by raw materials, machinery, finished products, appliances for intercommunication, as travelling cranes, industrial railways; by snow and wind.

The geographical and community location further eliminates materials more expensive than others, while no more durable. The lower type of building (rural) may use wood, the city building may not economically select this material, but confine itself to steel, brick, concrete; being taller and requiring more fire protection, and larger loads on the supports. Again, the geographical location, disregarding community, will be the determinator, according to materials available, and their relative prices.

The temporary or permanent uses will determine the general qualities quite largely, of the materials, and is a highly important consideration. Sometimes a combination of the two may co-exist, as already stated under general planning and foresight. Clearly, less durable materials may be used; but even in the constructions avowedly temporary it may be well to consider whether some fundamental portion should not be of a more durable type, as many a small and tentative beginning has developed into a permanency.

Nor is the planning of the buildings complete before the economic working conditions of the human machines are considered. Looking aside from sociological conditions as ably treated by others, the engineer or architect can look after some items, wholly indispensable for economical working conditions, and comprised generally under the heads of light, heat, general hygiene and protection from fire. The light and general hygiene make for factory location in the country by a large margin. There should be plenty of windows, to admit light, and they should be movable, to afford ventilation. Windows as well as skylights should be of a material giving diffused, not direct sunlight, and have wire mesh to minimize risk from adjacent fire, or falling skylight glass.

While window ventilation will do very well for industries of a cleanly and odorless kind, the ventilation may be aided largely by some active type of ventilators on the roof, which with a slow movement of outside air help to draw the air about. But in factories employing either a great number of workers in a small space, or necessarily accompanied by noxious gases, or ill-smelling odors, a real fan blowing system should be used, in conjunction with the heating system; for no person can work well in foul air, which lowers vitality, numbs an active mind and sets at naught the intrinsic economy of the best planned shop and the finest tools.

What has been said about ventilation may include heat in this way, that whatever system is used, fresh air must be supplied in abundance. The hot air system seems to furnish both heat and fresh air, and deserves a full study in all cases.

Under hygiene may be mentioned the advisability of modern sanitary toilet and wash rooms; and in all economically planned factories of to-day this is given consideration as inculcating good habits and bodily comfort.

Protection from fire is fortunately receiving more attention from day to day. It is not always possible to eliminate inflammable materials as they may form the raw materials or the finished product. But the factory can be made fireproof, and this can be effected only by having incombustible materials of construction and ample exits, at a definite location, of easy access and stairs easy of descent. The definite location is of high importance, as the panicky fear numbs the sense of location except that it be deeply rooted in the mind.

That the exit or exits shall be ample sized comes next; that doors may open outwards; that the junctions of stairs meeting at successive floor levels may widen out and allow lower floor tenants to break into the crowd rushing down; and finally that the grade of descent may not be steep enough to cause stumbling. All narrow winding steps should be eliminated.

Based on the above conceptions two general exit types may be suggested, an inside stairs or an outside, but it must be, in either case, wholly closed by incombustible materials. There are advantages and dangers in both. The advantages of the inner stairs are worth study. The sense location which is almost wholly gone in a panic, instinctively turns to it, (the inner stairs) it is the regular building stairway; everybody knows where it is. The automatically closing door at each floor should be characteristically denoted as by a vivid coloring or inscription. This stairway, or these stairways, as the case may be, terminate in the general hallway, always fireproof—right outside is the street and safety. The disadvantage of this automatically closed (at each floor) wholly incombustible stairway, which must be easy of access, familiar of location, easy of descent, ample of proportion, safe at its base as to street exit through the familiar general entrance hall, traversed every day, is that doors at the various floors may be smashed or left open, admitting smoke, maybe flames.

If we consider the outside stairs, this must likewise be essentially the same as the inner, same case of descent, etc., etc., and will terminate at its base in a court or on the sidewalk. That it may fill with smoke or flame for the same reasons as before stated, seems evident. The advantages and safety in automatic sprinklers are so well understood that nothing needs be said but to commend them. Only we must be sure that the standpipe has water in it. Fire drills are advisable, and in tall (city) factories, absolutely necessary.

Interest and taxes are both apt to be higher in the city, from cost of land, cost of buildings, etc., thus favoring the smaller city, or rural location. Light, heat and power may cost less in the city for small plants. Some of the large companies furnishing these commodities have made lower rates recently. The country location, at some special place where water power is cheap, may be more economical, but this commodity is now quite rare, in the majority of states, at a low rate. For steam-making a soft coal may be used in the country, but hardly ever in the city, due to hygienic reasons.

The disposal of by-products in almost every industry has developed so much that it is now a distinct item of economy, and must be practiced where possible. Metal scrap is remelted; saw dust is used in lining ice houses; textile waste becomes paper; parts of animal waste tissue and soft bone becomes glue, and so on, in a most surprising way. And this is rightly becoming more and more recognized, as the natural resources of the country grow smaller and smaller, strict economy must be practiced.

Economy in Sales.—This would appear to mean getting as large a return as possible on the manufactured product. Assuming a good sales department that can dispose of articles at a fair price, it is seen that the economy in the raw materials and fabrication now enables the sales department to compete with other sellers, taking away the handicap of high cost. Of course, the articles do not sell automatically, so to speak; but the highly important human agency of sales manager, sales agents and travelling salesmen now take hold aided by economy in raw materials and fabrication and their own talents, quite well