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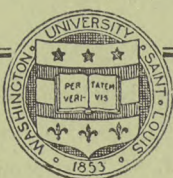
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# WASHINGTON UNIVERSITY MEDICAL ALUMNI QUARTERLY



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● Talcum Powder Granuloma —  
A Frequent and Serious Postoperative Complication

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# The Washington University Medical Alumni Quarterly

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## Talcum Powder Granuloma: A Frequent and Serious Postoperative Complication\*

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**T**HIS STUDY of talc granuloma is being presented in order to stress the seriousness and frequency of a known postoperative complication and to suggest a way by which it may be prevented.

During the past 14 years sporadic reports of talcum powder granulomas following surgical operations have appeared in the literature. Because some of these reports have dealt with a small number of cases scattered over a long period of observation, many surgeons and pathologists have tended to consider the problem chiefly as one of academic interest. During the period in which no apparent solution to the fundamental problem was in evidence there perhaps was some excuse for this attitude. Now that alternatives to the

use of this dangerous agent in the operating room are available, it is well to realize the variety and seriousness of the complications that may arise from the use of talcum powder on surgical gloves.

This study reviews 37 cases of talcum powder granulomas producing symptoms serious enough to require admission to the Barnes Hospital for treatment. In each instance a previous operation had resulted in the leaving of enough talcum powder in the wound to result in a severe silicotic reaction with consequent serious postoperative complications.

Antopol<sup>1</sup> in 1933 was the first to call attention to the clinical and pathologic significance of Lycopodium and talcum powder granuloma in surgery. He pre-

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Fig. 1A

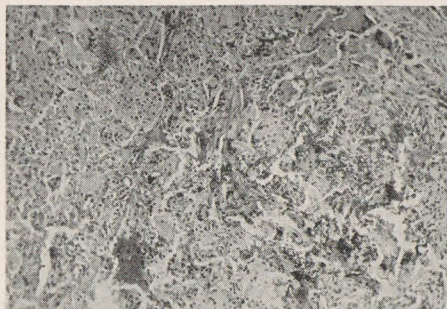


Fig. 2A

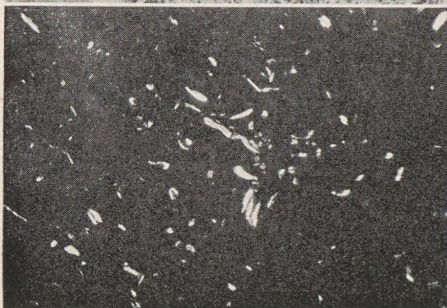
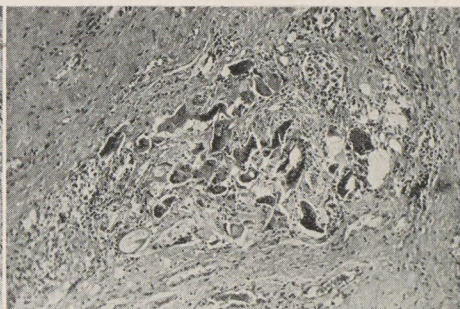


Fig. 1B



Fig. 2B

Fig. 1A—Talc granuloma in lumbosacral extradural space following laminectomy. The process is recent and there are numerous giant cells. (H & E x 150.)

Fig. 1B—Photograph of same field seen in Fig. 1A taken with polarized light to demonstrate the massiveness of contamination. (x 150.)

Fig. 2A—Active reaction to talc in the wall of the ileum following apendectomy. This had resulted in a persistent fecal fistula. The fibrosis around the giant cells is dense and had extended deep into the intestinal wall, where it was associated with secondary infection (H & E x 150).

Fig. 2B—Photograph of same field seen in Fig. 2A taken with polarized light to demonstrate the birefringent talc. (x 150.)



Fig. 3A

Fig. 4A

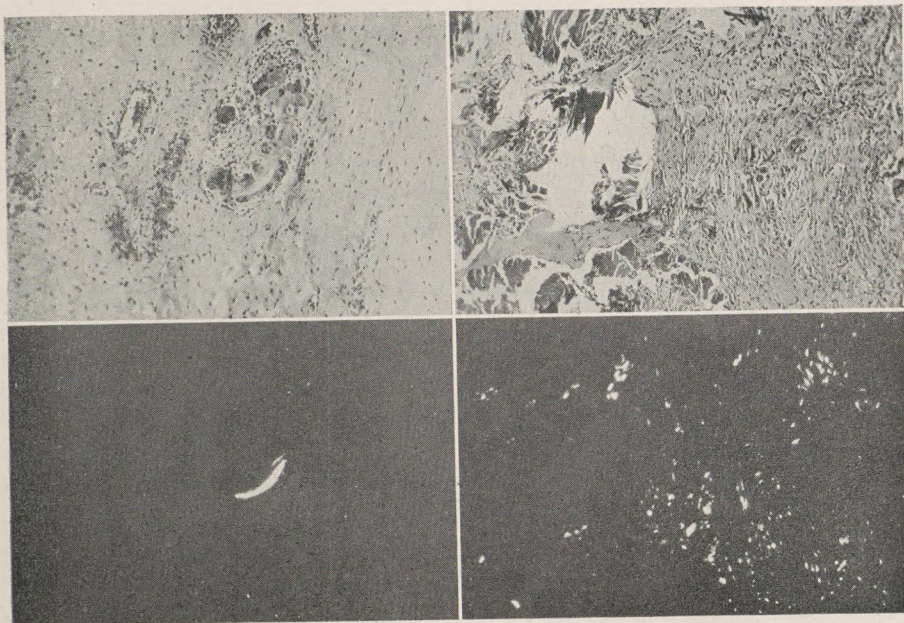


Fig. 3B

Fig. 4B

Fig. 3A—Reaction to an unusually large talc crystal. This followed appendectomy, and the resulting lesion was diagnosed roentgenologically and clinically as regional ileitis. There was a diffuse area of edema and fibrosis involving the terminal ileum. (H & E x 150.)

Fig. 3B—Photograph of same field seen in Fig. 3A taken with polarized light (x 150).

Fig. 4A—Reaction to talc adherent to chromic catgut. This was a peritoneal suture and resulted in the formation of adhesions with subsequent intestinal obstruction. We have noted stenosis of enterostomy stoma as a result of such a reaction to talc contaminating suture material.

Fig. 4B—Photograph of same field seen in Fig. 4A taken with polarized light to demonstrate widespread contamination with birefringent talc.



sented 6 cases of granuloma caused by Lycopodium spores and talcum powder crystals introduced into a surgical wound from the surgeon's glove. He pointed out the clinical similarity of these lesions to both neoplasm and to tuberculosis.

Erb<sup>3</sup> in 1935 reported 6 cases of talcum powder granuloma. In 3 of these cases the granuloma was an incidental finding but in the other 3 patients, the talc granuloma was the fundamental cause of the postoperative complaints. One of these cases had a severe talc reaction deep within the brain substance following a neurosurgic procedure.

In 1936, one other case was reported by Owen.<sup>12</sup> A year later Fienberg<sup>4</sup> reported five instances in which talc crystals were discovered in microscopic sections by the use of crossed Nicol prisms. Birefringent material (of which talc is an example) will by this method of examination rotate a beam of polarized light. The latter author reviewed 30,000 cases and states he found but 5 examples of talc granuloma. He reviews, however, only those cases that had been diagnosed as foreign body reaction of an unknown type.

Grieco<sup>7</sup> in Italy reproduced talc granuloma in animals by injecting a fine suspension of talc crystals subcutaneously and intraperitoneally. He demonstrated that only a few crystals were required to incite a large mass of inflammatory reaction.

Ramsey and Douglass<sup>13</sup> in 1940 added 5 cases to the literature and cautioned against the use of talcum powder in the operating room. The same year German<sup>5</sup> noted the similarity between

the reaction of the subcutaneous tissue to silica and that of the microscopic picture in sarcoid, pointing out that foreign body granulomas might well be confused with sarcoid.

Ten more cases were added to the literature in 1941 and 1942 when McCormick and Ramsey,<sup>11</sup> Byron and Welch,<sup>2</sup> and Ramsey<sup>14</sup> reported a variety of manifestations of this underlying granulomatous lesion. These authors noted the production of peritoneal granulomas, and of chronic draining sinuses caused by the seeding of talcum powder into the peritoneal cavity during various surgical procedures.

Weed and Groves<sup>21</sup> in an effort to find the mechanism of talcum powder contamination of wounds, studied surgical gloves after their operative use. They found that in 74.4 per cent of all operations at least one of the gloves used by the operating team was torn. Of all gloves examined 22.6 per cent showed perforation following use in the operating room. This work emphasizes the fact that simple washing of the gloved hand would not remove the danger of contaminating the surgical field with talcum powder. A relatively large amount of powder remains inside the glove and can easily be spilt into the wound when a glove is perforated.

German<sup>6</sup> in a subsequent report reviewed 20 cases in which he found upon microscopic examination large numbers of talc crystals within the tissue. He required 3 or more crystals per microscopic field before he would consider talc as a causative agent. From his animal experiments in the production of talc granuloma, he states that concom-



itant tissue trauma is necessary in the region of talc implantation for the production of granuloma.

Wells<sup>22</sup> in 1944 noted a number of cases in which talc granuloma had caused a failure of surgical wound healing.

A number of authors have thus recognized the dangers in the use of talcum powder. Seelig, Verda and Kidd<sup>17</sup> in 1943 were the first to offer a substitute for this offending material. They suggested the use of potassium bitartrate powder which they pointed out caused no such tissue reaction as did talc, and was relatively resistant to autoclaving. They also called attention to the bacteriostatic properties of this powder. Subsequent to their report, this material has been adopted by a number of surgeons throughout the country with varying success. The greatest drawback to the use of potassium bitartrate is that if autoclaved for longer than 20 minutes it tends to caramelize, making rubber gloves sticky as well as decreasing their elasticity.

Seelig<sup>18, 19, 20</sup> in a series of three papers in 1944 and the year following, re-emphasized the dangers of talcum powder in the operating room, and offered another more desirable substitute in the form of a specially treated starch powder. It was felt that this new agent once available would replace both talcum powder and potassium bitartrate.

Recently Lichtman<sup>8, 9</sup> *et al.* have published two papers reviewing the entire problem very thoroughly. They present a large series of lesions in which the reaction to talcum was considered to be an etiologic factor, and

discuss the microscopic similarity between the talcum lesions, sarcoid and tuberculosis. They also point out the similarity between talcum powder granuloma and some of the manifestations of regional enteritis.

During recent years surgical specimens showing chronic inflammatory lesions have been examined by us with crossed Nicol prisms, and many clinically unsuspected cases of talcum powder reaction have been identified. The prevalence of these lesions and their varied clinical manifestations prompted us to review the surgical pathologic material at the Barnes Hospital in an effort to correlate our experience with this condition. Many cases coming to reoperation prior to the recognition of the propensities of talcum powder to cause such granuloma had been incorrectly diagnosed, only to be discovered upon re-examination in the light of later knowledge. It is interesting to note that in several cases the pathologist remarked upon the reaction as being "similar to one around a foreign body," but talc was not incriminated until after Antopol's article in 1933.

The fact that talc crystals are found in a microscopic section does not necessarily mean that they underlie the essential nature of the pathologic lesion. A high percentage of cases at reoperation show evidence of the presence of a few talc crystals but in most cases they are merely an incidental finding. Crystals around the periphery of the section are felt to be contaminants, probably from the examining pathologist's glove. For this reason precipitated calcium carbonate is used as a dusting powder in the



TABLE I

Case No.	Original Operation	Time Between Orig. Op. and Appearance of Symptoms	Chief Complaint	No. of Operations Subsequent	Operations Performed	Duration of Symptoms	Died
1.	Appendectomy	3 wks.	Intestinal obstruction	1	Lysis adhesions	6 wks.	
2.	Appendectomy	5 days	Abdominal sinus	5	I&D. Curetings. lap.	2 yrs. +	
3.	Suprabc prostatectomy	0	Abdominal sinus	2	Curetings	2 mos.	
4.	Removal of wart	0	Scar on face	8	Plastic to face	2 yrs. +	
5.	Appendectomy	5 days	Abdominal sinus	2	Excision sinus	17 mos. +	
6.	Cholecystectomy	0	Abdominal sinus	2	Lap. I & D.	8 mos.	
7.	Salpingectomy, oophorectomy	5 days	Urinary and fecal fistula	3	Closure fistulae	10 yrs.	
8.	Myomectomy, appendectomy	0	Abdominal sinus	2	Excision sinus, I&D	10 mos. +	
9.	Appendectomy	0	Abdominal sinus	1	Excision sinus	2 mos.	
10.	Appendectomy, oophorectomy	9½ yrs.	6 days	Fecal fistula	2	Closure fistula	6 mos.
11.	Laparotomy	0	Abdominal sinus	2	Lysis adhesions	6 mos.	
12.	Appendectomy	5 mos.	Mass in RLQ	1	I & D. abscess	1 mo.	
13.	Appendectomy	0	Fecal fistula	4	I&D, excision sinus, resection	1 yr.	
14.	Appendectomy	3 wks.	Abdominal sinus	3	Excision sinus	2 yrs.	
15.	Herniorrhaphy	0	Mass, sinus	2	I & D.	3 yrs.	
16.	Appendectomy	0	Fecal fistula	3	Closure fistula	21 yrs.	
17.	Laparotomy	3 mos.	Intestinal obstruction	6	Lysis adhesions, colostomy, resection ileum	3 yrs.	
18.	Appendectomy	3 mos.	Abdominal sinus	2	Excision sinus	6 mos.	
19.	Appendectomy	14 mos.	Abdominal sinus	4	I&D. curetings	2 yrs.	
20.	Appendectomy	0	Abdominal sinus	4	Laparotomies, exploration	26 mos.	
21.	Nephrectomy	2 mos.	Lumbar sinus	1	Excision sinus	2 yrs.	
22.	Appendectomy	7 mos.	Mass in RLQ	2	I & D.	20 mos. +	
23.	Appendectomy	0	Abdominal sinus	3	Lysis adhesions, I&D.	7 mos. +	
24.	Appendectomy	0	Intestinal obstruction	5	Lysis adhesions, ilectomy	3 yrs. +	
25.	Gastrectomy	1 mo.	Obstruction anastomosis	5	Esophagoplasty, lysis adhesions	6 mos.	
26.	Abdominal hysterectomy	1 wk.	Fecal fistula	2	Ileocecostomy, closure	3 mos.	X
27.	Laminectomy	2 mos.	Sinus	1	Excision sinus	6 mos.	
28.	Laparotomy	1 yr.	Intestinal obstruction	3	Ileostomy, resection		
29.	Laparotomy	1 wk.	Abdominal sinus	3	I & D.	6 mos.	
30.	Appendectomy	2 mos.	Intestinal obstruction	3	Lysis adhesions, resections	6 mos.	X
31.	Thoracotomy	0	Chest sinus	2	Curetting sinus	10 mos.	
32.	Appendectomy	10 yrs.	Intestinal obstruction	3	Lysis adhesions, enterostomy	11 yrs.	
33.	Abdominoperineal resection	2 yrs.	Stenosis colostomy	1	Enlargement colostomy stoma	6 mos	
34.	Laminectomy	0	Pain in leg	1	Laminectomy excision granuloma	13 mos.	
35.	Abdominoperineal resection		Stenosis colostomy	1	Enlargement colostomy stoma		
36.	Cholecystectomy	0	Intestinal obstruction	3	Lysis adhesions	2 yrs.	
37.	I&D. perineal abscess	0	Perineal sinus	2	Excision perineal sinus	2 mos	



surgical pathologic laboratory, it being adequate as a powder and impossible to confuse with talc crystals because of the inability of chalk to rotate polarized light.

We have tried assiduously to avoid indicting talcum powder as the primary etiologic agent in a case until certain criteria have been fulfilled. These are:

1. The finding of doubly refractile crystals in the microscopic section. These crystals must be within the body of the material sectioned.

2. The crystals must have the morphology of talc, as differentiated from lint, fibers of cotton, silk, cholesterol crystals, etc.

3. A typical foreign body reaction must be present immediately around these crystals, which includes the presence of multinucleated giant cells, round cells, and a varying amount of vascular fibrous connective tissue.

4. Clinical interpretation consistent with talcum powder granuloma. This includes a previous operation at the site of granuloma formation, and no other evident source of origin to explain the condition.

Using these criteria, 37 cases have been identified in which a reaction to talcum powder produced the essential lesion. Table I summarizes the important data of these cases.

Not included in this series is a considerably larger group in which all of the criteria mentioned above could not be satisfied. In this latter group the majority of the patients had undergone previous laparotomies with resulting dense diffuse adhesions. As can be noted in the photomicrographs, a minute amount of talc is capable of pro-

ducing a wide fibrotic reaction. The cellular reaction in these cases was identical with that resulting from talc, but because sufficient amount of talc could not be identified, we have not felt justified in including them in the present series. We call attention to them, however, to stress the point that the talc reaction in our opinion plays a prominent role in many instances in the formation of that type of dense stenosing fibrosis so often associated with postoperative symptoms.

The most striking fact concerning this group of postoperative patients is the diversity of the clinical syndromes that they represent. The most common finding is that of a surgical wound that failed to heal postoperatively. Twenty-three cases (62 per cent) had such a manifestation: 15 had a chronic abdominal sinus, 1 a lumbar sinus, 1 a sinus in the chest wall, and 1 a perineal sinus. A few of these were simple superficial wounds and were considered clinically to be stitch abscesses. Others extended deep into the peritoneal cavity.

Besides these sinuses, five fecal fistulas were found. Before including these cases, ample evidence of talc deep in the sinus wall was required, for many doubly refractile vegetable bodies could pass into such a fistulous tract from the lumen of the intestine. As in Lichtman's series<sup>8</sup> many of these cases with fecal fistulae had been thought clinically to have regional enteritis.

Table II shows the frequency of the various clinical complaints.



TABLE II  
CLINICAL COMPLAINTS IN 37 PATIENTS WITH POSTOPERATIVE  
TALCUM POWDER GRANULOMA

Sinus .....	18
Abdominal sinus .....	15
Lumbar sinus .....	1
Chest sinus .....	1
Perineal sinus .....	1
Fecal fistula .....	5
Intestinal obstruction .....	7
Tumor mass .....	3
Neurologic signs .....	2
Stenosis .....	2

Most of the patients in this series had many previous operative procedures before being seen in this hospital. Eight patients (22 per cent) had four or more operations. The average patient had 2.5 operations with no assurance that more procedures would not be required after discharge. In two patients further surgery is known to have been performed at other hospitals when emergency procedures were necessary.

The type of operation performed in treating these complaints were varied. Seventeen patients had closure or attempted closure of a chronically draining sinus. Many of these patients required multiple operations. Lysis of postoperative intestinal adhesions was carried out in seven cases, and a like number required bowel resection. Incision and drainage, with curettage of sinuses was performed in 21 cases.

The condition most often confused with talc granuloma clinically in this series was tuberculosis. This was due to the chronicity of the signs and symptoms and to the similarity in the gross between the granulomatous lesions. Non-caseous tuberculosis was a repeated suggestion in the clinical his-

tories, and gross examination often lent weight to the diagnosis. The microscopic picture was of course always slightly atypical of tuberculous infection.

As previously noted, regional enteritis was often suggested when small bowel symptoms predominated.

Talc granuloma is a chronic condition. In this series, symptoms ranged from a few months to 21 years. During this time there were long silent periods in which no evidence of foreign body was seen. Then without obvious stimulus there were symptoms of irritation. Although a few cases had their first symptoms occur in a matter of months after operation, most had some evidence of foreign body reaction during their immediate postoperative hospital stay. Those cases with obstructing intestinal adhesive bands seemed to have late evidence of their talc reaction, perhaps because it required some time for the adhesions to form and become constrictive.

There were two deaths in this series.

The primary operations during which time talc was implanted represent procedures in all branches of surgery and



its specialties. The most common operation responsible for talc spillage was appendectomy (49 per cent), followed by laparotomy for unknown procedures (11 per cent). Gynecologic operations accounted for 11 per cent of the cases, genitourinary, orthopedic, plastic, thoracic and neurosurgical procedures each were responsible for at least one example of talc spillage and subsequent reaction.

The danger of this silicotic reaction, therefore, is universal. In some areas small granulomas may cause fewer symptoms than others. This proliferative process once present usually persists for years. The part it plays in the production of postoperative abdominal adhesions has been tragic and apparent. The damage in other surgical procedures such as craniotomy, while present, has been less obvious.

#### PATHOLOGY

Upon gross examination talc granulomas are not pathognomonic. In cases where a mass was observed, the operative notes almost invariably mention the hard consistency and pearly white or grey color of the tumor. In many cases biopsy of the area was made upon laparotomy because of the dense consistency of the area, which suggested malignancy. When small multiple, discrete, areas of reaction were seen at operation, the surgeon's note often mentions the resemblance to miliary tubercle formation. Adhesive bands within the peritoneum were noteworthy because of their dense inelastic consistency and their vascularity. The pathologist usually described the smaller

lesions as feeling shotty when rolled between the fingers.

The largest granuloma in this series was a sausage shaped mass involving the transverse colon, measuring 14 cm. in length and 8 cm. in width. (Case No. 30.) Most of the granulomas, however, were small nodules measuring about 1 cm. in diameter.

Microscopically talc granuloma fits in with those agents that upon introduction into the body cause a foreign body reaction of the proliferative type.<sup>10</sup> Pulmonary silicosis has been widely studied, and talc (Magnesium Silicate) reaction is merely a localized form of this same condition.

Talc crystals are seen microscopically to be surrounded by masses of fibrous tissue in which there is excessive collagen production along with inflammatory cells. Individual talc crystals are seen to be the nidus of the inflammatory reaction, which has a peculiarly wild and unoriented appearance. Connective tissue strands are mixed in whorls and cross currents as they envelop the irritating talc particles. The cellular response consists of foreign body giant cells which surround (and in the case of small crystals also ingest) the talc particles. No evidence of destruction of these non-absorbable particles is seen so that the reaction by no means resolves the condition. The multi-nucleated cells in some cases reach tremendous proportions, generally with a clear cytoplasm in which numbers of small nuclei are eccentrically clustered. Small round cells are typically in evidence. No caseation is ever seen.



The microscopic similarity to a tubercle is evident, for a focus of inflammatory reaction is surrounded by lymphocytes, giant cells, and a proliferative connective tissue response. Identification of talc crystals in the center of the lesions is of course the point of differentiation. This can be performed on routine examination merely by using a strip of polaroid material between the light source and the microscopic slide, and other such polarizing strip between the slide and the eye arranged so as to darken all but birefringent particles.

Foreign body reactions from other materials are often similar microscopically to that due to talcum powder crystals. The reaction to suture material is of interest in this respect. Strands of cotton or silk are themselves slightly birefringent. It was noticed in several cases, however, that strands of such sutures were surrounded by a halo of birefringent particles that did not appear to be silk or cotton fibers, but rather to be of the nature of talcum powder crystals. For this reason, several sutures were mounted on a slide and examined with polarized light. It was found that sutures that were new and dry showed none of these birefringent particles. Suture material from the same source was then wet in water and run through a hand that had been dusted with talcum powder. The particles of talc obviously were transferred to the wet suture, and became adherent. It is possible, therefore, that much of the foreign body reaction ascribed to suture material may actually be due to the tiny talc particles that are adherent to the thread.

From our own experience and from that of others where talcum powder is used on the hands and gloves or where it is on the scrub nurse's table it is a source of danger. The deposition of a thin layer of talc on gauze sponges, packs, and on the instruments follows the all too frequent and vigorous powdering of the hands preparatory to donning gloves. With care this hazard may be lowered, but even the utilization of utmost care cannot completely exclude the possibility of occasional accidental contamination.

The ability of talc to spread throughout a room can easily be demonstrated by placing a dark piece of paper or a book on one side of the room, then carefully powdering the hands on the opposite side of the room. In a matter of a few minutes a thin layer of talc will be seen settling on the darkened surface.

It would seem to us that the best answer to the problem is either the use of wet gloves or the substitution of an innocuous dusting powder. As previously mentioned, potassium bitartrate has been used as such a substitute. More recently, starch treated with formaldehyde in order to prevent the formation of a gel upon autoclaving has been tried. Seelig has shown the lack of tissue reaction to this material in a series of elaborate animal experiments.

Various treated starch compounds have been introduced into many animals (dogs, mice, rats, and guinea pigs). In no case does the powder elicit a granulomatous response. The innocuousness of starch in the tissue and the rapid rate of its dissolution is clearly



evident when the powder is injected into the anterior chamber of a rabbit's eye. Examination of an animal four days after 2 mg. of formalized starch has been introduced into the right eye, and 2 mg. of talc had been injected into the anterior chamber of the left eye shows that starch has been absorbed, leaving no reaction. Severe fibrosis and tissue reaction is seen, on the other hand, in the talcum treated eye. The talc reaction subsequently caused blindness.

Unfortunately, however, very recent clinical experience has disclosed an unexpected difficulty. The formaldehyde starch is somewhat unstable, and seems to split up on ageing, liberating free aldehyde. This, of course, can act as an irritant to the hands of the surgeon. One corporation interested in developing the new powder seems to have used other aldehydes, and to have added magnesium carbonate to increase the "flow" of the powder. We have found previously that magnesium carbonate produces granulomata; moreover, the new aldehyde-starch powder has evoked hand irritation in one of our resident surgeons.

As a result of the more recent experience, we are still searching for an adequate substitute for talcum. More time

must elapse before we can be sure that the aldehyde treated starch is completely innocuous to both the patient and the surgeon. In the meantime, as previously stated, potassium bitartrate, properly sterilized, can be used. Talcum must be banned from the field of surgery.

#### SUMMARY

1. Thirty-seven cases of postoperative complication due to talcum powder granuloma have been presented.

2. These cases represent a wide diversity of complications, ranging from simple wound abscesses to serious sequelae such as fecal fistulae and intestinal obstruction.

3. The clinical and pathologic nature of this condition has been discussed.

4. Emphasis has been placed upon the requirements of a suitable alternative dusting powder for use in the operating room.

5. Review of our experimental and clinical trials of formalized starch compounds as dusting agents in the operating room has been given.

6. The starch compounds as now produced are not completely stable, and must be further modified before we recommend their use.



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## Proceedings of the Washington University Medical Society

**T**HE first meeting of the Washington University Medical Society for the school year 1948-49 was held Thursday, October 21, at 8 p. m. in the Auditorium of the School of Medicine, and the date for the second meeting was set for December 8th at a meeting of the Council of the Society on September 27.

Following its reorganization last year, the Medical Society had five very

successful meetings, and hopes to enjoy an equally successful season in 1948-49. The final session last spring was devoted to the presentation of papers submitted by students in the annual competition for the Borden Undergraduate Research Award, which was won by James F. Nickel, M.D., 1948.

Abstracts of the three papers presented at the student meeting on May 20, are published herewith:

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### COMPARISON OF TRANSFUSION SURVIVAL, MECHANICAL FRAGILITY AND SICKLING SUSCEPTIBILITY IN SICKLE CELL ANEMIA AND SICKLE CELL TRAIT ERYTHROCYTES

By James F. Nickel, M.D.

*Department of Medicine*

This investigation was undertaken for three reasons: (1) to determine the mechanism for the increased hemolysis in sickle cell anemia; (2) to analyze the differences in behavior of red blood cells from patients with sickle cell anemia and the sickle cell trait; and (3) to search for evidence that forms of sickle cell disease intermediate between the "anemia" and the "trait" might exist.

These problems were approached first by measuring the survival of red blood cells transfused from patients with sickle cell anemia and the trait into normal recipients, and of cells transfused from normal subjects into patients with the sickle cell trait. A technique was then developed which

permitted study of the mechanical fragility of normal erythrocytes and of cells from patients with sickle cell anemia and the trait, under high tensions of oxygen and carbon dioxide. Finally, a study was made of the relative ease of sickling in cells from the two types of patients.

The results obtained indicate that the normal hemolysis in sickle cell anemia is the result of an inherent defect in the erythrocyte itself. The cells in their sickled form are abnormally sensitive to mechanical trauma. Red blood cells from patients with the sickle cell trait sickle less readily and for this reason probably withstand the trauma of circulation in a more normal manner. Cells from individuals with the sickle



cell trait survived normally when transfused into healthy recipients. No evidence was discovered for the existence

of forms of sickle cell disease intermediate between the sickle cell trait and the anemia.

### GLYCOGEN IN HUMAN BLOOD CELLS

**By Robert P. Gibb, M.D.**

*Department of Pathology*

Three different histochemical methods were applied to the study of glycogen in normal and abnormal peripheral blood and bone marrow films. The techniques employed were the chromic acid-silver-methanamine procedure of Gomori, the periodic acid-fuchsin sulfurous acid technic of Hotchkiss and the Bauer-Feulgen stain. Control sections were treated with saliva to remove the glycogen.

Large amounts of glycogen were demonstrated in the cytoplasm of polymorphonuclear, metamyelocytic, and myelocytic neutrophilic leukocytes and in the extra granular cytoplasm of eosinophilic leukocytes in films from normal individuals. Megakaryocytes

and the cytoplasm of monocytes contained moderate amounts of glycogen, and platelets and the cytoplasm of lymphocytes smaller amounts.

Examination of peripheral blood and bone marrow of patients with various hematologic, metabolic, and infectious diseases revealed no significant differences in glycogen content from the normal with the possible exception of polycythemia in which a suggestive increase in cellular glycogen was observed in polymorphonuclear leukocytes, platelets, and megakaryocytes. A moderate amount of glycogen was observed in multiple myeloma cells. Large cells in patients with infectious mononucleosis did not stain for glycogen.

### THE EFFECT OF TETRA-ETHYL AMMONIUM CHLORIDE ON THE RESPONSE OF THE ADRENAL GLAND TO SENSORY NERVE STIMULATION

**By Seymour Reichlin, M.D.**

*Department of Neuropsychiatry*

There is considerable evidence indicating that, in some manner, the central nervous system may control the output of adrenal cortical hormones. It recently has been shown that epinephrine activates the adrenal cortex. An attempt was made to dissociate adrenal medullary activity from adrenal cortical activity in the response to stimulation of the

central end of the sciatic nerve in rats by using the drug tetra-ethyl ammonium chloride (TEA). The adrenal ascorbic concentration technique of Sayers was used to indicate cortical activity, and changes in blood sugar to indicate medullary activity.

In the course of the investigation it was learned that the adrenal concentra-



tion of ascorbic acid was affected by the emotional stress incident upon simple laboratory handling. The blocking agent of itself activated the adrenal cortex, and sensory stimulation in the rat pre-treated with TEA failed to lower the ascorbic acid to values obtained by sensory stimulation alone. This observation

could not be ascribed to a specific ganglionic effect since similar doses also prevented the effect of injected epinephrine; the amounts needed for this effect were very toxic. It was concluded that the use of the drug for this type of investigation was sharply limited by its own harmful properties.

## Dr. Elman Returns from Medical Teaching Mission in Poland and Finland

A feeling of genuine friendship and appreciation for an insight into the newer concepts of medicine was engendered by the 11-man medical teaching mission which visited Poland and Finland during July and August, according to Dr. Robert Elman, professor of clinical surgery at the School of Medicine. Dr. Elman was one of the members of this teaching team, which was a joint project of the World Health Organization and the Unitarian Service Committee.

Truly international in character, the mission was composed of seven United States doctors and one each from Czechoslovakia, Sweden, Switzerland, and England. These 11 men represented specialties including internal medicine, anesthesiology, pediatrics, psychiatry, radiology, and four types of surgery — general, neurological, orthopedic and thoracic. Activities of the group were varied among formal lectures, round table discussions, ward rounds, clinical conferences, operations and demonstrations at the University of Warsaw, University of Cracow, University of Poznan, Kosciuszko Hospital in

Piekary, Poland, University of Helsinki and University of Turku in Finland.

The mission took with it American textbooks, medical and surgical journals, reprints, and moderate amounts of medical supplies, particularly the newer drugs developed in this country. The members helped establish blood banks and contributed their own blood at one hospital in Poland as an example to break down objections. The visiting group found that much of the hospital equipment was modern, having been donated by U. N. R. R. A. and the Unitarian Service Committee.

Dr. Elman expressed a belief that considering that 60% of the doctors in Poland had been killed during war and the handicap of inadequate supplies, the physicians there were doing a remarkable job in caring for the people. They are tremendously eager to learn of new methods and have an insatiable desire for United States medical publications, so difficult to obtain there, he said.

Dr. Elman gave a lecture, using many of the color slides he photographed on the trip, at the First Unitarian Church of St. Louis on October 8.



## Woman Ranks First in Class of '48

A woman student, Miss Helen Estelle Clark of Paris, Texas, led the 1948 class in medicine with the highest average for the entire four-year course at Washington University and was the recipient of the Alpha Omega Alpha Fraternity Prize. Now Dr. Clark, she is serving a year's internship in medicine at Barnes Hospital in St. Louis.

Miss Clark was one of nine medical students who were graduated with the degree of doctor of medicine cum laude during the Commencement Exercises of Washington University on June 8. The others were: Virgil R. Bleisch, Bernard T. Garfinkel, Alfred H. Lampe, Daniel L. Morgan, Frank B. Norbury, Gerald T. Perkoff, Seymour Reichlin, and Arthur H. Stein, Jr.

The Borden Undergraduate Research Award of five hundred dollars was awarded to James F. Nickel for his research on the "Comparison of Transfusion Survival, Mechanical Fragility and Sickling Susceptibility in Sickle Cell Anemia and Sickle Cell Trait Erythrocytes," an abstract of which appears in this issue of the QUARTERLY. The George F. Gill Prizes in Anatomy and Pediatrics went to Myron W. Wheat, Jr., and Bernard T. Garfinkel, respectively. Miss Harriette Lutz won the Howard A. McCordock Book Prize for excellence in pathology, and the Sidney I. Schwab Book Prize in psychiatry went to Milo L. Heideman, Jr.

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Please notify the Medical Alumni Office when your address changes.

## '48 Class Interning in All Parts of Country

Washington University School of Medicine is represented in hospitals all over the country through the internships now being served by members of the 1948 class in medicine. A tabulation according to area gave the following results:

The St. Louis area leads in number of students serving internships, with a total of 38. St. Louis City Hospital has 12; Barnes Hospital, 10; Jewish Hospital, 7; St. Luke's Hospital, 7; and Missouri Baptist Hospital, two. One other graduate is interning in the state of Missouri and he is in Kansas City.

Chicago ranks second, having eight members of the '48 class interning there. The state of California has six, New York City claimed five, and Minnesota has four. Following these come Michigan with three, and Washington, D. C., Maryland, state of Washington and North Carolina, each with two.

The states of Ohio, Connecticut, Pennsylvania, Iowa, Alabama, Indiana, Massachusetts, Tennessee, Utah and Wisconsin each have one interne from Washington University. Serving outside the continental United States are one graduate at Queen's Hospital in Honolulu, and one girl at the Permanente Foundation in Vancouver, British Columbia, Canada.

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The 1948 graduates received excellent internship appointments, according to Dr. Thomas Hunter, assistant dean, and will represent Washington University's extensive medical program in their new jobs.



## 351 Enrolled in Medical School for '48-'49

Enrollment for the four classes in the School of Medicine totaled 351 students, including 31 women, upon completion of registration on September 11. The freshman class, which registered on September 8, numbers 86 students, while there are 83 sophomores, 86 juniors and 96 seniors. Of the 31 women students, only two are in the first year class, with seven in the sophomore class, eight seniors, and 14 juniors.

Other departments in the Medical School registered at various times during the week of September 13, when regular classes in medicine began their sessions. Twenty-five students registered in occupational therapy; 13 in hospital administration; nine in physical therapy; and three in orthoptic technology. In the long-term postgraduate courses, 23 enrolled in otolaryngology and 11 in pediatrics. The department of anatomy has 19 postgraduate students.

All students were given the regular physical examinations and, in addition, the freshmen this year took a battery of aptitude, personality and other special tests as part of their orientation program.

### Cancer Research Move from Barnard Completed

With the move of equipment and personnel from Barnard Free Skin and Cancer Hospital to the School of Medicine completed on September 13, cancer research in the Department of

### Yale Publications Received as Memorial to Dr. Fred Towsley Murphy

A special exhibit of 177 publications of the Yale University Press which have been received by Washington University in memory of Dr. Fred Towsley Murphy, professor of surgery in the School of Medicine from 1911 to 1919, was on display in the Medical Library from October 1 through 15. Dr. Murphy was a graduate of Yale College, class of 1897, and was the founder and first commanding officers of Washington University's 21st Hospital Unit in World War I, 1914-1918.

The volumes in this collection are largely historical, medical and scientific, but a few dealing with literature have been included. The books on medical and scientific subjects will become a part of the Medical Library, while those in history and literature are to be added to Ridgley Library on the University campus. In connection with this memorial gift, a special gift book plate was designed by Yale University Press, with reproductions of the seals of both Washington and Yale Universities. Each of the 177 volumes in this collection contains one of the book plates as a permanent memorial to Dr. Murphy.

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Anatomy is now centralized in the department proper. Research activities already have been initiated in the newly-remodeled laboratories on the third floor of the North Building, and with the concentration of work under one roof, these activities can be much better integrated.



## Departmental News

### Anatomy

Dr. Warren Andrew, professor of anatomy at George Washington University in Washington, D. C., has been appointed visiting professor of anatomy for the six-month period beginning September 1. He will substitute for Dr. Mildred Trotter, professor of gross anatomy, who is on a year's leave of absence as anthropologist for the U. S. Army in the Territory of Hawaii.

Dr. Theodore Rosenthal, research associate in cancer, returned in September after spending five months studying at the Carlsberg Laboratory in Copenhagen, Denmark, where he worked under Dr. Heinz Holter and Dr. Lindstrom-Lang.

Dr. George G. Rowe has returned to Washington University after two years with the army and will be instructor in gross anatomy.

### Biological Chemistry

The Francis P. Garvan Medal honoring women in chemistry was awarded to Dr. Gerty T. Cori, professor of biological chemistry, at a general session of the American Chemical Society on August 31. Dr. Cornelia T. Snell of New York accepted the award for Dr. Cori, who was on vacation at the time.

Dr. Paul W. Preisler, assistant professor, was elected secretary of the Division of Biological Chemistry of the American Chemical Society at a meeting in Washington, D. C., early in September. He succeeds Dr. John T. Edsall of Harvard University.

### Neuropsychiatry

Dr. Ivan Mensh of Chicago arrived in St. Louis August 30th to take over his duties as instructor in medical psychology at the School of Medicine. Dr. Mensh comes here from the department of psychology at Northwestern University, and recently received his Ph.D. degree from that school.

Dr. Robert I. Watson, associate professor of medical psychology, and Mr. Samuel Granick, instructor in medical psychology, attended the American Psychological Association meeting held in Boston from September 6 to 11. Mr. Granick gave a paper on "The Relationship between a Projective and a Questionnaire-Type of Personality Test in Clinical Diagnosis." During the meeting, Dr. Watson was elected to the Editorial Board of the *Journal of Clinical Psychology*.

### Ophthalmology

Dr. M. Hayward Post, professor of clinical ophthalmology, was elected chairman of the Eye Section of the American Medical Association at the annual convention which was held in Chicago late in June. He will hold office for one year.

### Pathology

Dr. Robert A. Moore, Dr. Margaret G. Smith, and Dr. Barnet M. Levy attended the First International Poliomyelitis Congress, which was held in New York City from July 12 to 17.

Dr. Edmond I. Shwayri, a graduate



### Pathology (Cont.)

of the American University of Beirut in Lebanon, has joined the department with a fellowship from the Rockefeller Foundation.

During the middle of September, Dr. Robert A. Moore, professor of pathology, attended a meeting of the Gerontology Study Section at the National Institute of Health in Bethesda, Md., and was in Washington, D. C., for meetings of the Advisory Committee on Cancer Control for the United States Public Health Service, the American Association for the Advancement of Science, and the Scientific Advisory Board of the Army Institute of Pathology.

The St. Louis Pathological Society met in the department of pathology at the School of Medicine on September 24th with the members of the department giving four papers for the program. Dr. Ruth Silberberg, instructor in pathology, was in charge of the program, which was as follows: "Anatomic Changes in Poisoning by Ethylene Glycol," by Dr. David Smith; "Experimental Studies in Leptospirosis," by Dr. Parker Beamer; "Modification of the Vascular Response in Experimental Hypersensitivity," by Dr. Gustave Dammin and Dr. Samuel Bukantz; and "Arteritis in Infancy with Aneurysm of the Coronary Artery and Myocardial Infarction," by Dr. Clarence Pickard and Dr. Gustave Dammin.

### Pediatrics

During the annual meeting of the American Pediatric Society, held in Quebec, Canada, from May 24 to 26,

Dr. Jean V. Cooke, professor of pediatrics, was elected president for the ensuing year.

Dr. James Goodfriend, instructor in pediatrics and assistant physician on the staff of Children's Hospital, died July 5 of heart disease at his home in Clayton. He came to Washington University on July 1, 1946, when he was appointed an assistant in pediatrics. He was appointed instructor on July 1, 1947. A graduate of the University of Missouri in 1935, Dr. Goodfriend won a Rhodes Scholarship and attended Oxford University in England, receiving his Ph.D. degree from there in 1937. He received his M.D. degree from Northwestern University in 1940.

### Pharmacology and Preventive Medicine

On their return from a nutritional survey at St. John's, Newfoundland, Dr. Oliver Lowry, professor of pharmacology, and Dr. Robert Shank, professor of preventive medicine, reported that the group of doctors conducting the investigation were fortunate in being able to examine many of the original group which were examined four years ago. At that time several doctors made a survey of the physical condition of residents there prior to the time that enriched grain was inaugurated in the food diet.

Many of the scientists on this recent trip were members of the original examining group. Their general conclusion was that the physical condition of their subjects had improved after the addition of enriched grain, but final re-



### **Pharmacology and Preventive Medicine (Cont.)**

ports are awaiting tabulation of data and completion of chemical analyses of samples which were brought back.

### **Physiology**

Dr. William Sleator has been appointed assistant professor of biophysics in the department of physiology, starting October 1.

Dr. J. W. Duyfs, professor of physiology at the University of Leyden in the Netherlands, was a visitor in the Department during August.

### **Radiology**

Dr. Wendell G. Scott, associate professor of clinical radiology, has been appointed a member of the Committee on Radiology of the Division of Medical Sciences for the National Research Council. The Committee will act as advisor to the Veterans Administration and other federal agencies. During a meeting of the Rocky Mountain Radiological Society in Salt Lake City, Utah, from August 12 to 14, Dr. Scott presented papers on "The Importance of Early Diagnosis of Carcinoma of the Colon," and "Low Back Pain and the Evaluation of Radiographic Methods of Diagnosis."



## Publications of the Faculty

June - September, 1948

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## Alumni News

1880

**Porter J. Mitchell** died at his home in Rocheport, Mo., on April 21 of this year at the age of 86 years.

1881

**William G. Estill** of Lawson, Mo., died November 27, 1947.

1887

**Henry R. Smith** of Detroit, Texas, passed away at his home on June 21, according to a note from his daughter. Dr. Smith, who was 93, had practiced medicine in Detroit and Red River County for 66 years and was past president of the Northeast Texas Medical Society and of the Red River Medical Society. His daughter writes that "He was so very proud of Washington U. and its continued development."

1891

Funeral services for **Walter E. Gibson** were held July 26 in De Soto, Mo., where he had practiced medicine for 54 years. He served as mayor of De Soto for ten years and was active in many civic affairs. He retired from practice two years ago.

1894

**George B. Tuttle** recently moved from Boonville, New York, to Arlington, Virginia.

**Horace W. Soper** was selected president-elect of the National Gastroenterological Association at the latest meeting in New York City.

1895

**John M. Brooks** now lives on Route 1 at Diamond, Mo., and recently moved from Neosho, Mo.

1897

**E. B. Miller** of Wakita, Oklahoma, passed away last May 13 of a heart ailment.

1905

**Thomas J. Nalley** recently moved from Ontario, Calif., and is now living in Riverside, Calif.

**Marshall Wallis** writes that he has retired from practice at the age of 70 years and is living on and off a citrus grove in La Feria, Texas.

1914

The sudden death of **Joseph F. Bredeck** of a heart attack on October 4 stunned his family, his friends and the people of St. Louis, for he had been the city's crusading health commissioner for 15 years. After receiving his medical degree here, Dr. Bredeck spent three years in specialized study of tuberculosis, and in 1917 obtained a degree of doctor of public health from the University of Pennsylvania. He returned to St. Louis, was a medical officer in World War I, and in 1920 was appointed tuberculosis controller of St. Louis. In 1933 he was appointed health commissioner for the city and from that time until his death, was a fighter for the improvement of health standards in St. Louis. Over bitter opposition, he put through two major city ordinances—the standard milk and clean restaurant regulations. He gave much attention to venereal disease control and recently had been working on plans for higher ice cream standards. Three sons survive Dr. Bredeck, who was 58 years old.

1923

**Harold F. Corson** is now living at 1202 Park Ave., in Richmond, Virginia.

1925

**George S. Johnson** of Nashville, Tenn., died May 20, 1948 in Nashville.

1926

**Caleb Stone** is living at 1115 Terry Street in Seattle, Washington.

**Rodney Gray** has moved from Brooklyn, Wisconsin, to the town of Evansville in the same state.

1928

**Richard D. Kepner** is practicing psychiatry in Honolulu, where he has offices in the Young Hotel Building.



**W. F. Ossenfort** was transferred last June by the U. S. Public Health Service to the U. S. Merchant Marine Academy at Kings Point on Long Island, New York, where he is now Chief Medical Officer.

1929

A newspaper clipping received by the *Quarterly* tells of the work of **Brig. Gen. Crawford Sams**, who as Gen. Douglas MacArthur's Public Health and Welfare Secretary in Japan, has been in charge of persons who were injured and made homeless by earthquakes in Japan during recent months. General Sams has been in Japan since the close of hostilities, and before that time was on General Marshall's staff in Washington, D. C. Late in 1941 he helped direct the establishment of medical installations for the Army in the Middle East theater of operations and later became chief surgeon and directed the operation of U. S. Army hospitals in that area. He participated in four major campaigns during 18 months on overseas duty.

**Noka B. Hon**, who formerly lived in Chevy Chase, Maryland, has moved to Phoenix, Arizona.

1930

**Robert W. Boal** is now at the University of Nebraska Medical School in Omaha.

**Roy W. Tandy** has been transferred from the Naval Hospital in Oakland, Calif., to the Naval Air Station at Sand Point, Seattle, Wash.

1932

**John B. Grow**, who was a captain on duty at Fitzsimmons General Hospital in Denver, now has offices in the Metropolitan Building in that city.

1933

**Lt. Oreon Timm** has been transferred by the Veterans Administration Hospital at Fort Custer, Mich., to the V. A. Hospital in Danville, Ill.

**Edward Grose** is now with the University of Kansas Medical Center in Kansas

City, Kansas. He was living in Magna, Utah.

**Charles Oderr** has moved from the bustle of New York City to 17 Carman Rd., in Scarsdale, New York.

1937

**Willis Hayward** recently moved to a home at 3 North Main Street in Logan, Utah.

**Philip Risser** is now with the Olympic District Health Department at Port Angeles, Washington.

1938

**James F. Nolan** resigned last July as assistant professor of obstetrics and gynecology at W. U. School of Medicine to take a position on the staff of the Los Angeles Tumor Clinic in Los Angeles, Calif.

**Harry H. Abrahams** is now at Gallinger Hospital in Washington, D. C.

1939

**Robert E. Shank** is back in St. Louis as professor of preventive medicine and head of the department of preventive medicine and public health at W. U. School of Medicine. He was a member of a group which conducted a nutritional survey at St. John's, Newfoundland, in August.

**Mark Brockbank** is living at 1631 Kensington Ave., in Salt Lake City, Utah.

1940

**Robert L. Garrett** moved from the Charity Hospital in New Orleans to Oakland, California, where his address is 3324 64th Avenue.

**Russell J. Crider** recently moved from St. Louis, where he was an assistant in surgery on the School of Medicine staff, and is in Spokane, Washington.

1941

**Howard S. J. Walker, Jr.**, can be reached at 314 South Garth Ave., in Columbia, Mo.

**David Bachwitt's** address has been changed to 948 Woodland Ave., in South Charleston, West Virginia.



1942

**Herman Blumenthal** is now living in Kirkwood, Mo.

**Wendell Jones** has moved from Missoula, Montana, to Fort Riley, Kansas.

**Souther Tompkins** is living now in Rochester, Minn.

1943

**Rymal G. Williams** writes from Cedar City, Utah, that he completed a residency in pediatrics and also a residency in surgery at Denver General Hospital in July, 1947. He is now in an active-going practice in Cedar City, with particular interest in general surgery.

**John L. Cockrell** has moved from Richmond, Mo., to St. Louis.

**F. W. Knoke** has also returned to the St. Louis area from Detroit, Mich.; he is living in University City.

**H. C. Harding** has moved from Jefferson City, Mo., to 4160 S. W. Patrick Pl., in Portland, Ore.

1943

**David Stadtner**, formerly at Fresno General Hospital in Fresno, Calif., is now living in Stockton, Calif.

**Margaret Meyn** has moved from St. Louis to Terre Haute, Ind.

**William Middleton** began a residency in ophthalmology at the Illinois Eye and Ear Infirmary in July. He and his wife and their three-year-old daughter, Anne, are living at 6542 North Richmond in Chicago.

**Tom G. Stauffer** recently announced the opening of his office for the practice of psychiatry at the Chateau Lafayette in Scarsdale, New York.

**William J. Miller**, a captain in the U. S. Army Medical Corps, is chief of pediatrics at Fort Hamilton Hospital in Brooklyn, New York.

**James G. Owen** is back in St. Louis and living at 6444 Alamo Street in Clayton.

**David E. Krebs'** address has changed

from Sioux City, Iowa, to Lancaster, Texas.

1944

**Bruce Armstrong** can be reached at the Barton Memorial Hospital in Philadelphia, Pa.

**Marvin Pursell** is living in Webster Groves, Missouri, at 971 Greeley Ave.

**Buiford Burch** is with the Medical Research Department of Ohio State University in Columbus.

**Rowe Bisbee**, recently at St. Luke's Hospital in Denver, is now in Ada, Oklahoma.

**Albert Eisenstein** is living at 8706 Florence Ave., in Brentwood, Mo.

1945

**Marshall Conrad** has moved from Danville, Ill., to 20 South Gore in Webster Groves, Mo.

**Frank J. Kelly**, who was an assistant in medicine at W. U. School of Medicine, recently moved to New Orleans, La.

**Sanford Tuthill** has moved from Alexandria, La., to New Orleans, where he began a residency in internal medicine at the Ochsner Clinic and Foundation Hospital on July 1.

**Clarence Schulz** received an appointment as resident in psychiatry at St. Elizabeth's Hospital in Washington, D. C., starting last July.

**Norton Johnson** has been separated from the army and has begun a residency in obstetrics and gynecology at Bethesda Hospital in Cincinnati, Ohio.

On June 30, **Robert Weinhaus** was transferred from the U. S. Marine Hospital in Mobile, Alabama, to the Marine Hospital in New Orleans.

**Edward J. Twin**, formerly with the Veterans Administration Hospital at Marion, Indiana, is now living in Kansas City, Mo., at 3838 South Benton.

1946

**N. Balfour Slonim** is with the Veterans



Administration Hospital in Albuquerque, New Mexico.

**Walter Patt** is living at 1801 Tarson in St. Joseph, Missouri. He was formerly at Miami Valley Hospital in Dayton, Ohio.

**Boyd Hayward** is now at 820 East 52nd Street in Chicago, Ill.

**Robert Rutledge** is an assistant resident in pediatrics at St. Louis Children's Hospital in St. Louis.

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The Medical Alumni Office is anxious to keep in touch with your whereabouts and your activities. A penny post card giving your old and new address will be appreciated whenever you move—or if your mail is incorrectly addressed in any manner. News of yourself and any Medical School graduates you know is always very welcome for the Alumni News section. Your classmates want to hear about you!



# WASHINGTON UNIVERSITY

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Thomas Edward Blackwell, Ph.B., M.S., J.D.,

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The Summer School

Frank L. Wright, A.M., Ed.D., Director

Mary Institute, a preparatory school for girls, located at Ladue and Warson Roads, is also conducted under the charter of the University.