

sources of origin in the United States, where nearly all the research work has been done.

Systematic criteria have been applied by the authors in making a selection from the material they have examined. Summaries of all suitable studies, grouped together in relation to various aspects of the instructional film, and the interpretations arising from each group, form the bulk of the report.

General findings previously reached by the Pennsylvania organization have much influenced the theoretical basis for the grouping of these summarized studies. In the present article some of the items in this new report that have not been mentioned before, or stressed, in the Pennsylvania Technical Reports will be indicated.

The film's contribution to comprehension, rather than to rote memory, constitutes one such item. People taught with films are found to be better able to apply their learning than people who have had no film instruction. In tests carried out by P. J. Rulon², pupils taught by text-plus-films excelled those taught on a text-only basis by a larger margin on 'eductive' than on 'rote' questions, the ratio being 24.1 to 14.8 per cent. Performance on eductive questions could be predicted more accurately from a knowledge of mental ability and previous achievement than could performance on rote questions. Differences between rote and eductive scores were in the same direction as differences between verbal-test and picture-test scores. From this Rulon concluded that "picture tests measure education to a greater extent than do the verbal tests". The contribution of films to comprehension is borne out by the work of P. E. Vernon³, who conducted an experiment on the value of the film and filmstrip in the instruction of adults, and of J. J. Gibson⁴, both of which are also summarized. In Rulon's investigation the superiority of the text-plus-films over the text-only group was found to be greater three and a half months after the films had been shown than it had been immediately afterwards. Several other summarized studies show the contribution of films to a long-term retention of knowledge.

There can be symbolic or mental practice when learning a motor skill from films. Verbal formulations seem greatly to facilitate learning for some individuals. These matters—linked to the larger one of the relationship between language and thought—affect practically the part that can be played by speech in films. The work of M. A. May⁵ on the psychology of learning from demonstration films, W. E. Twining⁶ on mental practice and physical practice in learning a motor skill, H. A. Ruger⁷ on the psychology of efficiency, and several others, is summarized and considered.

Based on the evidence of all the studies, generalization is attempted in the last chapter of the report. According to the authors, people learn more quickly, and retain better what they have learnt, when appropriate films are used than when they are not used. More learning results from a combination of films with other instructional means than by either alone. The learning from films may be of facts, of motor skills, of concepts leading to increased comprehension, and of concepts leading to the formation of attitudes and opinions. Moreover, instructional films stimulate other learning activities. It is possible for a film to be equivalent "even to an excellent instructor in so far as the instructor's function is communicating the facts or demonstrating the procedures presented in the film".

"Films have greatest influence when their content reinforces and extends previous knowledge, attitudes, and motivations of the audience." Three of the ten principles of film-influence again stress the need for specific and confined objectives when designing instructional films, including careful regard for the characteristics of the audience. Four other principles are more distinctively related to the film medium: the influence of films is primarily in their visual presentation; pictorial context is important; the treatment of a film should generally be subjective; and the rate of putting forward new facts and ideas should be properly regulated. In the final principles the importance of introductions, summaries, etc., either built into a film or provided by the teacher, and of the teacher's leadership, are emphasized.

C. DENIS PEGGE

¹ *Nature*, **168**, 775 (1951).

² "The Sound Motion Picture in Science Teaching" (Cambridge, Mass.: Harvard University Press, 1933).

³ *Brit. J. Educ. Psychol.*, **16**, 149 (1946).

⁴ Motion Picture Testing and Research. Report No. 7: Army Air Forces Aviation Psychol. Prog. Res. Rep. (Washington, D.C.: Gov. Printing Office).

⁵ *J. Educ. Psychol.*, **37**, 1 (1946).

⁶ *Res. Quart. Amer. Assoc. Hlth. Phys. Educ. and Rec.*, **20**, 432 (1949).

⁷ *Arch. Psychol.*, **19**, No. 15 (1910).

THE ROCKEFELLER FOUNDATION

REPORT FOR 1950-51

A REVIEW of the work of the Rockefeller Foundation for the year 1950 was not published, because any definitive discussion of plans and programmes was impossible while the Foundation was being reorganized to meet the changing conditions of a world in transition. The review by the president, Mr. Chester I. Barnard, now published*, covers the two years 1950 and 1951, during which the Foundation's income was almost 30 million dollars, nearly 17 millions being received in 1951. Grants and appropriations totalled 11,247,964 dollars in 1950 and 21,158,880 dollars in 1951; of this, in 1951, 3,796,270 dollars went to the Division of Medicine and Public Health, which was formed in 1951 by merging the International Health Division and the Medical Sciences Division, these two bodies receiving in 1950 2,326,840 and 1,240,900 dollars, respectively. At the same time, as a further result of a survey of the Foundation's activities, the Natural Sciences Division, which received 2,092,515 dollars in 1950, was reconstituted as the Division of Natural Sciences and Agriculture, to which 3,680,208 dollars went in 1951. A closer co-ordination of all activities of the Foundation was also recommended by the Survey Commission, and Mr. Barnard reaffirms the belief that the broad basis of the Foundation's planning should be human ecology. The Division of Social Sciences received 4,585,895 dollars in 1951, and the Division of Humanities, 1,658,072 dollars; the corresponding figures for 1950 are 2,122,085 and 1,491,250, while a further 5 million dollars in 1951 went to the General Education Board.

Reviewing the work of the Foundation in public health and medicine, Mr. Barnard records that from 1914 to the end of 1951 the Foundation expended nearly 24 million dollars on medical education and

* The Rockefeller Foundation: a Review for 1950 and 1951. By Chester I. Barnard. Pp. 126. (New York: Rockefeller Foundation, 1952).

research in the medical sciences; nearly 14 millions, more than two decades of work, costing the lives of six scientific workers, went to the isolation and identification of the causal agent of yellow fever and the development of a practical method of culturing the virus for the large-scale production of the vaccine. A definitive history of this work, edited by Dr. G. K. Strode, was published in 1951 under the title "Yellow Fever", and also in 1951 the Nobel Prize in Physiology and Medicine was awarded to Dr. M. Theiler, a virologist on the team which developed the vaccine. The programme of the new Division is now being developed with four objectives: the advancement of professional education; the study of medical care; the investigation and control of specific diseases and deficiencies; and the development of the health sciences.

For the first, it is proposed to make relatively modest grants at strategic points within a faculty to strengthen its teaching, and an exploratory survey is now being made of the status of medical education in South America. The medical care programme will be concentrated on scientific aspects of training and research, especially in the biosociology of disease, in the expectation that, when research has accumulated and systematized the data into a scientific discipline, medical schools will introduce students to the practice of community medicine with an emphasis on 'social diagnosis' comparable to that on physical diagnosis. Under the third objective, special attention is being directed to the study of virus infections transmitted by mosquitoes, ticks, lice and other insects. A survey of the major virus problems of Egypt is being made in co-operation with the United States Naval Medical Research Unit, and a virus research laboratory has been established at Poona in collaboration with the Ministry of Health of the Indian Government. The fourth objective includes a grant to the University of Oregon Medical School for research in constitutional medicine, and grants for studies of child psychology and guidance, medical studies of old age, etc.

In December 1951 the trustees of the Foundation decided that experimental biology would continue to be an active interest in the natural sciences programme but on a reduced scale in the United States, and the greater part of the effort will be devoted to the promotion of scientific agriculture. The Mexican agricultural programme, on which the Foundation has spent more than 1.7 million dollars since its inauguration in 1943, is now operating on an annual appropriation of 320,000 dollars from the Foundation, with additional funds from the Mexican Government, and animal husbandry is being added to the programme in 1952, commencing with chickens and pigs. The Colombia project for the improvement of corn, wheat and other basic food crops, which received 50,000 dollars in 1950 and 135,000 dollars in 1951, has benefited in many ways from the pioneering in Mexico: some of the new varieties of wheat developed for Mexico proved to be remarkably well adapted to Colombia, and under the revised programme for the natural sciences it is proposed to extend similar operating projects in scientific agriculture to other Latin American countries. A further appropriation of 100,000 dollars was made in December 1951 to finance for three years the agricultural aspects of a six-year programme for the agricultural development of the State of Mexico, while a consultant of the Division of Social Sciences is surveying the social problems involved with the view of a co-ordinated 'human ecology' approach to the

interrelated problems of food, health, education and social relations.

Apart from these agricultural programmes in Mexico and Colombia, grants made for experimental biology and related fields of science have averaged 2 million dollars in each of the six post-war years, and, of this, 1.6 million dollars was distributed in the United States; this amount is to be decreased during the next few years to about 500,000 dollars, while the grants distributed in Europe and in Latin America will be increased to at least 500,000 and 700,000 dollars, respectively, with a further 1.5 millions for the programmes operating in agriculture.

During the period under review the main interest in experimental biology has been biochemistry, and during 1950-51 grants totalling nearly 1.5 million dollars were made for this purpose, including 168,615 dollars to the Polytechnic Institute of Brooklyn for an intensive attack on the problem of protein structure. Grants for enzymology totalled 589,000 dollars, including 35,000 dollars for Prof. H. A. Krebs's work at the University of Sheffield on sugar metabolism. Some 202,000 dollars has been contributed in support of the Conservation Foundation's programme for the study of the conservation of animal and plant life, water sources and productive soils.

In the social sciences the Foundation's programme seeks to assist all the disciplines which can contribute to the development of a science of social behaviour, the application of social science to human problems, the discovery and development of social science talent or the establishment of a firm basis for social philosophy. For research in economics 400,000 dollars were appropriated in 1950 to the National Bureau of Economic Research; 140,000 dollars went in 1951 to Harvard University for Prof. W. Leontief's study of economic structure, and 122,750 dollars went in 1950-51 to the Food Research Institute, Stanford University, partly to complete a five-year study of world operations in food and agriculture during the Second World War. An additional 420,000 dollars were appropriated in 1950 for support over five years of the Russian Institute of the School of International Affairs, Columbia University, and 180,000 dollars to the International Studies Group of the Brookings Institution for research, etc., on American foreign policy. Grants were also made for several studies of problems of ageing, while in December 1951 a capital grant of 1.5 million dollars was made to the Social Science Research Council. Grants totalling 242,500 dollars have been made to the American Law Institute of Philadelphia in furtherance of the preparation of a comprehensive criminal code for recommendation to the State and Federal governments. Altogether, grants for the social sciences totalled more than 2 million dollars in 1950 and more than 4.5 millions in the following year.

A survey of opportunities in the humanities, which commenced in 1950, has led to the selection of three types of humanistic studies for support: first, language, logic and symbolism, representing the Foundation's interest in means of communication of knowledge; intercultural understanding, with the emphasis on the dissemination of knowledge; and humane values. In the first group, 50,000 dollars were appropriated for a detailed analysis and description of the Russian language, under Prof. R. Jakobson at Harvard University, and 69,000 dollars for an integrated study of the theory of language and

symbolism at the University of Michigan. In the second, 325,000 dollars were appropriated in 1950 for the studies initiated at Cornell University, with field headquarters at Bangkok, into the effects of technological and economic change on the peoples of South-East Asia, the effects of the United States and the United Nations programmes on the political structures and ideologies in the area, and the status of Chinese and Indian minority groups there. The Institute of Islamic Studies at McGill University, Montreal, has received 214,800 dollars for a five-year period, and grants totalling 194,000 dollars have been made in support of the programme of American studies, launched jointly in 1950 by the University of Tokyo and Stanford University.

The grants, totalling nearly 1.5 million dollars in 1950 and more than 1.6 million dollars in 1951, made through the Division of Humanities, were, Mr. Barnard points out, inspired by the belief that in this field, as in the social sciences, the emphasis is no longer on knowledge but rather on the contribution that may be made to the processes by which our attitudes, beliefs and judgments of value are developed, made more coherent and integrated into a harmonious pattern. If these processes are to be kept healthy in a free society, Mr. Barnard suggests that it is important, first, that the society have creative effort which is really producing new ideas and putting them into understandable forms. Criticism is also essential, to keep creative workers operating on constructive lines; lastly, what Mr. Barnard terms—for want of a more descriptive word—experience is also needed. These are among the reasons which lead the Foundation to foster research and writing in modern history—for example, dramatic writing—and to promote the freedom of the Press. Of the 3,149 applications for aid declined in 1951, 973 were for fellowships, scholarships and travel and training grants, and 618 for support of scientific research projects and teaching programmes.

UNITED STATES PULP AND PAPER INDUSTRIES

IN a world where raw materials of all sorts are at a premium, a publication, No. 7 of the Royal School of Forestry, Stockholm, entitled "U.S. Pulp and Paper Industry with Special Reference to its Supply of Raw Material"*, is of particular interest. The consumption in the United States of paper and paperboard prior to the Second World War amounted to about 50 per cent of the total world consumption, and the corresponding figure has now risen to about 70 per cent, owing to the rise in the United States domestic consumption; this latter rose from 15.2 million metric tons in 1940 to 22.5 million metric tons in 1949, the equivalent of an increase from 114 kgm. to 153 kgm. per head of the population. In Sweden, where the consumption per head is probably the largest in Europe, the corresponding consumption for the same year was 80 kgm.

The question is, how are the United States to cover their long-term needs in the way of paper and board, and fundamentally this is a question of

* Kungl. Skogshögskolans Skrifter 7: Förenta staternas massa- och pappers-industri med särskild Länsyn till des råvaruförsörjning (U.S. Pulp and Paper Industry with Special Reference to its Supply of Raw Material). Av. Th. Streyfert. Pp. 85. (Experimentalfaltet, K.S., 1952.)

raw-material resources. How much can they obtain from their own forests? The balance must be imported. In 1949, 35 per cent of the paper and board consumption was covered by imports in the form of paper, wood pulp or pulp wood. The consumption of pulp wood rose from 14.5 million cubic metres in 1925 to 17.8 million in 1935 and 24.2 million in 1949. In the last-named year the United States imported 4.3 million tons of paper (the bulk of it newsprint), 1.6 million tons of wood pulp and 4.3 million cubic metres of pulp wood. All the pulp wood, the greater bulk of the newsprint, and three-quarters of the wood pulp came from Canada and Newfoundland, and the balance from Scandinavia and Finland.

At the same time the forests of the United States have been yielding a progressively increasing volume of raw material. Pulp wood has increased from 12.7 to 44.7 million cubic metres between 1925 and 1949. This is partly due to the amount coming from new forests in the southern States and Pacific north-west. More intensive valuations of the volume of timber in the coniferous forests are now available, and it is apparent that over-cutting, that is, exceeding the annual increments put on, is taking place in the coniferous forests. In the hardwood forests, for long neglected, the annual increment considerably exceeds the volume felled. It is in this latter type of forest that the United States will have to look in the future for some of their requirements. In how far the annually increasing demands will be met by Canada, Scandinavia and other European countries and so forth is problematical, for Europe requires a far larger amount of these materials than are at present available to her.

PROXIMITY OF GENES CONTROLLING THE FERMENTATION OF SIMILAR CARBOHYDRATES IN SACCHAROMYCES

By PROF. CARL C. LINDEGREN and GERTRUDE LINDEGREN

Biological Research Laboratory, Southern Illinois University, Carbondale, Illinois

FOUR different genes in *Saccharomyces* controlling the hydrolysis of alpha-glucosidic saccharides are on the same chromosome. The genes *MA*, *MZ* and *MG* controlling the hydrolyses of maltose, melezitose and alpha-methyl glucoside are in one linkage group¹: (1) *MA* and *MZ* were shown to be linked by frequency of recombination; (2) *MA* and *MG*, which usually recombine freely, were shown to be on the same chromosome by the spontaneous appearance of a crossing-over suppressor in one family. The observations presented here show that *SU* (which controls the fermentation of sucrose and raffinose by producing a beta-fructo furanosidase) is a member of the same linkage group. *Saccharomyces* chromosomes are extraordinarily long genetically, and in most experiments *MA*, *MG* and *SU* recombine independently. Linkage between *MG* and *SU* was revealed by the suppression of crossing-over between them, presumably due to the spontaneous occurrence of an inversion. The pedigree described below overlaps one described