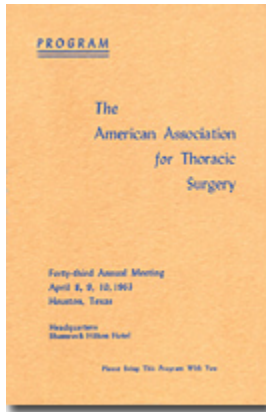


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MONDAY MORNING, APRIL 8, 1963

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Monday Morning, April 8, 1963

8:30 A.M. Business Session (Limited to Members)

Emerald Room

8:45 A.M. Scientific Session: REGULAR PROGRAM

Emerald Room

1. A Continuing Clinical Survey of Adenomas of the Trachea and Bronchus in a General Hospital

EARLE W. WILKINS, JR., R. CLEMENT DARLING (*by invitation*), LAMAR SOUTTER, and RONALD C. SNIFFEN (*by invitation*), Boston, Mass.

Since our initial report nine years ago, the total experience of the Massachusetts General Hospital in the management of adenomas of the trachea and bronchus has been reviewed. Over the period of years, 1909 through 1961, there have been 70 carcinoid adenomas and 6 cylindromas diagnosed by histological examination at this hospital. This series has been analyzed according to the duration and type of symptoms as well as roentgenologic and bronchoscopic findings. Transthoracic resection was carried out in 59 patients; 17 patients received either no treatment or palliative therapy in the form of repeated bronchoscopic resections or small doses of irradiation. Follow-up data are presented for all patients. Emphasis is placed on type and extent of disease encountered and mode of therapy used. Optimal and alternative methods of management are discussed.

2. Primary Carcinoma of the Lung: Experience with 1340 Patients

RAYMOND J. BARRETT, J. C. DAY, P. V. O'ROURKE, HOSSEIN SADEGHI (*by invitation*), RICHARD W. PERRY (*by invitation*), and WILLIAM M. TUTTLE, Detroit, Mich.

Between January 1, 1947, and April 1, 1962, the authors have seen 1340 patients with primary carcinoma of the lung. Male-female ratio was 8:1, over 80% were of the white race, and more than 65% were in the age range of 50-70 years. Approximately 50% of the tumors were of squamous cell type; "oat cell", and adenocarcinoma accounted for slightly less than 20% each. "Alveolar cell" incidence was approximately 3%. Explorability and resectability varied with the type of patient population in the respective hospital. Thus explorability ranged from a low of 21% to a high of 70%. Correspondingly, the resectability rate varied from below 5% to a high of 40% in the institution where the bulk of the resections were performed. Slightly over half the resections were pneumonectomies with a mortality rate of 7%. The

remainder, consisting of lobectomies, bilobectomies, and an occasional segmental resection, had a mortality rate below 3%. An extensive follow-up of the series is underway and prognosis will be related to site of the tumor, its size and cell type, extent of the resection, incidence of positive nodes and effect of adjuvant radiotherapy.

3. A Follow-up On Patients With Bronchogenic Carcinoma Locally "Cured" By Pre-operative Irradiation

NORMAN H. BAKER (*by invitation*), Columbus, Ohio,
R ADAMS
COWLEY, and FERNANDO G. BLOEDORN
(*by invitation*), Baltimore, Md.

A myriad of adjunctive procedures have been added to surgery for bronchogenic carcinoma in the past thirty years in the hope of improving long term results. Recently pre-operative irradiation followed by resection has shown some promise in the treatment of this disease. The resected lung and mediastinal nodes are reported to be sterilized (containing no viable tumor cells histologically) in fifty percent of the cases. This group should theoretically give the highest cure rate. All cases that had been receiving pre-operative irradiation followed by resection since 1956 were reviewed. There were 19 patients in whom the specimen was reported to contain no tumor. Careful re-examination of the specimens disclosed undetected tumor in two. The remaining 17 patients were followed up to the present time. The long term results in this group were disappointing. These cases will be reviewed and the operability, pathology and survival will be discussed.

4. Hypertrophic Pulmonary Osteoarthropathy

H. EDWARD ROLLING,
GORDON K. DANIELSON,
RALPH W. HAMILTON (*all by invitation*), and
WILLIAM S. BLAKEMORE Philadelphia, Pa.

Pulmonary neoplasms in man occasionally are associated with pulmonary osteoarthropathy. In two of our patients with pulmonary neoplasms the first manifestations were pain in the extremities and characteristic changes in the limbs. These findings have been recognized in many patients with various pulmonary diseases. In the affected limbs there is an overgrowth of vascular connective tissue which is invaded by periosteal new bone formation. Overgrowth of tissue in the digits gives rise to clubbing of them in man but not in other species. We have used the measurement of the increased blood flow in the limbs to follow the course of the disease. In patients where the blood flow was measured before, during and/or after operation, the blood flow was found to return to normal as the hilum was dissected, and the changes in the extremities regressed during the postoperative period. The regression has been noted following removal of the intrapulmonary lesion, vagotomy, or even exploratory thoracotomy. These observations and others made upon dogs indicate that the increased limb flow is maintained by a reflex, probably with afferent impulses arising in the pleura and traveling in the vagus nerves. Illustrative laboratory and patient observations will be presented.

5. Pleurectomy in the Treatment of Pleural Effusion Due to Metastatic Malignancy

R. JENSIK, J. E. CAGLE (*by invitation*), C. PERLIA

(*by invitation*), S. TAYLOR (*by invitation*), S. KOFMAN (*by invitation*), and E. J. BEATTIE, JR Chicago, Ill.

An analysis of our patients dying from breast carcinoma with pleural metastases revealed that about 40% of them died from pulmonary insufficiency. Hence, a vigorous attack on malignant pleural effusion was begun. Fifty-one pleurectomies were done on 49 patients in the five-year period from January 1957 to January 1962. All of these procedures were done to halt the rapid accumulation of pleural effusion caused by carcinomatous invasion of the pleura. The commonest sites for the primary disease were the breast (17 cases) and the lung (12 cases). In eight patients the primary was undetermined. The ages ranged from 32 to 80 in 32 females and 17 males. The operative mortality was 5.8%. Six additional patients died of their disease within a month of their pleurectomy, and five patients have been lost to follow-up. The remaining 35 patients have had an average survival time of 9.3 months; one patient was doing well 26 months after surgery. The interval between the treatment of the primary disease and the onset of pleural effusion was not directly related to survival time after pleurectomy. Plural fluid cytology was positive in only 14 of 32 patients who had this examination.

6. Spontaneous Pneumothorax

W. G. GOBBEL, JR., W. G. RHEA, JR., I. A. NELSON (*all by invitation*), and R. A. DANIEL, JR. Nashville, Tenn.

Since the incidence of recurrence of spontaneous pneumothorax after conservative non-operative treatment has been poorly documented and the place of surgical treatment inadequately defined, 119 consecutive cases on whom follow-up data were available have been studied. General consensus seems to dictate that a patient must have several episodes of spontaneous pneumothorax before being considered for surgical treatment, suggesting that the incidence of recurrence is low and/or results of surgical treatment are poor. In this study the recurrence rate after conservative non-operative management was 52% after the first pneumothorax, 62% after the second, and 83% after the third during the follow-up period that averaged six years. Thirty-one cases were treated by parietal pleurectomy and excision or oversewing of bullae and blebs. There were no operative deaths. There have been no recurrences over an average follow-up period of five and one-half years. Bullae and/or blebs were present in all operative cases. There was no evidence that the operation impaired pulmonary function. Since the incidence of recurrence is great after conservative non-operative management as contrasted to the very satisfactory results without mortality after parietal pleurectomy with bullae and bleb excision, early surgical intervention is recommended.

7. Colon Replacement of the Esophagus in Children

WILLIAM A. HOPKINS, Atlanta, Ga.

Studies have already shown that the colon is an adequate transplant for the esophagus in children. We have had the opportunity of utilizing colon transplant to replace the esophagus in seven cases of congenital atresia of the esophagus. The colon was used in one case of stricture following repair of tracheoesophageal fistula. The first one of these children was done at the age of six, and the child is now eleven years of age and doing well. Motility studies on the transplanted colon have been carried out by cinefluorography. Surgery was performed after the children had an upper

esophagostomy and gastrostomy for a period of four to six years and, in one case, after eleven years. The operation was performed with two teams; transplantation of the right colon to the anterior mediastinum was accomplished in all cases. There was no mortality or morbidity in this group of cases. The technique of surgery utilized, as well as the long-term studies on the nutrition of these children, has been completed and presented in the paper. They all, without exception, are progressing well. A movie demonstrating the cinefluorographic motility of the esophagus and its emptying function will be shown.

MONDAY, AFTERNOON, APRIL 8, 1963

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Monday, Afternoon, April 8, 1963
2:00 P.M. Scientific Session: REGULAR
PROGRAM

Emerald Room

**8. Surgical Treatment of Tetralogy of Fallot:
Experience with Indirect and Direct
Technics**

GRADY L. HALLMAN (*by invitation*), and

DENTON A. COOLEY, Houston, Texas

The introduction of technics of direct or definitive repair of tetralogy of Fallot stimulated most surgeons to abandon the indirect or palliative procedures developed by Blalock and Taussig and by Potts. As experience has accumulated, however, the need for selectivity of operative technic has become apparent in order to reduce over-all morbidity and mortality in some patients. Clinical experience for this presentation includes 450 patients of whom 200 had open correction of the anomaly and the remainder underwent systemic-pulmonary arterial anastomosis. Among the 250 patients undergoing anastomosis, 12% died after operation. Sixty of these patients were less than one year of age and eight died after operation (13%). Systemic-pulmonary shunt is now used routinely in severely cyanotic infants. Open repair using temporary cardiopulmonary bypass in 200 patients resulted in 30 deaths (15%). In 65 patients who underwent direct repair following one or two previous operations 11 died (17%). Technical aspects of open repair in our clinical series will be discussed including the use of dextrose solution to prime the extracorporeal circuit, disposable oxygenator, normothermia, transverse ventriculotomy, patch grafts, and the method for closure of previous anastomoses.

9. Postsurgical Complete Heart Block: Management and Long-Term Results

C. WALTON LILLEHEI (*and by invitation*) ROBERT D. SELLERS,

and ROBERT S. ELIOT, Minneapolis, Minn.

Management of complete block following open heart surgery has passed through several stages. Early management of this complication was by sympathomimetic amines. This therapy resulted in few survivals. With the introduction of direct myocardial stimulation in 1956, there was a dramatic decrease in initial mortality. Analysis of our experience with 196 patients sustaining complete heart block has revealed important information. The reversion rate was 66%, but no patient reverted to sinus rhythm after four weeks. From 1957-1962, 37 blocked patients were discharged postoperatively in good condition and on Isuprel. Fifty-four per cent of these patients died during the *first year* despite good medical management. Another died three years and one died four years later. Further, most deaths occurred suddenly in asymptomatic patients and with complete repair of the defect at autopsy. Therefore, we believe, no blocked patient should be discharged without an implanted pacemaker. The need for a variable rate or P wave pacemaker will be substantiated by experimental and clinical data. The type of defect in which persistent block occurs, the techniques, and results obtained with pacemaker implantation in children as young as three years old, and in patients with total aortic valve replacement will also be presented.

10. The Surgical Significance of Hypertrophic Infundibular Obstruction Accompanying Valvular Pulmonic Stenosis

J. W. GILBERT, A. G. MORROW, and

J. L. TALBERT (*by invitation*), Bethesda, Md.

A systolic pressure gradient within the outflow tract of the right ventricle is frequently observed immediately after the relief of valvular pulmonic stenosis. This residual obstruction is generally recognized as being due to secondary muscular hypertrophy but opinion differs as to whether, under these circumstances, infundibulectomy should be performed. The presence, severity and ultimate fate of secondary muscular obstruction was evaluated in 42 patients before and after pulmonary valvulotomy. In every patient preoperative right ventricular angiocardiograms revealed abnormal systolic constriction of the infundibulum and in 21 patients this was particularly severe. The right ventricular pressure immediately after valvulotomy was 50 mm. Hg or more in 22 patients. Late study, however, indicated satisfactory regression of infundibular hypertrophy in all but five patients. Persistence of intraven-tricular obstruction was not related to age, preoperative

severity of stenosis, immediate residual gradient, or the presence of a patent foramen ovale. By angiocardiography, however, the outflow tracts of these patients were characteristically deformed. It is concluded that infundibular resection is not routinely indicated at the time of pulmonary valvulotomy but should be predicated upon the presence of certain angiographic findings which may be identified preoperatively.

11. The Surgical Treatment of Acquired Calcine Aortic Stenosis

DONALD G. MULDER, WILLIAM P. LONGMIRE, JR., and

ALBERT A. KATTUS, JR. (*by invitation*), Los Angeles, Calif.

The objective in treating patients with aortic stenosis is to obtain complete and lasting relief from the valvular obstructive process in the safest manner possible. In some instances, debridement of obstructing and immobilizing valvular calcifications (aortic valvuloplasty) can be readily accomplished and the operative objective achieved. In those valves more extensively involved, cusp excision and prosthetic replacement will be necessary. Fifty-seven patients whose predominant lesion was calcine aortic stenosis have undergone operation at the UCLA Medical Center. Cusp debridement was the procedure in 29 cases. Cusp replacement was used in the remaining 28 cases, although debridement was frequently done in addition in this group. Patients were selected for operation on the basis of symptomatology and left heart catheterization data. None were excluded because of age, congestive heart failure, or extensive valvular calcification. The average preoperative pressure differential across the aortic valve was 90 mm. Hg, while postoperatively it was 7 mm. Hg. Operative mortality was 22%, and there were four additional late deaths. The follow-up period has ranged from two months to four years, and 28 patients have been followed for more than two years. The operative technique, including myocardial management, will also be discussed.

12. Clinical Experience with Total Mitral Valve Replacement with Prosthetic Valves

F. HENRY ELLIS, JR., DWIGHT C. MCGOON

ROBERT O. BRANDENBURG (*by invitation*), and

JOHN W. KIRKLIN; Rochester, Minn.

Experience with total mitral valve replacement in 42 patients between January and November, 1962, form the basis of this report. This period is selected for analysis because in it perfusion techniques, myocardial management, and criteria for case selection have been relatively uniform. Reconstructive procedures were done on 161 patients operated upon by open techniques prior to this period without uniform long-term restoration of good valve function. Recently, therefore, we have usually limited operation to patients with severe symptoms, and in the majority, total replacement has been performed. Twenty-six

replacements have been done with the Starr-Edwards ball valve prosthesis and 16 with a flexible monocusp prosthesis. There were 17 hospital deaths. When patients requiring operation on more than one valve are excluded, hospital mortality rates were 13% with the small monocusp valve and 28% with the ball valve. Although mortality rates from total valve replacement are reported to be high, patients surviving without complications from the prosthesis have an excellent result even when advanced chronic congestive heart failure was present preoperatively. Our surgical experience will be analyzed with the purpose of (1) identifying the types of cases most suitable for reconstructive operations and (2) reducing the complications from mitral valve prostheses.

13. Surgical Treatment of Dissecting Aneurysms of the Aorta with Cardiac Tamponade

MICHAEL ROHMAN (*by invitation*), ROBERT H. GOETZ (*by invitation*), and DAVID STATE New York, N.Y.

Over 50% of dissecting aneurysms of the aorta originate in the ascending portion of this vessel in such proximity to the aortic valve that even minimal retrograde extension may be lethal as a result of 1) rupture into the pericardium, 2) acute insufficiency of the aortic valve or 3) compression of the coronary arteries. Fortunately there frequently are a number of hours or days between onset of symptoms and death. This provides sufficient time for complete diagnostic studies and institution of corrective surgery. We have had experience with three patients during the past year who developed dissecting aneurysms of the ascending aorta. Two of the three patients had developed signs of cardiac tamponade from hemorrhage into the pericardium and all had acute aortic insufficiency. Prograde and retrograde aortography confirmed the diagnosis. All three patients underwent successful excision of the proximal ascending aorta harboring the dissection, reposition of the aortic cusps, and teflon graft replacement using cardiopulmonary bypass and iced saline cardioplegia. Slides will be shown to demonstrate the diagnostic methods and pathology encountered. A short movie will demonstrate the operative technique and document the presence of hemopericardium (350 cc.) in one of the patients, resulting in severe cardiac tamponade.

TUESDAY MORNING, APRIL 9, 1963

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Tuesday Morning, April 9, 1963
8:30 A.M. Scientific Session: THORACIC SURGERY FORUM

Emerald Room

14. Major Airway Collapsibility in the Pathogenesis of Obstructive Emphysema

W. GERALD RAINER, DAVID HUTCHISON, JAMES NEWBY,

ROGER HAMSTRA, and JOHN R. DURRANCE (*all by invitation*), Denver, Colo.

Sponsored by HENRY SWAN

Contrary to the time-honored concept that the pathology in obstructive emphysema is limited to the bronchiole-alveolar level, the generalized destructive process could be explained more readily if *central* airway obstruction could be demonstrated. *Methods:* Forty subjects (10 normal volunteers and 30 with varying degrees of emphysema) were subjected to cinefluorographic study of the trachea and main bronchi. In twenty of these subjects, additional synchronous determinations of intratracheal and intraesophageal pressure changes, and spirometric and pneumotachygraphic values were recorded for correlation with the cinefluorographic studies. Airway deformation and effects on airflow were studied under conditions of various intrathoracic pressures. Major airway collapse accompanying forced expiration and cough in emphysema is demonstrated. Pressure-flow data show high intrabronchial pressures below the point of tracheal collapse associated with severe reduction of expiratory airflow. On the basis of these studies, it is felt that, although the origin of emphysema is in the smaller branches of the tracheo-bronchial tree, the destructive effects of prolonged intermittent increases in intrathoracic pressure produce severe changes in the *trachea and major bronchi* that are responsible for the severe airway obstruction and consequent alveolar destruction characteristic of chronic obstructive emphysema.

15. Evaluation of the Functional Anatomy of the Thoracic Duct by Lymphangiography

MARVIN POMERANTZ, JEAN R. L. HERDT, DAVID S. ROCKOFF, and

ALFRED S. KETCHAM (*all by invitation*), Bethesda, Md.

Sponsored by WILL C. SEALY

Utilizing lymphangiography the anatomy and fluid dynamics of the thoracic duct has been studied. The thoracic ducts of 70 patients without thoracic disease and 30 patients with thoracic disease have been evaluated. Twenty-five patients had cinefluorography of their thoracic ducts under varying conditions. Five patients had studies prior to and following cervical thoracic duct ligation incidental to radical neck dissection. Five dogs had cervical ligation of their thoracic ducts and an additional five dogs had intrathoracic division of their thoracic ducts. Serial lymphangiograms were performed on these animals. These findings were correlated with human studies. The numerous variations in the anatomy of the thoracic duct reported from cadaver studies has been substantiated by these functional lymphangiographic studies. Thoracic duct displacement was found in two patients, one with a benign, the other with a malignant mediastinal neoplasm. Cinefluorography revealed a lack of intrinsic peristalsis, ampullary filling with inspiration, and emptying with coughing or the Valsalva maneuver. Following cervical ligation either some degree of thoracic duct lymph stasis was present or lymph returned to the blood vascular system through collateral channels. This study demonstrates visually the numerous functional anatomical variations of the thoracic duct and the dynamics of flow within the duct.

16. The Use of Plastic Adhesive in Pulmonary Surgery

ROBERT J. WILDER, HERMAN PLAYFORTH, MICHAEL BRYANT

(*all by invitation*), and MARK M. RAVITCH, Baltimore, Md.

To determine the value of rapidly polymerizing adhesive in pulmonary surgery, seventy animal experiments have thus far been performed. In the first group of dogs, bronchial closures and bronchial anastomoses were made with Eastman 910 Monomer. In a second group, the pulmonary apex was amputated and the raw surface sealed either with adhesive alone or with adhesive and a free pericardial graft. In a group, the security of the bronchial closure was evaluated using (a) silk sutures, (b) tantalum staples, (c) and Eastman 910 Monomer after standard inoculation of the bronchial stump with staphylococcus aureus. The results demonstrate that with plastic adhesive alone, the dog bronchus can be satisfactorily closed or anastomosed. In addition, the raw transected lung surface is easily sealed either with pericardium and adhesive or with adhesive alone. A comparison of the three methods used for closing the bronchial stump in the face of heavy bacterial contamination has demonstrated no significant difference in fistula and death rates between silk suture, tantalum staples or adhesive closures in 30 experiments.

17. Pulmonary Function Studies in Canine Lung Transplantations

KEITH REEMTSMA, ROBERT E. ROGERS (*by invitation*),

JOHN F. LUCAS, JR. (*by invitation*), FRANK E. SCHMIDT (*by invitation*),

FRANK H. DAVIS, JR. (*by invitation*), and

OSCAR CREECH, JR. New Orleans, La.

The functional status of the transplanted canine lung usually has been assessed by the survival period and x-ray appearance. In the present series of 32 lung transplants serial determinations of oxygen consumption, minute ventilation and pulmonary blood flow were performed on the normal and transplanted canine lung. Left lung homotransplantation was performed with anastomoses of the left pulmonary artery, left bronchus and left atrium. Following insertion of a bronchspirometric tube, simultaneous determinations of oxygen consumption and minute ventilation were obtained for each lung. Using the Fick principle as modified by Fishman, differential pulmonary blood flows were calculated for each lung. In the immediate post-transplantation period, oxygen consumption by the transplanted lung was markedly depressed, although minute ventilation of the transplanted lung approached that of the normal lung. Serial determinations usually showed good ventilatory function of the transplant until shortly before death, persistence of impaired oxygen transfer by the transplanted lung throughout the post-transplantation period, and moderate variation in the blood flow through the transplant. These studies suggest that the oxygen transfer by the transplanted lung is markedly impaired despite reasonably well-maintained ventilation and blood flow.

18. Physiological Alterations of Cardiopulmonary Function in Dogs Living One and One-half Years on Only a Reim-planted Right Lung

SALVATORE L. NIGRO, RICHARD H. EVANS, JOHN R. BENFIELD

(*all by invitation*), and WILLIAM E. ADAMS Chicago, Ill.

Previous reports have shown that dogs can survive after reimplantation of one lung, but usually die when the contralateral lung is removed. Twenty dogs were subjected to complete removal and immediate reimplantation of the right lung. On removal, the lung was perfused with heparin-normal saline solution, chilled to 10° C and then reimplanted. Of the twenty dogs operated upon, fourteen survived. Angiocardiograms were done to demonstrate the patency of the pulmonary vascular pattern. Mean pulmonary artery pressures varied from 11 to 8 mm Hg. By bronchspirometric studies, it was found that the transplanted lung had a reduction in ventilatory function of about 10%, while the oxygen uptake was depressed by some 25%. Pulmonary compliance was decreased about 20%. When an animal thus prepared was subjected to a total left pneumonectomy, fatal pulmonary hypertension was produced with pulmonary artery pressure 55/25 and mean 33. Therefore, staged pulmonary resections combined with bronchial stenosis on the opposite side were substituted for one-stage pneumonectomy. Some of these dogs have survived on the reimplanted lung alone for one and one-half years and are living and healthy. In these dogs, the pulmonary artery pressures are elevated. The results of these completed studies, including histologic studies of the lung, will be presented and their significance discussed.

19. Autoimplantation and Homotransplantation of the Lung: Further Studies

JAMES D. HARDY, (*and by invitation*) MARTIN L. DALTON, JR.,

SADAN ERASLAN, and FIKRI ALICAN, Jackson, Miss.

Successful homotransplantation of the lung would of course provide a therapeutic weapon of great value in the management of a wide variety of lung diseases which produce respiratory insufficiency. The present series of studies was designed to explore technical, physiologic and immunologic factors in lung transplantation. Initially lung *autoimplantation*, immediate or delayed, was performed in a series of over 100 dogs to evaluate effects upon respiratory reflexes, the reimplanted lung and the animal generally. The effects of late contralateral pulmonary artery ligation, contralateral pneumonectomy, contralateral pneumonectomy and reimplantation and contralateral multiple lobectomies were recorded. Respiratory reflexes originating in at least a portion of the contralateral lung must be preserved. Denervation of a lung often diminished respiratory efficiency. To prolong lung *homograft* takes (130 dogs) the following drugs or maneuvers have been evaluated: BW 57-322 (Imuran), BW 57-322 plus Actinomycin C, methotrexate, 6-mercaptopurine, and drugs plus mother-to-grown offspring homotransplants as well as offspring-to-mother homotransplants. The BW 57-322 proved to be the most effective of the drugs in prolonging homograft survival in dogs.

20. Prolonged Survival of Orthotopic Homotransplants of the Heart in Animals Treated with Methotrexate

DAVID A. BLUMENSTOCK (*by invitation*), Cooperstown, N.Y.,

HERBERT B. HECHTMAN (*by invitation*), New York, N.Y.,

ALFRED JARETZKI, III, JAMES D. HOSBEIN (*by invitation*) Cooperstown, N.Y.,

WALTER ZINGC (*by invitation*), Winnipeg, Manitoba, Canada,

and JOHN H. POWERS (*by invitation*), Cooperstown, N.Y.

The survival of homografts of skin, spleen, and lung has been prolonged by treating the recipient animal with methotrexate. The effect of this drug upon orthotopic homotransplants of the heart has been studied. The hearts of 36 dogs were excised and replaced with homografts from unrelated donors. The recipient animal was given methotrexate, 0.2 mg./kg. on the day following operation and 0.1 mg./kg. on alternate days thereafter. Thirty-one animals died during the first 24 hours after transplantation. Five animals survived and were sustained 2, 10, 17, 26, and 42 days solely by the transplanted heart. The usual survival of a heart placed in an untreated animal is four to six days. These results indicate significant suppression of rejection of the transplanted heart by methotrexate. Histologic and electrocardiographic studies of these animals will be presented.

21. Combined Gas and Heat Exchange in Extracorporeal Circulation

NICHOLAS P.D. SMYTH (*by invitation*), and BRIAN BLADES,

Washington, D.C.

In extracorporeal circulation there would seem to be obvious advantages in combining the functions of gas and heat exchange in one unit, since each requires the dispersion of blood over a large surface area. Priming volume of the system would be reduced, and also the length of tubing and the number of connections used. We selected the vertical screen oxygenator for modification, firstly because of its known efficiency, and secondly because its absence of moving parts made the task theoretically easier. In the proposed modification the wire screens of the oxygenator would be replaced by thin metal plates, through the center of which the heat exchange fluid would circulate, and on the surface of which the blood would be filmed for gas and heat exchange. Using a single 30 x 45 cm. test plate, heat exchange was studied by circulating heparinized dogs' blood across the plate in a closed system. Inlet and outlet temperatures for blood and heat exchange fluid were measured serially at various flow rates. Gas exchange was studied using partial bypass in an anesthetized dog. Arterio-venous oxygen difference across the plate was measured at various flow rates. Data showing satisfactory gas and heat exchange will be presented.

22. Capillary Membrane Oxygenator

BRUCE R. BODELL, JAMES M. HEAD, LOUIS R. HEAD,

ANTHONY J. FORMOLO (*all by invitation*), and JEROME R. HEAD

Chicago, Ill.

In the past few years it has been recognized that an ideal oxygenator for use in extracorporeal circulation systems is one in which a membrane (permeable to CO₂ and O₂) separates blood from gas. This paper reports initial experiments in extracorporeal circulation using a fixed blood volume, closed system, membrane oxygenator of new design and concept employing silastic capillary tubing (0.012" X 0.025") as a gas transport to the blood pool. The oxygenator is an assembly of disposable units which can be mass produced and distributed in presterilized packages. Cardiac bypass perfusions were carried out on ten 85 lb. sheep at flow rates of 2-3L/min. All but one animal survived the perfusions. Blood pH, pCO₂, and pO₂ determinations were made at intervals over 45 minutes of bypass. Oxygen saturations of 99% were maintained in all animals. A problem of CO₂ retention was encountered. By altering design to increase gas flow in the capillary tubing, it was possible to reduce the pCO₂ at 45 min. from 120 mm Hg to 70 mm Hg. Further alterations of design are in progress to enhance CO₂ elimination and reduce priming volume from 2000 cc. to 1000 cc.

23. The Feasibility of Hypothermic Perfusion Under Hyperbaric Conditions in the Surgical Management of Infants with Cyanotic Congenital Heart Disease

W. F. BERNHARD, E. S. TANK (*by invitation*), and ROBERT E. GROSS

Boston, Mass.

Experience in our laboratory indicates that administration of oxygen at an environmental pressure of 35-39 p.s.i. greatly increases the arterial O₂ saturation of cyanotic infants. Although the clinical improvement is temporary in nature, the possibility of performing palliative or corrective surgery during pressure therapy seemed worthy of investigation. Studies were performed in a large compression chamber which accommodated a team of five investigators. Utilizing a miniature pump-oxygenator, hypothermic perfusions were carried out in 40 dogs (3.0-8.0 Kg.) at a pressure of 35 p.s.i. Certain biochemical parameters were monitored during perfusion, which ranged in length from 60-180 minutes; pO₂, pCO₂, pH, CO₂ combining power, plasma lactate, pyruvate and free hemoglobin. Arterial pressure, venous pressure, and EKG tracings were also recorded. Oxygen consumption (under pressure) was calculated at 37°C. and at reduced

temperatures (37°-15° C). These experiments indicated that the oxygen in physical solution (6.0-8.0 vols.%), along with reduced metabolic requirements, permitted either prolonged, low-flow, perfusions (5-15 cc/Kg./min.) or extended intervals of total circulatory arrest without evidence of hypoxia or acidosis. Cardiac surgery for infants, performed in a compression chamber, with low-flow perfusion at reduced temperature, appear to be feasible.

24. Fat Embolization with Cardiomyotomy Using Cardiopulmonary Bypass

FEODOR CAGUIN (*by invitation*), and M. G. CARTER, New Haven, Conn.

The occurrence of symptoms indicating central nervous system damage following cardiac surgery with extracorporeal circulation led us to study a group of 92 patients undergoing 93 heart operations during the period April 1958 to January 1962. Five of the first 48 patients exhibited varying degrees of delirium, hallucinations, amnesia and tremors without localizing neurological signs. All patients recovered. Air, calcium and antifoam embolism and electrolyte changes were all deemed most unlikely causes. Fat embolism from blood aspirated via the cardiac sucker seemed a possible explanation. A second group of 45 patients were studied with 24 hour urine samples examined for fat globules before and after cardiomyotomy. Ten of these developed lipuria and all 10 had some or all of the neurological findings previously observed. Mental changes were not seen in 35 patients without lipuria. Fifteen random non-cardiac thoracotomy patients were similarly studied with negative findings. These data suggested that fat embolization probably was responsible for the reversible neurologic damage. Since this study, great care has been taken to discard all blood spilling from the interior of the heart into either the pericardium or thorax and no further cases with mental changes or lipuria have been observed.

25. Hemorrhage due to Fibrinolysis Occurring with Open Heart Operations

DAVID A. TICE, GEORGE E. REED, ROY H. CLAUSS, and

MELVIN H. WORTH (*all by invitation*), New York, N.Y.

Sponsored by WALTER W. FISCHER

Hemorrhage due to fibrinolysis occurred in nine of the last fifty-five patients undergoing open heart surgery with cardiopulmonary bypass. Fibrinolytic activity was determined by a rapid method (reconstituted whole blood clot lysis) previously described. Fibrinolysis was significantly reduced and hemorrhage controlled in all patients by treatment with Epsilon Amino Caproic Acid or Trasylol. Death occurred in four of the nine patients; three due to heart failure with low cardiac output and one due to cerebral complications (air embolism). Lysis was associated with eight hypothermic and one normothermic perfusions. Three patients had less than 70 minutes and three had more than 130 minutes of perfusion. Metabolic acidosis was graded one to four plus using a nomogram previously described. No definite association of degree of acidosis with fibrinolytic activity was observed. All hypothermic patients received low molecular weight dextran (Rheomacrodex), constituting 15% of the priming volume of the pump oxygenator. Preliminary findings in ten recent patients suggest that fibrinolytic activity is associated with a rise in circulating lysosomal enzymes, acid phosphatase and beta glucuronidase.

26. Acidosis as a Cause of Renal Shutdown During Extra-corporeal Circulation: Its Correction by the Use of Tham

JOHN E. CONNOLLY (*and by invitation*) SAMUEL L. KOUNTZ, and

JAMES M. GUERNSEY, Palo Alto, Calif.

Renal shutdown persists as a serious complication that may accompany cardiopulmonary bypass, particularly if prolonged. In an attempt to clarify the etiology of such renal failure, we have measured renal blood flow under varying conditions. In eight experiments, dogs were connected to an oxygenator primed with fresh blood. The animal's right renal artery was encircled with an electromagnetic flowmeter providing continuous recording of renal blood flow. Frequent blood pH and pCO₂ determinations were made. The effects of low flow and high flow, total and partial cardiopulmonary bypass on renal blood flow were determined. Surprisingly renal blood flow paralleled blood pH, falling rapidly with development of acidosis. As others have shown, low bypass flow rates resulted in metabolic acidosis. However, acidosis

with markedly depressed renal blood flow was seen with high flow rates when acidosis was induced by adding excess CO₂ to the oxygenator or lactic acid to the animal. THAM given during bypass rapidly corrected the acidosis returning renal flow to normal. These experiments indicate that acidosis is a cause of reduced renal blood flow and renal failure under certain conditions of cardiopulmonary bypass. Renal blood flow will remain in normal ranges if normal blood pH is maintained during bypass.

TUESDAY AFTERNOON, APRIL 9, 1963

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Tuesday Afternoon, April 9, 1963

2:00 P.M. Executive Session (Limited to Active and Senior Members)

Emerald Room

3:00 P.M. Scientific Session: REGULAR PROGRAM

Emerald Room

Address by the President

Julian Johnson, Philadelphia

"A Surgeon and Something More"

Address by Honored Guest

Andrew Logan, F.R.C.S.

Reader in Thoracic Surgery, University of Edinburgh

Surgeon to the Royal Infirmary

Edinburgh, Scotland

"The Surgical Treatment of Carcinoma

of the Esophagus and Cardia"

27. Surgical Experience in the Management of Atypical Myco-bacterial Infections

SAM W. LAW, DANIEL E. JENKINS, IRVING CHOFNAS, DAVID BAHAR,

FRANCES WHITCOMB (*all by invitation*), H. T. BARKLEY, and

MICHAEL E. DE BAKEY) Houston, Texas

Increasing recognition of pulmonary disease due to atypical Mycobacteria has emphasized the need for precise information about the results of treatment of these patients. The frequent drug resistance in these organisms and slow clinical response to chemotherapy in this disease has caused concern about the effects of surgical intervention. During the past ten years, 68 operations have been performed on 64 patients with pulmonary disease caused by atypical Mycobacteria. There were 56 patients with Group I infections, 2 with Group II, 5 with Group III, and one with Group IV infection. The sputum was positive pre-operatively in 47 of the 68 operations. There was no operative mortality. This experience will be evaluated in relation to the species of atypical organism, sputum positivity, surgical specimen positivity, type and duration of chemotherapy, type of operative procedure, and ultimate result. The low complication rate compares favorably with the results of surgery in typical tuberculosis, and with other reports of surgery in atypical infections. In our experience, early surgery can be recommended, and resections of less than a lobe are safe and efficacious.

28. Massive Plombage Thoracoplasty Versus Pneumonectomy in the Treatment of Pulmonary Tuberculosis

THOMAS F. BOYD (*by invitation*), and JOHN W. STRIEDER, Boston, Mass.

In the surgical treatment of pulmonary tuberculosis, the mortality rate for pneumonectomy is distressingly high, whereas that for plombage thoracoplasty is very low. If sputum conversion and a good clinical status resulted from massive plombage thoracoplasty in those cases which would ordinarily require pneumonectomy, this procedure might supplant pneumonectomy as the surgical operation to be performed for the lung destroyed by tuberculosis. In this study, 28 patients were subjected to massive plombage thoracoplasty (stripping of either 8, 9 or 10 ribs) rather than to pneumonectomy with no operative deaths. At the time of surgery, the oldest patient was 64 years and the youngest 18 years (mean of 41 years). Twenty-four of the 28 had positive sputum at the time of surgery. All of the patients were followed from 6 to 146 months (mean of 74 months in successful cases) after surgery. In 20 of the 28 patients so treated, sputum conversion and good clinical status were achieved by means of this procedure. Massive plombage thoracoplasty should always be considered before pneumonectomy is selected as the treatment of pulmonary tuberculosis.

Tuesday Evening, April 9, 1963

7:00 P.M. Banquet and Dancing

Emerald Room

Attendance limited to Members of the Association and their ladies, Invited Speakers and their ladies

Dinner dress preferred

WEDNESDAY MORNING, APRIL 10, 1963

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Wednesday Morning, April 10, 1963

8:30 A.M. Scientific Session: REGULAR PROGRAM

Emerald Room

29. Surgical Treatment of Pulmonary Embolism

DENNIS M. L. ROSENBERG, *(and by invitation)*

CHARLES PEARCE, and JOHN MCNULTY, New Orleans, La.

During the past fifty years or so, there has been no remarkable change in the treatment of thromboembolism. Pulmonary embolism continues to be a complex disease and a threat to life. One hundred records of autopsied cases occurring at Charity Hospital and Touro Infirmary in New Orleans have been studied. Of significance in this group were 29 patients who survived for two hours after the onset of severe symptoms and 12 patients who lived more than 12 hours. For certain patients in this group who specifically develop sustained hypotension and progressive deterioration the authors propose a more direct approach, suggesting pulmonary embolectomy with the aid of extracorporeal circulation. Experience with two such cases is outlined. Details of pre-operative study and diagnosis are presented, together with the technique of surgery and suggestions for the use of rapidly available, portable and disposable pump-oxygenator units. This approach has been used successfully twice and suggests strongly that early diagnosis and treatment by embolectomy may reduce the still appalling figure of approximately 3,000 deaths each year in the United States from pulmonary embolism. Emphasis is made on cognizance of the disease, aids to earlier recognition, and energetic medical or surgical treatment.

30. Tricuspid Atresia: A Step Towards Corrective Treatment

SIR RUSSELL BROCK, London, England

Tricuspid atresia is the Cinderella of the surgery of congenital heart disease. This is because it is one element in a whole range of abnormalities, some so complex as to be untreatable. Operation has consisted of a shunt procedure, an excellent palliative in very ill children; the immediate results have been reasonably good, but the late results are less so. In one group the essential lesion is atresia of the inflow tract of the right ventricle but with adequate development of the outflow tract and of the pulmonary artery. In these an associated valvar or infundibular stenosis can be relieved with great improvement. A more important lesion, however, is stenosis (or small-ness) of the ventricular septal defect through which all blood to the lungs must pass. A logical treatment is deliberate enlargement of the defect by an open operation. An example of such an operation is reported. In this case the condition of the right ventricle prevented a total cure which would have involved closure of the atrial and ventricular communications and insertion of a valve between the right atrium and right ventricle. This could be a feasible procedure for which surgeons should be alert.

31. Hypertrophic Subaortic Stenosis: Evolution of a Surgical Technique

A.R.C. DOBELL, and H. J. SCOTT (*both by invitation*),

Montreal, Canada

Sponsored by LLOYD D. MACLEAN

We have operated upon four patients with severe hypertrophic subaortic stenosis. With each experience our surgical technique was modified and our understanding of this perplexing disease broadened. In the first operation we learned the importance of maintaining the cardiac beat in order to understand the dynamic outflow tract constriction. At the second we learned that simple incision of the involved muscle would not relieve the obstruction. For this reason muscle was resected in the third operation with a cutting current applied to a wire loop passed into the left ventricle from the aorta. Only in the fourth operation were ideal conditions achieved. Here the exposure was by way of the left atrium with bisection of the aortic leaflet of the mitral valve. Excellent exposure of the entire ventricular septum was provided and four grams of muscle was resected from the outflow tract with a wire loop. The pressure gradient was abolished. The patient was recatheterized four months later. Our understanding of hypertrophic subaortic stenosis is by no means complete. Nevertheless the advantages of the transatrial approach justify its description in detail.

32. Stenosis of the Branches of the Pulmonary Artery

MILTON WEINBERG, JR , MAGNUS H. AGUSTSSON (*by invitation*),

IVAN D'CRUZ (*by invitation*), JUAN P. BICOFF (*by invitation*),

MAJID BEHAVESH (*by invitation*), JOHN RAFFENSPERGER (*by invitation*),

and EGBERT H. FELL, Chicago, Ill.

Stenoses of single or multiple branches of the pulmonary artery are frequently unrecognized and have received little attention in regard to the surgical treatment of congenital heart disease. These are, however, relatively common anomalies which may be of critical importance in patients undergoing heart surgery. Cardiac catheterization studies and angiocardiograms have demonstrated stenoses of one or more branches of the pulmonary artery in 88 patients. In 27 of these, the lesions were not accompanied by other defects. In 61 patients, the stenoses were associated with a wide variety of cardiac anomalies, the most common being ventricular septal defect (20), pulmonary valvular stenosis (16), patent ductus arteriosus (7), and tetralogy of Fallot (5). In the majority of this group of patients undergoing operation, usually for the associated anomalies, the pulmonary artery branch stenoses were either mild or limited to the branches of one lung. In eight patients, however, three of whom died, the high degree of obstruction to pulmonary blood flow resulted in persistence of severe right ventricular hypertension after correction of the associated defects. Cardiac catheterization data and angiocardiograms demonstrating the stenoses are presented, and the anatomic variations are discussed in relation to surgical significance.

33. Clinical Experience with Local Hypothermia in Elective Cardiac Arrest

EDWARD J. HURLEY, RICHARD R. LOWER, EUGENE DONG, JR.,

R. CREE PILLSBURY (*all by invitation*), and NORMAN

E. SHUMWAY, Palo Alto, Calif.

Prolongation of the safe period of myocardial anoxia is easily and innocuously achieved by the introduction of isotonic saline at 0-4° C. into the pericardial cradle about the heart. Experimentally, simple immersion of the heart within such a solution permits resuscitation after 7 hours of myocardial anoxia. Among the initial 210 patients operated upon consecutively at the Stanford Medical Center for congenital or acquired heart disease during cardiopulmonary bypass, 98 underwent elective anoxic cardiac arrest to facilitate repair. Lesions encountered in this group of patients included 26 ventricular septal defects, 23 Fallot's anomaly, 48 aortic valvular lesions, and one sinus of Valsalva fistula. The age range was 19 months to 65 years. Utilizing a disc oxygenator without heat exchanger, periods up to 58 minutes of anoxic cardiac arrest were tolerated with the myocardium protected by topical hypothermia. An effective heart beat was established in every instance. There were three deaths in the 98 patients, none of which was related to the method of elective cardiac arrest. The purpose of this paper is to describe the technique of myocardial protection by topical hypothermia and the results obtained.

34. Comparative Merits and Results of Blood Primes and 5% Dextrose in Water Primes of Heart-Lung

Machines: Analysis of 250 Patients

NAZIH ZUHDI, JOHN CAREY, WILLIAM SHELDON (*all by invitation*),

and ALLEN GREEK, Oklahoma City, Okla.

Two series of consecutive patients had open heart surgery using moderate internal hypothermia (28-30 °C as measured in the mid esophagus) and low flow rates (20 ml per kilogram of body weight per minute). In 43 patients, the double helical reservoir bubble oxygenator was primed with blood. In 207 patients, it was definitively primed with 5% dextrose in water (using the formula: weight in kilograms x 16 ml.) producing true hemodilution. The latter series is subdivided into two groups. In the first group, banked citrated blood was used to replace the measured loss from the surgical field as it occurred. In the second group, banked citrated blood was used only if blood loss from the surgical field was excessive and then preferably administered after the termination of the cardiopulmonary bypass; establishing the fact that total cardiopulmonary bypass, per se, is safely conducted without any blood. The basic principles involved will be discussed, the relative merits outlined, and the results tabulated.

35. Renal Complications of Open Heart Surgery: Predisposing Factors, Prevention and Management

THOMAS J. YEH, EDWIN L. BRACKNEY, DAVID P. HALL (*all by invitation*),

and ROBERT G. ELLISON Augusta, Ga.

One hundred and fifty-three consecutive cases of open heart surgery were analyzed for renal complications. While over 80% had abnormal microscopic urinary findings postoperatively, only 16 developed serious renal complications; 6 of these were classified as having renal tubular acidosis (high output renal failure) and 10 as acute renal failure. Statistical analysis indicates that hemolysis in excess of 200 mgm %, perfusion over one hours duration, flow rate less than 1.8 L/M²/min with or without hypothermia, and use of Magnesium-Egglugate preserved blood for priming, singly or in combination predisposed to renal damage. There were no cases of serious renal complication among 51 patients in whom flow rates were greater than 2.2 L/M²/min regardless of other factors, suggesting that renal damage may be completely preventable with use of high flow rates. Prophylactic Mannitol has been used in 30 consecutive cases with eminently good results. All 16 cases of serious renal complications were managed conservatively with or without ion exchange resin. Artificial renal dialysis was required in only one case of renal failure with survival. There was only one renal death in this series.

36. Endarterectomy in the Treatment of Coronary Artery Disease

DONALD B. EFFLER, LAURENCE K. GROVES, (*and by invitation*)

F. MASON SONES, JR., and EARL SHIREY, Cleveland, Ohio

Endarterectomy has been advocated for definitive treatment of arterial disease. At present, we believe that this direct approach has limited application and should be reserved for those patients who demonstrate localized obstruction of the main arteries. Selection of the candidate for coronary endarterectomy requires precise evaluation of the coronary vessels and their disease patterns. This evaluation is accomplished by Sone's method of selective coronary arteriography. The arteries are opacined by direct injection of contrast medium; selective filling of each vessel is recorded by cine-photography. Our experience is limited to operations upon four patients who presented segmental occlusion of a main coronary artery. The area of occlusion represented at least 75% reduction in normal vessel caliber and each patient was incapacitated by angina pectoris. The operations utilized total body perfusion and cardioplegia induced by regional hypothermia. Endarterectomy was performed under direct vision and the vessel reconstructed with vein patch graft. Coronary endarterectomy is a major surgical undertaking and limits of its application are emphasized. One patient failed to survive operation; postmortem dissection demonstrated distal dissection of the intima. Follow-up study in three survivors by postoperative arteriograms is presented.

WEDNESDAY AFTERNOON, APRIL 10, 1963

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Wednesday Afternoon, April 10, 1963

2:00 P.M. Scientific Session: THORACIC SURGERY FORUM

Emerald Room

37. Evaluation of Two Prostheses for Total Replacement of the Mitral Valve

F. S. CROSS, *(and by invitation)* A. N. GEREIN, and

R. D. JONES, Cleveland, Ohio

Although significant advances have been made in the clinical use of total valve prostheses, continued research is necessary to improve designs, materials, and techniques of insertion. Two types of mitral replacements have been developed and tested. The first is a modified Starr valve, constructed entirely of silicone rubber, incorporating what are felt to be important changes in the design of the attachment ring. The second, likewise constructed of silicone rubber, eliminates the necessity of a cage, and substitutes a lens-shaped body for the ball. This latter valve is more compact and it can be constructed with a larger orifice to afford better hemodynamic relationships. Both valves have been studied in a fatigue testing apparatus. They have been inserted in 65 dogs with the longest survival being eight months to date. In vivo studies include problems of insertion, patterns of fibrin formation, pressure relationships across the valves, and cineangiocardiograms. As a result of these studies clinical use of the ball valve is anticipated prior to the meeting.

38. Sutureless Mitral and Aortic Valve Prostheses

GEORGE J. MAGOVERN, and HARRY W. CROMIE

(by invitation), Pittsburgh, Pa.

In order to simplify both the methods of insertion and fixation of prosthetic mitral and aortic valves and thereby lessen both the time of cardio-pulmonary bypass and the hazard of postoperative thrombus formation, two valves have been designed and clinically employed in the aortic and mitral positions which utilize a rapid mechanical nonsuture fixation which has not previously been described. These valves employ a cage-ball mechanism, but housed within their base are multiple curved pins which following insertion of the valve in the desired position, are simultaneously ejected through orifices in the lateral rim of the base of the valve, and engage the adjacent tissue for fixation, thus eliminating the prolonged period of time necessary for suturing the prosthesis in position. The valves have been used in the aortic position on three patients, and in the mitral position on one patient, with follow-up of four to nine months. In all patients the fixation has been satisfactory. The design and mechanism and the continued progress of the clinical application will be described. Coronary perfusion and/or hypothermia have not been necessary in the aortic replacement.

39. An Inverted Tricuspid Plastic Mitral Valve

RICHARD W. ERNST, and HARRY D. STOKES

(both by invitation), Dallas, Texas

Sponsored by DONALD L. PAULSON

Adherence to flow principles with regard to turbulence and resistance led to the development of a tricuspid valve which functions conversely to presently available valves. Suspended on three pillars the leaflets move toward the center of the valve to open, and close by approximation to the valve's annulus. The dome of the valve is located in the center of the left atrium. No space is taken up in the left ventricle. The valve is molded in one piece including leaflets and annulus thus giving added strength. Tissue in growth is permitted by cementing porous material circumferentially to the annulus. In the pulse duplicator no gradient was obtained with a flow of eight liters per minute. In the dog a pressure of 8/2 mm Hg was obtained in the left atrium with a similar valve. This valve has the following advantages: (1) absence of turbulence; (2) absence of "dead" space, thus avoiding formation of thrombi; (3) no component of the valve occupies the left ventricular lumen and thus the ventricular myocardium cannot be damaged and the diastolic filling can be maximal; (4) the valve is molded in one piece, giving it added strength.

40. The Implantable Synchronous Pacer in the Treatment of Complete Heart Block

SOL CENTER, DAVID NATHAN, CHANG-YU WU, and

PHILIP SAMET *(all by invitation)*, Miami, Fla.

Sponsored by THOMAS H. BURFORD

An implantable synchronous pacer has been modeled to synchronize the activity of the atria and ventricles. Previous work in animals has proven the feasibility of long term pacing in the treatment of complete heart block. Synchronous pacers have been implanted in patients with Stokes-Adams disease. Physiologic studies were obtained before and after implantation to determine cardiac function under varying degrees of activity. In its simplest form, the atrial potential is picked up from the left atrium, relayed to the pacer, delayed and amplified, and then conducted

to the electrode implanted on the left ventricle resulting in a ventricular contraction. With this pacer, naturally induced speeding or slowing of the atria will cause the ventricles to follow as the heart responds to body demands. The battery life of the unit is four or five years. Safeguards have been built into the unit to prevent ventricular rates above 115 and below 60. In the event of return to normal sinus rhythm the pacer follows but does not interfere with normal rhythm.

41. The Denbrillator and Cardiac Burns

LAURENCE M. RIVKIN, San Francisco, Calif.

The deleterious effects of electrical cardiac defibrillation are primarily the result of burns. These burns are caused by heat developed as the resistance of the heart transforms electrical energy into heat. The heat produced by shocks from a defibrillator was measured after implanting micro-miniature thermocouples in the myocardium. Shocks were administered from an AC and a condenser discharge ("DC") defibrillator. The effect of increasing voltage and varying the duration (AC) or wave form (DC) was studied. In addition, hearts of varying mass were utilized. Approximately 800 determinations were made. In 20 dogs, shocks were applied to the exposed heart. The animals were sacrificed hours to days later and the myocardium examined for burns. This study suggests criteria for predicting the safety of a technic of internal cardiac defibrillation. This is particularly important in the use of the "DC" de-fibrillator where heat and burns are produced despite the small amount of power applied.

42. Hemodilution Studies in Extracorporeal Circulation Employing a Rotating-Disc Oxygenator

DONALD R. KAHN, HUGO F. HIDALGO, GEORGINE M. STEUDE

(*all by invitation*), and HERBERT SLOAN, Ann Arbor, Mich.

In order to evaluate hemodilution using a rotating-disc oxygenator with a 2000 ml. priming volume, the following concentrations were used: 1) all blood, 2) 25% Dextran-75% blood, 3) 50% Dextran-50% blood, 4) 75% Dextran-25% blood, 5) 100% Dextran, 6) 50% 5%G/water-50% blood, 7) 75% 5%G/water-25% blood, 8) 100% 5%G/water. Total cardiopulmonary bypass was instituted in dogs for one hour at 32 °C. hypothermia with flow rates between 50-85 cc/kg/minute, depending upon the amount of venous return. No extra blood was given during or after perfusion. Volume in extracorporeal circuit was unchanged. Studies were obtained before and one hour after perfusion. Selected dogs were studied at one week. During perfusion all dogs did well. Venous return was best, and, therefore, higher flow rates were maintained in the hemodilution experiments. 100% hemodilution dogs died in 24 hours. The remaining dogs stayed well after perfusion. Platelet decrease, plasma hemoglobin, PH, pCO₂, and pO₂ were the same for all groups. Total blood volume was greater after perfusion in the hemodilution group than in the all blood group, but the red cell volume was proportionally lower depending upon the degree of hemodilution. With hemodilution the usual unaccountable blood loss after perfusion was not present.

43. The Perfusion Hematocrit

HOWARD L. GADBOYS (*by invitation*), and ROBERT S. LITWAK,

New York, N.Y.

It has been demonstrated that hypovolemia involving both erythrocytes and plasma is seen frequently following extracorporeal circulation. The purpose of this communication is present data suggesting that immediate and late blood volume alterations are not clearly reflected in the postperfusion hematocrits. Fifty-eight patients had pre- and postperfusion blood volume studies with Cr⁵¹ and RISA. Simultaneous hematocrits were done. The pump-oxygenator was primed with whole blood in 26 cases and 30% hemodilution was employed in 32. Ninety-nine determinations 4 and 18 hours *postperfusion* showed RCV fall averaging 22% from control whereas the hematocrit fell only 5%. Six observations on the second and third post-perfusion days revealed RCV and Hct drops of 32% and 22% from control respectively. Eight determinations on the fourth to thirteenth days demonstrated RCV to be only 9% less than control despite a 31% decline in Hct. Thirty-two patients perfused with *hemodilution* had 4 hour postperfusion RCV fall of 24% from control but simultaneous Hct fall of only 4%. The 26 *non-diluted* patients averaged 17% RCV decline while the hematocrit fell 3%. It is felt that these discrepancies relate to sequestrative changes of the homologous blood syndrome and that treatment of "postperfusion anemia" with blood may be unwarranted.

44. Coronary Artery Flow Patterns in the Intact Dog

SANFORD A. HEPPS (*by invitation*), BENSON B. ROE, and

BURT RUTKIN (*by invitation*), San Francisco, Calif.

A reliable, accurate electromagnetic flowmeter probe small enough to be implanted surgically on the anterior descending coronary artery has been developed to evaluate coronary artery flow patterns in the conscious, intact animal

under various conditions of exercise, drug infusion and aortic valve incompetence. Undamped coronary artery pulse curves have been obtained with simultaneous ascending aortic flow curves and electrocardiograms. A satisfactory technique has been developed for obtaining frequent zero flow baseline and for obliterating EKG interference. Mean and cyclical coronary flow changes have been measured during treadmill exercise and after infusion with a variety of pressor agents and vasodilators. Alterations in the coronary flow curve in relation to ventricular systole are demonstrated in the presence of aortic valve incompetence. Studies to date include reliable data on eight animal preparations with consistent results showing significant differences in coronary flow with several drugs commonly used to augment the coronary circulation. Further studies are in progress and will be described.

45. Peripheral Vascular Responses During Hypothermia

WILL C. SEALY, ALAN LESAGE (*by invitation*),

and W. GLENN YOUNG, JR Durham, N.C.

Alterations of the reaction of the peripheral vascular tree by hypothermia may significantly influence the development of temperature gradients and post-hypothermic metabolic acidosis. In 30 dogs cooled to as low as 7°C by a pump oxygenator, the following experiments were done: (1) Sympathetic stimulation by carotid occlusion and central vagal stimulation, (2) Peripheral vagal stimulation, (3) Injection of nor-epinephrine, (4) Injection of quinidine, (5) Studies of dilution curves. Sympathetic stimulation failed to increase the blood pressure at 18°C, though, as an indication of impulse transmission, cardiac effects of peripheral vagal stimulation continued until 10°C was reached. Norepinephrine caused an increase (110% to 180%) in blood pressure at 7°C. Quinidine not only reduced (50%) the blood pressure at 7°C, but blocked the action of nor-epinephrine. Mixing curves obtained at 7°C indicated paralysis of the peripheral vascular bed. During varying levels of hypothermia, the difference in the response of the peripheral vascular tree to stimulation and to nor-epinephrine suggests that this may be important in the development of areas of rapid and slow perfusion during induction and reversion of hypothermia. The possibility will be discussed of using these facts for instituting a more uniform perfusion during hypothermia.

46. The Importance of the Azygous Vein in Superior Cava Pulmonary Artery Anastomosis

W. STERLING EDWARDS, and L. M. BARGERON, JR.

(*by invitation*), Birmingham, Ala.

In a series of 18 patients with tricuspid atresia treated with a superior cava right pulmonary artery shunt, there were three deaths in the first ten patients from cerebral edema. In all ten patients the azygous vein was ligated and the anastomosis made at its junction with the vena cava. In the next six patients the azygous was left open. The immediate postoperative course, especially in infants was significantly smoother, with no evidence of the "Superior Vena Caval Syndrome". One patient did not get the usual improvement in cyanosis, however, until the azygous was ligated at a second operation. This experience led to the development of a simple technique of encircling the azygous with a loose ligature which is brought out to a small subcutaneous button for azygous ligation 2-3 days postoperatively. This allows decompression of the superior cava through the azygous immediately after operation but permits azygous ligation a few days later to obtain full superior caval flow through the right lung.

47. Inflow Occlusion for Coronary Arteriography: Experimental Comparison with Other Methods

J. Y. TEMPLETON III, R. R. GREENING (*by invitation*),

C. FINEBERG, (*and by invitation*) T. G. PETERS,

J. R. GRIFFITH, C. L. REESE, and D. L. CLARK, Philadelphia, Pa.

Injection of radio-opaque material into the base of the aorta produces satisfactory opacification of the coronary arteries when cardiac output is temporarily diminished by acetyl choline cardiac arrest (Bjork) or by increasing endothoracic pressure (Nordenstrom). A third method, that of inflow occlusion by inflating the balloon of a specially devised catheter in the right atrium has been developed by us. In these experiments the three methods were used in varying sequence in each animal and the results compared. Arterial and venous pressures, electrocardiograms and electroencephalograms were recorded. Appropriate roentgenograms were made using the Franklin rapid film changer

and cine radiographs were obtained using the Marconi Image Amplifier. Satisfactory visualization of the coronary arteries was obtained by all three methods. Inflow occlusion produced less disturbance of cardiac function, may be done under local anesthesia, may be readily repeated and is controllable so that cardiac output can be altered to the degree desired. Successful application of the method for coronary arteriography in patients with angina has begun and will be included in the report.

48. Autogenous Vein Aorto-Coronary Bypass: An Experimental Study

LESTER R. SAUVAGE, STEPHEN J. WOOD, and KENNETH M. EVER

(all by invitation), Seattle, Wash.

Sponsored by ROBERT E. GROSS

We have thus far done 26 coronary bypass experiments in the dog. An autogenous external jugular vein graft is run from the upper thoracic aorta to the circumflex or the anterior descending coronary artery. The procedures are done using moderate hypothermia without extra-corporeal circulation. The technical difficulties have been appreciable, but less than anticipated. Six animals are living at this time, from 6 to 77 days since operation. In all of these survivors the graft has been anastomosed to the side of the distal circumflex coronary artery. In 5 of the 6 the circumflex coronary was ligated proximal to the anastomosis. In one the left main coronary was ligated. Four of these survivors had postoperative coronary arteriography at a mean period of 43 days after operation. All grafts were patent. None showed dilatation. Excellent filling of the coronary bed was apparent. Despite difficult problems, it is our belief that bypass surgery of the coronary arteries is a feasible undertaking with considerable clinical potential. Further experimental work should resolve many of the remaining difficulties. The technic of the procedure, postoperative coronary cineangiograms, autopsy specimens and additional studies will be presented.

ALPHABETICAL ROSTER

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The American Association for Thoracic Surgery 1962-63

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ADA, ALEXANDER E. W.. 139 East 94th
St., New York 28, N. Y.
ADAMS, HERBERT D.....
Lahey Clinic, 605 Commonwealth Ave.,
Boston 15, Mass.
ADAMS, RALPH..... Huggins
Hospital, Wolfeboro, N. H.
ADAMS, WILLIAM E..... University of
Chicago, 950 East 59th St., Chicago 37, Ill.
ADKINS, PAUL C..... 901 23rd St., N.W.,
Washington 7, D. C.
ADLER, RICHARD H.100 High St.,
Buffalo 3, N. Y.
ALLBRITTEN, FRANK F., JR.
University of Kansas Medical Center,
Kansas City 12, Kan.
ALLEY, RALPH D..... Albany
Hospital, Albany, N. Y.
ANDREWS, NEIL C.466 West Tenth
Ave., Columbus 10, Ohio
ANKENEY, JAY L... 2065 Adelbert Road,
Cleveland 6, Ohio
ASHBURN, FRANK S..... 835 Eye St.,
N.W., Washington 6, D. C.
AUERBACH, OSCAR Veterans Adm.
Hospital, East Orange, N. J.
BAFFES, THOMAS G.The Children's
Memorial Hospital, Chicago 14, Ill.
BAHNSON, HENRY T..... Presbyterian-
University Hospital, Pittsburgh 13, Pa.
BAILEY, CHARLES P.
New York Medical College, 1249 Fifth
Ave., New York, N. Y.
BARKLEY, HOWARD T.4414 Montrose
Blvd., Houston 6, Texas
BARONOFSKY, IVAN D.233 "A" St.,
San Diego, Calif.
BARRETT, RAYMOND J.18280 Fairfield
St., Detroit 21, Mich.
BATTERSBY, JAMES S..... 1040 W.
Michigan St., Indianapolis 7, Ind.
BEATTIE, EDWARD J. JR.....
1753 W. Congress Parkway, Chicago 12,
Ill.
BEECHER, HENRY K.... Massachusetts
General Hospital, Boston 14, Mass.
BELL, JOHN W..... Veterans Adm.
Hospital, Seattle 8, Wash.
BENOIT, HECTOR W. JR.503 Plaza
Parkway Bldg., Kansas City 12, Mo.
BENSON, CLIFFORD D..... 1515
David Whitney Bldg., Detroit 26, Mich.
BERG, RALPH, JR.... 231 Medical Center
Bldg, Spokane 4, Wash.

BERGMANN, MARTIN 4409 W. Pine
Blvd., St. Louis 8, Mo.
BERNATZ, PHILIP E... Mayo Clinic,
Rochester, Minn.
BIGELOW, WILFRED G.. 300 Medical
Arts Bldg., Toronto, Ontario
BLACK, HARRISON... 319 Longwood
Ave., Boston 15, Mass.
BLADES, BRIAN 901 Twenty-third St.,
N.W., Washington 7, D. C.
BLAKEMORE, WILLIAM S. 3400 Spruce
St., Philadelphia 4, Pa.
BLOOMER, WILLIAM E.. 841 North
Ave. 63, Los Angeles 42, Calif.
BOSHER, LEWIS H... 1200 E. Broad St.,
Richmond 19, Va.
BOYD, DAVID P. Lahey Clinic, 605
Commonwealth Ave., Boston 15, Mass.
BRADSHAW, HOWARD H.
Bowman Gray School of Medicine,
Winston-Salem, N. C.
BRANTIGAN, OTTO C... 104 W.
Madison St., Baltimore 1, Md.
BREWER, LYMAN A. III 658 South
Bonnie Brae St., Los Angeles 57, Calif.
BRINDLEY, G. VALTER, JR.. Scott and
White Clinic, Temple, Texas
BROOKS, JAMES W... 1200 E. Broad St.,
Richmond 19, Va.
BROWN, IVAN W., JR..... Duke
University Hospital, Durham, N. C.
BROWN, ROBERT K.. 1624 Gilpin St.,
Denver 6, Colo.
BROWNRIGG, GARRETT M.. 47 Queens
Road, St. Johns, Newfoundland
BRUNEAU, JACQUES..... 847 Rue
Cherrier, Montreal 24, Quebec
BUCKINGHAM, WILLIAM W. 314
Professional Bldg., Kansas City 6, Mo.
BUGDEN, WALTER F. 1200 East Genesee
St., Syracuse 10, N. Y.
BURFORD, THOMAS H.. Barnes
Hospital, St. Louis 10, Mo.
BYRON, FRANCIS X. 1136 West 6th St.,
Los Angeles 17, Calif.
CALLAGHAN, JOHN C..... 502
Medical Arts Bldg., Edmonton, Alberta
CAMPBELL, GILBERT S.... 800
Northeast 13th St., Oklahoma City 4, Okla.
CARLSON, ROBERT I.
Sunmount Veterans Adm. Hospital, Tupper
Lake, N. Y.
CARR, DUANE 20 S. Dudley St.,
Memphis 3, Tenn.
CARTER, MAX G. 670 George St., New
Haven, Conn.

CHAMBERLAIN, JOHN MAXWELL....
23 East 79th St., New York 21, N. Y.
CHAMBERS, JOHN S., JR.2850 Sixth St.,
San Diego 3, Calif.
CHESNEY, JOHN G.1550 N.W. 10th
Ave., Miami 37, Fla.
CLAGETT, O. THERON... Mayo Clinic,
Rochester, Minn.
CLATWORTHY, H. WM., JR... 695
Bryden Road, Columbus 5, Ohio
CLOWES, GEORGE H. A., JR.....
Medical College Hospital, Charleston, S.
C.
COHN, ROY B..... Stanford
Hospital, Palo Alto, Calif.
COLEMAN, FRANK P.... 1111 W.
Franklin St., Richmond 20, Va.
CONDON, WILLIAM B.1825 Gilpin St.,
Denver 18, Colo.
CONKLIN, WILLIAM S.. 511 S. W.
Tenth Ave., Portland 5, Ore.
CONNOLLY, JOHN E.Stanford Medical
Center, Palo Alto, Calif.
COOLEY, DENTON A.
Baylor University College of Medicine,
Houston 25, Texas
COTTON, BERT H... 111 Congress St.,
Pasadena, Calif.
COWLEY, R. ADAMS..... University
Hospital, Baltimore 1, Md.
CRANDELL, WALTER B..... Veterans
Adm. Hospital, White River Junction, Vt.
CRAWFORD, E. STANLEY... 1200 M. D.
Anderson Blvd , Houston 25, Texas
CREECH, OSCAR, JR.
Tulane University School of Medicine,
New Orleans 12, La.
CROSS, FREDERICK S..... 11311
Shaker Blvd., Cleveland 4, Ohio
CURRERI, ANTHONY R... 1300
University Ave., Madison 6, Wis.
CUTLER, PRESTON R.. 535 East 1st
South, Salt Lake City 2, Utah
DAILEY, JAMES E..... 347 Hermann
Professional Bldg, Houston 25, Texas
DAMMANN, JOHN F..... 632 Preston
Place, Charlottesville, Va.
DANIEL, ROLLIN A..... 410 Medical Arts
Bldg., Nashville 12, Tenn.
DANIELS, ALBERT C.... 490 Post St.,
San Francisco 2, Calif.
DAUCHTRY, DEWITT C.. 1550 N.W.
10th Ave., Miami 37, Fla.
DAVILA, JULIO C... 3401 N. Broad St.,
Philadelphia 40, Pa.

DAVIS, EDGAR W..... 1150
Connecticut Ave., Washington 6, D. C.
DAY, J. CLAUDE..... 307 David
Whitney Bldg., Detroit 26, Mich.
DE BAKEY, MICHAEL E.
Baylor University, Dept. of Surgery,
Houston, Texas
DECAMP, PAUL T.... 3503 Prytania St.,
New Orleans 15, La.
DELARUE, NORMAN C... 25 Donlea
Drive, Toronto 17, Ontario
DENNIS, CLARENCE... 989 Edgewood
Ave., Pelham Manor, N. Y.
DESHAIES, GEORGES..... 37
Bellingham Road, Montreal, Quebec
DETERLING, RALPH A., JR..... 171
Harrison Ave., Boston 11, Mass.
DODRILL, FOREST D.... 641 David
Whitney Bldg., Detroit 26, Mich.
DOMM, SHELDON E.1918 W. Clinch
Ave., Knoxville 16, Tenn.
DORNER, RALPH A..... 710 Equitable
Bldg., Des Moines 9, Iowa
DORSEY, JOHN M.636 Church St.,
Evanston, Ill.
DRAKE, EMERSON H.. 18 Bramhall St.,
Portland 3, Maine
DRASH, EVERETT C..... University of
Virginia Hospital, Charlottesville, Va.
DUGAN, DAVID J..... 459 30th St.,
Oakland 9, Calif.
EFFLER, DONALD B... Euclid and East
93rd Sts., Cleveland 6, Ohio
EHRENHAFT, JOHANN L.....
University of Iowa, Iowa City, Iowa
ELLIS, F. HENRY, JR... Mayo Clinic,
Rochester, Minn.
ELLISON, ROBERT G.. Medical College
of Georgia, Augusta, Ga.
EMERSON, GEORGE L..... 11 Rochester
St., Scottsville, N. Y.
EVANS, BYRON H..... 2930 North
Fresno St., Fresno 3, Calif.
FALOR, WILLIAM H.208 Medical Arts
Bldg., Akron 4, Ohio
FELL, EGBERT H..... 122 South
Michigan Ave., Chicago 3, Ill.
FERGUSON, THOMAS B.One Davis
Blvd., Tampa 6, Fla.
FINDLAY, CHARLES W., JR..... 180
Fort Washington Ave., New York 32, N.
Y.
FISCHER, WALTER W.170 East 78th St.,
New York 21, N. Y.
FORD, JOSEPH M..... 1056 Fifth Ave.,
New York 28, N. Y.

FORD, WILLIAM B.3500 Fifth Ave.,
Pittsburgh 13, Pa.
FORSEE, JAMES H., MAJ. GEN. (MC),
USA
5207 Falmouth Rd., Westmoreland Hills,
Washington 16, D. C.
Fox, ROBERT T.2136 Robin Crest Lane,
Glenview, Ill.
FRANK, HOWARD A.330 Brookline
Ave., Boston 15, Mass.
FRENCH, SANFORD W. III904 East
Main St., Barstow, Calif.
GAENSLER, EDWARD A.229 Dudley
Road, Newton Centre 59, Mass.
GAGNON, EDOUARD D.902 Est., Rue
Sherbrooke, Montreal, Quebec
GEBAUER, PAUL... Leahi Hospital, 649
Pokole St., Honolulu, Hawaii
GERBODE, FRANK..... Presbyterian
Medical Center, San Francisco 15, Calif.
GIBBON, JOHN H., JR..... 1025
Walnut St., Philadelphia 7, Pa.
GORDON, JOSEPH..... 717 Encino
Plaza, N.E. Albuquerque, N. M.
GLENN, FRANK525 East 68th St., New
York 21, N.Y.
GLENN, WM. W. L.... 333 Cedar St., New
Haven 4, Conn.
GOLDMAN, ALFRED... 416 N. Bedford
Drive, Beverley Hills, Calif.
GORDON, JOSEPH..... 717 Encino
Plaza, N.E., Albuquerque, N.M.
GRACE, ARCHIBALD J..... Suite 310,
450 Central Ave., London, Ontario
GRAVEL, JOFFRE-ANDRE.. 11 Place
George Vth, Quebec 4, Quebec
GREER, ALLEN E.. 430 N. W. 12th St.,
Oklahoma City 3, Okla.
GRIMES, ORVILLE F.
University of California Hospital, San
Francisco 22, Calif.
GROSS, ROBERT E.300 Longwood Ave.,
Boston, Mass.
GROVES, LAURENCE K.Cleveland
Clinic, Cleveland 6, Ohio
GROW, JOHN B..... 3705 E. Colfax,
Denver 6, Colo.
HAICHT, CAMERON..... University
Hospital, Ann Arbor, Mich.
HANLON, C. ROLLINS. 1325 S. Grand
Blvd., St. Louis 4, Mo.
HARDY, JAMES D.... University of
Mississippi Medical Center, Jackson, Miss.
HARKEN, DWIGHT E..... 67 Bay State
Road, Boston 15, Mass.
HARRISON, ALBERT W.

Medical Branch, University of Texas,
Galveston, Texas
HARRISON, ELLIOTT. 750 W.
Broadway, Vancouver 9, B. C.
HARTER, JOHN S. 118 W. Medical Arts
Bldg., Louisville 17, Ky.
HELMSWORTH, JAMES A.
Cincinnati General Hospital, Cincinnati 29,
Ohio
HEROY, WILLIAM W... East Gate Road,
Lloyd Harbor, Huntington, N. Y.
HIGGINSON, JOHN F..... 1430 Chapala
St., Santa Barbara, Calif.
HOCHBERG, LEW A..... 563
Rockaway Parkway, Brooklyn 12, N. Y.
HOLINGER, PAUL H.... 700 N. Michigan
Ave., Chicago 11, Ill.
HOLLAND, ROBERT H.. 3216 Beverly
Drive, Dallas 5, Texas
HOLMAN, CRANSTON W..... 862 Fifth
Ave., New York 21, N. Y.
HOPKINS, WILLIAM A..... 1293
Peachtree St., N.E., Atlanta 9, Ga.
HUDSON, THEODORE R.E. Washington
St., Chicago 2, Ill.
HUFNACEL, CHARLES A. 3800
Reservoir Road, N.W., Washington 7, D.
C.
HUGHES, FELIX A., JR... Kennedy
Hospital, Memphis 17, Tenn.
HUMPHREYS, GEORGE H. II 180 Fort
Washington Ave., New York 32, N. Y.
HURLEY, GERARD A. P..... 3869 Cote
Des Neiges Rd., Montreal 25, Quebec
HURWITT, ELLIOTT S..... Montefiore
Hospital, New York 67, N. Y.
HURWITZ, ALFRED
Maimonides Hospital, 4802 Tenth Ave.,
Brooklyn 19, N. Y.
JAHNKE, EDWARD J., JR.
Walter Reed General Hospital, Washington
12, D. C.
JARVIS, FRED J..... 1115 Columbia St.,
Seattle 4, Wash.
JENSIK, ROBERT J..... 224 South
Michigan Ave., Chicago 4, Ill.
JOHNS, THOMAS N. P..... 6305
Towana Road, Richmond 13, Va.
JOHNSON, ELGIE K.. 230 Hilton St.,
Hempstead, N. Y.
JOHNSON, JULIAN..... 3400 Spruce St.,
Philadelphia 4, Pa.
JOHNSTON, FRANK R.
Bowman Gray School of Medicine,
Winston-Salem, N. C.

JOHNSTON, JAMES H., JR. 710 N. State
St., Jackson 2, Miss.
JONES, JOHN C. 1136 West 6th St., Los
Angeles 17, Calif.
JOYNT, G. HARRY C..... 399 Bathurst
St., Toronto, Ontario
JULIAN, ORMAND C. 25 E. Washington
St., Chicago 2, Ill.
KARLSON, KARL E..... 451 Clarkson
Ave., Brooklyn 3, N. Y.
KAUSEL, HARVEY W. Albany Hospital,
Albany 8, N. Y.
KAY, EARLE B.... 10515 Carnegie Ave.,
Cleveland 6, Ohio
KEE, JOHN LESTER..... 3810 Swiss
Ave., Dallas, Texas
KEELEY, JOHN L..... 30 North
Michigan Ave., Chicago 2, Ill.
KELLEY, WINFIELD O..... Uncas-
on-Thames, Norwich, Conn.
KENT, EDWARD M..... 3500 Fifth
Ave., Pittsburgh 13, Pa.
KERGIN, FREDERICK G.
139 Private Patients Pavilion, Toronto
General Hospital, Toronto 2, Ontario
KESSLER, CHARLES R. 1321 21st Way,
South, Birmingham 5, Ala.
KEY, JAMES A. 170 St. George St.,
Toronto, Ontario
KING, RICHARD..... Suite 233, 340
Boulevard, N.E., Atlanta 12, Ga.
KINSELLA, THOMAS J. 1251 Medical
Arts Bldg., Minneapolis 2, Minn.
KIRBY, CHARLES K. 3400 Spruce St.,
Philadelphia 4, Pa.
KIRKLIN, JOHN W... Mayo Clinic,
Rochester, Minn.
KIRSCHNER, PAUL A.... 2 East 92nd St.,
New York 28, N. Y.
KITTLE, C. FREDERICK
University of Kansas Medical Center,
Kansas City 12, Kan.
KLASSEN, KARL P..... Ohio State
University, Columbus 15, Ohio
KLEPSEY, ROY G.... 1835 Eye St., N.W.,
Washington 6, D.C.
KLOPSTOCK, ROBERT Veterans Adm.
Hospital, Brooklyn 9, N. Y.
LAIRD, ROBERT. 399 Bathurst St.,
Toronto, Ontario
LAM, CONRAD R..... Henry Ford
Hospital, Detroit 2, Mich.
LAMBERT, ADRIAN 768 Park Ave., New
York 21, N. Y.
LANGSTON, HIRAM T.... 1919 West
Taylor St., Chicago 12, Ill.

LAUREY, JAMES R.... 5710 16th St.,
N.W., Washington 11, D. C.
LEEDS, SANFORD E.2211 Post St., San
Francisco 15, Calif.
LEES, WILLIAM M..... 7000 N.
Kenton Ave., Lincolnwood 46, Ill.
LEWIS, F. JOHN..... Northwestern
University Medical School, Chicago 11, Ill.
LILLEHEI, C. WALTON
University of Minnesota Medical Center,
Minneapolis 14, Minn.
LINDSKOG, GUSTAF E..... 50 Marvel
Road, New Haven, Conn.
LITTLEFIELD, JAMES B.
University of Virginia School of Medicine,
Charlottesville, Va.
LONGMIRE, WILLIAM P., JR.
UCLA School of Medicine, Los Angeles
24, Calif.
LYNCH, JOSEPH P..... 1180 Beacon St.,
Brooklyn 46, Mass.
LYNN, R. BEVERLEY... R.R. #1,
Westbrook, Ontario
MACKLER, S. ALLEN..... 104 S.
Michigan Ave., Chicago 3, Ill.
MACMANUS, JOSEPH..... 491
Delaware, Buffalo 2, N. Y.
MADOFF, IRVING M... 1180 Beacon St.,
Brookline 46, Mass.
MAHONEY, EARLE B..... 260
Crittenden Blvd., Rochester 20, N. Y.
MAIER, HERBERT C..... 3 East 71st St.,
New York 21, N. Y.
MAJOR, ROBERT C.. 1477 Harper St.,
Augusta, Ga.
MALONEY, JAMES V., JR.
UCLA School of Medicine, Los Angeles
24, Calif.
MANNIX, EDGAR P., JR.12 Forest Turn,
Manhasset, Long Island, N. Y.
MAURER, ELMER P. R.. 507 Union
Central Bldg., Cincinnati 2, Ohio
MAUTZ, F. R.... 10515 Carnegie Ave.,
Cleveland 6, Ohio
MAYER, JOHN H., JR.... 503 Plaza
Parkway Bldg., Kansas City 12, Mo.
MCBURNEY, ROBERT P..... 899
Madison Ave., Memphis 3, Tenn.
MCDONALD, JOHN R.... Harper
Hospital, 3825 Brush St., Detroit, Mich.
McGOON, DWIGHT C..... Mayo Clinic,
Rochester, Minn.
MECKSTROTH, CHARLES V.....
University Hospital, Columbus 10, Ohio
MELICK, DERMONT W.. 909 East Brill
St., Phoenix 6, Ariz.

MELTZER, HERBERT..... 505 Medical Arts Bldg., Edmonton, Alberta
MENDELSON, HARVEY J... 2065 Adelbert Road, Cleveland 6, Ohio
MERENDINO, K. ALVISUniversity of Washington, Seattle 5, Wash.
MERKEL, CARL G..... 8 Church St., Saranac Lake, N. Y.
MEYER, BERTRAND W.922 Keatley Road, La Canada, Calif.
MICHELSON, ELLIOTT..... 1801 Eutaw Place, Baltimore 17, Md.
MILLS, WALDO O.... 1445 Medical and Dental Bldg., Seattle 1, Wash.
MINOR, GEORGE R.... University of Virginia Hospital, Charlottesville, Va.
MISCALL, LAURENCE.... 11 East 68th St., New York, N. Y.
MOORE, THOMAS C..... Indiana University Medical Center, Indianapolis, Ind.
MORRIS, JOE D..... 1801 Weldon Blvd., Ann Arbor, Mich.
MORROW, ANDREW G..... National Heart Institute, Bethesda 14, Md.
MOULDER, PETER V.950 East 59th St., Chicago 37, Ill.
MULLER, WM. H., JR.University of Virginia Hospital, Charlottesville, Va.
MULVIHILL, DANIEL A..... 15 East 77th St., New York 21, N. Y.
MUSTARD, WILLIAM T.200 St. Clair Ave., W. Toronto 7, Ontario
NEALON, THOMAS F. JR.. 1025 Walnut St., Philadelphia 7, Pa.
NELSON, RUSSELL M.. 333 South Ninth East St., Salt Lake City, Utah
NEMIR, PAUL, JR.. University of Pennsylvania, Philadelphia 4, Pa.
NEPTUNE, WILFORD B.135 Francis St., Boston 15, Mass.
NEWMAN, MELVIN M.3800 E. Colfax Ave., Denver 6, Colo.
OLSEN, ARTHUR M.. 102 2nd Ave., S.W., Rochester, Minn.
O'NEILL, THOMAS J. E..... Suite 110, Centennial Bldg., Philadelphia 25, Pa.
O'ROURKE, PAUL V..... 307 David Whitney Bldg., Detroit 26, Mich.
OVERHOLT, RICHARD H.135 Francis St., Boston 15, Mass.
PAINE, JOHN R.... Buffalo General Hospital, 100 High St., Buffalo 14, N. Y.
PAPPER, EMANUEL M.... 622 West 168th St., New York 32, N. Y.

PARKER, EDWARD F.. 158 Rutledge Ave., Charleston 8, S. C.
PAULSON, DONALD L.3810 Swiss Ave., Dallas, Texas
PECORA, DAVID V..... Box 20, Ray Brook, N. Y.
PERKINS, REX BEACH..... 1919 Seventh Ave., South, Birmingham 3, Ala.
PETERS, RICHARD M..... University of North Carolina, Chapel Hill, N. C.
PHILLIPS, FRANCIS J.. 2220 E. Northern Lights Blvd., Anchorage, Alaska
POLK, JOHN W.. 315 Professional Bldg., Springfield 4, Mo.
POOL, JOHN L..... 755 Park Ave., New York 21, N. Y.
POPPE, J. KARL..... 1130 S.W. Morrison St., Portland 5, Ore.
POTTS, WILLIS J..... 707 Fullerton Ave., Chicago 14, Ill.
RAMSAY, BEATTY H.11600 Wilshire Blvd., Los Angeles 25, Calif.
RASMUSSEN, RICHARD A.Blodgett Medical Bldg., Grand Rapids 6, Mich.
RAVITCH, MARK M..... Baltimore City Hospital, Baltimore, Md.
READ, CHARLES T..... 550 West Thomas Road, Phoenix, Ariz.
RICHARDS, VICTOR..... Presbyterian Medical Center, San Francisco 15, Calif.
RICCINS, H. MCLEOD..... 1031 Fifth Avenue, New York 28, N. Y.
RIPSTEIN, CHARLES B.... 15 Birch St., Great Neck, L. L, N. Y.
ROBERTSON, Ross..... 410-750 West Broadway, Vancouver 9, B. C.
ROE, BENSON B.
University of California Medical Center, San Francisco 22, Calif.
ROSEMOND, GEORGE P... 3401 North Broad St., Philadelphia 40, Pa.
ROSENBERG, DENNIS M.. 1539 Delachaise St., New Orleans 15, La.
RUMEL, WILLIAM R.535 East 1st South, Salt Lake City 2, Utah
SABISTON, DAVID C.. Johns Hopkins Hospital, Baltimore 5, Md.
SALYER, JOHN M..... 2032 North Broadway, Santa Ana, Calif.
SAMSON, PAUL C..... 15 La Salle Ave., Piedmont 11, Calif.
SANGER, PAUL W.Doctors Bldg., Kings Drive, Charlotte, N. C.
SAROT, IRVING A... 107 East 85th St., New York 28, N. Y.

SCANNELL, J. GORDON...
Massachusetts General Hospital, Boston
14, Mass.

SCHAFFNER, VERNON D..... 12
Cornwallis St., Kentville, Nova Scotia

SCHRAMEL, ROBERT J... 1430 Tulane
Ave., New Orleans 12, La.

SCOTT, HENRY W., JR. Vanderbilt
University Hospital, Nashville 5, Tenn.

SEALY, WILL C.. Duke University
Hospital, Durham, N. C.

SEILER, HAWLEY H.. 517 Bayshore
Blvd., Tampa 6, Fla.

SELEY, GABRIEL P.. 799 Park Ave.,
New York 21, N. Y.

SHEETS, LAWRENCE M.
614 Medical Professional Bldg., San
Antonio 12, Texas

SHUMACKER, HARRIS B, JR.
Indiana University Medical Center,
Indianapolis 7, Ind.

SIRAK, HOWARD D..... Ohio State
University Hospital, Columbus 10, Ohio

SKINNER, EDWARD F. 20 S. Dudley St.,
Memphis 3, Tenn.

SLOAN, HERBERT..... University
Hospital, Ann Arbor, Mich.

SNYDER, JOHN M..... 1236 Moffit Ave.,
Bethlehem, Pa.

SOMMER, GEORGE N. J., JR.. 120 W.
State St., Trenton 8, N. J.

SOUTTER, LAMAR..... 577 Bridge St.,
Dedham, Mass.

SPENCER, FRANK C.
University of Kentucky School of
Medicine, Lexington, Ky.

STARKEY, GEORGE W. B..... 319
Longwood Ave., Boston 15, Mass.

STATE, DAVID... Albert Einstein College
of Medicine, New York 61, N. Y.

STEPHENS, H. BRODIE 384 Post St., San
Francisco 8, Calif.

STOREY, CLIFFORD F. 6330 Alvarado
Road, San Diego 20, Calif.

STRANAHAN, ALLAN.. Albany
Hospital, Albany, N. Y.

STRIEDER, JOHN W... 1180 Beacon St.,
Brookline 46, Mass.

STRODE, JOSEPH E.
Straub Clinic, Kapiolani St. at Thomas
Square, Honolulu 14, Hawaii

STRUG, LAWRENCE H. 2435 Octavia
St., New Orleans 15, La.

SWAN, HENRY II.. 303 Josephine St.,
Denver 6, Colo.

TABER, RODMAN E..... Henry Ford
Hospital, Detroit 2, Mich.
TAKARO, TIMOTHY.... .Veterans Adm.
Hospital, Oteen, N. C.
TAYLOR, FREDERICK H..... .1012
Kings Drive, Charlotte, N. C.
TEMPLETON, JOHN Y. III.... 311 Airdale
Rd., Rosemont, Pa.
THOMAS, GORDON W.
Int. Grenfell Association, St. Anthony,
Newfoundland
TIMMES, JOSEPH J.. Seton Hall College
of Medicine, Jersey City, N. J.
TOCKER, ALFRED M.Suite D, Medical
Arts Bldg., Wichita 14, Kan.
VARCO, RICHARD L.
University of Minnesota Medical Center,
Minneapolis 14, Minn.
VINEBERG, ARTHUR M.1390
Sherbrooke St., W., Montreal 25, Quebec
VORWALD, ARTHUR J.
College of Medicine, Wayne State
University, Detroit 7, Mich.
WADDELL, WILLIAM R.4200 East 9th
Ave., Denver 20, Colo.
WALKER, JAMES H.... 1323 Quarrier St.,
East, Charleston 1, W. Va.
WALKUP, HARRY E.... 1790 Broadway,
New York 19, N. Y.
WARE, PAUL F.... 124 Russell St.,
Worcester, Mass.
WATERMAN, DAVID H..... 1918 West
Clinch Ave., Knoxville 16, Tenn.
WATKINS, ELTON, JR.
Lahey Clinic, 605 Commonwealth Ave.,
Boston 15, Mass.
WATSON, WILLIAM L..340 East 72nd
St., New York 21, N. Y.
WEBB, WATTS R..... University
Hospital, Jackson, Miss.
WEISEL, WILSON... 324 E. Wisconsin
Ave., Milwaukee 2, Wis.
WHITE, MARION L., JR.Huntington
Bank Bldg., Huntington, W. Va.
WILKINS, EARLE W., JR..... Zero
Emerson Place, Boston 14, Mass.
WILLIAMS, MARK H..... 63 Front St.,
Binghamton, N. Y.
WILSON, JOHN L..... American
University of Beirut, Beirut, Lebanon
WILSON, NORMAN J.. 135 Francis St.,
Boston 15, Mass.
WIPER, THOMAS B.Suite 615, 909 Hyde
St., San Francisco 9, Calif.
WOLCOTT, MARK W..... Veterans Adm.
Hospital, Coral Gables, Fla.

WOLFF, WILLIAM I..... 30 Central Park
South, New York 19, N. Y.
WOODS, FRANCIS M.135 Francis St.,
Boston 15, Mass.
WRIGHT, GEORGE W.11311 Shaker
Blvd., Cleveland 4, Ohio
WYLIE, ROBERT H.. 903 Park Ave., New
York, N. Y.
YOUNG, WM. GLENN, JR.
Duke University Medical Center, Box
3617, Durham, N. C.

ASSOCIATE MEMBERS

ACKMAN, F. DOUGLAS.. 1374
Sherbrooke St., W., Montreal 25, Quebec
ADAMS, JESSE E., JR.301 Medical Arts
Bldg., Chattanooga 2, Tenn.
ADELMAN, ARTHUR..... 751 East 63rd
St., Kansas City 10, Mo.
AITCHISON, DAVID B..... Mountain
Sanatorium, Hamilton, Ontario
ANDERSEN, MURRAY N.. 462 Grider
St., Buffalo 15, N. Y.
ARONSTAM, ELMORE M.Fitzsimons
Army Hospital, Denver 30, Colo.
BERNHARD, WILLIAM F.. 300
Longwood Ave., Boston 15, Mass.
BESKIN, CHARLES A.3929 Convention
St., Baton Rouge, La.
BLALOCK, JOHN B.... 3503 Prytania St.,
New Orleans 18, La.
BLOOMBERG, ALLAN E.... 1095 Park
Ave., New York 28, N. Y.
BOUGAS, JAMES A..... 135 Francis St.,
Boston 15, Mass.
BOUSQUET, ERNEST O... 5689
Boulevard Rosemont, Montreal, Quebec
BRYANT, JOSEPH R..... 321 West
Broadway, Louisville 2, Ky.
BURBANK, BENJAMIN... 244 Henry St.,
Brooklyn 1, N. Y.
CAHAN, WILLIAM G.444 E. 68th St.,
New York 21, N. Y.
CHANDLER, JOHN H... 616 W. Forest
Ave., Jackson, Tenn.
CHODOFF, RICHARD J... 255 South 17th
St., Philadelphia 3, Pa.
CHUNN, CHARLES F.. 316 Magnolia
Ave., Tampa 6, Fla.
CINCOTTI, JOHN J.. Veterans Adm.
Hospital, Sepulveda, Calif.
COHEN, MORLEY..... 1200 Grosvenor
Ave., Winnipeg 9, Manitoba
COLE, FRANCIS H... 1375 Gpodbar Ave.,
Memphis, Tenn.

COLLINS, HAROLD A.....
Vanderbilt University Hospital, Nashville,
Tenn.
CONNAR, RICHARD G. One Davis Blvd.,
Tampa 6, Fla.
COOKE, FRANCIS N.... 25 S.E. Second
Ave., Miami 32, Fla.
CORDELL, A. ROBERT..... 963
Kenleigh Circle, Winston-Salem, N. C.
Cox, WILLIAM V.... 133 Court St.,
Auburn, Maine
CRACOVANER, ARTHUR J.... 103 East
78th St., New York 21, N. Y.
CRASTNOPOL, PHILIP. 1221 East 21st
St., Brooklyn 10, N. Y.
CRECCA, ANTHONY D. 376 Roseville
Ave., Newark 7, N. J.
DAFOE, COLIN S..... 508 Medical Arts
Bldg., Edmonton, Alberta
DASCH, FREDERICK W..... Union St.
and Avenue C, Schuylkill Haven, Pa.
DAVIS, MILTON V..... 3707 Gaston
Ave., Dallas 10, Texas
DEATON, W. RALPH, JR.. 1027
Professional Village, Greensboro, N. C.
DEBORD, ROBERT A.. 1240 Jefferson
Bldg., Peoria, Ill.
DECKER, ALFRED M., JR. 8 Church St.,
Saranac Lake, N. Y.
DEMATTEIS, ALBERT..... 2612 Pleasant
Valley Blvd., Altoona, Pa.
DESFORGES, GERARD 49 Lake Ave.,
Melrose 76, Mass.
DILLON, MARCUS L., JR... 203 Frances
St., Durham, N. C.
DIVELEY, WALTER L... 410 Medical
Arts Bldg., Nashville 12, Tenn.
DODDS, G. ALFRED..... 807 Broadway,
Fargo, N. D.
EDWARDS, W. STERLING 619 S. 19th
St., Birmingham 9, Ala.
FINEBERG, CHARLES..... 309 Ellis
Road, Havertown, Pa.
FINNERTY, JAMES..... Brookhaven
Medical Arts Bldg., Patchogue, N. Y.
FITZPATRICK, HUGH F..... St. Luke's
Hospital, New York 25, N. Y.
FRIEDLANDER, RALPH The Bronx
Hospital, New York 56, N. Y.
FRIESEN, STANLEY R. 39th and
Rainbow, Kansas City 3, Kan.
FROBES, ALFRED S... 1425 Scrope
Road, Rydal, Pa.
FULLER, JOSIAH... 205 W. 2nd St.,
Duluth 2, Minn.

GARAMELLA, JOSEPH J..... 1629
Medical Arts Bldg., Minneapolis, Minn.
GERBASI, FRANCIS S.
426 Eastland Center Professional Bldg.,
Detroit 36, Mich.
GILBERT, JOSEPH W., JR..... National
Heart Institute, Bethesda 14, Md.
GWATHMEY, OWEN... 501 East
Franklin St., Richmond 19, Va.
HALL, DAVID P.. Medical College of
Georgia, Augusta, Ga.
HAMPTON, FOSTER, JR.Suite 101,
Interstate Bldg., Chattanooga, Tenn.
HANNER, JOSEPH M..... United States
Naval Hospital, Jacksonville 14, Fla.
HARRISON, ROBERT W.1800 Wealthy
St., S. E., Grand Rapids, Mich.
HAUPT, GEORGE J.... 306 Lankenau
Medical Bldg., Philadelphia 51, Pa.
HAUSMANN, PAUL F..... 2309 West
State St., Milwaukee 3, Wis.
HEANEY, JOHN P..... Medical
Professional Bldg., San Antonio 12, Texas
HERING, ALEXANDER C..... United
States Naval Hospital, Chelsea 50, Mass.
HERRERA, RODOLFO..... 11 Calle #2-
37, Guatemala City 1, Guatemala
HERTZLER, JACK H..... 4377 West
Maple Road, Birmingham, Mich.
HEWLETT, THOMAS H., Colonel, 0-
57932
Fitzsimons General Hospital, Denver Colo.
HILL, Lucius D. III..... 1118 Ninth Ave.,
Seattle 1, Wash.
HOLSWADE, GEORGE R..... 525 East
68th St., New York 21, N. Y.
HOOD, R. MAURICE.. 10-A Medical Arts
Square, Austin 5, Texas
HOWARD, JOHN M..... 230 North
Broad St., Philadelphia 2, Pa.
INGRAM, IVAN N... 655 Sutler St., San
Francisco 2, Calif.
IOVINE, VINCENT M.1150 Connecticut
Ave., N.W., Washington 6, D. C.
JAMPLIS, ROBERT W... 300 Homer
Ave., Palo Alto, Calif.
JARETZKI, ALFRED III..... Atwell
Road, Cooperstown, N. Y.
JENSEN, NATHAN K.1629 Medical Arts
Bldg., Minneapolis 2, Minn.
JOHNSON, CLIVE R.800 Fifth Ave., Fort
Worth 4, Texas
JOHNSON, FRANK E..... 829 Medical
Arts Bldg., Minneapolis 2, Minn.
JUDD, ARCHIBALD R.304 N. Fourth St.,
Hamburg, Pa.

KAUNITZ, VICTOR H... 4083 Delaware Ave., Tonawanda, N. Y.
KAY, JEROME HAROLD..... 122 North Alta Vista Blvd., Los Angeles 36, Calif.
KEMLER, R. LEONARD.... 576 Farmington Ave., Hartford 5, Conn.
KENNEY, LEO J.456 Cherry St., S. E., Grand Rapids 3, Mich.
KRAEFT, NELSON H.. 1433 Miccosukee Road, Tallahassee, Fla.
KUNDERMAN, PHILIP J..... 185 Livingston Ave., New Brunswick, N. J.
KUNSTLER, WALTER E.1538 Sherbrooke St., W., Montreal 25, Quebec
LASLEY, CHARLES H..... Hillcrest and Pierce, Clearwater, Fla.
LAWRENCE, GEORGE HUGH1118 Ninth Ave., Seattle 1, Wash.
LAWRENCE, MONTAGUE S..... University of Iowa, Iowa City, Iowa
LEIBOVITZ, MARTIN..... 812 Medical Arts Bldg., Tulsa 3, Okla.
LEWIS, J. EUGENE, JR.. 634 North Grand Blvd., St. Louis 3, Mo.
LEWIS, RUBIN M.. 2435 Webster St., Berkeley, Calif.
LITWAK, ROBERT S..... 5th Ave., at 100th St., New York 29, N. Y.
LUCIDO, JOSEPH L..... 634 North Grand Blvd., St. Louis 3, Mo.
MACDONALD, NEIL..... Medical Arts Bldg., Windsor, Ontario
MACLEAN, LLOYD D.. Royal Victoria Hospital, Montreal, Quebec.
MACOVERN, GEORGE J.... 3500 Fifth Ave., Pittsburgh 13, Pa.
MAHAFFEY, DANIEL E... 1112 Heyburn Bldg., Louisville 2, Ky.
MALM, JAMES R..... 180 Fort Washington Ave., New York 32, N. Y.
MANGIARDI, JOSEPH L..... 520 Franklin Ave., Garden City, N. Y.
MASON, JAMES M. III1023 South 20th St., Birmingham 5, Ala.
McKEOWN, JOHN L., JR... 203 Forrest Ave., Narberth, Pa.
MENDELSSOHN, EDWIN..... 1351 West Tabor Road, Philadelphia 41, Pa.
MILLER, ARTHUR C.2130 North Arrowhead Ave., San Bernardino, Calif.
MILLER, CARROLL C.304 Humphrey St., Swampscott, Mass.
MILLER, FLETCHER A..... Mount Sinai Hospital, Minneapolis 4, Minn.
MILLER, GEORGE E..... 214 Sixth Avenue West, Calgary, Alberta

MORRIS, GEORGE C., JR..... 1200
M. D. Anderson Blvd., Houston 25, Texas
MORSE, DRYDEN P.... 302 East Main
St., Moorestown, N. J.
MORTENSEN, JD East First South, Salt
Lake City 2, Utah
MOUSEL, LLOYD H.
Dept. of Anesthesiology, The Swedish
Hospital, Seattle 4, Wash.
MULDER, DONALD G.
University of California Medical Center,
Los Angeles 24, Calif.
MUNNELL, EDWARD R.. 301 N.W. 12th
St., Oklahoma City 3, Okla.
NARDI, GEORGE L.Massachusetts
General Hospital, Boston 14, Mass.
NEERKEN, ADRIAN J..... 404 Bronson
Medical Center, Kalamazoo 4, Mich.
NETTERVILLE, RUSH E..... 514 E.
Woodrow Wilson Drive, Jackson 6, Miss.
NEWMAN, ROBERT W..... Medical
Arts Bldg., Knoxville, Tenn.
OCHSNER, ALTON, JR.
Ochsner Clinic, 3503 Prytania St., New
Orleans 15, La.
O'NEILL, JAMES F..... 140 Roslyn Ave.,
Glenside, Pa.
OVERSTREET, JOHN WM.
508 Hermann Professional Bldg., Houston
25, Texas
PAUL, JOHN S.Baker VA Center,
Martinsburg, W. Va.
PEABODY, JOSEPH W., JR.
1150 Connecticut Ave., N.W., Washington
6, D. C.
PINKHAM, ROLAND D.
Suite 1445, Medical & Dental Bldg.,
Seattle 1, Wash.
PONTIUS, ROBERT G.... 125 DeSoto St.,
Pittsburgh 13, Pa.
PRATT, LAWRENCE A.... 15621
Windmill Pt., Grosse Pointe Park 30, Mich.
QUINLAN, JOHN J..... Nova Scotia
Sanatorium, Kentville, Nova Scotia
RANSDALL, HERBERT T., JR.
Louisville General Hospital, Louisville 2,
Ky.
REEMTSMA, KEITH..... 1430 Tulane
Ave., New Orleans 12, La.
RIVKIN, LAURENCE M..... 2320 Sutler
St., San Francisco 15, Calif.
ROBBINS, S. GWIN..... 899 Madison
Ave., Memphis 3, Tenn.
ROBINSON, GEORGE..... 105 Stevens
Ave., Mount Vernon, N. Y.

ROBINSON, JOSEPH L..... 205 South
Broadway, Los Angeles 12, Calif.
ROSS, RALEIGH R.2 Medical Arts Square,
Austin 5, Texas
RUBENSTEIN, LAURENCE H.... 571
Woodlawn Ave., Glencoe, Ill.
RUBIN, MORRIS..... 2021 Grand
Concourse, Bronx 53, N. Y.
RYAN, BERNARD J.. 375 East Main St.,
Bay Shore, N. Y.
RYAN, THOMAS C.... 90 Shenango St.,
Greenville, Pa.
SANES, GILMORE M... 3500 Fifth Ave.,
Pittsburgh 13, Pa.
SCHUSTER, SAMUEL R... 300
Longwood Ave., Boston 15, Mass.
SCHWARTZ, SEYMOUR I.. 260
Crittenden Blvd., Rochester 20, N. Y.
SELMAN, MORRIS W.2302
Meadowwood Drive, Toledo 2, Ohio
SEYBOLD, WILLIAM D.665 Travis St.,
Houston 25, Texas
SHIELDS, THOMAS W.700 North
Michigan Ave., Chicago 11, Ill.
SHUMWAY, NORMAN E.Stanford
Medical Center, Palo Alto, Calif.
SKINNER, A. M..... Homer Folks
Tuberculosis Hospital, Oneonta, N. Y.
SNYDER, HOWARD E..... 103½ E. Ninth
Ave., Winfield, Kan.
SPEAR, HAROLD C.1550 N.W. 10th
Ave., Miami 36, Fla.
STARR, ALBERT.... 3181 S.W. Sam
Jackson Park Road, Portland 1, Ore.
STAYMAN, JOSEPH W.. 8815
Germantown Ave., Philadelphia 18, Pa.
STENSTROM, JOHN D.220-1105
Pandora Ave., Victoria, B. C.
STEPHENSON, SAM E., JR.. Vanderbilt
Univ. Hospital, Nashville 5, Tenn.
STERN, HAROLD..... 100 York St., New
Haven 11, Conn.
SULLIVAN, HERBERT J..... Medical
Arts Bldg., Hamilton, Ontario
SWENSON, ORVAR..... The Children's
Memorial Hospital, Chicago 14, Ill.
TAYLOR, WARREN J... 452 Pleasant St.,
Maiden, Mass.
TEST, FREDERICK C. II..... 20252
Meyers Road, Detroit 35, Mich.
THROWER, WENDELL B.
Medical College Hospital of South
Carolina, Charleston, S. C.
TILLOU, DONALD J.... 311 W. Church
St., Elmira, N. Y.

TRICERRI, FERNANDO E.. 3 Chemin
Mornex, Lausanne, Switzerland
VALLE, A. R.
USPHS #10374, American Embassy, APO
230 c/o PM, New York, N. Y.
VAN FLEIT, WILLIAM E.. 407 Jefferson
Med. Arts Bldg., South Bend 17, Ind.
WALKER, GEORGE R..... 289 Cedar St.,
Sudbury, Ontario
WATKINS, DAVID H.Denver General
Hospital, Denver 4, Colo.
WEINBERG, MILTON, JR.2632 Central
Park Ave., Evanston, Ill.
WHEAT, MYRON W., JR.
Univ. of Florida College of Medicine,
Gainesville, Fla.
WHITESIDE, WILLIAM C.415 Medical
Arts Bldg., Victoria, B. C.
WICHERN, WALTER A., JR..... 620 Park
Ave., New York, N. Y.
WILLIAMS, G. RAINEY800 N.E. 13th
St., Oklahoma City 4, Okla.
WITMER, ROBERT H.... 126 East
Chestnut St., Lancaster, Pa.

SENIOR MEMBERS

AMBERSON, J. B..... Bellevue
Hospital, New York 16, N. Y.
AUFSES, ARTHUR H... 165 East 72nd
St., New York 21, N. Y.
BADGER, THEODORE L.... 264 Beacon
St., Boston 16, Mass.
BALLON, DAVID H..... 1538
Sherbrooke St., N., Montreal 25, Quebec
BARNWELL, JOHN B.... R.D. 2,
Blairstown, N. J.
BECK, CLAUDE S... 2065 Adelbert Road,
Cleveland 6, Ohio
BENEDICT, EDWARD B....
Massachusetts General Hospital, Boston
14, Mass.
BERRY, FRANK B..... 4301
Massachusetts Ave., Washington 16, D. C.
BETTMAN, RALPH B..... 104 South
Michigan Ave., Chicago, Ill.
BETTS, REEVE H.Veterans Admin.
Hosp., Oteen, N.C.
BIRD, CLARENCE E.64 Alfred Stone
Rd., Providence 6, R. I.
BISCARD, J. DEWEY..... 422 Doctors
Bldg., Omaha 31, Neb.
BLALOCK, ALFRED... Johns Hopkins
Hospital, Baltimore 5, Md.
BLOCK, ROBERT G..... Montefiore
Hospital, New York 67, N. Y.
BORTONE, FRANK..... 2765 Hudson
Blvd., Jersey City 6, N. J.

BURNETT, W. EMORY..... Broad and
Ontario Streets, Philadelphia 40, Pa.
BUTLER, ETHAN FLAGG956 West
Water St., Elmira, N. Y.
BYERS, H. RODDICK..... Ganonoque,
Ontario
CARLSON, HERBERT A... 21 Seventh
Place, Long Beach 2, Calif.
CARTER, B. NOLAND..... Madeira,
Cincinnati 43, Ohio
CHURCHILL, EDWARD D.269 Prospect
St., Belmont 78, Mass.
CLERF, Louis H.5575 Eighth Ave., North,
St. Petersburg 2, Fla.
COLE, DEAN B..... Professional Bldg.,
Richmond, Va.
COOPER, DAVID A..... 1520 Spruce St.,
Philadelphia 2, Pa.
COURNAND, ANDRE
Bellevue Hospital, 27th St. & 1st Ave.,
New York 16, N. Y.
CRIMM, PAUL D..... Boehne
Hospital, Evansville 12, Ind.
CURTIS, GEORGE M.
Ohio State University College of Medicine,
Columbus, Ohio
DAVIDSON, LOUIS R.. 30 East 60th St.,
New York 22, N. Y.
DOUGLASS, RICHMOND.... Veterans
Adm. Hospital, Castle Point, N. Y.
DOVELL, CHAUNCEY, Colonel (MC),
USA (Ret.)
62 South Boxwood St., Hampton, Va.
ELOESSER, LEO. 490 Post St., San
Francisco 2, Calif.
FAULKNER, WILLIAM B., JR..... 20
San Rafael Way, San Francisco 27, Calif.
FERGUSON, R. G..... Balfour Apts.,
Regina, Saskatchewan
FLICK, JOHN B.... 819 Black Rock Road,
Gladwyne, Pa.
FREELANDER, SAMUEL O.
2460 Fairmount Blvd., Cleveland Heights
6, Ohio
GALE, JOSEPH W..... University
Hospitals, Madison 6, Wis.
GARLOCK, JOHN H.East 77th St., New
York 21, N. Y.
GEARY, PAUL..... 1430 Highland Ave.,
Plainfield, N. J.
HARPER, FREDERICK R..... 1825 Gilpin
St., Denver 18, Colo.
HARRINGTON, STUART W..... Mayo
Clinic, Rochester, Minn.
HARRISON, HARLON W., CAPT. (MC),
USNR

U.S. Naval Training Command, Omaha,
Neb.
HART, DERYL Duke University, Durham,
N. C.
HAYES, JOHN N..... 24 Church St.,
Saranac Lake, N. Y.
HEAD, JEROME R..... 55 E.
Washington St., Chicago 2, Ill.
HEINBECKER, PETER
Washington University Medical School, St.
Louis 10, Mo.
HOLMAN, EMILE..... Presbyterian
Medical Center, San Francisco 15, Calif.
HUDSON, WILLIAM A..... Hudsonakers,
Jasper, Ark.
JANES, ERNEST C.... 250 Main St., East,
Hamilton, Ontario
JANES, ROBERT M.... 904 Medical Arts
Bldg., Toronto 5, Ontario
JOHNS, FRANK S. Johnston-Willis
Hospital, Richmond 21, Va.
JOHNSON, HOLLIS E.... 2122 West End
Ave., Nashville 5, Tenn.
KING, DONALD S..... Hitchcock
Clinic, Hanover, N. H.
KIPP, HAROLD A..... Mercy
Hospital, Pittsburgh 19, Pa.
KNOEPP, LOUIS F. Veterans Adm.
Hospital, Alexandria, La.
LEAHY, LEON J..... 176 Bryant St.,
Buffalo 22, N. Y.
LESTER, CHARLES W.. 70 E. 80th St.,
New York 21, N. Y.
LEVEN, N. LOGAN..... 1464 Lowry
Medical Arts Bldg., St. Paul 2, Minn.
LOCK-WOOD, A. L. 300 Bloor St., E.,
Toronto, Ontario
McINTOSH, CLARENCE A.. 1390
Sherbrooke St., W., Montreal, Quebec
MEADE, RICHARD H. 750 San Jose
Drive, S.E., Grand Rapids, Mich.
MEYER, HERBERT WILLY.. Box 507,
Rancho Santa Fe, Calif.
MOERSCH, HERMAN.... 1064 Plummer
Lane, Rochester Minn.
MOORE, RICHARD L.. 180 Ft.
Washington Ave., New York 32, N. Y.
MUDD, JAMES L..... 634 N. Grand Blvd.,
St. Louis 3, Mo.
MURPHY, JAMES D.... U. S. Veterans
Adm. Hospital, Oteen, N. C.
MYERS, J. ARTHUR. 730 La Salle Bldg.,
Minneapolis, Minn.
NEUHOF, HAROLD Box 198, Huntington
Road, Stratford, Conn.

NIXON, JAMES W..... 1121 Nix
Professional Bldg., San Antonio 5, Texas
OATWAY, WILLIAM H., JR.....
La Vina Sanatorium, Altadena, Calif.
OCHSNER, ALTON. Ochsner Clinic,
3503 Prytania St., New Orleans 15, La.
ORNSTEIN, GEORGE965 Fifth Ave.,
New York, N. Y.
PACKARD, EDWARD N.142 Park Ave.,
Saranac Lake, N. Y.
PICKHARDT, OTTO C.. 66 East 79th St.,
New York, N. Y.
PROCTER, OSCAR S..... Box 662, San
Antonio, Texas
RIENHOFF, WILLIAM F., JR.... 1201 N.
Calvert St., Baltimore 2, Md.
RIGLER, LEO G..... Cedars of
Lebanon Hospital, Los Angeles 29, Calif.
ROGERS, W. L.. 490 Post St., San
Francisco 2, Calif.
ROSS, DUDLEY E.St. Adolphe de
Howard, Quebec
SCHMIDT, HERBERT WM..... Mayo
Clinic, Rochester, Minn.
SHAW, ROBERT R..... Avicenna
Hospital, Kabul, Afghanistan
SKINNER, GEORGE F..... 36 Coburg St.,
St. John, New Brunswick, Canada
SMITH, DAVID T..... Duke
University, Durham, N. C.
STEELE, J. D..... Veterans Adm. Hospital,
San Fernando, Calif.
THOMPSON, SAMUEL A.. 850 Park
Ave., New York 21, N. Y.
THORBURN, GRANT..... 1602 West
Genessee St., Flint, Mich.
TOUROFF, ARTHUR S. W..... 994 Fifth
Ave., New York 28, N. Y.
TYSON, M. DAWSON.Hitchcock Clinic,
Hanover, N. H.
VAN ALLEN, CHESTER M..... State
Hospital, Bikaner, Rajputana, India
WANGENSTEEN, OWEN H.
University of Minnesota Medical Center,
Minneapolis 14, Minn.
WEINBERG, JOSEPH A..... Veterans
Adm. Hospital, Long Beach 4, Calif.
WELLES, EDWARD S.... 20 Church St.,
Saranac Lake, N. Y.
WILLAUER, GEORGE..... 1930 Chestnut
St., Philadelphia, Pa.
WILSON, JULIUS LANE..... 1790
Broadway, New York 19, N. Y.
WOODRUFF, WARRINER..... 8 Church
St., Saranac Lake, N. Y.

MEMBERS DECEASED

LEON T. LEWALD WILLIAM M.
TUTTLE

ANNUAL MEETING DATES

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Meetings of the American Association for Thoracic Surgery

1918-Chicago.....	President, Samuel J. Meltzer
1919-Atlantic City.....	President, Willy Meyer
1920-New Orleans.....	President, Willy Meyer
1921-Boston.....	President, Rudolph Matas
1922-Washington.....	President, Samuel Robinson
1923-Chicago.....	President, Howard Lilienthal
1924-Rochester, Minn.....	President, Carl A. Hedblom
1925-Washington.....	President, Nathan W. Green
1926-Montreal.....	President, Edward W. Archibald
1927-New York.....	President, Franz Torek
1928-Washington.....	President, Evarts A. Graham
1929-St. Louis.....	President, John L. Yates
1930-Philadelphia.....	President, Wyman Whittemore
1931-San Francisco.....	President, Ethan Flagg Butler
1932-Ann Arbor.....	President, Frederick T. Lord
1933-Washington.....	President, George P. Muller
1934-Boston.....	President, George J. Heuer
1935-New York.....	President, John Alexander
1936-Rochester, Minn.....	President, Carl Eggers
1937-Saranac Lake.....	President, Leo Eloesser
1938-Atlanta.....	President, Stuart W. Harrington
1939-Los Angeles.....	President, Harold Brunn
1940-Cleveland.....	President, Adrian V. S. Lambert
1941-Toronto.....	President, Fraser B. Gurd
1944-Chicago.....	President, Frank S. Dolley
1946-Detroit.....	President, Claude S. Beck
1947-St. Louis.....	President, I. A. Bigger
1948-Quebec.....	President, Alton Ochsner
1949-New Orleans.....	President, Edward D. Churchill
1950-Denver.....	President, Edward J. O'Brien
1951-Atlantic City.....	President, Alfred Blalock
1952-Dallas.....	President, Frank B. Berry
1953-San Francisco.....	President, Robert M. Janes
1954-Montreal.....	President, Emile Holman
1955-Atlantic City.....	President, Edward S. Welles
1956-Miami Beach.....	President, Richard H. Meade
1957-Chicago.....	President, Cameron Haight
1958-Boston.....	President, Brian Blades
1959-Los Angeles.....	President, Michael E. De Bakey
1960-Miami Beach.....	President, William E. Adams
1961-Philadelphia.....	President, John H. Gibbon, Jr.
1962-St. Louis.....	President, Richard H. Sweet (Deceased 1-11-62)
.....	President, O. Theron Clagett

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**THE AMERICAN ASSOCIATION
FOR
THORACIC SURGERY
Charter Members
June 7, 1917**

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William Branower	Morris Manges
Harlow Brooks	Walton Martin
Lawrason Brown	Rudolph Matas
Kenneth Bulkley	E. S. McSweeney
Alexis Carrel	Samuel J. Melter
Norman B. Carson	Willy Meyer (Founder)
J. Frank Corbett	James Alexander Miller
Armistead C. Crump	Robert T. Miller
Charles N. Dowd	Fred J. Murphy
Kennon Dunham	Leo S. Peterson
Edmond Melchior Eberts	Eugene H. Pool
Max Einhorn	Walther I. Rathbun
Herman Fischer	Martin Rehling
Albert H. Garvin	B. Merrill Ricketts
Nathan W. Green	Samuel Robinson
John R. Hartwell	Charles I. Scudder
George J. Heuer	William H. Stewart
Chevalier Jackson	Franz Torek
H. H. Janeway	Martin W. Ware
James H. Kenyon	Abraham O. Wilensky
Adrian V. S. Lambert	Sidney Yankauer