

## 8. Evaluation

### INTRODUCTION

The work was done. The question arises—has it any value for medical science? Perhaps the unhappy doctors in the Ghetto, prey to the same intellectual deterioration they so vividly described as a result of starvation, themselves were deluded into thinking that they were accomplishing a meritorious piece of work. Perhaps they were merely occupying themselves, in an existentialist sense, because they were unwilling to face the facts of life—and death. Perhaps the material (fateful word!), was insufficient in quantity or poorly chosen. Perhaps the details of the experiments were faultily thought out or their execution mishandled. Perhaps the conclusions were already drawn before the project was started.

True enough, such delusions have appeared before, and with less reason, in the history of science. The great Newton occupied himself with apocalyptic calculations. The Ptolemaic theory was well-founded on careful observation. The early scientists found no difficulty in proving experi-

mentally the existence of phlogiston and the caloric fluid.

There is only one adequate test for the value of a scientific study such as this and that is the judgment of other investigators in the same field. To determine whether the Warsaw Ghetto project on starvation was a worth-while effort the specialists in the field of nutrition must be consulted. And to do that, pertinent questions must be asked: Was this study necessary? Has not this work been done before? What did the material consist of? What were the controls? How well qualified were the investigators? Were the results explicable? Were the conclusions valid? Is there evidence from other sources to support the conclusions? And finally, what was added to the fund of scientific knowledge?

### NECESSITY FOR THE PROJECT

There can be no question as to the necessity for the study. Probably the most comprehensive review of the literature on famine and starvation is found in the Minnesota Experiment Report by Professor Keys and his associates. After going over the literature they came to the conclusion, before starting their own experiment during World War II, that up to that time there had been no really thorough scientific study of the effects of chronic under-nutrition, of starvation, in human beings. All studies done before then were incomplete, lacking in essential data, measurements, etc., and consisted mainly of clinical observations.<sup>1</sup> Their conclusion was accepted by the United States government and by the various foundations and organizations that supported their extensive and expensive study. As will be shown, other than the Minnesota

study, there has been no other research comparable to the Warsaw project.

That other authorities felt the need for such studies can be seen from the following list of similar researches carried out from the beginning of World War II:

(a) the Belgian studies of 1940-1944, done with good technical facilities and access to medical libraries and not disturbed by any breakdown in civil order, but very limited by the small number of cases observed;

(b) the Louvain Prison studies, where four hundred men received 1700-1800 calories per day;

(c) the siege of Leningrad reports, which gave little factual data in detail on the previous degree of nutrition or on the effects of starvation on the population as a whole;

(d) the Paris mental hospital reports from 1941-1942, giving incomplete data on patients living on 1500-1800 calories per day for about twenty months;

(e) the Danish reports on concentration camp prisoners, compiled after the liberation, on a total of 1282 persons.<sup>2</sup>

It is obvious that the Warsaw project was not an idle gesture but a definite attempt on the part of the Ghetto doctors to fill a gap in scientific knowledge.

## MATERIAL AND TECHNIQUES

But regardless of the doctors' good intentions, the project, in order to qualify as a serious investigation, has to meet definite standards as to the type of material studied. On the basis of extensive study of data from various sources, Keys and his associates came to the conclusion that

starvation could be studied only if the subjects had subsisted for from six to twelve months on 30 to 50 per cent fewer calories than previously consumed, leading to a loss in body weight of from 20 to 40 per cent.<sup>3</sup> In their own study of thirty-six conscientious objectors, they therefore set up a diet of from 1570 to 1700 calories for the starvation period of 24 weeks, giving an average weight loss of 25 per cent; the average daily diet consisted of 275 gms. carbohydrates, 50 gms. protein and 30 gms. fats.<sup>4</sup> For comparison with previous studies the following table is instructive:<sup>5</sup>

<i>Group</i>	<i>Average Daily Calorie Intake</i>
French Prisoners of War (World War I)	2245
Germans—Blockade Period, April 1916	2343
July 1916	2232
April 1917	1985
German Prisoner of War Camp (World War II)	1611
Paris Mental Hospital April 1941	1447
Netherlands Famine—Third quarter of 1944	1529
Dachau September 1944	1017
May 1945	533

Needless to say, the Warsaw Ghetto supplied patients in sufficient quantity and sufficiently starved to meet the criteria. In discussing the Warsaw report, which was made available to him only after the Minnesota Experiment was completed, Keys comments:

The majority of detailed scientific reports on the effects of famine in man have been based on observations made during the phase of refeeding or attempted rehabilitation. Though a few days or weeks of medical care and extra alimentation may not greatly alter the picture, the situation in the actual period of starvation is of particular interest. The studies made in the Warsaw Ghetto are of unusual value. Technical work at Warsaw was surprisingly sound (in spite of the conditions under which they worked) and has the great advantage that

it concerns a population group of all ages and both sexes. . . . [Autopsies were important] but more important were the tests and measurements made in the living.<sup>6</sup>

As for the autopsies in starved patients, there had never been so many nor so detailed post-mortem examinations giving weights of the organs as were done in the Ghetto.<sup>7</sup> The Danish investigators say,

A remarkable contribution to our present knowledge of famine disease has been made by Jewish physicians in the ruins of the besieged Ghetto of Warsaw. In spite of the appalling circumstances the authors have succeeded in performing an excellent clinical, physiological and anatomical study . . . on the active phase of starvation . . . thanks to surprisingly sound technical investigations, this monograph can be considered as unique.<sup>8</sup>

Controls present no problem. The meticulous care with which all except "pure" cases were excluded, the verifications at autopsy, the comparison with previously studied subjects (as in Dr. Apfelbaum's work on heart dysfunction)—all these were controls. An even better control on the results is available by checking those obtained in Warsaw with those in other studies on semi-starved patients.

### COMPARATIVE FINDINGS

The most cursory comparison of the results from various studies shows how careful, even under the most distressing conditions, were the Ghetto doctors. Any detailed analysis would be out of place here, but some brief mention must be made of the findings elsewhere and how they agree or disagree with the findings in Warsaw.

The Minnesota group found the same blood changes as were found in Warsaw and the same block in migration of cells from the bone marrow into the circulating blood.

This lack of "ejectory stimulus" and the lack of parallelism in the red and white cell counts was also noted by Gillman and Gillman in their studies of chronically undernourished black South Africans.<sup>9</sup>

The latter authors confirm the rarity of peptic ulcer in semi-starved individuals,<sup>10</sup> as do the Danes.<sup>11</sup>

As for blood volume, so carefully studied in Warsaw, Keys reports a relative increase of plasma volume in starvation along with an absolute decrease of 8.6 per cent in total blood volume, findings consistent with those in Warsaw. The hydration of the tissues and its apparent lack of relation to osmotic pressure has been noted by many other authors. The peculiarity of the edema has been confirmed by a Mexican group.<sup>12</sup>

The cold cyanotic skin and the pigmentary changes were found in South Africans, Americans, and Mexicans, as well as in the Warsaw Jews. The apathy and depression occurring in chronic hunger have been a constant finding in all the studies along with the unchanged sensory perception and the lessened reactivity to drugs and antigens. The low basal metabolic rate, so crucial for an understanding of the whole syndrome, is confirmed by the Minnesota and Mexican data.<sup>13</sup>

The methods of the Warsaw doctors gave almost the same result (about -50%) for cardiac minute-volume as the elaborate technique used in Minnesota (-44.8%).<sup>14</sup> Low voltage of the ECG, bradycardia and disturbances in carbohydrate metabolism were found both in Warsaw and in Minnesota.<sup>15</sup> In agreement also was the striking absence of the classic vitamin deficiencies such as keratomalacia and scurvy.<sup>16</sup> As for rickets, Wilder, in his foreword to Keys' book, comments on how rarely rickets is found in the chronically calorie-deficient child.<sup>17</sup> Even such a comparatively trivial observation that the parotid glands become

enlarged was not overlooked, a finding previously noted and forgotten.<sup>18</sup>

Were there any differences at all? Indeed there were. Emphysema, so prominent in the Warsaw report, was not found at all in the Minnesota experiment.<sup>19</sup> Gingivitis was found in both studies, but dental caries only in Warsaw.<sup>20</sup> And yet, both of these signs, by their very nature taking a long time to develop, may have been absent in Minnesota because of the shorter (24 weeks) duration of the experiment.

One other difference, non-medical, existed. Keys remarks on the great increase in crimes of violence during periods of famine.<sup>21</sup> In the Warsaw Ghetto, all the violence came from the starvers, not the starved.

### CONCLUSIONS

On the basis of their findings the Warsaw doctors came to the conclusion that prolonged starvation in human beings leads to a specific disease entity which they called "starvation disease." They regarded this disease as one of adaptation to a peculiar prolonged and ungovernable stress-calorie deficiency. The same inference was reached by other workers unaware of the Ghetto studies. Professor Kleiber says, "An animal dying of starvation may be compared to the engine an automobile has which is left idling at a very low rate and which 'dies' when the rate of idling is too low to maintain the proper function of the carburetor and of the sparking device."<sup>22</sup> Keys and his collaborators agree:

Adaptation [is] a useful adjustment to altered circumstances. When the total basal metabolic rate decreases in starvation . . . it is certainly a favorable change in that it reduces the caloric deficit as compared with what it would be in the

absence of such change in the basal metabolism. To the starving individual the reduced metabolic rate means that, at a given food intake, this rate of loss of strength and endurance is diminished and that, to cover it to the limit, he will survive longer.<sup>23</sup>

They point out that a decrease of 40 per cent in the BMR is equivalent to a gain of almost six hundred calories per day.

The best example of the adaptive process is seen in the circulatory system. Keys says, as did the Ghetto investigators, ". . . the slow heart rate is adaptive in that it responds to a circulatory demand which is decreased because of the reduced metabolism of the body . . . the peripheral circulation is a compromise between the demands of tissue metabolism and heat conservation."<sup>24</sup>

The manner by which adaptation occurs is still obscure. Gillman and Gillman imply that the endocrines play a large role in the deranged metabolism of chronic undernutrition.<sup>25</sup> The Mexican investigators state that the syndrome is one of chronic hypopituitarism with secondary changes although they admit that the cause of the pituitary suppression is not known.<sup>26</sup> Keys and the Warsaw group also agree that hormonal changes are of great importance in the development of the syndrome.

It would be fruitless to pursue the discussion of the value of the Warsaw studies further. It is indeed a grave and wonderful thing that was done in the dark days of the Warsaw Ghetto. The fact that science has benefited by the devotion of the doctors adds further lustre to their memory.