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A keen-eyed mountaineer led his overgrown son into a country schoolhouse. "This here boy's arter larnin'," he announced "What's yer bill o'fare?"

"Our curriculum, sir," corrected the schoolmaster, "embraces geography, arithmetic, trigonometry—"

"That'll do," interrupted the father. "That'll do. Load him up well with triggernometry. He's the only poor shot in the family."

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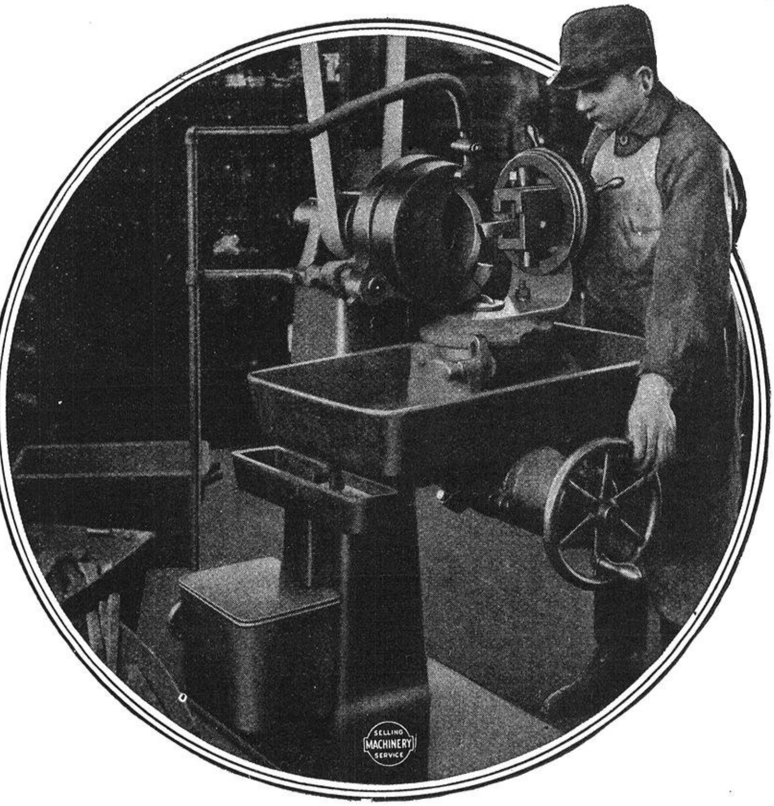

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VOL. XXIV. DECEMBER, 1919 NO. 3

AERIAL PHOTOGRAPHIC MAP MAKING AND INTERPRETATION

By JAMES ALBERT SCHAD, C. E., 1916.

One of the war's developments which is of interest to engineers, and which may prove of greater interest in the future because of its possible application to the commercial and industrial development of the Nation in peace times, is aerial photography. Of special interest is the photographic map interpretation phase of the work.

Aerial photography in all its aspects is rather a broad subject, and, because engineers are doubtless more interested in the map interpretation branch of the subject than in the phase peculiar to photography, this paper will deal especially with maps and map interpretation.

Definitions.

Before discussing the subject it will be well to review a few elementary definitions. A map is a representation of the earth's surface, or a portion thereof, showing the relation of the various parts represented according to some scale or projection. An aerial photograph is one made from an aeroplane in flight. An aerial photographic map is a map made up of one or more aerial photographs. When there is more than one photograph, the several views are matched together, thus making a mosaic. A photographic reconnaissance map is an aerial photographic map of a large area made to a small scale (usually 1 to 50,000.) A battle map is one based on and made from an aerial photographic reconnaissance. Battle maps are of different scales: 1 to 20,000, 1 to 10,000, 1 to 5,000. A stereo is a combination of two aerial photographs so mounted that when examined in a stereoscope, the terrain and the works of man shown on the photograph will be seen in relief.

Taking the Photographs.

In making exposures for a mosaic map, several factors are important. In order to prevent undue distortion of the photographs, the aeroplane should fly at an altitude not less than 3,000 meters (about 10,000 feet) and preferably—especially in hilly country—about 5,000 to 6,000 meters (16,000 to 20,000 feet.) In country similar to that of Ithaca, N. Y., where the difference in elevation between the level of Lake Cayuga and that

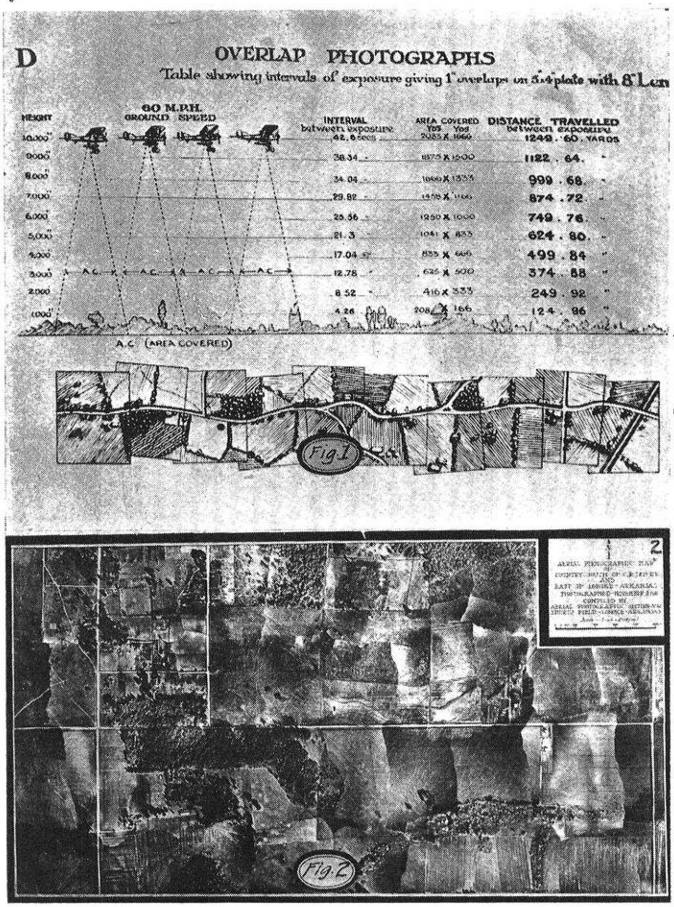


FIG. 1.—Table showing the interval between exposures, area covered, and distance traveled between exposures for varying altitudes.

FIG. 2.—A mosaic photographic map.

of surrounding hills is close to one thousand feet, the distortion makes the accurate matching of the several photographs difficult unless the exposures are made at the higher altitudes. Also this distortion vitiates the accuracy of the scale. The distortion is due to the fact that the field of view is not flat. The valleys, being at a greater distance from the lens than the summits of the hills, are reproduced in the photograph to a scale somewhat smaller than that of the hills. If the aeroplane flies at the higher altitudes, the ratio of its elevation to that of the hills is greater and the distortion is correspondingly decreased.

The next important factor is the overlap of one photograph on the adjacent ones. Practice has shown that for mosaic work this overlap should be about one-quarter the dimension of the photographic plate.

The speed at which the plane flies is more a question of the mechanics of the aeroplane than one in photographic mapping.

The following formula serves as a means of determining the interval between successive exposures in photographic mapping.

$$\text{Interval} = \frac{(\text{Width of plate—overlap}) \times \text{Altitude}}{\text{Speed} \times (\text{Focal length of lens.})}$$

Example: Find the interval between exposures in seconds where

Size of plate (c. m.)	$= 13 \times 18$
Overlap (c. m.)	$= \frac{1}{4} \times 13 = 3\frac{1}{4}$
Altitude (meters)	$= 5000$
Speed (meters per sec.)	$= 45$
Focal length (c. m.)	$= 26$

$$\begin{aligned}\text{Interval} &= \frac{(13 - 3.25)\ 5000}{45 \times 26} \\ &= \frac{9.75 \times 5000}{45 \times 26} \\ &= 41.6 \text{ sec.}\end{aligned}$$

Figure 1 is a table showing the interval between successive exposures, area covered, and the distance traveled between exposures for varying altitudes. The speed of the aeroplane is 60 miles per hour; 1-in. overlap on 4-in. x 5-in. plates is used; the camera lens has a focal length of 8-in. The various intervals between exposures were determined from the formula above. At the bottom of the illustration is a plan of the terrain covered.

It will be noted that all the dimensions and data used in the figure are in the English system whereas in the example above the metric system has been used. In the several army schools of aerial photography in this country, instructions were given in both systems. At the front, with the French, the metric system

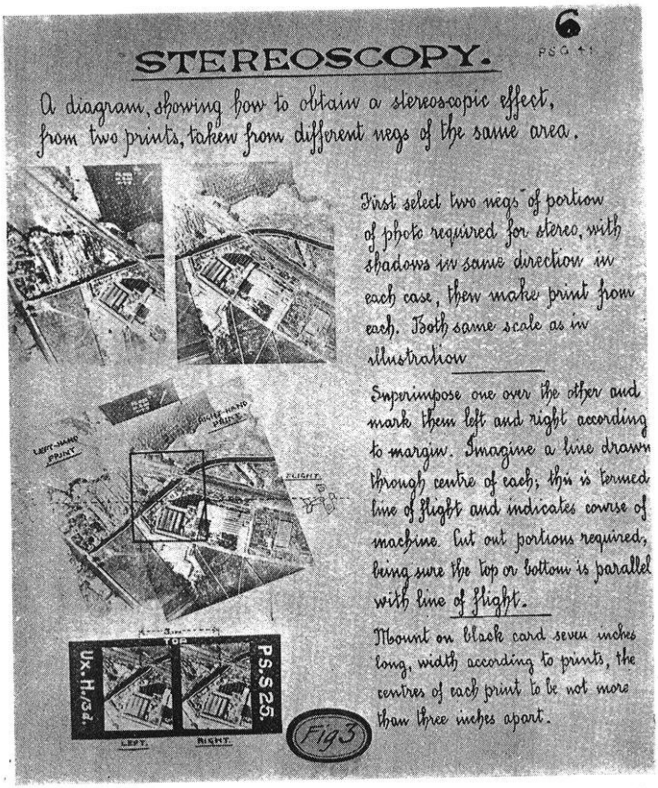


FIG. 3.—*Instructions for making a stereo.*

was of course used. It will be noted also that the heights vary from 10,000 feet downward, and that the ground speed of the aeroplane is cited as low as 60 miles per hour. Experience subsequent to the preparation of these data showed the advisability of flying at the higher altitudes. Later tables give altitudes up to 17,000 feet.

At the actual moment of exposures the aeroplane should be at the determined altitude. Otherwise the proper amount of overlap will not be obtained, and an enlargement or a reduction of the photograph would need to be made in order to have all parts of the mosaic to the same scale. Although it is not necessary that the line of flight be horizontal, the aeroplane itself should be in a horizontal position when the exposure is made. If the plane is banking for a turn or is in a nose dive when the exposure is made, an oblique photograph will be the result. This obliquity can be rectified in the laboratory, but it is better practice to have the aeroplane in a horizontal position when the exposure is made.

Building Up the Map.

After all the necessary exposures have been made the plates are taken to the laboratory and developed. Prints are then made from the developed negatives. With the prints at hand each one is mounted on a pasteboard so that each print matches the adjacent ones. In this manner the photographic reconnaissance map is made. The matching is done as follows: Prominent features, such as highways, streets, and railroads, common to two adjacent prints are made to coincide. A highway, for example, shows on one print. Some portion of the highway will show on the adjacent print because of the overlap. The second print is then placed over the first so that identical points coincide, and each of the common features of the second print is superimposed over the corresponding feature of the first. Each photograph is thus oriented with reference to the others.

The actual joint is made in one of three ways, "butt", "cut", or "tear". The butt joint is analagous to the same joint in joinery. In the cut method one photograph is cut with a knife edge along a line common to both prints. This line is preferably on an oblique with the roads and highways shown, so that there will be as many prominent features as possible to match. In the tear method the print is simply torn to a feather edge along the line desired. The purpose of the feather edge is merely to give the joint a neat appearance. A scrutiny of Figure 2 will reveal that it is made up of many smaller photographs that were fitted together by the tear method.

The principal use to which a mosaic map, especially a reconnaissance map, is put by the 'militaire' is to provide the Staff and Intelligence Department with a means for studying the

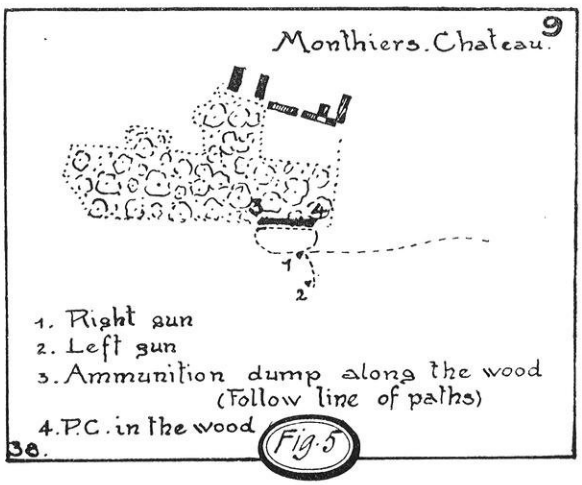


FIG. 4.—*Map showing two guns, post of command, and ammunition dump.*
FIG. 5.—*Sketch showing interpretation of Fig. 4.*

front as a whole. It is of use in planning offensives, and in studying and collating data concerning enemy operations, such as movement of troops, construction of railroads, and the establishment of ammunition depots.

Stereo.

In some ways stereo is the most important of all photographic work. Vital information concerning attack, obtainable in no other way, has been obtained by means of the stereo. In making exposures for stereoscopic work the general features to be kept in mind are the same as those for mosaic work. The interval between successive exposures is calculated in the same manner as indicated in the previous formula. The overlap is dependent upon how large an area of the print it is desired to have a stereo of and also the amount of stereoscopic effect wanted.

The stereoscopic effect comes from photographing a certain feature, such as a house, first from one angle and then from another. Two views of the same object, but from different angles, are obtained. When these prints are mounted properly with the distance between identical points equal to the average distance between a man's eyes (2¾-in. = 68 m. m.) the relief stands out when the photographs are viewed through a stereoscope. Care must be taken in the mounting of the prints which is described in Figure 3. For example, if the right and left prints are interchanged, the entire relief will be reversed; a smoke stack will appear as a deep hole in the ground.

In order to exaggerate the relief for the purpose of close scrutiny for details, a hyper-stereoscopic effect can be obtained by increasing the time between successive exposures. Thus we shall assume that the exposures are such that the distance traveled relative to the ground between successive exposures is 200 meters. The result will be that the relief is exaggerated and the stereoscopic effect is that which would be obtained by a man in the plane if his eyes were 200 meters apart.

The purpose of a stereo is to provide a means for studying the relief in detail. Those details which could not be shown in an ordinary map, because of the fact that the map is a representation in two dimensions only, can easily be detected in a stereo. The location of craters, shell holes, machine gun nests, enemy gun emplacements, and dug-outs can thus be determined. The size of dug-outs and the probable number of men housed can be estimated by the amount of excavated earth which has been removed. Stereos help greatly in planning offensives. The trenchwork of the enemy is studied, effect of artillery fire is ascertained, and points which would be snares to our troops in advancing are located. By such a study losses to our infantry are confined to a minimum. The ground to be advanced over is studied by means of the stereoscope to determine when all barbed

FIG. 6.—*Map showing battery.*

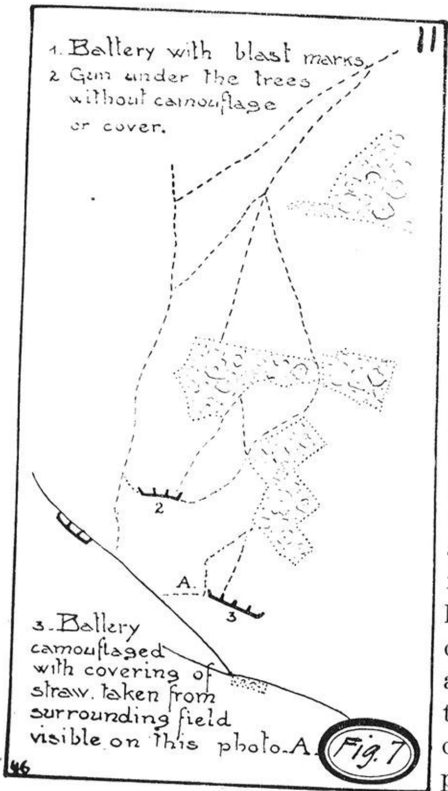


Fig. 7.—Sketch showing interpretation of Fig. 6.

wire has been cleared away, when all machine guns have been silenced, whether the ground proposed to be taken can be crossed and held after it is taken, and that our men will not be caught in surprise attacks of any kind.

Map Interpretation.

In interpreting photographs and maps, all the available data, such as reports of scouting parties and of artillery observers and information obtained from prisoners, should be kept in mind. The proper co-ordination from all relative information renders the information more efficient. Also, as the enemy positions are taken, the map interpreter should compare his previous conclusions concerning the territory with the actual conditions as he finds them. The results of such comparison should be used as a guide in making future interpretations.

On an aerial photograph, a battery appears as a white rectangle with either two or four black dots located symmetrically within. The white rectangle is the foundation on which the gun is mounted and the dots are the guns. These dots appear in twos or fours depending on the number of guns in the battery. A single gun appears as a black dot in a rectangle of white. Thus we can locate the two guns in Figure 4. In Figure 6, even though the position is camouflaged, we can see faintly the circular dot showing one of the guns in the battery. In instances where batteries are camouflaged it is better to substantiate suspicions as to the presence of the battery by taking a stereo of the position.

Barbed wire appears as a slightly wide and hazy black line. A break in the wire suggests that a listening post or a machine gun nest is located in the vicinity. The men pass through the break in going to the gun or the listening post.

A shell hole appears as a black blotch surrounded by an irregular white ring. Numerous shell holes appear on the illustrations.

A listening post is always in an advanced position. In a number of cases they are located in large shell holes. A thin white line leading forward from the front line trenches suggests a listening post.

A railroad appears as a black line and is distinguished by its geometrical curves. The side tracks and spurs are noted. By following along a railroad, we can usually locate an ammunition dump at the road's terminus.

A trench mortar battery is located in the trenches and appears as four black rectangular spots.

The distinguishing marks of machine guns are usually white squares or small black dots. The black dots are generally in pairs and appear at the end of an open bayou or a trail.

A few examples will illustrate the interpretation of photographs. Figure 5 is an interpretation of Figure 4. The two guns are easily discernible as black dots surrounded by a rectangle of white. It will be noted that each avenue of advance is guarded by a gun. These guns are located in this manner so that an enfilade fire down each of the two roads can be obtained. The battery post of command and the ammunition dump supplying these two guns are located in the corner of the wood as shown. Note the well defined path from the dump and the post of command to the battery. These were made by the men who served the guns. Shell holes are seen in numerous places on Figure 4.

Figure 7 is an interpretation of Figure 6. Notice the distinct paths made by the men in gathering straw from the surrounding field when they were camouflaging the battery shown at 3. It is quite probable that a stereo of this battery was taken so as to determine definitely the gun's location. From a stereo, the relief of the straw covering would stand out and thus the battery would be easily recognizable.

Figure 8 is an oblique photograph (one taken with the camera inclined toward the earth instead of being vertical) taken at a low altitude. The trenches show very distinctly. Notice the two communicating trenches leading to the enemy's rear.

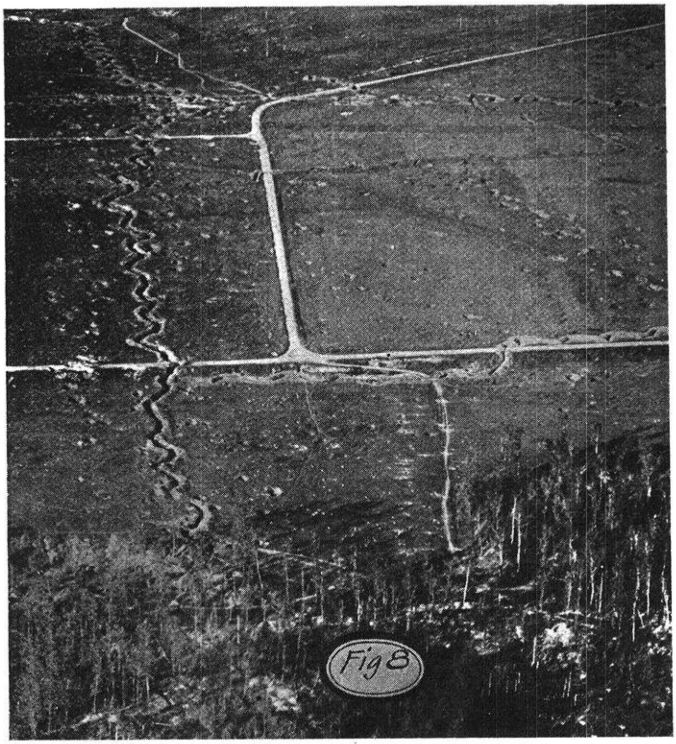


FIG. 8.—*Oblique photograph taken at low altitude.*

Figure 9 gives an idea of an aerial photographic mapping camera and Figure 10 shows one of the methods of mounting the camera on the aeroplane. The latest practice however was to mount the camera on the inside of the fuselage at the feet of the observer and over a hole in the floor of the fuselage.

The Aerial Camera.

By referring to Figure 9, we can get an idea of the mechanism of a semi-automatic camera. The unexposed plates are loaded into the magazine "a". The plates drop into position for exposure and, after exposure, are removed to the right by what is known as a changing mechanism. From here, the exposed plates drop into the receiving magazine "b".

The exposure is made by pushing the lever "f" or the plunger "c". The former is used when there is no observer in the plane and the exposures are made by the pilot. The latter is used when there is an observer in the rear pit who makes the exposures.

Power for the operation of the changing mechanism is obtained from the wind turbine "d". Air impinging against the blades causes the propeller to revolve and this motion, acting through the flexible connection "g", operates the mechanism.

This camera is sometimes called a semi-automatic camera, since the exposure must be made by hand.

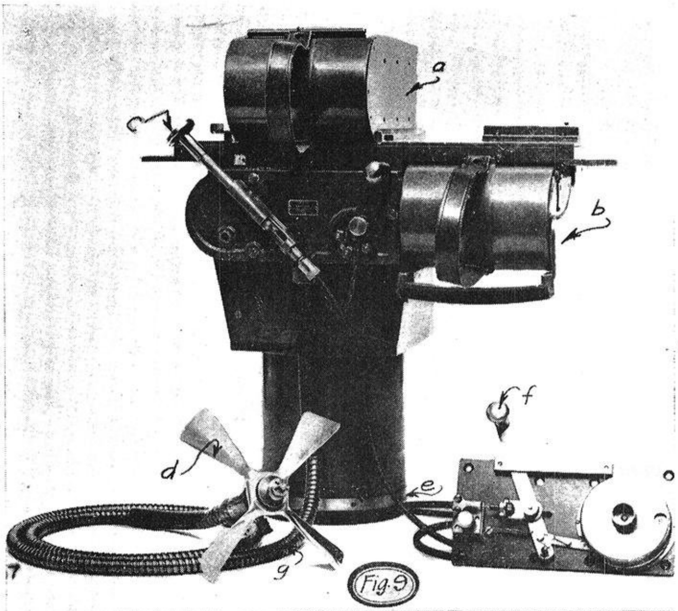
The Eastman K-1 camera, which is especially adapted to mapping work, is entirely automatic, the exposures being made automatically at pre-determined intervals.

Possibilities of Aerial Photography.

Now that actual hostilities are over the thoughts of those engaged in aerial photography turn to its possibilities as an aid to business and commerce in times of peace. There are several fields of endeavor in which this new method of preparing maps can be used.

The great disadvantage in the ordinary transit method of making a survey of a territory is the great amount of time consumed in the field and in the office. Using an Eastman K-1 automatic, wind-turbine-controlled film camera and flying at 10,000 feet, 200 square miles could be covered with 100 plates. In this way the mapping of railroads for valuation work could be made a matter of weeks instead of years.

In estimating the amount of timber in a forest reserve timber cruisers, pedometers, and mules are used. This, at its best, gives only an approximate idea of the quantity and kind of timber. If a mosaic map were made swamp areas could be determined accurately. A study of the foliage of the trees would tell what kind of timber predominated. Obliques and stereos would



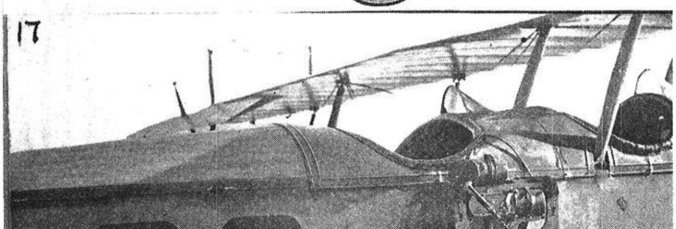


FIG. 9.—*Semi-automatic camera.*
FIG. 10.—*Camera mounted on fuselage.*

show the heights of trees, and from this a more accurate estimate of the amount and kind of timber could be made and in a much shorter length of time.

Due to lack of good maps, the development of real estate and industrial sites is often delayed. This delay is caused by time consumed in preparing necessary maps in the ordinary method. By using aerial photography a map of a 30 to 40 square mile development could be made ready in 48 hours.

Pen and ink sketches are the usual methods for advertising industrial plants. In some cases these are misleading due to the optimistic and idealistic thoughts of the artist. An aerial photograph would tell the true story of a plant and in a more comprehensive manner.

Traverses for parties exploring frontier sections could be made by aerial photography and thus the parties would have a very useful piece of information in their hands as they proceeded.

By the use of pan-chromatic plates, mineral bearing areas could be discovered due to the photographic effect the color of the soil would have on these plates.

Most of the photographs used in this paper were given the writer by the Photographic Branch Air Service, Washington, D. C. It is through the courtesy of the Service that the illustrations are published and the writer takes this means of thanking the Air Service.

Much of the thought concerning the possible future use of Aerial Photography comes from a lecture delivered by Captain M. A. McKinney at Camp Stuart, Va., when the writer was still in the military service, and from the former's paper on *Aerial Photography* in the April, 1919, issue of *Flying*.

WHY I WISHED I HAD STUDIED ENGINEERING

By Celian Ufford,
Scholar in Letters and Science.

The Great War is over now so I may speak out and be unafraid of a G. C. M. or other dire result of my garrulity, and those who read may learn why once—but only once—I wished I had been an engineer.

In September, 1917, I was still in that exalted state then characterized as "possessed of the war fever" in spite of having been rejected for That Man's Army sundry times on sundry counts. Examiners had turned me down because of symptoms of every affliction from dandruff to dorso-vertebral-triple-subluxation. Various members of the A. M. A. had grudgingly granted me all the way from six weeks to as many months of this mortal toil; but they wouldn't brighten my declining hours by letting me take a pot-shot at Wild Bill Hohenzollern. In spite of the many rejections I persevered. I was turned down by the militant Marines and seemed doomed to serve with the Jewish Cavalry or the Yiddish Artillery—pet names for the fighting Q. M. C. and the battling Ordnance—but tried Aviation as a last resort.

In order to be fairly sure of acceptance I made a flying trip to our Mid-Western-Metropolis and obtained temporary correction of some of the most obvious flaws in my physical makeup. Whereupon, through a friend of a friend of mine I got an examination for flying several months earlier than would have been possible without "a graft."

That exam! Those who have gone through the mill of that hectic day of physical, mental, and nervous torture will be spared a repetition of the horrors. Yet, "may I not" recall the belladonna, the whirling chair, the backward and downward sinking, the righting oneself, the wronging oneself (thank Heaven for that welcome bucket so opportunely near at hand.) the gas jet, the balancing stunts, the wiggling fingers, the jar and tag and crossed out name, the kicking oneself, the questionnaire(no, never seasick at all), the say "ugg" and cough, the stop watch and the inevitable 64 whisper.

And then, oh mes enfants, if thou hast lived through all this, cometh the Reg. Army Exam,—the heart, the lungs, the finger prints, the rogues' gallery, the swear allegiance.

I have over-run my story. Cometh now Ye Mental Exam. "College man? Mental Exam? Cinch"—say you. Ah! you excellent engineers! Then did I understand why the flying personnel of Woody's Winged Wonders were either plumbers, steamfitters, chauffeurs, or—*Engineers.*

It reminded me of a court-room scene in a modern Sex Play. Only, Great Scott, it wasn't. I came out of it almost completely unmanned. The characters: One Captain Veneno, and mine own ambitious, ingenuous self.

Question: Want to be a pilot?

Answer: Yes sir, if you please sir.

Q.: Humph!

A.: I have owned and operated motorcycles sir.

Q.: What make?

A.: Two Indians and—

Q.: Humph! that's bad. What else?

A.: A Harley-Davidson, '17, twin '16, with a Rogers Side Car, sir.

Q.: Humph! Whatstha difference between an intermittent and a continuous spark?

A.: Don't know sir. I haven't been out with girls much, sir.

Q.: Great Caeser's H. Ghost! What's a carburetor good for?

A.: To charge batteries with which, you might say, sir.

Q.: The Hell I would. Do you know what the insides of your motorcycle look like?

A.: No sir. I've run it all winter, but never had any occasion to monkey with its inwards, sir.

Q.: You were in luck there, but sorta outa luck here. What's a cosine?

A.: I'm not a Mason, sir. You see, my dad said to me, he said—

Q.: Shut up before I blow up! Ever blow soap bubbles?

A.: Yes sir, once.

Q.: Good! You're going to be a balloonist. Sign here. Aeroplane pilot! O my Gawd!

So I had to join the Balloon Section, S. E. R. C. And that is why Eddie Rickenbacker is our Premier Ace, why we didn't win the war a year earlier, and why, oh why! I didn't—oh, why didn't I?—study Engineering instead of the Economics of Agriculture.

ENTROPY—A SIMPLE INTRODUCTION TO THE TERM

By Hobart D. Frary,

Ass't Professor of Steam and Gas Engineering.

Two fundamental notions of thermodynamics are: (1) The conservation of energy, and (2) the degradation of energy. They state that (1) energy can not be destroyed, but (2) it tends to degrade or degenerate into less useful forms,—to become less available for useful work. Like water, energy tends to flow down hill,—to seek the lowest level.

Heat is the lowest form of energy; for all other forms of energy may be completely converted into heat without effort, whereas it takes special apparatus and effort to convert heat into any other form of energy and the conversion can never be complete. The availability of heat to do work depends upon its level, that is, its temperature, above the temperature of the surrounding medium or lowest available exhaust temperature.

In the study of heat transformations, therefore, it is necessary to have some measure of the availability of the energy as well as of the amount of that energy. It is this necessity which has given rise to the notion of entropy. Entropy is a measure of the unavailable part of the heat energy of a substance. Like heat, however, entropy is only relative; it is not possible to define what is meant by zero entropy; it is possible only to discuss changes in entropy.

Entropy may be defined as follows:* *If from any cause the unavailable energy of a system is increased and if the increase be divided by T_0, the lowest temperature (absolute) available for a cold body, the quotient is the increase of entropy of the system.* From this definition the ordinary mathematical definition for entropy of a gas may be developed as follows:

For Reversible Processes

Let an amount of heat $\triangle Q$ be supplied to a gas. The maximum amount of this heat which can be converted into work is

$$\triangle Q \left(\frac{(T_1 - T_0)}{(T_1)}\right),$$

*Goodenough's Principles of Thermodynamics, page 59.

where T_1 is the absolute temperature at which the heat is supplied and T_0 is the lowest available exhaust temperature. Hence the unavailable part of the energy is

$$\triangle Q - \triangle Q \frac{T_1 - T_0}{T_1} = T_0 \frac{\triangle Q}{T_1}.$$

Dividing by T_0 we have, from the above definition,

$$\triangle \phi = \frac{\triangle Q}{T_1};$$

that is, the change of entropy equals the heat supplied divided by the absolute temperature at which it is supplied. If the temperature varies the relation must be written

$$d\phi = \frac{dQ}{T};$$

that is, the rate of change of entropy equals the rate at which heat is supplied divided by the absolute temperature at the instant. For a change of state from state 1 to state 2 with variable temperature

$$\triangle \phi = \int_1^2 \frac{dQ}{T}; \qquad (1)$$

that is,

$$\triangle \phi = \int_1^2 \frac{dS + dI + dE}{T}, \qquad (2)$$

where $\triangle S$ represents sensible heat, $\triangle I$ internal latent heat, and $\triangle E$ external latent heat or heat used in doing external work.

From this definition of the change of entropy during reversible processes it follows that: (1) When heat is added to a system there is an increase of entropy corresponding to the amount of unavailable energy in the heat added. (2) When heat is abstracted from a system there is a decrease in entropy corresponding to the amount of unavailable energy in the heat abstracted. (3) If there is no change in heat there is no change of entropy; that is, the entropy of any isolated system, subjected to reversible processes only, remains unchanged, although there may be changes of entropy among the different parts of the system. If all the processes in nature were reversible the entropy of the universe would remain constant.

For Irreversible Processes

For irreversible processes equation (2) gives too small values for $\triangle \phi$, because in all irreversible processes energy which might have been completely converted into work is dissipated in sensible heat, in which form the energy can not be completely converted into work.

This may be illustrated by considering an irreversible adiabatic process such as takes place in performing Joule's well known experiment. Two vessels A and B of equal size, both perfectly insulated so that no heat can pass in or out, are connected by a passage containing a stop-cock. Vessel A is filled with a perfect gas at a pressure P and a temperature T while vessel B is completely exhausted. When the stop-cock is opened part of the gas in A rushes into B. The temperature in A falls according to the adiabatic law, while, as the gas in B comes to rest, its temperature rises, the work done by the gas in A in imparting velocity to the gas in B being dissipated in heat. When the temperature has become uniform in A and B it is found to be the same as originally, namely T, and the pressure is ½ P. Indeed this must evidently be the case for a perfect gas since no heat is supplied or abstracted and no external work is done.

In this experiment there is no change of heat in the system; $\triangle S$, $\triangle I$, and $\triangle E$ are all zero. Equation (2) would therefore give us zero change in entropy. But this can not be correct since work would have to be done on the gas to get it back to its original condition; there is evidently a loss of availability in the process—an increase in unavailable energy.

The amount by which the unavailable energy is increased can be determined by imagining the gas returned to its original condition by reversible processes. This can be done by compressing the gas isothermally. In order to do this an amount of work given by

$$\triangle E = -\int_2^1 AP\,dV,$$

where $A = \dfrac{1}{778}$, P is the pressure, and dV is the rate of change of volume, must be supplied. This work, which is 100 per cent available energy, is converted into heat, only part of which is available. The unavailable part, computed as already indicated, is

$$\frac{T_0}{T_1}\triangle E = -T_0\int_2^1 \frac{AP\,dV}{T}.$$

We have thus returned the gas to its original condition of pressure, volume, temperature and entropy, but at the expense of the availability of the energy $\triangle E$ whose entropy has been increased by an amount

$$\triangle\phi = -\int_2^1 \frac{AP\,dV}{T}.$$

Hence the increase of entropy in the irreversible adiabatic expansion must have been

$$\triangle\phi = \int_1^2 \frac{AP\,dV}{T}. \qquad (3)$$

The increase of entropy in an irreversible process of any kind may be found, as in the preceding example, by imagining the gas returned to its original condition by one or more reversible processes and computing the change of entropy obtained.

Thus we see that every irreversible process causes an increase in the entropy of the universe or of any isolated system inside of which the process takes place. Since all processes in nature are irreversible the entropy of the universe is constantly increasing although the entropy of some parts (not isolated) may decrease.

For Any Process

A general formula* may now be given for all processes both reversible and irreversible, namely:

$$\triangle\phi = \int_1^2 \frac{dS + dI + AP\,dV}{T}. \qquad (4)$$

For reversible processes the formula is evidently the same as equation (2) For irreversible adiabatics it reduces to equation (3). It will be found also to be applicable to other irreversible processes.

Since the right hand member of equation (4) is a definite integral it follows that entropy is a point function; that is, the change of entropy between state 1 and state 2 depends only on the values of pressure, volume, and temperature at these two states and is independent of the process or path by which the system is changed from state 1 to state 2. This follows also from the definition of entropy in terms of unavailable energy since energy is a point function. By reason of this important property of entropy it is possible to construct tables for any gas from which the entropy for any given condition, above some convenient datum, may be obtained; and such tables may be used without regard to the nature of the processes under consideration, whether reversible or irreversible.

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*Hirshfeld and Barnard, Heat-Power Engineering, page 66.

AMONG THE 'CADIANS

One phase of engineering work of which very little is heard here in the North is the location and construction of the small but very numerous canals which traverse parts of the South, particularly the Delta country in the State of Louisiana. The whole southern portion of that state, for about 150 miles from the Gulf, is at an elevation ranging from sea level to maybe 12 feet without a single eminence; so sea level canals can be dug at a slight expense. These canals, or bayous as they are called, are the arteries for trade, the highways being very poor,—so poor that they can not be used in wet weather. Mail, passengers, freight of all kinds, and even funerals are conducted on these waterways.

This past summer the writer was employed by the Government Corps of Engineers in making a survey for a proposed link in this system, which link would shorten the distance between the rice fields of western Louisiana and new Orleans. The country through which the line was run presented many problems, as parts of it were through such a thick swamp that even with four mean clearing brush but half a mile's progress could be made a day. Other delays were occasioned by wasps, mocassins, and, last but not least, mosquitoes, which were so plentiful that it was necessary at times to have a man do nothing but brush them off the transitman with a branch.

The people encountered while doing this work were an interesting lot; for this section of the country is the "Land of the Acadians", and the tomb of Evangeline is shown to travelers. Most of the poorer class could not speak any English but have clung to the 'Cadian or mixed French. The better class who owned or managed the plantations were very hospitable and treated us well. A remarkable thing was the low wage paid to plantation hands who worked from sun-up till sun-down for $1.25 per day. On the whole the South has many interesting features and holds much in store for an engineer who takes up work there.

P. K. S.

THE ENGINEER AND THE COMMUNITY

By E. H. Sniffin,
Manager of the Power Dept., Westinghouse Elec. & Mfg. Co.

It is useful sometimes to stand off a little way and take a view of your work, the field of your activity and its relation to the general scheme of things. To go up on a mountain, so to speak, and look down upon the world, to ponder what its inhabitants are all doing and why, and where you fit into the plan. One may well muse over the purpose of it all. It seems like a very fair earth, where men ought to be very decent and very comfortable. Then why have they made such a sorry mess of it? Perhaps it is in the divine scheme that they should make a mess of it? We know there has always been a terrible struggle, perhaps always will be, for the things that bring us food, covering, shelter and delight for the senses, and the landscape will soften very gradually as men slowly learn that it is not a struggle of units, but a struggle of humanity in the mass; that we cannot live alone, but that we depend upon each other and that the one substantial happiness that comes to any man is to be measured by the extent of his service to others.

And so I cannot talk about the engineer until I find his place in this scheme of things; and when I see what he has done for the world, when I find that within the last century he has practically revolutionized the living conditions of civilized people and made the world more habitable than was even dreamed of by the greatest imaginations of former ages, I am bound to conclude that the engineer, perhaps above all others, has contributed most to the material welfare of humanity. What is known as the world's industrial revolution began about a hundred years ago when by the application of steam as motive power and the inventions of machines for various purposes which it stimulated, and the onward march of scientific discovery, there followed the age which has culminated in our own day in a world transformation. And what a romance it has been, this work of the engineer. Not alone for money gain has he labored, albeit he has made it for others, but to him has come a wealth greater—

> "Than all Boraca's vaunted gold,
> Than all the gems of Samarcand".

the consciousness of a great world service. He has hitched his wagon to a star. Do you remember that beautiful poem of Kipling's which begins—

> "When earth's last picture is painted,
> And the tubes are twisted and dried".

and then he describes that heavenly existence where—

> "No one shall work for money,
> And no one shall work for fame,
> But each for the joy of the working,
> And each in his separate star,
> Shall draw the thing as he sees it,
> For the God of Things as they are."

The engineer does not have to die to do that. He does it while he is here. He has been the interpreter of physical facts and natural laws and marshalled them into useful paths of world employment. He has "drawn the thing as he sees it, for the God of things as they are." I sometimes imagine when I look at a great piece of engineering work,—an ocean steamer, a long span of bridge, a big dam, an immense power-house,—that if the creator of it should have passed into the shadows, his soul must still hover near this monument of its earthly expression, for that would be Heaven indeed.

It is this feeling that I have for the engineer, the love and esteem I hold for him, that prompts me to ask this question,—why is not the engineer a more conspicuous member of the community? The query is by no means original with me. It is beginning to concern the engineer himself. It has been accentuated perhaps by his large contribution to our victory in the great war, not only through his engineering achievements, but his power of organization and administration, the employment of a mind trained to deal with facts and form accurate conclusions. It has been the frequent topic before many of our engineering societies.

The problem, it seems to me, lies more particularly with the engineer as an individual and that is the chief thought in my mind. Why is he not a more conspicuous citizen? Why do we not have more of the benefit of his trained mind in our public affairs? Is he to be so highly specialized in his profession as not to be a man among men, he of the trained mind, and not help to solve the problems common to us all? Shall we leave it to the lawyers to hold public offices? If so, I am wondering what special qualifications the lawyer has for the public service that the engineer does not possess, or at least might not readily acquire. I can very easily imagine that the engineer in his lifetime search for facts, for the truth of things, dealing as he must with economic problems which suffer no gloss or guile, might indeed be a very valuable public servant. I am told that the membership of the Sixty-Fifth Congress contains not a single engineer in either the Upper or Lower House. It must be a matter of chagrin to us, when we come to think of it, that in our country with its wonderful scientific and mechanical achievements which have been the biggest thing in our development there stand out very few among our engineers or scientists whose voice is heard in our National councils. What a pity; and how much better it would be for the country if the reverse were true.

I think the trouble starts at the school. I am glad to say that that feature is improving, but I think rather slowly. As a rule technical school graduates have shown too much the effect of a specialized training at the expense of an education. The engineer seems to be stamped upon them at the expense of the man. Their general interest in things has not been stimulated. They have not the catholicity of taste or ready response to environment that marks the well rounded man. Then followed their years of work, their concentration upon the thing they loved, with little heed for the verities or amenities of our common social existence. I do not complain of the engineer's usefulness. There is nothing but praise to be said for the value of his work. But he lives in a world of men who have their own way of appraising his value and I am contending that he has the training that will enable him to serve them in a greater degree still, if he will come out of his hermitage and mingle with the open world. We must remember that in our own country there is very little spontaneity of recognition of the men of science. In the older countries they are selected for distinguished honors. Great Britain knights her Thompsons, her Parsons, her Whitworths, her Bessemers, a long list of them who take place with her statesmen, her scholars, her publicists. Poincare, the President of France, is said to be one of the world's great mathematicians.

Clemenceau was once a physician and I am told that there are about seventy physicians in the present Chamber of Deputies. And Paderewski is now running Poland. If this artist, who I suppose is temperamental, can leave his keyboard and work with all his brain and brawn and heart and soul for the nationality of his country, what do you suppose the engineer might do? Artist that he is, he fits very well into my theme. Our first President was an engineer. Franklin was a scientist. But both of these great men had other compelling interests that made their names immortal. The habit went out of fashion at an early date.

The fact is that our own country is not inclined to exalt a man into realms of distinction beyond his definite accomplishment, although it does quickly recognize him for what he does, and it is as true of human nature here as elsewhere, that your light gives better illumination when exposed than when hid under a bushel. Our friend, the engineer is too modest. Any man would be who spends his life struggling with natural laws; he finds out how small he is. And I suppose it to be natural that he should view with but casual interest the many phases of our social life, and especially the banalities, as he sees it, of politics. So he keeps aloof from all these trifling, artificial, unsubstantial affairs, and remains the engineer. And the public lets him have his way. Now this is undoubtedly very wrong. There is nothing more true than the fact that people live upon the earth in a social state of interdependence, the most successful of them under representative forms of Government. Through these representatives National, state and municipal laws and local ordinances are enacted, supposed to give the maximum benefit to the greatest number. These important functions are exercised often from political motives purely. Very often the motive is honest and sincere, but the result is unwise, unsound and sometimes vicious in its consequences. Do you suppose, for instance, that the hydroelectric situation in our country today would have existed had there been among our law makers enough men with the engineering and economic knowledge to know what they were doing? No, it required a world war, with its stress upon every ounce of our National energy to make us fully realize that we have about twice as much undeveloped water power in this country as there is steam power in use, including locomotives, scarcely any of which will invite a dollar of capital under our present ill-considered laws. So the president is now trying to speed up the remedial legislation that has been under consideration for many years.

But, as I said before, the engineer will not be picked from his profession to serve in public life. He must himself show social and public activity. He must make men aware of him. I wonder if I might say he must advertise himself—that word "advertise" has a new significance to me since I have seen how necessary and successful it was in such a good and worthy cause as our Liberty Bond campaigns. When Emerson said that if you could do something better than any one else could do it, the world would make a path to your door, even though you lived in the heart of a wood, he had in mind only one phase of human nature. It is equally a fact that the greatest truth that was ever established will be accepted more readily if it hits you in the face at every turn. Not as an engineer shall he advertise, but as a man of superior mind, who in the sweep of his knowledge and the sincerity of his purpose shall become a strong and helpful influence in our public affairs. We are living in a critical period of the world's history. We have just expended nearly ten million lives and two hundred billions of wealth, and were ready to give all our lives and all our wealth to preserve our heritage of freedom and righteousness. Thrones have been demolished and Governments upset and the world is trying to find its way, let us hope, to a new and better order of existence. Meanwhile there are tens of millions of people living under conditions of social chaos, and it would be a bold man who could say how far it will go, or indeed, whether our own fair land shall be immune from the blight of these poisonous theories that have already spread from the Volga to the Rhine. Let us hope not. But let us make sure that it shall be every man's duty to come out of his isolation into his fullest obligations of citizenship; that men of trained mind and trained character shall seek their places in the councils of our country; and that the engineer above all others shall no longer exclude himself from the fullest measure of public service.

EDITORIALS

LET'S KEEP THE TROPHY

In the lower hall of the Engineering building stands the Nelson trophy, typifying the athletic ability of the engineers. At the present writing it looks as though this were soon to be moved to another building. Cross country runs and the football game have resulted in victories for other colleges, and it will require hard fighting in all other sports to retain the college supremacy. It can be done, however, and every engineer who has athletic ability should be active in his particular sport. Lack of time is a poor excuse. The engineering course is doubtless harder than many others, but by systematizing his work there is no reason why the average student should not have time for athletics. Let's keep the Nelson trophy! W. A. K.

SUCCESS

To every mind that word has a more or less definite meaning. To most of us it brings to mind ease and a pile of gold. That is one kind of success,—financial success. Truly we can do little without money; but real success cannot be judged from a bank book as too often it is. Almost anyone who sets his mind on it can acquire wealth; but in so doing he is apt to lose the happiness he expected to find with it, thereby defeating his purpose.

W. A. K.

MORE POLITICS

The sophs have raised their voices in derision and haw-hawed our query of last month as to why the engineers had not gone out after more class offices. It seems that the soph engineers rounded up about everything that was loose in their class. FRED G. SMITH is President and EDWARD H. BEARDSLEY is Treasurer; both are mechanicals. RICHARD T. BEGLINGER, a chemical engineer, is Sergeant-at-Arms. It's some record and we'll say they had the laugh coming.

VIEWS OF AN ALUMNUS ON THE UNION ENGINEER

In the October number of THE WISCONSIN ENGINEER, I note a review of a number of THE TECHNICAL MAN, the official organ of the Union of Technical Men. It is certainly to be regretted that many engineers find it necessary to join a union affiliated with the American Federation of Labor to gain recognition and adequate compensation. A membership of over fifteen hundred technical men in one local shows the appeal being made by agents of the union. Since an engineer is an arbitrator between capital and labor, it is clearly evident that as soon as the engineer joins a union affiliated with the American Federation of Labor he becomes a partisan and can no longer act in a neutral manner. Therefore, if he could find an organization able to afford him relief from his difficulties and which is not bound to any other organizations, he would not be obliged to sacrifice his professional reputation nor his position as arbitrator.

Such an organization is now in existence with a membership of nearly 10,000, and with branches in many colleges and most of the large cities. The American Association of Engineers was formed a few years ago to aid the engineer in a social, economic, and political way and its growth in membership and influence proves its worth. It is estimated that about 7,000 engineers will be accepted as members in 1919; and, within a few months, this association will be the largest engineering society in the United States. It is not now and never will be, affiliated with the American Federation of Labor.

L. F. BOON.

NOW COME ON WITH YOUR SUGGESTIONS

The spirit back of the decision of the engineering faculty in forming the student-faculty committee should be heartily commended by all engineering students. This move, which gives students a voice in educational matters of their college, evinces an open-minded policy on the part of our faculty. The faculty has recognized our serious purpose in being here, and, because of the intimate contact we have with all departments, has deemed our opinions worthy of consideration. Every student should realize that the committee was put into his hands to further the interests of the student body and should support it accordingly. With hearty co-operation there can be no question as to the future importance of the student-faculty committee.

D. W. N.

THE KNIGHTS OF ST. PATRICK

A recent letter from the Engineer's Club of the University of Missouri to the Dean and to one of the local clubs invited the College of Engineering to send a delegate to the national St. Patrick's convention, which was held on the 5th and 6th of December, at Columbia, Missouri. Owing to the fact that this letter arrived at a rather late date, and because it was not possible to present the matter to the student body and gather definite opinion on the invitation in time, no delegate could be sent. However, definite information on the St. Patrick movement may be circulated in the various clubs in the near future.

CLEAN OUT YOUR VOCABULARY

A man once began to introduce a joke in his after-dinner speech with: "I believe there are no ladies present." General Grant, who was at the banquet, replied: "No, but there are gentlemen present." The speaker omitted that story from his speech.

Perhaps this story can be made to apply to places in and about the engineering building. In our school, where the presence of ladies is not always enjoyed, we sometimes overhear someone pop the safety valve and spill a lot of curses, just because he has begun his drawing at the wrong point, or has lost an hour's work on account of some fundamental blunder. Certain men are heard using profane language liberally, practically inserting curses between syllables, even in ordinary conversation. Cursing not only lowers a person's position on the moral scale; it is also the degradation of one's language. A profane person soon loses the ability of expressing emphasis in decent terms. His language is liable to rot away like that of the ordinary negro army cook. We do not advocate the wearing of wings, especially not for engineers, but we do know that the use of heavy language is unnecessary.

A Merry Christmas and Happy New Year

ALUMNI NOTES

By WILLARD A. KATES

M. E. ALLEN, '06, 1228 Peoples Gas Bldg., Chicago, is a contracting engineer with the Federal Bridge and Structural Co.

ALBERT O. AYRES, c '16, is manager of the Eau Claire Sand and Gravel Company, at Eau Clarie.

We have received word that the marriage of RAY E. BEHRENS, c '19, and Miss Miriam Hancock, ex-'19, will take place on Christmas day. Behrens was a former advertising manager of the ENGINEER.

CAPT. AUBREY H. BOND, c '17, Corps of Engineers, is in attendance at the graduate schools of the U. S. Army at Camp Humphreys, Va. He may be addressed Care Adjutant, U. S. Army, Washington, D. C.

HERBERT H. BROWN, c '17, married Jane Miller of Milwaukee, then was commissioned as a Lieutenant of Infantry. He served overseas in the 170th Brigade and was discharged as a Captain. Herb is at present employed by the Worden-Allen Company of Milwaukee.

R. H. CARPENTER, m '14, 907 LaFayette Parkway, Chicago, is an engineer with the Link Belt Co.

E. J. CONNEL, m '15, formerly with Joseph T. Ryerson & Sons, Chicago office, has been transferred to their New York office at 30 Church St.

GORDON F. DAGGETT, ex-c '14, was recently elected president of the Madison Church Federation Council. The council is composed of delegates from 14 Madison Churches and was organized to unite and co-ordinate church interests in Madison.

C. W. ELLSWORTH, c '14, is a designer with the Austin Company at Chicago. His address is 1456 Fargo Avenue.

R. W. ENGSBERG, e '14, is a telephone engineer with the Automatic Electric Co.

W. K. FITCH, M. E. '13, writes that he is now permanently located at Cleveland, where he may be reached in care of the Dravo-Doyle Co., Citizens Bank Bldg.

D. S. FOWLER, c '17, should now be addressed at Watertown, Wis.

A. F. FREDERICKSON, m '18, is Chief Tool Designer for the Waukesha Motor Co.

PAUL C. GILLETTE, C. E. '18, is with H. D. Walbridge & Company doing valuation work. His address is 319 Morrell Place, Johnstown, Pennsylvania.

JOHN GLAETTLI, c '09, is working at the San Diego plant of the Emergency Fleet Corporation. His address is 3036 Olive Street.

A. G. HOPPE, m '17, who is with the Chicago and Northwestern Railway, and is making tests on locomotives running between Madison and Milwaukee, visited the Engineering Building between runs. His address is 3906 Vliet Street, Milwaukee.

H. F. JANDA, c '16, is assistant professor of engineering at the University of Cincinnati.

JOSEPH F. KUNESH, c '14, is Hydrographic Engineer for the State of Arizona. Hiss address is Room 12, Agricultural Hall, University, Tucson, Arizona.

H. G. KISLINGBURY, e '08, E. E. '10, is with the Union Electric Light and Power Co., 315 N. 12th St., St. Louis, Missouri.

STUART C. LAWSON, min. '17, is connected with the sales department of the Otis Elevator Co. in New York as chief estimating engineer.

CARROLL H. LUCKEY, c '14, has a new son, Carroll Messer Luckey, who was born on his father's birthday anniversary, November 6. Luckey is with the Great Northern Railway at Fargo, N. D.

F. C. MCINTOSH, c '18, is manager of the Pittsburgh office of the Johnson Service Co. He took his new position in September, after two years of army service. Century Bldg

O. W. MELIN, c '10, gives his address care of the Structural Engineering Department, Western Electric Co., Chicago.

G. T. MOORE, m '18, visited us last month. He was an ensign in the navy and received his discharge recently.

W. F. NICKEL, c '13, is a mining engineer for the Anaconda Copper Mining Co. at Butte, Montana.

FRANK ROBERTS, m '18, is in the turbine department of the Allis-Ch~~almers C~~o.

W. C. ROWSE, a former instructor in steam and gas, is with the Franklin Motor Car Co. at Syracuse, N. Y., as Assistant to the President.

EDWARD SCHILDHAUER, e '97, paid us a visit at Homecoming. He was in charge of the installation of the lock machinery of the Panama Canal, then served with the Emergency Fleet Corporation during the war. Schildhauer is located at present with the Stenotype Company at Indianapolis.

CHARLES STEWART, m 1'6, is efficiency expert for the Dodge Motor Company at Detroit.

C. P. STIVERS, '13, Major in the infantry, is assistant chief of staff of the 6th Div. at Camp Grant. He was in France over 11 months and saw action in the Vosges. Stivers comes from a military family and expects to follow the family tradition and remain in the army permanently.

GEORGE TRAYER, c '12, who was overseas with the 28th Engineers, has returned to the University as Instructor of Mathematics.

W. W. TRURAN, e '17, is with the New York elephone Company at 195 Broadway, New York.

E. O. WERBA, min. '19, is with the Meriden Iron Co. at Hibbing, Minnesota. Until recently he was in the employ of the Grand Rapids Gas & Coke Co. at Grand Rapids, Mich.

WILLIS R. WHITBY, c '04, who left the service of the Grand Trunk Pacific on Jan. , 1918, after many years of railway service, and went into the hardware, furniture, and undertaking business in a small Canadian town, writes a long letter to his old class mates, Professors Kinne, Owen, and Van Hagan. Part of his letter is of general interest and we offer it below:

"Stephen is not a bad little town of between three and four thousand people. Of course like all other towns of any size at all, they were going to make it a city a few years ago when the boom was on. They got far enough to have all the modern conveniences, and a lot more debts than any healthy town should have. Imagine a town of this size having an up-to-date system of cluster street lights close enough together in the business portion of the town to make it as light as day when they are all on. As a matter of fact only one of the five lights on each post is usually turned on, to save juice.

"Stephen is located in the Souris Lignite coal district, and when I say we have all kinds of coal, it is no joke; we get coal put in the cellar for three dollars per ton. Next year the Government is establishing an experimental plant in this district for making briquettes out of the lignite coal, and I think this district has a future before it along this line. There are miles and miles of this coal land, the vein varying in depth from two to fourteen feet. The big mines are located right on the level prairie, and use a shaft and hoist for bringing up the coal. There are a few mines in the district that mine from twenty to forty cars a day while there any number of little mines all over the country, most of them along the valley of the Souris river, and they are opened up by driving straight in at the level of the outcrop, or by using a slight incline."

F. C. WESSEL, g '07, manager of the Rawlins Electric Light and Fuel Company at Rawlins, Wyo., was killed on the afternoon of November 7 when a belt broke and struck him on the head.

JAMES P. WOODSON, c' 16, who was 1st Lieut. in the 307th Engineers in France, has returned and is civil engineer with the Alabama Power Company, at Birmingham, Ala.

P. F. ZINKE, e '04, may be addressed at 66 S. Lincoln St., Hinsdale, Ill.

W. A. REINERT, c '11, is Assistant Professor of Civil Engineering in charge of agricultural engineering at the Armour Institute of Technology in Chicago. His address is 6405 Eggleston Ave.

MR. and MRS. H. H. FORCE, e '10, announce the birth of their son Chester Reade on November 19.

CAMPUS NOTES

By Wilson D. Trueblood

GRAB your baggage and
GET that train!

LOOK OUT!

We heard a law stude say the other day that if we didn't quit teasing him he would tell Santa Claus on us.

Lucky little co-ed among the engineers!
A thousand to caress you and to dry your baby tears
A dozen rough-neck profs to give you exes plus
A score or more instructors to give yourself to fuss
Lucky little co-ed are we so rough to thee?
Surely you will answer, "You're as nice as nice can be."

TAU BETA PI ELECTION

The following men were initiated into Tau Beta Pi, honorary engineering fraternity, at a banquet at the Park Hotel on Monday evening, December 15:

M. D. Jackson, 21, high junior

H. E. Schrader, 20	H. D. Timm, '20
Frank Karger, '20	A. G. Schutte, '20
A. W. Gaubatz, '20	E. E. Meisekothen, '20

Be at Lathrop Hill, December 19 at nine, with your best girl on your arm and your Sunday manners loudly in evidence to participate in that memorable event, the annual "Plumbers Ball." Thompson's ten-piece orchestra will help you to shift the old brogans around until one bell, at which time Dean Nardin will wish you a merry Christmas and send you to bed. If you don't dance, come and see Bill Hamblen in a white shirt.

As the result of a terrific bombardment of perfumed notes I wish to state:

NOT RESPONSIBLE FOR ANYTHING PUBLISHED IN THIS COLUMN.

The Editor.

NOTORIOUS ENGINEERS

RAGATZ, ROLAND. Known as the boy wonder of the engineers. Brother of Lowell Ragatz, creator of the world-famous magazine, the *Octopus* (but don't hold that against Roland.) Author of the popular novels HOW TO MAKE TAU BETA PI and WHY ENGINEERS SHOULD NOT FUSS. For interview phone Otto Kowalke.

KATES, WILLARD. The Beau Brummel of the plumbers. Tall, stately, and with a winning smile. In an interview he quotes. "The only reason why I do not fuss co-eds is because I am afraid of painter's colic." Advocates Varsity gym work for all Prom chairmen.

HAMBLEN, JENNINGS GRAPE-JUICE. Most perfect specimen of a cowboy ever tamed and brought to an institution of higher learning. Still, however, persists in dread of women and stiff collars. Advocate of red flannel underwear for rheumatism. Main point of beauty lies in a skin as pink as the blush of a maiden and soft as the breezes of spring. For advice phone Oakwood 9R2.

After carefully digesting the Octopus we have come to the conclusion that there is still some chance for us.

At the election held on November 24 the following men were elected to the newly created student-faculty committee:

Seniors: C. P. Kidder, H. A. Schroeder, W. E. Blowney, E. K. Norice and D. V. Slaker.

Junior: S. H. Gregg, F. C. Taylor, F. H. Brown, G. H. Head, and W. Link.

Sophomores: F. W. Nolte, W. D. Trueblood, and E. M. Barnes.

The freshman representatives will be elected at the beginning of the second semester. Dean Turneaure and one appointed faculty member will represent the faculty.

A QUESTION FOR PHILOSOPHERS TO DETERMINE

When the wintry wind doth blow
And there fall the flakes of snow
Where do the little birdies go?

The following engineers are working with the Gym Team: FINN AANESEN, M. E. 3, FRANK B. GOLLEY, E. E. 2, BERGER A. HAGEN, M .E. 3, and WILLARD KATES, E. E. 3.

WHAT SHE HAD

DAISY (earnestly)—"No, she isn't exactly pretty, but she has that indefinable something ——"

HAROLD (impatiently)—"Yes, I know. My girl's old man has piles of it, too."—*Tit-Bits.*

Willard Kates, recently appointed assistant Prom chairman, is now on the market for a Queen. Specifications have been submitted to Dean Nardin who will select the lucky woman after a series of try-outs at Kehl's, and drill in the manual of arms at Lathrop parlors. None in the stone age need apply.

Recent issues of the "Electrical World" contain a series of two articles by H. M. CROTHERS on instrument transformers, and three by F. A. KARTAK on timing devices used in the Standards Laboratory.

AN ENGINEER'S PROVERBS.

A good rubber turneth away wrath.
Faint ink never won fair blueprint.
There's no use coloring over spilt ink.
A rolling stone gathers no cement.
It's a poor scale that can't be read both ways.
The flat wheel makes the greatest sound.
It's an ill explosive that blows nobody up.
Measure in haste and repent in the office.
The better the description, the better the deed.
A night in town is worth two hundred in the bush.
A steep grade is rather to be chosen than two great bridges.
What is missed in tracing will not come out in the blueprint.

The following men were elected to Eta Kappa Nu this fall: C. Donaldson and H. R. Huntley, 20; M. D. Jackson, E. D. Johnson, W. A. Kates, and H. Lindner, '21.

Students in Steam and Gas 3a ought to noticeably increase the sales of the ENGINEER this month. We have in mind their search after a simple explanation of entropy, by the "Little Frary in our home."

Shop is more popular than ever this year. Reason: Fair co-eds have entered the sanctuary of grease and manly labor. They even swarm into the short-horn courses.

The Mining Club put across another tasty treat in the form of a steak-broil, November 19th. Six new members were initiated into the dark and awesome secrets of the Club, bringing the number in the Club up to fifty-seven. Don Mowry, Secretary of the Madison Association of Commerce, spoke on the advantages of locating a zinc recovery plant in Madison.

"HIGH GEAR"

What's that? The slogan of the Engineer's Dance? Exactly! The "High Gear" was invented by Ronald I. Drake, senior chemical, and his design will be used in making up special programs for the "Plumber's Ball."

The Engineer was represented at the Wisconsin Intercollegiate Press Association, held in Madison on November 28 and 29 by C. A. Weipking, Editor, and W. J. Rheingans, Manager.

After a couple of steins of that Mining Club 2.75% coffee, one of the members contracted the first stages of the D. T.'s and wrote:

WE MINERS

Of all the Engineers,
We Miners are the best.
We have good times, do all our work,
And still have time to rest.

The work we do is deep—
Not clear perhaps to you,
But all we do is blast and dig,
Dig, dig the whole day through.

We have a Miners' Club—
The pep club of the Hill.
We throw good feeds, and smoke good smokes,
Not scared to eat our fill.

We are one fam-i-lee
Of brothers, good and true.
Our "Dad" is Prof. Mc Caff-e-ry,
The man who sees us through.

L. H. H.

And, talking of poetry, here is another effort by one who bet not wisely, but too well:

The frost is on the punkin
And the fodder's in the shock
But our coin is close to zero
And our watch is now in hock
We look into the future
With thoughts that clearly spell
In the next game with Ohio
We're going to give them Fits.

All prospective students of Organic chemistry are advised to include in their pre-requisites conversational Hebrew and architectural drawing.

$C = 2\pi R$

The math shark and the engineer each shoved forty-one cents worth of microscopic coupons through the wicket to the blond Vesta of the cafeteria and selected a tooth pick. As they side-stepped through the door and skillfully avoided collision with the long line of waiting patrons, the math shark patted his vest and let out his belt a notch. The act of letting out the belt awoke an avaricious gleam in his eye and he turned to his prospective victim with the cooing question, "Say, little Wizeheimer, I think that it is about time that we took in a show but I don't want to pay for it if I can help it." "You aren't any different about shows than you are about anything else," said the engineer, "What's on your mind?" "Just a plain business proposition," the shark answered. "I'll give you a little problem and ask a simple question. If you answer correctly the show is on me provided you will pay the bills if you answer incorrectly." "Spill it," the engineer commanded. "Well here you are: Suppose that a cable were stretched around the earth at the equator so that the ends just met as the cable lay on the surface. After the cable is stretched it is found necessary to raise it on poles so that it will stand six feet from the surface of the earth all the way around. Of course it will be necessary to splice in an extra piece of cable if the ends are to meet in the new position. And I ask you, as man to man, which figure will be nearer to the extra length required, one foot of cable or one mile of cable?"

"One mile," blurted for the engineer; but even as he spoke a foolish smile spread over his face. "Stung again," he said. "When will I learn to lay off your stuff? Well, what's your choice, Fatty Arbuckle or the Orph?"

In a recent preliminary exam in one of the classes presided over by Joyful Jimmie, the following questions were asked:

1. Why is a motor?
2. Same for a generator.
3. Define wattless occupation. Give the period of a simple harmonica.
4. 10% for neatness.
5. 2¾% for cheerfulness.

SHOP DOPE

The new shops have almost passed the mirage stage. If nothing unexpected happens work will be under way next summer. Some time in the future, it is intended, the whole section on University Ave., from Breeze Terrace to and including the Forest Products Lab., will be given to the College of Engineering. There will be three buildings, identical with the Forest Products Lab., on the street, and three large shop buildings in the rear. Only one of these rear shop buildings is to be built for the present. It will be a single story structure of the modern factory type, and with a saw tooth glass roof. All existing departments of the shop will be accommodated, since its floor plan will measure 130 by 180 feet.

Junior: Say, our prof in Steam and Gas spent a half an hour this morning telling us how good we were.

Soph: I suppose that was the gas part of it?

Mr. Payton is designing a baby cupola that will enable the foundry to get out castings on one day's notice.

With sore knuckles and bandaged fingers frosh Engineers, in Shop 2, are turning their learned minds to the development of a machine that will do their chipping and filing for them without chipping and filing their knuckles.

An alumnus writes as follows:

"May I congratulate you on your Devil's Lake story in the October issue of the Wisconsin Engineer? It is exceptionally good. I am glad to know that our friend Lenny Smith still tells the old tales. When I was a freshman, in 1908, I knew these stories before I had the pleasure of hearing some of them from Lenny himself.

"During the 1912 camp the particularly appropriate song LENNY SMITH was written—author unknown. It is sung to the tune of Casey Jones. I thought that you might be interested, so here it is:

1. Come all you fellows if you don't want to miss,
   The wonderful tales of our Lenny Smith,
   About 170 degrees in the shade,
   How he dug through the mountains with a little toy spade.

CHORUS:
Lenny Smith was an engineer,
Lenny Smith an engineer was he,
Lenny Smith worked down on the border
And planted all the bench-marks on the Rio Grande.

2. One day he was working on a mountain top,
   And there he took a good old fashioned flop,
   He grabbed for his transit as he fell through the air,
   And believe me the bubble never moved a hair.

3. Lenny worked for a salary high,
   He never let refraction enter his eye,
   Down on the border where the climate was hot,
   He took with ease a thousand mile shot.

4. At camp our Lenny is a good old scout,
   He lets us go when the lecture is out,
   The lecture is out when the lights don't go,
   And the fellows like it better than a movie show.

"While this is rather aside from the point I would like to know whether Ray Owen has really become as handsome as his picture on page 41 would have us believe."

On a recent geology trip to Ablemans, one conscientious student took along a traveling bag in which to bring home specimens of rock. On the way home he left the bag outside while he went into the station to purchase his ticket. A helpful friend spied a dead cat on the track and added it to the collection in the bag. The conscientious student, who was suffering from a cold and couldn't smell, failed to understand why his friends shunned him on the homeward journey. The other passengers seemed strangely restless and the brakeman came in and opened the windows. It wasn't until he had reached home with his precious specimens and the landlady had phoned for the Health Department to come and investigate the unusual odor that persisted on her street, that he discovered that someone had spoofed him.

HOW ABOUT A MINSTREL SHOW?

The Mixer was a complete financial success, as indicated by a net profit of about $28. This sum has been added to the fund of $11, the amount left over from the mixer last spring. These pieces of "velvet" remain in the joint treasury of the engineering societies, and constitute a source from which future all-engineers stunts could be financed. Wouldn't it be a good idea to use the accumulated fund to start the preparations for the Engineers' Minstrels or for some similar St. Patrick's Day stunt? The Minstrels were at one time a traditional activity of the engineers, and since no minstrel performance has been given for four years, the show would doubtless be a grand success. If the minstrels are to be given, preparations should be started early. Here is the chance for those who want to push the stunt across.

At a banquet given by Pi Tau Sigma, honorary mechanical engineering fraternity, on the evening of Wednesday, Dec. 3, the following men were initiated: B. E. James, N. J. Schaal, L. F. Campbell, C. F. Hanson, and F. E. Downey, '20; D. W. McLenegan and P. W. Romig, '21.

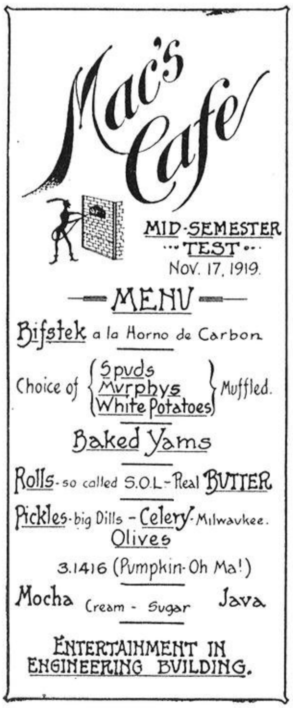
The foundry and pattern shops have won the world's speed record by turning out a pattern and pouring a casting from it in twenty minutes.

Even with the proximate abandonment of the interesting old relic, they still make improvements on the shop. The students in foundry practice have been relieved of much mental worry and physical exertion by the addition of an inclined railway charging apparatus for the cupola; in fact, they were so pleased to see it going up that they even deigned to help it a bit.

The forge shop will no longer remind one of a gas dug-out; a new ventilating fan has been installed.

In the November issue we mentioned that H. D. FRARY was recently appointed assistant professor in the Steam and Gas Department. Some errors appeared in that statement which we wish to correct. Professor Frary received his bachelor's degree in mechanical engineering at Minnesota, in 1908, and his M. S. degree at the same institution in 1909. In 1910 he was appointed magnetic observer on the Magnetic Survey ship which was sent out on a two-and-a-half year cruise around the world by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Following that he spent six months with the General Electric Company and then went to Germany where he spent a year (1913-1914) in the study of applied mathematics. Upon his return he taught math at the University of Iowa for a year and then went to the University of Illinois where he taught math and took graduate work. He received his Ph. D. in 1918. Just before his appointment at Wisconsin he had been on the staff of the Forest Products Laboratory for a year and a half.

Did you ever try to count off the number of college songs which Wisconsin engineers sing? If you have helped in the performances of the "Ruff-neck Choir" on the steps outside, you may have sung several of the usual songs; if you were one of the crowd at Devil's Lake at some time or other, you probably learned to sing a goodly number; and if you were included in some of the well-organized song-fests given by smaller groups in the school, you may have heard twenty or thirty good engineer's songs. But, as a matter of fact, there are over fifty lively songs in circulation about the engineering school, counting only those songs that are sung primarily by the engineers. The majority of these songs are known to only a few of the engineers, and since the uncommon ones are perhaps the funniest ones, most of the fellows would be glad to learn them. Plans are under way for publishing a song book. Watch for it; it will contain a bunch of good Wisconsin songs, and quite a few rare specimens will be included. Of course, the "Engineer's Songs" will be featured.



THE FACULTY MIXER

When our faculty mixes she sure do mix. On November 17, one hundred and six engineering faculty members, wives and guests sat down to a 6:15 p. m. "Bifstek" supper in the Mining Laboratory. It was like the old times of 15 years ago when the faculty used to get together for games and dancing in the corridors of the Engineering Building. Professors McCaffery and Shorey, blast furnace chefs, cooked everything except the pie and the dill pickles over the assay furnaces, and fed the crowd until no one could eat any more. After the supper the folks adjourned to the Engineering Building for games. There was something for all tastes,—from bean bags to bowling. The bean bags wrought out some strong arms; and the bags smoked down the hall so hard and fast that anyone in front of the firing line was forced to take cover. Regular kids, those profs. A program in the auditorium was the final feature. Mrs. Jimmie Watson gave two piano solos and played for the general singing. Mrs. Withey sang, Prof. Van Hagan caricatured some of the faculty members at the blackboard, and Prof. Millar gave a humorous reading.

Twenty-seven senior civils, led by Professors Kinne, Corp and Smith, visited Milwaukee on November 19th to 21st, to inspect structural and hydraulic manufacturing plants, street pavements, bridges, water works and the sewage disposal plant.

THE CHANGING WORLD.

The man who used to spend all his time perfecting perpetual motion has a new diversion; he's trying to cross airplanes so they'll lay eggs.—*Buffalo "News."*