

evident that it is a somewhat indefinite boundary line.

To express the distribution of any species it ought to be sufficient to enumerate the divisional numbers of the areas in which it occurs and its ultimate limits to the north and south and in an easterly and westerly direction. Range of altitude in each division, or at any rate in each belt, is of as much importance as range in latitude.

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*THE COMMITTEE OF ONE HUNDRED OF
THE AMERICAN ASSOCIATION FOR
THE ADVANCEMENT OF SCIENCE*

REPORT OF THE SUBCOMMITTEE ON THE SELECTION
AND TRAINING OF STUDENTS FOR RESEARCH

At the meeting of the Committee of One Hundred of the American Association of Scientific Research in April, 1914, the chairman was authorized to appoint a subcommittee on the Training and Selection of Students for Research. He subsequently appointed the following members: Professor R. A. Harper, Columbia University; Professor R. G. Harrison, Yale University; Professor G. A. Hulett, Princeton University; Professor W. Lindgren, Massachusetts Institute of Technology; and Professor E. W. Brown, Yale University, chairman. This subcommittee has conducted its discussion mainly by correspondence, but held a meeting on May 14 last at which four of the members were present. The report which follows is signed by these four members of the subcommittee; Professor Harper, being absent from the meeting and being unwilling to sign the report, resigned.

The education of students naturally is divided into school, undergraduate and postgraduate instruction. The first of these is too large a question to touch on in this connection. The third on the whole is well organized, and at the present time practically consists only of students intending to take up research or those needing the higher degrees for educational careers. Hence most of the work

of the sub-committee was in the direction of considering what might be done to further the interests of the abler students in their undergraduate careers. In using the phrase "abler students" the subcommittee had in mind the upper twenty to thirty per cent. of the classes.

In order to find out what was done in the various colleges and universities of the United States a circular was sent out to about forty, which were considered representative of the various systems of instruction throughout the country. This circular inquired what facilities were provided for the more able amongst the undergraduates for furnishing them with a better and more rapid training than the ordinary student. If such facilities were offered, inquiry was made as to what form these facilities took. It was also asked whether any money rewards were given for high attainments, and whether the institution had any knowledge of the results obtained from these facilities. About thirty of the forty selected institutions sent replies sufficiently detailed for the subcommittee to obtain a fair idea of what was being done throughout the country in this connection. It appears that five universities have specially organized courses in which the better students are able to have greater facilities for progress than the majority. Two others have courses laid out without, however, appearing to put much stress upon them. The remainder have little or nothing organized. These organized courses are generally referred to as "honors courses." Practically all of the institutions adopting them use the same methods, consisting of segregation into separate classes, extra work in connection with the ordinary courses, a limit for admission to such courses, a general final examination, less class-room work, and a complete program for junior and senior years. These different methods depended on the particular department, much freedom being given to the various departments. A fair idea of the various plans adopted may be gathered from the catalogues of the universities of Columbia, Minnesota, Princeton and Yale. Princeton has the preceptorial system in addition, but the expense of this makes it of doubtful value for

most institutions and it is not considered essential.

The subcommittee approves in general of these methods of looking after the interests of the abler students and strongly recommends that equivalent plans be made by all institutions of collegiate rank. As stated above, these methods refer to the work in junior and senior years. In freshman and sophomore years, where many classes are large enough to be taken in sections, it is recommended that the sections be formed according to the ability of the students as early as this can be ascertained. In this manner the best students will be able to advance more quickly and so be better prepared for the special arrangements for the later years. The subcommittee feels that in the past nearly all the time and energy of the instructor has been given to the lower end of the class, and that in consequence, the upper end has seriously suffered. While it may be true that a certain amount of stimulus is given to the whole class by the best men, the loss to the latter far outweighs any possible gain that might accrue to the majority from the presence of these men in the classroom. The latter often leave college with diminished powers if increased knowledge, having never felt the need of making great efforts in order to accomplish what is asked of them. The result is a serious loss of time and efficiency even for those who later take up professions which demand hard and concentrated work. The loss to the community is even more serious, particularly in respect of the number of men who will not make new efforts to develop their full capacities. The real interests of the nation are better served by giving to the upper twenty per cent. of the class an education suited to their abilities than by allowing these abilities to be frittered away for the sake of a doubtful gain to the remaining eighty per cent. In any case, it is not likely that the education of the latter will suffer under the democratic principles of our government.

As to the methods to be adopted, the subcommittee favors segregation into separate classes as in general the best. The question, however, of expense to the institution arises.

This can be met in several ways. In most departments elective courses are given which are taken only by a few students. The majority of these are naturally the best students in the department, but there are generally a certain number who take an elective for other reasons. It is recommended that the latter be excluded unless their previous work is of high grade so that these courses may be confined to the best students. It will be found in most cases that a considerable number of the elective courses can be so confined without serious loss to the rest of the students. Where this plan can be adopted no new expenditure for extra courses will be incurred. The excluded students will choose from the remainder of the list of electives, which, in the larger institutions at least, is greater than the needs of those who are not making a serious study of the subject demand.

In some subjects where segregation is not feasible extra work can be assigned, but this work should be carefully laid out and published in the catalogue as an essential part of the honors course and not left to the momentary inclination of the instructor.

Many institutions report that their instructors give extra time to promising students. While in isolated cases much benefit is derived by the students, it is not recommended as a permanent plan. Additional work for which he receives no compensation is laid on the instructor already overburdened with teaching, and an incentive from competition to most of the better students is lacking.

Harvard University reports that it has no specially organized plans for the interests of the abler students, but that many of them are able to take advanced courses in their undergraduate years because there is no sharp line of distinction between graduate and undergraduate courses. This method has been adopted for several years in some of the larger institutions with fully organized graduate departments, but it is not possible for the great majority of the colleges.

A final examination covering the whole of the special work for the honors course is advisable, and a considerable amount of stress

should be laid on the results. The subcommittee recommends that the question of outside examiners for this purpose be seriously considered. These examiners would set the papers but not necessarily examine the answers of the students. It was pointed out that with the system of outside examiners there is a considerable degree of cooperation between the student and his instructor. The papers should deal mainly with the general principles and fundamental facts of the subject, and only rarely with questions of detail in special portions of the subject.

The subcommittee also believes that the courses might very properly include one or two subjects in each department for which no class-room instruction is provided.

It is believed that the effect of these methods will be greater progress and more thorough instruction to the better students in the fundamentals of all subjects. A higher degree of stimulation to work and to take an interest in scientific pursuits will undoubtedly result, so that greater numbers with better training will be induced to enter the graduate schools and to take up research as a permanent career. These students will also feel that their work is of value to them and will not search outside for opportunities to make use of their powers.

The subcommittee obtained reports on the systems adopted in Germany, France and England. It did not appear that, at the present stage of American education, a close examination of the systems of Germany and France would be useful to the work of the committee. They are highly organized from the bottom to the top. In Germany and France admission to the university is gained by a difficult examination which eliminates the majority of those who can not obtain real profit from university courses. In German universities almost no pressure of any kind is brought to bear on any students good or bad, except by means of the final examination and the thesis. At Cambridge and Oxford the honors schools have long been definitely established. About forty per cent. of the students enter them and they receive separate instruction from the outset. Until the last two decades, but little thought

was given to the work of the remaining sixty per cent., but the interests of the latter have recently been seriously considered and much improvement has been made.

A difficult situation is brought about by the student having no knowledge of his after career during his undergraduate course, so that he is not able to choose his line of work effectively. While vocational training is not in question in this connection, all the training for scientific work needs thorough and broad foundations. If the student has a knowledge of his after career he is able to choose his course so that these foundations may be well and truly laid. It is recommended, therefore, that advice be given to all students in college to choose their careers as early as possible.

The majority of those who expect to do research look to positions in colleges and universities in order to earn a living. Information should be given them as to research positions in the government service and also those in industrial laboratories. Work under the government appears to be somewhat better paid than that in the collegiate world, but there is some limitation on the problems which may be taken up for research. In the industrial laboratories these differences are still greater.

It is recommended that students be encouraged to change their institution between the undergraduate and postgraduate work. A greater breadth of view is desirable. It is also recommended that students be encouraged to choose their university for postgraduate work on account of the quality of the men in the subject rather than for other reasons. Much can be done by the advice of the undergraduate teaching body in this respect.

The subcommittee was only able to deal with these questions as far as the colleges and universities were concerned. Some information was forthcoming as to the situation in the technical schools, but it did not feel itself in a position to undertake this part of the work. It recommends that a new subcommittee consisting of a fuller representation of those connected with technical instruction be appointed to consider what measures should be taken to secure the objects in view.