

THE TETE RADIO-ACTIVE MINERAL AREA IN PORTUGUESE EAST AFRICA

A BRIEF SURVEY OF CASES AFFECTED BY RADIO-ACTIVE RAYS

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The atomic age on which we are embarking is now a few years old, and it is time that information on nuclear science were disseminated both among medical men and the public. The medical man will in the near future come in contact with patients affected by this new scientific development. The South African public will feel the impact of this new science through the mines which develop uranium ore. We feel justified, then, in publishing for the first time in South Africa some data from Portuguese East Africa, though brief and not yet fully accounted for.

One of us (A.S.) recently saw a patient (the co-writer) who, after spending some months in the highly radio-active area of a uranium mine in Portuguese East Africa, presented some disturbing symptoms, pointing to possible causation by radio-active rays:

The patient's first experience was in October 1954, after spending 3 days in workings at Inhatobue Mine, where a certain amount of pitchblende is found but where the radio-active intensity is relatively low. The first symptoms were exhibited a day after leaving the mine and consisted of vomiting, though not violent. Thereafter a general feeling of unwellness set in and persisted for 2 days. Nausea, headache, dizziness and vertigo were manifested.

In June 1955 after working for 2 weeks at Mavuzi mine in places where radio-active intensities varied up to 300 backgrounds, the patient suffered a fresh onset of symptoms, in the form of a sudden and violent attack of vomiting.

The most marked symptom was now deterioration in vision. It became difficult to read even the well illuminated scales of the instruments. Plotting of maps and drawing became hard labour. Nevertheless, distance vision remained good, so that it was thought that accommodation of the eye had been affected. This condition has not cleared up yet. Indeed, without spectacles, vision at close quarters is poor, so that occasionally food on a plate looks very blurred.

Acute headache was often experienced and this is still

so today. The headache is localized behind and above the eyes and is sometimes accompanied by stabbing pain in the eyes, as well as nervous jumping of the eyes.

After the first attack of vomiting the patient took to suppressing the urge to vomit whenever it was felt, which was at irregular intervals and under all conditions. It might come on at meal times, when walking in the bush, at night in bed—there seemed to be no specific set of conditions that would cause the sudden and intense feeling of nausea. Even after the patient finally left the area at the end of September a strong recurrence of nausea and the associated general malaise occurred on 18 October, and lesser manifestations thereafter.

During the period 12 June to 28 September 1955 the patient on 3 occasions went away from the mine to non-radio-active areas, and on each occasion experienced a feeling of great relief, as though a considerable burden had been lifted from his limbs. On returning to the mine the lassitude, headaches, nausea and sleeplessness would return within 72 hours.

Owing to the very active life on the mine, the patient's weight fell from 178 lb. to 168 lb. The diet was rich in meat and potatoes, poor in green vegetables and fruit. He took one Paludrine pill every week as prophylaxis against malaria. The intake of alcohol was low, amounting to 1 pint of red wine daily. That of water was generally large, averaging 1 gallon daily, some days rising to 2 gallons (all drinking water is imported from Tete, 30 miles away).

We carried out examinations in this case, all with negative results, on the blood for abnormal cellular composition, the urine (24-hour collection) for radio-activity, the eyes for possible neutron-induced cataract, and the sperm for oligospermia or aspermia, which are often encountered in patients suffering from effects of gamma rays.

Other tests that may be used in investigating radio-active effects are:

(a) Objective studies of frontal-lobe functions to reveal an acute or late impairment of these functions.

- (b) Urine analysis for amino acids, which are excreted in 2-20 times the normal amounts.
 (c) Quantitative analysis for radio-active substances.

OTHER CASES IN THE MINE IN THE TETE RADIO-ACTIVE AREA

The radio-active effects upon humans is complicated by the diseases from which nearly all residents suffer here; i.e. malaria in Europeans and malaria, trypanosomiasis, epilepsy, syphilis, leukaemia and hookworm in Natives. However, a small number of reasonably healthy Europeans came into the area and stayed there long enough for curious manifestations to develop:

Case 1. European male aged 30 years, unmarried, resident in the area more than 5 years. Reputedly suffering from chronic malaria, on which account was frequently absent from work for two or three days at a time. Soon after the start of operations he commenced to have violent vomiting attacks, so that the Mine Manager sent him to Beira for medical observation and treatment. He returned after 2 weeks, having received no treatment because, beyond ordinary malaria, nothing tangible could be found. His own statement was: 'I'm a bit ashamed at having wasted 2 weeks in Beira. I felt so fine and there wasn't really anything wrong with me'. Within a week of his return vomiting attacks recommenced.

Case 2. European male aged 45 years, married, came into the area in mid-June 1955 and immediately commenced working in all highly radio-active areas. Free from malaria. After one month had sudden vomiting attacks. Suffered acutely from lassitude and failing vision, the latter so much that it was difficult to read instrument scales, even when well illuminated. This man made regular visits to places out of the area and on each occasion recovered within 24 hours from the feeling of lassitude and the urge to vomit. During September, after the quarry had been opened, he commenced to feel sharp foot-discomfort, and on testing his boots with the scintillometer found them to register 100 backgrounds. Occasionally blood was found in the urine. The tendency to vomit was always present during August and September but was always suppressed—sometimes with difficulty. During September stiffness in joints became very evident. All these symptoms ameliorated as soon as he left the area at the end of September. On 18 October a relapse of the symptoms was experienced in Johannesburg and vision continued to give trouble. Despite stronger spectacles the eyes are still unsatisfactory today, stabbing pains in the eyes are frequent and also sharp localized headache just above and behind the eyes. The urge to vomit is still felt occasionally.

Case 3. European male aged 35 years, resident in area 10 years, mainly in radio-active parts. Malaria sufferer but otherwise strong and much more active than average Moçambicano. Complains of difficulty in moving his legs when he has been in contact with radio-active concentrates, but otherwise does not exhibit the symptoms above outlined.

Case 4. European male aged 34 years, married, resident in area 7 years, throughout which time has been in frequent contact with radio-active ores and concentrates and has regularly visited all mines and workings. Suffers from malaria, arthritis and leukaemia (his doctor attributes the leukaemia to radio-activity). Acute lassitude and strong tendencies to vomit are very marked.

Case 5. European female aged 30 years, married, resident in area 7 years. Although for 5 years she lived only on the fringe of the radio-active area, she vomited strongly daily, until the 5th month of pregnancy, when this symptom disappeared. Child born mid-June 1955; the woman showed no symptoms, although during August and September the radio-active intensities in the dwelling house trebled. The infant, within a few days of arriving in the area, began to exhibit curious skin growths which cleared up, but not entirely, on fresh orange juice being given.

Case 6. European male aged 45 years, a miner. Malaria sufferer, but otherwise strong and apparently resistant to effects of radio-activity. Although his work brings him daily into close contact with highly radio-active ores in the mass, he seems to be little affected, beyond occasional stiffness in limbs and, on one occasion, a very marked eye condition that was ascribed to radio-active dust.

Case 7. European female aged 40 years, married, visited the area

for 10 days in August. Free from malaria. Within 24 hours suffered arthritic pains in left hand and arm, which became more acute each day, but which passed away within 24 hours of leaving area. Her 4-year-old boy suffered no apparent effects during the visit, but immediately on leaving developed inflammation of tonsils for which he had to be treated.

Case 8. Native male aged 25 years, living in Manager's dwelling. Apparently strong. Two weeks after commencing service started having sharp attacks of vomiting.

Case 9. Native male aged 30 years, serving as mechanic's assistant. Worked for 6 hours at the delivery end of the concentrating table, directly handling the radio-active concentrates. Was ill for 4 days, with violent vomiting, temperature, headache and inability to use limbs. This man had been stung by a large scorpion 3 weeks previously, resulting also in great pains, which he ascribed to the anti-serum which the nurse had injected and of which he did not approve.

Case 10. Native aged 40 years, a miner, had been working regularly in adits and on the surface for 3 years. When sent down a shaft where radio-active intensity is 200 backgrounds, temperature over 105° F and humidity 85%, after 4 hours he fell unconscious following very violent vomiting, and on coming round found difficulty in using his legs.

These instances in Natives could be multiplied many times. In the Capompo quarry, where the radio-active intensity varies between 200 and 300 backgrounds, labourers soon began to complain of aching feet. Other symptoms of radio-active sickness are somewhat masked by the effects of inherent diseases and the relative frequency of heat exhaustion. However, it was soon noted that, merely by carrying radio-active dust on the clothes, the Native labourers contaminated their compound so that intensity rose in 2 months from 3 backgrounds to 60 backgrounds.

DISCUSSION

It appears that 4 periods may be singled out in the disease:

1. Period of primary general reaction
2. Period of apparent clinical good health (latency)
3. Period of marked clinical manifestation of the disease
4. Period of recovery

The 1st period begins immediately after irradiation and lasts up to 3 days. The 2nd period lasts a varying time (2-3 weeks). In the 3rd period functional nervous effects appear. The 4th period is characterized by considerable improvement in the patient's general condition. Early (prophylactic) application of antibiotics, and the therapeutic use of various haemostatic drugs, have been recommended as an effective method of treatment of acute radiation disease, helping to alleviate the severity of symptoms of the 3rd period and bring about clinical recovery.¹

The effects of irradiation may be seen in various occupational and other conditions; for instance: (a) patients submitted to radiation therapy, (b) workers in medical radiology, (c) workers in the nuclear-energy industry, and (d) workers in the uranium-mining industry. International standardization and inter-comparison of experience would be of great value in this field. Although radiation is easily measured, it is difficult to get reasonable uniformity when these measurements are made in diverse ways and places.²

In industrial establishments where there is a risk of harmful radiations great importance is attached to ventilation, and most working places are kept under

50 mm. water vacuum, so that all fumes pass up a chimney. Also special overalls and other clothing are furnished to all workers. Special dosimetric services are provided in all such installations.³

Low-level radiation attacks the blood, and although white-cell counting does not afford any measure of protection to a worker, real danger does threaten in the development of leukaemia, though severe blood changes caused by radiation do not necessarily develop into leukaemia. Another of the critical tissues is the lens of the eye. Long-continued small doses do not cause cataracts, but neutrons have a highly selective action on the lens.

The gonads are also sensitive to irradiation. Sterility, abnormal children in the first generation, and long-term genetic effects are evidenced. Shortening of the life-span in animals has also been evident, and the permissible maximum of 0.05 r. per day has a factor of safety of only 2. Damage to the genes is always permanent and no recovery seems possible. Irreversibility of the changes produced by irradiation is a general condition. In describing the injurious effects Stone discussed the question of how dosage is to be rated and what weekly dosage rate should be adopted. He mentions that persons over 45 years of age may safely be subjected to double the dosage permissible for those below that age, because the latent period for the appearance of injuries may be longer than the remaining life span of a person over 45.⁴

Other classes of person exposed to possible risk of dangerous irradiation include: miners and millers of

other radio-active ores, personnel of atomic energy plants, residents of areas in which radio-active sewage and wastes are released, people administering or receiving radio-active isotopes in medicine, users of radio-active isotopes in research and industry, makers of thorium gas-mantles.

SUMMARY AND CONCLUSIONS

A description is given of cases affected by irradiation in uranium mining. It is still too early to assess the full significance of the effect of these irradiations on the human body. Experimental work is being carried out at present in many parts of the world, and the closest cooperation exists. South Africa, being an important centre of uranium production, ought to cooperate with the rest of the world in the same manner. More information on the subject should be given to medical men and the public in general. The devising and standardizing of methods of detection, prevention and treatment are of the greatest importance.

REFERENCES

The following references are to the Proceedings of the International Conference on the Peaceful Uses of Atomic Energy convened by UNO and held at Geneva on 5 July 1955. Published at Geneva by UNESCO.

1. USSR: p. 617.
2. WHO: p. 778.
3. Letavet, I.: p.689.
4. Stone, W.: p. 89.