mathematical shapes of optical reflectors, but large flat surfaces must be used. They should always be painted a dead white. The enamelling of reflectors to have a shiny surface is a mistake; they do not give as good an effect to begin with and even the best rapidly lose their gloss.

The following table, due to Dr. Sumpner, gives the reflecting power of various surfaces and shows what a wide variation in the number of lights required for a given illumination may be caused by a change of interior decoration:

White blotting paper	82 pe	er cent.
Ordinary foolscap	70	"
Newspapers	-70	""
Yellow wall paper	40	**
Blue paper	25 ·	"
Dark brown paper	13	
Dark chocolate paper	4	••
Plain deal (clean)40	-50	**
Plain deal (dirty)	20	"
Yellow painted wall (clean)	40	••
Yellow painted wall (dirty)	20	••
Black cloth	1.2	**
Black velvet	.4	"

When studying out the lighting of a given place we must consider whether we merely wish for a general sense of the space being nicely or brilliantly lighted, as in a ball room or dining room; or whether particular spots or objects need to be clearly illuminated, as the goods in a shop or the tables in a library.

The most important step to good illumination is to secure to the utmost extent possible that no bright spots or lines of light shall strike the eye. The moment the eye sees the source of light it closes itself up for protection from the direct rays and consequently cannot receive as much of the light reflected from neighboring objects, and therefore does not see them dis-The following experiment will illustrate this very tinctly. Take a shop with two show windows and hang the clearly: lights in one window about the level of the eyes, as is so commonly done, and in the other put the same number of lights in good reflectors close up to the ceiling. Now go across the street and note the result. In the first window the goods on exhibition are fairly well lighted, but it is a discomfort to look at them long and nothing is seen behind them. In the other window the goods are shown up beautifully and you can look at them as long as you wish and at the same time can see right back into the shop and see the goods on the shelves and counters.

In the smaller towns and in many cases in the larger ones the question of getting exactly the best illumination and effect from the lights must be subordinated to that of the cost both of the fitting up and of the current consumed. Also a certain amount of deference must be paid to the ideas of the owners.

Thus in lighting show windows the very best method is to light them from overhead, or from the corners, with lamps in deep and powerful reflectors that will throw the light directly on the goods to be shown and will shield it from everywhere else. If it is necessary for the proprietor to be as economical of light as possible this can hardly be done, as these lamps are useless for general illumination in the shop. In such a case as this clusters under good flat reflectors on the ceiling of the window are best. These show the goods in the windows very nicely, they make the front look much brighter, and at the same time throw a very considerable quantity of light into the front part of the shop where it is most required.

An exceedingly common case is a shop from 20 to 25 feet wide, 40 to 50 feet deep with two show windows, the ceiling being from 10 to 12 feet high, and used for dry goods, tailoring. groceries, etc. A very good arrangement for this is to put a three-light cluster and flat reflector in each window, and three similar three-light clusters down the centre of the shop. The main switch should be placed at a convenient spot near the door by which the employees enter and will of course turn on all the lights. Another switch should then be arranged to turn off the window lights, and another to turn off two lights in each of the clusters in the centre. This will be found to be a most convenient and economical arrangement for the customer, who can proportion his light to the weather and amount of business doing. While the central station man will find that, if the shop is open in the evenings at all, the whole of the lights will be on long enough to cover the maximum demand, or standing charges.

These clusters should not be more than 10'6" from the floor; were these lights raised to 15 feet the direct light from them would be reduced one-half, calling for double the number to produce the same illumination, but since in this case the reflection from the ceiling and walls would be somewhat increased, probably an increase of 50 per cent. in the number of lights would be sufficient.

Drug stores generally call for special treatment, and the lighting must be made to harmonize with and to show off the fittings. Brackets on the top of the shelving and a handsome electrolier in the centre are generally very acceptable, but as the result desired is more in the way of brilliant effect than of mere illumination for the showing of goods, each case must be studied out to suit the purse and the tastes of the persons concerned.

In the matter of churches the great desideratum is the even distribution of the light, with absence of shadows and the total avoidance of all spots or lines of light that will strike the eye of the congregation, or of the minister, especially during the sermon. The minister, the choir and the organist of course require plenty of light, and it often calls for considerable ingenuity to supply their needs without having a bank of lights most unpleasant to the congregation. If such a group of lights cannot be avoided it should be provided with a switch within convenient reach so that it can be turned out during the sermon. In Anglican and Roman Catholic churches which have chancels separated by an arch from the main body of the building, the lights can often be arranged on this arch so as to be entirely hidden from the congregation and yet throw a very pleasant light on the choir and reading desks.

Lodge rooms should be well lighted, and as they are often finished in very dark colors this is a difficult matter. The lights should be divided into groups controlled by switches, and those at the desks of secretary and treasurer are often wanted to be independent of the others in the room. A dimmer is a valuable addition and should be arranged to control all the lights except those just mentioned. It should be a regular theatre dimmer of ample capacity. Lodges are not as a rule paying customers because their use of the light is irregular and the income per light from them very small. Nevertheless it pays to give a good deal of attention to the fitting up of them, because many get educated to good lighting through them whom it would be difficult or impossible to reach in any other way. It will require a good deal of work to get the first one well done and especially to get the dimmer introduced, but after that it will be comparatively easy.

## SOME NOVELTIES IN SWIND BRIDDE CONSTRUCTION ON THE TRENT VALLEY CANAL.\*

## By R. B. WOODWORTH.+

The Trent Valley Canal, now in process of construction by the Dominion of Canada, is projected to extend from Georgian Bay through the province of Ontario to Lake Ontario, and is expected to be of great public value as a waterway. Its construction has naturally demanded numerous highlevel and swing bridges. Several of these were erected during the past year by the Central Bridge & Engineering Co., of Peterborough. Ont., and the purpose of the present paper is to describe certain peculiarities in the construction of the two more important of these, in the design and detail of which the present writer was directly interested.

These were the swing bridges to carry the Grand Trunk Railway over the canal at Nassau, Ont., and the Canadian Pacific Railway over the canal at Ashburnham, Ont. The former had a clear span of 2171/2 feet c. to c. of end lifts, and the latter a span of 187 feet c. to c. of end lifts. Both were of the same general design, riveted lattice trusses with minor differences due to the different lengths of span and the idiosyncracies of the men who framed the new Canadian tariff. When the material for the long span was ordered angles were most economical; when we came to detail the short span the tariff had made it preferable to use channels. Both were figured for the loadings given under Class II. of the 1896 specifications of the Department of Railways and Canals, viz.: the dead load of the spans themselves, cross ties, rails, etc., at 500 lbs. per lineal foot of span, and a rolling load of two 112-ton locomo-

\*From the Engineering News.

<sup>†</sup>Draughtsman Carnegie Steel Co., Pittsburg, Pa.