fectious diseases also indicates a positive relationship between lymphocytes and tumor growth. The sex hormones are known to be a factor in tumor production; unbalance of the sex hormones has been found to stimulate growth of lymphoblastic tissue.[10] Lymphocytosis occurs in some stages of syphilis, a fact that may account for the greater incidence of carcinoma of the lip in syphilitics.[11]

Lymphopenia. Not only are there correlations between an increase in the number of lymphocytes and increased incidence and growth of tumors, but there are also correlations between a decrease in the number of lymphocytes and decreased incidence and growth of tumors.

Chronic inanition decreases both the blood lymphocytes and the growth of tumors. Stern and Willheim state that "the prevailing majority of authors have expressed the opinion that food restriction is followed by depression of neoplastic growth."[12] Animal experiments give evidence to prove that the amount and kind of food affects the incidence of tumor development. No tumors occurred in C3H mice placed upon a diet in which the carbohydrates and fat were reduced to one third.[13] Inanition has been found by many authors to reduce the number of circulating lymphocytes and to cause involution of lymphoid organs.

Furthermore, observations have frequently been made that primitive societies are less well nourished and have a lower incidence of cancer[14] and also that cancer is less frequent among people having progressive tuberculosis,[14] a condition found by Sabin[15] to be accompanied by lymphopenia. However, the statistical significance of these observations has not been established.

The therapeutic effect of radiation agrees with the idea that a reduction in lymphocytes reduces tumor growth. Mottram[16] found that x-rays over a wide range of intensity caused a 50 per cent. decrease in the number of circulating lymphocytes, and Michels[17] found that the lymph nodes underwent fatty involution following x-rays.

Nucleus of the Lymphocyte. The most obvious characteristic of the small lymphocyte is its enormous nucleus in proportion to the amount of cytoplasm. No other cell in adults has a nucleus nearly as large in proportion to the cytoplasm except sperm, cells that are known to initiate the division of another cell. Basophilic staining reveals that most lymphocytes have larger nucleoli and contain more nucleic acid than most cells. Staining also shows that there are two kinds of small lymphocytes varying in their degree of basophilic staining. Stowell[18] thoroughly reviews the literature on the role of thymonucleic acid in tumors and concludes that a disturbance of the nucleoproteins forms the basis for an "intracellular cause of neoplasia." The lymphocyte may have a part in modifying nucleoproteins and be the source of the greater amount of thymonucleic acid found in carcinomas.[19]

There may also be a relationship between normal growth processes and quantitative chemical changes initiated by lymphocytes on the one hand, and abnormal growth and abnormal lymphocytosis on the other. The thymus gland has long been thought to have a part in normal growth; at the present time thymocytes are considered to be the same as lymphocytes. Lymphoid tissue involutes with age, the decrease being particularly coincident with the attainment of mature growth in the case of the thymus gland. In addition, those tissues of the adult that are most active mitotically contain large numbers of lymphocytes. The bone marrow continues production of blood cells throughout life and contains quantities of lymphocytes. During pregnancy the mammary gland of the adult is also subjected to rapid growth, a change accompanied by the invasion of lymphocytes into this organ.

Summary. Lymphocytes are present in metastases of mammary carcinomas, in tissues containing the mammary tumor inciter and at neoplastic foci caused by irritation. Unbalance of sex hormones stimulates lymphoblastic tissue and increases tumor incidence. Inanition and radiation reduce the number of circulating lymphocytes and also the growth and occurrence of tumors. The nucleus of the lymphocyte is considered to be a possible factor causing a disturbance of the nucleoproteins.

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WHAT IS EDUCATION AND WHAT IS DISPENSABLE?

THE suggestions offered by H. M. Dadourian[1] include two ideas which seem quite opposite. I fully

[1] H. M. Dadourian, SCIENCE, 101: 612, 1945.

concur as to the "pressure due to mounting scientific knowledge," but I look with suspicion upon proposals for streamlining education. Dadourian suggests elimination of everything which is not indispensable. He also suggests teaching of physical and biological sciences from kindergarten through high school. The latter should find favor with science teachers, but would it not be one of the dispensables of others?

The second group of suggestions which troubles me includes "greater use of the historical and philosophical approach." I have wanted to follow this but have been unable to see how to include it in courses already too short for fundamentals. "Greater use of the laboratory method" is also suggested, but I gather from slight exposures to the streamliners that this is a waste of time.

Many years ago a colleague expressed the opinion that there was too much duplication in education. My old-fashioned mind, impressed with the difficulties the modern generation has in simple sums and grammatical constructions, responded: "Yes. To-day we shall teach $2 \times 2 = 4$; to-morrow we must not repeat that, but teach something else."

I have long felt that learning should be regarded as a photographic process. A good impression is secured by using a fine stop and long exposure. The modern photographer reduces time by use of faster plates, and there are those who hold that modern methods of teaching accomplish a similar end. It is probably fortunate that we can not change the brain cells so easily. Nature slowly heals over the scars of volcanic eruption and those of devastating war. Two times two are still four; there still are 24 hours in each day; plants still synthesize the life-giving carbohydrates.

Some years ago I evolved a definition of education, *viz.*, "something to keep the child busy while he is growing up." I have been told that this is all wrong, that modern methods recognize definite goals and procedures. Perhaps this period is not "education." Perhaps education only begins with graduation from college. Perhaps it is largely extra-curricular. Many of our students profess to have discovered that it is so. In any case, we need to recognize that it differs greatly in individuals and in subjects. Differences in opinion are usually differences in interpretations. My definition could scarcely be training for a profession, and those who do not approve of it can easily hold that all education should be training for profession.

After more years of trying to participate in education, I still feel that my definition has some merit. I recall some pithy advice of another colleague of the old school: "It doesn't matter what courses you take. Pick out the best teachers and take the hardest courses they offer." My own son wrote to a leading law school to ask what undergraduate courses they would suggest. They recommended no specific courses but only that he take substantial ones and follow them through.

After some years of trying to use short cuts in laboratory biology, I find myself tending to revert to the old style requirement of making drawings, because they give longer exposures and opportunity to raise questions which cause students to begin to think and to consider what they are seeing. Others will no doubt succeed better with new methods. Good teachers are deplorably rare and too often are drawn into more lucrative fields.

The pressure due to mounting knowledge is very real. It is serious. Perhaps we wonder if we begin to see reasons why ancient civilizations decayed after reaching a high peak. I am a pessimist. It is difficult to be otherwise, faced with colossal waste of war, strife and bickerings, when there is crying need for reasonable cooperation. There are heartening signs of serious attempts to meet the present situation, and it should be possible to at least postpone general calamity.

Reasonable solution of present affairs will not relieve the pressure due to mounting knowledge. I have no panacea to offer, unless it be willingness to know less, to do less, to live more slowly and sanely. The streamliners and post-war adjustmenters would have us believe that they are solving problems, but when the smoke and dust have cleared away, even if our civilization tumbles, two and two will still make four, the sun will still shine and the earth will be green.

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SCIENTIFIC BOOKS

THE VELOCITY OF LIGHT

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