The laboratory, of course, lends itself very freely to this type of procedure, and while there are various methods of laying out the program, it will probably be found in general that the best way is to arrange for each level a series of exercises or tasks, increasing in the order of difficulty so that the whole class is kept together on topics from day to day, and that the spread of achievement will be represented by quantity and quality of work on each topic. This is opposed to the idea, often prevalent, of setting out a mediocre standard and allowing the good students to pass rapidly from topic to topic, thus gaining time. There is no topic in any subject that does not lend itself to various degrees of intensive and effective work, and it is a better test of a good student that he shall have done a higher amount and a better quality of work on every topic than that he shall have passed rapidly over a minimum requirement.

VI. THE REWARD OF THE INDIVIDUAL

The greatest reward for a good student is the joy of achievement. If we once liberate the good student, give him facilities and encouragement to work at his natural level of successful achievement, formal and outward marks of distinction will be of little consequence as compared with the deep satisfaction in doing this kind of work. To make this enjoyable, many institutions must, however, change their atmosphere so that both students and faculties will hail the superior student with approbation, instead of looking upon him as a "grade-getter" or a union scale breaker.

Nevertheless, the good student should be entitled to certain rewards. Aside from the privilege of being relieved from learning things that he already knows, doing things that he already knows how to do and marking time for the sake of the order of the class, certain natural rewards would be in place. Under the plan I have advocated, high grades will assume an entirely new meaning, and will in themselves constitute a much desired goal, a reward of honor which requires no special action of the faculty, because high grades under the conditions described will imply that the student has traveled in high sections, covered a much more extensive field and done a far better quality of work than is now ordinarily required.

If honors are to be awarded by the faculty in a professional school, I think that they should be awarded on the basis of ranking of a number of students who have good grades, taking into account, first, the grade; second, the special marks of achievement deserving of recognition, particularly a scholarly attitude; third, balance of activities, representing health, socialization and academic life, and fourth, personality, in the sense in which personality is judged when an engineer is to be employed.

Taking this broader basis into account would protect the institution from making the egregious mistakes that are often made when honors are awarded on the basis of mere school record.

In the above, I have proceeded upon the assumption that students shall be held together during the customary period of four or five years in the regular order of topics and shall all take the same time. This, I think, would be entirely justified when, in the new order of things, the good student can have during these years the most excellent opportunities for natural growth and self-expression.

There is, however, another possibility which I should advocate if we can not recognize motivation on the basis of ability, and that would be to adopt the method of individual instruction, which would enable the student to finish his course in a time somewhat proportionate to his capacity for work. There are many points in favor of this method, aside from the mere justice of it, and many of the difficulties which have seemed to stand in the way are mere bogies. However, if I had my choice, I should take the stand in favor of keeping the student in the engineering course to cover specific subjects in a specific time, and then differentiate the quantity and quality of the work to be done in each topic.

I have spoken as an outsider, as boldly as briefly, on some of the most vital subjects touching engineering education, and have deliberately tried to set forth the ideas in high lights and concrete form, in order that they may be tangible as a basis for discussion. Some of the things I advocate are already coming into general practice. All have been tried in some form. I have sought to find fault with existing conditions in a constructive spirit, and am glad to recognize that engineering draws as high a grade of students as any other profession and is probably better taught. I bring no revolutionary theory or simple solution, but it seems to me that the items I have mentioned are among the next vantage grounds that we might survey in engineering education.

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SHADED TOPOGRAPHIC MAPS

THE latest advance in the art of mapmaking at Washington is seen in certain inch-to-a-mile governmental maps on which the relief, still shown by contour lines as heretofore, is rendered more apparent by the addition of shading. The device is not new: it has been employed, for example, on the 1:100,000 map sheets of Italy published some years ago by the Military Geographical Institute at Florence, and on certain maps of the Rocky Mountain region published by the Geological Survey of Canada; but shading is a rarity on American official maps, and in few if any others yet issued is the shading so delicately treated as on those here to be described.

The maps under consideration are at present in process of more or less experimental production by the Geological Survey under the Interior Department, and by the Corps of Engineers under the War Department, each organization working for its own objects and by its own methods in friendly competition; indeed, some of the engineer officers concerned with the making of the maps had their topographic training as members of the Geological Survey. A first trial was made by both organizations two years ago on the contour map of the Monument Springs quadrangle, Texas; more recent trials, which appear to be in several respects more successful than the first one, are on maps of different quadrangles.

The maps prepared by the Geological Survey are expressively shaded by hand on photographically enlarged prints, as if under a northwestern illumination, the shading being darker where the contours are close together, and lighter where they are open spaced. The shaded map is then reproduced on reduced scale by successive photographic and lithographic processes and printed on the original contour map. It is found desirable that a contour map should be recently printed before the shading is overprinted upon it, in order to avoid inaccuracies of registration that might result from the use of contour maps a year or more old, the paper of which may have shrunk appreciably.

The maps prepared by the Corps of Engineers[1] are reproduced photographically from obliquely illuminated models, the making of each model requiring several processes: first, cutting out successive sheets of cardboard along the contours of a somewhat enlarged original map, the cardboard outside of the contours being used to build up an inverted relief or mold; second, a positive, cast from the mold and reproducing the successive "steps" of the cardboard sheets, is graded with beeswax and tooled to a smooth finish; third, a new mold is made from this positive; fourth, a final positive or model is made from the new mold: it is this model that is then photographed down, under oblique illumination, to the desired scale, and the shades thus secured are printed on the original contour map.

On examining the maps thus produced, it is immediately manifest that they make the relief of the land surface wonderfully clear; indeed, at a little distance it is difficult to believe that the maps are printed on flat paper, so vivid is their model-like appearance. If such maps came into general use, their educational effect on adults as well as on junior students will be geographically most beneficial; for while the appreciative reading of contour maps requires special training, the reading of a shaded map requires only such training as the eye naturally acquires in its everyday experience of illuminated objects. Shaded maps, therefore, teach the facts concerning land forms in an emphatic way that contour maps do not. It will be interesting to learn what response is excited by these excellent maps among the public of the several areas that they represent, as well as in the schools and colleges in other parts of the country where maps are used in teaching.

In the meantime a comparison of the maps thus far issued brings forth some interesting contrasts. The most striking at present is merely a matter of colors employed. The sheets lately published by the Geological Survey for certain quadrangles in Pennsylvania and West Virginia are given an appearance of much delicacy by the use of light tints: the contours are printed in a lighter brown than that used on ordinary maps; the cultural features, including names, are printed in a dark gray instead of in full black as usual; and the shading of the relief is very gently modulated, so gently, indeed, as to give the impression that the map is veiled. A somewhat darker shading might be better.

The engineers' maps for certain quadrangles in California and Washington are more vigorous in appearance: the contours are in strong brown, culture in full black, and the shading is fairly dark: hence the whole effect is bolder than that of the survey sheets, and may give the impression of stronger relief than that possessed by the areas represented. Here a somewhat lighter shading might be recommended. In both sets of maps the presence of contour lines on the illuminated slopes lessens their illumination and thus tends to weaken the impression that is intended to be given; here the pale brown contours of the survey maps are less obvious than the darker brown of the engineers' maps.

The above differences are not inherent. They can be lessened, if desired, by the use of different inks. If the maps are to come into general use, the same color-scheme of shading is evidently desirable for both sets. A more fundamental difference is found in the distribution of the shading. On the survey sheets, the down-slope of a hill or ridge away from the assumed source of illumination is shaded from crest to basal stream line, lighter for gentler slopes, darker for stronger slopes. The other side of the ridge sloping toward the source of light is left unshaded.

[1] An account of the development of these maps has been prepared by Major Albert M. Walker, under the title, "The military map of the future," and published in the *Military Engineer* for September–October, 1923.

But on the engineers' maps, the shade on the non-illuminated down-slope of a ridge is not infrequently continued beyond the basal stream line by the shadow of the ridge on the next up-slope: hence the line of change between shade and illumination does not here always lie along the stream line of a valley bottom; indeed, a subordinate ridge on the non-illuminated slope of a higher ridge may be wholly shadowed in this way. As the contours are somewhat obscured by the dark shading here adopted, a close inspection is needed in order to determine whether the edge of the dark tint in a hilly area lies along a valley bottom or not; and to this extent the easy legibility of the maps is lessened. On the other hand, partly because of stronger shading, partly because the shadow of a lofty ridge extends out over the low land somewhat beyond the ridge base, the engineers' maps give a more immediate impression of dominant features, the recognition of which on the survey maps calls for closer attention.

As to the relative truthfulness of the two sets of maps: It is a general principle that every additional process introduced between an original manuscript map, as drawn by a skilful topographer in the field, and the final printed map, ready for distribution to the public, is likely to cause some slight loss of accuracy. Such loss is presumably minimized in photographic processes, but even there difficulties arise in connection with such matters as the variation of a sheet of paper with changes of humidity, as above alluded to. Manual processes are more difficult to control, and they here intervene in both the methods of producing shaded maps: in the hand-shading and in certain lithographic processes of the survey maps, and in the contour cutting as well as in certain later processes such as the building of the cardboard negative and the tooling of the first positive of the engineers' maps. But in both cases, errors are lessened by care; and as far as I have had opportunity of inspecting the work of making the maps, skilful care is exercised at every step of both methods.

The delicacy of the hand-shading on the survey maps is truly admirable; yet it can hardly have the authenticity of the shades as photographed from a model on the engineers' maps. Similarly, the accuracy of the jigsaw contour-cutting for the engineers' maps is remarkable; it is much increased by the use of a fine wire-like saw, with minute teeth on all sides, so that the cardboard may be fed against it in any direction; yet it would seem impossible that sharp angles such as are occasionally found in contour lines should be cut by this mechanical device. Again the tooling of the beeswax on the first cast model may fail to follow the cut contour lines here and there, especially in sharp reentrants. Yet as far as I have been able to learn, the final accuracy of the two sets of maps is closely comparable.

These new-style maps as produced by the Geological Survey have not been officially given any special designation. "Shaded maps" would seem to be a natural name for them, as they are darkened only on slopes turned away from the source of illumination. A possible confusion may be feared from the misuse of the term, shaded, for hachured maps also, but such confusion would be avoided if hachured maps were so called. The name "Shadow maps" has been proposed, but it seems unsuitable because the term, shadow, is properly used for the darkened part of a surface which is turned toward, not away from the source of illumination, but which fails to be illuminated by reason of some opaque object that stands in the way of the light. True, the engineers' maps include some shadows of precisely this kind, as has been pointed out above; but they are on the whole disadvantageous features, and as such do not serve well for a name. The engineers' maps have been officially called "Pictorial relief maps," but apart from the cumbersomeness of a trinomial term, the word "pictorial" seems unsuitable because, vivid as the maps are in the expression of relief, they are not at all pictorial in the ordinary sense of that word, which is commonly associated with perspective representation, and not with vertical projection.

The technical uses of these fine maps by the organizations which produce them are not here considered: it is their geographical value that should bring them into general notice. Fortunately, they are not secret official documents.

All the shaded maps thus far produced by the Survey and by the Engineer Corps may be purchased by the general public at ten cents each.

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SCIENTIFIC EVENTS

FIRST CONFERENCE OF SPECIAL LIBRARIES AND INFORMATION BUREAUS

THE first Conference of Special Libraries and Information Bureaus was held from September 5 to 8, at High Leigh, Hoddesdon, Herts, England. Over eighty men and women interested in various ways in the collection and dissemination of informative matter attended.

The objects of the conference were outlined at the opening session by Dr. R. S. Hutton, director of the Non-Ferrous Metals Research Association, and J. G. Pearce, director of the Cast Iron Research Association. It has long been felt that many diverse agencies concerned with the treatment of information have