



The "bedspring" antenna at Belmar, New Jersey.

see page 34

Waves

FROM OUTER SPACE

by James C. G. Conniff

Mankind is now on the verge of drawing reverently as near as we are likely to come in this life to what the English poet Henry Vaughan may have had intimations of when he wrote, during the century that saw the birth of the optical telescope, "I saw Eternity the other night, like a great ring of pure and endless light."

JUST when man was figuring on a little peace and quiet up there in a space capsule, or on duty in an orbiting observation satellite, it turns out there is really no peace and quiet anywhere. The universe itself is talking an invisible, hitherto inaudible, blue streak. Man learned to cock his ear for it only yesterday, but this celestial chatter has been clacking away since time began. Till time ends, moreover, current evidence is strong that the supposed absolute silence of interplanetary and intergalactic space will go right on crackling with its as yet only partially decoded message-for-mankind.

For public consumption, at this writing, the word on the whole mysterious phenomenon is fivefold: 1) these relentless voices from outer space are radio waves of enormous power and antiquity which 2) bore in on us from the uttermost reaches of the cosmos and 3) are probably not of living human origin 4) for technical reasons and 5) because in the billions of years it takes these signals to get here, whoever started them coming would be long since dead.

If our fast-moving programs in radio astronomy—as this new science is called

—*should* unravel a message from the dead, so to speak, it will be once again because we are finally getting a move on in the now familiar U. S. pattern of playing scientific tortoise to the rest of the world's complacent but initially energetic hare. Our mounting Sunday-punch effort to catch up on the meaning of space signals is doubly ironic because the talking universe was discovered by an American in 1932 and thereafter ignored here. Half a dozen other countries, including the Soviet Union, got the jump on us in spades by recognizing the importance of this accidental find and going to work on it at once.

What they did, in effect, was to get a head start on X-raying the universe. They determined among other things the true shape of the Milky Way—something no optical telescope could accomplish. This was possible because, paradoxically, some of the most brilliant celestial bodies we see give off comparatively weak radio waves, while the most powerful sources of radiation are invisible even to the largest optical telescopes. Only the new "radio eye" could see through more solid things to map these mysterious objects, and for the longest while our scientists were just not looking.

Now at last, with that herculean drive which somehow always kind of makes up for earlier foot-dragging, the U. S. is into radio astronomy up to its ear-

mechanisms—many of them veiled by strict security—amplify the capacity of man's senses to receive and record the incoming signals, and of his brain to interpret them.

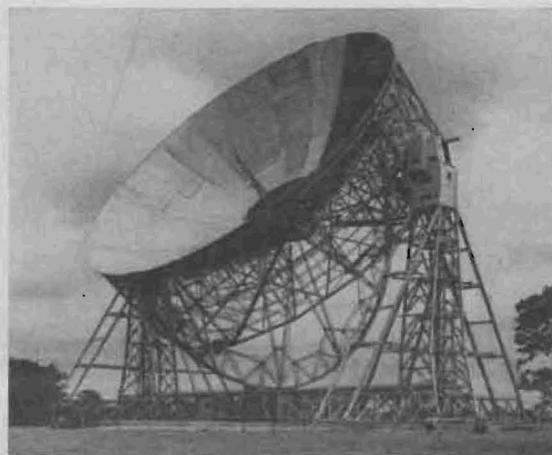
What are they "seeing" or listening to — these huge latticework metal saucers which resemble and in fact function very much on the same principle as radar? How does the embrace of their shallow-dish receiver manage to bring within man's grasp the modern actual equivalent of that mediaeval legend about "the music of the spheres"? Are these radio signals from the extreme borders of creation detectable only with the aid of costly, outlandish-looking precision equipment?

The radio telescope picks up radiation which man's eyes, designed for the relatively narrow range of light waves, are not sensitive enough to perceive. It translates this "gain" of invisible microwaves into squiggles on a graph or automatically typed number combinations which are most meaningful to trained scientists. Yet you can both hear and see this "background noise" from outer space, as radio engineers call it, on ordinary household equipment.

Set your radio dial between stations, for example, and turn up the volume. Hear that loud hissing, part crackle and part roar? Some of it, including the hum, is in the set itself. But to a large extent you are listening to signals from

mitter called Alpha Herculis, is 2,400,000,000 miles in diameter, or 25 times the 93-million-mile gap between our earth and the sun. The most powerful, Cygnus A, was identified by radio telescope as recently as 1968. Cygnus A is made up of two galaxies that are sweeping through each other head-on, but are vast enough to keep their respective billions of stars millions of light-years apart. This cosmic "collision" is so far away—270 million light-years—that its signals of a billion billion watts, which you see tonight on TV, were launched while this planet was still a ball of primordial fire.

Anybody who takes even a casual look at radio astronomy owes it to himself to re-examine his ideas about time and

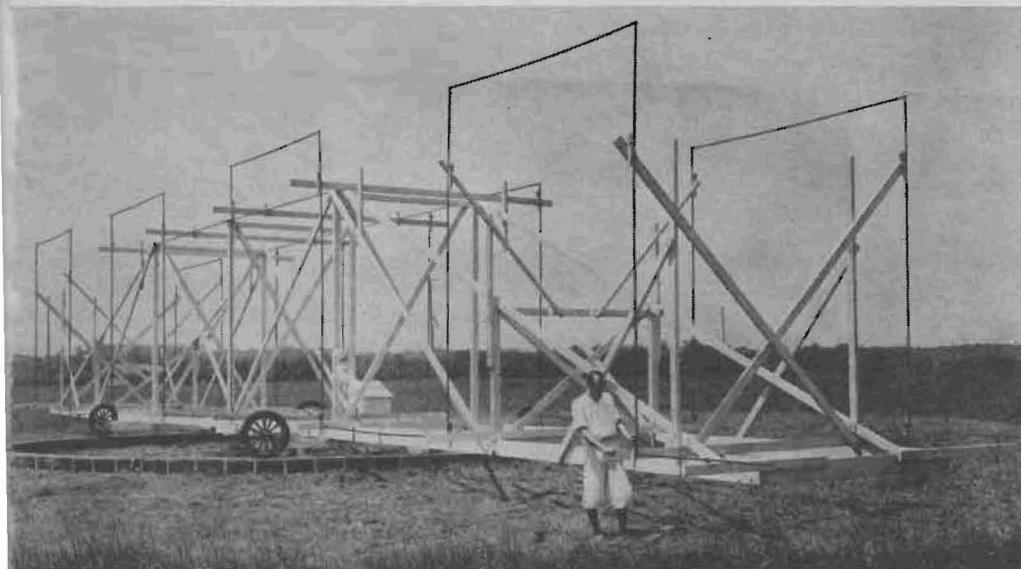


The famous 250-foot-diameter Jodrell Bank radio telescope in England, world's largest.

distance. You are dealing here with dimensions so all-fired *big* that miles as we know them just do not signify. That is why, long before the radio telescope, optical astronomers saved themselves brain-fag and reams of paper by inventing condensed-milk terms like "light-year," "cosmic year," and "astronomical unit."

A light-year is the distance light can go at 186,200 miles per second in a calendar year: about 6 trillion miles. A cosmic year is the time it takes our sun to circle the center of our galaxy—the Milky Way—one: 200 million years. An astronomical unit is the aforesaid 93-million-mile stretch between us and the sun.

The need for these fantastic yardsticks was inevitable from the moment when, 350 years ago, the Dutchman Lipperhey and the Italian Galileo devised the first crude optical telescopes. Before then, even with the naked eye, man marveled at the glory of the heavens and gradually made use of it. Nomadic peoples planted, harvested and worshipped by seasons determined from the stars. Ancient nations like the Egyptians pushed celestial observation forward enough to compute a 365-day calendar



The late Karl G. Jansky with rotating antenna which he used to discover radio waves, and whose studies resulted in the science of radio astronomy.

drums. We may yet win the leadership we could have enjoyed far less expensively long ago. Like enormous upended parasols or gleaming, symmetrical Queen Anne's Lace of aluminum and steel, the antennas of radio telescopes have begun to flower in the last few years across our landscape. In their windmill-type support structures and nearby operations buildings, complex electronic

worlds beyond.

The same is true of the "snow" or pinpoint background flicker on your television screen. On Channel 2, which has the longest TV wave length, some four-fifths of the graininess in your picture is a radio barrage from deep in intergalactic space. It comes from huge natural transmitters.

The biggest one, a single-star trans-

and locate structures like the pyramids. Mediaeval Arab astronomers built on this knowledge to provide the more accurate information about star positions and the earth's dimensions which at least to some degree guided the mind and the ships of Columbus.

Each time Saint Ignatius Loyola gazed on the heavens he found that this earth's clotted clay grew dingier for him, so it is not idle to speculate how deeply he might have been transported if he had lived to view his beloved stars through an optical telescope. Yet, even with the latest of these huge and costly instruments, we are confronted with an irony of man's expanded senses which seemed unassailable till the advent of the radio telescope. For, from Galileo

light waves. Unlike optical telescopes, whose usefulness is limited almost entirely to clear nights, the radio telescope functions 24 hours a day, even in foul weather. Moreover, the "radio window" it looks through is a good 10 times wider than the comparative slot to which light waves confine optical astronomy.

Hence, there are only two things preventing the newborn science of radio astronomy from peering, as it were, "into infinity." They are 1) background "noise" or radiation from the telescope's own electronic equipment and its environment, which drowns out or confuses weaker radio signals from space, and 2) the diameter of its parabolic antenna, or wave-gathering "dish," which like the diameter of the lens of your eye

Thus, a man in a pitch-dark room is invisible, but with the right equipment you could "see" his radio waves. You could also see the radiation of a cake of ice, because it is nowhere near absolute zero. Sticking a knife-blade into a flame won't do its temper any good, but as it glows red you will witness the knife's invisible radio waves being boosted into light waves.

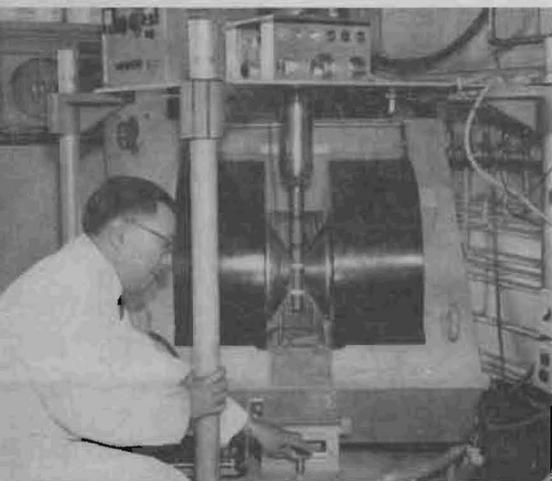
The sun is our prime example of this phenomenon. As we note and daily live by its invisible radiation, however, we must remember the invisible radio waves which the sun is also giving off and which our eyes cannot detect. So far no radio telescope has been sensitive enough to sift out the sun's radio waves because its light waves are so intense. That will come. Meantime, the radio telescopes we have are doing fine elsewhere in the universe. The much bigger ones we are building may unravel its ultimate secrets.

This is a fantastic achievement when you consider that it has come about practically overnight. Nobody had heard of radio waves a century ago. Then Maxwell, in 1873, framed the theory which Hertz vindicated in his laboratory 15 years later. Man-made radio waves were a scientific fact! From that point the development of radio communication, followed by TV, is a story no less wondrous for being familiar to us all.

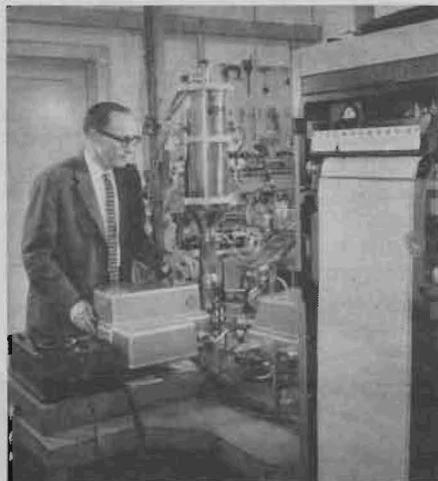
But the invisible *natural* radiation of all created things went unrecorded till a Bell Telephone Laboratory engineer named Karl G. Jansky stumbled on it at the start of the Thirties. Assigned to determine what was garbling transoceanic radiotelephone communications, Jansky built an antenna for this purpose at Holmdel, N. J. During many months of study he noted a steady mysterious hissing in his equipment which he could find no explanation for. At last he was forced to conclude that it came from outer space. But his documented findings, presented at the International Scientific Radio Union convention in Washington in April, 1933, were politely shelved and he himself was transferred to other work. At the time of his discovery, Jansky was 27 years old. He did not live to see the marvels other young men would accomplish with it.

Because of Jansky, we may be in sight of finding out as much as man can grasp about what actually took place at the moment in which the universe began. This in turn should provide strong clues or better about where it is headed, the mind-torturing conundrum of its limits (what could be "outside" it?), and how and when it may end. Radio astronomy will also give us much more accurate data on interplanetary and intergalactic distances—with space travel in the immediate offing, it is no longer enough to

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Sounds from outer space are recorded on moving graphs, amplified 1000 times.



View of the "guts" of the "dish" radio telescope, like the Navy's 600-footer.

to the 1948 dedication of Hale Observatory's 200-inch reflecting telescope on Mount Palomar in California — which just recently has been improved to penetrate 2 billion light-years into space—we have been forced to observe the night skies around us with about the same clarity as a fish would enjoy peering surfaceward from the bottom of a deep and stormy sea.

The reason is our atmosphere, a 6,000-million-billion-ton wrapper which enshrouds us more than 100 miles deep. Though this air envelope is itself invisible, its gases and dust combine with meteorological disturbances and light-bending characteristics to blur up considerably our "optical window" on the universe. Through that narrow "window," therefore, telescopes dependent on light waves can see just so far out into the universe and no further. In many parts of the heavens optical telescopes are blocked also by huge opaque gas clouds called "nebulae" which light waves cannot penetrate.

No such disadvantages hamper the radio telescope. The kind of electromagnetic radiation it is geared to detect goes right through obstacles that stop

determines how much radiation can be picked up to permit "seeing" for greater distances. Happily, American electronic genius is on the brink of taking both barriers in stride.

This is particularly gratifying as a counterbalance to the inexcusably smug dismissal by American scientists, for more than a decade, of the very idea that radio astronomy could add anything to already existing astronomical data. It was a case of our watchers of the skies feeling they had all the answers, so why bother re-examining the questions?

Not only was it known that all electromagnetic radiation—light waves, radio waves, TV waves, radar emanations—are of the same kind but different in length. It was also well established that everything in creation above a temperature of absolute zero (-459.6° F.) radiates to some degree. Even objects near but not at the complete molecular motionlessness of absolute zero's deep-freeze emit radio waves of enormous variation in length. These invisible radio waves get shorter and shorter as temperature rises. Finally, when the object is hot enough, it gives off light waves and becomes visible.

VOICES

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know the sun's distance from earth, as we do now, only within 10,000 miles.

Radio astronomy is already in a position to provide worldwide, interference-free radio and TV communication. In developing this application, it has made good use of moon and ionosphere—an electrically charged layer 25 miles up—as relays to bounce its microwave signals off. Recent experiments indicate that once our forthcoming giant radio telescopes reveal enough about what is under its cloud atmosphere, Venus too may play a part. So will man-made satellites, spotted in permanent orbit to act as relays when the moon or other heavenly body is not in position.

Neither military nor peacetime gains would have been possible, in all likelihood, if during the decade of American inertia radio astronomy had not had as champion a brilliant Chicago radio engineer named Grote Reber. Convinced that Jansky's find was epochal, Reber vainly needled fellow scientists to do something about it. They pretended he didn't exist. The self-described "stubborn Dutchman" thereupon built his own dish antennas—now operated by the National Bureau of Standards—and made priceless pioneering observations while children bedeviled his instrument, nosey pilots deafened him by accidentally flying down his invisible beam, and the neighbors muttered about what they thought was an oddball machine for controlling the weather. Till 1942, Grote Reber was the only radio astronomer in the western hemisphere.

That year the British ran into a 2-day blackout of anti-aircraft radar. At first they thought it was a new Nazi jamming device. When they discovered instead that it was radiation from violent storms on the sun, they were relieved—and secretly excited. They kept their excitement a secret till World War II ended, then stepped up their investigation of extraterrestrial radiation. At first they made do with surplus radars. But the work was too vital. In 1951, austerity or no, England took the lead at one stroke by erecting the world's biggest radio telescope, the University of Manchester's 250-foot-diameter behemoth, in a cow pasture at Jodrell Bank. Australia, Holland, Belgium and the U.S.S.R. were not far behind. Only the United States lagged.

But not by much. At this writing, although the Russians are said to be building a 350-footer, we are about to steal the show for a long time to come with the Navy's 600-foot instrument at Sugar

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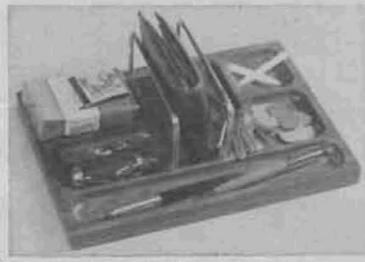
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Grove, Va. This monster, completely steerable like the British one, is scheduled for completion by 1961 at a present estimated cost of \$79 million. It is located in Sugar Grove, a mountain village of 250 souls, because after Navy had scoured the nation for 5 years with an electronic caravan, Sugar Grove proved to be the find for minimum man-made and natural radio interference. It also has fewest hurricanes, tornadoes and earthquakes. For these same reasons, the National Science Foundation is building a 140-footer only 30 miles away, at Green Bank, W. Va.

Not to say that this relatively balmy region hasn't any radio interference. Though the Federal Communications Commission has laid down a 1,000-square-mile "radio quiet" zone around both telescopes, and the Federal Aviation Agency is re-routing commercial aircraft and re-locating radio beacons, such delicate instruments could still be thrown out of kilter by a defective neon sign.

The U. S. Naval Research Laboratory, which is in charge at Sugar Grove, has therefore taken precautionary steps against the day when the two great installations, with their staffs, families and suppliers — not to mention tourists — swell the local population to 5,000 and more. To handle the attendant increased need for electric power, Navy engineers have already set up a program, under special West Virginia legislation, to help farmers, businessmen and homeowners within a 2-mile radius to "adjust, modify and repair" their power equipment to avoid interfering with either of the big radio eyes. That includes everything from switchboards to TV sets, thermostats to electric blankets, X-ray machines to car ignitions, radios and electric shavers. The Navy will bury its own telephone and power lines and locate its shops 4 miles away. The Green Bank facility will almost certainly follow suit.

Taxpayers made nervous by seeing the military take over on such a scale can relax, for the most part, because of two kinds of supervision that were in being from the start. First, the Sugar Grove Technical Director is a civilian, 41-year-old James Hugh Trexler, a non-college-graduate electronics genius who, in 1954, was the first man to bounce his voice off the moon. More important, Congress has kept and is keeping a sharp eye on the whole operation. Only last spring House members held additional appropriations hearings to find out, among other things, 1) why the Navy figured to need almost 10 times as much money for its total facility as

(Continued on page 37)

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VOICES

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the National Science Foundation would spend for Green Bank, and 2) if the two instruments didn't pretty much duplicate each other. For security reasons on the Navy project there had to be considerable technical discussion off the record, but the upshot was that the taxpayers' watchdogs came away satisfied. With Foundation testimony in support, it all added up to the Navy's legitimately needing the sums asked for, and there being practically no duplication between the basic research aims of the Green Bank Telescope and the top-secret defense goals of Sugar Grove.

Taken together, this pair of advanced-design telescopes will comprise the largest radio sanctuary on earth. Green Bank will function as the National Radio Astronomy Observatory under Associated Universities, Inc. (AUI), the same team of 9 eastern universities which operates the atomic research facility at Brookhaven on Long Island. Sugar Grove will be known as the Navy Research Radio Observatory. Its 600-foot-diameter aluminum-and-steel reflector alone will weigh 20,000 tons — more than one of the Navy's missile-toting-destroyers—and will penetrate a breath-taking 38 billion light-years into space. That is 19 times further than Palomar can peer, or 228,000 billion billion—228,000,000,000,000,000,000,000,000 miles.

Since a manned rocketship at escape velocity—25,000 m.p.h. or say 70 miles per second—could not reach the nearest star other than our sun in less than 12,000 years, the workaday citizen is tempted to say so what? Why all this expensive reaching so obviously beyond man's grasp? The answer is in man's insatiable thirst to *know*.

The Navy instrument, when not focused on purely defense objectives, may solve the physical riddle of what kind of universe we inhabit. Is it an "exploding" model formed by the bursting, 5 or 6 billion years ago, of a single primeval atom containing all matter, as Abbé Georges Lemaitre theorized in 1931? If so, the edges of that explosion should become definable between 5 and 10 billion light-years out—and this the 38-billion-light-year Sugar Grove telescope can easily ascertain. But then, what lies beyond?

Or is the universe a "steady state" proposition, as more recent sky scholars like Britishers Hoyle, Gold and Bondi maintain? Is new matter constantly being created to provide a balance for what gets used up, so that we dwell in a physical equilibrium without limits? If fineness of tuning in these new space-probing devices can determine whether

(Continued on page 38)

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FROM WEST GERMANY

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38mm. Unbreakable lenses. Brings in distant objects, animals, people, etc. Synchronized center focusing. Full-size binoculars. Free shoulder straps and lens cloth. Send check, cash or money order for prompt FREE delivery. Sorry, no C.O.D.'s. Money back guarantee. Sold only by mail, only by THORESEN, Inc., Dept. 116-M-78, 585 Water Street, New York 2, N. Y.

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Patented
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Saves Time — Saves
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Back!

Push it like a vacuum cleaner! No lifting, no stoop! Clears snow in minutes instead of hours from any surface—even gravel or dirt. Slides on sleigh runners. Handles heaviest snow. 18" steel blade, 54" no-stoop handle. Weighs less than 5 lbs. Only \$4.95. Postage paid. Same price in Canada. No COD's at this low price, please. Satisfaction guaranteed or money back.

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PERFECT GIFT!

\$495
postpaid

CATHOLIC ADS

Continued from page 15

all because of the help given her by the Knights of Columbus.

"This time last year," says a Culver, Indiana, woman, "I would never have dreamed of becoming a Catholic. Now I really wish to do so, and all because of one of your advertisements in a magazine I was reading. I had considered myself a good Christian until I started reading your pamphlets. Now I realize how wrong I was."

Ronald M. Teer, publicity chairman of Mater Christi Council No. 3352, Williamstown, New Jersey, calls the Religious Information Bureau, "of ours one of the greatest features of the Knights of Columbus."

Letters received in response to our advertisements are predominantly from people interested in the Faith. Only rarely are any received that attempt to debate the doctrinal claims made in the ads. But now and then one undertakes to criticize for other reasons, such as the woman who resented the Supreme Convention's resolution protesting the laying of the U. S. Capitol cornerstone with Masonic ceremonies. That, she said, was bigotry.

VOICES

Continued from page 37

the hydrogen atoms scattered thinly throughout the universe are themselves generators of radio waves, and hence "hot," it will be evidence that new matter is being created in this colossal thermonuclear reactor called the cosmos. On the other hand, it may be that the outermost galaxies, receding from us at a speed which increases with distance, will attain the speed of light at 10 billion light-years and so never be able to get their radio signals back to us—like the runner on Eddington's expanding track, for whom the tape recedes faster than he can run.

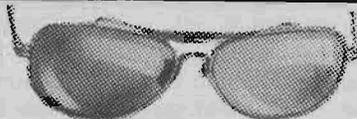
Finally, it may be that the new radio astronomy will reveal that the universe curves back on itself, either like the inside of a globe or in reverse like a saddle. In that case man may find himself, after much sublime effort, one with the Arabs, who have for centuries gazed on the stars and beyond them seen, simply, God.

Nonetheless, thanks to Karl Jansky, the maser, and other more startling achievements to come, mankind is now on the verge of drawing reverently as near as we are likely to come in this life

(Continued on page 42)

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Now you can IMPROVE your NIGHT vision and ELIMINATE dangerous GLARE at once with this amazing new invention—LITENITE NIGHT DRIVING GLASSES. These remarkable glasses are made of special amber lenses that let through INFRA-RED light. INSTANTLY you see more clearly! Headlamps of oncoming cars look like soft amber lights—yet everything else is in sharp focus. Amazing, unbelievable until you actually put LITENITE on!

Not This — But This



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NEW LARGE MODEL FOR ALL MOTORISTS **Flashy**

- Flashy is the red warning light that may save your loved one's life.
- Flashes approximately 72 times per minute—can be seen for considerable distance.
- Always ready—plugs into cigarette lighter socket with cord to reach all parts of the car—no batteries to wear out.
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UNIVERSAL STAMP SERVICE

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COLUMBIA

COLUMBUS

Continued from page 39

Next to be considered of those attributes of Columbus from which he drew constant strength and from which we may draw beneficial example, are his courage and perseverance. The detailed story is too well known to make it necessary to rehearse here the numerous rebuffs he experienced while attempting to interest the various sovereigns of his immediate world in his dreams of exploration. What commands our attention and admiration is the strength which he drew from sources deep within himself that permitted—no, drove him to return again and again, undismayed. Only a man of extraordinary courage could have returned repeatedly to those who, in some cases, indicated a more than slight belief that his mentality was not what it should be and expressed their belief bluntly and vociferously. Only a man of unfathomed perseverance would have ignored the obvious hostility which radiated from some of the most prominent and influential scholars of the day when they did all in their power to discredit both him and his proposed project.

Incorporated in the saga of Columbus the seeker of the truth will find shining examples of many more of those values of which the world of today is in such desperate need and assurance. He will find apparent Columbus's inherent sense of justice, so often abused; his loyalty to, and deep awareness of, his family responsibilities; his almost stark self-discipline which earned for him the plaudits of even his severest critics; his foresight which, in his time, gained for him only the gibes and sneers of those less gifted; and finally, his painfully earned, carefully preserved, but generously communicated, knowledge.

For 77 years, the members of the Knights of Columbus have been aware of the responsibilities which devolve upon them of maintaining an unblemished record of sustaining for posterity the eternal values bequeathed to them by their founders through their choice of Christopher Columbus as their Patron and as their example of a way of life.

It is with this thought in mind that on this 467th anniversary of Christopher Columbus's discovery of our world, I cordially invite you, on behalf of the members of the Knights of Columbus, to choose him for *your* patron. We would share with you those eternal values which we have grown to appreciate and which we know will bring to you a sense of peace, assurance, and achievement in a world where peace and achievement are the reward of those only who are willing to work and sacrifice for them.

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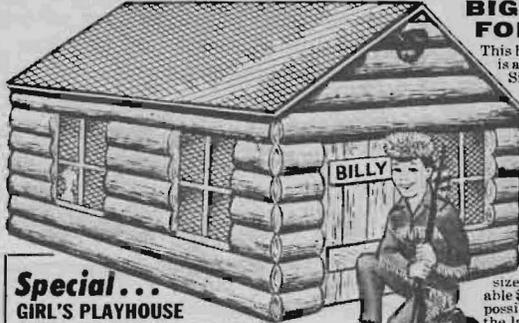
NOVEMBER 1959

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Special... GIRL'S PLAYHOUSE NOW AVAILABLE!
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Attention Council and fund raising secretaries: 40% off above prices in lots of a dozen or more.
STADRI CO., Dept. C-11, 6 Ave., Whitestone, N. Y.

VOICES

Continued from page 38

to what the English poet Henry Vaughan may have had intimations of when he wrote, during the century that saw the birth of the optical telescope.

"I saw Eternity the other night
Like a great ring of pure and endless light."

NATIONAL SHRINE

Continued from page 7

zen to be canonized.

Dominating the north wall is a huge figure of Mary, the Immaculate Queen of the Universe. On the same wall are set smaller figures of great defenders of the Faith.

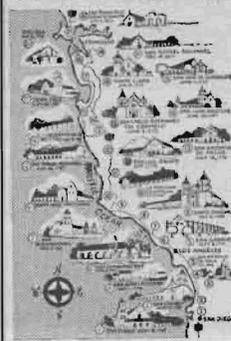
The two huge figures of the Blessed Virgin—Mary Immaculate on the south wall and the Immaculate Queen of the Universe on the north wall—are the work of the world-famed sculptor, Ivan Mestrovic. They are already thought by some critics to be perhaps the crowning works in the career of the 76-year-old artist, an exile from Yugoslavia. Mestrovic, however, is by no means the only well known religious artist whose work is to be seen on the walls of the Shrine. Others represented there include John Angel, known to millions through his sculpture in St. Patrick's Cathedral, New York; George Snowden, Pietro Montana, Adolph Block, Joseph Fleri, Lee Lawrie, Thomas LoMedico and Ulysses A. Ricci. Altogether, the exterior of the building bears 137 main sculptured items of ornament, as well as scores of inscriptions.

While the Shrine will be substantially complete by the November 20 dedication date, the work of finishing it remains a task for future years. The great beauty of the famous crypt church, however, gives a hint of what is to come. One principal feature of the interior decoration will be complete by November. This is a huge mosaic, which will cover the entire wall of the upper north apse, directly behind the main altar. It will be the largest single mosaic in the world and will depict Christ, the Almighty King, or "Pantocrator," the Greek word for this title. The mosaic is the work of Polish-born artist, John de Rosen.

"A masterpiece of religious architecture . . ." The words of Pope St. Pius X were first written in a spirit of hopeful optimism and glowing enthusiasm. Now, the great National Shrine of the Immaculate Conception stands as testimony that they are today only a simple statement of fact.

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\$1.00 ppd.

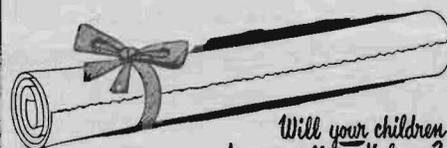
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