9

2C
5

OTS: 60-11,591

JPRS: 2624

23 May 1960

INDIVIDUAL DOSIMETRY OF SOLDIERS IN AN ATOMIC ATTACK

by Aleksandar Mezic

YUGOSLAVIA

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.

PRICE: $0.50

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

JPRS: 2624

CSO: 3825-N

INDIVIDUAL DOSIMETRY OF SOLDIERS IN AN ATOMIC ATTACK

/This is a translation of an article written by Dr Aleksandar Mezic in "Vojnosanitetski Pregled", Vol XVI, No 12, 1959, Belgrade, pages 1015-1022./

As distinguised from debitmetry /?/, which indicates the intensity of ionizing radiation to which an object is exposed at a definite time and location, dosimetry shows the total quantity of radiation absorbed by an irradiated object. The significance of dosimetry for an army group is twofold. The kind of medio-surgical tactics to be applied in the event of an atomic explosion, as well as the course of operative action to be taken subsequently, will depend on the correct dosimetry of men.

Impact on the Medical Organization

The use of atomic weapons in some future war would greatly affect both the organization of the medical corps and the specialization work, which would have to undergo fundamental changes. In the first place, the use of atomic weapons would influence the initial organizational step regularly taken throughout the corps - the classification of injured and wounded. The older principles, namely, classification of wounded by urgency of need for help and evacuation according to the type and seriousness of wounds, would require significant corrections in cases where, besides the element of injury, that of radiation is present (radiological mixes). This would frequently occur in places close to the center in the event of an atom bomb exploded in air, but it would occur in places further away from the explosion only when radioactive fallout is present, i.e., in cases of surface or underground explosions. In the case of thermonuclear weapons, a great number of radiological mixes would always occur, regardless of the type of explosion.

The criterion of classification of wounded prevailing at present would necessarily have to be changed and replaced by a new one in cases where lighly wounded men absorb a fatal dose of ionizing radiation, becoming condemned to inevitable death regardless of the maximum medical help provided, while more gravely wounded men, irradiated with insignificant doses of ionizing rays, can be saved by prompt surgery. When classifying the victims of nuclear weapons agression, not only the mechanical injuries and their resulting consequences butalso the degree of irradiation of each of the wounded or injured would have to be taken into consideration. Undoubtedly, this will only be possible on the basis of dosimetrical data for each individual.

It is true that certain American authors do not attribute much significance to individual dosimetry of soldiers in war because they believe that the only proper method of determining the ability of soliders for further combat is clinical observation of all those suspected of injuries from radiation in 24 hours. But, despite this, the problem of individual dosimetry is still very timely. In almost all countries attention is being given to it and endeavors are being made to perfect organization and work in that field.

The fact that radioactive radiation (particularly that which takes place after radioactive fallout) is not evenly distributed over the territory exposed, and that the circumstances in which individuals find themselves at the time of an explosion are varied (shelter, trench, kind of clothes worn, location in a vehicle, etc.), necessitates subjecting every person to careful dosimetry.

The result of dosimetry of an injured solider would significantly influence not only classification but also other organizational forms of work in different stages of care of the wounded as well as on the scope and type of specialized work. The fact that irradiation with larger doses of ionizing rays acts unfavorably on the health of each injured and wounded, lessening the prospects for their recovery, and that in some cases radiation disease develops much faster - creating counterindications for undertaking certain surgical or therapeutical interventions of some other type which would contribute more to the cure of the wounded had there been no radiation damage - would, in the future, largely influence the type and scope of help that it would be possible to give to irradiated wounded men. In additioh, a specific problem would arise in the army medical corps regarding the need for classifying and separating the irradiated (who show no clinical symptoms, as well as those who will show symptoms of radiation disease) in separate wards or centers in which a specific system of work, cure and care of the irradiated would be applied.

Care of Irradiated Men

In an operative zone the medical corps would be faced with new tasks dominated by the problem of deciding the fate of a large mass of men injured by radiation that would occur suddenly at the same time in several places. As previously mentioned, among the affected there would be a number of injured without any visible signs of the disease, i.e., without clinical symptoms, as well as a great number of injured who would be in the phase of developed radiation disease, while among both groups there would be a certain number of radiological mixes.

It should be mentioned that besides mixes of mechanical and thermal origin, which do not present particular difficulites in deciding the method and place of administering care, there would also appear radiological mixes that would require great effort and intervention as regards administering care, particularly during the preparations in peacetime for the purpose of solving this problem most satisfactorily in war. Radiation sickness, regardless of the degree of its gravity, in a short time makes almost every irradiated a serious and immobile or nearly immobile patient. It will therefore probably be necessary for them to be placed and permanently nursed deeper behind the medical units and institutions of combat area for a relatively longer period of time.

The institutions in which such injured are placed should also have a surgical department for nursing surgico-radiological mixes, since the injured would probably not be placed in surgical institutions of combat area which must, by all means, preserve their flexibility and maximum mobility. This means that a new need may arise for administering to a category of injuries and wounds (involving graver radiation affection) which until now was outside customary surgical institutions. It is certain that the exceptions will be the cases with surgically crticial indications which, besides their injuries from radiation, will have to be subjected to surgical care in santitation stations of the division or in other similar surgical institutions on the battlefield. It should be mentioned that the transportation of the sick and wounded of this kind should not be delayed for any length of time, but, regardless of the fact that these mixes do not represent urgency of the first degree, attempts should be made, within the limitation of available means, to evacuate them as soon as possible, since under the affects of radiation the condition of wounds worsens due to infection and hemorrhage. Further, abdominal injuries aggravate the normally existing gastro-intestinal syndrome; oversensitivity to anesthetics, barbiturates and the like occurs. It is desirable that such mixes be taken care of, if possible, before acute radiation syndrome.

The gravest form of mixes would be burns combined with injuries from radiation where, because of the damage to the hemopoietic system and unavoidable infections, a high rate of mortality would occur. In the future this would certainly represent a serious problem.

All the elements mentioned above would have to be taken seriously into consideration in the classification of the wounded and sick. To fulfill this requirement, i.e. the most satisfactory classification, dosimetry reading of wounded and sick would unquestionably have to performed on the spot or the nearest place to the operative actions of units offering the necessary protection and conditions for such work.

Impact on Operative Units

In estimating most accurately the effect of action of a nuclear explosion for the purpose of undertaking the most efficient measures of protection, defense, and removal of obstacles for the performance of combat assignment, it is necessary to take into consideration a certain number of elements on which the unit commander's decision about the scope and type of further actions would depend. The following, among others, should be enumerated: the type of explosion; the intensity and location of explosion; and also other data which should be provided by various other services, such as, reconnaissance, ABC, medical service, and others. This is all necessary if the commander of the unit is to undertake measures necessary for the removal of the immediate consequences of the atomic attack itself, as well as for counteraction against the enemy (active defense, counterattack of a broader scope, etc.). Consequently, the commander would base his decision regarding further action on his personal observation and the content of the reports which he would subsequently receive.

Observation of a nuclear explosion could show whether an explosion is aerial and, if so, its altitude. If the altitude in question is less than 600-700 meters, the type of explosion could also be determined by the color of the flame which, in an aerial explosion, is normally brighter than the sun, while the fireball does not touch the earth and rises rapidly upwards. In surface explosions (under 150 meters high), the fireball is darker in color, while large craters, from which huge pillars of earth and dust rise upwards, are created where the explosion occurs. Thermal radiation and primary radioactive radiation, as distinguished from air radiations, are considerably diminished in surface explosions; in addition, an earthquake is felt in surface explosions. The air wave in surface explosions is two-thirds smaller than that in aerial explosions. Compared with aerial explosions, in surface explosions the secondary radioactive radiation involving wide contamination of terrain and all other objects is far greater and depends primarily on the size of the bomb, the size of the crater, atmospheric conditions at the time of the explosion and other factors.

Based on personal observation and aided by quickly received information from the monitoring service, as well as from other services and departments, the commander of the unit is able to mark on his working map rather accurately the centers of explosion, the regions of heavy, medium and light losses, and he can make a rough estimate of the situation even before more detailed information about the explosion reaches him. This is a very great advantage to him since, with the help of this estimate, he is able to determine with great certainty the intentions of the enemy and to undertake immediately indispensible measures to thwart enemy action. In aerial explosions a particular danger is the threat of enemy penetration over the terrain covered by the atomic attack. As to the use of irradiated men in combat, the commander would, for a certain critical time, use these men also, since the irradiated (except the most serious cases) do not require urgent medical intervention, isolation or evacuation. Their premature evacuation would noticeably affect the numerical size of the unit and, consequently, its operative capacity.

In the majority of cases of surface atomic explosion, no situation arises in which one should react too speedily, since the resultant debris remains out-of-bounds for a certain time for the enemy as well, who must study the situation carefully, as regards the scope and degree of contamination, so that he can decide whether to skirt the contaminated area or cross over it, naturally, taking necessary precautionary measures (using only tanks, rapidly plowing a narrow path, etc.), which always slows the advance considerably. Most often a unit commander would receive information, estimates of the situation and a set of possible courses of action to fulfill the operative objective from a higher command, whose orders and directions would be prepared in collaboration with, and upon suggestions of, experts from the ABC service.

It should be mentioned that medical aspects must also influence the commander's decision to utilize his unit for crossing over the contaminated area. That is to say, the commander would probably reach such a decision only on the basis of data on the degree of radioactive contamination of the terrain so that he could, on that basis, predict with the highest certainty the amount of radiation to which the unit might be exposed in a given time while crossing the contaminated terrain. It is understandable that such a decision would be considered only when the data showed the avoidance of dangerous doses to be possible.

But no less important would be the data that the unit commander would receive from the medical agencies. These data would be important because they would primarily refer to the short and long-range perspective of utilizing the wounded, contaminated and irradiated soldiers. Although the commander, as already mentioned, will under certain conditions, without waiting for the information and suggestions from the ABC and the medcial corps, engage all men in battle regardless of the degree of their irradiation, it will, nevertheless, be necesaary to adopt a practice of compulsory examination of all men in all units as to their degree of irradiation after each known explosion in the vicinity of the unit's area of action. Regardless of the fact that we are now practically helpless to give effective first aid and treatment to those irradiated with fatal doeses of ionizing radiation, some concrete achievements nevertheless exist which give hope that in a possible future atomic war it would be feasible to extend efficient help to injured individuals under the conditions that such help is given in time, i.e. while the injured are still in partly good and curable condition.

All the means at the disposal of contemporary medical science (bone marrow extracts, transplantation of bone marrow and other tissue, menotherapy by neutralization of radioactive materials, transfusion with large quantities of leucocytes and thrombocytes in order to stop bleeding, oxygenotherapy, treatment with B_{12} and others), although still in the experimental phase, give hope that a certain number of those injured by radiation could successfully be cured under the condition that the degree of their injury be established as accurately as possible, and that they are subjected to treatment in appropriate institutions as soon as possible.

For this reason it would be necessary not only for medical personnel but for all men in the army to learn as best they can to recognize the first and slightest external symptoms of radiation sickenss. Medical personnel as well as the organs of the ABC service would not only have to learn how to diagnose the irradiated by clinical symptoms, but also how to classify them on this basis (by degree of illness). In health institutions this would be much easier and more reliable, but insufficient. It would be indispensible to estimate urgently and reliably the condition of each individual right on the field, so as to determine his further service in the unit and possible use in combat, as well as the treatment required.

Such a request could be made because, even today, it is possible to determine with certainty by reliable objective methods the degree of irradiation, i.e. contamination by radioactive materials, in a operative zone. The most effective means to that end is an individual dosimeter with which all members of an army would be supplied in the event of atomic attack.

Basic Characteristics of Personal Dosimeters

To supply each member of the armed forces and every citizen in the country with individual dosimeters, to organize a service for reading dosimetry results and to insure the exchange of dosimeters, their distribution and so on, is far from a simple matter. The difficulties involved are already apparent in the problem of selecting the types of dosimeters to be used by members of the armed forces. The most important features to consider in choosing an individual dosimeter are:

- that it be capable of giving data about the absorbed dose within the required limits of accuracy;

- that it be capable of enduring all the conditions to which a soldier is subject in war without harmful consequences or decreased efficiency, which means that its construction and the materials it is made of must be resistant to shock and insensitive to moisture and fluctuating temperatures;

- that it might not handicap the soldier because of its shape, size, or weight and that it be suitable for carrying anywhere on the person (on clothes, under clothes, etc.);

- that it be simple in construction so as to enable its mass production without complex technical installations;

- that it be capable of registering the absorbed doses of radiation which occur under wartime conditions (10-1,000 r);

- that it be as inexpensive as possible so as not to burden the state budget too much;

- that the reading of its results be fairly simple for those who are specially trained, while untrained persons would not be able to decipher the indications.

Types of Individual Dosimeters

There are, today, in many countries several types of dosimeter which, although they have already been in use for years, are still being researched, experimented with and improved in order that the army and civilians might be better served in the event of enemy attack with nuclear and thermonuclear weapons. Each of these dosimeters has its weak and strong points. Each of them is suitable for utilization under war conditions to a greater or lesser extent.

To comprehend the basic principles on which individual dosimeters work it is necessary that one be reminded of the following:

Nuclear radiation possesses kinetic energy, i.e. it is capable of producing a large number of effects by passing through certain substances. It is known that radiation causes blackening of photographic film, ionization of many gases, fluorescence by passing through certain hard crystals, fluids and gases, etc.

Many of these effects are utilized for recording and detecting nuclear radiation as well as for determining the quantity of energy given by radiation to the substances through which it has passed.

The instruments which utilize the above-mentioned effects for recording and detection are called detectors, while those which determine the quantity of energy absorbed by a certain substance are called dosimeters.

It should also be stressed here that dosimeters are constructed primarily to fit their particular use. Some of them measure the intensity of radiation, others the interval dose, still others the velocity of radiation and so forth. Of primary significance to the army are purely integral individual dosimeters, which are used to determine the total dose of radiation absorbed within a given time period.

Such integral individual dosimeters may be divided into three categories: physical, chemical and biological.

Among physical dosimeters is an electrical device built in the shape of a fountain pen which is electrically charged and, under the action of radiation, discharges its electricity. The loss of electricity is easily readable on a scale along which a quartz hair moves. The advantage of these dosimeters is their easy readability and suitability for carrying. The apparatus for charging the dosimeters is slightly larger than a matchbox and can therefore be easily carried. Almost all other electrical individual dosimeters are constructed in such a manner that they can receive the necessary electric charge from electric lines or batteries, or the charge can be produced by friction (ionometer).

Dosimeters in the form of fountain pens, although desirable because of their shape, did not prove entirely practical for mass use, especially not for use in the army in time of war. They are very sensitive to external shocks and jolts and could consequently give incorrect results, since the latter would depend on many unforeseeable occurrences and conditions. Research and development of instruments which would react according to the degree of biological injury is therefore continuing today. Working on this principle, it is possible that the quantitative measurement of the absorbed dosage of radiation could be determined with a greater degree of certainty (Fig. 1, 2, 3).

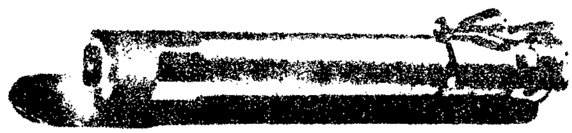

Fig. 1 Dosimeter in the shape of a fountain pen

Dosimeters which work on the principle of scintillation should also be included among physical individual devices. These utilize special substances which scintillate after being exposed to radiation. The degree of scintillation is compared to a standard scale in such a way that data on the magnitude of received dose is obtained. Measuring the absorbed dose by this type of dosimeter has, according to experts, certain advantages as compared with other instruments. These dosimeters register both minimum doses of 5 mr as well as maximum doses of up to 1,000 r.

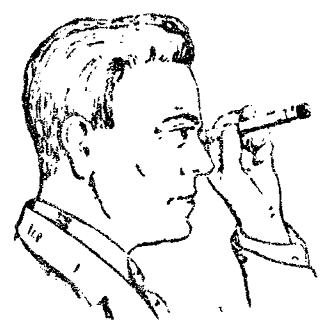

Fig. 2 Reading the results (absorbed dose) on a fountain-pen-type dosimeter

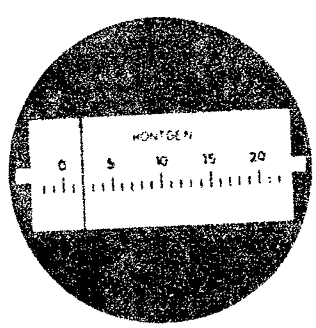

Fig. 3 Scale and quartz needle on a fountain-pen-type dosimeter

In dosimeters for individual monitoring, built on the principle of scintillation, a plate made of an appropriate substance that scintillates under the action of radiation is placed in a sealed glass tube which, in turn, is placed in an aluminum box for protection from visible light. The method of measuring radiation with scintillating substances is, in principle, simple and relatively fast. In a few seconds the absorbed dose of radiation can be determined by special auxilliary equipment in the form of a small portable set (photomultiplier and monitor). The scale on the apparatus is graded in roentgens.

Among the individual dosimeters which are currently considered to be most suitable for mass use, particularly by the armed forces in a possible future war, are the so-called film-dosimeters or photographic dosimeters. The basic feature of all such dosimeters is two rolls of film of the size used for photographing children's teeth, which are placed in separate containers, one on top of the other. The film is sensitive to gamma radiation and is placed in impermeable wrappings of synthetic material. Two sets of film are utilized so that, in cases of small dosage, the first film will be read. If the irradiated person receives a large dose of radiation, this can be read on the second film, since the first, prepared for the reading of small doses, becomes useless for reading large doses.

The transfer of the identifying code number on the film is a matter of great significance. For this purpose the impressed number which is the identifying code is perforated on the film with a special needle. The numbering system is so devised that, even with two or three errors, a rapid identification of the owner is possible.

According to the type of dosimeter, the film is covered with various emulsions and protected by aluminum and lead sheets. There are dosimeters designed in such a way that the unprotected part of the film indicates beta radiation, while the part of the film that is covered with cadmium indicates neutron radiation. All these dosimeters are fairly sensitive and could give data on radiation dosages from 0-800 r and more.

For example, the Chassende-Baroz (C.B.) device, adopted by the infantry, navy and air force, as well as by the civil defense service of France, is made with two emulsions for radiation measuring: the first emulsion is for doses of from 10-200 r on a narrow track; the second is for doses of from 200-800 r on a wide track. One part of the emulsion serves as a test. Gaging is performed with cobalt 60.

The C.B. dosimeter, which is built on the principle of direct photographic effect, i.e., without the amplifying shield screen, gives practically the same answer regardless of radiation intensity up to 106 r/hour. This is most important for registering primary radiation produced by nuclear weapons.

Emulsions used in the C.B. dosimeter for larger doses in wartime do not show a significant loss to gradual fogging even in periods of three days in cases of intensive doses and even after a month for medium doses. In order to equalize the effects of radiation of various energies to which men could be exposed in war, the C.B. dosimeter is housed in a lead casing, (about 60 grams in weight) which permits a sufficiently uniform response up to 75 kev.

Finally, there is a simple method of identification for C.B. dosimeters. The name of the person carrying it (or a number) is written on the case of the dosimeter and the same is done on the back of the emulsion, from which it could not be erased.

These dosimeters could be stocked for several years. The best storing conditions are provided by the method (of the "Heat Seal" type) which utilizes plastic materials and aluminum. After a number of years a certain corrective coefficient should be used when the dosimeter is read. The same principles have led to constructing a dosimeter for monitoring radiation absorbed by personnel exposed to harmful radiation in their work. These dosimeters contain, in addition to a test emulsion, at least two emulsions for measuring doses of from 10 milliroentgens to 10 roentgens.

The reading of results on the film dosimeters is based on comparisons between the blackened film and a series of films irradiated with known doses. The work is performed with a deciphering apparatus which is small in size and suitable for troop work (smaller units such as battalions), while the apparatus in a larger model (operating on the photometrical principle) can serve successfully in centers. The work of deciphering results is very simple; models for checking up to 10 film dosimeters in one or two minutes are in existence. (Fig. 4)

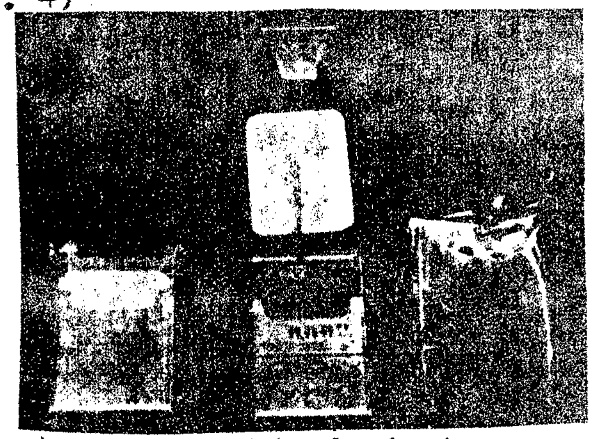

Fig. 4 Photographic dosimeter

Given a speed of work of this order, the reading of dosimeters would not modify or slow down the classification work or the administration of medical assistance to the injured. With the aid of dosimeters, measurement of gamma rays can be attempted; since injuries caused by these rays are usually the most numerous, these are of highest interest to the medical service in such situations.

One advantage of this type of dosimeter is the fact that the reading of its results does not require any complex laboratory equipment and can be performed on the battlefield itself. In addition, as already mentioned, the work can be done with great speed. These dosimeters also show the cumulative effect of several consecutive doses of ionizing rays absorbed by a person.

<u>Chemical individual dosimeters</u>. These dosimeters usually contain a specific liquid (in tubes) which, under the action of ionizing radiation, changes its color or shade according to the quantity of absorbed rays. The reading of results is performed by comparisons with the standards for a particular dosimeter. Chemical dosimeters of various type are in use today, such as a chloroform dosimeter consisting of a chloroform capsule to which bromocreusol-red or some other substances are added to serve as an indicator. Because of their advantages these dosimeters will probably be used in the army. Such dosimeters are usually very stable, of simple manufacture, the material of which they are made can almost always be found in sufficient

quantities, the reading of its results is also fairly simple and, therefore, today work on researching and improving dosimeters of this type is extensive.

Biological individual dosimeters. Dosimeters of this type are only in the research stage. For the time being, practically speaking, there are no biological dosimeters. Biological dosimeters are actually animals, placed at various distances from the centers of experimental explosions of nuclear bombs, for the biological detection of radiation dose. This dose is determined on the basis of the death rate of laboratory animals, as well as on the basis of clinical and patho-anatomical changes that can be discovered in the animals.

Dosimetry which could even give only an approximate picture of the degree of anatomical-biological damage from internal radiation caused through ingestion or inhalation of radioactive particle is, for the moment, still not possible. In any event, all types of injuries from internal radiation, especially those of inhalatory nature, should be considered very serious, because the sources of radiation, regardless of how minimal, cannot be easily removed and, during long and direct contact with tisses, sonner or later cause irreparable damage, often with fatal consequences.

It should be pointed out at the end of this chapter that in constructing individual dosimeters their shape is carefully considered. At present, they are made in various shapes depending on the place where they are to be worn, in other words, depending on what parts of the body would be most exposed to the harmful action of radioactive gamma rays. So, for instance, individual dosimeters could be obtained today not only in the shape of a fountain pen, but also in the shape of a wrist watch (bracelet dosimeter), various little boxes and the like (Fig. 6, 6).

Reading a Dosimeter and the Procedure / Followed / with the Irradiated

Relying on past experiences and considering situations which would take place in a possible future war, it could be assumed with certainty that despite the high morale of troops - the concern of which belongs to the commanding staff of each unit - each nuclear explosion would cause the feeling of fear, disorder, excitement and, sometimes, even a pre-panic state to a greater or lesser extent. If

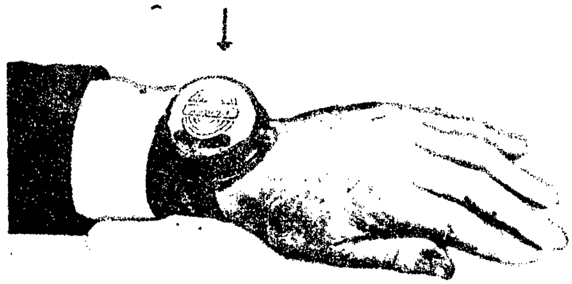

Fig. 5. Dosimeter in the shape of a wrist watch

Fig. 6 Dosimeter in the shape of a smaller box

all those who would be irradiated by fatal doses were to know the truth about the fatal perspective, the situation would be catastrophic. The consequences would be particularly grave on the battlefield where, in their psychological confusion, individuals could sometimes act harmfully on the entire collective, causing not only a type of epidemic but, in the right sense of the word, an "explosion" of panic, demoralization, and all the dangerous consequences of such moods. Such a danger would arise if each individual in the unit could read the absorbed dose of ionizing rays on their individual dosimeters. For this reason a dosimeter should be so constructed as to make the reading of values it would indicate accessible and understandable only to a certain number of trained persons, who would keep these results absolutely secret and would report them only to designated superiors. To prevent these secret readings from "leaking", it would be necessary to assure the possibility of changing "codes" regarding the reading of results whenever the designated superiors deem it necessary.

Perhaps, at first glance, this seems to be an insignificant detail but, when large groups of men are in question, a thought should always be given to such problems. It is very difficult to foresee what a large number of men - even at the front - would be capable of doing once aware and certain of being condemned to a slow, painful and inevitable death. The question of reading dosimeters must therefore be approached with utmost seriousness. The organization of this work must be prepared to the minutest detail and measures that should be undertaken in various situations should be foreseen in order to ascertain with the greatest possible certainty the reliability of obtained results. Undoubtedly, great difficulties will arise in this work in view of the many men that should be engaged in this project, but this does not minimize the need to exert maximum efforts for the purpose of discovering such forms of work that would be satisfactory. There are many suggested solutions to this question; for example, that the reading of dosimeters be performed only by the organs of the ABC and medical service, that the reading be accessible also to designated military officers, etc. For the time being, however, each of these suggestions still has many shortcomings, so the problem still awaits solution, a solution which will certainly not be universal but will be adapted to specific conditions in each individual country.

Parallel to these immediate problems is the question of corresponding documentation, because the degree of irradiation, except for a possible rough orientation arrived at on the basis of certain clinical symptoms, would be difficult to determine during the later stages of evacuation. For this reason it would be of importance to enter as soon as possible, in code, into the corresponding columns of the card of the wounded the dosimetrical results obtained. This could, by the way, only be entered subsequently since, for the moment, such columns still do not exist. Naturally, such data could be entered in some other more suitable manner as, for example, on a separate paper, by separate tallying and so forth. The injured, ready for evacuation, should not be deprived of individual dosimetry, regardless of the fact that during the evacuation, until he reaches the point of destination, he carries with him the paper with the entered result of dosimetry. This is necessary for registering possible subsequently absorbed doses of radiation on the way to the designated insitution in which he would remain for treatment.

Independent of checking individual dosimeters, it would certainly be necessary in specific situations to examine men for contamination by radioactive particles, which would remain on soldiers in the form of dust. This would not represent difficulties because if would be performed by a radiation detector (G.M. counter) which almost every army has at its disposal today. Decontamination from radioactive dust mustbe performed at the nearest suitable place using methods and means which would, in a given situation, be available and most suitable.

After reading a dosimeter and establishing the degree of contamination, the treatment of men would probably vary in different armies according to the situation in which they find themselves and to the attitude toward this problem. This is mentioned because various authors have different attitudes and because they interpret the gravity, i.e. danger of certain degrees of irradiation, in different ways. In connection with this they suggest that various actions be taken as regards the care of irradiated soliders.

Irrespective of still-existing differences of opinion regarding the level of danger of irradiation and the capability of irradiated soliders for combat, it could be generally said that the majority agree on the following:

A soldier should not be removed from the operative zone if he has absorbed 100 r. In case signs of a lighter illness appear, he should be placed off duty for several days in the unit or in the foreground medical institutions, after which he could return to the frontline;

Those irradiated with 200-400 r may be kept on duty for a short time, but for a short time only. This is because hospitalization, though not immediately after irradiation, is indispensible to them. It should be stressed that the percentage of fatality among these persons is still very high;

Those irradiated with 400-600 r or even more should necessarily be withdrawn from combat and sent to health institutions for longer treatment. At an irradiation of 400 r, the death rate amounts to over 50 percent, while at an irradiation of 600 r and over death is, so to speak, inevitable. Another reason why men in this category should be withdrawn from combat is that the first signs of radiation sickness may appear even after half an hour, one hour, or even sooner. From that moment on, even the slightest effort would worsen their condition and chance of recovery. Besides, the presence of such seriously ill and usually hopeless patients (and this, as already mentioned, develops very rapidly) in operative units does not have a favorable impact on the combat spirit of the remaining soliders. Quite to the contrary, it could do more harm than good for these irradiated to help in combat actions.

Finally, one should be reminded of the following. Regardless of which type of individual dosimeter is adopted and who is given charge of the dosimetry of men, it is important, as has been stressed by different authors, that the personnel designated for this work be trained as soon as possible. At first it appeared that the practical training of this type was impossible or very complex. By careful utilization of radioactive isotopes in the form of sealed preparations and other means, however, practical exercises without which the entire training of men during peacetime would remain insufficient, could be successfully performed. Consequently, the success of the training will to a large extent depend not only and exclusively on good programs, but also on the skill and inventiveness of the instructors in charge of training designated men in the skill of dosimetry, so that in the event of an atomic attack they can fulfill their assignments satisfactorily.

This work was accepted on Sept er 21, 1959