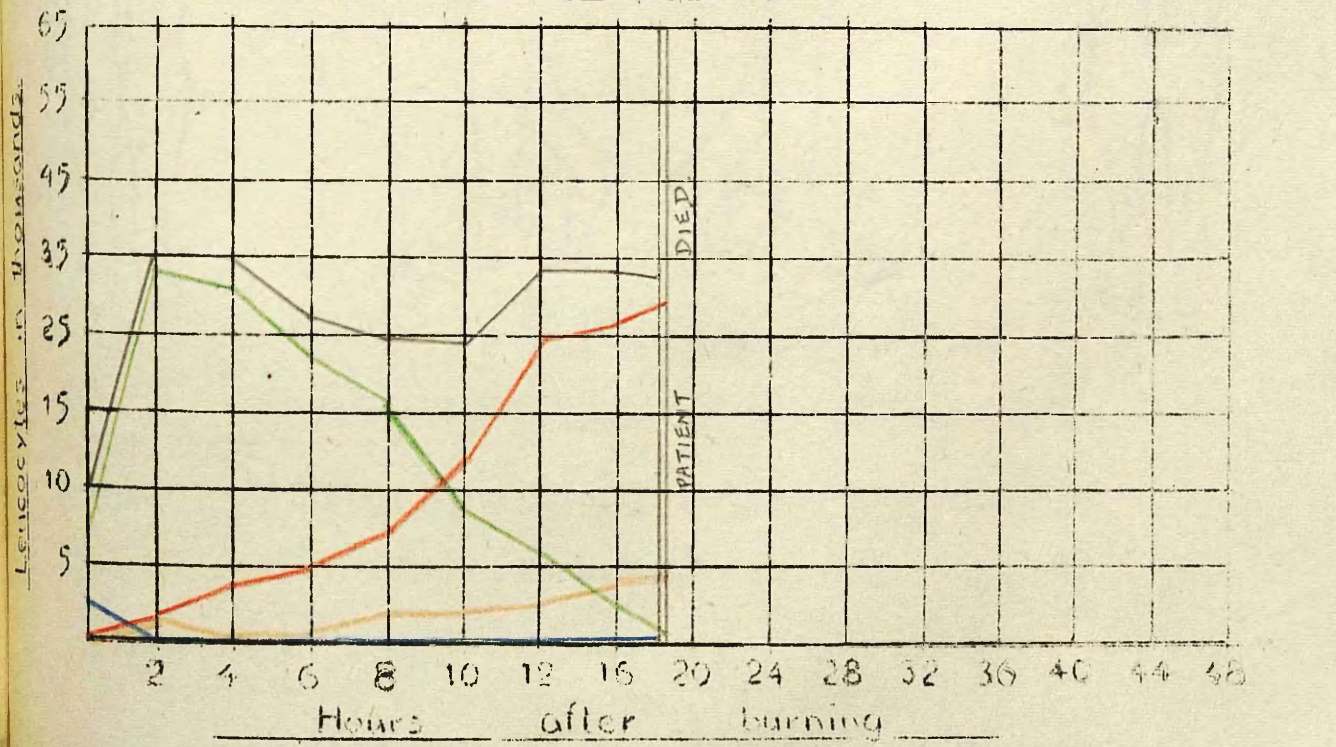
Distribution as shown on chart overleaf

How sustained Overturnd pot of tea

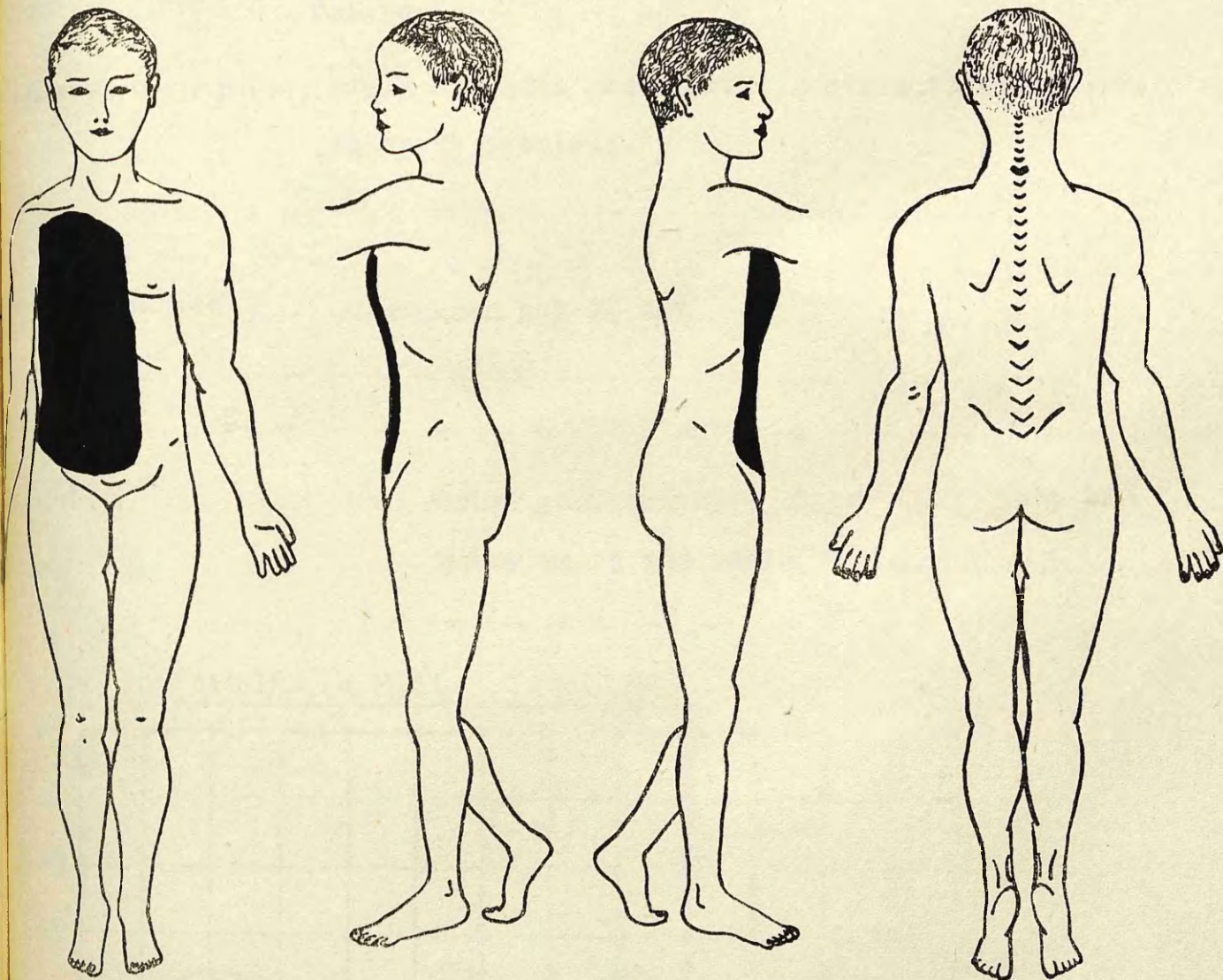
Condition on admission Admitted thirty minutes after injury.

Cried continuously. Temp. 100. Pulse rapid and weak.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 102

**TREATMENT**

**1% Sulphanilamide in Cod Liver Oil  
Emulsion.**

Age of patient **1 year**

Case No **103**

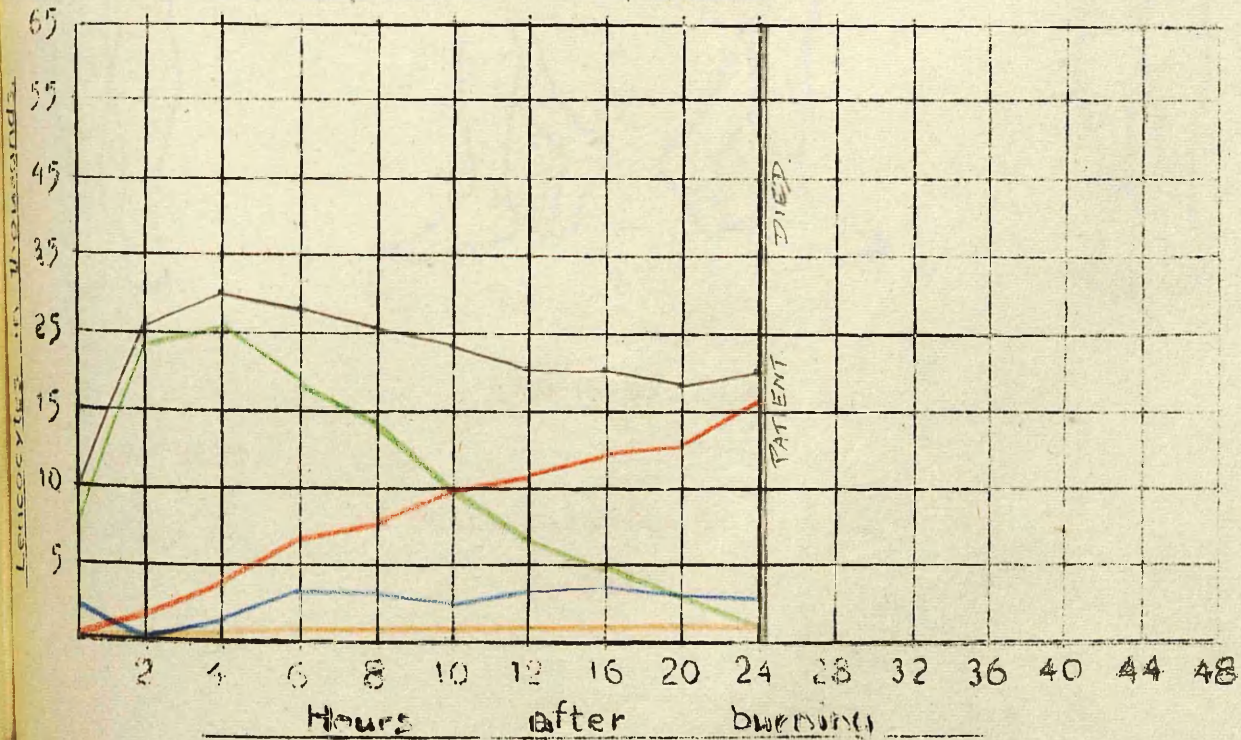
Sex of patient **Female**

Nature of injuries **Scald of chest and arms. Distribution as shown on chart overleaf.**

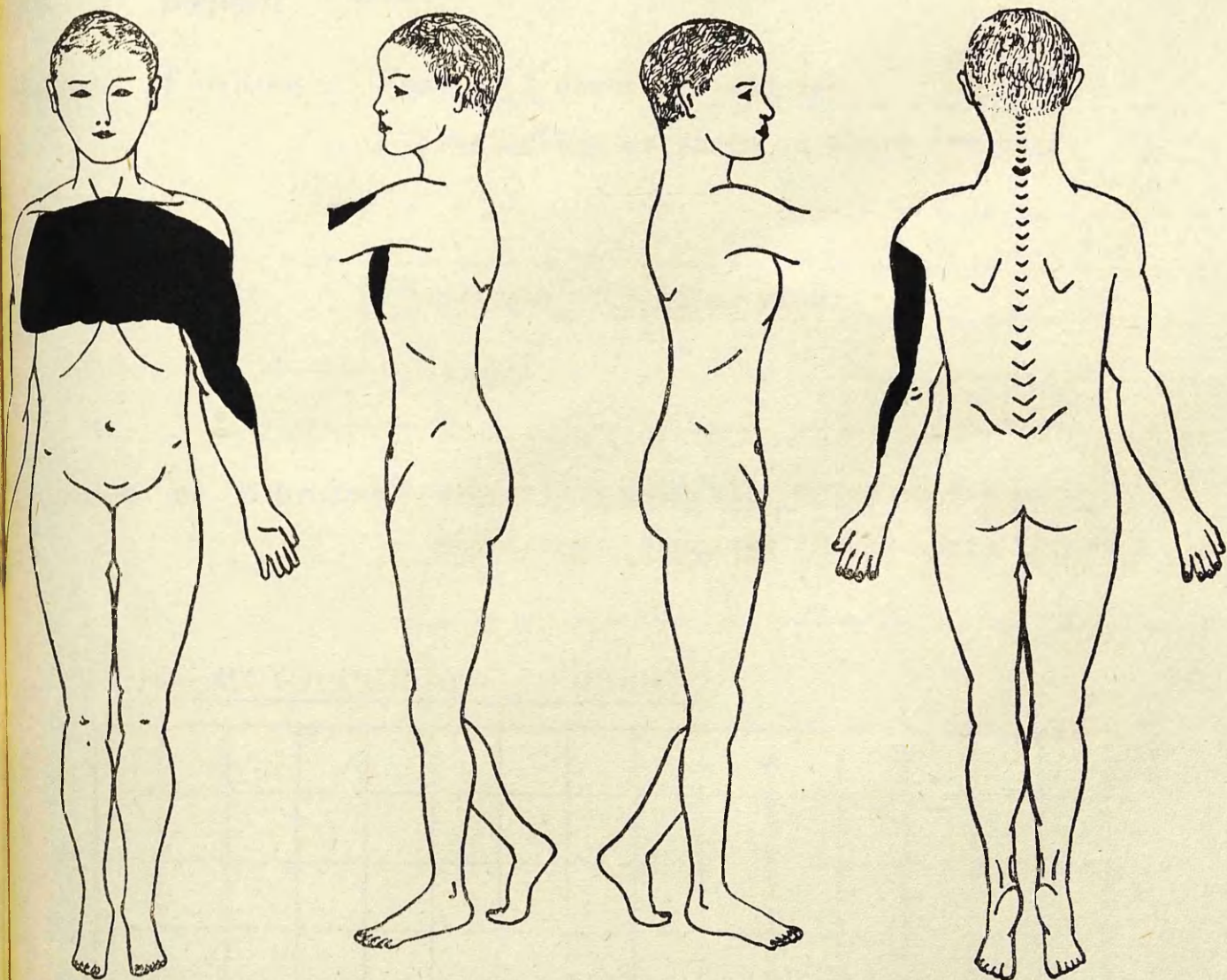
How sustained **Overtaken pot of tea**

Condition on admission **Cried continuously. Shivering. Temp. 100**  
**Pulse rapid and weak**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Myeloblasts ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 103

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 3 years

Case No. 104

Sex of patient Male

Nature of injuries Scald of chest and abdomen.

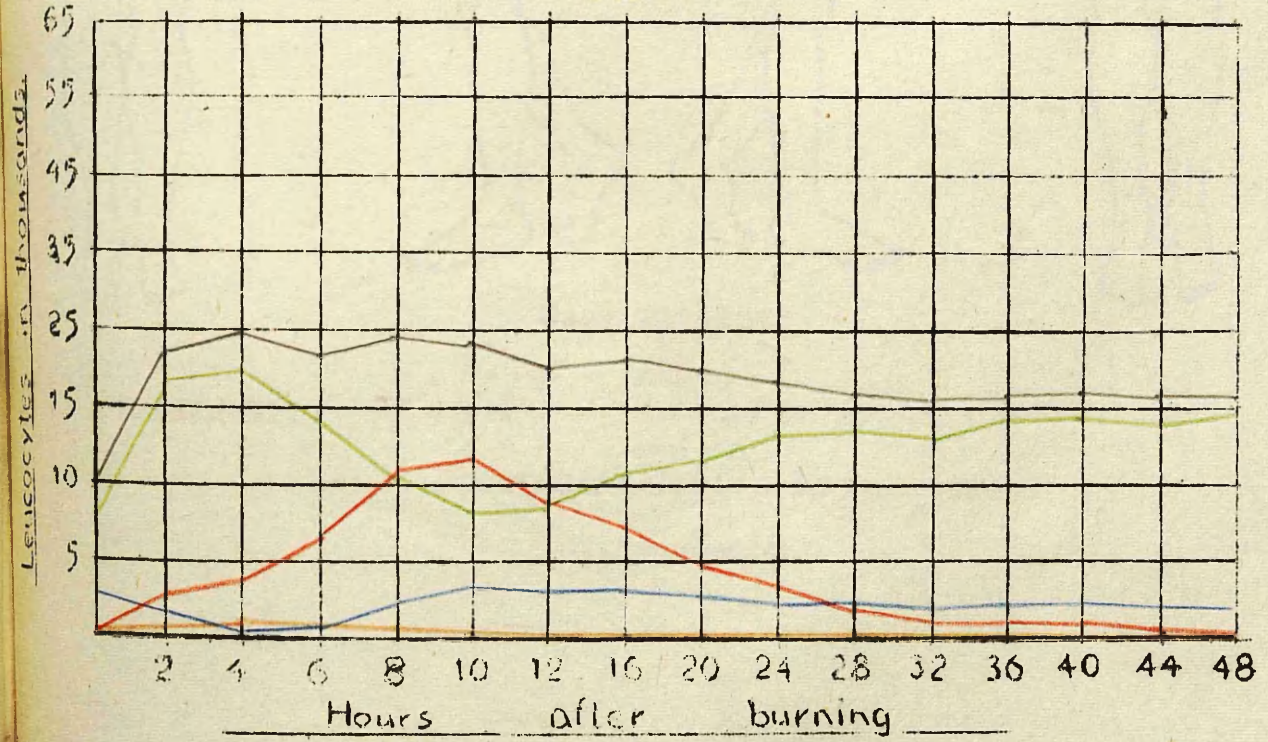
Distribution as shown on chart overleaf.

How sustained Upset pan of boiling water.

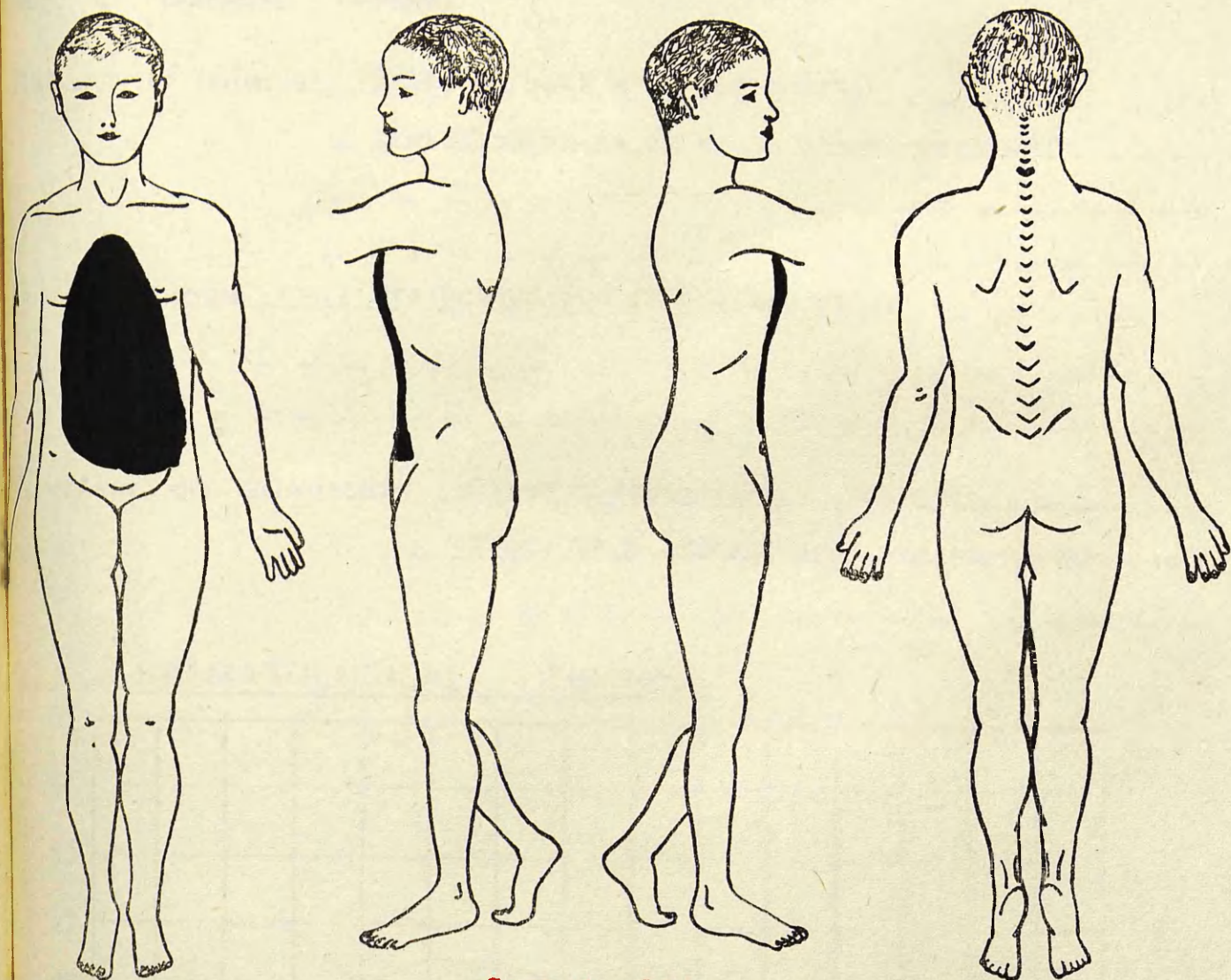
Condition on admission Apparently painful. Cried continuously.

Shivering. Temp. 98 Pulse rapid and weak

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 104

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 2 years

Case No. 105

Sex of patient Female

Nature of injuries Scald of both arms and chest.

Distribution as shown on chart overleaf.

How sustained Overturnd pan of boiling water

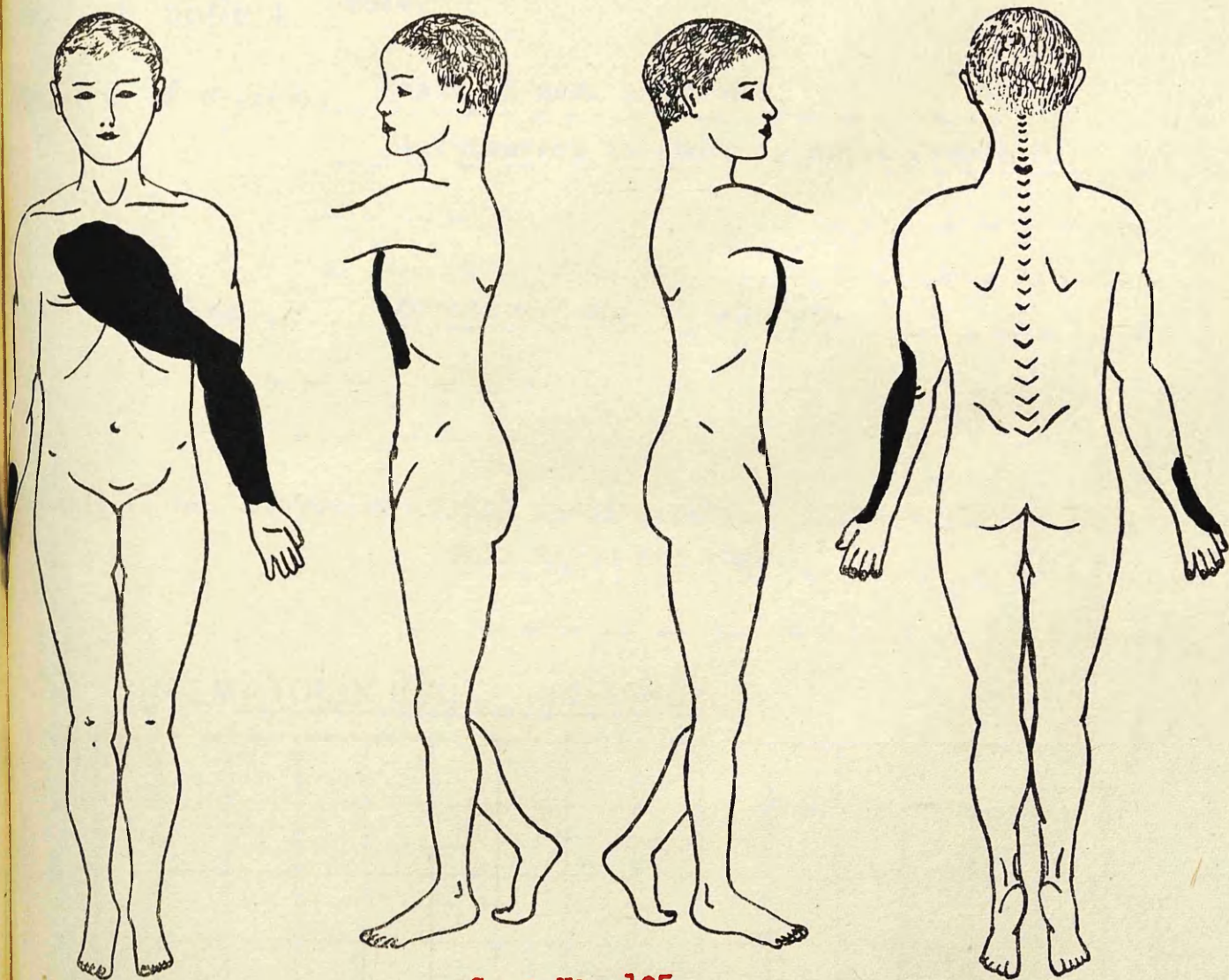
Condition on admission Cried continuously. Shivering.

Temp. 97.8 Pulse rapid and very weak.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 105

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 18 months.

Case No. 106

Sex of patient Male.

Nature of injuries Scald of neck and chest.

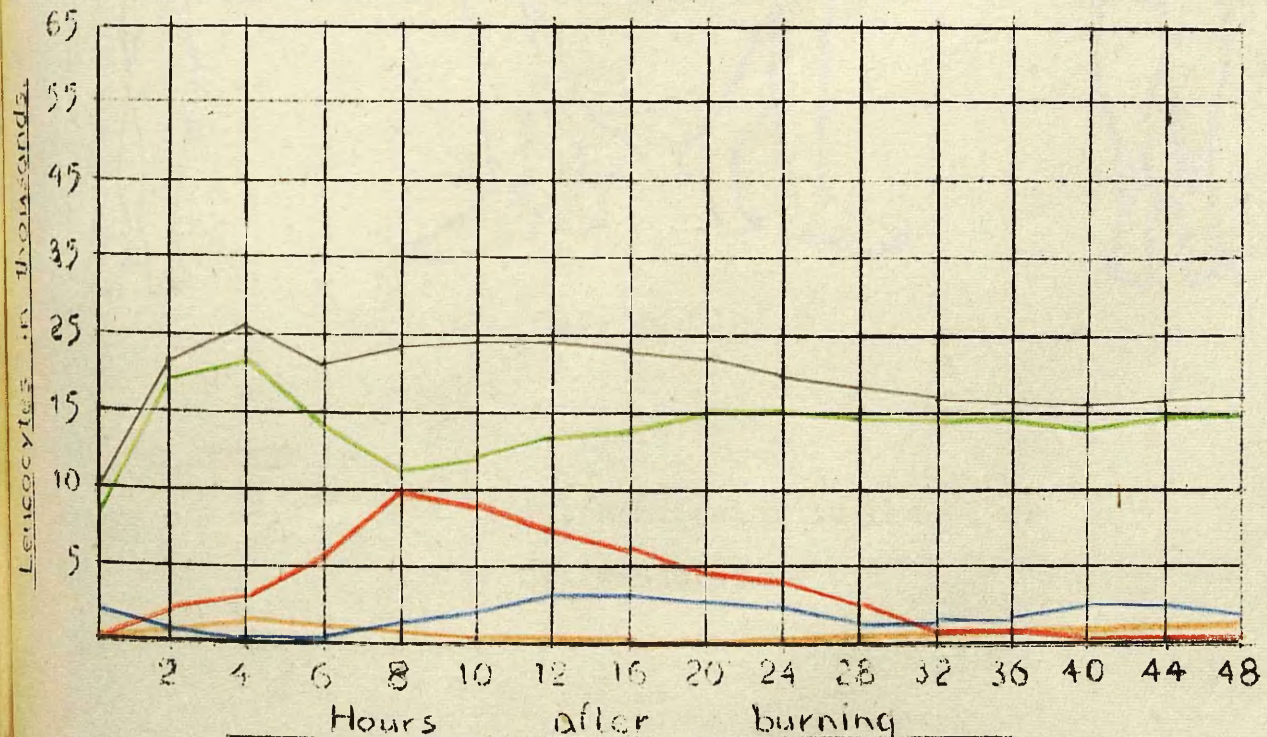
Distribution as shown on chart overleaf.

How sustained Overturnd cup of hot tea.

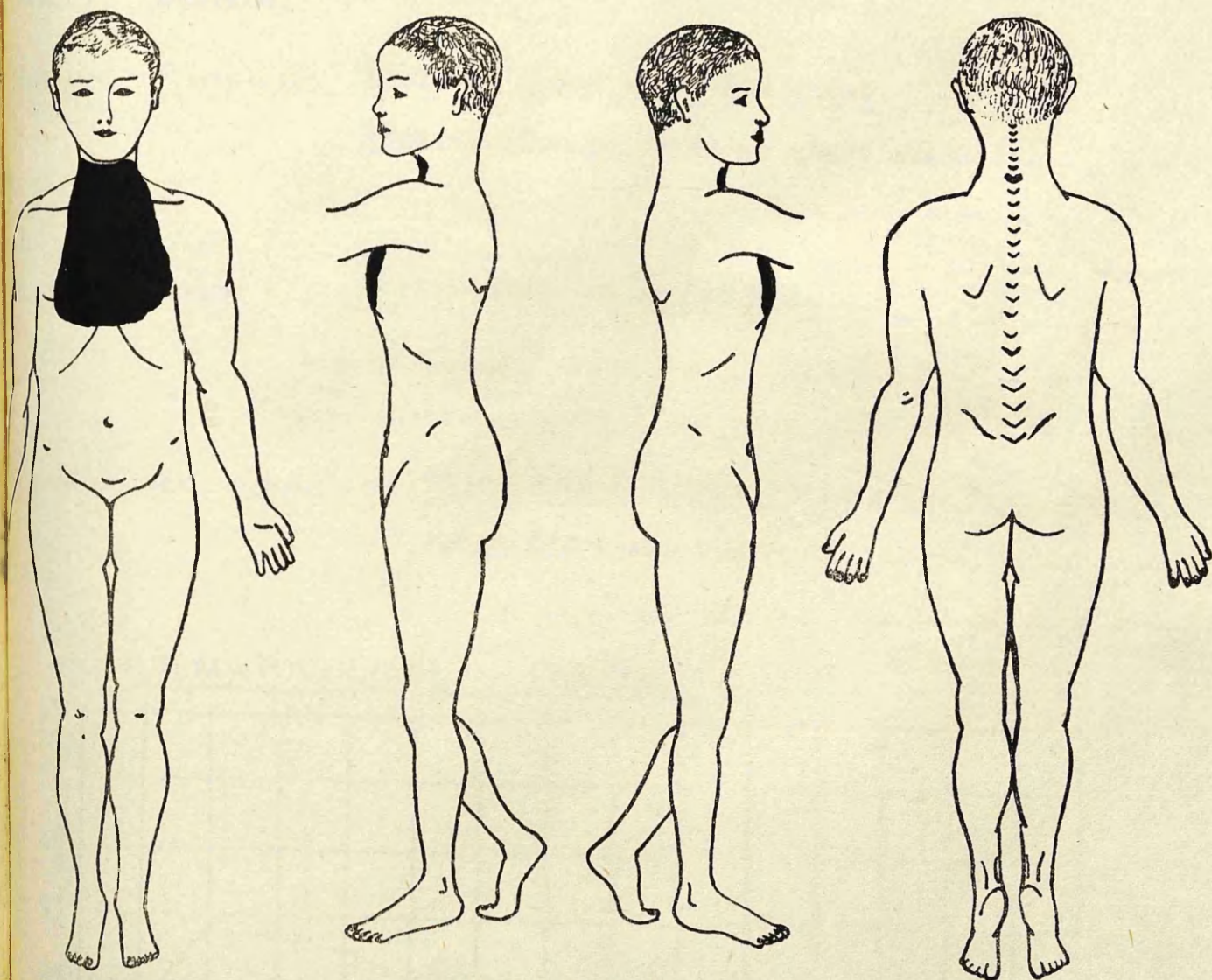
Condition on admission Cried continuously. Shivering. Temp. 97.8

Pule Rapid and weak.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_

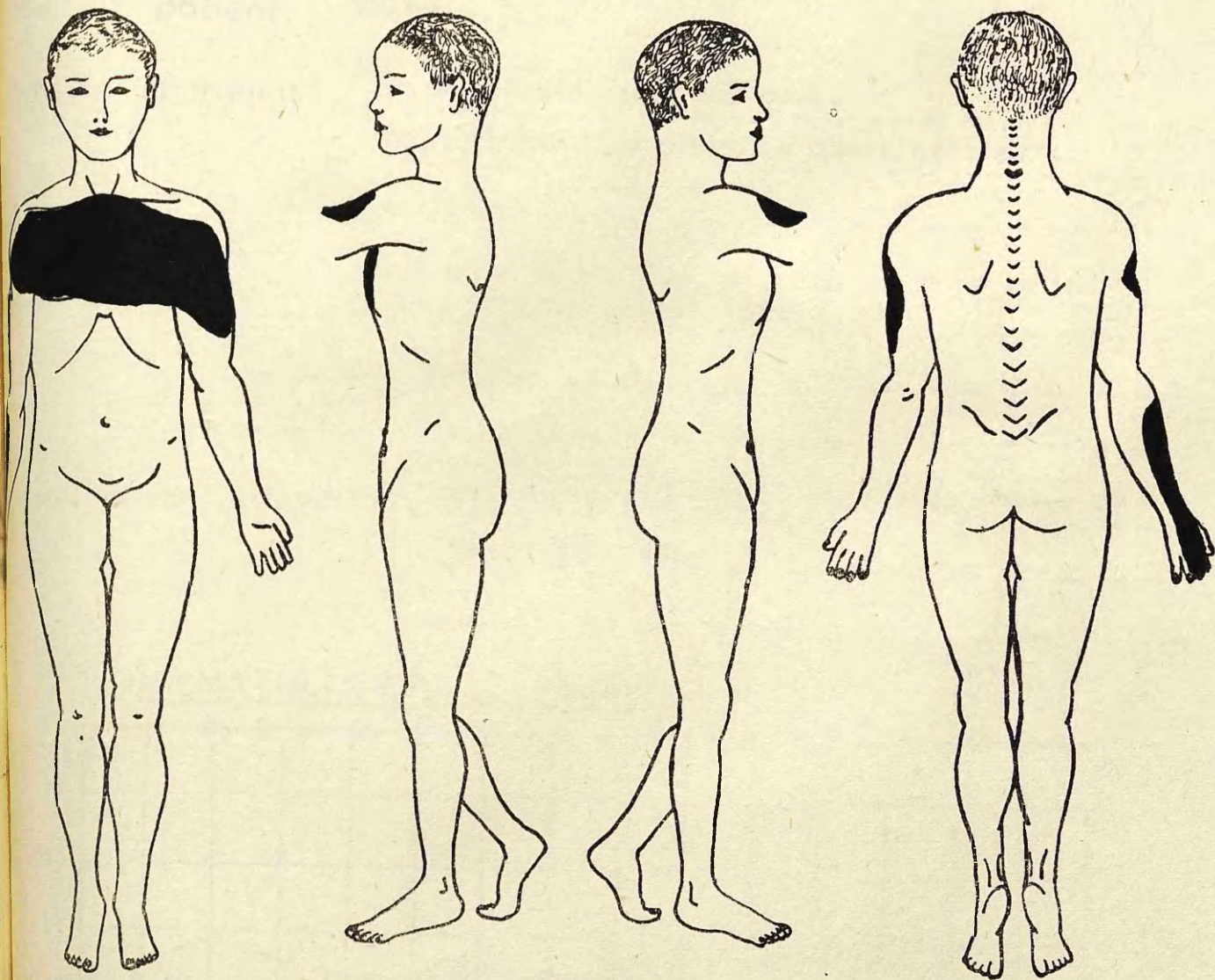


Case No. 106

**TREATMENT**

1% Sulphanilamide in Cod Liver  
Oil Emulsion.





Case No. 107

**TREATMENT**

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 3 years.

Case No. 108.

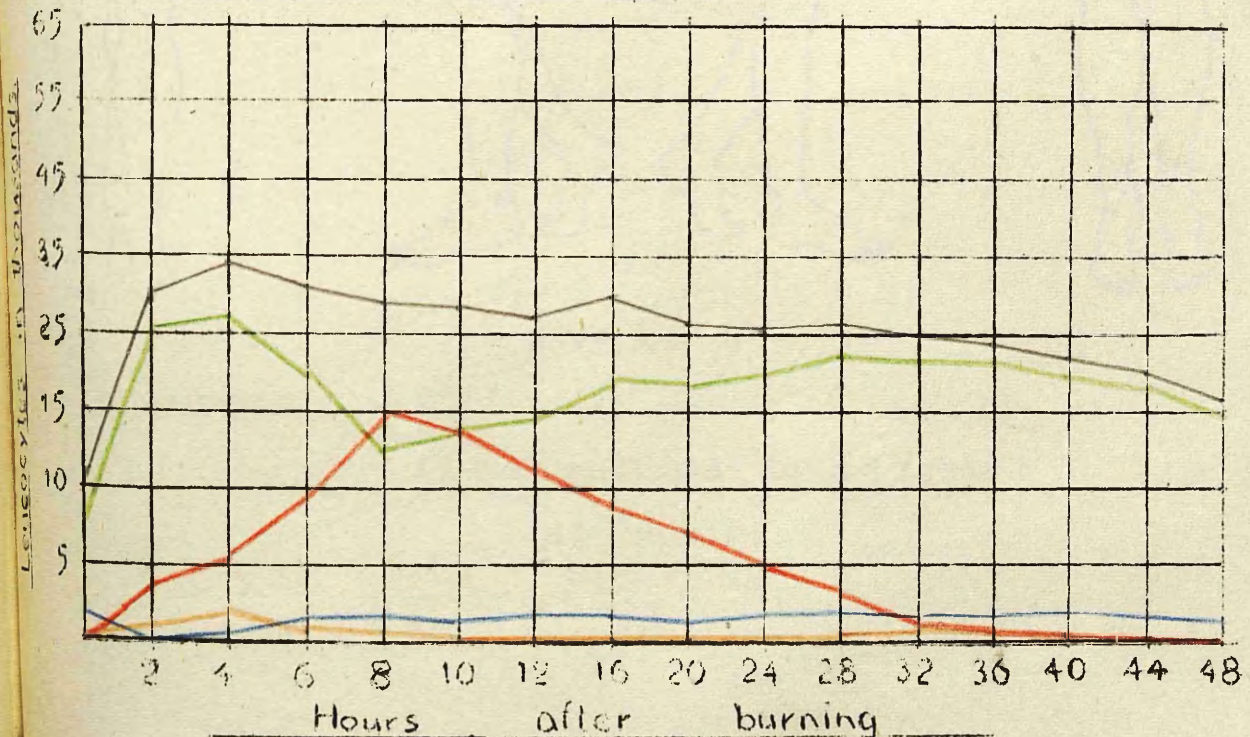
Sex of patient Male.

Nature of injuries Burns of buttocks and back.  
Distribution as shown on chart overleaf.

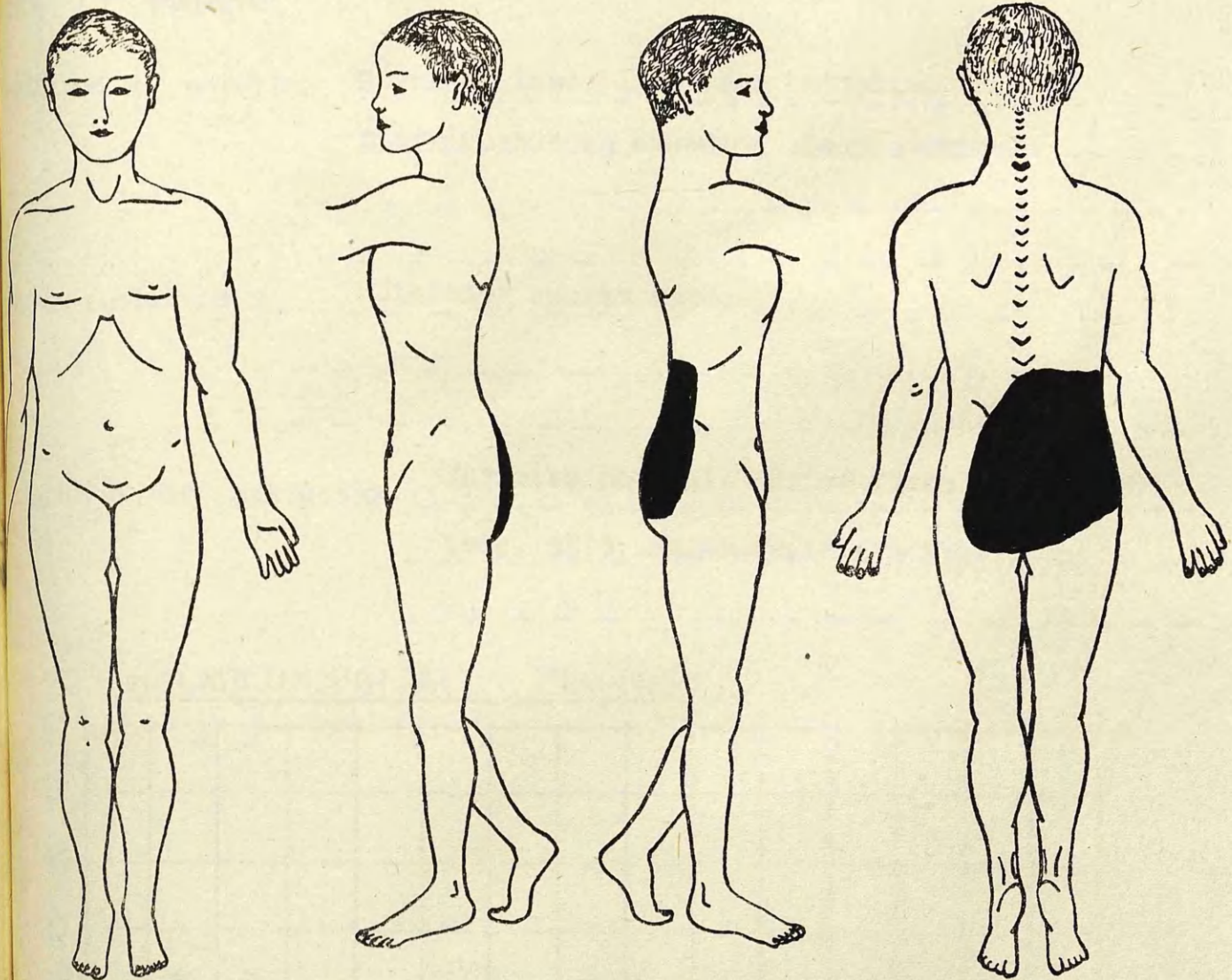
How sustained Bed clothes caught fire.

Condition on admission Cried continuously. Shivering. Temp. 98  
Pulse 150 weak.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Myeloblasts \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 108

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 4 years.

Case No. 109

Sex of patient Female

Nature of injuries Burns of lower limbs and buttocks.

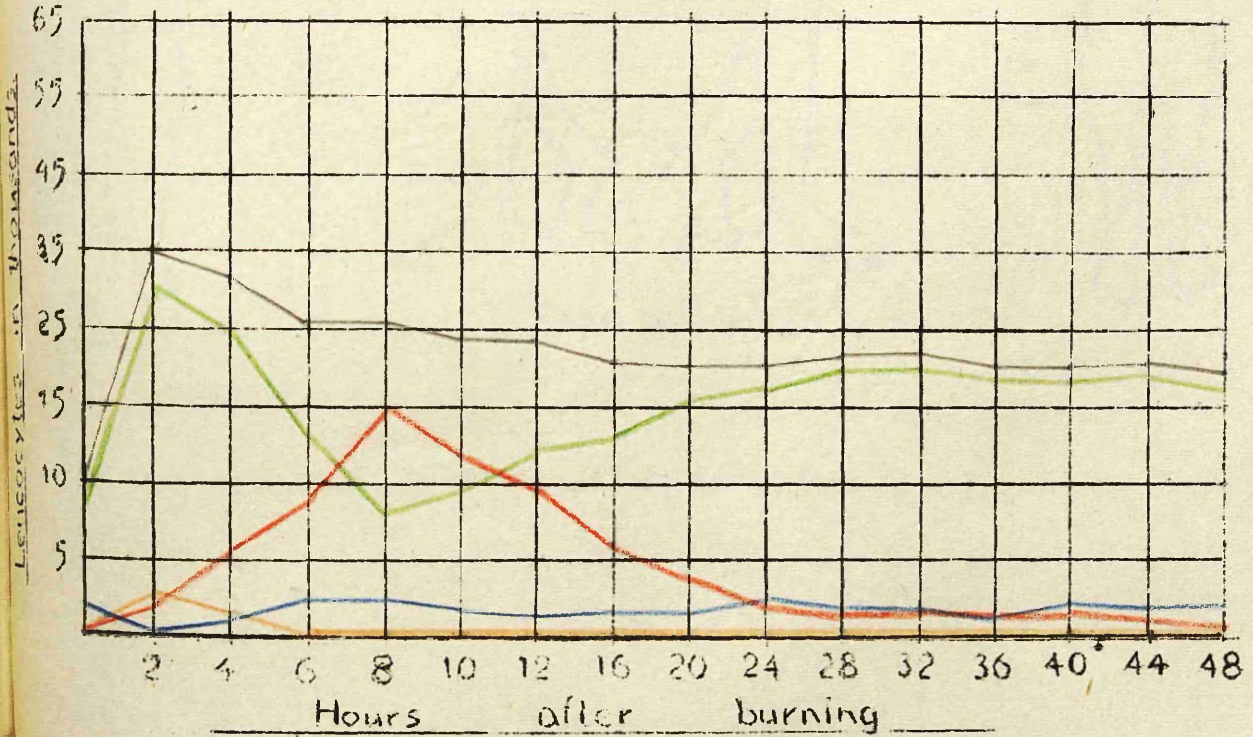
Distribution as shown on chart overleaf.

How sustained Clothing caught fire.

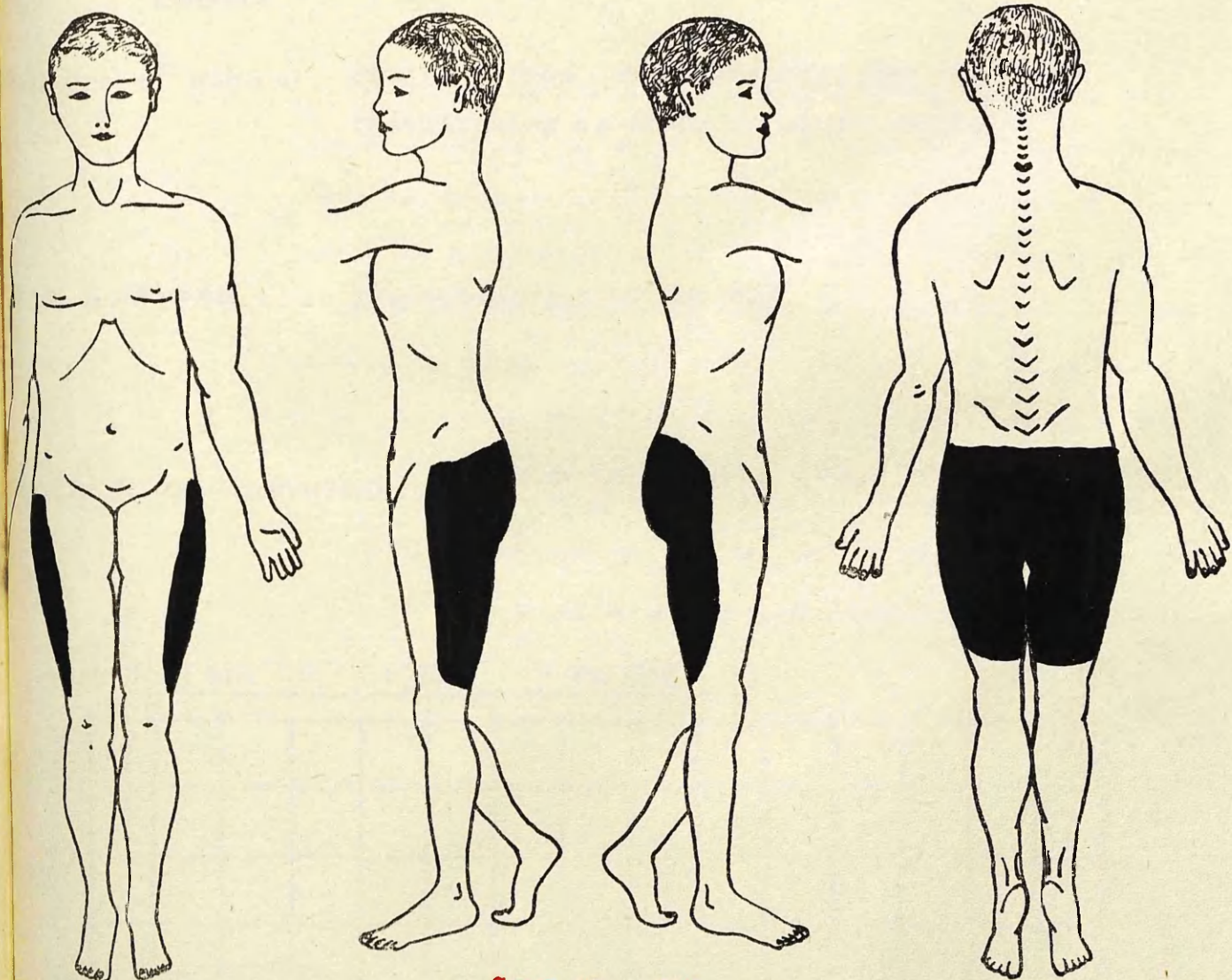
Condition on admission Injuries painful. Cried fitfully.

Temp. 99.9 Pulse rapid and weak.

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes } \_\_\_\_\_  
 Myrmorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 109

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 2 years.

Case No. 110

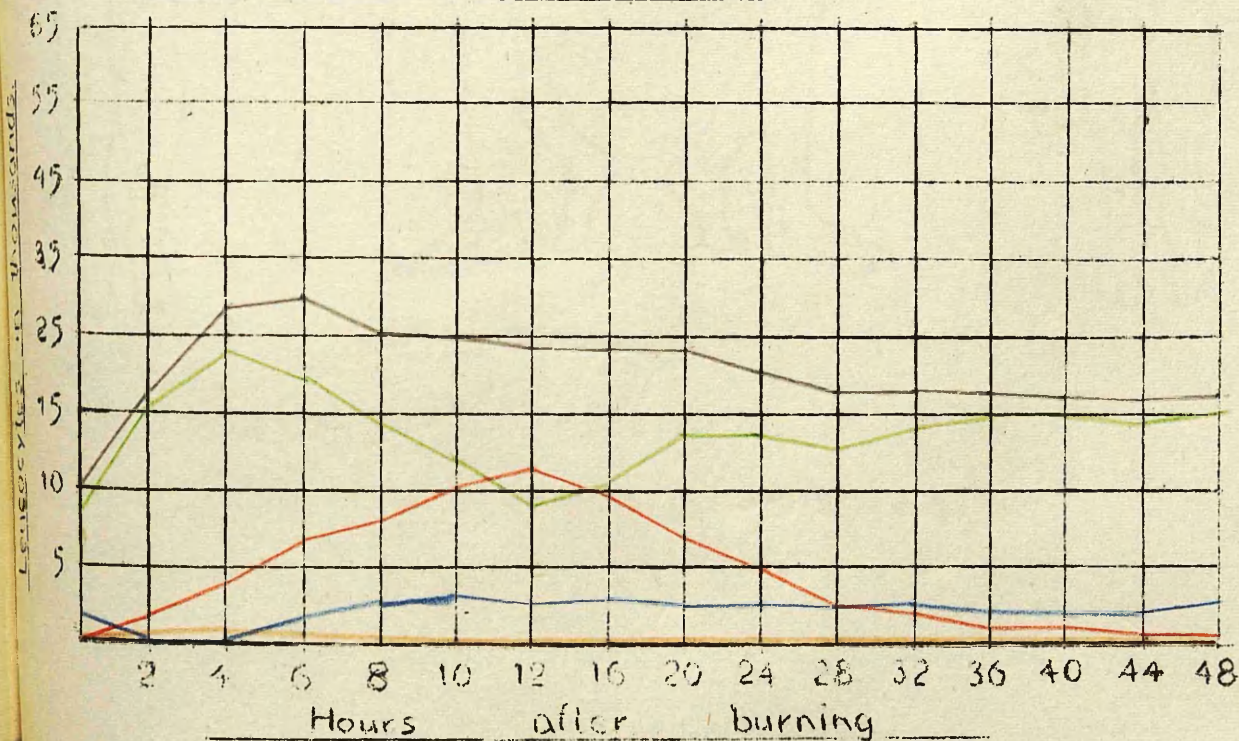
Sex of patient Male.

Nature of injuries Scald of face, right shoulder and arm.  
distribution as shown on chart overleaf.

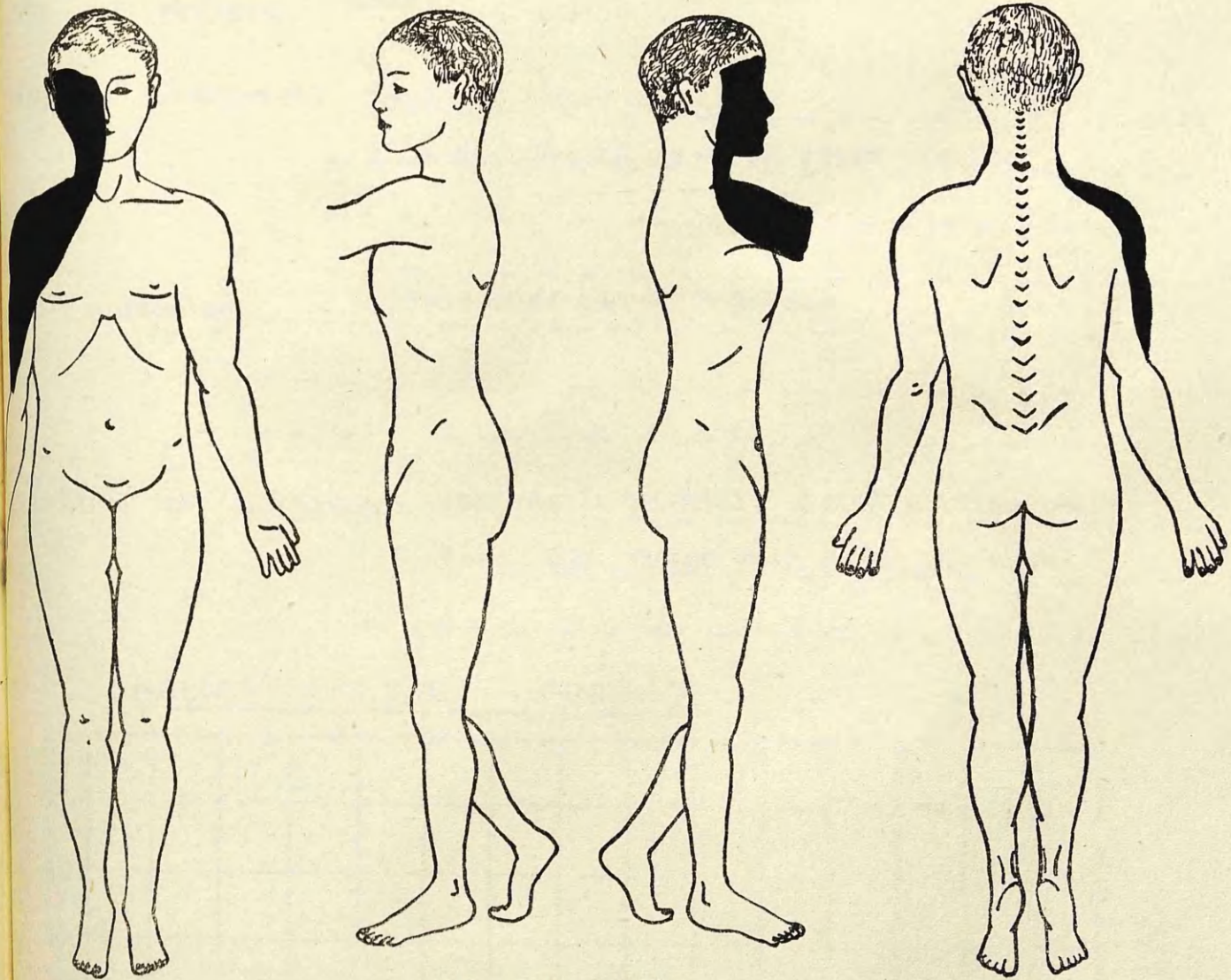
How sustained Overturned cup of hot tea.

Condition on admission Cried continuously. Temp. 99.2 Pulse very  
rapid

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Myeloblasts \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 110

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 3 years

Case No. 111

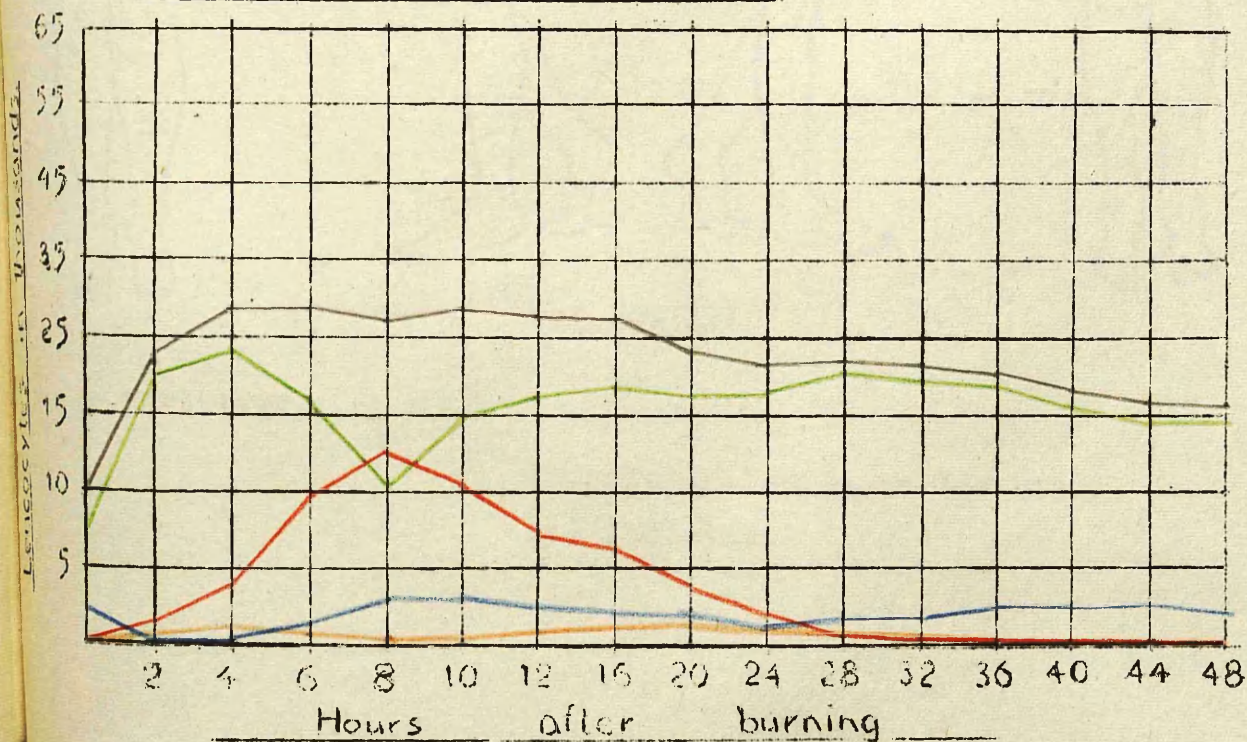
Sex of patient Male.

Nature of injuries Scald of chest and arms.  
distribution as shown on chart overleaf.

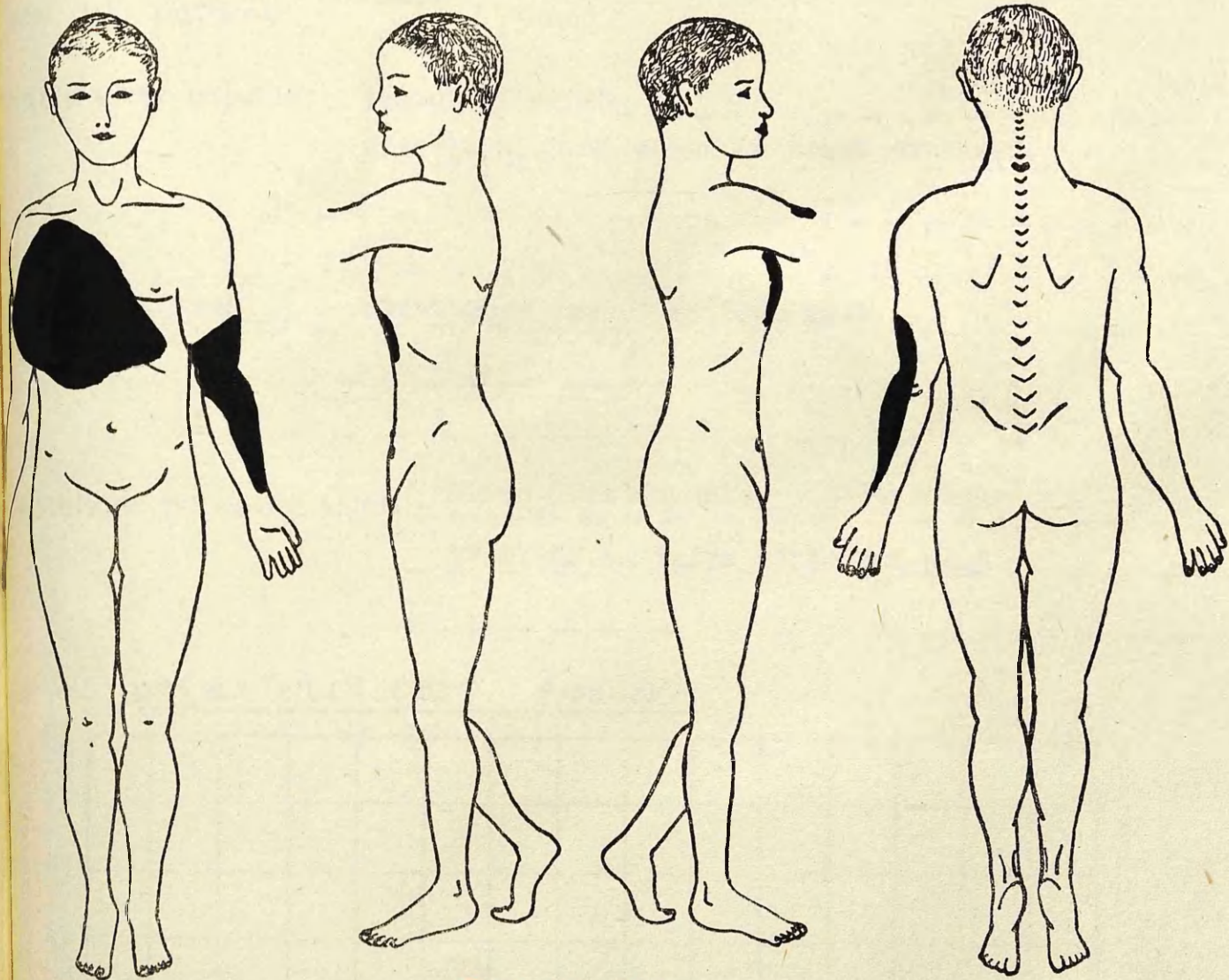
How sustained Overtured can of hot tea.

Condition on admission Apparently painful. Cried continuously.  
Temp. 100 Pulse very rapid and weak

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ----- Metamyelocytes ----- Lymphocytes } -----  
& Monocytes } -----  
Myeloblasts ----- Stab Nuclears ----- Toxic Granulocytes -----



Case No. 111

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 3 years.

Case No. 112.

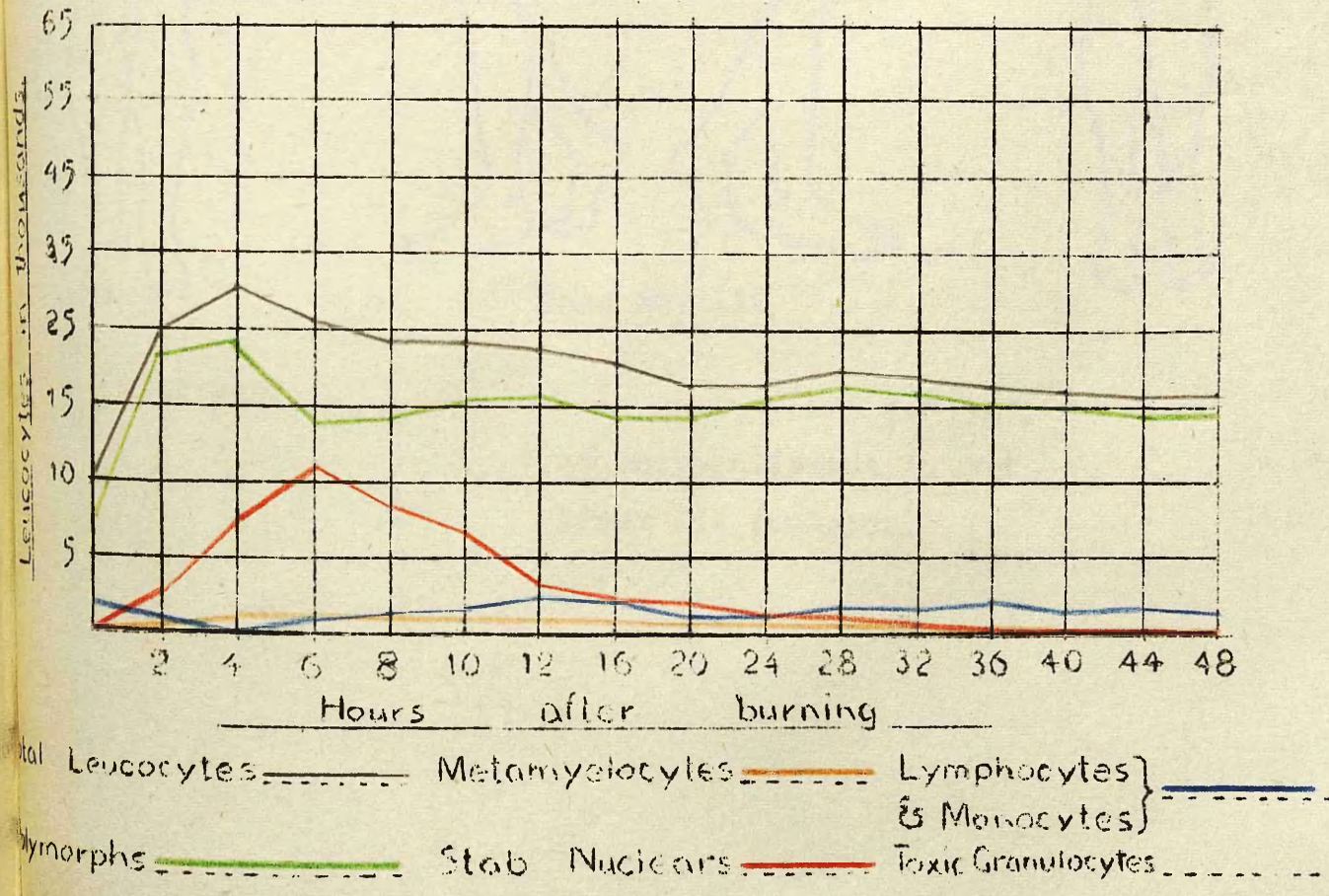
Sex of patient Female

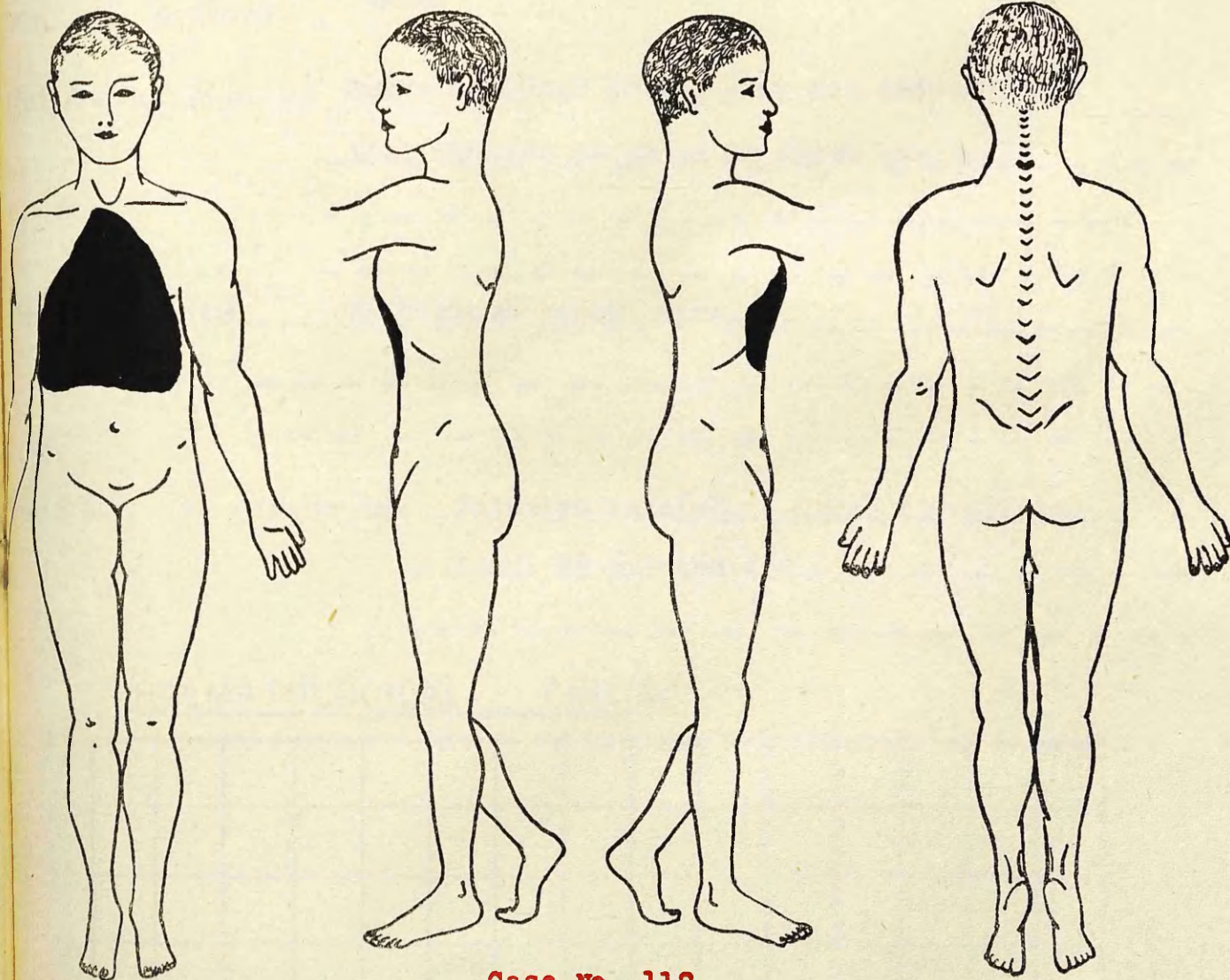
Nature of injuries Scalds of chest.  
distribution as shown on chart overleaf.

How sustained Overtured can of boiling milk .

Condition on admission Cried continuously. Shivering.  
Temp. 97.6 Pulse rapid and weak

HAEMATOLOGICAL FINDINGS





Case No. 112

TREATMENT

1% Sulphanilamide in Cod  
Liver Oil Emulsion.

Age of patient 12 years

Case No. 113

Sex of patient Male.

Nature of injuries Burns of lower limbs, back and abdomen.

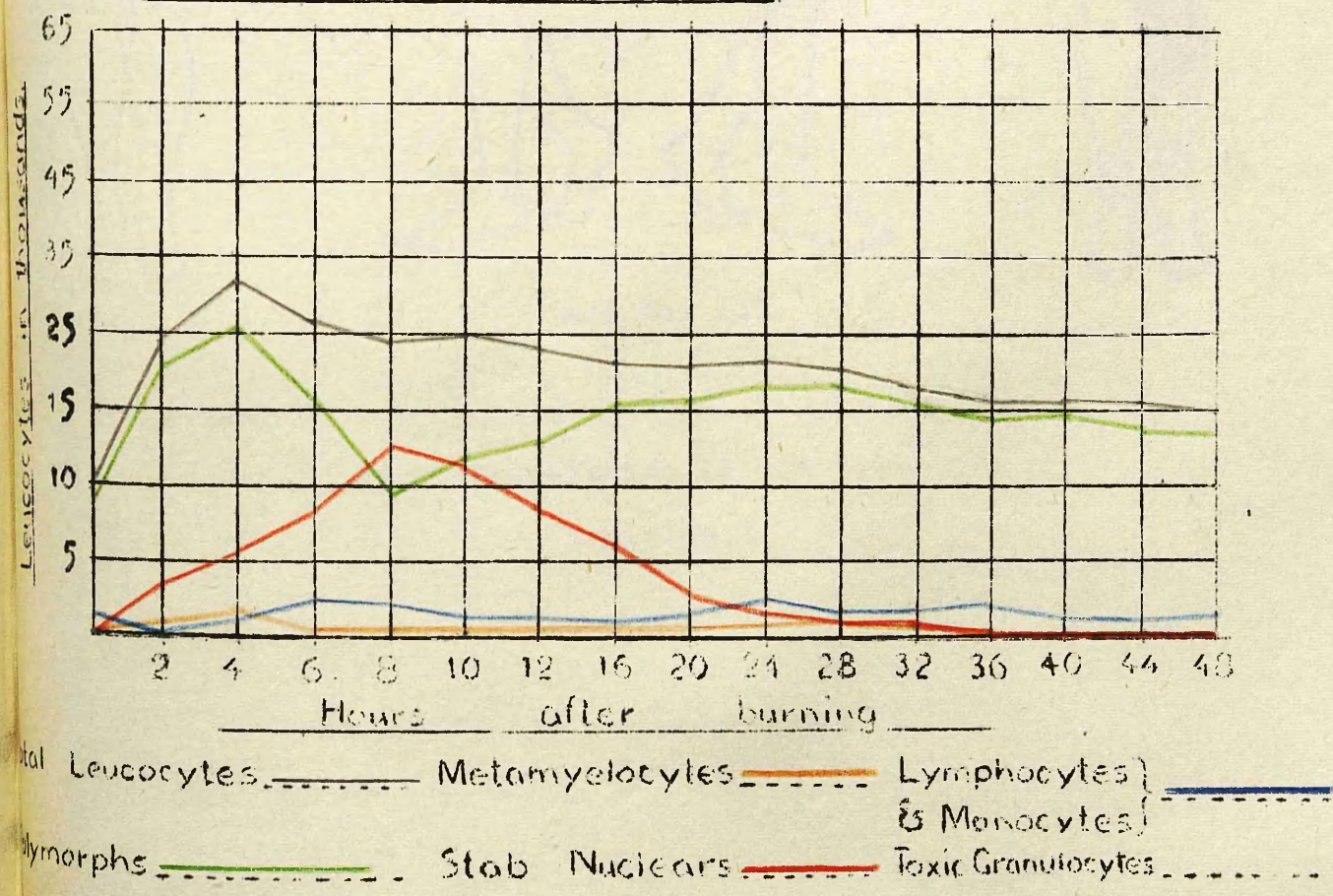
Distribution as shown on chart overleaf.

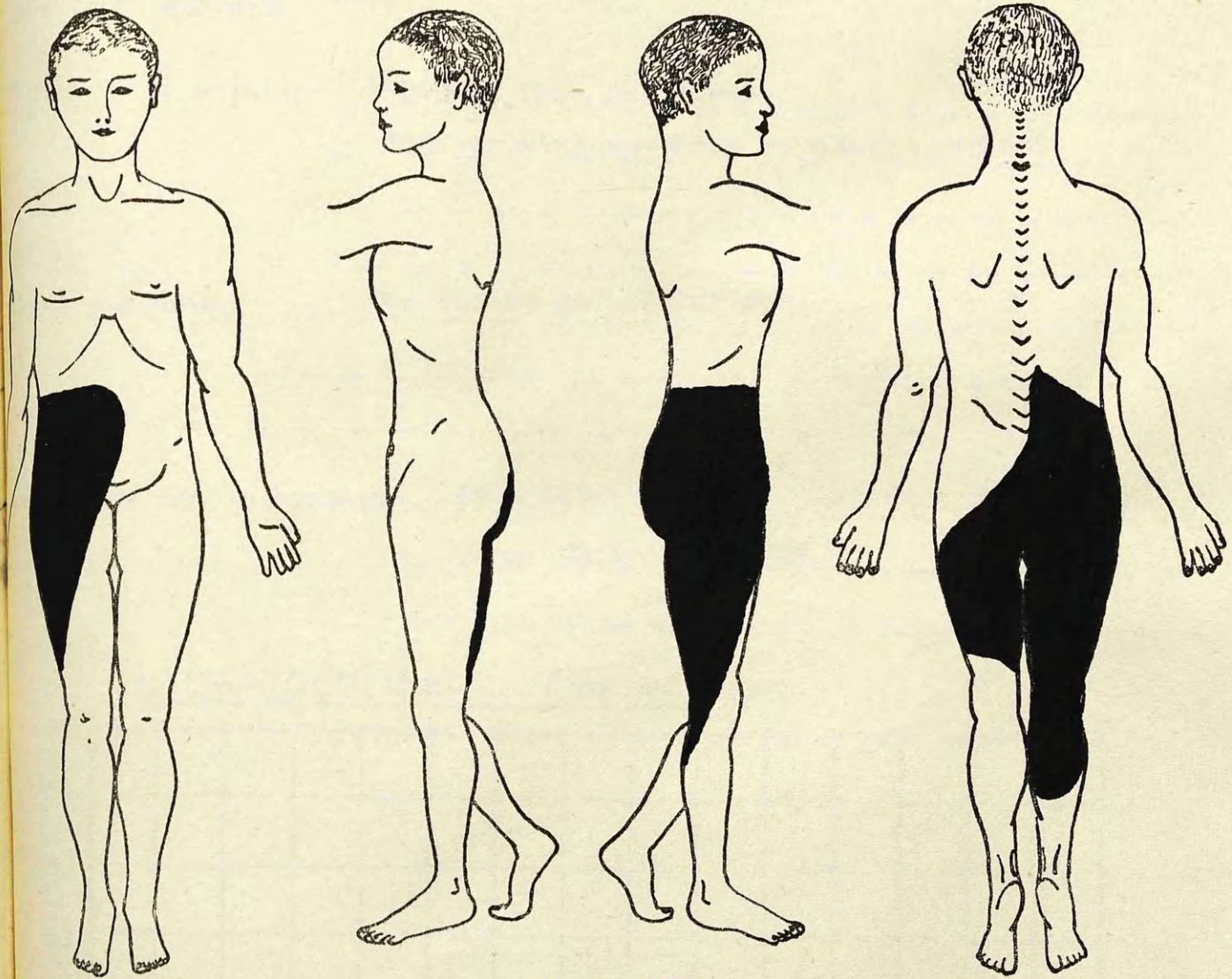
How sustained Mackintosh caught fire.

Condition on admission Injuries painful. Cried fitfully.

Temp. 99.6 Pulse 130

### HAEMATOLOGICAL FINDINGS





Case No. 113

**TREATMENT**

**1% Sulphanilamide in Cod Liver Oil**

**Emulsion.**

Age of patient 6 years

Case No. -114-

Sex of patient Male

Nature of injuries Scald of face and chest.

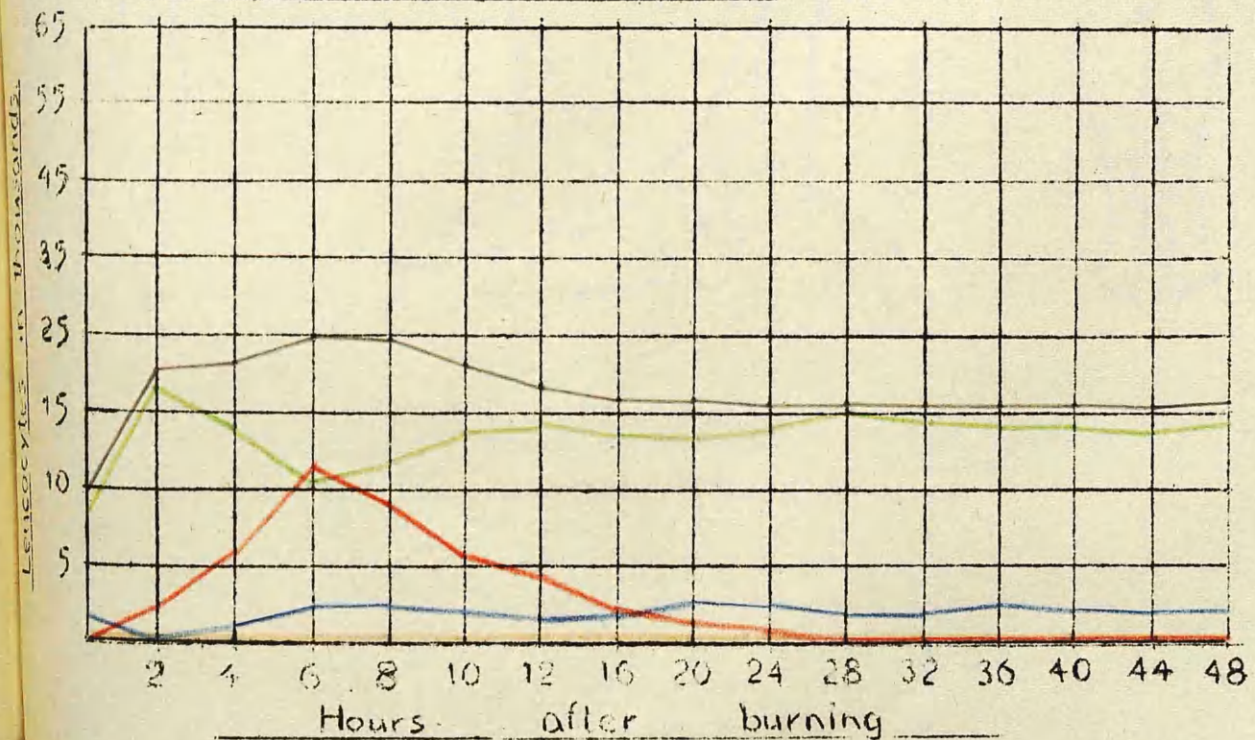
Distribution as shown on chart overleaf.

How sustained Overtured pot of hot tea.

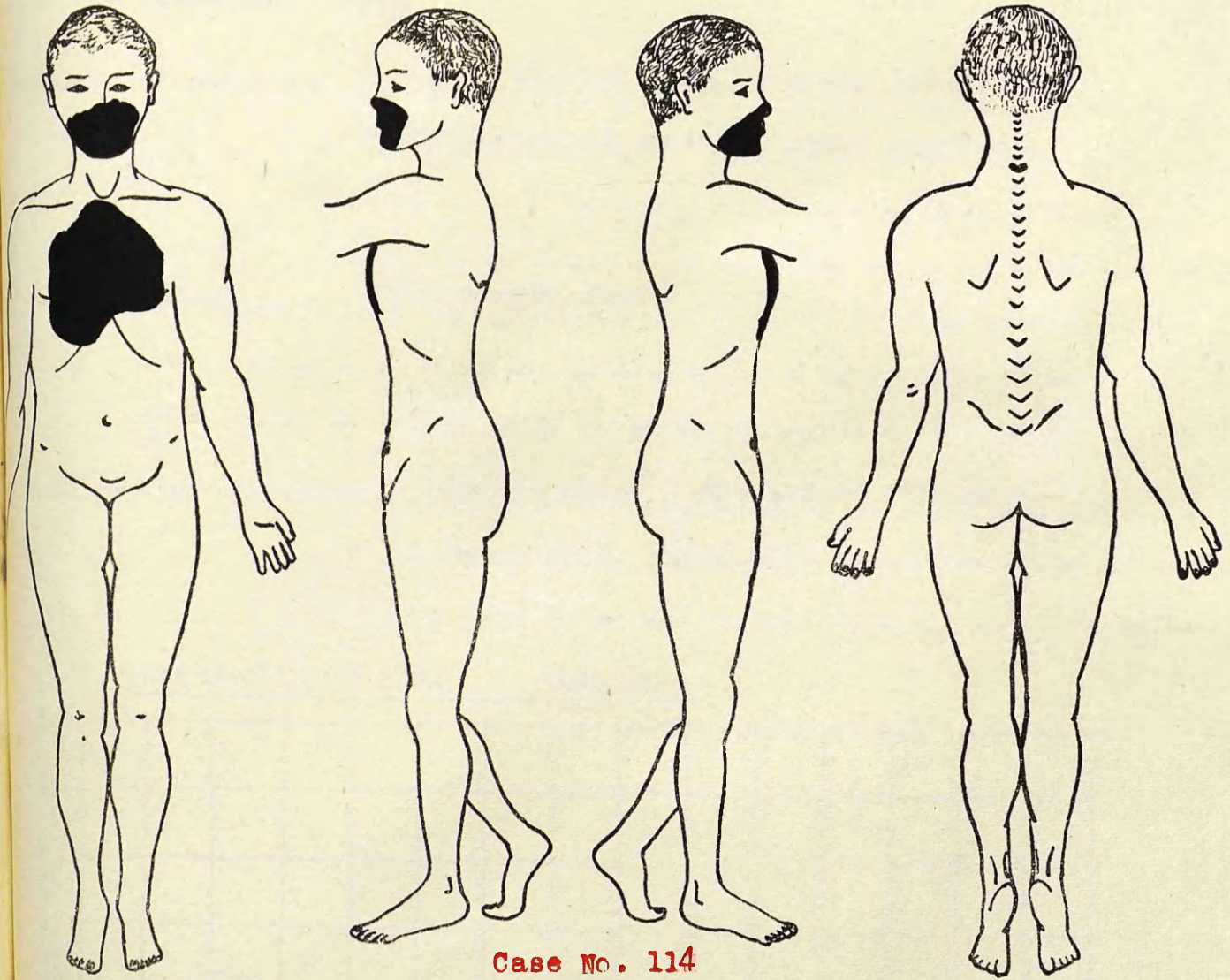
Condition on admission Apparently painful. Cried continuously.

Temp. 99.8 Pulse 140

HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
 & Monocytes }  
 Myeloblasts ——— Stab Nuclears ——— Toxic Granulocytes ———

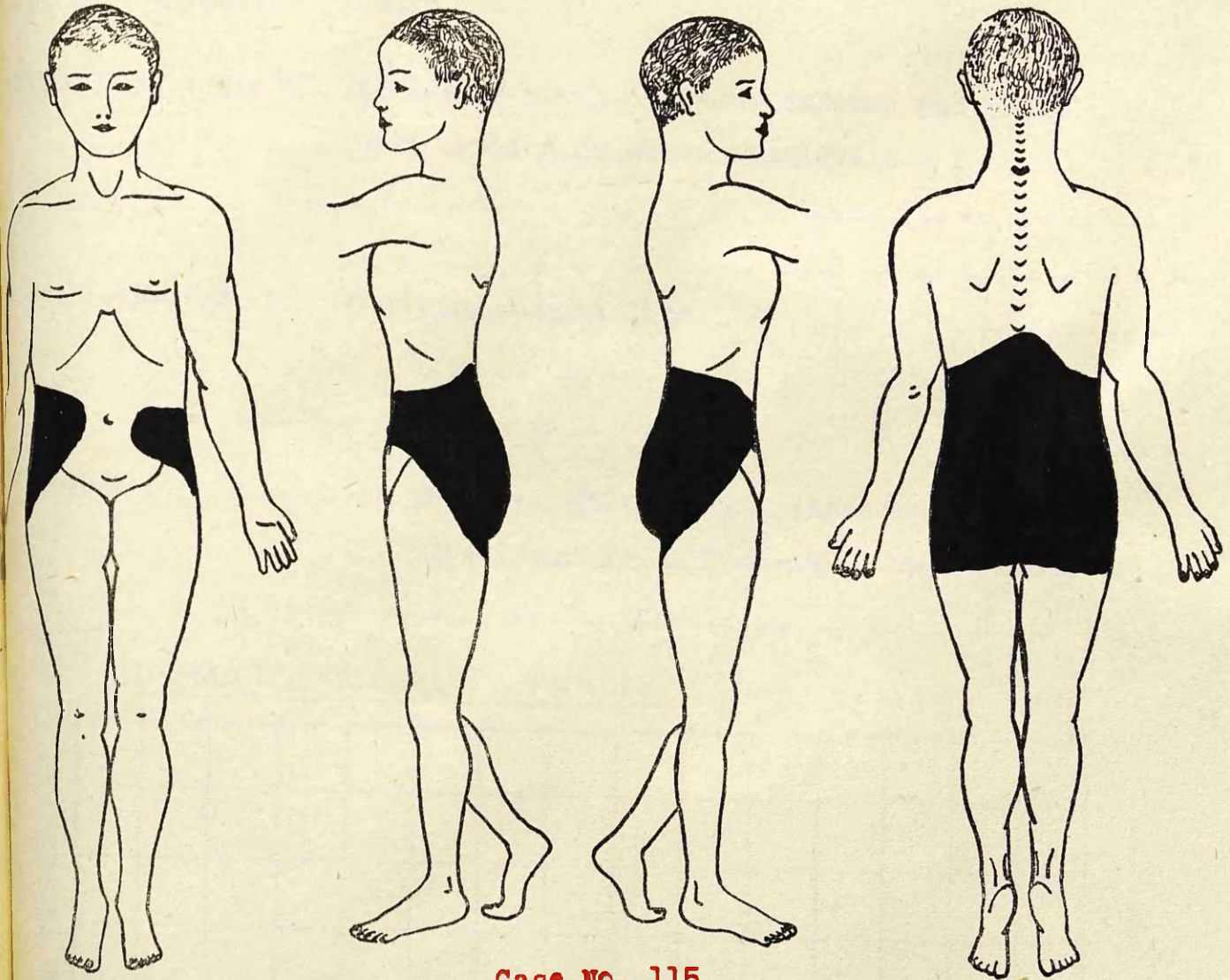


Case No. 114

**TREATMENT**

1% Sulphanilamide in Cod Liver  
Oil Emulsion.





Case No. 115

**TREATMENT**

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient... **14 years**

Case No. **116**

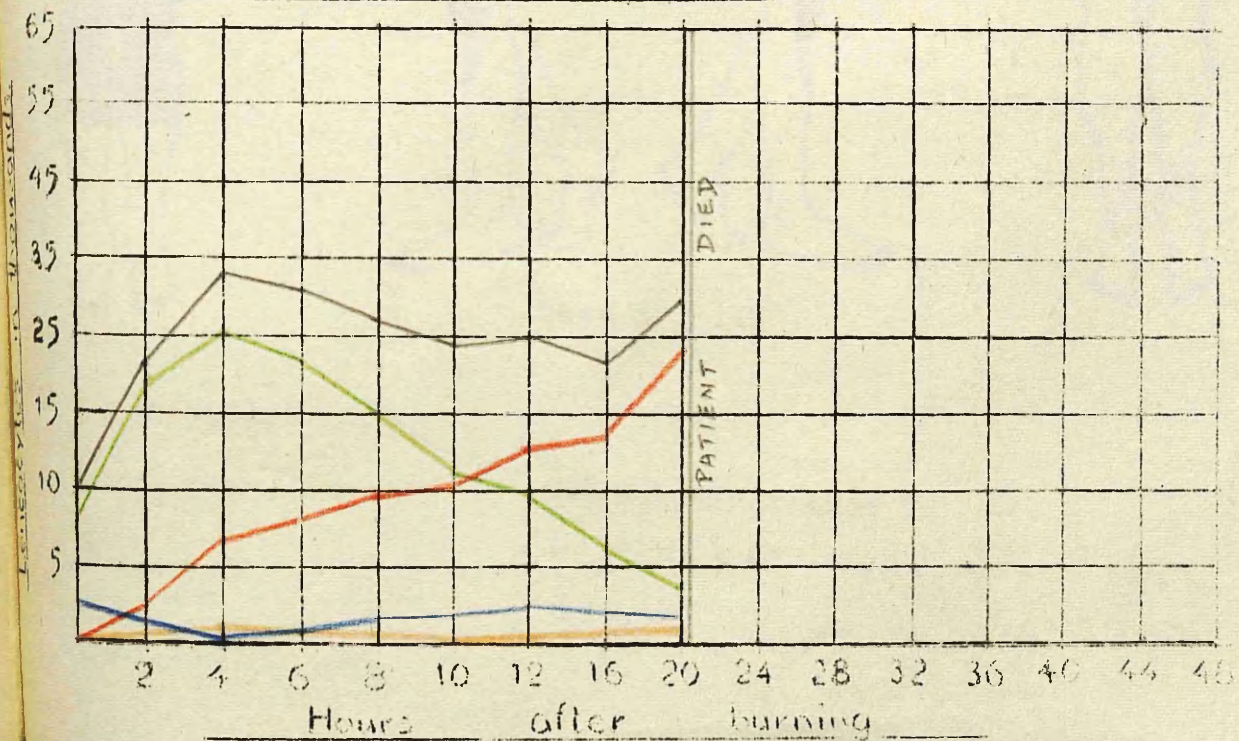
Sex of patient... **Female**

Nature of injuries... **Extensive burns of legs, abdomen and back.**  
**Distribution as shown overleaf.**

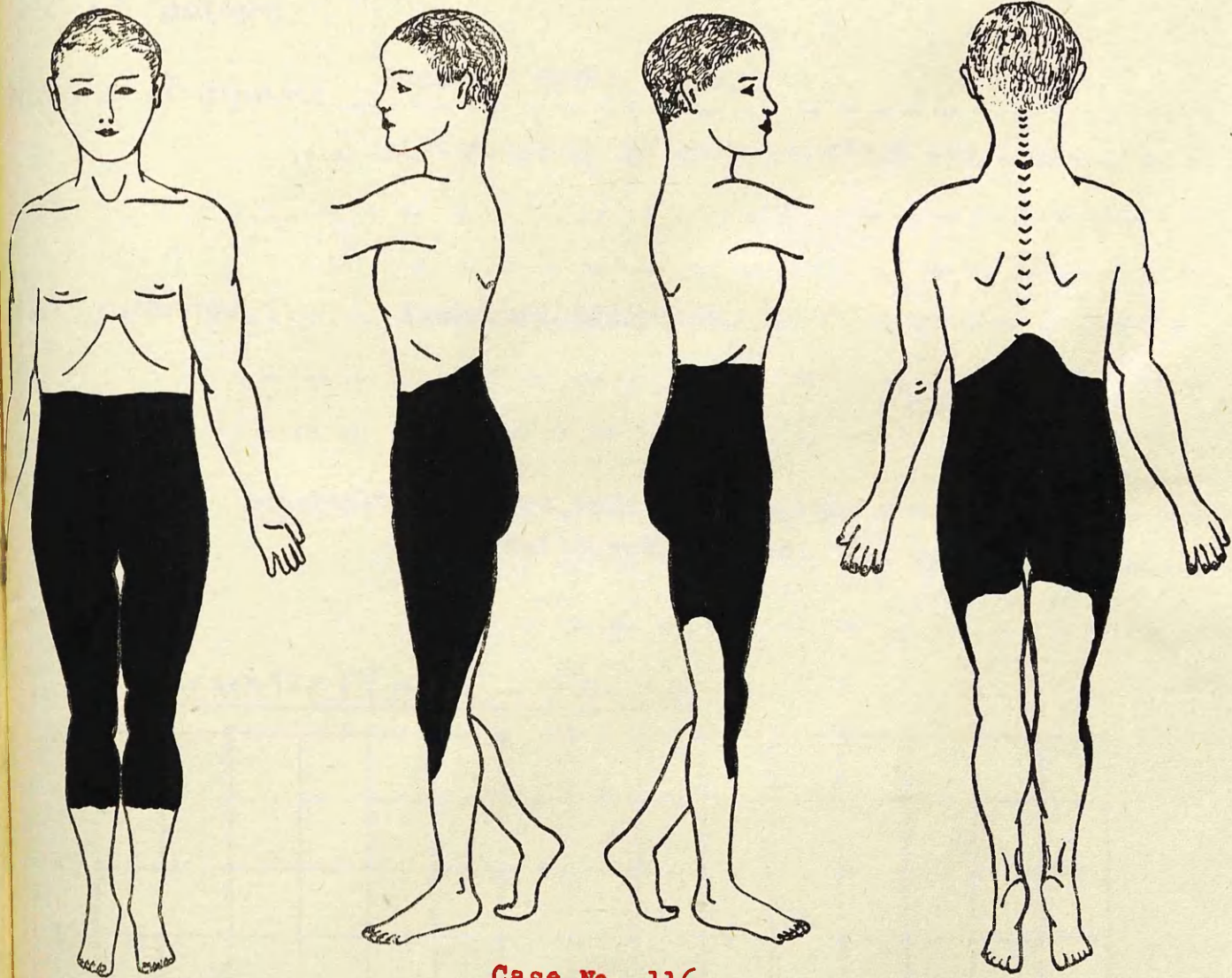
How sustained... **Clothing caught fire.**

Condition on admission... **No pain, shivering. Answered questions**  
**intelligently. Temp. 99 Pulse 126**

### HAEMATOLOGICAL FINDINGS



Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Myeloblasts ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 116

TREATMENT

1% Sulphanilamide in Cod  
Liver Oil Emulsion.

Age of patient 16 years.

Case No. 117

Sex of patient Male.

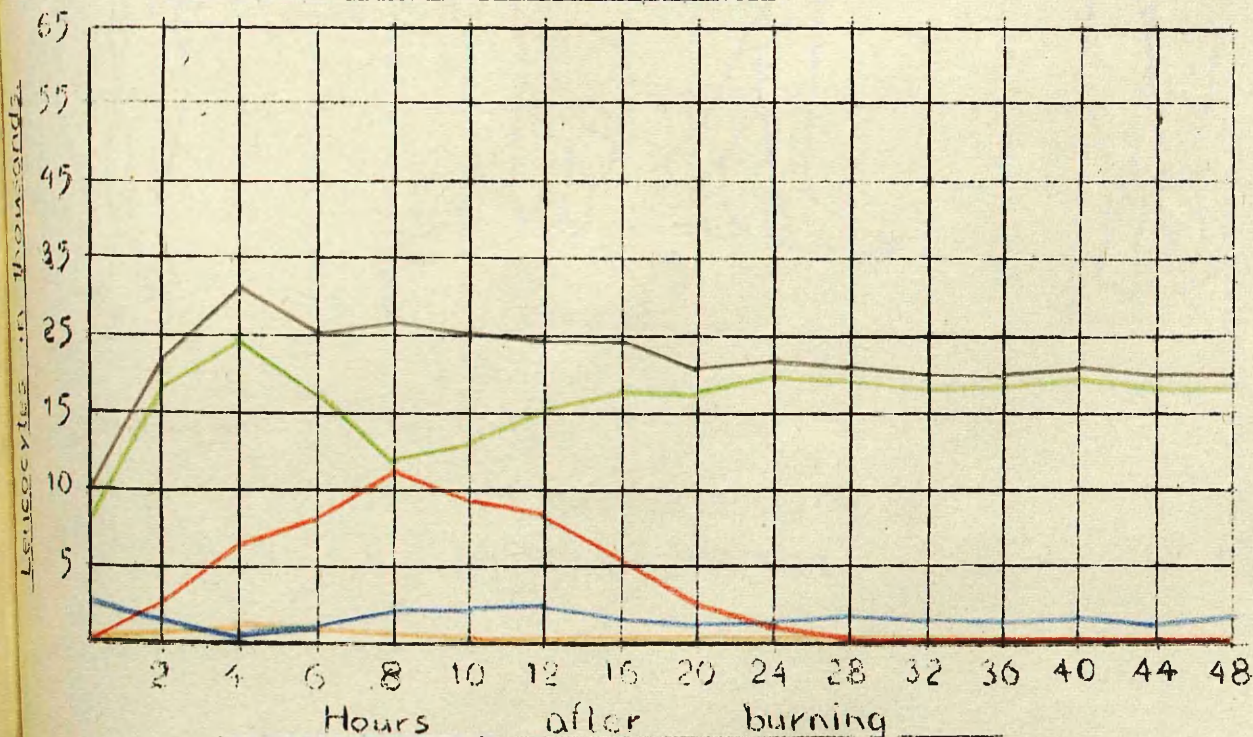
Nature of injuries Burns of upper limbs.

distribution as shown on chart overleaf.

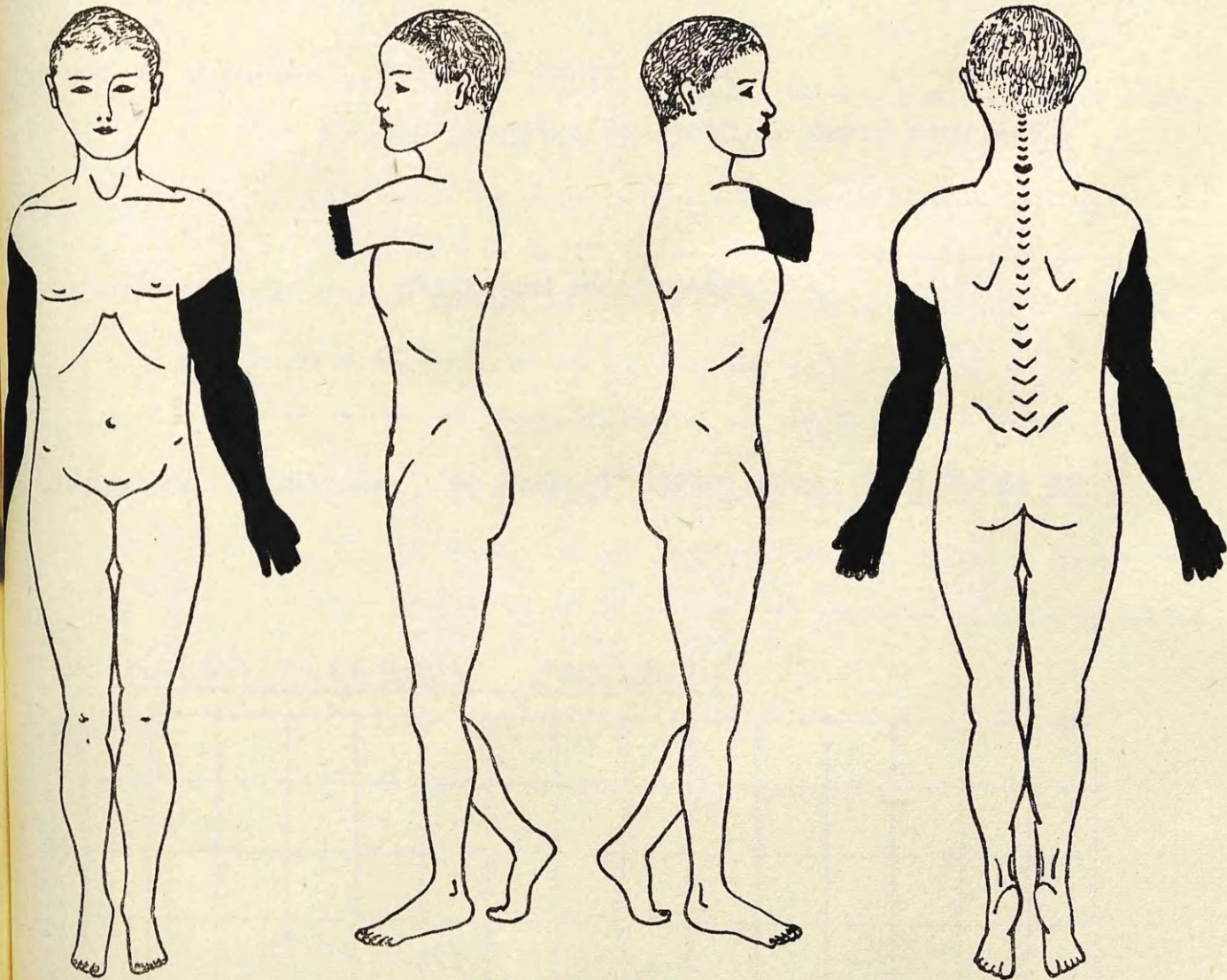
How sustained Acetylene explosion.

Condition on admission Burns painful. Answered questions intelligently. Temp. 98.8 Pulse 96

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 117

TREATMENT

1% Sulphanilamide in Cod  
Liver Oil Emulsion.

Age of patient **18 years.**

Case No **118**

Sex of patient **Male.**

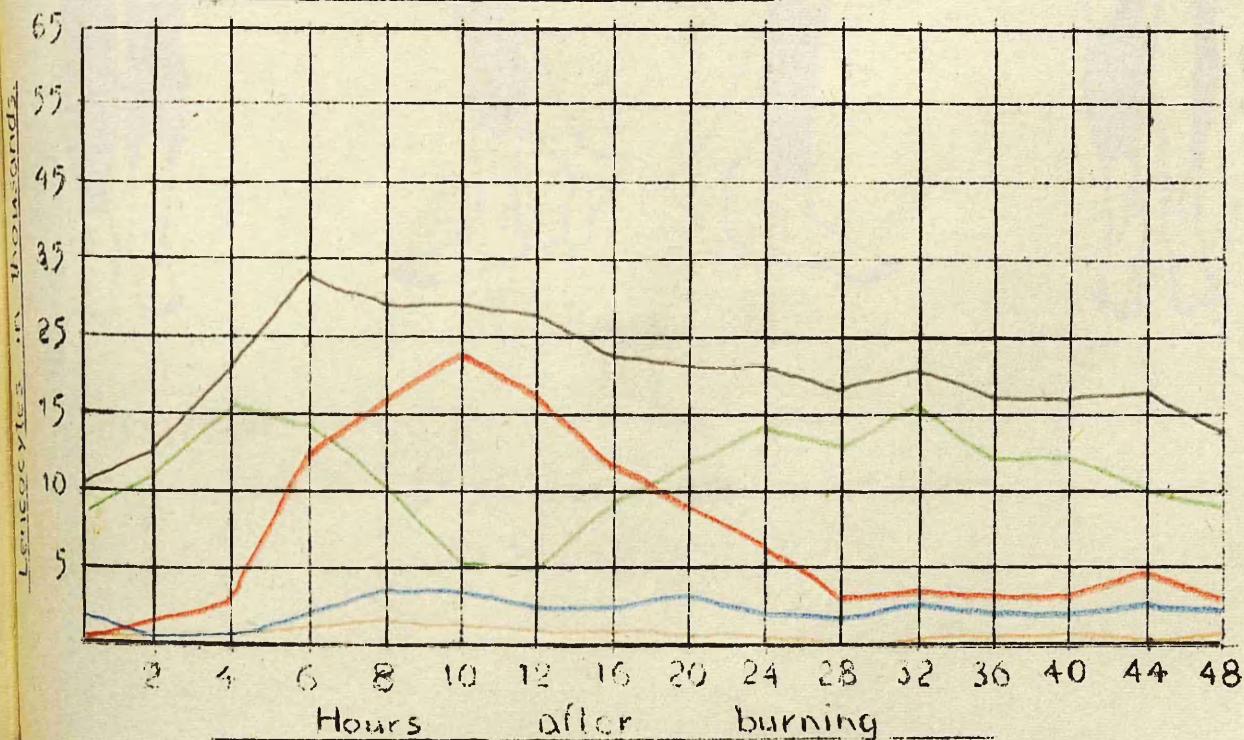
Nature of injuries **Burns of lower limbs.**

**Distribution as shown on chart overleaf.**

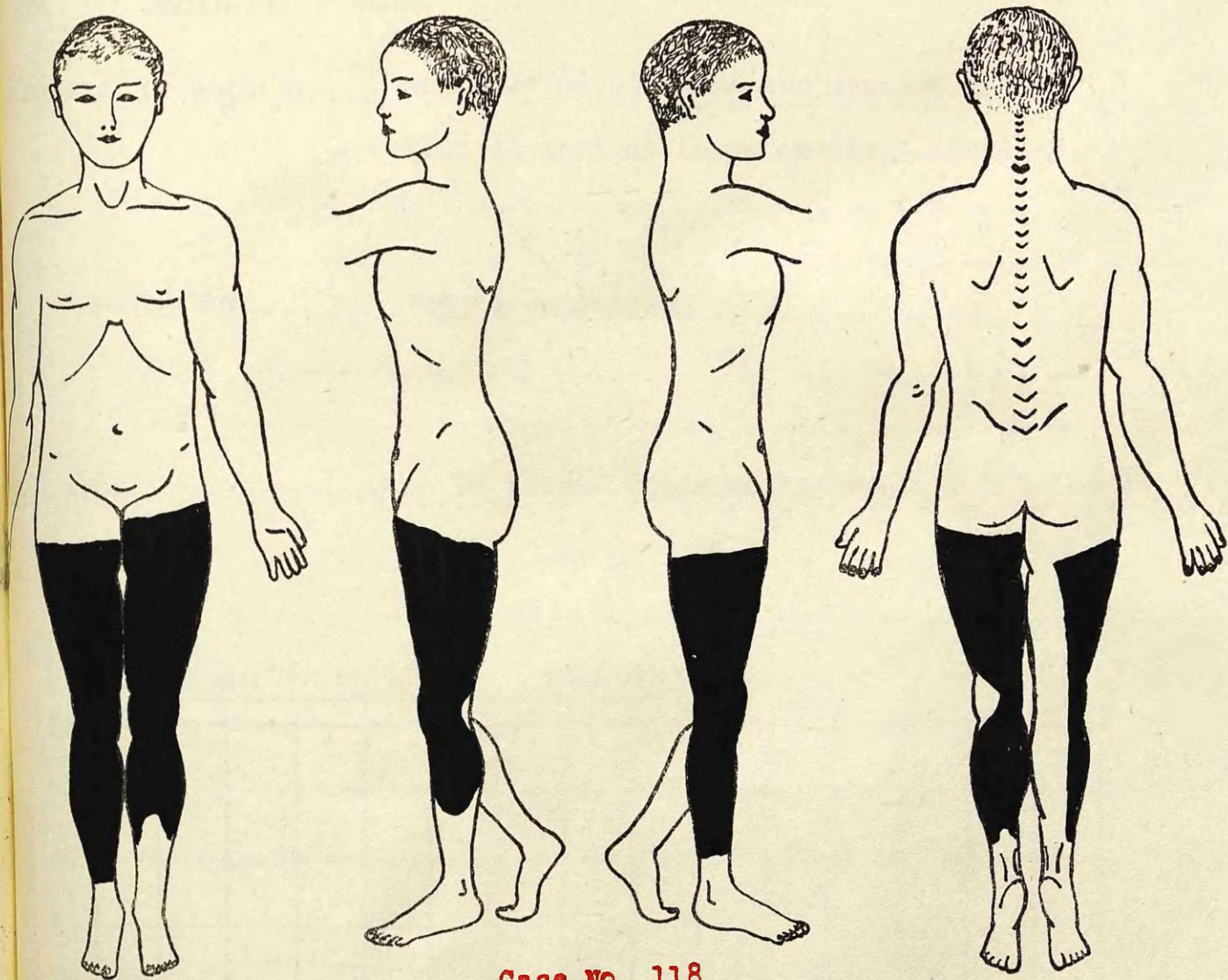
How sustained **Dungarees caught fire.**

Condition on admission **No pain. Thirsty. Temp. 98.8 Pulse 94**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ----- Metamyelocytes ----- Lymphocytes } -----  
& Monocytes } -----  
Stab Nuclears ----- Toxic Granulocytes -----



Case No. 118

**TREATMENT**

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient... **47 years.**

Case No. **119.**

Sex of patient... **Male.**

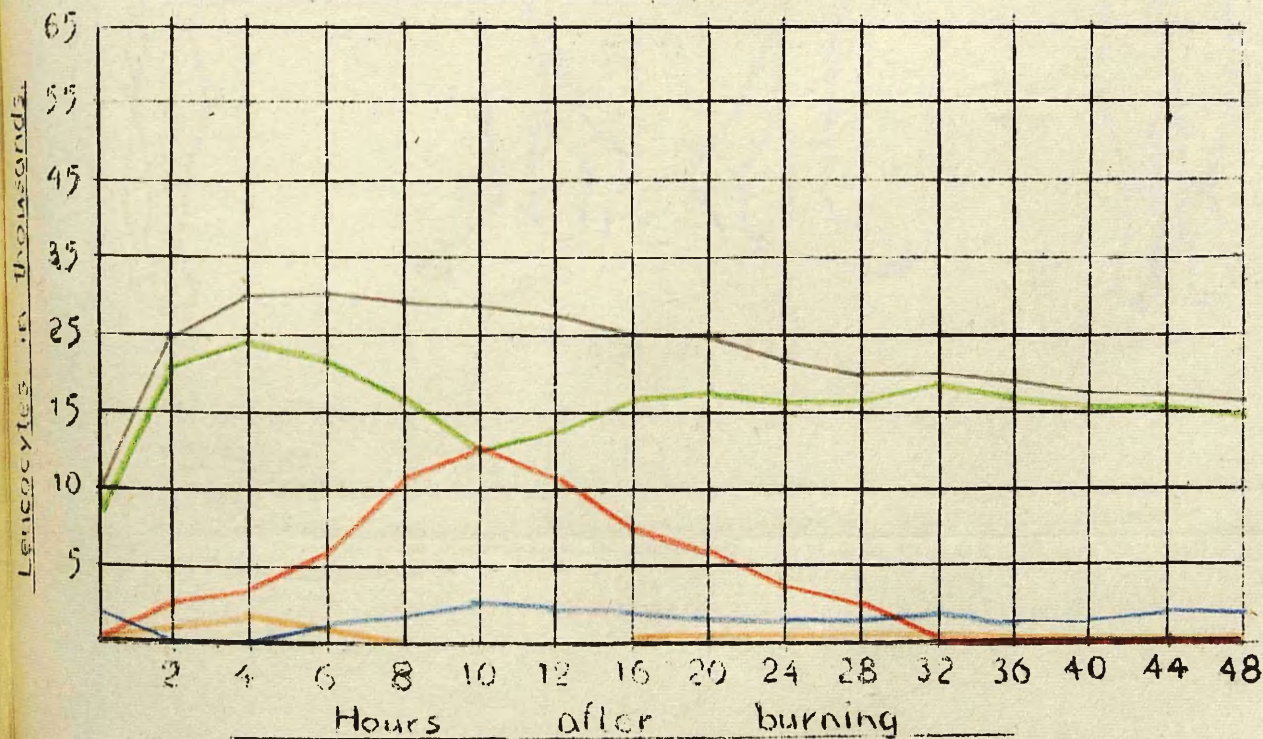
Nature of injuries... **Burns of upper limbs and shoulders.**

--- **distribution as shown on chart overleaf.**

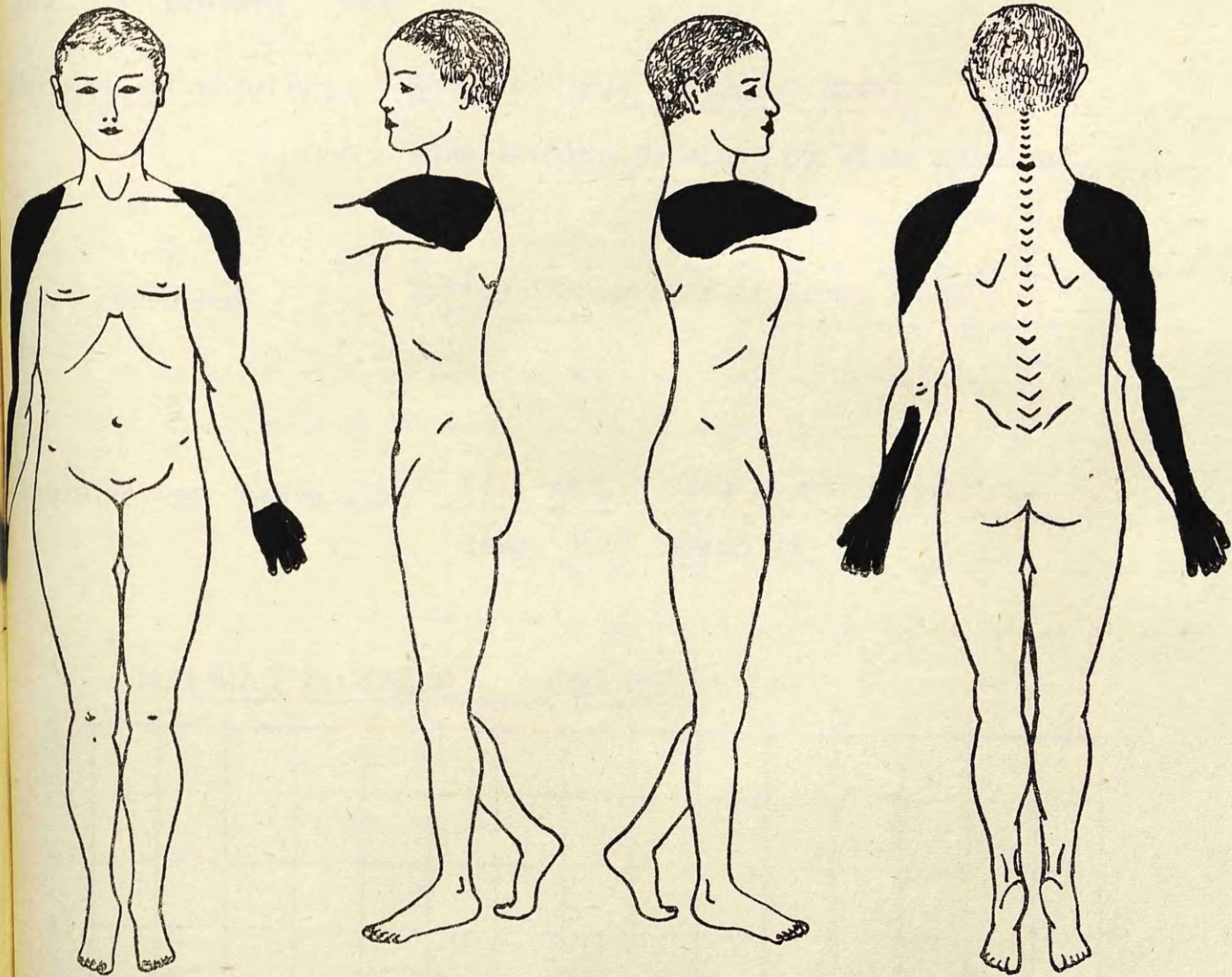
How sustained... **Petrol explosion.**

Condition on admission... **No pain. Fells well. Temp. 98.1 Pulse 88**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 119

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **36 years**

Case No. **-120-**

Sex of patient **Male**

Nature of injuries **Burns of face and upper limb.**

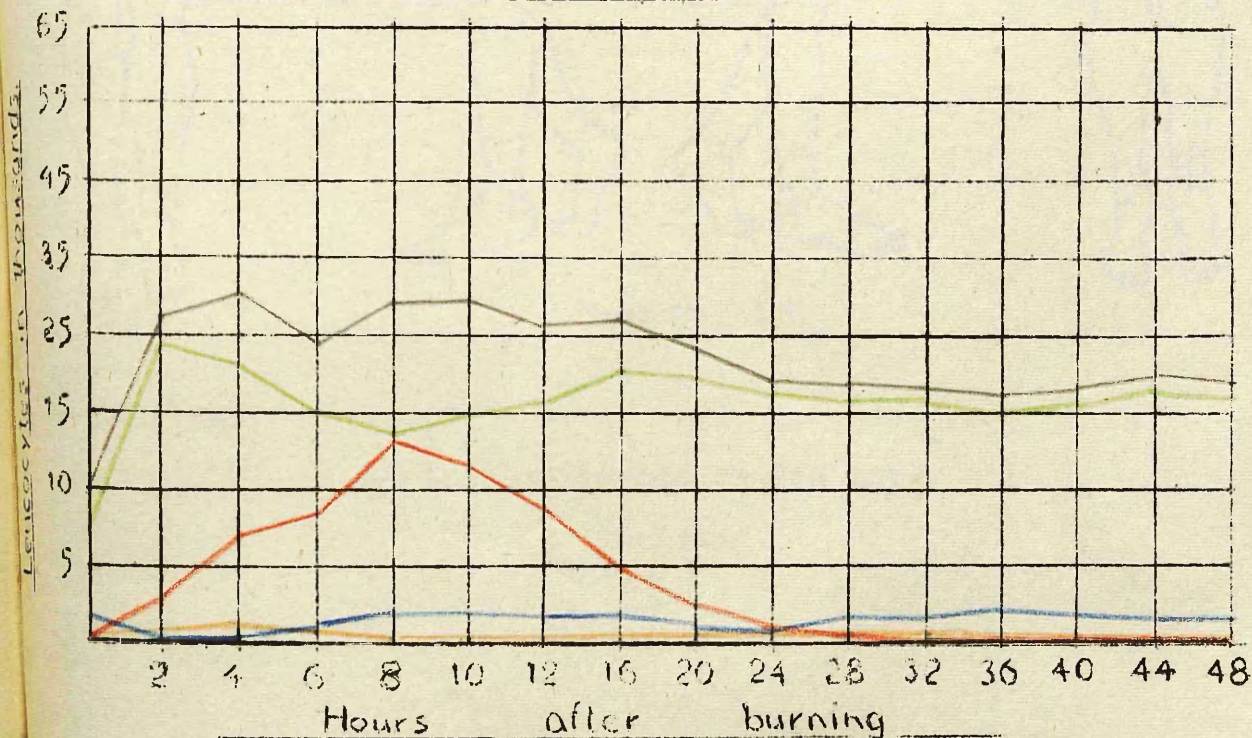
**Distribution as shown on chart overleaf.**

How sustained **Extinguishing fire in ships hold.**

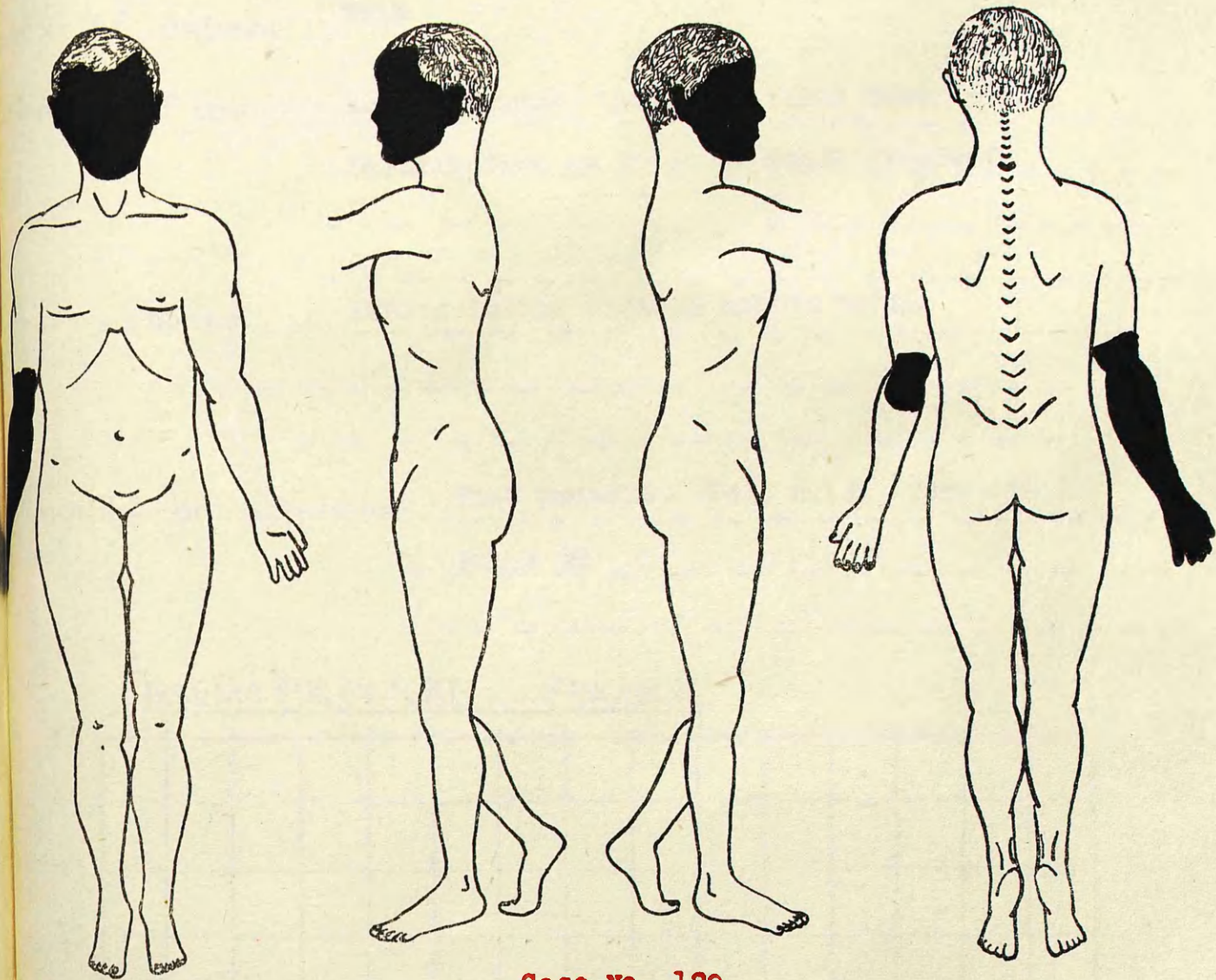
Condition on admission **Felt well. Face slightly painful.**

**Temp. 98.8 Pulse 86**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 120

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **59 years**

Case No. **121**

Sex of patient **Male**

Nature of injuries **Burns of upper limbs and right foot.**

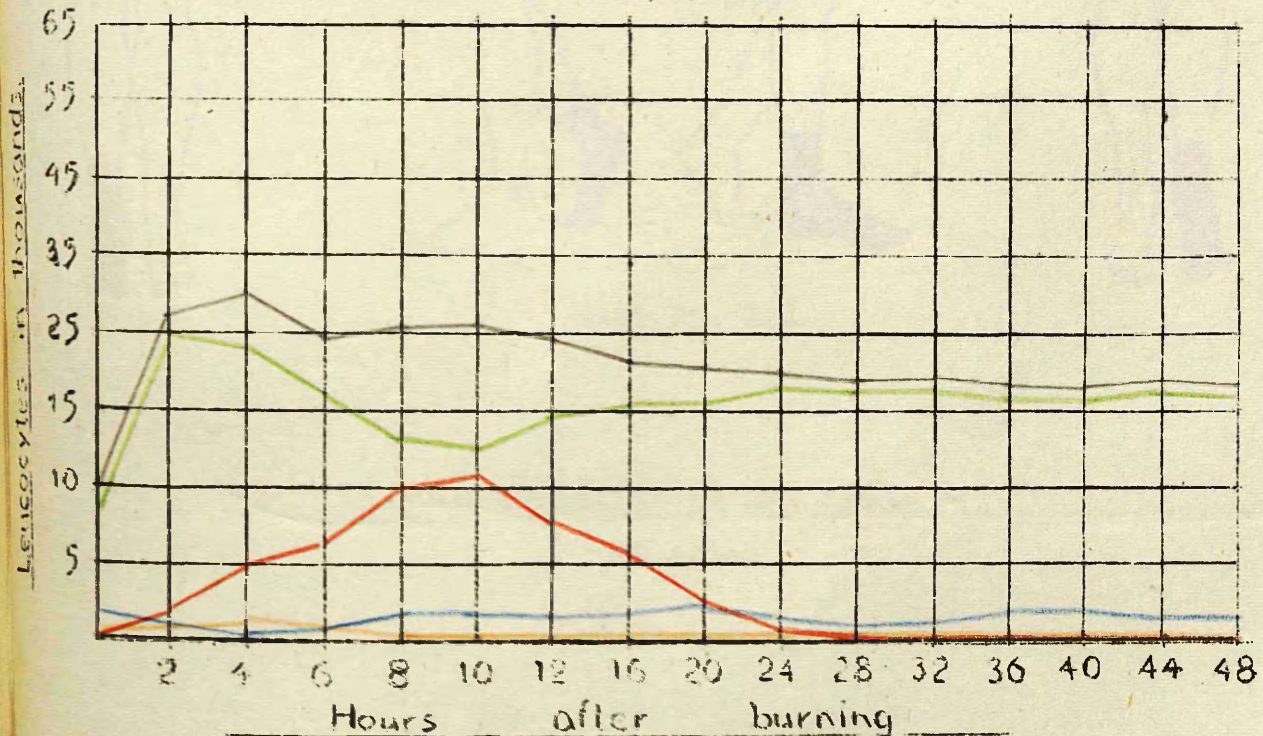
**Distribution as shown on chart overleaf.**

How sustained **Extinguishing fire in ship's hold.**

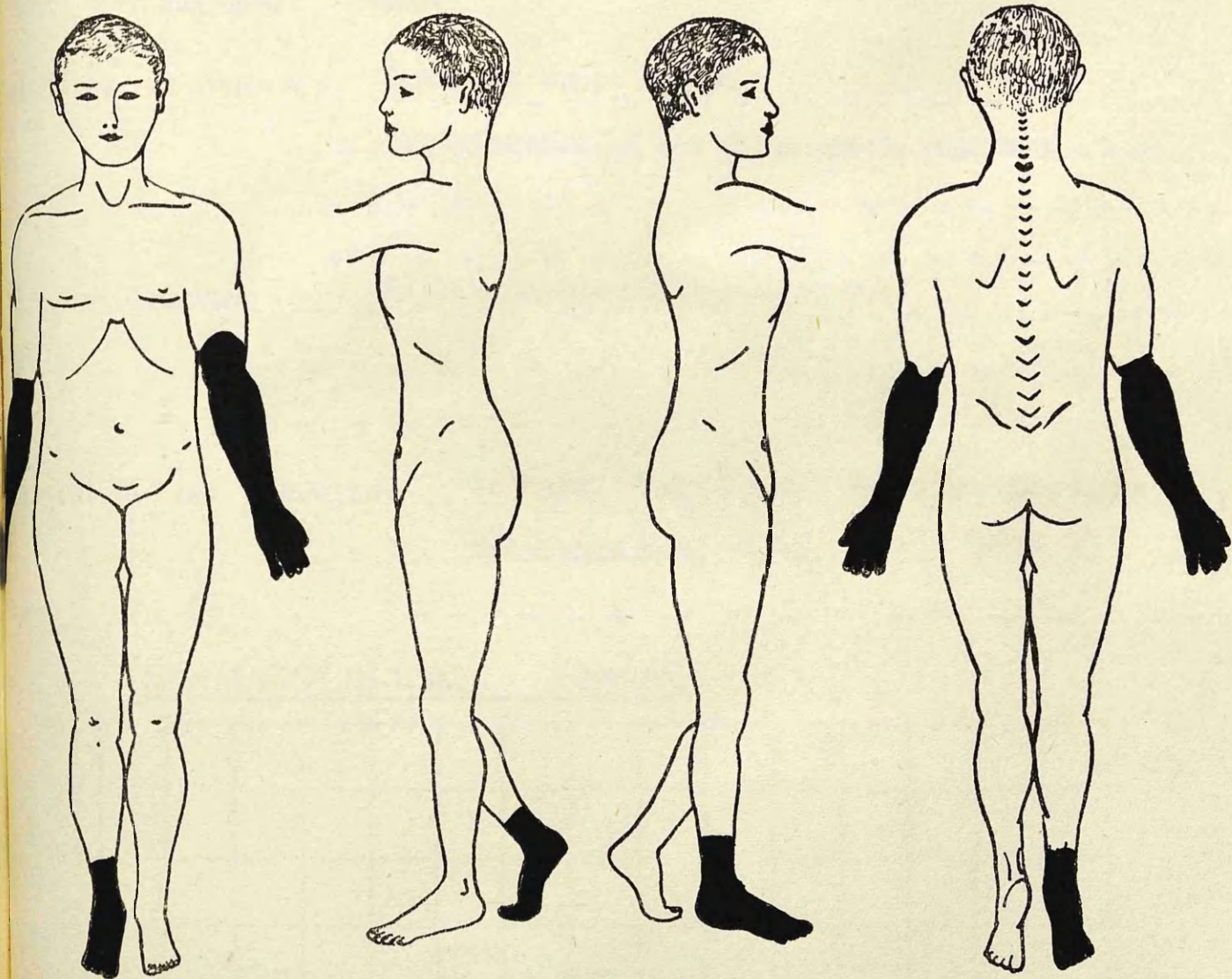
Condition on admission **Foot painful. Felt cold. Temp. 98.1**

**Pulse 92**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_

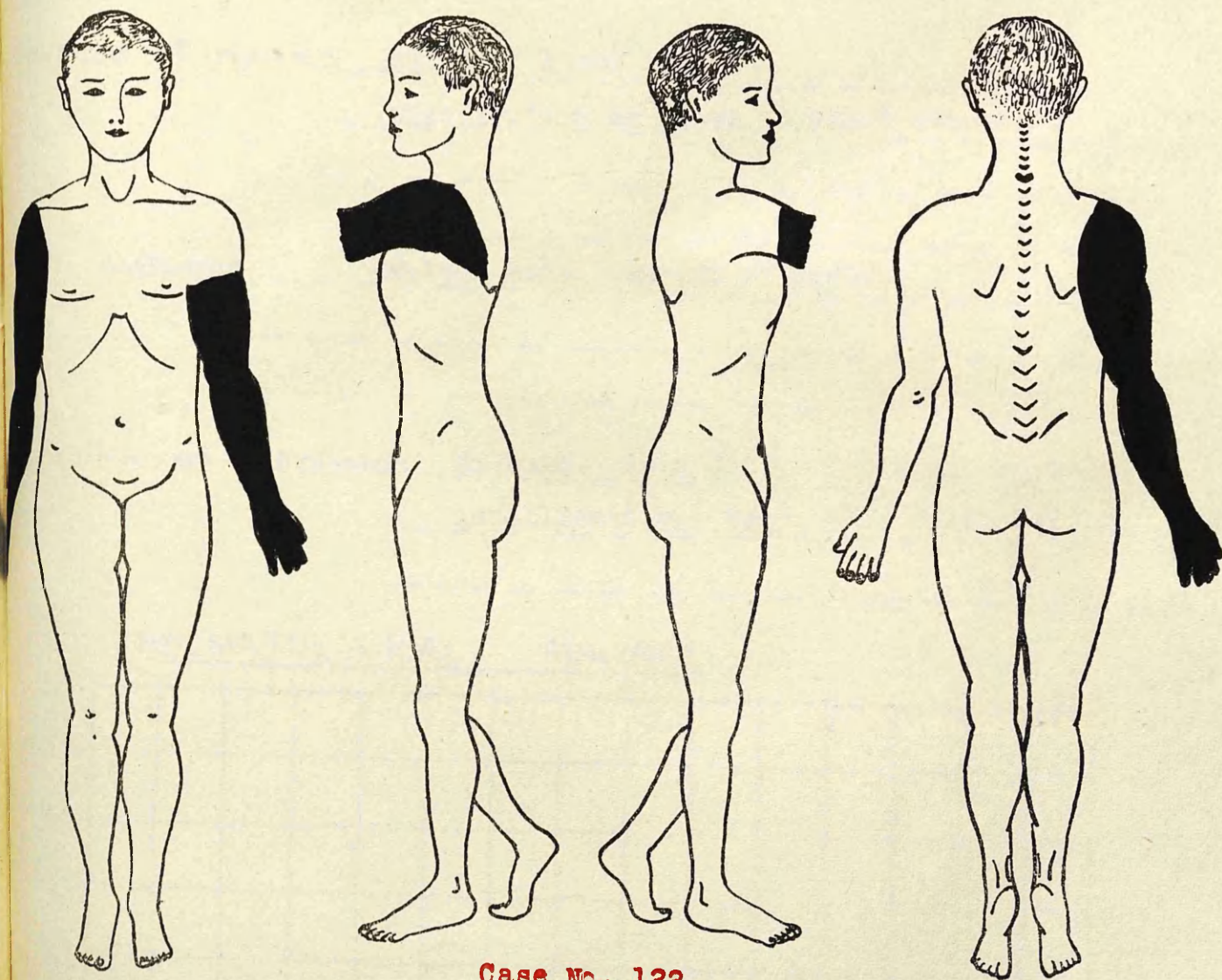


Case No. 121

TREATMENT

1% Sulphamylamide in Cod Liver Oil  
Emulsion.





Case No. 122

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient **50 years**

Case No. **123**

Sex of patient **Male**

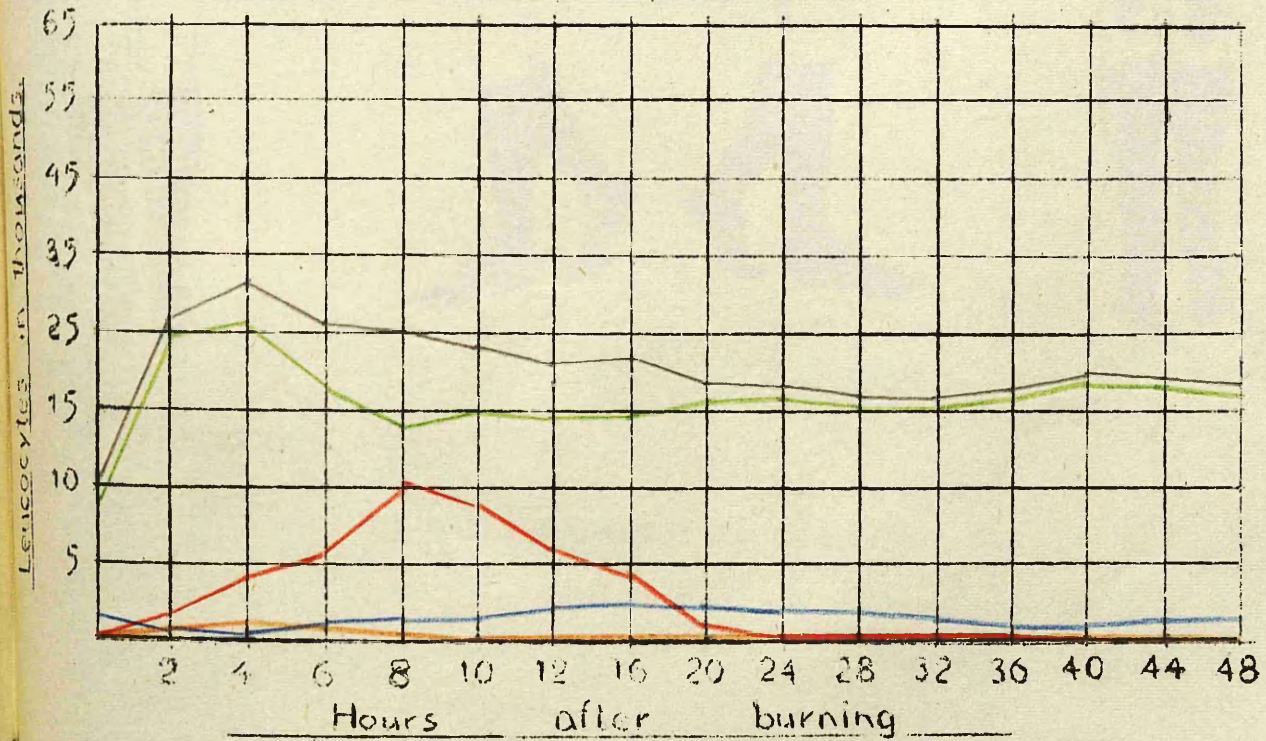
Nature of injuries **Burns of lower limbs.**

**Distribution as shown on chart overleaf.**

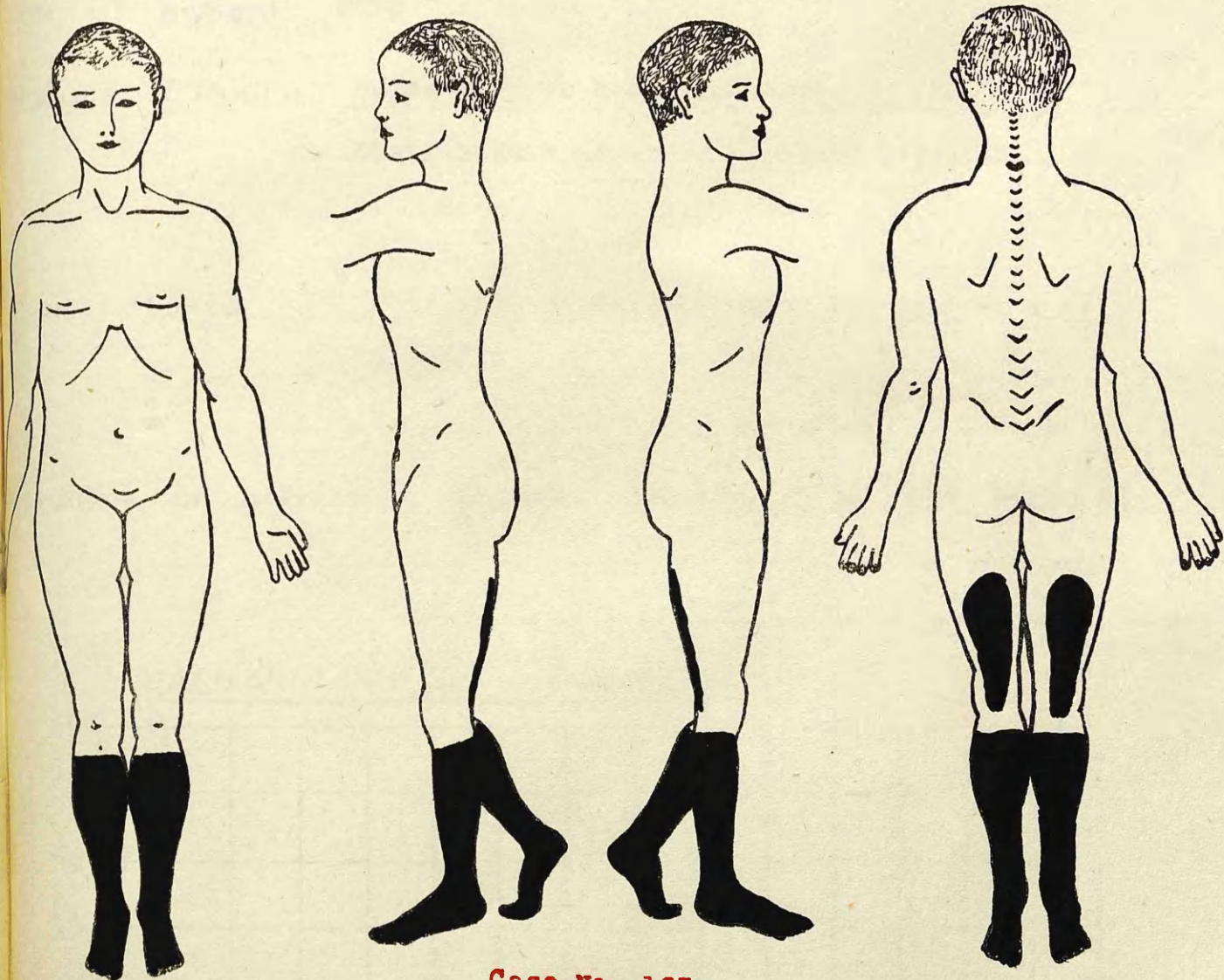
How sustained **Molten metal ran out of mould.**

Condition on admission **No pain. Felt Cold. Answered questions intelligently. Temp. 97.6 Pulse 102**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes } \_\_\_\_\_  
Myelomorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 123

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 42 years

Case No. 124

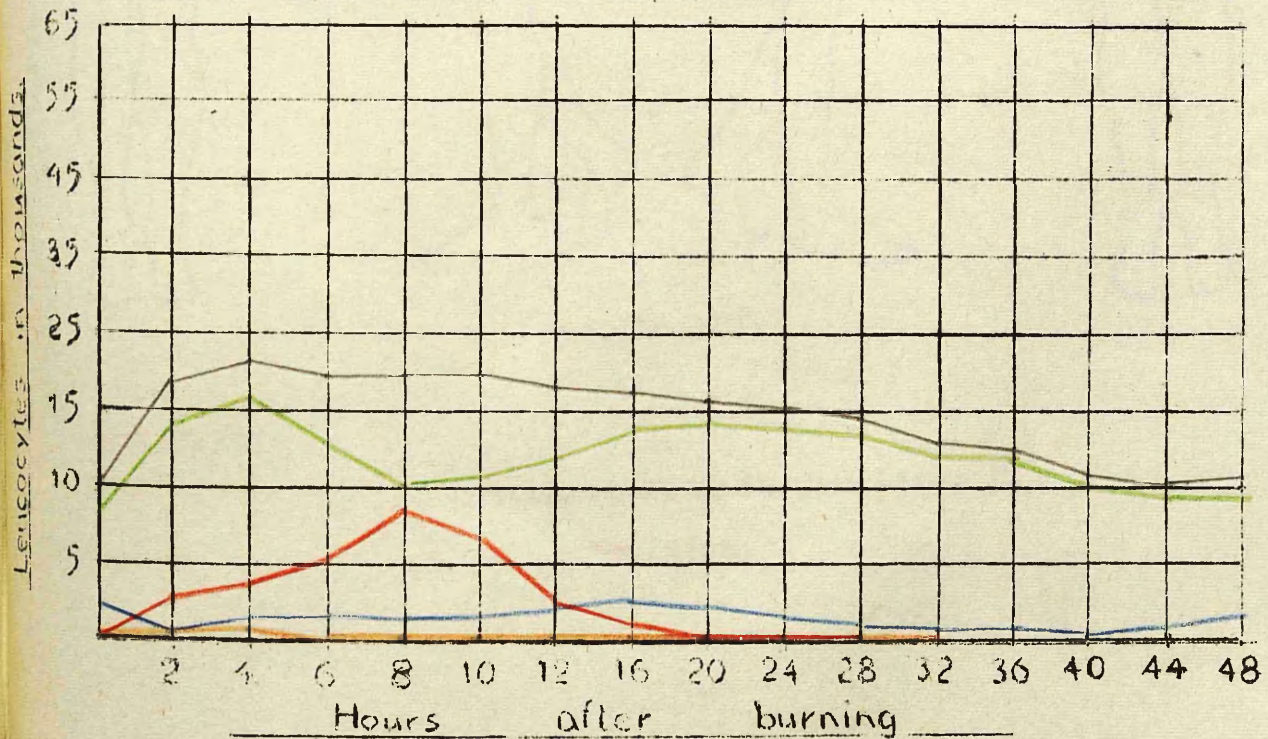
Sex of patient Male

Nature of injuries Burns of both hands and arms.  
Distribution as shown on chart overleaf.

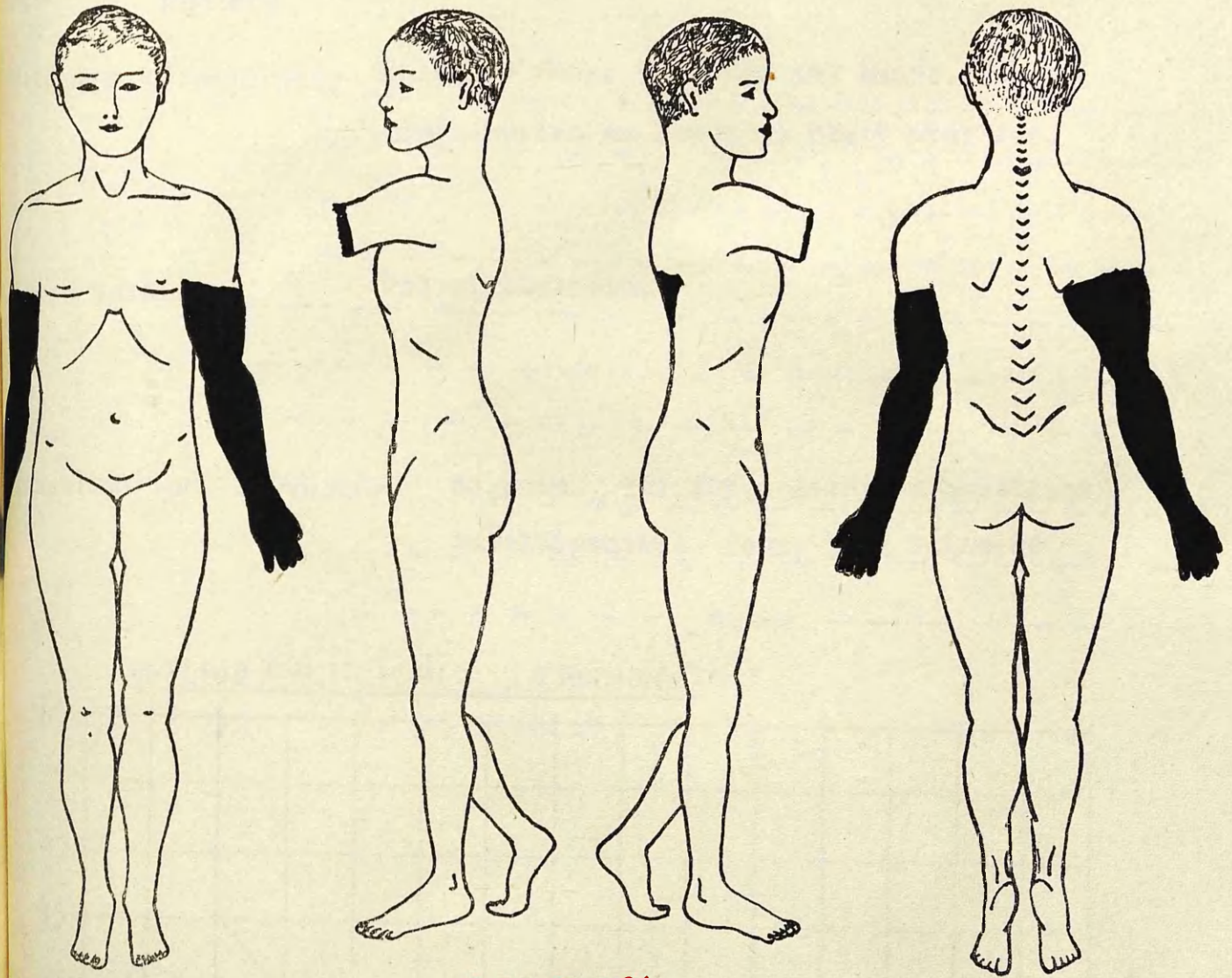
How sustained Fell into fire while under the influence of  
alcohol.

Condition on admission No pain. Talative. Temp. 99.2 Pulse 96

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Polymorphs \_\_\_\_\_  
Metamyelocytes \_\_\_\_\_ Stab Nuclears \_\_\_\_\_  
Lymphocytes & Monocytes } \_\_\_\_\_  
Toxic Granulocytes \_\_\_\_\_



Case No.124.

**TREATMENT**

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **31 years.**

Case No. **125**

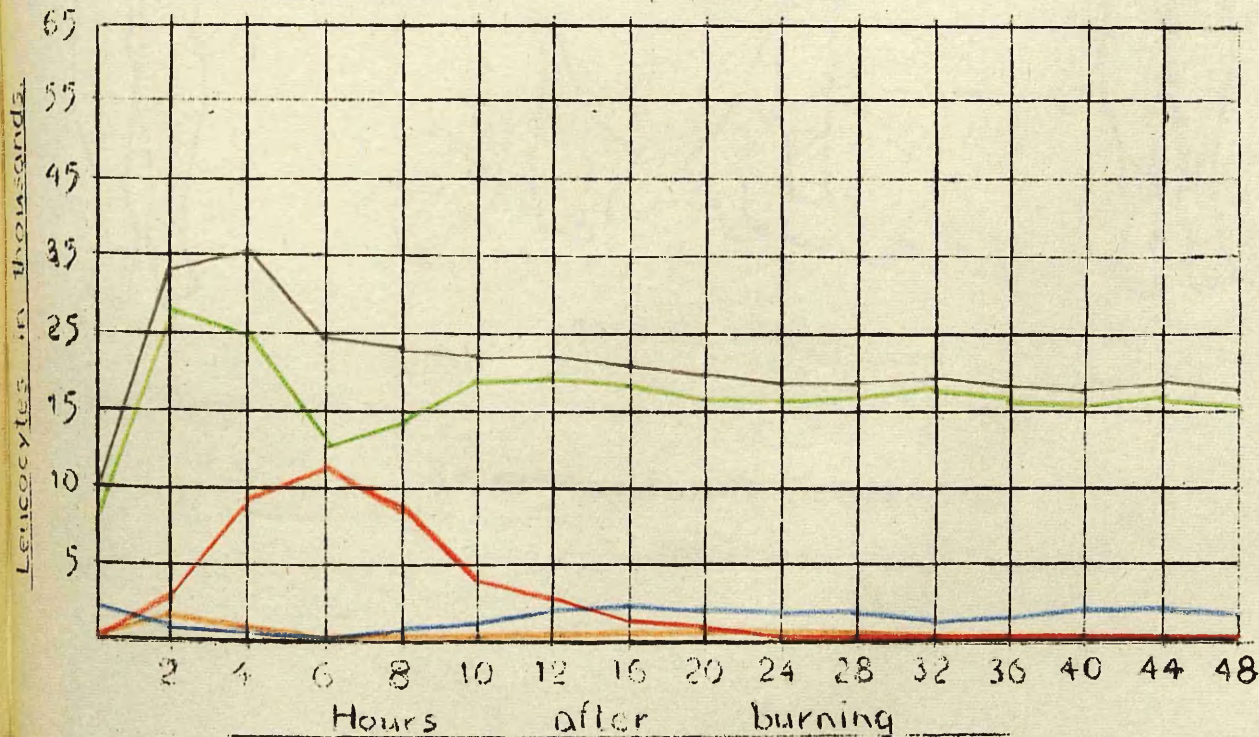
Sex of patient **Male.**

Nature of injuries **Burns of neck, fo rearms and hands.**  
**Distribution as shown on chart overleaf.**

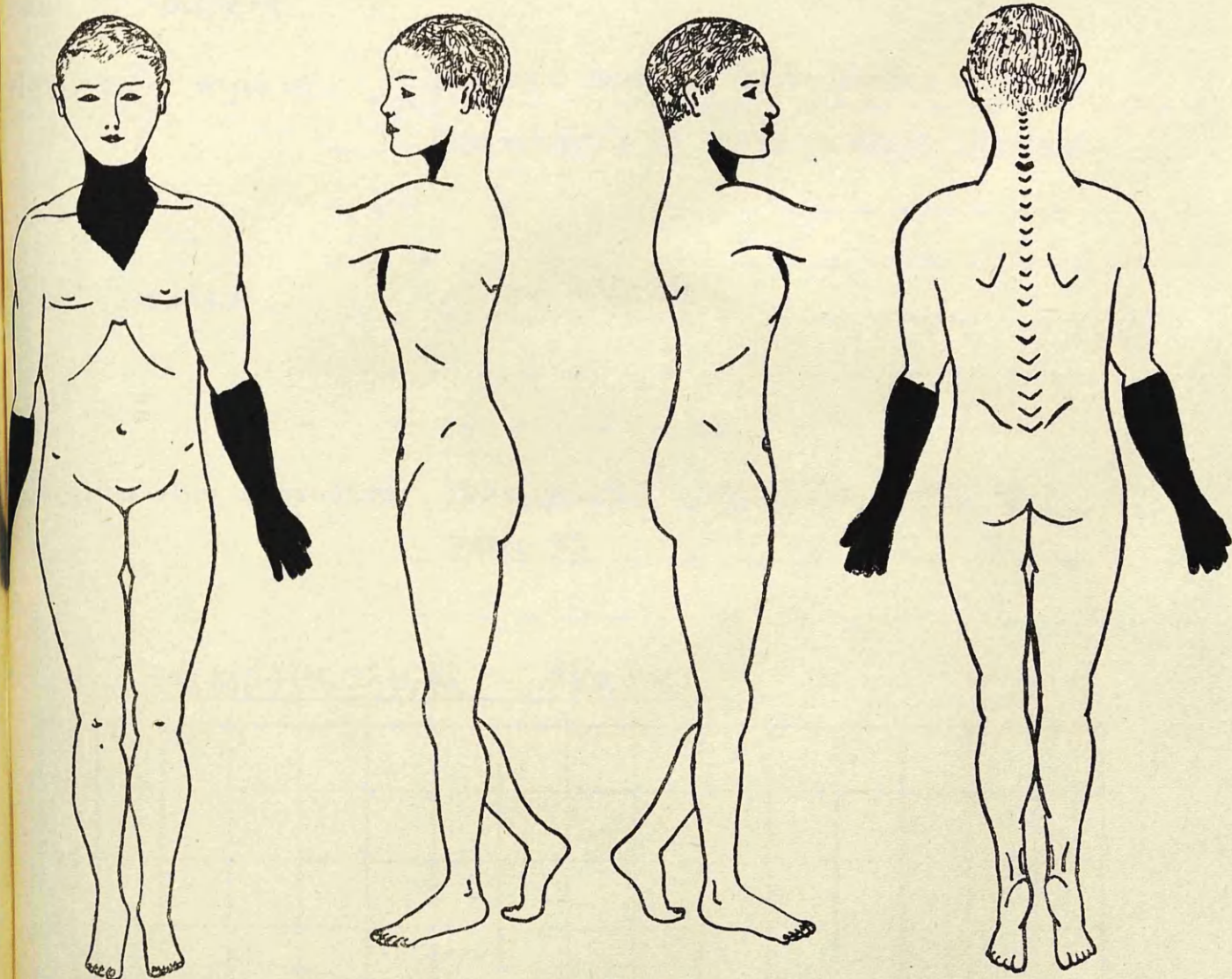
How sustained **Petrol explosion.**

Condition on admission **No pain. Thirsty. Answered questions**  
**intelligently. Temp. 98.4 Pulse 82**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 125

TREATMENT

1<sup>g</sup> Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 26 years.

Case No. 126

Sex of patient Male.

Nature of injuries Burns of face and upper limbs.

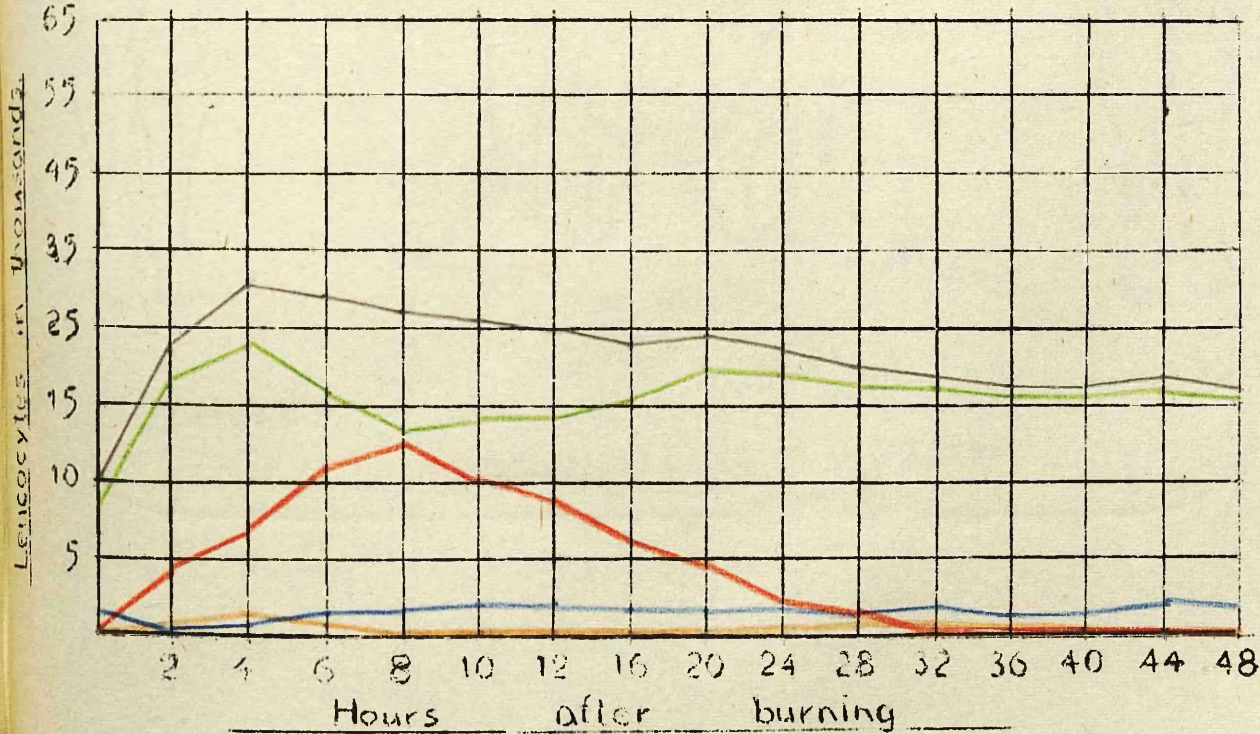
Distribution as shown on chart overleaf.

How sustained Petrol explosion.

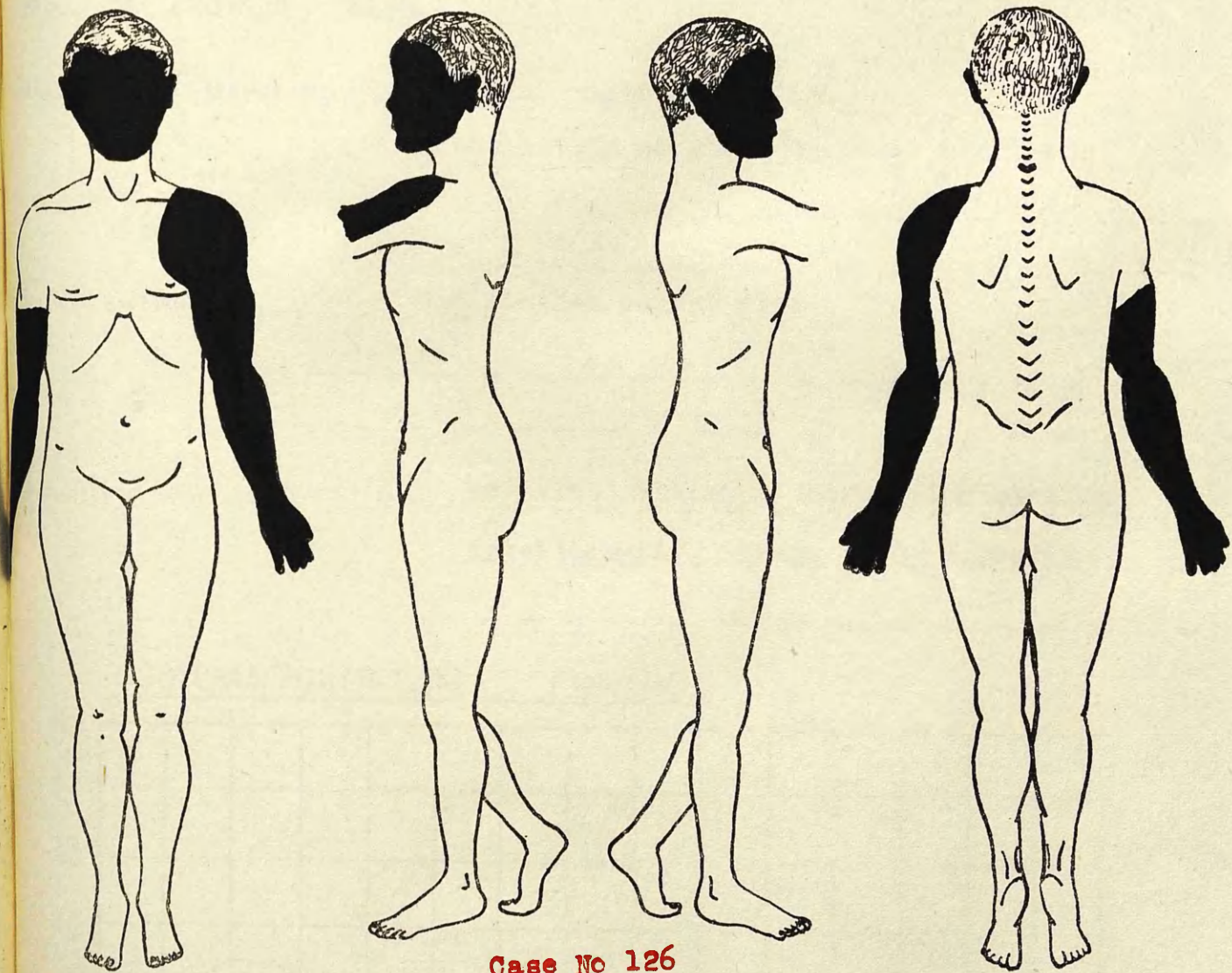
Condition on admission Face painful Talkative. Temp. 98.7

Pulse 90

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No 126

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 30 years.

Case No. 127

Sex of patient Male.

Nature of injuries Burns of right lower limb.

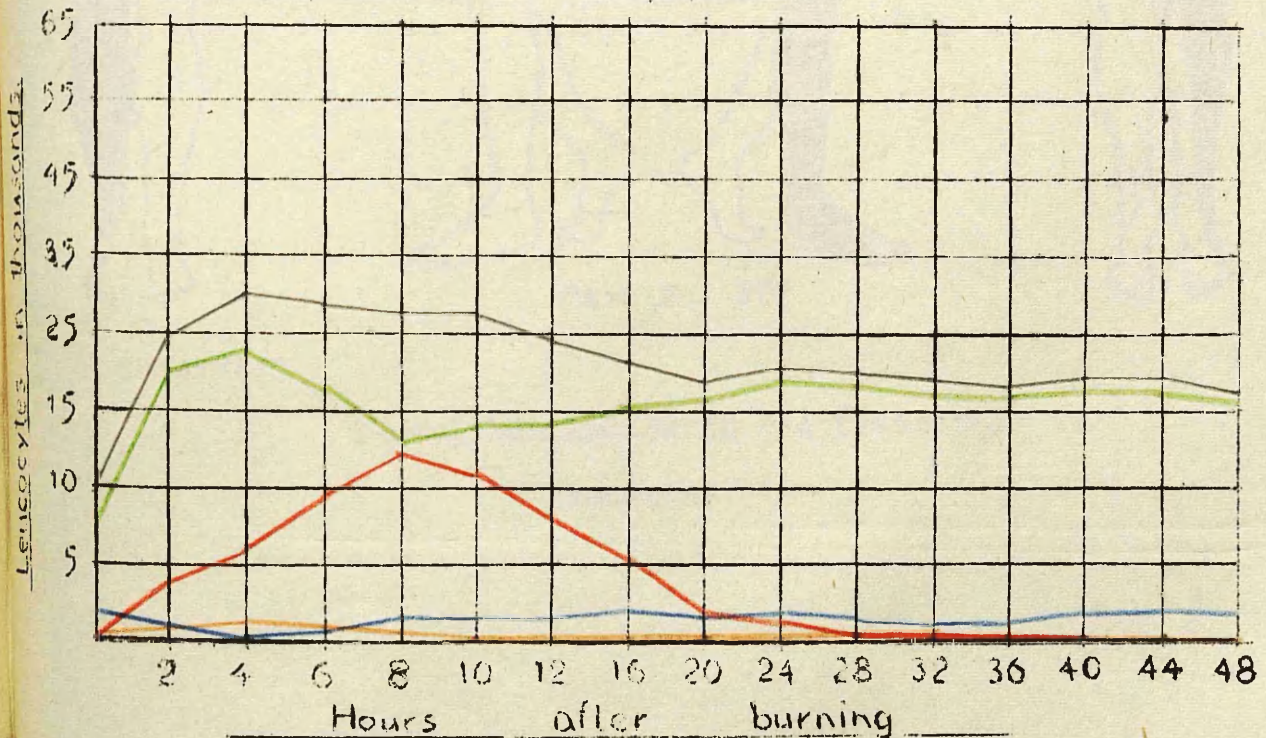
Distribution as shown on chart overleaf.

How sustained Bed clothes caught fire.

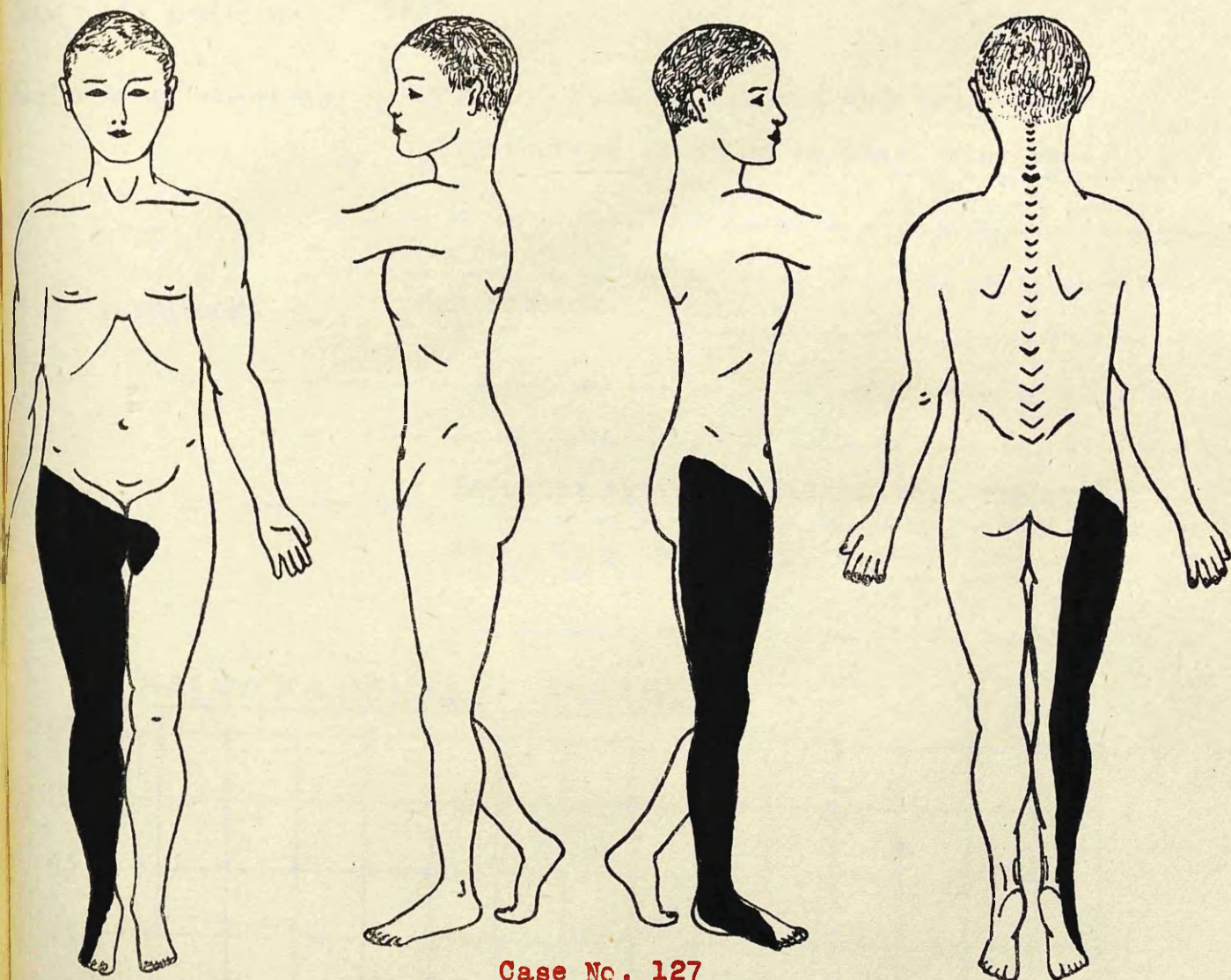
Condition on admission No pain. Thirsty. Answered questions

intelligently. Temp. 98.8 Pulse 92

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Myeloblasts \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 127

TREATMENT

1% Sulphanilamide in Cod Liver Oil

Emulsion.

Age of patient **22 years.**

Case No. **128**

Sex of patient **Male.**

Nature of injuries **Burns of back, chest and abdomen.**

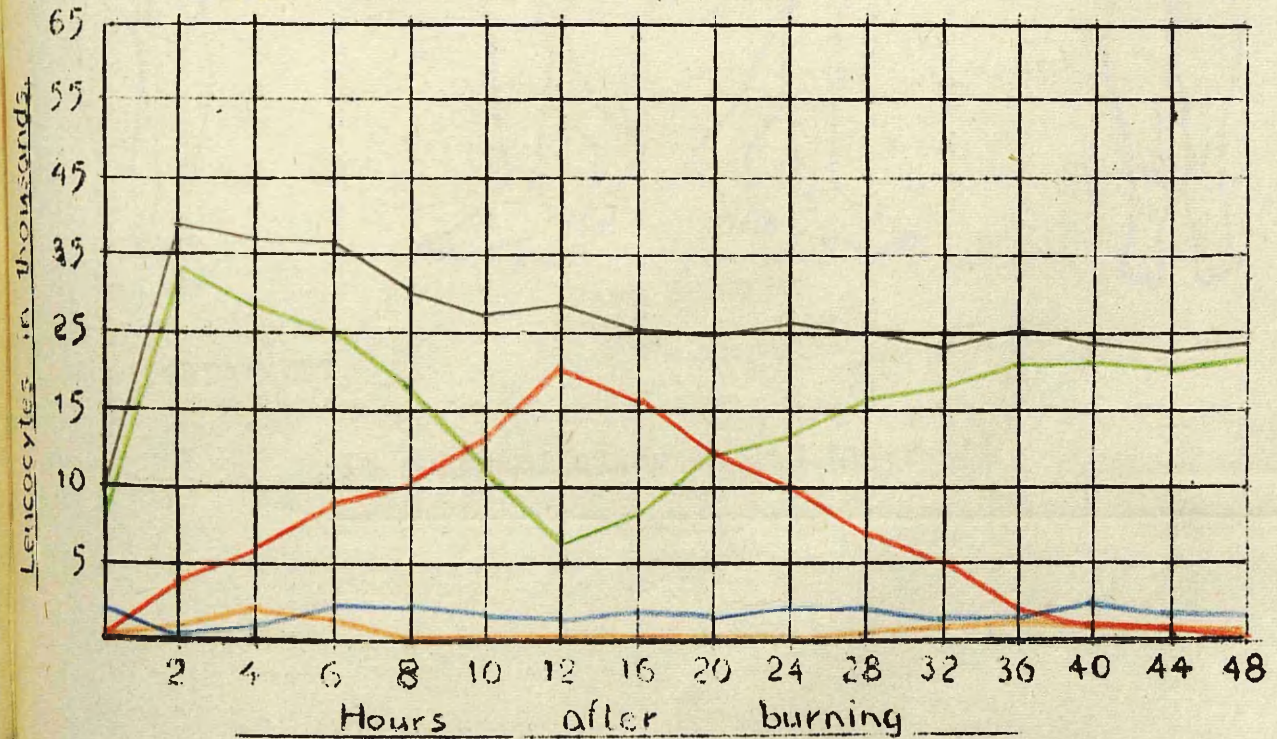
**Distribution as shown on chart overleaf.**

How sustained **Sun bathing.**

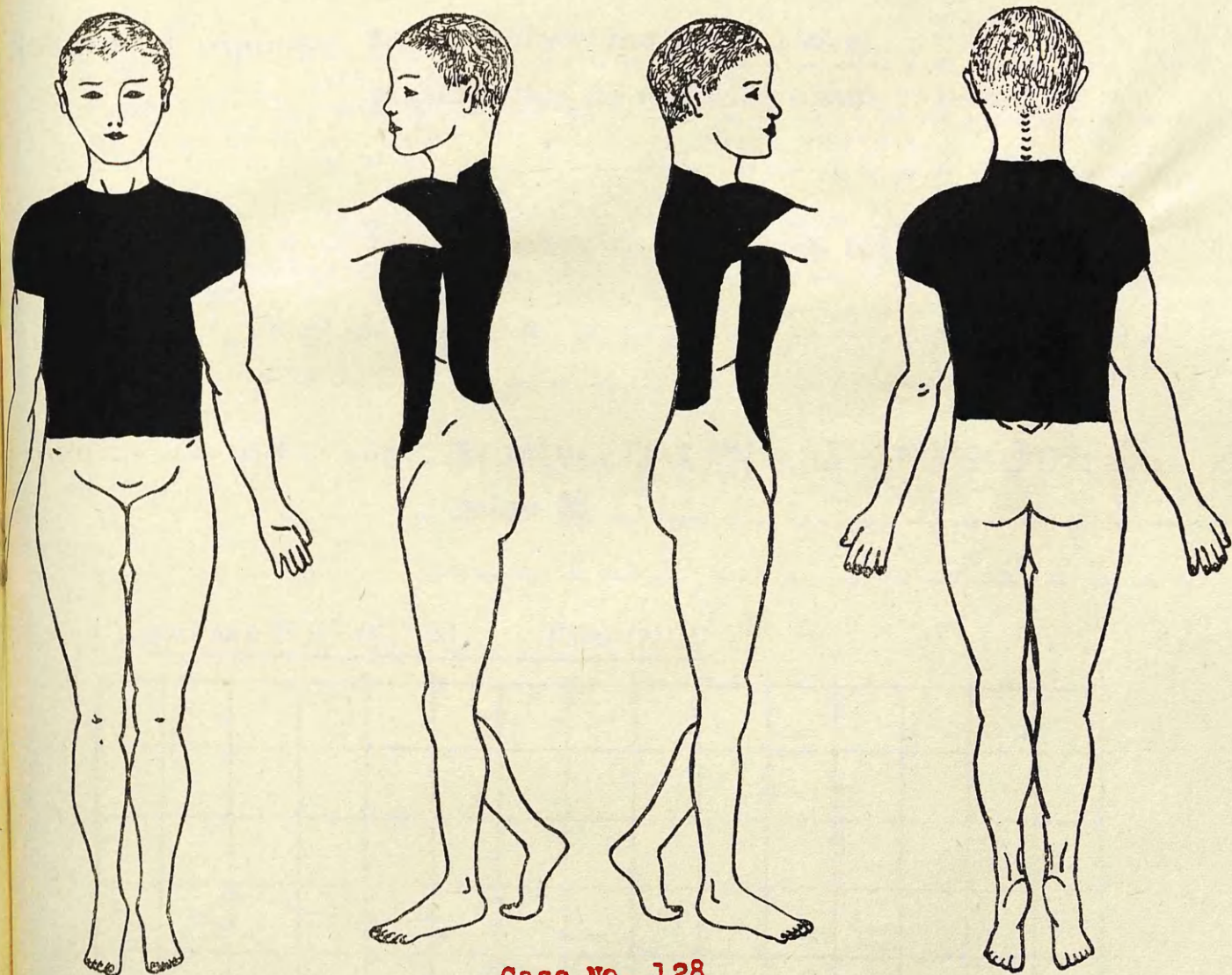
Condition on admission **Injuries painful. Talkative. Thirsty.**

**Temp. 99.6 Pulse 96**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 128

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient. **28 years**

Case No. **129**

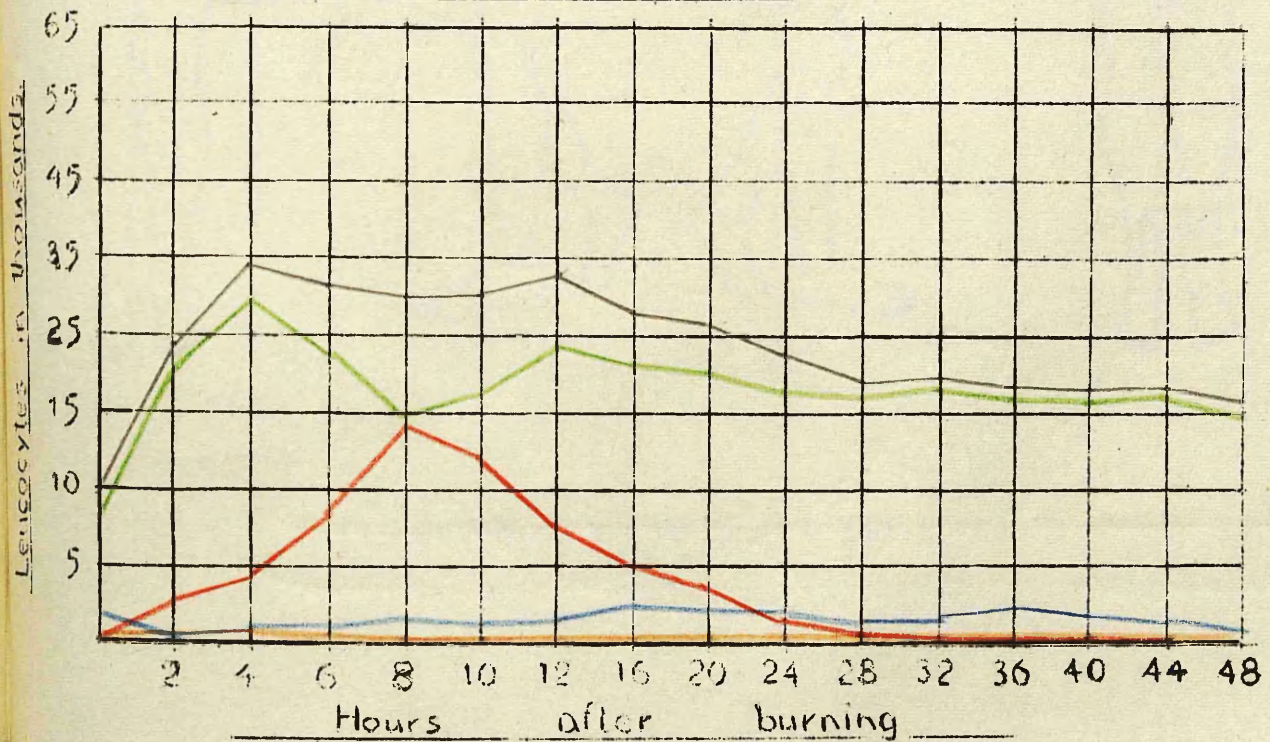
Sex of patient. **Male.**

Nature of injuries. **Burns of face and upper limbs.**  
**Distribution as shown on chart overleaf.**

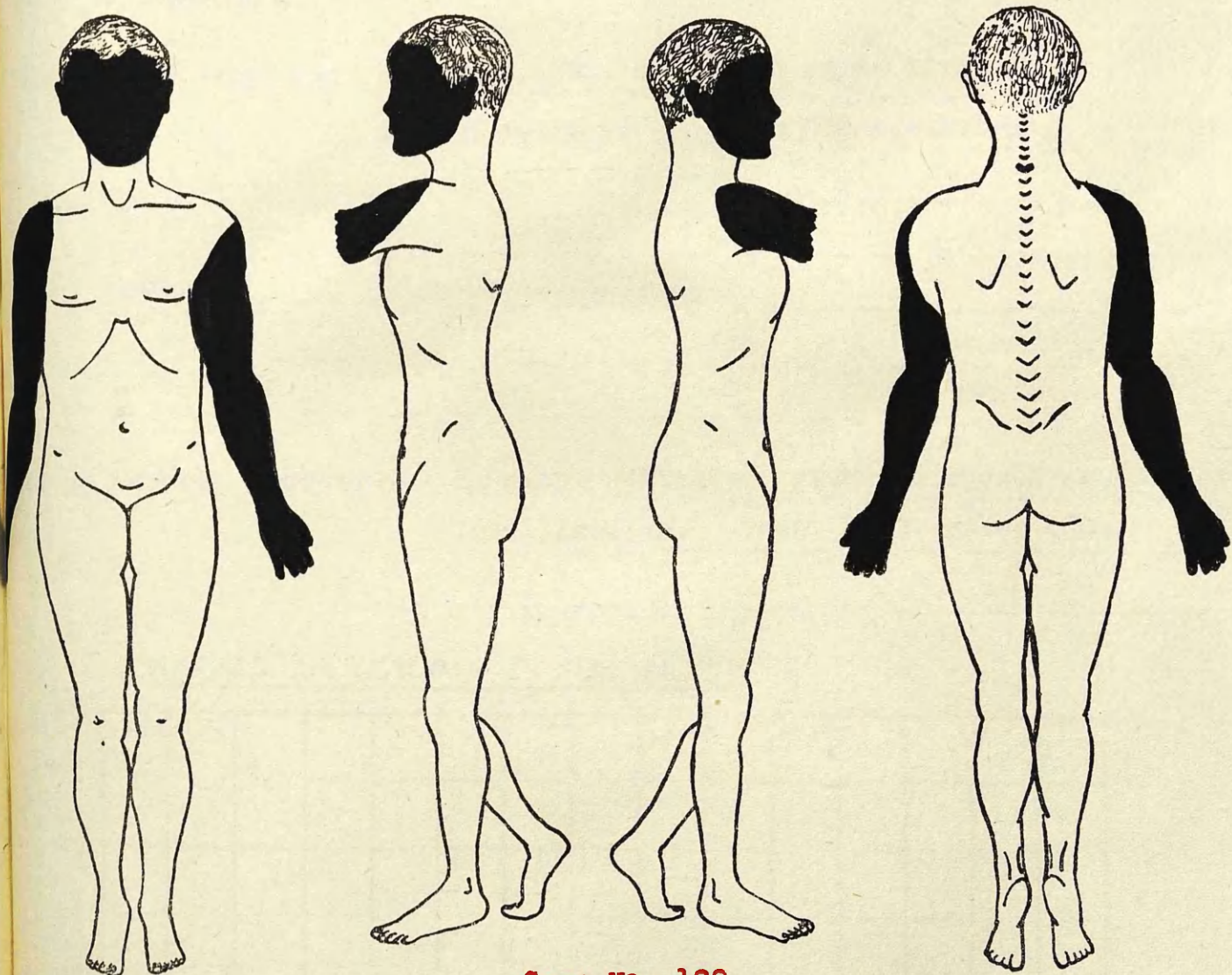
How sustained. **Extinguishing fire in ship's hold.**

Condition on admission. **No pain. Felt well. Talkative. Temp. 99.**  
**Pulse 88**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_



Case No. 129

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 19 years.

Case No. 130

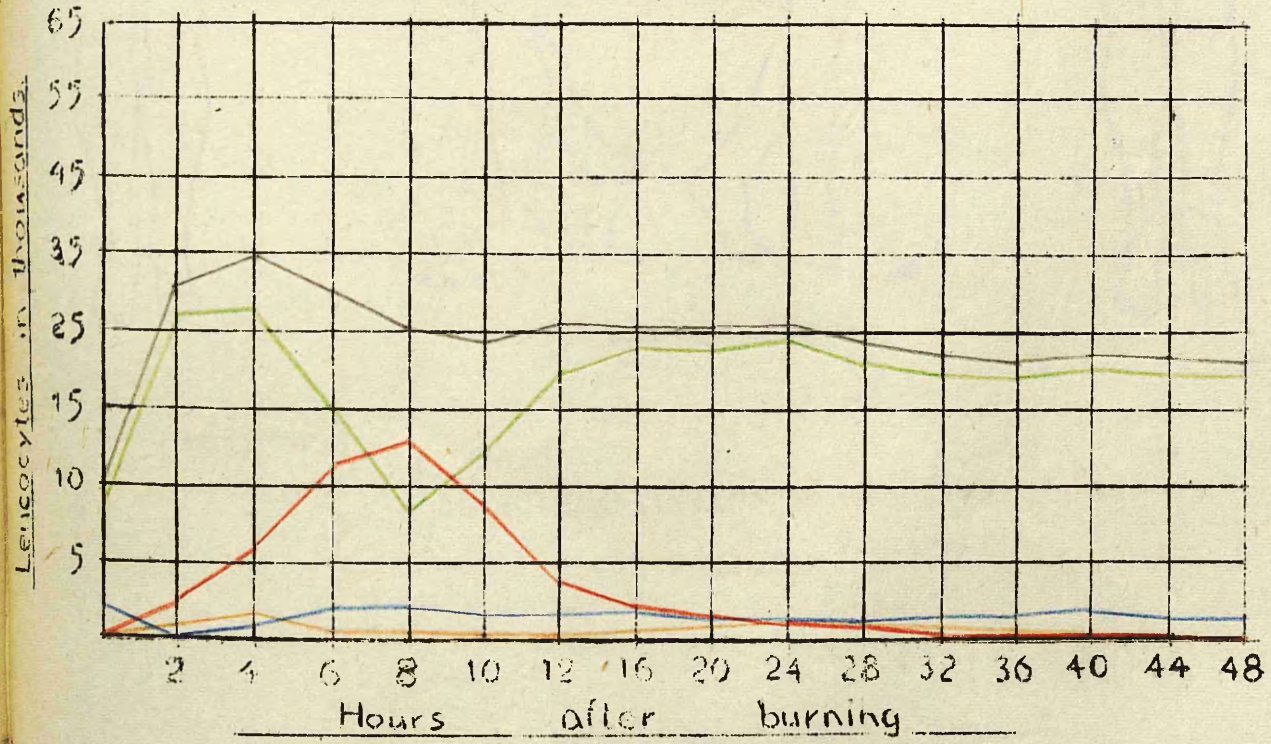
Sex of patient Male.

Nature of injuries Burns of face, chest and upper limbs.  
Distribution as shown on chart overleaf.

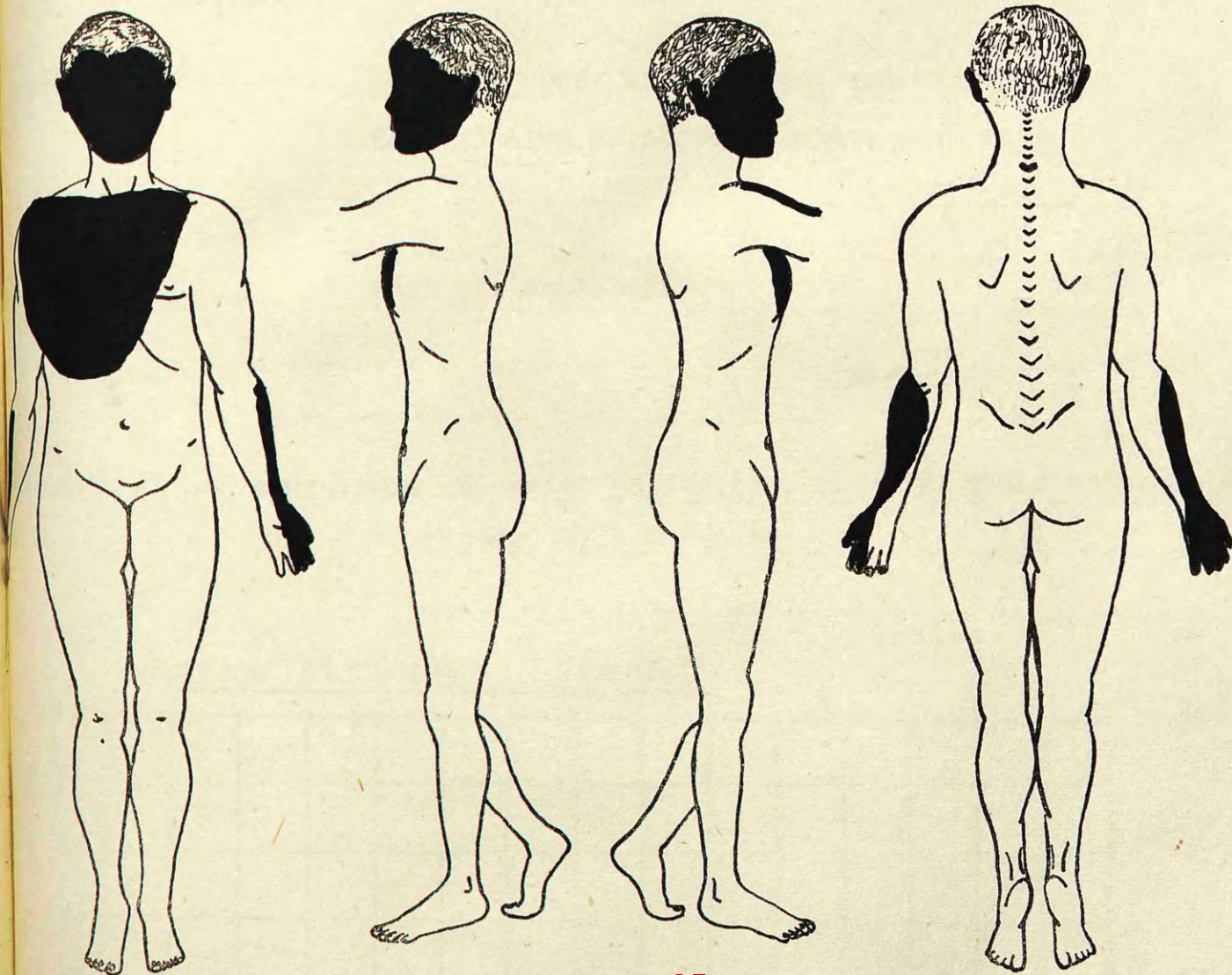
How sustained Coal Pit explosion.

Condition on admission No pain. Thirsty. Answered questions  
intelligently. Temp. 99.2 Pulse 120

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 130

TREATMENT

1% Sulphanilamide in Cod Liver

Oil Emulsion.

Age of patient 20 years.

Case No. 131

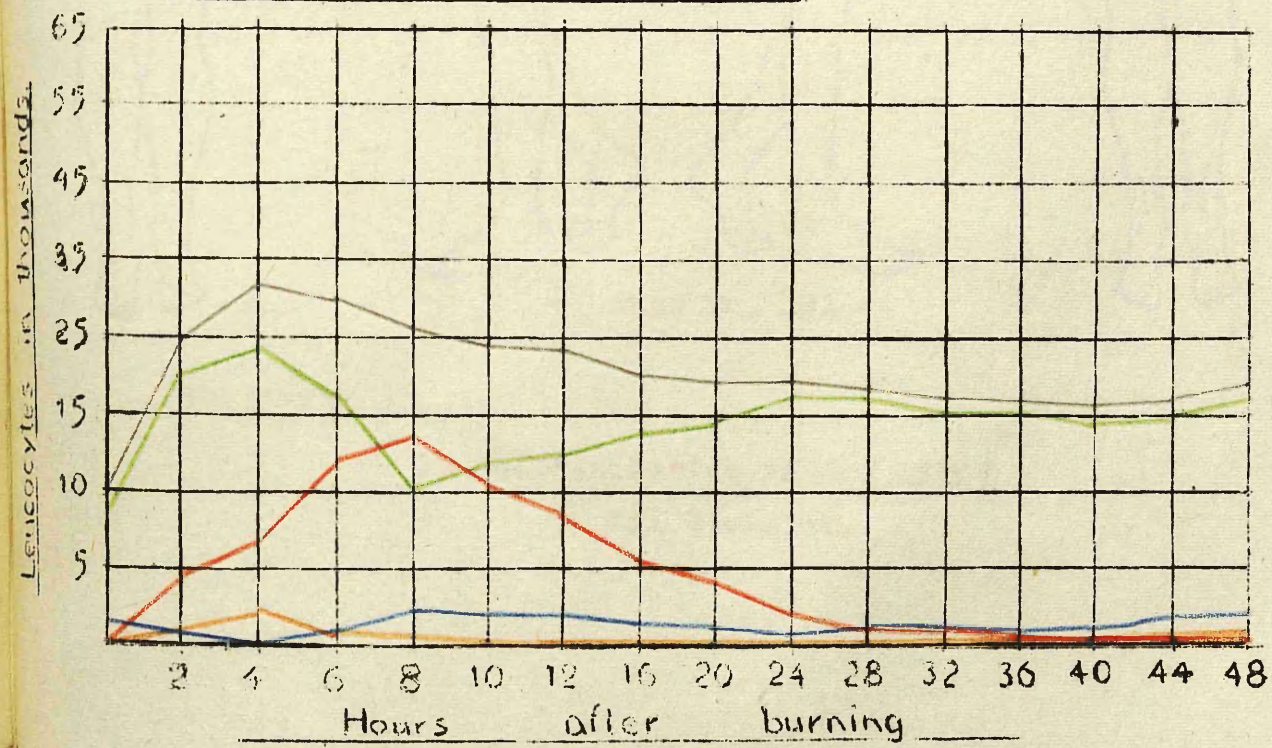
Sex of patient Male.

Nature of injuries Burns of upper limbs, chest and abdomen.  
distribution as shown on chart overleaf.

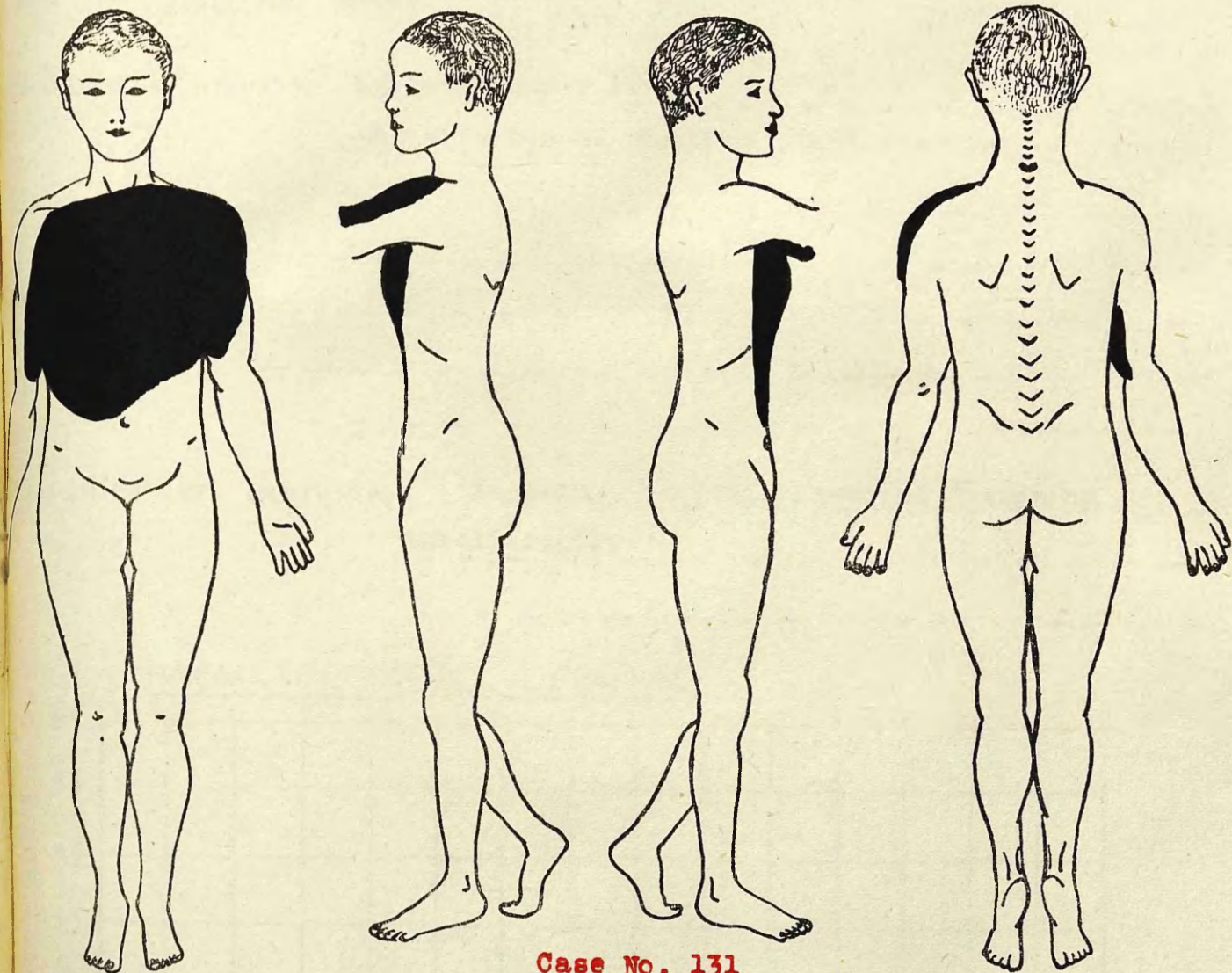
How sustained Coal pit explosion.

Condition on admission No pain. Shivering. Thirsty. Disorientated.  
Temp. 97.8 Pulse 98

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 131

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 22 years.

Case No. 132

Sex of patient Male.

Nature of injuries Burns of upper limbs.

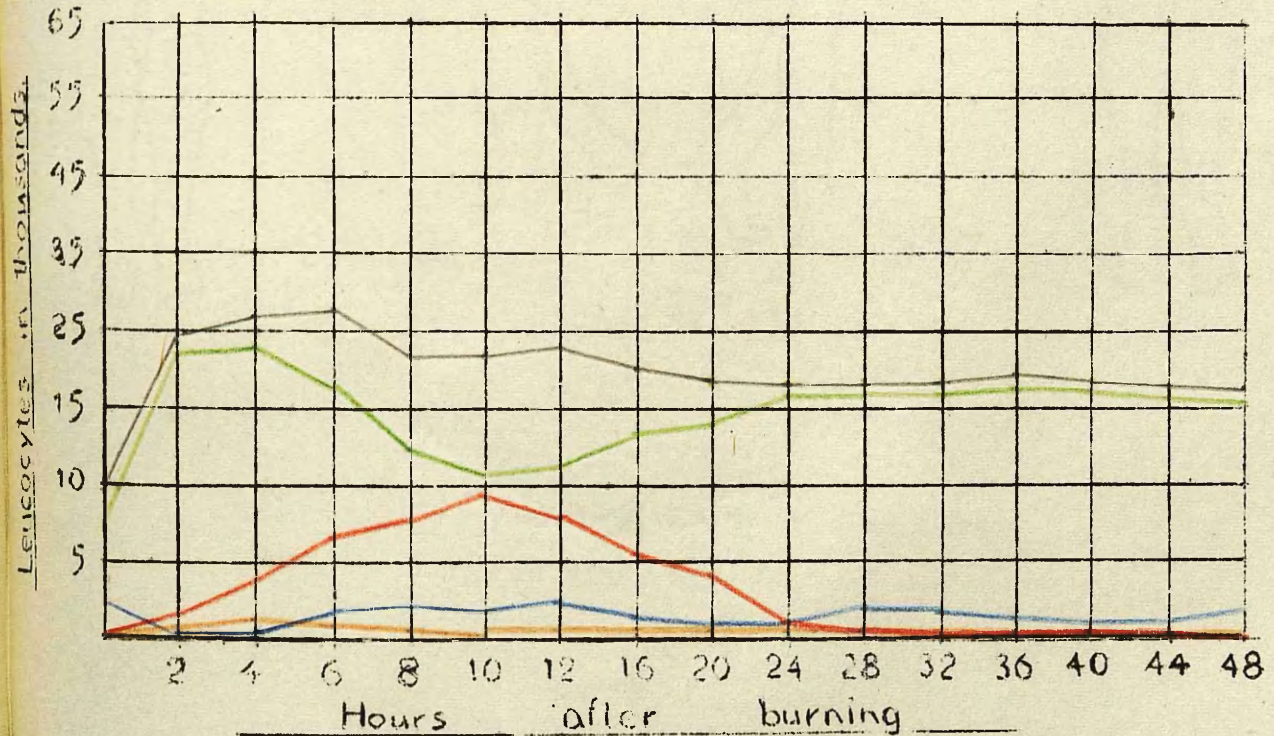
distribution as shown on chart overleaf.

How sustained Coal Pit Explosion.

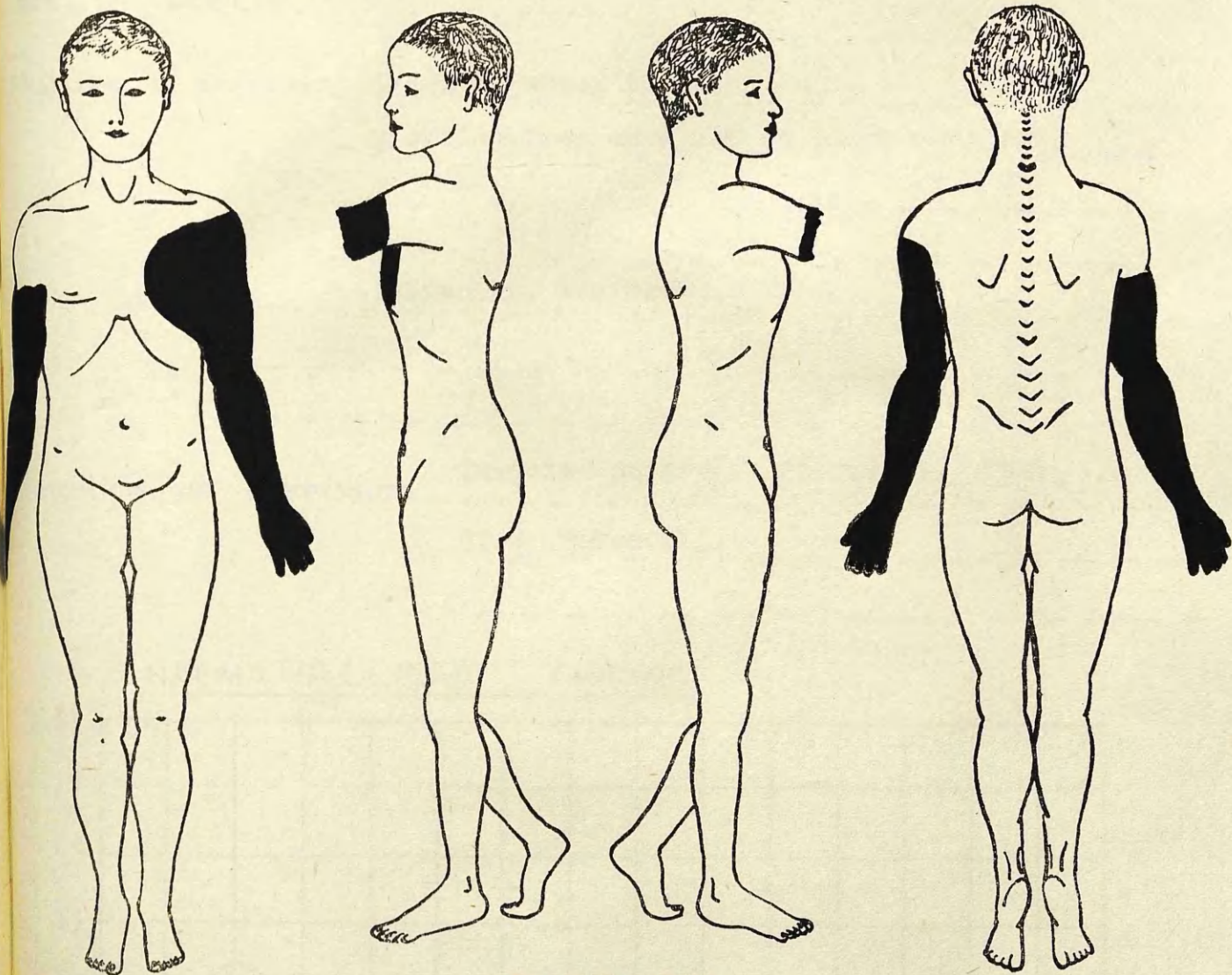
Condition on admission No pain. Thirsty. Answered questions

intelligently.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 132

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient **17 years.**

Case No. **133**

Sex of patient **Male.**

Nature of injuries **Burns of upper limbs.**

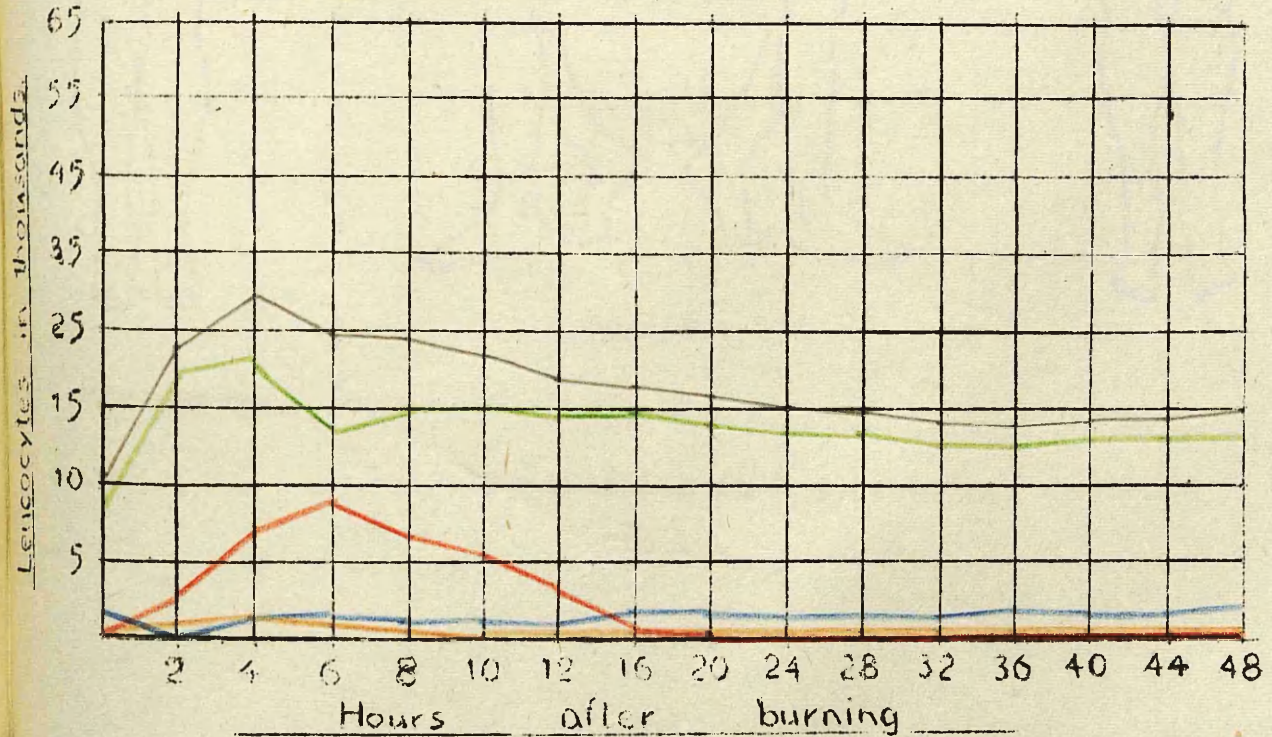
**Distributions as shown on chart overleaf.**

How sustained **Blow lamp explosion.**

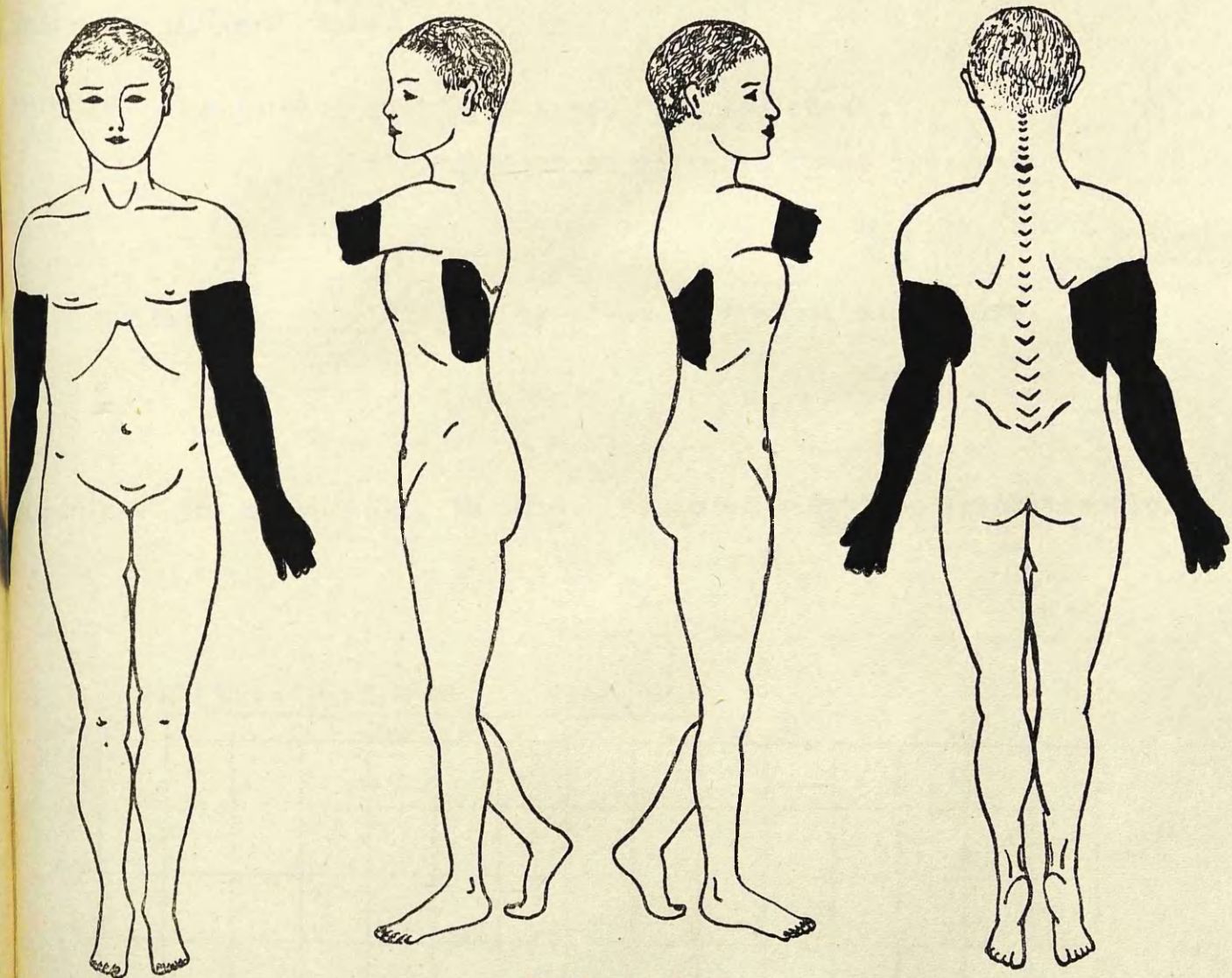
Condition on admission **Injuries painful. Shivering. Temp.**

**97.8 Pulse 114.**

**HAEMATOLOGICAL FINDINGS**



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
 & Monocytes }  
 Blymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 133

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **57 years.**

Case No. **134.**

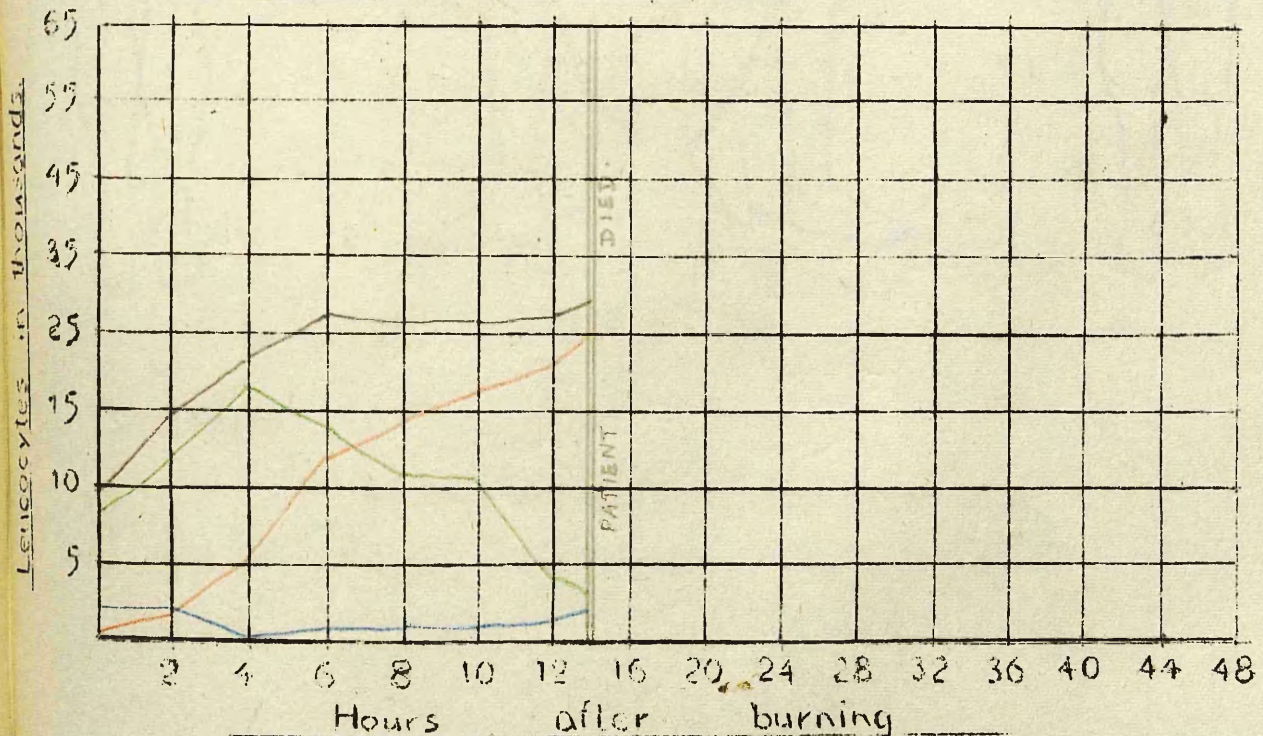
Sex of patient **Male.**

Nature of injuries **Scalds of arms, face and chest.**  
**distribution as shown on chart overleaf.**

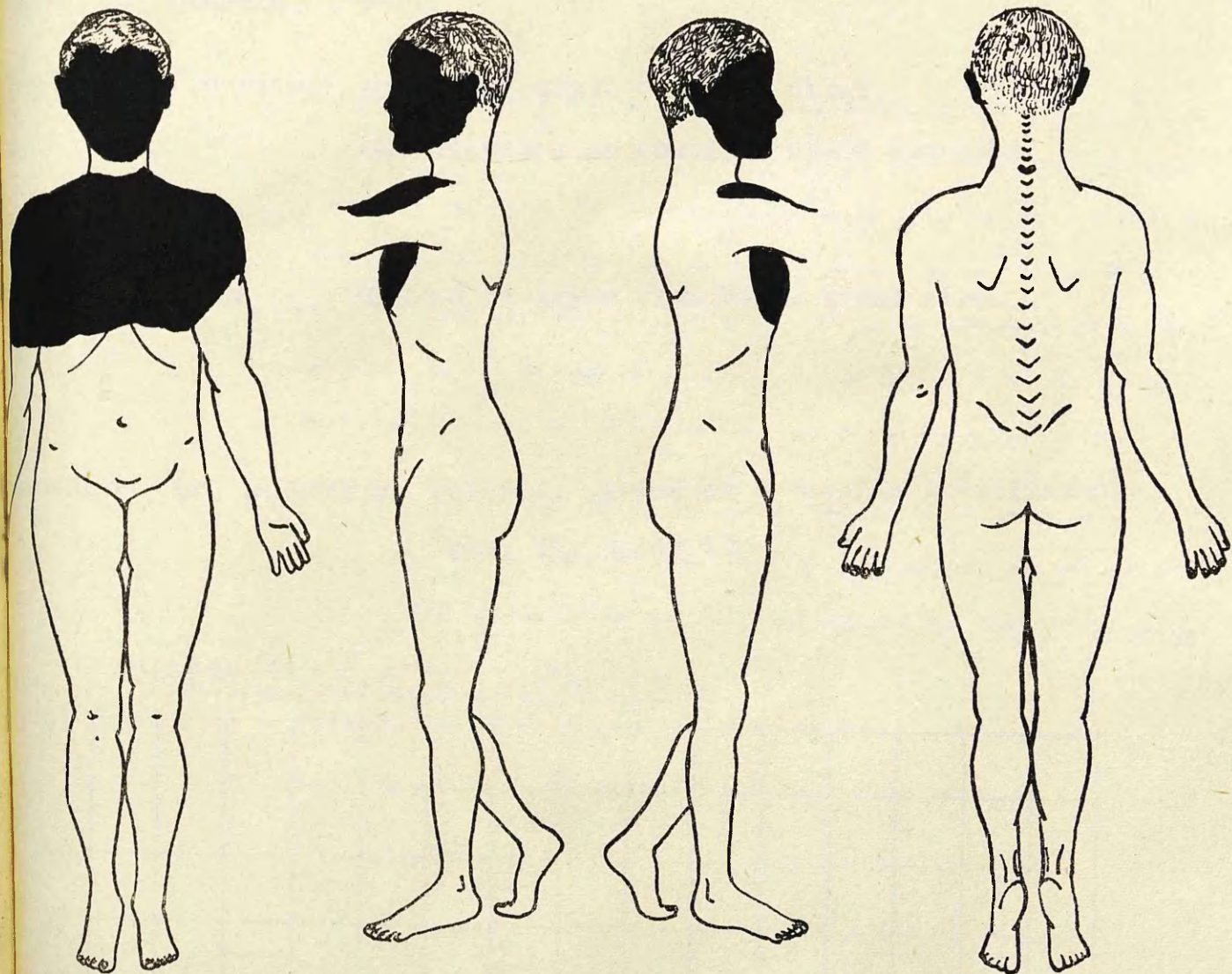
How sustained **Scalded by steam from burst steam pipe.**

Condition on admission **Painful. Answered questions intelligently.**  
**Temp. 98.9 Pulse 90**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes }  
 & Monocytes }



Case No. 134

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 25 years.

Case No. 135.

Sex of patient Male.

Nature of injuries Scalds of arms, face and chest.

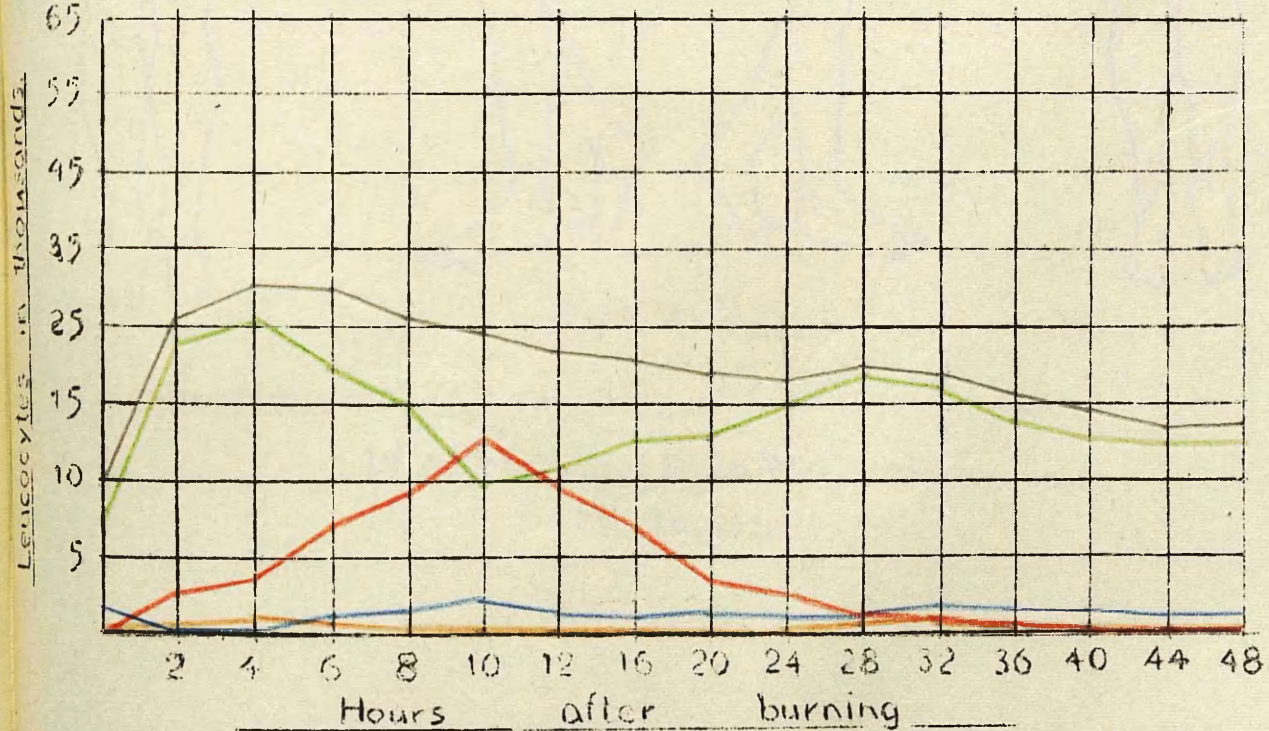
- distribution as shown on chart overleaf.

How sustained Scalded by steam from burst steam pipe.

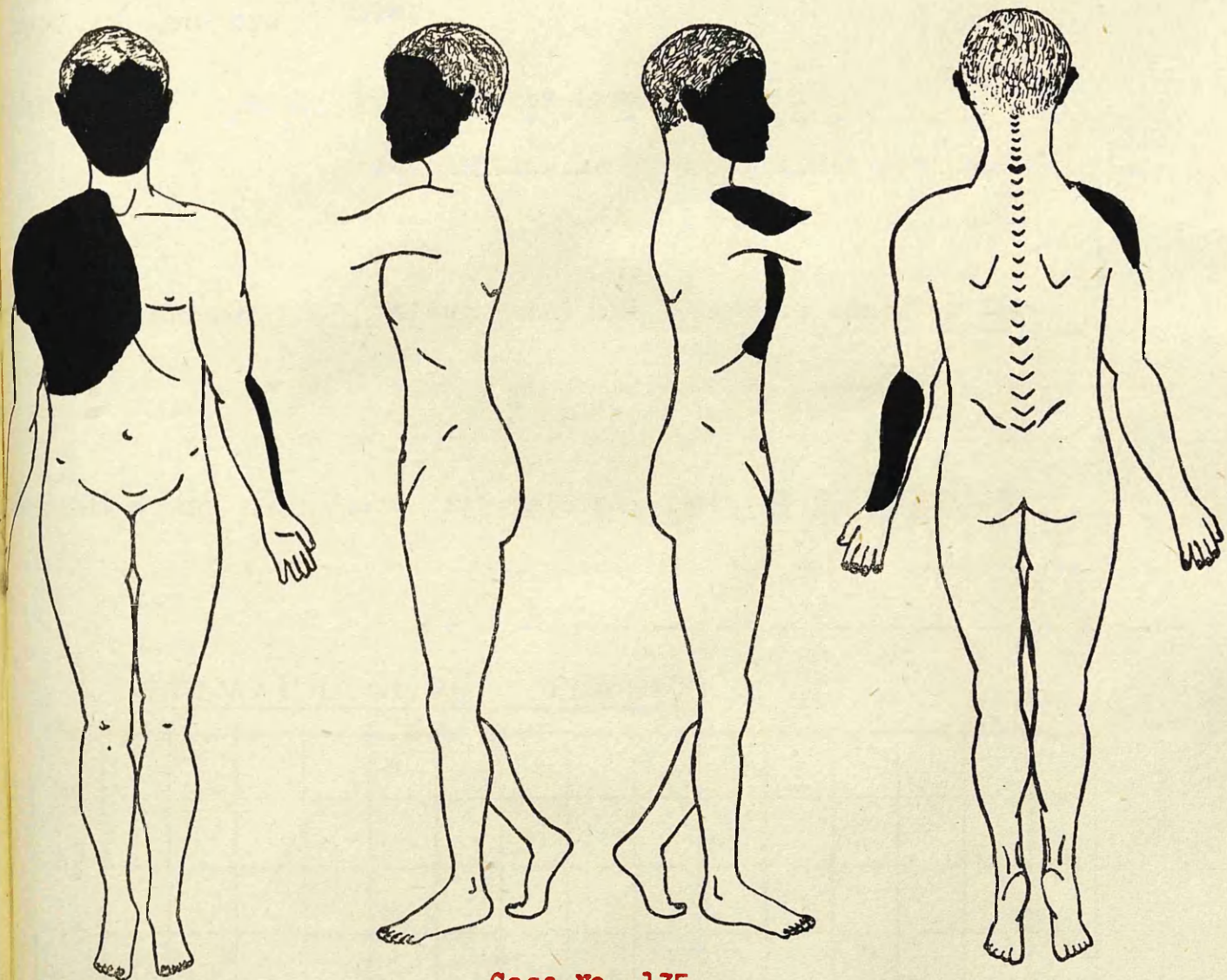
Condition on admission Painful. Answered questions intelligently.

Temp. 99 Pulse 100

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Lymphorpha \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 135

**TREATMENT**

**1% Sulphanilamide in Cod Liver  
Oil Emulsion.**

Age of patient 33 years.

Case No. 136

Sex of patient Male.

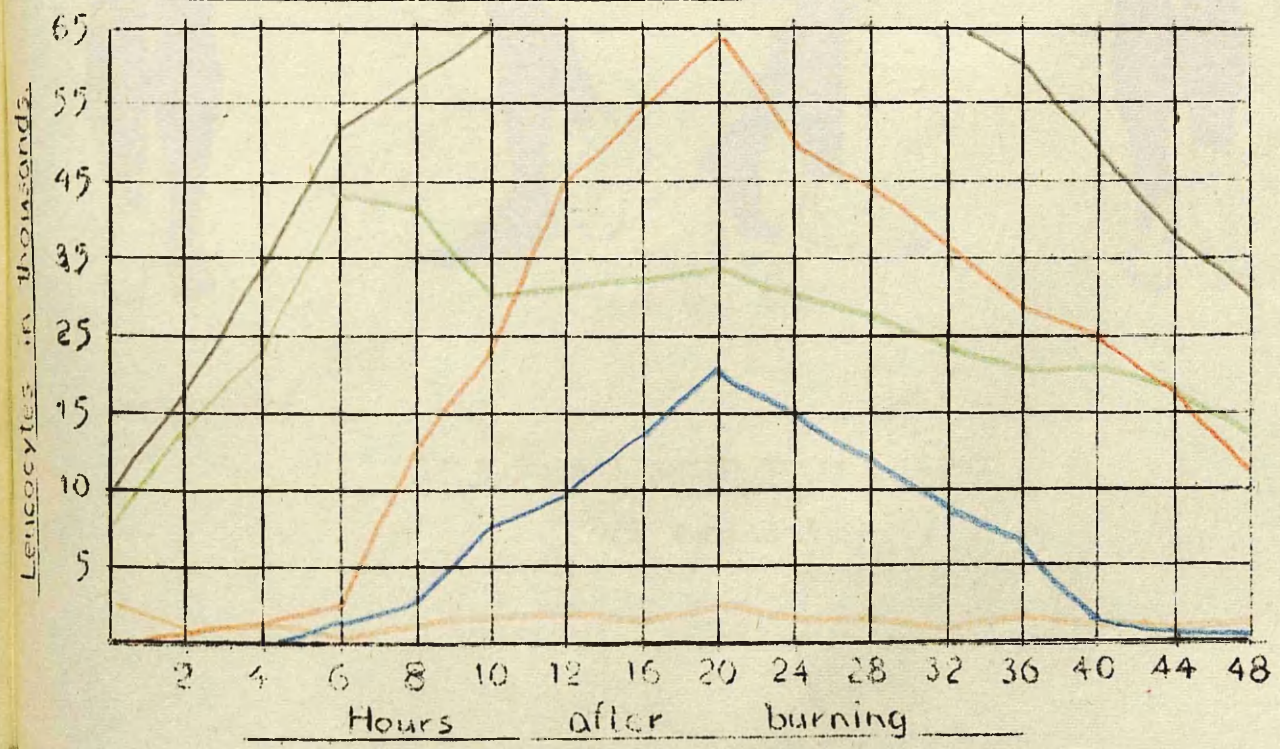
Nature of injuries Burns of the lower limbs

- Distribution as shown on chart overleaf. -

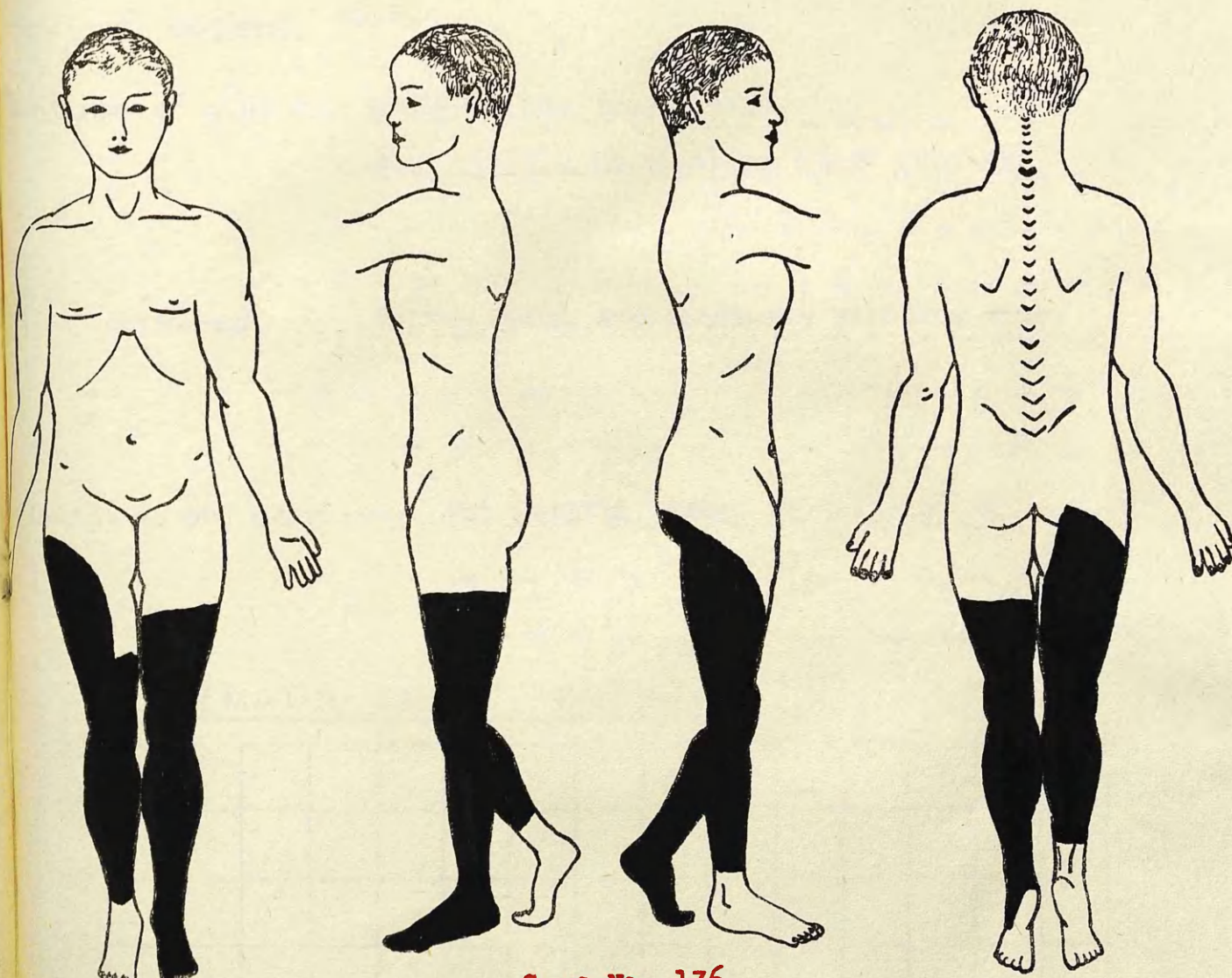
How sustained Molten metal and dungarees catching fire.

Condition on admission Not painful. Temp. 97.5 Pulse 100

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
 & Monocytes }  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 136

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 40 years.

Case No. -137-

Sex of patient Male.

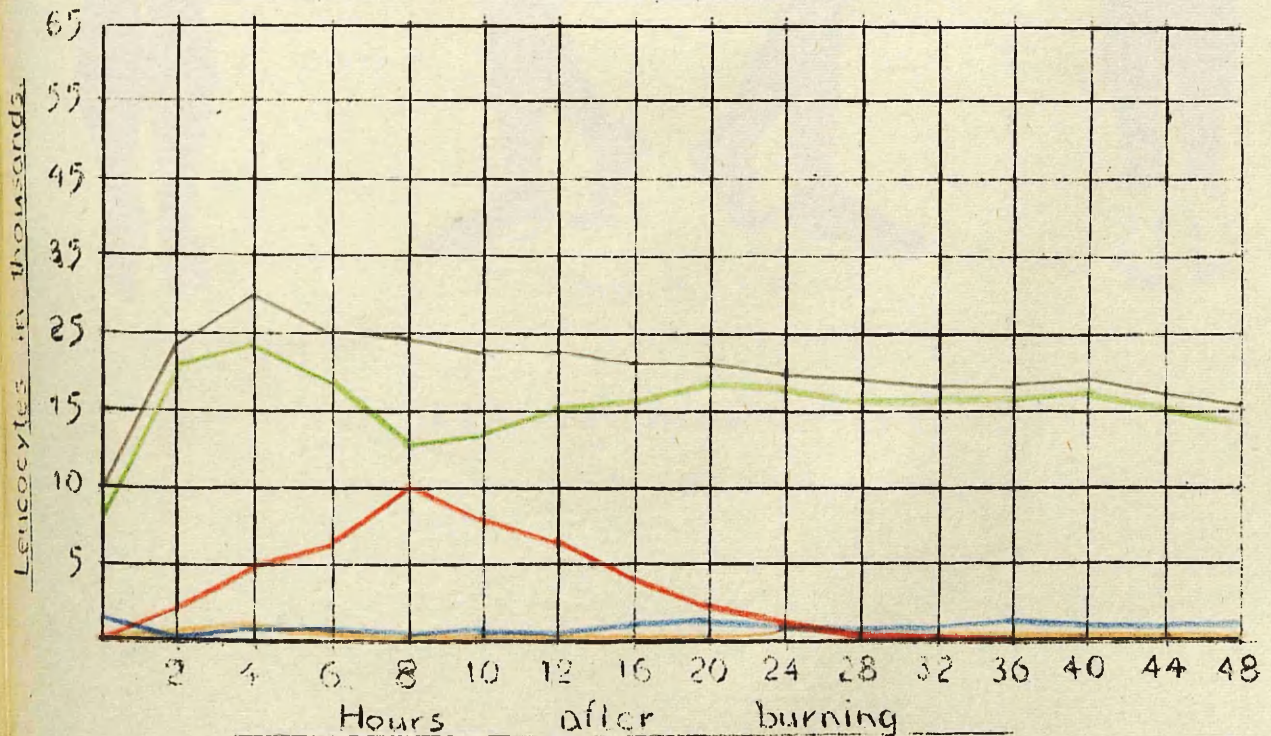
Nature of injuries Burns of the lower limbs.

Distribution as shown on chart overleaf.

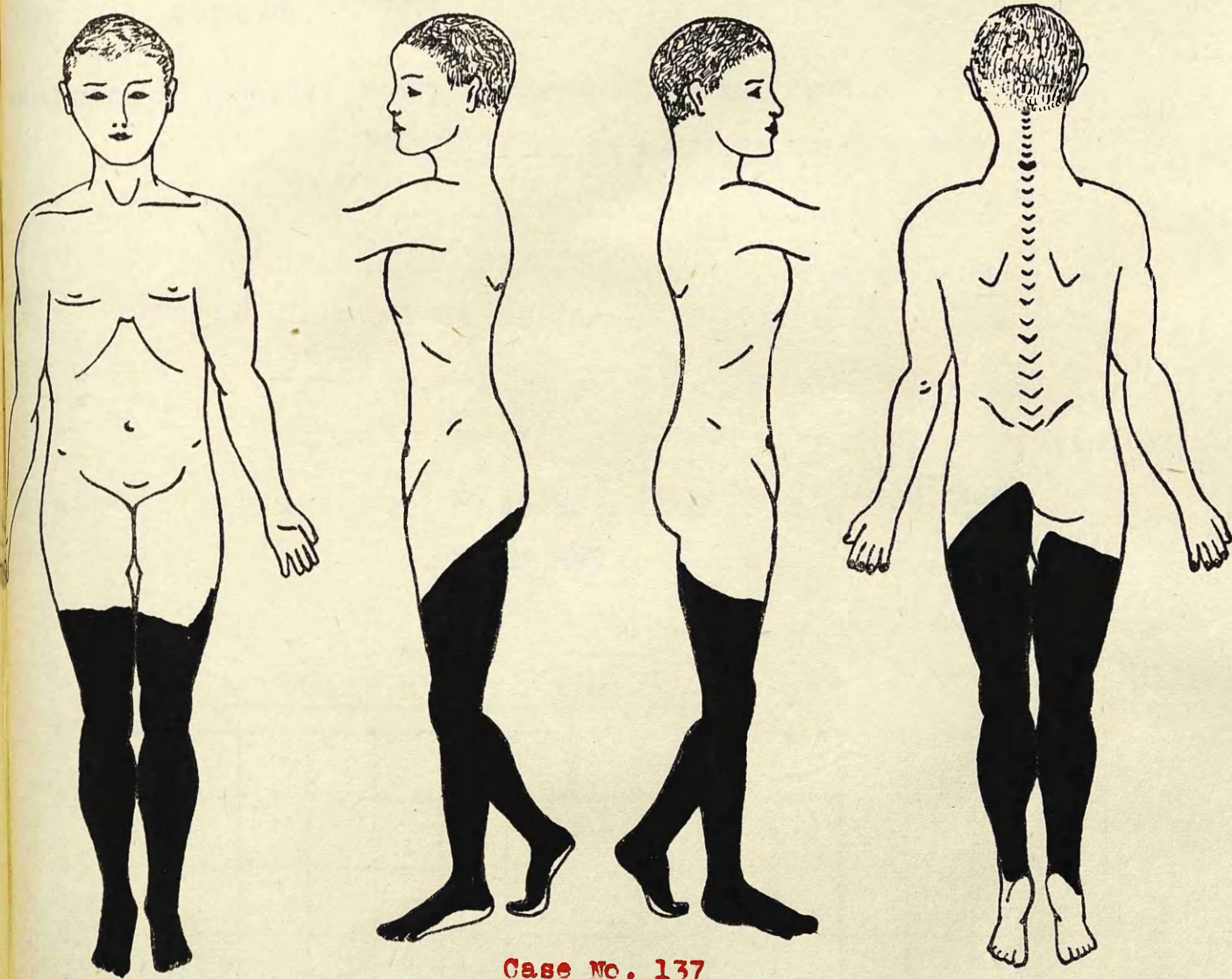
How sustained Molten metal and dungarees catching fire.

Condition on admission Not painful Temp. 98.5 Pulse 92.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
( & Monocytes ) \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 137

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 30 years.

Case No. 138

Sex of patient Male.

Nature of injuries Burns of upper limbs and face.

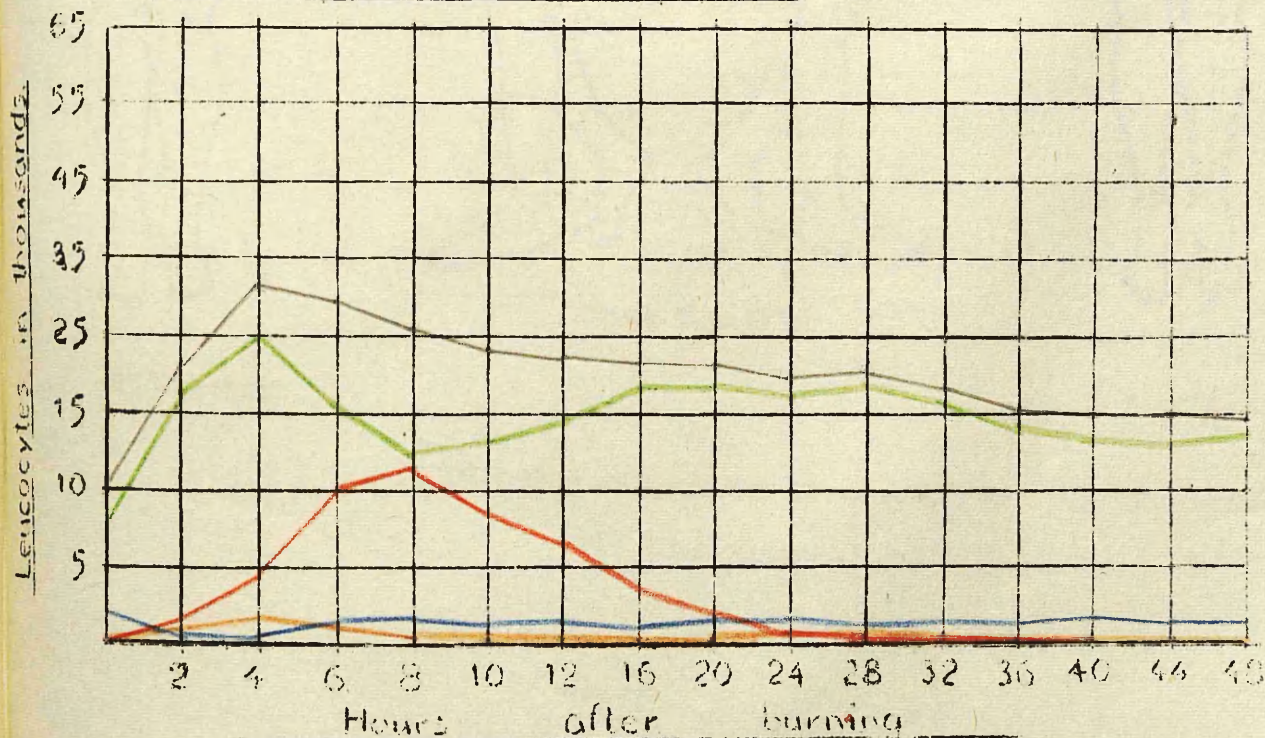
Distribution as shown on chart overleaf.

How sustained Gas explosion.

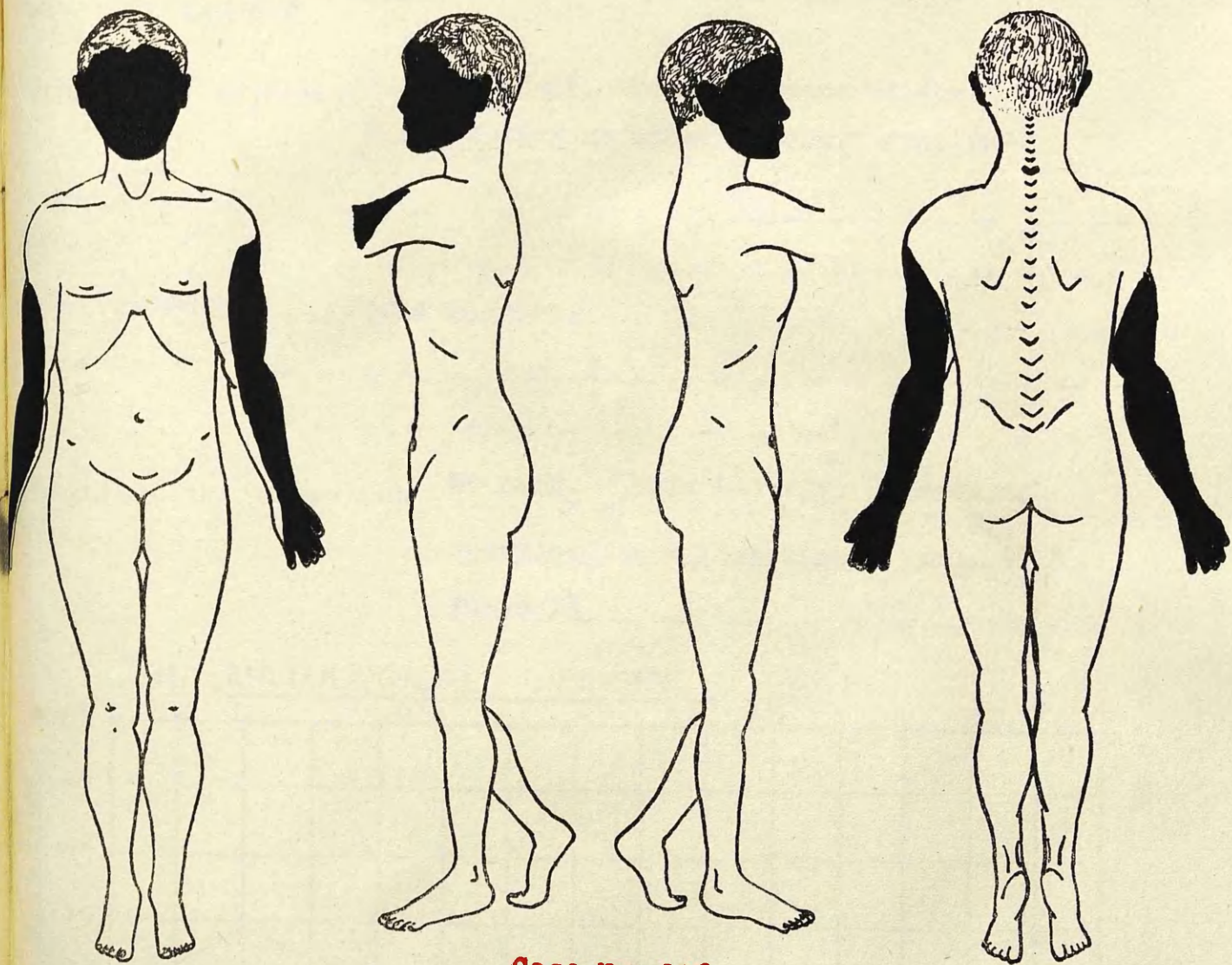
Condition on admission No pain. Talkative. Temp. 102

Pulse 100

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes }  
Monocytes }  
\_\_\_\_\_



Case No. 138

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient **41 years**

Case No. **139**

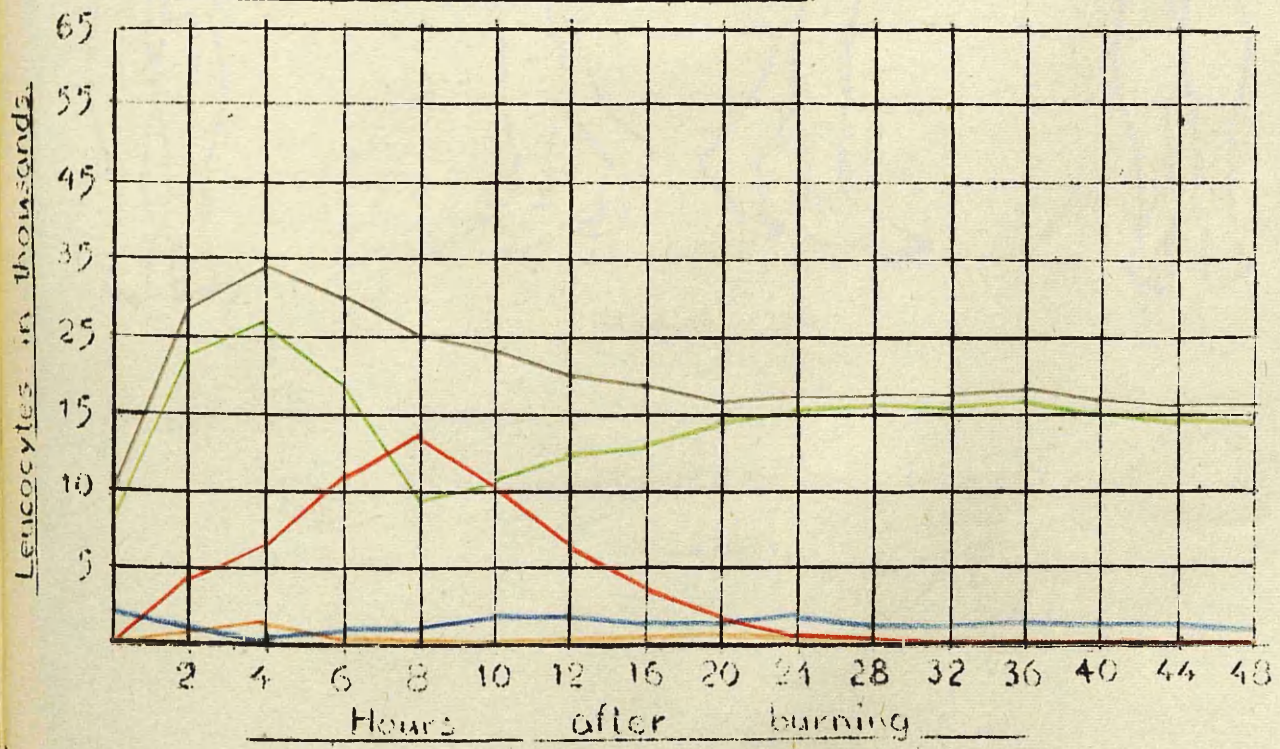
Sex of patient **Male.**

Nature of injuries **Burns of face, chest and upper limbs.**  
**Distribution as shown on chart overleaf.**

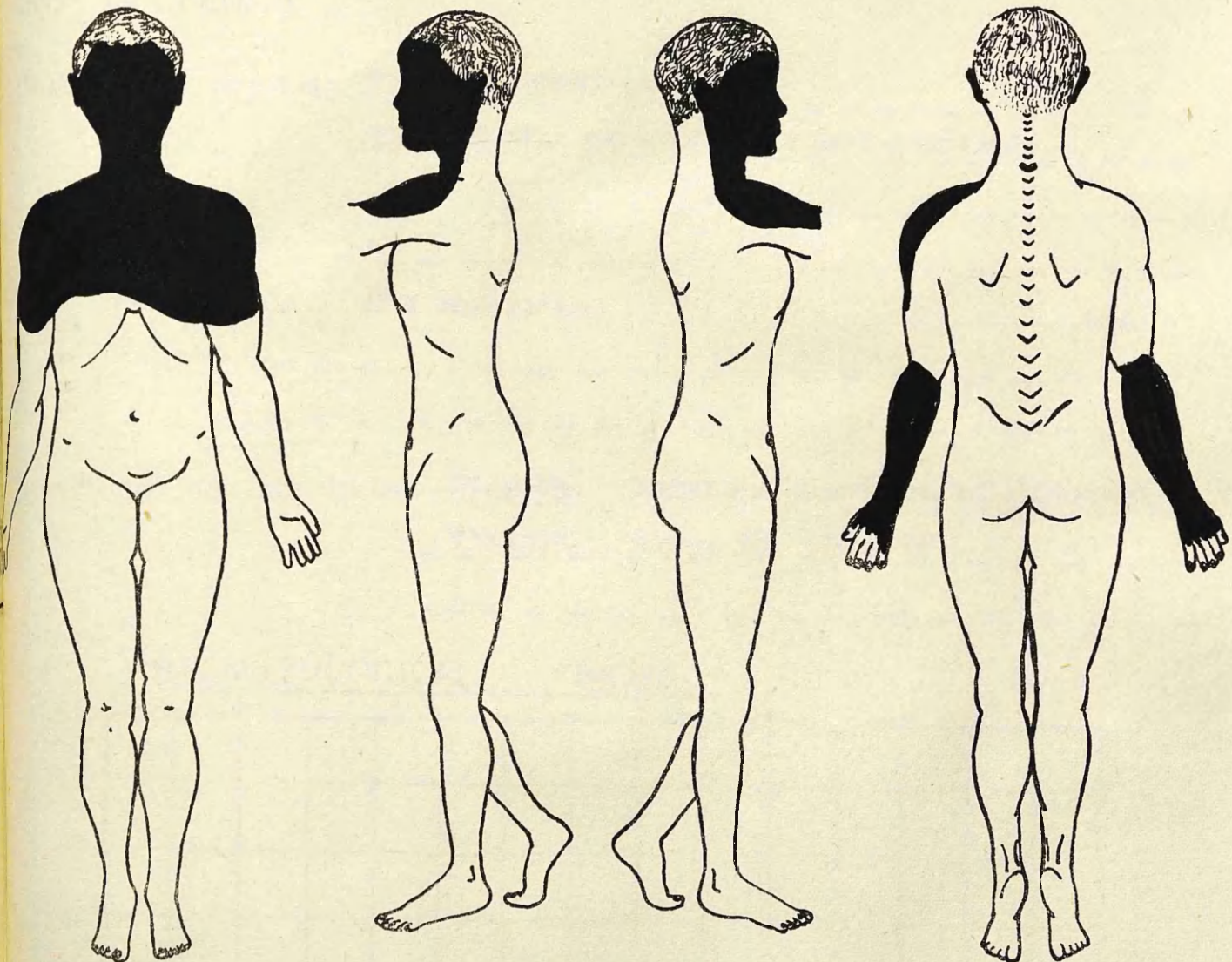
How sustained **Gas explosion.**

Condition on admission **No pain. Very thirsty. Answered**  
**questions intelligently. Temp. 98.8**  
**Pulse 78**

HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 139

**TREATMENT**

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient **53 years**

Case No. **140**

Sex of patient **Male.**

Nature of injuries **Burns of upper limbs.**

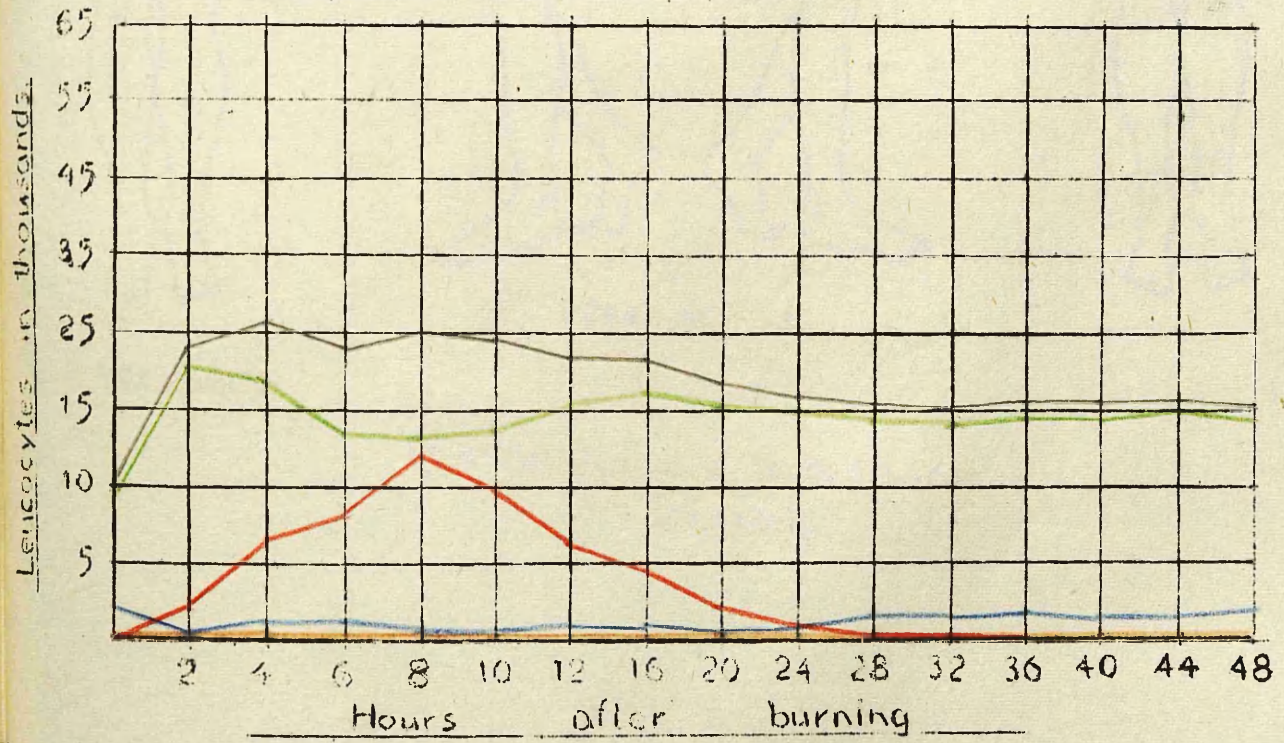
**Distribution as shown on chart overleaf.**

How sustained **G<sup>a</sup>s explosion.**

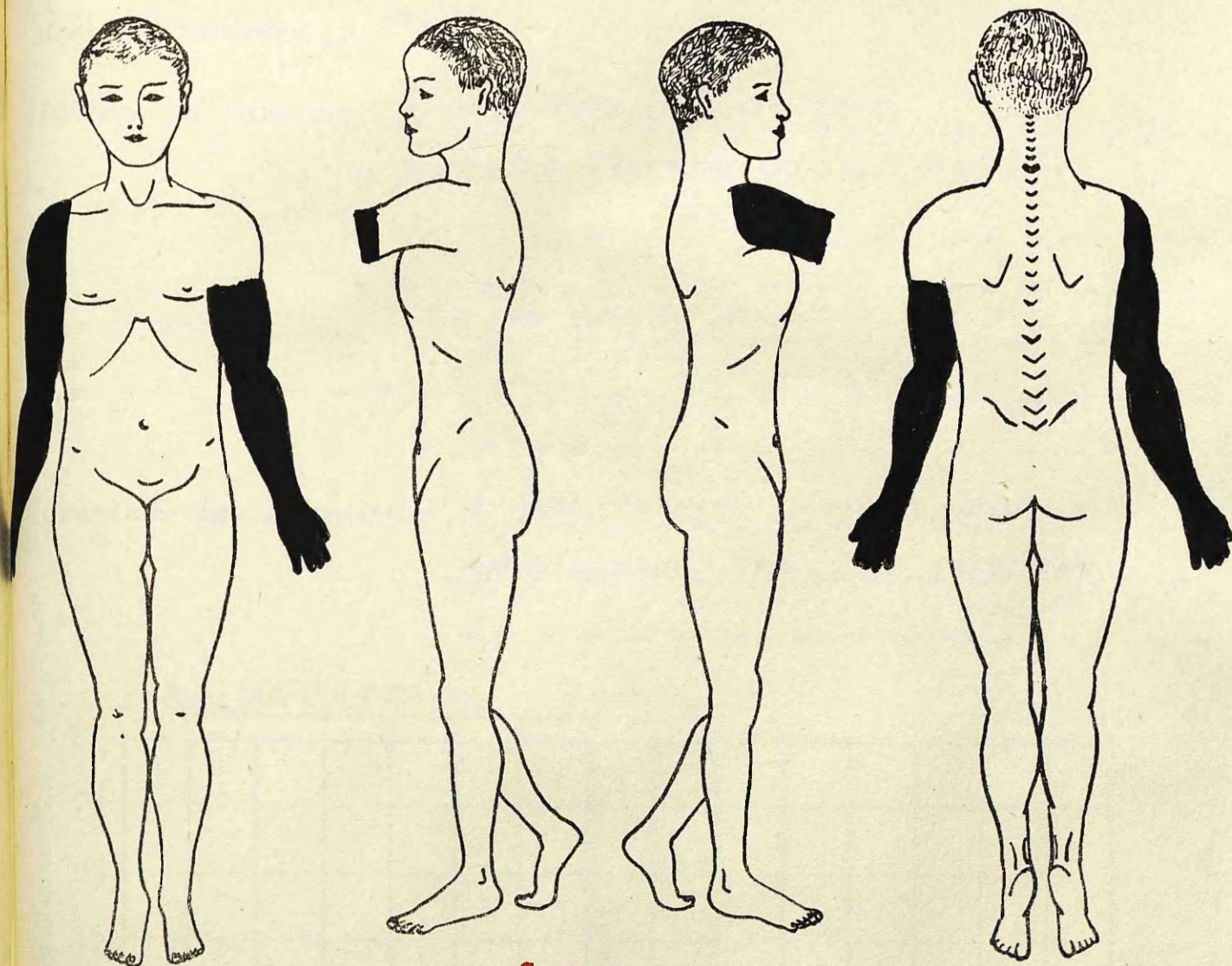
Condition on admission **No pain. Answered questions intelligently.**

**Thirsty. Temp. 98 Pulse 88**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
 & Monocytes } \_\_\_\_\_  
 Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 140

TREATMENT

1% sulphaniamide in Cod Liver  
Oil Emulsion.

Age of patient 17 years.

Case No. 141

Sex of patient Female.

Nature of injuries Burns of back and lower limbs.

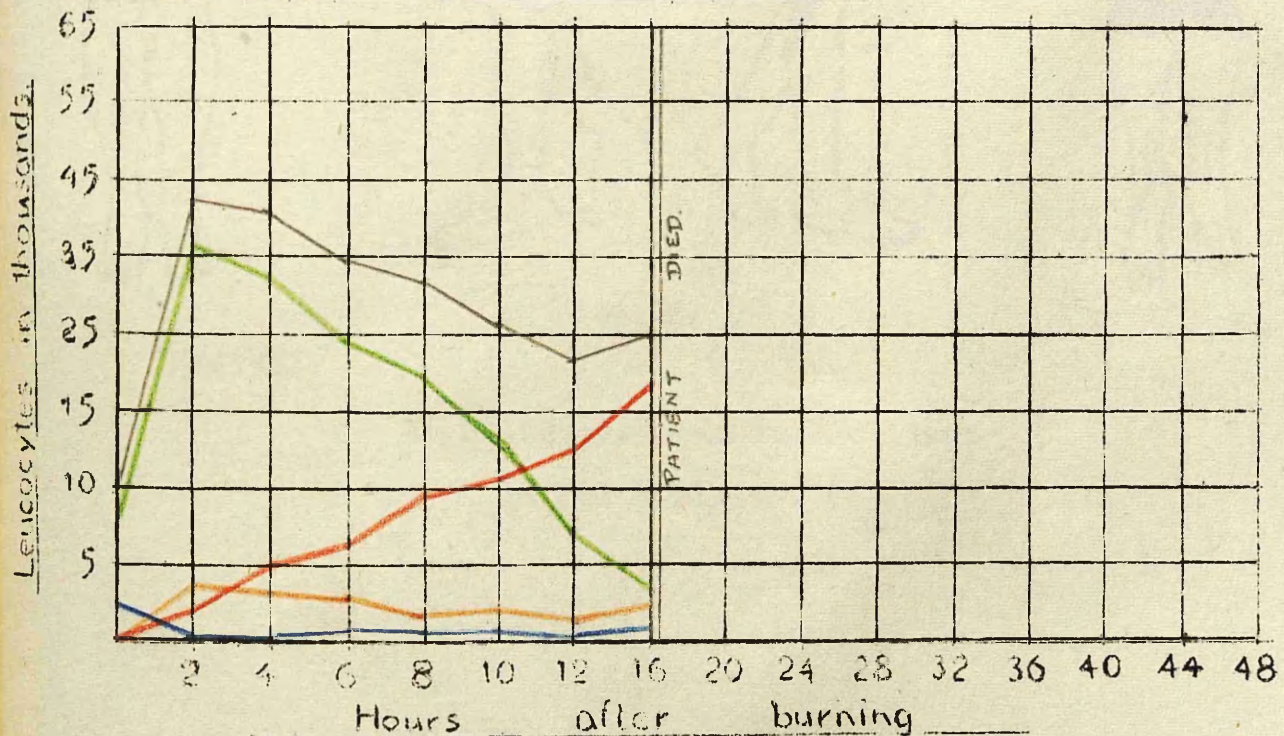
Distribution as shown on chart overleaf.

How sustained Fell into bath of hot water.

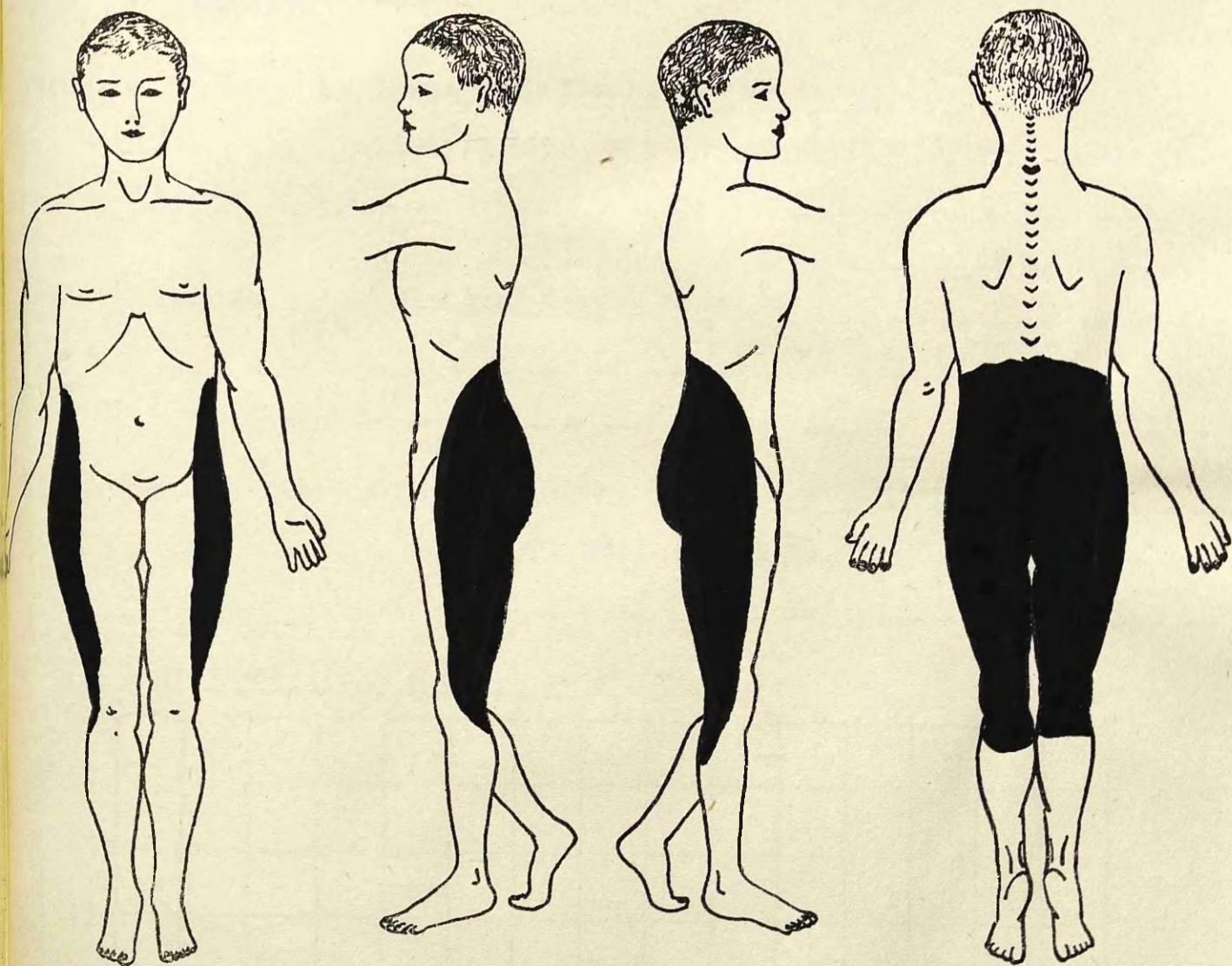
Condition on admission No pain. Thirsty. Answered questions

intelligently. Temp. 99.7 Pulse 104

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
( & Monocytes ) \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 141

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient 16 years.

Case No. 142

Sex of patient Female.

Nature of injuries Burns of buttocks and back.

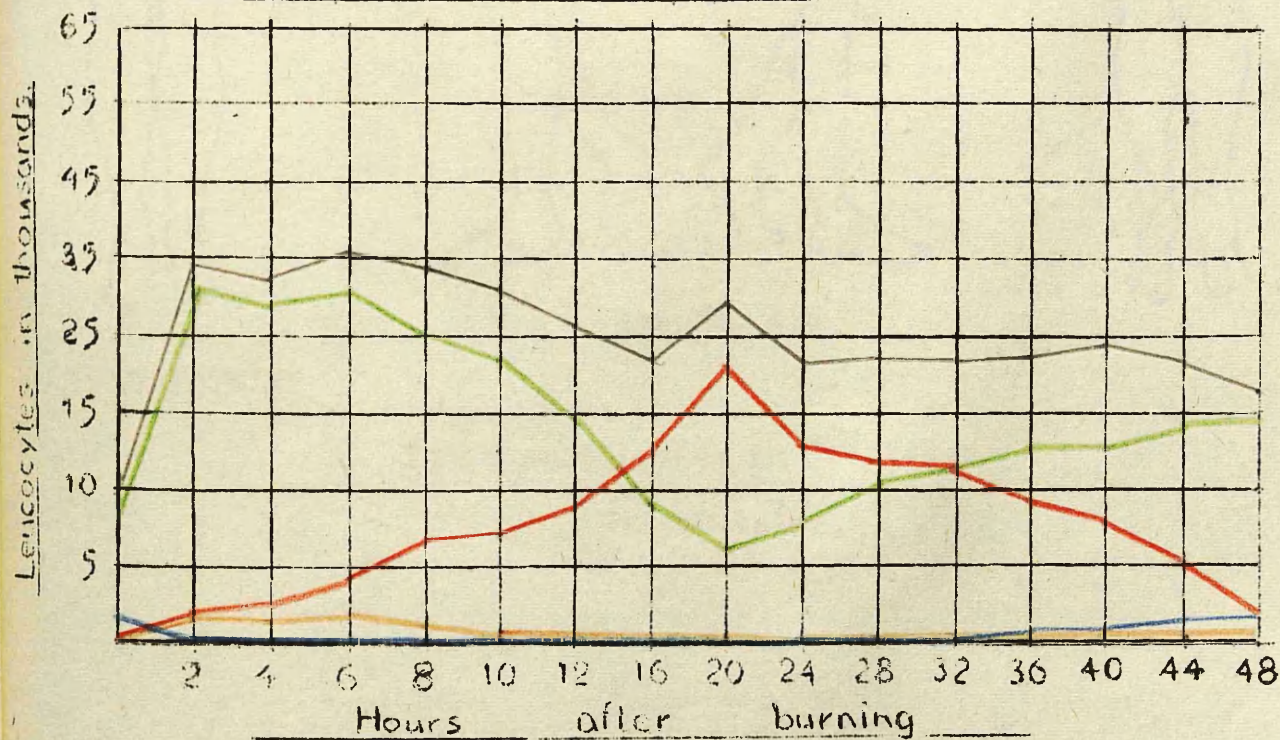
Distribution as shown on chart overleaf.

How sustained Clothing caught fire.

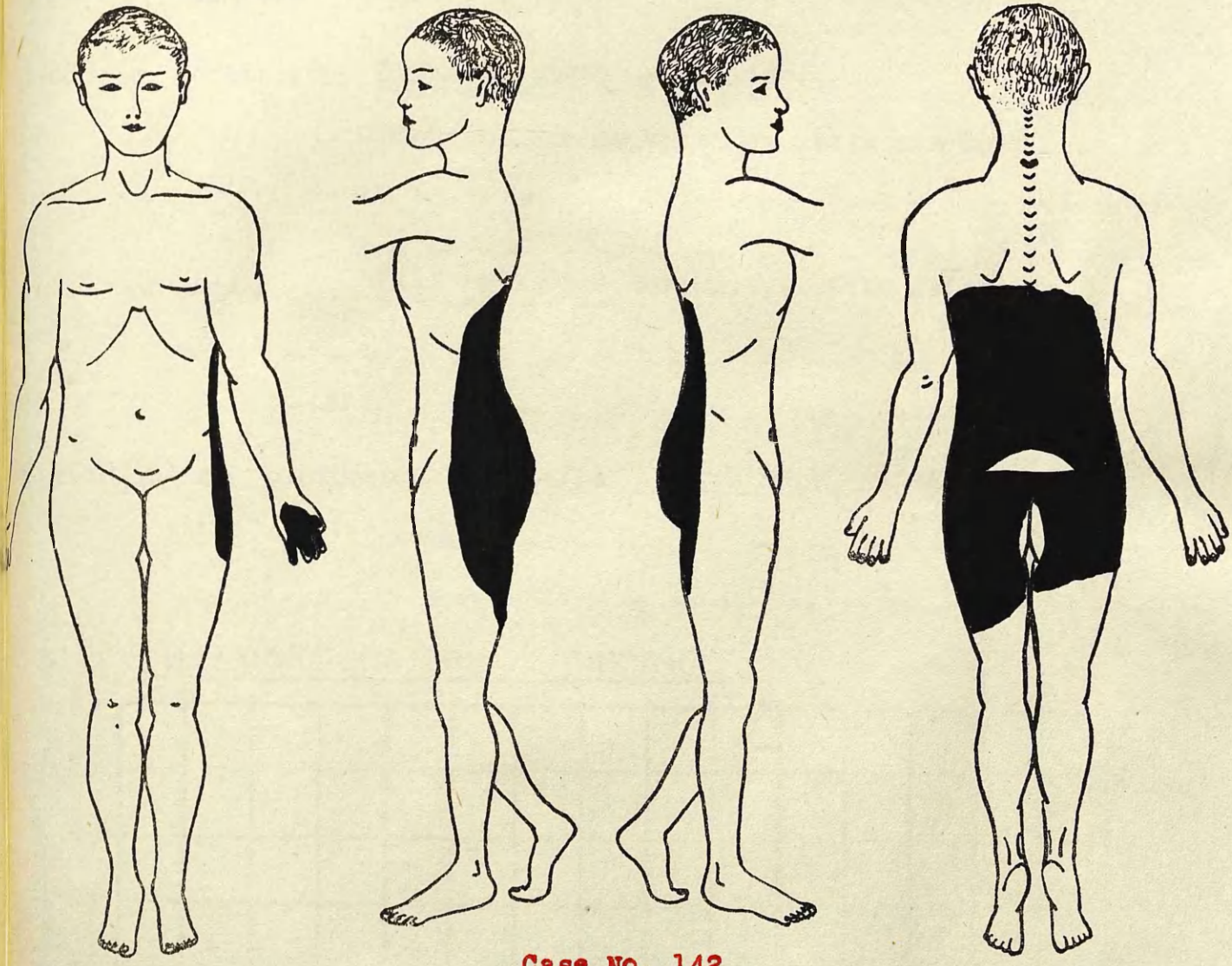
Condition on admission Painful. Answered questions intelligently.

Temp. 98.2 Pulse 88

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 142

TREATMENT

1% sulphahnilamide in Cod Liver  
Oil Emulsion.

Age of patient 22 years.

Case No. 143

Sex of patient Female.

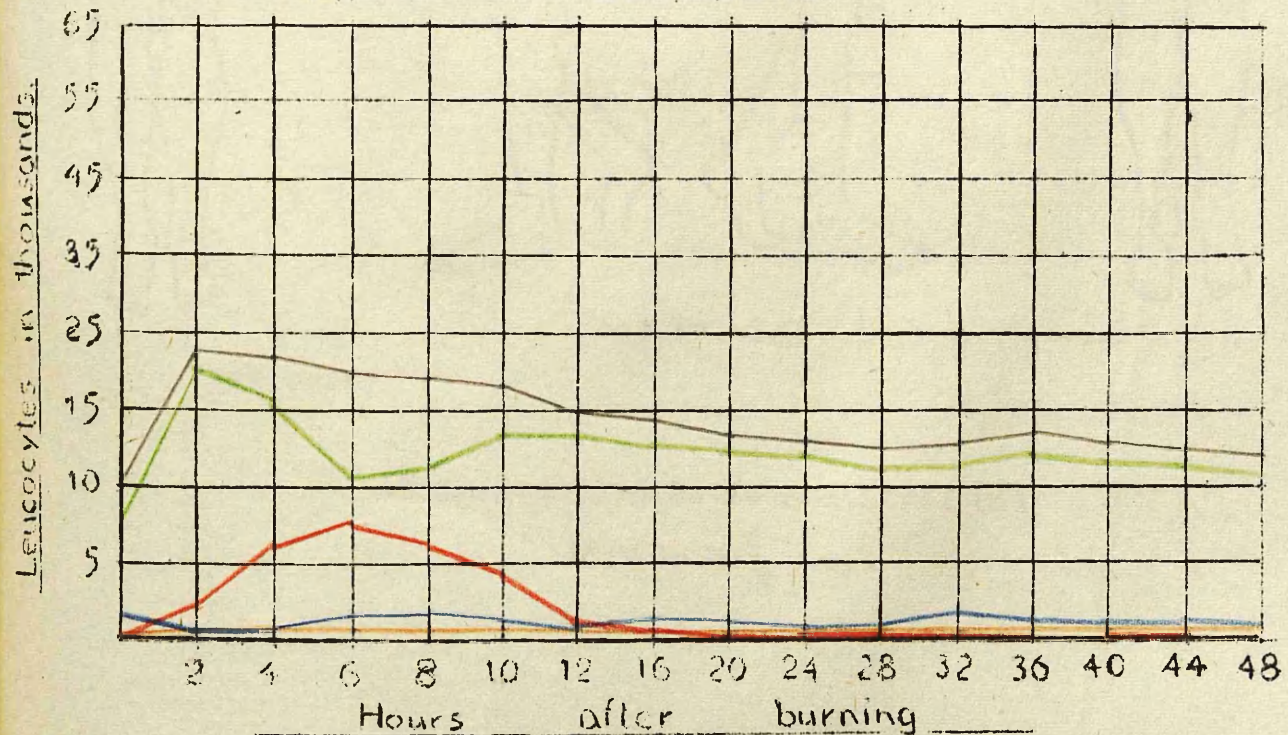
Nature of injuries Burns of right upper limb.

-Distribution as shown on chart overleaf.-

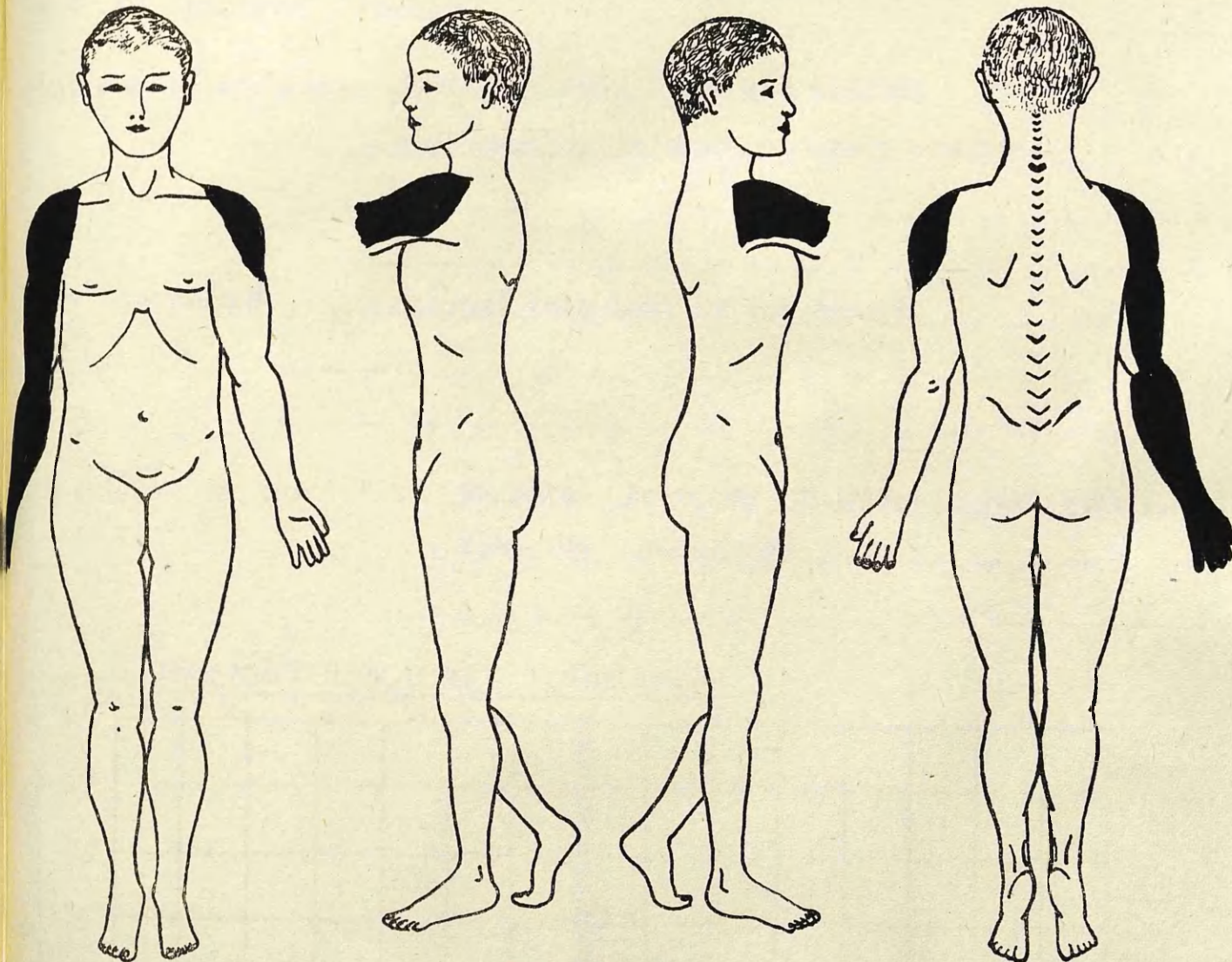
How sustained Fell into fire during epileptic seizure.

Condition on admission Painful. Temp. 99.9 Pulse 106

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 143

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.

Age of patient 16 years

Case No -144-

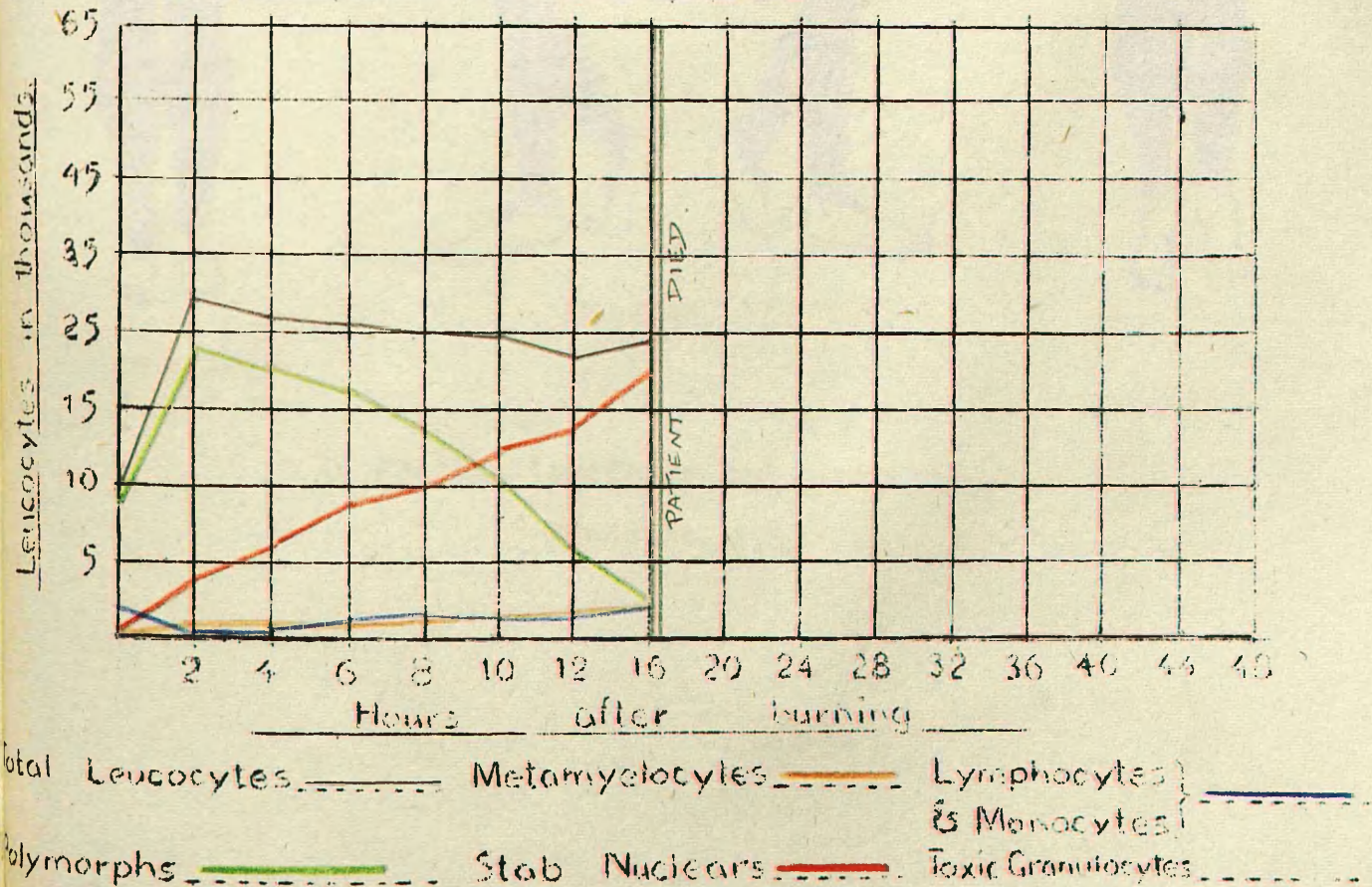
Sex of patient Female

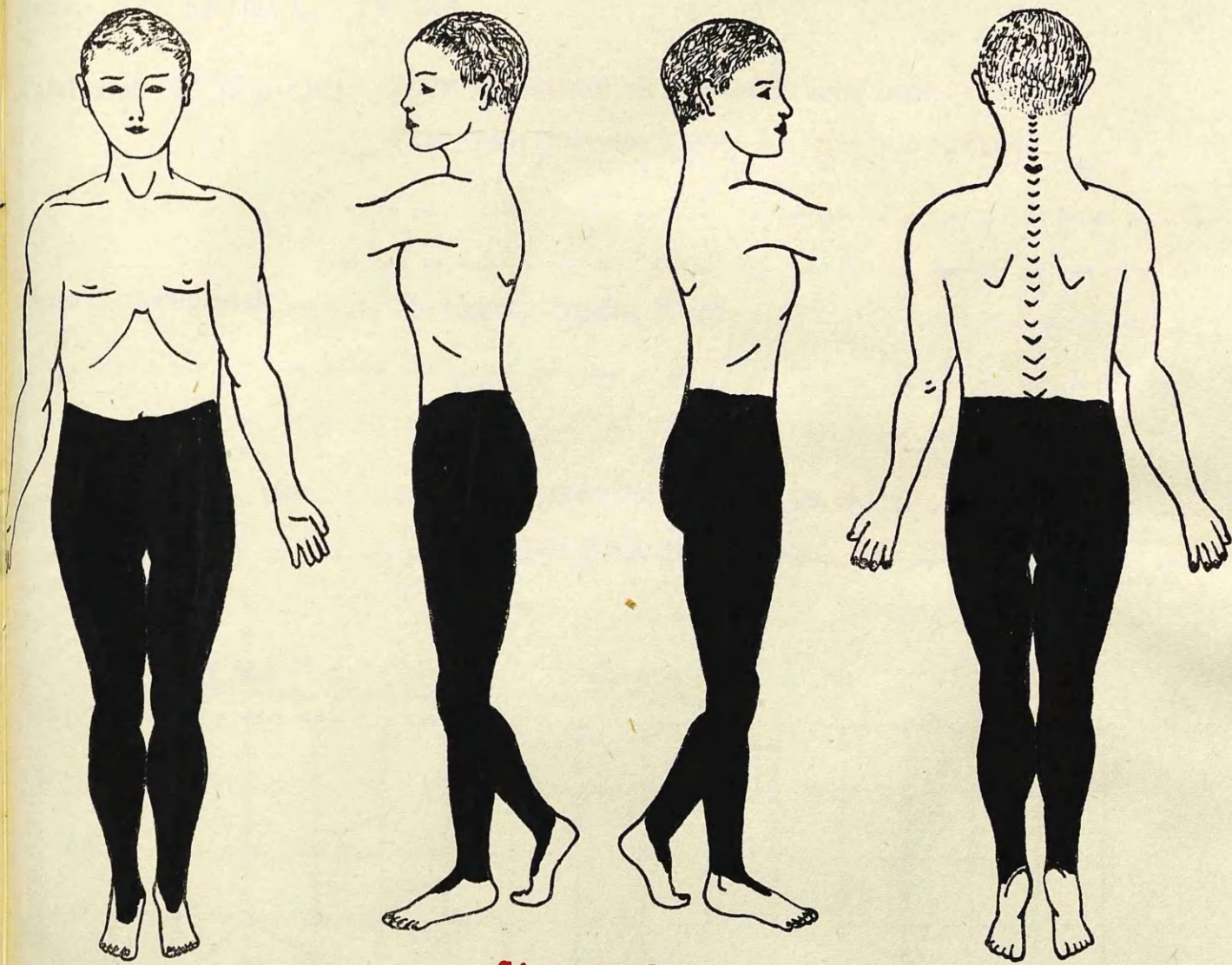
Nature of injuries Scald of lower limbs and abdomen  
Distribution as shown on chart overleaf.

How sustained Slipped into bath of hot starch.

Condition on admission No pain. Answered questions intelligently.  
Temp. 99 Pulse 100

### HAEMATOLOGICAL FINDINGS



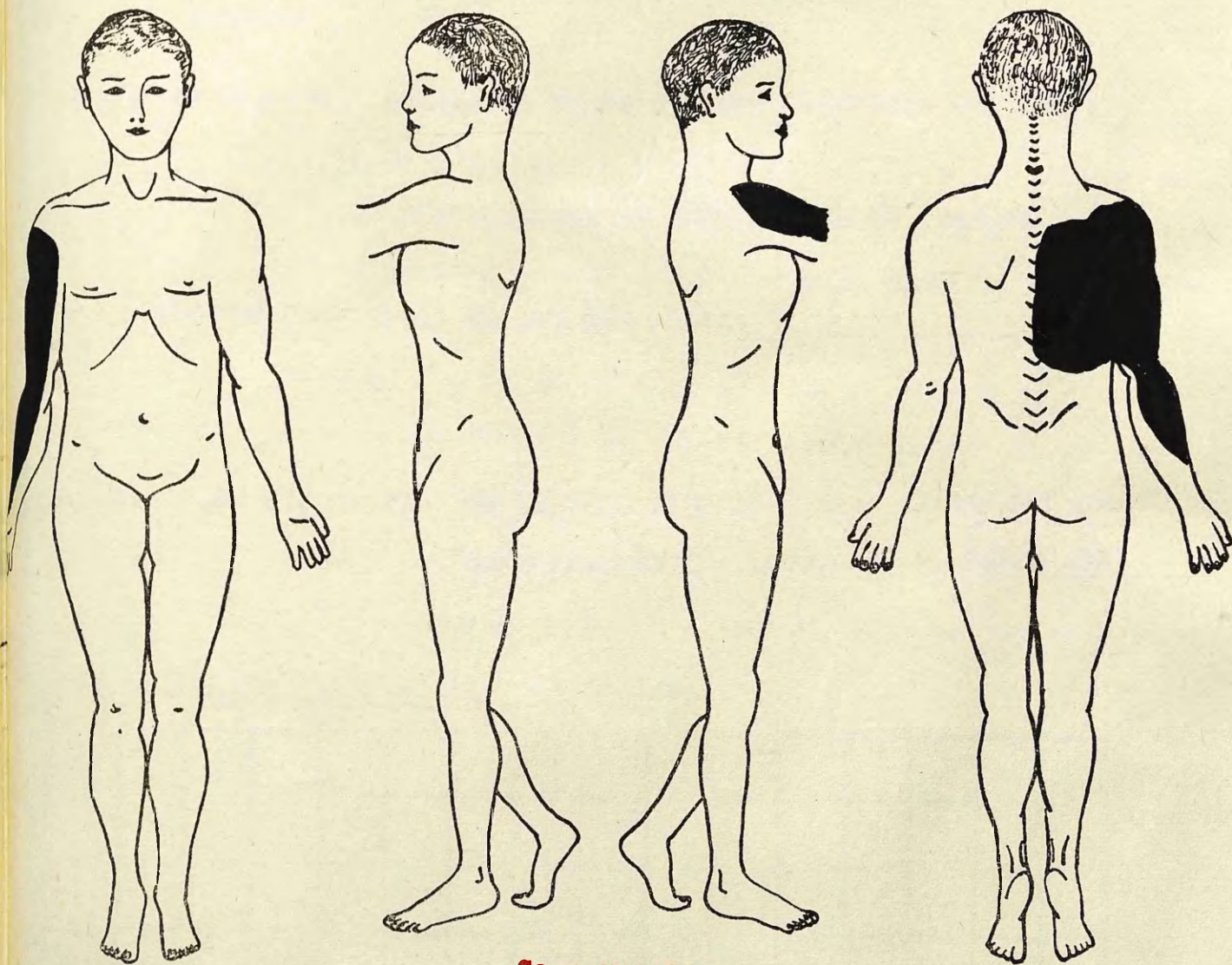


Case No. 144

TREATMENT

1% Sulphanilamide in Cod Liver Oil  
Emulsion.





Case No. 145

TREATMENT

1% Sulphanilamide in Cod Liver  
Oil Emulsion.

Age of patient..... **38 years**

Case No. -146-

Sex of patient..... **Male**

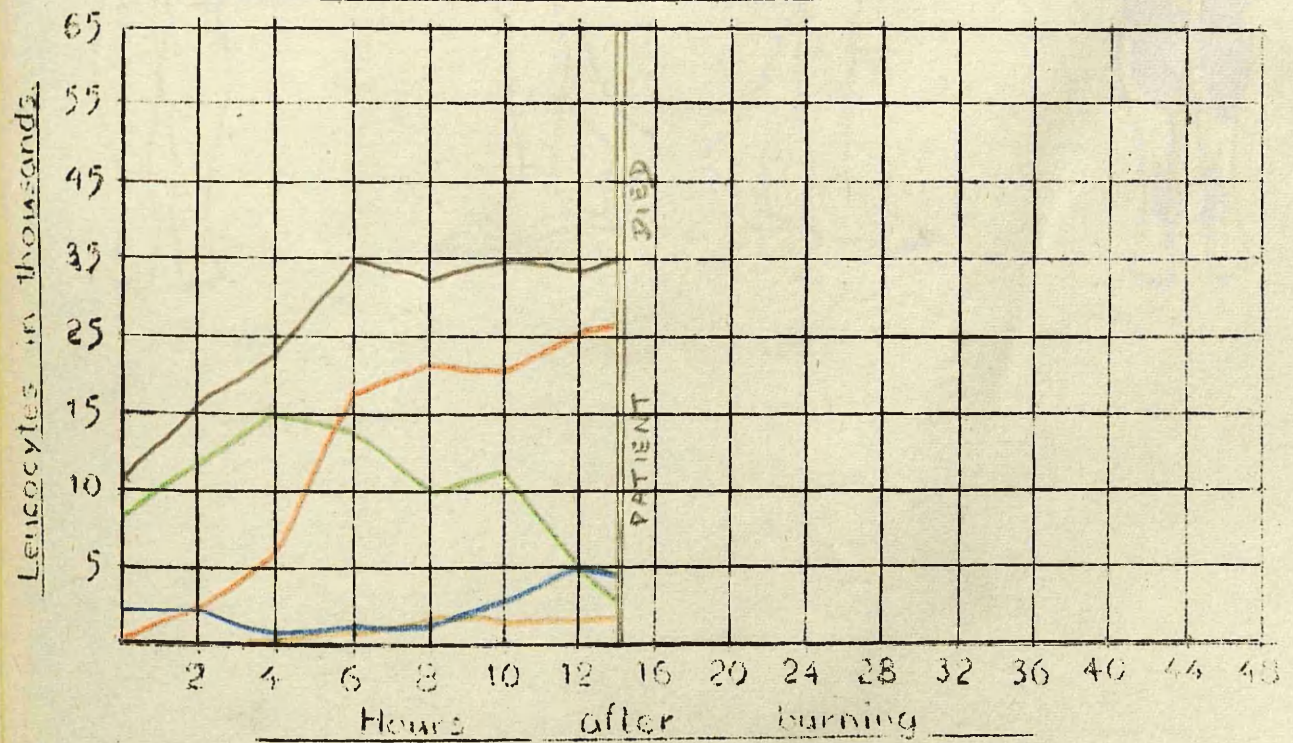
Nature of injuries..... **Extensive burns of back, buttocks and lower limbs.**

- **Distribution as shown on chart overleaf.**

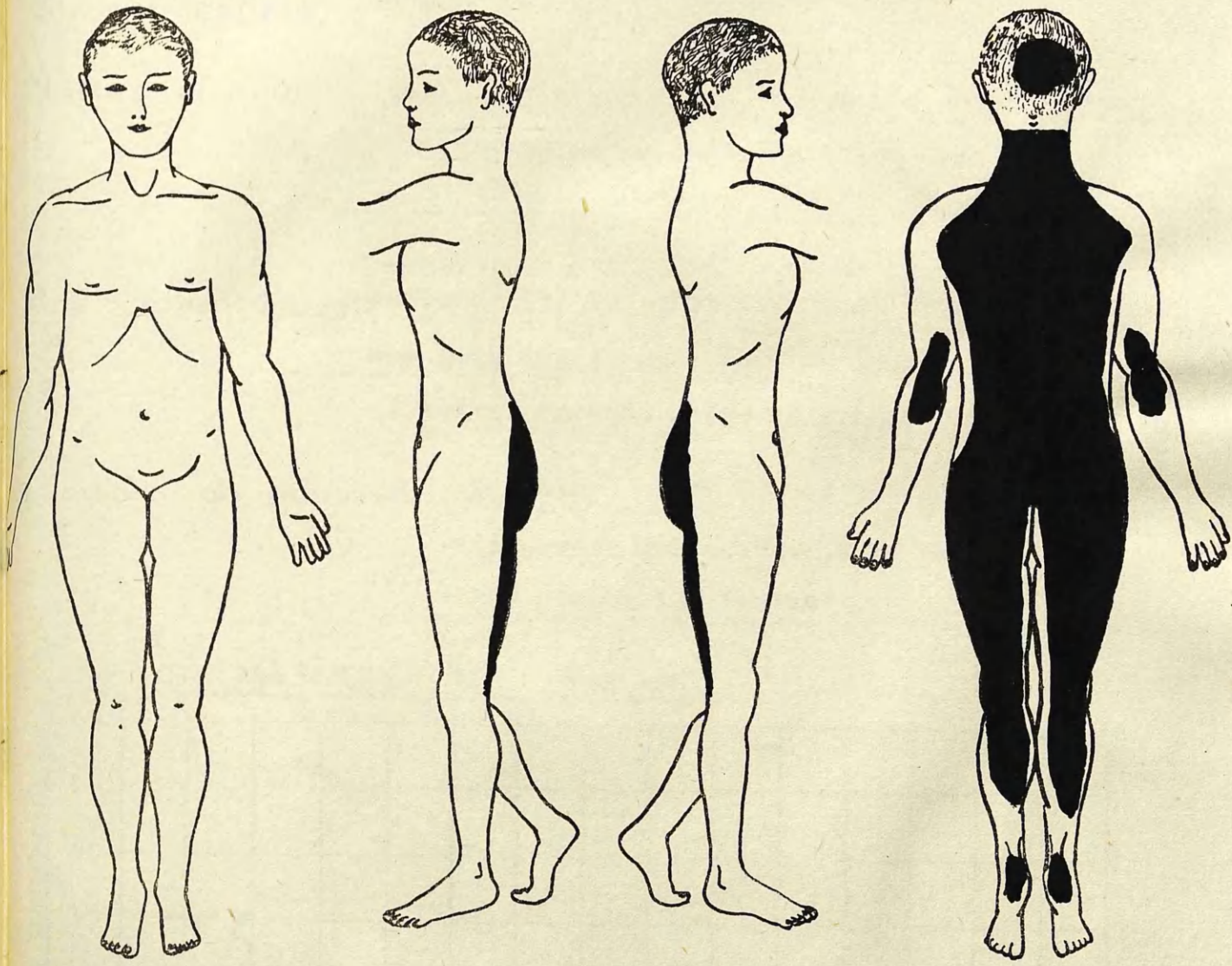
How sustained..... **Fell on red hot ingot.**

Condition on admission..... **No pain. Very thirsty. Answered questions intelligently. Temp. 100.2 Pulse 110**

HAEMATOLOGICAL FINDINGS



Total Leucocytes..... Metamyelocytes..... Lymphocytes }  
 & Monocytes }  
 Polymorphs..... Stab Nuclears..... Toxic Granulocytes.....



Case No. 146.

TREATMENT

None.

Age of patient 18 years.

Case No. 147.

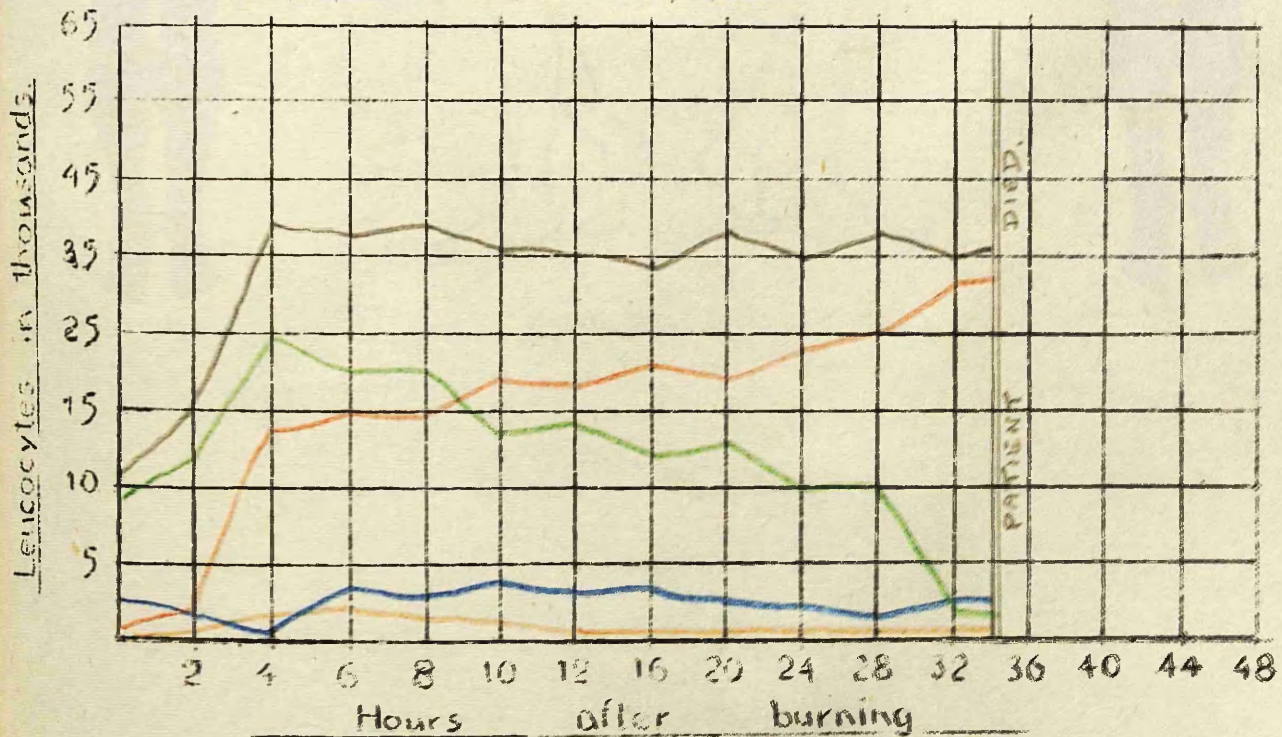
Sex of patient Male.

Nature of injuries Burns of lower limbs, trunk and upper limbs.  
Distribution as shown on chart overleaf.

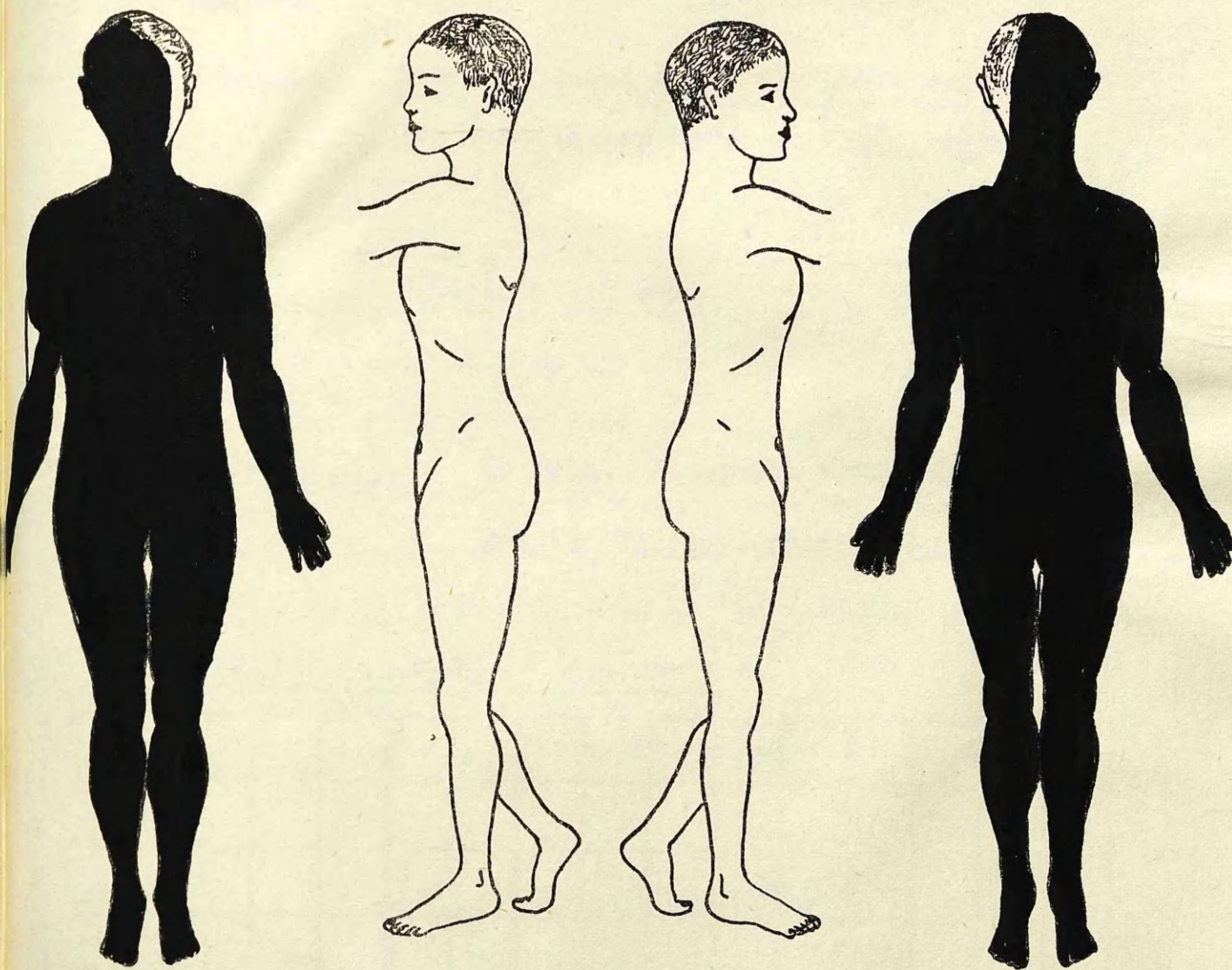
How sustained Patient flew to kvte into high tension cables.  
The kvte was flown from thin copper wire, in place  
of twine and this acted as a conductor.

Condition on admission No pain. Very drowsy but could be roused  
to answer questions. Very thirsty. Temp.  
105 Pulse 120 feeble.

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
& Monocytes }  
Polymorphs ——— Stab Nuclears ——— Toxic Granulocytes ———



Case No. 147.

TREATMENT

None.

Age of patient **41 years.**

Case No. **148**

Sex of patient **Male**

Nature of injuries **Burns of upper and lower limbs and back.**

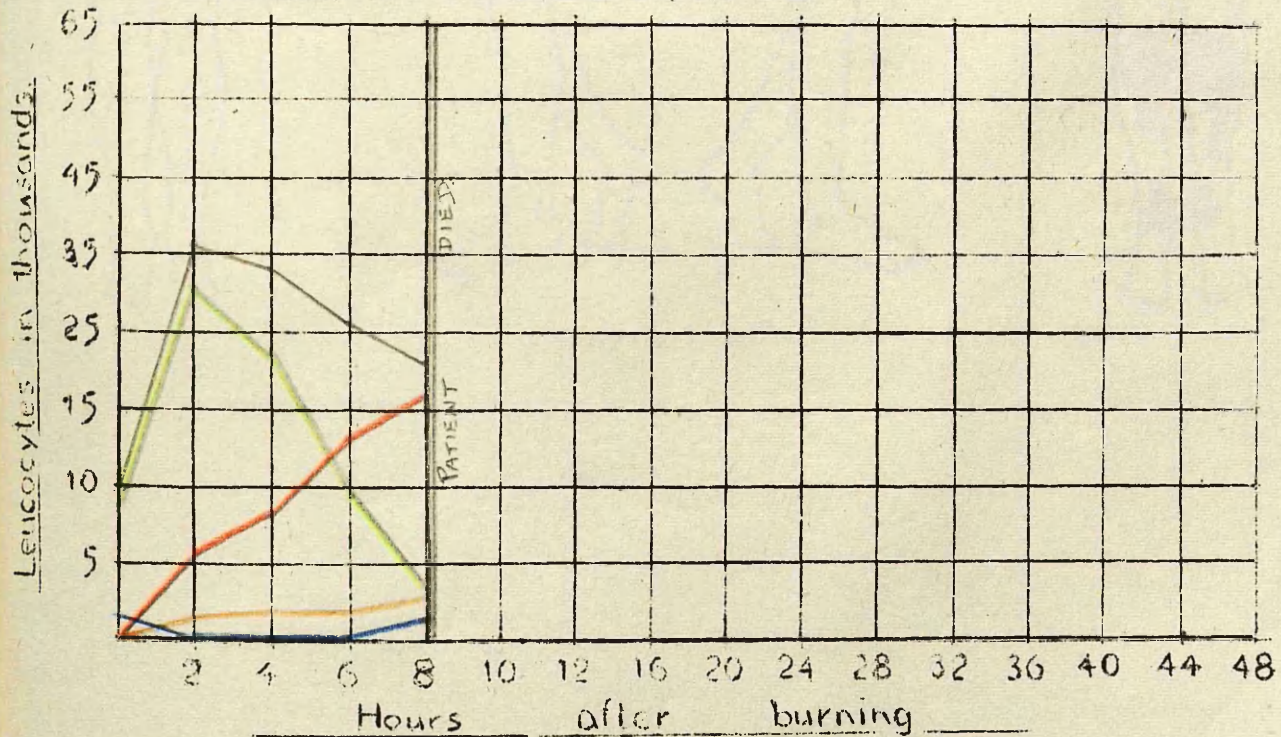
**distribution as shown on chart overleaf.**

How sustained **Fell into hot slag.**

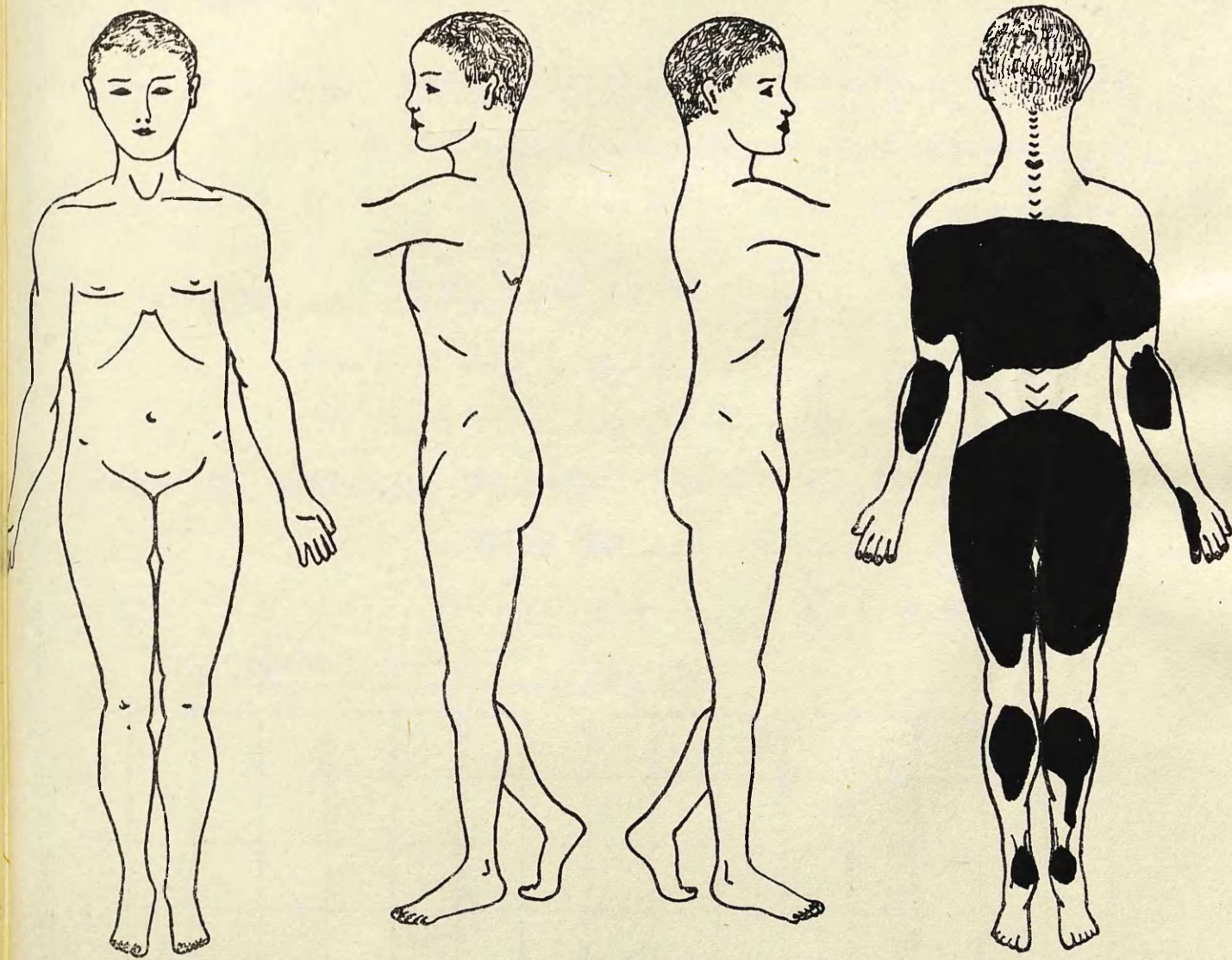
Condition on admission **No pain. Under the influence of morphine**

**grs.  $\frac{1}{2}$  Thirsty. Temp. 100 Pulse 96**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes } \_\_\_\_\_  
& Monocytes } \_\_\_\_\_  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 148.

TREATMENT

None.

Age of patient **26 years.**

Case No. **149**

Sex of patient **Female.**

Nature of injuries **Burns of thighs, abdomen, buttocks and backs.**

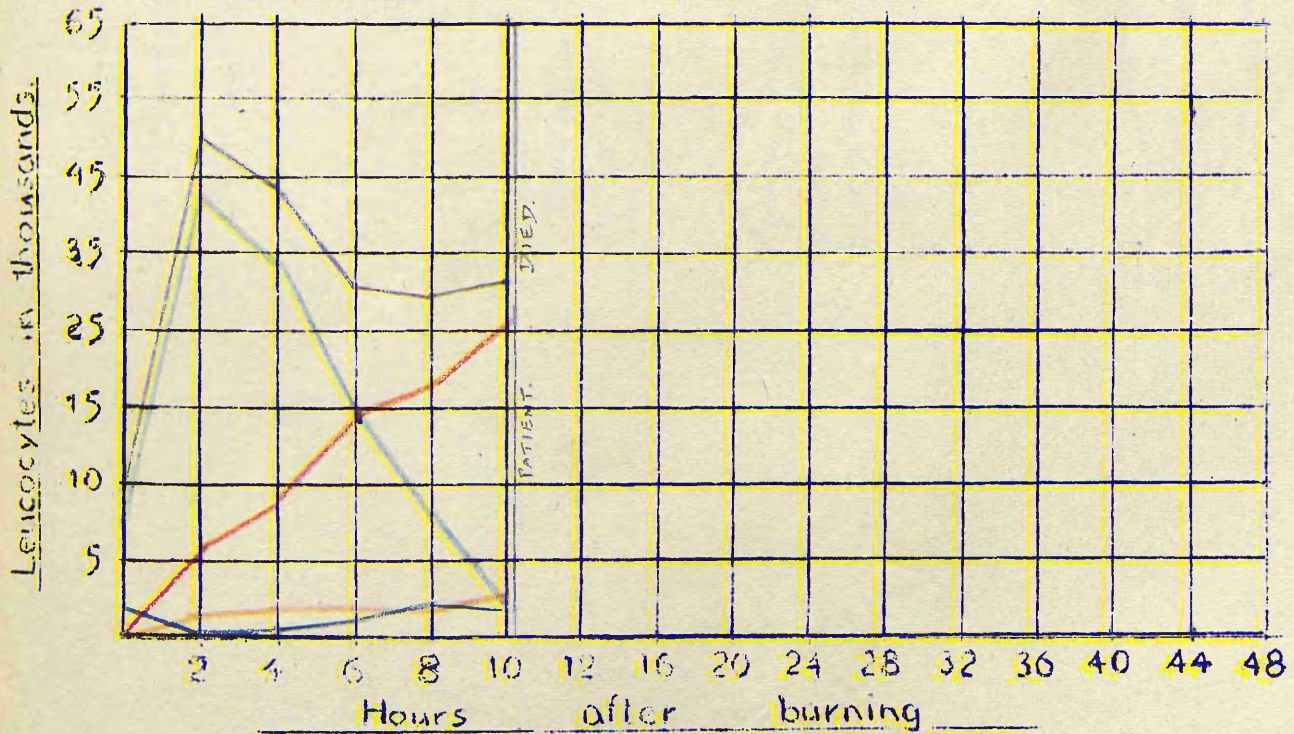
**Distribution as shown on chart overleaf.**

How sustained **Night dress caught fire.**

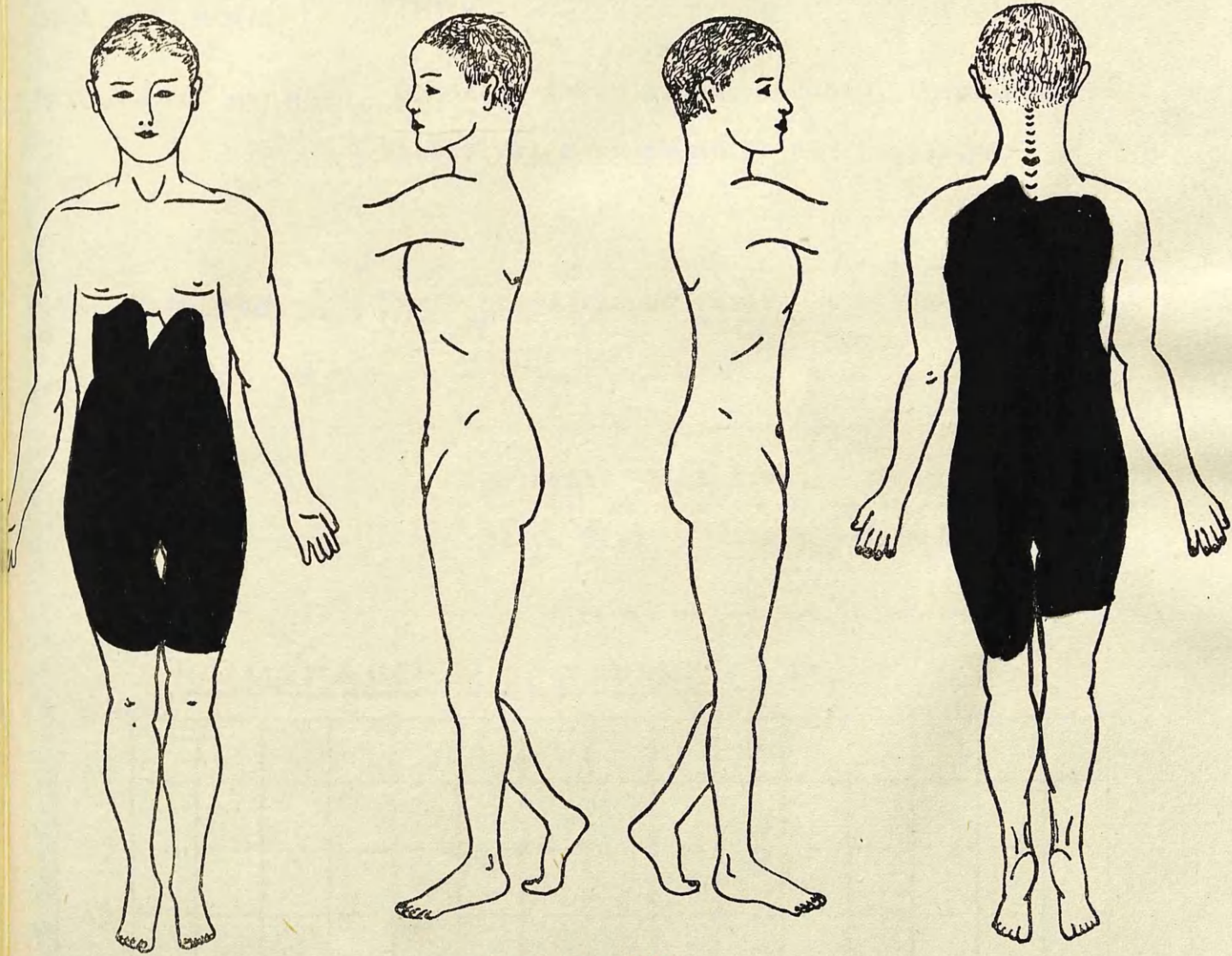
Condition on admission **No pain. Shivering. Temp. 97.7**

**Pulse 100**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes \_\_\_\_\_ Metamyelocytes \_\_\_\_\_ Lymphocytes }  
& Monocytes }  
Polymorphs \_\_\_\_\_ Stab Nuclears \_\_\_\_\_ Toxic Granulocytes \_\_\_\_\_



Case No. 149.

TREATMENT

None.

Age of patient **76 years**

Case No. **150**

Sex of patient **Female**

Nature of injuries **Burns of lower limbs, abdomen, chest and back.**

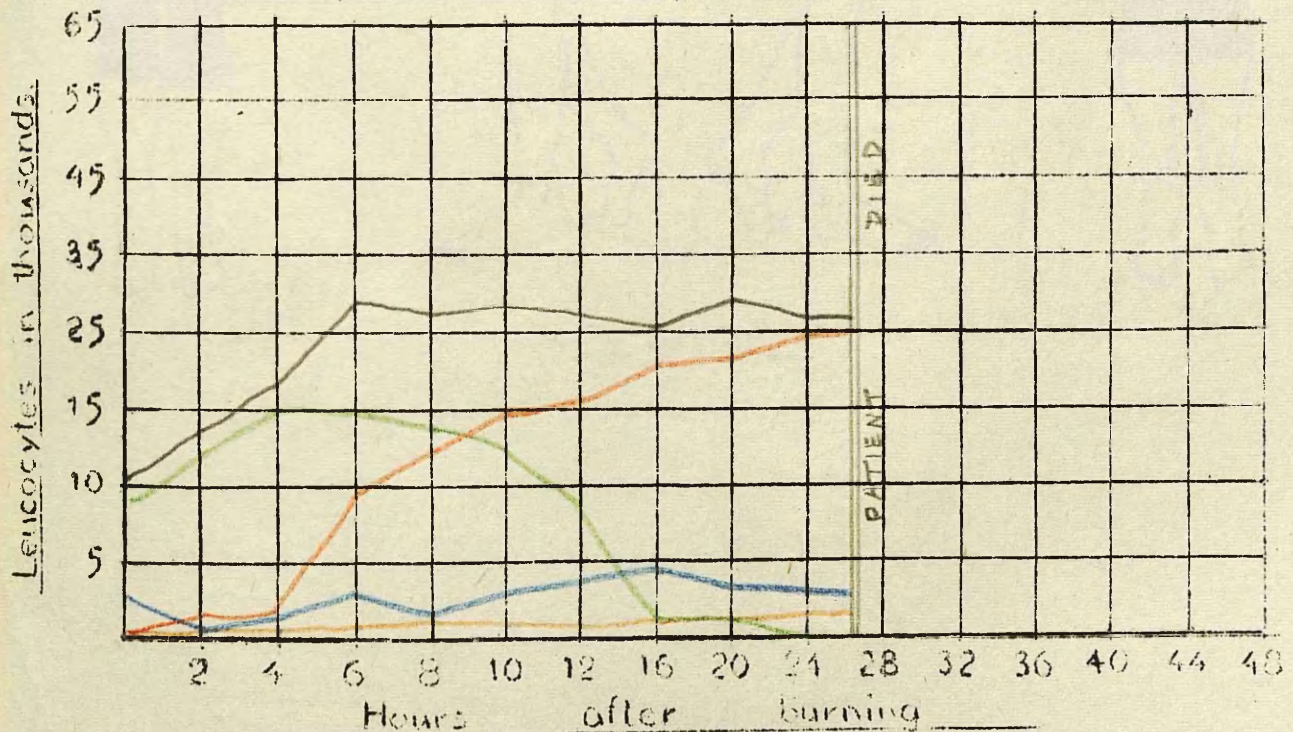
**Distribution as shown on chart overleaf.**

How sustained **Night dress caught fire.**

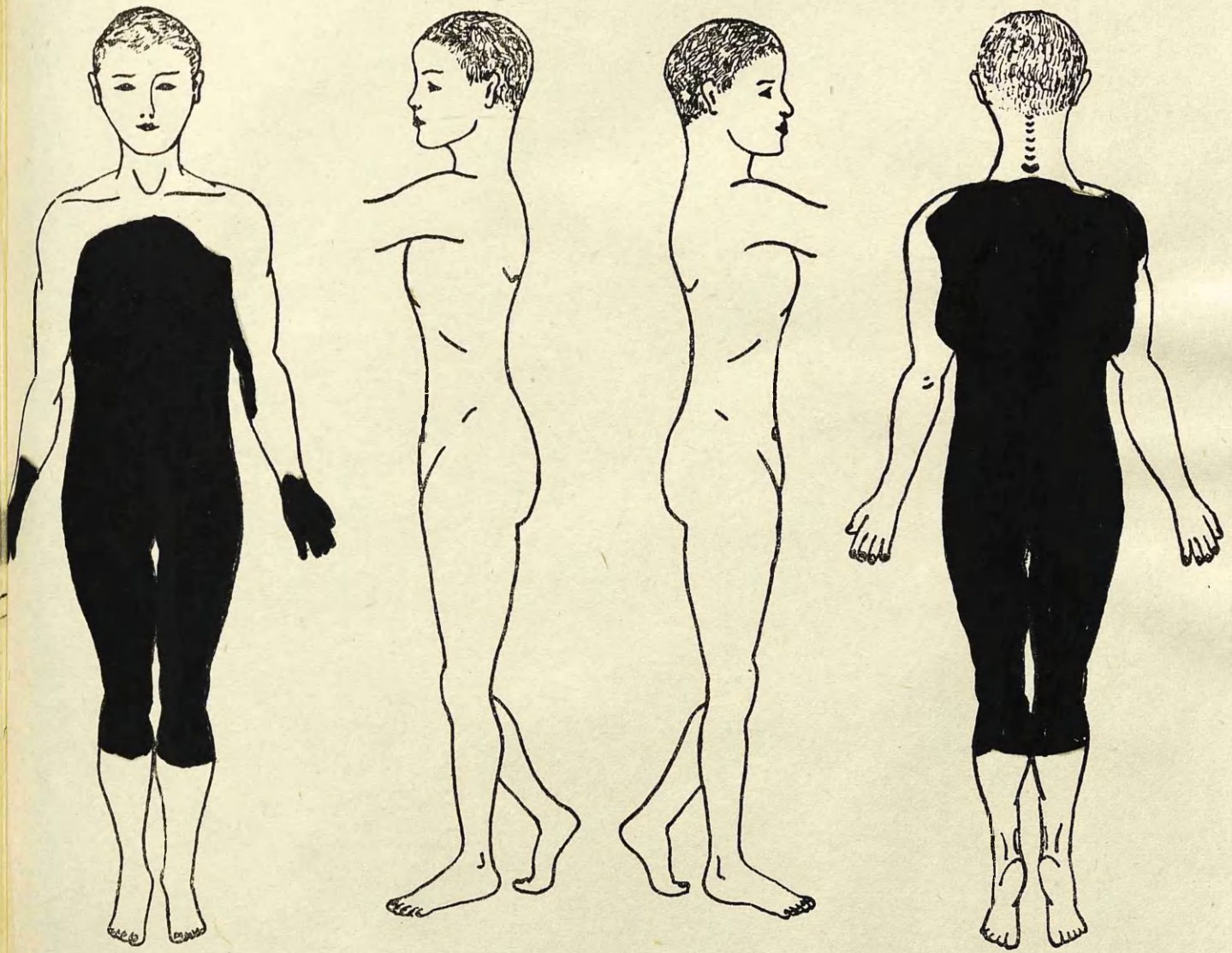
Condition on admission **No pain. Talkative. Disorientated.**

**Temp. 97.8 Pulse 110 very weak**

### HAEMATOLOGICAL FINDINGS



Total Leucocytes ——— Metamyelocytes ——— Lymphocytes }  
Polymorphs ——— Stab Nuclears ——— Monocytes }  
Toxic Granulocytes ———



Case No. 150.

TREATMENT

None.