URANIUM–THORIUM COLLOID IN THE TREATMENT OF CARCINOMA

GEORGE T. PACK AND FRED W. STEWART

(From The Memorial Hospital, New York City)

At the International Conference on Cancer in London, 1928, Hocking advocated the treatment of malignant new growths by intravenous injections of colloidal uranium. Since it was impossible to prepare a stable colloidal uranium, Hocking deemed it desirable to employ a mixed uranium-thorium colloid which proved stable over a long period of time. The preparation in its final state contained one per cent uranium, was stable for a period of 3 months, and withstood sterilization by boiling. Since no deleterious effects followed the intravenous administration of the colloid and since some apparent benefit resulted from its use, we thought it desirable to treat a small series of advanced cases after the manner suggested by Hocking. The effort was made to select cases in whom little or no beneficial results were to be anticipated through the employment of surgery or radiation and where any untoward results of the intravenous uranium-thorium colloid could not make the patient's condition appreciably worse. In the course of a few months 8 cases received this treatment. Some of them were given the amount of the colloid recommended by Hocking, others received double that amount, and 2 patients got slightly less than the recommended dosage. The following case reports indicate briefly the course of the disease in a series of patients treated with uranium-thorium colloid.

Case No. 1. L. F., male, aged 54, entered the clinic Dec. 19, 1928, complaining of persistent ulceration of the lower lip. He had used tobacco since the age of eighteen. He smoked one cigar and 6 cigarettes daily and chewed one package of tobacco.

1 Aided by the Lucius N. Littauer Fund for Chemotherapy.

per week. He brushed his teeth once in two weeks and until three years ago had never visited the dentist. In July of 1927, 21 teeth were extracted for caries and pyorrhea.

In October, 1927, the patient accidentally burned his lip with the lighted end of a cigarette. The burn failed to heal and a painless ulcer appeared, persisting for eight months without appreciably increasing in size. In September 1928 the ulceration began to grow rapidly. On admission there was an ulcerated, infected lesion involving the left side of the lower lip. It measured $2.0 \times 3.0 \text{ cm}$. The surface was indurated and the lip deeply infiltrated. There were two small shotty nodes in the left upper deep cervical chain. The patient wore an upper plate, a bridge over the lower incisors, and a gold cap on a tooth opposite the lesion. There was marked pyorrhea and some buccal leukoplakia.

The Wassermann was negative. A biopsy was reported as squamous carcinoma, grade II, radioresistant. The patient was treated by radiation as follows:

<table>
<thead>
<tr>
<th>Date</th>
<th>Dosage</th>
<th>Apparatus</th>
<th>Filter</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-28-28</td>
<td>.80 millicurie hours</td>
<td>compound applicator, 0.5 mm. Ag, lip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-19-28</td>
<td>150 milliampere minutes, 175 KV., 30 cm. dist., 0.5 mm. Cu, left neck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-22-28</td>
<td>150 milliampere minutes, 175 KV., 30 cm. dist., 0.5 mm. Cu, right neck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10-29</td>
<td>300 milliampere minutes, 175 KV., 50 cm. dist., 0.5 mm. Cu, left neck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-14-29</td>
<td>300 milliampere minutes, 175 KV., 50 cm. dist., 0.5 mm. Cu, right neck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-27-29</td>
<td>3000 millicurie hours</td>
<td>tray, 3 cm. dist., 2.0 mm. brass, lip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-29-29</td>
<td>1000 millicurie hours</td>
<td>tray, 3 cm. dist., 2.0 mm. brass, lip</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The disease infiltrated too deeply to be cured by surface applications and the case was thought suitable for uranium-thorium colloid. A total of 45 cc. was administered intravenously in 5 cc. amounts, between April 16, 1929, and June 10, 1929. Before beginning the treatment the blood count was as follows: hemoglobin 80 per cent; erythrocytes 4,256,000; leukocytes 9,400; differential, polynuclears 77 per cent, large lymphocytes 3 per cent, small lymphocytes 14 per cent, transitionals 5 per cent, basophiles 1 per cent. The blood urea nitrogen was 5.6 mg., the blood sugar 111 mg. The urine showed albumen 2 plus, and some diacetic acid. Subsequent urine analyses during the period of treatment revealed a trace to a 2 plus albumen at all
save one examination. Diacetic acid was reported twice, sugar once, hyaline and granular casts three times, pus once.

The uranium-thorium mixture had no apparent effect on the growth of the tumor. It increased in size and became badly infected. Large cervical nodes appeared, the patient became markedly anemic and died July 18, 1929. The treatment produced no systemic reactions.

Case No. 2. A. S., female, aged 44 years, entered the hospital Jan. 21, 1929, with a carcinoma recurrent in a mastectomy scar. The initial tumor was first noted 18 months previously and had existed for one year previous to the radical mastectomy. The recurrence had been present for 2 months. Physical examination revealed an irregular, flat, raised, red, nodular tumor mass in the lower edge of the left mastectomy scar. It measured 10.0 × 4.0 cm. The right breast was almost entirely filled with a tumor mass some 8.0 cm. in diameter. The right axillary and the left supraclavicular nodes were large and hard. Radiographs of the chest revealed evidence of pleural and pulmonary metastases. Save for the mammary cancer the patient was in excellent physical condition. A biopsy showed infiltrating adenocarcinoma.

Sixty cubic centimeters of the uranium-thorium colloid were administered intravenously in 12 injections of 5.0 cc. each. The patient received 3 injections per week beginning Feb. 2, 1929. Previous to the treatment a blood count showed hemoglobin—75 per cent, erythrocytes—3,800,000, leukocytes—8,400, polynuclears—64 per cent, large lymphocytes—8 per cent, small lymphocytes—27 per cent, basophiles—1 per cent. The blood urea nitrogen was 12.3 mg. and the blood sugar 96 mg. per 100 cc. Another blood count, Feb. 6, 1929, revealed hemoglobin—85 per cent, erythrocytes—4,366,000, leukocytes—8,200, polynuclears—62 per cent, large lymphocytes—5 per cent, small lymphocytes—22 per cent, eosinophiles—6 per cent, basophiles—1 per cent, transitional cells—4 per cent. Nearly one month later there was no essential change in the blood picture. On Feb. 13, 1929, the blood urea nitrogen was 9.5 mg. Daily urine analyses from Feb. 4, 1929, to Mar. 6, 1929, gave no
evidence of sugar nor acetone bodies. Traces of albumen were reported on Feb. 12, 26, 28, and on March 1. Casts were reported on Feb. 11, 12, and 16.

No roentgen nor radium therapy was employed. The patient showed an occasional rise in temperature to 100. The right cubital vein was thrombosed from improper neutralization of the colloid. The tumor mass was not reduced in size nor was its character altered. The patient failed to report for further observation and her ultimate fate is unknown.

Case No. 3. Colored female, aged 40 years, applied to the Memorial Hospital on May 14, 1929, complaining of a mass in the right breast and a recurrent tumor of the left breast, the latter in a mastectomy scar. Aside from variola 14 years previously the past history revealed nothing of interest. The present illness dated from 1913 at which time the patient noted a small mass in the left breast. This tumor remained quiescent for 10 years after which interval it slowly increased in size. The skin over the tumor thickened and caused itching. The patient lost 21 lbs. In 1926, a left radical mastectomy was performed after which she remained well for one year. In 1927 a mass was felt in the right breast. This tumor steadily and painlessly increased in size.

Physical examination revealed a fairly well-nourished negress. Beneath the mid portion of the scar on the left chest was a large, indurated, tender tumor, 4.0 cm. in diameter. In the central portion of the right breast was a large, hard mass. The nipple was completely retracted. There was a large firm node in the right axilla and a similar node in the left supraclavicular space. The chest radiograph revealed a dense, discrete, circular shadow at the right base at the level of the seventh interspace. The heart was slightly enlarged and fine; moist rales were heard at the right base posteriorly. The liver was not palpable.

On May 14, 1929, the hemoglobin was 80 per cent, erythrocytes—4,160,000, leukocytes—4,800, polynuclears—57 per cent, large lymphocytes—21 per cent, small lymphocytes—16 per cent, eosinophiles—1 per cent, transitional cells—5 per cent. Blood urea nitrogen was 15.7 mg., blood sugar—84.9 mg. A
trace of albumen was found in the urine. Uranium-thorium colloid was administered in 8 injections of 5.0 cc. each from May 14, 1929, to June 2, 1929. A blood count on May 27, 1929, showed hemoglobin—80 per cent, erythrocytes—3,920,000, leukocytes—6,800, polynuclears—63 per cent, large lymphocytes—15 per cent, small lymphocytes—16 per cent, transitional cells—6 per cent. One week later the leukocytes were 8,800, polynuclears—56 per cent, large lymphocytes—20 per cent, small lymphocytes—12 per cent, transitional cells—7 per cent, eosinophiles—3 per cent, and basophiles—1 per cent. Urine analyses gave the following results:

<table>
<thead>
<tr>
<th>Date</th>
<th>Albuminuria</th>
<th>Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-14-29</td>
<td>albumen, a trace</td>
<td></td>
</tr>
<tr>
<td>5-18-29</td>
<td>albumen, a trace; pus</td>
<td></td>
</tr>
<tr>
<td>5-19-29</td>
<td>albumen, 2 plus; pus; many granular casts</td>
<td></td>
</tr>
<tr>
<td>5-22-29</td>
<td>albumen, 2 plus; hyaline and granular casts</td>
<td></td>
</tr>
<tr>
<td>5-25-29</td>
<td>albumen, 2 plus; abundant pus; many hyaline casts</td>
<td></td>
</tr>
<tr>
<td>5-27-29</td>
<td>albumen, 3 plus; hyaline casts</td>
<td></td>
</tr>
<tr>
<td>6-1-29</td>
<td>albumen, 3 plus; hyaline and granular casts</td>
<td></td>
</tr>
</tbody>
</table>

No radiation therapy was employed. In this instance the uranium-thorium colloid seemed definitely nephropathic. The entire series of injections was not completed on account of the illness following the injections. The albuminuria increased with each succeeding injection. Later severe abdominal pain and edema of the lower extremities developed. There was no obvious effect on the mammary cancer. Because of the patient's inability to return to the hospital we were unable to secure additional blood or urine for examination. The patient's condition grew steadily worse and death ensued in September, 1929. No autopsy was performed and the possibility of renal damage remains in consequence unconfirmed.

Case No. 4. R. S., male, aged 54 years, entered the hospital April 9, 1929, with a recurrent tumor of the lip, cheek, and jaw. Five years previously he had first noted a sore in the mid line of the lower lip. Two years later it had been removed by a wedge-shaped incision at another institution. He remained free from recurrence for one year. Then in the latter part of 1927 the tissues of the lower lip became indurated and ulcerated and
another operative removal was attempted. Since December 1928 a large swelling has occupied the left jaw and cheek. He had pain radiating toward the top of the head and had lost 22 lbs. in 3 months. On physical examination the entire lower lip was infiltrated and rigid from the vermilion border to below the mental tubercle. The left lower alveolar process on the outer side, the gingival-buccal gutter and the tissues of the cheek and submaxillary region were involved by an enormous mass measuring 10.0 × 14.0 cm. An ulcerating necrotic tumor, 6.0 cm. in diameter, bulged into the mouth from the buccal mucosa. The external mass extended below and back of the left ear and to the mid line anteriorly. It gave the impression of some cystic degeneration. Stereo-radiographs of the jaws revealed extensive destruction of the left mandible. Two biopsies were reported, the first indicating the impossibility of distinguishing on the basis of the slide alone between a very anaplastic carcinoma and a spindle cell and giant cell sarcoma of unknown origin. The second biopsy favored the anaplastic carcinoma. In view of the history the tumor was undoubtedly carcinoma. 

At the time the uranium-thorium treatment was started the hemoglobin was 70 per cent, erythrocytes—3,896,000, leukocytes—15,400, polynuclears—86 per cent, large lymphocytes—2 per cent, small lymphocytes—7 per cent, transitional cells—1 per cent, myelocytes—4 per cent. The blood urea nitrogen was 7.5 mg. Sixty cubic centimeters of the colloid were administered in 12 injections of 5.0 cc. each from April 9, 1929, to May 13, 1929. On May 5, 1929, the blood picture was essentially unchanged, the urea nitrogen 9.9 mg., the blood sugar 100.2 mg. Urine examinations were as follows:

4–12–29 ........................................... albumen, trace
4–19–29 ........................................... albumen, trace
4–23–29 ........................................... albumen, trace
5–4–29 ........................................... trace of sugar
5–13–29 ........................................... hyaline casts

During the treatment the lesion grew rapidly, filling a large portion of the oral cavity. The drug was possibly nephropathic since bilateral edema of the legs and thighs and ascites developed.
The patient died 2 months after the conclusion of the treatment. No autopsy was performed and the relation of the edema to possible renal damage remains problematical.

Case No. 5. D. P., female, aged 56 years, applied to the hospital on May 10, 1929, complaining of multiple skin nodules following a left radical mastectomy. In November of 1927 she first noted a mass in the left breast. This tumor grew rapidly during the next 2 months and a radical mastectomy was performed at another hospital. In a short time numerous skin nodules appeared over the trunk, neck, scalp, and upper arms. When the nodules first presented themselves they were accompanied by an inflammatory reaction which shortly subsided, after which the tumors became larger and more indurated. The patient was asthenic and had lost 22 lbs. On physical examination the patient was cachectic. The skin surrounding the operative scar was indurated and contained many firm, subcutaneous nodules which extended into the axilla. Scattered over the skin of the abdomen, back, neck, scalp, and upper arms were many firm subcutaneous nodules varying in diameter from 0.5 to 5.0 cm. Some of the tumors were dark red in color, others were surrounded by red or pink areolas. One or two were fluctuant. None were tender. There were hard, firm nodes in the right axilla and left supraclavicular space. The right breast was infiltrated with carcinoma. Radiographs of the chest revealed some increase in density of peribronchial shadows.

The patient received 2 series of treatments with the uranium-thorium colloid, the first of 60 cc., from May 10, 1929, to June 5, 1929, the second of 55 cc., from June 26, 1929, to July 19, 1929. There was no evidence of growth restraint. Lymphedema appeared in the left arm, the patient grew increasingly cachectic and realizing the hopelessness of her condition returned to Italy to die.

The laboratory data were as follows:

\begin{align*}
5-11-29 & : \text{Blood sugar} & \ldots & 110.0 \text{ mg.} \\
5-13-29 & : \text{Blood urea nitrogen} & \ldots & 13.3 \text{ mg.} \\
6-6-29 & : \text{Blood urea nitrogen} & \ldots & 19.1 \text{ mg.} \\
7-22-29 & : \text{Blood urea nitrogen} & \ldots & 23.3 \text{ mg.}
\end{align*}
Repeated blood counts showed:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10-29</td>
<td>75</td>
<td>4,040,000</td>
<td>5,400</td>
<td>63</td>
<td>7</td>
<td>37</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6- 5-29</td>
<td>75</td>
<td>3,840,000</td>
<td>4,800</td>
<td>65</td>
<td>8</td>
<td>20</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>6-19-29</td>
<td>80</td>
<td>4,320,000</td>
<td>4,200</td>
<td>68</td>
<td>2</td>
<td>25</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7- 8-29</td>
<td>75</td>
<td>3,880,000</td>
<td>6,800</td>
<td>59</td>
<td>14</td>
<td>18</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>7-15-29</td>
<td>80</td>
<td>4,100,000</td>
<td>5,000</td>
<td>60</td>
<td>8</td>
<td>26</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Twenty urine analyses revealed the following positive results:

- 5-18-29 ........................ Albumen, trace. Pus
- 5-20-29 ........................ Albumen, trace
- 5-25-29 ........................ Albumen, 1 plus. Pus, hyaline casts
- 5-27-29 ........................ Albumen, 1 plus
- 6-20-29 ........................ Albumen, 1 plus. Few hyaline casts
- 7- 8-29 ........................ Albumen, trace
- 7- 2-29 ........................ Albumen, trace
- 7-15-29 ........................ Albumen, 2 plus
- 7-19-29 ........................ Albumen, 2 plus

Case No. 6. M. M., negress, aged 39 years, applied to the Memorial Hospital on March 22, 1929, complaining of masses in the left breast, axilla, and supraclavicular space. In January of 1928 she had become aware of a mass in the left breast. A few weeks later she observed that the right breast was unusually large and heavy. Six months later the left supraclavicular and cervical nodes were involved and in December of 1928 the left arm became swollen. She suffered from dyspnoea on exertion. Physical examination showed the left breast larger and heavier than the right. In the upper, outer quadrant near the tail of the breast was a diffuse, firm mass. In the left axilla a group of enlarged, hard, semi-fixed nodes were palpated. The left supraclavicular and cervical nodes were enlarged and hard. There was lymphedema of the left arm. The liver was not palpable. There was a decrease in breath sounds at both lung bases, more marked over an area of 5.0 cm. in diameter at the extreme left base. Here there was dullness to percussion. A radiograph of the chest revealed no metastases.

The patient received 60.0 cc. of the uranium-thorium colloid in 12 injections of 5.0 cc. each between March 22, 1929, and
April 26, 1929. There were no constitutional reactions nor were there any alterations observed in the tumors. The left breast continued to increase in size. The axillary nodes became fixed and adherent to the skin. The lymphedema became more pronounced and when last seen Oct. 11, 1929, the patient was seriously ill in an advanced stage of the disease. Her death was reported Nov. 16, 1929.

The results of laboratory examinations were as follows:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3-22-29</td>
<td>70</td>
<td>3,496,000</td>
<td>6,600</td>
<td>51</td>
<td>11</td>
<td>33</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5-1-29</td>
<td>. . .</td>
<td>3,380,000</td>
<td>4,600</td>
<td>55</td>
<td>7</td>
<td>39</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-15-29</td>
<td>. . .</td>
<td>3,720,000</td>
<td>4,800</td>
<td>55</td>
<td>8</td>
<td>31</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3-27-29</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5-3-29 . . . Blood urea nitrogen, 12.0 mg.
3-22-29 . . . Urine, albumen, a trace. Hyaline casts
5-16-29 . . . Urine, albumen, one plus. Hyaline casts

Case No. 7. K. L., female, aged 46 years, applied to the Memorial Hospital on Jan. 28, 1929. In August of 1928 she had noted a small painless nodule in the skin below and medial to the right breast. Two months later she first observed that the breast was large and hard. In December, 1928, the breast ulcerated. The patient was fearful of an operation and did not consult a physician until 4 days prior to admission to the clinic. On admission the right breast was greatly enlarged and completely replaced by a hard tumor mass measuring 12.0 cm. in diameter. The central portion, including the nipple, was superficially ulcerated. The margins of the ulcer were firm and infiltrated. There were several nodules in the skin below the breast and above the costal margin. Large nodes, the largest 2.5 cm. in diameter, were palpated in the right axilla and there were several hard nodes in the left axilla. A radiograph of the chest revealed what was interpreted as evidence of metastases although not extensive. The breath sounds were diminished over the right chest posteriorly. The liver margin was palpable but smooth.

The patient received 2 series of uranium-thorium colloid, the first of 60 cc. administered between Feb. 6, 1929, and March 9,
1929, and the second of a like amount, between April 15, 1929, and May 15, 1929. The laboratory data prior to and during the treatment were as follows:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2-6-29</td>
<td>80</td>
<td>4,176,000</td>
<td>7,200</td>
<td>61</td>
<td>10</td>
<td>19</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>3-4-29</td>
<td>65</td>
<td>3,712,000</td>
<td>9,400</td>
<td>72</td>
<td>2</td>
<td>23</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3-25-29</td>
<td>65</td>
<td>3,424,000</td>
<td>10,200</td>
<td>85</td>
<td>7</td>
<td>4</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>4-8-29</td>
<td>65</td>
<td>3,312,000</td>
<td>12,400</td>
<td>81</td>
<td>4</td>
<td>15</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5-4-29</td>
<td>60</td>
<td>3,400,000</td>
<td>15,200</td>
<td>90</td>
<td>2</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5-13-29</td>
<td></td>
<td></td>
<td>11,000</td>
<td>93</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Blood urea nitrogen 2-7-29 9.9 mg. Blood sugar 2-13-29 12.2 mg. 4-16-29 11.4 mg.

Forty urine analyses were made between 2-1-29 and 5-18-29. The positive findings were as follows:

- 2-8-29: albumen, 1 plus
- 2-14-29: albumen, trace
- 2-18-29: granular casts
- 2-19-29: granular casts
- 3-25-29: albumen, trace. Abundant granular casts
- 4-9-29: albumen, 1 plus. Many hyaline casts
- 5-4-29: hyaline casts
- 5-9-29: albumen, 1 plus. Hyaline casts
- 5-11-29: many hyaline and granular casts. Albumen, 1 plus
- 5-13-29: pus and granular casts. Albumen, 1 plus
- 5-15-29: abundant granular casts. Albumen, 1 plus
- 5-16-29: pus and many granular casts. Albumen, 1 plus
- 5-17-29: many granular casts. Albumen, 1 plus
- 5-18-29: abundant granular and hyaline casts. Albumen, 1 plus

The first intravenous injections were not satisfactorily neutralized and produced thrombosis and sterile inflammation. Subsequent injections gave rise to no untoward local phenomena. After the treatments severe inflammatory reactions occurred about many of the skin nodules. After the first series of injections some of the nodules on the chest wall completely disappeared, the involved breast became smaller, the ulceration was less in extent and the bleeding from its surface practically ceased. This was the only instance where definite effects on the tumor could be seen and these were but transient, since new nodules
developed later. The ulceration of the right breast remained badly infected in spite of local measures to control it. During the last few weeks of life a large abscess developed in the right axilla. This was incised and drained and a culture of the pus was reported hemolytic streptococcus. The temperature ranged from 101 to 103. A radiograph of the chest revealed a thickened pleura and fluid at the right base. The patient died May 23, 1929. An autopsy was performed and yielded the following diagnoses:

1. Carcinoma of the right breast with metastases to skin, axilla, supraclavicular nodes, pleura, diaphragm and by direct extension from the latter to the dome of the liver. Histologically the tumor was a small cell, diffusely infiltrating adenocarcinoma with foci of old thrombosis, necrosis, and infection. The infection alone would be sufficient to account for the changes in the tumor.

2. Axillary and supraclavicular abscess with pus-filled sinus 15.0 cm. in length extending from broken down supraclavicular nodes to axilla and into pectoral muscles.

3. Purulent pleuritis and pericarditis.

4. Vegetative endocarditis (streptococcic) of the mitral valve.


6. Extensive central necrosis of the liver.

7. Acute splenic tumor.

8. Acute streptococcic nephritis.


10. Arteriosclerosis.

Sections showed but slight evidence of the injected colloid in the Kupffer cells of the liver but the central necrosis and bile pigmentation were so extensive that any additional material would have been readily obscured in the absence of some specific stain. Sections from the kidneys failed to show characteristic features of uranium nephritis.

Through the courtesy of Dr. Failla of the physics department the radioactivity of the spleen, liver, and tumor tissue was determined. Spleen (85 grams), radioactivity positive; liver
URANIUM-THORIUM COLLOID

(117 grams), radioactivity positive; tumor tissue (60 grams), radioactivity negative. In other words the radioactivity was confined to organs where all past evidence goes to show that colloidal material is phagocyted.

Case No. 8. W. S., male, aged 38 years, applied to the hospital on Feb. 27, 1929, for treatment of a carcinoma of the lip. For 20 years he had had a gold-capped tooth opposite the lip lesion. He had smoked excessively for many years, always holding the cigar at the site of the lip tumor. He had likewise carried a pipe in the same location. He chewed a moderate amount of tobacco. In November of 1927 he first noted a sore on the inner side of the lower lip on the right. It enlarged rapidly within a month. A physician took a Wassermann, found it positive, and treated the patient for lues. The lesion failed to improve. On physical examination, within the right oral commissure and involving the buccal mucosa and the lower lip as far as the vermilion border, was a tender, indurated ulcer. One right submaxillary node was enlarged and hard. The patient was scheduled to have radium treatment followed by neck dissection. After completion of the radiation the patient disappeared for a period of 8 months. When he finally did return to the clinic in May 1929, the right submaxillary and cervical nodes were hard and matted together by metastatic masses; the primary tumor had recurred in the right cheek which was perforated and a discharging sinus communicated externally and with the mandible, which latter was partially exposed and necrotic. The case was regarded as inoperable and hopeless and was therefore considered suitable for the uranium-thorium colloid. No radiation had been given for about one year previous to instituting the intravenous treatment.

The patient received 2 series of treatments, each totalling 60 cc. (12 injections of 5.0 cc. each), the first series between May 24, 1929, and June 16, 1929, the second from June 27, 1929, to July 23, 1929. A biopsy was reported, squamous carcinoma, grade II, radio-resistant. A blood Wassermann was 4 plus. The blood counts, blood chemistry, and essential urinary findings were as follows:
At autopsy the region of the right mandible from the corner of the lip to the level of the thyroid cartilage was occupied by a deeply excavated, ulcerated, necrotic, hemorrhagic mass of tumor measuring some $5.0 \times 7.0$ cm. The mass extends inward, exposes the mandible where there is a pathological fracture. The ramus of the mandible is almost completely bare. The tumor is hard, pearly gray, and suggests a cellular tumor. There are no distant metastases. The other organs are essentially normal in gross.

Microscopic examination of the liver reveals no evidence of necroses. The Kupffer cells are swollen, show signs of multiplication and are distended with material which with the ordinary hematoxylin-eosin stain appears slightly greenish. It is arranged in refractile, spherical, varying-sized particles, which completely fill the cells. An occasional Kupffer cell is apparently necrotic and is invaded by polymorphonuclear leukocytes and a reactive Kupffer cell proliferation surrounds the necrotic cell. It is the usual type of liver picture observed with many colloidal metals. The spleen shows similar phagocytized material in its reticulo-endothelial apparatus. The splenic leukocytes are increased and there is a considerable plasma cell content. No microscopic evidence of the colloid can be seen in sections of the tumor. The kidneys show no characteristic changes of uranium nephritis.
Tests for radioactivity of the desiccated organs by Dr. Failla gave the following results:

- Spleen: 35 gms. Radioactivity: 1 plus
- Liver: 83 gms. Radioactivity: 2 plus
- Kidney: 62 gms. Radioactivity: zero
- Tumor: 24 gms. Radioactivity: zero

SUMMARY AND CONCLUSIONS

1. Eight cases of carcinoma were treated with intravenous injections of uranium-thorium colloid after the manner recommended by Hocking.

2. In one patient only was there evidence of temporary benefit as judged by disappearance of certain skin metastases from a breast carcinoma. In this case the improvement was but transient and there was no evidence that life was prolonged or that there was any definite palliation.

3. In the remaining 7 cases there was no evidence of improvement of any sort following the treatment.

4. In 2 patients the colloid was possibly nephropathic, although no autopsies were performed for confirmation.

5. In 2 autopsied cases the uranium-thorium colloid was found deposited in the Kupffer cells of the liver and in the splenic reticulo-endothelial apparatus. In these cases the desiccated livers and spleens were radioactive whereas the desiccated tumor tissues showed no evidence of radioactivity.

Note: The authors desire to acknowledge their indebtedness to Dr. Helen Quincy Woodard for her preparation of the colloid and for the desiccation of the organs and to Dr. G. Failla for his measurements of organ radioactivity.