ILLINOIS

TECHNOGRAPH

November

1942

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NOMOGRAPHS

BERMAN LOCATOR

AMERICA'S SEVEN ACES

NAMES IN THE NEWS

TECHNOCRACKED

OUR SOCIETIES

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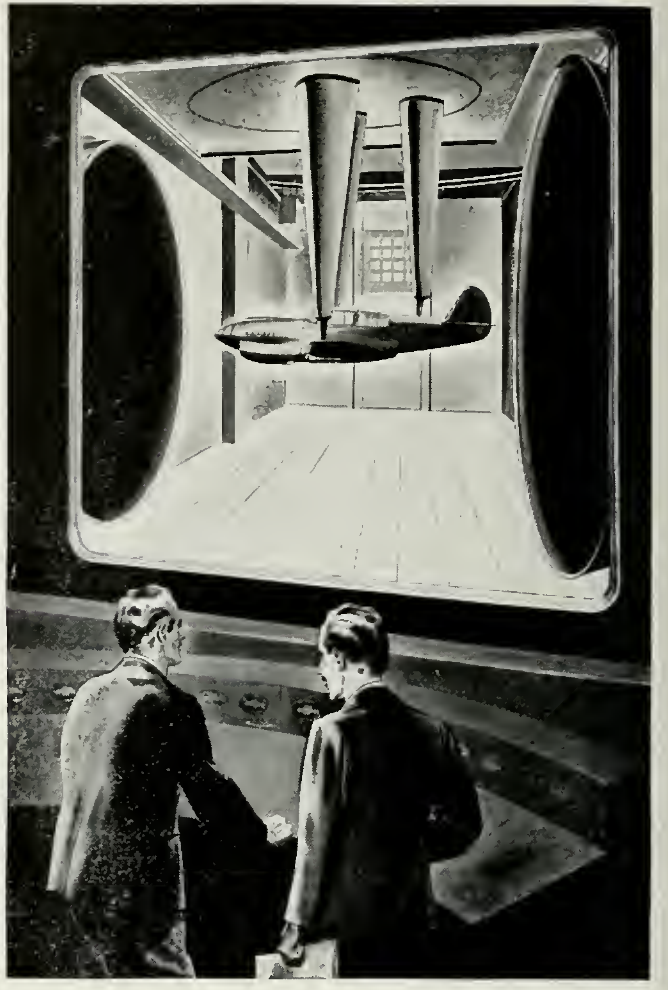
20¢

HE SPECIALIZES IN "BIG STUFF."
L. A. Kilgore has been designing electric generators, rectifiers, and motors ever since he joined Westinghouse . . . but his 40,000 h.p. Wright Field wind-tunnel motor tops them all. Kilgore received his E. E. at the University of Nebraska and his M.S. at the University of Pittsburgh.



The hurricane that shapes an eagle's wings.

THE LIGHTNING SPEED of the modern warplane has brought a lot of headaches to aircraft designers.

Wind-tunnels, the "proving grounds" of aviation, were satisfactory for studying the performance of the lighter, slower planes of yesterday. But they were not adequate for today's fighter planes . . . with top speeds of *over 400 miles per hour.*

To investigate the terrific forces at work at these high speeds, the U. S. Army demanded a wind-tunnel that would produce a tornado many times greater than Nature's wildest gale.

Army officials asked Westinghouse to take over the job of *building the electric motor* to drive the fans in this tunnel.

The two fans were to be truly colossal . . . 40 feet across, with a combined weight of nearly 150 tons. They were to be mounted on a 16-inch solid steel shaft, 120 feet long. Merely starting this great mass in motion, with minimum disturbance to the power system, was the toughest kind of engineering problem.

To complicate the problem further, a wide range of air speeds is required for wind-tunnel testing. And at each air speed the motor speed must be held constant, regardless of fluctuations in the electric power lines.

L. A. Kilgore . . . in collaboration with J. C. Fink . . . tackled the problem. In twelve months these Westinghouse engineers designed and supervised the construction and installation of a 40,000 hp wound-rotor induction motor . . . world's largest of its kind . . . an installation that met every Army requirement.

That 40,000 horse power motor . . . a direct result of Westinghouse "know how" . . . is now in service in the new $2,500,000 wind-tunnel at Wright Field. Large airplane models and actual-size motors, with whirling propellers, are tested and studied in its 400-mile-an-hour windstream.

• • •

Kilgore and Fink have given vital aid to winning the war . . . for they have helped to make it possible for Army experts to learn many new facts about plane performance and plane design, facts of utmost importance in gaining and maintaining air supremacy over the Axis.

Today the need for engineers is very great. Of the 300 young engineering graduates who joined Westinghouse last spring, many are already showing great promise in engineering.

Westinghouse looks to the Class of '43 for its future scientists and engineers.

• • •

THE WESTINGHOUSE ENGINEER . . . a quarterly magazine brimful of interesting articles on electronic research and electrical engineering . . . keeps you posted on the latest scientific developments. Profusely illustrated. Subscription, only 50¢ a year. Address: Westinghouse Electric & Manufacturing Company, Department 6N-17, East Pittsburgh, Pennsylvania.

Westinghouse

. . . MAKING ELECTRICITY WORK FOR VICTORY

NOVEMBER ★ 1942

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Frontispiece . . .

In the 20-below zero temperature of the refrigerated "igloo" of a Westinghouse laboratory, a circuit breaker is being prepared for a high-voltage test. *(Cut courtesy Westinghouse).*

★

Cover . . .

All-out production of war materials by American Industry. *(Cut courtesy General Electric).*

A SHORT COURSE

. . . *in Nomography*

By MR. S. H. PIERCE

Associate in G.E.D.

Through the ages man has endeavored to find methods for simplifying calculation of numerical equations so that speed and accuracy may be achieved. One notable forward step was Napier's discovery of logarithms that was published in 1614. By means of a table of logarithms, a thorough understanding of its use and accuracy in application to specific problems, one is able to shorten the time required to determine the answer to a mathematical equation.

Lieutenant Amèdèe Mannheim, a French artillery officer, found that he required a faster means of calculation in order to train his guns on a target with greater speed. He constructed one of the first slide rules that took advantage of the principles of logarithms but eliminated the necessity of adding logarithmic numbers to realize an answer. Of course his slide rule was not the "slip stick" of beauty and dexterity that we see on the hip of most every engineer today, but it was a modest beginning in the field of rapid calculation.

Eventually the alignment chart, or nomograph, was devised by Maurice d'Ocagne in 1899. His classical work on this subject was published in the book "Traitè de Nomographie." Briefly, a nomograph is an arrangement of scales, each representing a variable in an equation, that are spaced and graduated so that by laying a straight edge across them at known values the unknown quantity may be read directly. Such a chart can be used by persons who have had comparatively little training in mathematical problems and the results obtained are sufficiently accurate for most engineering work. There is no difficulty in determining the position of the decimal point as is the case with slide rule calculations and furthermore, the time saved by the use of nomographs is tremendous.

Many forms of alignment charts have been devised to represent the diversified types of equations that are encountered; also, several methods are used in their design. Since each variable in an equation is represented by a scale on the chart, it is necessary to have at least as many scales as there are variables in the equation. Also the arrangement of the functions of the variables has a bearing on the form of chart to be used. The illustration below, Figure 1, shows typical arrangements of scales for several type forms of equations. Where an equation has a product of functions it may be reduced to a sum of functions by taking logarithms of the equation. Such scales would be graduated logarithmically on the chart.

Two methods generally used in designing nomographs are the determinant and the geometrical method. The use of determinants is a delicate mathematical procedure and is used best by those who have had considerable experience with them. Excellent results are obtained by the novice with the geometrical method if he has an

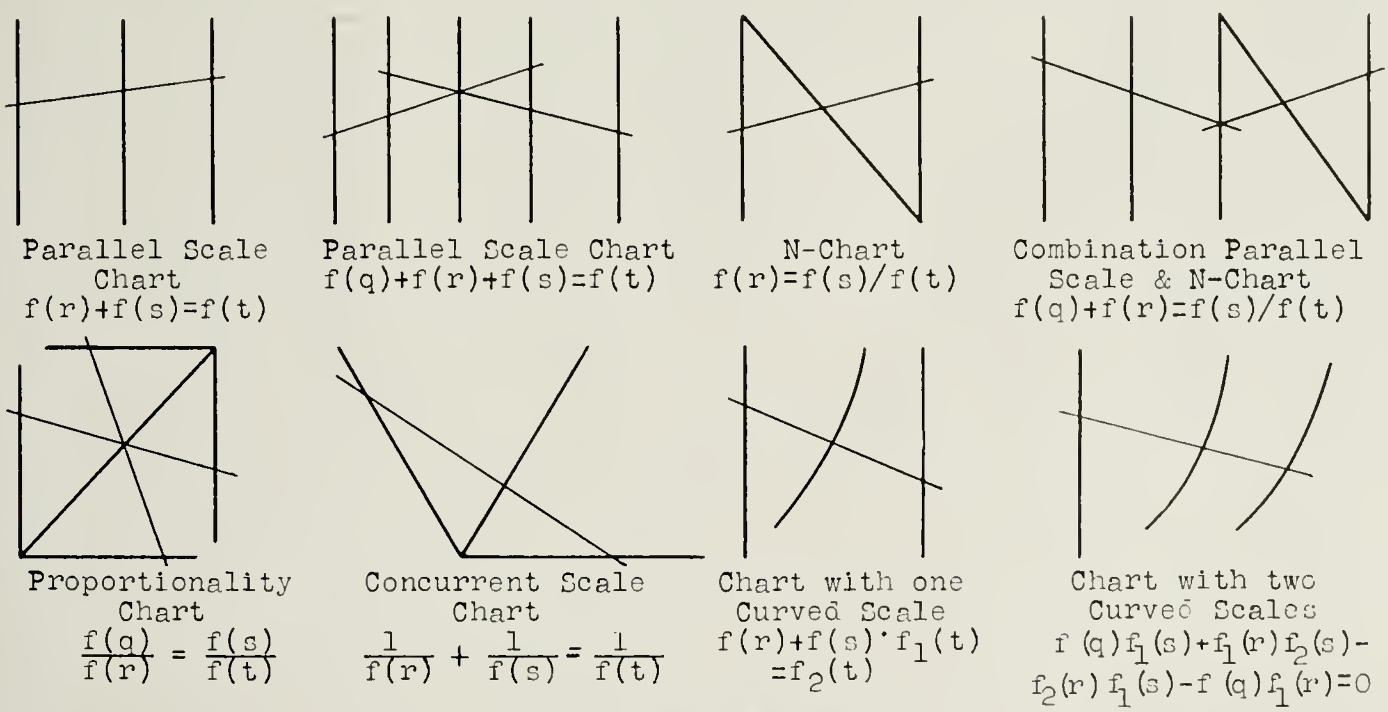

Fig. 1. Common Chart Forms

average knowledge of algebra, logarithms and geometry.

All parallel scale charts of three or more variables have as their basis the simple three variable parallel scale nomograph shown in Fig. 1. The type form of equation that this chart solves is $f(r) + f(s) = f(t)$ and the functions do not necessarily have to be of the same kind. The function of (t) is plotted on the middle scale and the other functions are plotted on the outside scales.

When designing a chart for this type of equation, the relative scale spacing and the method of graduating them, to give a proper solution, must be determined. The derivation of these relationships is short and will be given below.

The separate scales are called functional scales, because they indicate distances that are proportional to the values of the functions for the numbered values of the variable. In making a functional scale between certain definite limits, the values of the function are multiplied by a factor of proportionality. This factor is termed a functional modulus and is designated by the letter "m" with a subscript to denote the function to which it is assigned.

The meaning of a functional modulus may be made clear by an example such as the scales on a mechanical engineer's scale. The length of the full size scale is divided into twelve one inch units so that one inch on the scale represents one unit of measurement. On the $\frac{1}{4}'' = 1''$ scale there are forty-eight units and in this case one-fourth inch on the scale represents one of these units. The value, one-fourth inch per unit is termed the functional modulus for the scale.

Expressed in mathematical form: where L_X is the length of the scale, m_X is the functional modulus, $f(X_2)$ the upper limit of the function of the function to be plotted and $f(X_1)$ the lower limit of the function

$$L_X = m_X\,[f(X_2) - f(X_1)] \quad \cdots \quad (1)$$

If the lower limit of the function is zero, then

$$L_X = m_X\, f(X_2) \quad \cdots\cdots \quad (2)$$

Figure 2 shows the geometrical basis for the construction of a three variable parallel scale chart that solves an equation of the form $f(r) + f(s) = f(t)$.

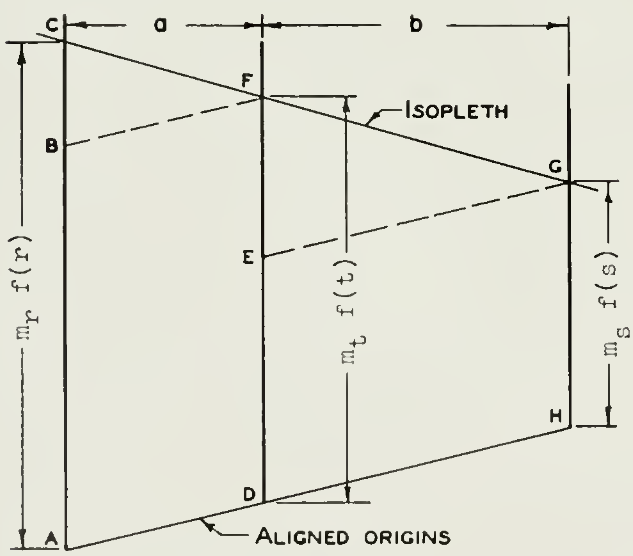

Fig. 2. Geometrical basis for construction of Parallel Scale Charts

It is assumed that A, D and H are zero values of the functions (r), (t) and (s) respectively and the isopleth is a line that intersects the three scales at values satisfying the given equation. BF and EG are drawn parallel to AH.

From the similar triangles BCF and EFG

$$\frac{BC}{a} = \frac{EF}{b};\ \text{or,}\ \frac{AC - DF}{a} = \frac{DF - GH}{b} \qquad (3)$$

From the previous discussion, the lengths of the functional scale are

$$AC = m_r f(r),\ DF = m_t f(t) \text{ and } GH = m_s f(s)$$

Substituting these values in equation (3) and collecting terms

$$m_r f(r) + \frac{a}{b} m_s f(s) = m_t\left(1 + \frac{a}{b}\right) f(t) \quad \cdot \quad (4)$$

To reduce this equation to the type form $f(r) + f(s) = f(t)$, the coefficients of the three terms must be equal, or

$$m_r = \frac{a}{b} m_s = m_t\left(1 + \frac{a}{b}\right).\ \text{If } m_r = \frac{a}{b} m_s, \text{ then}$$

$$\frac{m_r}{m_s} = \frac{a}{b} \quad \cdots\cdots\cdot \quad (5)$$

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This establishes the scale spacing a/b in terms of the functional moduli of the two outside scales.

$$\text{If} \quad m_r = m_t\left(1 + \frac{a}{b}\right), \text{ then } m_r = m_t\left(1 + \frac{m_r}{m_s}\right)$$

$$\text{or } m_t = \frac{m_r m_s}{m_r + m_s} \quad \cdots\cdot \quad (6)$$

which gives the relationship between the outside scale functional moduli and the functional modulus for the center scale. Equations (1), (5), and (6) are always used in designing any parallel scale chart and they should be learned thoroughly by the beginner.

The application of these equations in designing a simple chart will be given for the kinetic energy equation, $KE = WV^2/64.4$ with limits of the velocity V from 30 to 90 feet per second and the weight W from 10 to 100 pounds. The limits for KE are 140 to 12,600 foot-pounds as found by substituting the values of W and V in the equation.

Conversion of the equation into a sum of functions is accomplished by taking logarithms of the expression to obtain

$$\text{Log K.E.} = \text{Log W} + 2\ \text{Log V} - \text{Log } 64.4$$

The constant term Log 64.4 may be disregarded, as it will be taken care of automatically when the third scale is plotted. It is possible to choose functional moduli for two of the scales but the moduli for the third scale is determined from equation (6) above.

Equations for the lengths of the W and V scales are:

$$L_W = m_W[\text{Log } 100 - \text{Log } 10] = 1 \cdot m_W$$

$$L_V = m_V[2\ \text{Log } 90 - 2\ \text{Log } 30] = 0.954 m_V$$

If we choose $m_W = 10''$ per unit and m_V also $10''$ per unit, the lengths of the W and V scales will be $10''$ and $9.54''$ respectively. The ratio of a/b will be unity so that the middle scale will be placed exactly half way between the outside scales.

Calculation of the functional modulus for the center scale is determined from equation (6).

$$m_{KE} = \frac{m_W m_V}{m_W + m_V} = \frac{10 \times 10}{10 + 10} = 5 \text{ inches per unit}$$

This completes the calculations needed to construct

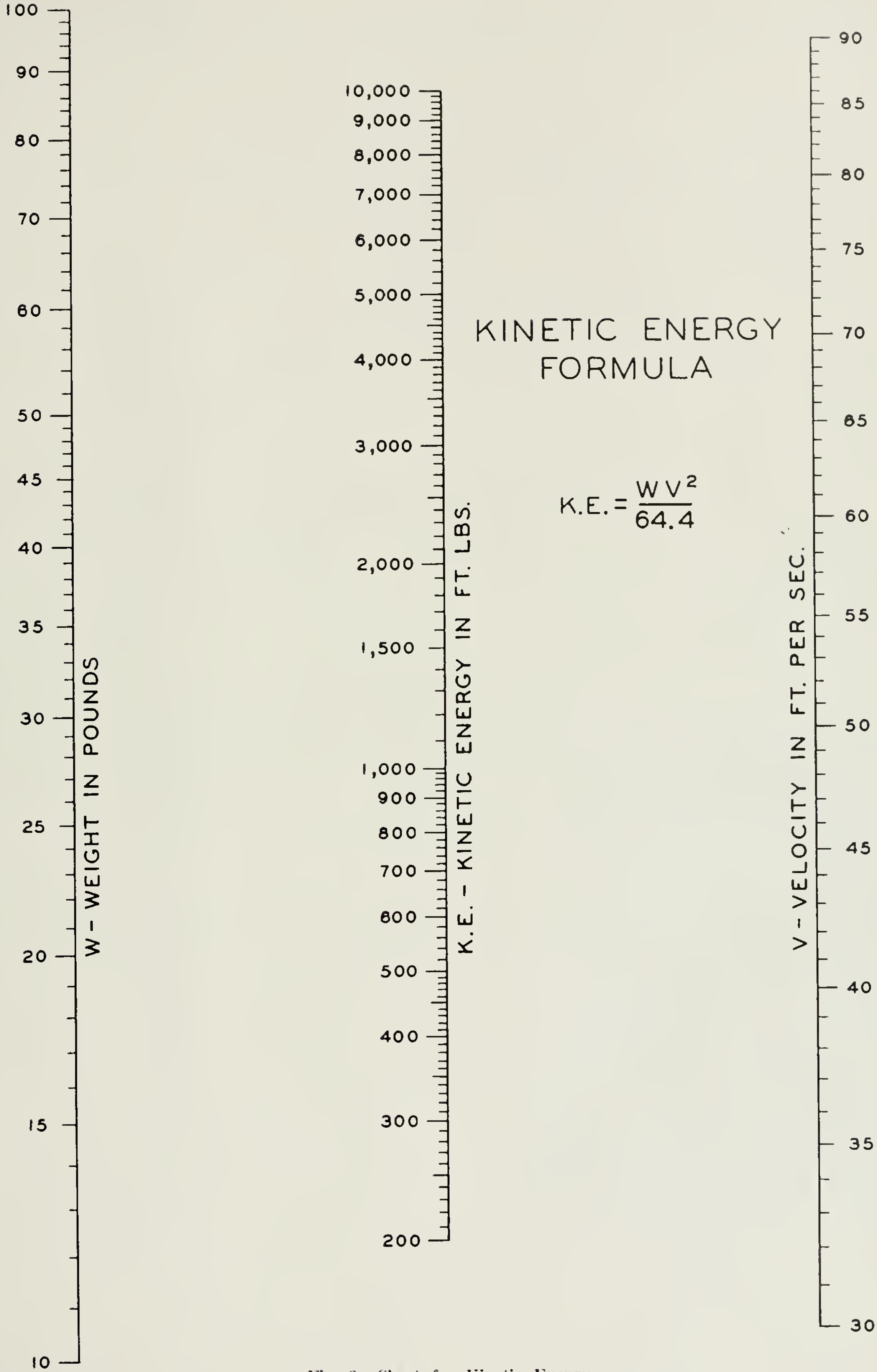


Fig. 3. Chart for Kinetic Energy

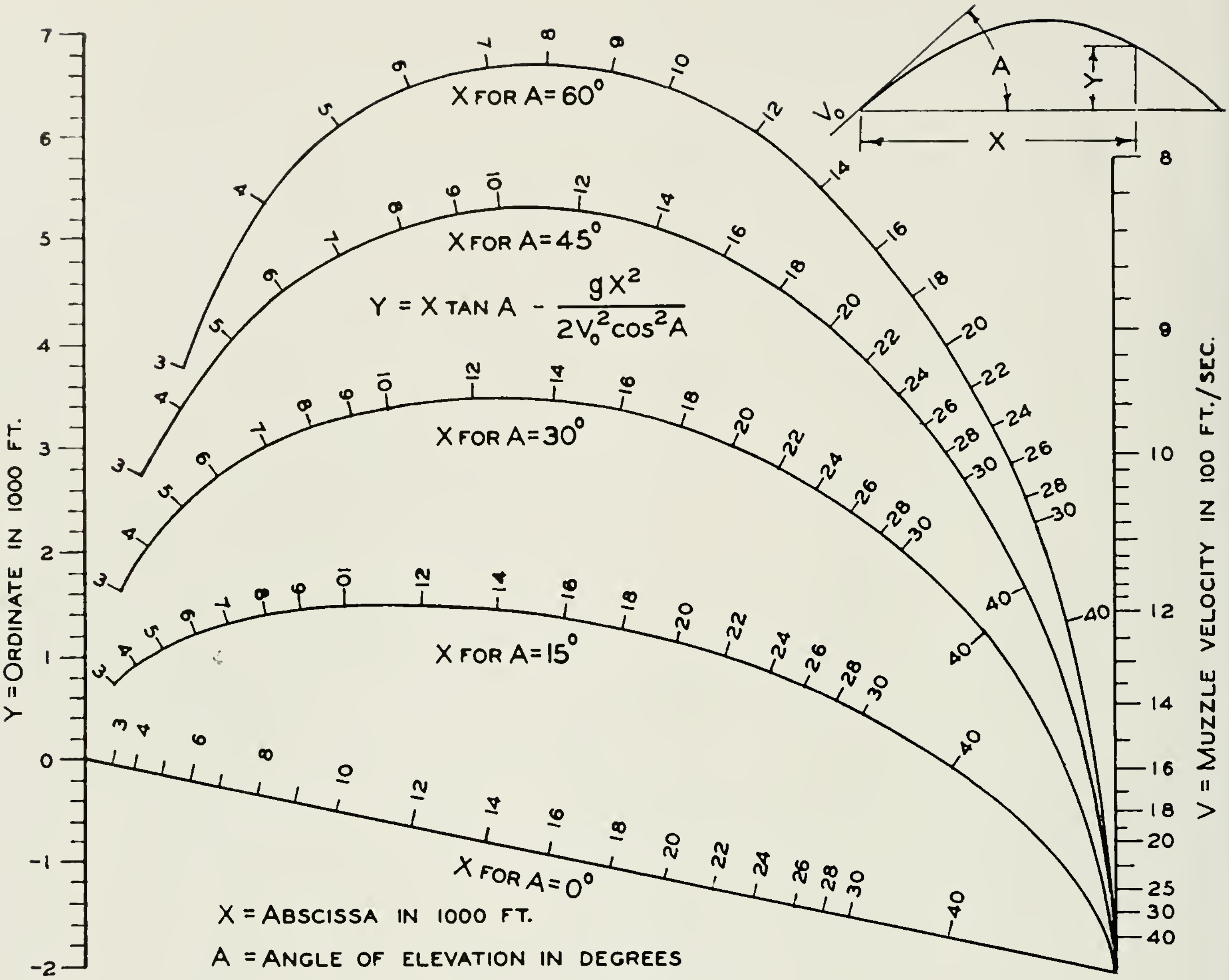


Fig. 1. Projectile Trajectory Chart

the nomograph. To plot values of W = 10, 20, etc. to 100 on the W scale, multiply the logarithms of these numbers by the functional modulus m_W = 10 and mark off these distances on the left hand scale. The V scale is plotted by multiplying values of the function 2 Log V, when V equals 30, 40, etc., by the functional modulus m_V = 10 and marking these distances on the right hand scale.

If a line is drawn connecting the values of W = 10 and V = 30 its intersection with the middle scale is the point where KE = 140. This establishes a starting point for graduating the K.E. scale logarithmically using a functional modulus of 5″ per unit. After marking the major graduations it is best to check the chart to be sure that it solves the equation for several positions of the isopleth. Further subdivisions can be added to allow accurate reading of intermediate values. Figure 3 shows the completed chart for this equation.

The equation for projectile trajectory contains four variables but for convenience is reduced to one of three variables by assuming values for the angle "A". Since the variable X appears in two different functions, the scales for X are curved. It is interesting to note that in most cases two values of X are obtained when using an isopleth across the chart. An examination of the path of a projectile, as shown in the sketch in the upper corner of Figure 4, shows that this is to be expected.

In recent years the various technical journals have been publishing charts for use in engineering fields. Civil engineers would be interested in the charts designed by Lieutenant James R. Griffith, USNR, formerly professor of structural engineering at Oregon State College. These have been published monthly in Western Construction News since 1939. Electrical Engineering for December 1940 contains an article by Guido E. Farrara dealing with charts for electrical engineers. A large number of charts are found in mechanical engineering magazines because they are especially useful for formulas that are met in mechanical design.

From this brief description of the construction and use of alignment charts, it is evident that they are tools of great importance in the engineering world.

Note: Figures 1, 2 and 4 are reproduced from *Graphic Aids in Engineering Computations* with permission of the authors.

Professor Babbitt: Why are so many Chinese named Wing?

Homer Wong: Because fifty million Chinese can't be Wong!

THE BERMAN LOCATOR

By DONALD HALLBERG, G.E. '46

There was but one instrument of its kind in the world that could immediately locate bullets, metal fragments, and shrapnel which were lodged in the human body. This instrument was the Berman Locator. On the seventh day of December, 1941, by an act of fate it was placed in a Honolulu hospital. During the day which we remember so well, it helped a small number of doctors to treat 960 casualties! Such is the dramatic opening to the story of an instrument which was developed to fill a long-felt want in the field of surgical aid.

The Berman Locator was designed to aid surgeons in locating metal fragments which are lodged in the body. Despite the development of X-Ray localization devices by means of which the position of a foreign body may be indicated with high precision, the fact remains that at the operation, when an incision is made, the disturbances to the tissue by knife, forceps, and retractors move the foreign body from its original position, and the surgeon is left entirely on his own. Some may say: "Why not use a fluoroscope?" There are many difficulties connected with the use of the fluoroscope during an operation. First, the surgeons cannot readily protect his hands with lead gloves while operating. Then, the darkened room may endanger sterilization, and, as a number of attempts are usually necessary, much valuable time is lost. Because of these, and other difficulties, the fluoroscope is not entirely satisfactory. These facts make foreign body surgery extraordinary difficult, and surgeons of unquestioned skill are at times forced to give up in failure.

The Berman Locator, which is operated on the principle of electro-magnetic induction, safely, silently, gives the surgeon instantaneous and continuous localization of metallic foreign bodies both from the exterior, prior to operation, or within the incision during an operation. The locator, which is a light instrument, weighing only 20 pounds, has none of the disadvantages of the X-ray, when used at the operating table. It is quick, reliable, highly sensitive, small, easily portable, and has no injurious radiation or high voltages, is readily sterilizeable, and is used under full illumination of the operating field.

In quite a number of foreign body operations, this instrument has been used without a single failure, and in some cases without the aid of X-ray photographs. It must be emphasized, however, that the locator is by no means intended to take the place of or render superfluous, the usual X-ray localization prior to operation. In some simple cases, such as a small fragment in the hand, where the history is fully known, the locator itself may be quite sufficient. In general, though, and particularly where there may be multiple fragments, X-ray photographs, if at all available, should be obtained first.

Essentially, Model BL3 is a modified form of vacuum tube voltmeter comprising a probe containing a search coil and its associated circuit, connected to a high gain amplifier whose output feeds into a meter circuit. The probe and meter circuits are so balanced that when there is no metal within the effective field of the probe, the meter reading is approximately zero. When metal is introduced within the effective field of the probe, the original inductive balance is disturbed, and the meter needle rises higher and higher until a maximum indication is reached where the probe is closest to the body.

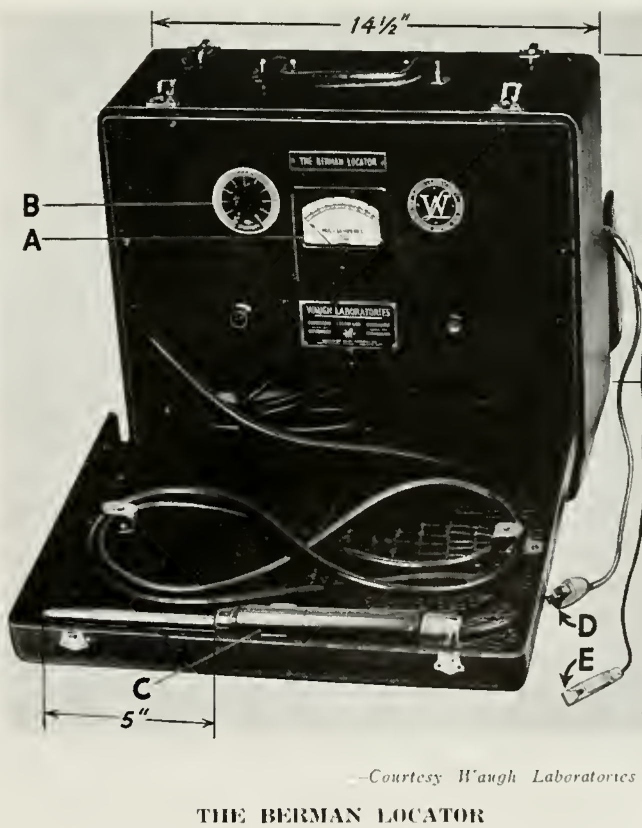
Each instrument is provided with a 20-foot ground lead which terminates in a spring clip. This clip should be attached to a good ground, such as a water pipe, an electrical conduit, or other grounded metallic conductor which has been thoroughly cleaned of rust, paint, dirt, etc., so that a good electrical contact is assured. This is necessary for two reasons: the elimination of body capacity, which may affect the meter indications, and the removal of static charges which may otherwise cause tiny sparks upon contact with the probe.

On the instrument panel there is but one operating control, located near the upper left-hand corner, marked "Sensitivity." This control is combined with the 115-volt A.C. power switch, and is similar in its action to the ordinary volume control of a radio receiver. The low senstivitiy is obtained near the "off" position of the control and the maximum sensitivity is obtained at the extreme right-hand end of the dial.

The probe handle has a control sleeve can be rotated to the right or left, and can also be slid up or down. This sleeve moves two inductive elements whose correct adjustments are essential for obtaining maximum efficiency in the operation of the locator. For a better understanding of these controls, the following information will be helpful.

The detecting circuit associated with the probe consists

(Continued on page 18)



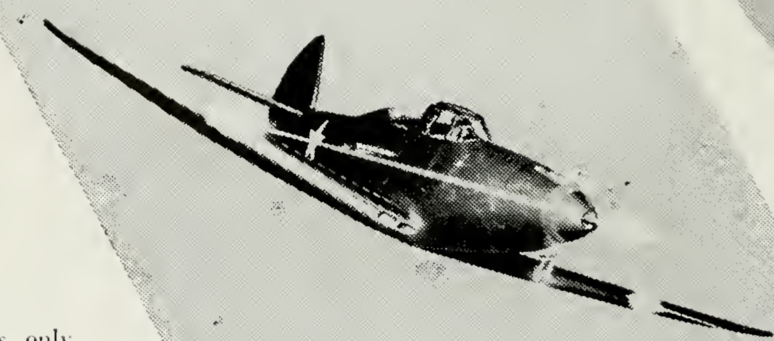
—*Courtesy Waugh Laboratories*

THE BERMAN LOCATOR

- A. Indicating Meter
- B. Switch and Sensitivity Control
- C. Probe
- D. Power Plug
- E. Grounding Connection

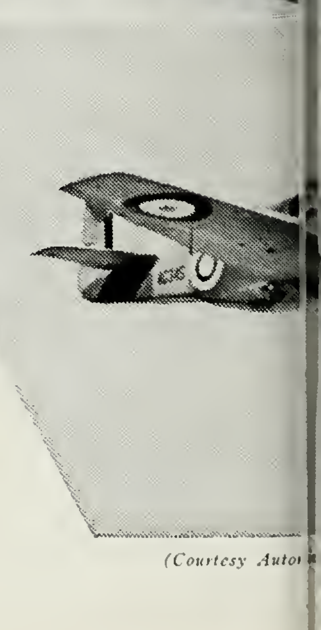
★

The F4F Wildcat is the Navy's standard fighter. Its short, barrel-like fuselage and stubby wings make it ideal for use from the cramped space of aircraft carrier decks. Powered with a radial air-cooled engine, it mounts heavy calibre guns in the wings.



The Army's P-39 Aircobra is the world's only single-engine fighter armed with a 37-mm. cannon. In addition, it is armed with heavy and light machine guns. Designed to operate out of small fields, as a destroyer of heavily armored bombers and as an attacker of armored ground forces, it has been in successful combat as high as 30,000 feet.

The Army Air Force's newest threat to an axis' bid for air supremacy is the huge and powerful P-47 Thunderbolt. No foreign fighter in service has an engine as powerful as its 2,000 h.p., 18-cylinder, air-cooled, turbosupercharged, radial motor, that drives this seven-ton devastator. These power plants, the fruit of years of American aviation industry pioneering, are now being produced in quantity by a former motor car manufacturer. The Thunderbolt may prove to be one of the most sensational fighters of the war.



The Army's P-51 Mustang fighters got their baptism of fire in the hands of the R.A.F. Their speed, maneuverability and firepower made them important factors in the air war before Pearl Harbor. Rated among the best by the British, it has been used with devastating effect in operations over northern France. The Mustang was designed primarily for ground force cooperation. It performed brilliantly in the Dieppe raid. Like most Army fighters, the Mustang derives its motive power and firepower from the automotive industry.

(Courtesy Auto

The Army's P-40 Hawk is a versatile performer with an imposing battle record on all fronts. It has written brilliant chapters of history in the hands of the famous "Flying Tigers" in China, in the Far East, the Near East, and on the Russian front.

In its new F4U Corsair, the Navy has a fighter of great horsepower now in production. The engines of Corsairs are the same as those used in the Thunderbolts, and are being manufactured in quantity by an automotive company. Other automotive plants are supplying wings and sections of the airframes. Designed to take off from carrier decks, the Corsair is one of the world's fastest planes.

One of the most effective fighters is the Army's P-38 Lightning. Powered by two turbosupercharged, liquid-cooled engines of automotive industry design and manufacture, it is a single-place craft of tremendous speed. Capable of working at extreme altitude, it carries cannon and machine guns, also produced on automotive assembly lines. Lightnings are designed to intercept, attack and pursue, to dive into enemy craft and blast them out of the sky. Weighing nearly seven tons, the Lightning is built to get "upstairs" fast—about seven miles up, if necessary.

All of these airplanes are being turned out wholly or in part by former automobile manufacturers, who have changed over to the production of war planes. The unique design of the Aircobra was made possible by an automotive manufacturer's development of its liquid-cooled power plant and its unique power-transfer principle. Like Aircobras, Hawks are also powered with liquid-cooled engines. The Mustang derives its motive power and firepower from the automotive industry. Throughout the automotive and aviation industries, formerly competing companies, have banded together for the teamwork which modern war demands of fighters.

- Production)

NAMES *in the* NEWS

By WILLIAM R. SCHMITZ, Ch. E. '45

and

LEE A. SULLIVAN, M. E. '46

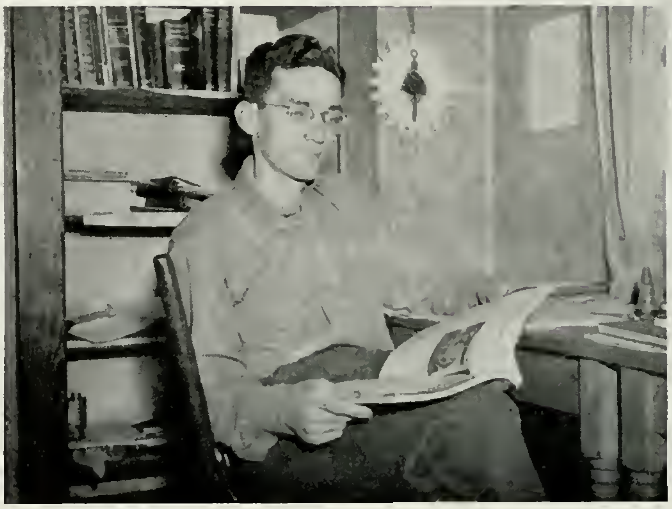
PAUL SALERNO

Paul Salerno is chairman of A.S.M.E., member of Pi Tau Sigma, Tau Beta Pi, and is the writer of "Technocracked" appearing elsewhere in this issue. Paul spent his first two years at Wright Junior College in Chicago. After that he stayed out of school for two years and worked. It was then that he found out that he wanted to be a mechanical engineer.

Since transferring to Illinois, Paul has been doing very well. He has a fine 4.4 scholastic average and is working on a research project in the T.A.M. department. He is working on water ejector pumps and is writing a thesis on it. Subjects relating to hydraulics have been especially interesting to Paul. The idea of being a business executive appeals very much to Paul and he would like to work himself eventually to that position.

Paul has several hobbies including photography, bowling, and tennis. Paul does some dating, but saves most of it until he goes home to Oak Park. He says the worst trouble down here is that there aren't enough coeds, but what there are, aren't too bad.

Like all the other outstanding engineers, Paul thinks that all too many engineers stay too close to their books. He says only half of a college education is gained in the classroom. The other half comes from working in activities and meeting people. That is one reason he likes being chairman of A.S.M.E., he gets to meet all the guest speakers.



PAUL

☆

STERLING SNYDER

One of the most likeable fellows in the Engineering school is Sterling Snyder. He is president of A.S.C.E. this semester and is doing a good job of it. The biggest job, according to Sterling, is to keep the various committees coordinated and functioning properly. It takes a lot of time, but the enjoyment he receives makes it worth while.

STERLING

Coming from Memphis, Tenn., Sterling uses his southern accent and good looks to the best advantage in dating the coeds around the campus. In the words of a civil engineer, he says, "My dating is statically indeterminate." Sterling believes the girls at Illinois are a lot more industrious than the girls down South, but they also have slightly less beauty.

Sterling came to Illinois partly because his father, who is also a C.E., was much impressed by the work turned out by Illinois engineers. Quoting Sterling, "One hardly realizes how outstanding men at Illinois are until he works for practicing engineers who constantly refer to methods of analysis of engineering problems developed by men at Illinois."

Sports, especially softball and tennis, appeal very much to Sterling. He also has one other favorite pastime, and that is eating—eating fried chicken. He enjoys hearing classical music too.

☆

JIM MEEK

Activity man among the civil engineers is Jim Meek. Jim is business manager of the Illio, President of Phi Delta Theta, member of Chi Epsilon, A.S.C.E., Phi Eta Sigma, Skull and Crescent, Sachem, Ma-Wan-Da, T.N.T., Scabbard and Blade, and is a Cadet Captain in the Engineers Corps.

Hailing from Carrolton, Illinois, Jim has done very well since he came to Illinois. He has a nifty 4.25 scholastic average and is teaching G.E.D. I this semester. He passes this little bit of advice on to the freshmen, "Study hard and make the most of every available opportunity."

JIM

Jim is quite a sportsman. He likes to hunt, fish, and participate in athletics of all kinds, especially football, basketball, track, wrestling, volleyball, tennis, and handball. He also takes in a good number of social affairs. His attentions have all been directed to one girl since he has his pin on the woman's editor of the Illio.

A business manager of the Illio, Jim is kept pretty busy. It is his job to take charge of all underclassmen working on the Illio business staff. He is also responsible for all sales, bills, and anything connected with the financial end of the Illio.

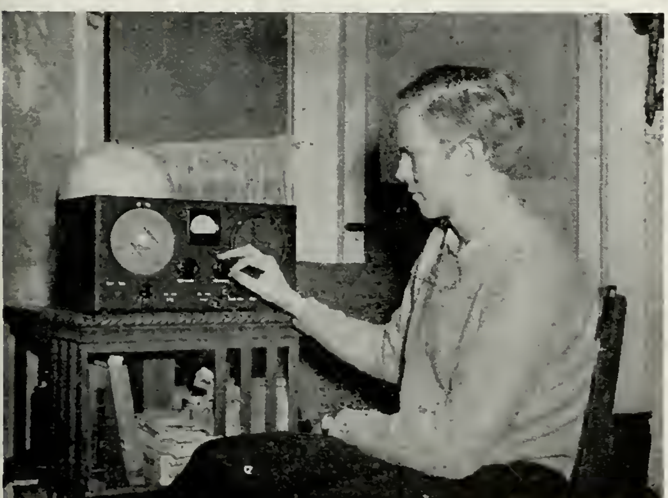
Jim first got his taste of engineering from his uncle, and ever since he has liked that kind of work. This last year he worked on a project determining the mixing temperature on the setting of concrete.

☆

ART POPE

Art is a member of Phi Eta Sigma, Scabbard and Blade, T.N.T., Pershing Rifles, secretary-treasurer of Military Council, Cadet Major of the Engineers, senior manager of the Theater Guild, and is on the military ball committee.

As manager of the Theater Guild, Art has charge of everything that takes place, except the actual production. It is his job to advertise the show and see that the house is full the night of the performance. This takes most of his spare time, but Art still finds time to do some reading and fencing. He also likes boat riding and horseback riding.



ART

Art was president of his sophomore class and likes to work in politics. He has especially enjoyed the contacts he has made with people, and the new ideas he has received from them.

His pet peeve is women who wear too much make-up. So girls, you had better beware if you hope to interest Art. Art says that he hasn't done much dating lately, but has been going with a girl at Evanston. His home town is Lake Forest, Illinois.

Art thinks there ought to be some way in which students and faculty members could get to know each other better. One other suggestion that Art has is that Illinois needs a lake. He particularly admires Wisconsin's lake, but on the whole he likes Illinois' campus better than any he has seen.

☆

JACK BOGGS

Jack Boggs is a mechanical engineer and came to Illinois from the deep South. Sarasota, Florida claims this fair-haired son and is justly proud of him. There are several reasons why Jack came all the way to Illinois, but the main reason is that he wanted to go to a good engineering school, naturally it was Illinois.

JACK

Jack has been an active man since he arrived on Illinois campus. He is senior manager of Intramural athletics, president of Alpha Tau Omega, member of Scabbard and Blade, T.N.T., Sachem- Ma-Wan-Da, and is a Cadet 1st Lieutenant in the Engineers Corps. He has also worked on The Daily Illini.

It may be just a coincidence, but Jack's home-town girl is also going to school at Illinois. He has been going with her for five years and she now has his pin. He says that he likes to take in all dances and big social events possible.

Jack thinks that the engineers here at Illinois don't get out enough and enjoy themselves. Everyone should be in an activity, and still keep up his studying. Jack likes popular music and rates Glenn Miller as his favorite band. Jack, himself, used to play a saxophone.

From his early youth, Jack has worked with his father, who is a civil engineer. He says that he finally would like to get into aeronautical engineering. Jack has done pretty well since coming to Illinois as shown by his good 4.1 scholastic average.

Our Societies . . .

By BYRON M. ROBINSON, M. E. '44

TAU BETA PI

On Wednesday night, November 18, Tau Beta Pi will have a meeting for all the pledges. At this time pledges will sign into the chapter record, and will receive their pledge rules. Tau Beta Pi will hold its formal initiation and initiation banquet on November 28 at 5:45 o'clock followed by a dance at 9 o'clock. This will be held in the Union Building. All actives, and especially faculty members of Tau Beta Pi, are invited to attend not only the banquet but also the dance. Further details, as well as a reservation blank, have been mailed to all members. Jay Hinchcliffe, E. E. '43 is handling the banquet arrangements; and Bob Kallal, Ch. '43 and George Asselin, Ch. '43 are taking care of the dance.

A. S. M. E.

At the fourth meeting of the Student Branch of the A.S.M.E., held on November 13, papers were presented by four senior mechanical engineering students. The titles of the papers and the men who presented them are as follows:

"Effect of Hot Quenching on the Toughness of High Speed Steel" by Gus Greanias.

"Water Ejector Pumps" by Paul Salerno.

"The effect of Range of Stress on the Fatigue Strength of a Phenolic Plastic" by W. A. Lindahl.

"Creep Test of a Phenolic Plastic" by Otto Hintz.

Members of the Peoria section of the A.S.M.E. were present at the meeting as guests of the student chapter.

A. I. E. E.

"Electric Power and the War Effort" was the interesting and very up to the minute subject discussed at the AIEE meeting of November 4th. The meeting held in conjunction with the Urbana section of the AIEE was addressed by Mr. T. G. LeClair who proved himself to be a most capable and enlightening speaker as well as possessing a very amiable and friendly attitude toward questions asked of him after the session. It was encouraging to see a goodly number of engineering students from all classes present and from all expressions, it was very well received.

"Our student AIEE section is the only organization on Campus which represents the Electrical Student and unites both student and faculty in a united effort of mutual benefit. The AIEE needs you and even more, you need us. We certainly welcome you at any and all of our sessions," says Vern Rydbeck, chairman.

A. S. C. E.

At the second meeting of the A.S.C.E., held October 15, Ensign Burnett of the U. S. Naval Diesel School spoke on "The Part the Civil Engineer Plays in the Navy." At the October 29 meeting, Mr. Paul Kent of the General Paving Company presented color movies and spoke of the building of Illinois highway 45 between Urbana and Rantoul. On November 13 and 14, the Illinois chapter was host to the Annual Midwest Conference of Student Chapters of A.S.C.E.

S. B. A. C. S.

At the third meeting of the Student Branch of the American Ceramic Society, held November 3, Mr. C. S. Pierce, Director of the Porcelain Enamel Institute, Washington D. C., spoke on "How the Enameling Industry is Meeting the War Needs." He gave many interesting insights into the war work of that industry, and he stated that the future of the enameling industry looks bright. With the announcement that plans for the pig roast to be held December 10 were well under way, the meeting was adjourned to enjoy refreshments of cider and doughnuts.

CHI EPSILON

Senior civil engineers who will be initiated into Chi Epsilon this semester are Bill Hickman, Erwin Mueller, Erasmo Mendez, Bob Randall, and Lowell Lambert.

The incoming juniors are Howard Eichstadt, Sidney Epstein, Eugene Estes, Harold Hecker, Sheldon Leavitt, Bob Mosher, Carl Mueller, Harold Schwellenstattl, Arthur Skale, George Thomson, and Robert Tillman.

PI TAU SIGMA

A meeting entertaining prospective members was held on October 14 at which time Prof. O. A. Leutwiler, one of the charter members, gave a talk on the history and purposes of Pi Tau Sigma. From the group eligible, seventeen were selected and pledged on October 22. They were: H. H. Aiken, C. C. Arnold, K. N. Drager, G. G. Greanias, J. W. Huff, P. Kohler, R. E. Kraft, B. J. Lattyak, J. J. Luza, R. G. Moldt, D. E. Munie, W. J. North, B. W. Porter, C. J. Roach, R. G. Settle, V. K. Viitanen, and W. J. Worley.

At the meeting on November 4, Elmore Mays, President, was elected delegate to the Pi Tau Sigma National Convention which was held in Minneapolis, Minnesota on November 12, 13, and 14. He reported that the convention was both beneficial and enjoyable.

KERAMOS

Keramos began its activities of the year with a pledge smoker at the Illini Union Building on October 28. Tuesday, November 3, eight "neophytes" began their period, which ended with an informal initiation and a "feed" on November 12. Sunday evening, November 15, the following men were formally initiated into Keramos: F. A. Peterson, research department on Enamel Standards; C. R. Filipi, instructor in Ceramic Engineering; F. P. Shonkwiler and Ray Davies, seniors; W. J. Prentice, M. Klimboff, J. D. Peterson, and J. M. Durrant, juniors.

SIGMA TAU

Sigma Tau had a smoker for rushees at the T.K.E. fraternity, on October 22, featuring a quiz program conducted by Bill Lindahl, G.E. '43. Cider and doughnuts were served at the end of the meeting to relieve the mental strain. Tentative arrangements have been made for an initiation banquet at the end of November.

(Continued on page 22)

BERMAN LOCATOR *(Cont. from page 11)*

of carefully balanced inductive elements, one of which is in the probe tip. In this balanced condition, there is no input from the detecting circuit into the meter circuit. When a piece of metal approaches the probe sufficiently to be within the effective range of its electro-magnetic field, the probe tip element suffers an inductance which raises or lowers its voltage or produces a shift in its phase with respect to the balance of the circuit. When any of these effects take place, the original balance is upset, and the meter needle moves toward the high end of the scale.

Magnetic metals such as iron and steel affect the circuit by virtue of their high magnetic permeability increasing the inductance and raising the voltage of the probe tip element, with practically no phase shift. Magnetic metals are detectable in the order of their magnetic permeability.

Non-magnetic metals such as silver, copper, aluminum, magnesium, lead, platinum, which affect the detecting circuit in a different manner, have eddy currents generated in them through the action of the alternating electro-magnetic surrounding the probe. These eddy currents produce a local magnetic field which reacts with the probe tip element, lowering its voltage somewhat and causing a relatively large phase shift. These non-magnetic metals are detectable in the order of their electrical conductivity; silver, copper, and aluminum being the most easily detected, while the poorer conductors such as lead, platinum, etc. have a correspondingly lower order of detectability.

Thus, the two general classes of metals, the magnetic and the non-magnetic, are detected through entirely different and somewhat opposed action of the circuits, the magnetic metals being detected largely by voltage change, and the non-magnetic metals, mainly by phase shift. This requires a slight readjustment of the probe handle control sleeve when going from magnetic to non-magnetic metal detection if maximum sensitivity of the instrument is to be realized.

The necessary circuit adjustment for maximum efficiency of detection is conveniently made with a control sleeve on the probe handle. This control sleeve by its movement varies the inductance and shifts the phase of the probe circuits. Sliding the control sleeve up and down varies the inductance, and, therefore, the voltage of the probe circuit. Rotating the control sleeve to the right or to the left shifts the phase of these circuits. This is accomplished without any sliding or other electrical contacts, but by purely inductive means.

In the circuit alignment of the instrument at the factory, the probe circuits are accurately balanced for both voltage and phase. But because the sensitivity of the probe is considerably higher at a slight unbalance than at the point of absolute balance, the meter needle is depressed electrically, below the scale zero, so that in the actual use of the instrument a definitely predetermined amount of unbalance is imposed upon the circuit in order to bring the needle up within the meter scale. This is what the operator accomplished with the handle control when he adjusts the instrument to the zero of the meter scale.

Since by "balance" is meant the point at which there is no input into the meter circuit, a condition approaching balance is indicated by the meter needle moving in a downward direction toward the zero of the meter scale. Since there are two different conditions for which a balance is obtainable, namely, voltage and phase, and since the two are very nearly indepedent of each other, a balance may be obtained for either one while the other is unbalanced. For example, if a phase balance is desired, the control sleeve is rotated in the direction which causes the meter needle to move downward toward zero, until some point is reached at which the needle reverses its direction, and moves off toward the high end of the scale. The point at which the needle reverses its direction is the Phase Balance point and may occur at any point on the meter scale, depending upon the degree of voltage balance at the time. Exactly the same is true of a voltage balance. The lowest position of the needle in the direction toward the zero that is possible to obtain when the control sleeve is slid up and down is the voltage balance point, and this may occur at any point on the meter scale depending upon the degree of phase unbalance at the time. Due to fact that the instrument has a depressed zero, an absolute balance (simultaneous voltage and phase balance) would cause the meter needle to go below the zero of the meter scale; so that in practical use of the instrument only one balance, either voltage or phase, is obtained while the other is unbalanced sufficiently to bring the needle within the meter scale.

It is the hope of Sam Berman that his locator can be used on the field of battle to help save the lives of many more wounded soldiers.

TECHNOCRACKED...

By PAUL SALERNO, M. E. '43

PORTRAIT OF AN ENGINEER

A peculiar breed . . . the engineer
Not even a date can interfere
With his ambition
To win recognition.
Forever will he persevere.

Handbook open . . . slipstick working
Never, never, his duty shirking
Attempts acrobatics
With laws of mathematics
Somewhere near, the answer's lurking

Far into the night does the oil burn
Study and cram and try to learn
The rules of mechanics
And thermodynamics.
All else is of little concern.

You'll agree his plight's distressing
In fact this tale is quite depressing
To be a right guy.
Any change would be a blessing.

* * * * *

Coed to roommate: "I don't care much for that engineer you have been dating lately. He whistles dirty songs."

* * * * *

Instructor: Mr. Johnson, what is an octogenarian?
Johnson: I don't know, but it must take a long time to become one. They're all real old people.

* * * * *

In case any of you boys have been feeling pretty sharp lately, I wish you would try your hand at some of these.

1. Is it legal for a man to marry his widow's sister?

2. If three cats can kill three rats in three minutes, how long will it take 100 cats to kill 100 rats?

3. If a farmer has $3\frac{3}{4}$ haystacks in one corner of a field, $4\frac{1}{3}$ haystacks in another corner and $2\frac{2}{5}$ haystacks in a third corner, how many haystacks will he have if he puts them all together.

4. A big Indian and a little Indian are walking along a street. The little Indian is the son of the big Indian but the big Indian is not the father of the little Indian. What is the relationship?

5. A steel ladder hangs over the side of a ship. The rungs are a foot apart and the lowest rung just touches the water surface. The tide begins to rise at the rate of four inches per hour. How long will it take the water to reach the third rung from the bottom?

6. I have two common U. S. coins in my pocket. They total sixty cents and one is not a dime. What are the coins?

ANSWERS:

1. A dead man can't marry anyone.

2. Three minutes

3. One big haystack.

4. The big Indian is the mother of the little Indian.

5. The water level will never rise above the lowest rung because the ship rises with the tide. Stupid, aren't you?

6. A half-dollar and a dime. One coin is a dime and the other isn't.

* * * * *

First student: I feel like telling that professor off again.
Second: Waddaya mean, "again."
First: I felt like it yesterday, too.

* * * * *

A college boy wrote the following letter home.

Dear folk$:

Gue$$ what I need mo$t. That'$ right. $end $ome $oon. Be$t wihe,

Your $on,
Joe.

His father answered:

Dear Joe:

NOthing ever happens here. NOt a thing. Write aNOther NOte soon. NOw I must say goodbye.

Love,
Dad.

* * * * *

FAMOUS LAST WORDS

Here's hoping you all have a very enjoyable Thanksgiving vacation.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933.

Of The Illinois Technograph published eight times a year (Oct., Nov., Dec., Jan., Feb., Mar., Apr., and May) at Urbana, Illinois for October, 1942.

State of Illinois
County of Champaign } ss.

Before me, a notary public in and for the State and County aforesaid, personally appeared Dean E. Madden, who, having been duly sworn according to law, deposes and says that he is the business manager of The Illinois Technograph and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management and the circulation, etc., of the aforesaid publication, for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations.

That the names and addresses of the publisher, editor, and business manager are: Publisher, Illini Publishing Company, University Station, Urbana, Illinois:

Editor, L. Byron Welsh, Champaign, Illinois
Business Manager, Dean E. Madden, Champaign, Illinois.

That the owner is the Illini Publishing Company, a noncommercial corporation, whose directors are A. R. Knight, Fred H. Turner, C. A. Moyer, and Mrs. Ralph B. Clark of Urbana, Illinois, and Fred Siebert, Joseph Rarick, Margie Bitzer and Christ D. Kacalieff of Champaign, Illinois.

DEAN E. MADDEN, Business Manager.

Sworn to and subscribed before me this 26th day of October, 1942.
(SEAL)

ALICE SMITH, Notary Public.

OUR SOCIETIES *(Cont. from page 16)*

A. S. A. E.

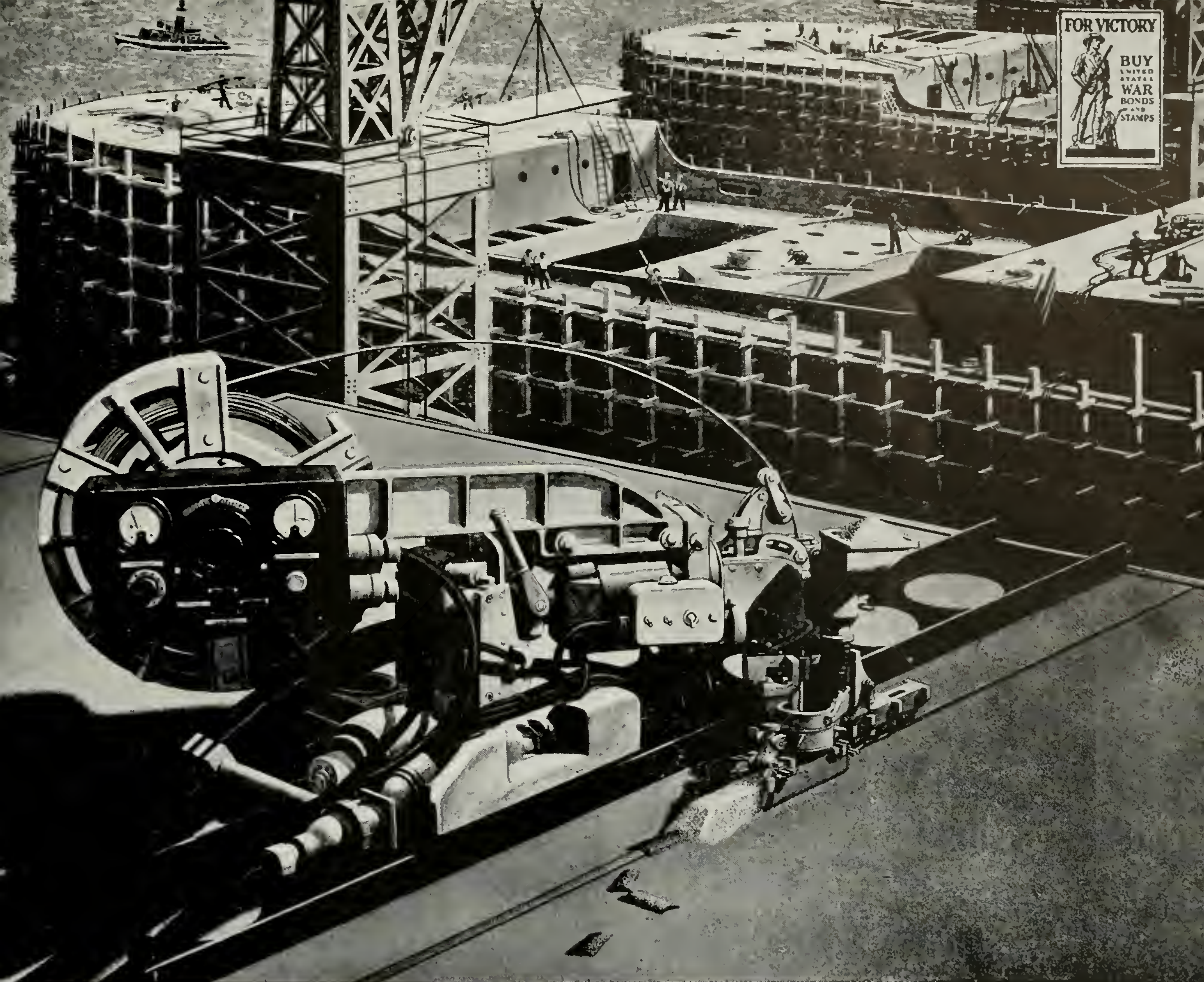
The first meeting of A.S.A.E. on October 6 was devoted to acquainting the members with two aspects of Civilian Defense. Mr. Fred Wiley of the local CD organization presented two sound films—*The Incendiary Bomb* and *The Air-Raid Warden.*

On October 12, Mr. Leslie Wright, Assistant State Co-ordinator of the U.S. Soil Conservation Service, addressed the group, choosing as his subject, *The Engineer and Soil Conservation.* His talk was highly appreciated in that it helped to answer the question foremost in the minds of most of us, namely, what is expected of us when we enter a particular branch of the engineering profession.

The Officers are arranging to have one of the engineers from the Ferguson Company—developers of the Ford-Ferguson Tractor—as the speaker at one of the regular meetings in the near future.

TAU NU TAU

On September 22, a rushing meeting of T.N.T. was held. Instructions were given in the field stripping of the 4.5 caliber pistol. As a result of this meeting, 34 pledges attended formal pledging on September 29. The honor system for cadets was discussed at the meeting of October 15. On November 3, the pledge period ended, and a personal defense demonstration was given by Coach Hek Kenney. On November 13 and 14, an Engineer unit and T.N.T. maneuver was held at Collison, Illinois. At the November 24 meeting, the army jeep was demonstrated. The annual T.N.T. formal dance is to be held at the Union Building on January 9, 1943.



MAKING ONE-PIECE SUITS FOR *SHIPS!*

THERE'S NEWS on America's ship ways today . . . an amazing machine that unites steel plates without noise, fuss, sparks or visible arc! A process that is helping to construct those marvels of speed, strength, safety, and carrying capacity . . . "all-welded" ships!

This process . . . known as "Unionmelt" Welding . . . joins steel plates of any commercial thickness as much as 20 *times faster* than any other similarly applicable method! And it produces uniformly high-quality welds!

How does it work? A special welding composition . . . "Unionmelt" . . . flows from a hopper and blankets the edges to be joined. Within this granulated mixture, intense concentrated heat is generated by electric current. A bare metal electrode and the edges being welded are melted and fused. Some of the "Unionmelt" melts and remains as a temporary protective coating over the weld.

The process is completely automatic. Special apparatus feeds the "Unionmelt," the welding rod, and the electric current. Speed and current values are adjusted by an operator.

"Unionmelt" welding is also speeding up the construction of fighting tanks and chemical tanks . . . artillery mounts and aircraft parts . . . pressure vessels and locomotive boilers . . . pipe and pipe lines . . . and all kinds of heavy mechanical equipment.

Working with this unique process is an astoundingly fast Linde method of preparing steel plates for welding. White-hot oxy-acetylene flames . . . cutting simultaneously at different angles . . . bevel and square-up steel plates as fast as they are needed! Together, these two processes are speeding up the fabrication of key equipment at a remarkable rate.

Many years of research into welding, flame-cutting, flame-fabricating, and flame-conditioning of metals have given Linde engineers a vast store of useful knowledge about these methods. Have you a war production problem which might be solved by this "know how"?

The important advances in the cutting, conditioning and fabrication of metals made by The Linde Air Products Company have been facilitated by collaboration with Union Carbide and Carbon Research Laboratories, Inc., and by the metallurgical experience of Electro Metallurgical Company—which companies also are Units of Union Carbide and Carbon Corporation.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

GENERAL OFFICES: New York, N. Y. Offices in Principal Cities

G-E Campus News

GIRLS, GIRLS, GIRLS

INASMUCH as only one-third of the 12,000 engineers who will graduate in 1943 will be available for private industry, General Electric is hiring young college women to do work formerly done by male engineers.

Forty-four "test women" are on the job now, and others will report each week until the quota (150) is reached. The girls will make computations, chart graphs, and calibrate fine instruments for use in the machine-tool industry.

Miss Virginia Frey (U. of Michigan), one of the 12 women in the country who received engineering degrees this year, is the only graduate engineer in the group. However, each of the others has majored in either mathematics or physics and has received training in both.

Although no one expects these girls to become full-fledged engineers, most of them will be given the Company's famous "test" course.

HI–YO, SILVER!

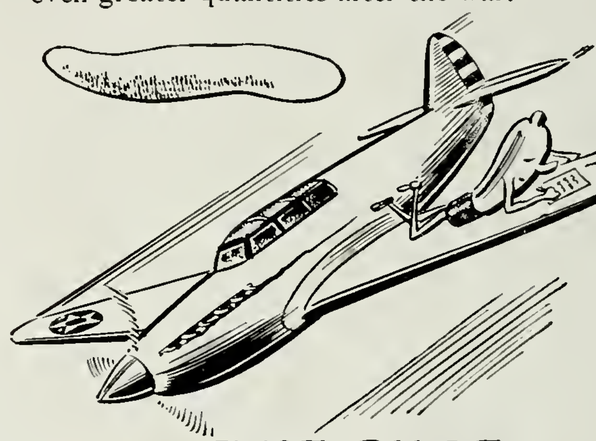
BROTHER, can you spare a dime?

Manufacturers don't really need it yet, but they are using more and more silver as other metals become increasingly difficult to get. G-E engineers, for example, are using silver in the manufacture of electric apparatus in order to conserve tin, copper, and other scarce materials.

There is now at least a little of the precious metal in almost every motor, generator, transformer, and other piece of equipment built by General Electric for the war.

In many cases the use of silver adds to the cost—a consideration secondary to production at present. Here its use is probably temporary.

But in current-carrying contacts and in brazing alloys, the use of silver results in an improvement in quality sufficient to justify the greater cost. For these purposes, silver will very likely be used in even greater quantities after the war.



TEST PILOT

THE versatile electronic tube has now become somewhat of a test pilot. On test flights, it goes along and writes a complete record of the strains on certain structural parts of the plane as it dives and twists and streaks across the sky.

When a fighter plane goes into a power dive at 500 miles an hour, for example, it has to withstand terrific strains. How great a strain is a vital question to the designer, who wants to know whether he can reduce the weight of the plane to give it greater speed.

Here's how the electronic tube helps furnish the answer to that question: strain gages measure minute changes in dimensions, converting them into tiny electric impulses which electronic tubes amplify sufficiently to drive a highly sensitive oscillograph galvanometer; the galvanometer makes a permanent record of the impulses on a photographic film. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC