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# NUTRITION
## IN A NUTSHELL

ROGER J. WILLIAMS

A foremost authority on the science of nutrition presents in simple language the facts about our nutritional needs.

With Illustrations by Nell Taylor

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WITH ILLUSTRATIONS BY NELL TAYLOR

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# PREFACE

The whole story of nutrition, with or without a happy ending, cannot be told yet because it is still unfolding. Week by week, year by year, and decade by decade, new clues are coming to light in the research laboratories of the world.

The story becomes more interesting as new clues develop. It is ten times more intriguing now than it was when middle-aged practicing physicians heard it in their medical-school days. It promises to be more thrilling a decade from now.

As a biochemist I have been in the midst of this story since the very early chapters. When nutritional science was in its infancy I helped teach medical students in the University of Chicago what was then known about the subject. Since then I have been for decades actively and continuously engaged in exploring, discovering, and developing better insights into nutrition and its meaning.

The time has come for one who can present a first-hand rather than a second- or thirdhand account to tell the story of nutrition to nonscientists who are not interested in the technicalities of biochemistry. Nutrition is at the threshold of new and revolutionary developments and its potentialities for the improvement of health are vast.

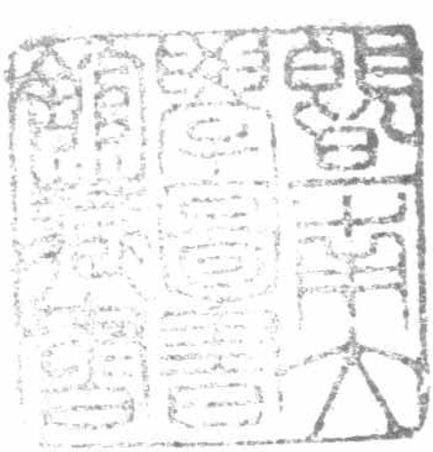
The general story—beginning at the beginning—has never been told in this form before. The approach is fresh and the point of view forward looking. While expert nutritionists and physicians may well ponder over the contents of this little book, it is being written primarily for the public, each of whom has a stake in the outcome.

There exists for each individual a personal story of his own nutrition which he may be able to modify or even revolutionize. Whether this story can be manipulated to yield a happy ending depends in part on his own understanding and insight into what nutrition is all about. Understanding and insight are one's only protection against those who, on the one hand, may regard nutrition as a science completely wrapped up twenty years ago, or on the other hand, against those who make extravagant and ignorant claims for their own faddist notions.

*Roger J. Williams*

# NUTRITION IN A NUTSHELL

The proof of the pudding is in the eating
*and in the subsequent metabolic effects.*



# THE AUTHOR

It can safely be said that no one has deeper insight or is more qualified to write on the subject of nutrition than Roger J. Williams. He is the discoverer of pantothenic acid, a key B vitamin required in the machinery of all oxygen-using organisms, and did pioneer work with folic acid, an anti-anemia vitamin, and gave it its name. Since 1941, Professor Williams has been Director of the Clayton Foundation Biochemical Institute at the University of Texas, where more vitamins and their variants have been discovered than in any other laboratory in the world.

Born in India in 1893, the son of missionary parents, he received his B.S. degree from the University of Redlands and his M.S. and Ph.D. degrees from the University of Chicago. As early as 1919, when nutritional science was a mere infant, he was teaching medical students in the University of Chicago about nutrition and writing his doctoral thesis on the nutrition of yeast cells and their vitamin needs. Ever since, at the University of Oregon, Oregon State University, and the University of Texas, he has been exploring in the field of nutrition and has played a substantial role in bringing our knowledge of nutrition—including man's nutrition—to its present advanced and forward-looking state.

Long recognized by fellow scientists as a leader in nu-

trition and biochemistry, Professor Williams is a member of numerous scholarly and scientific organizations. In 1946, he was elected to membership in the select National Academy of Sciences. He also received the Mead Johnson Award of the American Institute of Nutrition and honorary degrees from Redlands, Columbia, and Oregon State University.

His broad knowledge has been utilized in connection with his membership on the medical boards of the National Polio Foundation, the Multiple Sclerosis Society, and the Muscular Dystrophy Associations of America, Inc., as a consultant for the American Cancer Society, and as a member of the National Food and Nutrition Board.

In 1957, he became President of the American Chemical Society, the largest scientific organization in the world. He is the only biochemist who has been so honored.

In this book he writes in simple language, not as a highbrow scientist nor as a faddist but as a well-qualified expert who answers honestly and practically many questions—novel and commonplace—for people who eat regularly and suspect that what they eat makes a difference.

# ACKNOWLEDGMENTS

I should like to acknowledge with grateful appreciation the help of those who have read the manuscript of *Nutrition in a Nutshell* during the various stages of its preparation and who have offered suggestions and/or encouragement. Among these are my colleagues: Robert E. Eakin*, Margaret A. Eppright*, James B. Gilbert†, C. Richard King, T. S. Painter*, Richard B. Pelton, Lester J. Reed*, Lorene L. Rogers*, William Shive*, D. J. Sibley, Jr.†, Frank L. Siegel*, Alfred Taylor*, George W. Watt*, Daniel M. Ziegler*, and M. Phyllis Williams, my wife. Others located elsewhere who have given similar help are Walter C. Alvarez†, Edward L. Bortz†, Vernon Cheldelin*, Conrad A. Elvehjem*, E. E. Howe*, Ralph W. Gerard*†, Grace A. Goldsmith†, Robert S. Goodhart†, Wendell Griffith*, C. Glen King*, Chauncey Leake*, O. Lee Kline*, Herbert E. Longenecker*, Lloyd C. Miller*, Irvine H. Page†, H. R. Rosenberg*, W. Henry Sebrell†, Fredrick J. Stare*†, Roger W. Truesdail*, R. R. Williams*, and Lemuel D. Wright*.

None of these individuals should be held responsible for what is in the final copy. A few of them (but very few) would differ from me on some substantial points. The comments of all have been carefully weighed.

I wish particularly to acknowledge the help of my secretary, Alice M. Timmerman, whose expertness and devotion to her job has engendered admiration on the part of all who know her.

*Roger J. Williams*

* These individuals hold nonmedical doctorate degrees (usually the Ph.D. degree).

† These individuals hold M.D. degrees.

# NUTRITION IN A NUTSHELL

# CONTENTS

CHAPTER I

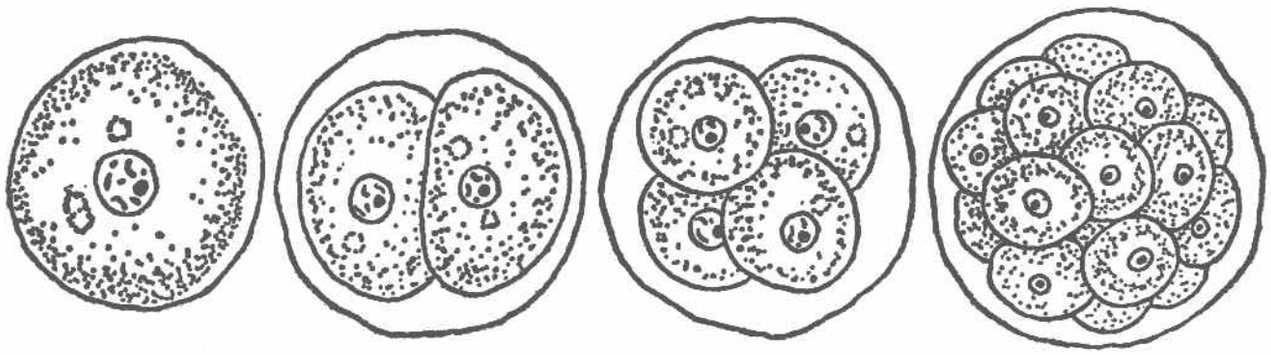
# WHEN DOES NUTRITION START?

At that dramatic moment when a microscopic wiggly male cell pushes its way into a much larger egg cell and joins forces with it, a human being begins to exist, and nutrition starts.

This developmental period, when things can definitely go "right" or "wrong," is vitally important, and nutrition can exert a profound influence that is felt throughout life. The growing embryo which becomes organized to an unbelievable degree, cannot be produced from nothing; it must get its sustenance hour by hour and day by day from the mother—who in turn gets from the food that she eats everything that she passes on to her child-to-be.

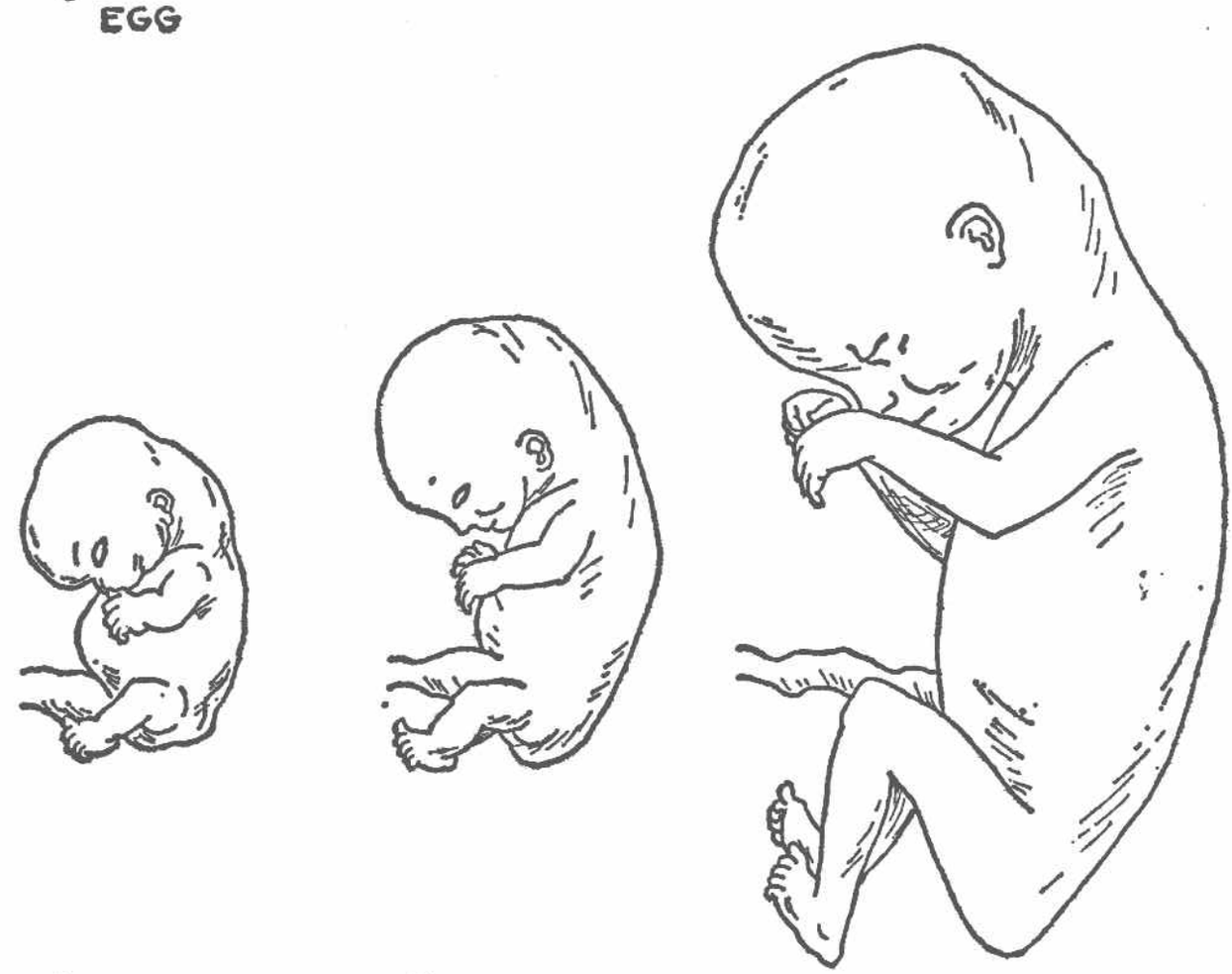
If the mother is not completely healthy and well nourished in every respect, she may fail to furnish the embryo with the best nutrition. In this case all sorts of difficulties—major or minor—may arise depending upon what nutritional items are in short supply and how great are the shortages. Deformities, stillbirths, retarded mental development, miscarriages and other more obscure troubles that show up in later life may have their origin in improper embryonic nutrition.

The story of human nutrition contains many blank pages because experimentation must be limited. No sci-



THE FIRST 4 DAYS OF HUMAN DEVELOPMENT
MICROSCOPIC VIEW (x 100)

FERTILIZED EGG | 2 WEEKS | 4 WEEKS | 6 WEEKS



8 WEEKS | 9 WEEKS | 12 WEEKS

HUMAN EMBRYOS, ACTUAL SIZES

It is during embryonic development that nutrition starts.

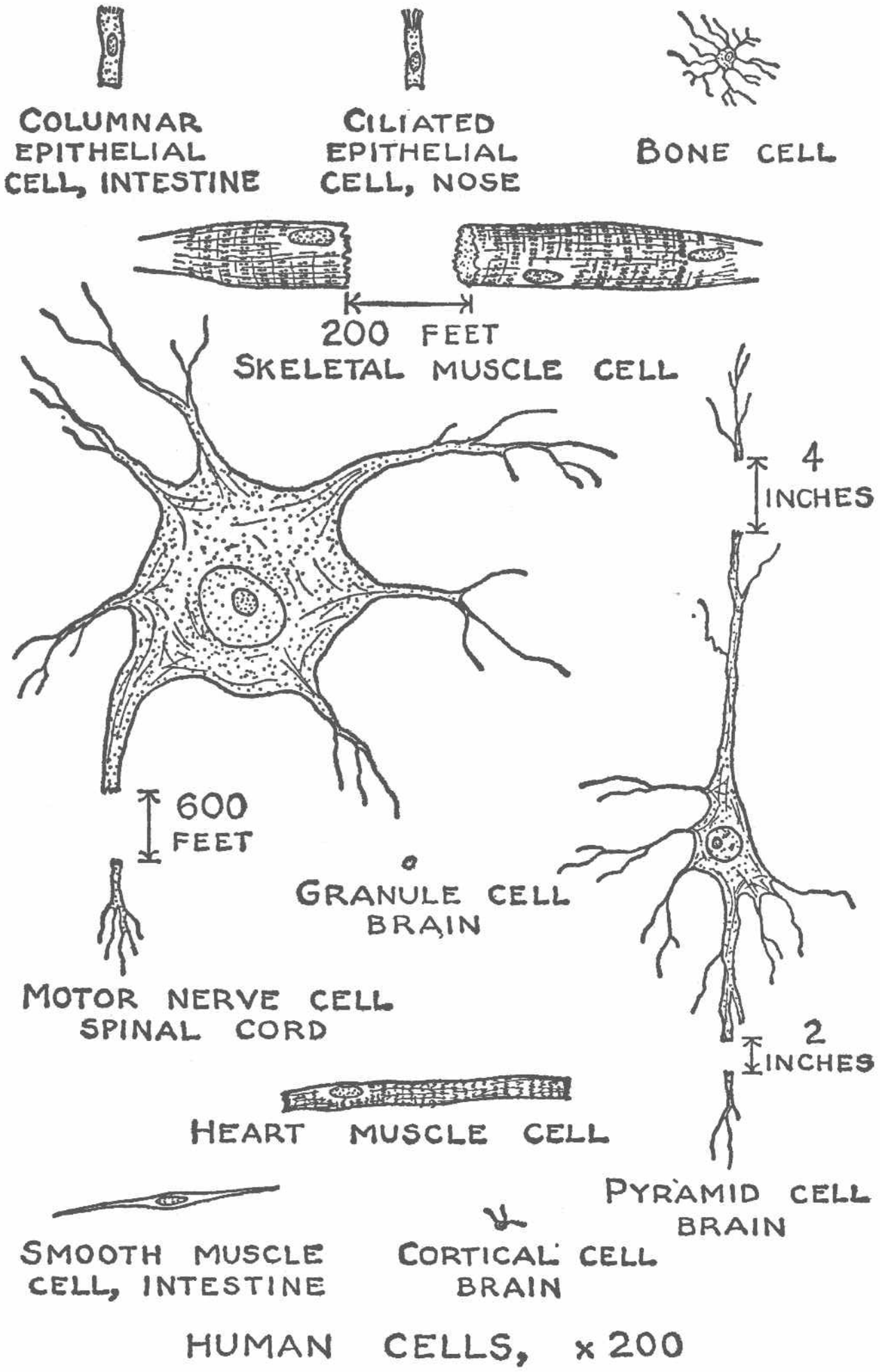
entist will deliberately starve or partially starve an unborn baby in order to find out what troubles will develop later in life! Experiments of this sort can be done with animals which, for purposes of improving human life, are expendable. In animals, difficulties in great variety and of extreme severity can be produced at will merely by furnishing—through the mothers—faulty nutrition to the growing embryos.

Various stages in the development of a human being are shown in the illustrations on page 2. After the male cell has penetrated the egg cell, the fertilized egg is large enough to be visible to the naked eye. Just barely, however, as it has a diameter less than that of an ordinary pin. To show more what it looks like and how it develops during the first four days, pictures are shown (p. 2) enlarged 100 times. The *actual* sizes and appearance of the embryos in later weeks are shown in the lower illustrations on the same page.

But this gives only a gross picture. When the original fertilized egg cell divides and subdivides, the "daughter" cells are at first almost duplicates of the original parent cell. Before many generations have been produced, the daughter cells begin looking more and more like "adopted" daughters and before long they lose all resemblance to the original parent. Some become bone cells, some muscle cells, some nerve cells, some skin cells, some blood cells; hundreds of different kinds of cells develop and often billions of each kind.

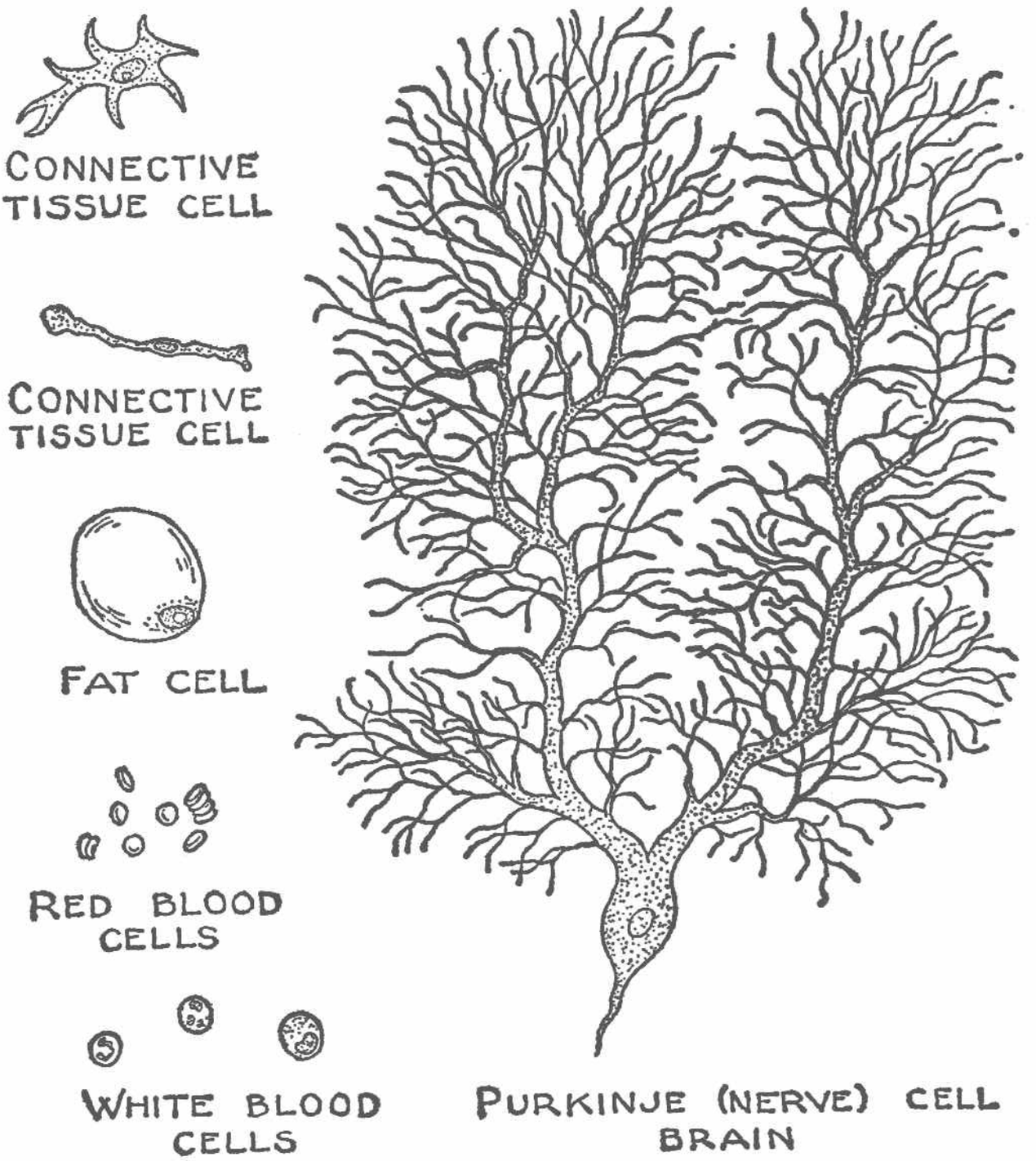
This mysterious process of becoming different is little understood. Biologists appropriately call it "differentiation."

The almost unbelievable lengths to which the differentness extends is made clear in the pictures of twenty different human cells, (pp. 4, 5) all magnified to exactly




HUMAN CELLS, x 200

Each of twenty types of cells represented in the illustrations above and on the facing page (as well as many more types) needs




HUMAN CELLS, x200

day-to-day adequate nutrition. Each type probably has a set of needs which is quantitatively if not qualitatively distinctive.

the same degree (× 200). The smallest cell shown, even when magnified to this extent, appears smaller than a birdshot, while the largest appears enormous by comparison. A motor nerve cell appears like a string 600 feet long with a frayed "knot" on one end about the size of a marble. A skeletal muscle cell on the same scale is often about the size and shape of a 200-foot-long pencil. Tremendous variation in form is also shown. Some are like little buttons; certain nerve cells (Purkinje) have the form of a branching tree.

Chemical analyses of these differentiated cells show that they vary greatly in composition. Some, for example, have a very high percentage of protein, others have very low percentages by comparison. Each has distinctive kinds of protein. Some have unique types of fatlike substances not found in others. Fat cells contain a large percentage of fat; brain cells on the other hand contain little or no true fat. The expression "fat head" is always a misrepresentation.

Due to differences in composition, every type of cell has distinctive nutritional needs, yet they all must derive their nourishment from the fluids that bathe them. What each cell type needs and exactly what happens when the needs are only partially satisfied, are open questions by no means completely answered.

Some types of human cells have been grown outside the body in glass vessels (tissue culture) in recent years. From such studies it has been found that different cells have distinctive needs (which may be quite different from the nutritional needs of the body as a whole), and that cells in general can be nourished at various levels of efficiency. Cells can be cultured in various solutions containing different assortments and proportions of ingredients, with *varying degrees of success*. In some solutions