The wealth and physical well being of any State or Nation are based on its natural resources and on human labor. Human labor without the resources can accomplish nothing and natural resources without human labor are valueless. Pennsylvania is rich in that she has both the natural resources, the will to work in very large measure, and is ready to take a chance. It is not that her resources are so much greater than those of her sister States but that the knowledge of her resources through public and private surveys has been coupled with easily accessible deposits, excellent transportation facilities, and proximity to large markets.

This explains why with less than 4 per cent of the coal in the country, she annually meets over 40 per cent of the country's need. With no better limestone than many of her neighbors she annually quarries one-fourth of the limestone used in the country and produces one-third of the portland cement. She mines one-tenth of the sand and gravel used and one-fifth of the glass sand. She makes 60 per cent of all the metallic paint, 64 per cent of all the paint from slate and shale, and quarries more than one-tenth of all the stone used. Coal was mined at Pittsburgh 100 years before the Pocahontas coal in West Virginia was discovered or recognized as of value, if discovered. Though mining only 3/4 of one per cent of all the iron ore mined in the country, she makes nearly one-half of the country's pig iron. Because of her willingness to work she has grown rich by using Michigan iron, West Virginia gas, Brazilian manganese, zinc and a
dozen other metals or ores from the South and West, chryolite from Greenland, and "silk from Cathay".

As a mineral producer Pennsylvania stands alone, head and shoulders above any of the other States, producing in 1918 more than one-fifth or 22 per cent of all the mineral values of the United States, and nearly three times as much as her nearest competitors. In 1918 her mineral production, not including the value of her coke, ferroalloys, and pig iron, was nearly $1,000,000,000 out of a total production for the country of $5,500,000,000; adding the three manufactured products mentioned, would make her total more than $1,500,000,000. In 1918 she led in the quantity or value of cement, raw clay, bituminous and anthracite coal, coke; ferroalloys, pig iron, lime, zinc and lead pigments, slate, and stone, 12 in all; was second in clay products, natural gas and sand-lime brick; and third in the production of graphite.

Pennsylvania is listed as producing commercially 37 minerals. This list, however, includes all the different kinds of clay under one head, and so of some other minerals. If the different minerals and rocks having different characters that fit them for different uses had been listed separately, the number would be much higher. Under the heading of clay, for example, is included kaolin, or white clay, suitable for china; river clay suitable for common brick; flint fire clay; shale for tile or vitrified brick; and under-clays of the coal measures suited for pottery.

It has sometimes been asserted that Pennsylvania is self sufficient in her mineral resources. That is far from true, much less true than of some other States. For example, Tennessee has in commercial quantity, nearly every mineral mined in Pennsylvania and in addition she has barite, bauxite, gold, silver, lead, zinc, manganese, phosphate, and fluorite, that are lacking in Pennsylvania or exist only in trivial quantities.

Coal is predominantly the mineral resource of Pennsylvania. The value of her coal produced in 1918 was almost exactly $800,000,000. Leaving out of account coke, pig iron and ferroalloys, which in 1918 were worth over $550,000,000, the other principal mineral products of Pennsylvania are clay products, cement, natural gas, and petroleum.

As a recital of the resources of the State in the usual way, while handy for reference, is apt to be dry reading and is not likely to be impressed on the memory, I propose to string my facts and figures along a tale about "the house that Jack built" in Pennsylvania.

Let us assume that Jack has made some money in McKeesport gas or Texas oil or in just plain profiteering, and has decided to build a house on a hill near Pittsburgh, overlooking one of the rivers. Being a loyal Keystonean, Jack has specified in the contract, that as far as possible all the materials going into the house are to be Pennsylvania products. An inquisitive turn of mind made him want to know where everything came from that was used, something of his State's production of that material, and of some things how much there was left. It will interest us to see how largely Pennsylvania could supply the materials for a house and its equipment.
Jack began to ask questions as soon as the cement and sand and gravel were hauled on the ground for the foundation. The cement, he learned, came from the Lehigh Valley district, which was the first to make portland cement in the United States, and today produces more cement than any other similar district in the world. Portland cement has been made there since 1869 and the district produces today more than one-fourth of all the cement made in the United States. The cement, he learned, is made from Trenton limestone, which looks much like shale, in fact it carries about one-fourth shaly matter, so that some of the mills simply grind up the rock as it is; though most of the mills have to mix in a little pure limestone which may come from southeastern Pennsylvania or New Jersey. Cement is made also in western Pennsylvania, from both limestone and slag, but on a smaller scale. The annual production of the State ranges from 20,000,000 to 30,000,000 barrels, worth $30,000,000 or more.

The sand and gravel, he learned, came from benches along the Allegheny River. When the great glaciers of the Ice Age filled the upper valley of the Allegheny, the river carried a heavy load of sand and gravel - so heavy that the channel became filled far above its present level. Later the river cleared its channel, but large beds of sand and gravel remain, forming benches along the flanks of the hills. During the war, when Danish grinding pebbles could not be had, it was found that the river gravels would serve, and Jack learned that pebbles from Delaware River had been used to grind his cement. Pennsylvania furnishes about one-tenth of all the sand and gravel used in the country.

The cellar wall to the ground level was built of sandstone from the coal measures of Clearfield County. He learned that the coal measure sandstones furnish a large quantity of rough structural stone and some high class building stone. The supply in Pennsylvania is endless, as very many hills in the western half of the State are underlain by sandstone, though not all is by any means suitable even for rough building purposes.

From the ground level to the first floor the walls were granite from southeastern Pennsylvania. Much of that part of the State, he learned, is underlain by schistose rocks or gneisses of little or no value as building material; but here and there the grain of the rock is more regular, so that some granite of very fair quality is quarried. In 1918 nearly one-third of a million dollars' worth was cut.

The first-story wall was "brownstone" from Hummelstown near Harrisburg, where this rock has been quarried for several generations. This is a true brownstone of Triassic age like that on Connecticut River, the use of which in past generations was the mark of wealth in New York and other eastern cities. The waste stone at Hummelstown, he learned, goes into sand-lime brick. Inquiring about the mortar colors, he was told that they came from Pennsylvania, and were a mixture of iron oxide, ground slate or shale, and culm from the coal washeries. This State produces about one-third of all mortar colors made in the United States.
Terra cotta tile was set in the wall between some of the windows. This tile, Jack learned, was a Pennsylvania product with an average value of $500,000 yearly.

The second-story wall was built of face brick backed with common brick, both Pennsylvania products. In fact, Pennsylvania stands second among the states in the value of clay products, which in 1918 totalled over $40,000,000 worth, including everything from common brick to china. Both face and common brick are made from the clays and shales of the coal measures. Armstrong County leads in the production of front brick and Philadelphia County in the production of common brick. In 1918 Pennsylvania made $5,000,000 worth of common brick and $1,500,000 worth of front brick.

Inquiring about the lime used in building the house, Jack was told that Pennsylvania produces one-third to one-fourth of all the lime made in the United States, the bulk of it coming from Blair, Center, Chester, Lancaster, Montgomery, and York counties. Over $6,500,000 worth was sold in 1918.

The roof of course was made with slate from the Slatington region. Jack was interested to learn that Pennsylvania supplies more than one-half of all the slate quarried in the United States. About two-thirds of the state's product goes into roofing slate and the rest into structural and sanitary material, black boards, electrical fixtures, school slates, etc. The slate comes from a broad belt of shale extending across the state from Delaware Water Gap to Franklin County and from a small area in York County. Slate is shale altered by pressure and jointed across the bedding. The joint faces make the slate faces. Pennsylvania produces from $2,000,000 to more than $3,000,000 worth of slate yearly.

The floors and partitions in Jack's house were made of hollow tile of which the state produces more than $1,000,000 worth yearly.

Jack had decided that the front hall must be in marble, and he had certain ideas of a pattern he wanted worked out in the marble wainscoting. He had some difficulty in finding what he wanted, for Pennsylvania is not a large producer of marble, but after a personal canvass of the field he satisfied himself with different-colored marbles from Chester, Montgomery, and Delaware counties, and included some serpentine in the pattern. The front steps, window sills, and outside door sills were of limestone, and Jack was interested to learn that limestone quarrying formed one of the state's largest industries. The quantity of dressed building limestone is insignificant, the bulk of the limestone going into flux, crushed stone, and lime.

As Pennsylvania makes nearly $2,000,000 worth of sewer pipe yearly, Jack had no trouble in getting his supply from close by.

Then for a time the house was turned over to the heating engineers, plumbers, and electricians, and Jack was kept busy asking questions. First, he learned that iron, which all of them used, has been made from ore mined in all parts of the State, but that today it
is mined in only a few places. In the western part of the State iron ore occurs as a layer 6 inches to 1 foot thick on top of the Vanport or "ferruginous" limestone, and as bands of clay-ironstones in shales. In the central part of the State it occurs as hematite in the Clinton formation. This formation extends from New York to Alabama, and is the principal source of iron ore in the Birmingham district and furnishes no small part of the iron mined in Tennessee and Virginia.

In all the limestone valleys of central and southeastern Pennsylvania large pockets of limonite have been found. These pockets of iron ore led to the establishment of many iron furnaces in that part of the State, some of which are still going.

In southeastern Pennsylvania there are a few deposits of magnetite, notably at Cornwall, where 500,000 tons or more are mined each year from a great open pit nearly half a mile long and a quarter of a mile wide and sunk 250 feet below the original top of the hill. An interesting feature here is the fact that two companies are working in the same pit. One of them, however, under an old contract, may mine only so much ore as is necessary to run one furnace "as long as grass grows and water runs." You may guess that one furnace is no midget.

Until 1880, Pennsylvania led in the production of iron. In the early days of ironmaking the furnaces were located at, or near, the iron-ore deposits which furnished the ore for smelting. That the iron-ore deposits were widely distributed may be judged by the many small furnace-remains, now abandoned, to be found throughout the State. How much iron ore remains in the ground is a problem for the new Survey to solve. The Cornwall mines have been working since 1741 and will be working for another generation at least. There is a general impression that the native ores, except at Cornwall, were nearly exhausted when the Michigan ores began to enter the State. As much of the native iron ore was a surface accumulation produced by the weathering of limestones, it is possible that this is true, though it is certain that deposits remain that it will pay to work in the future.

As one thing leads to another, so the iron industry led to many others. Thus, iron smelting requires a flux, and that has led to mining large quantities of limestone for that purpose, $10,000,000 worth in 1918. The supply comes mainly from the Vanport limestone along the Beaver River, the Trenton limestone of Blair and Huntingdon counties and limestone of York, Lancaster, and other counties of southeastern Pennsylvania. The iron industry also demands fire brick, so Jack learned that Pennsylvania made in 1916, $24,000,000 worth of clay fire brick and $13,000,000 worth of silica fire brick. The clay fire brick is largely made from flint clay which is fairly abundant in Clearfield and a number of adjoining counties. Ganister valued at $150,000 or more is used in a single year for furnace and converter linings. Ganister is derived from the white sandstones that outcrop so prominently in some of the ridges along Juniata River. At present, most of the ganister is made by grinding the abundant float on the ridge slopes. The Medina sandstone, at the base of the Silurian has been found most suitable.
The conversion of iron into certain kinds of steel calls for graphite crucibles, so Pennsylvania has helped to meet the need by producing graphite. About 1,000,000 pounds of graphite was mined in 1918 from a small area west of Philadelphia. Still another industry created by the iron industry is that of supplying moulding sand. This sand comes mainly from the valleys of the Allegheny, Beaver and other rivers of the State. In 1918, it brought in the nice little sum of $950,000.

Then there is the coke business. Pennsylvania produced $150,000,000 worth of coke in 1918, most of it coming from the area in which the Pittsburgh coal bed is mined, though not all of the Pittsburgh bed will yield satisfactory coke. Connellsville is considered the type locality though satisfactory coke is now coming from the Klondike region of western Fayette County, and from Greene and southeastern Washington counties. There is also considerable coke made in other parts of the State, as at Johnstown and Punxsutawney. A side line connected with the iron industry is the making of ferroalloys needed in the production of special steels. Pennsylvania has to import the material for these alloys, but she has taken a leading place in their manufacture. Thus of 28 places in the United States making ferromanganese in 1918, 12 were in Pennsylvania; 11 of 18 places making spiegeleisen were in Pennsylvania; 1 out of 20 making ferro silicon; 5 out of 8 making ferrotungsten and 5 out of 6 making ferrovanadium, as well as the only places making ferromolybdenum. The total value of the ferroalloys produced in the United States in 1918 was over $115,000,000 and Pennsylvania's share was nearly $73,000,000.

The iron industry in Pennsylvania, however, is significant today not for the quantity of iron ore being mined but for the quantity of pig iron and steel being made. The value of Pennsylvania's annual output of pig iron is nearly $500,000,000.

When Jack questioned the plumber, he opened up an interesting subject though of very different magnitude from that of iron. He found that the plumber called for lead; sanitary ware made from china clays; soapstone to be used for laundry tubs; nickel for plating fixtures, and so on.

Lead is one of the minerals which Pennsylvania has produced only in very small quantity. Six tons produced in 1915 constitutes the State's output for the last 10 years. Very fine cabinet specimens are found, but practically no commercial ore. So Jack's plumber had gone outside the State to get lead. He had sent to Virginia to get soapstone, though some soapstone is found in Pennsylvania. The sanitary ware was made in Beaver County from clay, feldspar, and silica, all of which were Pennsylvania products. Pennsylvania produces 4,000 to 10,000 tons of feldspar a year. It comes from the southeastern part of the State where veins of igneous rock are exposed at the surface. Feldspar goes mainly to Trenton, New Jersey and East Liverpool, Ohio, where it is mixed with clay for making china and pottery. Pennsylvania, however, does produce some china clay or kaolin. It comes from the South Mountains in Adams.
and Cumberland counties and from Chester and Delaware counties. Much of this clay is used in paper and tile but some of it is used for fine china and enameled ware.

The nickeled fixtures recalled the fact that Pennsylvania long ago was a producer of nickel. A deposit of copper-nickel-cobalt ore was discovered at Gap, Lancaster County, in 1732. It was worked first as a copper mine. After being closed for many years, it was opened as a nickel mine and from 1863 to 1888 was the only nickel mine on the American continent. It was reopened in 1902 for a short time. Some people believe that much unmined nickel ore remains at Gap and it may again be the source of an industry.

Jack found the electrician using Pennsylvania copper as called for in the specifications. Copper ore is being mined with iron ore at Cornwall and more than 750,000 pounds of copper was obtained in 1918. Concentrates prepared by the electrical separation at Cornwall are shipped to Philadelphia for separating the pyrite and copper. In addition to copper wire, the electrician needs several insulating substances. Part of these are of porcelain, and others are mica and asbestos. Pennsylvania has been a producer of mica on a small scale for many years, the production coming from the southeast counties of the State. Asbestos has been mined on a small scale in Delaware County.

When the windows were put in, Jack was interested to learn that Pennsylvania produces more than one-third of all the glass made in the United States. Pennsylvania glass is made mostly from Pennsylvania sand. The principal sources are in the central and western parts of the State. The most important source is in Huntingdon and Mifflin counties where the sand is derived from the relatively thin Oriskany sandstone. This sandstone, which zigzags its way across the State from New York to Maryland is in many places over 99 percent silica. The next most important area lies in the upper Allegheny Valley in Elk, Forest, Venango, and Jefferson counties. Some glass sand is mined also in Fayette and Westmoreland counties. In all of these latter places, the sand is obtained from the Pottsville sandstone at the base of the coal measures.

In response to his inquiries of the painters, Jack learned that Pennsylvania is a great paint-making State. The pigment is made, in part, from low grade ores of iron or of chromium, or by grinding up shales or other materials of that kind. Or, the pigment is obtained from the refining of zinc and lead ores. Most of the mineral pigments are obtained from the eastern end of the State. Of peculiar interest is the mining of chromite in Lancaster County close to the State border. Chromite or chromic iron ore has in the past been mined in Chester and Delaware counties also, but at present the mine in Lancaster County is the only one operating. This ore is used mainly in the manufacture of chrome yellow, orange and green pigment. Among the other materials used in the manufacture of paint in the State are graphite from Chester County and soapstone near Easton.

One of the painters told Jack that Pennsylvania was one of the first States to mine and smelt zinc. The mines were in the Sauson
Valley of Lehigh County, and the ore was mainly a gray sphalerite. There was great difficulty in draining the mines because crevices in the limestone allowed water from the whole valley to flow into the pits, which were about 300 feet deep. A very large pump called "The President" was installed to remove the water. Today there are three large zinc smelters in the State, which supply a large quantity of zinc pigments. The zinc ores used to come from outside the State.

As the house neared completion, Jack became interested in fixing up the yard. He found that the driveway for the automobile was being paved with trap rock, an igneous rock quarried extensively in the southeastern part of the State for road making, it being the most durable rock known for that purpose. Across the sidewalk and in the lower slope of the drive, paving bricks were used, again drawing on the large clay products industry of the State. In 1918, Pennsylvania made over $1,000,000 worth of vitrified brick, using mostly shales occurring in the coal measures.

Then came the problem of fuel for heating. Was he to use coal, oil or natural gas? Jack had heard conflicting stories regarding the relative cost and efficiency of these three fuels, intermingled with rumors that the supply of all three was being reduced or approaching exhaustion. Some said that if he put in appliances to burn natural gas or oil, he might be compelled within a few years to take them out. I need not tell you what he learned about the relative cost and efficiency, but will confine myself to what he learned about the present condition of supplies and the future outlook.

Natural gas, he learned, had been put to practical use in New York State almost 100 years ago, but in this State it was first utilized about 1872. In 1883 pipo lines led gas from the Murrysville field to Pittsburgh and from then to the present the use of gas has steadily increased. He learned that Pennsylvania wells made their largest production in 1912 and had since declined. However, Pennsylvania's needs and demands have, for many years, far outrun her own production and the difference has come mainly from West Virginia; but in 1917, West Virginia reached her maximum production, and today her output is declining rapidly. It became evident to him that either Pennsylvania must reduce her demands or run short. He found that industrial users were already being cut off in cold weather in favor of household users and he found distinct indications that householders were likely in the future to be restricted to the use of natural gas in efficient cook stoves, hot water heaters adapted for burning natural gas, and such other incidental uses as cannot well be supplied by coal. Inquiring of the State Geologist, he learned that while the principal sources of natural gas have already been exploited, the old fields will still yield much gas and many minor new fields will probably be found. Some natural gas may be available for one or two generations more, but a study of all the conditions indicates that the output is likely to decline steadily.

He learned that the gas field now existing on the south shore of Lake Erie is almost certain to expand southward across Erie and Crawford counties, drawing gas from the Portage shale and Medina or "Clinton" sand. He also learned that there is a possibility of a
drill hole reaching the Medina sand under Chestnut Ridge or Laurel Hill. Much gas may yet come from the eastern part of the gas field though much fruitless drilling there has discouraged prospecting.

The oil situation was found to be much like that of natural gas. Oil as the source of an industry dates from the Drake well at Titusville in 1859. The industry reached its maximum in the State with a production exceeding 30,000,000 barrels following the discovery of the McDonald field in the early '90's. From that time the output declined to less than 8,000,000 barrels in 1912 and has since remained about stationary. It is possible that under the stimulus of present prices, the production for 1920 will exceed 8,000,000 barrels.

Oil in Pennsylvania is more completely developed than natural gas. Few, if any, really new oil fields are likely to be found. A map of the oil and gas fields shows that the production of oil and gas is confined to a narrow belt crossing the State diagonally from Bradford to the southwest corner, and that oil is confined almost entirely to the western half of that belt. While there may be many untested areas both east, northwest, and south of this belt that may yield gas, the only hope for more oil appears to lie in drilling untested areas within the fields already developed. These will doubtless yield a large amount of oil in the future and occasionally a gusher will be struck, such as the one recently drilled in northern Greene County, but Pennsylvania must depend more and more on outside sources.

One hopeful phase of the oil situation he found in the rejuvenation of fields supposed to be nearly exhausted. Thus, in the Bradford field the judicious introduction of water to the sand is forcing out of the rock more oil than was obtained originally, so that about 60 new wells a month are now being drilled in that field long thought to be approaching exhaustion. In other fields water does not force the oil out, but the Smith-Dunn process, using compressed air, is being tried. It therefore appears that some oil is likely to be produced in Pennsylvania for many years, though the amount will be small compared with the demand.

A study of the coal situation took a great load from the mind of our friend Jack, for he found that although for years Pennsylvania supplied two-thirds of the coal used in the United States, and still supplies nearly one-half of it, we have used up only about one-third of the anthracite coal and only about one-twentieth of the bituminous coal in the State; and that so far as his new house was concerned, he need not lie awake nights worrying for fear that some time in the future he would be too cold to sleep.

However, he was interested to learn from the State Geologist that the time will come when Pennsylvania will be at a disadvantage with some of the other States because while she still will have plenty of coal, it will all be in thin beds and expensive to mine. Ohio, Indiana, Illinois, and some other States have been sitting on their own apples while eating ours because ours were better, and therefore they will still have an abundance of cheap coal. The thick
and cheaply mined coal of Pennsylvania comes from either the Pittsburgh bed or from pockets of thick coal in other beds. The Pittsburgh bed is uniformly from 5 to 9 feet thick, and in the past has supplied the bulk of the coal mined - in recent years about 100,000,000 tons of the 170,000,000 tons of bituminous coal mined in the State. The Pittsburgh coal in some of the smaller basins, such as the Greensburg and Uniontown, will hardly last more than 20 to 25 years. The estimate given Jack of the quantity of Pittsburgh coal remaining in the ground was approximately 8,000,000,000 tons, of which one-half lies in Greene County. At the rate of 100,000,000 tons consumed annually, that bed would last 80 years.

The pockets of thick coal in other than the Pittsburgh bed are rapidly being depleted, and mining is shifting more and more to the thinner beds. The change becomes apparent with a study of any district in which the Allegheny or "Lower Coal Measure" coals are mined. For example, some 15 years ago, when the State Geologist made a study of the coal in the Punxsutawney district, he found that originally 65 per cent of the coal was in beds less than 3 feet thick, 25 per cent from 3 to 4 feet thick, and only 10 per cent was in beds over 4 feet thick. When this study was made (1905) nearly all the mining in the district was on coal beds 4 feet or more thick. Statistics show that 40 per cent of the coal produced in 1916 came from beds 4 feet or more thick; 57 per cent from beds 3 to 4 feet thick and 3 per cent from beds less than 3 feet thick. It was pointed out to Jack that 15 years more probably will see the disappearance of all coal 4 or more feet thick in that district, all mining will be on thinner beds, and instead of 3 per cent as in 1916, quite possibly from 25 to 50 per cent will be on beds less than 3 feet thick. Fifty years ago mining in the Moshannon field was on the Moshannon bed where the coal was 4$\frac{1}{2}$ feet or more thick. Coal less than 4 feet thick was left as unmineable. Today the same bed is being mined where only 30 inches thick as all of the thick coal is gone, including areas left in the early mining. While Jack found that Pennsylvania has coal enough to last several hundred years, he was led to conclude that years would probably see the exhaustion of all the thick and cheaply mined coal in the State.

Pennsylvania has been estimated to have had originally 21,000,000,000 tons of anthracite and 112,000,000,000 tons of bituminous coal. The anthracite field has been computed as 484 square miles in area. In 1892 A. D. W. Smith computed that 2,250,000,000 tons had been mined or lost and estimated that there was still to be gained over seven times as much coal as had already been mined. In 1910 M. R. Campbell estimated that the production and wastage had exhausted 4,300,000,000 tons. From 1911 to 1920 inclusive the production of anthracite will be not far from 825,000,000 tons. Allowing as much more for wastage would make the total exhaustion approximately 6,000,000,000 tons or about 50 per cent of the total. It may therefore be estimated that anthracite coal will be produced for another 100 years at least, though the cost of mining is bound to increase steadily.

The quantity of anthracite mined annually in Pennsylvania was greater than that of bituminous coal until 1897 when for the first
time the quantity of bituminous coal mined exceeded that of anthracite. To the close of 1918, the total quantity of anthracite that had been mined in Pennsylvania was 2,912,589,000 tons, and of bituminous coal, 3,559,178,000 tons. Although more bituminous coal has been mined the total exhaustion probably does not exceed 6,000,000,000 or the same as that of anthracite, and there is left in the ground 106,000,000,000 tons which should ultimately yield not less than 75,000,000,000 tons of coal. If we continue to mine 150,000,000 tons a year, the bituminous coal in Pennsylvania should last 500 years. But Jack was told not to forget that much of this coal is in very thin beds difficult and expensive to mine, and that much of it may be rendered unminable by the removal of thick lower beds.

Then came the problem of gasoline for his automobile, and Jack learned that Pennsylvania is producing a large amount of gasoline from its natural gas in addition to that derived by the distillation of petroleum. He found further, that in the early days, before the drilling of the Drake well, Pennsylvania supported a large industry which distilled oil from oil shales or cannel coal. A recent study showed that while the State's reserve of oil shales is not large, a small amount of gasoline may be derived in the future from these oil shales and cannel coals. Unfortunately, the thick beds of oil shale which outcrop in Ohio, Indiana, and Kentucky, are far below the surface in western Pennsylvania and outcrop only in central Pennsylvania, where they are so highly folded and metamorphosed that they contain no oil. Jack learned, therefore, that with the depletion of her own petroleum supply, Pennsylvania will become almost entirely dependent on outside sources for motor fuels. He was gratified to learn that some of the States west of Mississippi River contain such large deposits of oil shale that he need have no fear but that oil could be obtained for his motor car, at least as long as he lived, and at a price probably not greatly above present prices.

On inquiring what would be used if natural gas gave out, he was told that some of the large natural gas companies were already preparing to supply the needs of their customers with artificial gas, which would of course throw an additional burden on the State's coal reserve. He found, however, that there was a distinct tendency toward the use of gas obtained in making by-product coke and much talk of a time when most of the high volatile coals would not be used raw but would first be run through retorts so as to obtain from them the valuable by-products, after which the smokeless residue would be used in place of the raw coal. Of minor interest in this connection, he learned that bog iron ore was being mined in the upper Allegheny Valley for use in the treatment of artificial gas, where it serves to abstract the hydrogen sulphide. He also learned that a beginning had been made on the study of the treatment of mine waters, primarily to prevent stream pollution, but resulting in a material that was better even than bog iron ore for purifying artificial gas or by-product gas.

When the house was ready to be occupied, friend Jack found that china and other pottery was made in Pennsylvania and in part from Pennsylvania clays; that he could buy mineral waters from springs in Pennsylvania, this State supplying over 1,500,000 gallons yearly; that
olden days he might have purchased table salt from the brine wells in Allegheny County, and that for a time bromine was made from these brines. Indeed he learned that the first bromine extracted in this country had been obtained at Freeport. He learned that polishing powders are among Pennsylvania products, some of these being made from tripoli, some from ground sand; that he could get talcum powder made from Pennsylvania talc; and that water glass that his wife used for preserving eggs is made from rock found in the eastern part of the State.

Finally Jack found that if his wife's desire for jewelry was not extravagant, he might satisfy it with gems from Pennsylvania hills.