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Tissue reactions to foreign lipoid substances.

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THESIS

TISSUE REACTIONS TO FOREIGN LIPOID SUBSTANCES

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TISSUE REACTIONS TO FOREIGN LIPOID SUBSTANCES

INTRODUCTION

It is apparent from the infrequency with which oil granulomas are diagnosed clinically that many physicians and surgeons are still not aware of the relative frequency of "Oil Granulomas" occurring in the various tissues of the human body.

Oil granulomas, with their various manifestations as they occur in the different tissues and organs of the body, and the variety of terminology with which this condition is considered and described by various authors, are presented in this dissertation with clinical, pathological and histological pictures of the problem.

Some of the diverse terms under which one variety, now familiar to most of the medical profession as "Lipoid Pneumonia" is described in literature are: lipoid pneumonia, fat pneumonia, steatosis of the lung, pneumonoliposis, lipid cell pneumonia, paraffin pneumonia, oil pneumonia and oil aspiration pneumonia. Similarly, the same condition when found in other parts of the human body is variously referred to as paraffinoma, vaselinoma, oil granuloma, etc. To clarify matters, it would be better to designate these lesions as "Oil
Granulomas and then specify the particular type of oil involved in the production of the pathological lesion.

While lipoid pneumonia has been extensively described by Henry Pinkerton, Kane Ikeda, and others, reactions to oil in other locations have received little attention. The present discussion will consider separately the lesions arising in the other group of organs, review the literature available on these lesions up to the present time, and submit a detailed case with clinical and autopsy records to show an extensive involvement of the peritoneal cavity with mineral oil that leaked into it through a fistulous communication between the distal loop of a colostomy and the peritoneal cavity with seedings in the liver, spleen, mesentery and the lungs.
LITERATURE

The use of petrolatum products in medicine and surgery has been known for a long time. The products are used by themselves, or as vehicles for the transport of sclerosing chemicals. As sterile oils they are mainly used for the purpose of preventing adhesions after abdominal operations or as laxatives. As vehicles for sclerosing chemicals they are mostly used by rectal surgeons for injection therapy of hemorrhoids and by some surgeons for cosmetic purpose.

Paraffinomas are tumors resulting from the presence of paraffin or mineral oil in the tissues. They occur chiefly as a result of injudicious or unwittingly misguided therapeutic procedures. Davis\textsuperscript{18} defines a paraffinoma as a "Chronic inflammatory process involving skin and adjacent cutaneous tissues characterized clinically by the development of reddish purple indurated masses, painless, non-tender, persistent, not subject to ulceration and as a rule, ordinarily benign."

It was as far back as 1888, that Martin,\textsuperscript{50} first advocated the use of olive oil to cover denuded areas to prevent adhesions. Then Gersuny,\textsuperscript{28} in 1899, first used paraffin wax for cosmetic reasons. He injected wax of low melting point (40\degree C.) into the scrotum of a young man whose testicles were removed for tuberculosis of the testicles to simulate the presence of testicles in the scrotum. Encouraged by this,
Gersuny employed paraffin wax to correct hernias and sphincter incontinence. His procedure was widely accepted and used extensively for correction of facial deformities, cleft palates, atrophic rhinitis and for the permanent separation of divided nerves.

Heidingsfeld, in 1906, first described these tumors which resulted from the injections of paraffin wax. After an initial inflammatory reaction of short duration following the injection, the paraffin is surrounded by a thick layer of fibroblasts and may remain quiescent as a foreign body for a long time. Occasionally, after a period varying from several weeks to many years, a secondary reaction may supervene with resultant production of an extensive cellular infiltrate and fragmentation of the waxy mass. The end result is the elaboration of the characteristic granulomatous mass which has been designated the "Paraffinoma". The term itself did not come into being until 1913, when Benedek, realizing the nature of these lesions named them "Paraffinomas".

Since then many papers have been published on this subject. Paraffinomas of the face, nose, lung, breasts, peritoneum, rectum, penis, knees and ankles have been described. The essential pathology in all is the same, viz: a granulomatous proliferation of connec-
tive tissue and blood vessels and containing a series of oval or round cavities like Swiss cheese filled with oily material. Macrophages and foreign body giant cells are present but caseation is never seen.

The literature on the various types of oil granulomas is rather haphazard and reported by several authors as and when they came across them and so for the sake of schematizing the chronological order will be sacrificed and the subject presented as found in the various organs of the body with the exception of the lung which has been extensively covered by Henry Pinkerton, Kano Ikeda, G. F. Laughlin, and others.

Oil granulomas may be classified as follows:-
A) Subcutaneous:
   i) Face and nose
   ii) Breasts
   iii) Penis
   iv) Joints
B) Submucous: Rectal.
C) Intramuscular
D) Intraperitoneal
E) Thoracic:
   i) Extrapulmonary
   ii) Intrapulmonary

*SUBCUTANEOUS OIL GRANULOMAS:*

Paraffin tumors were first recognised some
50 years ago when the vogue for paraffin prostheses was at its peak. Since then many investigators have reported their presence in the different organs of the body. The following is a comprehensive list of subcutaneous oil granulomas as seen in the face, breasts, penis and joints.

The modes by which oil gains admittance to the subcutaneous tissues are: i) direct injection and ii) by surface application. The former is utilised mostly by surgeons for the correction of physical deformities and unscrupulous persons for reasons best known to them. The latter mode is mostly encountered in industrial hazards such as in trades where persons have recourse to work with high powered grease guns; wherein the grease penetrates the intact skin.

The principal etiological agents are liquid paraffin, paraffin wax and diesel oil.

These tumors are discovered accidentally or attention is drawn to their presence by the patients themselves due to the discomfort or the pain they produce or to claim compensation.

This type of oil granuloma is seen in cases of cosmetic repairs and malingerer's deception. Wolf in 1942, reported the case of a male aged 40 years who had
some 20 years back, following a resection, sustained a falling of the nose bridge. To obliterate this defect, the surgeon injected paraffin one month later. The patient suffered no ill effects immediately. Ten years later the patient noticed a tumefaction of the bridge of his nose which grew to the present size gradually. This patient sought advise because of the ugly deformity. Physical examination showed a tumor extending from the bridge to the tip of the nose, adherent to the skin, reddish-purple in appearance but showing no signs of inflammation. Histopathological report on the tissue submitted after resection of the mass revealed a fibrous tissue stroma containing innumerable foreign body giant cells surrounding elongated and oval spaces. These clear spaces were also found in the scar tissue away from the giant cells.

Production of artificial tumors by injection of high melting point paraffin into subcutaneous tissues about the knee joint to avoid military service has been reported by Murad\textsuperscript{58} in 1934, Flandin, Poumeau and Israel\textsuperscript{24} in 1935, Johnson\textsuperscript{39} in 1937, and Hyderdale and Mader\textsuperscript{33} in 1940. Hyderdale and Mader in 1940 reported the case of a Russian soldier who produced an artificial tumor in his left ankle at the beginning of the war of 1914–1918 to avoid being drafted. The deception worked
so well that the patient escaped being drafted. This patient also stated that his physician had injected wax in other parts of the body of other persons for the same reason. The Russian soldier presented himself at the Mayo Clinic in 1939 because of the growing discomfort. No histological studies were done on him; his case was only presented to demonstrate the ways used by charlatans to produce artificial tumors and to show the results of such a lesion after a lapse of 25 years.

The male penis and the female breasts have not escaped from their contributions in this problem. Quenu and Perol in 1947 and Bradley and Ehrgott in 1951 have reported cases of paraffinomas of the penis. These were produced to practice deception or to satisfy their sexual ego. Delascio, Giardiano and Pasqualucci in 1951 have reported cases of paraffinomas of the female breasts consequent upon injection of paraffin wax for cosmetic reasons. To this must be added the case of De Cholnoky (1939) of a male who had his breasts infiltrated with paraffin wax to pass off as a circus freak.

Watson in 1924 reported the case of a paraffinoma of the vas deferens and Whittaker in 1936 reported the case of a paraffinoma of the bladder. Both these cases are cited here to show the unusual com-
plications arising after injection of hernial sacs with paraffin oil to effect repair.

Finally to make this list of subcutaneous oil granulomas complete, it would not be out of place to mention the case of Brown and Joergenson\textsuperscript{47} (1947). These two workers reported yet another case of a male who had his breasts and genital organs infiltrated with paraffin oil to avoid being drafted in 1918. The confusion occasioned by the bizarre combination of genital lesions and apparent gynaecomastia and axillary lymphadenopathy was not dispelled by early efforts to prove presence of filariasis or testicular chorioepithelioma, and the finding of lipoid material in the lymph node escaped proper interpretation until foreign oil was demonstrated in the specimen removed from the breasts. The patient at first denied any deception but when pressed with the histological findings confessed having done so to avoid military service.

Carcinoma occurring in breasts in which paraffin has been injected is reported by Krohn\textsuperscript{42} in 1930.

Occupational paraffinomas of the hands have been reported by Bradley and Ehrgott\textsuperscript{11} (1951) and by Mason and Queen\textsuperscript{53} in 1941. These have been encountered in diesel engine mechanics who test carburetor jets with their fingers. A similar sequence of events
follows the injection of grease from high pressure guns. The pathology and treatment of this type of oil granuloma has been reported by Mason and Queen. The case cited by Bradley and Ehrgott is unique in that it resulted from external application of petrolatum concurrently with occupational exposure to a cutting oil.

**SUBMUCOUS OIL GRANULOMAS:**

Injection therapy of internal hemorrhoids was in vogue at the turn of the century. This procedure, however, has the unfortunate tendency to carry with it certain stigmas of its origin, viz: universality of application, guarantee of cure and secrecy of formulas. These together with the resultant complication led Rosser and Wallace in 1932 to investigate this problem. These authors injected hemorrhoids or injected under rectal mucosa of human subjects different types of oils, with or without phenol fortification, and commented upon the type of reaction produced. Their findings were briefly as follows:

Olive oil was used in six cases and the time interval between injection and the removal of a piece for biopsy varied from one minute to two months. After two months only a few droplets of oil remained. There was no definite fibrosis or cellular response. Schar-
Lach R stain showed fat droplets in phagocytic cells and a small amount of fat in the perivascular spaces. There was seen a small amount of oil in tissue removed at shorter intervals without any evidence of fibrosis. Apparently the olive oil is readily phagocytosed or otherwise utilized without producing any observable change. The shortest interval showed some mechanical separation of the tissue fibers without any cellular reaction. Grossly tumor formation was not present in any instance.

Mineral oil was used in five cases and the time interval varied from one minute to nine months. One minute tissue showed only mechanical separation of the tissue fibers. Other tissues removed at intervals of 10 days, 20 days and 9 months showed round or oval spaces lined by large cells with clear or lightly granular cytoplasm and occasionally appearing as syncitium. Several areas showed distinct foreign body type of giant cells with centrally placed nucleus; some of these had vacuoles within their cytoplasm. The amount of connective tissue proliferation varied considerably. Scharlach R showed these spaces to be filled with yellowish-orange staining oil. The larger spaces were only partially filled; the oil remaining at the
periphery, presumably part having escaped. Tumor forma-
tion was detected in all cases.

Cotton seed oil was used in thirteen cases. The time interval varied from 3 days to 10 months. Usually slight to moderate fibrosis resulted although in a few instances there was no increase in the connective tissue. There was also marked increase in the number of fatty vacuolations seen. Rarely a foreign body giant cell was present.

It was also shown that Phenol plays no appreciable part in the production of the tumor. It was the retention of the excipient and the consequent fibrosis that gave rise to the tumor formation. Olive oil produced no tumor formation; mineral oil always produced a tumor and cotton seed oil was intermediate in its effect.

Fried and Stone (1930) have reported the case of a man who presented himself for persistent and increasing constipation after an intrarectal injection of some unknown solution some two years ago. A preliminary diagnosis of sarcoma was made and a biopsy taken for diagnosis. Pathologic diagnosis was "Tuberculosis of the rectal wall." Consequently the lower portion of the rectum was excised. Gross specimen was described as being gray fibrous tissue in which were hard, clear,
transparent, gelatinous and yellow fatty areas. Microscopic studies showed small round cells and structures that resembled tubercles. Giant cells were present in large numbers, but there was no evidence of caseation. A few hyaline areas found after long search suggested hyalinized droplets of paraffin.

Jackman\textsuperscript{35} in 1940, confirmed the views of Rosser\textsuperscript{69} and Susnow\textsuperscript{76} in 1952 presented yet another interesting case.

Clinically there are no symptoms as a rule. However, a feeling of fullness or pressure or sense of incomplete evacuation may be complained of. Jackman\textsuperscript{35} describes a dull aching sensation in the rectum referred to the perineum or lower region of the back, and Rosser\textsuperscript{69} mentions sacral neuralgia as a clinical manifestation. Progressive constipation may be present due to immobility of the rectal wall produced by the fibrotic reaction in the mucosa of the rectum.

Digital examination may reveal a nodule or nodules usually in the internal hemorrhoidal region just above the anorectal margin. Nodules vary considerably in sizes from a pin point to a walnut. The nodules are firm and may or may not be attached to the mucosa. Too vigorous examination may abrade the overlying mucosa and produce bleeding. Proctoscope re-
veals these tumors as yellowish masses covered by an intact mucosa which is thin and at times adherent to it. These granulomas must be distinguished from such diverse conditions as tuberculosis and malignant neoplasms.

**INTRAMUSCULAR OIL GRANULOMAS:**

The two Freniet brothers described this type of oil granuloma for the first time in 1917. They reported that the latent period was several weeks to as long as two years. They blamed the impurities in the oil as well as the individual's own susceptibility as the etiologic factors in tumor formation. Their observations have been confirmed by Jorstad and Glenn (1928) who injected oil into the muscles of white rats and showed that after about 30 days there occurs a zone of fibrosis around the oil at the site of injection and after 3 months to 8 months a capsule composed of mature fibroblasts is definitely seen around the oil, some areas actually showing a hyaline change. Thus the tumor mass may not be felt for at least three months from the date of injections. At times a few of the animals do not develop these oil tumors and this
the authors explain on the basis of individual refractoriness to non-specific foreign body or that the time interval was not long enough before sacrificing the animals.

Following the Freniets, Mook and Wander (1918) reported a series of six cases of similar tumor formation after injection of camphor in oil during the attack of influenza.

In 1920, Letulle and Algave described the case of a soldier who had received similar injections during typhoid fever. They also reported a five-year old tumor in a woman who had injections of camphor in oil during puerperal sepsis; and a third one of multiple breast tumors which had been present for 16 years. In all these cases the nature of the oil was unknown.

In Dubois' patient the tumor appeared three months after the injections in the arm. Stokes and Scholl (1921) reported a case wherein the tumor affected the upper part of the arm and extended along the lymphatics not only towards the axilla but also downwards almost to the elbow. They reported this case so that such granulomas may not be mistaken for tuberculosis or malignant neoplasms. These cases are presented here with a view to draw the attention of the
medical profession to the fact that some obscure muscle pain may owe its origin to previous injection therapy.

**INTRAPERITONEAL OIL GRANULOMAS:**

The earliest reference to the occurrence of intraperitoneal oil granuloma dates back to 1934, when Norris and Davidson reported two cases of patients with peculiar abdominal symptoms following operations wherein liquid petrolatum had been instilled in the abdominal cavity to prevent adhesions. Both these patients made recovery after the final operation.

Subsequently Cruickshank in 1941, (Appendix 1.), reported one case together with clinical and autopsy findings. However, the effects of intraperitoneal instillation of petrolatum were studied and reported by Tantini as far back as 1935. McKechnie in the year 1948, (Appendix 2.), added another case with clinical and autopsy findings and in the same year Whitaker, Walker and Canipelli reported three more cases from clinical observations and had no biopsy or autopsy findings to report. Finally, Marshall in 1952 added yet one more case to this meager and small list.

A rather unusual variation of this type of
granuloma is reported by Jaffe (1934), viz: a paraffinoma of the appendix in a female patient. This is a rare instance as in this woman the usual characteristic history is not available and according to Jaffe she had no history of any abdominal operations; and he cited this case to illustrate a case arising from ingestion of liquid petrolatum over a number of years as a laxative.

The diagnosis of this condition presents problems peculiar to itself; in that most of the patients do not present any symptoms at all. Occasionally there may be a complaint of progressive constipation. There is no case on record to show that these tumors produce complete intestinal obstruction; however, cases are reported wherein partial obstruction was present. (Vide Whitaker et al.). Large hard nodular masses may be prominent findings in the abdomen as cited by Bennett and Collins (Appendix 3.), in their two cases. In almost all these cases, if care is exercised, a history of previous abdominal surgery can be obtained and with perseverance and diligence it will be possible to elicit a history of instillation of liquid petrolatum in the abdominal cavity before closure to prevent adhesions.
Roentgen film is the most important single aid in diagnosis, before exploratory laparotomy. Annular calcifications and calcific plaques visible throughout the abdomen together with heavy concentrations of calcium deposits in the pelvis suggests a strong possibility of oil granuloma according to Pugh. These findings were also reported by Bennett and Collins in their cases and by Whitaker et al. in their three cases. There are no distinctive features apart from calcification. However, the history of previous laparotomies, clinical picture of intestinal obstruction and the discovery of one or more large hard masses in the abdomen without the other signs of carcinomatosis should suggest the diagnosis.

Echinococcus cysts may calcify. Schalanger and Schalanger have reported 120 cases from radiological standpoint and they are of the opinion that majority of the echinococcal cysts are in the upper abdomen and it is usually possible to demonstrate the "Mother Cyst" in the liver. Besides the echinococcal cysts are limited in numbers.

Pseudomyxoma peritonei rarely calcify and are thus easily differentiated. Calcified leiomyomatas are usually few in numbers and possess a more or less flocculent type of calcification. Calcific lymph glands rarely
have a cystic appearance. Vascular calcifications are found in typical locations and are usually tubular in appearance. Calcified appendices epiploices are fewer in numbers and are freely moveable.

The other two most common conditions from which these must be distinguished and with which these are most commonly confused are: i) tuberculous peritonitis and ii) generalized carcinomatosis.

Grossly the oil granulomas vary considerably in size. They are of a yellowish colour and of variable consistency. Their walls may be quite thin and translucent or thick and opaque. They may or may not show calcification depending upon the time they are discovered. The older the lesion, the greater are the chances for calcification. Microscopically multiple cystic areas of varying sizes are seen surrounded by dense connective tissue. Proliferation of fibroblasts and the formation of collagen are evident. In some cases there may be paucity of cells of any type. Some lesions may be surrounded by dense acellular matrix only; whereas in other areas there may be seen dense cellular aggregations. Large macrophages with single nucleus or multinucleated foreign body giant cells may be seen, or histiocytes of epithelioid type but never a true tubercle formation. Most of the giant cells are located near
large vacuoles which contain the lipid material. Calcium deposits may be seen in scattered areas in the connective tissue surrounding these cysts.

THORACIC OIL GRANULOMAS:

i) EXTRAPULMONARY OIL GRANULOMAS:

The injection of oil in the space created by artificial pneumothorax to prevent adhesive pleuritis from obliterating the space or to treat tubercular empyema was first brought into favor by the French specialist Bernou in 1922. A number of oils found favor but liquid petrolatum, because of its low absorption rate and apparent freedom from irritative properties, gained first place.

Ballantyne, Clagett and McDonald (1952) recommended repeated examination of patients with oleothorax, for the development of effusion beneath the oil or pleural fibrosis occasioned by the oil may lead to increase of intrapleural pressure and dissemination of the oil into the surrounding tissue spaces. And since oil is non-compressible, migration of the oil may take place either into the lungs or into the mediastinum and into the lateral thoracic wall. Spread along the lymphatics also has been shown by these workers.
Pleural thickening occurs in all cases in which mineral oil remains for any length of time and except for preventing re-expansion of the lung on discontinuation of the oleothorax produces no other disability. However, perforation of the oil into the lung parenchyma is a distressing condition and has been reported by Browning, Rae and Rotenberg 13.

Migration of the oil into the thoracic wall is known to produce a demonstrable mass. Matson 54 has reported such types of paraffinomas to the extent of 12 per cent in the 50 cases he studied. Livieratos 48 (1936) reported two cases in which very extensive oil granulomas developed in the subclavian area with extension into the breast after oleothorax. In conclusion, it would not be out of place to cite the two cases of Toussaint and Toussaint 79 (1949) with esophageal compression secondary to oil granuloma of the mediastinum. In their first case dysphagia developed 19 years after the establishment of oleothorax; the second had a time interval of only 7 years before the onset of difficulty in swallowing. Esophagrams in both these cases showed an extrinsic mass compressing the esophagus.

ii) INTRAPULMONARY OIL GRANULOMAS:

Since Laughlin’s 45 first report of paraffino-
mas of the lung there have been such numerous reports
and such extensive experimental and clinical observa-
tions on this particular type of oil granuloma, that it
is considered impractical to go into this particular
problem. En passant, attention may be called to the
work of Henry Pinkerton,62,63 Kano Ikeda,34 Irving
Graef29 and others.
CASE PRESENTATION: Boston City Hospital Number: 1522799.

Miss C. L., an 83 years old white female was admitted on 2nd October, 1954, with the chief complaints of difficulty in breathing due to cough of one day's duration and "Cold" for the past two weeks.

She stayed in the hospital for ten days, during which time she was investigated and treated as a cardio-respiratory case and succumbed to her terminal illness inspite of treatment on the tenth hospital day, with a final clinical diagnosis of acute myocardial infarction.

At no time had the Service entertained the possibility of an abdominal lesion; this was perhaps because the patient was this time admitted on a new service instead of the original service, and hence the abdominal condition went undetected until discovered at autopsy. In view of the above, this case will be unfolded as the events took place and with particular reference to her abdominal condition.

Miss C. L., was first admitted on 21st January, 1950, with the complaint of having fallen on an icy sidewalk and inability to walk. An intertrochanteric fracture of the right femur was diagnosed and a Neufield nailing of the broken ends was done. Postoperatively, in addition to the routine treatment, she also received one ounce of mineral oil twice a day in view of
her being constipated. Then on 6th February, 1950, (16 days postoperative) she complained of moderate abdominal discomfort. At this time the abdomen was rather tender to touch. The same afternoon she complained of the abdominal pain and said that it was becoming severe; especially in the lower abdomen. The pain did not subside, remained constant and was not of a colicky character. There was no nausea or vomiting. In the evening the patient was still more uncomfortable and persisted in calling attention to her abdominal pain. Physical examination revealed visible peristalsis in a tympanitic abdomen which was also tender. No palpable mass was felt. However, there was generalized muscle guarding without any definite muscle spasm. Rectal examination revealed a tender cul-de-sac. Temperature: 103 F., pulse: 118 per minute, Total Leucocytic Count: 9,000 per cu. mm., urine analysis was negative. Sitting film of the Abdomen: showed a questionable area of right diaphragm which was interpreted as a fibrous strand and not as air under the diaphragm. Flat plate of the Abdomen: Revealed a markedly distended caecum and marked distension of the right colon with faecal masses. In other words, a specific diagnosis could not be made but the following were considered: (1) Intestinal obstruction of large bowel or transverse
colon due to faecal impactation or neoplasm, (2) Perforated viscera such as large bowel diverticulum, appendix or Gall bladder and (3) Infections like diverticulitis, appendicitis or cholecystitis.

She was kept under observation until the next morning. The pains still persisted and were of a generalized nature, but still more marked in the lower abdomen. They were not crampy. Peristalsis persisted. She was quite tender but not so spastic. A repeat X-ray of the abdomen showed air in the ascending colon. With these acute signs and symptoms a diagnosis of (1) a small perforation or (2) mesenteric thrombosis was considered, and the patient kept under further observation.

The same afternoon at 2 p.m. the temperature increased, the abdomen became acutely tender with marked distension and tympanitis. She still had the visible peristalsis despite evidence of diffuse peritonitis. A tentative diagnosis of perforation of the sigmoid colon was made and the patient prepared for emergency operation.

Under adequate spinal anaesthesia, the peritoneum was entered by a right rectus muscle splitting incision. On opening the peritoneum, the wound area filled with yellowish-gray malodorous turbulent fluid
which was obviously faecal in origin. This was removed by sponge and suction. On palpation, the distal sigmoid on its antero-lateral wall revealed a perforation measuring 3 x 4 cms., with thin necrotic discoloured edges. From this perforation, masses of faeces were seen protruding into the pelvis and filling most of it. After sponging the pelvis, a caecostomy tube was inserted into the sigmoid perforation through a left lower quadrant stab wound. A transverse colostomy was performed and the patient returned to the ward.

Since operation the patient had been doing well; she had regained peristalsis and the colostomy was functioning well. However, she continued to run a low temperature. From 9th February, 1950, (3 days postoperative), the distal loop of the colostomy was irrigated with 200 ml. of Mineral Oil for a period of 16 days. On 21st February, 1950, i.e. the tenth postoperative day, the tube placed in the sigmoid perforation came out spontaneously and so did the drain placed at the lower end of the incision. The sigmoid drainage site continued to ooze some pus but no faecal matter. The colostomy seemed to be functioning well and the wound seemed to be healing well. She continued to run temperature and it was thought that she was pocketing some pus somewhere. Accordingly, she was kept on anti-
biotics and twice daily irrigations of the colostomy ends. The lower end of the wound in the left lower quadrant continued to discharge pus and hence was irrigated on 13th March, 1950, (32 days postoperative) to wash out any pocket of pus within it. During irrigation it was found that the fluid escaped via the colostomy site, indicating that there was a fistulous communication between the wound and the colostomy. The patient was treated conservatively and prepared for an X-ray examination on 10th April, 1950, (60 days postoperative). The roentgen report read as follows: "Diverticulosis of the sigmoid with perforation and sinus formation, possibly extending to the outside."

Gradually the discharge became less and less and finally ceased. Repeat barium enema examination revealed diverticulosis of the sigmoid and no other lesion. As the patient was asymptomatic, she was discharged on 2nd May, 1950, (92 days postoperative) to be followed up in the Follow-up Clinic for (?) resection at a later date or early closure of the transverse colostomy.

The patient was again admitted on 26th September, 1950, for resection of the involved sigmoid colon and closure of the colostomy. At this admission, the barium enema examination was negative. On 30th
September, 1950, an exploratory laparotomy was performed under spinal anaesthesia.

The peritoneal cavity was entered with some difficulty, there being dense adhesions throughout the entire cavity. Many loops of the small intestines were encountered which were covered with a plaque-like rough gray-white material. A large pocket of gray-white to milky white liquid material resembling pus was encountered near the left lateral gutter at beginning of sigmoid. It contained approximately 75 to 100 ml., of aspirable material. This same material was found in large quantities in several other areas in the peritoneal cavity with no definite place of origin ascribable. No large bowel could be identified, at first, since omentum and abdominal wall were so firmly matted around it; however, it was possible to demonstrate the transverse colon and the sigmoid colon after some sharp and blunt dissection. No sign of fistula formation was found in the sigmoid. Cultures taken of the milky-white material proved to be sterile.

Intestinal resection or reconstruction was not thought possible at this time. The patient made a satisfactory postoperative recovery and agreed to return at a later date for re-valuation of her condition. Accordingly she was discharged on 2nd October, 1950.
This patient was admitted, for the third time, on 2nd April, 1951, for closure of the colostomy. She had gotten along well since discharge on 2nd October, 1950, and had actually gained about ten pounds in weight in the last six months.

Physical examination revealed a right rectus scar with a functioning transverse colostomy two inches to the right of the umbilicus. Barium enema examination carried out on 12th April, 1951 showed, "Fistula in the recto-sigmoid region". The patient was put on Sulphasuxidine in anticipation of the operation. Operation was performed under spinal anaesthesia supplemented by cyclopropane on 25th April, 1951.

Upon entering the peritoneal cavity, many dense and friable adhesions were found between all the loops of the intestines. After considerable blunt and sharp dissection, the transverse colon, the splenic flexure, the entire descending colon and the sigmoid colon were mobilized. There were gritty pin-head sized to one centimeter sized nodules over the surface of the small and large bowels. The area of the recto-sigmoid could not be freed completely but the entire sigmoid and left colon were freed and a wedge resection of the distal one-third of left colon was made together with a two layered end to end anastomosis. The bowel was tucked
against the lateral peritoneal wall in order to oblit-
erate as much as possible the raw areas in the lateral
peritoneal gutter. Abdomen was closed in the usual
manner and the patient returned to the ward in good
condition.

Histological examination of the specimen sub-
mitted after operation was reported as follows by the
Mallory Institute of Pathology; Number: S - 51 - 1925:

**GROSS DESCRIPTION :** "Specimen consists of a
segment of the large bowel, measuring 25 cms. in length
and a maximum circumference of 5 cms. It has been
previously opened. The pericolic tissue focally is
rather firm and on section reveals cystically dilated
spaces with smooth lining containing clear colourless
mucus. The cystic spaces are presumed to represent
former diverticuli. The largest such cyst measures
about one centimeter in diameter. Tissue surrounding
these cysts is firm and fibrous. There is no evidence
grossly of acute inflammation in these areas. The
mucosa of the sigmoid does not appear remarkable".

**MICROSCOPIC DIAGNOSIS :** "Chronic inflammation
and foreign body giant cell formation ".

This section, when reviewed, showed a dense
fibrous stroma; at places appearing almost collagenous,
with many lipoid filled macrophages and a few areas of
granuloma formation with foreign body type of giant
cells and minimal inflammatory reaction.

Subsequently the patient was once again pre-
pared for barium enema examination on 15th May, 1951.
The roentgen findings were consistent with scarring due
to previous surgery or inflammation.
The colostomy continued to function well. In view of this patient’s insistence to get rid of the colostomy, she was once again operated for closure of the colostomy on 20th June, 1951. Postoperatively she did quite well and made a fairly rapid recovery. She was finally discharged on 2nd August, 1951.

Since discharge in August 1951, the patient was evidently doing well and did not report at the Follow-up Clinic. For just over 3 years the patient seemed to be doing well and then on 2nd October, 1954, came to the Boston City Hospital with "Cold" and respiratory distress. At this time she was admitted to a Medical Service. The service not being aware of her abdominal condition treated her as a cardio-respiratory case.

Under treatment on the third hospital day (4th October, 1954) she developed acute pulmonary edema. Lungs were filled with fine moist rales on both sides. Cyanosis was noted about the nailbeds and lips. Pulse: 140 per minute with many premature ventricular contractions but no fibrillations. Although the temperature remained normal, the patient brought forth copious amounts of sputum and coughed continuously. It was thought of that a bronchopneumonic condition was triggering off the cardiac failure. About dawn, the pat-
ient's condition improved somewhat under treatment; pulse came down to 100 per minute but the premature ventricular beats persisted. At 7-45 a.m. the patient again relapsed, her pulse rate went up to 120 per minute and she coughed out blood tinged sputum. (This was considered to be due to the passage of nasal catheter.) Sputum examination was reported, "Negative for A.F.B.", by the City Laboratory.

Then on 11th October, 1954 the patient was seen by the nurse to climb out of the bed and fall to the ground and climb back into the bed. A few minutes after this she was found to be all right. However, at 10-30 a.m. she was noted to have stopped breathing and pronounced dead by the House Officer at 11 a.m.

The final clinical diagnosis was acute myocardial infarction.
AUTOPSY FINDINGS: (Autopsy Number: A - 54 - 808)

The autopsy was done on 12th October, 1954, 12 hours post-mortem. The body was that of a white female appearing the stated age of 83 years. She was well built and well nourished. Rigor mortis was present in both upper and lower extremities. There was marked post-mortem lividity (+ + + +) on the dorsal side and the lateral sides of the body. There was doubtful pitting edema of the lower extremities. There were encrusted lesions on the upper lip and the right side of the nose.

The anterior abdominal wall showed three old healed incisional scars: (1) Right paramedian line - 15 cms. long, (2) Left paramedian line - 22 cms. long, and (3) Left inguinal line - 2 cms. long.

The rather protuberant abdomen was opened by the conventional Y-shaped incision. There was considerable difficulty involved in identifying the various abdominal organs because of the very dense and fibrous adhesions between the anterior abdominal wall and the various organs. It was all in one mass and absolutely next to impossible to separate the coils of the intestines and the different abdominal organs. In fact, this could very well be called a "Frozen abdomen".

In the peritoneal cavity stretching across the
transpyloric plane was an elongated grayish-white firm fibrous "mass" extending from the tip of the ninth costal cartilage to the hilum of the spleen along the superior border of the pancreas. This "mass" measured 15 cms. in length and varied in breadth from 1.8 cm. near the gall bladder end to 5 cms. near the splenic hilus; in thickness it measured 3 cms. near the gall bladder end and 7 cms. at the splenic hilus. On section, it showed a large encysted space measuring 7 X 5 cms. filled with yellowish viscid liquid (Approximately 20 ml.) near its bulbar splenic end. The cyst wall was smooth and glistening and measured 0.6 cm. at its maximum. There were also present a few small cysts besides this one large one. All of the other cysts contained similar viscid yellow liquid. There was no gross evidence of acute inflammation or calcification.

The gastro-intestinal tract was one great mass of coils of the intestines matted together with one another, the other abdominal viscera and the greater and lesser omenta. The entire peritoneum was studded with numerous large and small cystic masses measuring from 0.2 cm. to 1.5 cm. in their greatest diameter. These cysts were mostly round or oval in shape, firm and on section exuded greasy yellowish slightly mucoid material. The cyst walls varied in thickness from less
than a millimeter to as much as six millimeters; some being very thin and almost translucent; while others were really thick, opaque and even hard. The cyst wall in nearly all of the cysts was grayish-white, smooth and glistening. The serosal surface of the intestines was studded with numerous small thickened masses measuring 2 to 4 millimeters in their greatest diameter. The intestinal mucosa did not show any pathological change. The distal colon showed diverticulosis but no evidence of acute inflammation. The stomach and the esophagus were not remarkable.

The liver was markedly enlarged and was firmly adherent to the mass. In addition, the right lobe of the liver was also adherent in its upper part with the diaphragm and the abdominal wall in the right hypochondrium. The inferior surface was adherent to the "tumor" mass and was not easy to separate. On section, the "tumor" mass was adherent to the capsule of the liver and seemed to arise from or grow into liver parenchyma from without. The cut surface presented egg white appearance and near its union with the spleen it contained a cystic space measuring in its maximum diameter 7 cms. which contained greasy yellowish mucoid material similar to the one seen in the other cysts. The cut surface of the liver was of a dark tan colour.
and presented the normal pattern. It fractured comparatively easily and felt slightly firm.

The spleen could not be removed from the matted mass without traumatization. Its capsule was thick and adherent to the mass coming from the inferior surface of the liver along the superior border of the pancreas. On section, the pulp was dark red in colour and could be easily scooped out. The mass itself did not appear to grow into the splenic parenchyma.

The kidneys were of normal size, shape and colour. There were a few small thin walled retention cysts on the surfaces. On section, the capsules striped easily revealing a finely granular surface. The cortices and the medullae were well differentiated and the cortico-medullary relationship appeared normal. The calyces and pelvizes of both the kidneys showed no abnormality. The ureters were not remarkable.

The adrenal glands were not grossly abnormal.

The gall bladder was inseparable from the mass in the right upper quadrant. It contained 20 ml. of viscid greenish yellow bile. The extra-hepatic biliary tract was patent and bile could be expressed into the duodenum by squeezing the gall bladder.

The ovaries and the tubes could not be identified. The uterus was smaller than normal in size and
on section was essentially normal.

The urinary bladder was adherent to the coils of the small intestine by dense fibrous adhesions. However, on opening the viscus, the mucosal surface was grayish-white in colour with occasional reddish discoloration.

The pericardial cavity contained a normal amount of the usual pale straw-coloured fluid and was not remarkable. The heart was normal in size, shape and colour. On section, the left coronary artery showed slight atherosclerotic narrowing of its lumen at its commencement. The right coronary artery was not remarkable. The endocardial surfaces were smooth and glistening and underneath them showed the dark tan myocardium. There was no fibrosis in the myocardium. The chordae tendinae and the papillary muscles were normal. The valve leaflets showed no gross pathological change. Aorta showed marked atherosclerotic change with degeneration and calcification of some of the plaques.

Both the pleural cavities were completely obliterated by dense fibrous adhesions between the two layers of the pleura, and required knife dissection for separation. The right lung externally presented a shaggy surface. It was sub-crepitant in its upper and middle lobes and slightly consolidated and boggy in its
lower lobe. On section, the pulmonary vessels were not remarkable and the bronchial tree contained mucopurulent discharge within it. The lung parenchyma appeared dark red in the lower lobe. The parenchymal architecture was grossly not characteristic of any pathological lesion. The left lung presented a more or less similar appearance. The upper respiratory passage was not remarkable.

The cranial examination revealed no abnormality.
HISTOLOGICAL EXAMINATION REPORT. (Section Numbers: A-54-808)

Tissue was preserved in Zenker's Solution and 10% Formalin. Haematoxylline-Eosine studies were done on Zenker fixed tissues and fat stain done on formalin fixed tissue.

Section from the large cyst wall revealed a dense fibro-collagenous tissue in which were seen many vacuoles and foreign body type of giant cells some of which were vacuolated. The cyst wall was not lined by any definite epithelial lining and the cysts varied in sizes. Fat stain revealed the presence of fat laden macrophages.

Section of the liver near the fibrous "tumor" mass revealed the mass to be composed of relatively dense fibro-collagenous tissue in which were present many vacuoles and foreign body type of giant cells, some of which were vacuolated. In some places the fibrous strands seemed to grow between cords of liver cells; pushing the latter sideways and forming in between vacuolated areas with giant cells and chronic inflammatory reaction. Fat could be demonstrated, by appropriate stain, in the capsular region.

The spleen showed fibrous thickening of the capsule, congestion of the parenchyma and moderate
hyalinization of the arterioles. Outside the capsule was a well defined vacuolated area of fibrous and collagenous tissue with large pale staining round cells. Occasional foreign body type of giant cell was seen. No demonstrable fat was detected.

The pleura was not remarkable. There appeared to be a partial collapse of alveoli. Within the alveolar spaces could be seen small amounts of blood and a few pigmented macrophages. Alveolar walls showed focal areas of fibrosis together with foreign body type of giant cells containing vacuoles. The bronchioles and the vessels were not remarkable. Fat stain revealed the presence of fat in the alveolar septae.
CHEMICAL EXAMINATION REPORT:

The cysts on sectioning exuded viscid yellow fluid which floated on water and was greasy to the feel.

At autopsy its nature was not suspected. However, at the Gross Autopsy Conference, the following morning, the possibility of it being mineral oil was suspected and accordingly a sample was collected and sent for chemical analysis to Dr. Frank Stratton.

The Chemical Analyser's Report read as follows:

"The specimen submitted behaves like mineral oil and shows an ultra-violet spectrum like mineral oil. The few differences noted could be readily ascribed to body elements taken up by the oil. I think it may be reasonably concluded that the oil submitted is primarily mineral oil."
FINAL ANATOMICAL DIAGNOSIS:

Lipogranulomatosis (Mineral Oil) of the peritoneal cavity with marked intestinal adhesions and focal collections of fat in the alveolar septae.
DISCUSSION:

Ever since Martin's\textsuperscript{50} advocacy of olive oil to cover denuded surfaces to prevent adhesions, many investigators have tried to find an agent that would prevent adhesions. For nearly 20 years after Martin's\textsuperscript{50} suggestion, the issue remained dormant until in 1908 Blake\textsuperscript{7} showed that sterile oil had a tendency to prevent early and direct adhesions of inflamed peritoneal surfaces. Subsequently Claypool\textsuperscript{15} and Wilkie\textsuperscript{85} in 1910 published papers supporting the use of olive oil, and Wilkie went so far as to advocate the use of oil for purposes of draining the wound and encouraging intestinal peristalsis. However, Cubbins\textsuperscript{17} in 1916, condemned this practice but concluded from his experimental work that olive oil had little or no deleterious effect upon the peritoneum.

The causative agent in oil granulomas of the peritoneum has been liquid petrolatum or mineral oil in almost all the cases. Other oils have been used at times, but experimental evidence has shown that vegetable oils are incapable of producing any reaction or preventing adhesions from developing. The commonly used petrolatum products are wool fat, petrolatum and liquid petrolatum.

The degree of reaction incited by various
products differs. Wallace\textsuperscript{70} has shown that olive oil produces no tumor, mineral oil always produces tumor and cotton-seed oil holds a position between these two extremes.

The time required to produce a lesion also varies considerably. Jorstad and Glenn\textsuperscript{40} have shown experimentally by injecting oil into the muscles of white rats that it takes about 3 months for the tissue to respond to the foreign substance and manifest any clinical sign; viz: to develop a palpable mass. At times even after longer periods there was no reaction and this they attributed to individual refractoriness to the non-specific foreign body or that the time interval was not sufficiently long enough.

After an initial inflammatory reaction of short duration following the injection, the paraffin is surrounded by a thick layer of fibroblasts and may remain quiescent for a long time. Occasionally, after a period varying from several weeks to many years, a secondary reaction may supervene with production of an extensive cellular infiltrate and fragmentation of the oily mass. The end result is a characteristic neoplasm which has been diversely called 'Vaselinoma', 'Paraffinoma' or 'Oil granuloma'. Johnson\textsuperscript{38} has suggested that allergy plays a role in the secondary reaction leading to the
formation of the neoplasm, and has also opined that trauma is a precipitating factor. These last two factors have so far not been substantiated by any other investigators.

Clinically there are no distinctive features of this condition apart from calcification. However, a history of previous laparotomies, clinical features of intestinal obstruction and the discovery of one or more large hard masses in the abdomen without the signs of generalized carcinomatosis or tuberculous peritonitis should suggest the possibility of this condition. Calcification, however, may not be noted until very late as can be seen from the following cases: 1) Whitaker's cases took 20 years or more to show calcification, 2) Bennett and Collins cases were spread over 10 to 20 years before manifesting calcific changes and 3) Cruickshank's case even after 3 years duration showed no evidence of calcification. In this respect, the case under consideration is similar to Cruickshank's, in that it too shows no calcification after about 3 years.

Grossly these granulomas are small to large masses varying from a few millimeters to a few centimeters. They may be perfectly round or oval in shape. Their colour may also vary from egg-white to yellowish white or gray-white. They may be thin and translucent
or thick and opaque. In consistency they vary from fluctuant cystic masses to solid nodules; and may or may not contain any fluid core depending upon the amount of oil engulfed.

Microscopically, multiple cystic areas of varying sizes are seen surrounded by dense connective tissue with proliferation of fibroblasts and formation of dense collagen. Some areas may be devoid of any cellular response while other areas may be heavily infiltrated by clusters of cells; large macrophages with ingested lipid within them or even multinucleated foreign body type of giant cells may be present or histiocytes of the epithelioid type may be present. It must be made quite clear that at no stage there is any tubercle formation or for that matter even caseation formation. Most of the giant cells are located near large vacuoles which contained the liquid petrolatum.

In the differential diagnosis a number of conditions have to be taken into consideration, viz:
i) Generalized carcinomatosis, ii) Tuberculous peritonitis, iii) Echinococcal cysts, iv) Pseudomyxoma Peritonei and v) Calcific nodes. The most important single diagnostic aid before experimental laparatomy is a plain roentgen film of the abdomen. It may show annular calcifications or calcific plaques visible throughout the
abdomen; heavy concentrations of calcium in the pelvis or no change at all. These calcific shadows must be differentiated from those of the calcific mesenteric nodes, renal and gall bladder shadows, phleboliths and calcific tumors of the uterus. The radiological findings were reported by Bennett and Collins in both of their cases and in this they were further borne out by Whittaker's report of similar findings in his three cases. The case under review differs from these cases in this respect.

The mode of entry of the oil into the peritoneal cavity is almost invariably through the surgical incision. However, Jaffe has reported a "Paraffinoma of the Appendix" in a female through the habitual use of mineral oil as laxative. The present case shows the effects of leakage of mineral oil into the peritoneal cavity through a fistulous communication between the peritoneal cavity and the distal loop of the colostomy done for intestinal obstruction. In all, this patient received a total quantity of 3,200 ml. of mineral oil in 16 days (Approximately 106 ounces in 16 days). This had leaked out into the peritoneal cavity and produced an extensive granulomatous reaction throughout the mesentery and had a well defined cystic mass extending from the inferior surface of the
liver to the hilum of the spleen along the superior border of the pancreas with many similar but smaller nodules on either side of this main mass. These masses were quite cystic and some were actually translucent. One feature that was quite obvious was that all these masses were subserosal and did not infiltrate the parenchyma of the organs concerned. However, the presence of oil laden macrophages in alveolar septae could not be explained on any other basis but lymphatic permeation. Lymph node involvement constitutes an example of lymphatic oil embolism as stressed by Wiedman and Jeffries and is a phenomenon characteristic of paraffin oil granulomas in contrast to the more usual type of paraffinoma. Since at autopsy, this condition was not suspected and in view of the fact that the abdomen was a solid mass worthy of the name of "Frozen Abdomen" lymph nodes could not be identified in the mass. Spread also occurs along the tissue spaces and has been described as producing chains of discrete nodules by Mook and Wander. The mesenteric nodules could be explained on this basis.

Finally no discussion of the problem could be complete without mentioning the recent trends in this field. Pope in 1914, tried to prevent peritoneal adhesions by interfering with the coagulation mecha-
nism. For this purpose he employed Sodium Citrate and reported favorably, but Sweet, Chaney and Wilson\textsuperscript{77} experimenting with Sodium Citrate failed to substantiate his claim. Next Payr\textsuperscript{61} in 1922, suggested the use of pepsin for the same condition but was refuted in the same year by Kubota\textsuperscript{43}. Then in 1928, Johnson\textsuperscript{38} advocated the use of amniotic fluid to prevent peritoneal adhesions and cited favorable cases. Unfortunately, doubt was cast on his work by the work of Lacey\textsuperscript{44} (1930) who stated that amniotic fluid merely lessened the density of the adhesions and did not prevent their formation.

Ochsner\textsuperscript{60} in 1936, found papain to be superior to trypsin in the prevention of peritoneal adhesions but Donaldson\textsuperscript{23} and Lehman and Boys\textsuperscript{46} were unable to demonstrate the effectiveness of papain in preventing the reformation of adhesions.

In 1938, Davidson\textsuperscript{20} found that heparin administered systematically by subcutaneous injections was an effective and safe agent in reducing the incidence of postoperative adhesions. In this, Davidson\textsuperscript{20} was supported by Lehman and Boys\textsuperscript{46} (1940) by their favorable experience. Unfortunately Chandy\textsuperscript{14} in 1950 failed to prove this in his experimental work on animals.

Lastly Scheinberg and Saltzstein\textsuperscript{71} in 1951
have reported marked reduction in the formation of peritoneal adhesions in dogs by the use of 10 mg. of Cortisone or 5 mg. of ACTH daily over a number of days. Besides Ragan68 in 1950 has shown that cortisone delays the healing of wounds and the experimental work to date with Cortisone and ACTH is too limited to draw any definite conclusions at this premature stage. It is but natural to expect that some solution will be found to this pressing problem in the not too distant future.
SUMMARY:

Many people have advocated the use of liquid petrolatum for the prevention of peritoneal adhesions but very few have drawn attention to the late and deleterious effect, viz: the formation of a granuloma.

The literature on this problem of oil granuloma is reviewed and the different lesions have been classified under groups so as to make it more compact and easy to comprehend instead of just naming the cases as they arose in the different parts of the human body.

A case is presented together with autopsy findings to illustrate the clinical, radiological and pathological findings and show how it agrees in some of the details described by previous workers notably Tantini, who in 1935, injected mineral oil intraperitoneally into guinea pigs over a period of months and succeeded in producing hyperplastic changes in the connective tissue and lining cells of the peritoneum with the formation of nodules. There was considerable variation in the response shown by the different animals used by Tantini. This is also true of humans, as many of them prove refractile towards mineral oil; not all human beings who receive this form of treatment develop oil granulomas.

To date literature has very few well authenticated cases to report. Norris and Davidson have two
cases to their credit. These cases had peculiar symptoms together with the history of liquid petrolatum being previously instilled in the peritoneal cavity. Later operations in each case revealed a chronic specific type of inflammation in which the histologic reaction was similar.

Cruickshank's case, as reported in the Lancet of January, 1941, is the first well documented case of paraffin oil granuloma of the peritoneum. To this McKechnie added his case in 1948. Finally Bennett and Collins have reported two cases in 1952. The present case is yet one more documented case in this series.

Clinically the subject is intriguing because of the fact that it is rarely thought of or it presents such a bizarre picture that more fulminating conditions are suspected.

In the diagnosis of oil granulomas, the history of constipation and use of mineral oil to remedy this and previous abdominal surgery for suspected intestinal obstruction are the most important distinguishing features. In addition to this, the roentgen film is a valuable guide.

The condition requires to be differentiated from such diverse diseases like tuberculous peritonitis,
generalized carcinomatosis of the abdomen, pseudomyxoma peritonei, pseudomyxomatous cystadenoma of the ovary, echinococcal cysts, calcified uterine tumors, etc.

Grossly, the tumor presents a nodular appearance, the nodules vary in sizes from a pin-head to walnut. In colour they are whitish to yellow-white. Consistency varies with the thickness of the wall and its contents. Histologically, there is a dense collection of fibrous and collagenous tissue with numerous or few Swiss cheese-like oval or round spaces. These spaces may be surrounded by lipoid filled macrophages and foreign body type of giant cells. There is, however, no caseation seen at any time. The cyst wall may show focal or extensive areas of calcification after many years.

The condition, if recognized early, is amenable to treatment and, hence the necessity to look out for it in cases which present an odd feature along with the signs and symptoms of the other conditions enumerated previously.
CONCLUSIONS:

Oil granulomas of the peritoneal cavity are a rare entity.

They may or may not present any characteristic clinical features. However, they must be considered whenever a patient presents a clinical picture of progressive constipation or intestinal obstruction with bizarre physical findings.

Previous abdominal operation should alert one to this clinical entity.

The etiological agent most commonly responsible for this condition is liquid petrolatum.

The time lapse between development of oil granulomas from the day when oil first enters the peritoneal cavity varies considerably in individuals; usually it takes a period of years before manifesting itself clinically.

It is a rare oil granuloma that undergoes calcification.

Neoplastic degeneration is unheard of.

Roentgen examination and elicitation of a history of the instillation of mineral oil at previous surgery are helpful in a pre-operative diagnosis of this condition.

The condition is amenable to treatment.
APPENDICES: In these will be presented the pertinent features of some interesting cases of "OIL GRANULOMAS OF THE PERITONEUM" as reported by other authors.

Appendix 1.

PARAFFINOMA OF THE PERITONEUM
by Alan H. Cruickshank, M.D.,16

Man aged 45, operated for gall bladder in 1920. Operated for intestinal obstruction on September 2, 1937 and again on December 7, 1937. At the last operation half a pint of liquid petrolatum was poured into the abdominal cavity to prevent adhesions.

On August 5, 1940, he again developed intestinal obstruction. At operation, intestines were matted together with very thick and dense fibrous adhesions and the bowel and the mesentery were studded with numerous small grayish-yellow nodules which looked like tubercles. Professor J. S. Young reported the specimen sent for examination as "cellular granulation tissue with many foreign body giant cells, and that there were no signs of tuberculosis or malignancy".

Patient died on August 7, 1940.

Autopsy was done 6½ hours post mortem. Peritoneal cavity contained 5 ozs. of fluid blood. Numerous fine nodules measuring up to 1 cm. in diameter were scattered over the serous coat of the small intestines, and dense adhesions bound all loops of the small
bowel together and to the colon and the bladder. The mesentery contained tumor-like nodules of varying sizes forming a mass 10 cm. by 7 cm. The nodules were cystic and contained oily material. The peritoneal aspect of the diaphragm was studded with tumor masses which were also cystic.

Histological examination revealed the cavities to be surrounded by an inner zone of dense fibrous tissue and an outer zone of cellular granulation tissue which included several foreign body giant cells. The giant cells were distributed in relation to the smaller cavities which had been occupied by globules of paraffin. In frozen sections, these globules stained with Sudan III appeared browner than neutral fat.
Appendix 2.

INTRA-ABDOMINAL VASELINOMA ASSOCIATED WITH OBLITERATIVE CHOLANGITIS by R. E. McKechnie, M.D., 55

Mrs. E. D., aged 43, was admitted to the hospital on 18th September. She stated that she felt well but was jaundiced for 6 weeks, and had recently vomited a large quantity of dark red blood.

History of present illness dated back 7 years. It commenced with pain in the right upper quadrant, not associated with jaundice. Was operated for jaundice, but no stone was recovered. Five months after operation she had again right upper quadrant pains; moderately severe and recurred over a period of 5 months. Towards the end of that time she began to have chills, fever and jaundice associated with pain. On exploration, dense fibrous adhesions were noted in the region of the common bile duct. Her recovery was not remarkable. Several months later she began to have recurring bouts of chills, fever and jaundice. At first every 4 to 5 months, but as time went by the attacks became more frequent. She vomited large quantities of bright red blood on several occasions in the past 2 years. About 6 weeks prior to admission, she had an attack of pain in the right upper quadrant associated with chills, fever and jaundice.
The symptoms subsided but there remained a fluctuant jaundice of moderate severity.

Physical examination revealed her to be a thin alert rather worried-looking patient. The abdomen was moderately distended with a caput medusae type of vein formation in the region of the umbilicus. There was an old healed upper right rectus incisional scar. The spleen was greatly enlarged. Liver was 4 fingers enlarged, firm and nodular. The flanks were dull to percussion suggesting ascitis.

A diagnosis of hepato-lienal syndrome was made and operation advised to have adequate biliary drainage. Exploration of the right upper quadrant revealed many dense fibrous adhesions effectively barring any approach to the liver. There were numerous large veins present and bleeding was controlled with difficulty. The operation was terminated when the patient deteriorated. Her post-operative condition was more or less satisfactory. On the 25th day after operation, she began to have frequent chills with fever of 104.6° Farenheit. The jaundice deepened and she had repeated attacks of hematemesis. Death occurred 3 days later.

At autopsy it was found next to impossible to separate the adhesions in the tissue underlying the operative site on the anterior abdominal wall. They
were specially dense in the region of the old gall bladder region. This overgrowth had obviously involved the hepatic and common bile ducts to such an extent that their actual location was a matter of extreme difficulty. The walls of the common and hepatic ducts were 2 to 3 mms. in thickness, due again to the dense fibrosis. The ducts, however, were patent; but the lumina were so minute in places that it would appear that bile could not have gained passage through them.

A cystic structure about the size of an hen's egg was found in the region of the common bile duct abutting on the visceral surface of the liver at the site of the old gall bladder. This structure had a thick fibrous wall, which on opening was found to contain vaseline.

Microscopically the wall showed a typical picture of a so-called paraffinoma characterized by very heavy, old and new fibrous tissue with many giant cells of the foreign body type.

In this patient it is presumed (no satisfactory records of previous operation could be obtained) that the operating surgeon used vaseline in the gall bladder fossa of the liver to prevent adhesions. Instead of preventing adhesions, the introduced hydro-
carbon initiated a sequence of events that led to the prolonged illness and eventual death of the patient.

This case was presented to draw attention of surgeons to the deleterious effects of certain hydrocarbons on the organs of the abdominal cavity.
Appendix 3.

OIL GRANULOMA OF THE PERITONEUM by H. S. Bennett, M.D. & E. N. Collins, M.D.

Case: 1.

A 64 year old white woman was first admitted to the Cleveland Clinic July 11, 1951 with the chief complaint of constipation which had progressed in severity over a two year period.

Six months previously, she had noted transient upper abdominal pain and during this period had become aware of a hard abdominal mass which did not increase in size. Two weeks before admission, the patient experienced an episode of nausea, vomiting and abdominal pain for which she was hospitalized by her family physician. The symptoms subsided after several enemas had been given.

In 1918, a uterine suspension was performed. In 1928 following a series of attacks of right upper quadrant pain, cholecystostomy and appendectomy were done. Seven months later the patient was operated upon and the gall bladder removed. She believes that a segment of the intestines as well as one ovary were also removed at this time. The patient stated later, when questioned directly, that at the time of laparotomy a quart of mineral oil was placed in the peritoneal cavity. Unfortunately hospital records for these surgical procedures
could not be obtained.

Physical examination revealed a poorly nourished elderly woman with temperature of 98.6°F., pulse rate: 76 per minute, and blood pressure: 116/80. Significant findings were limited to the abdomen. There were three well healed incisional scars, two in the right lower quadrant and one in the right upper quadrant. A large hard nodular mass was felt in the entire right side of the abdomen extending downwards into the pelvis. In the right upper quadrant and extending into the left upper quadrant a similar mass was present which moved with respiration. Pelvic and rectal examinations revealed the presence of multiple small firm nodules in the rectovaginal septum and above.

A scout X-ray film of the abdomen showed multiple discrete calcifications throughout the entire abdomen. Some were ring-shaped and others plaque-like. The calcifications varied in size from small flecks to large circular masses in the area of the liver. A lateral film demonstrated numerous calcified nodules in the pelvis and in the area of the rectum. Examination of the colon with a barium enema showed complete obstruction to the retrograde flow of barium at the splenic flexure. There was a smooth narrowing of the lumen which suggested to the roentgenologist that the obstruction-
tion was caused by extrinsic pressure or inflammation rather than neoplasm. There was no evidence of distended colon or small bowel proximal to the area of obstruction.

Other laboratory investigations were within normal limits; serology was negative.

At exploratory laparotomy the peritoneum was found to be studded with yellowish-white hard nodules 1 to 3 mm. in diameter which contained calcium. The entire peritoneal cavity was filled with inflammatory masses and thorough exploration was impossible. The colon disappeared into a solid mass in the left upper quadrant and the possibility of malignancy in this area could not be excluded. Specimens were taken for biopsy and an anastomosis performed between the terminal ileum and sigmoid.

Specimens obtained for pathologic studies consisted of several firm nodules which had been adherent to the peritoneum. These were ovoid yellowish white in colour, and cartilagenous in consistancy. Oily material was obtained in small amounts from the nodules and presumably represented liquid petrolatum placed in the abdominal cavity at a previous operation.

Microscopically, the sections revealed multiple cystic areas of varying sizes surrounded by dense
connective tissue. Proliferation of fibroblasts and dense collagen were evident. In some areas there was a paucity of cells of any type. Some spaces were surrounded by dense acellular matrix only. In other areas many cells were present. Large macrophages with single nucleus and in some instances multinucleated foreign body giant cells could be identified. Deposition of calcium was evident in scattered areas in the connective tissues surrounding the small cysts.

The patient was discharged on July 31, 1951.

Case 2.

A 43 years old white woman was first admitted to the Cleveland Clinic on July 8, 1947, complaining of recurrent pain in the left lower quadrant for the last 12 years. The pain was knife-like in character, relieved only by narcotics, and recurrent at intervals of several weeks. Severe constipation has been present for many years.

She gave a past history of three abdominal operations. The first was a Caeserian Section performed in 1935. In 1937, the abdomen was opened presumably to free adhesions, remove an ovary and ligate both tubes. In 1939, a "Fibroid Tumor" was diagnosed and laparotomy performed. The pelvis was reported as "Full
of cysts" and no definite procedure was carried out. Following this a course of deep X-ray therapy was carried out.

Physical examination revealed a small well nourished woman whose temperature was 97.9°F., pulse 86, and blood pressure 90/50. Significant physical findings were confined to the abdomen. There were two small well healed abdominal scars. A large mass extending from the cul-de-sac to the umbilicus was palpable. This felt hard and fixed. Hyperactive peristalsis was audible over the mass.

A scout film of the abdomen revealed multiple small ringlike shadows throughout the abdomen which were thought to represent calcified mesenteric cysts. Serial studies of the small bowel demonstrated a dilated and partially obstructed loop of ileum. Barium enema was not entirely satisfactory but some narrowing and irregularity of the sigmoid colon were noted. Other investigations were of no significance.

Portion of the operative note pertinent to this report follows:

"Beginning in the upper portion of the wound there were numerous oleomata, many of which were calcified and all of which contained oil in varying amounts. Fibrous tissue involved the bowel and was present throughout the pelvis. There were small calcified oleomata in the mesentery of the small bowel distributed along the lymphatic channels."
Three feet of the terminal ileum and a portion of the caecum were resected. The ileum was then anastomosed to the remaining portion of the caecum and the abdomen closed.

The pathologic diagnosis was: "Oleoma of parietoneal fat tissue and of the intestines, chiefly in the adventitia".

The findings on gross examination were as follows:

"The intestine is 115 cms long, matted together by dense adhesions, and forms with its mesentery a large fixed mass. The serosa is generally smooth, shiny and pink-gray but there are many firm yellow papules on the serosal surface that vary from 2 to 5 mm. in diameter. The bowel is soft and of normal thickness. The mucosa appears normal. Mesenteric fat is firm and contains many hard, cystic masses varying in diameter from 0.5 to 5.0 cm. When these cysts are sectioned, the wall is found to be hard and shell-like. Each is filled with a clear pale yellow oily fluid".

Microscopic study yielded the following findings:

"There are many irregular clear spaces of greatly varying size, nearly always adjoined by a zone of foreign body giant cells or histiocytes of epithelioid type. Between these areas there is a marked increase in connective tissue, which is in part, rather dense. There is, however, no tubercle formation. Several portions of the cystic structure show calcification in their thick fibrous wall".

Sections of the small intestines showed involvement of the muscularis and submucosa by the granulomatous process described above. Several lymph nodes were examined and found to contain cystic areas surrounded by a similar granulomatous process.
Photograph of the greater omentum showing multiple nodules on its surface.
Photograph of the "Mass" in upper abdomen showing the cystic component near the hilum of the spleen. Note the thick wall.
Photomicrograph of the Specimen (S-51-1925) x 225. Shows multiple cystic spaces with foreign body giant cells and lipoid filled macrophages.
Photomicrograph of the cyst wall (x 35) showing dense collagenous structure, large cystic spaces, chronic inflammatory reaction and foreign body type of giant cells. Top right hand corner shows muscle fibers where 'mass' was adherent to the posterior abdominal wall.
Photomicrograph of the liver. (x 200)

Shows foreign body giant cells, cystic spaces, fibrous stroma and thickened Glisson's Capsule. The fibrous component is seen to penetrate between the liver cells.
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ABSTRACT OF THE THESIS.

Introduction:

While lipoid pneumonia have been extensively described by many authors, reactions to oil in other locations have received little attention and are infrequently diagnosed. The present discussion will consider the varied extra-thoracic lesions, review the literature, and submit a detailed case with clinical and autopsy records to show an extensive involvement of the peritoneal cavity with mineral oil.

Literature:

Extra-thoracic oil granulomas may be classified as follows:

A. Subcutaneous Oil Granulomas. This type of granuloma, seen in cases of cosmetic repairs and malingering, results from direct injection or surface penetration due to pressure (grease guns). The usual agents are liquid paraffin, paraffin wax and diesel oil. These tumors are detected accidentally or attention is drawn to them by the patients either to obtain relief of pain or to claim compensation.

B. Submucous Oil Granulomas. Injection therapy of internal hemorroids initiates this lesion. Generally asymptomatic, they may cause a feeling of fullness or
pressure or sense of incomplete evacuation and progressive constipation may result from an immobile fibrotic rectal wall. Digital and proctoscopic examinations may reveal the presence of yellowish nodules just above the anorectal margin covered by intact mucosa which requires differentiation from tuberculous or malignant growth.

C. Intramuscular Oil Granulomas. These granulomas are invariably the result of camphor in oil injections and result in obscure muscle pain as in tuberculosis or malignancy.

D. Intraperitoneal Oil Granulomas. Clinically these cases are difficult problems in that the only finding may be progressive constipation. Careful history almost always elicits previous abdominal surgery and instillation of liquid petrolatum to prevent adhesions. X-ray film is the most important diagnostic aid, and the condition resembles tuberculous peritonitis, generalized carcinomatosis, echinococcus cysts, pseudomyxoma peritonei, and calcified leiomyomata, lymphatic glands and appendices epiploicae.

Case Presentation. (B. C. H. No: 1522799 / 1954.)

Miss C. L., an 83 years old white female was admitted on 2nd October, 1954, complaining of diffi-
culty in breathing due to cough of one day's duration and 'Cold' for the past two weeks.

In February, 1951, she underwent colostomy for a perforated sigmoid diverticulum. From the third post-operative day the distal loop of the colostomy was irrigated daily with 200 ml. of Mineral Oil for 16 days. A fistulous communication between the distal colostomy loop and the peritoneal cavity permitted leakage of the oil into the peritoneal space. Due to the patient's insistence on colostomy closure and episodes of partial intestinal obstruction, she required three subsequent explorations. No suspicion of oil granuloma was entertained and she was finally discharged in August, 1951, following successful closure of the colostomy. For 3 years, the patient was evidently well and did not report at the Follow-up Clinic. At the final admission in October, 1954, she was investigated and treated as a cardio-respiratory case and succumbed in ten days with a clinical diagnosis of acute myocardial infarction.

Autopsy Findings: (A-54-808; Mallory Institute of Pathology.)

Significant findings were in the abdominal cavity. A typical "Frozen Abdomen" with very dense adhesions between all the viscera. The mesentery, liver and
spleen presented many large and small nodules resembling carcinomatosis which on section were found to be oil-filled cysts. From the gall bladder area, extending along the superior border of pancreas to the hilum of the spleen lay a large cystic mass filled with thick viscid yellow liquid, which on chemical analysis proved to be mineral oil. Histologic sections revealed a granulomatous reaction with foreign body type of giant cells in a dense fibro-collagenous stroma with many vacuolated areas.

Final Anatomic Diagnosis:

Lipogranulomatosis (Mineral Oil) of the peritoneal cavity.

Discussion.

Various oils have been used in the prevention of abdominal adhesions but without success. The causative agent in oil granuloma of the peritoneum has been liquid petrolatum or mineral oil. The degree of reaction incited by these products differs as also the time required to produce the typical foreign body granuloma.

Summary and Conclusions.

A case of oil granuloma of the peritoneum has been described together with a review of the literature.

This is a rare condition which is difficult to diagnose but if diagnosed is amenable to treatment.