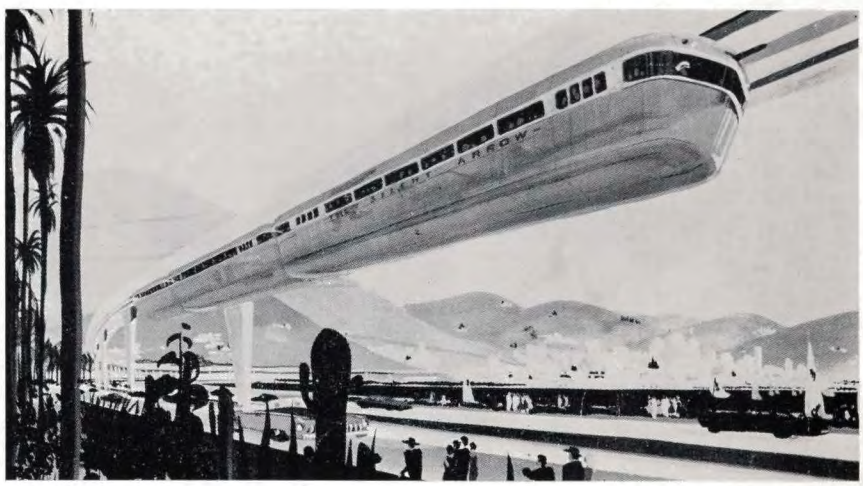
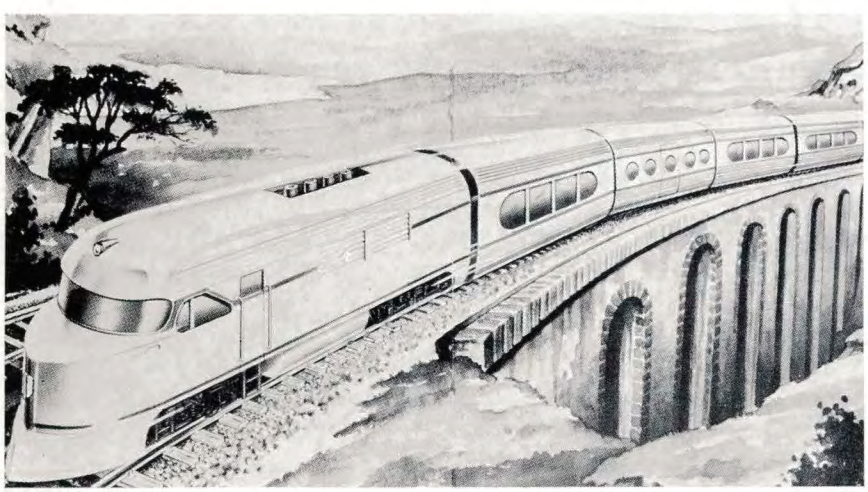
SC ENGINEER

MARCH
1955



The Silent Arrow

French Monorail.
International Monorail
and Societe Lyonnaise
Des Eaux Et De L'Eclairage



Talgo Train

Lightweight Train
Spanish Intercity Operation
American Car Foundry Industries
New York

Dream Bus

Modern Express Bus
Designed by Lurelle Guild for
Timken-Detroit Axle Division,
Rockwell Spring & Axle Company

Features: SYMPOSIUM ON MASS RAPID TRANSIT FOR LOS ANGELES

JUST HOW MUCH OIL DO WE HAVE?

Robert L. Land, Jr., Class of '51,
speaks from experience when he says,

U.S. Steel offers thorough training . . . exposes the graduate engineer to many interesting phases of the steel industry

ROBERT L. LAND, JR., graduated with a B.S. in Chemical Engineering in February 1951. He had previously been interviewed by U.S. Steel college recruitment representatives and had been offered a job. He began working in the Coke Plant at the Gary, Indiana Works of U.S. Steel immediately after graduation.

After extensive training and several promotions, Bob was made General Heater Foreman on November 1, 1954. This exceedingly important job makes him responsible for the proper heating and the quality of *all* coke produced at the Gary Works—the second largest coke plant in the world—with 16 batteries of coke ovens producing 15,000 tons daily. He has a crew of 60 and 8 foremen working under him.

Bob feels that U.S. Steel really gets the young graduate engineer off to a good start with a well-planned and complete training program. He says, "U.S. Steel offers the graduate engineer an excellent chance to work in a number of different fields."

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Symposium:

MASS RAPID TRANSIT FOR LOS ANGELES

Rapid Transit is defined as mass transportation usually by rail at high speed with short intervals between trains. Mass Transit is the movement of much larger numbers of people in a given time than by any other means of transportation. As an example, in New York one single track of transit line can carry from 40,000 to 50,000 passengers per hour. This is mass rapid transit. Los Angeles does not have mass rapid transit.

Since 1955 is a legislative year and a number of bills concerning mass rapid transit for Los Angeles await action by the California State Legislature, the following articles have been prepared to acquaint you, as a citizen of Los Angeles, with the local transportation situation. Included are a historical summary of transit facilities and planning, a discussion of the unique problems faced by transportation engineers engaged in studying Los Angeles transit, and a technical evaluation of the most recent advances in suspended railways.

The studies are intended to be objective and scholarly, despite the fact that the transit question in Los Angeles is one of the biggest political footballs in city history. ***THE EDITORS***

BACKGROUND: THIRTY YEARS OF DECLINE

Jacob Voogd, Editor-in-Chief

CITY planners and transportation engineers are trying to restore two adjectives. "Los Angeles has a superior mass-rapid transit system," was a true and oft-heard statement 30 years ago. Strike the words "superior" and "rapid" from the statement and you have the situation today.

Surface-bound busses and street cars carry the load. The term "mass transport" sufficiently characterizes their service.

The people of Los Angeles want to see the two missing words restored. They have seen previous proposals die from political apathy and self-interest. They are getting caught in larger traffic tangles each year. They hope to see in 1955 the start of a comprehensive program that will produce a form of mass-rapid transit providing the same fine service which the Pacific Electric system did in the twenties.

Huntington's Excellent System

During the last half of the 19th century, one of the four most powerful men in California was Collis P. Huntington. To help manage his various interests he had sent East for his nephew, Henry E. Huntington. When Collis died, Henry, who was managing the Southern Pacific-owned street car system in San Francisco, inherited his uncle's vast holdings. City transport had interested Henry and when he moved to Los Angeles in 1900 he decided to draw heavily on his street-car experience. He had a nose for business and he could smell a boom coming to this little town.

Henry's first step was to supplement the Los Angeles real estate inherited from his uncle. He invested heavily in land in the outlying districts, the beaches, foothills, and valleys. His next step was to plan a network of fast interurban car lines which would develop these country pastures into residential areas.

When the tracks for this system were

History of transit action and thought—the excellent Pacific Electric System built by Huntington—its disintegration—the automotive age influencing Los Angeles transportation—early transit studies—the feasibility report—what's in store.

laid it was found that they passed through miles of Huntington - owned land. During the boom that came, Henry's land profits were large; he plowed the money back into other Los Angeles enterprises. An ancient joke told of the child who left the Huntington Hotel, traveled down Huntington Boulevard in a Huntington street car, and arrived at Huntington Beach whereupon he asked if the ocean might also be Mr. Huntington's.

Henry's Pacific Electric system of electrically-operated street cars and trains was universally considered the finest mass-rapid transit system of its day. Transportation experts from all over the world came to Los Angeles to study its operation and routes. Suburban communities grew and prospered along the lines of the electric car. In fact, Huntington's Pacific Electric actually dictated the location of many suburbs and was in no small sense responsible for the spread-out character of contemporary Los Angeles County. Now this low population density poses a large problem for transportation experts.

The Automotive Age

The Pacific Electric was a surface system. None of its tracks were elevated, as in Chicago, none were subway as in New York. When it was forced to share the surface it started to suffer.

In 1911, the Huntington system was sold to the Southern Pacific Railroad, which was consolidating all of the 80 or so inter-urban and local transit operation in Southern California. The name Pacific Electric was retained and it continued to provide the area with fast, dependable, and safe rail service, although freight cars began appearing on the tracks in larger numbers.

In the mid-twenties the P. E. started meeting tough, unbeatable competition —the automobile. In 1920, which may be taken as the beginning of the common use of automobiles, the population of Los Angeles County was less than one million; ten years later it had more than doubled. This tremendous population growth coupled with the automotive thinking that took hold with the public strained existing road and streets. A boulevard system was built which satisfied the pressure of auto traffic but began the deterioration of the P. E. service. Not only were motorists being made out of former street car riders but boulevards were intersecting train tracks in numerous places, slowing down the electric cars.

As the P. E. service started its slow and agonizing death, the era of the automobile was born and grew virtually unchecked to its present proportions. Little attention was paid to the movement of masses of people; mass vehicle movement was primary.

We are still in the automotive age. The emphasis is on creating the space necessary for driving and parking cars. This thinking is exemplified by the extensive freeway program which will not be completed until about 1980.

Even the most ardent advocates of automobile transporation question the ability of freeways to handle all of the city's transportation requirement. Automobiles on freeways are not mass transit as a recent survey disclosed when it pointed out that each car on the freeway averaged 1.47 passengers. Neither are they rapid transit during peak hours of the day. Yet the automobile on a freeway continues to be the competition

1925
Kelker-DeLeuw Report

The report, prepared by Keller, DeLeuw and Company (consulting engineers), contains a comprehensive rapid transit plan for a unified transportation system to meet the needs when Los Angeles' population reached three million.

In general, the recommendations were:

1. Construction of a rail rapid transit system, employing both elevated and subway design, to be the backbone of a metropolitan transportation system. Essentially, four main lines were proposed for immediate construction on a radial basis from the center of the city.

2. A feeder system and cross-town service was to be provided by immediate construction of streetcar line extensions and installation of new bus lines.

3. Future construction dealt with expansion of the basic plan subject to modification for changing conditions.

Recommendations were based upon the conclusion that streetcar and bus service could not adequately serve the city's needs, and that rail rapid transit is required in all cities when they become really large.

The cost was estimated to be approximately $175,000,000 including cars, interest, and value of existing properties utilized—for the period 1925-1935. Following this, additional structures were to be built. The financing was to be provided by general bonds of the City of Los Angeles, special assessment districts and operating revenues.

1933
Baker Report

A major report on rapid transit was prepared by Donald M. Baker, consulting engineer of Los Angeles. The report recommended a rail rapid transit system as the only solution to the mass transportation problem. The system involved a combination of elevated, subway and private right-of-way construction.

The proposed system was not as extensive as the program recommended in 1925, but comprised four lines radiating outward from central Los Angeles in four directions to connect the main population areas with the Central Business District. The system proposed was so located that it could, in the future, be extended by grade separations and extensions of subway and/or elevated structures to meet development and population growth.

The total cost of the system was estimated at $37,200,000. Suggested financing involved a thirty million dollar bond issue with the balance of the money to be derived through the National Industrial Recovery Act then in effect. The act authorized a maximum 30% government grant on comprehensive public works programs. In this case, the grant would have amounted to $10,700,000, and of the total, $7,200,000 was for construction and the balance of $3,500,000 was for payment of debt service during the early years of operation.

The report contained considerable analysis of economic factors. No field studies were made specifically for this report. Information contained in previous studies and data supplied by the transit companies were used. A considerable amount of the preliminary work was done by the Pacific Electric Company.

any proposed mass rapid transit system will have to beat to succeed.

The Bus as Mass Transit

The automobile brought with it a counterpart — the bus. The bus is a means of local mass transportation, but is often not rapid transportation. The bus is also a surface device. Speed is governed by the automobile traffic with which it shares the roadways. Since 1938, when the declining P. E. system began converting many of its rail facilities to bus service, the bus has become the principal mass carrier. The war years saw bus transport prosper. Since the war, bus patronization has dropped while automobile use has gained the upper hand.

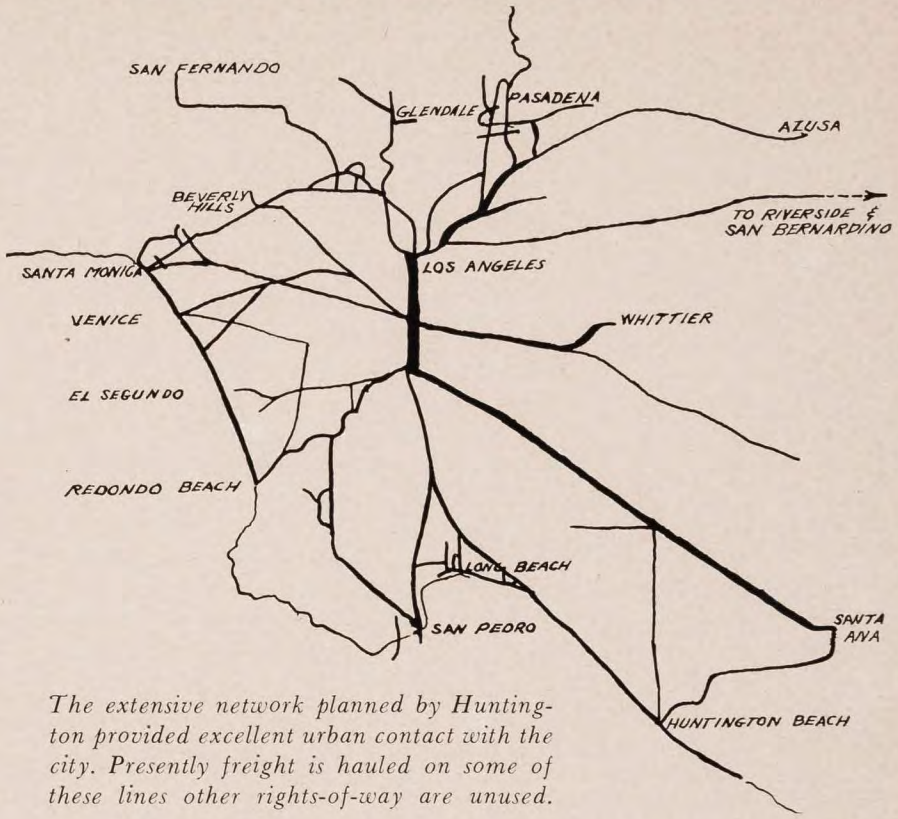
Two principal bus operators serve the Los Angeles area at present. One is Los Angeles Transit Lines which is 58% owned by National City Lines of Chicago, a transit organization which owns bus facilities in more than 50 cities. L. A. Transit is an outstanding example of good management. Despite decreasing passenger totals each year it has maintained service and managed to operate at a profit.

The other carrier is Metropolitan Coach. It was formed in 1952 to absorb and operate the bus and street car facilities of the P. E. system. Since inception this company has had a marginal existence, although recently it managed to show a small profit.

These two carried over 300 million passengers last year, showing that mass transport demand is far from negligible.

The bus companies maintain that busses can answer the mass transit problem. To make of the bus a *rapid* mass transit medium several proposals have been presented. Among them are bus-on-freeway systems, bus subways in congested downtown areas, and elevated

HUNTINGTON'S PACIFIC ELECTRIC NETWORK



The extensive network planned by Huntington provided excellent urban contact with the city. Presently freight is hauled on some of these lines other rights-of-way are unused.

1939
W. P. A. Report

A W. P. A. survey was made during the years 1938 and 1939. The project was sponsored by the City. Supervising personnel, consultants and equipment were financed by the Citizens Transportation Survey Committee.

The report presents summaries of field, office and derived data relating to transportation in Los Angeles metropolitan area. It is a compilation of data on a factual survey concerned with riding habits, passenger movements, origin and destination studies, distribution of automobile ownership and like information.

Selected Findings:

1. 85% of Public Transport patrons walk to point of boarding. 80% of patrons live within 2 blocks of lines.
2. Bulk of patronage results from regular daily trips.
3. Approximately 33% of inbound patronage of local rail lines L. A. Railway and P. E. Railway was handled between 7 and 9 A.M. More than 40% of P. E. interurban and Motor Transit Coach passengers traveled during that period.
4. 48% of L. A. Railway patrons transfer in order to get to their destinations on any single line. 33% of coach patrons ride directly to destination on one line. P. E. local rail lines show 71% of all riders as direct. 50% of L. A. Motor Coach Co. ride direct.
5. L. A. Railway and L. A. Motor Coach show 13 to 14% transferring a second time and 1% a third time.
6. 20% of employees of industrial establishments checked used public transportation, 71.7% used private cars, 7% walked, and 1.3% used other means or did not state.
7. Automobile ownership proportionate to population in various sections studied, regardless of economic status.

1945
DeLeuw - Cather Report

In 1945, another attempt was made to formulate an acceptable transit program for the Los Angeles Area. Three consultants, DeLeuw-Cather and Company, Harold Lewis, and Joe R. Ong were employed by the City to review past reports and make recommendations regarding both transit and highway traffic. Their report was divided into four parts. The first was a statement of the problem. The second, by DeLeuw-Cather, was entitled "Rapid Transit Development." The third, by Harold Lewis, related to the freeway program. The fourth, by Joe Ong, was entitled, "Local Surface Transportation."

The DeLeuw-Cather chapter recommended rail rapid transit on the following parkways: Santa Monica, Hollywood, Olympic, Inglewood, and Harbor. Rail rapid transit was recommended for those freeways on which it was anticipated that unacceptable congestion would result from busses and automobiles, if busses were used exclusively for rapid transit. It also recommended rail rapid transit on the Long Beach-San Pedro, Pasadena, Glendora, and Covina lines of the Pacific Electric. In addition, it made recommendations for bus rapid transit on freeways and subways on Broadway.

Although the Lewis report dealt largely with freeways, it also considered the terminal problem. He recommended that terminal planning should be considered as an essential part of the freeway program. This should include, (1) off-street bus terminals, (2) coordinated system of off-street automobile parking facilities, (3) off-street parking for tenants and customers of buildings, and (4) adequate off-street loading and unloading space for trucks.

The Ong report recommended a Central Business District subway for street cars and trolley coaches.

Divergent opinions were expressed on the type of service needed. One consultant recommended primarily rail rapid transit, another a bus system.

bus ramps as items for study. Bus company proposals and arguments appear to be based on the premise that metropolitan growth and expansion is leveling off. What will happen if metropolitan growth continues at its present pace has not been answered by bus advocates.

Logically enough the bus companies are seriously concerned when a proposal for a transit network, not privately owned, is presented to the city or state. Competition would be created that could not be met. Bus companies have spent millions of dollars improving their service. They may well have averted or postponed a transportation crisis. These privately-owned companies feel that their investments deserve sincere consideration if a public or quasi-public transit system is to be built.

Past Transit Thought and Effort

Ever since the advent of the automobile, transportation experts have expressed concern about the decline of mass rapid transit service. Considerable time, money, and report-writing has been devoted by various private and public bodies to studying and recommending the need for an integrated system. For many years this relatively undirected and unnoticed thought continued while boulevard and freeway builders barely kept ahead of traffic strangulation.

Before the end of World War II some forty reports were prepared. Only four can be classified as major reports. These four are commonly known as the Kelker-DeLeuw Report of 1925, the Baker Report of 1933, the WPA Survey of 1939, and the DeLeuw-Cather Report of 1945. They can be called major in that their conclusions were based on some degree of transportation research, including origin - destination studies. Their recommendations were not dissimilar (see below). All, except the WPA survey, which made no recommendations, suggested a rapid rail system with off surface portions in downtown. None of these reports received the serious consideration they merited.

The most comprehensive proposal, prepared by the Rapid Transit Action Group, was published in 1948. In 1947 this RTAG had been formed under auspices of the Los Angeles Chamber of Commerce. Members of the group were recognized transportation and economic experts. The report was published in a promotional booklet form. It recommended certain forms of rail rapid transit (see below) and was introduced in committee at the Legislature. The RTAG report also fell by the political wayside, never being translated into required legislation. Controversy has been hot and heavy about this report.

The University President's Report

After the war, when the traffic problem became more acute and existing rail and bus facilities began to prove unsatisfactory, another flock of reports landed on the desks of the Board of Supervisors of Los Angeles. Many of these were controversial, incomplete, and at times unsound. In 1949 the harassed Supervisors called upon the presidents of the major universities of California to help provide a sensible approach to the growing problem. The University Presidents' Committee was formed, composed of the heads of Caltech, USC, UCLA, Stanford, and UC at Berkeley. These men were to be assisted by the technical personnel of their schools. Dr. Lee DuBridge, head of Caltech, was appointed chairman.

The report of the University Presidents' Committee was submitted to 1950. It recommended that a thorough study be made of the larger aspects of transportation as tied up to the life of the city. All types of mass rapid transit economically feasible must be studied. It prescribed the steps to be undertaken. Two engineering firms competent to handle transportation studies of such a scope were named. This committee, being by its composition above

1948
Rapid Transit Action Group Report

A rail rapid transit plan was developed by a group of Los Angeles engineers, thoroughly familiar with local conditions. The RTAG was comprised of financial advisors; city and county private transportation engineers; construction engineers; state, country and private planners and researchers, and specialists in the field of transportation.

Rail operation was recommended on the following parkways: Santa Monica, Olympic (might be bus), Inglewood, Harbor, Ramona, East By-Pass, and portions of Hollywood. The following routes would operate in private rights of way: to Long Beach and San Pedro, to Bellflower, to Pasadena and Monrovia and to Burbank and Glendale. For the Central Business District, recommendations were a rail line from Sixth and Main to the East By-Pass, expansion of the Hill Street Subway Station, a Broadway subway, and pedestrian subways connecting the Broadway subway with Hill and Spring Streets at each station.

Estimated total cost excluding rolling stock was estimated to be $309,685,000. Gross annual passenger revenue of $59,150,000 was estimated. Financing through District bonds was recommended, with bond issues to be approved by the people.

The Metropolitan Traffic and Transit Committee of the Los Angeles Chamber of Commerce adopted the plan and drafted enabling State legislation—which was introduced in the Legislature but did not get out of Committee—for the formation of a transit district. The transit plan, according to the Committee, was intended only to be representative of the plans which might be possible and to demonstrate economic feasibility of a rail rapid transit network. It was not intended to be presented as the plan with which a transit district would proceed; however, it was largely so interpreted.

1950
University President's Report

This report establishes the fact that a new comprehensive study of transportation throughout the Los Angeles County Metropolitan Area is imperative.

There have been no extensive traffic or transit field studies since 1938; post-war population growth, industry expansion, major business and population shifts within the area, and decentralization leave no adequate basis from which sound conclusions can now be drawn.

Of 45 or 50 studies made during the past 25 years, only five could be called extensive, and that there now exists a divergence of opinion regarding trransportation of such magnitude as to paralyze action, at least pending more convincing data.

Scope of the new study, in addition to establishing data now lacking, should include the investigation of (1) the county's pattern of growth; (2) the relationship of a coordinated rapid transit system to healthy economic development; (3) economic and engineering features of all possible rapid transit systems—busses on freeways, subways, rail on freeways, rail on private property, monorail or other; (4) where rapid transit is needed; (5) how the final plan should be financed and (6) how the system should be owned and operated.

Recommended are broad outlines of the required organization, the sequence in which the various phases of the inquiry should go forward and, after a nation-wide search, the firms to carry out the study.

charges of partiality and self-interest, felt that a comprehensive economic and engineering approach would provide the routes and type of system necessary.

The report died from political and public inertia. Money for the study was not appropriated.

Formation of an Authority

Another opportunity to establish the machinery for a logical approach to the problem came in 1951 when the State Legislature created the Los Angeles Metropolitan Transit Authority. Unfortunately the birth of this Authority was so complicated by political wrangling that its scope and authority were limited to the point where a complete engineering, economic and financial approach appeared virtually impossible.

That year a bill was presented to the Legislature calling for the establishment of an Authority. The transport situation in Los Angeles was described as serious—so serious in fact that the problem should be attacked in a vigorous and expeditious manner immediately. An Authority, with members to be appointed by the governor, should be formed. This agency would have power to investigate the traffic situation, decide on the type of system (s) best suited, construct it, and ultimately operate it. Construction would be financed by floating a revenue bond issue, which is not a tax on private property. The Authority would, by obligation to the bond holders, be responsible for profitable and efficient operation. As within the recognized concept of an Authority, this agency would be tax-exempt and free from rate-fixing by the State Public Utilities Commission.

During discussion of the bill, advocates emphasized the necessity. Traffic strangulation was already inhibiting the growth of metropolitan Los Angeles. They pointed to the San Francisco Bay Bridge Authority. The Bay area needed a bridge in 1934, an Authority was appointed, and the bridge was built. The concept of an Authority was not new to California.

Opposition centered on the word "operate." It was held that this bill was equivalent to granting *carte blanche* to such an Authority. Any type of system could be imposed arbitrarily before the preliminary research both on the unique transit situation in Los Angeles and on the engineering aspects of the conveyance itself had been adequately conducted. Opponents were wary of having an untested monorail system forced on the city.

One component of the opposition revived the University Presidents' Report. This group insisted the bill was too heavily pointed toward hurried construction and operation. Here was the chance to create an agency that should be limited to initial powers of study only. The broad investigation suggested by the University Presidents should be the only work of the Authority. Enabling legislation for construction and operation could be requested later.

Proponents answered that these people were not defining an Authority, they were talking about a survey agency. By the time such an extensive survey was completed, Los Angeles would be one large traffic tangle.

The arguments of the two privately-owned transit companies were obvious. If this Authority were to build and operate a mass transit system, would it not be in direct competition with private enterprise? Should it not, therefore, be eligible for rate fixing by the State Public Utilities Commission and be subject to governmental taxation just as the private transit companies are? Proponents answered that no Authority presently existing in the state, including water districts and other public service agencies, was subject to these severe restrictions.

A ham-strung type of Authority resulted from that session in 1951. The bus companies had won their point. It was subject to rate fixing and taxation. Even more damaging was the restriction on scope of operation. The Author-

1954
Coverdale - Colpitts Report

Summary of Conclusions:

1. The characteristics of Los Angeles are different from those of any other city in the combination of its extent of area, the low density of its population, the high degree of automobile ownership and the lack of any system of surface-free mass rapid transit.

2. The monorail rapid transit route as proposed in this report and located within the area described in the act creating the Authority would, if adopted, be a proper beginning of mass rapid transit through the County.

3. Monorail as an interurban railroad, rather than an urban distribution facility, can be integrated appropriately with any future plan of rapid transit that may be adopted for the metropolitan area.

4. Economic and engineering features of a modern elevated rapid transit system should be given comparative study.

5. Action should be undertaken at this time by appropriate agencies exempting the Los Angeles Metropolitan Transit Authority from control by the State Public Utilities Commission and exempting the property as well as the bonds of the Authority from taxation to conform with the established policy of the State in order to accomplish public acceptability of the revenue bonds proposed to be issued for the financing of the transit system under study.

6. Appropriations should be made by the appropriate agencies of the State or County for the further steps in engineering, financing and administtration which necessarily must supplement the accompanying Feasibility Report.

7. Provided appropriate legislative action is taken and further reports are completed as required, the development of a mass rapid transit system by monorail for Los Angeles as herein described appears to be feasible.

1955
Town Hall Report

This report, the most recent one, has been submitted by members of the regional planning and development section of Town Hall, an organization of civic leaders meeting weekly in the Biltmore to consider community problems and public affairs.

A year-long study gave these conclusions:

1. A comprehensive study of traffic and transit problems must be undertaken in 1955 under the direction of an agency appointed for this purpose. The agency would choose the mass rapid transit method most suitable for the area.

2. The State Legislature should be asked to enact the enabling legislation for such an agency, provided with initial funds, and require that its survey be completed in 1957.

3. A timetable must be established, with the initial programming and financing to be completed by 1959.

4. Completion of the basic stages of a mass rapid transit system should be completed in three to five years after 1959.

5. The proposed agency, assisted by citizens' committee, must stay actively on the job until the agreed-upon program, backed by every governmental unit in the metropolitan area, is planned, financed and put into operation.

In a preface to the report, Chairman Samuel E. Lon Lunden wrote: "Traffic and transit is the most important problem of the Los Angeles metropolitan area. The longer a solution is delayed the more the development of the area will be handicapped. While the field is crowded with suggestions as to the most effective method of moving large masses of people in the enormous spread of the metropolitan area, action thus far has been paralyzed by a lack of unanimity regarding the various methods."

ity was to limit its interest to an eight-mile strip between Panorama in the San Fernando Valley and Long Beach, passing through downtown. Furthermore, the system would be monorail, nothing else. Members of the board were appointed by the governor. Ralph Merritt, a prominent Californian, former comptroller of the University of California, was appointed general manager.

Public argument about this Metropolitan Transit Authority continued hotly for the first few years of its life.

The Feasibility Report

The new Authority requested and obtained $100,000 from the County Board of Supervisors to undertake a restricted study of the feasibility of a monorail line from Panorama to Long Beach. The engineering firm of Coverdale and Colpitts of New York, one of the two recommended by the University Presidents, was engaged to prepare this report.

Coverdale and Colpitts are "banker's engineers." Because of an established reputation for sound economic and engineering research, any conclusions their engineers make on a project are carefully noted by financiers. Bankers and financiers will not buy revenue bonds for a project if the conclusions are not altogether favorable. Thus, the fate of the monorail line hinged on the results of the feasibility study.

The Feasibility Report was presented to the Supervisors in January of last year. It raised quite a few eyebrows. For the limited amount appropriated, Coverdale and Colpitts, with the help of two other engineering firms, had done a masterful bit of research. The Report concluded that "provided appropriate legislative action is taken and further reports are completed as required the development of a mass rapid transit system by monorail for Los Angeles as herein described appears to be feasible." The legislative action referred to is the exemption of the line from taxation and rate-fixing. If this were not done, Coverdale and Colpitts felt, public acceptability of the revenue bonds for financing the transit system studied could not be obtained.

Other portions of the Report not as highly publicized kept the monorail line from getting a clean bill of health. The fourth conclusion stated, "Economic and engineering features of a modern elevated rapid transit system should be given comparative study." Many conservative civic groups made note of this, pointing out that nothing had been proven to show that monorail was the *most* feasible. Other opposition groups concentrated on attacking the report proper, which was vulnerable since the appropriation for it had been so limited. Validity of the research procedures used to compile the origin-destination portion of the report was challenged. The engineering soundness of the split-rail type of monorail proposed was questioned. The publication of the report started a new phase of thinking on mass rapid transit, this time a bit more logical. Recently Town Hall, a body of civic leaders, restated the case for a broad and comprehensive study of transit in the whole area (see below).

What has resulted from the hectic argument since 1951? Some say only wasted time and money. The chances for the Authority's monorail line appear rather slim. Besides the legislative action required, opposition to this line has become formidable.

One valuable thing has been produced. Clear and consciencious thinking has been directed to the problem. The battle is not as embittered as it was four years ago. Many believe this thinking is reawakening interest in the broad recommendations of the university presidents.

What Will the Legislature Do?

There are a number of conflicting bills before this year's session of the Legislature. A reasonable program will have to be shaped from them.

It is apparent that the Authority has strengthened its position considerably since its establishment. Public interest has been generated in the possibility of monorail. The increasing inability of busses to supply adequate transport has benefitted the Authority. Neither has it hurt this agency to see more and more action groups and transportation experts concede that private capital can no longer be attracted to the transit field because of the high initial investment and long pay-out time.

The Authority is probably in a good position to request the Legislature to grant the broad investigative powers asked for in 1951 while playing down the constructing and operating clauses. Most experts agree that to disband the Authority would be a step backward. Recent public statements by Ralph Merritt (which have not attracted much attention from the press) may shed some light on the future orientation of the Authority. He stated that the Authority would definitely be interested in investigating the feasibility of

Statement for S.C. Engineer

J. L. HAUGH,

President of Metropolitan Coach Lines

Express motor coach service moving over the vast Freeway system is in my opinion the best approach to the solution of our complex problems of rapid mass transportation in Los Angeles Metropolitan area. Modern buses are capable of carrying as many people as a lane of automobiles a mile long. They will take up comparatively little space on a freeway—yet operate over the route in half the time it would take on ordinary streets. I believe an attractive transit service such as this, using motor coaches equipped with all the latest comfort and safety features, will encourage more people to use transit. In so doing, this will decrease the traffic load on the freeways as well as relieve the costly parking and traffic congestion in business areas.

The present and proposed operation of Metropolitan Coach Lines' buses on the freeways has a distinct advantage over any fixed type of rail line. Because of its flexibility, the motor coach can operate through residential and industrial areas, pick up passengers close to their homes and places of employment, then operate like an automobile after entering the Freeway. After leaving the Freeway, the bus can then distribute passengers close to their destinations.

The attractiveness of motor coach operation lies in its greater flexibility. New lines can be created and older lines re-routed, extended or re-adjusted to bring transporation to areas of rapid industrial and population growth. In downtown areas, motor coaches load at the curb thus providing greater convenience and safety for passengers who do not have to use a center-of-the-street loading zone. Traffic congestion is also relieved since elimination of the loading zones opens up an additional lane of traffic for private automobiles moving in each direction.

an integrated transit network throughout the area and that it was in no way proposing the monorail idea as the sole means of cheap, safe, and efficient transit. Other interesting points he has made include a statement that private transit companies should be compensated for operating losses suffered and that the old P. E. rights-of-way demand immediate study before they are lost.

As the 1955 Sacramento sessions draw near, the Authority and many powerful civic bodies appear agreed on the advantage of sound engineering and economic research. Engineering firms such as Coverdale and Colpitts can provide many of the answers if given the time and money. This recognition of the ultimate value of an unbiased engineering approach appears to be drawing various interests closer together.

The big question is still how rapidly preliminary phases should be completed. Some groups insist on the slow but complete investigation outlined by the university presidents; others say necessity dictates a faster pace. The recent Town Hall report tries to stand in the middle. Although it affirms the 1950 report, definite deadlines are offered.

With proper guidance by the Legislature, 1955 may well be a year of consequence. Perhaps this year the necessary machinery for starting a comprehensive program that will produce mass rapid transit will be set up. Whether this machinery is embodied in the existing Metropolitan Transit Authority or not, it is hoped that one day an integrated transit system will provide the same fine service offered by the P. E. system in the twenties.

Statement for SC Engineer
STANLEY N. LANHAM

Vice-President of Los Angeles Transit Lines

Metropolitan Los Angeles is best described as an area encompassed by a circle of about 25 miles diameter, with its center in downtown Los Angeles and containing 120 communities, 40 being incorporated cities, with a total population as of October 1954, estimated at 4,500,000.

About half of these people live in the inner area, say in a circle with a 10 mile radius, the other half in the outer area. During the past 10 years the population growth in the inner 10 mile circle has practically ceased.

Nearly all the new construction of industrial buildings, retail centers, banks, and similar service institutions, schools, churches, branch libraries and other cultural facilities, has been in the outer portion.

Population density in this outer portion area averages only 1360 to the square mile.

Population in the City of Los Angeles itself averaged only 4300 to the square mile at the time of the 1950 census, and this compares to 88,000 for the Borough of Manhattan, 25,000 for the City of New York, and to densities ranging downward from this to a minimum of about 12,000 to the square mile in the others of the 10 largest cities in the United States.

So a transit system to be useful here, must be prepared to carry people from their far flung residential areas to the several hundred industrial and retail areas where they are employed and to the facilities to which they wish to travel. The travel pattern of the people in this area is a helter-skelter pattern, with a great many points of origin and a multitude of destinations, both of which are constantly changing.

The people of the area have the highest automobile registration per capita in the world, one car to every 2.1 people. The average peak hour occupancy rate of these cars is 1.5 persons.

The automobile has made it possible for the people of this area to live far from where they work and has conditioned them to shop, go to school, or seek entertainment at locations far from home. Public transit has the job of giving those who do not have an automobile immediately available a kind of service that will most nearly equal the service the automobile offers.

This means that it must be fast, flexible, able to travel wherever the automobile will travel, convenient, economical, and capable of altering its routes to conform to the rapidly changing pattern of the community development.

The only mass transit system thus far devised that meets all of these requirements is a bus system composed of three types of service:

1. Local lines, with stops every three or four blocks;

2. Limited stop express lines, which will pick up passengers reasonably near to their points of origin, swing on to the freeways for rapid travel over the longer distances, stop at bus turnout and loading facilities provided for the purpose only at major transfer points, then leave the freeways to deliver passengers reasonably near to their destinations;

3. Through express lines, designed to connect the more remote points, with few stops in between and these only at major localities.

Such a system will accomodate all who now wish to ride transit and may always be able to do so, for because of the highly decentralized nature of the community there is nowhere a demand for a high capacity service, but rather many demands for relatively low capacity services able to cover the whole, complex area.

Such a system imposes no new expense on the public other than the nominal cost of building bus turnout and loading facilities as an integral part of the freeway system.

Creation of such a system does not preclude the possibility of the community later building some other type of transit system.

Such a system can be put into operation now, using existing streets and those portions of the freeways that have been completed and thus give immediate relief.

Such a transit system can be adapted to the changing pattern of this community; it can be modified, as time goes on, to conform with changes in the development of the metropolitan area. It can provide the multiplicity of routes necessary in such a highly decentralized community within reasonable cost limits. Such a transit system takes maximum advantage of facilities already available or which will be constructed in any event, and avoids the double expense of building an entirely separate system for mass transit in addition to the costly system already built or planned for the automobile.

By making full use of such a system of bus lines, the community can avoid the needless expense of building costly, high capacity facilities for which there is no present need and is still at liberty to build a high capacity when, as, and if, there is ever a genu- cost.

This type of rubber tired transit system is recommended by the transit industry as the best possible transit system which can be created in the shortest possible time at the least possible ine demand for it.

TRANSPORTATION ENGINEERING AS THE ANSWER

Ben Levine

Features Editor

LOS ANGELES, in respect to transportation, is in a class by itself. The city spreads out in all directions over some twelve hundred square miles. Forty-six incorporated cities and unincorporated areas in Los Angeles County are part of the metropolis. Surburban development is already spilling over into Orange, San Bernardino, and Riverside Counties. The movement of population is the highest of any city in the United States. About a third of all people living in the county relocate within a three-year period—a nomadic city. "In a class by itself" is an understatement, and to city planners and transportation engineers it can be a nightmare.

The problem of how best to serve the transit needs of such a diversified and transient community is singular. The transportation engineer cannot draw as heavily on experience gained in laying out transportation systems for eastern cities. To provide the answers for the needs of Los Angeles he will have to demonstrate considerable ingenuity.

When he has the answers, then he must realize he holds the strongest weapon there is to resolve paralyzing divergence of opinion and political argument.

Compiling Statistics

The first step in the solution of a mass transportation problem is to find out as much as possible about the travelling habits of the people living in the area. More specificially: Where do people live in relation to where they work and play? How do they travel to and from work and play? How much time is involved in this travel? How much does it cost them?

The compilation and analysis of this information is called an "origin and destination" survey, or, to the more initiated, simply an O & D. The O & D is the all-important study that answers the why, when, and where of any proposed transit system. The analysis of the information obtained from the survey is relatively routine. It is the mechanics of taking the survey that poses the problem. The uniqueness of a city like Los Angeles; the low population density of so large an area, makes the problem a difficult one. Add to this the high mobility and it is apparent that the problem becomes imposing. Too many small streams flow into the metropolitan reservoir from all directions, whereas a city like New York has four or five large rivers of transients entering and leaving.

Postal Zone Technique

The most recent O & D study for the Los Angeles area was made by Ruscardon Engineers, headed by Don Baker —a past master at O & D for Los Angeles, having conducted one in 1933. The Ruscardon study was part of the Cloverdale and Colpitts monorail feasibility report of 1953. Unfortunately the study was confined to the transit needs of inhabitants of a strip between San Fernando Valley and Long Beach, passing through downtown. However, this O & D was a good example of the ingenuity that will be necessary to solve the increasing transit needs.

Although limited by an insufficient appropriation, Ralph Merritt (General Manager of the Metropolitan Transit Authority) and Don Baker devised a means for obtaining the necessary O & D statistics. Some 900 industrial concerns doing business in the strip for the proposed monorail line were solicited. These concerns contributed the time and labor necessary to provide Ruscardon Engineers with the postal zones of their employees. The postal zone numbers combined with the location of the concerns was sufficient to establish a pattern of travel habits within that area. It was by no means a complete survey, but a job had been done. Enough information was there for Coverdale and Colpitts to assess the feasibility of a monorail line.

Pacific Electric Survey

Some years ago the Pacific Electric undertook an O & D Survey of the people that were using its facilities. The method used was simple and effective.

The area covered by the P. E. system was split into sections, and the survey was conducted a section at a time. Coded cards were printed and given to workers who were stationed at all stops in that section. As a passenger boarded the car he was given a card that had been punched to show the time of day and the location. When the passenger alighted at his destination he merely handed his card to another worker who punched in the corresponding location and time. If the passenger were transferring to another car the card was marked accordingly and returned. For a completed trip, the worker retained the card at his station. The results were quite valuable—but only to the P.E.

Other O & D Methods

One method, not yet tried in Los Angeles, is the "return post" method. A post card or questionnaire with a stamped addressed envelope is mailed to as many homes as possible. The questions are answered and dropped into a mail box for delivery to survey headquarters. The success of this type of O & D method depends mainly on publicity and advertising. Even with good promotion there is a strong possibility that the results will be statistically biased.

Still another method is the home interview. Although unquestionably the best insofar as accurate and complete information is concerned, it is also quite expensive and time consuming. A variation of this method employs the statistics of the census bureau. Their charge for an O & D service is about $1 per head which would lead to a sizable total for a comprehensive survey.

These are some of the methods. The transportation engineer can use any one or a combination of them. Or he may even come up with a new and better type of survey procedure.

Los Angeles as a unique city—methods of compiling and origin and destination study —desire line maps—various types of transit proposed for Los Angeles—ways a system can be owned and operated—the value of competent engineering analysis.

The Desire Line Map

When the survey is finished the data are coded and transferred to IBM cards for summarization. The analysis of these vast data is an interesting aspect of the transportation engineer's work.

Extensive use is made of graphic presentation and graphic analysis. The simplest and clearest of the graphic methods is called the "desire line" map. This map is prepared in the following manner.

For the perfect map, a line should be drawn from each origin to its corresponding destination. Theoretically each line would represent one person making a complete one-way trip. This would require a chart the size of Los Angeles.

For simplification an IBM summary is utilized to cut the ratio to, for example, one line per 100 trips. The result is a confusion of lines converging on various centers in the city (see cut). The lines and their points of concentration are agglomerated into new lines, properly weighted for traffic density, on a clean map. The thickness of this line will be proportional to the volume of transit; the heaviest lines denote the greatest desire. They are drawn between origin areas and destination areas. These desire lines are then used to establish the strips that will attract optimum passengers for a transit facility.

Type of Transit

The engineer is now concerned with the type or types of facilities that will be constructed to operate along the routes proposed by the desire line studies. His final selection will have to be based on the following criteria: Speed, safety, comfort, convenience, appearance, cost, and adaptability to the proposed route.

Many different facilities have been proposed to the city planners of Los Angeles. Each has advantages and disadvantages. Among the more prominent are suspended railway (see Jim Armstead's article), the express bus, the subway, the Talgo train, and the modern forms of the conventional elevated train.

The express bus, as proposed, would operate on an elevated ramp or in a subway in the congested downtown, eliminating the slow schedule performance. Out of town it would run on the freeways and arrive at the destination area free to circulate and discharge passengers near their homes—an important advantage. Disadvantages are the high cost of elevated ramp or subway construction and the blocking of light to sidewalks and storefronts by the solid ramp required.

The subway is, of course, the ideal type of rapid transit as it does not interfere with street traffic or produce problems of so-called "light, air, and access" in connection with property along the route, but its cost is often prohibitive, especially in these days of high prices.

The Talgo train (see cover) is a modern light-weight train being used in Spain for inter-city transport. Each has but two wheels and depends on the previous car for support, not unlike certain toy trains. It is powered by diesel, but could be electrically driven and has the advantage of being light (aluminum construction) and thoroughly tested. As proposed, the Talgo train might operate on the center mall of freeways and become elevated downtown. Although faster than the bus, it would not have mobility in suburbs. A feeder bus system would be necessary.

Other forms of elevated trains have been offered. Their operation would be similiar to the El of Chicago, but much more modern. Elevated trains would cost less than monorail, but require more overhead support. Experience from eastern cities in their operation is an advantage.

The Economic Factors

After a study of the various types of transit available, the transportation engineer becomes an economic engineer. He must weigh the proposed system in terms of real estate values and the effect on future growth and development of areas. He must evaluate, for presentation to the proper legislative bodies, all the foregoing facets of the problem in terms of private ownership, public ownership, or authority ownership. There are several tangibles involved in the different types of ownership and management.

A transit system under private ownership is a privately financed, tax paying

DESIRE LINES

Graphic presentation of O & D results. Sequence: desire lines, major desire lines, and optimum location lines

public utilities whose fares are subject to approval by the State Public Utilities Commission. Management has an obligation to the stockholders for profitable operation.

A publicly-owned transit system may be financed by tax monies and have fares set by the concerned administrative body. Profits would be reflected in lower rates or increased service whereas a deficit would be covered by a general tax fund.

An authority, if patterned after those of other cities such as Chicago, would be a self-supporting tax-exempt entity permitted to set the fares necessary to meet obligations. Officers are usually appointed by the governor of the state. A revenue bond issue provides initial capital and thus obligation for sound operation is to holders of the bond issue, usually insurance companies and banks

Engineering in Politics

While he is preparing his O & D, while he is selecting his type of facility, and while he is weighing the economic and psychological factors, the transportation engineer stands in the troubled waters of local politics. An issue of such magnitude is never devoid of political action. Many important and controversial opinions are vented, whether they be inspired by self-interest or honest effort.

Such a divergence of opinion has been present in Los Angeles. Although dignity and guidance is often lent to the controversy by actions such as the recent appointment by Mayor Poulson and Supervisor Ford of a number of prominent non-technical men to a Citizen's Transportation Committee to study the transportation problem [this Committee has not yet released comments], differing viewpoints, often purely emotional, keep confusing the issue.

The only apparent possibility for a common meeting ground for these varied opinions is in the logic resulting from a sound engineering and statistical analysis of the entire situation, with sufficient money and freedom of action allotted to do the job properly. Under such conditions it should be possible to obtain a factual evaluation of the transit picture. With the facts before them, the law-makers will be able to enact the legislation required to serve the interest of the communities that they represent.

MONORAIL: A NEW IDEA IN TRANSIT

Jim Armstead
Associate Editor

The word monorail has caught on in Los Angeles. Although few people know more about it than what breaking down the word into its components, "mono" and "rail," yields, the word is heard and seen frequently these days.

The word monorail, as used by transportation engineers, denotes a railway idea—a system for mass transit, including cars, structures, stations, and signals. It is well to consider in detail the latest engineering thinking on this novel, and virtually untested proposal for the solution to the Los Angeles transportation headache.

When large cities feel the pinch of traffic on their ground surface traffic lanes, three courses of alleviation are open. The first, which appears to be the easiest, is to build more grade-separated surface traffic routes as Los Angeles has been doing by building freeways. Placing busses and even railways (to use the center mall) on the freeways has been suggested as a means of acquiring mass rapid transit.

Another solution is that of sub-surface traffic—the subway. The subway is a good answer. It will handle the large movements of traffic, is not hampered by surface traffic, and has a private right of way. Unfortunately, it has been demonstarted that hardly any city in this country can afford the luxury of a subway sufficiently extensive to provide traffic relief.

The third solution is elevated roads or railways. The familiar elevated train running on conventional tracks built close to the ground is objectionable for several reasons. The supports cause additional surface congestion; the trains are noisy; the tracks and supports shut off light and air; and, with several lines of supporting columns in the street, real estate values are lowered along the route.

A more modern form of elevated, that of the elevated roadway on which busses with pneumatic tires could operate, removes many of the objections to the older type of elevated trains. The roadway, however, still presents a roof over the street which shuts out light and air. Because of the compelling necessity for removing this characteristic, which is particularly objectionable in residential streets, the thought of hanging a car from an overhead track was originated. Since the car would not depend on the track width for stability against overturning, the track gauge could be narnowed. Also, because the car is suspended from the track, the supporting structure could be raised higher above the street. This thinking led to the design of "monorail." Monorail means, in essence, a car hanging from and traveling on a rail supported high above the surface.

Variations of the Monorail

Monorail construction is not a new engineering idea. Practical industrial monorails have been long used in this country in large industrial plants and warehouses. Industrial monorails illustrate the concept, but are slow-moving and ponderous devices.

The city of Wuppertal, Germany, features an electric monorail system. It has operated successfully for over 50 years. The cars hook to the single overhead rail by an arm with a wheel on it. This rail

Monorail as a novel form of mass rapid transit—existing monorail lines—proposed line for Los Angeles—prime mover hookup —signalling system offered—advantages of monorail—unanswered questions on modern monorail.

is supported laterally and within an inverted U structure. Riding on a single rail, it is a monorail within the truest sense of the word. The Wuppertal line exemplifies the "classical" monorail. Modern variations feature a "T" shaped structure.

Non-suspended monorail systems are also in existence. The cars sit on the rail. One type is the "saddlebag monorail" with cars balanced on either side of the single rail. A system of this type, called the Lartigue monorail, was operated for many years by the French in eastern Africa. If not properly designed or operated it could overturn, track and all.

Another type sits on the track and is held upright by a gyroscope. It is not hard to visualize what happens when the gyroscope fails.

The latest development is the Alweg A running model was recently demonstrated near Cologne in Germany. It has a bearing surface upon which the car runs and vertically curved extensions below the frame of the car to which wheels, bearing on the sides of the structure supporting the rail, are attached. The Alweg, unfortunately, requires an extensive supporting structure.

Latest American Development

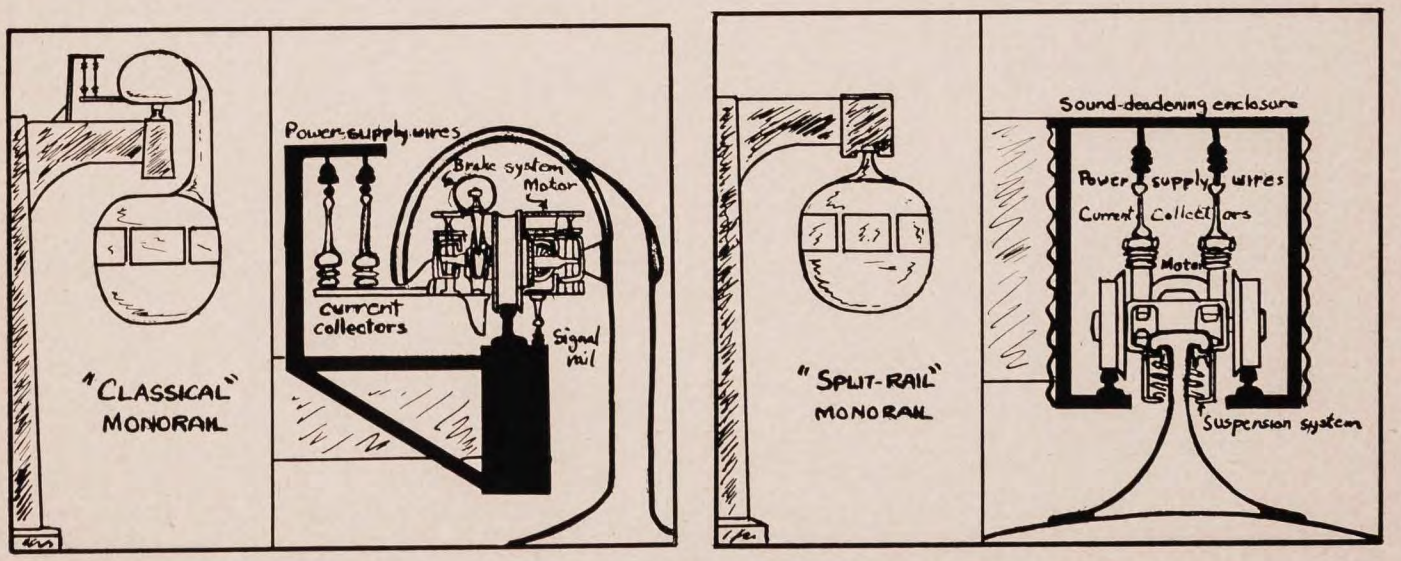
An outgrowth of the "classical" monorail of Wuppertal and the better industrial monorails has been the proposal for a "split-rail" monorail. Cars would be suspended between two closely spaced rails housed in a one-piece enclosure. Gibbs and Hill, a New York firm which engineered the electrification of the Pennsylvania Railroad, has analyzed the various systems and leans toward the split-rail monorail, on steel wheels, as the best alternative. This firm also did that portion of the recent Feasibility Report on a monorail line for Los Angeles concerned with design of the monorail system. Although their studies were confined to a version of the classical monorail, they feel a split-rail has distinct advantages. Gibbs and Hill's proposed system for Los Angeles and their executive vice president's (Edward Anson, a leading expert on monorail) statements on the split-rail monorail comprise the foremost thinking on monorail today.

The Split-Rail Idea

In some of the better designed industrial monorail systems there are two wheels opposite each other running on two bearing surfaces (rails); one on each of the two sides of a flange of a single structural member, like an I-beam. The load is suspended from a frame hung below the two wheels. Hence, monorail systems are not limited to the use of a single bearing surface or rail.

By merely splitting the two bearing surfaces on the bottom flange of the structural I-beam, and supporting them by a revised but integrated structure, and by suspending the load from a point between the wheels instead of from a frame around them, the idea of another type of suspended railway is conceived. This type may be called the split-rail type suspended monorail or simply a suspended railway. Adapting this arrangement to operation with loads and speeds required for mass rapid transit, results in a truck running inside the integrated mono-structure on rails located with precision as to alignment and surface and closely gauged to each other so as to con-

Artist's conception of the classical and the split-rail versions of monorail. The classical, based on a monorail line running in Wuppertal, Germany, would probably feature the driving motors riding on top of the rail. The split-rail would have the motors and wheels riding inside of the sound-deadened girder box which would be roughly forty by fifty inches in cross-section. T-shaped supports, about seventy-five feet apart, would support the rails thirty feet above ground.



stitute practically a single support. By suspending a passenger car from properly designed tracks a satisfactory railway results. The railway can go underground as a subway, if need be, still suspended.

To accomodate the truck inside the split-rail girder of the suspended railway, the integrated structure becomes somewhat wider than the corresponding girder for the classical or single rail monorail. This added width, however, is insignificant because the girder would be located about thirty feet above the street and the difference of thirty inches in width at that elevation could hardly result in any material increase in shadowing of the street. Enclosing the girder with removable sound deadening skin would result in less noise and in dry rail operation, during wet weather.

One of the advantages of a split-rail system, having the two bearing surfaces, is the decreased possibility for derailment. On the classical monorail system a hook is provided to avoid serious damage in case of derailment, and therefore, the classical monorail is safe but the close clearances within the girder of the split-rail system make derailment practically impossible.

The cars of both the classical monorail and the split-rail or suspended railway are free to swing to compensate for centrifugal forces due to negotiating curves. However, in the case of the classical monorail, there is no control on the amount of swing except the restraint afforded by adjoining cars. Because the truck in the split-rail suspended railway system would always run on an even keel and car sway would be entered about a point in the truck, it would be possible to apply well-known methods of restraint to control the amount of swing of any individual car if that is found desirable.

Supporting Structures

The modern concept of suspended monorail has progressed considerably beyond the original design now operating in Germany. Many of the suggested improvements have been inspired by progress in structure and equipment designs of modern surface systems.

The running surface could be supported by a simple girder or member of sufficient strength to eliminate the necessity of cross-bracing between the two rail supports of a double track line. This cuts out unsightly lattice-work. The supporting structure may be an arch type or a single column with suitable cantilever brackets in the form of a "T." Columns could be centrally located in the street so as to interfere as little as possible with street traffic. The supporting structure for the running surface is so proposed as to provide sixteen feet clearance between the bottom of the cars and the surface of the street or ground. Thus, any semblance of a floor above the street would be eliminated.

The stations on the overhead portions of the line would be located over the streets with mezzanines below the train platforms. Access can be had by stairways or escalators.

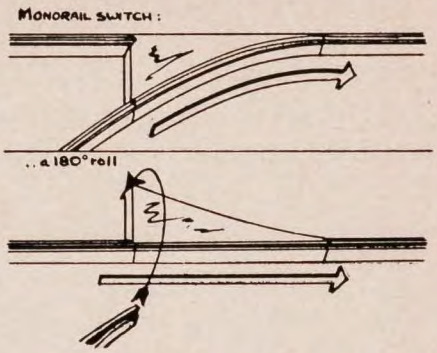
The car body, truck and drive are logical adaptions of aircraft fuselage design practice, PCC car development, torque converter drive application to motor driven vehicles. Modern high strength, lightweight materials, would certainly be used and the latest devices for providing safety by signaling and train control could be an integral part of the design.

Power Plant

As proposed, all cars are equipped wth modern high-speed AC squirrel cage type induction motors propelling the cars through hydraulic torque converters. These motors would be mounted in the trucks above the rail and no power circuits would be needed in the suspended cars. An induction motor under this arrangement comes up to speed very rapidly and the necessity of converters to convert AC to DC current is eliminated.

Using two trucks per car with each truck having two sets of driving wheels, allows the use of smaller lighter motors and it is believed will permit good schedule performance. The entire weight would be available for rapid acceleration and braking rates within permissible values of adhesion. This latter feature of design is of prime importance because rates of acceleration and deceleration, even more than maximum speed on level tangent track, determine the average or schedule speeds for runs up to one mile or even more in length. As top speed is increased, the consumption of power and cost of motor equipment increases even more rapidly, which indicates the selection of a top speed of about sixty miles per hour.

THE SWITCH



Monorail switches will have to differ widely from conventional railroad switches in that the car hangs below the rail. To solve this a switch that revolves 180 degrees as a unit has been proposed.

With the rates of acceleration and deceleration believed available, this top speed would result in an average speed including station stops equal to that of the modern, conventional PCC car.

Signal System

A modern signal and automatic speed control system would be provided to insure safety of operation on a minimum headway of 90 seconds. To avoid possible confusion between signal aspects and background colored lighting, cab signal indications would be provided in each train's operating compartment. Any change of signal aspect to a more restrictive indication, that is, for example, one showing closer approach to a preceding train, requires acknowledgement by appropriate action on the part of the following operator. An alternative braking is automatically initiated. Closing-up movements involving passing of a stop signal could be made, at slow speed only, following acknowledgement of the signal aspect of the operator first bringing the train to a full stop.

Questions Left Unanswered

The engineering firm of Coverdale and Colpitts points out in their section of the same 1954 Feasibility Report which carried the Gibbs and Hill monorail design: "There is not now in any city in the world any suburban or interurban service operating at the over-all speed contemplated for this line. All ot the various elements entering into the design have been tried and tested. The

only thing that could be considered an innovation is the assembly of all of these particular features in this type of operation. The monorail system contemplated herein is not at all comparable with the one that has been operating in Germany for many years." (Although these remarks apply to the modernized classical system proposed, they are just as apt to the split-rail proposal.)

There are specific engineering questions that need answering. When all of the separate features that have been described are assembled into an integrated operation, what will the repeated unbalanced loads caused by the passing of cars do to the structural materials? What are the fatigue strength requirments of crossarms, rails, and supports? In short, can these structures withstand the tremendous torques developed by repeated high-speed loads?

Some other questions can be posed. Is metal to metal contact the most acceptable solution, or might rubber wheels provide a quieter ride and faster acceleration? How well will a completely new type of switch system proposed operate? Will the cars hold to the station platforms magnetically, as proposed. And how will the effect of time, vibration, and natural occurances, (earthquakes, etc.) affect the suspended rail and rail structure?

These questions, and others, need answering. Before a large investment is made, trials must be conducted on reasonably sized models. Better yet, on a full-scale test strip. Such tests are expensive, but if it is conservatively assumed that industry spends 1% of its appropriations on practical research then a proposed 200 million dollar investment in a monorail system would justify two millions spent for answering these important questions.

Although the modern split-rail monorail has received planning, design, and publicity, and has appealed to the imagination of many people, it has one serious disadvantage. The fact that no full-scale split-rail line exists hurts its chances for immediate adoption by any city. Will a city take the risk?

To many engineers, a mass rapid transit system employing modern monorail concepts remains visionary until a span is built and tested under all possible conditions.

End of Symposium

Reprints available on request.

ENGINEERS CAN WRITE BETTER TECHNICAL REPORTS

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An approach to better technical writing: cut and shorten where possible . . . cull bookish words . . . substitute action

YOU, as an engineer, can improve your technical reports by adopting methods used by professional writers. Failure to do so may result in injustice to yourself and to your career.

Since your writing is judged by the same criteria as that of the professional writer, you must use the same methods to get comparable results. Some of these methods are really the writers' "tricks of the trade." One is the use of short sentences.

The short sentence is probably the greatest help to understandable writing. It permits spacing of ideas. Ideally, each sentence should be limited to one thought. Very often, however, simple sentences are incapable of communicating complete thoughts. Sentences become longer as modifying and qualifying words are introduced and as relationships between subject and object are developed.

As sentences become longer, relationships between words become less clear. Such sentences are harder to understand and may require rereading. They often lead to errors in grammar. Consequently, long sentences must be watched.

During recent years researchers have come up with a "readability formula" or criterion. The formula shows that when average length of sentences runs over 20 words, thoughts become difficult to understand.

Here is a standard in terms of words per average sentence:

Under 10—Easy to read
15—Fairly easy
20—Standard
25—Difficult
Over 30—Very difficult

Here is how you can measure the readability of your writing. Pick several blocks of seven sentences at random throughout your manuscript. Average the sentence lengths of each block of seven; then average the average of each block.

Remember this: A sentence of over 25 words generally can be cut into two short ones. After several long sentences, insert a short one to act as a "rest" for the mind. Aim to get more sentences into the easily grasped 10- to 15-word length.

There's another reason why technical people in particular should write short sentences. In ordinary writing, shorter words can be substituted to help the reader understand. Generally, technical words cannot be simplified. Short sentences can compensate for this limitation.

Here's an example:

Technical sentence:

"Corrosion damage was not distributed uniformly on the tube surface but was concentrated at random locations."

Newspaper sentence:

"A 14-year-old boy was arrested last night while he was robbing a jewelry store.

Both sentences have 16 words. But the technical sentence has 92 letters in its 16 words, the newspaper sentence only 63 letters. Short, common words will help keep the letter-count down. Some technical people have trouble here.

Because of misplaced deference to convention, many empty, bookish, formalistic, and legalistic words and phrases creep into our speech and writing. Most of them can be called "nonworking" words. Cull them and substitute "action" words. Here are a few examples:

Avoid	Use instead
with respect to	for, about
effectuate	carry out
ascertain	find out, learn
for the purpose of	for
in the nature of	like
in view of the fact of	because, since
presently	now
along the lines of	like
subsequent to	for, after
avail yourself	use

Many technical people are troubled over paragraphing. What should a paragraph include? When do you begin a new paragraph? In modern usage, paragraphs are becoming shorter. In newspapers, for example, almost every sentence is a paragraph.

In technical reports, paragraphs should be well constructed. The first sentence of a good paragraph should be the topic sentence. It should tell the reader what's going to be said in the paragraph. It should also provide a transition (if such is needed) from the preceding paragraph. This topic sentence should be short and direct.

A good paragraph should also have a summarizing sentence which should warn the reader—"this is the end; prepare for another thought or another subject."

The length of a paragraph depends on two things: subject matter and consideration for the reader.

The rule of composition on paragraphing is clear. When the thought or subject promised in the topic sentence is exhausted, start a new paragraph. Consideration for the reader may modify this rule somewhat. Written with the reader in mind, paragraphs should do several things:

- Give the reader visual evidence of a break in thought.
- Provide just enough material on each thought, or facet of a subject, not to tire his mind.
- Provide a "hook" for the reader's attention.

Therefore, it is better to over-paragraph. The reader won't object.

There are three major pitfalls to paragraphing:

- Lack of topic sentence.
- Lack of unity.
- Improper development of central thought.

To see if you have observed the rules of good paragraphing, check your paragraphs against these questions:

1. Is the topic sentence concise?
2. Does the paragraph need a transition sentence?
3. Does the paragraph contain more than one central thought? (Yes? Then split the paragraph.)
4. Can the paragraph be broken into two by regrouping information? (This is desirable and worth the effort.)
5. Does material in the paragraph cover what was promised in the topic sentence?
6. Is a summarizing sentence needed?

After you have written the first draft, edit it with a good dictionary at hand, and perhaps even a book on grammar to resolve doubtful construction.

Read your manuscript several times. First read over the entire draft to get the "feel" of it. Does it tell a story simply and concisely? Cut and shorten where possible.

Read it over a second time, looking for bad sentences, lack of topic sentences, and errors in grammar. If time permits, put the manuscript out of sight for a day or two. Then read it a third time before letting it out of your hands.

Paying attention to rules of composition and grammar is not enough. The professional writer soon learns many things that are not taught in college composition courses. You, as a report writer, should practice them too. For example, have confidence in your writing. You cannot do anything well unless you have confidence in your ability. Also, you must show interest in your writing. A good report is the result of a lot of hard work—and enthusiasm. But most of all, you've got to write if you want to be good report writer. Writing is something that can be learned only through practice.

Reprinted from "Chemical and Engineering News"

STAFF AND DISTAFF

(continued from page 4)

new faces. Dave Stone is now a permanent guest. Yu Chu Chao, an exchange student from Formosa, is handling librarian duties. Bob Lamson and Dole Kelly are new staff writers. New faces and new ideas will keep the magazine moving at its fast pace. We welcome more of both.

The Next Issue

Look for a very interesting May issue. Paul Fryar and Ben Levine will co-edit this issue. Already planned are features on Lift-Slab construction, a modern method of building construction, and low-temperature evaporation, a process finding local application for concentrating fruit juices. The usual dull stuff such as the pin-up will be there too. A biography of Dean Vivian will be included. Our Dean has had a varied and colorful lifetime. Reading his biography will enlighten you on the reasons for his progressive thoughts on engineering education at SC.

An Important Correction

Kim Novak will not be seen in "Five Against the Wall" as stated in the December issue. She will, however, appear in "Five Against the House."

25¢

Richmond Station of the Philadelphia Electric Co.

Weeks of work shrink to days as

photography weighs mountains of coal

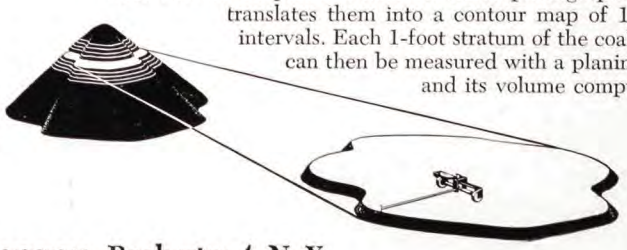
Aero Service Corporation takes stereo pictures of the coal piles at a utility's 10 storage sites—reports the fuel reserves on a single inventory date at 25% lower cost than with other methods

It used to take a surveying crew weeks to measure and figure the contents of the Philadelphia Electric Co.'s big coal piles. Now a camera and an airplane work together to cut the time to days. Overlapping pictures are taken from the air. Then with stereo plotting equipment the volume of the heap is calculated.

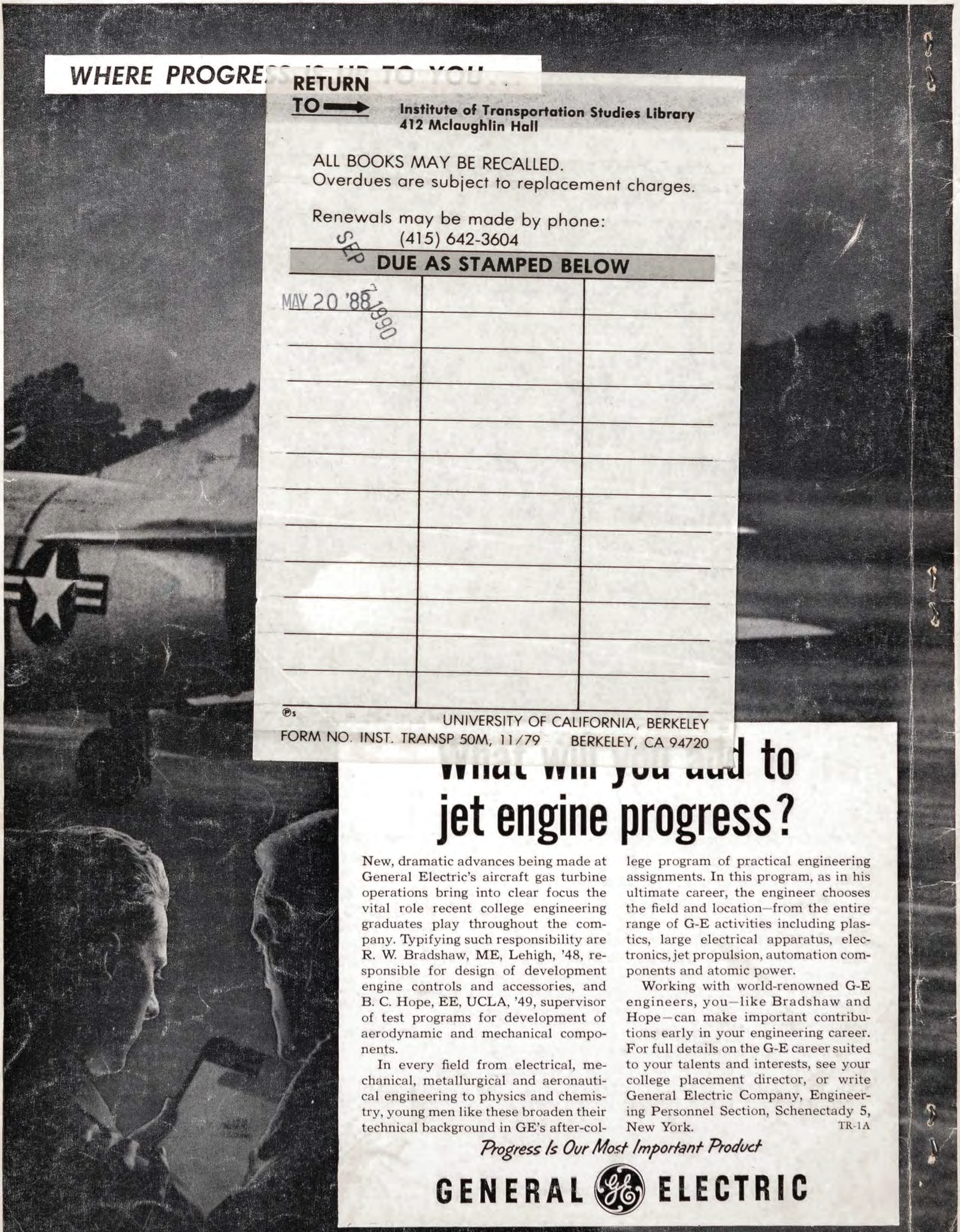
Streamlining the inventory job is a natural for photography. It's being used to count metal rods, automotive parts, telephone calls as well as tons of coal. But photography works for business in many other ways as well —saving time, reducing error, cutting costs, improving production.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning service man, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Aero Service Corporation takes its stereo photographs and translates them into a contour map of 1-foot intervals. Each 1-foot stratum of the coal pile can then be measured with a planimeter and its volume computed.



Eastman Kodak Company, Rochester 4, N. Y.



What will you add to jet engine progress?

New, dramatic advances being made at General Electric's aircraft gas turbine operations bring into clear focus the vital role recent college engineering graduates play throughout the company. Typifying such responsibility are R. W. Bradshaw, ME, Lehigh, '48, responsible for design of development engine controls and accessories, and B. C. Hope, EE, UCLA, '49, supervisor of test programs for development of aerodynamic and mechanical components.

In every field from electrical, mechanical, metallurgical and aeronautical engineering to physics and chemistry, young men like these broaden their technical background in GE's after-college program of practical engineering assignments. In this program, as in his ultimate career, the engineer chooses the field and location—from the entire range of G-E activities including plastics, large electrical apparatus, electronics, jet propulsion, automation components and atomic power.

Working with world-renowned G-E engineers, you—like Bradshaw and Hope—can make important contributions early in your engineering career. For full details on the G-E career suited to your talents and interests, see your college placement director, or write General Electric Company, Engineering Personnel Section, Schenectady 5, New York. TR-1A

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