GENERAL SCIENCE

# California

## Science Service Medical Writer Takes a Vacation By Visiting Laboratories of Astronomy and Physics

By JANE STAFFORD

BARON GRIMM, the man who wrote Snow White and the Seven Dwarfs, had a world-famous idea about a looking glass which has kept its appeal for little girls and grown women for several generations.

Modern astronomers with their real mirrors, however, have out-stripped story-teller Grimm by a much greater distance than the difference between the one-and-a-half-inch mirror in your vanity and the towering 200-inch reddish thing they told me was a mirror when they showed it to me in one of the "shops" at the California Institute of Technology. By way of identification, this giant looking glass is the mirror for what will be the world's largest telescope, to be mounted on Mt. Palomar, 200 miles to the south of Pasadena.

It might be very nice to look into a mirror that tells "who is the fairest in the land," especially if you have a sneaking suspicion, as Snow White's murderous step-mother had, that you are that fairest person. But think of looking into a mirror that turns back time as nothing else in the world can do, and that wipes out space with the speed not of lightning but of light itself. This is a mirror, moreover, that will thumbprint the farthest stars and at the same time give a clue to the structure of the tiny, invisible atoms which, bulked together, make up you and me and the sun and the stars and the 200-inch mirror itself and the tiny bit of glass in your vanity and everything else in the world.

### Related to Baking Dishes

This famous 200-inch mirror looks nothing like any mirror you ever saw or looked in. It stands about three times as tall as the average person. I looked down on it from a balcony at the end of a room that seemed as vast as a cathedral and even at that distance the thing—it is hard to call it a mirror after you have seen it—looked huge. It is made of Pyrex glass, related to but not the same as the Pyrex baking dishes.

I was warned I would be disappointed when I saw it. From the standpoint of a woman looking at a mirror, it is disappointing. It does not even look like glass. It has more the appearance of a huge circular slab of concrete which has had rusty water spilled over it. Of course, the mirror surface was turned away from me, but it would look the same from the other side at this stage, because it has not yet been polished. The scientists are still "figuring" it, meaning they are still measuring and calculating its size and shape and reflecting power down to the last fraction.

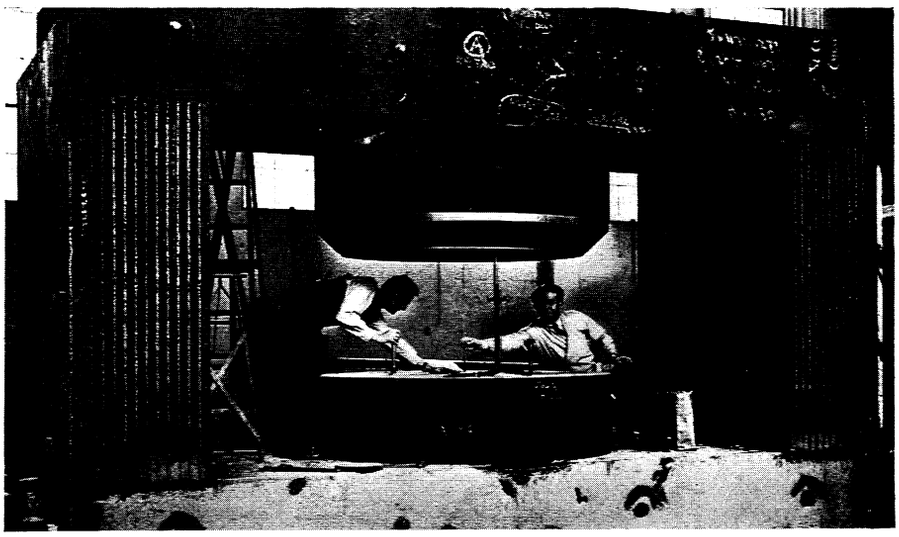
### Dustless Garb

Greatest care is being taken of it. No one except the crew working on it is allowed in the same room. Everyone else—even such distinguished visitors as former President Hoover—must view it from the same glass-enclosed balcony I stood on. The men working on the mirror must change from street clothes to special white uniforms and soft-soled shoes every time they enter the room containing the mirror, just as surgeons change before entering an operating room. This is because the slightest bit of hard material, even a grain of dust or sand, might spoil the giant mirror.

When it is finished and all polished, it will be the shiniest mirror in the whole world, I am sure, judging from the gleaming bits of other astronomical mirrors I saw lying about the shops at the offices of Mt. Wilson Observatory, not far away in the same city. Even when it is finally polished, I doubt whether anyone will look at his reflection in the giant mirror, and though rouge (jeweller's rouge) is used for the polishing, I am equally certain no woman will touch up her lips or powder her nose in front of this truly grand looking glass.

### To Catch Starlight

It will be used to catch the light from stars so far away that they could not be seen even by looking into the powerful telescope itself. These stars are so far distant that it has taken hundreds of millions of years for their light to come near enough our earth so that there is a chance it will be caught by the 200-inch mirror when it is finally mounted and turned toward the sky. While it will thus extend the boundaries of our universe some three times their present limits and open up an unexplored sphere about thirty times the volume of that which has already been sounded, its greatest value will lie in the new



*THE CYCLOTRON*

*This new atom smasher already promises discoveries of aid in the battle against human ills.*

knowledge it can give of already discovered objects in the heavens.

This new knowledge can be gained because of the greater aperture or light-collecting power of the 200-inch mirror over any other now in existence. Modern astronomers, you know, do not observe stars directly to any extent. The only times they even look through their telescopes are when they are focusing on some object. Instead they expose photographic plates and take pictures, through the telescopes, of the stars, moon and other heavenly bodies.

The pictures show far more than the eye can see through the telescopes, because the eye can only receive a relatively small number of light waves at a time. (If you remember your physiology, you know that you do not actually see objects but the light waves or rays reflected from them.)

Photographic plates, exposed for hours at a time, receive more light waves than the eye and store them up one on top of another so that very feeble waves or rays in time add up to enough to make a picture or visible image. The astronomer then studies this picture and sees on it hundreds of thousands of stars he could not otherwise see at all.

The 200-inch telescope mirror will not only show more stars but will give much clearer pictures or images of the ones already discovered. The astronomers then can learn more about gigantic and age-old stellar aggregations that lie far beyond the limits of our "universe" or galaxy.

### Starlight and Music Above

The place is a mountain in Southern California, over a mile high.

The scene is the lofty, pitch dark interior of the dome that houses the 100-inch telescope of the Mount Wilson Observatory of the Carnegie Institution of Washington. The steel plate floor clanks as you walk or stumble over it. All around you is a vast, mysterious blackness. A faint red light shows occasionally at one side. Looming high overhead is the gigantic steel-girdered open frame of the telescope tube. Through the open segment of the dome you see a piece of sky powdered so thickly with stars that it is hard to find an inch of unstarred sky. Through the air you suddenly hear music—not of the stars but the swelling strains of a symphony orchestra.

Then William H. Christie, the astronomer in charge of the Observatory for the week, tells you, as every other astronomer also insists, that observing (astronomer's term for star-gazing) is dull and tedious and that the real fun and excitement in his work comes at the desk in the Observatory offices down in Pasadena.

It is hard to believe that at first while you are under the spell of the telescope's glamorous setting. Later, after watching Mr. Christie observing for an hour or so with the 60-inch telescope, I began to understand that night after night of it might become tedious and that the radio concert was not just an extra bit of artistry to enhance the scene but a very welcome and useful diversion for the observers.

### Clanking Noises

First Mr. Christie and an assistant had to move the telescope from the position used for the weekly Friday night public demonstration to one focusing on the particular object Mr. Christie wanted to study. This took some little time, although it is of course all done by machinery down below, and there were a couple of hollow clanking noises which would have delighted a murder mystery fan.

Off to one side there is a special, very complicated looking but very accurate clock which together with some astronomical tables enables the observers to set the telescope at exactly the right angle for viewing a particular object at whatever time they choose on any night. They do not even need to look through the telescope to find the object, and in fact, for some very distant ones, they could not see it if they looked. But they know it is there at that particular location and that if observing conditions are good it will appear on the photographic plate.

When the telescope was finally set, Mr. Christie seated himself before the eye piece to find and watch a guiding star, and as he slipped an unexposed photographic plate into position, his assistant set an alarm clock, and departed down the stairs, leaving us in blackness. There were three of us there talking and asking questions, but ordinarily Mr. Christie or any other observer would have been left alone to watch, his head tilted back at a neck-cricking angle, until the alarm rang 45 minutes later. Sometimes the watching period is much longer, four or five hours, if the object under observation is very far away and its light so feeble that it takes much time for enough of it to accumulate on the photographic plate to make an image or picture.

After the alarm rang, Mr. Christie removed the plate and took it downstairs to develop it. The results, as he showed us, were disappointing on this particular night. The definition was not sharp enough. This was not a good night for "seeing," he said, explaining that there was too much motion in the upper air. Consequently the light rays from the distant stars would waver a bit before falling on the photographic plate, thus giving a blurred rather than a clear image.

The astronomer working at the 100-inch telescope was probably having an even duller, more tedious time. He was not using the telescope for photographic observation but for spectroscopic observations.

Because of the motion of the earth, the giant telescopes must be moved slightly in the opposite direction to keep a particular star constantly in focus. The telescope is set so that a bright star is centered where two fine lines seen through the eye piece cross, and the observer must keep that same star always right on the center of the cross.

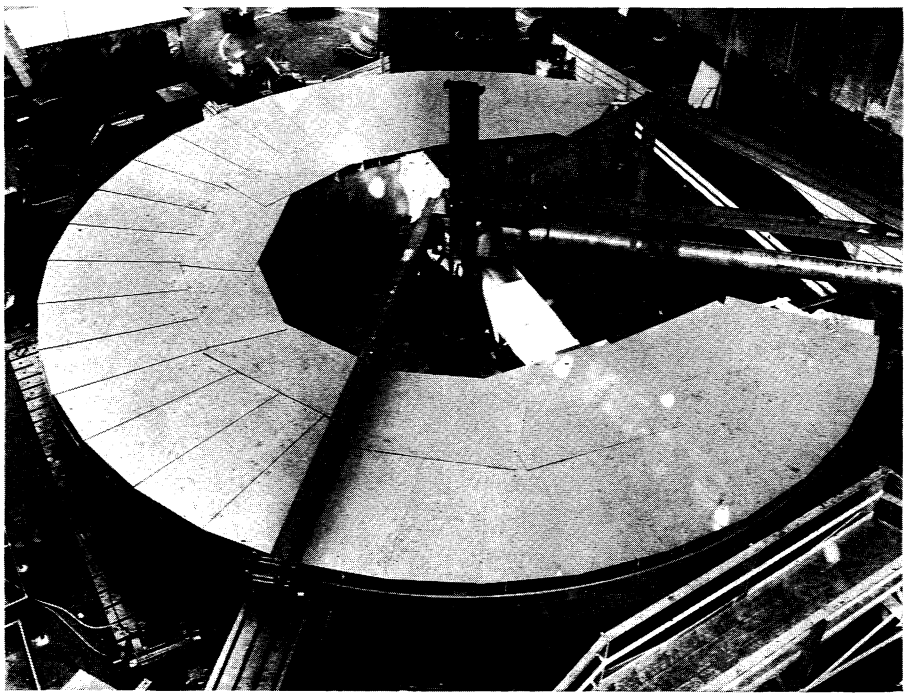
It is easy enough to keep the telescope turning by turning a small hand wheel, but to sit watching one star and those cross lines for four solid hours is something else—especially on cold winter nights. Yet that is what the spectroscopic observer must do.

The results of this work are photographs of black vertical bands of various widths. To the layman they look pretty dull, but the scientist reads much of importance in these bands. They are really photographs of the spectrum of a star or nebula or other astronomical body. Most familiar spectrum is the sun's, which we know as the rainbow.

### Human Touch in Physics

The most striking thing about the radiation laboratory of the University of California at Berkeley is, to me, the humanness of the place.

Here is a gigantic and powerful electro-magnet weighing 75 tons, but soon to be dwarfed by a 215-ton one when the new cyclotron is built. Here is the cyclotron, chief scientific wonder of an age of scientific wonders. Here invisible atoms are smashed, rays more powerful than X-rays are generated, here the old alchemists' dream of transmuting the elements is made to come true, the chemistry of our school days is revolutionized, and here, perhaps, will come aid for conquering some of mankind's most baffling malignant diseases.



*UNDER GIANT SUNBONNET*

*The great bearing for the 200-inch telescope was protected from the sun's heat as the finishing touches were placed on it.*

I walked into the wooden building with a feeling of awe that was not lessened by the sight of enormous pieces of unfamiliar machinery and complicated wiring, nor by the knowledge that probably each of the shirt-sleeved men who looked like garage mechanics and were working ten times as hard and fast, was a doctor of philosophy with important scientific achievements to his credit.

Four hours later, after having talked to Dr. E. O. Lawrence, who invented the cyclotron, and after having it all explained by Dr. Donald Cooksey, who works with Dr. Lawrence, and Dr. Joseph G. Hamilton, who is in charge of the medical angles, I came away amazed not only at what is being done and what may be accomplished, but at the simple, folksy atmosphere and the friendly, genial spirit that pervades the place.

### Children Watch

For example, there is the story about Dr. Cooksey and the small boys. Almost every day after school a number of 12- and 14-year-olds can be seen, noses pressed to the windows, eagerly watching the activity inside. Whenever he has time, Dr. Cooksey said, he calls them in and shows them around, explaining the cyclotron and answering their questions. Late one night as he was leaving he found a high school boy and his girl, out on a date, who had come down to the Radiation Laboratory to watch through the windows. Late as it was, Mr. Cooksey brought them inside, too, and talked to them.

### Physicists of Tomorrow

The questions these children ask show, Dr. Cooksey said, that theirs is no idle curiosity but an intelligent interest in what is being done in the laboratory. He attributes this to such influences as Buck Rogers cartoons. He believes that as a result in another 10 years there will be a tremendous number of brilliant young physicists in the country.

Another human touch that made me feel more at home was the little boy's express wagon which I saw standing next to the cyclotron and which apparently is used to haul small but heavy material around. This use of a perfectly common, every day sort of object as equipment in an important physics laboratory fitted in with Dr. Cooksey's evident pleasure in telling how they buy pistons from second-hand trucks and remodel them in their own shop to fit a special part of the apparatus. He talked about this piece of economic ingenuity just as proudly as a woman might tell a friend about her success in remodeling last year's dress.

Later when we were standing near the furnaces in which the pistons are melted down, he said the noise always reminded him of Lorna Doone—the part of the book which describes one of the characters hearing a strange noise at night and knowing it meant that the Doones were up to mischief on the moors.

The cyclotron itself is surrounded by three-foot thick gray-painted water tanks to protect the staff from the powerful rays generated when atoms are split, so that it looks like a turret of a battleship. It is surprising to find how many of the impressive pieces of apparatus are not, in a sense, essential parts of the cyclotron but are needed to protect the staff or to keep the apparatus cool, or to operate the (*Turn to Page 92*)

ASTRONOMY

## Grind Giant Bearing For 200-Inch Telescope

**See Front Cover**

THE HUGE 317,000-pound horseshoe-shaped bearing for the 200-inch Mt. Palomar telescope has just been ground and polished until its surface is true to within five one-thousandths of an inch.

Nearly as perfect as mechanical science can make it, the bearing soon will leave Pittsburgh on the long water passage which will take it down the Ohio and Mississippi Rivers, across the Gulf of Mexico, through the Panama Canal and back up the Pacific to San Diego. From there it will be transported slowly up Mt. Palomar to come to rest in its new home at the observatory of California Institute of Technology.

Engineers at the Westinghouse Electric and Manufacturing Company in Pittsburgh were able to obtain the high accuracy of grinding surface only because they built a huge "sunbonnet" that shaded the bearing and reduced the swelling and shrinking of the enormous block of steel under the sun's rays.

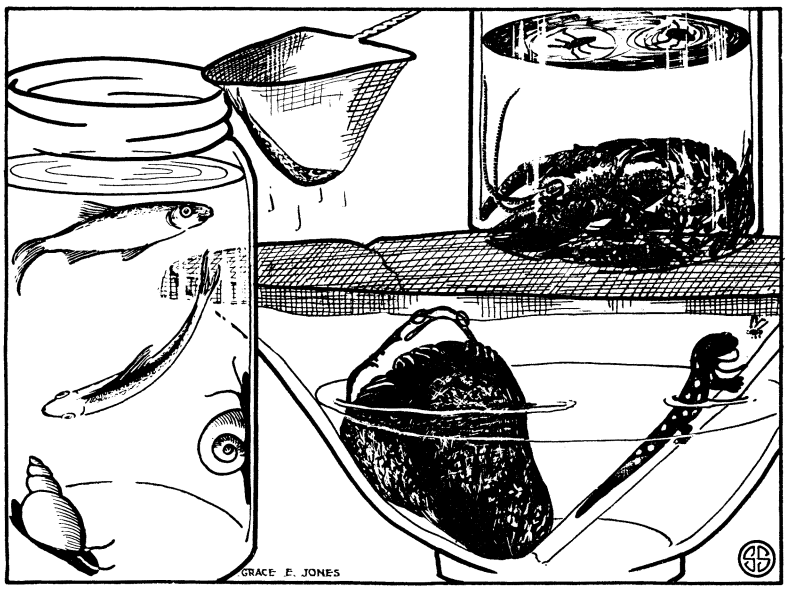
It is estimated that the grinding machines traveled over seven miles of surface in smoothing the bearing.

The cover picture of SCIENCE NEWS LETTER this week shows Westinghouse engineer Dr. Stewart Way making the final inspection of the surface on the great bearing.

## Inexpensive Summer Fun

# To Bring 'Em Back Alive Is Fun For You, Too

(Eighth of a series of 12 articles. Next week—Collecting Birds' Nests)




*LIVE COLLECTION*

***You don't have to be a tropical explorer to bring 'em back alive. An aquarium will do nicely. Nor are fish the only marine animals that make interesting pets. Whatever you do, try to make your aquarium reproduce as nearly as possible the environment of your specimen before you captured it. And when you are through with your pets, give them their liberty again.***

BRINGING 'em back alive is not an exclusive privilege of explorers in the tropical jungles. Anybody who is doing a little collecting may quite reasonably wish to keep some of his specimens alive and wiggling. Many forms of animal life may be kept that way without any discomfort to themselves, and with considerable interest to the collector.

While it is possible to capture small wild animals like field mice, squirrels, and even skunks, and to bring them to some degree of tameness, nevertheless perhaps the easiest creatures to keep are those that live in water. Most of these creatures are more easily observed if kept in a jar of water on a table or windowsill than they can be in their native haunts, where all too often they hide in the mud or stones or dead leaves on the bottom.

The inhabitants of your aquarium collection may be quite various—small fish, frogs, turtles, snails, mussels, crayfish, water insects; on the seashore small crabs and other crustacea, sea anemones, live starfish and sea-urchins, etc. In general, anything that swims the lesser waters or clings to rocks or burrows in the bottom can be included. It is best to collect things that live in the warmer, quieter pools, because the livelier cold-water or deep-water forms are less likely to survive in the kind of living quarters you can give them.

What you keep your water-loving pets in is less important than how much water you give them.

A discarded glass bowl, or the ubiquitous glass fruit jar, will make a proper enough aquarium, and even an ordinary tin can will do for many of the smaller bottom-dwelling forms that are heedless of light or avoid it. But there must be plenty of water, and the water must be changed fairly frequently, to keep it reasonably clean and fresh.

When you are changing the water, don't dump it all out, and your specimen along with it. Just pour all of it off except for the bottom inch or so, then quickly refill with fresh water. And don't put a solid cover over the top, ever. Water animals need air just as you do, except that they get it dissolved in the water. Covering the jar with a lid prevents air from getting to the water surface in sufficient quantity.

When you want to examine your crayfish or baby snapping turtle more closely, the best way is to empty the contents of the jar gently into a large pan with a white bottom and take away the dirt and leaves he likes to hide in. After you have studied him as long as you like to, put him back in the jar again, with the rubbish he loves.

And by all means, after you have kept your pets for a while, take them back where you got them and turn them loose again. That's the fairest and most humane thing to do.

**For more information about collecting for aquaria and a list of books and pamphlets on the subject, send us a postcard with your name and address. Ask for Bulletin 8. Address Science News Letter, 2101 Constitution Ave., Washington, D. C.**

*Science News Letter, August 6, 1938*

## From Page 87

magnet or for other controls. The control board itself is in the outer room, and seems to have dozens of dials and switches on it.

Not being a physicist, I shall not try to explain how the cyclotron smashes atoms of matter, nor how it endows sodium, familiar to us all in our table salt, with radioactivity, nor how it changes an atom of one element into another element. Physicists are interested in these achievements because of what can be learned from them about the structure of the atom and similar abstract but important matters.

Medical research is also going on at this Radiation Laboratory, and perhaps the efforts to develop better weapons for fighting disease and relieving human suffering account in part for the human touch which I felt everywhere in the midst of the awesome machines and physical apparatus.

A number of mankind's worst disease enemies, among them cancer, heart disease, and leukemia, may find themselves smashed by the cyclotron along with the atoms that are disintegrated in this new, powerful tool of modern physics.

### What Does the Train Say?

Nursery lessons will have to be revised.

The answer to "What does the cow say?" is still "Moo." The duck still says "Quack-quack." But what does the train say?

Trains of the modern world do not say "Choo-choo." They say "Hmmm." The soft purr of clean, oil-fueled Diesel engines that swallow up the miles without a puff or a snort.

Without a jolt or a jar, either. We pulled out of the station at Los Angeles so smoothly I did not know we had started until I looked out of the window, and it has been the same at each of the few stops so far. You don't have to hold on while you are brushing your teeth on this train, either. She cruises along at 90 miles an hour (120 on the open flat stretches) but the engineer is considerate about curves.

"Have to be careful not to spill the wine back there," our first engineer, E. R. Bailey of Los Angeles, said laughingly as he slowed for a curve coming through the mountains.

Through the courtesy of the Union Pacific Railroad officials, I was sitting right up there beside him, watching him operate the longest and most powerful Diesel locomotive in the world.

The 17-car train is nearly one-quarter of a mile long. The locomotive itself is 210 feet long and consists of three power cars, each equipped with two 900-horsepower, 12-cylinder Diesel-Winton engines. A total of 5,400 horsepower. The covered wagon pioneers had to depend on the power and speed of two horses or more likely two oxen to draw them across the continent.

### French Dinner

Right after dinner, a French dinner totally unlike the typical train meal, the conductor escorted me forward to the locomotive. He told me to wear old gloves and as we entered the first power car, gave me a piece of waste for additional protection, but everything was so clean I really did not need it. No dust, no dirt, no cinders, not even the grease and oil I had expected to see. It was blazing hot, however. The conductor said that when he had brought Deanna Durbin up a few nights earlier she got cold feet when she felt the heat.

He took me by the hand and hurried me along a narrow corridor barely two feet wide between the outside of the car and the engines, first passing by the boiler for heating water for the train and for heating the cars in winter, the air conditioning apparatus, and the double set of batteries that furnish lights for the train. Although there are two complete sets, only one is used, the other being there for emergencies.

There are two electrician-mechanics to care for the engines and electrical equipment. Unlike the engineer, fireman, brakeman and conductor, these two men are on the train for its entire run, working day and night shifts. The rest of the crew, which often includes a supervisor, is changed every few hundred miles.

### Cool and Airy

Finally we climbed up three steps into the cool, airy, clean cab and the engineer invited me to sit in his seat and to pull the whistle cord—two long and two short. That was a moment to be envied by all the small boys of my acquaintance, including some who are now grown men.

The locomotive controls at the engineer's left reminded me of those on the old electric automobiles. There are two, the upper one for forward speeds, and the lower one for reverse. There is a lever to operate the mechanism that spills sand on the rails when they are slippery, and, because of the high speeds attained, there are two braking systems besides the deadman pedal under the engineer's foot which stops the train if the pressure is withdrawn. A tiny noise, Ping, tells the engineer every time the contact between each brake and wheel is made.

### Grand View

After I had been shown all these controls, I moved over into a comfortable high leather seat with a grand view through the wide V-shaped windshield and Mr. Bailey, the engineer, slipped a fresh cigarette into his holder while he and the supervisor, B. J. Ayers, explained other things to me.

They explained about the block signals whose beautiful emerald green lights shone every mile, or half-mile down the track. I saw these lights change to red as we sped past. They pointed out rock fences at the foot of towering mountain cliffs. These are between the mountain sides and the rails. They are wired so that if a rock slide starts, the first fragment hitting these fences sets all the block signals to red,

which tells the engineer to stop the train.

Speaking of stops, this train has, among other records, that of making the longest non-stop passenger run in the world. This is the 325 miles between Caliente, Nev., and Salt Lake City. Non-stop means not even a stop for servicing the train or receiving orders.

They had me guess at the speeds. I did pretty well at first—watched from the side windows and tried to think of an automobile's speed, and guessed 50 miles an hour when we were making 56. A little later they asked me again, but I was way off that time. We were riding so smoothly it hardly seemed any faster, but the speedometer showed 92.

It was so lovely riding up in the cab that I hated to leave. There was a cool, clean breeze coming through the windows, which, incidentally, operate like those of an automobile, including non-draft features. And of course, there are windshield wipers, defrosters and sun shields, and it is heated in winter. Quite a contrast to the sooty, cold, uncomfortable cabs behind the steam locomotives from which the engineer has to lean out of the window most of the time to see the track ahead.

The same contrast between the old and the new in trains is seen and quite literally felt in the rest of the streamliner. Travel luxury seems to have reached its acme on a train like this. All of it, of course, is due to the engineering scientists who developed not only Diesel engines for smooth speed but also air conditioning which makes you comfortable and permits the interior decorator to introduce beauty and novelty into the surroundings.

*Science News Letter, August 6, 1938*

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More than 44,000 children have been measured so far in the effort to determine standard sizes for clothing.

PHYSIOLOGY

# Calves Found to Gain Weight On "Indigestible" Nitrogen

## Findings May Mean That Livestock Benefit From Increased Nitrogen After Fertilization of Pasture

PRACTICAL results of great importance to the livestock industry may come from experiments at the University of Wisconsin, in which it has been shown that calves can gain weight on forms of nitrogen not supposed hitherto to be digestible and assimilable by animals.

The work was done by a three-man team: Prof. E. B. Hart, H. J. Deobald, and Dr. G. Bohstedt. They used four male calves. One of the animals was kept on a low-protein ration, as a control. Another was used as a second control, receiving a conventional ration of milk protein in addition to the low-protein ration.

The other two received supplementary diets of simple nitrogen salts; the first getting ammonium bicarbonate and the second urea. These are the salts supposed to be of no value as stock feed. Yet the animals did gain weight on them, 105 and 110 pounds respectively in 14 weeks. This was intermediate between the small gain (65 pounds) shown by the low-protein calf and high gain of 126 pounds by the calf receiving the milk protein.

What caused this gain is a physiological riddle for which the three experimenters do not at present venture an answer. It may be possible that bacteria in one part of the calf's multiple stomach transformed the simple compounds into more complex ones, digestible by the animal. Then, when the bacteria passed on into another section of the stomach, digestion may have occurred in the ordinary way. But this explanation is as yet only conjectural.

It will be necessary to carry on more extensive feeding trials before the full economic possibilities of this pioneer research project can be developed. However, at least three lines of possible significance are indicated:

(1) Livestock probably benefit from the increased nitrogen content which fertilization produces in pasture grasses, quite apart from their higher protein content and better yield.

(2) The feeding value of the newly developed silage made from alfalfa plus molasses may not be seriously injured by the breakdown of part of its protein into ammonia compounds, through bacterial fermentation.

(3) It may eventually be found practical to use such relatively simple nitrogen compounds as ammonium bicarbonate and urea to replace part of the higher-priced protein supplements in present-day stock rations.

*Science News Letter, August 6, 1938*

## • Radio

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