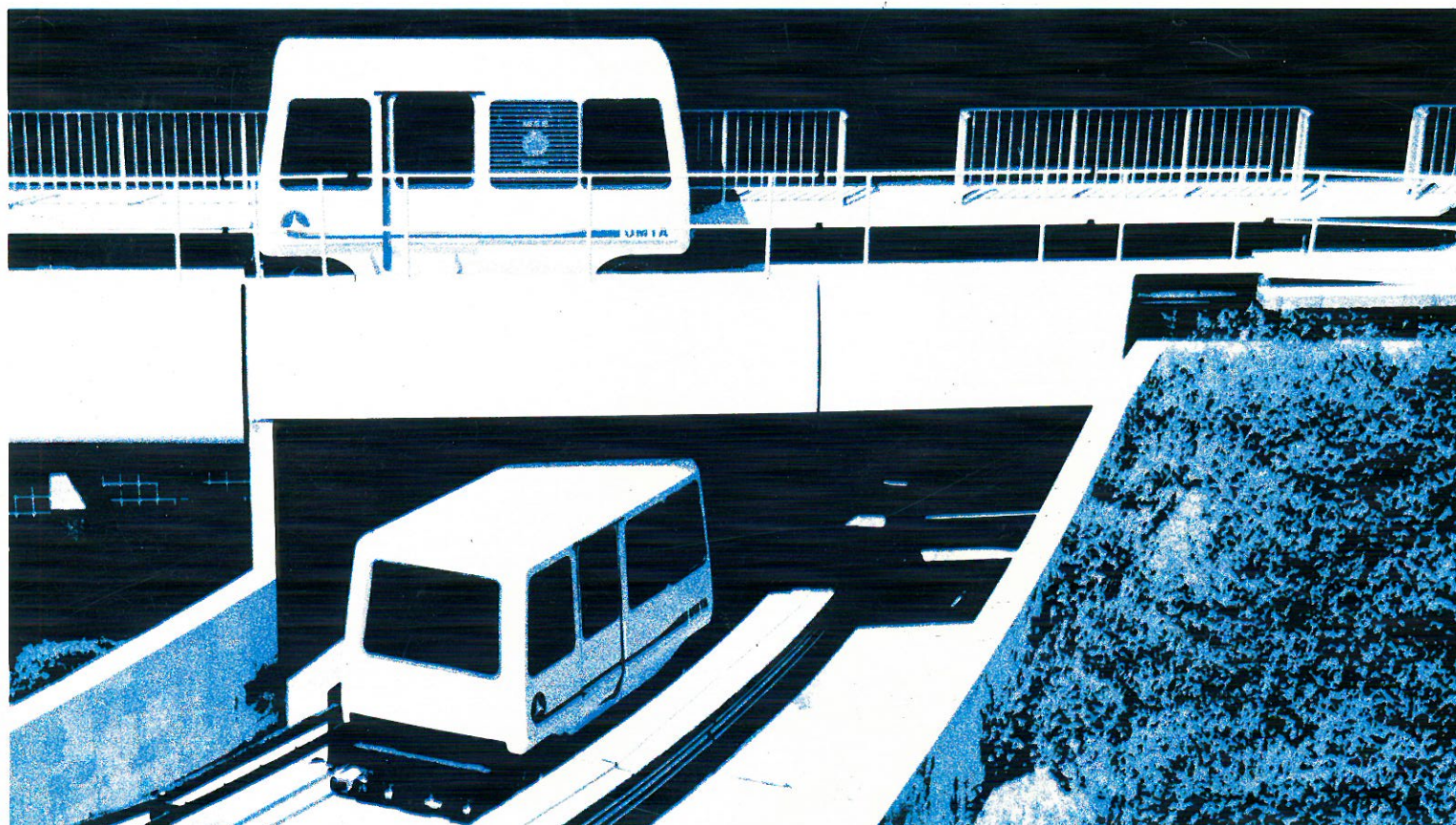


PRT

PERSONAL RAPID TRANSIT



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West Virginia University**

Samy E. G. Elias
Assistant to the President for Rapid Transit

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|----------------------|---------------------|
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The West Virginia University-Morgantown Personal Rapid Transit (PRT) System is the first of its kind in the world — one of the few fully automated mass transit systems that truly gives its passengers a ride into the future.

PRT is controlled by a system of computers with no vehicle operators or ticket takers. During rush hours, the cars leave the stations on a computer-arranged schedule. During off hours, they work just like an elevator — push the button and your personal car will arrive. And unlike your private car, PRT vehicles take care of themselves after you reach your destination.

The PRT story began in Morgantown — a town that rejected an east-west railroad in the 1840s because it was feared the trains would scare the cows. And it looks like the PRT idea will spread throughout the world. Transportation experts from 15 foreign countries have visited Morgantown to study the PRT System and a similar experimental system is being constructed in Japan. Several American cities are considering PRT-type systems.

The key problem for transportation in urban areas is the amount of time wasted. "Fifty years ago, you could travel in downtown Manhattan at about eleven miles an hour with a horse and buggy. Today during rush hours you are lucky to average seven miles an hour in a car," observed Samy E. G. Elias, chairman of WVU's Department of Industrial Engineering who conceived the PRT System.

In the mid-1960s, engineers and traffic experts began meeting and talking about new transit systems to alleviate such problems. Their meetings were made possible under the federal Urban Mass Transit Act of 1966, which funded a series of seminars for top management officials of rail and bus systems and transportation engineers. Two of the first

seminars were held at WVU in the summer of 1967 and attracted transportation experts from throughout the country.

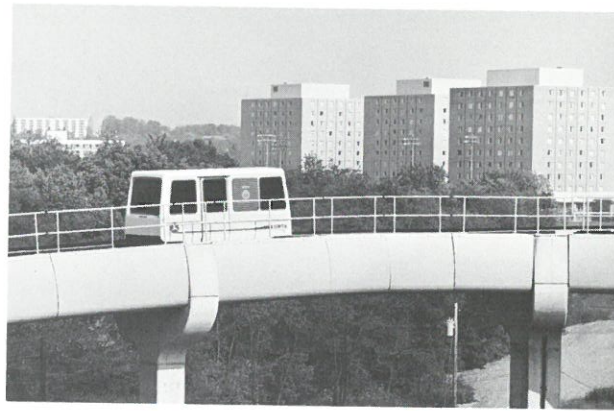
"The most important thing we did was talk," Dr. Elias recalled. "And it soon became clear that most engineers were interested in transit systems for large metropolitan areas or even on a national scale. The idea of a rapid transit system for small cities was discussed, but there wasn't much enthusiasm.

"Later, some of us at the WVU College of Engineering decided that a rapid transit system was going to be built in some small city sometime in the future — and that it might as well be Morgantown and it might as well be now. So we drafted a proposal and, through the efforts of Congressman Harley Staggers of West Virginia, we were able to present it personally to John Volpe, who was Secretary of Transportation at that time," Dr. Elias said.

The proposal was approved in July, 1969, and WVU was awarded a grant by the U. S. Department of Transportation to study the feasibility of constructing a rapid transit system in Morgantown. WVU also contributed funds for the study. The Department of Transportation increased its contributions so that three instead of two proposed systems could be evaluated. And in September, 1970, Secretary Volpe visited Morgantown and made an additional grant for a preliminary design study.

In April, 1971, contracts to build the PRT System were awarded by the Department of Transportation and ground-breaking ceremonies were held at WVU on October 9, 1971. Construction remained nearly on schedule through the winter and spring, and Phase I of the system was dedicated on October 24, 1972.





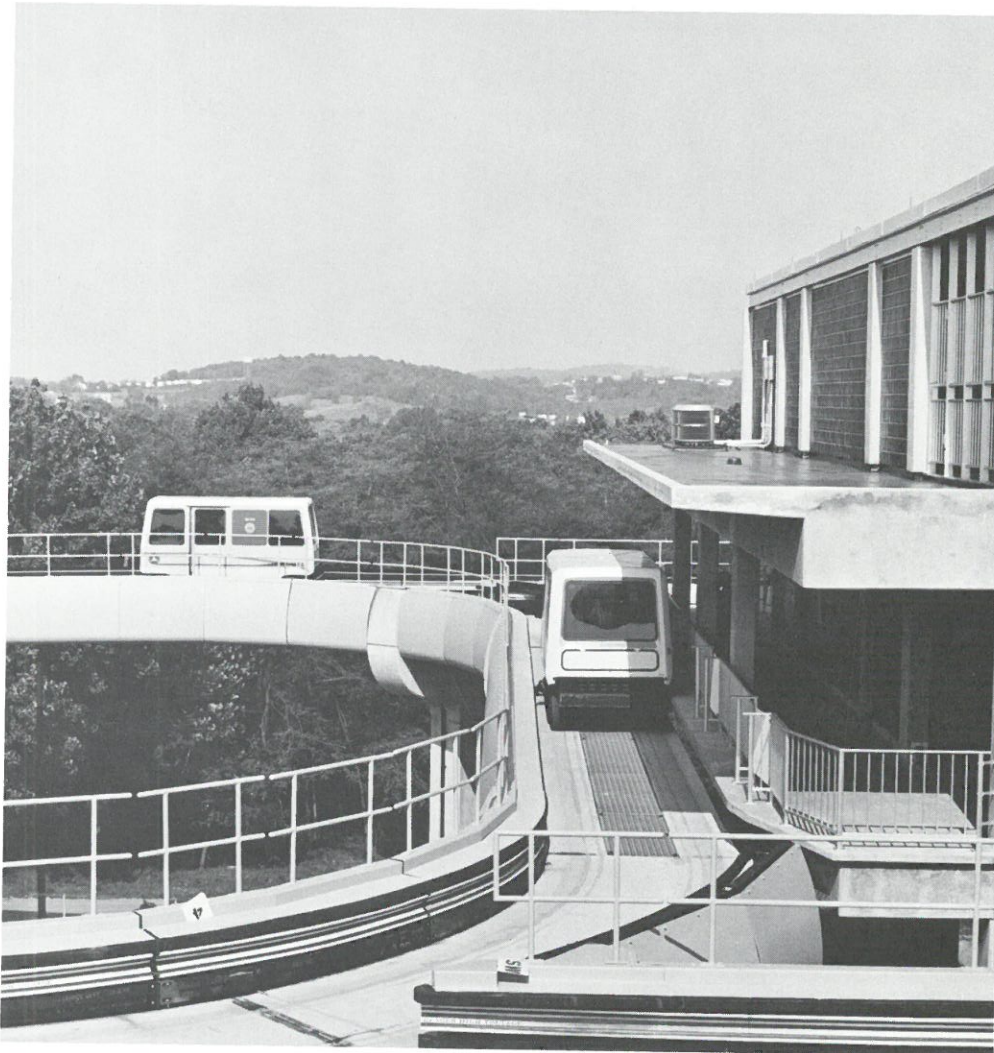
The purpose of the PRT System is twofold — to serve WVU's 17,000 students, 5,000 faculty and staff, and the people of Morgantown; and to serve as a national demonstration-research project.

WVU is spread over three campuses — they are only a few miles apart but they are separated enough to prevent students from walking between campuses to attend successive classes. To solve this problem, the University operates an inter-campus bus system, one of the largest in the nation. But the interval between classes still had to be increased from 10 to 20 minutes. Traffic jams won again so the interval between classes was changed back to 10 minutes and students were discouraged from scheduling successive classes on different campuses. The PRT System should alleviate this problem and thus greatly increase the choice of classes for many students.

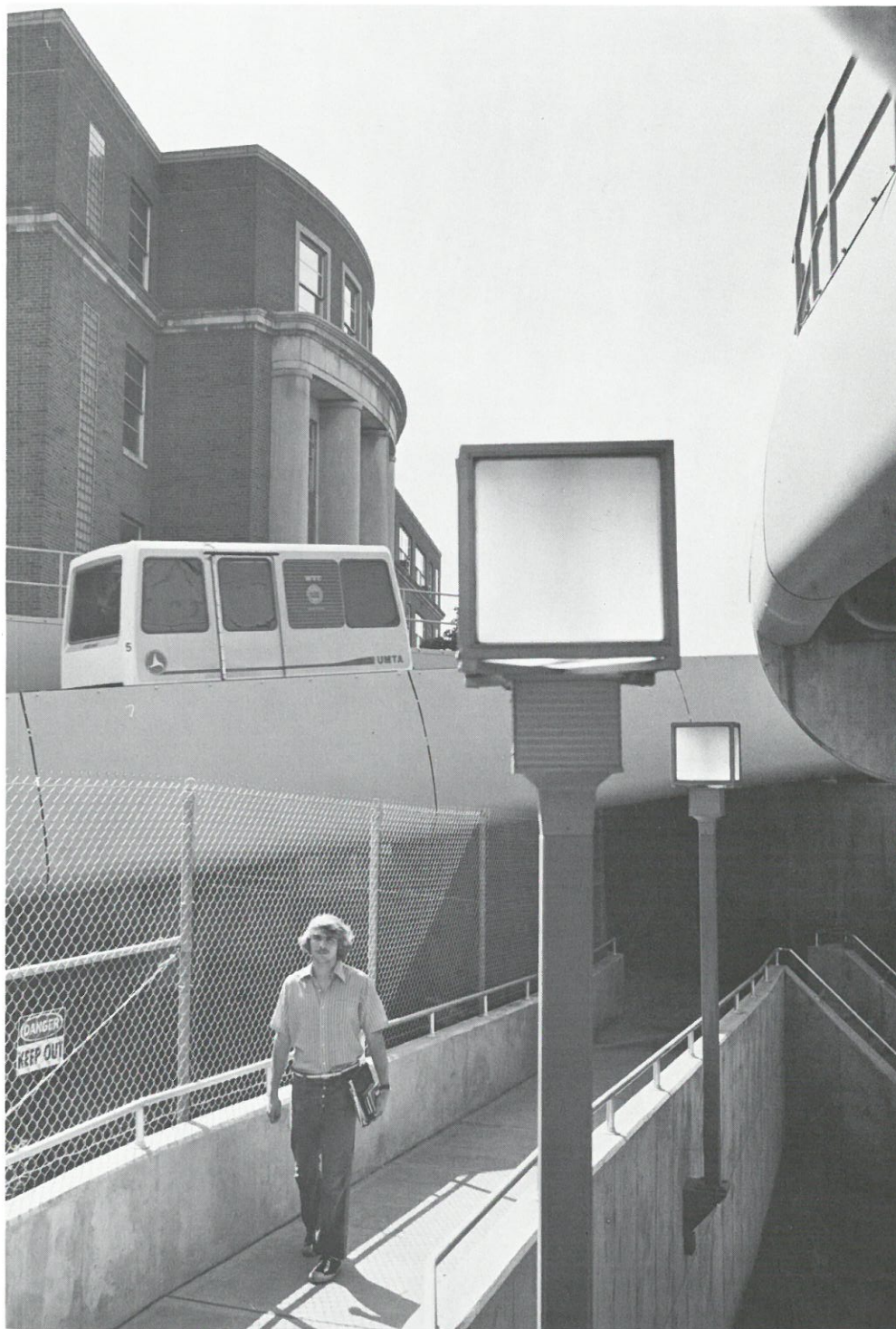
As a national demonstration-research project, the choice of Morgantown (population 37,000) was advantageous for several reasons. Because of students changing classes, there will be at least five peak demands for transportation a day. Normally, non-university cities only have morning and evening peak demands. This means researchers will obtain more data in a shorter time because of the greater variety of transportation demands.

The hills of Morgantown provide another advantage. If a rapid transit system can work on the Morgantown terrain, it can work in almost every other city in the country. Another advantage is the varied climate of the city, which has its share of ice, snow, rain, fog, and sunshine.

Upon completion of Phase II of the system, there will be six passenger stations, a maintenance facility and central control area, 9.4 miles of single lane guideways, and about 100 vehicles.







The three existing stations are in downtown Morgantown on Walnut Street behind the Monongalia County Courthouse, on the WVU Downtown Campus, and across from the Engineering Sciences Building on the Evansdale Campus. There are now 5.4 miles of single lane guideways and 45 vehicles.

The stations to be built in Phase II will be at the Coliseum, near Allen Hall on the Evansdale Campus, and at the Medical Center. The importance of Phase II to the viability of the system lies in the fact that there are 3,000 parking places near the proposed stations and more parking areas are planned. As conceived, ample parking and feeder bus lines are integral parts of the complete system.

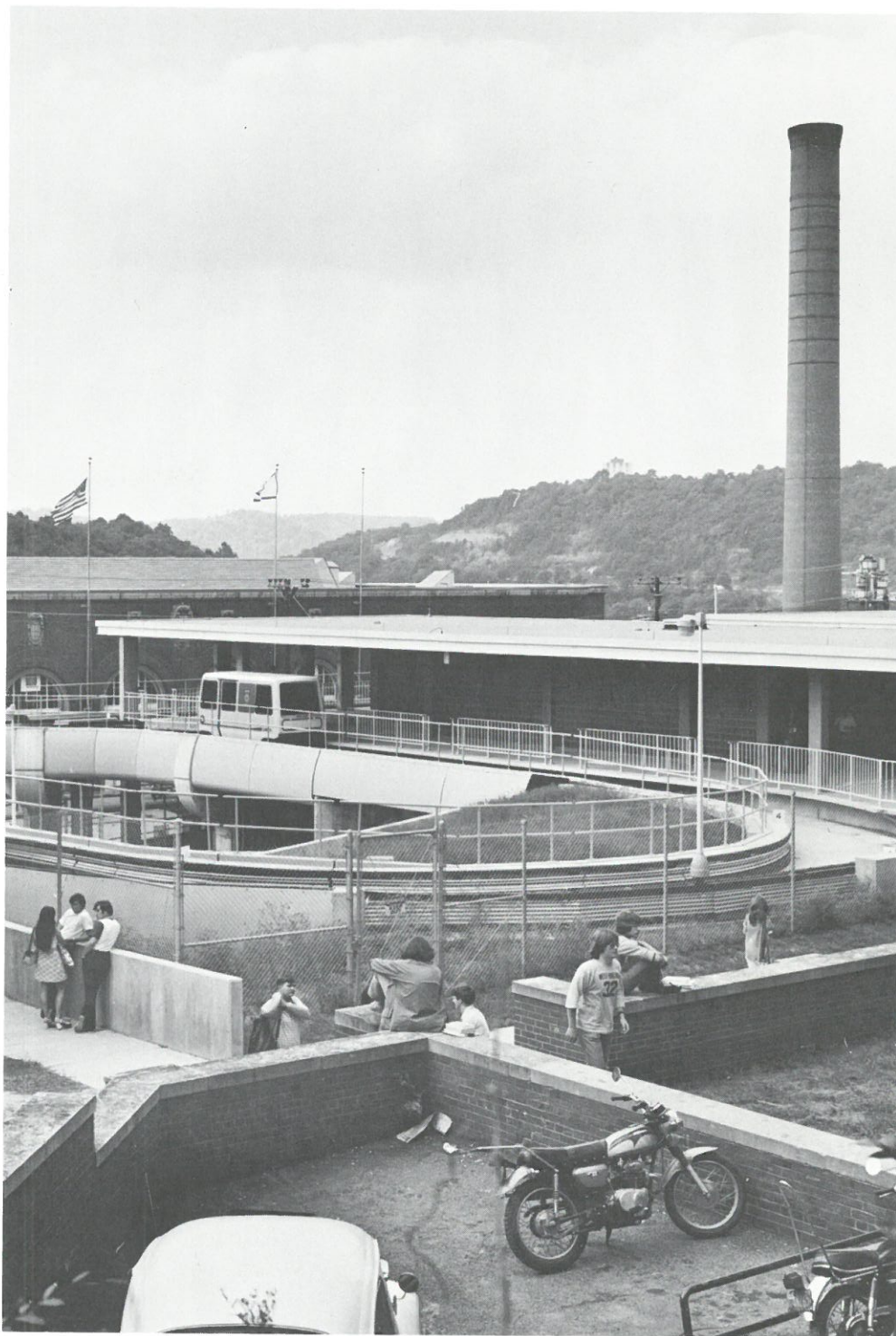
Approximate travel times between stations are: Walnut Street to Downtown Campus — two and a half minutes; Downtown Campus to Engineering Station — five minutes; Engineering Station to Coliseum — one and a half minutes; Coliseum to Allen Hall Station — two and a half minutes; Allen Hall Station to Medical Center — two and a half minutes.

Each vehicle can carry eight seated and twelve standing passengers and can travel at speeds of up to 30 miles per hour. The entire system will have a peak capacity of 1,100 passengers in 20 minutes. The vehicles can be spaced at a minimum of 15 seconds apart. The spacing and movement of the vehicles are controlled by a system of computers.

The vehicles run on four rubber-tired wheels and are propelled by electric motors. The dual guideways (one for each direction except at the stations) will facilitate movement and will increase safety. The safety factors built into the system are expected to prevent collision of vehicles.

The PRT System is a joint venture of federal, state, and local organizations. WVU through the West Virginia Board





of Regents, the State of West Virginia, the Monongalia County Court, and the City of Morgantown supplied the land for the stations and the guideways. And the U. S. Urban Mass Transportation Administration constructed Phase I of the system under its research and development program.

Phase I contracts totaled \$60 million, which included the cost of research, construction, and testing of the system with its 45 vehicles. Since the PRT System was the first of its kind involving a new technology, research and development accounted for about 40 percent of the \$60 million. If the research and development funds are removed, construction of the guideways and stations amounted to about half of the total cost.

The WVU inter-campus bus system is financed partly by fees collected from all students, and the same method is expected to be used in financing operation of the PRT. It is estimated that initially it will cost students about 10 to 20 cents a day for as many rides as they want. The same yearly or semester fee would be charged townspeople and University faculty and staff. Single tickets for occasional riders are expected to cost more.

Term passes and dispensing machines to sell single tickets are expected to reduce operating costs by eliminating offices at each station. They also will speed up service and eliminate the problem of handling large amounts of change. For football games and other popular events, special ticket sellers will be located at each station.

The single greatest problem with a mass transportation system is getting people to use it. The American Transit Association reports the number of riders on public transit systems in the United States has declined by at least 85 percent since the early 1950s. Such declines mean higher



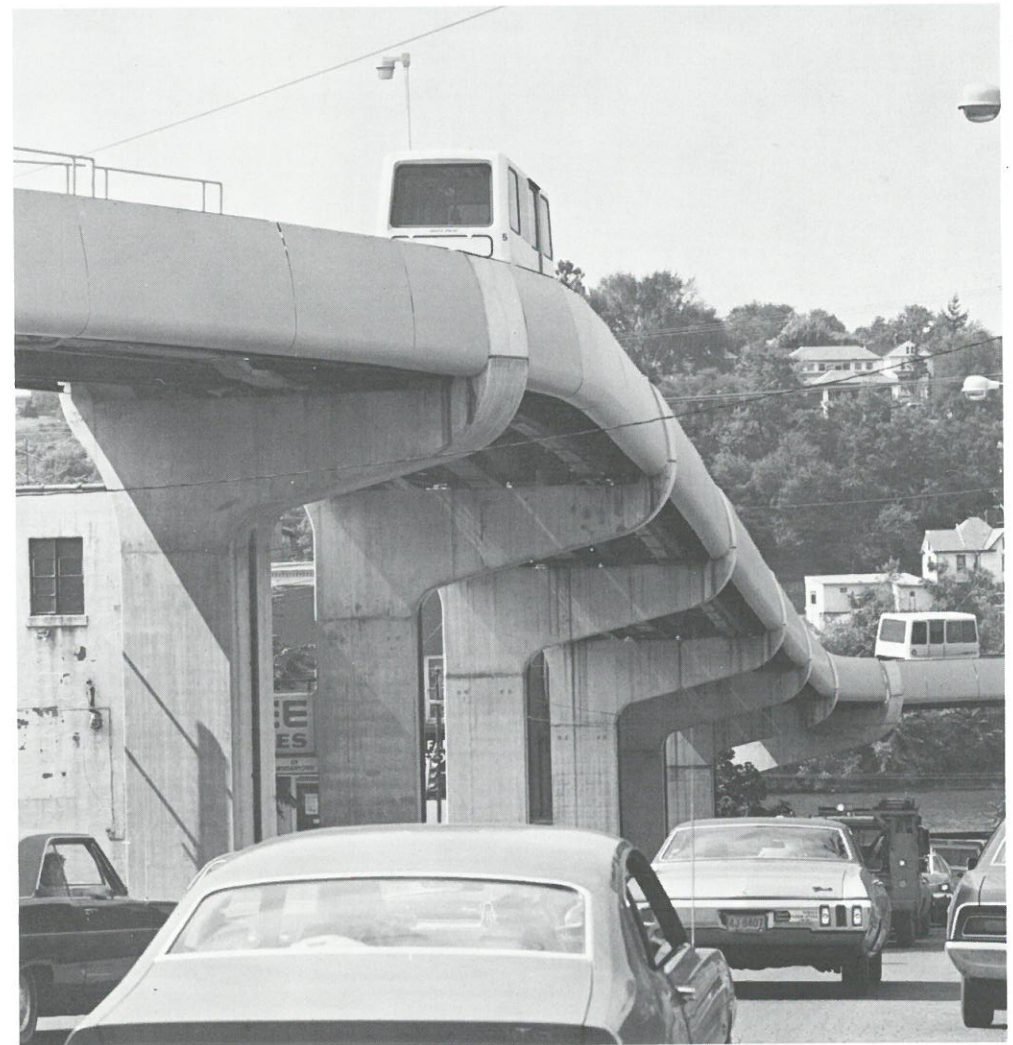
fares and poorer services. And higher fares and poorer services mean less passengers.

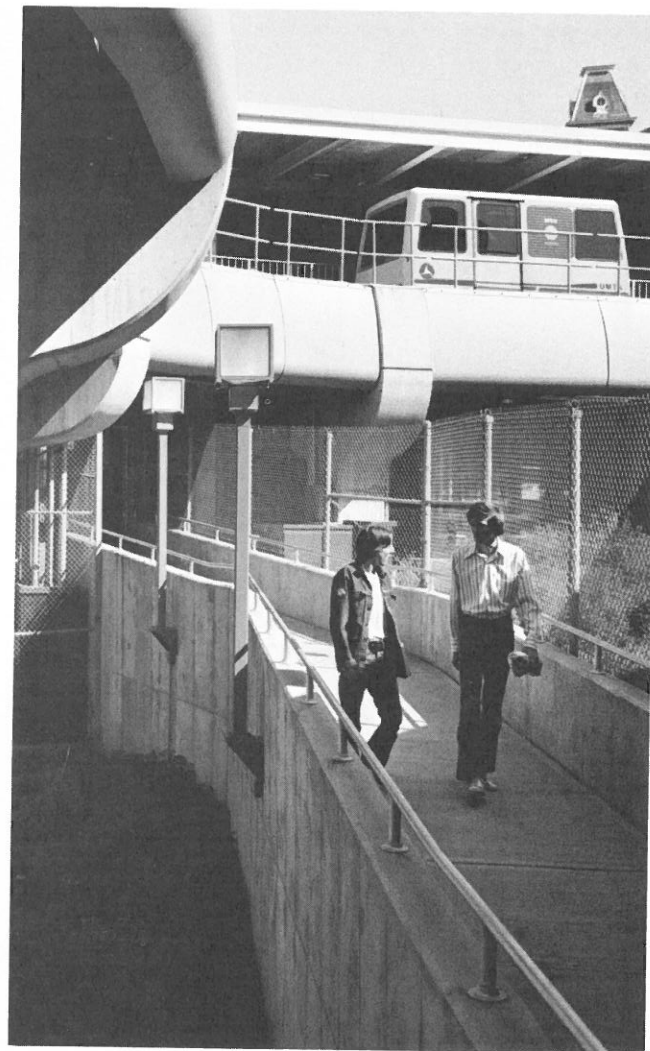
"Most people think public transportation is just fine — for the other fellow," Dr. Elias observed. "The private automobile, which was originally designed as a means of transportation, has in many areas become the greatest obstacle in getting from one place to another. A single person driving around at seven miles an hour in a six-passenger car, with an engine large enough to power a tank, is neither economically sound nor ecologically defensible.

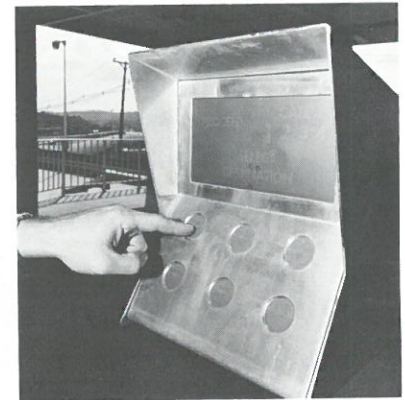
"However, despite this waste, the traffic jams, and lack of parking spaces, people in some areas have to use their private cars because there is no alternative. The PRT is going to give our students and the people of Morgantown an alternative," Dr. Elias said.

The first regular passengers are expected to ride the PRT in the fall of 1975.

Every aspect of the PRT's potential impact on the environment was considered during its planning. Only two houses and one business, a salvage yard, were removed in order to construct the system. This was accomplished by using existing rights-of-way along streets, a railroad, and undeveloped land owned by the University. The vehicles are powered by electric motors, which means air pollution is avoided. And noise pollution should be at a minimum because the vehicles run on rubber-tired wheels.







PRT Technical Data

System (complete)

| | |
|------------------------------|--|
| Peak capacity | 1,100 people in 20 minutes |
| Headway | 15 seconds |
| Vehicles | 100 |
| Stations | 6 |
| Guideways, length | 9.4 miles of single lane |
| Operational modes | scheduled (peak hours), demand (off hours) |
| Fees | |
| Semester pass | approximately 10 to 20 cents a day |
| Individual tokens | 25 cents a ride |
| Systems manager | The Boeing Company |
| Architecture and engineering | Frederic R. Harris, Inc. |

Guideways

| | |
|---------------|--|
| Type | elevated and at grade |
| Construction | reinforced concrete and steel |
| Maximum grade | 10 percent |
| Heating | ethylene glycol-water solution circulating in pipes in guideway base |

Vehicle

| | |
|----------------|-----------------------|
| Capacity | 8 seated, 12 standing |
| Top speed | 30 miles an hour |
| Body | Fiber glass |
| Weight | |
| Empty | 8,650 lbs. |
| Maximum load | 11,700 lbs. |
| Length | 15.5 feet |
| Width | 6 feet |
| Turning radius | 30 feet |
| Steering | 4-wheel |
| Suspension | air bag |
| Power | 575 volts, 3 phase |
| Drive motor | 60 hp, dc |

Controls

| | |
|---------------------|---|
| Computers | PDP-11 (Digital Equipment Corp.) |
| Accident prevention | |
| Type | fail-safe with independent collision avoidance system |
| Data transmission | low frequency transceivers with loop antennae imbedded in guideway and mounted on vehicle |



When Samy E. G. Elias first drove into Morgantown with his family to report for work at West Virginia University, he was in a hurry to settle down. Unfortunately, it took him almost an hour to drive through downtown traffic. At first he thought he had hit an unusual traffic jam; later he learned this was the normal state of affairs.

What Morgantown needs — and other small cities as well — is a rapid transit system with parking lots near each terminal, Dr. Elias concluded. Fortunately, Dr. Elias, who is chairman of West Virginia University's Department of Industrial Engineering, was in a position to put his idea into action.

The idea is now the WVU-Morgantown Personal Rapid Transit (PRT) System, and Dr. Elias serves as assistant to WVU President James G. Harlow for the project.

Dr. Elias came to the U. S. from Egypt in 1956. Since then more than one of his ideas have been put into practice. His techniques for using computers to schedule buses were considered a breakthrough in urban transportation and are being used in several cities.

He also has developed an automatic monitoring device to determine the location of buses in a system and the number of passengers each is carrying. When coupled to a suitable computer, the devices enable almost instantaneous rescheduling of buses on a particular route. Five of these devices were tested by the New York Transit Authority.

Dr. Elias received his bachelor's degree in aerospace engineering from Cairo University, his master's degree from Texas A&M University, and his doctorate from Oklahoma State University. He joined the WVU faculty in 1965, and he was named chairman of the Department of Industrial Engineering in the College of Engineering in 1969.

Half of the nation's population lives within 500 miles of Morgantown, the home of West Virginia University. Morgantown is on the Monongahela River, about 70 miles south of Pittsburgh, Pa. It is at the intersection of Interstate 79, which runs north and south, and Corridor E of the Appalachian Development Highway System.

One of the fastest growing areas of West Virginia, greater Morgantown has a population of 37,000. The area's largest employer is WVU, which has a faculty and staff of 5,000 and a student body of 17,000.

Major industries in the area are coal mining, fine glassware, chemicals, and the manufacture of plumbing fixtures. An airport and two railroads add to the transportation facilities provided by the river and the highway system.

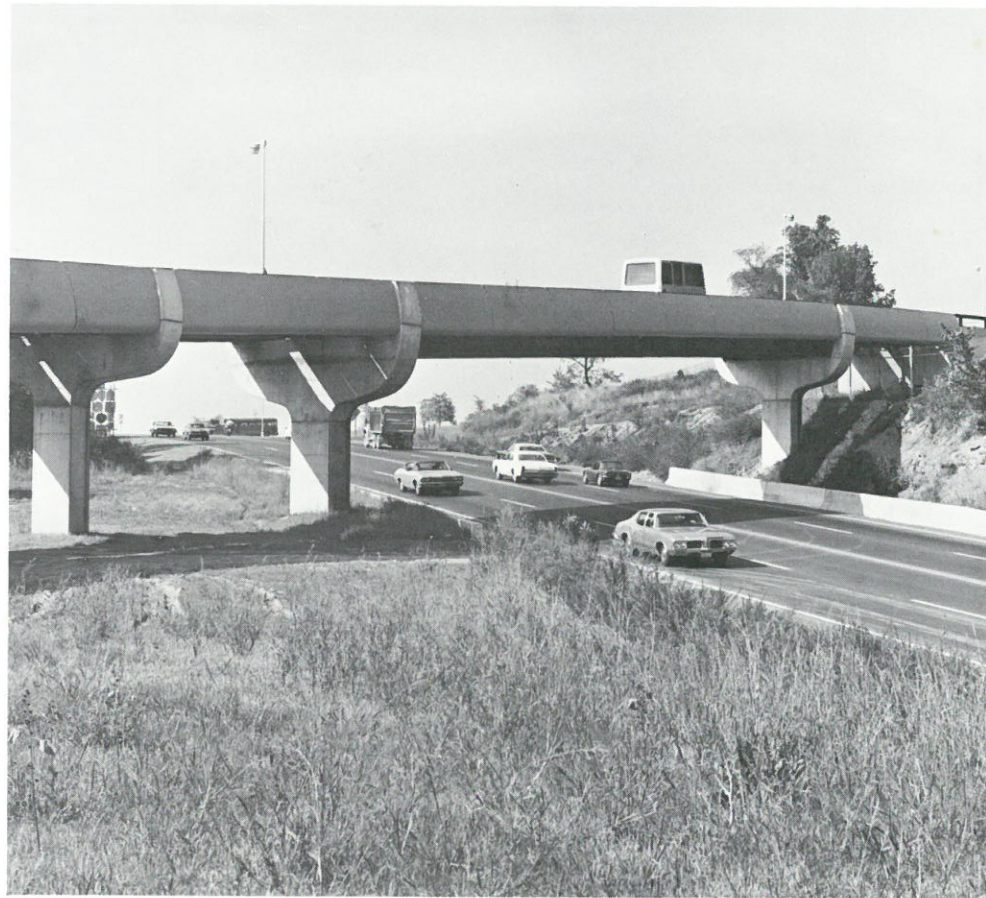
Besides WVU's extensive research facilities, Morgantown is the home of the U. S. Appalachian Center for Occupational Safety and Health, the U. S. Bureau of Mines' Energy Research Center, the U. S. Forestry Sciences Laboratory, the Robert F. Kennedy Youth Center of the U. S. Bureau of Prisons, the West Virginia Geological and Economic Survey, and the West Virginia headquarters of the U. S. Soil Conservation Service and the U. S. Farmers Home Administration. The American Association of Cost Engineers also has its headquarters in Morgantown.

KEY

- Existing System
- - - Proposed Phase II
- ① Walnut Station
- ② Downtown Campus Station
- ③ Control/Maintenance
- ④ Engineering Station
- ⑤ Coliseum Station
- ⑥ Evansdale Station
- ⑦ Medical Center Station



In 1972, the PRT System received two national awards. The National Society of Professional Engineers named the PRT System as one of the nation's top ten outstanding engineering achievements of the year and the PRT guideway across Monongahela Boulevard (right) was cited as one of the 18 most beautiful new steel bridges to be built. The PRT System was designed by Frederic R. Harris, Inc., of Stamford, Conn.





PERSONAL RAPID TRANSIT
