

E.W. James on Designating the Federal-Aid System and Developing the U.S. Numbered Highway Plan

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Frederick W. Cron, an engineer with the U.S. Bureau of Public Roads (BPR) from 1928 to 1969, was also a highway historian. While working on an article about the numbering of America's main highways, he contacted a former BPR coworker and friend, E. W. James. The following is Mr. James' response, which covers the numbering of highways, designation of the original Federal-aid system, and other topics. Mr. Cron's article, "Touring by Numbers-Why and How," appeared in *Public Works*, February 1968.

Washington, Feb. 21, 1967

My dear Cron,

I have made an unconscionable delay in replying to the direct inquiry of your letter of Jan. 19, a letter which I really welcomed because of the particular inquiry it carried. It was welcome because for the first time [since] it has occurred, it gives me a chance to tell of many of the administrative devices and patterns that we developed at the start of Federal Aid Roads to meet, defeat, correct and defend many of the conditions which faced us or were produced by the F.A. system itself.

At 90 years I am still good above the neck; but this cannot safely be assumed to be an everlasting condition. And when my memory fails, on many details source material will have vanished. For there are few living now of those who worked with me in those days through the teens of the 20th century, and practically none of the older ones who played any parts of importance. So at the start I must be somewhat personal in order to establish why I was so often Johnny-on-the-Spot and became so widely, variously and effectively involved in the early administration of Federal Aid Roads.

In 1910 Charlie Moorefield and I were the only new full trained road engineers who came into the B.P.R. (under a different title then). There were some cubs who came in later, and in 1912--13-14 a handful of all ratings. In 1910 I had already had 2-1/2 years in the Philippines Bureau of Public Works, and six months with U.S. Engineer Corps on the Intracoastal Canal, Narragansett District. In the Islands I had reached District Engineer rating and had 2 provinces about the total size of Connecticut, with all classes of public works including even well drilling for potable water supply. So in practical experience I was rated a little above Moorefield, and that was the single chance that got me geared into the Fed. Aid machine so intimately at the start.

It was in 1912 that I learned that something tremendously big in the engineering and administrative line was in the making. At that time the U.S., road-wise was still in the mud. The B.P.R. since 1896 had been building demonstration roads, mostly of "sand-clay" to interest and encourage people, mostly farmers. As late as the 2d F.A. Act [counting the experimental program, he's referring to the 1916 Act] only 11 states, as I recall had highway departments. New [sic] was indeed still in the mud. To contemplate such a program and national project as Federal Aid has become was almost beyond reason. Actually, whoever was originally responsible for the concept produced eventually the greatest engineering program under a single cover that the world has ever known, and it is still under way after 54 years.

It started really with the Post Road Act of 1912 [Post Office Appropriation Act of 1913, approved August 24, 1912]. I chanced to be handy and asked to sit in (and say nothing) at an informal meeting in [Director Logan] Page's office with Page, [J. E.] Pennypacker [Chief of Road Economics, U.S. Office of Public Roads], his man Friday, George Coleman, Va., and Henry Shirley, Md. The purpose was a completely informal discussion of how to use the Post Road Act, and I

learned, which few persons then knew, that that small tentative tryout was really to determine and advise Congress in a final report what optional national jurisdictional area should be considered most feasible, practical, and generally best to cooperate with the Federal Government in some huge plan for joint construction of roads.

At that time I think no one in the group had a clear idea of the possible magnitude of the concept or the program they were discussing off hand. They talked of counties, Congressional Districts, Improvement Districts of all kinds; levies, drainage, road, etc., and of course the States. I blurted out that we already knew that nothing less than a State should be considered. I think it was Pennypacker who seemed to incline toward Congressional Districts because he was thinking in terms of a pork-barrel distribution of funds that would almost certainly be in the final program. I think my butting in was in a way my undoing and my chance. From then on in that conference, and depending on my common sense and no real knowledge of what really was coming on the wind, I argued States of course, and we ended up agreeing that we all knew the answer that the Post Road Exploratory work should produce. Next to the States, then 48, came counties (3,000 \pm) not administratively feasible; Congressional Districts (475 \pm) open to 475 fights over pork-barrel funds; Improvement Districts; ad infinitum; indefinite, too varied, and impermanent.

There were many other conferences of the brass hats. Others were drawn in for good or better ideas; A. B. Fletcher (Cal.), A.L. Johnson (Ill.), Hathaway (?), Greene (N.Y.), Pratt (N. Car.), and no doubt others. I sat in at none of these talks which were held in Washington, Atlanta, etc., and did not know what big plans were in the making, until Page put me in charge of the Post Road Act administration.

Under that Act we built exploratory roads in Maine, Maryland, Virginia, Ohio, Kentucky, Tennessee, Minnesota, and Texas. Beyond that list my memory revolts. We cooperated with States, counties and one or two Improvement Districts. But the bigger concept was moving ahead, and Congress did not await our final Post Road Act report, but on oral advice I suppose, passed the first Federal Aid Act. They later got a Post Road Report confirming their wise choice of the States as the administrative agents to cooperate henceforth with the Federal Government in what developed as the hugest program of public works and road construction that the world has ever seen.

The first Federal Aid Act provided for no system of roads, set no definite standards of design and construction, set forth no specifications, and was virtually wide open at both ends. A. B. Fletcher complained that the B.P.R. was building up a mass of red tape.

Wednesday, March 1, 1967.

At this point I must deviate somewhat to maintain my connection with the early work and show how suddenly I came into the top picture of administration under the Federal Aid laws.

The conditions indicated above caused me to think of many things that no one else apparently gave much thought to. I could see what was sure to happen unless deliberate steps were taken to prevent. Reviewing projects, filing, handling, and referring to filed material were in my mind. We were getting plans in hard rolls 3 feet long; corresponding profiles in equally tight rolls 12 inches long. Some plans came flat with left and right folds so they could be opened like pages of a book, if you could find a place in the office where you could lay them down.

If Fletcher was having complaints, we certainly were having our troubles. Specifications were really in worse shape. They came on typed sheets, mimeographed, paper pamphlets, bound volumes. A few were indexed; most were not. If you looked for a specific requirement, you seldom could find it without thumbing through scores of pages.

Now, just before Page was selected, stepped up, and was appointed to the B.P.R. (then by a different name), he had been testing engineer for the Massachusetts Highway Department of which Fletcher was one of the original members, I think. The two had worked together for some years, and Page was a great admirer of Fletcher. So when the incoming letters from California indicated a good timing and a hint from Fletcher, I took up the whole matter of standard plans and specifications with Page and used the implied suggestions of Fletcher as a lever. Of course the first reaction was NO! Forty-eight States were too jealous of their own ideas to permit the B.P.R. to interfere in any such way. I argued

and explained how I thought it could be done with common sense, which would appeal to the States. He finally said to go ahead and give him detailed suggestions.

I at once went to New York to see my friend, Dr. Agnew, at the Engineering Building, then on 39th Street, where he was Executive Secretary of the American Standards Association. Up to that time he had been getting lots of good advertising but little practical introduction of his many proposed standards into industry. It was then War Time, and minds were on other matters. When I laid my problem of paper before him he greeted me joyfully. Here was a case where a successful standard could be put to possible wide practical use at once. I explained that my problem ran from drawing paper, through tracing cloth, to blue print paper and printing and drying machines. Everything must fit with the least changes and greatest economy possible. Our contacts ended in the standards of drawing papers, tracing sheets and blue printing with a minimum of waste at any point in the use of the standard sizes. Everything fitted. I saw Muth & Co., our local Washington representative of Kenffel & Esser. A man came down from the head office and agreed to make plates for the standard tracing sheets, with borders laid on, square block for title, all needed profile ruling for sheets half line and half matching profile, or 2/3 line and 1/3 profile, etc. As you probably know, we used those standards for years and may do so still. All this took months, for I am skipping, but it was finally worked out.

In specifications I had a happy thought, and wrote my idea of standards in just four lines:

1. Description of work.
2. Material specifications.
3. Methods of construction.
4. Basis of Payment.

This was an outline and a frame for specifications. What the States filled was their business; but we made it plain that if we didn't have what we wanted in its proper place, we would assume it lacking and come back at them.

All this I took from time to time as Agnew and I worked together, and Page approved.

In the meantime the second Federal Aid Law [1921] came along, and I was on the spot time and time again to consider the new puzzles of administration and make suggestions. The new Law established the now famous Seven Percent Road System, and we had to revise the Rules and Regulations. I think the old committee headed by M. Coffee, Solicitor of the Department of Agriculture, which had drafted the original Rules and Regulations, had dissolved long before this, but my memory fails me on this detail. In any case the new draft included the standards of plans and specifications and that operation was closed.

The new law prescribing the Seven Percent System did so in language that permitted cooperation on not to exceed seven percent of the certified mileage of public roads in each State, the roads selected to be connected and correlated. This provision raises at once two questions; and later several others.

1. Why 7 percent?

I have never had a better explanation than that of [William Colfax] Markham, [Executive] Secretary for years of the [American] Association of State Highway Officials. Of course, 5 percent or 10 percent would have been a more natural figure, but why 7 percent? As Markham explained: Senators [Tasker L.] Oddie of Nevada, long gone, and Carl Hayden of Arizona, still on duty at 88 years plus or minus, were both strongly interested and concerned in the whole Federal Aid Road program. They wanted to be sure that their States would have at least two cross State roads, based on their certified public road mileage, one say east and west and one at approximate right angles north and south. Using undoubtedly incorrect or questionable mileage, they figured that 7 percent was the lowest fraction that would give them what they wanted and figured they needed. So they saw to it that 7 percent was written into the law. That's that. Whether Markham was right, I cannot say.

2. Connected and correlated.

With the 7 percent providing, as assumed, four points on the boundary of each, Nevada and Arizona cannot take the connecting roads on a 7 percent system that California, Utah, Idaho, and New Mexico can deliver. So that's that. As far as I know, no criticism has ever been based on this mathematical impasse. In fact, the 7 percent is so flexible that it need cause no alarm administratively now. No State except Maryland selected at the start the full 7 percent permitted; and the law permits one percent additional each year after the first 7 percent are constructed. Maryland has used this privilege.

The creation of the 7 percent connected road system raised, however, a much more puzzling and disturbing problem. How was the 7 percent, assumably of the most importance in each State, to be selected? The possible contentions of cities, county seats, counties, Congressional Districts, etc., came at once into this problem in a large way. Could a method of selection be devised that would be feasible, permitting a flexible selection by each State that would be practicably invulnerable? That was the question put to me.

Page had died in the late summer or early fall of 1918 [December 9, 1918]. Captain P. St.J. Wilson and I carried on until MacDonald came into the B.P.R. as Director in April 1919. By that time I had an answer ready. I told him what I proposed and asked for a small committee to assist me, men of my own selection. He told me to go ahead, as he did frequently on many matters during the next 34 years, when I retired, October 31, 1953 and he had already gone. I selected Bob Eastham of Virginia, and Shoemaker, then, I think head of the Omaha District office.

We first selected from the Post Office Department the only complete uniform set of State maps showing only county outlines. The Post Office used them I think for laying out R.F.D. routes in counties. From the Census Bureau we got population; agricultural produce in dollars; manufacturer's, mineral, and forest products also in dollars and by counties. We laid the quantities out for each of the five items, each on a separate set of maps, in each State and in each county of each State. Calling the total State population 100, we determined the population index for each county. This process was repeated for each of the five significant items. We then combined the indices for all items by counties in each State giving a total of 500. We then divided the combined county indices by 5, bringing the total index figure back to 100 with a single county index representing the importance of that county in the State as a whole.

We reduced these county indices first to circles, which were not distinguishable enough, so we adopted squares as emblems of the indices. When these squares, blackened in, were put into their appropriate counties on a clean map, we had a series of emblems through which diagrammatic routes could be laid out. Routes through the heaviest emblems were routes through the generally wealthiest and all around most important county areas. Road locations could be made catching obvious local control points along these diagrammatic lines, and you had a selection from best to poorest almost staring you in the face.

When Congressmen came in later complaining at their State's choice, we had the answer always ready. His change for better or worse according to index maps. Usually they learned to leave us alone, so completely did the scheme work.

Finally, to justify the entire system as selected, I called on Fred Mills, one of my handiest assistants. He was not a trained engineer but was a very good workman. He had been trained in sail as a midshipman in the Cunard service. He had worked under U.S. Admiral Walker, the first U.S. head of the Panama Canal work. Walker didn't know one end of the Canal job from the other, incidentally. But Mills had done weeks and months of stream gauging in the Chagres Valley and knew his way in engineering for my job. I told him I wanted to find the centroid of the Federal Aid system so far as selected. He wanted to know what I was going to do with it. I told him I would let him know later after he found it.

He went to work, using an origin of some plain and simple location off the California coast. When he came back some days later I asked about his method. He said many western States were easy enough. He drew two long diagonals and used the intersection as State centroid. States like Wyoming, Colorado, Kansas, the Dakotas, etc., were of this class. Then he computed the cadastral distance to the assumed origin and multiplied the State mileage of selected routes by the distance. I asked what he had done about Idaho, Delaware and Florida. He ducked his head and said he had spun them on a pin. He had in fact drawn two long diagonals, used the intersection as a tentative centroid, spun a cardboard cut out of the State on a pin. When it stopped the heavy end was down. He drew a vertical line through the

pin hole, moved the pin down a little, spun it again, and so by trial and error found an approximate centroid for these very irregular States. When he had all his arms calculated and had the entire total around the origin, he divided, of course, by the total road mile and got an arm for a general centroid and placed [sic]. I asked him where it fell, and he replied that I couldn't guess. Then he told me that the general centroid of the whole system was in the same county in Indiana (I think) where the Census Bureau computed the center of national population to lie.

This trick confirmed that our road system was distributed to conform to population distribution as closely as any one could reasonably ask, and vindicated a great deal of our careful and thoughtful methods of work.

At this point we have developed a method for establishing a satisfactory pattern for a nation-wide road system. The provision of law controlling the distribution of funds mathematically among the States, staved off the Pork-Barrel vultures in Congress. Our system of indices establishing essential degrees of importance of principal roads in all States and Congressional Districts within each State kept the vultures away locally. Our somewhat doubtful, but impressive scheme, for justifying the whole pattern to date was satisfactorily effective. The years of subsequent clean and smooth operation proves all of this. Standards had been created as needed to permit good administration and for years we have had it to the great credit of Chief MacDonald and the B.P.R. Staff.

With this momentous road system planned and ready for construction, how were we to handle it as a going project? Its parts, as I had early assumed and provided for, were to be numerous, in high figures. The parts must be labeled or distinguished in some way so they could be handled conveniently and filed, yes; but in addition they must be named somehow so the public could see them, on records, maps, and in place on the ground.

At this point my memory fails me. There are too many details. I know how we got where we were going, but the multitude of resulting detail is beyond my coverage. I must suggest that somewhere, somehow, you get a copy of a report entitled: *Report of Joint Board on Interstate Highways* [October 30, 1925]

In this report you will find clearly indicated the routes resulting from the Board work. I was secretary of the Board and most of the details passed through my hands at one time or another. At one of the first meetings the general question presented above was thrown into my lap. I knew it must come sooner or later and had given it considerable thought. You will quickly see on scanning the report the conditions we faced in the particular task laid before us. There were two conditions that must be met. (1) The scores of named routes, roads and trails must be eliminated. Such a method of designating so large a system of roads on a fairly established pattern was not feasible. It was too cumbersome, it had a bad background of unintelligent but kindly, serious and friendly efforts by hundreds, maybe thousands of good road advocates and effective road boosters. In opposing such a group we were pushing aside some of the biggest and best support we had for the big road plan. The good would have to go with the bad. Organizations like the Lincoln Highway, the Dixie Highway, the Old Spanish Trail Associations which were sound agencies could not be reserved while three or four score "skip-by-night" agencies were to be ignored and washed out. (2) The second puzzle in the task at hand was to devise a scheme that would take up all the named routes we wished to save, in whole or in part; be flexible enough to permit expansion over a long period, and above all fit the United States as an area without an established road system of old, and now about to create one on a magnificent plan.

When this task was put into my lap, I was instructed to confer with A. B. Fletcher, then of California, who apparently had some good ideas for the job in hand. This "Committee of Two" did not last long. Mr. Fletcher asked me to his office at once and showed me his big idea. It would be the longest single road in the world. It could be numbered No. 1 and was laid out on a U.S. map he had on his desk, from a point, Seattle or Portland, away up in the north west to Key West below the tip of Florida. It would be the greatest road in the world! As I listened and looked, I first wondered where No. 2 road would be laid, and where Nos. 5, 10, 50 and 100? A road map of such a system would be a map of chaos, not of roads. I saw at once that Mr. Fletcher and I were not thinking along the same lines, and I saw that I had better go it alone.

By that time I had my idea of the second task under control, and with Fletcher of little help I saw that I must show my hand at once, and have so good a solution that it would carry me past the first task of shoving the trail organizations aside.

So I went ahead on that basis. As you know, the U.S. is about twice as wide as it is from North to South, and with this I saw a complete pattern of just what I wished. It stares one in the face, it is so simple and so adjustable. With north-south roads numbered odd from east to west, and east-west roads numbering even from north to south, you at once start a simple, systematic, complete, expansible pattern for a long time development.

Numbered on the 10's; 10, 20, 30, etc., to 90 would provide nine principal east-west routes. Numbered on the 11's and 5's; 1, 5, 11, 15, etc., to 101 on the Pacific Coast, you would provide the 20 base routes for the north-south pattern.

With this pattern complete in my mind I had two approaches that I hoped would take the whole job off the slate at once: Paul Sargent, of Maine, and the Lincoln Highway Association. I had been helpful to the Association in the First World War, and Sargent had been Assistant Director of the B.P.R. from 1913 to Page's death in 1918, and I had done an assignment in Maine for him during that interval, and knew him well and his background.

So I got at once in touch with Sargent on my proposed numbering scheme, putting pressure on my proposed Route No. 1, which I suggested as the first route along the Atlantic side of the U.S.A., following as far as possible the old, historic Falls Line roads. As soon as I mentioned the Falls Line Route Sargent said he was with the whole idea, and that the Falls Line Route really began up in Maine, at Fort Kent and the Canadian border. It was fairly distinct to Boston and Providence, where it headed Narraganset Bay; somewhat indistinct to New York, and then along the River Falls Line to Augusta, Georgia. At Trenton the falls of the Delaware, at Conowing the falls of the Susquehanna, at Georgetown (Washington) the Potomac falls, at Frederick, Virginia, the Rappahannock, at Richmond, the James, at Petersburg, the Appomattox, at Roanoke, N.C., the Blackwater, at Camden, the Santee, and finally at Augusta, Ga., the falls of the Savannah. At that point the coastal plain becomes so broad and flat that the falls line disappears and at Jacksonville, Florida the road follows the coast, now, to Key West. Sargent knew his colonial geography and said he was with my proposals all the way.

Having assisted the Lincoln Highway Association in the First World War, I next went to Detroit to their headquarters and laid my scheme before them, very frankly telling them that it would mean the end of the Lincoln Highway Association, the Dixie, and all others. They understood it all; said they were for a big plan for roads across the U.S.; would be with my scheme if I would give the Lincoln Highway recognition so far as possible in the No. 30. I agreed to do all I could to put it across, and so had their support toward washing out all the named routes. They were the strongest of all the Associations and with them with us, who could be against us?

So I built the numbering plan on the lines I had laid out. The two puzzles were answered by that scheme and is set forth in the Report you should have a copy of somewhere. The Board accepted my numbering plan as presented.

The next job was to determine designs for signs, signals, and markers. At a Board meeting I was sitting at the side of Frank Rogers of Michigan. As we discussed a possible distinctive and unique marker for all the Federal Aid System, he doodled and produced a sort of shield. He handed it to me. I think I improved on his design by drawing a picture of our present shield. He took it back, presented it to the Board as just what was wanted, and that was that.

Other caution and danger signs were discussed but the end was near. Again they threw the thing at me, and I had a wonderful committee to assist me. I wanted to open the huge sign market in sight to as wide a variety of materials as possible, and I explored the field of embossed metal, flat enameled iron, wood, cast aluminum, and cast steel and iron. I covered the enameling plants from Baltimore to just west of Chicago. I wrote the first specifications for enameling, according to the Superintendent of the Baltimore Enameling Company, that he had ever seen. They all had their own secret processes for slurries and temperatures. Working with Harry Neal of Ohio we developed a line of wooden signs with paint dips for background colors, and silk stencils for letters, numbers, and design details. Up in Lebanon, N.H. I found an ingenious Yankee who had developed an aluminum alloy he called Alloy E. He assured me it would not be cracked by bullets and demonstrated its toughness by smashing a cast sheet down on the point of a blacksmith's anvil. The sheet was dented, but not broken or cracked, and so it went. The last I heard Ohio was still using wood. Most other States use enameled sheets.

All types of signs except direction signs are designed to go on a two foot blank.

There were color studies made with the help of the U.S. Bureau of Standards and that was about the end of the Joint Board work on the materials for the Federal Aid 7 percent System.

The new Interstate System uses a different shield marker, different colors, and numbers routes so far as I know on the 5' and 0's, beginning at the west coast and ending with 95 on the Atlantic Coast. I had no hand in that work because I had retired before they could use me for further detail.

Copied from original letter
handwritten by:

Mr. Edwin W. James
