AWARDED NOBEL PRIZE—In 1940, Dr. Selman A. Waksman, of Rutgers University, showed this plate to members of the National Academy of Sciences meeting in Washington. It shows one of his early experiments in obtaining germ killers from the soil. At that time the* SCIENCE NEWS LETTER *(May 4, 1940) reported: "Conquest of the entire world of disease-producing germs seems possible as a result of the discovery . . . of germs in garden and field soil which destroy disease germs of the gram-negative group. Disease germs of the gram-positive group can also be destroyed by chemicals extracted from germs found in soil."

MICROBIOLOGY

Nobel Prize to Waksman

Award in medicine and physiology goes to Dr. Selman A. Waksman, Rutgers University discoverer of streptomycin and other antibiotics. Discoveries revolutionized medicine.

➤ THE AWARD of the 1952 Nobel prize in medicine and physiology to Dr. Selman A. Waksman of Rutgers University, discoverer of streptomycin and other antibiotics, will give added support to the Institute of Microbiology now building in New Brunswick, N. J.

For Dr. Waksman is a down-to-earth scientist whose greatest desire is to continue investigations upon the microorganisms and their effects that have revolutionized medicine, industry and agriculture. He will add the approximately $33,000 Nobel prize money to his share of streptomycin royalties that he is, for the most part, plowing back into research upon microorganisms.

The faculty of the Caroline Medico-Surgical Institute, Stockholm, which awarded the Nobel prize to Dr. Waksman, cited him for "his discovery of streptomycin, the first effective antibiotic against tuberculosis." The prize will be presented by Swedish King Gustaf Dec. 10.

The development of Dr. Waksman's researches that are honored by the Nobel prize is told in this account officially prepared in connection with the Institute of Microbiology:

Streptomycin, which has proved a miracle drug of even greater potentialities than penicillin, was isolated in September of 1943. But the work which made its discovery possible had been under way in Dr. Selman A. Waksman's laboratory at the College of Agriculture, Rutgers, since 1915.

The search at New Jersey's State University for an antibiotic substance which would have the power to destroy or weaken microbes dangerous to man and animals actually began in 1939. It was preceded by long and valuable work aimed at specific agricultural and industrial problems linked with microbes in the soil—their role in the decomposition of plant and animal residues in nature, their valuable work in making compost, in providing the necessary nutriment for the growth of mushrooms, in the manufacture of enzymes, in the production of sulfuric acid, in the ability of microbes to destroy steel pipes.

Underlying all work in antibiotics is the discovery by early researchers that certain varieties of microbes had the power to destroy others. Dr. Waksman had formally explored this phenomenon in its application to human disease in 1932 when, under a grant from the National Research Council, he undertook to study the fate of tuberculosis microbes when exposed to the action of the billions of microbes present in each handful of soil.

In 1939 he sharply altered the line of his former agricultural investigations and set to work on the development of microbial strains which would have therapeutic value for humans and animals. The outbreak of the war helped make his decision, as did the success of a former student and protege, Dr. Rene Dubos of the Rockefeller Foundation, in developing tyrothricin.

Dr. Dubos, who came here from France and was trained at Rutgers under Dr. Waksman, contrived the unbelievable feat of actually training a microbial strain to exist on pneumococcus microbes as food. He also successfully developed a practical method for reducing the antibiotic substances produced by these trained microbes to a powder. His work found immediate practical application in the treatment of various infections in man and in animals.

Dr. Waksman set himself two specific problems. One was to find a microbe with the power to produce an antibiotic capable of interfering with the growth of and destroying the hard waxy water-repellent walled microbe which caused human tuberculosis. The other was to find a microbe capable of destroying pathogenic (dangerous) microbes without harmful effects upon the tissues of the host, namely the human and animal body. Penicillin was discovered in England during the progress of the experiments and showed great power against one of the great microbial groups—the gram-positive forms (capable of being dyed with a certain stain). One of streptomycin's early predecessors of the same general family, namely streptothricin, indicated that it had promise in the other half of the microbial population—the gram-negative organisms.

From the beginning of his work in 1915, Dr. Waksman had taken particular interest in a variety of microbes known as actinomycetes. His work with this particular group of organisms is probably one of the longest continued researches by an individual upon a research project.

The Actinomycetes

When his new line of investigation began, he quite naturally used as laboratory material those organisms upon which he had worked so long. Back in 1915, Dr. Waksman and R. E. Curtis, then working under Dr. Jacob Lipman, isolated *Actinomyces griseus.* From a strain of this organism, now known as *Streptomyces griseus,* came the miracle drug streptomycin.

The diversion above serves merely to

illustrate the interconnections and long history of microbiological research. Though streptomycin was discovered in 1943, the basic knowledge which lay behind its discovery had been accumulating in one laboratory alone for almost 30 years. And its foundation in turn dated back to Pasteur, Koch and even far beyond.

Streptomycin's Predecessors

A year after the work began in 1939, its first result evolved. It was actinomycin, derived from Dr. Waksman's old friends the actinomycetes. It had remarkable properties to destroy microbes, but was almost as efficient at destroying living animals. It could easily have been used as an animal poison. Soon after actinomycin came clavacin and fumigacin. These as well were either too toxic or not active enough.

Rapid progress was made in 1942 when the announcement was made of the discovery of a selective agent which killed many bacteria and slowed to a stop the growth and reproduction of others. Christened streptothricin, it was streptomycin's direct predecessor. Its importance lay in the fact that it showed a murderous preference for gram-negative microbes, thus supplementing the gram-positive killing power of penicillin and tyrothricin.

Streptothricin showed great promise in the animal body. It successfully attacked varieties of bacteria that had resisted other agents and seemed not too toxic. Its bright promise dimmed, however, when it was found to have a delayed toxic effect—it wiped out the disease infection, but, days or weeks later, the animal succumbed to streptothricin itself.

But the trail was growing hot.

Needle in a Haystack

It is worth delaying here for a moment to consider the mathematical odds against emerging with the substance desired. They are beyond calculation. To begin with, the variety of microorganisms is infinite. Every type has its own variants. And every variant in turn can be altered by the tiniest changes in diet, temperature, agitation, or even by the shape of the flask in which it is grown.

As an example, one group of bacteriologists worked without success to duplicate an experiment performed in another country. They followed all directions, with microscopic precision, but never secured the desired result. After numerous attempts, the reason emerged. Specifications had directed growth at "room temperatures." In the country where the experiment had originally been performed, room temperature was a few degrees lower. The characteristics of the bacteria produced were completely different when the temperature was changed by even a few degrees.

Such were the complications that were involved in the search for a strain of microbes which would perform the tasks desired.

Dr. Waksman set in motion two types of exploratory testing. One involved literally starving the bacteria in a sample of soil, then introducing a dangerous bacterial strain. The method, used by Dr. Dubos in "training" bacteria determined whether the soil microbes could learn to exist upon the dangerous strains as food. This is necessarily a slow method.

Simultaneously, he started testing work with agar plates. This involved growing cultures of pathogenic bacteria, then dropping other living organisms (from the soil, manure pile or peat bog) into the culture. If a clear patch developed around the second group, it showed that the newly-introduced microbes were wiping out the hosts in their cloudy culture.

Mathematically it was possible for the endless search and testing to go on for years. Using such methods, he and his student Albert Schatz succeeded in isolating two individual promising strains of *Streptomyces griseus*. One came from the throat of a chicken, the other from a heavily manured field.

Good Against TB

Even more miraculously, the strains were effective on both the problems being attacked—against the armored tuberculosis bacillus as well as the general group of gram-negative types. Amid growing excitement, the tests went from test-tube to laboratory animals—still with almost universal success.

Heavy-yielding, the strains aroused great hopes, but were abruptly checked as the strains became less vigorous and yielded increasingly less streptomycin.

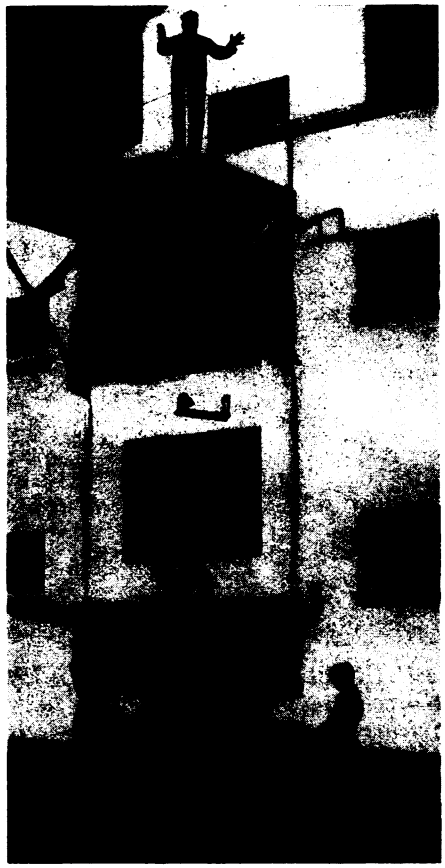
With intuition that came from recognition of the importance of the soil itself as the power plant of all life, Dr. Waksman finally planted these microbes in rich earth in the hope that new generations would regain their parents' strength. They did—and more. Showing their unpredictability, the microbes developed new strains, which were even more active.

But streptomycin was still months away from its first sensational conquests. Thousands of tests were still to be doggedly made. Endless searching went on for better ways to grow and purify and strengthen the product.

Finally tests were made upon live chick embryos and white mice—the Poultry and Animal Husbandy Departments laboratory nearby gave valuable assistance at this point since Dr. Waksman's laboratories did not have the necessary elaborate animal-testing facilities. The delicate embryos and small animals furnished ideal testing ground, both for the ability of the preparation to do its job and also to test toxicity.

Coming through with flying colors, the tests were expanded to baby chicks, guinea pigs, then finally, through commercial laboratories, such as Merck and Co., at Rahway, N. J., where many former Waksman students served, to the clinics.

Merck scientists improved the manufacturing processes still further, built a pilot plant for small-scale manufacture. Then finally, late in 1944, small quantities were released to the Mayo Clinic for tests. Later, as additional quantities from Merck's miniature factory became available, the Army joined the testing work. Other universities and hospitals began to amass test results.



FREE FALL—The man on the canopy has just dropped a tank with accompanying motion picture camera, shown half way down. During the fall pictures were taken, one of which is shown on the opposite page. The shots demonstrate that an object in free fall has no weight.

The secret of the miracle drug soon "leaked" out and the discovery of streptomycin and its medical miracles flashed around the world.

But streptomycin is not the end of the road. It has been followed by new antibiotics—grisein, streptocin, and finally neomycin. The potential of the latter has led to speculation that it may replace streptomycin—certainly it may prove to be an important supplement, since it is highly active against bacterial strains which seem to develop a resistance to streptomycin.

Science News Letter, November 1, 1952

Airplane engines today cost about $17 per horsepower.

Winter squash provides good amounts of calcium, iron and phosphorus in addition to several vitamins.