

# 1969 ANNUAL MEETING PROGRAM

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## COMMITTEES

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## MONDAY MORNING, MARCH 31, 1969

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**MONDAY MORNING, MARCH 31,  
1969**

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

**8:45 A.M. Scientific Session: REGULAR  
PROGRAM Grand  
Ballroom**

**1. Human Cardiac Transplantation:  
Clinical Experience**

M. E. DEBAKEY, E. B. DIETRICH,\* G.  
P. NOON,\* W. BUTLER,\*  
S. A. KINARD,\* J. M. LEWIS,\* J.  
E. LIDDICOAT,\* and D. K. BROOKS,\*  
Houston, Texas

Cardiac transplantation as a form of treatment for end-stage heart disease has met with a degree of early success and certainly warrants further investigation. This report deals with our accumulative experience including a discussion of operative technique and donor-recipient selection with specific emphasis on the role of tissue typing and immunosuppressive therapy in these cases. The postoperative course will be reviewed with reference to clinical and laboratory signs and symptoms of rejection and the treatment used for its prevention and control. Special studies regarding the effectiveness of antilymphocytic globulin and suggested dosages and route of administration will be discussed. Results obtained in these cases with postoperative hemodynamic and angiographic studies will be included.

**2. Function of the Transplanted Human  
Heart**

GRADY L. HAZLMAN,  
LOUIS L. LEATHERMAN,\*  
ROBERT D. LEACHMAN,\*  
DONALD G. ROCHELLE,\*  
DONALD L. BRICKER,\*  
ROBERT D. BLOODWELL,\*  
and DENTON A COOLEY, Houston, Texas

The transplanted heart is a denervated organ. Experience with cardiac transplantation in 12 patients has permitted us to make physiologic observations of the human heart under these conditions. All transplanted hearts resumed activity soon after removal of vascular clamps, some in sinus rhythm, some in ventricular fibrillation. Fibrillation was easily converted with direct current countershock. Both recipient and donor sinus nodes remained intact and produced P waves in the electrocardiogram, but only the impulse from the donor node was associated with ventricular contraction. Cardiac output was measured in 6 patients before, during, and after exercise at intervals following operation. Resting outputs were normal and increased with exercise in a variable fashion utilizing both intrinsic and humoral mechanisms. Heart rate and systemic arterial pressure were observed during the Valsalva maneuver. The usual change in heart rate did not occur because of denervation, but response of the systemic arterial pressure was normal. Reflex control of the recipient's own SA node remained intact as illustrated by slowing of the respective P wave in the electrocardiogram. This presentation will summarize the function of the transplanted heart at rest and its response to exercise, Valsalva maneuver, cold, pain, and various drugs.

**3. Cardiac Transplantation in Man. II:  
Immunosuppressive Therapy**

EDWARD B. STINSON,\* EUGENE DONG,  
JR.,\* and NORMAN E. SHUMWAY,  
Palo Alto, Calif.

The Stanford program of immunosuppressive management for cardiac transplantation was developed from clinical experience in renal and hepatic transplantation, from our past experience with canine cardiac transplantation, and from the progress of our first seven clinical cases. *Protocol:* Patients accepted for transplantation are given azathioprine 1 mg per kilogram per day until the day of surgery. Immediately preoperatively the patients are given a loading dose of azathioprine 4 mg/kg orally and the first dose of antilymphocyte globulin administered intramuscularly. During surgery, methylprednisolone is infused intravenously for a total dose of 5 mg/kg. On the first postoperative day maintenance immunosuppressive therapy is begun consisting of azathioprine 2-3 mg/kg per day, prednisone 2-3 mg/kg per day, and daily antilymphocyte globulin. Prednisone and antilymphocyte globulin are tapered gradually after the first two postoperative weeks. Of the seven patients, rejection was not identified in four. In the three remaining patients, four episodes of rejection were well documented by electrocardiographic, hemodynamic, enzymatic, and general systemic indicators. Three rejection crises were reversed successfully by combined therapy consisting of massive intravenous infusions of methylprednisolone given rapidly and actinomycin D as well as systemic heparinization. One patient died six weeks postoperatively of inadequate treatment. None of the four surviving patients has evidence of residual cardiac impairment.

#### **4. Dissecting Aneurysms of the Aorta: Treatment and Results in 54 Patients**

M. W. WHEAT, JR., Gainesville, Fla, P.  
D. HARRIS,\* J. R. MALM,  
G. KAISER,\* F. O. BOWMAN, JR.,\* New York,  
N.Y., and  
R. F. PALMER,\* Gainesville, Fla.

During the past 4 ½ years, 54 patients with acute dissecting aneurysms of the aorta have been treated on two separate thoracic surgical services, one in New York City and the other in Gainesville, Florida. Twelve of these underwent surgical correction with a mortality rate of 25 per cent. Forty-two patients were treated with drugs during the acute phase with a mortality rate of 10 per cent. In the group of 42 patients treated with drugs, 48 per cent were seen within 24 hours, 90 per cent within one week and all within two weeks of the onset of symptoms. Forty-eight per cent originated in the descending aorta and 52 per cent involved either ascending aorta, arch of the aorta, or both. The diagnosis was confirmed by aortography in 51, autopsy in one, and clinical impression in two cases. The indications for surgical approach to the aneurysm itself have been significant aortic valve insufficiency, poor response to drugs, or progression of the dissection. Contrary to recently published "Reservations," absence of hypertension, ischemic limbs, and paraplegia are not contraindications to successful drug therapy. This study validates further the concept of the use of drug therapy in most patients with acute dissecting aneurysms of the aorta.

#### **5. Complications of Prophylactic Digitalization in Thoracic Surgical Patients**

EDWARD A. STEMMER, Long Beach,  
Calif., GEORGE L. JULER,\*

and JOHN E. CONNOLLY, Irvine, Calif.

Because of the increased incidence of cardiac arrhythmias in thoracic surgical patients, many surgeons employ prophylactic preoperative digitalization. Our experience with 564 patients undergoing thoracotomy for non-cardiac lesions does not support this policy. Prophylactic digitalization was not employed from 1954 to 1959. The incidence of postoperative arrhythmias in 295 patients was 6.5%. Thirteen of these patients, or 4.4% of the entire group, died as a result of arrhythmia. After 1960, prophylactic digitalization was employed in 169 unselected patients and omitted in an additional 100 patients. Thirty-eight (23%) of the 169 digitalized patients developed cardiac arrhythmias postoperatively. Eleven of these patients, or 7.0% of the 169, died as a result of the arrhythmia. The incidence of arrhythmias in the 100 patients without prophylactic digitalization was 8.0% with a 4.0% postoperative mortality due to the arrhythmia. It was apparent that a patient's chance of surviving a post-thoracotomy arrhythmia was better (70% vs 55%) if he had been prophylactically digitalized. However, the greatly increased incidence of arrhythmias in digitalized patients resulted in a post-thoracotomy mortality of almost twice that of patients who had not been prophylactically digitalized. The advantages of prophylactic digitalization of noncardiac surgical patients are more apparent than real.

#### **6. Heart Block in Children: Treatment with a Radiofrequency Pacemaker**

WILLIAM W. L. GLENN, NATALIE DELEUCHTENBERG,\*

DANIEL W. VAN HEECKEREN,\* GENICHI SATO,\* and WADE G. HOLCOMB,\*  
New Haven, Conn.

A transthoracic radio-frequency (R-F) pacemaker has been implanted in 9 children at Yale since 1961. In three, aged ½, 1 and 4 years, heart block was congenital. In six, aged 6-10, block followed repair of a ventricular septal defect. One patient died 2 months after implantation, and one reverted to normal sinus rhythm enabling discontinuation of pacing. In the remaining 7 patients the average duration of pacemaker function is 2¼ years (29 months), ranging from 16 to 37 months. In four patients a dysfunctioning of implanted radio-receiver required replacement, twice in one case. The same defect, found in all receivers, has been corrected. To allow for growth of the child, a loop of the myocardial electrode (cathode) is coiled in a teflon bag and placed in the subcutaneous tissue of the chest wall. Experiments with young pigs have shown that the wire will uncoil as the subject grows. Observations on cardiac output at various heart rates, in two patients aged 2 and 6 years demonstrate a parallel increase in output with rates up to 120 per minute. Advantages of the R-F pacemaker for children with heart block are small size, externally controlled rate and power source and the infrequent (if ever) need for reoperation.

#### **7. Hemodynamic Consequences of Respiratory Insufficiency Following Trauma**

DONALD B. DOTY,\*  
ROGER V. MOSELEY,\* and BASIL A. PRUITT,\*  
Washington, D.C.

Sponsored by JUDSON G. RANDOLPH

Ability to maintain an increased cardiac output to supply increased tissue oxygen demand following tissue trauma may be the determining factor in the

recovery or death of the injured patient. Concomitant respiratory insufficiency with incomplete ability to oxygenate the blood may place further work requirements on the heart sufficient to exceed its reserve pumping capability and result in high cardiac output failure. A uniform group of previously healthy soldiers were studied following battle injury in Vietnam to determine the hemodynamic consequences of trauma with associated respiratory insufficiency. There were 27 patients who had arterial hypoxemia ( $pO_2 < 80$  mm Hg) in whom serial hemodynamic studies were performed. The mean cardiac index was  $4.1 \text{ L/min.M}^2$  with 75% of the values above accepted resting normal of  $3.0 \text{ L/min.M}^2$ . Highest cardiac output values were associated with marked physiologic intrapulmonary shunting of blood (venous admixture). Such high levels of cardiac output were usually well tolerated by these young patients. Five patients were observed to have increasing cardiac output until death occurred presumably as a result of increasing hypoxemia. Clinical course of these patients will be detailed. A low cardiac output was found only with concomitant severe hypovolemia documented by blood volume studies.

## **8. Diagnosis and Management of Mediastinal Masses in Children**

J. ALEX HALLER, JR., DAVID MAZUR,\* and WILLIAM W. MORGAN, JR.,\*  
Baltimore, Md.

Mediastinal masses in children represent a wide variety of conditions which present numerous problems in management. To give factual, clinical perspective to therapy we have reviewed records of eighty children treated for mediastinal masses in The Johns Hopkins Hospital between 1933 and 1968. Arbitrary division of the mediastinum into anterior, middle and posterior compartments was most useful for diagnosis and management. Thymic hyperplasia and teratomas were the commonest masses of the anterior mediastinum, lymph node neoplasms and infection were predominant lesions of the middle mediastinum and neurogenic tumors and duplication cysts formed the overwhelming majority of posterior masses. Forty per cent of all mediastinal masses were malignant with a 65% mortality. Except in infants with hyperplasia of the thymus in whom steroids were both therapeutic and diagnostic, operative intervention was necessary to establish the diagnosis and in most cases to excise the mass. Combined Cobalt-60 irradiation and drug therapy were used for primary lymph node tumors and undifferentiated stem cell tumors. X-ray features of different masses will be discussed as well as the drug regimens for malignant lesions. Technical features of several unusual congenital anomalies of the mediastinum will be stressed.

## **9. The Effects of Pneumonectomy in Children**

QUENTIN R. STILES,\* BERT W. MEYER,  
GEORGE G. LINDESMITH,  
and JOHN C. JONES, Los Angeles, Calif.

During the past 25 years, 22 total pneumonectomies have been done at the Childrens Hospital of Los Angeles. The reason for most of these was a destroyed lung from chronic suppuration, but 6 were done for neoplasm. The age ranges were from one month to seventeen years. Followup on most of these has been for many years and has included a period of life when the post-pneumonectomy patient still has a considerable period of expected body growth. A pneumonectomy is well tolerated by the child in the

immediate postoperative period. There was one death during this time in this group. The long term followup shows that these children continue to grow and develop normally. An attempt is made to evaluate objectively the effects of pneumonectomy upon future growth and development and upon the prognosis for a normal life expectancy in children who must have an entire lung removed.

**10. Superior Mediastinotomy: An Improved Modification of Previous Approaches to the Diagnosis and Evaluation of Chest Disease Without Palpable Nodes**

JOHN ARTHUR JACOBNEY,\* Denver, Colo.

Sponsored by WILLIAM B. CONDON

Utilizing a horizontal incision above the suprasternal notch with gentle retraction, this technique affords exposure of both right and left paratracheal and carinal nodes using surgical dissecting technique without the restriction of working through an endoscope. This represents a logical progression from the approaches of Daniels, Harken, Radner and Carlens. It has the advantages of maximum exposure of the suspect nodes using the most efficient and safe methods of dissection in an area where complications can be life threatening. In a series of 1,285 undiagnosed chest lesions without palpable nodes, superior mediastinal exploration produced a tissue diagnosis in 53%. This compares favorably with 32% using cervicomediastinal exploration and 25% using scalene fat pad biopsy. In evaluating operability of patients with bronchogenic carcinoma, of 1,577 cases, 770 or 49% were considered operable. Of more importance is that at operation 607 or 79% of the 770 patients were considered resectable for cure. In the author's series there have been no complications. Two and seven tenths per cent of mediastinoscopies have had complications, notably pneumothorax, transient recurrent nerve palsy and hemorrhage. A film of this procedure will be presented as a demonstration of an approach that allows proper surgical dissecting technique instead of endoscopic biting or tearing procedures for the biopsy of nodes within the mediastinum.

\*By Invitation

## MONDAY AFTERNOON, MARCH 31, 1969

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### MONDAY AFTERNOON, MARCH 31, 1969

**2:00 P.M. Scientific Session: REGULAR PROGRAM**

**Grand Ballroom**

**11. Aortic Valve Replacement: Long Term Results**

ROBERT D. BLOODWELL,\* J. EDWARD OKIES,\* GRADY L. HALLMAN, JR.,  
and DENTON A. COOLEY, Houston, Texas

Total excision and prosthetic replacement has become the most satisfactory method of treatment of advanced acquired aortic valvular disease. Overall hospital mortality among 799 patients undergoing aortic valve replacement during the past six years was 12 per cent. Current mortality's eight per cent despite denying no patient because of severity of cardiac disability. Late deaths have brought the cumulative mortality to 29 per cent. Despite reduced risk of valve replacement, late complications have not been eliminated. Late thromboembolic complications have occurred in patients who had remained clinically improved for long periods after operation providing an overall incidence of 12.2 per cent. Half of the emboli occurred over one year after operation. While ball variance occurred in early ball and seat valves, none has occurred in

modified ball valves used during the past three years. Ninety percent follow-up is available for patients operated upon over one year ago. Clinical trial of various types of prostheses used permits comparison of mechanical complications, thromboembolism, and late mortality. Low hospital mortality, salvage of many extremely ill patients, functional and clinical improvement in most patients, and a low incidence of late complications and valve malfunction provide a basis for continued use of prosthetic aortic valve replacement.

## **12. Biological Factors Affecting Long-term Results of Valvular Heterografts**

ALAIN CARPENTIER,\* and CHARLES DUBOST,\* Paris, France

Sponsored by FRANK GERBOPE

The use of valvular heterografts raises two sorts of problems: technical and biological. Having been subjected to a great deal of work, the technical problems seem to be solved, whereas the biological problems still remain relatively unknown, although they play a great part in the long term results of this kind of graft. Since September 1965, date of the first successful valvular heterograft in human, we have used this method in aortic, mitral or tricuspid position sixty-one times, using different methods of preservation of the graft (freeze drying, chemical sterilization, formaldehyde, neta-periodate, ethylenglycol and glutaraldehyde). Analysis of these results shows that the method of preservation used is the essential factor in the long-term durability of the grafts. In the light of this clinical experience and biochemical studies the criteria of efficiency of a method of preservation have been defined as follows: 1. Guaranteed sterilization. 2. Elimination of the antigenic components previously defined in laboratory, i.e. soluble proteins, glycoproteins, mucopolysaccharides, cells. 3. Prevention of the collagen and elastin denaturation. 4. Protection against the cellular ingrowth. When the method used respects all these criteria the long term fate of the grafted valves becomes excellent.

## **13. Tricuspid Insufficiency in Patients Undergoing Mitral Valve Replacement: Conservative Management, Annuloplasty, or Replacement?**

JAMES R. PLUTH,\* ROBERT L. FRYE,\* and F. HENRY ELLIS, JR.,

Rochester, Minn.

Severe mitral valve disease may be accompanied by tricuspid insufficiency of variable magnitude. Opinions vary as to whether or not the insufficiency should be surgically corrected at the time of mitral valve replacement and, if so, by what means. This review concerns 148 mitral valve replacement procedures carried out between January, 1963, and January, 1968, on patients with associated tricuspid insufficiency. Twenty-two had intrinsic disease of the tricuspid valve with combined stenosis and insufficiency. Pure tricuspid insufficiency was present in the rest. The overall hospital mortality was 18 per cent. In 89 patients no procedure was performed on the tricuspid valve; tricuspid annuloplasty was done in 34 and tricuspid valve replacement in 25. Follow-up study, including cardiac catheterization, in some instances suggests that pure tricuspid insufficiency secondary to mitral valve disease and right heart failure does not always regress after mitral valve replacement, nor is tricuspid annuloplasty always effective. Tricuspid valve replacement is usually required in the presence of combined mitral and tricuspid valve disease, and when pure tricuspid insufficiency of severe degree is present.

## **14. Aortic Arch Atresia and Aortic Arch Interruption: Operative Experience with 11 Children**

R. L. TAWES, JR.,\* P. PANAOPOULOS,\* E. ABERDEEN,\* D. J. WATERSON,\*

and R. E. BONHAM-CARTER,\* London, England

Sponsored by H. BRODIE STEPHENS

Aortic arch atresia and interruption are rare anomalies which are usually fatal in early infancy. Only 18 of the 111 reported cases were living children and only 12 underwent operation. Our 11 cases were preoperatively diagnosed by angiocardiography and cardiac catheterization in five, and by thoracotomy in six. Nine had aortic arch atresia, two had interruption. Operation corrects or palliates the triad of cardiac defects that usually exist with this anomaly: atresia or interruption, patent ductus arteriosus, and ventricular septal defect. The patent ductus was ligated, the atresia resected, and the aorta anastomosed end to end in three cases. In five others with atresia a hypoplastic arch precluded this anastomosis, therefore the left subclavian artery was anastomosed to the descending aorta in four, and to the aortic arch in one. One infant died before any definitive operative procedure. The pulmonary artery was banded in two of these infants. In the two infants with aortic arch interruption, only pulmonary artery constriction was attempted. Four of the nine children with aortic arch atresia survived operation and left the hospital. The five deaths were in infants less than six months of age. The two neonates with aortic arch interruption died at operation.

## **15. Neurologic Abnormalities Following Open Heart Surgery**

HUSHANG JAVID, HENRY M. TUFO,\* HASSAN NAJAFI, WILLIAM S. DYE,\*

JAMES A. HUNTER, and ORMAND C. JULIAN, Chicago, Ill.

While numerous reports of central nervous system disturbances following open heart surgery have appeared in the literature, the precise incidence, natural course and causes of these disturbances remain unknown. The following longitudinal study of 100 consecutive patients undergoing open heart surgery was developed to answer the following questions: (1) What is the incidence, magnitude and reversibility of central nervous system dysfunction following open heart surgery? (2) What factors are related to the occurrence of these disorders? Preoperative studies consisted of tape recorded interviews designed to elicit medical and psychological information in addition to complete neurological examination, standardized mental status evaluation and five psychometric tests. The following results were observed. Half of the sample had one or more neurological signs present at the time of the first postoperative examination. Fourteen of 15 operative deaths had evidence of focal or diffuse cerebral damage. Neurological abnormalities remained at the time of discharge in 12 patients. Of the survivors, one-third exhibited one or more of the following: disorientation, memory disturbance, bizarre motor restlessness, visual hallucinations and depressed intellectual function. Several factors appeared to be important in the genesis of these changes: severe preoperative depression, advanced age, and a prolonged period of persistent low mean arterial pressure during bypass.

## **16. Pericardial Tamponade Following Open Heart Surgery**

RUSSELL M. NELSON, CONRAD B. JENSON,\* and

WENDELL M. SMOOT III,\* Salt Lake City, Utah

The occurrence of pericardial tamponade in the postoperative period can produce severe hemodynamic alterations. The differential diagnosis from low cardiac output syndrome due to other causes becomes important considering the necessity for reoperation for the relief of significant tamponade. Therefore, a retrospective study has been done to analyze the records of 422 patients subjected to open heart surgery in a ten year period from 1959 to July of 1968. Significant pericardial tamponade was diagnosed in sixteen of these patients, and confirmed in 14. Two patients had myocardial insufficiency found at the time of re-exploration. The incidence was greatest among patients having open operations on the aortic and mitral valves, and least among the congenital abnormalities. Low arterial pressure, high venous pressure and a paradoxical pulse occurred most commonly as expected. Abnormal chest X-rays, electrocardiograms, or muffled heart tones were present in less than half of the cases. The average amount of thoracostomy drainage was 1200 ml. in the tamponade group, similar to the amount drained from the control group of patients subjected to open heart surgery without pericardial tamponade. Seventy-five per cent of the patients with pericardial tamponade developed this problem within the first two days following surgery. At reoperation, a specific site of bleedings was not found in 50% of the patients. Patients with primary myocardial insufficiency exhibited the same hemodynamic abnormalities, but their thoracostomy drainage was significantly less. Differential diagnosis and proper treatment programs for postoperative pericardial tamponade will be presented.

### **17. Pericardectomy in Non-Tuberculous Pericarditis**

DONALD G. MULLEN,\* MARCUS L. DILLON, W. GLENN YOUNG, JR.,  
and WILL G. SEALY, Durham, N.C.

During the last fifteen years we have performed pericardectomies on twenty-four patients who had non-tuberculous pericarditis. This review is concerned with the indications for surgical therapy, the course following the operation, and the long-term follow-up of these patients. Particular emphasis will be placed on those patients who had recurrent episodes of pain, and those in whom the pericardectomy was done for prevention of constriction. The cause of the pericarditis was trauma in two patients, rheumatoid disease, one patient; unsuspected tumor, four patients; and, presumably a virus in 17. The indications for operation included diagnosis, constriction, prevention of recurrent episodes of pain or tamponade, and recurrent fluid accumulation. It is concluded from this study that an aggressive approach is indicated in patients with non-tuberculous pericarditis who demonstrate persistence or recurrence of symptoms, and in whom there is evidence from the character of the fluid that constriction will likely occur. Early removal of the anterior pericardium will prevent some of the more serious complications of this disorder.

### **18. Partial Cardiopulmonary Bypass, Hypothermia, and Total Circulatory Arrest: A Life Saving Technique in Certain Complicated Situations**

G. WALTON LILLEHEI, and ROBERT J. ELLIS,\* New York, N.Y.

Six years ago we were presented with a patient bleeding from a hole in the ascending aorta exposed in the depths of an infected sternotomy who had had two open heart procedures and at this time had a staphylococcus septicemia. With manual aorta compression, operation was instituted by peripheral cannulation, partial bypass, and total body hypothermia. At 21°C the pump oxygenator was shut off and the blood drained into the oxy-generator. During circulatory arrest of 21 minutes the hole was closed and an uneventful early and late recovery followed. Since then, we have used this method as an emergency (occasionally electively) in 30 patients with a variety of complicated situations many of which would have been impossible by any other approach. These included most frequently infected sternotomy wounds with massive hemorrhage. Other occasional indications were adult tetralogies with massive bronchial flow, aortic-innominate vein arteriovenous fistulas, ruptured acute myocardial infarctions, unusual tears in inferior cava or arch of the aorta, large coronary arteriovenous fistula into the posterior right ventricle. Twenty-three (75%) have been successful. Conversations with others indicate that the value and simplicity of this technique, which will be presented in detail, is not generally recognized.

### **19. A New Operation for Correction of Transposition of the Great Arteries, Ventricular Septal Defect, and Pulmonary Stenosis**

G. G. RASTELLI,\* ROBERT B. WALLACE, and DWIGHT C. MCGOON,  
Rochester, Minn.

Hospital mortality rate for complete correction of transposition associated with ventricular septal defect (VSD) and subvalvular pulmonary stenosis (SPS) by creating transposition of venous return has been 61% (8 of 13 patients) at the Mayo Clinic. The location and variable nature of the SPS prevent adequate surgical relief, and this is probably responsible for high surgical mortality. A new "anatomic" correction for this type of transposition was devised in which SPS was relieved without a direct approach to it. This repair consists of (1) division of the main pulmonary artery, the cardiac end of which is oversewn, (2) construction of an intracardiac tunnel between the VSD and the aorta, and (3) construction of a new right ventricular outflow by anastomosing a homograft of ascending aorta, including the aortic valve, between the distal end of the pulmonary artery and the right ventricle. This repair may achieve better correction than would transposition of venous return, because the left ventricle is made to eject into the aorta and the right ventricle to eject into the pulmonary artery. Two patients 14 and 15 years were successfully operated on with this technique. Cardiac catheterization and angiocardiographic findings before and after operation will be presented.

### **20. Ebstein's Anomaly: Further Experience with Definitive Repair**

KENNETH L. HARDY,\* and BENSON B. ROE, San Francisco, Calif.

A functional concept of the altered cardiodynamics in Ebstein's anomaly and a reconstructive operation to correct them was described before this Association by one of us (KLH) in 1964. The patient reported at that time, now five years postoperative, remains clinically well and active, in a functional Class 1 status. While the relative rarity of this lesion does not provide an opportunity for extensive experience, we have now treated a total of six patients by the operation originally described with satisfactory functional correction in every case. There has been one death, not related to the method of repair. This experience supports the original belief that the procedure is effective and provides a more desirable alternative to the presence of a mechanical device in the low pressure side of the heart with its commitment to lifelong anticoagulation and the threat of repeated pulmonary emboli. In this consecutive series, it was feasible to correct the dysfunction without having to consider the need for a prosthetic valve or foreign tissue. Further observations about the anatomical constants and



variables in the Ebstein heart will be demonstrated to facilitate operative evaluation and repair of the abnormality. Minor technical refinements of the basic technique have evolved from this experience and will be described.

\*By Invitation

## TUESDAY MORNING, APRIL 1, 1969

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### TUESDAY MORNING, APRIL 1, 1969

#### 8:30 A.M. Scientific Session: THORACIC SURGERY FORUM

##### Grand Ballroom

#### 21. Myocardial Viability and Hypothermia

WILLIAM W. ANGELL,\* LAYTON RIKKERS,\* EUGENE DONG,\*  
and NORMAN E. SHUMWAY, Palo Alto, Calif.

Myocardial hypothermia has been used for anoxic preservation in cardiac transplantation and in several hundred other open heart procedures at the Stanford Medical Center. It permits 2 hours of total anoxia without myocardial damage. A quantitative relationship (related to organ viability) was defined between temperature and the interval of anoxia. The interval of anoxia compatible with viability (defined as survival of the transplanted heart without infarction) was determined in 40 canine hearts at 37, 30, 22, and 15°C. Function was studied by left ventricular pressure curves, heart rate, contractility, oxygen consumption, CO<sub>2</sub> production, enzyme liberation, edema formation, and light and electron microscopic morphology. The allowable interval of anoxia proved to be a linear function of the log of

temperature. This is also permitted a prediction of viability in any given heart undergoing anoxia at variable temperatures. ( Viability was accurately predicted in 10

human and 10 canine hearts from the

formula:

Proven preoperative donor heart

viability is essential to successful heart

transplantation. Any heart can be definitively evaluated as a donor organ if the temperature and anoxic interval are known.

#### 22. The Microcirculation of Transplanted Hearts

WILLIAM E. NEVILLE, ROQUE PIFARRE,\* JOHN W. BALIS,\* WILLIAM COX,\*  
FRANCIS DWAN,\* and EDWARD S. RAPPAPORT,\* Hines, Ill.

The gross, histologic and ultrastructural changes of hearts, orthotopically transplanted from goat-to-dog, dog-to-dog and dog-to-goat were studied. The coronary blood flow, heart contractility, color and ultrastructure appeared normal in dog hearts transplanted to either dogs or goats. On the other hand, the goat hearts transplanted to dogs failed to contract properly, and rapidly developed bluish red discoloration with sharp diminution of coronary blood flow within one hour after transplantation. Histologic and ultrastructural studies in these hearts showed- 1) Obstruction of capillaries by agglutinated erythrocytes, and marked endothelial damage without platelet aggregates and fibrin deposits 2) Interstitial edema and extravasated erythrocytes, 3) Typical changes of acute ischemic damage of the myocardium, namely, mitochondrial swelling, loss of glycogen, clumping and margination of nuclear chromatin. Since dog erythrocytes are appreciably larger than goat erythrocytes, it is suggested that differences in size and other properties as well accounts, in part, for the rapid agglutination of these cells in the microcirculation following heterologous heart transplantation. The possibility exists that similar events in the capillary circulation may be responsible for the "acute immunologic rejection" of transplanted organs in man.

#### 23. The Immediate Prophylactic Role of Myocardial Revascularization Following Internal Mammary Artery Implantation into Normal Myocardium

SUSUMU TANAKA,\* WILLIAM R. RASSMAN,\* RICHARD FLEMING,\*  
ROBERT J. ELLIS,\* and G. WALTON LILLEHEI, New York, N. Y.

The functional effects of internal mammary artery implantation (I.M.A.) into normal myocardium and ischemic myocardium of dogs was compared. Implantation performed in normals demonstrated 90% patency at 6 months and there was *no difference* in patency rate into ischemic muscle. However, I.M.A. implants into ischemic myocardium showed angiographically much more widespread connections at 3 months. However, a striking finding of these studies was demonstration that I.M.A. implants into healthy myocardium did after 6 months show, following creation of acute ischemia, an immediate (within 60 sec.) widespread opening of collateral vessels equal in size and number to those visible in animals with chronic ischemia. The following measurements were also taken: ventricular size (utilizing epicardial strain gauges), ventricular and systemic pressures, coronary artery flow and implanted I.M.A. flow. Acute ischemia was then created by coronary artery hgations. Contribution of blood from internal mammary implants significantly offset immediate effects of acute ischemia confirming the angiographic observations. Conclusion: I.M.A. implantations are capable of establishing widespread latent arterial communications without need of mvocardial ischemia. The number, size and area of distribution of these communications become immediately functional in the presence of acute ischemia.

#### 24. Experimental Evaluation of Myocardial Tunnelization as a Method of Myocardial Revascularization

ISAM N. ANABTAWI,\* HUBERT F. RIEGLER,\* and ROBERT G. ELLISON,

Augusta, Ga.

The protective effect of surgically created myocardial tunnels between the left ventricular chamber and the myocardium was studied in dogs whose myocardium was rendered ischemic by ameroid constriction of left coronary artery. Four of five control dogs whose myocardium was made ischemic without benefit of tunnels died within two months of operation from extensive myocardial infarction whereas ten of 13 animals protected with tunnels were alive and well five months after operation. Tunnel communication with the left ventricular chamber could be demonstrated in the early postoperative period whereas at autopsy five months later no communications were present indicating healing closure of the endocardial entry site. The tunnels, however, remained patent as large myocardial blood channels which freely communicated with both right and left coronary artery branches. Endothelial cells could be seen lining some channels. The results indicate the feasibility of vascularizing multiple areas in the myocardium by creation of channels which promote intercoronary passage of blood between branches of both coronary arteries. This seems preferable to the limitation of two artificially implanted internal mammary arteries with their inherent risk of thrombosis.

## **25. The Hemodynamics and Coronary Arteriographic Patterns During Acute Myocardial Infarction**

F. R. BEGO,\* M. A. KOOROS,\* G. J. MAGOVERN, E. M. KENT,  
L. B. BRENT,\* and W. B. GUSHING,\* Pittsburgh, Pa.

The effects of coronary occlusion on left ventricular function have been studied extensively in the experimental laboratory but the left ventricular response during acute coronary occlusion has not been studied in man. This paper presents our findings in 51 patients who have been studied 10 hours to 4 weeks following the onset of myocardial infarction and describes 1) the coronary angiographic pattern in acute myocardial infarction and 2) the intra-ventricular pressures and angiographic assessment of left ventricular function. Five patients were studied within twenty-four hours of the onset of their myocardial damage with right and left heart catheterization, selective angiocoronary arteriography and left ventriculography. There were no complications. The remaining forty-six patients had selective coronary arteriography and left ventriculography to study the arteriographic pattern in evolving myocardial infarction. The results demonstrate that retrograde left heart catheterization with selective coronary arteriography can be successfully applied to any phase of coronary arterial disease and points put by illustrating the arteriographic pattern in all phases of myocardial infarction the potential surgical implications of acquiring this physiological and angiographic data within hours of the onset of an occlusion of the coronary artery.

## **26. The Effect of Excessively High Perfusion Pressures on the Histology, Histochemistry, Birefringence and Function of the Myocardium**

A. HEDLEY BROWN,\* MARK V. BRAIMBRTDOE,\* NELSON R. NILES,\*  
FRANK GERBODE, and MARY S. AGUILAR,\* San Francisco, Calif.

During operations on the aortic valve, the coronary arteries may be perfused at higher pressures than normal. The purpose of this investigation is to demonstrate that high perfusion pressure does in fact damage the heart. The model was an isolated heart preparation. One group of hearts was perfused at normal aortic pressures, and another at elevated aortic pressures. Myocardial damage was assessed by the following methods: (a) Histochemistry (Succinic dehydrogenase, free phospholipids) (b) Birefringence of myocardial fibers (c) Hematoxylin and Eosin stain (d) Ventricular wall tension (e) Velocity of contraction (f) Ventricular compliance (g) Ventricular wall thickness. Perfusion was carried out for three hours. There were significant changes in both ventricular wall tension and velocity of contraction in both groups. Hearts perfused at high pressures had a significant marked loss of ventricular compliance and increase in ventricular wall thickness. Histochemistry and birefringence were not significantly altered in either group. Microscopic examination demonstrated marked difference in the two groups. Hearts perfused at normal pressure were normal. Those perfused at high pressure were congested, edematous and exhibited red cell infiltration between myocardial fibers. These results indicate that high coronary artery perfusion pressure is detrimental to the myocardium and should be accurately controlled during aortic valve surgery.

## **27. Postoperative Isoproterenol Ventricular Arrhythmias: Conversion with Insulin**

S. A. HOFFMAN,\* H. W. WALLACE,\* H. ZINSSER,\* Philadelphia, Pa.,  
A. E. BAUE, St. Louis, Mo, and W. S. BLAKEMORE, Philadelphia, Pa.

Postoperative open heart patients who have previously received digitalis and diuretics frequently develop ventricular arrhythmias when isoproterenol is administered. To study this, hypokalemia was produced in dogs. Isoproterenol did not induce ventricular arrhythmias in nondigitalized hypokalemic dogs, while in digitalized hypokalemic dogs, the administration of isoproterenol caused ventricular arrhythmias. The administration of KGL was found to abolish these arrhythmias. When a combination of slow and rapid acting digitalis was used, the administration of KCL resulted in heart block. Isoproterenol, 2 ug./min., produced serious ventricular arrhythmias in six hyperkalemic patients in acute renal failure on long term digitalis and diuretics. The addition of regular insulin (0.05 units/ug. of isoproterenol) effectively converted the ventricular arrhythmias to a normal rhythm. This insulin supplement in addition reduced the myocardial requirements for isoproterenol by 90 per cent of its dose to 0.2 ug./min. Beta adrenergic reception stimulation by isoproterenol probably affected the relationship of cardiac glycosides and myocardial potassium. Insulin presumably altered the intracellular-extracellular potassium balance.

## **28. An Operative Technique for the Prevention of Reflux Following Oesophagostomy**

F. G. PEARSON, and R. M. PARRISH,\* Toronto, Ontario

Oesophago-gastrostomy is the simplest method of reconstruction following oesophagectomy for carcinoma of the intrathoracic oesophagus, but results in frequent and significant disability due to gastro-oesophageal reflux. Ottosen of Denmark (1959) described a modified oesophagogastric anastomosis in which a long segment of intrathoracic oesophagus is inyaginated into the gastric fundus, permitting normal swallowing but preventing significant reflux. This modified anastomosis was used in 12 consecutive patients at the Toronto General Hospital with carcinoma of the middle or lower third of the oesophagus managed by resection and oesophagostomy in one stage. Follow-up varies from 9 months to 3 years after operation. Nine patients are still living and 3 have died of recurrent carcinoma. The effectiveness of the modified anastomosis in preventing reflux has been evaluated by clinical assessment, detailed cine-radiographic follow-up, and oesophagoscopy. There were no operative deaths and no anastomotic leaks. None of 12 patient has developed

symptomatic reflux, none have shown evidence of aspiration, and none have developed oesophagitis or stricture proximal to the anastomosis. Although the number of patients reported is small, and the follow-up period relatively short, current observations merit an optimistic preliminary report.

### **29. Autonomic Innervation in Achalasia of the Esophagus**

D. M. JACOBOWITZ,\* P. BERG,\* S. A. STEINBERG,\* and P. NEMIR, JR.,  
Philadelphia, Pa.

Studies were carried out on the autonomic innervation at various levels of the esophagus in the normal dog and in a group with severe naturally occurring achalasia. The parasympathetic innervation has been studied by the histochemical method for acetylcholinesterase and, for the first time, sympathetic innervation by a histofluorometric method for the localization of catecholamines. The adrenergic innervation is seen primarily in the Auerbach's plexus and about blood vessels and not innervating the smooth muscle as classically believed. No change in the innervation of the adrenergic and cholinergic fibers was observed in the body of the normal and dilated esophagus. In animals with achalasia the sympathetic fibers in anatomical proximity to Auerbach's plexus are either absent or markedly reduced in the lower esophagus as compared to the normal. These findings indicate that the primary derangement in achalasia is a spasm on the basis of parasympathetic predominance rather than a failure of relaxation. Moreover, studies indicate that the effectiveness of esophagomyotomy is through restoration of autonomic balance. Since the influence of catecholamines on the esophagus may be either stimulatory or inhibitory, we are presently testing certain alpha and beta stimulator and blocking agents using cine-roentgenographic, manometric and electromyographic techniques.

### **30. The Experimental Treatment of Esophageal Strictures by Intralesional Steroid Injections**

KEITH W. ASHCRAFT,\* and THOMAS M. HOLDER, Kansas City, Kan.

The treatment of short esophageal strictures by dilatations has often been frustrating and unsuccessful. The demonstration that keloids, hypertrophic scars, and burn contractures resolved after intralesional injection of triamcinolone diacetate suggested a new method of management of esophageal stricture. This drug enhances the solubility of saline extractable collagen and depresses mucopolysaccharide formation in the synthesis of collagen. Short esophageal strictures were created in 15 dogs by sodium hydroxide burns. These strictures were documented by endoscopy and by cine radiography. Nine animals received intralesional injections of triamcinolone endoscopically. Six animals served as controls - three receiving no treatment and three receiving saline injections. None of the 15 strictures were dilated and all animals were maintained on a liquid diet. Repeat cine-esophagrams and esophagoscopy were performed prior to sacrifice. Of the treated animals seven demonstrated at least a four-fold increase in cross sectional area at the stricture. Two were unchanged. None of the controls improved. Four patients with short esophageal strictures were treated by this method. Three of these had undergone multiple dilatations prior to the addition of the steroid injections. All showed marked and lasting relief of the stricture functionally and radiographically.

### **31. Oxygen Consumption During Cardiopulmonary Bypass Circulation: Effect of Pulsatile Flow**

RICHARD B. SHEPARD,\* and JOHN W. KIRKLIN, Birmingham, Ala.

Portions of the microcirculation may not be perfused during shock and during some types of cardiopulmonary bypass. While tolerable for short periods, this is disadvantageous over long periods. To test the hypothesis that perfusion of the microcirculation is more complete with pulsatile than with non-pulsatile flow, 23 calves were subjected to 4 hour periods of complete cardiopulmonary bypass circulation (2.1 L/min/M<sup>2</sup>; 36.5-37°C) using a disc oxygenator. A roller pump was used for non-pulsatile perfusion (NPP) (13 animals). A modified roller pump was run at pulse rates of 60-70 for pulsatile perfusion (PP) (10 animals). Phasic flow and pressure were measured in the animals. Oxygen consumption during NPP was 126 ± 25 cc/min/M<sup>2</sup>; during PP it was 159 ± 16 (p < .001). During PP, the pulsatile component of hemodynamic energy was not significantly different from that existing before and after bypass (.7 < p < .8). It was higher by 8500 ergs/cm<sup>3</sup> blood during PP compared to NPP (.001 < p < .005). Bronchial artery flow was 128 ± 56 cc/min/M<sup>2</sup> during PP and 36 ± 11 during NPP (p < .001). The data suggest that in these calves perfusion of the microcirculation was more complete when flow was pulsatile than when it was non-pulsatile.

### **32. Improved Organ Function During Cardiac Bypass With a Roller Pump Modified to Deliver Pulsatile Flow**

LLOYD A. JACOBS,\* EDWARD H. KLOPP,\* WOODROW SEAMONE,\*  
STEPHEN R. TOPAZ,\* and VINCENT L. GOTT, Baltimore, Md.

The importance of pulsatile flow during cardiac bypass has not been completely established. Evidence is accumulating, however, suggesting that steady flow perfusion causes greater disturbance of physiologic function than pulsatile perfusion. To further evaluate this hypothesis, a roller pump has been modified to achieve pulsatile flow by the addition of a torque motor powered by a triangular waveform. Rate and stroke volume are adjustable and pulsatile or steady flow may be selected. The femoral artery pressure waveform produced in the dog is nearly indistinguishable from that seen in the intact animal. Total left heart bypass has been performed in twenty dogs, five with steady flow and fifteen with pulsatile flow. Dogs perfused with steady flow showed immediate, large decreases (85-100%) in urine output and creatinine clearance; those perfused with pulsatile flow showed only small (10-15%) decreases in urine output and creatinine clearance during four-hour perfusions. Furthermore, those perfused with pulsatile flow showed smaller changes in peripheral resistance, less edema and somewhat lower serum lactate levels. It was possible to demonstrate unimpaired renal function, reflexes and responsiveness after twelve hours of pulsatile perfusion.

### **33. A Central-Flow, Low-Profile, Leaflet-Deforming Mitral Valve Prosthesis Free of Prolonged Anticoagulation Requirements**

K. W. EDMARK,\* W. J. HILL,\* G. I. THOMAS, and T. W. JONES,  
Seattle, Wash.

Described is a new concept in artificial heart valve prosthesis which is a central-flow, leaflet-deforming valve giving normal heart sounds, free of murmurs or clicks. The advantages of this valve are its laminar central-flow characteristics with low profile and its non-thrombogenic surface coating of tetrafluoropropylene, which does not require long-term

anticoagulant therapy. The anti-thrombogenic properties of this valve have been developed after four years of animal implant experimentation, with dog survival beyond two years. It has also been fatigue-tested beyond 405 million cycles, with a closing pressure of 250 mm. Hg, giving a fatigue life beyond 40 years, with a flex life beyond ten years. The presentation will include laboratory data and the clinical experience in the initial ten patient implants, beginning February, 1968, and continuing.

\*By Invitation

## TUESDAY AFTERNOON, APRIL 1, 1969

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### TUESDAY AFTERNOON, APRIL 1, 1969

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

**Grand Ballroom**

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

**Grand Ballroom**

*Address by the President*

**Edward M. Kent, Pittsburgh, Pennsylvania**

*Address by Honored Guest*

**E. J. Zerbin, M.D.**

**University of Sao Paulo Medical School**

**Sao Paulo, Brazil "The Surgical Treatment of Tetralogy of Fallot"**

**34. Surgical Considerations in "Atypical" Mycobacterial Pulmonary Disease**

R. T. Fox, K. V. VEERRAJU,\* WILLIAM M. LEES, and T. W. SHIELDS,

Chicago, Ill.

The medical management of pulmonary disease caused by Mycobacteria other than M. Tuberculosis is fairly well accepted, with use of varying combinations of "first-line" and "second-line" drugs. Despite the rather poor success rate of this management the role of surgery has been controversial. As in any other type of surgery, the fate of the non-operated patient must be weighed against the mortality, morbidity, and ultimate favorable results in the surgically treated patient. In order to document the excellent results and minimal adverse effects of surgery we have analyzed our series of patients with "Atypical" Mycobacterial disease. From 1951 through 1967, 163 patients with such disease have had definitive surgery. There have been 153 resections (12 bilateral) and 27 plombage thoracoplasties (5 bilateral). Major complications consisted of seven instances (4.5%) of broncho-pleural fistula, two with post-operative bleeding necessitating re-operation, and two of lobar atelectases. Twenty four patients (15.6%) had minor space problems. There was no surgical mortality in the entire group. Five of the resected patients ultimately needed further surgery to achieve control of the disease. Two of the plombage patients needed additional surgery. The final success rate has been approximately 96%.

**35. Pulmonary Complications in Burn Patients: A Comparative Study of 700 Patients**

ROBERT J. FLEMMING,\* FRANK C. DIVINCENTI,\* BASIL A. PRUITT, JR.,\* and  
FRANKLIN D. FOLEY,\* Fort Sam Houston, Texas

Sponsored by W. GLENN YOUNG, JR.

Comparison of 311 burn patients in 1962-1963 with 389 in 1967 reveals that with the advent of topical chemotherapy, pulmonary complications are now the leading cause of death in burn patients. Pneumonia is foremost, occurring in 17% of all burn patients and in 50% of mortalities in 1967. Complications of tracheostomy, including pneumothorax, are the second leading complication. Pulmonary edema, suppurative thromboembolism, pulmonary melioidosis, and empyema as a result of pneumothorax treatment are less common but difficult in management because of the burn. Bronchiectasis as a late sequela to smoke inhalation is rare but of unusual interest. Greater use of respirators in 1967 led to an increased recognition of "oxygen toxicity," although identical histologic findings have been noted in patients who did not require respiratory support. The pneumonias currently seen are considered to be airborne in contrast to hematogenous pneumonia which was common in 1962-1963. Increased use of respirators and unnecessary tracheostomy are considered important in this relative increase in airborne pneumonia. Prolonged hypoxemia and alkalosis occur in most burn patients, suggesting ventilation-perfusion abnormalities. The application of the basic principles of thoracic surgery as modified in the treatment of the burn patient and as related to these complications is emphasized and discussed in detail.

**36. Respiratory Failure in Infants Following Cardiovascular Surgery**

J. J. DOWNES,\* H. NICODEMUS,\* and J. A. WALDHAUSEN,  
Philadelphia, Pa.

Acute respiratory failure commonly follows operations for congenital heart disease in infants because of the associated abnormal pulmonary circulation. Our criteria for respiratory failure include: abnormal arterial carbon dioxide tension (PaCO<sub>2</sub>), physiologic dead space-tidal volume ratio greater than 0.50, increased respiratory frequency, and excessive work of breathing. Of 99 infants operated in a 2 year period, 41 met these criteria and received mechanical ventilation. Despite severe, complex lesions, 17 (42%) survived after mechanical ventilation of 24 hours to 3 months duration. Of the 58 infants without respiratory failure, all but one survived. Pulmonary sequelae of high alveolar oxygen tensions contributed to the deaths of 3 infants early in the series. Subsequently, the inspired oxygen concentrations were maintained at the minimum level consistent with an arterial oxygen tension (PaO<sub>2</sub>) above 35 mmHg (cyanotic lesions) or 70 mmHg (acyanotic lesions). Controlled constant volume ventilation aided by morphine and chest physiotherapy provided optimal distribution of gas and

minimal alveolar-arterial oxygen tension gradients. An indwelling systemic arterial catheter permitted frequent determination of pH, PaCO<sub>2</sub>, and PaO<sub>2</sub>, and continuous pressure monitoring. We conclude that respiratory failure following cardiovascular surgery in infants can be successfully treated with mechanical ventilation.

\*By Invitation

## TUESDAY EVENING, APRIL 1, 1969

**7:00 P.M. Reception**

**Pavilion Room**

**8:00 P.M. Dinner and Dancing**

**Terrace Room**

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

**Dinner dress preferred**

## WEDNESDAY MORNING, APRIL 2, 1969

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### WEDNESDAY MORNING, APRIL 2, 1969

**8:30 A.M. Scientific Session: THORACIC SURGERY FORUM**

**Grand Ballroom**

#### **37. A Permanent Transvenous Atrial Electrode Catheter**

NICHOLAUS P. D. SMYTH, LASZLO VASARHELYI,\* and WILLIAM MCNAMARA,\* Washington, D.C.

Synchronous pacing in patients with complete heart block offers several advantages over asynchronous (fixed rate) and demand pacing. These include: response to increased physiological demand by an increase in rate as well as stroke volume, and preservation of the hemodynamic advantage of the "atrial kick." The lack of a suitable transvenous electrode for permanent "P" wave pick-up has restricted the application of synchronous pacing, since thoracotomy is still required for reliable detection of the "P" wave. Patients with symptomatic bradycardia without heart block are currently treated by demand ventricular pacing. A more logical treatment for many of these patients would be demand or fixed rate, atrial pacing. The lack of a suitable transvenous electrode for permanent atrial pacing has slowed the development of this approach. We have developed a unipolar catheter electrode which can be inserted transvenously and securely positioned in the right atrium. Studies in the dog show stable location of the catheter, with satisfactory "P" wave pick-up and atrial capture on stimulation for up to 30 days. Atrial stimulating thresholds are consistently higher than ventricular thresholds measured in the same animal at the same time. A modification of the catheter suitable for use in patients has been developed and clinical trial is in progress. Satisfactory short-term results have been obtained in two patients.

#### **38. Long-Term Follow-Up of a New Method of Pacer Lead Implantation**

JAMES R. JUDE, KAZI MOBIN-UDDIN,\* CARLOS R. LOMBARDO,\* and GEORGE M. CALLARD,\* Miami, Fla.

Cardiac pacemaker leads were implanted under local anesthesia on the out-flow tract of the right ventricle in 25 patients over a period of three years. The parasternal approach used did not enter the pleural space. It retained the simplicity of the transvenous method with the reliability of the epicardial suture technique. The pacer power pack was placed in the epigastrium or sub-pectoral area. Both fixed rate and demand pacemakers were employed. In three patients the incision was extended to the left and the electrodes placed on the left ventricle

due to the absence of a bare area on the right ventricle. One patient died post-operatively of renal failure. There have been no late deaths. The battery pack has been replaced in six patients giving an opportunity to study the threshold for stimulation of the electrodes on the right ventricle. The thresholds varied from 1.5 to 4.0 milliamperes with the longest measured at 24 months of 2.5 milliamperes. No lead difficulties have been seen with follow-up up to 36 months, in view of changing opinions, an employment of a transvenous electrode with problems of repositioning or perforation, this method provides an alternative simple method of placement without general anesthesia.

### **39. Water and Solute Excretion Following Cardio-Pulmonary Bypass with Hemodilution: The Effects of the Osmolarity of the Perfusion-Prime**

J. B. DAS,\* A. J. ERAKLIS,\* and J. E. JONES,\* Boston, Mass.

Sponsored by ROBERT E. GROSS

Renal water and solute excretion was studied following open-heart surgery with hemodiluted primes of varying osmolarity (290 mOsm/L-377 mOsm/L). The water and electrolyte content of skeletal muscle and red cells before and following bypass was also measured. With hyperosmolar primes, a hypertonicity of the plasma and a sharp osmotic diuresis was noted within the first six hours after cardio-pulmonary bypass. In the next 18 hours the urinary output for the hyperosmolar groups dropped well below (22.5 ml/hour/1.73m<sup>2</sup>) that for the iso-osmolar group (37.3 ml/hour/ 1.73m<sup>2</sup>). However, the total solute excretion in the hyperosmolar group was only slightly higher (729 mOsm/day/1.73m<sup>2</sup>) than the solute excretion in the iso-osmolar group (672 mOsm/day/1.73m<sup>2</sup>). The obligatory water loss is greater in the hyperosmolar groups leading to a relative dehydration, persistent hyperosmolarity of the serum, hypernatremia and high BUN levels. The water and solute excretion was correlated with changes in water and electrolyte content of red cells and skeletal muscle. An increase in sodium and water content of the cells accompanied by a potassium washout was noted during cardio-pulmonary bypass at the highest prime-osmolarities studied. The data collected suggests that monitoring the osmolarity of the prime prior to cardio-pulmonary bypass and the patient's serum post-operatively will offer a guide to fluid therapy and avoid sudden shifts of water and electrolytes between fluid compartments.

### **40. Development of a Membrane Oxygenator: Overcoming Blood Diffusion Limitation**

ROBERT H. BARTLETT,\* DIANE KITTREDGE,\*  
BERTRAM S. NOYES, JR,\*  
RALPH WILLARD,\* and PHILIP A. DRINKER,\* Boston, Mass.

Sponsored by DWIGHT E. HARKEN

Current membrane oxygenators are limited by diffusion of oxygen through the laminar blood film at the membrane surface, achieving only 10-30% of the gas transfer capacity of the membrane. We have previously described the convective mixing produced in a fluid flowing through a torsionally oscillating helix. This principle, applied to membrane oxygenator design, has been shown to eliminate the blood film limitation. A helix of 5-mil silicone rubber membrane was made by wrapping 10 feet of .25 in. diameter tubing around a 12 inch cylinder. Oxygen transfer to blood *in vitro* increased from 45 cc/m<sup>2</sup>/min. to 203 cc/m<sup>2</sup>/min. as the frequency of oscillation was increased. Maximum possible oxygen transfer through 5-mil silicone rubber tubing is 205 cc/m<sup>2</sup>/min. (670 mmHg gradient). These observations were repeated in veno-venous and arterio-venous bypass in dogs. The oxygenator has performed at maximum transfer rates *in vivo* periods up to 7 hours. In this system there is no blood-gas interface, hemolysis is negligible, and bubbling cannot occur. Rapid flow through the oscillating large-bore

tubing prevents stagnation and decreases the tendency to thrombosis. Studies are underway to evaluate prolonged extracorporeal oxygenation in the dog.

#### **41. An Appraisal of Blood Trauma and the Blood-Material Interface Following Prolonged Assisted Circulation**

W.  
F. BERNHARD, L. BUTTON,\* T. ROBINSON,\* S. KITRILA  
KIS,\* and  
C. G. LAFARGE, Boston, Mass.

Assisted circulation (flows of 1500-3000 ml/minute) was carried out (continuously) in 30 calves (7-120 days), employing a totally implantable, Left Ventricular-Aortic assist pump. The pneumatically actuated, double-valved device was completely lined with flocked Dacron fibrils to encourage deposition of a smooth, cellular interface. In some experiments, the pump matrix was seeded with bovine fetal fibroblasts to accelerate pseudoendothelial development. These primitive cells, maintained in tissue culture (37°C), were obtained from fetuses (two to five months gestation) by trypsinization of muscle and connective tissue. In 20 animals, sacrificed after 30 days of bypass, histologic study of the lining revealed masses of viable fibroblasts and collagen attached to the Dacron matrix. Identification of fetal cells was accomplished with liquid scintillation using  $C^{14}$ -Thymidine. Blood trauma was minimal and consisted of: a 15 percent hematocrit reduction; temporary (14 day) increase in incubated osmotic fragility; and a 24 hour increase in mechanical fragility. Erythrocyte survival (D.F.P.<sup>32</sup>) was reduced approximately ten percent (24 day half-life). Red cell mass ( $Cr^{51}$ ) was also less, with a reciprocal rise in plasma volume. Plasma hemoglobin, haptoglobins, reticulocyte count, platelets, and intracellular cations were unchanged.

#### **42. Closed Chest Left Heart Bypass Without Anticoagulation**

AKIO WAKABAYASHI,\* WILLIAM  
DIBTRICK,\* and JOHN E. CONNOLLY,  
Irvine, Calif.

Need for heparinization has been a major handicap preventing prolonged assisted circulation. Experiments were undertaken to devise a non-thrombogenic transseptal left heart bypass unit. A Dennis transseptal cannula, an arterial cannula, and polyvinyl tubings were coated with Graphite-Poly-urethane-Polyvinyl. The pump consisted of a silicone rubber bag with Dacron velour linings energized with compressed oxygen via an adjustable automatic switch and solenoid valve. Two homograft aortic valves were used as inlet and outlet valves of the pump. The following circuit was established in six dogs and tested for 10 to 30 hours without anticoagulation. The circuit consisted of a Dennis transseptal cannula placed through the right jugular vein into the left atrium. The blood was then pumped from the left atrium back to a carotid artery. Blood pressure and primary output were maintained within normal range throughout all bypasses. No transfusions were required. All dogs survived and none showed blood diarrhea which is common when an extracorporeal circulation with heparinization is used for a prolonged period. No clotting was found in the pump unit and no animal showed neurologic damage at later sacrifice. This is the first successful use of left heart bypass for a prolonged period without thoracotomy and heparinization.

#### **43. On-Line Digital Analysis of Respiratory Mechanics and the Automation of Respirator Control**

MARK HILBERMAN,\* JOHN  
SCHILL,\* and RICHARD M. PETERS,  
Chapel Hill, N.C.

The construction of an automatic system of respirator control depends on detailed studies of respiratory mechanics in the postoperative period. At first a digital control system will be

essential. We have used a medium-sized digital computer to perform breath-by-breath analysis of pressure and flow, measurements which are then used to calculate compliance, resistance, total work, resistive work, tidal volume, and rate. A 40% reduction in compliance and a 40% increase in resistance is quite usual on the first day after cardiac surgery, however in individual cases large changes predict deterioration of function and may be used for alarm purposes. Previous work has demonstrated the deterioration of respirator efficiency following such pulmonary changes and detection of these acute changes form essential input for a respirator control system. We have a number of measurements which show that the pressure the respirator "sees" is not necessarily the same one "seen" by the lungs (because of nasotracheal tubes, etc.). This discrepancy must be taken into account if a successful system is to be developed which will warn the physician and control a respirator. Both the needed information and the possible network will be demonstrated.

#### **44. Protracted Survival After Homotransplantation of the Lung and Simultaneous Contralateral Pulmonary Artery Ligation**

FRANK J. VEITH,\* KENNETH RICHARDS,\* and PARVEZ LALEZARI,\*  
New York, N.Y.

Sponsored by ALLAN E. BLOOMBERG

Previous attempts to demonstrate the absolute functional adequacy of homografted lungs by ablation of contralateral pulmonary function have failed. Twenty dogs underwent left lung homotransplantation. When the pulmonary artery anastomosis was made distensible by spatulation of host and donor artery or by insertion of a vein patch, the vascular resistance of the transplant decreased 14-52% following ligation of the right pulmonary artery which was performed immediately after completion of the transplant. Recipients were treated with low dose azathioprine and rabbit anti-dog lymphocyte serum. All dogs lived at least 5 days after operation showing that transplanted lungs with a distensible arterial anastomosis can provide total pulmonary function and can vasodilate to accept the entire cardiac output without damage to the pulmonary microvasculature. Eleven dogs survived 4-20 weeks without pulmonary hypertension or decreased exercise tolerance. Eight still live. Thus, with distensible arterial anastomoses and heterologous anti-lymphocyte serum, lung homotransplantation can dependably produce recipient survival even when the transplant is responsible for total respiratory and pulmonary vascular function. These observations indicate the absolute functional adequacy of lung homografts and provide an experimental basis for lung homotransplantation in patients with pulmonary hypertension.

#### **45. Intermittent Inflatable Endotracheal Cuffs**

JAMES F. ARENS,\* and JOHN L. OCHSNER, New Orleans,  
La.

Long-term controlled and assisted ventilation has resulted in complication secondary to the cuffs on either endotracheal or tracheostomy tubes. Constant cuff pressure causes ischemia of the tracheal wall with subsequent stenosis. A cuff that inflates only during the inspiratory phase of the respirator and deflates during the expiratory phase will allow better blood flow to the trachea. A device has been designed to produce a constant volume of air delivered only during inspiration to the cuffs when either a pressure cycle or volume cycle respirator is employed. Series of anesthetized dogs which were ventilated mechanically for 72 hours have been compared. Ten dogs had constantly inflated cuffs and another 10 had cuffs intermittently inflated by the designed device. At completion of the experiment the animals were sacrificed. In a similar series, the animals were allowed to recover and were sacrificed two weeks later. In each series the tracheae were compared grossly and microscopically. Results of



this study revealed a marked difference. The advantages of the intermittently inflated cuff will be reviewed and the mechanical device used to inflate and deflate the cuff will be demonstrated. Use of this device should prevent tracheal ischemia associated with long-term ventilation.

#### 46. Oxygen Consumption After Oxygen Therapy for Hypoxemia

A. G. GROVES,\* J. H. DUFF,\* A. P. H. MCLEAN,\* R. LAPOINTE,\* and L. D. MACLEAN, Montreal, Quebec

Although increased oxygen concentration of inspired air will often correct hypoxemia, it has not been shown that oxygen therapy improves oxygen consumption ( $\text{VO}_2$ ). This study attempts to determine the relationship between arterial  $\text{pO}_2$  and  $\text{VO}_2$  after administration of 50%  $\text{O}_2$  to hypoxemic patients in septic shock, hypoxemic post-operative patients with atelectasis, and the dog with atelectasis produced by balloon occlusion of the right mainstem bronchus. In 5 hypoxemic patients with septic shock, average  $\text{pO}_2$  while breathing 20%  $\text{O}_2$  was 47 mmHg and average  $\text{VO}_2$  was 272 ml/min. Administration of 50%  $\text{O}_2$  increased average  $\text{pO}_2$  to 87 mmHg but average  $\text{VO}_2$  was unchanged (265 ml/min). Two of these patients had hyperlactacidemia (98 mg%, 74 mg%). Similarly, in 5 patients with atelectasis, 50%  $\text{O}_2$  raised the  $\text{pO}_2$  but  $\text{VO}_2$  did not increase.

	CONTROL		ATELECTASIS	
	20% $\text{O}_2$	50% $\text{O}_2$	20% $\text{O}_2$	50% $\text{O}_2$
$\text{pO}_2$ mmHg	98.7	236.5	51.7	74.5
$\text{VO}_2$ ml/min	147.8	147.4	170.	167.
M.V. l/min	5.84	4.82	9.65	6.29
TEMP.	100.5°	100.13°	102.2°	101.97°

The table summarizes data obtained from 10 dogs before and after bronchial occlusion. Although 50%  $\text{O}_2$  increased average  $\text{pO}_2$  in dogs with atelectasis,  $\text{VO}_2$  was not increased.  $\text{pO}_2$  does not reflect  $\text{VO}_2$ . In ranges of  $\text{pO}_2$  seen clinically, administration of 50%  $\text{O}_2$  increased arterial  $\text{pO}_2$  but failed to improve  $\text{VO}_2$ .

#### 47. Mitral and Aortic Valve Replacement with Autogenous Fascia Lata on a Stent

W. STERLING EDWARDS, ROBERT B. KARP,\* and DAVID ROBILLARD,\* Birmingham, Ala.

Autogenous tissue has not received extensive clinical trial in cardiac valve replacement because of difficulty in constructing functioning valves at the operating table. Senning reports occasional incompetence from tailoring errors in constructing aortic valves of fascia lata, but in those with competent valves, he reports a five year follow-up without degeneration or calcification of the fascia, which is quite impressive. A technique has been developed to construct tricuspid semilunar valves of autogenous fascia lata. Fascia is cut to a pattern, folded over a mold designed from the sinuses of valsalva and sutured to a rigid metal stent. The stent is not cloth covered, but is completely covered by fascia so that no foreign material is exposed to blood and so that autogenous tissue is sutured directly to the valve ring for secure healing. The valve is constructed and tested for competence with water pressure while the chest incision is made and cannulations performed. Human aortic and mitral valves have been successfully replaced using this technique. Valves of this design can be inserted as quickly as a prosthesis. They can be made any size; procurement, sterilization and storage are not a problem, and there should be no rejection.

#### 48. A New Technique for Replacement of the Mitral Valve by a Homograft Semilunar Valve

MAGDI H. YACOB,\* and C. FREDERICK KITTLE, Chicago, Ill.

In 13 patients the mitral valve was replaced with either an aortic or pulmonary homograft; in 7 of these the aortic valve was also replaced with a homograft. A new technique of implanting the aortic valve in the mitral position has been devised to maintain function of the aortic sinuses, to allow mobility of the mitral orifice, and to avoid any protrusion into the left ventricular cavity. These have been mentioned as criticisms of previous techniques. The aortic valve and its adjacent aorta are sutured at both ends to a Dacron tube slightly longer than the sinuses are deep. A collar of pericardial-covered Dacron is attached to the atrial side of the graft. The ventricular side of this prosthesis is sutured first to the mitral annulus; on the atrial side the collar is sutured to the atrium constituting a new atrial floor. Of 13 patients (34 to 68 years old) 10 are living and well; 5 are double and 5 single valve replacements. Valves were generally prepared by radiation and freezing. Postoperative results from 2-12 months indicate a very good correction of the hemodynamic lesion. In no instance has anticoagulant therapy been used or thrombo-embolic phenomena observed.

#### **49. Hemodynamic State Following Open Mitral Valve Replacement and Reconstruction**

CLAUDE A. ROULEAU,\* ROBERT L. FRYE,\* and  
F. HENRY ELLIS, JR.,

Rochester, Minn.

Hemodynamic studies were carried out preoperatively, at operation, for 3 days after operation, and prior to dismissal in 36 patients undergoing open operations on the mitral valve. In 27 patients the valve was resected and replaced, a Kay-Shiley disc valve being used in 9, a Smeloff-Cutter full orifice ball valve in 9, and a Starr-Edwards valve in 9. Nine patients had mitral valve reconstruction. The cardiac index was lowest on the afternoon of operation, (1.9 (L/min/M<sup>2</sup>) after prosthetic replacement and 1.5 (L/min/M<sup>2</sup>) after valve reconstruction) but increased from a preoperative mean of 2.1 to 3.1 at dismissal after valve replacement and from 2.2 to 2.9 after reconstruction. LA and PA pressures decreased immediately after operation. Pulmonary arteriolar resistance showed an early increase but was below preoperative values at dismissal. Left ventricular enddiastolic pressure was above normal in the immediate postoperative period. There was no statistically significant difference in hemodynamics between the four operative procedures. It is concluded that the low cardiac output seen after open operations on the mitral valve is not related to the presence of a prosthesis within the heart, to valve design or to the disruption of normal chordal papillary attachments.

\*By Invitation

## **WEDNESDAY AFTERNOON, APRIL 2, 1969**

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**WEDNESDAY AFTERNOON, APRIL  
2, 1969**

**2:00 P.M. Scientific Session: REGULAR  
PROGRAM**

**Grand Ballroom**

#### **50. Bronchoplastic Procedures for Bronchogenic Carcinoma**

DONALD L. PAULSON, HAROLD G. URSCHEL,  
JR., J. JUDSON MCNAMARA,\*  
and ROBERT R. SHAW, Dallas, Texas

Bronchoplastic procedures in combination with radical lobectomy have been used for bronchogenic carcinoma in 52 patients since 1952, 6 per cent of all resections. The procedure is feasible and applicable for the localized hilar carcinoma, preferably without nodal

involvement, but it may be used also as a compromise with pneumonectomy for the more extensive lesion. Preoperative irradiation has been used for 20 patients to attain better localization. The site of greatest usefulness for this procedure is the localized epidermoid carcinoma involving the right upper lobe bronchial orifice (35 patients). Wide sleeve resection of the right main bronchus combined with right upper lobectomy, thorough mediastinal nodal dissection, and anastomosis of the intermediate bronchus to the stump of the main bronchus accomplishes the same ends as a pneumonectomy, with the advantage of preservation of the middle and lower lobes. The results to date, calculated by the life table method, indicate a 40 per cent overall 5-year survival rate, 50 per cent in the group of patients in whom the procedure was done deliberately as an adequate operation for the particular carcinoma concerned and 20 per cent for those in whom it was done as a compromise with pneumonectomy.

### **51. Preoperative X-ray Therapy as an Adjuvant in the Treatment of Bronchogenic Carcinoma**

T. W. SHIELDS, Chicago, Ill., G. A. HIGGINS, JR.,\* R. L. LAWTON,\*  
A. HEIBRUM,\* and R. J. KEEHN,\* Washington, D.C.

A randomized study of preoperative X-ray therapy in patients with bronchogenic carcinoma was carried out by VA Surgical Adjuvant Cancer Chemotherapy Study group. One hundred sixty-seven patients were randomized for preoperative X-ray therapy and 165 as controls. An X-ray dose of 4,000 r to 5,000 r was given in 4 to 6 weeks followed by operation within 4 to 6 weeks. The control patients were operated upon shortly after randomization. Eighty-six of the treated patients and 90 of the control patients were resected. Twenty X-ray patients and 63 controls underwent thoracotomy only. No operative procedure was performed in the remaining patients. The 30-day mortality and morbidity were essentially the same in both groups. The last patient was accepted for study 10 months ago and the last operation was performed 7 months ago. A marked difference in survival, six months following clinically curative surgery was seen: 44.6% for preoperative X-ray patients and 81.7% for controls,  $P < 0.01$ . The reasons for the poor survival in patients treated with X-ray therapy are obscure, but does not appear to be related to delay in performing surgery. Routine preoperative X-ray therapy in patients with bronchogenic cancer appears of little benefit and actually may exert a harmful effect resulting in a substantially reduced survival following curative resection.

### **52. Abdominal Exploration in the Evaluation of Patients with Carcinoma of the Thoracic Esophagus**

JAMES M. GUERNSEY,\* and D. FREDERICK KNUDSEN,\* Stanford, Calif.  
Sponsored by JAMES B. D. MARK

Five year survival is uncommon for patients with carcinoma of the thoracic esophagus. In an attempt to select patients who would benefit from preoperative x-ray therapy, forty patients with carcinoma of the thoracic esophagus in whom no metastatic carcinoma could be found by conventional means, were subjected to exploratory laparotomy prior to embarking on this treatment plan. At abdominal exploration, sixteen of

the forty patients had metastatic squamous cell carcinoma from the esophagus in the celiac lymph nodes. No patient had tumor outside of these lymph nodes. All patients were then subjected to 6,600 rads of 6 MeV radiation to the primary lesion and to the celiac lymph nodes if they were involved with tumor. Four weeks later, total esophagectomy with simultaneous reconstruction was carried out when possible. All sixteen patients with metastatic carcinoma of the celiac lymph nodes are dead of their disease within eleven months of the beginning of treatment. Of the twenty-four patients with negative celiac lymph node biopsies, only ten have died of their disease. Our experience demonstrates that patients with metastatic esophageal carcinoma in the celiac lymph nodes are not candidates for radical radiation therapy or surgery.

### **53. Spontaneous Rupture of the Esophagus: A Review of a Large Series and Comments on a New Method of Treatment**

OSLER A. ABBOTT, WILLIAM D. LOGAN,  
JR., CHARLES R. HATCHER,  
and PANAGIOTIS N. SYMBAS,\* Atlanta, Ga.

A study of 41 cases of spontaneous rupture of the esophagus is presented. These have resulted from the usual causes; i.e. posterior fossa brain surgery, alcoholism, pre-existing lower esophageal disease, and some idiopathic cases. Comparison of the result of 22 cases treated without open thoracotomy versus a more aggressive approach is made, especially those in which a positive diagnosis was made within 48 hours of onset. Special emphasis is placed on nine (9) patients diagnosed after 24 hours who are treated by a special "T-tube" method. Survival in this group was remarkably high, especially when compared to a similar group of equally late diagnoses in whom direct surgical repair was performed. Certain errors in application of the "T-tube" method were noted in all such cases which did not survive or had major complications. In those patients wherein this type of treatment was applied correctly, we experienced no deaths, major complications or strictures. Certain diagnostic points are emphasized which should lead to earlier recognition of this disease.

### **54. Clinical and Hemodynamic Assessments of Fabric-Covered Starr-Edwards Prosthetic Valves**

ROBERT L. REIS,\* D. LUKE CLANCY,\* KEVIN  
O'BRIEN,\*

STEPHEN E. EPSTEIN,\* and ANDREW G.  
MORROW, BETHESDA, MD.

Fabric-covered Starr-Edwards prostheses (Model 2300 aortic, models 6300 and 6300c mitral) were utilized in 96 patients. None of 13 early deaths was related to valve function. No late deaths occurred in 33 patients surviving isolated aortic replacement; 3 have had cerebral emboli, and 2 have severe hemolytic anemia. Thirty-five patients survived isolated mitral replacement; 4 have had systemic emboli, 2 of which were fatal. Three of 15 patients living after multiple replacements have died late (valve unrelated), and 2 others have had emboli. In 22 patients with aortic prostheses resting peak systolic gradients, measured 6 months post-operatively, averaged 43 mm. Hg (12-75); aortic areas averaged  $0.60 \text{ cm}^2/\text{M}^2$  (0.35-1.07). In 28 patients with mitral prostheses, mean left atrial pressure averaged 16 mm. Hg (6-28) at rest, and 28 mm. Hg (20-40) during exercise; orifice areas averaged 1.03

cm.<sup>2</sup>/M<sup>2</sup>(067-1.43) for 2M, and 1.18 cm.<sup>2</sup>/M.<sup>2</sup> (0.82-1.69) for 3M valves. Nine of the 77 surviving patients remain severely symptomatic (class III or IV), all have poor hemodynamic results, and one mitral prosthesis has been replaced. Serial hemodynamic assessments, now in progress, will indicate whether the valves are stenotic at insertion or become so from tissue ingrowth. Valves of these designs are no longer employed in this clinic.

### **55. Early Clinical Results with Cloth-Covered Prosthetic Cardiac Valves**

F. C. SPENCER, R. H. CLAUSS, G. E. REED, and  
D. A. TICE,  
New York, N.Y.

Cloth-covered, steel-ball prosthetic valves were recently developed to decrease thromboembolism and ball variance. In the 12 month period ending September, 1968, 119 such prostheses were inserted as single or double valvular replacements, with 16 deaths within one month after operation. Anticoagulant therapy was begun 4 to 7 days after operation and continued indefinitely. Only one embolus has occurred (incidence approximately 1 per cent), a massive fatal one 15 days after operation. In an earlier reported series of 66 mitral replacements, the frequency of thromboembolism was 12 per cent. Prosthetic valve function has been excellent to date, with no recognized occurrence of late stenosis of the cloth-covered prostheses. A detailed clinical comparison of the new prostheses with over 430 previous ones (Starr-Edwards, disc, Magovern) will be presented.

### **56. The Experimental and Clinical Results of a Modified Cage Disc Mitral Prosthesis**

G. J. MAGOVERN, F. R. BEGG,\* E. M. KENT, W.  
B. GUSHING,\*  
M. L. GERBER,\* and D. L. FISHER,\* Pittsburgh, Pa.

The process of tissue encapsulation of heart valve prostheses has been effective in reducing thromboembolic complications but has introduced additional functional problems. This paper describes our experimental results following several modifications of a cage disc mitral prosthesis designed to prevent the complications specific to cloth covering a valvular prosthesis, and describes the clinical results in thirty patients in whom the most favorable design was ultimately employed. There were four hospital deaths and one late death, and the remaining twenty-five patients are well. Anticagulation was maintained for three to six months and then discontinued and there have been no early or late thromboembolic complications, one month to twelve months following insertion. We feel this prosthesis has several advantages: 1. Total Dacron cloth covering to permit encapsulation. 2. A vertical cuff sewing ring to facilitate placement and prevent inflow orifice tissue impingement. 3. A hypobaric metallic disc which as yet has not caused cloth distinction. Follow-up results and postoperative catheterization data will be presented on all survivors. The results show that the design of the fixation ring, the method of covering the cage, the type of material employed, the design of the disc and the fixation position, all have a bearing on the ultimate result.

### **57. Internal Thoracic (Mammary) Arteriography: A Questionable Index of Myocardial "Revascularization"**

Y. KATO,\* C. H. DART, JR.,\* R. G. FISH,\* W.  
M. NELSON,\*

S. M. SCOTT, and T. TAKARO, Oteen, N. G.

Internal thoracic (mammary) arteriograms performed on 139 patients one to five years after implant operations showed that 31% of implants could opacify coronary arteries well, 55% poorly or not at all, and in 7% implants were occluded. Nevertheless, late mortality, incidence of infarction, and relief of symptoms were similar in all three groups. There was striking variation in coronary opacification, depending on position of catheter tip. The significance of this variation was studied in 140 implant arteriograms in nine previously operated animals. Arteriography itself almost always caused temporary elevation of implant flow. If the volume of contrast medium was kept constant, the number of opacified vessels and the intensity of opacification varied directly with injection pressure and measured flow in the implant induced during arteriography. In some patients, and in all animals in which arteriography produced increase in implant flow, the contrast medium instead of progressing distally in the usual manner, appeared to move back and forth in the opacified proximally occluded coronary, suggesting movement against intercoronary collateral flow. Since internal thoracic arteriography itself alters implant flow, this procedure cannot be used as a quantitative evaluation of myocardial revascularization. These observations help to explain the inconsistencies in the clinical results following internal thoracic artery implantation.

#### **58. The Aggressive Surgical Approach to Coronary Disease**

W. DUDLEY JOHNSON,\* HAROLD  
HARDING,\* and DERWARD LEPLEY, JR.,  
Milwaukee, Wis.

The published criteria of acceptable risks for coronary artery surgery have often denied help to the patients most in need. For 20 months we have extended our criteria so that 192 of 197 patients presented have been accepted for surgery (advanced age, 3-vessel disease and elevated end-diastolic pressure notwithstanding). Impressive results have been achieved using combinations of the following three basic procedures: (1) All ventricular aneurysms are excised (21 patients), (2) All avascular areas of the left ventricle are attacked using 4 to 9 separate arterial implants from a single internal mammary artery pedicle, and (3) Immediate improvement in coronary flow using vein grafts from the ascending aorta to any available coronary vessel (28 patients). Fifteen of the 28 vein grafts were placed to branches of the main coronary arteries. All those restudied to date show patent veins and improved coronary flow. The mortality has been 11% and is lower in the group with vein grafts. One hundred per cent clinical follow-up has been accomplished and only five of 192 patients are unimproved at two months or longer after surgery. A description of operative techniques and representative postoperative angiograms will be presented.

#### **59. Left Ventricular Resection for the Poorly Functioning Heart with Coronary Artery Disease**

JEROME HAROLD KAY, EDWARD F. DUNNE,\*  
BERNARD G. KROHN,\*  
HAROLD K. TSUJI,\* JOHN V. REDINGTON,\*  
ADOLFO MENDEZ,\*  
and OSCAR MAGIDSON,\* Los Angeles, Calif.

Large portions of the left ventricle distal to the papillary muscles have been removed from thirteen patients with pronounced coronary artery disease, revealed by selective coronary arteriography. Portions of the ventricular septum have been removed also. In four more patients, the non-functioning posterior portion of the left ventricle has been plicated. In fourteen patients, revascularization was also performed. Preoperatively, a forward left ventriculogram in all patients revealed a noncontractile distal % to % of the left ventricle or nonfunctioning posterior portion of the left ventricle. Before surgery, the left ventricle in these patients ejected only 20 to 53% of the end-diastolic volume (normal 70%). After surgery, ventriculographic studies in ten patients revealed the ejection fractions to be normal or significantly improved. Removing the noncontractile distal % to % of the left ventricle or plication of the posterior portion of the left ventricle significantly improved the cardiac function. These areas are not aneurysms and differ in that the involved areas have muscle with fibrous involvement.

\*By Invitation

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 ANDREWS, NEIL C..... Room N-146, 410 W. Tenth Ave, Columbus, Ohio 43210  
 ANKENNEY, JAY L... 2065 Adelbert Rd, Cleveland, Ohio 44106

ARONSTAM, ELMORE M.. Box 53, Letterman General Hospital,  
San Francisco, Calif. 94129  
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Pittsburgh, Pa. 15213  
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BAIRD, RONALD J..... 72 Clarendon, Toronto 7 Ontario Canada  
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BARRETT, RAYMOND J.18280 Fairfield St Detroit, Mich. 48221  
BARTLEY, THOMAS D..... University of Florida College of Medicine,  
Gainesville, Fla. 32603  
BATTERSBY, JAMES S..... 1040 W. Michigan St., Indianapolis, Ind. 46202  
BAUE, ARTHUR E..... 216 S. Kingshighway, St. Louis, Mo. 63110  
BEALL, ARTHUR C., JR..... 1200 M. D. Anderson Blvd., Houston, Texas 77025  
BEATTIE, EDWARD J., JR.. 444 East 68th St, New York, N. Y. 10021  
BELL, JOHN W..... Veterans Administration Hospital, Seattle, "Wash. 98108  
BENOIT, HECTOR W., JR.503 Plaza Parkway Bldg., Kansas City, Mo. 64112  
BERG, RALPH, JR.508 West Sixth Ave., Suite 504, Spokane, Wash. 99204  
BEROMANN, MARTIN4409 W. Pine St., St. Louis, Mo. 63108  
BERNATZ, PHILIP E... Mayo Clinic, Rochester, Minn. 55902  
BERN HARD, WILLIAM F.. 300 Longwood Ave., Boston, Mass. 02115  
BESKIN, CHARLES A.3929 Convention St, Baton Rouge, La. 70806  
BIOELOW, WILFRED G.. Toronto General Hospital, Toronto 2,  
Ontario, Canada  
BLACK, HARRISON... 319 Longwood Ave., Boston, Mass. 02115  
BLAKE, HU AL7765 Devonshire Dr., Knoxville, Tenn. 37919  
BLAKEMORE, WILLIAM S.19th and Lombard St, Philadelphia, Pa. 19146  
BLALOCK, JOHN B.. 1516 Jefferson Highway, New Orleans, La. 70121  
BLOOMBERG, ALLAN E.... 1095 Park Ave., New York, N. Y. 10028  
BLOOMER, WILLIAM E.3640 Atlantic Ave., Long Beach, Calif. 90807  
BLUMENSTOCK, DAVID A... Mary Imogene Bassett Hospital,  
Cooperstown, N. Y. 13326  
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BOYD, THOMAS F.452 Pleasant St., Maiden, Mass. 02148  
BRAUNWALD, NINA S.... 225 W. Dickinson St., San Diego, Calif. 92103  
BRINDLEY, G. VALTER, JR.. Scott and White Clinic, Temple, Texas 76501  
BROCKMAN, STANLEY K.29th St. & Ellis Ave., Chicago, Ill. 60616  
BROOKS, JAMES W... 1200 E. Broad St., Richmond, Va. 23219  
BROWN, IVAN W., JR..... 1600 Lakeland Hills Blvd., Lakeland, Fla. 33802  
BROWN, ROBERT K.. 1727 Gilpin St, Denver, Colo. 80218  
BRUNEAU, JACQUES.... 3875 St. Urbain, Suite 307, Montreal 18,  
Quebec, Canada  
BRYANT, LESTER R..... University of Kentucky Medical Center,  
Lexington, Ky. 40506  
BUGDEN, WALTER F.1200 East Genesee St., Syracuse, N.Y. 13210  
BURDETTE, WALTER J.M. D. Anderson Hospital & Tumor Institute,  
Houston, Texas 77025  
CALLAGHAN, JOHN C..... Suite 550, 8409 112 St., Edmonton,  
Alberta, Canada



CAMISHION, RUDOLPH C. North Park Dr. & Airport Highway,  
Pennsauken, N. J. 09109  
CAMPBELL, GILBERT S. .... University of Arkansas Medical Center,  
Little Rock, Ark. 72201  
CANTRELL, JAMES R. .... 325 Ninth Ave., Seattle, Wash. 98104  
CARTER, MAX G. 670 George St., New Haven, Conn. 06511  
CASTANEDA, ALDO R. .... University of Minnesota Hospitals,  
Minneapolis, Minn. 55414  
CENTER, SOL 637 DuPont Bldg, Miami, Fla. 33131  
CHAMBERS, JOHN S., JR. 2850 Sixth Ave., San Diego, Calif. 92103  
CHBSNEY, JOHN G. 1550 N. W. 10th Ave., Miami, Fla. 33136  
CLATWORTHY, H. WILLIAM, JR. ... 695 Bryden Rd., Columbus, Ohio 43205  
CLAUSS, ROY H. .... 566 First Ave., New York, N. Y. 10016  
CLOWES, GEORGE H. A., JR. ... 818 Harrison Ave., Boston, Mass. 02118  
COHEN, MORLEY ..... 295 Dromore Ave., Winnipeg, Manitoba, Canada  
COHN, ROY B. .... Stanford Hospital, Palo Alto, Calif. 94302  
COLE, FRANCIS H. .... 188 South Bellevue, Memphis, Tenn. 38106  
COLLINS, HAROLD A. 519 Huckleberry Rd., Nashville, Tenn. 37205  
CONKLIN, WILLIAM S. 511 Southwest Tenth Ave., Portland, Ore. 97205  
CONNOLLY, JOHN E. .... University of California at Irvine, Irvine, Calif. 92664  
COOLEY, DENTON A. 1200 M. D. Anderson Blvd., Houston, Texas 77025  
CORDELL, A. ROBERT Bowman Gray School of Medicine,  
Winston-Salem, N. C. 27103  
COTTON, BERT H. ... 111 Congress St., Pasadena, Calif. 91105  
COWLEY, R. ADAMS. .... University Hospital, Baltimore, Md. 21201  
CRANDELL, WALTER B. .... Veterans Administration Hospital,  
White River Junction, Vt. 05001  
CRAWFORD, E. STANLEY ... 1200 Moursund Ave., Houston, Texas 77025  
CROSS, FREDERICK S. .... 11311 Shaker Blvd., Cleveland, Ohio 44104  
CULNER, MORRIS M. 2233 Post St., San Francisco, Calif. 94115  
CURRERI, ANTHONY R. ... 1300 University Ave., Madison, Wis. 53706  
CUTLER, PRESTON R. 535 East 1st South St., Salt Lake City, Utah 84102  
DAICOFF, GEORGE R. .... University of Florida College of Medicine,  
Gainesville, Fla. 32603  
DALE, W. ANDREW ... 2000 Church St., Nashville, Tenn. 37203  
DAMMANN, JOHN F. "Barrsden" Stony Point Rd., Charlottesville, Va. 22901  
DANIEL, ROLLIN A. .... 410 Medical Arts Bldg., Nashville, Tenn. 37212  
DAUGHTRY, DEWITT C. 1550 N.W. 10th Ave., Miami, Fla. 33136  
DAVILA, JULIO C. .... 3401 North Broad St., Philadelphia, Pa. 19140  
DAVIS, MILTON V. .... 3434 Swiss Ave., Suite 405, Dallas, Texas 75204  
DEATON, W. RALPH, JR. 1027 Professional Village,  
Greensboro, N. G. 27401  
DE BAKEY, MICHAEL E. 1200 Moursund Ave., Houston, Texas 77025  
DECAMP, PAUL T. 1514 Jefferson Highway, New Orleans, La. 70121  
DELARUE, NORMAN C. ... 25 Donlea Drive, Toronto 17, Ontario, Canada  
DENIORD, RICHARD N. 1911 Thomson Dr, Lynchburg, Va. 24501  
DENNIS, CLARENCE ... 989 Edgewood Ave, Pelham Manor, N. Y. 10802  
DERRICK, JOHN R. .... University of Texas Medical Branch,  
Galveston, Texas 77551  
DESFORGES, GERARD. .... 452 Pleasant St., Maiden, Mass. 02148  
DETERLINO, RALPH A., JR. .... 171 Harrison Ave., Boston, Mass. 02111  
DEWALL, RICHARD A. 247 Northview Rd., Dayton, Ohio 45419  
DILLARD, DAVID H. ... 12712 39th N.E., Seattle, Wash. 98155  
DIVELEY, WALTER L. ... 121 Twenty-First Ave., North,  
Nashville, Tenn. 37203  
DOBELL, ANTHONY R. C. .... Royal Victoria Hospital,

Montreal 2, Quebec, Canada  
DOMM, SHELDON E.1918 W. Clinch Ave., Knoxville, Tenn. 37916  
DORNER, RALPH A..... 710 Equitable Bldg, Des Moines, Iowa 50309  
DRAKE, EMERSON H.. 18 Bramhall St, Portland, Me. 04102  
DUGAN, DAVID J..... 459 30th St, Oakland, Calif. 94609  
EDWARDS, W. STERLING... 1919 Seventh Ave. South,  
Birmingham, Ala. 35233  
EFFLER, DONALD B.... Euclid and East 93rd St., Cleveland, Ohio 44106  
EHRENHAFT, JOHANN L..... University Hospitals, Iowa City, Iowa 52240  
EISEMAN, BEN..... 4200 E. Ninth Ave, Denver, Colo. 80220  
ELLIS, F. HENRY, JR... Mayo Clinic, Rochester, Minn. 55902  
ELLISON, ROBERT G.. Medical College of Georgia, Augusta, Ga. 30902  
EMERSON, GEORGE L..... 11 Rochester St, Scottsville, N. Y. 14546  
EVANS, BYRON H..... 3291 W. Billiard, Fresno, Calif. 93703  
FALOR, WILLIAM H.208 Medical Arts Bldg, Akron, Ohio 44304  
FERGUSON, THOMAS B... Barnes Hospital Plaza, St. Louis, Mo. 63110  
FINDLAY, CHARLES W, JR..... 180 Fort Washington Ave.,  
New York, N. Y. 10032  
FINEBERG, CHARLES..... 829 Spruce St., Philadelphia, Pa. 19107  
FISCHER, WALTER W.170 East 78th St., New York, N. Y. 10021  
FITZPATRICK, HUGH F..... St. Luke's Hospital, New York, N. Y. 10025  
FLYNN, PIERCE J.. 1115 D St., San Bernardino, Calif. 92410  
FORD, JOSEPH M..... 1056 Fifth Ave., New York, N. Y. 10028  
FORD, WILLIAM B..... 220 Meyran Ave., Pittsburgh, Pa. 15213  
FOSTER, JOHN H..... Vanderbilt University Hospital, Nashville, Tenn. 37203  
FOX, ROBERT T.2136 Robin Crest Lane, Glenview, Ill. 60025  
FRANK, HOWARD A.330 Brookline Ave, Boston, Mass. 02215  
FRENCH, SANFORD W, III... 307 East Buena Vista, Barstow, Calif. 92311  
FROBESSE, ALFRED S... 1425 Scrope Rd., Rydal, Pa. 19046  
GAENSLER, EDWARD A.229 Dudley Rd., Newton Center, Mass. 02159  
GAGNON, EDOUARD D.. 30 Est Blvd St. Joseph, Suite 1003,  
Montreal, Quebec, Canada  
GARAMELLA, JOSEPH J..... 1629 Medical Arts Bldg.,  
Minneapolis, Minn. 55402  
GARDNER, RICHARD E.. 490 Post St., Room 1230,  
San Francisco, Calif. 94102  
GEBAUER, PAUL... Leahi Hospital, Honolulu, Hawaii 96816  
GERST, PAUL H.622 W. 168th St., New York, N. Y. 10032  
GILBERT, JOSEPH W., JR..... 1091 North Jamestown Rd.,  
Decatur, Ga. 30033  
GLENN, WILLIAM W. L..... 333 Cedar St., New Haven, Conn. 06510  
GOTT, VINCENT L.Johns Hopkins Hospital, Baltimore, Md. 21205  
GRAVEL, JOFFRE-ANDRE170 Grande-Allee West, Quebec 6, Quebec, Can  
GREER, ALLEN E.1211 N. Shartel, Oklahoma City, Okla. 73103  
GRILLO, HERMES C.... Massachusetts General Hospital, Boston, Mass. 02114  
GRIMES, ORVILLE F..... University of California Hospital,  
San Francisco, Calif. 94122  
GROVES, LAURENCE K.Cleveland Clinic, Cleveland, Ohio 44106  
GWATHMEY, OWEN..... 501 E. Franklin St., Richmond, Va. 23219  
HALL, DAVID P.1000 E. Third St., Chattanooga, Tenn. 37403  
HALLER, J. ALEX, JR.. Johns Hopkins Hospital, Baltimore, Md. 21205  
HALLMAN, GRADY L., JR... 1200 Moursund Ave., Houston, Texas 77025  
HANLON, C. ROLLINS..... 1325 South Grand Blvd, St. Louis, Mo. 63104  
HARDY, JAMES D.... University of Mississippi Medical Center,  
Jackson, Miss. 39216  
HARKEN, DWIGHT E..... 67 Bay State Rd., Boston, Mass 02215

HARRISON, ALBERT W.3155 Stagg Drive, Beaumont, Texas 77701  
HARRISON, ROBERT W.1810 Wealthy St., S.E,  
Grand Rapids, Mich. 49605  
HAUPT, GEORGE J.... 306 Lankenau Medical Bldg., Philadelphia, Pa. 19151  
HEANEY, JOHN P..... Medical Professional Bldg., San Antonio, Texas 78212  
HEIMBECKER, RAYMOND O.. Toronto General Hospital,  
Toronto 2, Ontario, Canada  
HEKOY, WILLIAM W..... East Gate Rd., Lloyd Harbor,  
Huntington, N. Y. 11743  
HERRERA, RODOLFO..... 6a Avenida 8-71, Zone 10, Guatemala City,  
Guatemala  
HEWLETT, THOMAS H.... Fresno County General Hospital,  
Fresno, Calif. 93702  
HIOOINSON, JOHN F..... 2320 Bath St, Suite 213,Santa Barbara, Calif. 93105  
HILL, LUCIUS D.1118 Ninth Ave., Seattle, Wash. 98101  
HOLDER, THOMAS M.39th and Rainbow, Kansas City, Kans. 66103  
HOLLAND, ROBERT H.. 3216 Beverly Drive, Dallas, Texas 75205  
HOLSWADE, GEORGE R.517 E. 71st St., New York, N. Y. 10021  
HOOD, R. MAURICE... 3100 Red River, Austin, Texas 78705  
HOOD, RICHARD H., JR..... 408 Travertine, San Antonio, Texas 78213  
HOPKINS, WILLIAM A.1293 Peachtree St, N. E., Atlanta, Ga. 30309  
HUDSPETH, ALLEN S..... Bowman Gray School of Medicine,  
Winston-Salem, N. C. 27103  
HUFNAOEL, CHARLES A.3800 Reservoir Rd., N.W.,  
Washington, D. C. 20007  
HUGHES, RICHARD K.2293 Dallin St, Salt Lake City, Utah 84109  
HURLEY, G. A. P..... 3869 Cote des Neiges Rd, Montreal 25, Quebec, Can  
HURWITZ, ALFRED..... 4300 Alton Rd, Miami Beach, Fla. 33140  
JAHNKE, EDWARD J., JR.1596 San Leandro Lane,  
Santa Barbara, Calif. 93103  
JAMPLIS, ROBERT W.Palo Alto Clinic, Palo Alto, Calif. 94301  
JAVID, HUSHANO. 1725 W. Harrison St., Chicago, Ill. 60612  
JENSIK, ROBERT J..... 1725 W. Harrison St., Chicago, Ill. 60612  
JOHNS, THOMAS N. P.6305 Towana Rd, Richmond, Va. 23226  
JOHNSON, ELGIE K.. 1077 Northern Blvd., Roslyn, N. Y. 11576  
JOHNSON, FRANK E..... 706 Medical Arts Bldg, Minneapolis, Minn. 55402  
JOHNSTON, FRANK R..... Bowman Gray School of Medicine,  
Winston-Salem, N. C. 27103  
JOHNSTON, J. HARVEY, JR.710 North State St., Jackson, Miss. 39201  
JONES, THOMAS W.715 Minor Ave, Seattle, Wash. 98104  
JOYNT, GEORGE H. C... 25 Leonard Ave., Suite 102, Toronto 2b,  
Ontario, Canada  
JUDE, JAMES R.Jackson Memorial Hospital, Miami, Fla. 33136  
JULIAN, ORMAND C.1725 West Harrison St, Chicago, Ill. 60612  
KAISER, GEORGE C... 1325 S. Grand Blvd., St. Louis, Mo. 63104  
KARLSON, KARL E..... 451 Clarkson Ave., Brooklyn, N. Y. 11203  
KAUSEL, HARVEY W.Albany Hospital, Albany, N. Y. 12208  
KAY, EARLE B.. 2475 E. 22nd St., Cleveland, Ohio 44115  
KAY, JEROME HAROLD..... 318 South Alvarado St., Los Angeles, Calif. 90057  
KEE, JOHN L., JR..... 3707 Gaston Ave., Dallas, Texas 75246  
KEMLER, R. LEONARD..... 21 Woodland St., Hartford, Conn. 06105  
KENNEDY, JOHN H.... Metropolitan General Hospital,  
Cleveland, Ohio 44109  
KEY, JAMES A.170 St George St, Toronto, Ontario, Canada  
KING, HAROLD..... 1100 West Michigan St, Indianapolis, Ind. 46207  
KINO, RICHARD340 Boulevard, N. E., Atlanta, Ga. 30312

KIRKLIN, JOHN W.. University of Alabama Medical Center,  
Birmingham, Ala. 35233  
KIRSCHNER, PAUL A.... 2 East 92nd St., New York, N. Y. 10028  
KITTLE, C. FREDERICK.. 950 E. 59th St., Chicago, Ill. 60637  
KLASSEN, KARL P..... Ohio State University, Columbus, Ohio 43215  
KLEPSBR, ROY G.1835 Eye St., N. W., Washington, D. C. 20006  
LAFORÉ, EUGENE G... 2000 Washington St., Newton Lower Falls,  
Mass. 02162  
LAMBERT, ADRIAN768 Park Ave., New York, N. Y. 10021  
LANOSTON, HIRAM T.... 1919 West Taylor St., Chicago, Ill. 60612  
LAWRENCE, G. HUGH1118 Ninth Ave, Seattle, Wash. 98101  
LAWRENCE, MONTAGUE S..... University Hospitals, Iowa City, Iowa 52240  
LEE, WILLIAM H., JR..... 55 Doughty St., Charleston, S. C. 29401  
LEEDS, SANFORD E.2211 Post St., San Francisco, Calif. 94115  
LEES, WILLIAM M..... 7000 North Kenton Ave., Lincolnwood, Ill. 60646  
LEMMON, WILLIAM M.220 North 15th St, Philadelphia, Pa. 19102  
LEPLEY, DERWARD, JR..... 8700 W. Wisconsin Ave., Milwaukee, Wis. 53226  
LILLEHEI, C. WALTON. 525 E. 68th St., New York, N. Y. 10021  
LILLEHEI, RICHARD C..... University Hospitals, P. O. 490,  
Minneapolis, Minn. 55455  
LITTLEFIELD, JAMES B..... University of Virginia School of Medicine,  
Charlottesville, Va. 22901  
LITWAK, ROBERT S.... 5th Ave. at 100th St., New York, N. Y. 10029  
LYNCH, JOSEPH P..... 2000 Washington St., Newton Lower Falls-  
Middlesex, Mass. 02162  
LYNN, R. BEVERLY.... R. R. No. 1, Westbrook, Ontario, Canada  
MACKLER, S. ALLEN104 South Michigan Ave, Chicago, Ill. 60603  
MACLEAN, LLOYD D.. Royal Victoria Hospital, Montreal 2,  
Quebec, Canada  
MACMANUS, JOSEPH E..... 73 High St, Buffalo, N. Y. 14203  
MADOFF, IRVING M... 1180 Beacon St., Brookline, Mass. 02146  
MAGOVERN, GEORGE J.... 3500 Fifth Ave., Pittsburgh, Pa. 15213  
MAHONEY, EARLE B..... 260 Crittenden Blvd, Rochester N. Y. 14620  
MALM, JAMES R..... 180 Fort Washington Ave, New York, N. Y. 10032  
MALONEY, JAMES V, JR.... UCLA Medical Center, Los Angeles, Calif. 90024  
MANNDC, EDGAR P, JR.. 12 Forest Turn, Manhasset,  
Long Island, N. Y. 11030  
MARK, JAMES B. D..... 751 South Bascom Ave., San Jose, Calif. 95128  
MAURER, ELMER P. R.. 250 Wm Howard Taft Rd., Cincinnati, Ohio 45219  
MAYER, JOHN H., JR.... 503 Plaza Parkway Bldg., Kansas City, Mo. 64112  
McBURNEY, ROBERT P.. Suite 524, 910 Madison Ave,  
Memphis, Tenn. 38103  
McCLENATHAN, JAMES E.... The Children's Hospital,  
Washington, D. C. 20009  
McGOON, DWIGHT C..... Mayo Clinic, Rochester, Minn. 55902  
MECKSTROTH, CHARLES V..... Ohio State University Hospital,  
Columbus, Ohio 43210  
MELICK, DERMONT W..... University of Arizona College of Medicine,  
Tucson, Ariz. 85721  
MENDELSON, HARVEY J... 2065 Adelbert Rd, Cleveland, Ohio 44106  
MEREDITH, JESSE H.Bowman Gray School of Medicine,  
Winston-Salem, N. C. 27103  
MERENDINO, K. ALVINUniversity of Washington, School of Medicine,  
Seattle, Wash. 98105  
MERKEL, CARL G..... 8 Church St, Saranac Lake, N.Y. 12983  
MEYER, BERTRAND W.. 922 Keatley Rd., La Canada, Calif. 91011

MICHELSON, ELLIOTT. 200 W. Cold Spring Ln., Baltimore, Md. 21210  
MILLER, DON R..... University of Kansas Medical Center,  
Kansas City, Kans. 66103  
MILLER, FLETCHER A..... Creighton-St. Joseph Hospital, Omaha, Neb. 68102  
MILLER, GEORGE E..... 214 Sixth Ave., West, Calgary, Alberta, Canada  
MILLS, WALDO O.1120 Cherry St, Seattle, Wash. 98104  
MINOR, GEORGE R.  
University of Virginia Hospital, Charlottesville, Va. 22901  
MOORE, THOMAS C.1200 E. Broad St., Richmond, Va. 23219  
MORRIS, GEORGE C., JR..... 1200 M. D. Anderson Blvd., Houston, Texas 77025  
MORRIS, JOE D..... University Hospital, Ann Arbor, Mich. 48104  
MORROW, ANDREW G..... National Heart Institute,  
Bethesda, Md. 20014  
MORSE, DRYDEN P.... 500 Chester Ave, Moorestown, N. J. 08057  
MORTENSEN, JD..... 535 East 1st South St., Salt Lake City, Utah 84102  
MOULDER, PETER V.8th and Spruce Sts., Philadelphia, Pa. 19107  
MULDER, DONALD G.... UCLA Medical Center, Los Angeles, Calif. 90024  
MULLER, WILLIAM H., JR..... University of Virginia Medical Center,  
Charlottesville, Va. 22901  
MUNNELL, EDWARD R.  
301 Northwest 12th St, Oklahoma City, Okla. 73103  
MUSTARD, WM T.Suite 1225, 123 Edward St, Toronto 2, Ontario, Canada  
NAJAFI, HASSAN..... 1725 W. Harrison St, Chicago, Ill. 60612  
NARDI, GEORGE L.Massachusetts General Hospital, Boston, Mass. 02114  
NEALON, THOMAS F., JR. 170 W. 12th St, New York, N. Y. 10011  
NELSON, RUSSELL M.. 508 East South Temple, Salt Lake City, Utah 84102  
NEMIR, PAUL, JR..... 19th & Lombard Sts, Philadelphia, Pa. 19146  
NEPTUNE, WILFORD B.135 Francis St., Boston, Mass. 02115  
NEVILLE, WILLIAM E..... Veterans Administration Hospital, Hines, Ill. 60141  
NEWMAN, MELVIN M.4200 E. Ninth Ave., Denver, Colo. 80220  
NICHOLS, HENRY T..... 245 North Broad St., Philadelphia, Pa. 19107  
NIGRO, SALVATORE L..... 610 Poplar St., Elmhurst, Ill. 60126  
OCHSNER, JOHN L.. 1516 Jefferson Highway, New Orleans, La. 70121  
O'NEILL, THOMAS J. E..... 110 Centennial Bldg, Philadelphia, Pa. 19125  
PAPPER, EMANUEL M.... 622 West 168th St, New York, N. Y. 10032  
PARKER, EDWARD F.. 158 Rutledge Ave, Charleston, S. C. 29408  
PATE, JAMES W..... Suite 652D, 951 Court Ave, Memphis, Tenn. 38103  
PAULSON, DONALD L.3810 Swiss Ave, Dallas, Texas 75204  
PAYNE, W. SPENCER.. Mayo Clinic, Rochester, Minn. 55902  
PEABODY, JOSEPH W., JR..... 1234 19th St, N.W., Washington, D. C. 20036  
PECORA, DAVID V..... 3493 Meadowdale Blvd., Richmond, Va. 23234  
PERKINS, REX B..... American Cyanamid Co. Bldg., Chamblee, Ga. 30005  
PETERS, RICHARD M..... University of North Carolina, School of Medicine,  
Chapel Hill, N. C. 27514  
POLK, JOHN W.. 315 Professional Bldg., Springfield, Mo. 65806  
PONTIUS, ROBERT G.... 106 Lothrop St., Pittsburgh, Pa. 15213  
POPPE, J. KARL..... 2525 N. W. Lovejoy St., Portland, Ore. 97210  
QUINLAN, JOHN J..... Nova Scotia Sanatorium, Kentville,  
Nova Scotia, Canada  
RAINER, W. GERALD... 701 E. Colfax Ave, Denver, Colo. 80203  
RAMSAY, BEATTY H.11600 Wilshire Blvd., Los Angeles, Calif. 90025  
RANSELL, HERBERT T., JR.. 511 South Floyd St., Louisville, Ky. 40202  
RASMUSSEN, RICHARD A.Blodgett Medical Bldg,  
Grand Rapids, Mich. 49506  
RAVITCH, MARK M.. 950 E. 59th St., Chicago, Ill. 60637  
READ, C. THOMAS3411 N. Fifth Ave, Phoenix, Ariz. 85013

REDO, S. FRANK. 525 East 68th St, New York, N. Y. 10021  
REED, WILLIAM A..... 5931 High Drive, Shawnee Mission, Kans. 66208  
REEMTSMA, KEITH University of Utah College of Medicine,  
Salt Lake City, Utah 84112  
RHEINLANDER, HAROLD F... 171 Harrison Ave., Boston, Mass. 02111  
RICHARDS, VICTOR..... 460 Cherry St., San Francisco, Calif. 94118  
RIVKIN, LAURENCE M..... 2320 Sutter St, San Francisco, Calif. 94115  
ROBINSON, GEORGE..... 105 Stevens Aye., Mount Vernon, N. Y. 10550  
ROE, BENSON B..... University of California Medical Center,  
San Francisco, Calif. 94122  
ROSEMOND, GEORGE P... 3401 North Broad St., Philadelphia, Pa. 19140  
ROSENBERG, DENNIS M.. 3600 Prytania St, New Orleans, La. 70115  
RUBENSTEIN, LAURENCE H.... 571 Woodlawn Ave., Glencoe, Ill. 60022  
RUBIN, MORRIS..... 2021 Grand Concourse, New York, N. Y. 10453  
SABISTON, DAVID C.  
Duke University Medical Center, Durham, N. C. 27706  
SALYER, JOHN M.1125 E 17th St., Suite N-560, Santa Ana, Calif. 92701  
SAROT, IRVING A... 107 East 85th St., New York, N. Y. 10028  
SAUVAGE, LESTER..... 1009 Summit Ave., Seattle, Wash. 98104  
SAWYERS, JOHN L.Nashville General Hospital, Nashville, Tenn. 37210  
SCANNELL, J. GORDON  
Massachusetts General Hospital, Boston, Mass. 02114  
SCHRAMMEL, ROBERT J... 4440 Magnolia St., New Orleans, La. 70115  
SCHUSTER, SAMUEL R... 300 Longwood Ave, Boston, Mass. 02115  
SCHWARTZ, SEYMOUR I.. 260 Crittenden Blvd., Rochester, N. Y. 14620  
SCOTT, HENRY W., JR.Vanderbilt University Hospital,  
Nashville, Tenn. 37203  
SCOTT, STEWART M.. One Northwood Road, Asheville, N. C. 28803  
SEALY, WILL C.. Duke University Hospital, Durham, N. C. 27706  
SEILER, HAWLEY H.. 517 Bayshore Blvd., Tampa, Fla. 33606  
SELEY, GABRIEL P.. 799 Park Ave., New York, N. Y. 10021  
SENNING, AKE..... Surgical University Clinic A, Kantonsspital, 8006  
Zurich, Switzerland  
SEYBOLD, WILLIAM D.6624 Fannin St, Houston, Texas 77025  
SHIELDS, THOMAS W.333 E Huron St, Chicago, Ill. 60611  
SHUMACKER, HARRIS B, JR..... Indiana University Medical Center,  
Indianapolis, Ind. 46207  
SHUMWAY, NORMAN E.Stanford Medical Center, Palo Alto, Calif. 94302  
SIRAK, HOWARD D..... Ohio State University Hospital, Columbus, Ohio 43210  
SKINNER, EDWARD F.20 S. Dudley St., Memphis, Tenn. 38103  
SLOAN, HERBERT..... University Hospital, Ann Arbor, Mich 48104  
SMYTH, NICHOLAS P. D..... 110 Irving St., N.W., Washington, D. C. 20010  
SNYDER, JOHN M.... 1236 Moffitt Ave., Bethlehem, Pa. 18015  
SOUTTER, LAMAR..... 577 Bridge St, Dedham, Mass. 02026  
SPEAR, HAROLD C.1550 N.W. Tenth Ave., Miami, Fla. 33136  
SPENCER, FRANK C..... 550 First Ave., New York, N. Y. 10016  
STARKEY, GEORGE W. B..... 605 Commonwealth Ave, Boston, Mass. 02215  
STARR, ALBERT... 3181 S. W. Sam Jackson Park Rd., Portland, Ore. 97201  
STATE, DAVID... Albert Einstein College of Medicine, New York, N. Y. 10061  
STEPHENSON, SAM E, JR... 2000 Jefferson St., Jacksonville, Fla. 32206  
STERN, HAROLD..... 2 Church St, So., New Haven, Conn. 06519  
STRANAHAN, ALLAN.. Albany Medical Center Hospital, Albany, N. Y. 12208  
SWAN, HENRY..... 6700 W. Lakeridge Rd., Denver, Colo. 80227  
TABER, RODMAN E..... Henry Ford Hospital, Detroit, Mich 48202  
TAKARO TIMOTHY..... Veterans Administration Hospital,Oteen, N. C. 28801  
TAYLOR, FREDERICK H.1012 Kings Drive, Charlotte, N. C. 28207

TAYLOR, WARREN J... 452 Pleasant St., Maiden, Mass. 02148  
TEMPLETON, JOHN Y, III.... 311 Airdale Rd., Rosemont, Pa. 19010  
THAL, ALAN P..... University of Kansas Medical Center,  
Kansas City, Kans. 66103  
THOMAS, GEORGE I..... 715 Minor Ave, Seattle, Wash. 98104  
THOMAS, GORDON W.Int. Grenfell Association, St. Anthony,  
Newfoundland, Canada  
THOMSON, NORMAN B, JR..... 219 Bryant St., Buffalo, N. Y. 14222  
TIMMES, JOSEPH J.Seaton Hall College of Medicine,  
Jersey City, N. J. 07304  
TOCKER, ALFRED M... 401 College Hill Medical Towers,  
Wichita, Kans. 67208  
TRUSLER, GEORGE A.... 123 Edward St., Suite 1225, Toronto,  
Ontario, Canada  
URSCHEL, HAROLD C, JR.3810 Swiss Ave., Dallas, Texas 75204  
VARCO, RICHARD L..... University of Minnesota Medical Center,  
Minneapolis, Minn. 55414  
WADDELL, WILLIAM R.4200 East Ninth Ave., Denver, Colo. 80220  
WALKER, JAMES H.... 1323 Quarrier St., East, Charleston, W. Va. 25301  
WALKUP, HARRY E.R. F.D. No. 1, Worton, Md. 21678  
WARDEN, HERBERT E..... West Virginia University Medical Center,  
W. Va. 26506  
WATKINS, ELTON, JR.... 605 Commonwealth Ave., Boston, Mass. 02215  
WEBB, WATTS R... Southwestern Medical School, Dallas, Texas 75235  
WEINBERO, MILTON, JR.1725 W. Harrison St., Suite 448,  
Chicago, Ill. 60612  
WEISEL, WILSON..... 2266 North Prospect Ave., Milwaukee, Wis. 53202  
WESOLOWSKI, SIGMUND A.  
Mercy Hospital, Rockville Centre, N. Y. 11570  
WHEAT, MYRON W, JR..... University of Florida College of Medicine,  
Gainesville, Fla. 32603  
WHITE, MARION L., JR.. First Huntington National Bank Bldg., Suite 330,  
Huntington, W. V. 25701  
WICHERN, WALTER A., JR..... 620 Park Ave, New York, N. Y. 10021  
WILDER, ROBERT J.200 W. Cold Spring Ln., Baltimore, Md. 21210  
WILKINS, EARLE W., JR..... Zero Emerson Place, Boston, Mass. 02114  
WILLIAMS, G. RAINEY..... 800 Northeast 13th St., Oklahoma City,  
Okla. 73104  
WILLMAN, V. L.1325 South Grand Blvd., St. Louis, Mo. 63104  
WILSON, JOHN L..... Stanford Medical Center, Palo Alto, Calif. 94304  
WILSON, NORMAN J..... Parramore Hospital, Crown Point, Ind. 46307  
WITMER, ROBERT H.... 126 East Chestnut St., Lancaster, Pa. 17602  
WOLCOTT, MARK W.  
1900 Columbia Pike, Apt. 413, Arlington, Va. 22204  
WOLFF, WILLIAM I.... 10 Nathan D. Perlman PL, New York, N. Y. 10002  
WOODS, FRANCIS M.135 Francis St., Boston, Mass. 02115  
YEH, THOMAS J..... Memorial Hospital of Chathan County,  
Savannah, Ga. 31401  
YOUNG, W. GLENN, JR.... Box 3396, Duke University Medical Center,  
Durham, N. C. 27706  
YOUNG, WILLIAM P.1300 University Ave., Madison, Wis. 53706

#### **Associate Members**

ADAMS, JESSE E, JR.. 1000 E. 3rd St., Chattanooga, Tenn. 37403  
ADELMAN, ARTHUR.. 601 E. 63rd St., Suite 503, Kansas City, Mo. 64110  
ALLEN, PETER... 2966 West 45th Ave., Vancouver, B. C., Canada  
ALMOND, CARL H.... University of Missouri Medical Center,

Columbia, Mo. 65201  
BAISCH, BRUCE F.... 644 E. Regent St., Inglewood, Calif. 90301  
BARKER, WALTER L.1919 West Taylor St., Chicago, Ill. 60612  
BENFIBLD, JOHN R.1000 W. Carson St., Torrance, Calif. 90509  
BERGER, ROBERT L..... 736 Cambridge St, Boston, Mass. 02135  
BLAIR, EMIL..... University of Vermont College of Medicine,  
Burlington, Vt. 05401  
BOUSQUET, ERNEST O... 5689 Boulevard Rosemont, Montreal,  
Quebec, Canada  
BRYANT, J. RAY..... 1169 Eastern Parkway, Louisville, Ky. 40217  
BURBANK, BENJAMIN... 244 Henry St., Brooklyn, N. Y. 11201  
BURKE, JOHN F.... Massachusetts General Hospital, Boston, Mass. 02114  
CAHAN, WILLIAM G.444 East 68th St, New York, N. Y. 10021  
CAMPBELL, DANIEL C., JR., COL., USAF, MC.. USAF Hospital,  
Scott Air Force Base, Ill. 62225  
CHANDLER, JOHN H..... 616 West Forest Ave., Jackson, Tenn. 38301  
CHODOFP, RICHARD J... 255 South 17th St., Philadelphia, Pa 19103  
CINCOTTI, JOHN J..... Veterans Administration Hospital,  
Sepulveda, Calif. 91340  
CONNAR, RICHARD G.One Davis Blvd., Tampa, Fla. 33606  
CONRAD, PETER W..... 2304 Westmoreland St., Falls Church, Va. 22046  
COOKE, FRANCIS N.25 S. E. Second Ave, Miami, Fla. 33131  
COX, WILLIAM V.... 133 Court St., Auburn, Me. 04210  
CRACOVANER, ARTHUR J.... 103 East 78th St., New York, N. Y. 10021  
CRASTNOPOL, PHILIP8 N. Circle Dr., Great Neck, L. I, N. Y. 11020  
CRECCA, ANTHONY D.376 Roseville Ave., Newark, N. J. 07107  
CRUTCHER, RICHARD R.2101 Nicholasville Rd., Lexington, Ky. 40503  
DAFOE, COLIN S..... 508 Medical Arts Bldg., Edmonton, Alberta, Canada  
DANIELSON, GORDON K., JR..... Mayo Clinic, Rochester, Minn. 55901  
DE BORD, ROBERT A.... 414 St. Mark Court, Peoria, Ill. 61603  
DECKER, ALFRED M, JR.8 Church St, Saranac Lake, N. Y. 12983  
DEMATTEIS, ALBERT..... 2612 Pleasant Valley Blvd., Altoona, Pa. 16601  
DEMOS, NICHOLAS J.107 Kensington Ave., Jersey City, N. J. 07304  
DEMUTH, WILLIAM E, JR..... 17 S. West St., Carlisle, Pa. 17013  
DEWEESE, JAMES A..... 260 Crittenden Blvd., Rochester, N. Y. 14620  
DILLON, MARCUS L., JR..... 1005 Minerva Ave., Durham, N. C. 27701  
DODDS, G. ALFRED..... 807 Broadway, Fargo, N. D. 58102  
DOOLEY, BYRON N..... Wilford Hall, USAF Hospital, Lackland AFB,  
San Antonio, Texas 78216  
DRAPANAS, THEODORE1430 Tulane Ave., New Orleans, La. 70112  
FABER, L. PENFIELD... 1753 W. Congress Parkway, Chicago, Ill. 60612  
FELTON, WARREN L, II..... 1211 North Shartel, Oklahoma City, Okla. 73103  
FINNERTY, JAMES..... Brookhaven Medical Arts Bldg, Patchogue, N. Y. 11772  
FONKALSRUD, ERIC W.... UCLA Medical Center, Los Angeles, Calif. 90024  
FRATER, ROBERT W. M.24 Prescott Ave., Bronxville, N. Y. 10708  
FRIEDLANDER, RALPH..... Grand Concourse and Mt. Eden Parkway,  
Bronx, N. Y. 10457  
FRIESEN, STANLEY R..... University of Kansas Medical Center,  
Kansas City, Kans. 66103  
FULLER, JOSIAH205 West 2nd St., Duluth, Minn. 55802  
GARRETT, H. EDWARD..... 910 Madison Ave., Memphis, Tenn. 38103  
GARZON, ANTONIO A.450 Clarkson Ave., Brooklyn, N. Y. 11203  
GENTSCH, THOMAS O.1550 N.W. 10th Ave, Miami, Fla. 33136  
GERARD, FRANKLYN P..... 377 Roseville Ave., Newark, N. J. 07107  
GERBASI, FRANCIS S..... 81 Lochmoor Blvd., Grosse Pointe Shores,  
Mich. 48236



GLASS, BERTRAM A.3600 Prytania St., New Orleans, La. 70115  
GOBBELL, WALTER G, JR..... Veterans Administration Hospital,  
Nashville, Tenn. 37203  
GONZALEZ, LUIS L.Eden and Bethesda, Cincinnati, Ohio 45219  
GRONDIN, PIERRE.... 5000 E. Belanger, Montreal 36, Quebec, Canada  
HATCHER, CHARLES R, JR.Emory University Clinic, Atlanta, Ga. 30322  
HAUSMANN, PAUL F..... 2309 West State St., Milwaukee, Wis. 53233  
HEAD, LOUIS R..... 55 East Washington St., Chicago, Ill. 60602  
HENLEY, WALTER S... 806 Hermann Professional Bldg.,  
Houston, Texas 77025  
HERINO, ALEXANDER C., CAPT., MC, USN..... U. S. Naval Hospital, Box 36,  
FPO New York, N. Y. 09593  
HERTZLER, JACK H..... 25301 Franklin Park Drive, Franklin  
Village, Mich. 48025  
HIROSE, TERUO..... 5830 Tyndall Ave., Bronx, N. Y. 10471  
HOWARD, HECTOR S, JR..... 910 Madison Ave., Memphis, Tenn. 38103  
HUMPHREY, EDWARD W..... Veterans Administration Hospital,  
Minneapolis, Minn. 55417  
HUNTER, JAMES A.... 1725 W. Harrison St, Chicago, Ill. 60612  
HURLEY, EDWARD J..... University of California, Davis, Calif. 95616  
INGRAM, IVAN N... 655 Sutler St., Suite 603, San Francisco, Calif. 94102  
IOVINE, VINCENT M.2520 L St., N.W., Washington, D. C. 20037  
JARETZKI, ALFRED, III.. 80 Fort Washington Ave, New York, N. Y. 10032  
JENSEN, NATHAN K.1629 Medical Arts Bldg, Minneapolis, Minn. 55402  
JOHNSON, CLIVE R.811 Fifth Ave., Fort Worth, Texas 76104  
JUDD, ARCHIBALD R.304 N. Fourth St., Hamburg, Pa. 19526  
KAHN, DONALD R..... University Hospital, Ann Arbor, Mich. 48104  
KAUNITZ, VICTOR H... 3878 Delaware Ave, Tonawanda, N. Y. 14223  
KERTH, WILLIAM J.... Pacific Medical Center, San Francisco, Calif. 94115  
KESHISHIAN, JOHN M... 2520 L St., N.W., Washington, D. C. 20037  
KILLEN, DUNCAN A..... Veterans Administration Hospital,  
Nashville, Tenn. 37203  
KINO, ROBERT D..... 1100 West Michigan St., Indianapolis, Ind. 46207  
KOVARIK, JOSEPH L.... 1633 Fillmore St, Denver, Colo. 80206  
KRAEFT, NELSON H.. 1433 Miccosukee Rd., Tallahassee, Fla. 32303  
KUNDERMAN, PHILIP J..... 185 Livingston Ave, New Brunswick, N. J. 08902  
KUNSTLER, WALTER E.1538 Sherbrooke St., West, Montreal 25,  
Quebec, Canada  
LASLEY, CHARLES H.1200 South Druid Rd., Clearwater, Fla. 33516  
LEFEMINE, ARMAND A.. 85 Jefferson St, Hartford, Conn. 06103  
LEIBOVITZ, MARTIN..... 451 Utica Square Medical Center,  
Tulsa, Okla. 74114  
LEPAGE, GILLES..... 445 Lockhart Ave, Montreal 16, Quebec, Canada  
LEVOWITZ, BERNARD S.555 Prospect Place, Brooklyn, N. Y. 11238  
LEWIS, J. EUGENE, JR.. 634 North Grand Blvd., St. Louis, Mo 63103  
LEWIS, RUBIN M.. 2435 Webster St., Berkeley, Calif. 94705  
LINBERG, EUGENE J..... University of Maryland Hospital,  
Baltimore, Md. 21201  
LINDESMITH, GEORGE G... 1136 W. 6th St., Los Angeles, Calif. 90017  
LOGAN, WILLIAM D., JR.Emory University Clinic, Atlanta, Ga. 30322  
LONG, DAVID M, JR..... 1825 W. Harrison St., Chicago, Ill. 60612  
LOWER, RICHARD R.1200 East Broad St., Richmond, Va. 23219  
LUCROO, JOSEPH L..... 634 North Grand Blvd., St. Louis, Mo. 63103  
LUI, ALFRED H. F.Wayne County General Hospital, Eloise, Mich. 48132  
MACKENZIE, JAMES W..... University of Missouri Medical Center,  
Columbia, Mo. 65202

MAHAFFEY, DANIEL E..... 366 Medical Towers South, Louisville, Ky. 40202  
MAIN, F. BEACHLEY..... Cincinnati General Hospital, Cincinnati, Ohio 45229  
MALETTE, WILLIAM G..... University of Kentucky Medical Center,  
Lexington, Ky. 40506  
MANDELBAUM, ISIDORE..... 1100 West Michigan, Indianapolis, Ind. 46207  
MANGIARDI, JOSEPH L..... 520 Franklin Ave., Garden City, N. Y. 11530  
MARABLE, SAMUEL A.. 410 West Tenth Ave, Columbus, Ohio 43210  
MAY, IVAN A.3115 Webster St., Oakland, Calif. 94609  
McORD, COLIN W... 421 W. 113th St., New York, N. Y. 10025  
McKOWN, JOHN J., JR.1031 Cedar Grove Road, Wynnewood, Pa. 19096  
McAUGHLIN, JOSEPH S..... 22 South Green St, Baltimore, Md. 21201  
MENDELSSOHN, EDWIN351 West Tabor Rd., Philadelphia, Pa. 19141  
MILLER, ARTHUR C..... Veterans Administration Hospital,  
Roseburg, Ore. 97470  
MILLER, CARROLL C.304 Humphrey St, Swampscott, Mass. 01901  
MILLER, DONALD B.Mary Fletcher Hospital, Burlington, Vt. 05401  
MITCHEL, BEN F., JR.3434 Swiss Ave., Suite 404, Dallas, Texas 75204  
NEELY, WILLIAM A.. 2500 N State St., Jackson, Miss. 39216  
NEERKEN, ADRIAN J..... 404 Bronson Medical Center,  
Kalamazoo, Mich. 49004  
NETTERVILLE, RUSH E..... 514 E. Woodrow Wilson Drive,  
Jackson, Miss. 39216  
NEWMAN, ROBERT W..... Medical Arts Bldg., Knoxville, Tenn. 37902  
OCHSNER, ALTON, JR.1516 Jefferson Highway, New Orleans, La. 70121  
OKINAKA, ARTHUR J.... 525 East 68th St., New York, N. Y. 10021  
O'NEILL, JAMES F.1425 Woodland Rd., Rydal, Pa. 19046  
OVERSTREET, JOHN WM.... 508 Hermann Professional Bldg.,  
Houston, Texas 77025  
PATON, BRUCE C.4200 East Ninth Ave., Denver, Colo. 80220  
PAUL, JOHN S.... Baker Veterans Administration Center  
Martinsburg, W. Va. 25401  
PEARCE, CHARLES W.1430 Tulane Ave, New Orleans, La. 70112  
PEARSON, FREDERICK G.170 St. George St., Suite 904,  
Toronto 5, Ontario, Canada  
PEMBERTON, ALBERT H.. 2040 West Wisconsin Ave,  
Milwaukee, Wis. 53203  
PENIDO, JOHN R. F.111 Congress St., Pasadena, Calif. 91105  
PERRY, JOHN F., JR..... #2 Red Fox Rd., North Oaks,  
St. Paul, Minn. 55110  
PIERUCCI, Louis, JR... 1025 Walnut St, Philadelphia, Pa. 19107  
PINKHAM, ROLAND D.1120 Cherry St., Seattle, Wash. 98104  
PRATT, LAWRENCE A..... USAID/PH/E, APO San Francisco, Calif. 96243  
RANDOLPH, JUDSON G.. 2125 13th Street, Washington, D. C. 20009  
READ, RAYMOND C..... Veterans Administration Hospital,  
Little Rock, Ark 72114  
REED, GEORGE E.. 550 First Ave., New York, N. Y. 10016  
ROBBINS, S. GWIN... 20 South Dudley St., Memphis, Tenn. 38103  
ROBICSEK, FRANCIS.... 1850 East Third St., Charlotte, N. C. 28204  
ROBINSON, JOSEPH L.... P. O. Box 1, Wailuku, Maui, Hawaii 96793  
ROPER, CHARLES L... Barnes Hospital Plaza, St. Louis, Mo. 63110  
ROSENKRANTZ, JENS G.4200 East 9th Ave., Denver, Colo. 80220  
ROSENWEIG, JACOB3755 Cote St. Catherine Road, Montreal 26,  
Quebec, Canada  
ROSS, RALEIGH R.2 Medical Arts Square, Austin, Texas 78705  
ROSSI, NICHOLAS P..... University Hospitals, Iowa City, Iowa 52246  
RUSSELL, PAUL S.Massachusetts General Hospital, Boston, Mass. 02114

RYAN, BERNARD J.. 375 East Main St, Bay Shore, N. Y. 11706  
 RYAN, THOMAS C.... 90 Shenango St., Greenville, Pa. 16125  
 SANES, GILMORE M.301 Buckingham Rd., Pittsburgh, Pa. 15215  
 SAUTTER, RICHARD D.Marshfield Clinic, Marshfield, Wis. 54449  
 SCOTT, HENRY J.... 3350 Cote des Neiges, Suite 540, Montreal 25,  
 Quebec, Canada  
 SELMAN, MORRIS W.2302 Meadowwood Drive, Toledo, Ohio 43602  
 SHERMAN, PAUL H..... 702 Jamestown Rd., Winter Park, Fla. 32789  
 SIDERYS, HARRY... 1815 N. Capitol Ave., Indianapolis, Ind. 46202  
 SILVER, ARTHUR W.612 W. Duarte Rd., Suite 603,  
 Arcadia, Calif. 91006  
 SMELOFF, EDWARD A.5301 F Street, Sacramento, Calif. 95819  
 SNYDER, HOWARD E..... 103/2 E. Ninth Ave., Winfield, Kans. 67156  
 SOROFF, HARRY S..... 171 Harrison Ave., Boston, Mass. 02111  
 STANSEL, HORACE C, JR..... 333 Cedar St., New Haven, Conn. 06510  
 STAYMAN, JOSEPH W.. 8815 Germantown Ave., Philadelphia, Pa. 19118  
 STEMMER, EDWARD A..... Veterans Administration Hospital,  
 Long Beach, Calif. 90801  
 STENSTROM, JOHN D.220-1105 Pandora Ave., Victoria,  
 British Columbia, Canada  
 SULLIVAN, HERBERT J..... Medical Arts Bldg, Hamilton, Ontario, Canada  
 SWENSON, ORVARChildren's Memorial Hospital, Chicago, Ill. 60614  
 TEST, FREDERICK C., II..... Veterans Administration Hospital,  
 Allen Park, Mich. 48101  
 THOMAS, PAUL A, JR..... Valley Forge General Hospital,  
 Phoenixville, Pa. 19460  
 THROWER, WENDELL B.171 Harrison Ave, Boston, Mass. 02111  
 TIES, DAVID A..... 550 First Ave., New York, N. Y. 10016  
 TILLOU, DONALD J.... 311 West Church St., Elmira, N. Y. 14901  
 TIMMIS, HILARY H... 2500 N. State St, Jackson, Miss. 39216  
 TRICERRI, FERNANDO E.P. O. Box 110, Geneva 12, Switzerland  
 TRIMBLE, ALAN S..... Toronto General Hospital, Toronto 2, Ontario, Canada  
 TRUMMER, MAX J..... U S. Naval Hospital, San Diego, Calif. 92134  
 VAN FLEIT, WILLIAM E.. 401 Jefferson Medical Arts Bldg.,  
 South Bend, Ind. 46617  
 WALDHAUSEN, JOHN A..... 3400 Spruce St., Philadelphia, Pa. 19104  
 WALKER, GEORGE R.... 289 Cedar St., P. O. Box 970, Sudbury,  
 Ontario, Canada  
 WALLACE, ROBERT B.... 200 1st St., S.W., Rochester, Minn. 55901  
 WATKINS, DAVID H..... 6039 North Waterbury Rd., Des Moines, Iowa 50312  
 WELDON, CLARENCE S..... 4960 Audubon Ave., St. Louis, Mo. 63110  
 WILCOX, BENSON R..... University of North Carolina, School of Medicine,  
 Chapel Hill, N. C. 27514  
 WILSON, HUGH E., III.. 6011 Harry Hines Blvd., Dallas, Texas 75235  
 ZUHDI, M. NAZIH430 N. W. 12th St, Oklahoma City, Okla. 73103

### **Senior Members**

ADA, ALEXANDER E. W.. 139 East 94th St, New York, N. Y. 10025  
 ADAMS, HERBERT D.. 605 Commonwealth Ave, Boston, Mass. 02215  
 ADAMS, WILLIAM E.... 55 East Erie St, Chicago, Ill. 60611  
 AMBERSON, J. B.... 16 Sherwood Drive, Hillsdale, N. J. 07642  
 AUERBACH, OSCARVeterans Administration Hospital,  
 East Orange, N. J. 07019  
 AUFSES, ARTHUR H... 301 E. 66th St, New York, N. Y. 10021  
 BADGER, THEODORE L..... 264 Beacon St, Boston, Mass. 02116  
 BARKLEY, HOWARD T.4414 Montrose Blvd., Houston, Texas 77006  
 BECK, CLAUDE S... 2065 Adelbert Rd, Cleveland, Ohio 44106

BEECHER, HENRY K.... Massachusetts General Hospital, Boston, Mass 02114  
BENEDICT, EDWARD B.... Massachusetts General Hospital,  
Boston, Mass. 02114  
BENSON, CLIFFORD D..... 1515 David Whitney Bldg, Detroit, Mich. 48226  
BERRY, FRANK B.... 169 East 69th St, New York, N. Y. 10021  
BETTS, REEVE H.... Room 1536, 475 Riverside Dr, New York, N. Y. 10027  
BISGARD, J. DEWEY..... 422 Doctors Bldg., Omaha, Neb. 68131  
BLADES, BRIAN..... 2150 Pennsylvania Ave, N.W., Washington, D. C. 20037  
BLOCK, ROBERT G..... Montefiore Hospital, New York, N. Y. 10067  
BORTONE, FRANK..... 2765 Hudson Blvd, Jersey City, N. J. 07306  
BRADS HAW, HOWARD H..... Bowman Gray School of Medicine,  
Winston-Salem, N. C. 27103  
BRANTIGAN, OTTO C..... 104 West Madison St., Baltimore, Md. 21201  
BREWER, LYMAN A, III658 S. Bonnie Brae St., Los Angeles, Calif. 90057  
BROWNRIGG, GARRETT M.. 47 Queens Rd., St Johns, Newfoundland  
BUCKINGHAM, WILLIAM W... 3560 Broadway, Apt 305,  
Kansas City, Mo. 64111  
BURFORD, THOMAS H... Barnes Hospital Plaza, St. Louis, Mo. 63110  
BURNETT, W. EMORY..... 47 E. Righters Mill Rd, Narberth, Pa. 19072  
CARLSON, HERBERT A... 21 Seventh Place, Long Beach, Calif. 90802  
CARLSON, ROBERT I.... 6514 N. Central Ave, Phoenix, Ariz. 85012  
CARR, DUANE20 S. Dudley St, Memphis, Tenn. 38103  
CARTER, B. NOLAND..... Madeira, Cincinnati, Ohio 45243  
CHURCHILL, EDWARD D.269 Prospect St., Belmont, Mass. 02178  
CLAGETT, O. THERON... Mayo Clinic, Rochester, Minn. 55902  
CLERF, LOUIS H.5575 8th Avenue, North, St Petersburg, Fla. 33702  
COLE, DEAN B..... Professional Bldg., Richmond, Va. 23219  
COLEMAN, FRANK P.... 1111 W. Franklin St, Richmond, Va. 23220  
CONDON, WILLIAM B.1850 Gilpin St, Denver, Colo. 80218  
COOPER, DAVID A.. 1328 Medford Rd., Wynnewood, Pa. 19096  
COURNAND, ANDRE..... 27th Street and First Aye, New York, N. Y. 10016  
CRIMM, PAUL D..... Boehne Hospital, Evansville, Ind. 47712  
DAILEY, JAMES E..... St Joseph Hospital, Houston, Texas 77002  
DANIELS, ALBERT C.... Box 6535, Carmel, Calif. 93921  
DAVIDSON, LOUIS R..... 1025 Fifth Ave., New York, N. Y. 10028  
DAVIS, EDGAR W... 4209 50th St, N. W, Washington, D. G. 20016  
DAY, J. CLAUDE..... 3790 Woodward Ave, Detroit, Mich. 48201  
DODRILL, FOREST DEWEY..... 641 David Whitney Bldg, Detroit, Mich. 48226  
DORSEY, JOHN M..... 2650 Ridge Ave, Evanston, Ill. 60201  
DOUGLASS, RICHMOND... 32 Vassar View Rd., Pougkeepsie, N. Y. 12603  
DOVELL, CHAUNCEY E.62 South Boxwood St., Hampton, Va. 23360  
DRASH, EVERETT C..... University of Virginia Hospital,  
Charlottesville, Va. 22901  
ELOESSER, LEO.... APTO Post 39, Tacambaro, Michoacan, Mexico  
FAULKNER, WILLIAM B., JR..... 20 San Rafael Way,  
San Francisco, Calif. 94127  
FELL, EGBERT H.... Haile Selassie I University, Public Health College,  
Gondar, Ethiopia  
FLICK, JOHN B.... 819 Black Rock Rd., Gladwyne, Pa. 19035  
FREEDLANDER, SAMUEL O..... 13710 Shaker Blvd, Cleveland, Ohio 44120  
GALE, JOSEPH W..... 1300 University Ave., Madison, Wis. 53706  
GEARY, PAUL... 1117 Waterway Lane, Delray Beach, Fla. 33444  
GERBODE, FRANK.... Pacific Medical Center, San Francisco, Calif. 94115  
GIBBON, JOHN H, JR.2103 North Providence Rd., Media, Pa. 19063  
GLENN, FRANK525 East 68th St., New York, N. Y. 10021  
GOLDMAN, ALFRED

9201 Sunset Blvd., Suite 906, Los Angeles, Calif. 90069  
 GORDON, JOSEPH..... 717 Encino Plaza, N.E., Albuquerque, N. M. 87101  
 GROSS, ROBERT E.300 Longwood Ave., Boston, Mass. 02115  
 GROW, JOHN B.2045 Franklin St., Room 910, Denver, Colo. 80205  
 HAIGHT, CAMERON..... University Hospital, Ann Arbor, Mich. 48104  
 HARPER, FREDERICK R..... 1825 Gilpin St, Denver, Colo. 80218  
 HARRINGTON, STUART W..... Mayo Clinic, Rochester, Minn. 55902  
 HARRISON, ELLIOTT..... 1260 West 38th St, Vancouver 13, B. C, Canada  
 HARRISON, HARLON W.5115 Judson Way, San Diego, Calif 92115  
 HART, DERYL. Duke University Medical Center, Durham, N. C. 27706  
 HARTER, JOHN S..... 1169 Eastern Parkway, Louisville, Ky. 40217  
 HAYES, JOHN N..... 24 Church St., Saranac Lake, N. Y. 12983  
 HEAD, JEROME R..... 55 East Washington St., Chicago, Ill. 60602  
 HELMSWORTH, JAMES A..... Cincinnati General Hospital  
 Cincinnati, Ohio 45229  
 HOLINGER, PAUL H..... 700 North Michigan Ave., Chicago, Ill. 60611  
 HOLMAN, CRANSTON W..... 862 Fifth Ave., New York, N. Y. 10021  
 HOLMAN, EMILE..... Pacific Medical Center, San Francisco, Calif. 94115  
 HUDSON, THEODORE R..... 251 E. Chicago Ave., Chicago, Ill. 60611  
 HUDSON, W. A..... Hudsonakers, Jasper, Ark. 72641  
 HUGHES, FELIX A., JR... Kennedy Hospital, Memphis, Tenn. 38115  
 HUMPHREYS, GEORGE H, II180 Fort Washington Ave,  
 New York, N. Y. 10032  
 JARVIS, FRED J..... 819 Boylston Ave., Seattle, Wash. 98104  
 JOHNS, FRANK S.Johnston-Willis Hospital, Richmond, Va. 23221  
 JOHNSON, HOLLIS E.... 2122 West End Avenue, Nashville, Tenn. 37205  
 JOHNSON, JULIAN..... 3400 Spruce St., Philadelphia, Pa. 19104  
 JONES, JOHN C.1136 W. Sixth St., Los Angeles, Calif. 90017  
 KEELEY, JOHN L..... P. O. Box 1336, Hines, Ill. 60141  
 KELLEY, WINFIELD O..... Uncas-on-Thames, Norwich, Conn. 06361  
 KENT, EDWARD M..... 3500 Fifth Ave., Pittsburgh, Pa 15213  
 KEROIN, FREDERICK G..... 2075 Bayview Ave., Toronto 12, Ontario, Canada  
 KESSLER, CHARLES R..... 5 Medical Arts Bldg., Birmingham, Ala. 35205  
 KINSELLA, THOMAS J.3644 Colfax Ave. South, Minneapolis, Minn. 55409  
 KLOPSTOCK, ROBERTVeterans Administration Hospital,  
 Brooklyn, N.Y. 11209  
 KNOEPP, LOUIS F..... Veterans Administration Hospital,  
 Alexandria, La. 71301  
 LAIRD, ROBERT..... P. O. Box 30, Toronto Dominion Center,  
 Toronto, Ontario, Canada  
 LAM, CONRAD R..... Henry Ford Hospital, Detroit, Mich. 48202  
 LEAHY, LEON J..... 176 Bryant St., Buffalo, N. Y. 14222  
 LESTER, CHARLES W.320 East 72nd St, New York, N. Y. 10021  
 LEVEN, N. LOGAN..... 1464 Lowry Medical Arts Bldg., St. Paul, Minn. 55102  
 LEWIS, F. JOHN..... Department of Surgery, Northwestern University  
 Medical School, Chicago, Ill. 60611  
 LINDSKOG, GUSTAF E.... 333 Cedar St, New Haven, Conn. 06510  
 LOCKWOOD, A. L.300 Bloor St., E, Toronto, Ontario, Canada  
 LONGMIRE, WILLIAM P., JR.... UCLA Medical Center,  
 Los Angeles, Calif. 90024  
 MAIER, HERBERT C..... 3 East 71st St, New York, N. Y. 10021  
 MAUTZ, F. R.... 13241 Ravenna Rd., Chardpn, Ohio 44024  
 McDONALD, JOHN R.... Harper Hospital, Detroit, Mich. 48201  
 McINTOSH, CLARENCE A.... 900 Sherbrooke St., West, Montreal,  
 Quebec, Canada  
 MEADE, RICHARD H.750 San Jose Drive, S.E.,

Grand Rapids, Mich. 49506  
MELTZER, HERBERT. 14127-98th Ave., Edmonton, Alberta, Canada  
MEYER, HERBERT WILLY.. Box 507, Rancho Santa Fe, Calif. 92067  
MISCALL, LAURENCE.... 11 East 68th St., New York, N. Y. 10021  
MOERSCH, HERMAN.... 1064 Plummer Lane, Rochester, Minn. 55901  
MOORE, RICHMOND L.. 3320 Woodridge Place, Lynchburg, Va. 24503  
MULVIHILL, DANIEL A..... 55 East Erie St., Chicago, Ill. 60611  
MYERS, J. ARTHUR..... 1316 Mayo Memorial Bldg.,  
Minneapolis, Minn. 55455  
NIXON, JAMES W..... 1121 Nix Professional Bldg.,  
San Antonio, Texas 78205  
OATWAY, WILLIAM H., JR..... La Vina Sanatorium, Altadena, Calif. 91001  
OCHSNER, ALTON..... 1516 Jefferson Highway, New Orleans, La. 70121  
OLSEN, ARTHUR M..... Mayo Clinic, Rochester, Minn. 55902  
O'RouKE, PAUL V..... 1151 Taylor Ave., Detroit, Mich. 48202  
OVERHOLT, RICHARD H.135 Francis St., Boston, Mass. 02215  
PAINE, JOHN R..... 100 High St., Buffalo, N. Y. 14203  
PHILLIPS, FRANCIS J. 2023 Leussac Drive, Anchorage, Alaska 99503  
PICKHARDT, OTTO C.. 66 East 79th St., New York, N. Y. 10021  
POOL, JOHN L..... 755 Park Ave., New York, N. Y. 10021  
PROCTOR, OSCAR S..... 1101 Garraty Road, San Antonio, Texas 78209  
RIENHOFF, WILLIAM F., JR..... 1201 North Calvert St., Baltimore, Md. 21202  
RIGGINS, H. McLEOD.... 1031 Fifth Ave., New York, N. Y. 10028  
RIGLER, LEO G..... Los Angeles Center for Health Sciences,  
Los Angeles, Calif. 90024  
RIPSTEIN, CHARLES B.... 15 Birch St., Great Neck, L. I., N. Y. 11020  
ROBERTSON, ROSS..... 410-750 West Broadway, Vancouver 9, B. C. Canada  
ROGERS, W. L... 490 Post St, San Francisco, Calif. 94102  
RUMEL, WILLIAM R.535 E 1st South St., Salt Lake City, Utah 84102  
SAMSON, PAUL C.15 LaSalle Ave, Piedmont, Calif. 94611  
SCHAFFNER, VERNON D..... 12 Cornwallis St., Kentville,  
Nova Scotia, Canada  
SHAW, ROBERT R..... 5323 Harry Hines Blvd., Dallas, Texas 75235  
SIMEONE, FIORINDO A..... 3395 Scranton Rd., Cleveland, Ohio 44109  
SKINNER, GEORGE F..... 36 Coburg St., St. John, New Brunswick, Canada  
SMITH, DAVID T..... Duke University Medical Center, Durham, N. C. 27706  
SOMMER, GEORGE N. J., JR... 120 W. State St, Trenton, N. J. 08608  
STEELE, J. D..... Veterans Administration Hospital,  
San Fernando, Calif. 91342  
STEPHENS, H. BRODIE..... 1105 Greenwich St, San Francisco, Calif. 94109  
STOREY, CLIFFORD F.550 Washington St, San Diego, Calif. 92103  
STRIEDER, JOHN W..... 2000 Washington St., Newton Lower  
Falls, Mass. 02162  
STRODE, JOSEPH E.888 So King St, Honolulu, Hawaii 96813  
STRUG, LAWRENCE H... 2435 Octavia St, New Orleans La. 70115  
THOMPSON, SAMUEL A.. 850 Park Ave., New York, N. Y. 10021  
THORBURN, GRANT. Box 387, Waynesboro, Pa 17268  
TOUROFF, ARTHUR S. W.47 East 67th St., New York, N. Y. 10021  
TYSON, M. DAWSONHitchcock Clinic, Hanover, N. H. 03755  
VAN ALLEN, CHESTER M..... State Hospital, Bikaner, Rajputana, India  
VINEBERO, ARTHUR M..... Suite 22, 1390 Sherbrooke St., W.,  
Montreal, Quebec., Canada  
VORWALD, ARTHUR J..... College of Medicine, Wayne State University,  
Detroit, Mich. 48207  
WANOKNSTEEN, OWEN H..... University of Minnesota Medical Center,  
Minneapolis, Minn. 55414

WATERMAN, DAVID H..... 1918 W. Clinch Ave., Knoxville, Tenn. 37916  
 WATSON, WILLIAM L.. 340 East 72nd St., New York, N. Y. 10021  
 WEINBERO, JOSEPH A..... 111 Marquez Place, Pacific Palisades, Calif. 90272  
 WILLAUER, GEORGE..... 6129 Greene St, Philadelphia, Pa. 19144  
 WILLIAMS, MARK H..... 63 Front St., Binghamton, N. Y. 13905  
 WILSON, JULIUS L.924 Canyon Rd, Santa Fe, N. Mex. 87501  
 WIPER, THOMAS B.... 60 Atwood Ave., Sausalito, Calif. 94965  
 WRIGHT, GEORGE W.11311 Shaker Blvd., Cleveland, Ohio 44104  
 WYLIE, ROBERT H..... 180 Fort Washington Ave., New York, N. Y. 10032

**Members Deceased**

FRANCIS X. BYRON EDWARD N. PACKARD  
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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  
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1930-Philadelphia..... President, Wyman Whittemore  
1931-San Francisco. President, Ethan Flagg Butler  
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1933-Washington President, George P. Muller  
1934-Boston President, George J. Heuer  
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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.. Presides, 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  
1963-Houston. President, Julian Johnson  
1964-Montreal President, Robert E. Gross  
1965-New Orleans President, John C. Jones  
1966-Vancouver, B. C. President, Herbert C. Maier  
1967-New York..... President, Frederick G. Kergin  
1968-Pittsburgh President, Paul C. Samson