PANEL DISCUSSION

Guest Editor: Louis N. Katz, M.D.

Rehabilitation of the Cardiac Patient

By Louis N. Katz, M.D., Robert A. Bruce, M.D., Norman Plummer, M.D., and Herman K. Hellerstein, M.D.

Moderator Louis N. Katz (Chicago, Ill.): Before I call upon my colleagues I wish to make a few introductory remarks. We as physicians must view heart disease in all its ramifications. Heart disease is primarily a chronic process. The problem is more than the immediate alleviation of acute exacerbations of the disease, involving a temporary sojourn in the acute hospital, or its equivalent at home. The management of the acute phases of heart disease is so exciting to the layman, medical student, house officer, and headline writer—and, unfortunately, to some physicians—that the chronic nature of this disease may be overlooked.

Care is required for the patient over months and years, care in which proper small things constantly repeated, surprisingly, have a great cumulative effect. In the last analysis, proper care means prevention of recurrences and ultimately of going to the normal population and preventing the disease from occurring in the first place.

However, it is not enough merely to stop the advance of disease. One must endeavor to restore the patient to the full life. This is rehabilitation. This philosophy should be the credo of all physicians and of all the ancillary professionals dealing with a cardiac patient incapacitated by his disease. Man is a complex creature with a mind and emotions, and illness affects him in his totality—mind and body besides heart and blood vessels.

You are all aware of iatrogenic heart disease in which the physician and the ancillary aid, by indiscreet or thoughtless remarks or actions, creates some of the manifestations of heart disease that are not organically present. Moreover, the patient with heart disease can also have his organic difficulties multiplied in the same way iatrogenically. Consequently, in rehabilitation one has to deal not only with the physical disability but with the mental and emotional attitudes of the patient, of his family, and even of the society in which he lives.

Rehabilitation to be effective must be complete. It must attempt to attack all aspects of the situation. It must represent an appreciation of the machinery that is deranged in the human body, of the recuperative powers of living things, and of the limits of the stresses that can be imposed. But it involves more than this. It involves an expert analysis of the patient’s mental attitude to his disease, the unraveling of the hidden fears that reside in him and his family. It requires the instillation of hope that he will attain within the limits of his body—and more than he expects—his birthright to happiness of the full life and gainful occupation in a job that is interesting and challenging.

There is therefore need for vocational evaluation and guidance. Proper rehabilitation rests upon the tripod of (1) the sympathetic, psychosomatically oriented, and scientifically trained cardiologist; (2) the kindly, psychiatrically trained medical social worker, and (3) the mature vocational counsellor. These 3 operating as a team, with the physician as their leader, in a society that recognizes that work is as much the fashion as birth, death,
and taxes, will bring into proper balance the somewhat one-sided approach to cardiovascular disease practiced by many, with its overemphasis on the acute dramatic phases and their spectacular alteration by therapy. It will lead to the addition to ordinary management of preventive medicine and rehabilitation in equal proportions.

We are just at the beginnings of a science of rehabilitation. The day must soon come when no alert community can neglect this important area, when no medical center is considered to be really a center unless it has an adequate rehabilitation program, and when this program reaches into every home, rich and poor alike. It will then be accepted that in treatment we do not stop by merely making people well, but well and useful.

We must stress as the aim of good medicine, the restoration of human beings to their normal role in the family, in their society, and at their work. This is no investment in bricks and mortar; it is an investment in human beings.

The beginnings of the science of rehabilitation have been made and the results already have been brilliant, exciting, and with great promise of better things to come. The field is already sufficiently advanced so that we may apply to rehabilitation the credo of the Heart Association: "There is hope for you and your heart through service, education, and research." But beginnings are not enough. We must expand our program of rehabilitation by creating more facilities, by educating everyone to its needs, and by supporting research to unravel the interrelationships of the emotions and the body machinery at work.

It was because I felt these things so sincerely that I accepted Dr. Harold Feil's invitation to moderate this symposium and to make these few introductory remarks.

I now will call on the panelists who will outline in the remaining time some particulars on rehabilitation. First I will call on Dr. Robert A. Bruce.

DR. ROBERT A. BRUCE (Seattle, Wash.): Fellow students of heart disease, I would like to suggest that effective rehabilitation of cardiac patients depends upon the favorable balance between physiologic capacity and energy requirements of the work load. Let us examine each of these areas briefly.

Energy requirement may be assessed from the approximate rate of oxygen consumed in the performance of the task and from the duration of effort. Although other characteristics are informative, the simplest measure of intensity of effort is the percentage ratio of oxygen consumption at work to its value at rest (fig. 1). This ratio fluctuates with work requirements and increases with peak loads to higher levels. The magnitude and frequency of these peak loads are also important. You will note that I have taken the value 400 per cent, which will refer to the stress test I am going to talk about later. A peak load is also depicted that is more nearly comparable to Dr. Master's 2-step test.

Examples of the approximate energy requirements of some ordinary daily activities indicates that these may be placed within broad categories representing slight, moderate, severe, and very severe work.1-3 Thus sitting, standing, talking, represent only slight physical activity, whereas walking slowly on a level, requires an appreciable but moderate expenditure. Walking on either lawn or snow, or walking upgrade, such as hill climbing, can be very severe work (fig. 1).

Similar measurements of energy requirements of common jobs in an aircraft industry in Los Angeles have been made available to me.3 Since much of the work is more or less mechanized, the energy expenditure for the particular job sampled does not seem to represent very severe work.

In like manner the energy requirements on the farm represent corresponding ranges for mechanized tasks, plus much higher energy requirement for certain manual tasks and chores. These do not take into account environmental heat stresses, which often occur.

The relative variance of 2 different industrial jobs of a highly repetitive character has been studied. On the basis of a large number
of tests on these noncardiac workers, "other factors" accounted for more of the variability than the relative importance of day-to-day variations in the same men, or man-to-man variations on the same day.

Furthermore, Wuest, Geddes, and Enterline3 did not find any significant difference in the energy requirements for noncardiac and cardiac employees performing the same industrial jobs. It is significant from the standpoint of job placement of cardiac patients that they probably do not have higher requirements than noncardiac subjects when performing the same task.

Now let us direct our attention to criteria for the evaluation of physiologic capacity for work.

Physiologic capacity of the cardiac patient fluctuates with both the natural history of disease and the effects of medical treatment. Clinically, physicians have used several criteria for determining whether work requirements exceed capacity of cardiac employees. Thus a history of symptoms on the job, such as fatigue, dyspnea, or pain, are helpful but not specific. Additional criteria are the worker's recognition of the lack of tolerance to recreational activities in addition to work, the needs for shorter hours of work or more rest, and medical treatment.
REHABILITATION OF THE CARDIAC PATIENT

Unless there are signs of pulmonary congestion, venous engorgement, or cardiac edema, the physical examination provides little insight into the possibility that the worker is overtaxing himself.

In the experimental clinical laboratory, symptoms and signs developing in response to a suitable stress may be helpful to test cardiac reserve capacity. The energy requirement should be increased about 400 per cent by an appropriate form of effort that involves large muscle masses, requires no training, and can be effectively standardized. Walking slowly at 1.7 miles per hour on a 10 per cent grade of incline on a motor-driven treadmill ergometer achieves these goals. Numbers of measurements may be made with a high degree of reproducibility. This does not necessarily determine whether any cardiac patient works in excess of his capacity, but it is helpful to determine whether tolerance of this level of exercise is impaired, since the majority of employees appear to have work requirements—except for peak loads—within this range. Under these arbitrary conditions, normal tolerance for exercise in an ambulatory subject may be defined as the ability to perform such an effort of walking for 10 minutes without symptoms, signs, or physiologic impairment, and with complete and rapid recovery within 3 to 5 minutes. Time is not available for an extensive discussion of important precautions and limitations of this test that have been presented elsewhere. However, I do want to emphasize that at the time the test is performed, it is essential that a physician be in attendance, and stop the test whenever symptoms of cerebral anoxemia or ventricular tachycardia are shown.

Results of this test have been compared with the opinions of a group of cardiologists, under the direction of Dr. Sparkman, who examine patients referred to the Northwest Cardiac Work Evaluation Clinic. In patients with either coronary artery or rheumatic valvular disease, dyspnea and fatigue were commonly encountered with this exercise test (fig. 2). Coronary patients more often developed chest pain. The most important sign was the inability to continue this exertion for 10 minutes. Forty-five per cent of the patients were unable to walk for 10 minutes, and from 5 to 15 per cent were unable to walk for as long as 3 minutes at this particular standardized work load. Another sign was the inability to raise the systolic blood pressure, or an actual fall in its level. Patients rarely show evidence of congestion, which disappears promptly within 4 or 5 minutes. The changes in the precordial electrocardiogram taken throughout the test are also important.

Based upon a modification of the fitness test developed at the Harvard Fatigue Laboratory several years ago, an index of physical fitness (PFI) has been utilized to express the cardiorespiratory performance. In this sense, fitness varies directly with duration of effort, efficiency of oxygen uptake in relation to ventilation, and inversely with cumulative heart rate for 3 minutes of recovery. Normal values range from 13 to 26. The relationships of exercise tolerance, to distribution according to etiology and functional capacity of 127 patients appraised by this clinic are shown.

Most of these patients were in classes II and III of functional capacity. The mean PFI for class I rheumatic patients was higher than that for class I coronary patients, probably because of the 25-year difference in mean age between the 2 groups. Although the mean PFI decreased progressively from classes I to IV, there was marked variation within each of these groups. Thus the exact value obtained is of limited value in comparing one individual with another, but of considerable value in comparing the results obtained serially in the same patient over a period of time.

The relationship between the subjective appraisal of functional capacity and the objective test of exercise tolerance has shown satisfactory agreement in 85 per cent of the rheumatic and 70 per cent of the coronary patients. The chief cause of discrepancies was found to be an unsatisfactory history, followed by occasional examples of excessive
limitation of physical activity either by patient or physician, recent convalescence, or other disease.

A not infrequent incidental by-product of the test procedure has been the reassurance of the patient who did not appreciate he could expend as much energy with little discomfort and no harm to himself. Another important by-product was the opportunity to demonstrate mechanisms of impairment, and permit the physician to advise the patient of his limitations in relation to symptoms. None experienced any significant untoward effect; all were carefully supervised by a physician in attendance. Fortunately the procedure rarely discouraged patients from returning for follow-up tests whenever requested.

Recently we have been determining the cardiac output at rest while the patient sits in a chair, and again during a steady state of exercise while walking on a treadmill. This is done by means of the dye-dilution technic, with an ear oximeter and Wieder-Viel’s direct-recording amplifier system with linear characteristics. Although 4 venipunctures are required, the necessity of either cardiac catheterization or arterial sampling is avoided. These data, together with oxygen consumption, heart rate, surface area, and hemoglobin concentration permit a graphic analysis by Rushmore’s diagrams of the relationship of changes in oxygen consumption to blood flow, arteriovenous oxygen difference, and venous oxygen reserve. Cardiac reserve can be analyzed in terms of changes in stroke index and heart rate.
It is too early to judge the ultimate value of such studies and obviously much more research is needed. Nevertheless from the preliminary experience accrued thus far, some form of objective evaluation of cardiac reserve is helpful in guiding the physician. Then the work prescription for the cardiac patient to be rehabilitated can be formulated in relation to both the energy requirements of the job and the functional capacity of the employee.

**Moderator Katz:** Thank you, Dr. Bruce. I think all will agree with me that this is a beautiful demonstration of the utilization of basic scientific knowledge in an area of community service.

The next participant in the symposium will be Dr. Norman Plummer.

**Dr. Norman Plummer (New York, N.Y.):** Dr. Katz, ladies and gentlemen, I shall discuss this problem today from the angle of the industrial physician. At a similar panel a year ago, Dr. Paul D. White stated: "I would like to emphasize the beneficial effect of work on body, mind, and soul in any occupation in which it is possible for a cardiac patient to engage. Idleness breeds unhappiness and is actually bad for the health. It is a rare patient indeed who is fit for nothing. It greatly pays to make every effort to find something, either vocational, or avocational, into which to fit the sick man or woman."

I am in full accord with Dr. White and think that an important part of the recovery from heart disease is the provision that the individual be occupied, and that in most instances this means that he should resume gainful employment. It is almost generally accepted today that cardiac patients want to work, that they can work and when properly placed, can work productively and without harm to themselves or to others.

That seems to make the employment of cardiac patients a simple procedure, particularly considering today's labor market where there are more jobs than people to fill them, and the further fact that in this machine age work is light and hours are short, both just right for the cardiac patient. Despite these facts, the employment of cardiac subjects (and other disabled workers) can often be a serious and perplexing problem.

Why should this be? Primarily it is because of what today is called interpersonal relationships. The employment of a cardiac patient often involves many complicated relationships between many different people, groups of people, and agencies, all approaching the problem with somewhat different attitudes and from different angles. Involved in a single cardiac case there is the employee, the employer or potential employer, the employee's family, his private physician and perhaps a specialist, a clinie, a social worker, and sometimes the local Heart Association, the union, the Workmen's Compensation Board, and finally, particularly if it becomes a compensation case, maybe 2 or 3 lawyers.

Do all of these people and agencies accept the principle that the cardiac patient wants to work, can work, and when placed properly, can work productively and without harm to himself? Maybe they do, but from my experience they do so with many qualifications.

Let us, for a moment, think in terms of some of the individuals involved in these interpersonal relationships. First, let us consider the cardiac employee. Let me emphasize at the start that there are millions of cardiac patients working effectively and continuously at productive jobs with great satisfaction to themselves as well as to their employers. On the other hand, many of them do not work effectively, when returning to work, or when given jobs. They may have been frequently absent, may be unreasonable in their requests for restricted duties, and when their disease progresses they may blame it on their job. Some individuals want the additional income that comes from employment but they desire—and many times this, I am sure, is in their subconscious mind—the leisure and the restricted activities of retirement. Usually, it is a psychologic reaction rather than organic heart involvement itself that results in the failure
of the cardiac patient to perform his job effectively.

Next, let us consider the employer. The crusade for the employment of the disabled naturally is directed primarily at employers. Many times the problems encountered by the employer are not accepted sympathetically. To be realistic we must recognize that the employer of these persons has some real risks and liabilities. The risks are mainly financial, such as the cost of increased absence and increased replacement, increased number of restricted assignments, and increased insurance and compensation rates. In one way or another large companies can absorb these extra costs. However, the small employer, and most employment is by the small employer, cannot. Therefore, most small employers do not employ cardiac patients knowingly, although, because they are small, they do not have the facilities for identifying and rejecting cardiac subjects when they are taking on new employees.

This difference between the large and the small employer is important. Almost all large companies have large numbers of cardiac employees on their payroll, although as a rule, they are methodical in rejecting applicants who have heart disease, considering that they are already carrying their responsibility by retaining those employees who develop heart disease while working for them.

In employing cardiac workers, proper placement is most important, not only for the employee, but in reducing the risks to the company. Most large employers, and some of the smaller ones, are doing an excellent job in this important activity of work classification and job placement. Dr. Hellerstein will cover this phase in his presentation. Many employers are deriving great satisfaction from employing the disabled. By doing this they find that they are hiring or retaining people who have acquired extra skills, aptitudes, and long experience. However, with few exceptions, good employees do not become better employees, because of an acquired disability such as heart disease. Our reasoning on this often becomes distorted. It is true that the stable, reliable employee with heart disease is, as a rule, more valuable than the unstable, unreliable employee without physical disability. However, we should bear in mind that there are extra problems and costs involved in hiring the handicapped. It can be said that most employers, certainly the larger employers, are accepting the cost problems and responsibilities of employing cardiac patients more and more. However, in doing so, they have 2 other necessary interpersonal relationships that often disturb them. One is the relationship with the private physician and the other with the Workmen’s Compensation Board, which often means relationship, as I mentioned before, with members of the legal profession.

Let us consider the employee’s private physician. From the angle of those of us in industry, this is a most important relationship.

As a rule, a cardiac employee’s attitude toward his job is strongly influenced by his private physician or cardiologist. When an employee having had a mild coronary, returns to work at the end of a year, i.e., at the end of his sickness benefits, instead of at the end of 2 or 3 months, i.e., the usually optimum time, it is his physician who has helped to develop this plan. When the employee is in his sixties, with a badly damaged heart, really desiring and needing to retire, and insists on returning to work again, it is the private physician with whom he is closely allied who is responsible. The cardiac worker who is overcautious and overconcerned, so that he is unable to work continuously and effectively, often derives this attitude from his private physician. In the case of the employee who develops heart disease or has a relapse and then in a remote and unreasonable way relates it to his job, it is usually his private physician who opens this claim as a workman’s compensation case.

Just as it is the minority of cardiac employees who work ineffectively, so it is the minority of doctors who create many of these problems in the employment of the disabled.
We must salute the vast majority of doctors who are properly oriented for so tremendous a service in encouraging cardiac patients to work. The medical profession nevertheless has much to do in terms of educating all physicians in the proper knowledge of heart disease, the understanding of human nature, and of jobs—all essential in order to carry out this most important phase of treatment.

Finally, let us briefly consider insurance and Workmen’s Compensation. Here is an important sphere of activity of the American Heart Association.

For many years members of the Heart Association have appreciated that both the application of Workmen’s Compensation Laws and the application of industrial insurance has had a tendency to penalize the employer of cardiac patients and in turn, to create obstacles to their employment or re-employment. Several years ago a committee known as the Committee on the Effect of Strain and Trauma on the Heart and Great Vessels, with Dr. Paul D. White as chairman, was appointed. About a year ago, Dr. White was authorized to appoint 2 subcommittees, one called the Clinical Pathological Subcommittee and the other the Medical, Legal, Insurance and Industrial Subcommittee. Both of these subcommittees during the past year were authorized to set up study groups with research associates reporting to responsible investigators who are members of the parent committee. The Clinical Pathological Subcommittee is evaluating the clinical and pathologic evidence that exists on the effect of trauma, strain, and stress on heart disease. The Medical Legal Subcommittee of which Mr. Barnett S. Fox and I are the responsible investigators, has a study group with Mr. Henry D. Sayer, former industrial commissioner of New York as full time research associate, compiling, analyzing, and evaluating Compensation Laws and court decisions as they relate to cardiovascular disease.

Also, Mr. Sayer and his staff are carrying out a survey in the insurance and industrial organization to ascertain and evaluate obstacles that exist in employing cardiac workers, particularly those that may arise from the application of insurance plans and Workmen’s Compensation. I can report progress and can tell you that valuable reports from those 2 study groups will appear. The subcommittees are planning to use the findings as a basis for recommendations to the Heart Association.

In conclusion I would say that there are a number of obstacles to the employment of cardiac patients but a better understanding of this entire problem will lead to a much better future for the cardiac worker in industry.

Moderator Katz: Thank you, Dr. Plummer. You have made it clear that it is not just numbers and machinery. It is a problem of integration in a complex society of private enterprise.

The subject will be continued by Dr. Herman K. Hellerstein.

Dr. Herman K. Hellerstein (Cleveland, Ohio): My pleasure and task is to discuss the Work Classification Clinic. Since the original unit was founded by Dr. Leonard Goldwater at the New York Bellevue Hospital in 1941, 42 similar units have been established and supported by the American Heart Association. Certainly today is an appropriate occasion to re-evaluate the work classification concept and to discuss the accomplishments, limitations, and experiences of various clinics throughout the United States. I am grateful to the directors of the Work Classification Clinics in New York, Boston, Philadelphia, Iowa, Seattle, and elsewhere, for providing data.

The accomplishments of the Work Classification Clinic can be divided into 3 categories: (1) service to patients, (2) education, and (3) potential and realized research value.

The Work Classification Clinic may play an important role in returning the cardiac patient to work. After a patient with heart disease has recovered from his acute illness, return to work is usually indicated, but in actual practice is often very difficult. The basic problem is to determine and to match
the patient's total capacity with the demands of a specific job. This cannot be solved by prescribing a "light job." Because the total problem is complex, a team approach is often required, in order to integrate and to concentrate the knowledge of multiple disciplines for the benefit of the individual patient.

The clinic team of the Work Classification Clinic generally consists of a cardiologist, vocational counselor, medical or psychiatric social worker, and occasionally a psychiatrist. The social worker plays a key role in evaluating the patient's pre-illness personality and temperament, attitudes, meaning of the illness to the patient, his intellectual and emotional understanding of his disease, his family and economic problems, and the emotional milieu of a job.

The vocational counselor obtains detailed information as to the work history, the subject's skills, education, work attitude, personality needs and work motivation, job features (skills, effort, responsibility, and working conditions), transportation problems, and exact details of the present or past employment.

The cardiologist evaluates cardiac function as well as structural changes and recognizes the importance of placing emphasis upon the function of surviving tissue. In addition to a complete medical history and physical examination, chest fluoroscopy, routine blood analysis, and exercise tolerance tests are performed. In the Cleveland experience Master's 2-step test has been performed in all but a few cases and the treadmill test of Bruce in approximately 100 cases.

After the studies are completed, the clinic team confers to present, discuss, and integrate the findings. The total energy requirements (work, basal, recreational) are estimated and related to the patient's response to exercise tests of known energy requirements (Bruce's test, 5 to 6 calories, Master's 2-step test, 7 to 8 calories),9 and to life activities, (walking, stair climbing, shaving, showering, gardening, etc.) whose energy requirements have been measured.10

A detailed practical work recommendation is made and forwarded to the patient's private and industrial physician. Personal communication with placement agencies, rehabilitation services, the employer, personnel manager, union steward, etc., may be necessary to implement the recommendations. The patients are re-evaluated every 3 to 6 months during the first year, and at 6 to 12-month intervals thereafter.

The results of this multidisciplinary approach have been remarkably similar throughout the country.

The source of referral of patients has depended upon the original orientation of the clinic in specific communities. In Philadelphia the main source has been the industrial physician, in Cleveland and other communities the source has been predominantly the private physician. The characteristics of the clinic population have been similar: 90 per cent are male; 90 per cent are white; from 50 to 75 per cent are in the age group from 35 to 54 years, which is usually the most productive phase of life. In 46 to 63 per cent of the patients the emotional impact of the illness on the patient has been as important as the organic heart disease itself in determining employability.11, 12

The etiologic types of heart disease were representative of clinical heart disease in mid-twentieth century America; 20 per cent rheumatic heart disease, 12 per cent hypertensive cardiovascular disease, 47 per cent arteriosclerotic heart disease with or without hypertension, 8 per cent no discernible heart disease; and the remainder included cor pulmonale, syphilis, congenital, and unknown heart disease.

In every clinic experience the employment status has improved. The number employed at the initial visit (approximately 30 to 40 per cent) has increased to 50 to 75 per cent at follow up visits. This is a substantial accomplishment! The occupational status has also shown a consistent change. A remarkably high percentage of the patients, 70 to 94 per cent, were able to remain in the same job category with little or no modification.
Effect of Occupation on the Medical Status.

There has been no evidence that the prescribed work has aggravated the course of heart disease of our patients. As of April 3, in Cleveland, no medical legal compensation claim has been made by any of our 1,100 patients over a period of 6 years. A very surprising and gratifying observation has been the fact that the patients improved while working. Dr. David Gelfand of the Philadelphia Work Classification Unit has reported that 55 per cent of the patients with rheumatic heart disease, 76 per cent of those with hypertension, and 65 per cent of those with coronary artery disease were medically improved or unchanged while working. Our experience in Cleveland has been similar. The fact that the cardiac and occupational statuses improved in the employed cardiac subjects and that approximately 75 per cent of all patients studied at the Work Classification Clinic were working at a follow-up visit must be recalled in the evaluation of certain heart operations that claim to be successful because a similar number of patients are employed after operations.

Summary of the Service Accomplishments.

Through the employment of a team consisting of a medical social worker, vocational counselor, and cardiologist, and through the use of clinical methods of evaluation, about 75 per cent of the patients with heart disease have been able to return to competitive industry in a great variety of jobs, without evidence of harm to the patient, his fellow worker, or employer. These jobs have provided status, self-esteem, and substantial remuneration. The educational value has been great also. We physicians have learned much about the contributions of other disciplines and about the course of heart disease. Over 200 physicians have participated in the functioning of the Work Classification Clinic in Cleveland. The clinic has been used to demonstrate to medical students a holistic approach to the patient.

In each community the Work Classification Clinic has focused attention upon the problem

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**Table 1.** Jobs Held by Work Classification Clinic Patients with Heart Disease

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<th>Clerical</th>
<th>Semi-Skilled</th>
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<td>accountant</td>
<td>assembler, motor</td>
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<td>box maker</td>
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<tr>
<td>office clerk</td>
<td>hand lathe, automatic</td>
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<td>order filler</td>
<td>instrument man</td>
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<td>police stenographer</td>
<td>mixing machine</td>
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<td>secretary</td>
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<td>timekeeper</td>
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<td>tool clerk</td>
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<th>Managerial and Official</th>
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<td>dispatcher</td>
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<td>Salesman</td>
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<td>social worker</td>
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Table 1 illustrates the wide variety of jobs successfully held by the cardiac patient, and invalidates the concept of a "cardiac job." Whenever possible the patient was advised to remain and usually was able to remain in the same industrial plant and in the same industrial and occupational classification. Downgrading as a result of heart disease has occurred in only 5 to 7 per cent of all cases.
of employment of the cardiac patient, and has demonstrated to management, labor, insurance carriers, physicians, and even legislators the value of the cardiac employee. In each locale the success of the Work Classification Clinic has encouraged the private and industrial physicians to be less fearful in advising employment for their cardiac patients. This encouragement has been similar to, but not as dramatic as that which Dr. Paul D. White gave to the medical profession and to cardiac patients throughout the world by the way in which he managed the rehabilitation of a famous patient.

The greatest accomplishment, however, is not in the service rendered, but rather the demonstration for the need for research in certain areas. One of the most striking needs is the prevention of invalidism. The physician, unwittingly or otherwise, plays an important role in the genesis of this invalidism. Since it is now established beyond a doubt that a patient with heart disease can work, the need for preventing iatrogenic invalidism becomes even more cogent.

One of the most important and difficult tasks in work classification is the estimation of the stress of a job and the capacity of the cardiac patient to meet it. I think the success of the various clinics may be attributed to good clinical judgment and intuition, the humanity and more optimistic philosophy that prevails today regarding the cardiac patient, and in greater part, I believe, their success is due to the fact that most jobs do not require much energy, and that cardiac patients have the capacity for such an expenditure.

Clinical tests to measure the cardiac patient's capacity to work have been valuable when interpreted properly. The response to Bruce's treadmill test or Master's 2-step test with an average load of 4 and 8 calories respectively must be related to the requirements of a specific job. Had we used Bruce's index of fitness alone as a criterion of employability, most of our class II and class III patients would not be working. There have been many discrepancies between this index of fitness and employability. For example, one patient with an index of 23.3 was not employable, while another with an index of 6.3 was employable. The determining factor was the availability of a job where energy requirements were less than that of the individual's capacity.

In the Cleveland Work Classification Clinic, we have referred generously to published data of Passmore and Durnin and others, in order to estimate the caloric requirements of various jobs. However, more information about current job requirements in contemporary America is needed. In the past 2 years, Dr. Amasa B. Ford and I have measured the caloric requirements of specific jobs in Cleveland industry. Sixty-seven subjects, including cardiac subjects and matched controls, were studied on the job. The workers included supervisors, machine operators, firemen, clerks, and service personnel. There was no statistical difference in the energy expenditure of the cardiac patient and the controls: at rest 1.30 calories per minute, S.D. 0.25, peak activity 3.04 calories per minute, S.D. 1.07, average during the entire shift 1.97 calories per minute, S.D. 0.48, and average expenditure during actual work was 2.29 calories per minute, S.D. 0.64. The minute ventilation of the cardiac subject and the controls was similar: at rest 8.74 L per minute, S.D. 2.0 L and during peak activity 16.9 L per minute, S.D. 4.8. During the customary pauses and breaks of the working day, the various parameters of cardiovascular function returned toward control values.

The pattern of energy expenditure has often been more important than the magnitude. In one illustrative case, a boiler fireman expended from 1.34 to 6.2 calories per minute. This was one of the heaviest jobs we evaluated. However, for 247 minutes of the day, the subject expended 1.34 calories, during resting and watching of controls; 3.9 calories for 246 minutes while using control devices, and mixing ingredients, and for 17 minutes, 6.2 calories were required during the shoveling and removal of ashes.

The frequency of rest periods, pauses, and
REHABILITATION OF THE CARDIAC PATIENT

relief of boredom influenced the performance during the working day. Variations in the energy requirements of the same task depended more on the basis of the personality needs of the worker than on the energy requirements of the job.

The effort required by these representative jobs (which admittedly excluded foundry workers, dock hands, etc.) is surprisingly small, and not significantly greater than that required by ordinary home activities. The average housewife expends more energy than her working mate, when she irons clothes (4.2 calories per minute), makes a bed (5.4 calories per minute), cleans windows (3.7 calories per minute), or peels potatoes (2.9 calories per minute). Little wonder that the male cardiac patient is so anxious to flee the home to return to his job!

Perhaps the most significant contribution of the Work Classification Clinic is the demonstration of the need of the following types of research:

1. To expand the science of ergometry: to determine the energy requirements of a wider range of occupations; to measure the changes in the physiologic costs with changes in work methods; to develop methods of job simplification; to study the phenomenon of fatigue.

2. To study the effects of underexertion (undereffort) as well as overexertion.

Since recent reports seem to indicate that physical fitness enhances survival in coronary occlusion, the deleterious effects of overautomation, oversimplification of jobs, boredom, and of restriction of the worker should be evaluated. In fact the effects of a program of physical fitness on work performance and on the course of heart disease should be studied systematically.

Conclusions. The experience of the Work Classification Clinic has demonstrated that cardiac patients are employable in a great variety of jobs, safely and productively, and clarifies the urgent need for basic research in ergometry, human physiology, and psychiatry to enhance the return of the patient with heart disease to the world of work.

Moderator Katz: Thank you, Dr. Hellerstein. You have made your presentation clearly and I am sure we now have a better understanding of the function of the Work Classification Clinic.

We now come to the period of discussion. I would like to ask Dr. Plummer to tell us whether he agrees with everything said by his fellow panelists.

Dr. Plummer: Dr. Katz, I can't say that I agree with everything that has been said. In the first place, I think Dr. Hellerstein's figures that show that work on the job requires less energy than the work done at home, should be confiscated. If these figures get to our women folk we shall be in trouble. Here is a question for you, Dr. Katz. Don't you think we should do something about that?

Moderator Katz: No, we shouldn't because ours is a society dominated by women, and after all, the male is the weaker sex!

Dr. Plummer: I am impressed with the physiologic tests described, but I do have a question that I would like to ask the other 2 members of the panel. Would Dr. Bruce and Dr. Hellerstein tell us how they believe this testing can actually be used in industry and whether this type of testing has some value in our medical departments in industry?

Dr. Bruce: The use of the treadmill is to standardize the exertion and to minimize the varieties. If we did no more than get employees to walk and time how far or how long they can walk, up to 10 minutes, it would not be difficult to derive useful and practical information.

Dr. Hellerstein: I don't think it is necessary for industry to study each employee on a treadmill in the plant's dispensary. There are simpler methods of estimating fitness. The industrial physician can make on-the-job observations in specific cases. However, I would like to emphasize that it is the responsibility of industry to determine whether a subject can or cannot fulfill certain jobs. It is unrealistic to assume that a young or apparently healthy older worker can withstand the stresses of certain high energy jobs.
**PANEL DISCUSSION**

**Moderator Katz:** The answer is yes, but the tests need not be as elaborate as those employed in research.

**Dr. Bruce:** I would like to direct one question to Dr. Plummer. Would he be a little more specific about his own experience as to how often the cardiac patient who returned to work in his own industry presented real problems to management?

**Dr. Plummer:** Dr. Bruce, I cannot give any percentages but certainly it is an every day occurrence that there are problems in getting a cardiac patient back on the job. We spend a great deal of time talking over these problems with the private physician. We find that the psychological factors for the most part are much more important than the physical factors. Occasionally we deal with a problematic case; the most problematic case is the one that gets over into compensation. I would like to ask you the question, whether anyone has ever measured energy requirements of extracurricular activities, as for example, at a compensation hearing. I have an idea that the doctor's blood pressure and his energy expenditure sometimes would go even higher than that of the employee or his counsel.

**Moderator Katz:** Does that require an answer or was that simply a question used to make a statement?

**Dr. Plummer:** Well, Dr. Katz, it can be either way.

**Dr. Bruce:** I have no data on that particular point.

**Moderator Katz:** Thank you both. And lastly, Dr. Hellerstein, do you disassociate yourself from your colleagues in any fashion, or have they stated the case fairly?

**Dr. Hellerstein:** I think they stated part of the case, i.e., all industrial physicians are not so enlightened as Dr. Plummer. Most industrial physicians are not heart surgeons.

**Moderator Katz:** We must get other industrial physicians to take up cardiac surgery.

Dr. Feil has just informed me that our time is up. Time has a habit of passing too rapidly. I am sure that there are many things still unsaid but what has been said should give all of us plenty of food for thought. May I thank my panel associates for excellent presentations and the audience for listening so courteously.

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