MATHEMATICS

Calculus Before Cannon

Mathematics Becomes Interesting When Applied As a Potent Weapon in Solving Pressing War Problems

MATHEMATICS, bugaboo of so many people throughout their schooling, is taking on new importance as a highly specialized but potent weapon in the national war effort. In fact calculus has to come before cannons if we are to design and build the finest armaments in the world in our fight against the Axis powers.

The nation needs men who can apply higher mathematics to many of the problems arising in war industries. Certain kinds of improvements in the complicated weapons we use await the basic work of mathematicians, especially in the field of aeronautics. These men must be trained, and trained quickly.

The seriousness of the situation may not be apparent to the average man, but the "critical lack" of experts in applied mathematics and mechanics in this country has been recognized by the Committee on the Survey of Research in Industry, appointed by the National Research Council and reporting to the National Resources Planning Board.

Before Hitler and the war, most work in applied mechanics—which is simply mathematics put to practical engineering use—was done in Europe, especially in Germany. Interchange of information was free and uncensored, and American industry was kept abreast of all important developments. Today all this is changed. Nations at war do not give away technological secrets.

Special Training Programs

This challenge to our ingenuity is not going unanswered. Half a dozen top-flight colleges and universities in the United States have set up special training programs to turn out men who know how to make mathematics work overtime for defense. It is new territory for us, but we are making progress.

Brown University has a program of instruction and research in applied mathematics and mechanics which is probably as broad and as comprehensive as any being offered today. Some 80 men have taken up the opportunity to learn how they can put mathematical knowledge to work. More men will be ready to take over special assignments soon.

Begun experimentally last summer, the program was launched as the first full-time venture of its kind in this country. Now Brown has a full-year course of study, which will probably be continued. Tuition is free, fellowships are available, and registrations are being accepted for the second semester. Dean Roland G. D. Richardson of Brown's Graduate School is in charge.

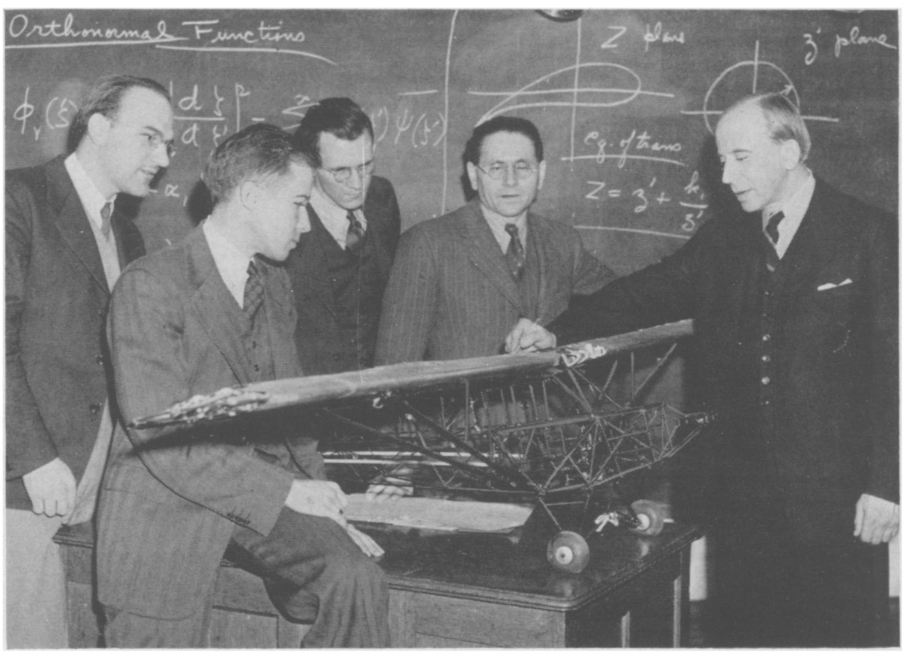
Essentially the applied mathematician fits into the wartime production picture as an efficiency expert. He understands the nature of engineering problems, and he has had intensive specialized training in the basic theories of higher mathematics. These mathematical tools equip him to solve certain kinds of industrial headaches expertly, with speed and exactness.

The applied mathematician waves no magic wand, nor can he say "open sesame" to every problem which the engineer meets, but when the applied mathematician and the engineer join hands, a good many mountains become mole-hills. Some problems ordinarily dealt with only by trial and error can be reduced to essential theories of higher mathematics. The engineer's costly experiments can frequently be cut short or eliminated. Defense can be speeded up.

Let's see what applied mechanics, or applied mathematics, is all about. It ties in with such fields as aeronautics, hydrodynamics, thermodynamics, elasticity, plasticity, electricity and magnetism. By its very nature it is a broad subject. Brown is treating the field very broadly and comprehensively, too, in its six courses and seminar groups.

One of the fields of engineering in which applied mathematics is especially valuable is dynamics. Dynamics is the study of everything that moves, from planets to electrons. Because this is a war of machines, Brown's work in dynamics is of course focused upon a practical knowledge of dynamics as applied to industry.

The theory of the gyroscope belongs in the realm of dynamics. There is much to be learned about this amazing instrument. It is used to steer torpedoes, and is



WAR APPLICATION

A problem in the theory of airflight is being discussed by Prof. Richard Mises (right) and Prof. Stefan Bergmann (center) with three future aeronautics experts.

MACHINE MATHEMATICS

Computing with calculating machines is being taught the advanced students who are also trained in graphical methods of applied mechanics, which will fit them for the kind of mathematical work required in war industries.

a key part of the "automatic pilot" and bomb-sights. At Brown, students are being taught the basic mathematical principles involved.

The problem of building the most efficient kind of ships involves questions like those of friction between water and a ship's hull, the energy spent in creating waves, and the push of a ship's screws. Behind all this lies the field of fluid dynamics, involving water-pressure, the behavior of currents, and other forces. The same field applies to conditions that planes meet in flight, with the air as the "fluid."

One aviation company in the United States is at work on problems connected with the physics and thermodynamics of aircraft heating and ventilating systems. The company wants to know more about heat balance factors throughout the induction system of carburated gasoline.

Another aviation concern is studying the dynamics of tricycle landing gears, the effect of wing deflections upon dynamic stability of planes in flight, and brake chatter for a wheel mounted on an axle flexible in bending and in torsion. These are all practical problems in dynamics where the applied mathematician could be of help, and are typical of the research on which the faculty and students at Brown are working.

The theory of vibrations belongs to the field of dynamics. It is easy for soldiers marching across a bridge to break step and avoid setting up serious vibrations which might make the bridge collapse, but it is not as simple to cut down serious vibrations in the complex machines of combat.

A typical problem confronting plane manufacturers is applying this theory to three-dimensional wing-flutter, a serious matter now that engines, cannon and other equipment are carried in plane wings. Vibration problems of a difficult nature have also come up in warships of various kinds. Modern battlewagons contain more machinery than any other vessels ever built.

Because every kind of material has definite elastic properties, elasticity is a key field of knowledge and is being treated accordingly at Brown. The theory of elasticity, with its far-flung mathematical ramifications, can be used to study such different problems as the twist of a ship's propellershaft, the expansion of a gunbarrel, and the bending of metal plates in aircraft during flight.

Engineers and designers of tanks, warships, cannons and bombers must know a good deal about the strength of materials, which is another way of describing elastic and plastic properties. They must be able to predict with mathematical exactness the initial buckling stress, the stress at which the buckles become permanent, and the yield strength and ultimate strength of the entire structure.

Airflight Theory

The theory of airflight was born after the Wright brothers had sent the first plane aloft at Kitty Hawk. Its modern ramifications include among other things the theory of air-wings and lift, pressure on wings and fuselage, and the theory of airfoils and propellers.

High speeds of modern planes bring about complications for the designer and engineer. One of these problems has to do with propeller efficiencies. At speeds approaching 500 miles per hour, engineers have found that radical changes must be made in propeller designs. Here is a field where applied mechanics can do yeoman's work.

To understand and use the theories of applied mechanics, the students at Brown must fly high into the rarefied atmosphere of the science. Their life-sustaining mathematical equipment includes a baffling array of signs and symbols amazing in their complexity. Because facility with these symbols and an understanding of their use is as important as a carpenter's knowledge of his tools, Brown is offering courses in partial differential equations and numerical and graphical methods of applied mathematics.

If Hitler's code and the war have done anything on the credit side for this country, it has been to drive scholars and research men across the Atlantic to the free colleges and universities here. The men who are teaching at Brown, including those who years ago refused to work with the Nazis, are among the best that Europe has produced.

There are Prof. Willy Prager and Prof. Richard von Mises, both of whom left Germany and went to the University of Istanbul when Hitler rose to power. Prof. Prager, in pre-Hitler days, was acting director of the Institute of Applied Mechanics of the University of Gottingen, structural inspector for the German Airsport League and scientific adviser to the Fiesler Aircraft Company, one of Germany's largest plane manufacturers.

Prof. von Mises' field is the theory of aeronautics. His research as professor at the Technological Institute in Dresden and as director of the Institute of Applied Mathematics at the University of Berlin was an outstanding contribution to the development of modern aircraft efficiency.

Prof. Stefan Bergmann is a Pole. Before coming to the United States he was an instructor and lecturer at the Institute of Applied Mechanics at the University of Berlin, and taught at the Technological Institute of Tomsk. Part of his research was done for the German Department of Airplanes. Prof. Willi Feller, a German, is the former head of the Institute of Applied Mathematics at the University of Kiel, and has taught for many years at the University of Stockholm.

From Canada has come Ireland-born Prof. John L. Synge, head of the Department of Applied Mathematics at the University of Toronto. Prof. Synge commutes by plane every week-end between Providence and his home city.

Prof. Jacob D. Tamarkin, a Russian, is one of the editors of *Mathematical Reviews,* an international journal of higher mathematics published at Brown. Before coming to the United States in 1925 he taught at the Electro-technical School of Petrograd and at the Petrograd School of Railroads.

What Brown has done so far has been made possible through the support of the United States Office of Education and the Carnegie Corporation.

Plans are being prepared to make the program a permanent one.

Science News Letter, March 21, 1942

PUBLIC HEALTH

Major Typhus Epidemic In England or Germany Unlikely

In Addition to Focus of Cases, Big Epidemic Depends On Disorganized Population; Delousing Effective

A MAJOR epidemic of typhus fever is unlikely in either England or, for the present at least, in Germany proper, even though the disease is widely prevalent, according to reports in German-occupied countries and in Spain and perhaps in northern Africa.

Lice spread the disease, but it is not solely attention to cleanliness, and therefore fewer lice, that will help protect England and Germany from typhus fever epidemics.

Two other factors are essential for the development of a major typhus fever epidemic: 1. A focus of typhus fever cases from which the lice can spread the disease; 2. A disorganized population.

"No big epidemic of typhus fever has ever taken place unless, in addition to lice and a typhus focus, there was also a badly disorganized population," Dr. R. E. Dyer, newly-appointed director of the National Institute of Health, U. S. Public Health Service, said emphatically.

Dr. Dyer is an authority on typhus fever, having established the fact that endemic typhus fever in the United States is spread by the rat flea, instead of the body louse which spreads European typhus.

War, famine and civil revolutions are the conditions necessary for the kind of disorganization of populations that is the third factor required to fan typhus fever into a large epidemic.

Famine certainly is not present in England nor, according to reports, in the Reich proper. War has failed to disorganize the population in England and there are no reliable reports of any such disorganization in Germany.

Steps must, of course, be taken and apparently are being taken to prevent the spread of typhus to the populations in England and Germany from soldiers returning from tyhus fever areas and from war prisoners and refugees.

Delousing is one effective measure of preventing the spread of typhus fever. It was extensively practiced among the armies on the Western Front in World War I. Troops in the trenches could be frequently relieved and sent to the rear for short periods for delousing. Such a procedure is not practical under conditions of open warfare.

Those who survive an attack of typhus fever are immune to the disease. This is believed to give the Russians some advantage at present, since large numbers of men in the Russian army now may have acquired immunity to typhus during the epidemic in Russia between 1917 and 1921. The Germans are not immune.

Vaccines against tyhus fever have been developed, but so far none has proved satisfactory. One developed by Dr. Herald R. Cox, of the U. S. Public Health Service, is being tested in Bolivia. It is too early for results of these trials to be known. No typhus fever has as yet been reported among either vaccinated or unvaccinated in the haciendas where the vaccine is under trial.

Science News Letter, March 21, 1942

Calcium carbonate, in the form of precipitated chalk, is used as an abrasive in tooth pastes and powders, and in silver polishes.

Onyx is calcium carbonate colored with a mixture of limestone and clay.