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Staff Meeting Report

Energy and the Evolution of Culture*

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Energy is presumably as old as the universe, but culture is, relatively speaking, a recent phenomenon. As an anthropologist, I am not competent to speak to the question of the nature of energy and its ultimate sources. For our purposes I shall merely accept energy as the capacity for doing work. I shall then proceed to consider in broad outline the history of man's increasing control over energy and the secondary consequences of his success in this energy control upon human culture at large.

Culture in anthropological terms is the sum total of learned behavior patterns that are characteristic of the members of a society and are therefore not the result of biological inheritance. We also recognize cultural patterns of behavior as those that are shared among all or some members of a society. Idiosyncratic behavior of single individuals, although learned, is not considered to be cultural.

Observation and experimental animal psychology have established the existence of protocultural producing capacities for many lower animal forms. Man alone, however, has reached a state of nervous development and potential behavioral adaptability sufficient to enable him to rely predominantly upon cultural rather than instinctual behavior.

We need not dispute the humor of Anatole France in his dictum that that which distinguishes man from the animals is lying and literature. Nor do we feel impelled to contradict the epicure, Jean-Louis, who eloquently declaimed, "After all, in what consists the difference between man and beast except in the possibilities of the former to learn the art of dining, while the latter is doomed forever to feed?" Dining and literature, indeed even lying, which is dependent upon speech, are after all nothing but aspects of culture. The difference between man and animal in these, as in so many other respects, is only a difference in degree, but a difference in degree so great that we are inclined to look upon it as difference in kind.

*This report was given at the Staff Meeting of the University of Minnesota Hospitals on November 1, 1957.

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The creation of culture is but a result of man's response to certain problems posed to him and all other organisms alike: the drives to self-maintenance and reproduction that must find expression under given conditions of natural environment and the limitations and capabilities inherent in the human organism and in group existence. Culture consists of a series of set or traditional solutions to problems of individual and group survival and self-maintenance that operate either directly or indirectly toward the achievement of these basic goals. But in the case of man, culture also creates many additional interests, and man is moved to act by acquired drives that are the product of cultural experience itself. Thus a great contemporary anthropologist, Ralph Linton, has been led to observe, not wholly facetiously, "It seems probable that the human capacity for being bored, rather than man's social or natural needs, lies at the root of man's cultural advance."

"Idle hands breed mischief," according to old adage, but the unbearability of an idle mind, when great minds have been sharpened and well exercised, also breeds culture. In more recent times the problem of the cultural consequences of energy control has taken on pressing significance because physical scientists are mentally restless: Rather than suffer boredom they would smash atoms and reach for the moon.

We are told that the course of cosmic evolution as expressed in the principles of thermodynamics is one of inexorable and progressive disorganization of matter with concomitantly wider diffusion of energy. The universe is running down. But here on this petty planet is occurring a form of evolution that for a billion and a half years has been moving in the opposite direction. Organic evolution has pressed steadily in the direction of ever increasing complexity of organization and concentrations of energy. All life is basically a struggle to capture free energy and to convert it to the ends of the organism in the maintenance of the vital process and, in the case of man, its derived extensions. Culture in large measure consists of man's inventive devices for capturing and converting free energy to his uses.

Let us now turn to historical anthropology for an over-view of what has happened in the course of the ages. The human story begins in the latter phases of the Pliocene geological period, somewhere around 1,300,000 years ago. Convincing archeological evidence of exceedingly crude Eolithic, or Dawn Stone Age, cultures has been found in pre-glacial deposits of the Late Pliocene period in eastern Britain. With the advent of the First Glaciation, opening the Pleistocene, or Glacial, period a million years ago, man was definitely established in England, China, East Africa, as evidenced by the fossil remains found in these parts. Numerous artifactual complexes representing Eolithic and Paleolithic cultures enduring throughout the four glaciations and their three interglacial epochs have been extracted from the soils and caves of Europe, Africa, and Asia. The Old Stone Age and the Ice Age are approximately coeval and lasted from 1,000,000 B.C. to roughly 10,000 B.C.

From the beginning to the end of the Paleolithic Age there was a steady, if painstakingly slow, improvement of material culture as revealed in the recovered artifacts that now crowd the great museums of Europe. Techniques of flaking flint were slowly improved through the generations so that hand axes, knives, scrapers and borers were stepped up in efficiency. Men lived at first as simple food-gatherers and later as food-gatherers and hunters. Their work went largely into collecting the free offerings of nature with their bare hands, even as apes do to this day. Their energy input and output was limited to what they as individuals could absorb into their bodies as food and give forth as human work. The tools of Stone Age man did little to increase the amount of energy that he could control to his own ends, but served, rather, to increase the efficiency of his energy expenditure. The digging stick was utilized as a lever the better to prize out roots and to move stones wherewith to get at grubs and plants. The hand ax gave surer and quicker results in gathering firewood and cracking skulls of beasts and fellow men. Such cultural devices increased the likelihood of obtaining sufficient energy-yielding food at the expense of other animals to maintain the life of prehistoric men. However, early prehistoric man had little or no control over energy beyond that which his own body could transmute and give forth.

Now the potential daily average energy of a healthy human adult is estimated as equal to approximately 3,000 pounds lifted one foot in one minute of work, or roughly 1/10 of a horsepower hour. Simple societies of recent savages who at the time of their discovery relied predominantly on food gathering augmented by limited hunting rarely exceeded one or two hundred members. When we include infants and sick and enfeebled adults, the per capita daily energy output is reduced to some 1/20 of a horsepower hour. The *total* daily energy available for use by an entire Stone Age type of society is and was therefore hardly more than a meager 10 horsepower hour at best.

Not much of a material or intellectual culture can be built on that base.

Today we sit here comfortably fed and well clothed in an imposing edifice devoted to the healing arts and sciences, a group of skilled practitioners and scholars who have achieved distinction in our society by working hard. But working hard at what? Not at applying our individual pittances of physical energy to wresting food from nature with bare hands, digging stick, and flint ax. What is the critical thing that has occurred between our times and those of the Old Stone Age to make this possible?

Is it not in large part that each of us in the United States, even according to Milliken's estimate a decade and a half ago, utilizes about 8,000 horsepower of electrical and internal-combustion energy per day? This is exclusive of all human, animal, or other forms of energy expended or used by us. The extra-human energy that we have brought under control has given us the wherewithal so marvelously to expand the rest of our culture.

If we now turn back to intervening culture history, we find that man required 10,000 centuries to work his way up through the Old Stone Age – 40,000 generations of humankind struggling to achieve the levels of cultural attainment of the Cro-Magnon cave dwellers of France as it existed 20,000 years ago! Improvement in technologies occurred at a steady but infinitesimally slow pace. Then quite suddenly a series of magnificent inventions took place. Almost simultaneously (over a few thousand years, that is) men domesticated the wild beast – the dog, the horse, the cow, the pig, the goat, and various fowl – and women (who appear to have been the seed-, berry-, and root-gatherers) domesticated certain wild plants – barley, wheat, rye, flax, and millet. The two new energy sources thus subdued or created for human use marked the formation of the New Stone Age. Man had suddenly achieved a break-through to a new level of energy control to bring about the first great cultural revolution of all time. Domestication of plants vastly increased man's control over solar energy, which is stored in plants through the action of photosynthesis. Domestication of animals made him a direct exploiter of animal energy. The power of the beast was bent to the will of man. The yield in food and other forms of animal energy per unit of human labor was dramatically expanded in the course of a few millennia between 15,000 and 8,000 B.C.

What then happened? The prevailing mode of life in Asia Minor, Asia, and subsequently in Europe changed from that of hunters to that of gardeners and pastoralists. The camp and cave gave way to the village. The tribe expanded from mere hundreds to thousands. Old institutions and customs went down, and new ways had to be worked out. Technology burgeoned everywhere. Boats were invented, as were weaving, pottery, the bow and arrow. Houses and walled cities sprang up. It was not that men were suddenly more intelligent, but that with their vast new energy resources they could maintain populations large enough to permit extensive division of labor and differentiation of function. Some men could be freed entirely from basic production to put their personal energies and efforts into secondary interests.

The Bronze Age saw no basic revolution in culture but merely an extension and improvement of the lines that the Neolithic revolution had made possible. In a few thousand years the great civilizations of the East reared on agriculture and handicrafts had taken their form. City life and the great classical empires emerged, reaching their peaks in most cases by 1,000 B.C. or shortly thereafter. Civilization was founded, and it then rested on a plateau of development for almost 2,000 years. For each level of energy control sets a ceiling on cultural expansion, although considerable variety in details and values may be worked out within the wide latitudes on each level.

The Iron Age, so-called, lasting from about 1500 B.C. to 1500 A.D., involved no fundamental cultural revolution. The efficiency of tools and weapons was stepped up, but only through the substitution of iron for bronze as bronze had earlier been substituted for stone. Man got a higher efficiency from the energy he utilized, but he had mastered no new and significant sources of energy for use.

Thus, although we do distinguish the Neolithic, Bronze, and Iron Ages on the basis of their material cultures, all were but part of a generalized cultural continuum that began with the Neolithic agricultural revolution and lasted until the Modern Era. It was in its way a great period in human history. With control over extra-human sources of energy, man in 10,000 years accomplished at least a thousand times more in culture building than he had in the previous million years. Yet by the year 1,000 A.D. he was not essentially much further along than he had ben in 1,000 B.C.

Came the Renaissance and the new spirit of inquiry. Out of its manifold probings of problems emerged the steam engine, and the Fuel Revolution was launched. We know, of course, that the expansion of Europe rested at first on effective utilization of wind energy rather than fuel. But however many ships may have sailed the seven seas, and however much excitement and cultural ferment may have resulted in consequence, the frontiers of cultural advance would never have been drastically modified by this alone.

The development of means of unlocking the potential heat energy in coal and confining the expansive energy of steam was something else. It produced what economic historians call the Industrial Revolution, or what we have referred to as the Fuel Revolution. This event was initiated only 250 years ago, and its social consequences are too familiar to be recounted here. The old forms of social life have been for the most part completely shattered. State, church, and family, as well as technological institutions, have undergone profound metamorphosis. This change and development have been so massive that we have suffered from chronic cultural indigestion ever since. The new plateau of culture to which we have raised ourselves with the energy powers of coal, oil, and electricity is at an altitude to which we had not yet acclimated ourselves as we approached the midpoint of the twentieth century. Yet, assuming we could one day attain political and social equilibrium there were indications by the 1940's that within a century or so we would have gone well beyond the optimum point of cultural expansion attainable on the level of conventional fuel energy.

But when in the summer of 1943 the first nuclear pile was activated under the concrete benches of Stagg Field in Chicago, a new era of energy control was initiated for mankind. The floodgates were thrown open for the third truly basic cultural revolution in all the history of humanity. In 1945 it was possible to release 33 million horsepower of energy from one kilogram of uranium through atomic fission. And this was done by techniques that converted but 1/10 of one per cent of the uranium mass into energy! A mere beginning.

What is the meaning of this new release of controlled energy? The laws of cultural evolution cannot tell us what the specific details of the future forms of society will be. But they do show that as the Neolithic technologies induced a thorough-going revision of previously existing societies and drove the expansion of culture ahead in a great spurt, as the technological innovations of the industrial revolution forced undreamed-of alterations in the ways of men, so the atomic age will be one in which old modes will become quickly outworn. We are destined to see such cultural changes in the new era that has burst upon us as will make all prior cultural development seem static by comparison.

Rational men will accept the inevitability of change and readjustment. To them it will be the challenge of the ages. They will not yearn for the tranquillity of life that will never be theirs. They will calmly and without panic accept the challenge that will test the much-vaunted plasticity and adjustment capacity of the human organism in an unprecedented way. They will turn all the powers of their intelligence, all their knowledge of society and culture, all their skills of scientific analysis to making the needed cultural changes as quickly and as effectively as possible.

The near future is bound to be unsettled and painful. With atomic wars it may become a nightmare that will make the next centuries of transition another Dark Age. But in the long view of culture history, which links history to prehistory, if the record of the past holds any meaning for the future it is this: Civilization as man has known it for the past 200 years is done; whether the new civilization will be reshaped by intelligent and rapid renovation of the present, or whether the whole structure must collapse and the new one be built from the bottom up, no man knows; but that man and culture will persist is almost certain; there is no absolute indication that a million years of existence is all that he shall have.

We are participant observers in the most dramatically significant era of all time. Not all of the social forces of the present and near future are subject to control. We Americans do not inhabit this planet alone. But we are significantly influencing the course of events in humanity's response to the Atomic Revolution. By training, natural endowment, and professional activities you have capacities for intelligent analysis and means of action whereby to guide and assist your fellowmen to rational and effective cultural adjustment for the new age. In many ways medical science shows the way.

These are times when a man can worry and fear. Or they are times when one can live with a high sense of excitement. For it is our destiny to live in the most pregnant period of all human history.

Staff Meeting Report

The Direct Vision Surgical Correction of Pure Mitral Insufficiency by Use of Annuloplasty or a Valvular Prosthesis*†

Report of Clinical Results

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For almost ten years now, stenotic lesions of the mitral valve have been satisfactorily treated by surgical measures. However, the regurgitant lesion of the mitral valve, despite its clinical importance as a major cause of cardiac disability, has continued to defy surgical repair. Numerous diverse surgical approaches have been described, and many ingenious devices have been inserted into the mitral orifice in an attempt to diminish the regurgitant flow. Most of these techniques have been directed at the posterior commissure, for this is the usual site of reflux; the anterior commissure is less frequently insufficient, because of the greater reserve of leaflet tissue in that area.

Substances such as pericardial tubes,[1] vein grafts,[2] and tendon grafts[3] placed in the posterior commissure to diminish the regurgitant channel have usually resulted in shrunken fibrotic struts. A rigid Ivalon sponge,[4,5] a mobile Ivalon sponge sling,[6] and a lucite baffle[7] have also been placed in the mitral orifice with minimal success.

Approximation and elevation of the posterior aspect of the mitral

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valve have been attempted by the use of pericardial strips,[8] vein slings,[9] and silk sutures,[10,11] and artificial cusps have been formed of nylon,[12] inverted veins,[13] and pericardium.[14]

One of the most popular clinical techniques has been the placing of a circumferential suture[15] around the mitral annulus to narrow the regurgitant area. This technique, however, is fraught with certain technical hazards and with other disadvantages reflected in the results, which have not been uniformly satisfactory.[16]

Pathologic Physiology

Mitral insufficiency may result from varying combinations of two primary factors: (1) an absolute loss of valve substance from cicatricial contraction of leaflet tissue and/or chordae tendinae, and (2) dilatation of the annulus fibrosus. Furthermore, these two factors are interrelated to the extent that severe insufficiency may result from compensatory left ventricular dilatation secondary to an initial deficiency – not necessarily severe – in the valve substance.

Moreover, for this same reason, mitral insufficiency – unlike its counterpart, mitral stenosis – when once established tends inherently to progress, even without further pathologic change in the valve itself. This happens because the regurgitant leak into the left atrium begets a compensatory left ventricular enlargement to increase correspondingly the cardiac output; and this, by further stretching the annulus, produces a greater regurgitant leak. This explains the clinical observation of cardiologists that regurgitant lesions of the mitral valve are tolerated far less satisfactorily than are stenotic ones.

The very variety of operations proposed to correct mitral insufficiency indicates the ineffectiveness of most of the techniques. Nevertheless, from an analysis of these experimental and clinical endeavors much basic knowledge has been gained. Several of the techniques reviewed above are sound in theory, and it has been obvious to us that a major reason for their lack of success is that without exception they have been performed by blind intracardiac manipulations carried out wtihout interruption of the circulation. Certainly the ability to observe the diseased valve during surgery should measurably improve the surgical results by assuring that the proper reparative procedure could be performed for each patient. The development of a safe and effective pump-oxygenator[17,18] has now made such open operations upon the mitral valve both possible and feasible.

During the past 14 months at the University of Minnesota Hospitals, five patients, all far advanced in their clinical courses, have undergone direct vision reconstruction of the mitral valve for pure mitral insufficiency. In four of these patients we have been favorably surprised to find valve leaflets that were remarkably good, being nearly normal in consistency. The regurgitant flow seemed to be due primarily to dilation of the annulus fibrosus of the mitral valve. In these patients, surgical repair was made by approximating the annulus fibrosus with silk sutures in the area of the reflux, a procedure termed annuloplasty. In the fifth patient the annulus was of normal circumference, and the regurgitation was due to a severe loss of substance involving the entire mural (posterior) leaflet of the mitral valve. Repair in this patient consisted of insertion of a prosthetic mural leaflet of compressed polyvinyl plastic sponge (Ivalon). The results in these five cases, all successful, are presented in this report.

Surgical Technique

Surgical Incision:

One of the important elements of our success with these patients has been the use of the thoracotomy incision for all five. Paradoxically, perhaps, the best exposure of the mitral valve is obtained through a left atriotomy performed through the right thorax.*

The patient is placed in a right lateral position, and the thoracotomy is performed through the bed of the right fifth rib. The venae cavae are cannulated in the usual manner through the right atrium. A third cannula is placed into the right atrium through a purse-string suture to aspirate the coronary sinus blood before it passes through the lungs into the left atrium. The arterial cannula is placed in the right common femoral artery. These cannulas are then connected to the pump-oxygenator[17,18] (bubble type) and the perfusion is begun. The wall of the left atrium is incised longitudinally near the interatrial groove anterior to the insertion of the pulmonary veins (Figure 1). This incision is readily performed without the need for any dissection of the interatrial sulcus, because the left atrium is usually of giant proportions in these patients. This atrial incision provides excellent exposure of the entire mitral valve region. Under direct vision with the left heart essentially dry and with the left ventricle beating, the pathologic lesion is carefully assessed by inspecting the leaflets, their commissures, and the chordae tendonae. Any stenosis present at the commissures is noted and corrected with the scissors. Fused chordae tendonae are separated. The insufficiency is frequently located at the

*This incision is equally effective for the direct vision commissurotomy operations for mitral stenosis.

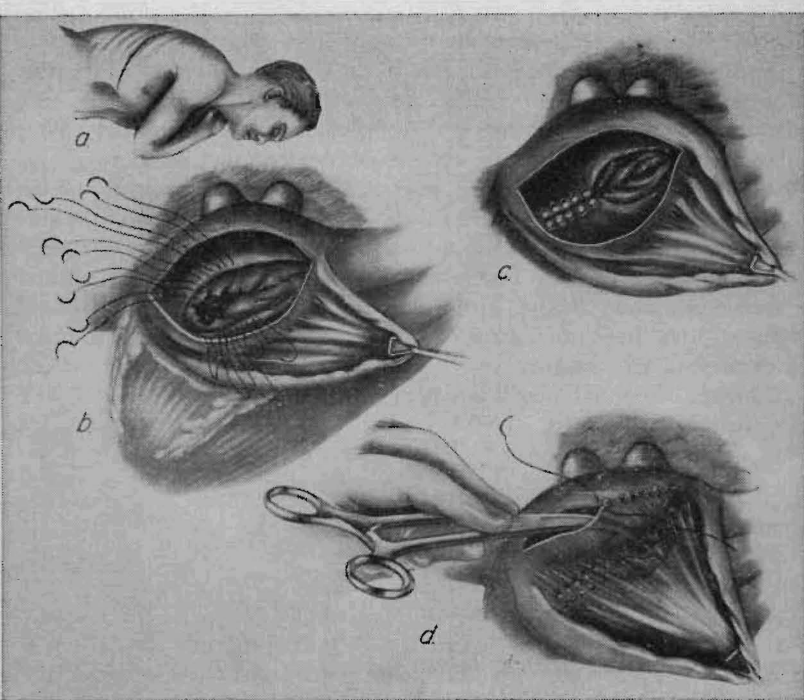

Figure 1. Technique of mitral annuloplasty. *(a)* Right thoracotomy. *(b)* Interrupted mattress sutures in the posterior commissure. *(c)* Sutures tied down over pillows of compressed Ivalon. *(d)* Closure of left atriotomy with running silk suture.

posterior commissure (Cases 1, 2, 3), but it may also be anterior (Case 4) or may involve an entire leaflet (Case 5).

Method of Annuloplasty

The technique of suturing the mitral annulus under direct vision with silk suture was first tested in the dog laboratory.[19] Although the procedure was well tolerated in the dog, the normal canine valve is an unusually delicate, paper-thin structure and thus a poor imitation of the diseased regurgitant valve. Clinically, when the annulus was greatly enlarged (Cases 1, 2, 3, 4) annuloplasty was performed opposite the insufficient area by placing interrupted mattress sutures of heavy silk in the annulus fibrosus. In this procedure, these sutures are tied down over pillows of compressed Ivalon sponge to prevent them from cutting out before healing is complete. These stitches bring about approximation at the annular level. Occasionally as many as seven or eight interrupted mattress sutures were placed in order to eliminate the regurgitant jet. A beating heart is preferred during the annuloplasty, for the blood ejected by the contracting left ventricle continues to delineate the area of insufficiency and indicates when the operative repair is complete. As the annulus is approximated, the surgeon may observe exactly how much additional plication of the annulus is required for ideal function. In each of the four patients in which the pathologic change was characterized primarily by annular dilatation (Cases 1 to 4), sufficient annular shortening to correct the regurgitation still left a mitral orifice of normal size (two or three finger breadths), so that no stenosis was introduced by the surgical correction.

After the annuloplasty is completed, the atriotomy is closed with a running silk suture, and the perfusion is terminated.

Insertion of Prosthetic Valve Leaflet:

In Case 5, despite a giant left atrium and advanced left ventricular enlargement, the annulus of the mitral valve was of normal circumference. The valve was markedly insufficient because of virtually complete disappearance of the mural leaflet by cicatricial retraction. Several plicating mattress stitches of silk were placed in the posterior annulus, and tentative approximation of these produced stenosis without correcting the regurgitation. Thus it was obvious that the normal leaflet had to be replaced by a space-occupying prosthesis that would provide sufficient substance against which the aortic (anterior) leaflet could abut during closure, and at the same time not produce a stenosis. Fortunately such an eventuality had been foreseen in our previous studies of autopsy specimens, and therefore an assortment of cylindrical cones in various sizes, made of compressed polyvinyl sponge, were available for insertion as described below (Case 5). Previous experimental studies[4] had indicated that this material, prepared in this fashion, was well tolerated in the left side of the heart without the danger of emboli, thrombi, late contractures, or appreciable scar formation.

Report of Cases

Pertinent clinical data on these five patients are summarized in Table 1.

Case 1. , a boy of 14, had had a murmur detected at nine months of age. When the patient was 11 years old, a coarctation of the aorta was resected, and the presence of mitral insufficiency was confirmed by exploratory cardiotomy. At the age of 12 he developed irreversible atrial fibrilla-

TABLE 1

SURGICAL REPAIR OF MITRAL INSUFFICIENCY UNDER DIRECT VISION UTILIZING A PUMP-OXYGENATOR

Case and Age	*Weight (kg.)*	*Corrective Procedure*	*Left Atrial Pressures (mm. mercury)*		*Duration of Bypass*	*Flow Rate (cc./min.)*	*Arterial pH*		*Clinical Result*
			Pre-	*Post-*			*Pre-*	*Post-*	
14 yrs.	28	Annuloplasty	43/26	18/10	23′ 35″	1200	7.62	7.63	Excellent
., 43 yrs.	75	Annuloplasty	48/20	30/20	25′ 38″	2600	7.50	7.49	Excellent
, 19 yrs.	45	Annuloplasty	30/15	20/12	28′ 50″	2300	7.44	7.51	Excellent
39 yrs.	56	Annuloplasty	50/20	17/5	22′ 22″	3000	7.41	7.43	Excellent
43 yrs.	59	Insertion of valvular prosthesis	—	—	35′ 21″	3500	7.43	7.39	Excellent

tion, which led to progressive cardiac deterioration. At the time of surgery on August 29, 1956, he was classified in American Heart Class IV E, being confined to bed with intractable right and left heart decompensation. He had a Grade IV systolic murmur and thrill at the apex. At operation both mitral valve leaflets were slightly thickened but otherwise appeared virtually normal. The annulus was greatly dilated, with posterior regurgitation. Operative repair consisted of placing five No. 2 silk mattress sutures in the posterior commissure and tying them down over pillows of compressed Ivalon sponge. The sutures completely obliterated the regurgitant jet, and there was no thrill in the atrium after completion of the perfusion. The left atrial pressure was reduced from 43/26 before to 18/10 mm. mercury after the reparative procedure. In the immediate postoperative period his improvement was rapid, and the most gratifying objective response was the 12 pound weight loss resulting from the diuresis of the chronic edema fluid in his tissues. Fourteen months after the operation he is doing so well that he has returned to school. The cause of the mitral insufficiency in this patient remains uncertain, although endocardial fibroelastosis was suspected.

Case 2. a 43-year-old man, had had no history of rheumatic disease, but atrial fibrillation was noted on the electrocardiogram in 1948. He had experienced progressive cardiac failure since 1948 with poor control by digitoxin. He had a laparotomy for mesenteric embolus in 1953, three years before surgery; a cerebral embolus six months before surgery resulted in a left hemiparesis from which he was gradually recovering. At the time of surgery, December 28, 1956, he was classified in American Heart Class IV D and had Grade III systolic and diastolic murmurs at the apex. At operation the mitral valve was heavily calcified, with some stenosis of the anterior commissure and a very large regurgitation posteriorly. The anterior commissure was incised 3 cm. and two No. 2 silk mattress stitches were tied over Ivalon in the posterior commissure. No atrial or ventricular thrill was felt after the perfusion. The atrial pressure was reduced from 48/20 to 30/20 mm. mercury after the annuloplasty. The patient, who had not worked during the seven years before surgery, now has returned to full time work as an x-ray technician.

Case 3. a 19-year-old girl, had had rheumatic fever at 14 years with heart failure necessitating digitoxin until the time of surgery. This young woman is familiar to most of our cardiologists since she has had multiple hospitalizations at this center for pulmonary infarcts and chronic decompensation. At the time of surgery she was classified in American Heart Class IV D with a Grade IV systolic murmur and thrill at the apex. At surgery on August 16, 1957, the mitral annulus was greatly dilated with slightly thickened leaflets. There was a marked posterior insufficiency with a significant reflux at the anterior commissure also. The annuloplasty was made by placing two No. 2 silk mattress sutures in the posterior commissure and one mattress suture anteriorly. After the sutures had been tied

Case 1. Case 3. Case 4. Case 5.

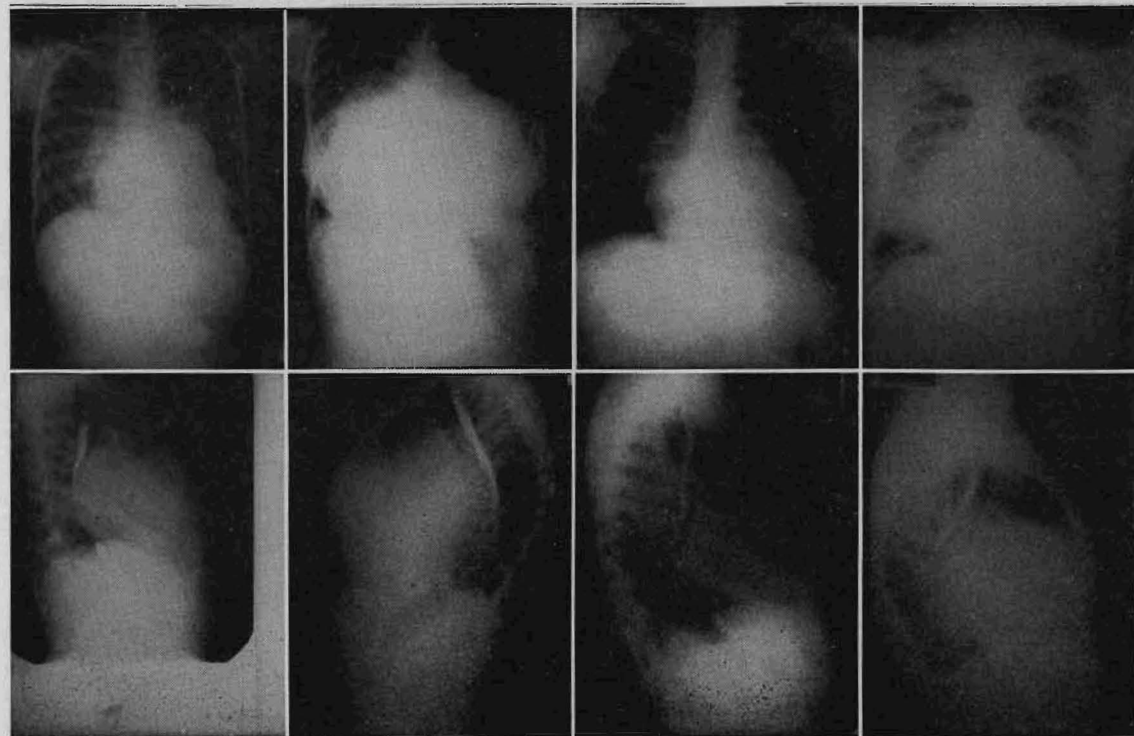

Figure 2. Preoperative chest x-rays of cases 1, 3, 4, 5. A.P. film above and lateral film below.

down over Ivalon, the valve was completely competent, and the atrial pressure was reduced from 30/15 to 20/12 mm. mercury. Postoperatively a soft Grade I systolic murmur was present. The follow-up has been short, but the patient is doing very well. With salt restriction relaxed, she is on a regular diet for the first time in years. Her own evaluation of the result is that she has been given, in her own words, "A New Life."

Case 4. a 39-year-old man, had had rheumatic heart disease at 21 years of age. Heart failure developed one year before surgery. The patient was well compensated on digitoxin, but he was unable to work as a farmer. At the time of surgery he was classified in American Heart Class III D and had a Grade III systolic murmur at the apex in addition to a Grade II diastolic murmur at the apex and atrial fibrillation. At surgery the mitral valve was widely regurgitant with slight stenosis at the anterior commissure. This stenotic anterior commissure was incised 1 cm. and the regurgitant channel in the posterior commissure was obliterated by two No. 2 silk sutures tied over Ivalon. The left atrial pressure was reduced from 50/26 to 17/5 mm. mercury, and postoperatively it was necessary to carry out phonocardiography to detect any systolic murmur. The follow-up has been short, but the patient is now on a regular diet and off digitalis.

Case 5. a 43-year-old woman, had had rheumatic fever at age 12 with the onset of atrial fibrillation at age 23 and episodes of cardiac decompensation that progressed until the time of surgery. A therapeutic abortion had been necessary when the patient was 25 because of severe decompensation in the fourth month of gestation. Paroxysmal nocturnal dyspnea, ascites, ankle edema, and frequent episodes of acute pulmonary edema were prominent in her history; the patient had been on digitalis and on a low salt diet for 20 years. On admission at this hospital she was classified in American Heart Class III D and had a Grade III systolic murmur at the apex. At surgery she went into shock as soon as she was anesthetized. Her heart action was very feeble and the systemic arterial blood pressure dropped to 60 mm. mercury and remained low during the opening of the chest. In the race to perform the cannulations and put the patient on the pump-oxygenator before cardiac action ceased entirely, it was not possible to take time to measure left atrial pressures. As soon as the patient was linked to the pump-oxygenator she improved, and the operation could therefore procede at a more leisurely pace.

Upon opening the left atrium there was observed a slight stenosis of the anterior commissure and severe posterior regurgitation. Since the mural cusp of the mitral valve was virtually absent, a large cylinder of compressed Ivalon sponge (4 cm. in length and 15 mm. in diameter) was placed horizontally under the mural cusp and sutured in place by four mattress sutures of heavy silk. The regurgitant jet was almost completely abolished by this procedure. The patient's heart took over immediately with a normal blood pressure at the conclusion of the operation. Postoperatively there was a Grade I systolic murmur at the apex. In the short follow-up the patient already appears improved, and it is quite obvious from her precarious condition before surgery that she could not have survived any operative procedure which did not immediately and substantially improve her mitral function.

Discussion

The results in these five patients clearly indicate the value of reparative procedures carried out upon the incompetent valve under direct vision. Moreover, it is apparent that the surgical treatment of mitral valve disease will not be completely satisfactory until the surgeon has at his disposal when needed an effective prosthetic valve to replace completely the one totally destroyed by the disease process. But as the principles and knowledge of reconstructive procedures increase, it is evident that this ultimate approach of complete valve replacement may be necessary much less frequently than we once had thought.

Summary and Conclusions

A new operative technique has been described for the correction of mitral insufficiency. This procedure, termed annuloplasty, consists in part of selective suturing of the annulus fibrosus under direct vision to reduce its circumference commensurate with the area of valvular tissue. In patients with severe loss of leaflet substance the insertion of a valvular prosthesis has been successful. The mitral valve is approached through a right thoracotomy and left atriotomy during a period of total cardiopulmonary bypass utilizing a pump-oxygenator.

Five patients have been treated by this operation to date. Before surgery all had been seriously incapacitated by severe mitral regurgitation. At present all are alive and significantly, even dramatically, improved. Moreover, the first patient, whose progress has been followed for more than a year, has not only sustained his initial gains but has continued to improve. Thus, although the series is small, the results indicate that surgical correction of mitral insufficiency is feasible, effective, and possibly life-saving.

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Coming Events

November 18-20 . . . Continuation Course in Physical Medicine for Specialists

November 26 . . . . . Special Lecture: Mistakes in Protein Synthesis; DR. GEORGE N. COHEN, Pasteur Institute, Paris, France; 214 Millard Hall; 4:00 p.m.

November 27 . . . . JACK FRIEDMAN LECTURE: DR. ULF G. RUDHE, Acting Chief of the Roentgen Diagnostic Department of Children's Clinic, Karolinska sjukhuset, Stockholm, Sweden; Mayo Memorial Auditorium; 4:00 p.m.

December 5-7 . . . . Continuation Course in Fractures for General Physicians

December 6 . . . . . JOURNAL-LANCET LECTURE: DR. WILLIAM F. NEUMAN, Associate Professor of Pharmacology and Biochemistry, University of Rochester School of Medicine and Dentistry, Rochester, New York; Mayo Memorial Auditorium, 11:30 a.m.

CORRECTION

Regrettably, the Medical School Faculty list that appeared in the October 15 issue of the BULLETIN omitted the name of Emeritus Professor S. E. SWEITZER, Division of Dermatology.

DR. EARL HILL, Clinical Assistant Professor, Department of Medicine, was erroneously listed as Clinical Instructor.

WEEKLY CONFERENCES OF GENERAL INTEREST

Physicians Welcome

Monday,	9:00 to 10:50 A.M.	OBSTETRICS AND GYNECOLOGY Old Nursery, Station 57 University Hospitals
	12:30 to 1:30 P.M.	PHYSIOLOGY- PHYSIOLOGICAL CHEMISTRY 214 Millard Hall
	4:00 to 6:00 P.M.	ANESTHESIOLOGY Classroom 100 Mayo Memorial
Tuesday,	12:30 to 1:20 P.M.	PATHOLOGY 104 Jackson Hall
Friday,	7:45 to 9:00 A.M.	PEDIATRICS McQuarrie Pediatric Library, 1450 Mayo Memorial
	8:00 to 10:00 A.M.	NEUROLOGY Station 50, University Hospitals
	9:00 to 10:00 A.M.	MEDICINE Todd Amphitheater, University Hospitals
	1:30 to 2:30 P.M.	DERMATOLOGY Eustis Amphitheater University Hospitals
Saturday,	7:45 to 9:00 A.M.	ORTHOPEDICS Powell Hall Amphitheater
	9:15 to 11:30 A.M.	SURGERY Todd Amphitheater, University Hospitals

For detailed information concerning all conferences, seminars, and ward rounds at University Hospitals, Ancker Hospital, Minneapolis General Hospitals, and the Minneapolis Veterans Administration Hospital, write to the Editor of the BULLETIN, 1342 Mayo Memorial, University of Minnesota, Minneapolis 14, Minnesota.