ware, umbrella handles, jewelry, brooches, silverware, knife, fork and spoon handles, belt buckles, hat pins, book covers, tail pieces, toys souvenirs, trade marks and many other lines of work.

It is hoped to publish drawings of these motives as soon as the drawings can be made. Each drawing will be labeled as to what the specimen is, where it was found, where it is now, its size, material, and, to a certain extent, with the region in which the type of motive is found. The area in which each motive is found is given, so, for instance, that a British Columbian manufacturer may know which motives are appropriate for British Columbian manufactures rather than use one appropriate only for Manitoba. Some of these areas extend into the United States as does the area of the maple leaf and the beaver; others are confined to parts of Canada. Reference is made to photographs, lantern slides, and published illustrations wherever such exist. The actual specimens are scattered in this museum, the Provincial Museum at Toronto, Provincial Museum at Victoria, the Museum of the Natural History Society, St. John, New Brunswick, the Provincial Museum at Halifax, the American Museum of Natural History, New York, the Museum of the University of Pennsylvania, the British Museum and museums in San Francisco, Florence, Italy, Berlin, Germany and elsewhere.

If this publication is issued it will no doubt be sent to every large library, every member of Parliament, every newspaper in Canada, probably, to all Canadian manufactures using designs and certainly to all such manufacturers who express the need for it.

As it may be months before all the drawings can be made the archeological office will make every effort to give free of all expense any practical aid that it can in the use of these motives. These data are at the service of any manufacturer who desires to call at the office. Possibly photographs can be made of a few of the motives for such manufacturers as specify just what they would like to have photographed. A typewritten list of the books containing pictures of some of the specimens will be supplied on request.

The office will do all in its power to hasten this work and will be obliged to manufacturers if they will call or write to offer suggestions and express their needs. Such an expression will very likely be of service to the office in securing the improvement and hasty publication of the album of motives.

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METHODS AND MATERIALS FOR THE PREPARATION OF WALL CHARTS

VARIOUS grades of paper, with or without cloth-backing, have been used extensively for many years in making charts to be used in lecture rooms. However, unbacked paper does not wear well, and cloth-backed paper is heavy and stiff, besides being expensive.

Shade cloth is cheaper, lighter, and much more durable than any chart paper. One variety known as Holland Shade Cloth is used by several workers in my acquaintance. A large chart of this cloth may be folded into a small package or rolled into a close roll convenient for carrying in a suit case to a meeting in some distant city. When unpacked it requires no heavy sticks to make it hang smoothly.

This cloth furnishes a fine surface for line drawings. The air brush may be used on it in shading, and wax crayons may be employed. However, when large areas of wash shading with a brush are involved, there is a good deal of puckering of the cloth. For this reason, I have made trials of other fabrics in the past three years, and I have found that so-called Peerless Cambric Shade Cloth, Ivory White, is excellent for large wash drawings. It does not pucker noticeably, and it has a good drawing surface. There is no trouble with "drying lines" in applying washes. This cloth is a little heavier and stiffer than Holland cloth, and it can not be packed so compactly without forming creases. I have recently been informed that the puckering may be avoided by mixing equal parts of 80 per cent. alcohol and the ink solution employed.

I have not found it practicable to erase ink

marks from shade cloth to any extent, but lead pencil marks are more easily removed than from paper. When a mistake is made with ink that can not be erased, I find it best to paste a bit of the shade cloth over the error. This is not noticeable at the distance of even the front row, in any ordinary lecture room.

For making lines, I find so called round-writing pens (single pointed) better than a ruling pen as it is hard to make lines broad enough with the latter instrument. Round writing pens may be obtained in different widths, and they are inexpensive. The wider pens are useful especially for making bold strong lines to be seen in a lecture room of some size.

Most of my charts are made with water-proof inks of the best grade. These are kept in various dilutions in a series of one-ounce bottles. Thus I keep about six dilutions of black ink in as many bottles labelled one to six, for use in neutral gray shading. A few drops of black ink in an ounce of water make a dark shade. Several drops of this added to an ounce of water in another hottle make a weaker solution, and so on according to the eye of the user.

I dilute the colored inks usually by placing a few drops of ink in an ounce of water, according to the color desired. Many varieties of color shade and tint may be obtained by mixing colors in water and by adding a little much-diluted black ink to a colored solution in varying proportions. It is my practise to dilute almost all of the ink used, to some extent. Softer and more pleasing effects are produced, and the ink goes farther. It is also more easily applied.

For class use and for convenience in storing, I find it desirable to have charts mounted. Two half-round pieces of one inch diameter are glued together with the lower end of the chart between their flat surfaces. To make the binding still more secure, nails are also used. Light one-half-inch half-round material is used for the top in the same way. Straps for hanging, of strong braid one half to three quarters of an inch wide and a foot or so long are fastened to the top strips at suitable places. These also serve in the usual way for tying the charts up when rolled. It is particularly important that the straps be attached strongly.

Some readers of this article may not be familiar with the possibilities of a pantograph in copying small drawings enlarged on charts. The best pantographs are expensive, and the cheapest unsatisfactory. However, I have found one costing about $5.00 of considerable service. It enables one to get the general outlines of the drawing, but these must be corrected by free-hand work later.

Neat labelling, that can be read in the rear seats of the room in which the chart will be used, is exceedingly important. It is my practise both with charts and lantern slides to avoid any details in either labelling or drawing that can not be distinguished easily in the more remote parts of any lecture room in which the illustrations are to be used.

It is distressingly common, especially when lantern slides are employed, to find this rule violated. Large sheets of typewritten material are often crowded into a lantern slide with the result that they can be read only when very near the screen, if at all. In the case of lantern slides, any details which can not be distinguished easily in the slide will also be too minute on the screen. In preparing charts it is a good practise to put letters and drawing details of various sizes on a blackboard which may be viewed from the most distant seats in order to determine the most practicable proportions.

Labelling may be quickly and neatly done with the aid of the so-called sign-painters' rubber stamps. Sets may be bought in various sizes and with both caps and small letters as well as Arabic figures, etc. Inks of various colors may be obtained for the stamping. Quick-drying inks save time in the preparation of a chart.

It is my experience that most and sometimes all the chart work described in this article can be done by student service under direction, especially if students who draw well are available.

Though I am reluctant to appear to advertise dealers, for the convenience of readers I think I am warranted in stating where the materials mentioned in this article may be purchased. The shade cloths may be purchased from the Remien and Kuhnert Co., 61 W. Grand Ave., Chicago. In September, 1916, I was given a price of 38 cents per yard for "Peerless Cambric Ivory White" shade cloth, 48 inches wide in entire rolls. The price was 44 cents per yard in small quantities. The White Holland shade cloth was slightly cheaper. Dr. G. R. LaRue, of the University of Michigan, has informed me recently that "Linaura Chart Cloth" sold by the Williams, Brown & Earle Co., Philadelphia, is very satisfactory.

For labelling, we are using a so-called "Sign and Price Marker" set, No. 48 in catalogue No. 28 of Meyer and Wenthe, 108 N. Dearborn St., Chicago. The catalogue price is $5.00 for the complete set. It is adapted to charts to be used in large lecture rooms. Set No. 6 at $4.00 and set No. 4 at $2.50 are recommended for smaller rooms. The round writing pens can probably be bought at many art and drafting instrument stores. Mine were obtained of A. H. Abbot and Co., 119 N. Wabash Ave., Chicago, ¼ gross for 25 cents.

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THE ELEMENTARY TREATMENT OF FORCE

THE discussion by G. S. Fulcher in SCIENCE, XLIV., 747, 1916, concerning some of the errors and inconsistencies in our elementary texts regarding the questions of force and Newton's laws of motion, are most timely. No doubt many of us who are trying to build up in the minds of our beginning students a sound structure of physical ideas, and above all, are hoping through physics to give them something of the scientific attitude, have almost despaired of finding a text which is free from the faults mentioned. To approach the ideal, a text should be brief in its statements but so explicit as to allow of but a single interpretation; it should not anticipate knowledge which obviously the beginning student does not possess, nor should it attempt to circumvent this deficiency by repeatedly referring the student to articles further along; it should, in fact, be written upon the premise that the only source of physical ideas which the average beginning student of physics has is his own experience.

In introducing force, therefore, all speculation and conjecture, made in the light of the author's own familiarity with the subject, is decidedly out of place, and can serve only to confuse the student. It should be presented to him primarily in terms of his immediate impressions, *i. e.*, in terms of his muscular sense. Let us tell him first that "force" is the term applied to the equivalent of a push or a pull. The average student has pretty clear ideas as to what such an action can accomplish. It is then not difficult to represent Newton's first law as a test for the absence of a force, nor the second law as a test for its presence. After familiarity with these notions has been gained, we can further represent the second law as a quantitative test for force, and can show how we can experimentally establish the relation $f = ma$. This may then be regarded as a more exact definition of force, derived from our observations upon objects external to ourselves. In all of this discussion it is of greatest importance to emphasize by repetition the fact that *whenever a force is exerted, two bodies are involved: A, the body acting, and B, the body acted upon.*[1] This is one of the outstanding

[1] In his reply (SCIENCE, XLV., 480, 1917) to A. H. Patterson (SCIENCE, XLV., 259, 1917), which was printed after the present paper had been submitted for publication, Dr. Fulcher has already emphasized this point.

In this connection, may I suggest that we discontinue the use of the phrase, "a force acts upon . . .," which is so exceedingly common in our texts? It seems to me that the phrase attributes to force a property which it does not possess. Why not be unequivocal and say "a force is exerted upon . . ."? This latter way of stating the fact serves better than the former in keeping the above italicized principle before the student, in that it deprives the notion of force of that seeming independence which does not pertain to it.