

# Railway Shop Up To Date

A Reference Book of Up to Date  
American Railway Shop Practice

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## *Preface*

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This book goes forth as a record of what is found to exist as the best in railroad shop practice, design, construction and equipment. The editor has striven earnestly and long to compile all the available data valuable to the railroad official seeking information, whether it be for the purpose of building a new shop to meet modern and future conditions, or increasing the efficiency of an existing plant.

It was not originally intended to make this book so broad and comprehensive; but there was found to be such a vast quantity of related data and information on the subject, that it was deemed advisable to extend its scope to its present proportions.

All material has been condensed as much as possible without sacrificing necessary details or impairing the lucidity of any descriptions, so that each kind of shop or particular kind of practice followed, may be clearly understood and comprehended.

The value of such a compilation as this depends largely upon the proper arrangement of facts in their natural and logical sequence so that the effects and results of the evolutions continually in progress, in the up to date railway shop, are readily arrived at by the reader. We have based our statements upon and drawn our conclusions from conditions as we have found them and have not theorized upon ideal conditions.

We want this work to stand for exactly what its name implies. There are so many good shops, each apparently the best under the peculiar governing conditions and each new shop to be built hereafter will be subject to

its own governing conditions, not possible to predict here, that it would be manifestly the sheerest folly to lay down a rigid policy or standard to be followed. We give what are found to be facts and governing conditions, but we know that there are new questions yet to be raised and unknown quantities in shop problems to be determined before any given problem can be solved.

It is necessary to go from the known to the unknown in this as in other lines of progress and we have attempted to supply information to help as far as we may. There is no doubt but that there will be found here one or more illustrations which will approximately fit the conditions to be met in building a new plant or modernizing an old one. While it is unlikely that an attempt would be made to plan one shop as an identical counterpart of another, each shop illustrated or described contains some features worthy of being emulated. Our aim has been attained if we have shown clearly the various types of modern railway shops.

We wish to express our appreciation of the kindly assistance rendered by the railroad officials with whom we have come in contact during the course of this work. It has been a pleasure indeed to note the willingness to assist and the interest evidenced in our undertaking. We only hope that our readers will find as much interest and pleasure in these pages as we have found in the associations formed in gathering the information for

RAILWAY SHOP UP TO DATE.

M. H. H.



# Railway Shop Up To Date

## Chapter I

### INTRODUCTORY

**A** STUDY of American railway shops of to-day reflects the fact that each railroad contemplating the construction of a new shop or preparing plans to remodel an old one, will find it necessary to work out its own destiny according to its own requirements and peculiar governing conditions. Present railroad shops embody many features worthy of being emulated and in many instances there are a number of details in the shop of one railroad which may be used to advantage in the shop of another. However, an attempt to plan a shop under the mere specification that it shall provide for a given number of locomotives, without a thorough investigation and study of all governing conditions, would hardly result in success. The same may be said of an attempt to lay out and construct one shop as an identical counterpart of another on a foreign road, for the reason that governing conditions would hardly be alike and these conditions would necessarily modify the shop design.

The preparation of plans for a new shop is universally preceded by a comprehensive study of the most successful shops in operation—both old and new. However, the progress of shop construction has not adhered to such lines that a precedent can be established or any rules formulated by which shops can be prepared to meet all conditions.

Comparative data regarding the equipment and output of different shops is apt to be misleading on account of the difference in demand upon the shops of various systems consequent upon conditions affecting locomotive repairs. The character of traffic, grade, curvature, water supply, type and size of locomotives, etc., varies for each locality and affects the demands upon the shop. Each shop therefore is designed and equipped according to the dictates of local surrounding conditions and influenced by the personal preference of those supervising the design.

It may be said that the general layout of a shop is not always representative of an arrangement considered the most satisfactory for the work to be accomplished, but rather the most practical under the circumstances governing at the time the shop was built.

Its location is dependent upon the convenience provided for the accommodation of the system, or portion of the system, which it serves; convenience with respect to centers of supply of labor and material and advantages with respect to cost of land, buildings, taxes, etc.

Plans have been influenced by shape and size of avail-

able land, by location of property with relation to direction of main line, by provision for construction of new shops or remodeling of old, by character and quantity of work to be done, whether for manufacture as well as repair, and whether for maintenance of cars, locomotives or both, by the demand to be made on the shop by departments other than the mechanical and by prevalent ideas of economy.

In earlier shops the use of the transfer table was the principal factor in determining the most practical lay out in providing communication among the buildings. The introduction of the powerful overhead traveling crane, capable of lifting the heaviest locomotive, is shown to have modified the arrangement of buildings. This is especially noticeable in the locomotive department, though the variation is evident in repair and building plants as a whole. In the small plants built to meet the demand of railway equipment in its early stages of development, the effort was to locate buildings containing machinery so that power could be delivered by line shafts driven from one engine and it was thought that the rope drive would facilitate such an arrangement. Later developments include the delivery of steam from one boiler house to two or more engines located at different points about the plant for driving line shafts. It is now generally conceded that the distribution of electrical power from one central plant provides the most satisfactory method of power transmission and permits the most flexible arrangements of buildings and equipment. Practically all recent designs of railroad shops include a power house centrally located—or nearly so—and containing all apparatus for power and light, and frequently the principal heating apparatus. Many of the older shops have been extended and electrical apparatus installed liberally.

It may be said then that the introduction of electrical apparatus and traveling cranes, together with the use of air driven small tools and appliances and heavier machine tools with high speed steel, have been the prominent features in the evolution of the railway shop to meet the demand of the constantly growing motive power and rolling equipment.

The railroads of the country are found to have shops varying in degree of development. Some of them were built about forty years ago for the repairs of about twenty-five engines and they are still in operation. The fact that most of the large roads of to-day represent the

growth and absorption of the small roads of the past, is largely responsible for the "back number" shops found at division points of so many systems which in a general sense are considered up to date. Some railroad companies, noticeably the New York Central and the Baltimore & Ohio, are providing small repair plants, standard to their respective systems, for light repairs and remote roundhouses and these are found to be of material assistance in relieving the principal shops.

Railroad managements are waking up to the necessity of good terminal facilities for maintaining running repairs on the heavier equipment of to-day and for quickly turning the power in minimum time consistent with its condition upon arrival at the terminal. This is reflected particularly by the terminal plants at Elkhart, on the L. S. & M. S. Ry. and at East Altoona on the Pennsylvania.

The tendency in recent years has been to build a principal or main shop at some central point on a system where the greatest number of locomotives will be accessible for repairs and at which the freight traffic centers. Such a point is not usually found to be the geographical center, but rather the business center of the system.

There is evidence of but little improvement in the way of new shops at division points and the tendency seems to be to concentrate the heavy repairs at the main shops and maintain the light and running repairs at the outside points.

This would seem to be conceded by the following from the report of the committee on shop layouts at the 1905 convention of the American Railway Master Mechanics' Association:

"No matter how large and complete the main shop may be, the outlying points can advantageously and profitably use a moderate tool equipment for taking care of running and light accidental repairs, leaving heavy repairs and manufacturing to be done at the main shops. With such an equipment and organization, we believe that relatively small shops are undesirable, expensive and unprofitable, and that the larger, completely equipped main shops will handle the repairs in the most satisfactory manner."

Granting then that the railroad main shops have received the most marked attention in improvement and provision for modern facilities, it is natural to turn to these as representative of the trend of shop progress. For this reason the diagrams and tables here presented are compiled principally from data descriptive of the main shops, including those most recently constructed and the most prominent among the older shops.

Shop kinks and devices for saving time and labor have been developed by individuals to meet the requirements of conditions surrounding their work. Such kinks often have been found worthy of imitation, sometimes with greater or less modification to meet conditions in other surroundings. New shops have felt the need of jigs, templates and methods, and have progressed but slowly until such devices and systems have been installed. The value of such items in the old shops was hardly appreciated until their want was felt in putting new shops into commission. Hence, items of older shop practice, where found efficient, are given prominent notice and in all cases governing conditions are considered in reaching conclusions.





# Railway Shop Up To Date

## Chapter II

### LAYOUT

#### GROUPING OF BUILDINGS.

FROM a careful comparison of shop layouts and an observation of the trend of progress represented by successive years, it is apparent that the aim in preparing plans has been to so arrange the buildings and several departments as to group those provided for the same class of work, locating those serving two or more groups on sites equally accessible to the several groups served and providing throughout for inter-communication among the buildings so as to facilitate the movement of material with the least amount of unproductive travel.

The transfer table is prominent as the vehicle for communication and distribution at older and smaller shop plants and the buildings at such plants are seen to be largely grouped around one or more transfer table pits as principal avenues or thoroughfares. The same tendency to group buildings around a main thoroughfare of movement and distribution is apparent in the layout plans of recently constructed large shops. In them, however, the transfer table is not the controlling feature, the seeming tendency being to minimize its use in order to remove the obstruction offered by the pit, to economize the space which it covers and to reduce the number of doors which would be required in the side of a building served by a table.

In the large modern plants the transfer table is found very generally to serve the passenger car department buildings, operated between the paint and repair shops, and the tendency, becoming more pronounced, is to group the other principal buildings about a long narrow space or thoroughfare served by a yard traveling crane. Such a layout provides for the location of the passenger car department at a remote part of the plant where the transfer table pit will offer no impediment to general yard traffic. In this arrangement of buildings and accessories of large modern plants lies a marked similarity to the grouping of buildings in the smaller shops about the transfer table pit as a main thoroughfare, for example at the smaller shops planned about 1898.

#### GOVERNING CONDITIONS.

Size, shape and topography of available land together with the condition of providing new shops throughout or remodeling old shops, have influenced the arrangement of buildings and layout of some shop plants as a whole. As a result there are shops which are representative, not of the most desirable design, but of the most practical arrangement under peculiar governing conditions. This fact accounts for some features which otherwise would be open to criticism and which include disadvantages, duly realized and reckoned with by the local officials when planning the shops. Such examples, fortunately, have emphasized the necessity of a freer scope for those

preparing shop plans and there is now more noticeable effort to procure land to suit the shop.

Further argument for a large tract of land in allowing free scope for a shop layout is the necessity of providing for future extensions, for yard room in which to store material for the several departments, for sufficient distance between buildings as a prevention against fire risks, as well as for open roadways to facilitate movements of wagons and fire fighting equipment.

The criterion by which a shop design is tested is its facility of operation and its capacity for returning equipment to service in minimum time. Results obtained in the operation of certain new shops have served to demonstrate more clearly to recent designers that utility is of greater importance than seeming economy in first cost. Such false economy has often proved very expensive by necessitating changes and alterations after shops were put into commission.

#### COMPACTNESS PROVIDED BY SINGLE TRANSFER TABLE.

About the period of 1898 to 1903 several shops were built in which there is a marked similarity in the layout and arrangement of buildings and accessories. In fact there is a greater resemblance among the general lines along which these shops were planned than is noticeable among shops built at any other period, until very recently. These are the shops of the Chicago Great Western at Oelwein, Ia.; Colorado & Southern at Denver, Col.; Chicago, Burlington & Quincy at Hannibal, Mo.; Wisconsin Central at Fond du Lac; Fort Worth & Denver City at Childress, Tex.; Oregon Short Line at Pocatello, Idaho, and Southern Pacific at East Los Angeles, Cal. Diagrams of several of these shop layouts are shown and by reference to them it will be seen that the principal buildings are grouped around a single transfer table. At these plants the locomotive erecting shops contain nine, ten and fifteen pits and are built to maintain repairs of from 150 to about 200 locomotives. For shops of this capacity and such size that a single transfer table can be used to advantage, it seems to be conceded generally that such a type is the most satisfactory. For the main shop of a comparatively small road or for a division shop of a large road, then, these shops establish a precedent for compactness and convenience.

At shop plants of larger capacity the size of buildings and size and shape of available land has usually restricted the advantages of the single transfer table and these conditions have been met by grouping some departments about two or more transfer tables and by modifying the track arrangements of the locomotive and car shops.

#### ACCESS TO SHOPS.

This brings the question to a point concerning the

transverse or longitudinal arrangement of erecting or repair stalls. Due consideration of these arrangements appears in later chapters referring particularly to the individual buildings. Their features for the present are restricted to such discussion as affects the layout.

#### LOCOMOTIVE SHOP.

Some older and small plants provided entrance to cross erecting shops by a fan tail track approach radiating from the roundhouse turn table or a shop lead and others provided a similar approach for a longitudinal shop. In earlier years a large transverse shop required a transfer table and the longitudinal shop required as many lead tracks as there are tracks in the erecting shop.

The introduction of the large traveling crane, capable of lifting the heaviest of locomotives, has provided advantageous features for both transverse and longitudinal shops. It has brought about improved facilities by which locomotives are delivered to and from the shop and such features naturally affect the layout of the shop plant in, so far as it is influenced by the locomotive shop as one of the factors.

The inference to be drawn from the design and arrangement of a number of the most recently constructed shops is that the transfer table is no longer generally considered a necessary adjunct to the transverse locomotive shop and by dispensing with this, the space previously occupied by the transfer table pit is available for yard room. Dispensing with the transfer table reduces the number of doors necessary in one side of the building, and removes an impediment to general yard traffic. Where such an arrangement prevails, engines enter and leave the shop over one track, either at one end or at the center of the building. If the building is parallel with the general line of yard tracks, engines must be delivered over a turntable, convenient to the entering lead, unless the roundhouse is so situated that the roundhouse turn table is available. If the building is arranged transversely with the general line of yard tracks, no turntable is necessary.

Longitudinal shops are usually arranged parallel with the general line of yard tracks and locomotives enter and leave the shop on the central of three working tracks. No turntable or transfer table is necessary with such an arrangement as a locomotive is transferred from the entering track to the working spaces of the other tracks, by the traveling cranes. At the Angus shops of the Canadian Pacific Ry. locomotives usually enter the shop on the center track, though each shop track is connected with the yard line, where they are stripped, and are delivered by the traveling crane to the working spaces. They leave the shop from the side track nearer the wall, where they are fired up within the shop as there is no roundhouse at this repair plant.

#### FREIGHT CAR SHOP.

Recent general practice indicates the more common use of longitudinal tracks in freight car repair and building shops, though two railroad companies use roundhouses in such capacity. The instances are the Pennsylvania Railroad at Altoona and Columbus and the Nor-

folk & Western Railroad at Roanoke. Access to the longitudinal freight car erecting shop is usually by a track approach at one or both ends of the main building, though at a few railroad shops built previously to 1900 and at a number of freight car manufacturing plants, the plan provides for a yard approach at one end of the main building and a transfer table at the other.

#### PASSENGER CAR SHOPS.

Both old and new shops, with a few exceptions, adhere to the common practice of providing transverse repair and paint shops served by a transfer table, for the passenger car department. Exceptions are the old shops of the Norfolk & Western at Roanoke, the Pennsylvania at Altoona and the more recently built (1902) shops of the Mexican Central at Aguas Calientes, Mex., and the Pittsburg & Lake Erie at McKees Rocks.

#### FLEXIBILITY PROVIDED BY ELECTRICAL POWER.

The effect upon shop layouts produced by the introduction of electrical transmission of power, is to permit greater flexibility in the location of buildings with respect to the requirements of departments which they serve and with regard to convenience of the shop plant as a whole. It is now possible for practically all apparatus for the generation of power to be confined to a single power plant located as nearly as possible at the center of the shop plant and in practically all recently constructed shops this arrangement is found to obtain. Individual buildings are located as requirements demand and the direction of the line shaft is no longer a controlling feature.

#### STOREHOUSE.

The location of the storehouse is a very essential factor. Its position practically determines the base of supplies. As a store house at a main shop usually supplies the system, this building requires a convenient arrangement of tracks to provide for the receipt and delivery of material. The storehouse is also the principal point of supply for the shop plant and as such its place is one easy of access to all departments. The most improved storehouse, together with its supply and store platform, usually constitutes a long narrow structure and the department includes scrap platforms, sheds and bins. It is frequently placed between the locomotive and car departments, however, its most convenient location is dependent upon the facilities provided for distribution of material. It is evident, therefore, that much depends on the location of the storehouse, from the standpoint of the efficiency of the individual shop plant at which it is located as well as convenient facilities for receiving and distributing material for the line.

At those shops concentrating the buildings about a transfer table the storehouse is located usually at one end of the transfer table pit in order that the table may be used as a vehicle for distribution. The storehouse platform of the Colorado & Southern at Denver has a section lowered to the level of the transfer table to facilitate handling material in this manner.

It is significant to note the similarity between this loca-

tion of the storehouse with regard to the transfer table pit as a thoroughfare of distribution and inter-communication and the location of the storehouse in shop plants having a crane covered thoroughfare or midway, as the principal avenue. This may be seen by reference to the diagrams illustrating the layouts of the Canadian Pacific at Montreal and the Big Four at Indianapolis. It is noticeable that a portion of the storehouse platform is served by the yard crane and that the crane so serves the principal buildings as to establish efficient communication between the storehouse and the several departments, and among the principal buildings.

#### ROUNDHOUSE.

It is substantially an established practice to locate the roundhouse near the locomotive, or machine and erecting shop and connect it with the same by a standard track. At Elizabethport, Central Railroad of New Jersey, the transfer table pit is between the roundhouse and the locomotive shop. This is unusual and is probably accounted for by the arrangement of buildings to suit the shape of available land and to place the roundhouse at a point convenient to the main line and to branch lines which diverge at this point.

There is a growing tendency to provide a small shop equipped to maintain roundhouse repairs independent of the main shop and thus establish light repair facilities close to the work, and at the same time relieve the locomotive machine shop of jobs which are constantly coming up and which necessarily are of such nature that it is difficult to prepare for them in advance. This usually includes machine and blacksmith shop facilities to handle running repairs only, for it is considered cheaper to send an engine requiring accidental repair work to the adjacent main or division shop, rather than attempt to maintain a large machine shop at the roundhouse for such emergency repairs as are apt to overtax their ordinary running repair facilities.

At the same time it is still common to find a few machine tools in a roundhouse at a main shop for machine work at night, and at other times that the shop may be shut down, yet the machine shop is depended upon for the heavier machine work required for running repairs.

At Collinwood, on the Lake Shore & Michigan Southern, there is a small independent machine and blacksmith shop for running repairs exclusively. This roundhouse is located some distance from the locomotive shop and hardly may be considered as a portion of the locomotive and car shop plant. It is fairer to consider this roundhouse in the light of an independent small plant.

The same may be said of the Elkhart roundhouse of the same road. At each of these roundhouses, there is a main or division shop sufficiently close to send driving wheels dropped in the roundhouse and requiring journals to be turned.

The East Altoona roundhouse of the Pennsylvania Railroad is located at a greater distance from the repair shop and is equipped to be more independent than either of those just mentioned, and driving wheel work is done at the roundhouse machine shop.

The details of this feature of roundhouse equipment are considered at greater length in a later chapter and are here presented as concerning the effect in preparing plans for a shop layout.

By thus providing for roundhouse equipment, the roundhouse can be conveniently situated at a point isolated from the shop and yet more convenient for either the freight yard, passenger station or both. The roundhouse being then isolated from the shop yard, the entire available land may be used as best suited to the requirements of the shop. The conditions governing the location of certain buildings to accommodate the requirements of the roundhouse are thus eliminated and a freer scope is allowed in locating the buildings to the best advantage of the several shop departments.

#### BLACKSMITH SHOP.

At shops for both locomotives and cars, there is usually one blacksmith shop to serve both departments. This shop, therefore, is usually so located as to be easy of access to both departments. Frequently its ground plan is L shaped, one section being devoted to the work of each department, each wing paralleling the department which it serves.

#### FOUNDRY.

The iron foundry is usually located at such a point that castings can be delivered conveniently to the storehouse for line shipments and direct to the several shops where castings are machined or assembled. At the Angus shops of the Canadian Pacific, there are two foundries. The gray iron foundry is situated on the midway in order that the output may be handled by the yard crane and the wheel foundry is located near the freight car department so that wheels may be delivered directly across the wheel storage yard to the truck shop where wheels and axles are mounted and assembled.

#### PLANING MILL.

Planing mills are commonly so placed that the finished lumber may follow the shortest path of productive movement from the lumber yard and through the various machines to the freight car erecting shop. Also in arranging the layout, it is customary to so locate the planing mill with reference to the power house that shavings from the various machines may be delivered readily to the boiler room by air ducts. This to some extent determines the location of the power house, in order to provide for use of shavings for fuel of one or more boilers. Except for this controlling feature the natural location of the power house is at the center of the plant.

#### LUMBER YARD.

Lumber yards, dry kilns, etc., are naturally located within easy access to the planing mill and effective transfer of material requires good track facilities throughout the lumber yard and connecting with the mill.

#### SCRAP DEPARTMENT.

Older shops made but little provision for storing, classifying, separating and disposing of scrap material. In view of the capital represented by scrap and the large amount which has been found to accumulate at principal shops, from both road and shops, the newer shops have

been made to include a scrap department as an important feature of the shop layout. This is usually in connection with the stores department. The use of traveling hoists located over several tracks in one portion of the scrap department is becoming more noticeable. Such hoists are found very useful in unloading cars of scrap that come in from the line and in sorting heavy material.

#### AUXILIARY DEPARTMENTS.

The smaller departments, such as brass foundries, bolt and nut shops, tin shops, upholstering shops, paint shops, etc., are located as best suited to the requirements of larger departments which they serve and they are considered more in detail in connection with the buildings in which they are usually located, instead of in connection with the general layout.

#### DISTRIBUTION OF MATERIAL.

Naturally the prime motive of the shop is to make repairs with maximum expediency and to return equipment to service in minimum time. Each building stands much in the same relation to the entire shop plan as the several component parts of a machine bear to the completed mechanism. This signifies the requirement of effective inter-communication among buildings. Distribution of material rapidly, economically and with least unproductive movement, then, is the keynote in the general arrangement of buildings, facilities and equipment.

Beginning with new supplies this includes the delivery of material from the store house to the several departments.

The peculiar character of repair work requires a certain amount of retroactive movement, for instance the movement of a locomotive frame to and from the blacksmith shop and the movement of other parts to and from the repair gangs, etc. Blacksmith shops and foundries, therefore, are so located as to provide for effective movement to and from the storehouse, locomotive erecting shop, car department shops, etc.

The arrangement and equipment of individual buildings are provided to suit their immediate needs and requirements of departments which they serve. Also the buildings are so located as to secure most effective operation, to provide for the movement of hand trucks of the industrial system and to include thoroughfares of inter-communication.

#### CLASSIFICATION.

Basing the classification of large shops for repairing both locomotives and cars upon the leading characteristics of the layout and the grouping of the principal departments, Mr. Walter G. Berg, chief engineer of the Lehigh Valley Railroad, who has given the subject of shop design much careful study, has classified American shop systems as follows:

A.—Complete transfer table layout.

- (a) All departments combined along one transfer table.
- (b) The various departments grouped along separate transfer tables.

B.—Combination of transfer table and longitudinal layout.

(a) Longitudinal freight car shop; all other departments, transfer tables.

(b) Longitudinal locomotive erecting shop, longitudinal freight car shop, and transfer table passenger car shop.

C.—Combination of a transfer table and a cross locomotive erecting shop with traversing crane for lifting engines over each other.

(a) Cross locomotive erecting shop with crane for lifting engines over each other, otherwise transfer tables for all other departments.

(b) Cross locomotive erecting shop with crane for lifting engines over each other, passenger car shop with transfer table, and longitudinal freight car shop.

D.—Layouts without transfer tables.

(a) All longitudinal layout.

(b) Cross locomotive erecting shop with crane for lifting engines over each other, otherwise longitudinal layout.

This classification is claimed to cover practically all railway shop systems of the country. The several combinations existing in any one shop have resulted from governing conditions and the personal preference of officials having the deciding vote.

The system of serving all departments by one transfer table seems to be commonly preferred for shops having a capacity of about fifteen locomotive stalls or less, to serve as the principal shop of a small road or as a division shop of a large road. It was said before that there is a greater similarity among the shops of this type than among any others until very recently. While the various systems may be included in Mr. Berg's classification, there is a marked dissimilarity among the general features of the ground plan layout of shops built about the same time and during successive years. There is now a growing tendency, evident from the general layout of recently built shops, to concentrate the departments about one crane served thoroughfare as an avenue of inter-communication and serving much in this capacity as did the transfer table in the shop system served by a single table. In such systems the groups are arranged around the avenue of inter-communication and each department is arranged within itself as requirements demand. The plants at Angus, on the Canadian Pacific, and Indianapolis on the Big Four, are arranged much on the same general principles, though the former includes a longitudinal locomotive shop and the latter a transverse locomotive shop. Each has a longitudinal freight car erecting shop and at each the passenger car repair and paint shops are arranged transversely and served by a common transfer table. The storehouse and locomotive shop are at one end of the midway and opposite to each other. The freight car repair shop and yard are at the farther end of the midway and the blacksmith shop, foundry, car machine shop, truck shop, etc., are grouped along the midway where they can be served by the yard crane. The



only transfer table in either of these plants serves the car department.

In this connection it is interesting to note that the Collinwood shops of the Lake Shore & Michigan Southern, built in 1902, are soon to be provided with a crane to serve a storage yard extending across the plant and occupying a position between two rows of the principal buildings. This area is between the locomotive shop, storehouse, power plant and passenger car department on one side and the brass foundry, bolt, blacksmith and car machine shops, mill building and new freight car repair shop (now under construction) on the other side. Provision for the future extension of all buildings is in two directions away from this area and the crane served yard will provide a thoroughfare among the principal buildings and a storage space controlled by the several departments.

In the locomotive shop the erecting pits are arranged transversely and this shop is not served by a transfer table. In the new freight car shop the repair tracks will be arranged longitudinally and the passenger car department is provided for by three transverse buildings served by two transfer tables. New cabooses are built in one of these buildings. This department occupies a corner of the plant in order that the transfer tables will offer no impediment to general yard traffic.

From a strictly up to date standpoint, the best practice for large shops is found to include a longitudinally or transversely arranged locomotive shop (according to the personal tastes of officials having the deciding vote) equipped with traveling cranes for transferring locomotives from the entering track to the erecting pit; a freight car erecting shop with longitudinal tracks, and two buildings served by a transfer table for the passenger car department, one located on each side of the pit, used for coach repair shop and paint shop respectively. All of these are commonly long, narrow buildings and the problem resolves itself largely into the matter of best locating these buildings to suit local governing conditions. The tendency has been to do away with the transfer table, except in connection with the passenger car department, especially in colder climates, and the passenger car department is usually located as remotely as possible in order that the transfer table pit will offer least impediment to general yard traffic.

The storehouse and minor shop buildings are located with relation to these buildings as best suited to the department or departments which they serve.

In the comparatively new plants the leading feature is the provision for inter-communication and compactness to contribute to delivery of material at the same time making due allowance for storage space to serve the principal departments and sufficient distance between buildings to guard against fire risks. It would, therefore, seem that the older shops represent more of a mongrel growth and a present day classification would group modern shops as follows:

1.—All department buildings combined along one

transfer table pit as a principal avenue of distribution and inter-communication.

2.—Principal buildings arranged along crane served runway as avenue of distribution and inter-communication with transfer table serving passenger car department only.

3.—Arrangement of yards without transfer tables in which the principal buildings are provided with longitudinal tracks, or in which there is a cross locomotive shop with other buildings arranged with longitudinal tracks.

4.—Mongrel growth to provide for increased capacity according to available facilities.

#### EVOLUTION OF OLD SHOPS.

The older shops, while including many up to date features, hardly represent the best general layouts or ground plan arrangements. Though these shops were considered ideal in every particular when built, improved facilities have been introduced which the older construction and arrangement of buildings prohibit unless the plant should be entirely rebuilt. In some instances this has been done either by securing new land at a distant point and erecting a new plant or by acquiring adjacent land and supplanting one or more departments at a time. In making such improvements, as the new buildings provided for transfer of departments, the space thus vacated has been utilized by other departments.

Where enlargements have been made to introduce modern facilities in an old plant, the new buildings are not always situated so as to produce the most economical movement of material.

While not intended as a criticism of the older shops, this is mentioned to illustrate how the latest shop plans show more compactness in the location of buildings and greater facilities for distribution of material among the various shops.

#### INDIVIDUAL EXAMPLES OF SHOP LAYOUTS.

In order to portray more clearly the characteristic features of railroad shop layouts, a number of the older shops are shown as well as several of the more modern, from which conclusions may be drawn as to the best practice. For this purpose the following are good examples:

##### I. C. R. R.—BURNSIDE.

At the Burnside shops of the Illinois Central Railroad the original plans provided for a blacksmith shop and boiler shop in the same building, separated by a fire wall, and located across the transfer table pit from the locomotive erecting and machine shop. The latter shop contains 24 transverse pits, served by a crane of 100 tons capacity, and the original ground layout provided for a future possible extension of this building to embrace 40 or 50 pits. This building originally included the principal car wheel work and wheels and axles were stored in the space beyond the locomotive shop.

During recent years the machine tool capacity has been largely increased by the construction of two long narrow galleries, or balconies, in the machine bay and by the removal of the car wheel department to a new shop which

has been built in addition to the passenger car repair shop. In order to provide greater facility in both blacksmith and boiler work, a new boiler shop has been built and the present locomotive department of the blacksmith shop is to be extended to include the old boiler shop.

The new boiler shop is located at a point beyond the old blacksmith shop and boiler shop and the pits are arranged transversely, served by an overhead traveling crane and includes the use of a transfer table. These improvements represent the provision of facilities for increasing work in the boiler, blacksmith and machine departments without increasing the capacity of the locomotive shop as a storage plant and will provide for a larger and more economical output with the same number of repair pits.

The boiler shop contains 24 erecting pits, or stalls, and this provision is made to meet the demand of the next 15 or 20 years, which accounts for the construction of a boiler shop of almost the same length as the locomotive erecting shop.

A new roundhouse has been added to the original plan, thus doubling the facility for roundhouse work.

#### A. T. & S. F.—TOPEKA.

The Topeka shops of the Atchison, Topeka & Santa Fe, are an example of the extension of the original plant, embracing car and locomotive shops, to provide a new locomotive department, modern in every particular, as well as an addition to the freight car repair department. The new shop buildings were erected on acquired land adjacent to the old shop plant and the area previously occupied by the locomotive shop has been converted to meet the requirements of auxiliary departments. The old locomotive shop was on the side of the main line tracks to Atchison, opposite to the present site.

The conditions peculiar to this plant are such that yard tracks enter from one end only and transverse traffic among the several buildings and departments is dependent upon cross tracks equipped with small turntables for push cars, at the intersections of longitudinal and cross tracks. While the location of the storehouse is convenient for line shipments in being near the main tracks, its position would appear out of the way so far as convenient distribution of material throughout the shop plant is concerned. The passenger coach shop and present paint shop is served by two transfer tables and there are no transfer tables in the other departments. The use of two transfer tables in the passenger car department is unusual and the second table is probably provided for delivery between the planing mill, storage yard and truck shop and the coach shop.

Arguments have been presented in favor of serving a passenger car shop with more than one transfer table, where the shop tracks are of such length as to provide a standing capacity of two or more cars on each track; but in view of the impediment to general yard traffic on account of the transfer table pit and the inconvenience provided by the accumulation of snow, the general tendency

has been to dispense with transfer tables wherever possible.

The planing mill at Topeka is conveniently located with regard to the passenger and freight departments. The freight car repair shed is the most liberal provision of its kind for this class of work of which information is at hand. Practically the entire freight repair yard is under roof. The principal buildings included in the additions providing for the locomotive department are the locomotive, blacksmith and wheel shops, powerhouse and isolated lavatory.

The locomotive shop occupies a position at one extremity of the plant, though later development included in the additional freight car department will extend the shop yard beyond the site of this building. The locomotive erecting pits are arranged longitudinally and the building includes the erecting, machine, boiler and tank departments. The central pit track extends the full length of the building and engines are stripped and finished on this track. In order that no congestion might result from this practice, a turntable is located east of the building and adjacent to the boiler department and tanks enter the shop over this table. To further facilitate this plan and the crane service, transverse stall tracks are provided for tender frame and tank work.

Additions are now being made at Topeka which include a new passenger car paint shop, and a new freight car plant which will be considered as an extension of the present freight car repair facilities.

The new paint shop will be situated 50 feet south of the present paint shop. It will be 320 feet long by 110 feet wide and will be served by a transfer table operating at the south side of the new building.

The additions to the freight car department will be in a group of new buildings situated on a tract of land about 1,300 feet east of the locomotive shop. This will include a freight car repair shed, 208 feet 6 inches by 900 feet, which, it will be observed, is larger than the present repair shed of the original plant; a freight car planing mill, 75 feet by 350 feet; a dry kiln, 50 feet by 60 feet; freight car structural steel shop, 80 feet by 200 feet; wheel shop, 60 feet by 100 feet, and scrap bins constructed of old sills. Adjacent to the freight car planing mill is a boiler and engine room, 44 feet by 50 feet and 36 feet by 50 feet respectively. On each side of the dry kiln is a small 6 foot transfer table to facilitate distribution from the dry kiln to the freight car planing mill.

#### C. & N. W.—CHICAGO.

At the Kinzie street, Chicago, shop of the Chicago & Northwestern Railway, all departments were originally grouped around several transfer tables before this plant was extended in 1901. Since that time a new longitudinal freight car repair shop has been built and the transfer table serving the locomotive shop has been extended to serve a newly constructed boiler shop which is modern in its equipment and includes the service of overhead traveling cranes. The erecting and machine shop is not served by overhead traveling cranes and locomotives entering the shop for all classes of repairs are stripped and

unwheeled in the boiler shop where crane service is available and, when necessary, boilers are removed from frames in the boiler shop. The skeleton and machinery are then transferred to the erecting shop by the transfer table and wheels are handled by a traveling jib crane.

#### P. & L. E.—MC KEES ROCKS.

The Pittsburg & Lake Erie shops at McKees Rocks, represent successive improvements for the locomotive and later for the car department and illustrate additions to provide for gradual improvements. The layout of this plant is limited by the shape and size of available land, being included in a peculiarly shaped narrow strip between the main tracks and the side of a hill.

The present caboose repair and tank shop and the coach repair shop are in old buildings once occupied by the locomotive shop. A few years ago a new locomotive shop was built which includes 20 transverse pits served by an overhead traveling crane capable of lifting an engine over those standing on the pits and a crane of small capacity for handling lighter parts, operating on runways at different heights. In this plant the boiler shop is in a separate building arranged at right angles to the locomotive shop. The blacksmith shop and storehouse are parallel to the boiler shop and this group of buildings represents a convenient arrangement for efficient service where it is preferred to place the boiler department in an isolated building. On the opposite side of the erecting and machine shop are two roundhouses and the power house. Both roundhouses are connected with the erecting shop and engines entering the shop for repairs are delivered over the roundhouse turntable. This arrangement obviates the necessity of a turntable to serve the erecting shop, and the whole layout represents a very compact grouping of buildings. One roundhouse is being used temporarily as a steel car repair shop.

The passenger car paint shop, while in a modern and convenient building, is peculiarly located on account of the lack of space and is some distance from the other car shops. A modern freight car shop has recently been completed. This shop is the best equipped, especially for work on steel cars, of which information is at hand. The shop arrangement includes longitudinal tracks. One bay is to be devoted entirely to repairs of steel cars and provision is made to include space for furnaces and other apparatus in handling parts of such cars.

#### B. R. & P.—DU BOIS.

The locomotive shops of the Buffalo, Rochester & Pittsburg at Du Bois, are comparatively new and modern shops and represent up to date practice. The locomotive shop includes the longitudinal arrangement of tracks with the erecting bay in the center and machine bay on each side. The shop originally included the boiler department at one end and the shop as then built was expected to turn out about 12 locomotives per month. Its present output averages 24 to 26 per month.

In order to secure this increased capacity a new boiler shop has been constructed so that the space heretofore oc-

cupied by machine tools for boiler work has been supplanted by machine tools for locomotive work and the standing capacity on the pits has been similarly increased.

The boiler shop is in a new, modern building located at a distance of 145 feet from one end of the locomotive shop and is arranged transversely with the latter. The stall tracks are transverse and are served by a crane of 30 tons capacity. The shop is served by a 45-foot transfer table which provides communication between any stall of the boiler shop and the longitudinal tracks of the erecting and machine shop, as well as with an entering or lead track.

The blacksmith shop is north of the erecting and machine shop with a distance of 40 feet between the two buildings. The roundhouse is located south of the erecting and machine shop with a distance of 275 feet from this shop to the center of the turntable. A straight transverse track across the erecting and machine shop, connects with the roundhouse on one side and with the blacksmith shop on the other. This track does not enter the blacksmith shop, but intersects a longitudinal track through the shop. The power house is north of the erecting and machine shop and east of the blacksmith shop. The storehouse is north of the erecting and machine shop. It is entirely surrounded by a platform at the height of an ordinary box car floor and is well served by track connections. The oil house is south of the storehouse and west of the roundhouse and is well situated with relation to both.

It is interesting to compare the general ground plans of the B. R. & P. shops with that of the locomotive department of the P. & L. E., as representative of two shops with about the same capacity, in one of which the locomotive erecting pits are arranged transversely and served by overhead traveling cranes, and in the other the pits are arranged longitudinally and served by overhead traveling cranes. In both plants the buildings are closer together than is usually customary and would indicate that with present day structures and fire protection equipment, shop designers are justified in planning for greater compactness in the arrangement of buildings. At Du Bois the buildings are capable of extension to meet greater demands of the future, while at McKees Rocks there is no further available land for the extension of shop buildings.

#### C. P.—ANGUS.

As compared with shops previously built the ground plan, or general layout of the Angus shops of the Canadian Pacific Railway represents an innovation in the general arrangement of principal buildings to provide for the several departments. The principal governing features are the disposition of the only transfer table, namely, that serving the passenger car department at a remote point in the plant where the transfer table pit does not impede general yard traffic and the introduction of a crane served thoroughfare as the principal avenue of inter-communication. The use of a traveling crane in the yard was not original with the Angus shop plant, nor did the idea of grouping the buildings about one thoroughfare of inter-

communication originate with this shop layout. Other shops had used overhead traveling cranes to advantage in the yards and several shops, referred to in the early part of this chapter as being similar to each other with regard to certain principal points and constructed about 1899, represented an arrangement of grouping buildings along a single transfer table pit which serves as an avenue of inter-communication.

The Angus shop represents a layout using both features to advantage, but omitting the transfer table as the principal vehicle of distribution. The buildings are grouped around a principal thoroughfare and the crane provides a vehicle for transferring material. At the same time the ground space covered by the crane is available for material tracks and as a road for teams and instead of offering an impediment to general yard traffic as would the transfer table pit, it provides greater facility in this connection. The crane also offers greater convenience as a means of delivery than does a transfer table.

The buildings are at right angles to the midway and a system of standard gauge material tracks for both longitudinal and cross traffic among the buildings is connected with the tracks of the midway by 8 foot turntables at track intersections. The system of material tracks, while of standard gauge, is independent, in that the 8 foot turntables will offer no impediment to locomotive traffic. The plant is served by a system of through tracks connected with a belt line surrounding the yards for delivery of material in carload lots to the various storage spaces. All departments are provided with large storage spaces which are particularly essential in view of the shop being largely a manufacturing concern.

The minimum distance between the buildings is 75 feet which, while providing against fire, is arranged principally to provide for storage space and trackage room throughout the yard. The land on which the plant is situated is of such size and the buildings are so located as to provide for the increase of all buildings in large ratio. Such additions may be made without interfering with future yard traffic and without greatly increasing travel among departments.

Cross travel of material from the lumber yard to and from the mill is provided for by a small transfer table at each end of the mill. The pits are quite shallow and do not interfere with foot traffic in the vicinity of the mill building.

The passenger car shop is served by a transfer table which is located beyond the zone of general yard traffic in order that no impediment may be offered by the pit. The transfer table travels parallel with tracks provided for yard traffic and cars are delivered to and from the transfer table over a curve. In view of the unlimited ground for the location of buildings it would appear that these shops would have been more convenient had this transfer table pit been arranged transversely with the yard tracks.

In view of the large size of this shop plant it would appear to be extremely well arranged and while ample provision is made for storage, the arrangement of the buildings is at the same time quite compact.

The locomotive shop and general storehouse are at the south end of the midway and on opposite sides. The blacksmith shop, gray iron foundry, pattern shop, car machine shop, truck shop, car erecting shop and planing mill are also adjacent. The planing mill and freight car shop are on opposite sides of the midway and are in the same straight line to provide for economical movement of material direct from the lumber yard through the mill machinery and to the car erecting shop. The gray iron foundry is near the locomotive shop to provide for the delivery of heavier castings. The blacksmith shop is located to serve both the locomotive and car departments and car material from this shop passes in natural sequence through the car machine shop and truck shop on its way to the car erecting shop. The wheel foundry is located contiguous to the freight car department with wheel and axle storage yard between it and the truck shop so that this building too is a feeder to the freight car erecting shop.

The locomotive shop provides for erecting, machine, boiler and tank departments within a single building which also includes work on pilots, running boards and other wooden parts. The erecting pits are arranged longitudinally.

The freight car paint shop is practically a continuation of the erecting shop so that transferring a car from the erecting shop to the paint shop consists in merely moving the car forward as in advancing from one stage of construction to the next. The mill, erecting and paint shops are located in a straight line with the lumber yard and dry kiln contiguous to the mill, an arrangement which presents most desirable features for delivery of material and for productive movement.

C. C. C. & ST. L.—INDIANAPOLIS.

The Big Four shop at Indianapolis is also an entirely new plant throughout and in general layout reminds one of the Angus shop. The principal features differ somewhat and are arranged to suit the governing conditions and tastes of those responsible for the design. In this shop the principal buildings are grouped around a midway 75 feet wide served by a 10-ton crane. As was said with regard to the Angus shop, the transfer table serving the car department is placed in a remote location. However, the direction of the transfer table pit appears more desirable inasmuch as it is arranged transversely to the general line of yard tracks and delivery to the table is more direct.

All departments and all principal buildings are directly tributary to the midway and the layout is somewhat influenced by the fact that the shop yard is adjacent to a large double hump gravity freight yard. A general system of tracks parallel to the main line track serves all departments and is connected to the main line at both ends of the shop yard. Cross travel among the several departments is provided for by transverse standard gauge industrial tracks and 8 foot roller bearing turntables at track intersections. The erecting and machine shop is a modification of the locomotive shop at Sayre, on the Lehigh Valley, the erecting pits being arranged transversely in two rows with the machine space between



them. These pits are parallel with the shop tracks so that a turntable is not absolutely necessary in delivering locomotives to the shop. However, a turntable is introduced which serves to assist inter-communication between the boiler shop and tank shop and erecting and machine shop, which are in separate buildings.

The blacksmith shop is conveniently located to serve both the locomotive and car departments. The storehouse is located very near the center of the yard from which point it serves the several departments conveniently. The iron and brass foundry are at the extreme west end of the yard so that the transportation of raw material at this point does not impede general yard traffic. One side of the iron foundry is served by the yard crane and a platform, one side of which is partly under the yard crane, extends from the iron foundry to the storehouse. Raw material enters one end of the foundry and finished castings are delivered directly to their destination in the shop plant or delivered to the storehouse for storage and for line shipments. The pattern shop, although convenient to the iron foundry, is isolated from all other buildings for fire protection.

The freight car repair yard is adjacent to the main freight switching yard so that the switching of repaired and bad order cars will be reduced to a minimum. The freight car repair shop is practically at the center of the south edge of the repair yard. The freight car department is across the midway from the passenger car department at the east end of the yard with the planing mill located on the north side of the midway, and between the passenger and freight car buildings. Lumber is stored at the extreme east end of the yards away from all buildings and lumber passes in regular sequence through the dry kiln, dry lumber shed and mill directly to its destination without doubling its course.

The wheel shop is located just north of the storehouse and is so situated as to serve equally well the car department, the tank shop and a depressed track for shipment of wheels to outside points.

The power house is situated at the center of the north side of the midway where it is at the center of distribution when all requirements of power are considered, and is so located with relation to the mill building as to provide for delivery of shavings by an exhaust system to the boiler room. All buildings using power are within a radius of 1,000 feet.

Lavatories and closets are in general located inside of or adjacent to all buildings with proper enclosures and ventilations.

There is a minimum distance of 75 feet between buildings for fire protection and there is ample yard area tributary to each building for storage space. The location and arrangement of buildings is such as to provide for 50 per cent increase in all departments without interfering with future yard traffic and without greatly increasing the necessary travel among the departments.

The principles adopted in the general arrangement are not affected by the necessity of providing roundhouse equipment and facilities. There will be two 25 stall

roundhouses at a point convenient to both the shops and terminal tracks of the eastbound and westbound yards.

#### L. & N.—SOUTH LOUISVILLE.

At the South Louisville locomotive and car shops provision for inter-communication is made by grouping the principal buildings tributary to two thoroughfares arranged at right angles with each other and assuming the form of an L. One of these avenues is a transfer table pit about 920 feet long and the transfer table serves the locomotive shop on one side, and the freight car erecting shop, planing mill, coach, paint and tender shops and storehouse on the other side of the pit. The other wing of the L is a storage yard, 1,000 feet long by 40 feet wide, for raw and semi-finished material and is served by an overhead, high speed, traveling crane of 10 tons capacity.

All departments are served by a system of standard gauge tracks which are tributary to a belt line encircling the entire shop plant. These tracks serve as the industrial system for the delivery of material among the buildings on hand cars and, inasmuch as delivery across the general line of tracks is provided for by the transfer table, there are no turntables in the track system, a feature which provides greater scope for general yard switching service throughout the plant.

The pits in the locomotive shop are arranged transversely and the boiler shop is included within one end of the locomotive shop. While engines entering the locomotive shop are commonly delivered over the transfer table, this shop is not entirely dependent upon the table as an engine may be delivered over a track entering the locomotive shop at about its center, and transferred by the traveling crane to any desired pit by lifting it over the others standing on the erecting floor. This arrangement presents an excellent provision against congestion, and while in general every day service the table is used only about five per cent of the time by the locomotive shop as against 95 per cent by the car department, either the crane or the transfer table may relieve the other in case of emergency, and it is hardly likely that both of them will be out of order at the same time.

The entire arrangement of buildings is for the economical movement of material, beginning with raw material in the storage yards and advancing to objective points near the center of the plant. All lumber enters at the south end of the yard and is distributed from the planing mill as required. Metal enters at the north end of the yard and the metal working shops are on that side of the plant, so that movement from storage yards to the individual shops will be over the shortest and most direct route. Similarly, the semi-finished product is delivered from one shop to the other, etc. Such progressive movement and delivery is particularly adaptable in that the shop plant is largely for manufacture and consequently there is much less retroactive movement than would obtain if the plant was devoted to repair work entirely.

The freight car repair shop and yard are accessible from the storage yard and the planing mill is in the

path between them and the lumber yard. The freight car erecting shop for new cars is on one side of the mill and the passenger car shops on the other and the transfer table provides communication among them.

The location of the general storehouse is such as to make it accessible to the transfer table pit, as an avenue of delivery, and near the belt line where switching facilities are available, thus serving the shop and the line to good advantage.

The power house is near the mill building to provide for delivery of shavings to the boiler room for use as fuel and considering the large amount of power required by the mill, as well as considering the general layout of the several shop buildings, the power house is not really far from the center of the plant as a whole.

Provision is made for extension of all buildings and such extensions will be made in directions away from the transfer table pit. A space has been retained for a new boiler shop so that by placing the boiler department in a new building, that portion of the locomotive shop now devoted to boiler work may be used for locomotive repairs and machine work, thus increasing the capacity of that shop.

In describing the transfer table it was explained that the locomotive shop is not entirely dependent upon the table, and in the event of accident to the transfer table, entrance to car and tank shops may be made by means of the yard tracks and all tracks in the buildings would be so accessible with the exception of two tracks in the coach shop.

#### C. R. R. OF N. J.—ELIZABETHPORT.

The Elizabethport plant of the Central Railroad of New Jersey presents an interesting example of a shop layout governed by the shape of available land, in which a transfer table serves both the locomotive and passenger car department and illustrating the effect of the location of the roundhouse as a prominent factor in the distribution of buildings. The available land, in this case, was in the form of a right angle triangle, two sides of the triangle being formed by the main line of the road and by a branch line. Another diverging branch line joins the main line at the same point, so that the most desirable location for the roundhouse was in the rectangular corner of the shop yard, near the juncture of the diverging lines. The oil house is naturally located near the roundhouse, and while it is generally considered desirable to arrange the oil house in connection with, or adjacent to the storehouse, it is, of course, natural to place the oil house near the roundhouse, where the location of store and round houses is such that the other practice cannot be followed. As the roundhouse is not equipped with an independent small shop for the maintenance of running repair work, it is essential that the locomotive shop should be near the roundhouse and communication between the two is provided by a straight track connected with the transfer table. While it is unusual to place a transfer table pit between these two shop buildings on account of the impediment which it

offers to traffic, it is reported by the shop management that no difficulty is experienced on this account.

The passenger car repair and paint shops are grouped on opposite sides of the transfer table pit and the blacksmith shop occupies a position convenient to both the locomotive and car shops. The storehouse, also, is located to be of equal access from both the locomotive and car departments and is well provided with track connections. The power house occupies a position which will be at the center of the plant when contemplated freight car shops have been erected.

The arrangement of the buildings provides for ample extensions and tributary to each building is liberal storage space.

#### C. & E. I.—DANVILLE.

The arrangement of buildings in the locomotive department of the Danville shop plant of the Chicago & Eastern Illinois would indicate the application of a principle of making the other buildings tributary to the roundhouse. The oil house, storehouse, blacksmith shop, erecting and machine shop and boiler shop are all adjacent to the roundhouse and while they are laid out squarely and on straight lines, their grouping assumes much the form of an arc of a circle with the turntable as a center.

The erecting and machine and boiler shops are served by a common transfer table and are on the same side of the transfer table pit. A straight track passing between these two buildings connects the roundhouse turntable with the transfer table.

Plans for contemplated car shops to be embraced within the same general plant, provide for passenger coach and paint shops to be located across the transfer table pit from the erecting and boiler shops and to be served by the same table. A planing mill and freight repair yard are to be situated beyond the present power house and when these additions have been made, the power house will occupy a place practically at the center of power distribution.

While the arrangement of buildings is most compact, provision is made for the future extension of all departments.

#### C. R. I. & P.—SILVIS.

The Silvis shop of the Chicago, Rock Island & Pacific is another example of the locomotive shop being constructed and plans provided at the same time for the addition of a car department in the future. This shop is an instance wherein practically no restrictions were provided as to shape and arrangement of buildings. Taking the shop plant as a whole, and including the car department as it is contemplated, one of the governing elements is the elimination of the transfer table from all departments except for serving the passenger coach and paint shops.

The shop yard is adjacent to the main line and a general system of through tracks parallel to the main line serve all departments and is connected with the main

line at both ends of the yard. There are nine miles of track in the yard. Two tracks extend through the erecting shop and one through the blacksmith shop. The storehouse is served by two tracks at each side and the power house is served by one track to provide for coaling facilities. At the east end of the locomotive shop are tracks for the storage of wheels.

The roundhouse is located west of the locomotive shop where it will be convenient to both the shop and the yard terminal, and engines entering the shop are headed in the desired direction by the roundhouse turn table. The buildings constituting the plant are separated by a minimum distance of 50 feet and there is ample yard space tributary to each building to provide necessary storage area. The principal buildings of the locomotive department are ranged near together and the buildings of the car department are conveniently grouped. The erecting, machine and boiler departments are in one building and the arrangement of erecting pits represents a rather novel feature. Locomotives enter the shop on a longitudinal track and are placed on erecting pits situated at an acute angle with the longitudinal track and representing what is known as the "herring bone" system.

The blacksmith shop is near the locomotive shop and one end of the building is used as a brass foundry. While not in a central position between the locomotive department and the proposed car department, the blacksmith shop is in a position which will be accessible to the latter when built. Its situation nearer the locomotive shop provides for immediate needs and material for car work is of such nature as to be more readily transferred than that which passes between the blacksmith and locomotive shops.

A scrap platform occupies a position east of the blacksmith shop and just north of the boiler department of the locomotive shop. The location of the storehouse is nearly central as regards the locomotive and car departments and a very interesting feature in connection with the storehouse is a large supply platform which is served by a crane of five tons capacity, having a span of 80 feet and traveling on a runway 400 feet long. This crane extends over one of the delivery tracks and over a part of the platform for its entire length. A delivery platform, 15 feet 8 inches wide, extends along each side of the building and at the west end is a platform 17 feet 8 inches wide, which extends to the refined oil house. The oil house is so situated as to be convenient to both the roundhouse and the storehouse.

The power house is at the north side of the locomotive department and will occupy a position nearly at the center of electrical distribution when the car department has been erected and when all classes of power are considered.

While the car department has not yet been constructed, the plans as now arranged provide for a passenger coach and paint shop served by a common transfer table, the pit to be arranged transversely with the general line of yard tracks. The freight car erecting shop will be east of the passenger coach shop at a distance of 230 feet.

One end of this shop will include a car machine shop. The planing mill is located southeast of the freight car repair shop where it is in position to serve both the freight and passenger departments, but nearer to the freight car shop, in view of the larger percentage of material naturally delivered to the latter.

Lumber is stored at the extreme east end of the yard and its location with regard to the dry kiln, planing mill and covered shed for storage of dry lumber, is such that lumber works through the dry kiln, planing mill and covered shed directly to its final destination without doubling in its course.

Provision is made for future extension of all buildings in both the locomotive department, which is already in service, and in the car department, not yet constructed.

#### RAILWAY CAR SHOPS.

Prevailing practice indicates a tendency to group car and locomotive departments in one general plant and including a number of buildings used jointly by both departments. The only shops devoted entirely to car work and operated strictly by railroads, are those of the New York New Haven & Hartford at Readville, the Delaware Lackawanna & Western at Scranton, the Missouri Kansas & Texas at Sedalia and the Wabash at East Decatur. At the Kingsland shop of the Delaware Lackawanna & Western, while originally planned for a combination car and locomotive plant, the car department was in operation before construction work began on the buildings of the locomotive department.

#### N. Y. N. H. & H.—READVILLE.

The Readville shop is operated for the maintenance and repairs of both freight and passenger equipment. In preparing for this shop plant, a site was selected at a convenient point near Boston, between two branch lines, the available land providing for good track arrangement and facilities and offered no restrictions as to shape and size of buildings. The plant consists of the following principal buildings, passenger coach paint and erecting shop, freight car repair shop, mill building, storehouse, blacksmith, iron machinery, truck and cabinet shops, and piping, turning and buffing shop, power house, dry kiln and hardwood shed. The property provides ample room for shop approaches and while the plant is a large one, the buildings are arranged very compactly.

The minimum distance between buildings is 50 feet, while there are but few instances in which there is a maximum distance of over 100 feet. The general layout plan provides for an arrangement of buildings, material yards, working tracks, supply tracks, etc., by which material passes from its source through the various buildings, machinery and departments to its destination with productive movement and without doubling in its course. The arrangement of buildings, providing standing capacity for cars, in both passenger and freight departments, are representative of prevailing ideas in this connection.

The passenger car erecting shop contains 10 tracks

at 24-foot centers, each holding 3 cars, providing a total standing capacity of 30 cars. This building is 25 feet from the transfer table. The transfer table pit is 75 feet wide, and 100 feet east of the transfer table is the paint shop which has the same standing capacity as the erecting shop. There is a second story in the south end of each building providing for varnish rooms, upholstery shop and toilet rooms. The space provided between the paint shop and transfer table is used for stripping and scrubbing cars and for storing them while waiting to enter the shop.

The freight shop includes the longitudinal arrangement of tracks and contains 7 tracks at 20 foot centers, having a standing capacity of 60 cars. These two departments are arranged with reference to the mill building, lumber yard and other buildings serving these departments jointly, so as to provide for the movement of material in natural working sequence.

The capacity of the shop under ordinary circumstances is 180 passenger cars per month for all classes of repairs and 1,000 freight cars receiving general repairs. The shop was constructed to concentrate the heavy car work of the railroad system at one point.

The storehouse is located south of the passenger car department and 100 feet from the blacksmith and iron machinery shop. It is on the opposite side of the plant from the car shop. The storehouse, machine shop, oil house, truck shop and coal storage space of the power house are served by two parallel tracks, thus providing for wheel work, heavy parts, material for the storage department, etc., in a comparatively narrow territory while buildings for lighter work are placed and grouped conveniently.

Electrical distribution of power is used throughout and those buildings requiring power are grouped near together and within a short radius of the power house.

The lumber yard is in the western portion of the shop yards away from all buildings and its location is such, when taken in connection with the location of the hardwood shed, dry kiln, mill building and the other departments, that lumber follows a progressive movement without doubling in its course through these several departments to its final destination.

The passenger car department is very close to the several auxiliary shops and is connected with the mill by two through tracks. A space, or avenue, 100 feet wide, separates the tracks of the freight car department from the through track to the lumber yard so that both the freight shop and freight car repair shop tracks are located conveniently to the source of supply.

The hardwood shed is 300 feet by 50 feet and the dry kiln is 125 feet by 75 feet. These buildings are larger than is common to most car departments, but is necessitated by the amount of cabinet work done on sleeping cars, parlor cars, etc., and required by the demand of a rather large cabinet shop.

Yard traffic throughout the plant is provided for by a system of parallel tracks which connect with a loop en-

circling the plant and all tracks converge near the east end of the yards. Cross traffic is provided for only by the transfer table and by an avenue 100 feet wide extending transversely across the plant.

Freight repair facilities include a system of tracks evenly spaced and arranged on 20-foot centers, west of the freight shop, and a system of tracks similarly arranged east of the shop with a standing capacity of 500 cars. The tracks of both yards converge and are connected by leads at opposite ends of the plant.

D. L. & W.—SCRANTON.

The Keyser Valley shops of the Delaware, Lackawanna & Western, located at Scranton, are designed and operated for the construction and repair of freight car equipment. The road maintains about 29,000 freight cars and the principal work is concentrated at this point. The capacity of the shop is about 1,200 heavy repairs per month, the construction of about 400 new box cars with steel reinforced under-framing, in addition to light repairs of about 7,000 cars in adjoining repair yard, per month. Practically no passenger work is done here save for the construction of a few baggage and milk cars. While the plant contains no shop building especially equipped for the repair of all steel cars, a number of steel hopper cars have been repaired very successfully, on which the principal work has been done in the blacksmith shop.

The general ground plan layout includes no transfer table service and the buildings are arranged according to a longitudinal system of tracks, the stall tracks of the various buildings and light repair yard being approached by leads connecting with the yard system of transfer tracks. Track approach to the shop yard is from one end only and there is no belt line encircling the yard. The shop buildings are between the point of approach and the principal storage yard and all cars loaded with raw iron, lumber, etc., to be delivered to the yard must traverse the length of the shop yards and are delivered over tracks passing between the buildings and within the limits of the industrial track system.

The principal buildings are arranged along both sides of a wide thoroughfare, toward the south end of which the storehouse and office building is located. They are placed at such distances as to provide ample room for yard storage of material, to allow for extension of all buildings and to insure against fire risks, as well as to admit liberal daylight. They are arranged in such a manner as to provide for the progressive movement of material from the iron and lumber storage yard at the east end of the plant through the several shops and stages without doubling. Inter-communication among the shop buildings for the distribution of material is provided for by a narrow gauge industrial track system. At the intersections of industrial tracks are turn tables which permit of transverse as well as longitudinal traffic and all industrial tracks through the various buildings are tributary to the transverse tracks through the principal yard thoroughfare.



The plant includes the following principal buildings: Two freight car repair shops, with a capacity of 48 cars each, one being used for the construction of new equipment and the other for heavy freight car repairs. On the side of the main thoroughfare opposite to the car repair shops are the mill, blacksmith and machine shops, all of which are of comparatively easy access from the repair shops. The mill is on the same center line as the shop for heavy freight repairs. Near the mill is the lumber shed, with open sides, for the storage of finished lumber. The blacksmith and machine shops form the two wings of an L, this arrangement providing for quick and convenient movement of material from the blacksmith shop, through the various machines on its way to the car shops. Nearby is a storage space for wheels and axles, from which they pass through the machine shop to cars on a depressed track, and they are delivered either to the car erecting shop or to the line, as needed. Just outside of the blacksmith shop is an iron shed and beyond the blacksmith shop is a coal house for the storage of coal used in this shop. The coal house is served by a trestle to facilitate delivery and unloading.

The power house occupies a position next to the machine shop and adjacent to the principal thoroughfare. Its location is such that all buildings requiring power are within a convenient radius and considering the supply of air required for the freight car repair shop, oil house, light repair track, etc., its situation conforms with the character of the plant.

The storehouse is at the north end of the principal thoroughfare. On each side is a platform of convenient height to a car floor and to the rear is a storage platform, 200 feet by 75 feet. The basement, first floor and portion of the second floor are occupied by the stores department, while the offices of the master car builder and his staff, and a drawing room for the car department, occupy a portion of the second floor.

The oil house and paint shop annex occupy a long narrow building, 280 feet by 20 feet and the two are separated by a fire wall. This building is located at a distance of 120 feet from the paint shop and 118 feet from the car erecting shop.

The paint shop is west of the car repair shop and the car erecting shop and has no direct track connection with either. It has a standing capacity of 60 cars.

Directly in front of the storehouse and office building is the yard for light repairs, in which about 250 or 300 cars are repaired per day. This yard contains 8 tracks arranged on 20 foot centers and between every alternate pair of tracks is a narrow gauge track of the industrial system. In this yard one track is reserved for the repairs of steel cars.

For convenience in storage and delivery of material this yard contains a series of long narrow material sheds in which are kept bolts, nuts, finished lumber, sheathing, car doors, couplers, etc.

There are two scrap platforms, or docks, in the yards, one of which is near the blacksmith shop and the other

near the light repair tracks. Both are equipped with air operated shears, and the various kinds of scrap are sorted into classified bins. The platforms are level with a car floor and industrial tracks traverse the length of each platform.

All lavatories are outside of the buildings. There are four of these located at various points of convenience, each 50 feet by 25 feet.

Lumber entering the mill from the lumber yard passes through doors at the end of the mill building, while lumber from the finished lumber shed passes through a side door conveniently located. From these entrances lumber follows paths of progressive movement through the various machines until finally loaded for delivery to the car erecting and machine shops. While much material is delivered from the mill on cars traveling over the industrial tracks, a great deal of it is transferred to the car building shop in box cars. Scrap pieces, shavings, etc., are loaded into special cars for delivery to the boiler room.

Raw iron for the blacksmith shop is stored nearby in order to facilitate quick delivery to the machines and hand forges. Progressive movement carries material through the machine shop, and onward to the car building shop or freight car repair shop.

#### WABASH—EAST DECATUR.

The East Decatur shops of the Wabash Railroad are located at a point convenient for serving the middle western district of the Wabash R. R. They are located on a tract of land containing 78 acres, which is well drained and which provides no limitation in the arrangement and layout of the buildings, tracks, etc.

On account of the mild climate and the almost complete absence of snow at Decatur, it is possible to repair freight cars out of doors during most of the year and for this reason no large provision is made for repairing freight cars under roof.

The plant has a sufficient capacity for 150 to 200 bad order cars per day and to build 12 to 15 new freight cars per day, as well as to give general repairs to from 15 to 20 passenger cars per month.

Repair tracks for bad order cars occupy the extreme southern portion of the yards. There are 4 repair tracks arranged in two groups of 2 tracks each, placed at 20-foot centers. Between each pair of repair tracks is a material distribution track and between the two groups are 3 material racks each 8 feet by 56 feet arranged at convenient intervals.

The main repair shop is 463 feet long and 188 feet wide and is intended chiefly for repairs of passenger cars. There are 4 repair tracks in this building arranged longitudinally and the principal buildings are located parallel with this shop and the freight car repair tracks. The buildings, therefore, are parallel with the general line of tracks. They are arranged compactly while providing for large future extensions, and the plant includes no transfer table. The buildings serving both

## RAILWAY SHOP UP TO DATE

departments are located between the car shop and the freight car repair tracks.

The blacksmith and machine shop occupy one building, 294 feet by 80 feet which is located next to the bad order tracks. In line with this building is the power house, 60 feet by 108 feet, which is located quite close to the planing mill and directly south of it. This not only places the power house near to the building which will consume the greatest amount of power, but also provides for the delivery of shavings and other refuse from the planing mill. The planing mill is 238 feet long by 80 feet wide and contains two longitudinal tracks, one of which completely connects the two systems of track on the east and west side of the shop plant.

North of the blacksmith and machine shop is a long shed, 210 feet by 90 feet for iron, coal and coke. The store house is 464 feet by 40 feet and is situated between this shed and the car shop. This places the store house practically at the center of distribution.

The offices occupy a position in one end of this building and on the second floor. The oil and paint shop is at the opposite end of the building. North of the car shop is a long building, 40 feet wide, which contains a cabinet shop 112 feet long; tin, upholstery and glazing shops, each 56 feet long, and a department for electrical work which is 70 feet long.

Other minor buildings include a dry kiln 80 feet by 20 feet; two dry lumber sheds; a concrete pit for fuel oil, 40 feet by 12 feet, and a septic tank, 45 feet by 12 feet. There are three depressed tracks with concrete walls at the sides of the excavations. One of these tracks is at the northwest corner of the yard and is 250

feet long. It is adjacent to a scrap shed, 20 feet by 28 feet, and is intended for loading and unloading scrap.

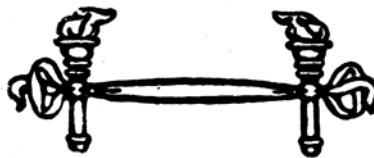
The minimum distance between buildings is 15 feet, while there are but few instances in which there is a maximum distance of over 85 feet.

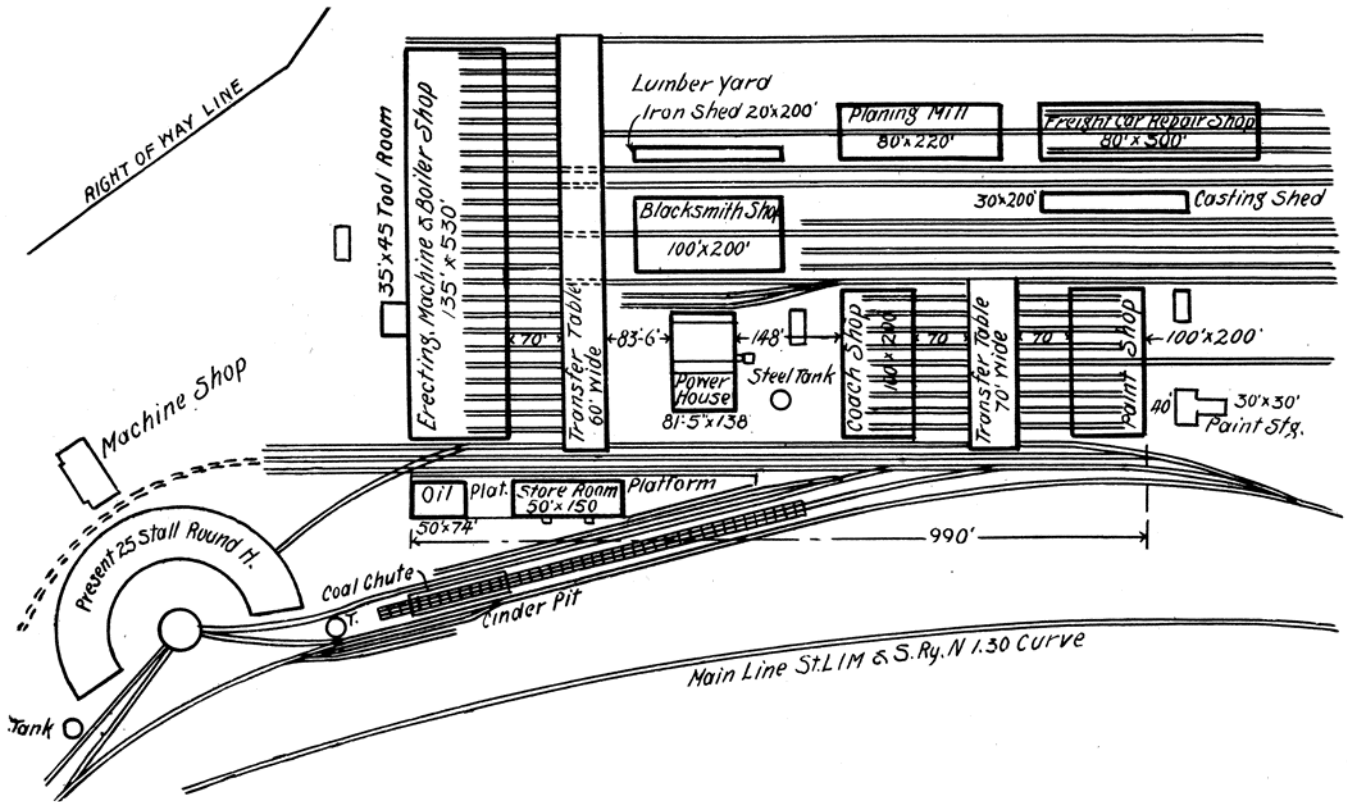
There is a complete system of drainage and the sewerage is taken care of by the septic system, the tank for this purpose being located at the extreme east end of the shop ground and of dimensions as heretofore given. There are two laboratory buildings conveniently located, each 42 feet 8 inches long by 22 feet wide.

The general layout provides for an arrangement of buildings, material yard, working tracks, supply tracks, etc., by which material passes from its source through the various buildings, machinery and departments to its destination with productive movement and without doubling its course.

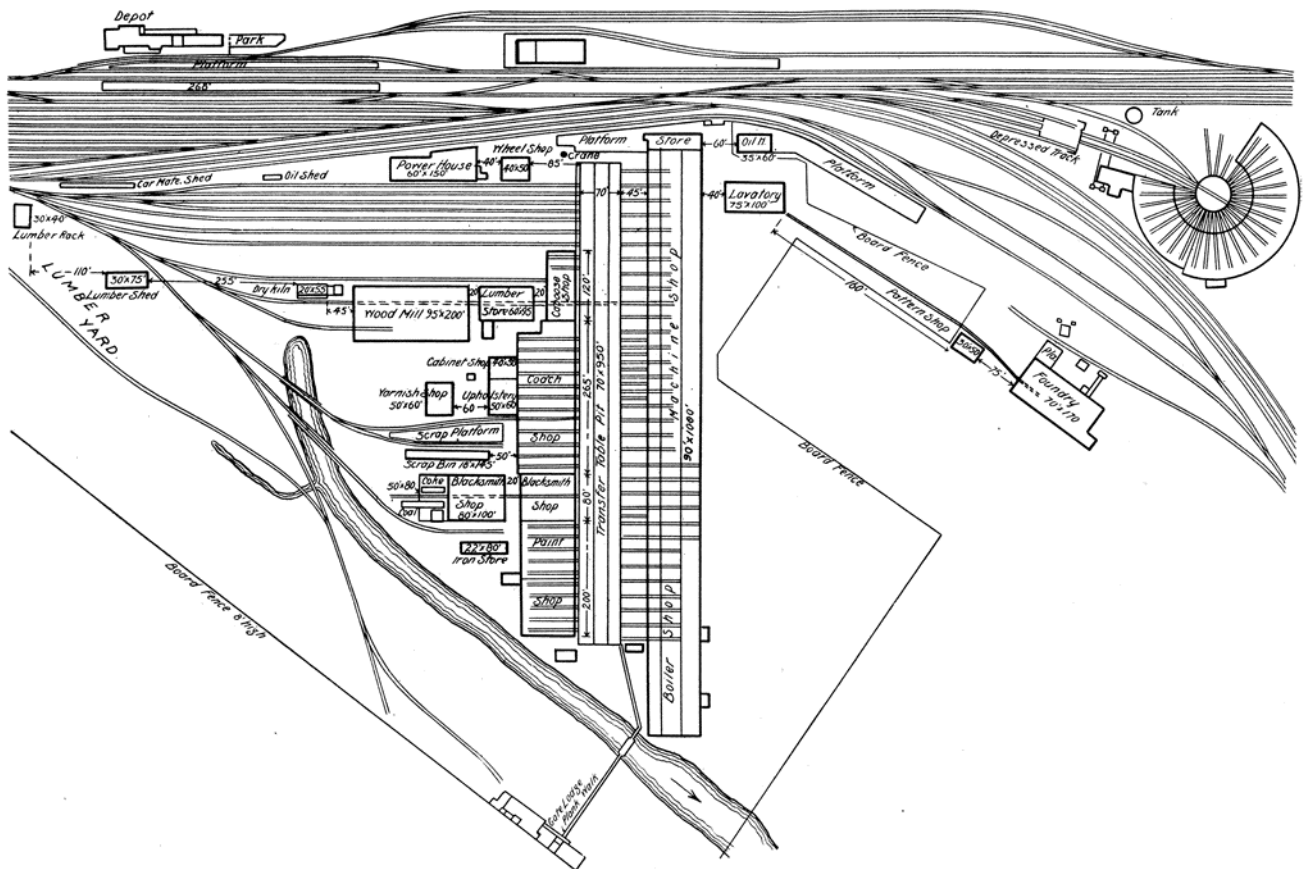
## SUMMARY.

These several examples are cited for the purpose of calling attention to certain characteristic features prominent in the layout arrangement of the plants mentioned. It is believed that by pointing out such features of the individual shops, greater weight will attach to each case than would obtain as a result of a mere general reference and more reasonable deductions may be drawn. The selection of a single existing shop typical of American ideas, or representative of best practice for all conditions or to meet the requirements of any road is practically impossible, and it is therefore necessary to study the peculiar governing conditions affecting the requirement of a single shop and design accordingly, as no special rule can be devised in such regard.



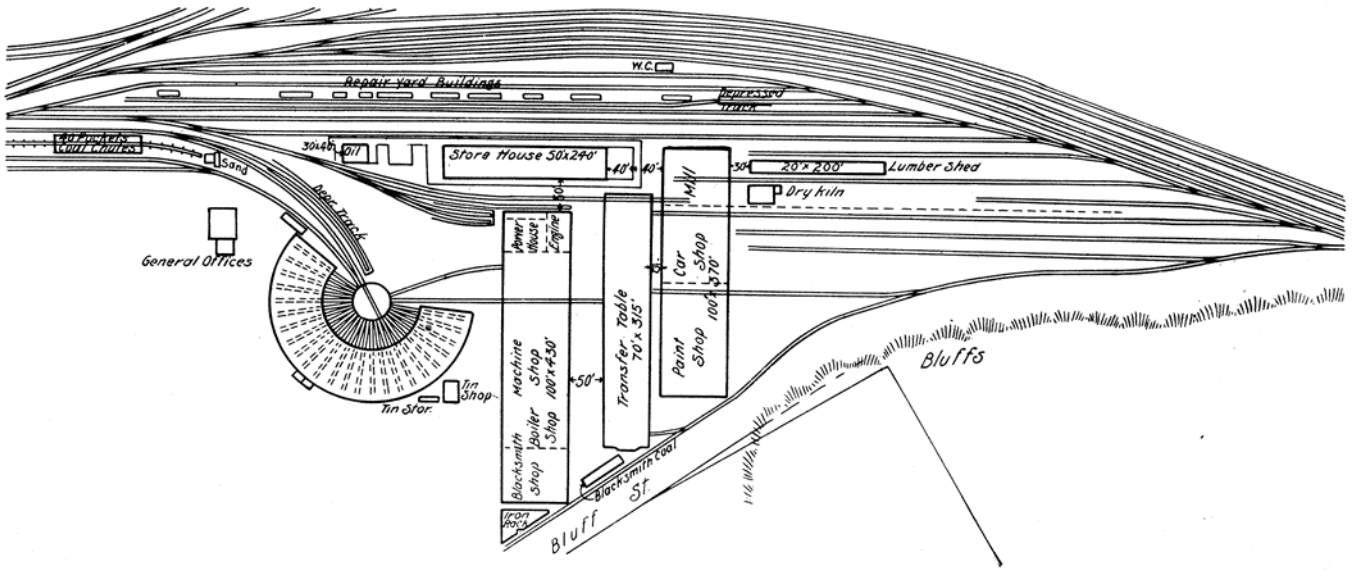


GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE ST. LOUIS, IRON MOUNTAIN & SOUTHERN RY. AT BARING CROSS, ARK.—ACCESS TO LOCOMOTIVE SHOP BY INDIVIDUAL TRANSFER TABLE, TO FREIGHT CAR SHOP BY TRACK APPROACH, TO PASSENGER COACH AND PAINT SHOPS BY INDIVIDUAL TRANSFER TABLE.

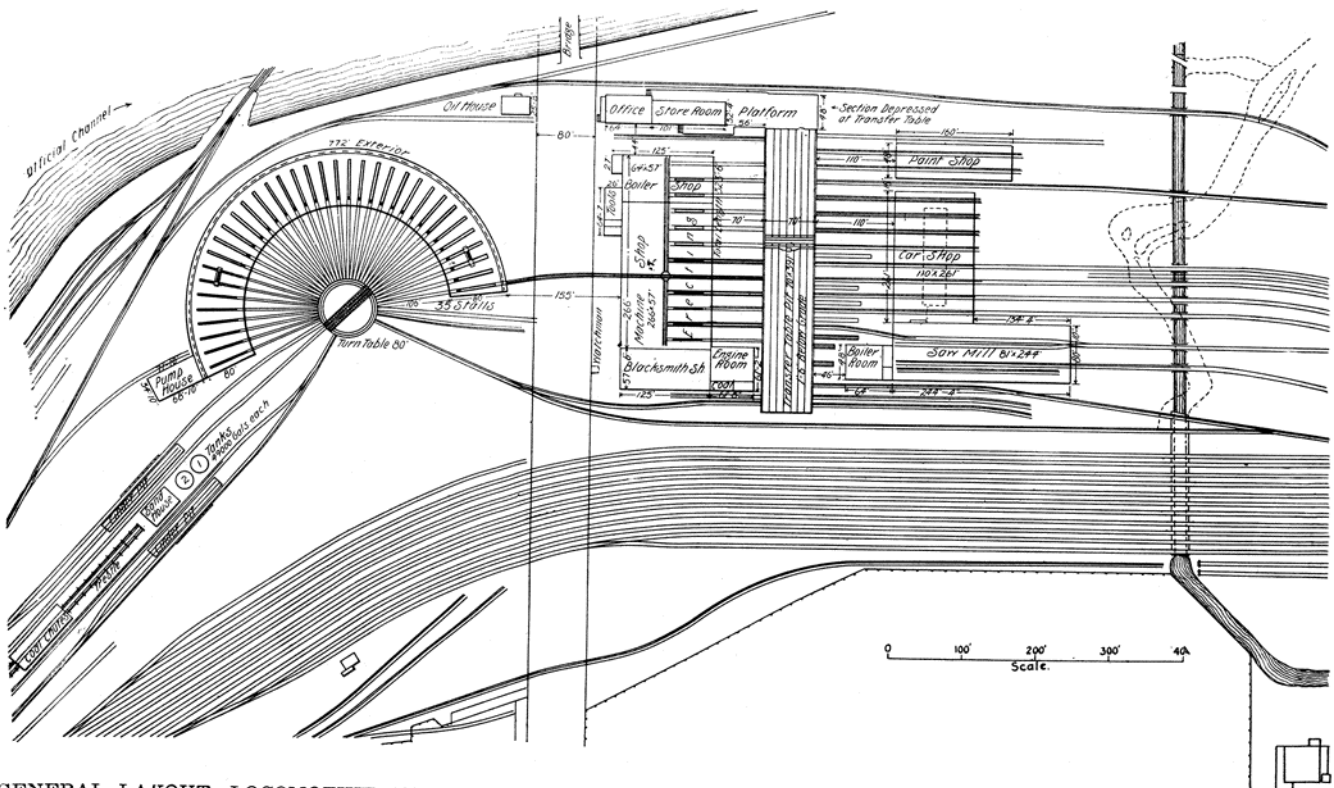


GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE CHICAGO GREAT WESTERN RY. AT OELWEIN, IA.—ALL DEPARTMENTS SERVED BY SINGLE TRANSFER TABLE.

RAILWAY SHOP UP TO DATE

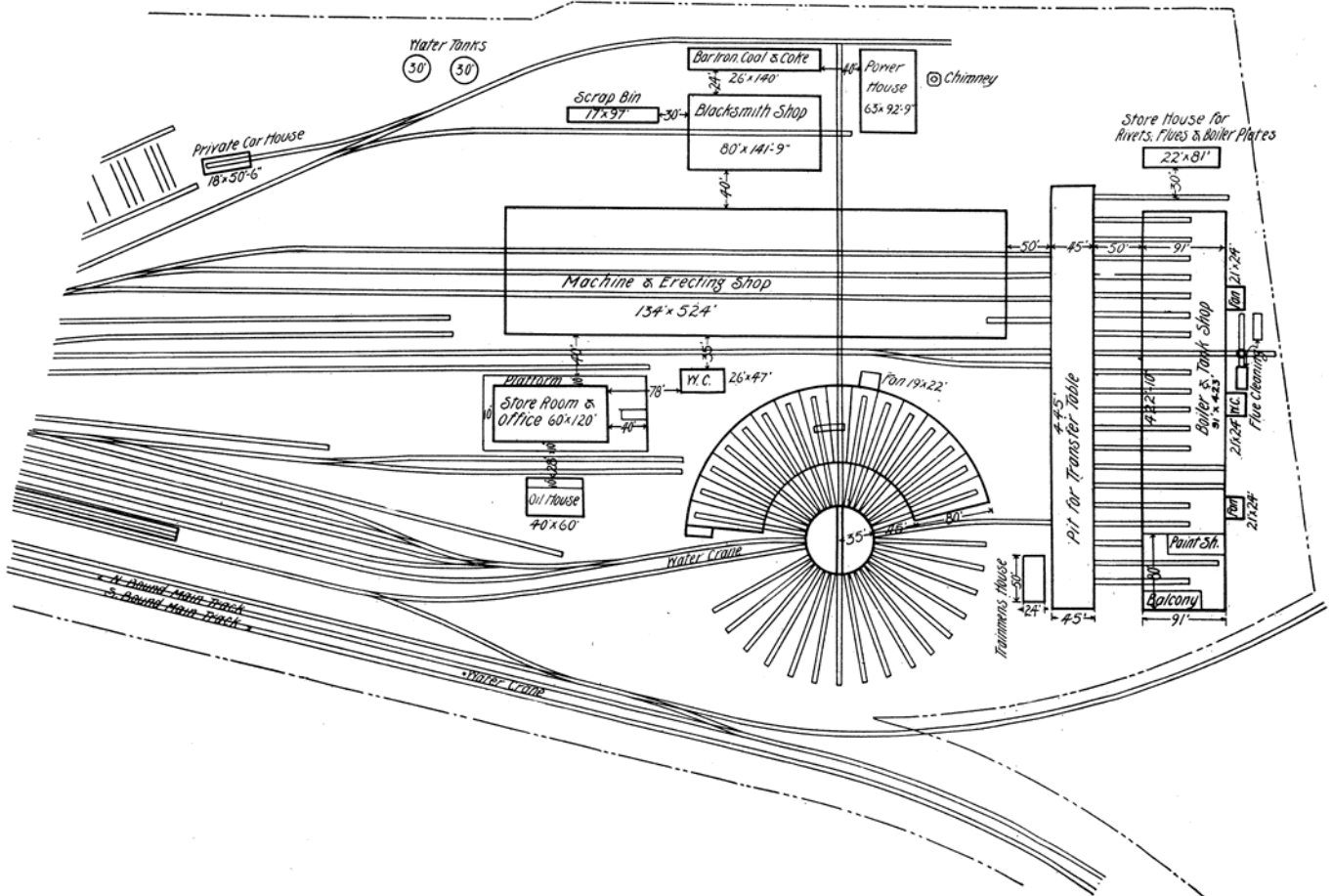


GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE CHICAGO, BURLINGTON & QUINCY RY. (H. & ST. J.) AT HANNIBAL, MO.—ALL DEPARTMENTS SERVED BY SINGLE TRANSFER TABLE.

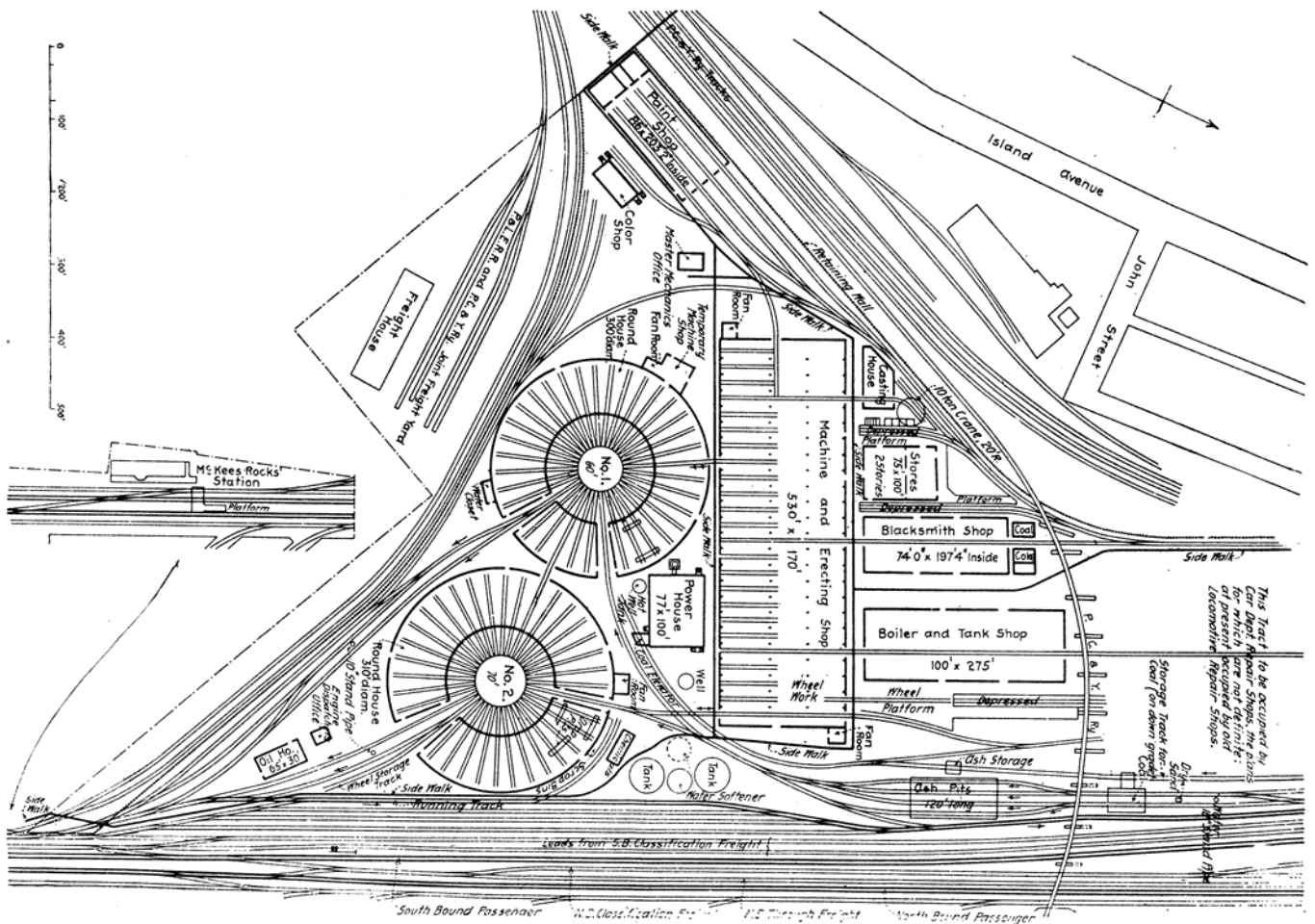


GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE COLORADO & SOUTHERN RY. AT DENVER—ALL DEPARTMENTS SERVED BY SINGLE TRANSFER TABLE.



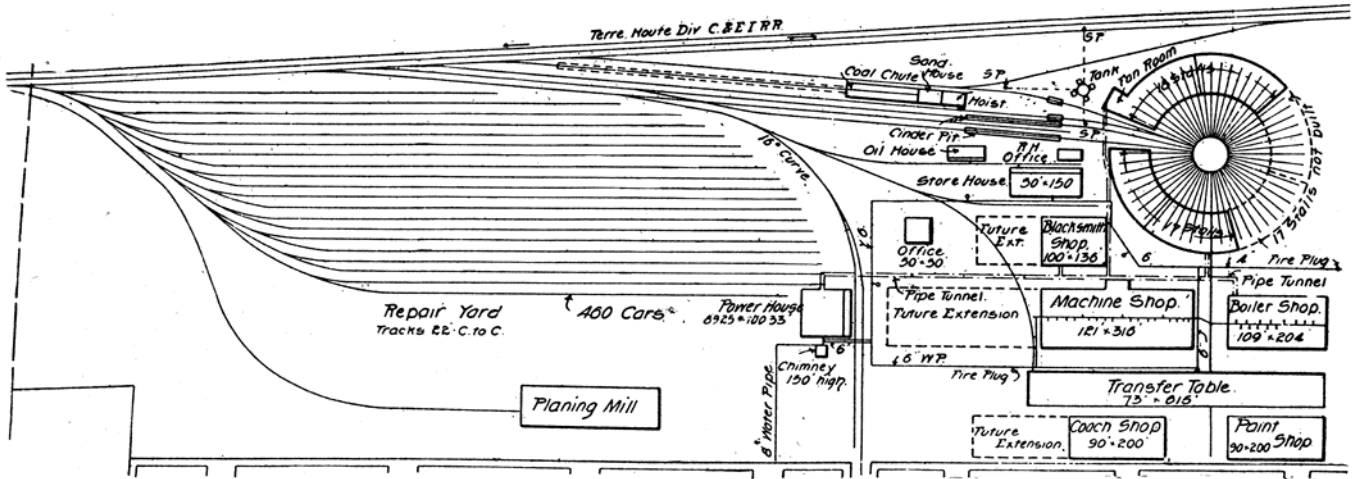


GENERAL LAYOUT—LOCOMOTIVE SHOPS OF THE BUFFALO, ROCHESTER & PITTSBURG RY. AT DU BOIS, PA.—LONGITUDINAL LOCOMOTIVE SHOP AND ISOLATED TRANSVERSE BOILER SHOP SERVED BY TRANSFER TABLE—ACCESS TO LOCOMOTIVE SHOP BY TRACK APPROACH AND TRANSFER TABLE.

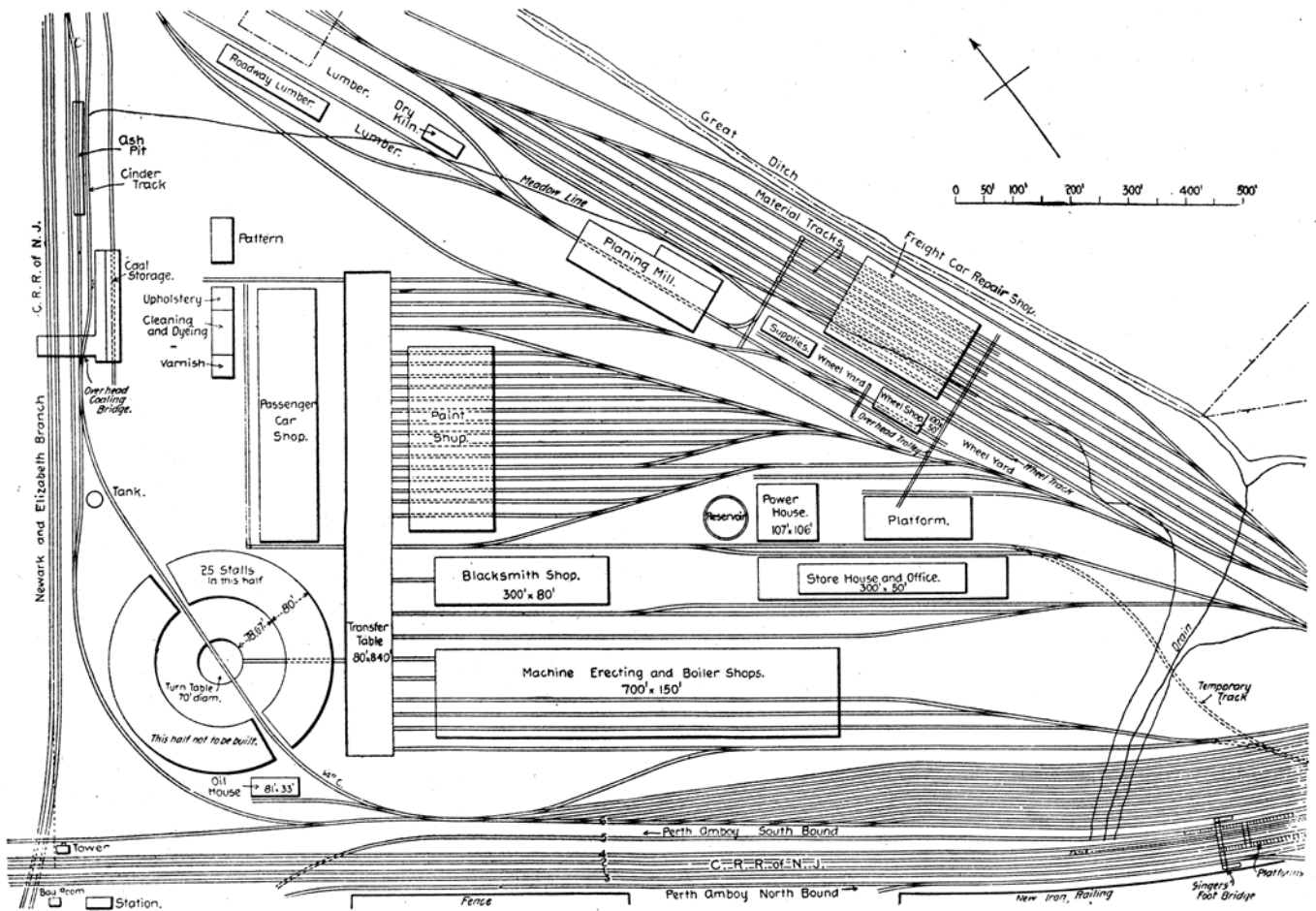


GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE PITTSBURG & LAKE ERIE R. R. AT McKEES ROCKS, PA.—TRANSVERSE LOCOMOTIVE SHOP WITH ACCESS FROM ROUNDHOUSE TURNTABLE—BOILER SHOP IN ISOLATED BUILDING—MINIMUM DISTANCE OF 25 FEET BETWEEN BUILDINGS.

RAILWAY SHOP UP TO DATE

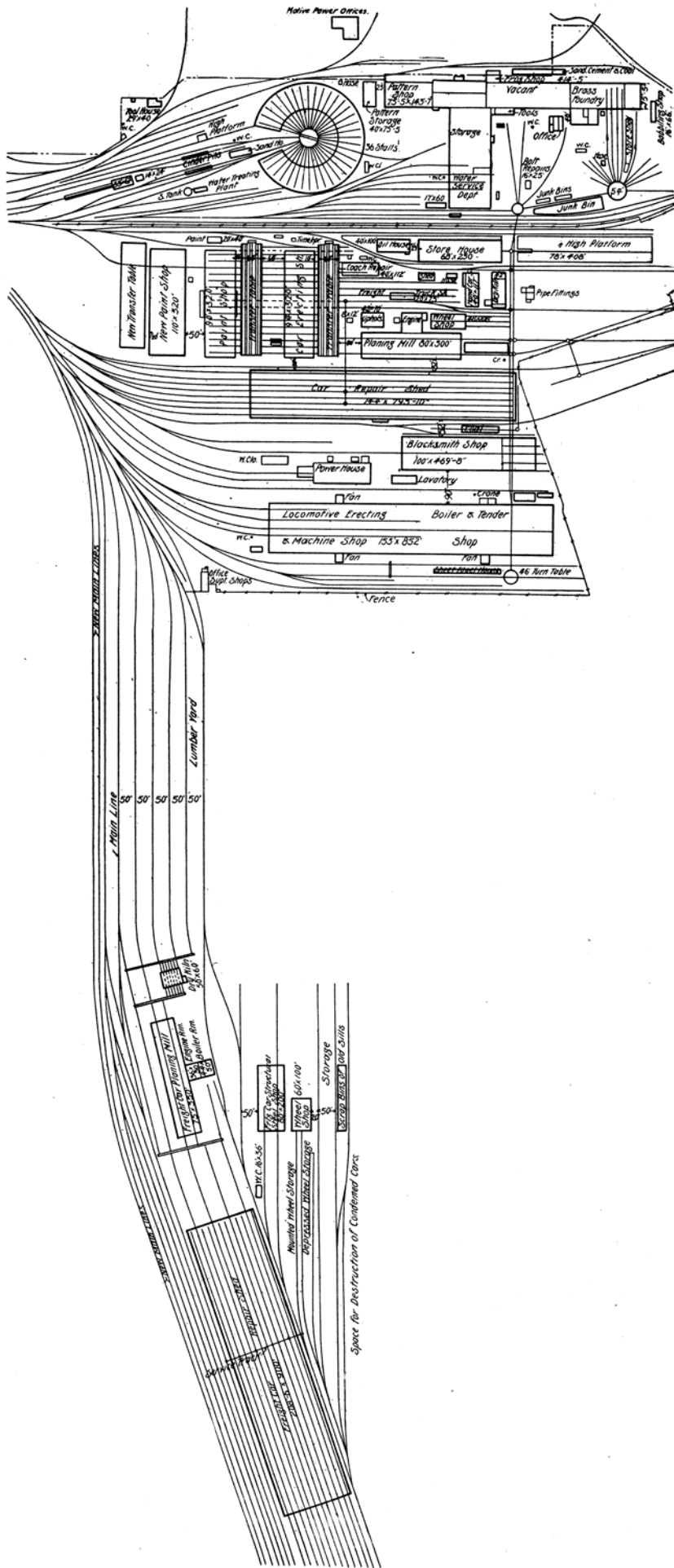


GENERAL LAYOUT—LOCOMOTIVE SHOPS OF THE CHICAGO & EASTERN ILLINOIS RY. AT DANVILLE, ILL.—ALL BUILDINGS TRIBUTARY TO ROUNDHOUSE—LOCOMOTIVE AND BOILER SHOPS SERVED BY SINGLE TRANSFER TABLE.—PROPOSED PASSENGER COACH AND PAINT SHOPS WILL BE SERVED BY COMMON TRANSFER TABLE AND ACCESS TO FREIGHT CAR SHOP WILL BE BY TRACK APPROACH.



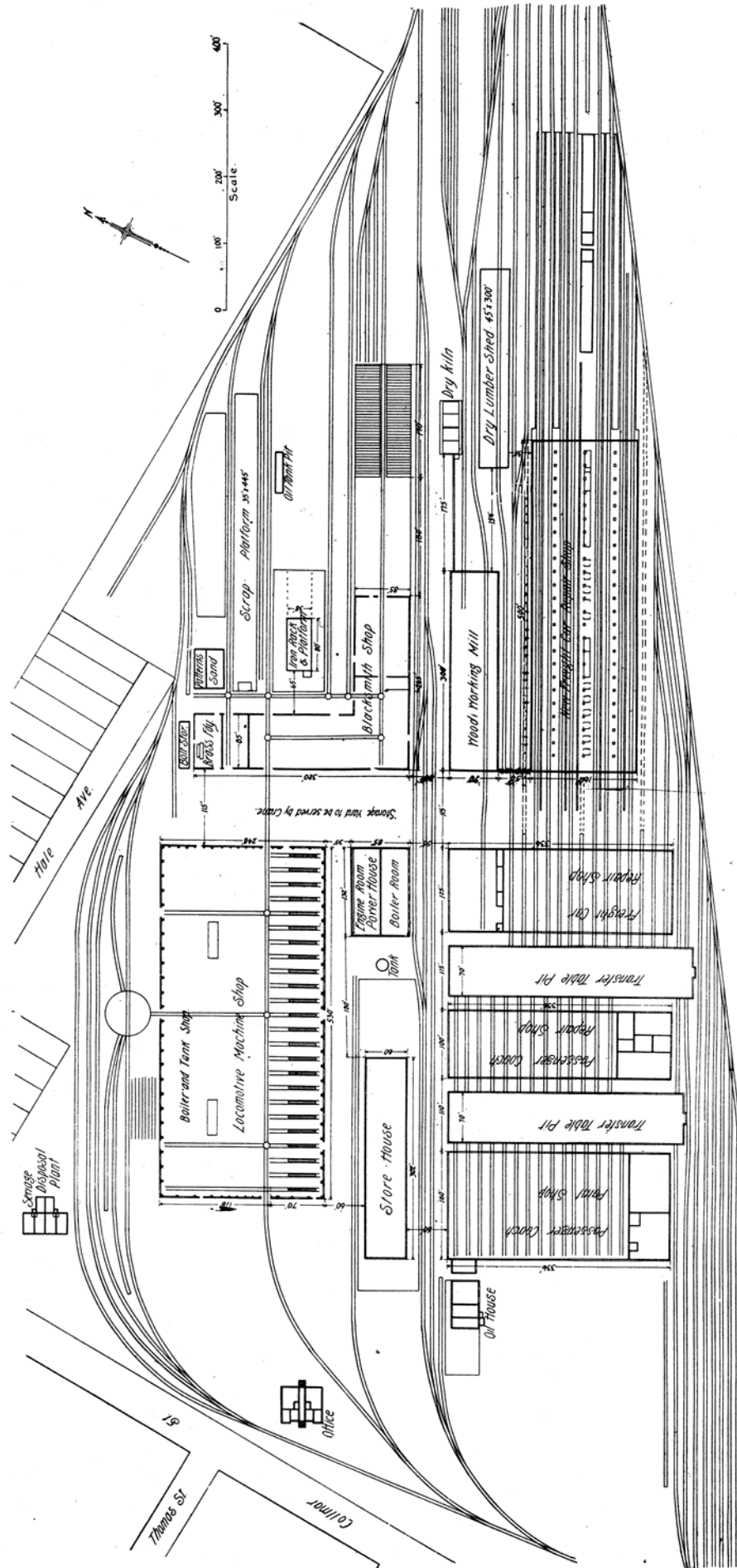
GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE CENTRAL R. R. OF NEW JERSEY AT ELIZABETHPORT, N. J.—ACCESS TO LONGITUDINAL LOCOMOTIVE SHOP AND TO PASSENGER COACH AND PAINT SHOPS BY SINGLE TRANSFER TABLE—PROPOSED LONGITUDINAL FREIGHT CAR SHOP WITH TRACK APPROACH.

# LAYOUT



GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE ATCHISON, TOPEKA & SANTE FE RY. AT TOPEKA, KAN.—ACCESS TO LOCOMOTIVE SHOP, TO TWO FREIGHT CAR REPAIR SHEDS AND TO FREIGHT CAR STRUCTURAL STEEL SHOP BY TRACK APPROACHES. PASSENGER COACH AND TWO PAINT SHOPS SERVED BY THREE TRANSFER TABLES.

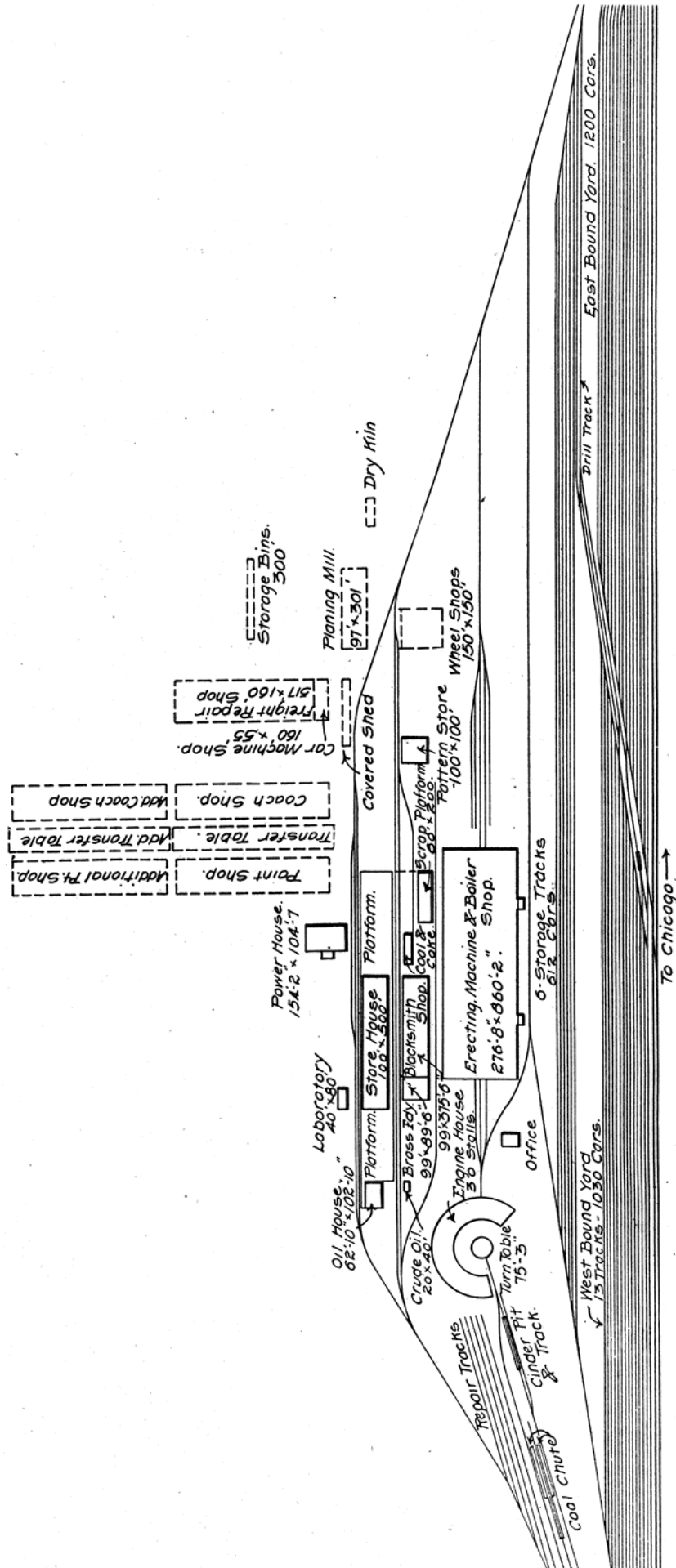
RAILWAY SHOP UP TO DATE



GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE LAKE SHORE & MICHIGAN SOUTHERN RY. AT COLLINWOOD, O.—TRANSVERSE LOCOMOTIVE SHOP WITH ACCESS BY TURNTABLE.—PASSENGER CAR DEPARTMENT SERVED BY TWO TRANSFER TABLES. LONGITUDINAL FREIGHT CAR SHOP WITH TRACK APPROACH.



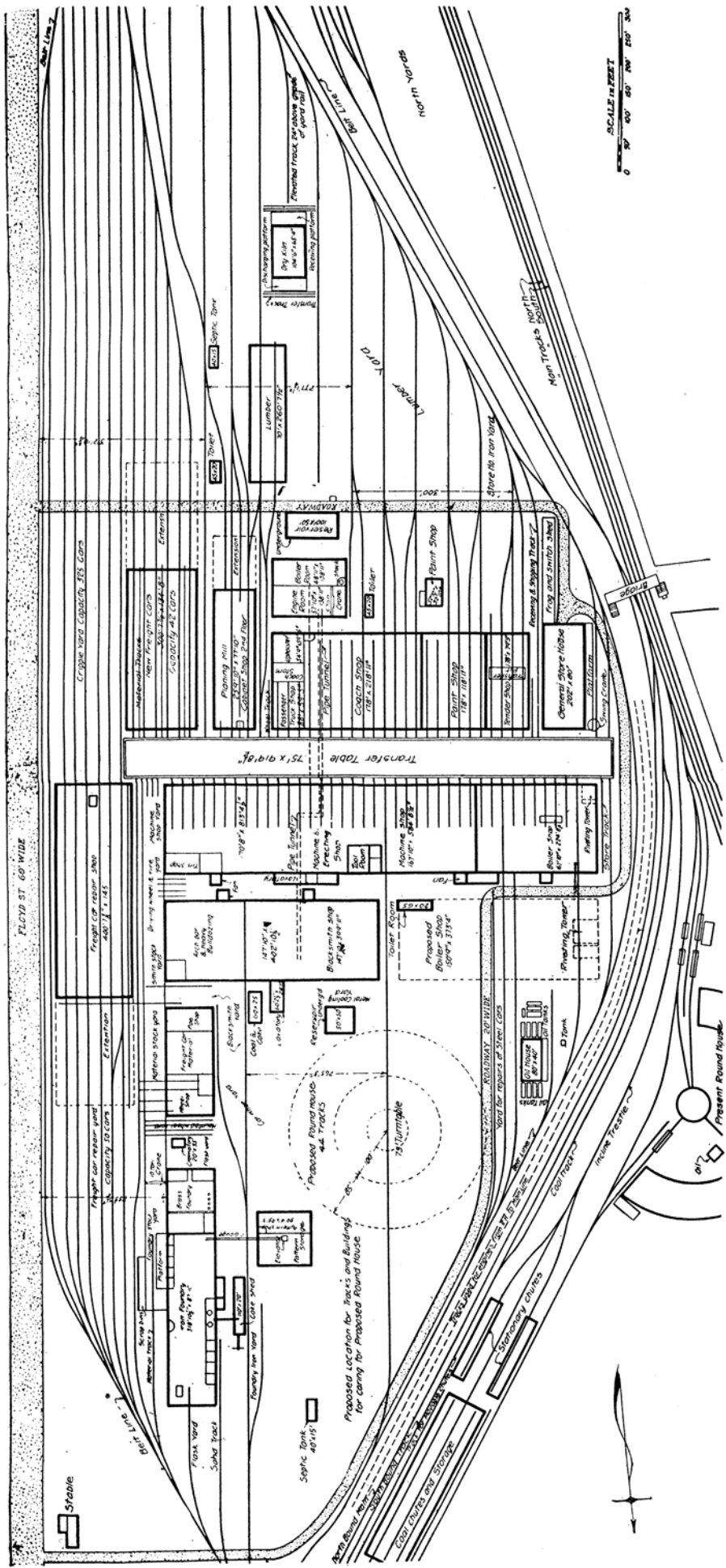
RAILWAY SHOP UP TO DATE



GENERAL LAYOUT—LOCOMOTIVE SHOPS OF THE CHICAGO, ROCK ISLAND & PACIFIC RY. AT SILVIS, ILL.—DIAGONAL LOCOMOTIVE SHOP WITH TRACK APPROACH FROM ROUNDHOUSE—PROPOSED PASSENGER CAR DEPARTMENT WILL BE SERVED BY ISOLATED TRANSFER TABLE.

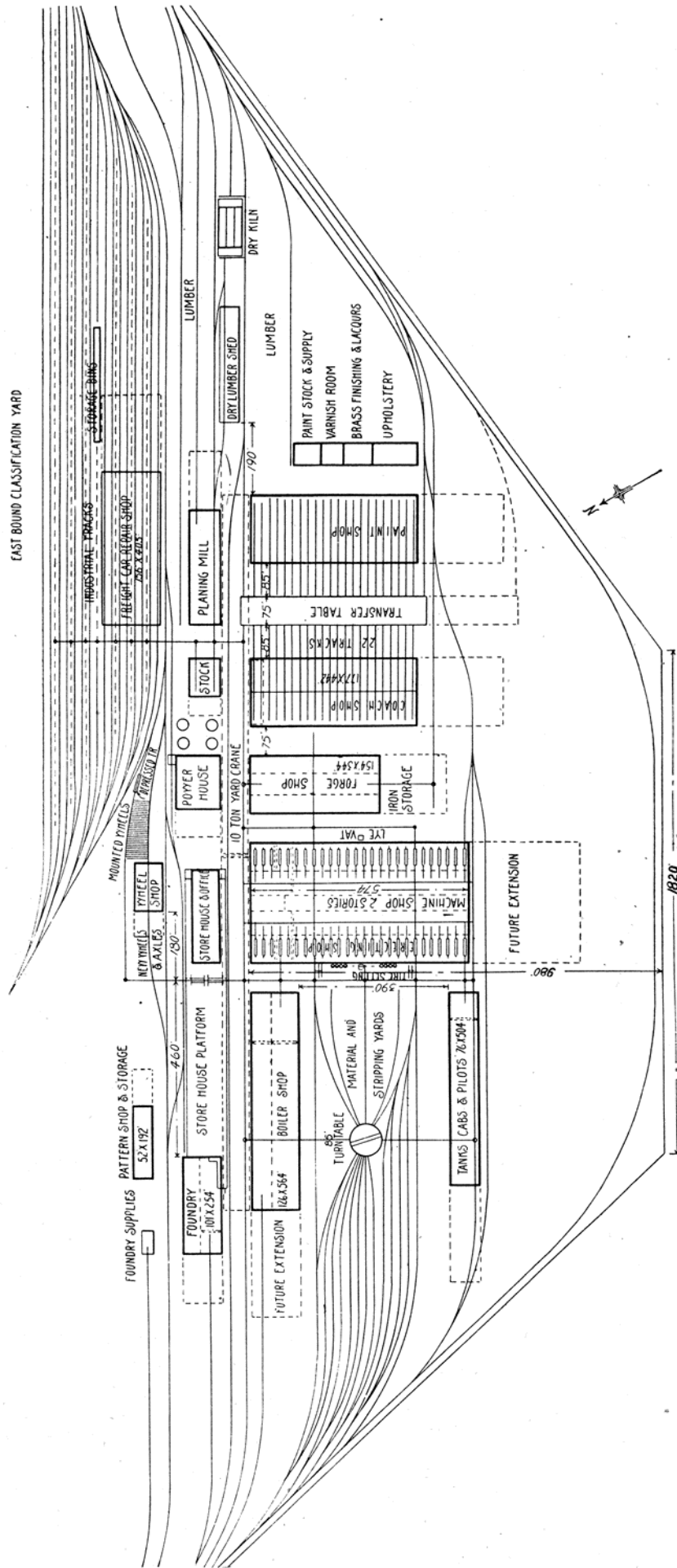


# LAYOUT



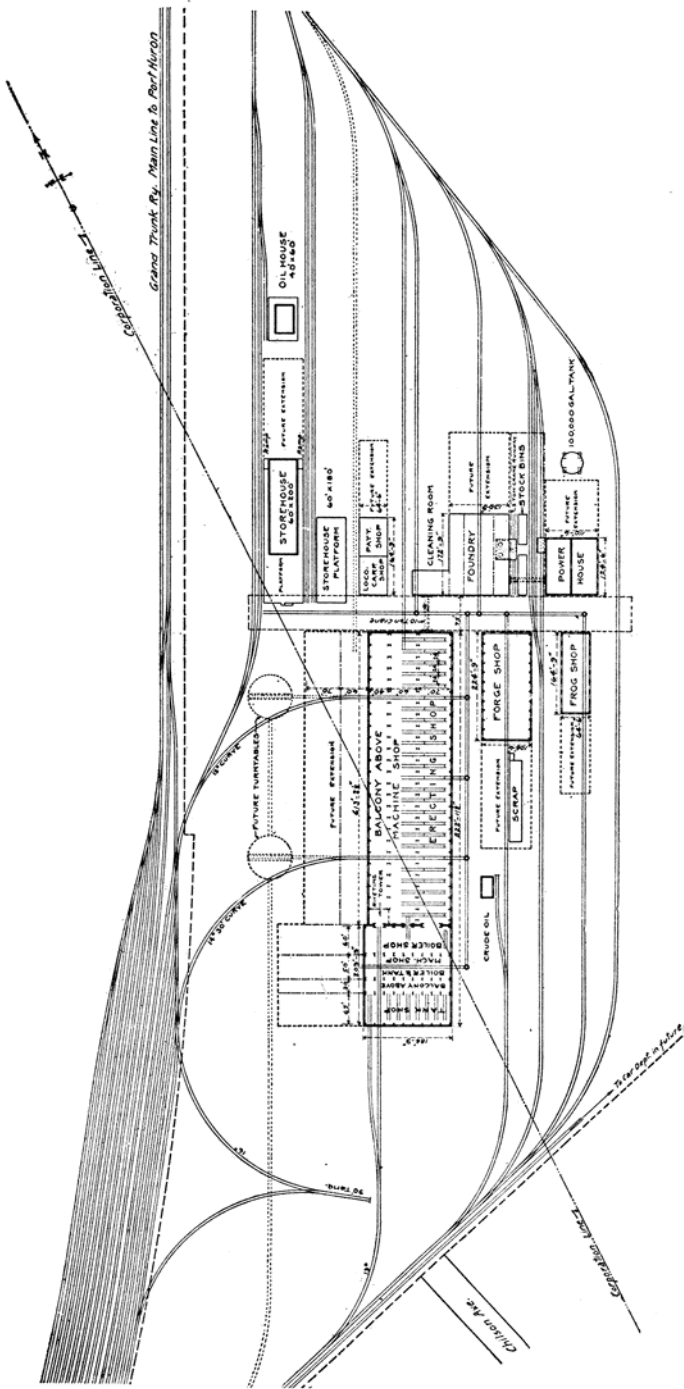
GENERAL LAYOUT—LOCOMOTIVE AND CAR SHOPS OF THE LOUISVILLE & NASHVILLE R. R. AT SOUTH LOUISVILLE, KY.—ALL DEPARTMENTS TRIBUTARY TO L SHAPED AVENUE OF DISTRIBUTION FORMED BY TRANSFER TABLE PIT AND CRANE SERVED STORAGE YARD.

RAILWAY SHOP UP TO DATE

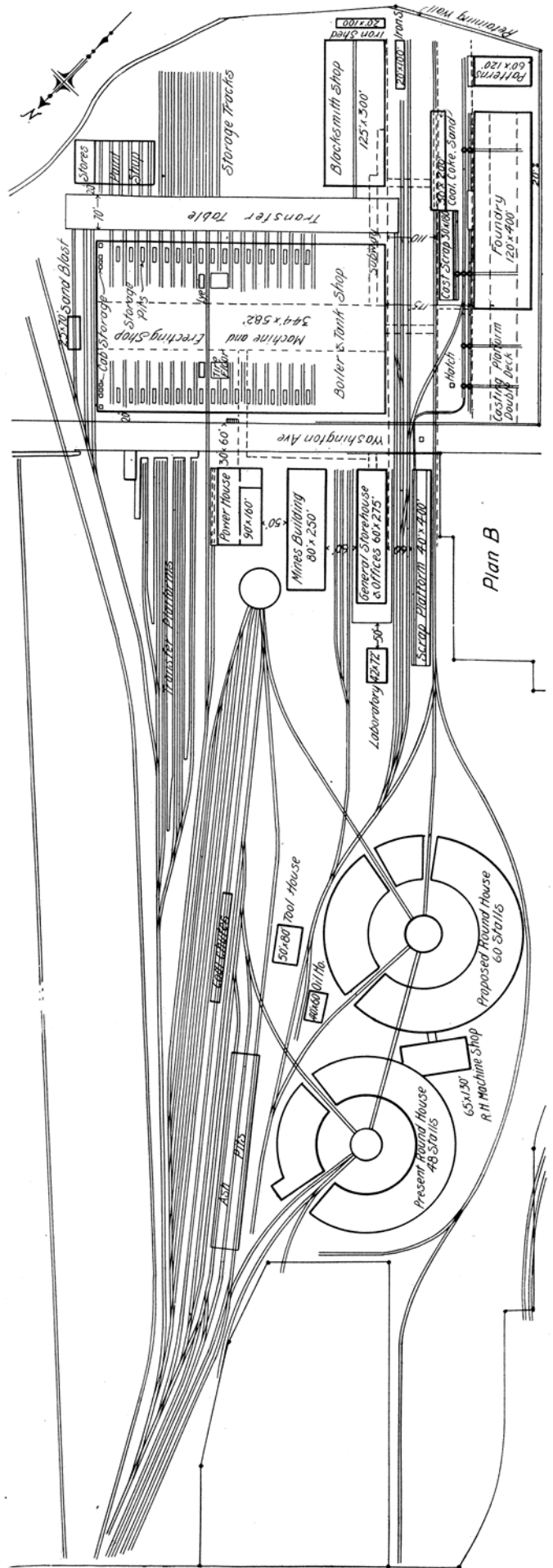


GENERAL LAYOUT.—LOCOMOTIVE AND CAR SHOPS OF THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS RY. AT BEECH GROVE (INDIANAPOLIS)—TRANSVERSE LOCOMOTIVE SHOP WITH TRACK APPROACH; PASSENGER COACH AND PAINT SHOPS SERVED BY SINGLE TRANSFER TABLE; LONGITUDINAL FREIGHT CAR REPAIR SHOP WITH TRACK APPROACH, ADJACENT TO FREIGHT SWITCHING YARDS. PRINCIPAL BUILDINGS TRIBUTARY TO CRANE SERVED AVENUE OF DISTRIBUTION.



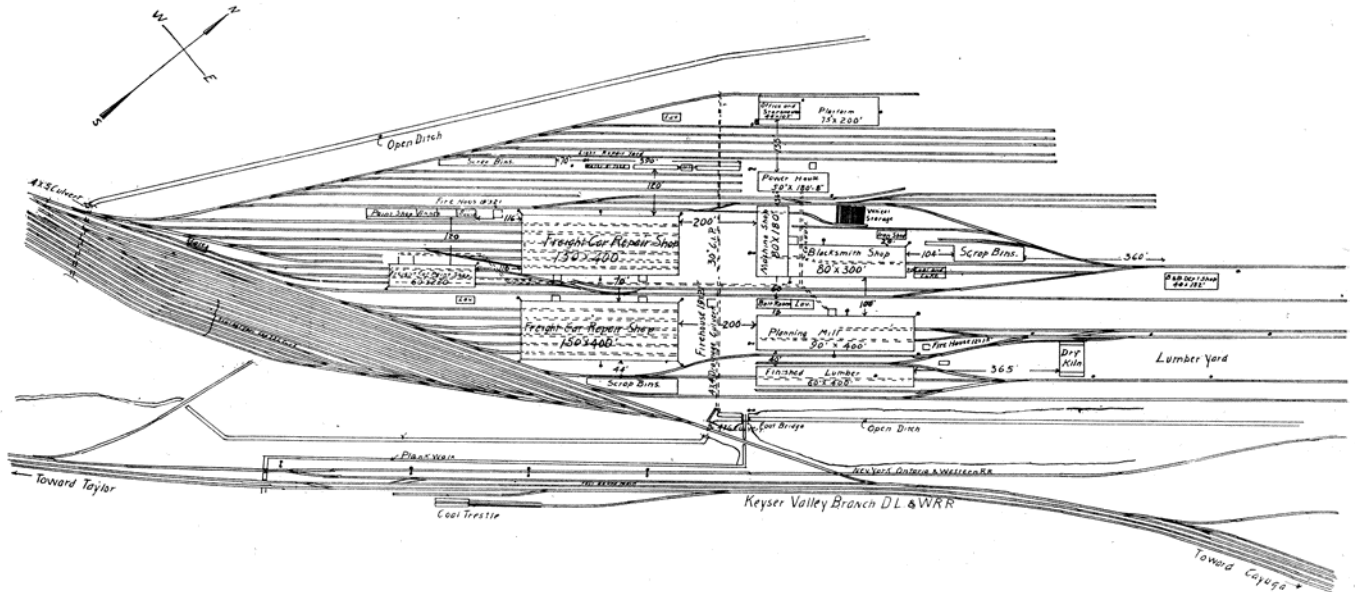


GENERAL LAYOUT--LOCOMOTIVE SHOPS OF THE GRAND TRUNK RAILWAY AT BATTLE CREEK, MICH.--TRANSVERSE LOCOMOTIVE SHOP. PRINCIPAL BUILDINGS TRIBUTARY TO CRANE SERVED AVENUE OF DISTRIBUTION.

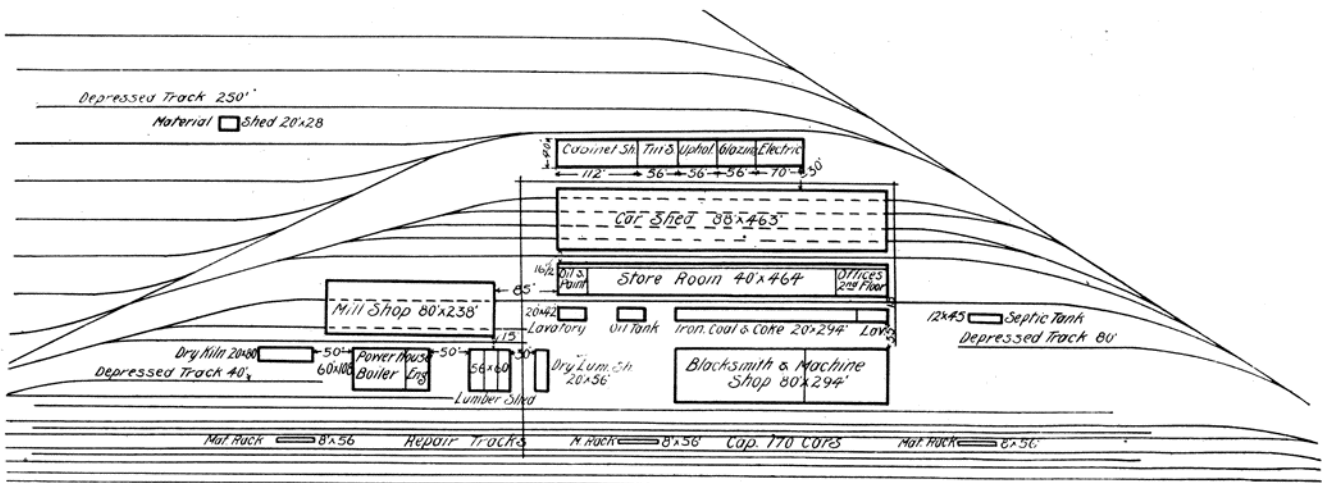


GENERAL LAYOUT--LOCOMOTIVE SHOPS OF THE DELAWARE, LACKAWANNA & WESTERN RAILROAD AT SCRANTON, PA.--TRANSVERSE LOCOMOTIVE SHOP WITH ONE ERECTING FLOOR SERVED BY TRANSFER TABLE. PRINCIPAL BUILDINGS TRIBUTARY TO CRANE SERVED AVENUE OF DISTRIBUTION.





GENERAL LAYOUT—FREIGHT CAR SHOPS OF THE DELAWARE, LACKAWANNA & WESTERN R. R. AT SCRANTON, PA.—TRACK APPROACH TO ERECTING SHOPS AT ONE END.



GENERAL LAYOUT—CAR SHOPS OF THE WABASH R. R. AT EAST DECATUR, ILL.—LONGITUDINAL ERECTING SHOP WITH TRACK APPROACH—FREIGHT REPAIRS IN THE OPEN.