

United States Government

Department of Energy

Oak Ridge Operations

# memorandum

DATE: July 31, 1989

704669

REPLY TO

ATTN OF: ER-122:Wallace

SUBJECT: TEAM REPORT OF FOREIGN TRAVEL BY ROBERT C. RICKS AND MARY ELLEN BERGER, ORAU

TO: Robert W. Wood, Director of Physical and Technological Research, ER-74,  
Headquarters, Germantown, Maryland

Attached is a copy of a team trip report prepared by Robert C. Ricks and Mary Ellen Berger covering their travel to Mexico during the period June 2-8, 1989. The travelers provided follow-up assistance in the treatment of the Salvadoran radiation accident victims.

The report has been reviewed and does not contain any classified information.

*for M.C. Wallace*  
Larry L. Radcliffe, Director  
Research and Laboratory Waste  
Management Division

Attachment

cc w/atchmt:

- R. O. Hunter, Jr., ER-1, HQ, FORS
- D. B. Waller, IE-1, HQ, FORS
- J. G. Coyne, MA-28, OSTI
- J. R. Martin, FA-71, ORO
- D. J. Cook, DP-82, ORO

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COVER SHEET  
FOR TRIP REPORTS SUBMITTED TO THE  
OFFICE OF ENERGY RESEARCH

Destination(s) and Dates for  
Which Trip Report Being Submitted: Mexico City, Mexico, June 2-8, 1989

Name of Traveler: Robert C. Ricks

Joint Trip Report  Yes

No

If so, Name of Other Traveler(s): Mary Ellen Berger

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TEAM FOREIGN TRIP REPORT  
MEXICO CITY, MEXICO  
JUNE 2-8, 1989

TRAVELERS:

Robert C. Ricks, Ph.D.  
Director, REAC/TS  
Medical Sciences Division

Mary Ellen Berger, R.N., Ed.D.  
Assistant Director, REAC/TS  
Medical Sciences Division

DESTINATION AND DATES:

Mexico City, Mexico  
June 2-8, 1989

PURPOSE OF TRIP:

To provide additional assistance, to obtain biological samples for analyses and to update medical information regarding the radiation accident victims from El Salvador.

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BACKGROUND INFORMATION

On February 5, 1989, three employees of DELMED entered a  $^{60}\text{Co}$  irradiator used for sterilizing plastics in San Salvador, El Salvador. These individuals received radiation exposures resulting in the acute radiation syndrome and serious local radiation injuries. REAC/TS became involved through a request for assistance from the International Atomic Energy Agency. In early March 1989, assistance was provided to the medical staff at the Hospital Angeles del Pedregal, Mexico City, Mexico, at the request of the Mexican government through IAEA, following airlift of these three accident victims from El Salvador. After the initial travel to Mexico City, REAC/TS maintained contact with Dr. Rafael Hurtado Monroy, the hematologist in charge of care of these patients at the Hospital Angeles del Pedregal. Although all three patients survived their hematological crises, there was early evidence that two of the patients might require surgical intervention (i.e. amputations) because of the acute local radiation injuries to their feet and legs. We had previously informed Dr. Rafael Hurtado Monroy that, following any amputations, REAC/TS desired tissue samples for histopathological analysis and bone samples for electron spin resonance dosimetry.

On May 31, 1989, REAC/TS was again contacted by Dr. Rafael Hurtado Monroy who requested assistance regarding 1) surgical amputation, 2) serum radioimmunoassay for erythropoietin (unavailable in Mexico), and 3) histopathological evaluations of bone marrow biopsies and additional follow-up cytogenetic dosimetry.

Dr. Rafael Hurtado Monroy indicated that surgical intervention was planned sometime between June 2-5. We suggested that magnetic resonance imaging of the affected areas and comparison with normal tissues be carried out prior to any surgical amputation.

Before departure we made arrangements with Dr. Sanford Krantz, Vanderbilt University Department of Hematology and Dr. Robert Lang, University of Tennessee Medical Center at Knoxville to assist with serum erythropoietin radioimmunoassay. REAC/TS staff departed for Mexico City on Friday, June 2, 1989.

DAILY ACTIVITIES

Friday, June 2, 1989

We departed early afternoon for Mexico City, Mexico, arriving in the early evening. We were met at the airport by a representative of the U.S. Embassy in Mexico City who provided transportation to our hotel.

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Saturday, June 3, 1989

After arrival at the Hospital Angeles del Pedregal, we met with Drs. Hurtado, Frankel, and Ihunada for a briefing on the status of the two patients and plans for the next several days. Dr. Hurtado reported that the patients' critical periods of hematological depression had passed and that local radiation injuries were the special problem at this time. He was seriously concerned, however, about the persistent anemia in the patient who had received the highest estimated whole body dose. Dr. Hurtado indicated his desire to administer erythropoietin, and I informed him that the cytokine is now available in the United States. I also informed him regarding our arrangements for erythropoietin level determinations at Vanderbilt and the University of Tennessee Hospital in Knoxville and indicated that it takes approximately two weeks to get the results of this test. Dr. Hurtado stated that this presented no problem since transfusions were being used to maintain red cell levels in the patient until test results were available. Dr. Frankel (Infectious Disease) indicated there were no major problems with systemic infections in either of the two hospitalized patients. The feet of both patients, however, demonstrated culturable pseudomonas and staphylococcal infections. Dr. Frankel indicated the only systemic infections noted were mild and related to Hickman catheters used for administration of GMCSF. These catheters have since been removed. Dr. Ihunada, staff endocrinologist, reported that the patient with the highest estimated dose was euthyroid but had elevated T-3 levels (related to T-3 conversion) and very high cortisol levels. Drs. Hurtado and Ihunada reported that this patient continued to have liver dysfunction with low albumin levels and elevated alkaline phosphatase.

We also discussed the arrangements for MRI's on both hospitalized patients. We learned that there were three MRI units in Mexico City, however only one was up and running. This one operational MRI unit was located at a federal military hospital, and it would be Tuesday or Wednesday before arrangements could be made for the MRI scans.

We then visited with each of the two hospitalized patients.

REAC/TS Case No. 1039.01. This patient received an estimated whole body dose of 4 Gy. Today the patient was alert and friendly and sitting up in bed with his feet elevated on a pillow. He appeared thin for his body build and he reported a weight loss ("5-10 kg") since the accident on 2/5/89. His scalp was evenly covered with dark hair, approximately 1/4 inch in length. The patient indicated that he had not epilated but had shaved his head after he learned that his workmate had epilated over the scalp. Facial hair consisted of a "new" mustache and beginning beard, with an uneven distribution of hair. Nasal and oral mucosa were pale, and a black coating was noted on the tongue. The patient reported eating a normal diet, but said he lacks an appetite. Several small scars were noted on his right chest wall where catheters had been removed. Skin of the abdomen appeared normally pigmented and smooth. Pubic hair was present. The anterior aspects of the lower legs exhibited spotty depigmentation. Legs were thin with weak, atrophic muscles. Both feet appeared to be swollen and deformed. There were no toenails on the feet.

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Pulses (dorsalis pedis and posterior tibial) in both feet were reported to be good. The right foot had open lesions with yellow, serous discharge and hard crust formation on the medial aspect of the foot, extending under and including the arch of the foot and the medial aspect of the great toe. The skin overlying the lateral malleolus was dusky in color and resembled an incipient decubitus. Healed areas appeared pinkish white with thin skin. (See drawing 1) The dorsum of the left foot was covered with a translucent brownish yellow eschar, with evidence of inflammation on the ankles at the junction of the crust and skin. The entire ventral area was an open lesion having several bullae filled with pink-red exudate. Areas of punctate bleeding were evident. The color of the great toe and two adjacent toes was duskier than that of the two smaller toes. The middle toe was blistered and had the darkest color. Dressing changes and/or manipulation of the feet or toes caused intense, incessant pain. (See drawing 2)

REAC/TS Case No. 1039.02. This patient received an estimated whole body of dose of 8 Gy. Today this patient was alert and friendly, lying in a recumbent position with his feet elevated on a pillow. Although he appeared heavier than he was in March, he was thin and his muscles were atrophic. His color was very pale. His scalp was covered with a new growth of fine, dark hair of approximately 3/8" length. Sclera were pale and white. A TEN catheter was present in the right nostril. The left nostril appeared to have a small non-inflammatory erosion of the mucous membrane with production of clear fluid. Oral mucosa was pale. The tongue had a central fissure and a greenish, fuzzy coating on its surface. A 2-inch scar was present below the right clavicle where a TPN catheter had previously been located. The abdomen had a normal appearance, but it was reported that the liver was enlarged. The pubic area had sparse hair. The urinary catheter, present on the previous visit, had been removed. (Dr. Hurtado indicated that it had been inserted on patient's arrival at the hospital in late February because a urethral structure, probably due to mucositis of the meatal tract, had caused urinary retention. Dr. Hurtado further reported that 10 days ago the patient had a "sterile hemorrhagic cystitis.") Skin of the penis and scrotum appeared normal at this time although a nurse reported that the penis had been inflamed on admission. Skin of the hands was thin, with patches of depigmentation on the dorsal surfaces and depigmentation of the palms. The fingers were fusiform in shape. Capillary refill time in the nail beds of thumbs and fingers was less than 2 seconds. The patient reported normal sensations in the hands, but an extreme sensitivity to cold. Motion of the fingers appeared normal. Both legs were thin. There was restricted motion of the right knee. The skin overlying the right tibia was depigmented to the knee. There was a thick (2-3 mm) translucent brownish yellow crust extending from approximately 6 inches below the knee down to and including the dorsum of the foot. The right foot was swollen. The toes had a fusiform appearance. There were no toenails. The patient was unable to move the toes. The first toe was black and necrotic from the second phalangeal joint to the tip. The middle toe had a necrotic area on the dorsal surface. Greenish exudate was seen on these toes. See drawing no. 3 demonstrating areas of open lesions on toes and sole of foot. A biological dressing (amniotic membrane) was present on the right sole. Manipulation of the foot, dressings, etc. was extremely painful to the patient. The left foot was also swollen, with fusiform shape of the toes. Toenails were absent. The

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the foot, dressings, etc. was extremely painful to the patient. The left foot was also swollen, with fusiform shape of the toes. Toenails were absent. The patient was able to bend the four small toes but not the great toe. The foot had pigmentation changes and crusted lesions of the great toe and medial aspect of the ankle. (See drawing 4)

Before returning to our hotel, we met with Ms. Mary Carmen, Director of Public Relations at the Hospital Angeles del Pedregal to arrange for copies of hospital records. We were particularly interested in obtaining any records that had since arrived from El Salvador. Before leaving the hospital, Dr. Hurtado informed Mary Carmen that no decisions for surgical intervention or other testing would take place until Monday, June 5.

Sunday, June 4, 1989

Since no visit to the Hospital Angeles del Pedregal was possible this day, summary notes regarding both patients and drawings of patients' feet were completed.

Monday, June 5, 1989

This morning we met with Dr. Tostado, vascular surgeon, for observation of dressing changes on both patients, any necessary debridement, and a discussion regarding amputation of a gangrenous toe in the patient REAC/TS Case 1039.02. We also used this opportunity to take photographs of both patients.

Dr. Tostado indicated that both patients had some circulatory problems in the digits of both feet, with patient REAC/TS No. 1039.02 in worse condition than the other patient. He reported that aggressive cleaning and removal of the crust increased the expression of injury distally, especially in this patient. Both patients had received digital subtraction angiography (DSA) testing which gave relatively normal results. However, Thallium-201 perfusion studies in patient REAC/TS No. 1039.02 (candidate for amputation) demonstrated decreased perfusion in the lower extremities.

During this morning's session, both patients had their feet debrided and washed with a betadine/sterile saline solution. Amniotic membranes were applied as a biological dressing on the right foot of patient REAC/TS No. 1039.02 and on the left foot of patient REAC/TS No. 1039.01. These amniotic membranes were then covered with gauze soaked in dilute betadine/saline solution. Dr. Tostado indicated that this technique was particularly useful at controlling pain and somewhat useful at controlling infection.

Following patient observation, we discussed the possibility for amputation in patient REAC/TS No. 1039.02. Dr. Tostado indicated that he felt a conservative approach to amputation was not for the patient's well-being and agreed that MRI testing was a good approach to determine viable vs. non-viable tissue. We discussed previous radiation accidents in which acute local radiation injury

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presented a poor prognosis when conservative surgical approach was followed. We discussed in particular the Pittsburgh accelerator accident and the numerous amputations required in that case. It was decided that the decision for amputation would be postponed until after the MRI tests were completed.

We later met with Dr. Oswaldo Muchineck, Cytogeneticist at the Hospital Angeles del Pedregal for the purpose of comparing results of Mexican and REAC/TS cytogenetics. We exchanged copies of respective cytogenetic reports and selected photographs of metaphase preparations. Cytogenetic dose estimates obtained in REAC/TS and Mexico were almost identical.

We then met again with Mary Carmen and Dr. Hurtado and learned that the MRI's were scheduled for approximately 11:00 a.m. on Wednesday, June 7 at the military hospital in Mexico City. Plans were made for one of the REAC/TS staff to accompany the patients to the military hospital and retrieve data as available. The other REAC/TS staff was to remain at the Hospital Angeles del Pedregal and conduct interviews with members of the nursing staff who had attended these patients.

Discussions were held regarding arrangements for obtaining blood samples for additional cytogenetic dosimetry, bone marrow for cytogenetics, bone marrow sections and smears for examination in the United States, blood samples for serum erythropoietin radioimmunoassay, copies of patient charts, and information on blood transfusions. We also arranged for a visit with Dr. Ricardo Secin, staff psychiatrist, to discuss patients' psychological status.

Tuesday, June 6, 1989

We met with Dr. Ricardo Secin to discuss the psychological status of patient REAC/TS No. 1039.02. Dr. Secin indicated that the patient was quite depressed and requires anti-depressant therapy. Therapy began soon after the patient's removal from reverse isolation. Dr. Secin noted that during isolation (the period of severe immunosuppression) the patient was so ill that, if psychological distress was present, it was not evident. A period of elation followed his release from isolation but he again demonstrated depression as the local injury to the feet evolved. Dr. Secin attributes the patient's withdrawal and depression to pain, a fear of death, displacement from home, and fear of amputation. He indicated that amputation had been discussed with the patient with an observed increase in depression. Dr. Secin indicated that the patient had not expressed hostility toward the medical staff and was extremely cooperative regarding REAC/TS. Dr. Secin indicated he had not seen the patient REAC/TS No. 1039.01 but would discuss this possibility with Dr. Hurtado.

We encouraged Dr. Secin to pursue a psychiatric evaluation of the patient REAC/TS No. 1039.01 and to assess the impact of the accident on family members and hospital staff. We then met with Dr. Frankel and Nurse Flores to discuss special nursing problems encountered in the care of these patients.

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Wednesday, June 7, 1989

In the morning, Dr. Ricks accompanied the patients to the military hospital for MRI scans. Dr. Berger remained at the Hospital Angeles del Pedregal to complete interviews with the nursing staff.

At the military hospital, Dr. D. E. Berlanga conducted the MRI study on patient REAC/TS No. 1039.02, the candidate for amputation. The results of the MRI study indicated general atrophy in the musculature of both legs attributed to four months of bedrest. Otherwise, the musculature was normal from the umbilicus to the feet. The right and left popliteal arteries were intact and showed no evidence of endarteritis obliterans. Likewise, the right tibial artery appeared normal. Dr. Berlanga noted, however, that there was medullary necrosis in the upper femur and ankle of the right and left leg and foot. Due to the arrival of a patient with a medical emergency, it was not possible to complete the MRI study on the second patient REAC/TS No. 1039.01. The procedure was postponed until the following Wednesday, June 13. Subsequently, the results of the MRI (patient REAC/TS No. 1039.01) were reported to be normal.

Following the patients' return to the Hospital Angeles del Pedregal, serum for erythropoietin levels and peripheral blood for additional cytogenetic analyses were obtained from both patients. Bone biopsies were performed and samples of bone marrow were obtained for cytological and cytogenetic analyses. We also received an update on patient hematology and necessary information regarding transfusion therapy.

Thursday, June 8, 1989

Left Mexico City, Mexico. Arrived Oak Ridge, Tennessee, approximately 7:00 p.m.

FOLLOW-UP

On June 19, 1989, Dr. Hurtado informed REAC/TS that gangrene had now spread to four toes of the right foot of patient REAC/TS No. 1039.02. Viability of tissue at the base of the toes and on the dorsal portion of the lower right foot was also deteriorating. A decision for amputation had been made on the previous Friday, June 16. It had been decided to amputate the right leg above the knee in order to assure adequate healing and a usable stump.

REAC/TS made arrangements to retrieve the amputated leg for pathological analysis and electron spin resonance of bone samples. Histopathological studies were to be conducted in Oak Ridge as well as at the Armed Forces Institute of Pathology. Allowing for the necessary paperwork to be completed in Mexico and arrangements for bringing the tissue into the United States, the leg was retrieved in frozen state on June 28, 1989.

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Cytogenetic dosimetry has now been completed on the peripheral blood samples and bone marrow cells brought back on Wednesday, June 7. Results of these analyses are compatible with original cytogenetic dose estimates. The bone marrow smears and biopsies were analyzed by Dr. Sanford Krantz, Vanderbilt University Medical Center, who reported that patient REAC/TS No. 1039.01 demonstrated a normal marrow while patient REAC/TS No. 1039.02 showed evidence of a hypoplastic marrow with myelodysplasia. Similar results were reported by Dr. Hurtado on June 29. Serum erythropoietin levels in patient REAC/TS No. 1039.02 (patient with red cell production problems) were found to be 40 times normal indicating that administration of erythropoietin was contraindicated. Patient REAC/TS No. 1039.01 had only slightly elevated serum erythropoietin levels compared to control.

REACT/S will continue to stay in touch with Dr. Hurtado regarding patient status and the need for any additional surgical interventions. If other amputations are necessary, arrangements will be made to ship frozen tissue samples to REAC/TS.

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6/5/89

DRAWING NO. 1

REAC/TS Case No.  
1039.01



Medial aspect

Red/purple  
cast to  
tissue over  
lateral  
malleous

Tissues swollen

No toe nails

Open lesions // // //

wet  
desquamation

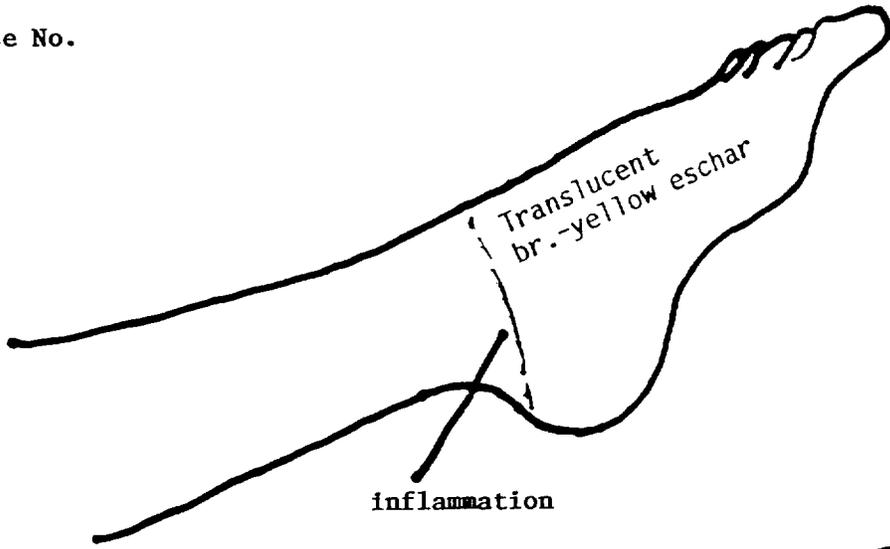
Right Foot

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DRAWING NO. 2

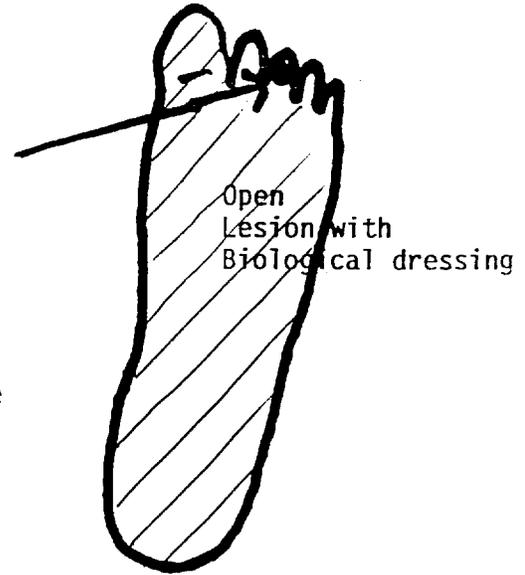
6/5/89

REAC/TS Case No.  
1039.01



Blistering  
dark color  
?gangrene

Some bullae  
present on  
sole with  
pink-red  
exudate



Tissues swollen  
No toe nails

(Sole of foot)

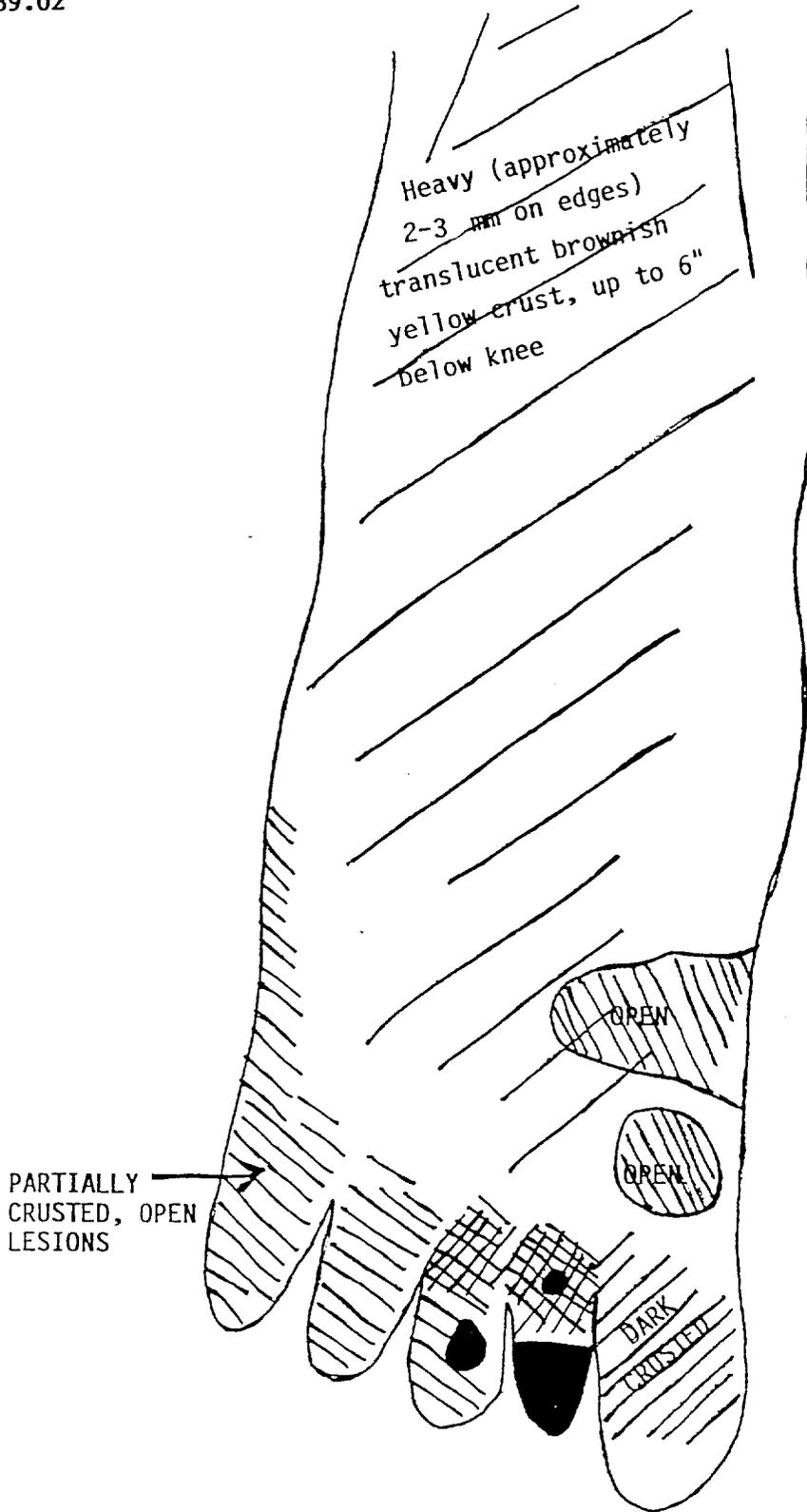
Left foot

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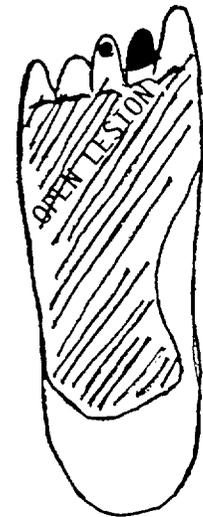
6/9/89

DRAWING NO. 3

REAC/TS Case No.  
1039.02



- Considerable swelling
- Fusiform toes
- No toe nails
- Unable to move toes
- Depigmented to knee
- Anterior tibial region crusted up to 6" below knee
- Greenish colored secretions on 2 more severely affected toes (X X)
- Necrosis ■
- Limited movement-right knee



(Sole of Foot)

Amniotic membrane applied

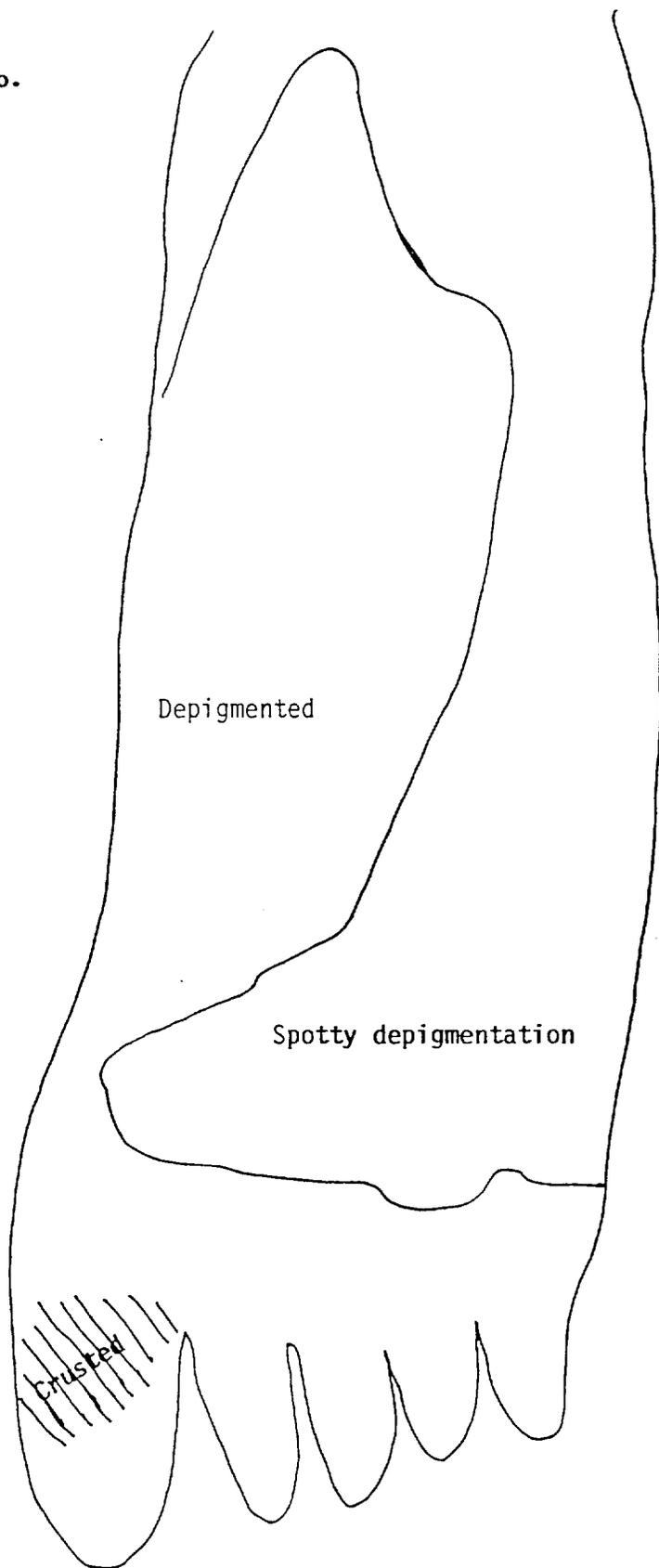
Right Foot

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DRAWING NO. 4

6/5/89

REAC/TS Case No.  
1039.02



- Considerable swelling
- Fusiform toes
- No toe nails
- Able to bend all but great toe



Left Foot

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