Sohio presents
Two Outstanding Exhibits
at Great Lakes Exposition

SOHIO'S contribution to the industrial development of the Great Lakes area will be dramatically revealed when the second Great Lakes Exposition opens May 29. Again this year, the central theme of the great Fair will be the history of the development of agriculture, transportation, communication, science and invention, modern machinery, literature, art and industry in the vast region of the middle West.

In addition to a greatly improved, more detailed display of Sohio's products and activities, housed in the same location in the Transportation Building that we occupied last year, Mr. W. T. Holliday, President of the Exposition this year, secured from the Museum of Science and Industry, Chicago, the most complete petroleum exhibit available anywhere in the world. The exhibit includes working models of all the operations involved in the commercialization of petroleum. The exhibit will occupy 5,000 feet of space in the Underground Exhibition Hall. The hall is a part of Cleveland's Mall and is a permanent structure devoted to exhibitions. The building is centrally located at the main entrance to the Exposition, and its 100,000 square feet of display space will be devoted to scientific exhibits grouped together as "The Making of a Nation".

The exhibit includes a replica of the famous Barber's Hill salt dome on the Texas coast, and visitors will be able to see how oil comes up inside the earth. Other miniatures will clearly show various geological formations in which petroleum occurs. The many methods of procuring oil will be demonstrated; one shows what happens when oil left below the surface cannot be reached by pumps and is brought up by means of water being forced into the well providing the pressure necessary to bring the oil to the surface.

The exhibit was developed at the Chicago Museum under the close supervision of Director J. R. Van Pelt, A. C. Carlton, curator of geology, and Lester Seelig, chief engineer. It is the finest thing of its kind in the world and its inclusion in Sohio's contribution to the Great Lakes Exposition will definitely add to the "Making of a Nation" exhibit and to Sohio's prestige.

Transportation Building Has Commercial Display

In addition to sponsorship of the Petroleum Exhibit, Sohio will have a commercial display in the same location occupied last year — the center section of the west end of the Transportation Building, which is located on the main avenue of the Exposition Grounds. The location will be the same, but the exhibit will be entirely new, and will include a large number of entertaining as well as educational features.

The area occupied by Sohio comprises 7,000 square feet. The entrance has been graphically illustrated on the cover of this issue of The Sohioan. The huge letters will
— bevel, worm and hypoid. It will be possible for visitors to learn exactly what takes place in their cars and see the actual operation.

A full sized automobile chassis equipped with dynamometers will reveal the satisfaction and economy available through the use of Sohio X-70 gasoline. Visitors will get into the car and operate it themselves and the thing they will observe about the operation of an automobile will amount to a driving course.

One of the outstanding displays will be an exact model replica of No. One Refinery. The model is complete in every least detail and includes railroad tracks and trains which are the most exact models ever developed. This display will be animated by means of flicker lights and the fact that the trains actually operate.

The scientific displays will be utterly fantastic. Ice will be made with a kerosene flame, heat will be produced through no visible means, lights will go on and off with no apparent connections, pictures will appear and change without any apparatus controlling them. These displays will truly be a hall of wonders and will reveal how far beyond practical present day uses, engineering science has progressed.

The Little Theater will be operated again this year with continuous showing of Sohio’s talking motion pictures. And on the wall, separating the theater from the rest of the exhibit will be a diorama of the Cleveland Airport, showing the Air Races in progress. Above the diorama there will hang an exact model of the China Clipper.

The displays are being arranged by Harry Gillett with the assistance of Robert Grussey and Ray Gerlack. Many of the technical features were contributed by Cleveland concerns. The model railroad equipment is owned by the Mi Loco Company; the automobile, by the Ford Motor Car Company; the chassis dynamometer, by the Bendix Corporation; the stroboscopic equipment, by the General Motors Corporation; the electro-thurmic units, by the Ajax Electrical Company; the Cleveland Model and Supply Company collaborated in the building of the airport model. Russell Gould designed the airport diorama as well as the effective motif at the entrance to the building, and figures and pictures used throughout the exhibit.
Sohio Engineers Devise Tamper-Proof Gear Seal

SINCE last November, when automobile models for 1937 made their bids for Mr. and Mrs. John Q's cash, the chief topic of interest has been the wide introduction of hypoid gears. Eleven manufacturers presented 21 models of new cars featuring the new gear.

The principal of the hypoid is not new—only its extended use is new. It is the result of the trend to greater speed and lower hung cars. In addition to greater gear tooth strength and greater axle quietness, the hypoid gear has permitted the elimination of the objectionable floor tunnel. The design makes it possible to drop the drive shaft down so that it clears the floor of the rear of the car.

From a lubrication standpoint, the hypoid gear has undoubtedly been the greatest challenge the petroleum industry has had to meet in recent years.

Sohio has anticipated the trend in automotive development and for the past ten years our engineers have worked in stride producing extreme pressure lubricants. And with the presentation of the hypoid gear in lower priced cars this year, Sohio had ready to service these cars the finest extreme pressure lubricant science has yet devised—Sohipoid.

During the past ten years the automobile industry has been continuously forcing more difficult lubrication problems upon the petroleum industry. Increasing pressures have necessitated extensive laboratory work to develop lubricants equal to the challenge. Not long ago, engineers considered 40,000 pounds' pressure to the square inch quite a lubrication problem. But in less than ten years the gear pressure has been stepped up to 400,000 pounds per square inch, and everyone admits that that is a lubrication problem.

The best natural lubricants available became inadequate to the task, and one after another broke down under the severe strain of heat or load or both. In addition to these taxes on lubricating ability, the wiping action of the hypoid gear rubs off ordinary lubricants. Thus it became necessary to go to properties other than petroleum for toughness and durability under this extreme pressure.

Experimentation revealed that sulphur added to petroleum oil produced a superior lubricant, entirely satisfactory under the pressure used a few years ago. Under extreme strain the sulphur compound let go and the search was on again for a better agent.

Chlorine, in various combinations, proved a good lubricant, but chlorine too has its weaknesses and disadvantages when the extreme pressures of today are encountered.

Lead was tried. Added to petroleum an excellent extreme pressure lubricant is created, but lead alone would not stay suspended in the oil and was therefore not dependable.

The next step was to introduce both lead and sulphur to the petroleum lubricant. Today the lead-sulphur compound is recognized by automotive and lubrication engineers to be the best answer to all present day problems. Sulphur and lead combined will stay suspended in the oil and therefore give protection from separation and wear; in solution the compound has proved to have the greatest known load carrying and heat resisting capacity.

Hypoid Gears Require More Than Lubrication

UNFORTUNATELY, properly servicing the new cars with the right lubricant is not all that is required if hypoid gears are to give the service and satisfaction of which they are capable.

With the introduction of compounds into refined petroleum, a chemical is produced, which requires both knowledge and care to preserve its effectiveness.
Gasoline Consumption Increases

IN 1923, the average American motorist used 394 gallons of gasoline in his car, paying 21 cents per gallon for it, or a total gasoline cost of $82.98. In addition, he paid a gasoline tax of $4.37 on his purchases of motor fuel.

Last year, per-vehicle consumption of gasoline had increased to 671 gallons, 70% over 1923, but the price of 14.1 cents was only two-thirds of the 1923 average. Total gasoline cost per vehicle had risen only 14% for 70% greater gailonage. Thus, for an additional fuel expenditure of only $11.63, the average motorist was able to travel 4,155 miles farther than in 1923. However, the cost of gasoline taxes per vehicle had risen to $35.90—800% greater than this charge against the motorist had been in 1923.

In short, as the oil companies concerned themselves with reducing the cost of gasoline to the consumer, the tax assessors were just as busy imposing increasingly drastic financial penalties on motor vehicle use.

Sohio has gone to insure protection against mixture is the greatest possible evidence of the company's confidence in Sohipoid.

In addition to the right lubricant, and just one kind of lubricant, all manufacturers strenuously urge owners of cars having hypoid gears to change the lubricant every 5,000 miles and to check the oil every 1,000 miles. This latter caution is the motorist’s final protection against failure of the hypoid gear lubricant. When an extreme pressure lubricant has broken down, it becomes stringy or excessively thick and must be changed at once.

By means of the under-the-hood record, which insures inspection of the oil every 1,000 miles, and the gear seal, which protects the customer against the possibility of the lubricant being tampered with, our customers transfer their lubrication problems to Sohio.

What greater faith is it possible to have in a product? And what greater convenience can a motorist enjoy than to shift to Standard Oil the responsibility of watching his lubrication needs.
WHAT is this, anyway? the technical student asked in amazement, "a kindergarten playground?"

A veritable bedlam arose from within the lubricating plant where finished motor oils were being made from the rough cuts of lubricating stock which came from the re-run stills. Here, Aladdin had told him on the way across the refinery yard, lube fractions were treated with phenol to eliminate certain undesirable properties, filtered and washed to remove impurities and improve their color.

The squeals of small voices mingled with the general rumpus as the pair stooped low to crawl inside one of the stills. They might have been in a city park playground. There were half a dozen toboggan slides slippery with some sort of oil and down these the tiniest of gnomes slid in glee while older ones solemnly checked the operation with stop watches.

"They are testing the 'oiliness' of different grades of lubricating oil," Aladdin explained, noting the consternation on his companion's face.

Here for the first time the student found the feminine sex represented. Three 'Lady gnomes' in neat, white dresses were examining the colors of a number of test tubes full of oil which showed various shades of green and amber in the artificial light. They would hold pieces of ribbon, which appeared to be standard samples, against the tubes and note the result on forms they carried.

Aladdin was chuckling to himself. "Funny thing," he remarked, "color is really no indication of the quality of a lubricating oil — but try to tell people that. It means some expense but if our customers demand oil of a certain hue, it is up to us to give it to them."

Just then the general confusion was pierced by a series of blood-curdling screams. Startled, the student whirled around to find a sort of personified steel bearing stretched on what appeared to be a torture rack of the Middle Ages. As one gnome slowly turned the handles which stretched and twisted his body, another judiciously poured oil over him at intervals, while a third held a stop watch on the period before the victim started screaming again. Beyond, a torturer slowly turned the other bearers waiting their turn on the rack.

"When any moving parts are improperly lubricated," Aladdin was elucidating, "the metal is tortured, you might say. So we test all kinds of bearings here to find out how much they can endure and what kind of oil helps them stand up best."

They talked with the boss Genie, and the student learned some of the tricks of making lubricating oils. In the days when only wagon wheels lumbered over the roads, he was told, teamsters were accustomed to smearing their axles with ordinary crude. The "golden grease" which was pumped from many of the early Pennsylvania wells (particularly one near Franklin, which yielded almost pure lubricating oil) was satisfactory enough for this purpose. Later, refiners learned to separate lubricating stocks from the gasoline, kerosene, fuel oil and other constituents of crude petroleum.

But still further problems were in store. The automobile had appeared on the horizon and, as it was perfected, pistons moved faster and faster in their cylinders, with increased engine temperatures. motorists demanded oils which need not be changed or added to at too frequent intervals. So the refiner turned to certain solvents discovered by laboratory technicians which would remove less desirable compounds from lubricating oil fractions.

Among these magic potions, the Genie told them, were sulphur dioxide, furfural (a liquid made synthetically from oat hulls), chloroform (a chlorinated ether) a coal tar product named cresol, and phenol, which is a carboxylic acid made from coal tar.

The science of solvent extraction, the student learned, was the very latest development in the technique of lubricating oil manufacture and made it possible for high compression cars to travel through all kinds of extreme weather without appreciable loss of oil and with changes necessary only half as frequently as was once the case when slower speed engines were employed.

"Ja," the Genie mumbled, "we use a lot of lubricating oil in this country. It would take—ach, let me see..." (he thumbed through a little book on the table) "...just 315,000 whales every year. Or 114 million tons of castor beans—a farm covering 150 million acres! All that for just one year's supply of lubricating oil for the wheels that turn."

They passed on to the next room and here a strange sight greeted...
Oil refining is a chemical industry in itself. Many products far removed from the popular notion of oil contain some petroleum derivative.

the student's eyes. There was a circle of huge cauldrons filled with steaming, sticky mixtures which giant creatures stirred continuously while little gnomes hopped about, pouring in a dash of this and a touch of that. But it was not a crude still.

"They are making greases here," Aladdin explained. "You see, grease is a mixture of certain grades of lubricating oil with special soaps. In some cases we even have to mix in a lead compound. We always use a leaded lubricant for hypoid gears and under other conditions where there is heavy pressure."

Whence All the Wax?

Aladdin shoved his hands in his pockets and started to whistle a tune as they retraced their steps across the refinery yard.

"Like dancing?" he inquired suddenly.

The student started. Vague recollections of a certain blonde in another world came to him. Was he dreaming after all? Before he could pursue the thought any further Aladdin continued.

"But of course you do. Maybe you wondered where the stuff they put on the floor came from. And the wax candles on your dinner table at night. And the wax paper in the kitchen, the sealing wax in the laundry, the wax caps on jelly jars on the shelf. We make them all right here."

They entered a long, low building and the student burst out laughing at what he saw. A score of gnomes were struggling with what appeared to be a huge book press which was nearly immersed in ice and rock salt like the can of
an old fashioned ice cream freezer. From the sides of the press a sticky white substance oozed and congealed.

Across the way was something that looked like an oversized salad bowl. In it was an egg beater held in place by guy wires while three or four gnomes stood tiptoe on the edge of the bowl and turned the handle industriously. Climbing up and looking into the bowl, the student found the same white particles clinging to the sides while in the center was an oily liquid.

"These," his host enlightened him, "are two of the best known ways of separating wax."

This household necessity, the student discovered, is suspended under ordinary temperatures in the oil. Back in the days of Col. Drake, refiners found that if they diluted heavy oil containing petrolatum with naphtha and allowed the mixture to stand during the winter months, wax would settle to the bottom. But as the automobile developed, motorists clamored for more speed, and refrigerating tanks to work all year around were the next step.

Finally the centrifuge was introduced. This works on the old principle of centrifugal force — when you set a mass in circular motion, the heavier particles tend to fly to the outside. So, just as whipped cream forms on the outside of the bowl first when the beater is turned, wax particles are flung outward and separated from the oil in the same way.

This, the student was told, was the way they obtained petrolatum, which looks something like a jelly. Wax crystals, which occur in lubricating oils, gas oils and some of the more viscous types, require different treatment.

"That," said Aladdin, "is what the 'book press' is for. We chill our oil down to the point where the wax is crystallized into solid particles. Then it is pumped through that press, which contains a series of perforated steel plates covered with canvas. The oil naturally is forced through the canvas, leaving the wax behind. Then all we have to do is open up the press and scrape off wax from the plates.

"There are other methods too," he concluded, "—filtering is one. This is for viscous oils containing wax in smaller crystals. We dilute the oil with a light naphtha, chill it rapidly, mix it with some material like clay and filter the entire mass through a cloth. The clay helps absorb the wax crystals, which can be separated out by melting and filtering."

The Magic Test Tube

A PAIR of white rabbits scurried out from under a still and scampered across the yard with a gnome in hot pursuit, calling them by name in his squeaky voice and pleading with them to stop.

The student collapsed on a barrel. "What next?" he finally managed to gasp between fits of laughter at the gnome's frantic efforts. "Don't tell me you make rabbits out of petroleum too!"

Aladdin shifted his chewing gum to the other cheek and rolled his eyes. "No," he confessed with an embarrassed grin, "our chemist Genie is probably putting on a show for some school children. We can make compressed food out of the hydrocarbons in petroleum but live rabbits are something they haven't even tried in the laboratory yet."

Before going in to watch the show, the two sat down for a smoke and to rest their feet. It was as bad as doing the Chicago Fair or the Texas Centennial. The student wanted to learn some more about these so-called by-products anyway. He knew, of course, that a great army of chemists labored in the laboratories of the petroleum industry and he had read that as a result of their unceasing research many new and useful products had been developed out of what once had been considered waste material.

"If the stockyards," one book had commented, "make use of every part of the pig except the squeal, the oil refineries go one step further — they use everything including the smell."
Aladdin told him that the search for useful work for by-products started originally as a necessity. Before cracking was invented, a plant would find its tanks overloaded with gas oil, fuel oil and other products left over after taking the gasoline out of the crude. It is not unheard of for a refinery to shut down until a market could be found for this material, which often sold for distress prices.

Cracking solved part of the problem by turning some of the gas and fuel oil into gasoline. In recent years, the student was told, the growing use of oil burners both in home and industry developed a market for gas oil, distillate and fuel oil potentially as great as the consumption of motor fuel.

But there were still the gases to be considered. Ordinary refining, Aladdin explained, yields a wide variety of products of more or less stable character chemically. That is to say, their molecules are not constantly jumping around, changing the chemical make-up. Cracking, on the other hand, in addition to increasing the yield of gasoline, provided a number of wild fractions which were hard to control as a bucking bronco. It took the chemists to discover that the same chemical activity of the molecules in these unstable compounds which rendered them unsuitable in a gasoline made them particularly adaptable for the manufacture of alcohols.

"Making petroleum alcohol," Aladdin continued, drawing a little sketch on the wall of the still with his chalk, "consists in a sort of chemical magic involving sulphuric acid, water and the particular fraction of crude oil we are using as charging stock. Take isopropyl alcohol, for instance. Maybe you never heard of it but I bet the dressing rooms of your football team reek with the stuff. It is widely used as a rubbing alcohol and is also used in certain cosmetics, perfumes and hair tonics.

"Anyway," the little man went on, blowing out a cloud of smoke, "we again come across our old friend the bubble tower. We run gas which has been extracted as undesirable from gasoline in what is called a stabilizer plant, into the bottom of our bubble tower. Sulphuric acid is introduced at the top and sometimes we add a mineral seal oil to make sure the two mix thoroughly. When we get finished we have isopropyl alcohol and sulphuric acid."

Other popular alcohols, the student learned, are butyl and amyl. The process for making them is a little different, a row of agitators being employed to mix the acid with a light naphtha cut. Both alcohols find a wide market as commercial solvents, particularly in the manufacture of lacquers, artificial leather, etc.

"Let's have a look inside," Aladdin invited, knocking the ashes from his pipe.

They were ushered into a sort of little theatre and took their seats in the rear. On the stage was a giant test tube held in place by props. A dark liquid boiled violently in the massive tube and heavy fumes spewed from its mouth.

"That," came a whisper from the student's companion, "is the Magic Test Tube."

As he spoke, the chemist Genie stepped out on the stage, wand in hand. He was magnificently attired in ivory satin and turban clasped in front with a huge jewel that seemed to flash sparks every time he turned his head. Stepping up to the Magic Test Tube, the Genie explained briefly with a gesture. From the smoking mouth of the tube spewed forth a substance which seemed to flash sparks every time he turned his head. Stepping up to the Magic Test Tube, the Genie explained briefly with a slight Oriental accent the inherent magic of petroleum and how, through many years of patient research among the laboratory retorts, his chemists had evolved new compounds which found their way into hundreds of different products far removed from petroleum.

"Look!" he invited, "I show you some of them."

The Genie stepped back and waved his wand in an imperious gesture. From the smoking mouth of the test tube an automobile tire tumbled.

"Carbon black and certain alcohol solvents, both petroleum products, go into all tires," Aladdin explained, "but this is entirely of synthetic rubber made from petroleum."

Again and again the Genie waved his wand and a heterogeneous collection of articles spilled from the Magic Test Tube while half a dozen gnomes sprang to pick them up and set them in neat piles. There was a pack of chewing gum, a bottle of perfume, several kinds of medicines. The familiar insect eradicator came tumbling out, to be followed by an almost complete collection from any woman's dressing table — cold creams, lipstick and other cosmetics. A can of ether such as they use in anaesthetics was next. Soap, a tank of cooking gas for a kitchen range, some pellets of concentrated food were next in the steady stream of products.

"Did you know," Aladdin whispered, "that during the War, German soldiers were said to have consumed something like 6,000 tons of ethyl esters of certain hydrocarbon fatty acids? We have no particular prospect of going into the compressed food business yet, but theoretically there is no reason why the chief ingredients of such concentrates cannot be prepared from petroleum hydrocarbons."

The Crystal Ball

LIKE sightseers at a World Fair, Aladdin and the student went from one part of the plant to another. Finally they reached a mysterious looking building near the exit gate in back of which a high fence hid from view all except the top of a massive concrete structure. The building bore the sign "House of the Future," and with a thrill of expectation the boy and his guide entered.

The interior was in utter darkness save for a single spotlight which shone down on a Genie who sat brooding before a great crystal ball.

"What's he doing?" whispered the student in an awestruck voice.

"Looking into the future of petroleum," Aladdin replied. "In that ball the Genie is seeing how much oil is left in the world and what mankind will do for gasoline and other petroleum products when it is gone."

The student was instantly all eagerness, but his host hastened to assure him that while they could
see dimly the answers to some of these questions in the mystic ball, only the Genie knew what the future would be.

They approached, and Aladdin spoke a few words in a strange tongue. The Genie stood up and without a quiver of his impressive features, bowed gravely. They were seated and the student gazed into the great crystal.

He saw great fields of oil wells passing in succession like a slow motion picture. Aladdin nudged him.

"I can tell you this," he volunteered. "There is enough oil in sight for essential uses in the United States alone to last us for another quarter of a century at the very least. In the ten year period from 1925 to 1935 we took 9.7 billion barrels out of wells in the United States — but enough new fields were discovered to provide 13 billion barrels of new stocks. And this does not include fields in countries abroad where we have only scratched the surface. Anyway," he concluded with a chuckle, "it is hard to run short as long as you continue to find as much as you use up."

The student was still not satisfied. He wanted to know what would happen when the world’s oil supply finally did give out.

Here the Genie intervened. "Look," he invited, pointing into the crystal with a faint smile.

As the student gazed into the crystal ball he saw great piles of coal, mountains of shale that reached up into the sky, mounds of lignite and barrels upon barrels labelled "fish oil," "cottonseed oil," or "seal oil."

"Back of this building," the Genie declared in his measured accents, "stands a great structure we call the hydrogenation plant. By mixing hydrogen under tremendous heat and pressure with certain hydrocarbon compounds — crude oil, coal, shale and lignite are a few of them — we can reform their chemical structure almost at will. There is our insurance policy. There is where your children’s or your grandchildren’s gasoline will come from, should Nature no longer supply us with petroleum."

"One of my men," he continued rapidly, "has estimated that one trillion barrels of gasoline could be obtained by cracking the tar derived from coal reserves already known to exist. That would be enough to run 25 million cars for 2,500 years.

"Then there is shale. From all known reserves of this product, at least 300 billion barrels of shale oil could be obtained, enough to keep all the cars in the world on the road at least 400 years.

"Cottonseed oil is not practicable to use here at present because of economic conditions but it is possible to obtain a 54 per cent yield of gasoline at high temperatures. Fish oil will yield between 37.5 per cent and 47.5 per cent gasoline and cracked seal oil will give you a 60 per cent gasoline cut.

"So you see, we have no fears for the future," he concluded with a smile.

Thanking the Genie, the student followed Aladdin through a secret door into the yard. Here a massive concrete structure greeted his eyes.

At the top a small army of gnomes raised a black flag and, with a cheer, the gnomes began to work a great battery of valves while he watched a pair of Genies clad in asbestos suits shoveling molecules while fire played around them and hydrogen shot into the chamber at terrific pressure.

For the first time the student was afraid. It was infernally hot and the smell of smoke pervaded the place. Aladdin did not seem to notice it, merely smiling enigmatically when the student called attention to the stifling heat.

There it was again — this time the unmistakable crackle of flames. The boy whirled about. Smoke filled the vast chamber, his eyes smarted and he choked. He tried to escape but was hemmed in on all sides. Now his clothing was afire, the flames creeping up his right arm while he watched them in a sort of paralyzed fascination.

He gagged with the smoke, tried to call out, then knew no more...